

**REPORT ON  
SOIL INVESTIGATION WORK AT THE  
PROPOSED CONSTRUCTION OF B+G+2  
STORIED INVESTMENT BUILDING AT SURYA  
NAGAR, BHUBANESWAR, ODISHA.**

**Submitted to  
Chief Engineer, Division Office  
Jeevan Prakash, Unit-VII  
Surya Nagar, Bhubaneswar**

**Geotech Consultant**

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## **1.0 INTRODUCTION**

For the design of foundation of structures at any site it is essential to have accurate & reliable information on the soil/rock strata met at the site to required depth. Geotechnical Investigations form an important part of the site investigation in any construction project. The objectives of the sub surface investigation is to provide the owner/Architect/Structural designer/Builder with adequate information about the existing geological features at the site and to enable them to design appropriate foundation system capable of supporting the loads to be transferred by the structure to the under lying soil/rock strata without causing any distress.

## **2.0 THE PROJECT**

Jeevan Prakash, Unit-VII, Surya Nagar Bhubaneswar has plan to construct the proposed Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

## **3.0 SCOPE OF WORK**

The scope of geotechnical investigation work undertaken at the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar, comprised of drilling 3 nos of bore holes, at locations indicated by the client. Each bore holes were drilled upto a depth of 10.0 m below existing ground level at the demarkated locations. Drilling in soil/rock was undertaken at the demarkated locations by installing a rotary drilling machine fitted with 150 mm dia cutters/Nx size diamond drilling bits.

SPT was conducted at 1.5 m depth interval in soil/rock strata below ground level upto termination of drilling at 10.0 m depth. Field N values obtained at each depth have been reported in the Record of Boring and Summarised Data Sheets.

The scope of work also included determination of properties of soil / rock met at the site through laboratory testing as per the provisions of relevant I.S code and preparing a geo-technical report indicating the properties of soil/rock encountered at the site and suggesting the type



of foundation considered suitable for the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

#### **4.0 INVESTIGATION**

The geotechnical investigations undertaken at the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar comprised of drilling 3 Nos of bore holes, Each bore holes were drilled upto a depth of 10.0 m below existing ground level over the demarkated location.

The scope of geotechnical investigation also included conducting SPT and collecting soil/rock samples, conducting laboratory tests, analysing the results of test and preparing a geotechnical report indicating the properties of soil/rock encountered at the site and suggesting the type of foundation considered suitable for the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

#### **5.0 FIELD WORK**

The field work comprised of locating the bore hole points, installing the mechanical drilling rig at the site and drilling 3 Nos of bore holes, Each bore hole were drilled upto a depth of 10.0 m below existing ground level at the locations as suggested by the client.

Drilling was resorted to by using a mechanical drilling rig with rotary drilling tools such as diamond drill bits.

Drilling is effected by the cutting action of a rotating tool bit kept in firm contact with the bottom of the bore hole. The bit is carried at the end of the hollow jointed drill rods. The drill rod is rotated by a suitable chuck. Bentonite slurry of required consistency is circulated continuously through the hollow drill rods. The slurry returns to the ground surface through the annular space between the drill rod and the wall of the bore hole/casing. The slurry flowing out of the cutter bottom gets mixed up with the cut soil/rock and flows to the ground surface and returns back to the slurry tank. The process is continuous and is used through out the drilling process.



## **6.0 SAMPLING**

SPT samples were collected at 1.5 m depth interval upto 10.0 m depth below ground level. SPT samplers were used to conduct SPT at different depths and collect disturbed soil samples from the strata below existing ground level at each location. SPT was conducted in soil at 1.5 m depth interval as indicated in the Record of Boring.

Field N values obtained from SPT at each depth have been reported in the borelog and summarised data sheets.

## **7.0 INSITU TESTS**

Insitu tests such as SPT measure the consistency of cohesive soil deposits and relative density of cohesionless soil deposits/rocks. The procedure consists of measuring the resistance offered by the soil/rock strata to the advancement of a device called Split Spoon Sampler. A standard split spoon sampler is used for the test. The sampler is advanced into the soil strata vertically, due to the free fall of a 63.5 kg. hammer falling through a height of 750 mm. Number of blows required to produce three successive 150 mm or less of penetration is recorded. The sum of the total number of blows required to produce the last 300mm or less of penetration is taken as the 'N' value or the Standard Penetration Resistance of the soil/rock at the depth under consideration. In case of very hard, compact soil/rock strata, total penetration of less than 300 mm is achieved. In such cases, the depth of penetration and the number of blows are recorded. The 'N' values recorded during field work at the above site have been reported in the record of boring and summarised data sheets.

## **8.0 GROUND WATER TABLE**

Location of the position of ground water table with respect to the proposed depth of foundation below existing ground level plays an important part in the design of foundation. Position of ground water table influences many engineering properties of soil including its bearing capacity. The position of ground water table fluctuates during wet and dry seasons.



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The depth of ground water table was ascertained by observing the level of free standing water in the washed and cleaned bore hole 24 hours after the completion of boring. The recorded depth of water level in the bore holes have been reported in the record of boring and summarised data sheets.

## **9.0 LABORATORY TESTS**

The soil/rock samples collected from the field are subjected to laboratory tests to determine the relevant properties. Laboratory tests were conducted as per the provisions of the work order and in conformity with the relevant code of practice prescribed by the Bureau of Indian Standards. The tests conducted in the laboratory included Specific gravity, Atterberg limits (LL & PL), Grain size analysis, and Free swell index (DFS). Results of tests have been reported in summarised data sheets, grain size curves.

## **10.0 BORELOG**

The bore log was prepared using the field data and Laboratory test results obtained on soil/rock samples collected from the bore holes at different depths at the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

The field data have been reported in the Record of Boring & Summarised Data sheets. The Laboratory test results on soil samples collected at site have been reported in the Summarised data Sheets, tables and graphs.

### **10.1 Bore Hole No. 1**

Bore hole No.1 was drilled upto a depth of 10.0 m below existing ground level at the demarkated location.

SPT was conducted at 1.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate



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refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Silty sand and Gravel (SM).

SPT was conducted at 3.0 m depth. Field N value of 23 has been recorded at this depth. The soil sticking to the SPT shoe was analysed and found to be Silty sand and Gravel (SM).

SPT was conducted at 4.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Silty sand and Gravel (SM).

SPT was conducted at 6.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Silty sand (SM).

SPT was conducted at 7.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 9.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 10.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

Drilling was terminated at 10.0 m depth.

Ground water table was not struck during drilling upto to 10.0 m depth.



## 10.2 Bore Hole No. 2

Bore hole No.2 was drilled upto a depth of 10.0 m below existing ground level at the demarkated location.

SPT was conducted at 1.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Silty sand and Gravel (SM).

SPT was conducted at 3.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 4.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 6.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 7.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 9.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 10.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate



refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

Drilling was terminated at 10.0 m depth.

Ground water table was not struck during drilling upto to 10.0 m depth.

### **10.3 Bore Hole No. 3**

Bore hole No.2 was drilled upto a depth of 10.0 m below existing ground level at the demarkated location.

SPT was conducted at 1.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

Micaceous sand stone with CR=8.0 % and RQD=0.0 % was met from 1.5 m to 3.0 m depth.

SPT was conducted at 3.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil from the SPT shoe slipped during extraction.

Micaceous Gritty sand stone with CR=8.66 % and RQD=0.0 % was met from 3.0 m to 4.5 m depth.

SPT was conducted at 4.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil from the SPT shoe slipped during extraction.

Micaceous Gritty sand stone with CR=7.0 % and RQD=0.0 % was met from 4.5 m to 6.0 m depth.

SPT was conducted at 6.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate



refusal to penetration at this depth. The soil from the SPT shoe slipped during extraction.

Micaceous Gritty sand stone with CR=6.0 % and RQD=0.0 % was met from 6.0 m to 7.5 m depth.

SPT was conducted at 7.5 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil from the SPT shoe slipped during extraction.

SPT was conducted at 9.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

SPT was conducted at 10.0 m depth. There was refusal to penetration at this depth, therefore field N value of 50 has been recorded to indicate refusal to penetration at this depth. The soil sticking to the SPT shoe was analysed and found to be Poorly graded Sand (SP).

Drilling was terminated at 10.0 m depth.

Ground water table was not struck during drilling upto to 10.0 m depth.

#### **11.0 FOUNDATION ANALYSIS**

The proposed site for the construction of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

Two nos of bore holes, at locations indicated by the client. Each bore holes were drilled upto a depth of 10.0 m below existing ground level by using a mechanical drilling rig installed at each location.

The details of the type of soil/rock met at different depths under each bore hole have been reported in the Record of Boring and Summarised Data Sheets.



The soil/rock strata encountered upto 10.0 m depth is predominantly Silty sand and Gravel (SM)/Poorly graded sand (SP) as shown in the Record of Boring.

The average Corrected 'N' value of 30 was obtained indicating the soil strata to be compact.

It is proposed to place Isolated column footings of size 1.5 m x 1.5 m and 2.0 m x 2.0 m at 2.0 m/2.5 m/3.0 m depth below ground level.

SBC of soil under Isolated Column footings of size 1.5 m x 1.5 m placed at 2.0 m depth is estimated at 238.7 kN/m<sup>2</sup> or say 200.0 kN/m<sup>2</sup> i.e 20.0 t/m<sup>2</sup>.

SBC of soil under Isolated Column footings of size 2.0 m x 2.0 m placed at 2.0 m depth is estimated at 238.0 kN/m<sup>2</sup> or say 200.0 kN/m<sup>2</sup> i.e 20.0 t/m<sup>2</sup>.

SBC of soil under Isolated Column footings of size 1.5 m x 1.5 m placed at 2.5 m depth is estimated at 303.7 kN/m<sup>2</sup> or say 250.0 kN/m<sup>2</sup> i.e 25.0 t/m<sup>2</sup>.

SBC of soil under Isolated Column footings of size 2.0 m x 2.0 m placed at 2.5 m depth is estimated at 297.6 kN/m<sup>2</sup> or say 250.0 kN/m<sup>2</sup> i.e 25.0 t/m<sup>2</sup>.

SBC of soil under Isolated Column footings of size 1.5 m x 1.5 m placed at 3.0 m depth is estimated at 373.6 kN/m<sup>2</sup> or say 300.0 kN/m<sup>2</sup> i.e 30.0 t/m<sup>2</sup>.

SBC of soil under Isolated Column footings of size 2.0 m x 2.0 m placed at 3.0 m depth is estimated at 360.8 kN/m<sup>2</sup> or say 300.0 kN/m<sup>2</sup> i.e 30.0 t/m<sup>2</sup>.

## **12.0 RECOMMENDATIONS**

Considering the properties of soil/rock encountered at the proposed site of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar.

- (i) Isolated column footings of sizes 1.5 m x 1.5 m and 2.0 m x 2.0 m



may be placed at 2.0 m /2.5 m/3.0 m depth below existing ground level.

- (ii) SBC of soil under footings of sizes 1.5 m x 1.5 m and 2.0 m x 2.0 m placed at 2.0 m depth below ground level may be taken as 200.0 kN/m<sup>2</sup> i.e 20.0 t/m<sup>2</sup>.
- (iii) SBC of soil under footings of sizes 1.5 m x 1.5 m and 2.0 m x 2.0 m placed at 2.5 m depth below ground level may be taken as 250.0 kN/m<sup>2</sup> i.e 25.0 t/m<sup>2</sup>.
- (iv) SBC of soil under footings of sizes 1.5 m x 1.5 m and 2.0 m x 2.0 m placed at 3.0 m depth below ground level may be taken as 300.0 kN/m<sup>2</sup> i.e 30.0 t/m<sup>2</sup>.



Prof. Dr. A.C. Ray

Foundation Engineering Consultant



### COMPUTATION OF AVERAGE CORRECTED N VALUE

**Name of the site:** Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar

**Soil Properties:**

$$\gamma_{sub} = 10.0 \text{ kN/m}^3$$

Depth	Field N value (N <sub>f</sub> )				Over burden pressure (P) = $\gamma_{sub} \times D$ kn/m <sup>2</sup>	Correction factor (C <sub>N</sub> ) = $\frac{0.77 \log 2000}{P}$	N value corrected for over burden pressure (N = N <sub>f</sub> × C <sub>N</sub> )	N value Corrected for dilatancy
	BH-1	BH-2	BH-3	Average N value				
1.5	50	50	50	50	15.0	1.64	81.81	48.41
3.0	23	50	50	41	30.0	1.40	57.58	36.29
4.5	50	50	50	50	45.0	1.27	63.44	39.22
6.0	50	50	50	50	60.0	1.17	58.63	36.82
7.5	50	50	50	50	75.0	1.10	54.90	34.95
9.0	50	50	50	50	90.0	1.04	51.85	33.43
10.0	50	50	50	50	100.0	1.00	50.09	32.54

Average correct N value =  $\frac{261.65}{7} = 37.37$  or say 30.0



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^{\circ}$ or say	$30.0^{\circ}$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	2 m

**Size of footing :**

B	1.5 m
L	1.5 m

**Bearing capacity factors :**

$N_q$	18.40
$N_{\gamma}$	22.40

**Shape factor :**

$S_q$	1.2
$S_{\gamma}$	0.8

Overburden pressure (q)	$20.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73

**Depth factor :**

$d_q$	1.23
$d_{\gamma}$	1.23

**Inclination factor :**

$i_q$	1.0
$i_{\gamma}$	1.0

Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$596.8 \text{ kN/m}^2$
Factor of safety (FS)	2.5

<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	$238.7 \text{ kN/m}^2$
Or say	$200.0 \text{ kN/m}^2$



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^\circ$ or say	$30.0^\circ$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	2 m

**Size of footing :**

B	2.0 m
L	2.0 m

**Bearing capacity factors :**

$N_q$	18.40
$N_\gamma$	22.40

**Shape factor :**

$S_q$	1.2
$S_\gamma$	0.8

Overburden pressure (q)	$20.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73

**Depth factor :**

$d_q$	1.17
$d_\gamma$	1.17

**Inclination factor :**

$i_q$	1.0
$i_\gamma$	1.0

Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$595.1 \text{ kN/m}^2$
Factor of safety (FS)	2.5

<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	<b><math>238.0 \text{ kN/m}^2</math></b>
Or say	<b><math>200.0 \text{ kN/m}^2</math></b>



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^\circ$ or say	$30^\circ$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	2.5 m
<b>Size of footing :</b>	
B	1.5 m
L	1.5 m
<b>Bearing capacity factors :</b>	
$N_q$	18.40
$N_\gamma$	22.40
<b>Shape factor :</b>	
$S_q$	1.2
$S_\gamma$	0.8
Overburden pressure (q)	$25.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73
<b>Depth factor :</b>	
$d_q$	1.29
$d_\gamma$	1.29
<b>Inclination factor :</b>	
$i_q$	1.0
$i_\gamma$	1.0
Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$759.3 \text{ kN/m}^2$
Factor of safety (FS)	2.5
<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	<b><math>303.7 \text{ kN/m}^2</math></b>
Or say	<b><math>250.0 \text{ kN/m}^2</math></b>



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^\circ$ or say	$30.0^\circ$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	2.5 m
<b>Size of footing :</b>	
B	2.0 m
L	2.0 m
<b>Bearing capacity factors :</b>	
$N_q$	18.40
$N_\gamma$	22.40
<b>Shape factor :</b>	
$S_q$	1.2
$S_\gamma$	0.8
Overburden pressure (q)	$25.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73
<b>Depth factor :</b>	
$d_q$	1.22
$d_\gamma$	1.22
<b>Inclination factor :</b>	
$i_q$	1.0
$i_\gamma$	1.0
Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$744.1 \text{ kN/m}^2$
Factor of safty (FS)	2.5
<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	<b><math>297.6 \text{ kN/m}^2</math></b>
<b>Or say</b>	<b><math>250.0 \text{ kN/m}^2</math></b>



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^\circ$ or say	$30.0^\circ$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	3 m
<b>Size of footing :</b>	
B	1.5 m
L	1.5 m
<b>Bearing capacity factors :</b>	
$N_q$	18.40
$N_\gamma$	22.40
<b>Shape factor :</b>	
$S_q$	1.2
$S_\gamma$	0.8
Overburden pressure (q)	$30.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73
<b>Depth factor :</b>	
$d_q$	1.35
$d_\gamma$	1.35
<b>Inclination factor :</b>	
$i_q$	1.0
$i_\gamma$	1.0
Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$933.9 \text{ kN/m}^2$
Factor of safety (FS)	2.5
<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	$373.6 \text{ kN/m}^2$
Or say	$300.0 \text{ kN/m}^2$



**Computation of SBC of Soil under Isolated Column Footing of Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar**

Average N Value ( $N_{av}$ )	30
Angle of internal friction( $\phi$ ) = $36.1^\circ$ or say	$30.0^\circ$
Bulk density of soil ( $\gamma$ )	$20.0 \text{ kN/m}^3$
Submerged density of soil ( $\gamma_{sub}$ )	$10.0 \text{ kN/m}^3$
Proposed depth of foundation (Df)	2.5 m
<b>Size of footing :</b>	
B	2.0 m
L	2.0 m
<b>Bearing capacity factors :</b>	
$N_q$	18.40
$N_\gamma$	22.40
<b>Shape factor :</b>	
$S_q$	1.2
$S_\gamma$	0.8
Overburden pressure (q)	$25.0 \text{ kN/m}^2$
$\sqrt{N\phi} = \sqrt{(\tan(45+(\phi/2)))^2}$	1.73
<b>Depth factor :</b>	
$d_q$	1.22
$d_\gamma$	1.22
<b>Inclination factor :</b>	
$i_q$	1.0
$i_\gamma$	1.0
Water table correction factor (w')	0.5
The ultimate net bearing capacity of soil ( $q_d$ )	$744.1 \text{ kN/m}^2$
Factor of safety (FS)	2.5
<b>Allowable bearing capacity of soil (<math>q_a</math>)</b>	$297.6 \text{ kN/m}^2$
<b>Or say</b>	$250.0 \text{ kN/m}^2$



**GEOTECH RESEARCH LABORATORY,  
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BARAMUNDA, BHUBANESWAR-751003**

**Chemical Test on soil sample**

Project Name : Geotechnical and other Investigation work for proposed B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar, Odisha.

Name of Client : Jeevan Prakash, Unit-VII, Surya Nagar, Bhubaneswar

Location : Unit-VII, Surya Nagar, Bhubaneswar

BH No. : 1

Date of receiving of sample : 01.02.2022

Date of Testing : 01.02.2022 - 09.02.2022

<b>Sr. No.</b>	<b>Test Parameters</b>	<b>Standard Methods</b>	<b>Result</b>
1	pH	IS 2720-Part -26 -1987	6.85
2	Chloride (mg/l)	EPA670/2.74.007	21.49
3	Sulphate as SO <sub>3</sub> (mg/l)	IS-2720-Part-27-1977	9.21



**GEOTECH RESEARCH LABORATORY,  
RAY INFRATECH  
50B-HIG DUPLEX, BDA COLONY,  
BARAMUNDA, BHUBANESWAR-751003**

**Chemical Test on soil sample**

Project Name : Geotechnical and other Investigation work for proposed  
B+G+2 storied Investment Building at Surya Nagar,  
Bhubaneswar, Odisha.

Name of Client : Jeevan Prakash, Unit-VII, Surya Nagar, Bhubaneswar

Location : Unit-VII, Surya Nagar, Bhubaneswar

BH No. : 2

Date of receiving of sample : 01.02.2022

Date of Testing : 01.02.2022 - 09.02.2022

Sr. No.	Test Parameters	Standard Methods	Result
1	pH	IS 2720-Part -26 -1987	6.79
2	Chloride (mg/l)	EPA670/2.74.007	20.49
3	Sulphate as SO <sub>3</sub> (mg/l)	IS-2720-Part-27-1977	9.34



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50B-HIG DUPLEX, BDA COLONY,  
BARAMUNDA, BHUBANESWAR-751003**

**Chemical Test on soil sample**

Project Name : Geotechnical and other Investigation work for proposed  
B+G+2 storied Investment Building at Surya Nagar,  
Bhubaneswar, Odisha.

Name of Client : Jeevan Prakash, Unit-VII, Surya Nagar, Bhubaneswar

Location : Unit-VII, Surya Nagar, Bhubaneswar

BH No. : 3

Date of receiving of sample : 01.02.2022

Date of Testing : 01.02.2022 - 09.02.2022

<b>Sr. No.</b>	<b>Test Parameters</b>	<b>Standard Methods</b>	<b>Result</b>
1	pH	IS 2720-Part -26 -1987	6.93
2	Chloride (mg/l)	EPA670/2.74.007	21.99
3	Sulphate as SO <sub>3</sub> (mg/l)	IS-2720-Part-27-1977	8.72















**GEOTECH RESEARCH LABORATORY, RAY INFRA TECH, BHUBANESWAR - 751 003**

**SUMMARISED DATA SHEET**

PROJECT - Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar

DATE OF COMMENCEMENT - 09.01.2021

DATE OF COMPLETION - 11.01.2021

GROUND RL. -

DEPTH OF GROUND WATER - Not Struck

BORE HOLE NO. - 1

TYPE OF BORING - Rotary Drilling

DIAMETER OF BORE HOLE - 150mm

DEPTH FROM G.L. m	SAMPLE TYPE	DESCRIPTION OF SOIL GROUP	GROUP LETTER SYMBOL	NATURAL MOISTURE CONTENT %	LIQUID LIMIT % (w <sub>L</sub> )	PLASTIC LIMIT % (w <sub>p</sub> )	PLASTISITY INDEX % (I <sub>p</sub> )	DIFFERENTIAL FREE SWELL %	GRAVEL + 4.75 mm	COARSE SAND + 2.00 mm	MEDIUM SAND + 0.425 mm	FINE SAND + 0.075 mm	SILT + 0.002 mm	CLAY -0.002 mm	'N' VALUE FROM SPT	UNIT WEIGHT / BULK DENSITY KN/m <sup>3</sup>	SPECIFIC GRAVITY	COHESION KN/m <sup>2</sup>	ANGLE OF INTERNAL FRICTION <sup>φ</sup>	COMPRESSION INDEX	UC Compressive STRENGTH qu KN/m <sup>2</sup> un soaked	Compressive STRENGTH qu KN/m <sup>2</sup> soaked	
1.50	SPT	Silty sand and Gravel	SM	-	Np	-	0.00	23.57	8.68	28.13	23.80	15.28	0.54	50									
3.00	SPT	Silty sand and Gravel	SM	-	Np	-	0.00	2.19	3.04	89.30	2.38	2.09	1.0	50									
4.50	SPT	Silty sand and Gravel	SM	-	Np	-	0.00	3.13	2.98	79.07	9.96	3.46	1.40	50									
6.00	SPT	Silty Sand	SM	-	Np	-	0.00	0.00	0.00	71.94	27.62	0.26	0.18	50									
7.50	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	63.0	36.40	0.40	0.20	50									
9.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	61.95	37.53	0.32	0.20	50									
10.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	58.43	41.02	0.35	0.20	50									



**GEOTECH RESEARCH LABORATORY, RAY INFRA TECH, BHUBANESWAR - 751 003**

**SUMMARISED DATA SHEET**

PROJECT - Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar  
 BORE HOLE NO. - 2  
 TYPE OF BORING - Rotary Drilling  
 DATE OF COMMENCEMENT - 10.01.2021  
 DATE OF COMPLETION - 11.01.2021  
 DIAMETER OF BORE HOLE - 150mm  
 GROUND RL. -  
 DEPTH OF GROUND WATER - Not Struck

DEPTH FROM GL. m	SAMPLE TYPE	DESCRIPTION OF SOIL GROUP	GROUP LETTER SYMBOL	NATURAL MOISTURE CONTENT %	LIQUID LIMIT % (w <sub>L</sub> )	PLASTIC LIMIT % (w <sub>p</sub> )	PLASTISITY INDEX % (I <sub>p</sub> )	DIFFERENTIAL FREE SWELL %	GRAVEL + 4.75 mm	COARSE SAND + 2.00 mm	MEDIUM SAND + 0.425 mm	FINE SAND + 0.075 mm	SILT + 0.002 mm	CLAY -0.002 mm	'N' VALUE FROM SPT	UNIT WEIGHT / BULK DENSITY KN/m <sup>3</sup>	SPECIFIC GRAVITY	COHESION KN/m <sup>2</sup>	ANGLE OF INTERNAL FRICTION	COMPRESSION INDEX	UC Compressive STRENGTH qu KN/m <sup>2</sup> un soaked	Compressive STRENGTH qu KN/m <sup>2</sup> soaked
1.50	SPT	Silty sand and Gravel	SM	-	Np	-	0.00	23.58	9.73	39.48	15.19	10.69	1.33	50								
3.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	66.63	21.05	11.06	1.26	50								
4.50	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	46.95	52.20	0.45	0.40	50								
6.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	53.07	45.90	0.63	0.40	50								
7.50	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	39.85	58.84	0.71	0.60	50								
9.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	32.46	66.46	0.68	0.40	50								
10.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	62.28	36.65	0.57	0.50	50								



**GEOTECH RESEARCH LABORATORY, RAY INFRA TECH, BHUBANESWAR - 751 003**

**SUMMARISED DATA SHEET**

PROJECT - Construction of B+G+2 storied Investment Building at Surya Nagar, Bhubaneswar  
 BORE HOLE NO. - 3  
 TYPE OF BORING - Rotary Drilling  
 DATE OF COMMENCEMENT - 12.01.2021  
 DATE OF COMPLETION - 12.01.2021  
 DIAMETER OF BORE HOLE - 150mm  
 GROUND RL. -  
 DEPTH OF GROUND WATER - Not Struck

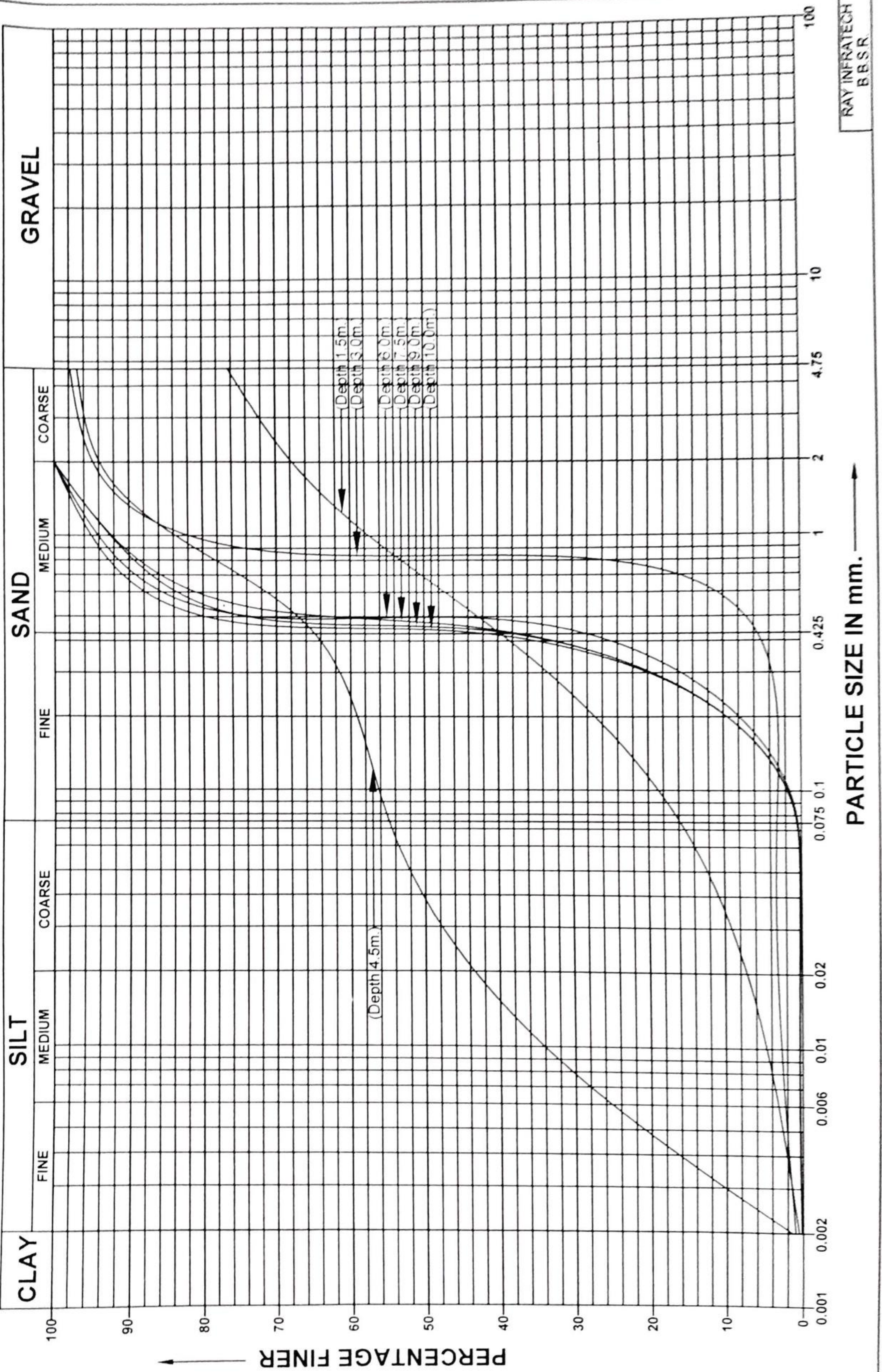
DEPTH FROM G.L. m	SAMPLE TYPE	DESCRIPTION OF SOIL GROUP	GROUP LETTER SYMBOL	NATURAL MOISTURE CONTENT %	LIQUID LIMIT % (w <sub>l</sub> )	PLASTIC LIMIT % (w <sub>p</sub> )	PLASTISITY INDEX % (I <sub>p</sub> )	DIFFERENTIAL FREE SWELL %	GRAVEL + 4.75 mm	COARSE SAND + 2.00 mm	MEDIUM SAND + 0.425 mm	FINE SAND + 0.075 mm	SILT + 0.002 mm	CLAY -0.002 mm	N. VALUE FROM SPT	UNIT WEIGHT / BULK DENSITY KN/m <sup>3</sup>	SPECIFIC GRAVITY	COHESION KN/m <sup>2</sup>	ANGLE OF INTERNAL FRICTION <sup>o</sup>	COMPRESSION INDEX	UC Compressive STRENGTH qu KN/m <sup>2</sup> un soaked	Compressive STRENGTH qu KN/m <sup>2</sup> soaked
1.50	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	7.15	76.45	11.75	3.51	1.14	50								
3.00	SPT	Micaceous Sand stone													50							
4.50	SPT	Micaceous Gritty Sand Stone													50							
6.00	SPT	Micaceous Gritty Sand Stone													50							
7.50	SPT	Micaceous Gritty Sand Stone													50							
9.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	59.58	39.66	0.56	0.20	50								
10.00	SPT	Poorly graded Sand	SP	-	Np	-	0.00	0.00	0.00	58.28	40.08	1.00	0.64	50								



# GRAIN SIZE DISTRIBUTION CURVE AT DIFFERENT DEPTHS

LOCATION :- PROPOSED CONSTRUCTION OF B+G+2 STORIED INVESTMENT BUILDING AT SURYA NAGAR, BHUBANESWAR, ODISHA.

BORE HOLE NO.- 1



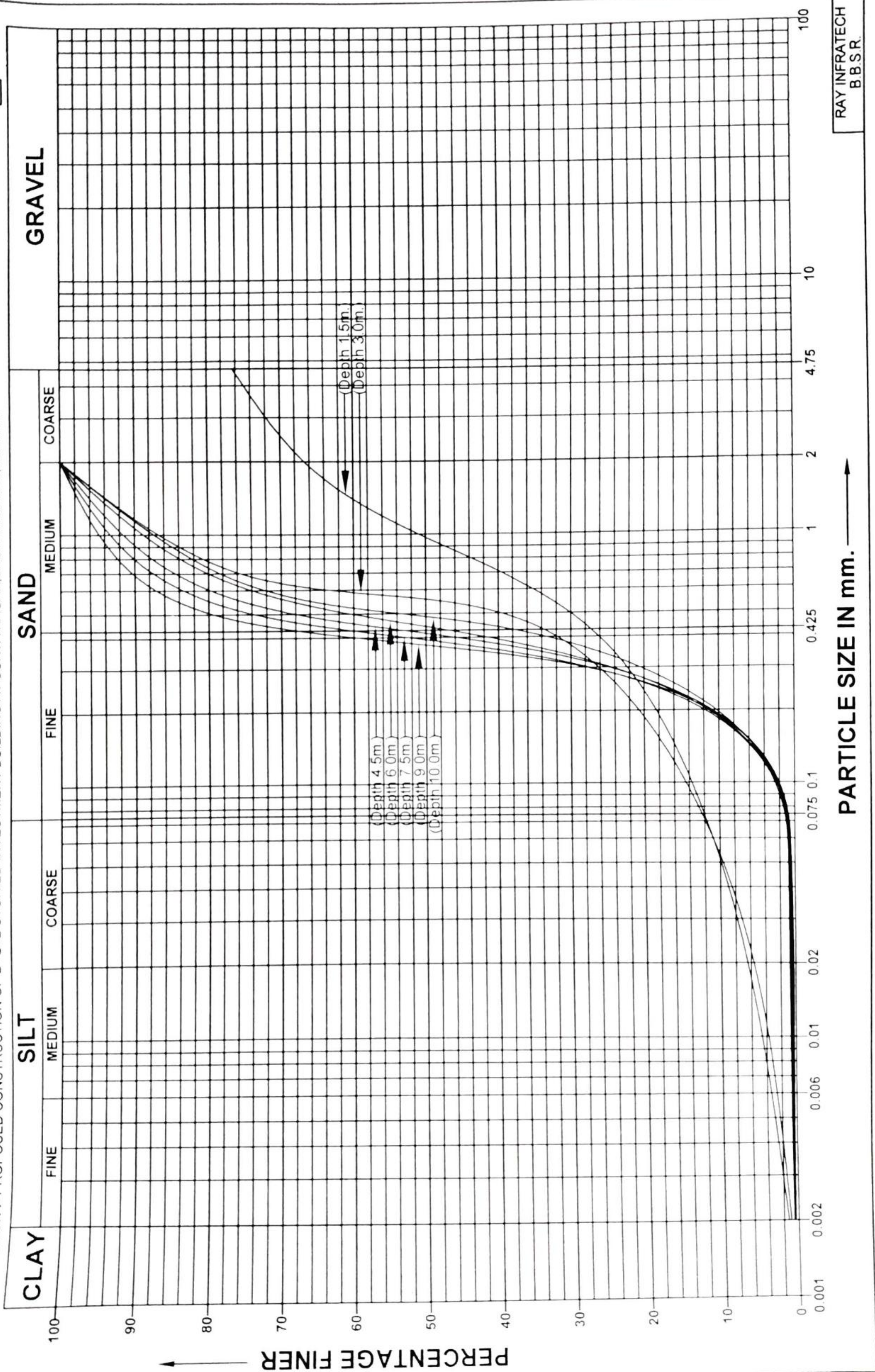
RAY INFRA TECH  
B.B.S.R.



# GRAIN SIZE DISTRIBUTION CURVE AT DIFFERENT DEPTHS

LOCATION :- PROPOSED CONSTRUCTION OF B+G+2 STORED INVESTMENT BUILDING AT SURYA NAGAR, BHUBANESWAR, ODISHA.

BORE HOLE NO.- 2



RAY INFRATECH  
B.B.S.R.



# GRAIN SIZE DISTRIBUTION CURVE AT DIFFERENT DEPTHS

BORE HOLE NO.- 3

LOCATION :- PROPOSED CONSTRUCTION OF B+G+2 STORIED INVESTMENT BUILDING AT SURYA NAGAR, BHUBANESWAR, ODISHA.

RAY INFRA TECH  
B.B.S.R.

