GEOTECHNICAL INVESTIGATION REPORT

SOIL INVESTIGATION REPORT FOR STATIC TEST FACILITY FOR PROPELLANTS AT BDL, IBRAHIMPATNAM.

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CONTENTS

Chapter One: Introduction

Sub-surface exploration plays an important role in the design for the construction of buildings and bridges. Before design, it is essential to study the behavior as well as the engineering properties of the sub-surface strata, which promotes the design more economic and perfect. It also enables to take precaution in the design for the structural safety. **"Soil Investigation for Static facility for Propellants at BDL, Ibrahimpatnam"** was decided to be designed on the basis of the sub-surface investigation test results. As such, the Graphics Designers, Hyderabd entrusted the sub-surface investigation work to M/s Architecture & Engineering Consultancy Services Pvt. Ltd vide work order No. –GD/AECS/2014-272 and Date:-13/05/2014. The scope of work comprised of boring five boreholes at site. The fieldwork included making of boreholes by Wash/Rotary Boring method. The scope also included conducting Standard Penetration Tests at regular intervals and collecting soil/rock samples for identification and logging purposes, and the collected soil and rock samples were tested in the Base Laboratory and the data were analyzed.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results. On the basis of field & laboratory test results and their analysis, suitable foundations have been suggested.

Chapter Two: Field Operations

2.1 General:

In an attempt for optimization in the design of foundation for the proposed structure to be constructed at this site, Geo-technical Investigation was done. The entire investigation work had been divided mainly into two parts. (i) Field works & (ii) Laboratory tests.

- Field works determine the types of sub-soil deposit and their characteristics.
- Laboratory tests help in determining the relevant geo-technical properties of the sub-surface deposits leading to finalization of foundation depth of the structure basing on Bearing Capacities of the foundation strata as well as the influence zone.

Final depths of boring and observation of water table for each borehole are given below.

2.2 Boring & In-Situ Tests:

Wash/Rotary boring method was adopted to bore holes to the required depth. UDS & SPT were conducted at regular intervals and the soil samples were brought to the laboratory with proper identification and labeling. Standard split spoon sampler was used for conducting Standard Penetration Test. The number of blows required to drive the sampler for the 1st, 2nd & 3rd 15cm depths were recorded. The total number of blows required to drive the split spoon sampler due to the free fall of a 63.5kg hammer through a distance of 75 cm for the 2nd and 3rd 15cm penetration were taken together as the field 'N' value or the standard penetration test (resistance) of the soil.

After the penetration to full depth, the sampler was carefully pulled out. The cutting shoe and the head were removed. The soil samples were then sealed in polythene bags and labeled properly by indicating the depth of bore hole mark, reference no. etc for visual inspection and identification of soil samples for logging of the bore holes.

The field 'N' values recorded at various depths have been reported in the summarized data sheet. Test results of soil samples & their bore logs were presented separately in the sub-soil report.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results.

Undisturbed soil samples were carefully extracted in such a manner that the moisture content and structure of soil did not get altered. Standard open tube sampler was used for the collection of undisturbed soil samples. Each end of the sampling tube was carefully sealed with wax, the bore hole number and depth were indicated on the tube for proper identification.

2.3 Sampling:

Representative soil samples were collected from the borehole confirming to IS: 1892-1979. Collected samples were properly sealed in polythene bags and labeled for proper identification during testing. The disturbed samples were used for classification of soils as per IS: 1498-1970.

2.4 Ground Water Table:

Observation of ground water table is important since it influences the bearing capacity of soil in different seasons. When the foundation remains submerged under water the bearing capacity is to be calculated considering the water table correction factor. Therefore while conducting tests during dry season, it is always necessary to enquire about the ground water table level.

Bore Hole No.	Termination Depth in m.	Water Table from the G.L. in m.
BH – 1	10.0 m.	Not encountered within the drilling depth
BH – 2	6.0 m.	- do -
BH – 3	6.0 m.	- do -
BH – 4	6.0 m.	- do -
BH – 5	6.0 m.	- do -

Chapter Three: Information about Laboratory Tests

Laboratory test conforming to relevant Indian Standard specifications were conducted on the soil samples collected from both the boreholes as detailed below. All laboratory tests were conducted as per SP: 36 Part-1 1987 of BIS.

3.1 Grain Size Analysis:

To obtain information concerning the type of soil met at various depths and to classify each soil strata, grain size analysis were carried out as per IS: 2720 (Part-IV). The results have been presented in the summarized data sheet.

3.2 Index Properties:

Soil consistency refers to the resistance of the soil offered against forces that tend to deform or rupture the soil aggregate. Consistency limits indicate the soil moisture content limits for various states of consistency. The consistency limits include Liquid Limit (L.L), Plastic Limit (P.L), and Shrinkage Limit (S.L). The difference between the numerical values of liquid limit and plastic limit of the soil is called the Plasticity Index (P.I). It indicates the range of moisture content over which the soil exhibits plasticity. It is determined as per the procedure laid down in IS: 2720 (Part-IV). Plasticity index was computed. Results of liquid limit and plasticity index have been reported in the summarized data sheets.

3.3 Specific Gravity:

The specific gravity of the soil sample is the ratio of the mass of a given volume of soil sample in air to the mass of an equal volume of water at 27^0C. Specific gravity of soil sample was determined as per the provisions of IS: 2720 (Part –III). Specific gravity of soil sample obtained during the test has been reported in the summarized data sheet.

3.4 Void Ratio:

Void ratio of different soil samples were determined in through appropriate formula.

3.5 DFS:

Differential free swell index of different soil samples were determined in the laboratory and are mentioned in the laboratory test result sheet.

3.6 Final Logging:

The logging of the boreholes as obtained during field work were checked with the disturbed and undisturbed soil samples and scrutinized with the findings of laboratory tests to avoid discrepancies, if any. The bore logs have been reported in the summarized data sheets.

3.7 Results of Test:

The findings of various in-situ and laboratory tests conducted on disturbed /SPT samples have been reported in the summarized data sheet. The soil has been classified into different categories base on their Engineering properties. A careful study of the sub soil strata was made in accordance with the provisions of IS: 1498-1970 to find out their suitability as foundation materials.

CHAPTER FOUR - RECORD OF BORING

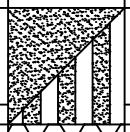
Name of Consultants: Architecture & Engineering Consultancy Services Pvt. Ltd.
Name of the client: Graphics Designers, Secunderabad.
Name of Work :Soil Investigation for Static test facility for Propellants at BDL, Ibrahimpatnam.
Ground surface level: Boring No:01
Type of boring: Rotary Driling
Diameter of boring: 100mm Date of boring started: 28/05/2014
Inclination: Vertical Date of boring completed:02/06/2014
Ground water table:Not found

01	02	03	04	05	06	07	08	09	10	11	12	13
Sl. No	Thickness of soil strata in m.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
				0.0								
01	3.0	----		1.0	Rock	S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
02		----		2.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
03		----		3.0		S.P.T.	>50	---	---	>50	0.09	SPT Rebounded, DS Collected.
04	6.0	----		4.5	Poorly graded sand	S.P.T.	>50	---	---	>50	0.05	SPT Rebounded DS Collected.
05		----		6.0		S.P.T.	>50	---	---	>50	0.04	SPT Rebounded DS Collected.
06		----		7.5		S.P.T.	>50	---	---	>50	0.06	SPT Rebounded DS Collected.
07		----		9.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, sample not recovered.
08	1.0	----		10.0	Rock	ROCK	---	---	---	---	---	Core recovery-33.0% RQD - Nil

Name of Consultants: Architecture & Engineering Consultancy Services Pvt. Ltd.
Name of the client: Graphics Designers, Secunderabad.
Name of Work :Soil Investigation for Static test facility for Propellants at BDL, Ibrahimpatnam.
Ground surface level: Boring No:02
Type of boring: Rotary Driling
Diameter of boring: 100mm Date of boring started: 08/06/2014
Inclination: Vertical Date of boring completed:09/06/2014
Ground water table:Not found

01	02	03	04	05	06	07	08	09	10	11	12	13
Sl. No	Thickness of soil strata in m.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
				0.0								
01	3.05	----		1.0	Poorly graded sand	S.P.T.	10	12	15	27	0.45	SPT conducted DS Collected.
02		----		2.0		S.P.T.	14	20	20	40	0.45	SPT conducted DS Collected.
03		----		3.0		S.P.T.	>50	---	---	>50	0.05	SPT Rebounded DS Collected.
04				3.05		---	---	---	---	---	---	
05	2.95	----		4.5	Rock	S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
06		----		6.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected

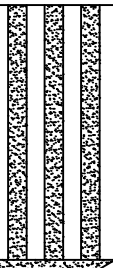
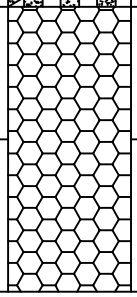
Name of Consultants: Architecture & Engineering Consultancy Services Pvt. Ltd.
Name of the client: Graphics Designers, Secunderabad.
Name of Work :Soil Investigation for Static test facility for Propellants at BDL, Ibrahimpatnam.
Ground surface level: Boring No:03
Type of boring: Rotary Driling
Diameter of boring: 100mm Date of boring started: 02/06/2014
Inclination: Vertical Date of boring completed:03/06/2014
Ground water table:Not found

01	02	03	04	05	06	07	08	09	10	11	12	13
Sl. No	Thickness of soil strata in m.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
				0.0								
01	1.05	----		1.0	Poorly graded sand mixed with silt	S.P.T.	>50	---	---	>50	0.05	SPT Rebounded DS Collected.
02				1.05		---	---	---	---	---	---	
03	4.95	----		2.0	Rock	S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
04		----		3.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
05		----		4.5		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
06		----		6.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected

Name of Consultants: Architecture & Engineering Consultancy Services Pvt. Ltd.
Name of the client: Graphics Designers, Secunderabad.
Name of Work :Soil Investigation for Static test facility for Propellants at BDL, Ibrahimpatnam.
Ground surface level: Boring No:04
Type of boring: Rotary Driling
Diameter of boring: 100mm Date of boring started: 04/06/2014
Inclination: Vertical Date of boring completed:05/06/2014
Ground water table:Not found

01	02	03	04	05	06	07	08	09	10	11	12	13
Sl. No	Thickness of soil strata in m.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
				0.0								
01	6.0	----		1.0	Rock	S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
02		----		2.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
03		----		3.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
04		----		4.5		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected
05		----		6.0		S.P.T.	>50	---	---	>50	0.00	SPT Rebounded, broken rock pieces collected

Name of Consultants: Architecture & Engineering Consultancy Services Pvt. Ltd.
Name of the client: Graphics Designers, Secunderabad.
Name of Work :Soil Investigation for Static test facility for Propellants at BDL, Ibrahimpatnam.
Ground surface level: Boring No:05
Type of boring: Rotary Driling
Diameter of boring: 100mm Date of boring started: 04/06/2014
Inclination: Vertical Date of boring completed:05/06/2014
Ground water table:Not found

01	02	03	04	05	06	07	08	09	10	11	12	13
Sl. No	Thickness of soil strata in m.	R.L. in mt.	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in m.	Remarks
				0.0								
01	2.4	----		1.0	Silty sand mixed with gravel	S.P.T.	15	20	21	41	0.45	SPT conducted DS Collected.
02		----		2.0		S.P.T.	18	23	>50	>50	0.40	SPT rebounded DS Collected.
03				2.4		---	---	---	---	---	---	---
04	0.64	----		3.0	Poorly graded sand mixed with silt	S.P.T.	>50	---	---	>50	0.04	SPT Rebounded DS Collected.
05		----		3.04		---	---	---	---	---	---	
06	2.96	----		4.5	Rock	ROCK	---	---	---	---	---	Core recovery-85.0% RQD - 30.0%
07		----		6.0		ROCK	---	---	---	---	---	Core recovery-90.0% RQD - 53.0%

CHAPTER FIVE - LABORATORY TEST RESULTS

SUB SOIL INVESTIGATION TEST RESULT OF THE SOIL SAMPLES COLLECTED DURING BORING OF B.H. No. 01

TEST CONDUCTED AS PER IS: 2720 (Pt. I, Pt. II, Pt. III , Pt. IV , Pt. V, Pt. XI / Pt. XIII , Pt. XXXX) AND IS: 1498 – 1970

Sl. No	Soil sample collected	Type of collection	Grain size analysis					Atterberg's Limits			Field Moisture Content in %	Bulk density in gm/cc.	Specific gravity	D.F.S. In %	Field S.P.T. Value	Group of soil.
			Fine Gravel In % (20mm to 4.75mm)	Coarse Sand In % (4.75mm to 2.0mm)	Medium Sand In % (2.0mm to 0.425mm)	Fine Sand in % (0.425mm to 0.075mm)	Silt (S)& Clay (C) in % (0.075mm to 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %						
1	**From 0.0m to 1.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
2	**At 1.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
3	**From 1.0m to 2.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
4	**At 2.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
5	**From 2.0m to 3.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
6	**At 3.0m depth**	SPT	10.32	6.03	35.68	45.06	2.91	16.0	Np	----	7.22	1.825	2.65	0.0	N > 50	SP
7	**At 4.5m depth**	SPT	8.63	12.22	44.52	33.55	1.08	16.0	Np	----	7.30	1.879	2.65	0.0	N > 50	SP
8	**At 6.0m depth**	SPT	0.32	0.40	64.42	32.16	2.70	18.0	Np	----	7.54	1.856	2.65	0.0	N > 50	SP
9	**At 7.5m depth**	SPT	0.00	0.26	13.18	71.18	15.38	20.0	Np	----	8.76	1.848	2.65	0.0	N > 50	SP
10	**At 9.0m depth**	SPT	STP Rebounded, sample not recovered												N > 50	----
11	**From 9.0m to 10.0m depth**	Rock	Rock strata, core recovery = 33.0% and RQD = Nil													

SUB SOIL INVESTIGATION TEST RESULT OF THE SOIL SAMPLES COLLECTED DURING BORING OF B.H. No. 02

TEST CONDUCTED AS PER IS: 2720 (Pt. I, Pt. II, Pt. III , Pt. IV , Pt. V, Pt. XI / Pt. XIII , Pt. XXXX) AND IS: 1498 – 1970

Sl. No	Soil sample collected	Type of collection	Grain size analysis					Atterberg's Limits			Field Moisture Content in %	Bulk density in gm/cc.	Specific gravity	D.F.S. In %	Field S.P.T. Value	Group of soil.
			Fine Gravel In % (20mm to 4.75mm)	Coarse Sand In % (4.75mm to 2.0mm)	Medium Sand In % (2.0mm to 0.425mm)	Fine Sand in % (0.425mm to 0.075mm)	Silt (S)& Clay (C) in % (0.075mm to 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %						
1	**At 1.0m depth**	SPT	3.72	2.33	79.33	14.44	0.18	16.0	Np	----	6.04	1.828	2.65	0.0	N =27	SP
2	**At 2.0m depth**	SPT	0.19	1.24	68.57	26.73	3.27	17.0	Np	----	6.87	1.820	2.65	0.0	N = 40	SP
3	**At 3.0m depth**	SPT	0.23	0.42	72.18	25.16	2.01	16.0	Np	----	6.56	1.885	2.65	0.0	N > 50	SP
4	**From 3.05m to 4.5m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
5	**At 4.5m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
6	**From4.5m to 6.0m depth**	Soft Rock	Rock strata, broken rock pieces collected												-----	----
7	**At 6.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----

SUB SOIL INVESTIGATION TEST RESULT OF THE SOIL SAMPLES COLLECTED DURING BORING OF B.H. No. 03

TEST CONDUCTED AS PER IS: 2720 (Pt. I, Pt. II, Pt. III , Pt. IV , Pt. V, Pt. XI / Pt. XIII , Pt. XXXX) AND IS: 1498 – 1970

Sl. No	Soil sample collected at	Type of collection	Grain size analysis					Atterberg's Limits			Field Moisture Content in %	Bulk density in gm/cc.	Specific gravity	D.F.S. In %	Field S.P.T. Value	Group of soil.
			Fine Gravel In % (20mm to 4.75mm)	Coarse Sand In % (4.75mm to 2.0mm)	Medium Sand In % (2.0mm to 0.425mm)	Fine Sand in % (0.425mm to 0.075mm)	Silt (S)& Clay (C) in % (0.075mm to 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %						
1	**At 1.0m depth**	SPT	0.82	0.92	60.36	32.56	5.34	17.0	Np	----	7.02	1.818	2.65	0.0	N>50	SP-SM
2	**From 1.05 m to 2.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
3	**At 2.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
4	**From 2.0m to 3.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
5	**At 3.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
6	**From 3.0m to 4.5m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
7	**At 4.5m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
8	**From 4.5m to 6.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
9	**At 6.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----

SUB SOIL INVESTIGATION TEST RESULT OF THE SOIL SAMPLES COLLECTED DURING BORING OF B.H. No. 04

TEST CONDUCTED AS PER IS: 2720 (Pt. I, Pt. II, Pt. III , Pt. IV , Pt. V, Pt. XI / Pt. XIII , Pt. XXXX) AND IS: 1498 – 1970

Sl. No	Soil sample collected at	Type of collection	Grain size analysis					Atterberg's Limits			Field Moisture Content in %	Bulk density in gm/cc.	Specific gravity	D.F.S. In %	Field S.P.T. Value	Group of soil.
			Fine Gravel In % (20mm to 4.75mm)	Coarse Sand In % (4.75mm to 2.0mm)	Medium Sand In % (2.0mm to 0.425mm)	Fine Sand in % (0.425mm to 0.075mm)	Silt (S)& Clay (C) in % (0.075mm to 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %						
1	**From 0.0 m to 1.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
2	**At 1.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
3	**From 1.0 m to 2.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
4	**At 2.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
5	**From 2.0m to 3.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
6	**At 3.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
7	**From 3.0m to 4.5m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
8	**At 4.5m depth**	SPT	STP Rebounded, sample not recovered												N>50	----
9	**From 4.5m to 6.0m depth**	Rock	Rock strata, broken rock pieces collected												-----	----
10	**At 6.0m depth**	SPT	STP Rebounded, sample not recovered												N>50	----

SUB SOIL INVESTIGATION TEST RESULT OF THE SOIL SAMPLES COLLECTED DURING BORING OF B.H. No. 05

TEST CONDUCTED AS PER IS: 2720 (Pt. I, Pt. II, Pt. III , Pt. IV , Pt. V, Pt. XI / Pt. XIII , Pt. XXXX) AND IS: 1498 – 1970

Sl. No	Soil sample collected at	Type of collection	Grain size analysis					Atterberg's Limits			Field Moisture Content in %	Bulk density in gm/cc.	Specific gravity	D.F.S. In %	Field S.P.T. Value	Group of soil.
			Fine Gravel In % (20mm to 4.75mm)	Coarse Sand In % (4.75mm to 2.0mm)	Medium Sand In % (2.0mm to 0.425mm)	Fine Sand in % (0.425mm to 0.075mm)	Silt (S)& Clay (C) in % (0.075mm to 0.001mm)	Liquid Limit In %	Plastic Limit In %	Plasticity Index in %						
1	**1.0m depth**	SPT	15.95	15.00	41.5	13.15	14.40	20.0	Np	----	7.23	1.802	2.65	0.0	N = 41	SM
2	**2.0m depth**	SPT	5.00	10.06	33.94	27.10	23.90	24.0	Np	----	7.12	1.810	2.65	0.0	N >50	SM
3	**3.0m depth**	SPT	0.00	0.00	64.46	30.10	5.44	17.0	Np	----	7.06	1.874	2.65	0.0	N > 50	SP-SM
4	**From 3.04m to 4.5m depth**	Rock	Rock strata, core recovery = 85.0% and RQD = 30.0%													
5	**From4.5m to 6.0m depth**	Rock	Rock strata, core recovery = 92.0% and RQD = 53.0%													

CHAPTER SIX

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	1	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.099 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	0.994	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.099 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	100	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	0.994	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.099 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.0990	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.0990	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.099 x (42.570 - 1) x 1.200 x 1.099 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.099 x 1.000 x 1.000 / 1000

= 5.4274 + 5.8067

Ultimate Net Bearing Capacity q_d = **11.2341** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **37.45 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 38.44 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	2	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.200 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.000	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.200 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	200	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.000	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.200 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.1980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.1980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.200 x (42.570 - 1) x 1.200 x 1.198 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.198 x 1.000 x 1.000 / 1000

= 11.9522 + 6.368

Ultimate Net Bearing Capacity q_d = **18.3202** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **61.07 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 63.07 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	3	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.320 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.65	
4	Submerged Density of Soil	γ'	1.065	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.320 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.065	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.320 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.2980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.2980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.320 x (42.570 - 1) x 1.200 x 1.298 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.298 x 1.000 x 1.000 / 1000

= 20.7198 + 7.348

Ultimate Net Bearing Capacity q_d = **28.0678** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **93.56 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 96.76 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	4.5	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.426 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.065	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.426 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	400	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.065	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.426 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.3970	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.3970	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.426 x (42.570 - 1) x 1.200 x 1.397 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.397 x 1.000 x 1.000 / 1000

= 29.6871 + 7.9085

Ultimate Net Bearing Capacity q_d = **37.5956** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **125.32 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 129.58 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	6	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.635 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.058	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.635 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	600	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.058	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.635 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.5950	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.5950	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.635 x (42.570 - 1) x 1.200 x 1.595 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.595 x 1.000 x 1.000 / 1000

= 50.5238 + 8.97

Ultimate Net Bearing Capacity q_d = **59.4938** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **198.31 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 204.66 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	7.5	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.784 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.784 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	750	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.045	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.784 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.7440	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.7440	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\,s_q\,d_q\,i_q + \frac{1}{2}\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

= 0.784 x (42.570 - 1) x 1.200 x 1.744 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.744 x 1.000 x 1.000 / 1000

= 68.2062 + 9.6874

Ultimate Net Bearing Capacity q_d = **77.8936** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **259.65 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 267.49 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		1	
2	Depth of Sample Collection	D_f	9	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.941 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.941 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	900	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.045 gm/cm^3

ϕ = 36.5 ^{o}

Nϕ = 3.936

Surcharge Intensity = q = γ' D / 1000 = 0.941 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.8930	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.8930	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.941 x (42.570 - 1) x 1.200 x 1.893 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.893 x 1.000 x 1.000 / 1000

= 88.859 + 10.5151

Ultimate Net Bearing Capacity q_d = **99.3741** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **331.25 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 340.66 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		2	
2	Depth of Sample Collection	D_f	1	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	=	27	SPT

Corrections as per Cl. 3.6. of IS 2131:1981

a) Due to Overburden 0.107 kg / cm2			27.00	
b) Due to Dilatancy		**N**	21.00	
2	Angle of Internal Friction	ϕ	33.4	^{o}
3	Specific Gravity of Soil	G	2.65	
4	Submerged Density of Soil	γ'	1.071	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = $q = \gamma' D$ = 0.107 kg / cm^2

Strata below Water Table = Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	100	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.071	gm/cm^3
	ϕ	33.4	^{o}
	Nϕ	3.449	

Surcharge Intensity = $q = \gamma' D / 1000$ = 0.107 kg/cm^2

Bearing Capacity Factors for ϕ = 33.4 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	28.532	s_q	1.200	d_q	1.0930	i_q	1.0000
Nγ	39.828	s_γ	0.800	d_γ	1.0930	i_γ	1.0000

Angle of Internal Friction Φ' = **24**

N_q	9.808
Nγ	9.782
Difference in N_q	18.724
Difference in N_y	30.0460

From interpolation the required values of Nq & Ny are =

N_q =	22.447
N_y =	30.063

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.107 x (22.447 - 1) x 1.200 x 1.093 x 1.000

+ ½ x 200.0 x 0.001 x 30.063 x 0.800 x 1.093 x 1.000 x 1.000 / 1000

= 3.0099 + 2.8154

Ultimate Net Bearing Capacity q_d = **5.8253** kg/cm^2

Net Safe Bearing Capacity (NSBC)= 19.42 T/m^2

Safe Bearing Capacity (SBC) = NSBC +q

SBC = 20.49 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		2	
2	Depth of Sample Collection	D_f	2	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	=	40	SPT

Corrections as per Cl. 3.6. of IS 2131:1981

a) Due to Overburden 0.212 kg / cm2			40.00	
b) Due to Dilatancy		**N**	27.50	
2	Angle of Internal Friction	ϕ	35.5	^{o}
3	Specific Gravity of Soil	G	2.65	
4	Submerged Density of Soil	γ'	1.058	gm/cm^3

Cohesionless Soil — Factor = 1.000

Overburden presuure = $q = \gamma' D$ = 0.212 kg / cm^2

Strata below Water Table = Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	200	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.058 gm/cm^3

ϕ = 35.5 ^{o}

Nϕ = 3.770

Surcharge Intensity = $q = \gamma' D / 1000$ = 0.212 kg/cm^2

Bearing Capacity Factors for ϕ = 35.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	36.390	s_q	1.200	d_q	1.1940	i_q	1.0000
$N\gamma$	54.168	s_γ	0.800	d_γ	1.1940	i_γ	1.0000

Angle of Internal Friction Φ' = **26**

N_q = 12.208

$N\gamma$ = 13.184

Difference in N_q = 24.182 Difference in N_y = 40.9840

From interpolation the required values of Nq & Ny are =

N_q = 34.879

N_y = 51.607

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.212 x (34.879 - 1) x 1.200 x 1.194 x 1.000

+ ½ x 200.0 x 0.001 x 51.607 x 0.800 x 1.194 x 1.000 x 1.000 / 1000

= 10.2908 + 5.2154

Ultimate Net Bearing Capacity q_d = **15.5062** kg/cm^2

Net Safe Bearing Capacity (NSBC)= 51.69 T/m^2

Safe Bearing Capacity (SBC) = NSBC +q

SBC = 53.81 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		2	
2	Depth of Sample Collection	D_f	3	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.317 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.058	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.317 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.058	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.317 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.2980	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.2980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.317 x (42.570 - 1) x 1.200 x 1.298 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.298 x 1.000 x 1.000 / 1000

= 20.5256 + 7.2997

Ultimate Net Bearing Capacity q_d = **27.8253** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **92.75 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 95.92 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		2	
2	Depth of Sample Collection	D_f	4.5	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.470 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.470 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	450	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.045	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.470 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.4460	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.4460	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\,s_q\,d_q\,i_q + \frac{1}{2}\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

= 0.470 x (42.570 - 1) x 1.200 x 1.446 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.446 x 1.000 x 1.000 / 1000

= 33.9022 + 8.0321

Ultimate Net Bearing Capacity q_d = **41.9343** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **139.78 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 144.48 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		2	
2	Depth of Sample Collection	D_f	6	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.627 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.627 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	600	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.045	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.627 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.5950	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.5950	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\,s_q\,d_q\,i_q + \frac{1}{2}\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

= 0.627 x (42.570 - 1) x 1.200 x 1.595 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.595 x 1.000 x 1.000 / 1000

= 49.8872 + 8.8598

Ultimate Net Bearing Capacity q_d = **58.7470** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **195.82 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 202.09 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		3	
2	Depth of Sample Collection	D_f	1	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.106 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.65	
4	Submerged Density of Soil	γ'	1.058	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.106 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	100	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.058	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.106 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.0990	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.0990	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.106 x (42.570 - 1) x 1.200 x 1.099 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.099 x 1.000 x 1.000 / 1000

= 5.8112 + 6.1806

Ultimate Net Bearing Capacity q_d = **11.9918** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **39.97 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 41.03 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		3	
2	Depth of Sample Collection	D_f	2	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.209 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.209 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	200	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.045 gm/cm^3

ϕ = 36.5 ^{o}

Nϕ = 3.936

Surcharge Intensity = q = γ' D / 1000 = 0.209 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.1980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.1980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.209 x (42.570 - 1) x 1.200 x 1.198 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.198 x 1.000 x 1.000 / 1000

= 12.4901 + 6.6546

Ultimate Net Bearing Capacity q_d = **19.1447** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **63.82 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 65.91 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		3	
2	Depth of Sample Collection	D_f	3	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.314 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.045	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.314 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.045	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.314 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.2980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.2980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.314 x (42.570 - 1) x 1.200 x 1.298 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.298 x 1.000 x 1.000 / 1000

= 20.3313 + 7.21

Ultimate Net Bearing Capacity q_d = **27.5413** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **91.8 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 94.94 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		3	
2	Depth of Sample Collection	D_f	4.5	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.473 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.052	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.473 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	450	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.052	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.473 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.4460	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.4460	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.473 x (42.570 - 1) x 1.200 x 1.446 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.446 x 1.000 x 1.000 / 1000

= 34.1186 + 8.0859

Ultimate Net Bearing Capacity q_d = **42.2045** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **140.68 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 145.41 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		3	
2	Depth of Sample Collection	D_f	6	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.631 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.052	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.631 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	600	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.052	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.631 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.5950	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.5950	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q\,(N_q - 1)\,s_q\,d_q\,i_q + \frac{1}{2}\,B\,\gamma\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma\,W'$

= 0.631 x (42.570 - 1) x 1.200 x 1.595 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.595 x 1.000 x 1.000 / 1000

= 50.2055 + 8.9191

Ultimate Net Bearing Capacity q_d = **59.1246** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **197.08 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 203.39 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		4	
2	Depth of Sample Collection	D_f	1	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.103 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.025	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.103 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	100	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.025	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.103 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.0990	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.0990	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.103 x (42.570 - 1) x 1.200 x 1.099 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.099 x 1.000 x 1.000 / 1000

= 5.6467 + 5.9878

Ultimate Net Bearing Capacity q_d = **11.6345** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **38.78 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 39.81 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		4	
2	Depth of Sample Collection	D_f	2	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.212 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.059	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.212 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	200	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.059 gm/cm^3

ϕ = 36.5 ^{o}

Nϕ = 3.936

Surcharge Intensity = q = γ' D / 1000 = 0.212 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.1980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.1980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.212 x (42.570 - 1) x 1.200 x 1.198 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.198 x 1.000 x 1.000 / 1000

= 12.6693 + 6.7437

Ultimate Net Bearing Capacity q_d = **19.4130** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **64.71 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 66.83 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		4	
2	Depth of Sample Collection	D_f	3	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.318 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.059	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.318 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.059	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.318 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.2980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.2980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.318 x (42.570 - 1) x 1.200 x 1.298 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.298 x 1.000 x 1.000 / 1000

= 20.5903 + 7.3066

Ultimate Net Bearing Capacity q_d = **27.8969** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **92.99 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 96.17 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		4	
2	Depth of Sample Collection	D_f	4.5	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.477 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.059	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.477 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	450	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.059 gm/cm^3

ϕ = 36.5 ^{o}

Nϕ = 3.936

Surcharge Intensity = q = γ' D / 1000 = 0.477 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.4460	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.4460	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.477 x (42.570 - 1) x 1.200 x 1.446 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.446 x 1.000 x 1.000 / 1000

= 34.4071 + 8.1397

Ultimate Net Bearing Capacity q_d = **42.5468** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **141.82 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 146.59 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		4	
2	Depth of Sample Collection	D_f	6	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.640 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5	^{o}
3	Specific Gravity of Soil	G	2.62	
4	Submerged Density of Soil	γ'	1.066	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.640 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	600	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.066	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.640 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.5950	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.5950	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.640 x (42.570 - 1) x 1.200 x 1.595 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.595 x 1.000 x 1.000 / 1000

= 50.9216 + 9.0378

Ultimate Net Bearing Capacity q_d = **59.9594** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **199.86 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 206.26 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		5	
2	Depth of Sample Collection	D_f	1	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	=	41	SPT

Corrections as per Cl. 3.6. of IS 2131:1981

a) Due to Overburden 0.101 kg / cm2			41.00	
b) Due to Dilatancy		**N**	28.00	
2 Angle of Internal Friction		ϕ	35.6	^{o}
3 Specific Gravity of Soil		G	2.65	
4 Submerged Density of Soil		γ'	1.012	gm/cm^3

Cohesionless Soil — Factor = 1.000

Overburden presuure = $q = \gamma' D$ = 0.101 kg / cm^2

Strata below Water Table = Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	100	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.012	gm/cm^3
	ϕ	35.6	^{o}
	Nϕ	3.786	

Surcharge Intensity = $q = \gamma' D / 1000$ = 0.101 kg/cm^2

Bearing Capacity Factors for ϕ = 35.6 ^{o}		Shape Factors		Depth Factors		Inclination Factors	
N_q	37.008	s_q	1.200	d_q	1.0970	i_q	1.0000
$N\gamma$	55.396	s_γ	0.800	d_γ	1.0970	i_γ	1.0000

Angle of Internal Friction Φ' = **26**

N_q	12.208		
$N\gamma$	13.184		
Difference in N_q	24.800	Difference in N_y	42.2120

From interpolation the required values of Nq & Ny are =

N_q = 35.768

N_y = 53.285

Ultimate Net Bearing Capacity $q_d = q (N_q - 1) s_q d_q i_q + \frac{1}{2} B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.101 x (35.768 - 1) x 1.200 x 1.097 x 1.000

+ ½ x 200.0 x 0.001 x 53.285 x 0.800 x 1.097 x 1.000 x 1.000 / 1000

= 4.6226 + 4.7324

Ultimate Net Bearing Capacity q_d = **9.3550** kg/cm^2

Net Safe Bearing Capacity (NSBC)= 31.18 T/m^2

Safe Bearing Capacity (SBC) = NSBC +q

SBC = 32.19 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		5	
2	Depth of Sample Collection	D_f	2	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.210 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.65	
4	Submerged Density of Soil	γ'	1.051	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.210 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	200	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil γ' = 1.051 gm/cm^3

ϕ = 36.5 ^{o}

Nϕ = 3.936

Surcharge Intensity = q = γ' D / 1000 = 0.210 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.1980	i_q	1.0000
$N\gamma$	66.444	s_γ	0.800	d_γ	1.1980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.210 x (42.570 - 1) x 1.200 x 1.198 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.198 x 1.000 x 1.000 / 1000

= 12.5498 + 6.6928

Ultimate Net Bearing Capacity q_d = **19.2426** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **64.14 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 66.24 T/m^2

Calculation of Safe Bearing Capacity from Standard Penetration Test

Soil Investigation Data

Site Information

1	Bore Hole No		5	
2	Depth of Sample Collection	D_f	3	m
3	Inclination of load to the vertical	α	0	^{o}

Laboratory Investigations

1	Standard Penetration Value from Field	>	50	SPT
	Corrections as per Cl. 3.6. of IS 2131:1981			
	a) Due to Overburden 0.326 kg / cm2		50.00	
	b) Due to Dilatancy	**N**	32.50	
2	Angle of Internal Friction	ϕ	36.5 ^{o}	
3	Specific Gravity of Soil	G	2.64	
4	Submerged Density of Soil	γ'	1.086	gm/cm^3

Cohesionless Soil Factor = 1.000

Overburden presuure = q =(γ' D)/1000 = 0.326 kg / cm^2

Strata below Water Table= Fine Sand and Silt

Ref: Fig.1 of IS 6403: 1981

Assumptions

1	Width of Foundation	B	200	cm
2	Depth of Foundation below Ground level	D_f	300	cm
3	Length of Foundation	L	200	cm
4	Shape of Base		Square	
5	Depth of Water Table	Dw	Not found	
	Effect of Water Table	W'	1.0	
6	Factor of Safety for	Sand	3	

Calculations

Submerged Density of Soil	γ'	1.086	gm/cm^3
	ϕ	36.5	^{o}
	Nϕ	3.936	

Surcharge Intensity = q = γ' D / 1000 = 0.326 kg/cm^2

Bearing Capacity Factors for ϕ = 36.5 ^{o}

		Shape Factors		Depth Factors		Inclination Factors	
N_q	42.570	s_q	1.200	d_q	1.2980	i_q	1.0000
Nγ	66.444	s_γ	0.800	d_γ	1.2980	i_γ	1.0000

Ultimate Net Bearing Capacity q_d = $q (N_q - 1) s_q d_q i_q + ½ B \gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$

= 0.326 x (42.570 - 1) x 1.200 x 1.298 x 1.000

+ ½ x 200.0 x 0.001 x 66.444 x 0.800 x 1.298 x 1.000 x 1.000 / 1000

= 21.1083 + 7.4929

Ultimate Net Bearing Capacity q_d = **28.6012** kg/cm^2

Net Safe Bearing Capacity (NSBC)= **95.34 T/m^2**

Safe Bearing Capacity (SBC) = NSBC + q

SBC = 98.6 T/m^2

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	1	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**37.450**	t/m^2		
Settlement from graph =	56.18	mm			
Depth factor =	0.85				
$S_{fd} = S_f$ x Depth factor =	47.75	mm			
Rigidity factor =	0.8				
Final settlement (S) =	38.2	mm	(Say	38	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	2	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**		**61.070**	t/m^2	
Settlement from graph =	91.61	mm			
Depth factor =	0.725				
$S_{fd} = S_f$ x Depth factor =	66.41	mm			
Rigidity factor =	0.8				
Final settlement (S) =	53.1	mm	(Say	53	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	3	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**93.560**	t/m^2		
Settlement from graph =	140.34	mm			
Depth factor =	0.66				
$S_{fd} = S_f$ x Depth factor =	92.62	mm			
Rigidity factor =	0.8				
Final settlement (S) =	74.1	mm	(Say	74	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	4.5	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**125.320**	t/m^2		
Settlement from graph =	187.98	mm			
Depth factor =	0.61				
$S_{fd} = S_f$ x Depth factor =	114.67	mm			
Rigidity factor =	0.8				
Final settlement (S) =	91.7	mm	(Say	92	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	6	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**198.310**	t/m^2		
Settlement from graph =	297.47	mm			
Depth factor =	0.58				
$S_{fd} = S_f$ x Depth factor =	172.53	mm			
Rigidity factor =	0.8				
Final settlement (S) =	138.0	mm	(Say	138	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	7.5	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**259.650**	t/m^2		
Settlement from graph =	389.48	mm			
Depth factor =	0.563				
$S_{fd} = S_f$ x Depth factor =	219.27	mm			
Rigidity factor =	0.8				
Final settlement (S) =	175.4	mm	(Say	175	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-1

Depth of foundation	9	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**331.250**	t/m^2		
Settlement from graph =	496.88	mm			
Depth factor =	0.56				
$S_{fd} = S_f$ x Depth factor =	278.25	mm			
Rigidity factor =	0.8				
Final settlement (S) =	222.6	mm	(Say	223	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-2

Depth of foundation	1	mt.			
Corrected N Value	21				
From graph As pr IS: 8009-1976	13.5	mm			
Effect of water table	0.5				
Corrected Settlement	27.00	mm			
Due to imposed load =	**NSBC =**	**19.420**	t/m^2		
Settlement from graph =	52.43	mm			
Depth factor =	0.85				
$S_{fd} = S_f$ x Depth factor =	44.57	mm			
Rigidity factor =	0.8				
Final settlement (S) =	35.7	mm	(Say	36	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-2

Depth of foundation	2	mt.			
Corrected N Value	27.5				
From graph As pr IS: 8009-1976	9	mm			
Effect of water table	0.5				
Corrected Settlement	18.00	mm			
Due to imposed load =	**NSBC =**	**51.690**	t/m^2		
Settlement from graph =	93.04	mm			
Depth factor =	0.725				
$S_{fd} = S_f$ x Depth factor =	67.46	mm			
Rigidity factor =	0.8				
Final settlement (S) =	54.0	mm	(Say	54	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-2

Depth of foundation	3	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**92.750**	t/m^2		
Settlement from graph =	139.13	mm			
Depth factor =	0.66				
$S_{fd} = S_f$ x Depth factor =	91.82	mm			
Rigidity factor =	0.8				
Final settlement (S) =	73.5	mm	(Say	73	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-2

Depth of foundation	4.5	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**139.780**	t/m^2		
Settlement from graph =	209.67	mm			
Depth factor =	0.61				
$S_{fd} = S_f$ x Depth factor =	127.90	mm			
Rigidity factor =	0.8				
Final settlement (S) =	102.3	mm	(Say	102	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-2

Depth of foundation	6	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**195.820**	t/m^2		
Settlement from graph =	293.73	mm			
Depth factor =	0.58				
$S_{fd} = S_f$ x Depth factor =	170.36	mm			
Rigidity factor =	0.8				
Final settlement (S) =	136.3	mm	(Say	136	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-3

Depth of foundation	1	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**39.970**	t/m^2		
Settlement from graph =	59.96	mm			
Depth factor =	0.85				
$S_{fd} = S_f$ x Depth factor =	50.96	mm			
Rigidity factor =	0.8				
Final settlement (S) =	40.8	mm	(Say	41	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-3

Depth of foundation	2	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**63.820**	t/m^2		
Settlement from graph =	95.73	mm			
Depth factor =	0.725				
$S_{fd} = S_f$ x Depth factor =	69.40	mm			
Rigidity factor =	0.8				
Final settlement (S) =	55.5	mm	(Say	56	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-3

Depth of foundation	3	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**91.800**	t/m^2		
Settlement from graph =	137.70	mm			
Depth factor =	0.66				
$S_{fd} = S_f$ x Depth factor =	90.88	mm			
Rigidity factor =	0.8				
Final settlement (S) =	72.7	mm	(Say	73	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-3

Depth of foundation	4.5	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**140.680**	t/m^2		
Settlement from graph =	211.02	mm			
Depth factor =	0.61				
$S_{fd} = S_f$ x Depth factor =	128.72	mm			
Rigidity factor =	0.8				
Final settlement (S) =	103.0	mm	(Say	103	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-3

Depth of foundation	6	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**197.080**	t/m^2		
Settlement from graph =	295.62	mm			
Depth factor =	0.58				
$S_{fd} = S_f$ x Depth factor =	171.46	mm			
Rigidity factor =	0.8				
Final settlement (S) =	137.2	mm	(Say	137	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-4

Depth of foundation	1	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**38.780**	t/m^2		
Settlement from graph =	58.17	mm			
Depth factor =	0.85				
$S_{fd} = S_f$ x Depth factor =	49.44	mm			
Rigidity factor =	0.8				
Final settlement (S) =	39.6	mm	(Say	40	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-4

Depth of foundation	2	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**64.710**	t/m^2		
Settlement from graph =	97.07	mm			
Depth factor =	0.725				
$S_{fd} = S_f$ x Depth factor =	70.37	mm			
Rigidity factor =	0.8				
Final settlement (S) =	56.3	mm	(Say	56	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-4

Depth of foundation	3	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**92.990**	t/m^2		
Settlement from graph =	139.49	mm			
Depth factor =	0.66				
$S_{fd} = S_f$ x Depth factor =	92.06	mm			
Rigidity factor =	0.8				
Final settlement (S) =	73.6	mm	(Say	74	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-4

Depth of foundation	4.5	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**141.820**	t/m^2		
Settlement from graph =	212.73	mm			
Depth factor =	0.61				
$S_{fd} = S_f$ x Depth factor =	129.77	mm			
Rigidity factor =	0.8				
Final settlement (S) =	103.8	mm	(Say	104	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-4

Depth of foundation	6	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**199.860**	t/m^2		
Settlement from graph =	299.79	mm			
Depth factor =	0.58				
$S_{fd} = S_f$ x Depth factor =	173.88	mm			
Rigidity factor =	0.8				
Final settlement (S) =	139.1	mm	(Say	139	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-5

Depth of foundation	1	mt.			
Corrected N Value	28				
From graph As pr IS: 8009-1976	9.0	mm			
Effect of water table	0.5				
Corrected Settlement	18.00	mm			
Due to imposed load =	**NSBC =**	**31.180**	t/m^2		
Settlement from graph =	56.12	mm			
Depth factor =	0.85				
$S_{fd} = S_f$ x Depth factor =	47.71	mm			
Rigidity factor =	0.8				
Final settlement (S) =	38.2	mm	(Say	38	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-5

Depth of foundation	2	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**		**64.140**	t/m^2	
Settlement from graph =	96.21	mm			
Depth factor =	0.725				
$S_{fd} = S_f$ x Depth factor =	69.75	mm			
Rigidity factor =	0.8				
Final settlement (S) =	55.8	mm	(Say	56	mm)

CALCULATION OF SETTLEMENT OF FOUNDATION

AS PER IS:8009 (Part -I)-1976

BH-5

Depth of foundation	3	mt.			
Corrected N Value	32.5				
From graph As pr IS: 8009-1976	7.5	mm			
Effect of water table	0.5				
Corrected Settlement	15.00	mm			
Due to imposed load =	**NSBC =**	**95.340**	t/m^2		
Settlement from graph =	143.01	mm			
Depth factor =	0.66				
$S_{fd} = S_f$ x Depth factor =	94.39	mm			
Rigidity factor =	0.8				
Final settlement (S) =	75.5	mm	(Say	76	mm)

Chapter Seven:-SAFE BEARING CAPACITY OF ROCK CORE SPECIMENS COLLECTED DURING THE BORING AT IBRAHIMPATNAM

TEST WAS CONDUCTED AS PER IS: 9143 – 1979 & IRC: 78 - 2000

Sample Reference	Bore hole reference	Sample collected from depth	Size of specimens		Length: Dia ratio of specimen	Correction factor for size Length:Dia	Cross-sectional area of the specimen in mm^2	Density in gm/cc	Water absorption in %	Compressive Load in KN	Compressive strength in N/mm^2	Corrected compressive strength in N/mm^2	Ave. corrected Compressive strength in N/mm^2	SBC		Condition of test Specimen
			Length in cm	Diameter in cm										in N/mm^2 or in Mpa	in T/m^2	
1	BH-01	9.0m to 10.0m	5.4	5.4	1:1	0.89	2290.5	2.552	0.48	43.0	18.77	16.71	15.67	1.96	196	WET
2			5.4	5.4	1:1	0.89	2290.5	2.605	0.42	38.0	16.59	14.77				
3			5.4	5.4	1:1	0.89	2290.5	2.588	0.47	40.0	17.46	15.54				
4	BH-05	3.04m to 4.5m	10.8	5.4	2:1	1.0	2290.5	2.665	0.32	52.0	22.70	22.70	22.73	2.84	284	WET
5			10.8	5.4	2:1	1.0	2290.5	2.638	0.38	57.0	24.89	24.89				
6			5.4	5.4	1:1	0.89	2290.5	2.650	0.35	53.0	23.14	20.59				
7		4.5m to 6.0m	10.8	5.4	2:1	1.0	2290.5	2.685	0.30	58.0	25.32	25.32	23.87	2.98	298	WET
8			10.8	5.4	2:1	1.0	2290.5	2.693	0.28	52.0	22.70	22.70				
9			10.8	5.4	2:1	1.0	2290.5	2.680	0.32	54.0	23.58	23.58				

Note : SBC of the rock specimen have been calculated by considering a Factor of Safety of 8 as per IRC : 78 - 2000

Chapter Eight: Analysis of the Sub Surface Investigation

The analysis of the sub-surface investigation test result of the soil samples collected during boring for the **"Soil Investigation for Static test facility for propellants at BDL, Ibrahimpatnam."**

BH : 1

1. It is seen that, from 0.0m to 3.0m depth, a rock strata is encountered and broken rock pieces were collected during boring, wherein three SPTs were conducted at 1.0m, 2.0m and 3.0m depth. The field N values from SPT are found to be more than 50.
2. From 3.0m to 9.0m depth, a non-plastic, non-expansive and very dense compacted poorly graded sand is presented, wherein five SPTs were conducted at each 1.5m depth interval. The field N values from SPT are found to be more than 50.
3. From 9.0m to 10.0m depth, (max depth explored) a rock strata is encountered, from which rock core samples were collected. The core recovery and RQD are found to be 33.0% and 0.0% respectively.

BH : 2

1. It is seen that, from 0.0m to 3.05m depth, a non-plastic non-expansive and medium to very dense compacted poorly graded sand strata is existing, wherein three SPTs were conducted at 1.0m, 2.0m and 3.0m depth. The field N values from SPT are found to be 27, 40 and more than 50 respectively.
2. From 3.05m to 6.0m depth, (max. depth explored) a rock strata is encountered and broken rock pieces were collected during boring, wherein two SPTs were conducted at 4.5m and 6.0m depth. The field N values from SPT are found to be more than 50.

BH : 3

1. It is seen that, from 0.0m to 1.05m depth, a non-plastic, non-expansive and very dense compacted poorly graded sand mixed with silt strata is existing, wherein one SPT was conducted at 1.0m depth. The field N value from SPT is found to be more than 50.
2. From 1.05m to 6.0m depth, (max. dept explored) a rock strata is encountered and broken rock pieces were collected during boring, wherein four SPTs were conducted at 2.0m, 3.0m, 4.5m and 6.0m depth. The field N values from SPT are found to be more than 50.

BH : 4

1. It is seen that, from 0.0m to 6.0m depth, (max. depth explored) a rock strata is encountered and broken rock pieces were collected during boring, wherein five SPTs were conducted at 1.0m, 2.0m, 3.0m, 4.5m and 6.0m depth. The field N values from SPT are found to be more than 50.

BH : 5

1. It is seen that, from 0.0m to 2.4m depth, a non-plastic, non-expansive and dense to very dense graded compacted silty sand strata is presented, wherein two SPTs were conducted at 1.0m and 2.0m depth. The field N values from SPT are found to be 41 and more than 50 respectively.
2. From 2.4m to 3.04m depth, a non-plastic, non-expansive and dense compacted poorly graded sand mixed with silt strata is presented, wherein one SPT was conducted at 3.0m depth. The field N value from SPT is found to be more than 50.
3. From 3.04m to 6.0m depth (max. depth explored), a rock strata is encountered, from which rock core sample were collected. The core recoveries and RQDs are varying from 85.0% to 92.0% and 30.0% to 53.0%.

Chapter Nine (a): Abstract of Safe Bearing Capacity (SBC)

Table -1

Location	Depth in mt.	Type of sample collected	Group of soil	NSBC in T/m²	Settlement in mm	SBP for 40mm settlement in T/m²
(BH 1)	1.0	S.P.T (N>50)	Rock	37.45	38	39.42
	2.0	S.P.T (N>50)		61.07	53	46.09
	3.0	S.P.T (N>50)		93.56	74	50.57
	4.5	S.P.T (N>50)	SP	125.32	92	54.49
	6.0	S.P.T (N>50)		198.31	138	57.48
	7.5	S.P.T (N>50)		259.65	175	59.35
	9.0	S.P.T (N>50)		331.25	223	59.42
(BH 2)	1.0	S.P.T (N=27)	SP	19.42	36	21.58
	2.0	S.P.T (N=40)		51.69	54	38.29
	3.0	S.P.T (N>50)		92.75	73	50.82
	4.5	S.P.T (N>50)	Rock	139.78	102	54.82
	6.0	S.P.T (N>50)		195.82	136	57.59
(BH 3)	1.0	S.P.T (N>50)	SP-SM	39.97	41	38.99
	2.0	S.P.T (N>50)	Rock	63.82	56	45.59
	3.0	S.P.T (N>50)		91.80	73	50.30
	4.5	S.P.T (N>50)		140.68	103	54.63
	6.0	S.P.T (N>50)		197.08	137	57.54
(BH 4)	1.0	S.P.T (N>50)	Rock	38.78	40	38.78
	2.0	S.P.T (N>50)		64.71	56	46.22
	3.0	S.P.T (N>50)		92.99	74	50.26
	4.5	S.P.T (N>50)		141.82	104	54.55
	6.0	S.P.T (N>50)		199.86	139	57.51
(BH 5)	1.0	S.P.T (N=41)	SM	31.18	38	32.82
	2.0	S.P.T (N>50)		64.14	56	45.81
	3.0	S.P.T (N>50)	SP-SM	95.34	76	50.18

(b) Abstract of Safe Bearing Capacity of rock

Table – 2

Location	Rock specimens collected from	Condition of specimen test		SBC		Type of rock
				in MPa	in T/m^2	
(BH 1)	9.0m to 10.0m depth	Set – 1	Wet	1.96	196	Soft Rock
(BH 5)	3.04m to 4.5m depth	Set – 1	Wet	2.84	284	Hard Rock
	4.5m to 6.0m depth	Set – 1	Wet	2.98	298	Hard Rock

Remarks: As per IRC: 78 – 2000,

Type of rock — Suggested Allowable Bearing Values for Ave. Condtn.

a. Hard Rocks ---------- 2.0 MPa to 3.0 MPa
b. Soft Rocks ---------- 1.0 MPa to 2.0 MPa
c. Weathered Rocks,
Conglomerates & Laterites ---- Not more than 1.0 MPa

Chapter Ten: Conclusion & Recommendations

1. Five boreholes have been advanced for the proposed project for the "**Soil investigation for Static test facility for propellants at BDL Ibrahimpatnam."**
2. Standing water table was not found during boring.
3. In the present case, the superstructure load is not known. Hence a low to moderate column load has been assumed.
4. The bearing capacity has been calculated as per IS: 6403, IS: 8009(pt-1), IS: 9143 and IRC-78-2000. The sample calculations are attached herewith.
5. It is suggested that an isolated square footing may be considered suitable for the proposed structures at 2.0m depth below the OGL, considering the SBP 30.0T/m2 corresponding to settlement of 40mm.
6. However considering the SBP as mentioned at **Chapter nine**, the designer may estimate the depth & Size of footing as per requirement.
7. For the safety of the structure a tie beam may be provided, to avoid the differential settlement. If the column load varies considerably, in such case also the tie beams become essential to avoid differential settlement.
8. Hyderabad city is included in the zone II of earthquake with low seismic intensity of Z=0.10.Hence due precautions may be taken to design the foundations of building as per IS:4326 and IS:1893.

Location map showing the Bore holes