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DEPARTMENT OF CIVIL ENGINEERING
ANNA UNIVERSITY
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DINDIGUL -624 622

SUB SOIL INVESTIGATION REPORT

NAME OF WORK : **Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District.**

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Date: 23-05-2022

To

The Executive Engineer,
T.N. Urban Habitat Development Board,
Madurai Division,
Madurai District.

Dear Sir,

Sub: Soil investigation report - Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District - reg.

Ref: Roc.No: 872/AE(P) 2018 , Date: 19-04-2022

...

With reference to the above, the soil investigation report for the Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District has been send. Kindly acknowledge the receipt for the report.

Thanking you

With regards,

JTW 23/5/22.

Staff In-charge & Principal Consultant

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CHAPTER-1

INTRODUCTION

1.0 PROEM

The Executive Engineer, T.N. Urban Habitat Development Board, Madurai Division has Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District. In order to get adequate data required for designing the foundations, he has proposed to conduct the sub-soil investigation to determine the foundation design parameters.

For the purpose of conducting sub-soil investigation, laboratory testing, designing the foundations and computing the Safe Bearing Capacity, the responsibility of carrying out suitable soil investigation was entrusted to **The Anna University, University College of Engineering, and Dindigul.**

This report contains the field and laboratory test results along with Design computations and recommendations for suitable foundation systems.

1.1 SCOPE OF WORK

The Scope of Geotechnical work includes the following:

- Making **Four** standard soil investigation bore holes of 150 mm diameter up to a depth of 30.00 m below existing ground level as directed by the Engineer-in-charge.
- Conducting Standard Penetration Test (SPT) in various depths at regular intervals (1.50 m) or change of soil strata.
- Collection of Disturbed Soil Samples from split spoon samplers.
- Collection of water samples from each bore hole.
- Conducting relevant laboratory tests on collected soil samples.
- Recommending the suitable type and depth of foundation.
- Yielding the Safe Bearing Capacity and Settlement for the recommended foundation.

1.2 LOCATION & DESCRIPTION OF STRUCTURE

The proposed Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District. The site is located in a rural area and the **4 boreholes** is made point as specified by the Engineer in charge.

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CHAPTER-2

FIELD INVESTIGATION

2.1 PROEM

The generally adopted field tests on soils are penetration and sounding tests. On the category of penetration tests, the Standard Penetration Test [SPT] is the one implemented as per IS 2131-1981 to study the stratification and characteristics of the sub soil in this project. Three boreholes of depth at 30.00 m is made with penetration test done for every 1.50 m.

2.2 EQUIPMENT AND METHODOLOGY

2.2.1 Rotary Boring

The method adapted for drilling the exploratory borehole was rotary drilling technique which was done using Calyx machine with direct mud circulation. The drill mud used was made of Sodium Bentonite. The mud returning upwards though the annular space between the drill rods and the side of the hold bring the cutting to the surface. Borehole was always kept filled with drilling mud to prevent any negative hydrostatic pressure within the borehole.

2.2.2 Standard Penetration Test

The Standard penetration test (SPT) is widely used to get the bearing capacity of soil directly at a certain depth. Standard penetration tests were conducted at the borehole locations, in accordance with IS: 2131. The N-value indicates the relative density, consistency, strength, etc. The tests were conducted at every 1.50 m or change of soil stratum up to the depth of termination of the borehole as directed by the engineer-in-charge.

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The test measures the penetration resistance of the split spoon sampler, when it is driven into the soil, at the bottom of a borehole in a standard manner. SPT split spoon sampler of standard size was driven into the soil from borehole bottom using 63.5 kg hammer falling from a standard height of 750 mm. Blow counts for the penetration of every 150 mm for a total of 450 mm penetration were recorded. The initial 150 mm penetration is referred to as seating drive and the blows required for this penetration are not considered as this zone is disturbed soil. The next 300 mm of penetration is referred to as the test drive and the number of blows required to achieve this fully is termed the penetration resistance or N-value.

2.3 SAMPLING IN BOREHOLES

The SPT-samples collected were disturbed soil samples and rock samples were collected as core recovery through core drilling on rock strata. Soil collected in the SPT sampler is preserved in polythene covers and transported to laboratory. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

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CHAPTER-3

LABORATORY INVESTIGATION

3.0 PROEM:

The collected soil sample was tested in Laboratory as per relevant procedure in Indian Standard codes. The tests are conducted to determine the index and the engineering properties of the sub soil.

3.1 TESTS ON SAMPLES

The following parameters were conducted on the soil samples:

- **Natural Moisture Content:**
  This test is conducted in all disturbed samples to find the water content in the soil samples as per **IS 2720 (Part 2) : 1973.**
- **Grain size Analysis Tests:**
  On the coarse-grained samples, grain size distribution tests were conducted as per **I.S.2720 (Part 4)-1985**, to know the gradation characteristics and to classify them.
- **Liquid Limit:**
  This test conducted in fine-grained soils to find the liquid Limit of the soil as per **IS 2720 (Part 5) : 1985**
- **Plastic Limit:**
  This test conducted in fine-grained soil to find plastic limit of the soil as per **IS 2720 (Part 5) : 1985**
- **Specific Gravity:**
  This test is conducted in all disturbed soil samples to find Specific gravity of oil as per **IS 2720 (Part 3) : 1980**

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- **Direct Shear Test:**
  This test conducted in coarse-grained soil to find the angle of shearing resistance of the soil as per **IS 2720 (Part 13) : 1986**
- **Unconfined Compression Test:**
  This test conducted in fine-grained soil to find Cohesion of the soil as per **IS 2720 (Part 10) : 1995**

3.2 SUMMARY OF TEST RESULTS:

The laboratory test results were done and the results of the various tests are given the annexure of the report. The test results for each borehole is given in the Annexure and a model results for the tests of a sample is enclosed in the Annexure.

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CHAPTER-4

FOUNDATIONANALYSIS

4.0 PROEM

The sub surface stratification at borehole locations, with respect to foundation/geotechnical engineering application are derived based on the visual identification, laboratory classification tests and field in-situ strength tests. Further, the strength parameters are estimated based on the in-situ strength test results as per the following correlation.

* For Coarse Grained Samples, Ref. Fig.1, IS: 6403 to estimate Angle of Shearing Resistance.
* For Fine Grained Samples, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength.

4.1 SOIL PROFILE

The profile of the area as observed in the bore hole is given in the bore log attached in the annexure. The Ground water table was not observed within the depth of exploration.

The stratigraphy of the sub soil in **BH 1** is comprised of **Top Soil** (0.00 – 0.40m), followed by **Sand** (0.40 – 2.80m), followed by **Kankur** (2.80 – 5.50m), followed by **Clayey Sand** (5.50 – 11.20m), followed by **Sand** (11.20 – 16.30m), followed by **Kankur** (16.30 - 26.80m) and futher followed by **Sand** (26.80 – 30.10m).

The stratigraphy of the sub soil in **BH 3** is comprised of **Top Soil** (0.00 – 0.60m), followed by **Clayey Sand** (0.60 – 7.30m), followed by **Sand** (7.30 – 11.80m), followed by **Well Graded Sand** (11.80 – 13.30m), followed by **Kankur with Sand** (13.30 – 16.10m), followed by **Sandy Clay** (16.10 – 17.90m), followed by **Sand** (17.90 – 19.20m), followed by **Kankur with Sand** (19.20 – 24.00m) and futher followed by **Sand** (24.00 – 30.20m).

The stratigraphy of the sub soil in **BH 4** is comprised of **Top Soil** (0.00 – 0.40m), followed by **Sand** (0.40 – 4.00m), followed by **Clayey Sand** (4.00 – 8.70m), followed by **Sandy Clay** (8.70 – 10.20m), followed by **Kankur with Sand** (10.20 – 22.50m) and futher followed by **Sand** (22.50 – 30.00m).

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4.2 SAFE BEARING CAPACITY AND SETTLEMENT

Safe bearing capacity of soil field test is done to check the capacity of the soil to withstand loads. The maximum load per unit area which the soil can bear without any displacement or settlements is designated as the "Safe bearing capacity of the soil. The bearing capacity of granular soil depends upon the unit weight and angle of internal friction of the soil. These two properties of granular soils are determined by standard penetration tests.

Safe bearing capacity of the soil is calculated using IS method 6403-1981

$$Q = C\,NC\,SC\,dC\,i_c + q\,(Nq-1)\,Sq\,dq\,i_q + 0.5\,B\gamma Nr\,Sr\,dr\,i_r$$

Where,

Q	= Ultimate bearing capacity	[kN/m²]
C	= Cohesion	[kN/m²]
q	= Effective surcharge at the base level of foundation	[kN/m³]
γ	= Bulk Density of soil	[kN/m³]
B	= Width of the Footing	[m]
Ny, Nq, Nr	= Bearing capacity Factor	
Sc, Sq, Sr	= Shape Factor	
dc, dq, dr	= Depth Factor	
i_C, i_q, i_r	= Inclination Factor	

Safe Bearing Capacity

Qs = Q / Fs

Qs	= Safe bearing capacity	[kN/m²]
Fs	= Factor of safety	

The factor of safety is considered as 2.5

Settlement calculations done as per IS-8009-(part-1) 1998

$$Si = Q_s B \frac{(1-\mu^2)}{Es} I$$

Si	= Immediate Settlement	[cm]
Qs	= soil Pressure	[kN /m²]
B	= Width of foundation	[m]
μ	= Poisson's ratio	
I	= Influence factor	
Es	= Elastic Modulus	[kN/m²]

(The Safe Bearing Capacity and Settlement Calculations are enclosed at the annexure)

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4.3 LATERAL LOAD CALCULATION

The Coefficient of earth pressure at rest K_0, is defined as the ratio of the Horizontal Effective Stress (σ_h) to the Vertical Effective Stress (σ_v) in soil. Thus,

$$K_0 = \sigma_h / \sigma_v$$

Here σ_v represents as SBC, Therefore

$$\sigma_h = SBC \times K_0$$

For normally Cohesionless Soils, the well – known expression for K_0 is,

$$K_0 = 1 - \sin\phi$$

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CHAPTER-5

DESIGN CRITERIA

5.0 PROEM

The foundation system design is an interface between super structure and the sub soil bearing strata characteristics. A sound foundation system should be safe against bearing strata shear response under the super structure load intensity. Similarly, the stability of the foundation system is governed by the bearing strata deformation response under the super structure load intensity. In addition, as a combined system of super structure and foundation, the overall stability is also governed by the super structure arrangement.

Considering the above aspects of foundation design, the suitable type of foundation system with respect to the sub soil conditions encountered at the borehole locations is presented in the subsequent sections.

5.1 BEARING STRATA CHARACTERISTICS

From field investigations, it can be observed that the sub-soil strata encountered at shallow depths i.e. below 28.00 m thick filled up soil strata are uniformly stratified coarse-grained type and good from both shear strength characteristics and deformation consideration to act as bearing strata for proposed impending loads form structure.

Considering the above, suitable foundation system is presented below.

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5.2 Foundation System

The type and the minimum depth of foundations are governed by the following factors:

i. The thickness of the top loose zone.

ii. Adequate depth of soil above founding level, to ensure mobilization of full safe bearing capacity.

iii. Adequate depth of soil strata below founding level of requisite strength to mobilize the safe bearing capacity and at the same time restricts the total and differential settlements within the allowable limits.

iv. The type and depth of foundation shall be decided by the design engineer according the analyzed load of the super structure.

v. The soil is designed considering the worse case of foundation soil condition. During rain, the water table may rise upto or above the base of the foundation. The water table correction is selected accordingly considering this scenario.

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CHAPTER-6

RECOMMENDATIONS

Based on the SBC and settlement calculations, site investigations the recommendations for foundation are as follows:

i. The recommended foundation is bored cast in-situ PILE FOUNDATION.

ii. **The pile having a load carrying capacity of 110.50 tons with a dia.of 500mm and minimum length of 30m from the ground level is recommended. The cut off level of the piles is 1m from the average ground level.**

iii. ***The supporting is structure on pile foundations irrespective of location of the structure. For the Nine storied structure and soil condition of the area bored cast in-situ pile foundation is a suitable choice. The pile with minimum length of 30m is considered suitable. The cut of level of pile recommended is 1m from the average ground level. The recommended capacities of piles of various diameters are below the bore Hole Tables 1,2,3 & 4.***

iv. Care shall be taken so that the ultimate bearing strata are none other than Soft Disintegrated Rock / Weathered Rock type.

v. Safe bearing capacity presented is computed considering any rise in the ground water table at or above the level of footing.

vi. Special provisions to contain any lateral collapse of soil from the walls excavated foundation pits are required.

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vii. In case, the ground water table is encountered within the recommended depths of foundation system, the same shall be bailed out continuously to keep the sub-grade well consolidated.

viii. The Design Engineer may choose an alternate foundation for the building structure and load.

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Bore Hole – 1

Diameter of pile (mm)	Length of Pile (m)	Pile Load Capacity (ton)	Lateral Load Capacity (ton)
500	20	77	34.3
	25	113	50.3
	30	153	68.3
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
700	20	124.5	55.5
	25	179	79.8
	30	240.5	107.2
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
900	20	181.5	80.9
	25	257	114.6
	30	340	151.6
1000	20	213.5	95.2
	25	300	133.8
	30	395	176.1

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Bore Hole – 2

Diameter of pile (mm)	Length of Pile (m)	Pile Load Capacity (ton)	Lateral Load Capacity (ton)
500	20	70.5	32.7
	25	104	48.2
	30	110.5	51.2
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
700	20	113.5	52.6
	25	164	76
	30	177	82.1
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
900	20	165	76.5
	25	234.5	108.8
	30	255.5	118.5
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
1000	20	193.5	89.7
	25	274	127.1
	30	300	139.2

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Bore Hole – 3

Diameter of pile (mm)	Length of Pile (m)	Pile Load Capacity (ton)	Lateral Load Capacity (ton)
500	20	70	32.4
	25	97.5	45.2
	30	143	66.3
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
700	20	112.5	52.2
	25	155	71.9
	30	222.9	103.4
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
900	20	164	76
	25	223	103.4
	30	315	146.1
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
1000	20	193	89.5
	25	261	121.1
	30	366	169.8

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Bore Hole – 4

Diameter of pile (mm)	Length of Pile (m)	Pile Load Capacity (ton)	Lateral Load Capacity (ton)
500	20	69.5	36.5
	25	98.5	51.8
	30	148	77.8
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
700	20	116	61
	25	153	80.5
	30	230	121
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
900	20	161	84.7
	25	215	113
	30	325	171
Diameter of pile (mm)	**Length of Pile (m)**	**Pile Load Capacity (ton)**	**Lateral Load Capacity (ton)**
1000	20	189	99.4
	25	250	132
	30	377	198.3

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7 PRECAUTIONS

Entire report should be studied before implementing the recommendations. Loose pockets of soil, if encountered shall be removed and backfilled with a levelling course of concrete shall be laid and construction of foundations with **IS CODE recommends** can be taken up subsequently.

8 LIMITATIONS

The soil investigations have been carried out at locations in the site chosen by the client so as to represent the entire site. The recommendations provided in this report are hence valid only for these test locations. However, if there is any change in sub soil conditions and properties at places between or beyond chosen test locations, Varaha Geotechnical Works may be contacted for further advice.

With passage of time, the recommendations may vary due to manmade and natural environmental changes.

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REFERENCE

1. IS: 6403-1981

2. IS: 2911-(part1/sec-2 0-1979)

4. IS: 8009 (Part-1) 1976

5. IRC 78:2000

6. Wayne C.Teng (1992) Foundation design, 13th reprint,

   Prentice - Hall of India Pvt.Ltd,

7. Bowles J.E, (1982) Foundation Analysis and design, 3rd edition, Mc Graw Hill International Book Co.

8. Tomlinson M.J. (1995) Foundation Design and Construction, 6th edition, Longman Group.

Field work was executed generally in accordance with IS specification listed below:

IS-1892 : Code of practice for Subsurface Investigation of Foundations.

IS-1498 : Classification and Identification of soils for General Engineering Purposes.

IS-2131 : Method for Standard Penetration Test for Soil

IS-2132 : Code for practice for Thin Walled Tube Sampling of Soil.

IS-5313 : Guide for Core Drilling Observations.

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BORELOGS

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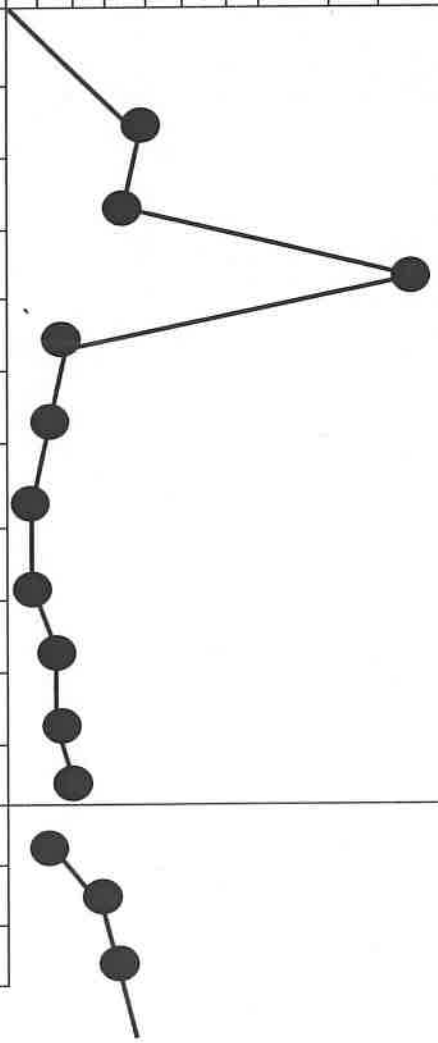
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NAME OF PROJECT: Proposed Construction of 396 Nos of Tenements (S+9) including Developement works at Subramaniapuram in Survey No. 21, Ward no.4, Block no.39 of Madurai Corporation in Madurai District.

Bore Hole No	01	Dia of Boring	150mm
Type of Boring	Rotary	Total depth	30.10m
Started on	07.05.2022	Depth of Water Table	2.50m
Ended on	09.05.2022		

Depth from ground level	Soil Profiles	Description of soil (Visual Identification)	Depth (m)	Type	15	30	45	N	Type of Samples
0.00m		TOP SOIL	0.40	Drill	-	-	-	-	WS
0.40m		SAND	1.50	SPT	8	14	21	35	DS
2.80m		KANKUR	3.00	SPT	9	13	19	32	DS
			4.50	SPT	18	27	R	>100	DS
5.50m		CLAYEY SAND	6.00	SPT	3	4	6	10	DS
			7.50	SPT	2	3	5	8	DS
			9.00	SPT	2	1	1	2	DS
			10.50	SPT	1	1	1	2	DS
11.20m		SAND	12.00	SPT	4	7	8	15	DS
			13.50	SPT	3	6	7	13	DS
			15.00	SPT	5	8	8	16	DS
16.30m		KANKUR	16.50	SPT	4	5	7	12	DS
			18.00	SPT	10	14	16	30	DS
			19.50	SPT	12	15	20	35	DS

Graphical Representation of SPT(N value)



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		21.00	SPT	13	16	20	36		DS
		22.50	SPT	17	20	22	42		DS
		24.00	SPT	10	12	14	26		DS
		25.50	SPT	9	11	13	24		DS
26.80m	SAND	27.00	SPT	8	11	13	24		DS
		28.50	SPT	8	10	12	22		DS
		30.00	SPT	9	12	14	26		DS

Bore Hole is Terminated at a depth of 30.10m Below G.L

DS - Disturbed soil sample

WS - Washing Sample

CR = Core Recovery

RQD = Rock Quality Designation

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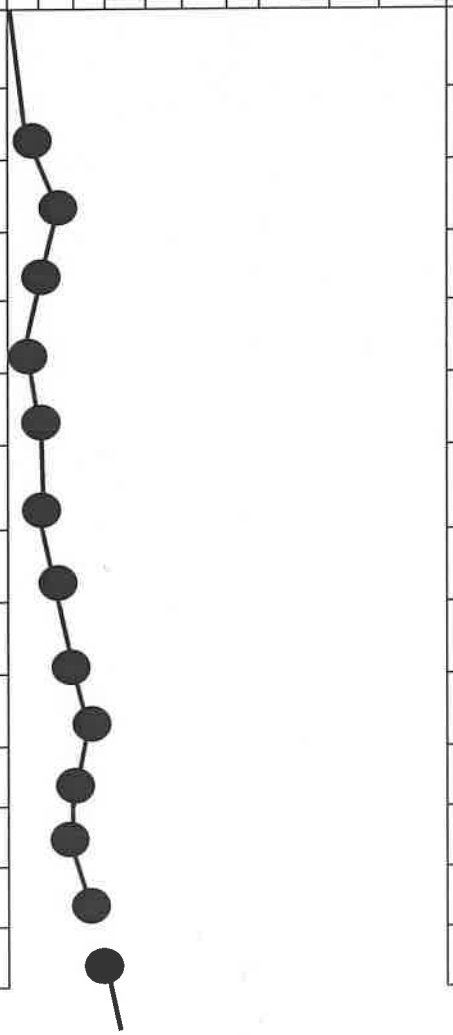
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Bore Hole No	02	Dia of Boring	150mm
Type of Boring	Rotary	Total depth	30.30m
Started on	09.05.2022	Depth of Water Table	2.00m
Ended on	10.05.2022		

Depth from ground level	Soil Profiles	Description of soil (Visual Identification)	Depth (m)	Type	15	30	45	N	Type of Samples
0.00m		TOP SOIL	0.30	Drill	-	-	-	-	WS
0.30m		SAND	1.50	SPT	3	3	6	9	DS
			3.00	SPT	4	6	9	15	DS
4.00m		CLAYEY SAND	4.50	SPT	2	3	4	7	DS
			6.00	SPT	3	2	3	5	DS
			7.50	SPT	4	3	5	8	DS
			9.00	SPT	3	5	6	11	DS
9.50m		KANKUR	10.50	SPT	8	9	9	18	DS
			12.00	SPT	10	9	14	23	DS
			13.50	SPT	11	12	14	26	DS
14.50m		SANDY CLAY	15.00	SPT	7	8	10	18	DS
			16.50	SPT	5	7	9	16	DS
			18.00	SPT	6	9	12	21	DS
19.00m		KANKUR	19.50	SPT	9	11	18	29	DS

Graphical Representation of SPT(N value)



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		21.00	SPT	11	13	19	32		DS
		22.50	SPT	11	14	16	30		DS
		24.00	SPT	13	16	19	35		DS
24.50m	SAND	25.50	SPT	6	9	12	21		DS
		27.00	SPT	8	10	15	25		DS
		28.50	SPT	10	12	16	28		DS
		30.00	SPT	9	11	15	26		DS

Bore Hole is Terminated at a depth of 30.30m Below G.L

DS - Disturbed soil sample

WS - Washing Sample

CR = Core Recovery

RQD = Rock Quality Designation

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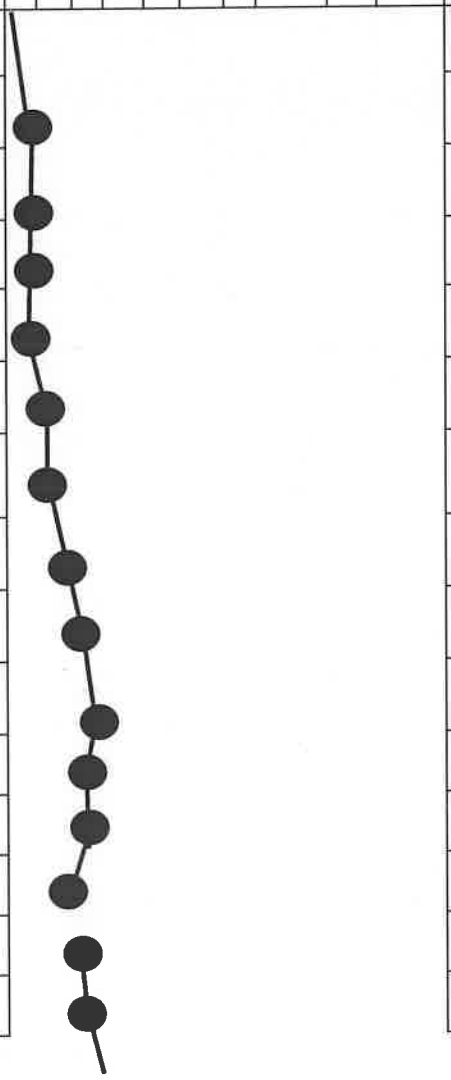
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Bore Hole No	03	Dia of Boring	150mm
Type of Boring	Rotary	Total depth	30.20m
Started on	09.05.2022	Depth of Water Table	3.00m
Ended on	11.05.2022		

Depth from ground level	Soil Profiles	Description of soil (Visual Identification)	Depth (m)	Type	15	30	45	N	Type of Samples
0.00m		TOP SOIL	0.60	Drill	-	-	-	-	WS
0.60m		CLAYEY SAND	1.50	SPT	2	2	3	5	DS
			3.00	SPT	1	3	2	5	DS
			4.50	SPT	1	2	2	4	DS
			6.00	SPT	1	1	1	2	DS
7.30m		SAND	7.50	SPT	3	6	8	14	DS
			9.00	SPT	5	7	8	15	DS
			10.50	SPT	7	9	11	20	DS
			12.00	SPT	8	10	13	23	DS
13.30m		KANKUR WITH SAND	13.50	SPT	10	12	13	25	DS
			15.00	SPT	8	9	12	21	DS
16.10m		SANDY CLAY	16.50	SPT	7	9	12	21	DS
17.90m		SAND	18.00	SPT	5	8	10	18	DS
19.20m		KANKUR WITH SAND	19.50	SPT	10	13	15	28	DS
			21.00	SPT	10	12	16	28	DS

Graphical Representation of SPT(N value)



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		22.50	SPT	12	13	16	29			DS
24.00m	SAND	24.00	SPT	11	13	15	28			DS
		25.50	SPT	9	11	13	24			DS
		27.00	SPT	7	9	12	21			DS
		28.50	SPT	11	11	12	23			DS
		30.00	SPT	8	8	10	18			DS

Bore Hole is Terminated at a depth of 30.20m Below G.L

DS - Disturbed soil sample

WS - Washing Sample

CR = Core Recovery

RQD = Rock Quality Designation

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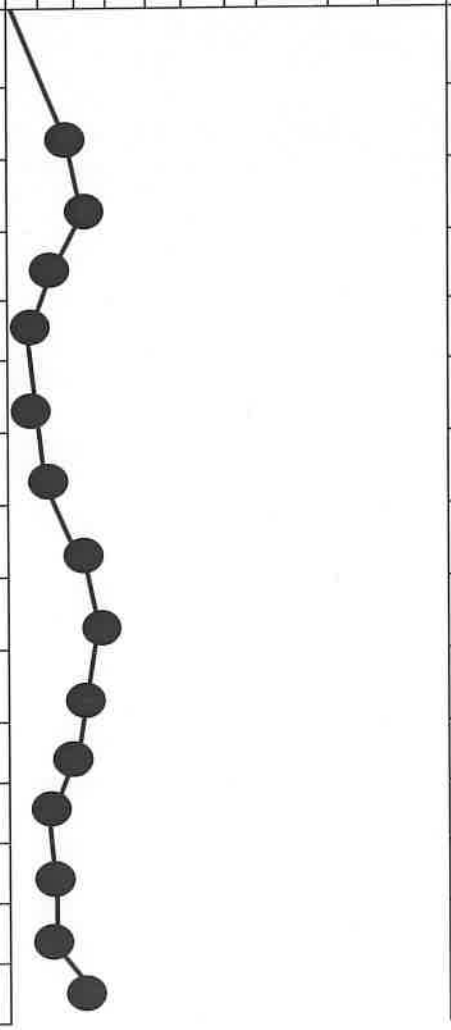
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Bore Hole No	04	Dia of Boring	150mm
Type of Boring	Rotary	Total depth	30.00m
Started on	11.05.2022	Depth of Water Table	1.50m
Ended on	12.05.2022		

Depth from ground level	Soil Profiles	Description of soil (Visual Identification)	Depth (m)	Type	15	30	45	N	Graphical Representation of SPT(N value)	Type of Samples
0.00m		TOP SOIL	0.40	Drill	-	-	-	-		WS
0.40m		SAND	1.50	SPT	6	8	11	19		DS
			3.00	SPT	8	9	12	21		DS
4.00m		CLAYEY SAND	4.50	SPT	2	3	6	9		DS
			6.00	SPT	2	3	2	5		DS
			7.50	SPT	1	1	2	3		DS
8.70m		SANDY CLAY	9.00	SPT	2	3	4	7		DS
10.20m		KANKUR WITH SAND	10.50	SPT	4	8	13	21		DS
			12.00	SPT	7	11	14	25		DS
			13.50	SPT	6	10	12	22		DS
			15.00	SPT	6	9	12	21		DS
			16.50	SPT	5	5	6	11		DS
			18.00	SPT	6	8	10	18		DS
			19.50	SPT	5	6	8	14		DS
			21.00	SPT	7	9	11	20		DS



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22.50m		SAND	22.50	SPT	6	7	8	15		DS
			24.00	SPT	7	9	10	19		DS
			25.50	SPT	8	9	12	21		DS
			27.00	SPT	8	11	15	26		DS
			28.50	SPT	9	12	16	28		DS
			30.00	SPT	10	14	16	30		DS

Bore Hole is Terminated at a depth of 30.00m Below G.L

DS - Disturbed soil sample

WS - Washing Sample

CR = Core Recovery

RQD = Rock Quality Designation

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LABORATORY TEST RESULTS

SITE NAME: MADURAI (SUBRAMANIYAPURAM)	BORE HOLE NO: 01	SC – CLAYEY SAND, GP – POORLY GRDED GRAVEL, SP– POORLY GRADED SAND, SW –WELL GRADED SAND

DEPTH BELOW GROUND LEVEL		SOIL PROFILE	SOIL CLASSIFICATION	DEPTH OF SAMPLE TESTED [m]	INDEX PROPERTIES										ENGINEERING PROPERTIES	
						SIEVE ANALYSIS % OF PARTICLES					ATTERBERG'S LIMITS			SPECIFIC GRAVITY	SHEAR TEST	
FROM [m]	TO [m]				W ATER CONTENT [%]	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT / CLAY	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX		(C) COHESION [t/m^2]	(φ) ANGLE OF INTERNAL FRICTION
0.00	0.40		TOP SOIL	0.40	-	-	-	-	-	-	-	-	-	-	-	-
0.40	2.80		SP	1.50	21.54	0	3	40	57	0	NP	NP	NP	2.61	NA	33.0
2.80	5.50		GP	3.00	17.54	0	18	24	50	8	NP	NP	NP	2.58	NA	29.6
				4.50	17.6	0	16	28	46	10	NP	NP	NP	2.60	NA	29.7
5.50	11.20		SC	6.00	18.7	0	5	59	31	5	NP	NP	NP	2.60	NA	28.3
				7.50	18.25	0	4	58	33	5	NP	NP	NP	2.61	NA	28.4
				9.00	18.65	0	4	56	33	7	NP	NP	NP	2.62	NA	28.5
				10.50	18.2	0	0	54	41	5	NP	NP	NP	2.58	NA	28.4
11.20	16.30		SP	12.00	20.85	0	0	76	24	0	NP	NP	NP	2.61	NA	28.3
				13.50	17.21	0	0	72	28	0	NP	NP	NP	2.57	NA	28.2
				15.00	18.6	0	0	69	31	0	NP	NP	NP	2.61	NA	28.1
16.30	26.80		GP	16.50	17.89	0	11	28	59	2	NP	NP	NP	2.59	NA	29.7
				18.00	18.23	0	13	23	55	9	NP	NP	NP	2.61	NA	29.7
				19.50	18.46	0	16	28	52	4	NP	NP	NP	2.60	NA	29.8
				21.00	17.57	0	14	29	51	6	NP	NP	NP	2.58	NA	29.6
				22.50	18.51	0	15	29	53	3	NP	NP	NP	2.59	NA	29.6
				24.00	17.68	0	16	30	50	4	NP	NP	NP	2.60	NA	29.6
				25.50	18.15	0	17	27	54	2	NP	NP	NP	2.62	NA	29.8
26.80	30.10		SW	27.00	18.2	0	13	58	29	0	NP	NP	NP	2.61	NA	28.9
				28.50	18.54	0	12	59	29	0	NP	NP	NP	2.60	NA	28.7
				30.00	23.21	0	14	54	32	0	NP	NP	NP	2.59	NA	28.8

*NP – Non Plastic, NA – Not Applicable

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SITE NAME: MADURAI (SUBRAMANIYAPURAM)	BORE HOLE NO: 02	SC – CLAYEY SAND, GP – POORLY GRDED GRAVEL, SP– POORLY GRADED SAND, SW –WELL GRADED SAND

DEPTH BELOW GROUND LEVEL		SOIL PROFILE	SOIL CLASSIFICATION	DEPTH OF SAMPLE TESTED [m]	INDEX PROPERTIES										ENGINEERING PROPERTIES	
						SIEVE ANALYSIS % OF PARTICLES					ATTERBERG'S LIMITS			SPECIFIC GRAVITY	SHEAR TEST	
FROM [m]	TO [m]				W ATER CONTENT [%]	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT / CLAY	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX		(C) COHESION [t/m^2]	(φ) ANGLE OF INTERNAL FRICTION [°]
0.00	0.30		TOP SOIL	0.30	-	-	-	-	-	-	-	-	-	-	-	-
0.30	4.00		SP	1.50	18.89	0	0	69	31	0	NP	NP	NP	2.61	NA	28.1
				3.00	19.43	0	0	71	29	0	NP	NP	NP	2.62	NA	28.3
4.00	9.50		SC	4.50	18.12	0	0	57	34	9	NP	NP	NP	2.60	NA	28.4
				6.00	21.31	0	0	68	22	10	NP	NP	NP	2.61	NA	28.7
				7.50	20.67	0	0	70	21	9	NP	NP	NP	2.63	NA	28.5
				9.00	20.96	0	0	69	20	11	NP	NP	NP	2.62	NA	28.6
9.50	14.50		GP	10.50	17.96	0	16	28	52	4	NP	NP	NP	2.59	NA	29.7
				12.00	18.23	0	17	25	50	8	NP	NP	NP	2.58	NA	29.6
				13.50	18.41	0	15	30	49	6	NP	NP	NP	2.62	NA	29.8
14.50	19.00		CS	15.00	21.1	0	0	19	33	48	59.8	20.14	39.66	2.67	4.7	NA
				16.50	20.15	0	0	18	32	50	59.7	20.3	39.4	2.66	5.1	NA
				18.00	20.32	0	0	20	28	52	60.1	21.4	38.7	2.65	5.3	NA
19.00	24.50		GP	19.50	17.68	0	15	28	49	8	NP	NP	NP	2.58	NA	29.6
				21.00	18.23	0	14	30	50	6	NP	NP	NP	2.60	NA	29.7
				22.50	17.92	0	16	27	53	4	NP	NP	NP	2.59	NA	29.6
				24.00	18.43	0	15	29	47	9	NP	NP	NP	2.62	NA	29.8
24.50	30.30		SW	25.50	20.45	0	12	57	31	0	NP	NP	NP	2.58	NA	28.8
				27.00	20.6	0	11	59	30	0	NP	NP	NP	2.59	NA	28.7
				28.50	20.2	0	13	58	29	0	NP	NP	NP	2.58	NA	28.9
				30.00	18.57	0	13	60	27	0	NP	NP	NP	2.59	NA	28.9

*NP – Non Plastic, NA – Not Applicable

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SITE NAME: MADURAI (SUBRAMANIYAPURAM)	BORE HOLE NO: 03	CS –SANDY CLAY, SC – CLAYEY SAND, GP – POORLY GRDED GRAVEL, SP– POORLY GRADED SAND, SW –WELL GRADED SAND

DEPTH BELOW GROUND LEVEL		SOIL PROFILE	SOIL CLASSIFICATION	DEPTH OF SAMPLE TESTED [m]	INDEX PROPERTIES										ENGINEERING PROPERTIES	
						SIEVE ANALYSIS % OF PARTICLES					ATTERBERG'S LIMITS				SHEAR TEST	
FROM [m]	TO [m]				WATER CONTENT [%]	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT / CLAY	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX		(C) COHESION [t/m^2]	(φ) ANGLE OF INTERNAL FRICTION [°]
0.00	0.60		TOP SOIL	0.60	-	-	-	-	-	-	-	-	-	-	-	-
0.60	7.30		SC	1.50	16.89	0	19	31	35	15	NP	NP	NP	2.60	NA	28.8
				3.00	17.25	0	20	31	34	15	NP	NP	NP	2.62	NA	28.9
				4.50	17.36	0	18	32	35	15	NP	NP	NP	2.62	NA	28.7
				6.00	18.71	0	17	32	38	13	NP	NP	NP	2.60	NA	28.6
7.30	11.80		SP	7.50	20.68	0	0	70	30	0	NP	NP	NP	26.0	NA	28.2
				9.00	19.52	0	0	72	28	0	NP	NP	NP	2.61	NA	28.3
				10.50	20.48	0	0	69	31	0	NP	NP	NP	2.60	NA	28.2
11.80	13.30		SW	12.00	19.32	0	11	60	29	0	NP	NP	NP	2.60	NA	28.7
13.30	16.10		GP	13.50	17.9	0	15	32	53	0	NP	NP	NP	2.62	NA	29.8
				15.00	18.2	0	17	37	46	0	NP	NP	NP	2.60	NA	29.6
16.10	17.90		CS	16.50	20.73	0	0	20	28	52	59.3	22.4	36.9	2.64	5.05	NA
17.90	19.20		SP	18.00	19.97	0	0	67	33	0	NP	NP	NP	2.60	NA	28.1
19.20	24.00		GP	19.50	17.53	0	16	34	50	0	NP	NP	NP	2.62	NA	29.8
				21.00	18.34	0	17	30	53	0	NP	NP	NP	2.60	NA	29.7
				22.50	18.45	0	11	35	54	0	NP	NP	NP	2.59	NA	29.6
24.00	30.20		SW	24.00	18.25	0	12	60	28	0	NP	NP	NP	2.60	NA	28.7
				25.50	20.21	0	11	59	30	0	NP	NP	NP	2.60	NA	28.7
				27.00	18.35	0	13	54	33	0	NP	NP	NP	2.60	NA	28.8
				28.50	19.22	0	11	59	30	0	NP	NP	NP	2.61	NA	28.7
				30.00	19.35	0	12	57	31	0	NP	NP	NP	2.60	NA	28.8

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SITE NAME: MADURAI (SUBRAMANIYAPURAM)	BORE HOLE NO: 04	CS –SANDY CLAY, SC – CLAYEY SAND, GP – POORLY GRDED GRAVEL, SP– POORLY GRADED SAND, SW –WELL GRADED SAND

DEPTH BELOW GROUND LEVEL		SOIL PROFILE	SOIL CLASSIFICATION	DEPTH OF SAMPLE TESTED [m]	INDEX PROPERTIES										ENGINEERING PROPERTIES	
						SIEVE ANALYSIS % OF PARTICLES					ATTERBERG'S LIMITS			SPECIFIC GRAVITY	SHEAR TEST	
FROM [m]	TO [m]				W ATER CONTENT [%]	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT / CLAY	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX		(C) COHESION [t/m^2]	(φ) ANGLE OF INTERNAL FRICTION φ_d
0.00	0.40		TOP SOIL	0.40	-	-	-	-	-	-	-	-	-	-	-	-
0.40	4.00		SP	1.50	20.35	0	0	71	29	0	NP	NP	NP	2.61	NA	28.2
				3.00	20.24	0	0	69	31	0	NP	NP	NP	2.61	NA	28.3
4.00	8.70		SC	4.50	17.23	0	20	31	35	14	NP	NP	NP	2.60	NA	28.8
				6.00	18.25	0	22	32	34	12	NP	NP	NP	2.60	NA	28.9
				7.50	17.12	0	19	31	35	15	NP	NP	NP	2.60	NA	28.7
8.70	10.20		CS	9.00	22.3	0	0	20	32	48	60.1	22.1	38	2.67	5.2	NA
10.20	22.50		GP	10.50	17.89	0	5	60	35	0	NP	NP	NP	2.62	NA	29.8
				12.00	18.23	0	8	68	24	0	NP	NP	NP	2.59	NA	29.7
				13.50	18.45	0	10	70	20	0	NP	NP	NP	2.61	NA	29.6
				15.00	17.61	0	6	62	32	0	NP	NP	NP	2.60	NA	29.8
				16.50	18.54	0	7	67	26	0	NP	NP	NP	2.62	NA	29.8
				18.00	17.74	0	4	72	24	0	NP	NP	NP	2.58	NA	29.6
				19.50	18.2	0	9	71	20	0	NP	NP	NP	2.61	NA	29.7
				21.00	17.9	0	8	76	24	0	NP	NP	NP	2.60	NA	29.6
22.50	30.00		SW	22.50	20.25	0	12	60	28	0	NP	NP	NP	2.60	NA	28.7
				24.00	20.54	0	11	60	29	0	NP	NP	NP	2.59	NA	28.7
				25.50	21.34	0	13	61	26	0	NP	NP	NP	2.59	NA	28.8
				27.00	17.65	0	11	64	25	0	NP	NP	NP	2.60	NA	28.7
				28.50	18.25	0	14	62	24	0	NP	NP	NP	2.61	NA	28.9
				30.00	18.21	0	12	62	26	0	NP	NP	NP	2.63	NA	28.7

*NP – Non Plastic, NA – Not Applicable

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MODEL RESULTS

NATURAL MOISTURE CONTENT
[As per IS-2720: Part 2 – 1973]

Bore hole no	**1**
Depth	**1.50**
Soil	**SAND**
Weight of empty Tray W1(g)	110
Weight of empty Tray + wet Sample W2 (g)	347
Weight of empty Tray + dry Sample W3 (g)	305
Weight of water W4 = W2-W3 (g)	42
Weight of dry soil W5 = W3-W1 (g)	195
Water content % W = W4/W5	**21.54**

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SPECIFIC GRAVITY

[As per IS-2720: Part 3 – 1980]

Bore hole no	**1**
Depth	**1.50 m**
Soil	**Sand**
Weight of empty Bottle W1(g)	500
Weight of empty Bottle + Sample W2 (g)	1032
Weight of empty Bottle+ Sample+ Water W3 (g)	1868
Weight of empty Bottle+ Water W4 (g)	1540
Specific Gravity = (W2-W1)/((W4-W1)-(W3-W2))	**2.61**

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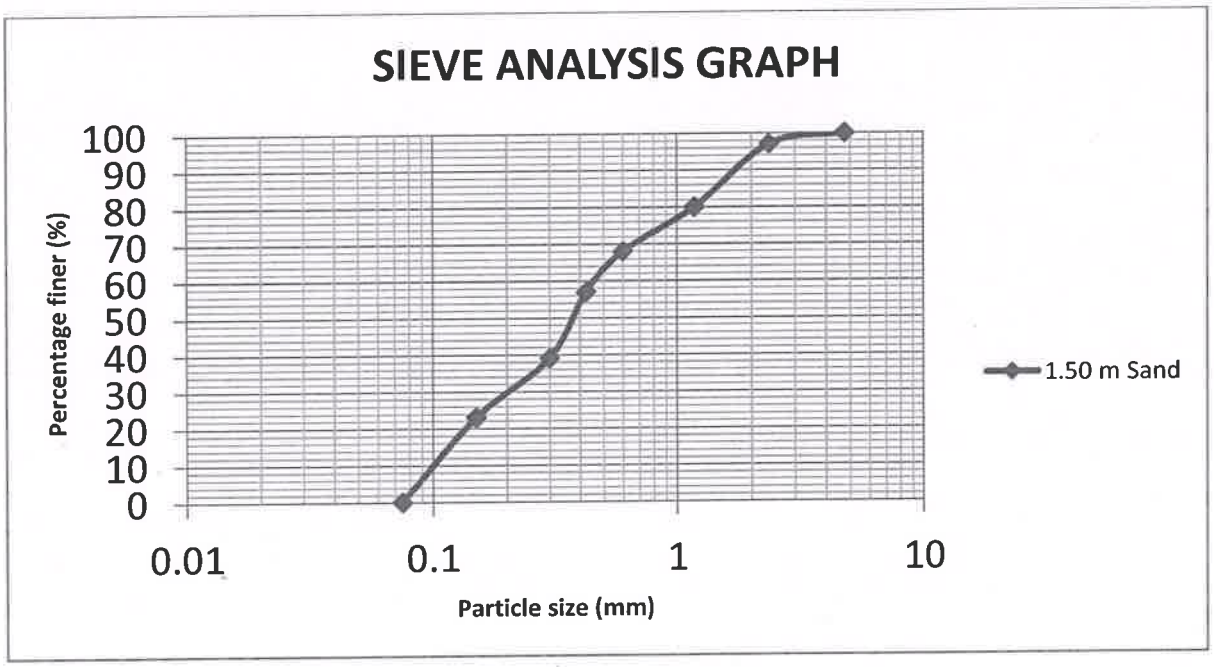
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GRAIN SIZE ANALYSIS

[As Per IS 2720: Part 4 – 1985]

Bore Hole = 1 Depth= 1.50 m ; Ws – Weight of Soil = 350 g

SISIZE	W.RETAIN	%W.RETA	C.%W.R.	% FINER
4.75	0	0	0	100
2.36	10.5	3	3	97
1.18	59.5	17	20	80
0.6	42	12	32	68
0.425	38.5	11	43	57
0.3	63	18	61	39
0.15	56	16	77	23
0.075	80.5	23	100	0
PAN	0	0	100	0



Soil Classification	Particle %
Gravel	0
Coarse Sand	3
Medium Sand	40
Fine Sand	57
Silt & Clay	0

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DIRECT SHEAR TEST

[As Per IS 2720: Part 13 – 1986]

Bore Hole = 1 ; Depth= 1.50 m (Sand)

Normal Stress	**0.5**	**kg/cm2**
Proving Ring Constant	**0.81421**	
Area of Specimen	**36**	**cm2**

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation (mm)	Shear Stress (kg/cm2)
0	0	0.00	0
50	12	0.50	0.271403
100	18	1.00	0.407105
150	24	1.50	0.542807
200	27	2.00	0.610658
250	29	2.50	0.655891
300	33	3.00	0.746359
350	35	3.50	0.791593
400	37	4.00	0.836827

Normal Stress	**1.0**	**kg/cm2**
Proving Ring Constant	**0.81421**	
Area of Specimen	**36**	**cm2**

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation (mm)	Shear Stress (kg/cm2)
0	0	0.00	0
50	16	0.50	0.361871
100	25	1.00	0.565424
150	31	1.50	0.701125
200	35	2.00	0.791593
250	39	2.50	0.882061
300	42	3.00	0.949912
350	45	3.50	1.017763
400	47	4.00	1.062996
450	50	4.50	1.130847
500	53	5.00	1.198698
550	55	5.50	1.243932

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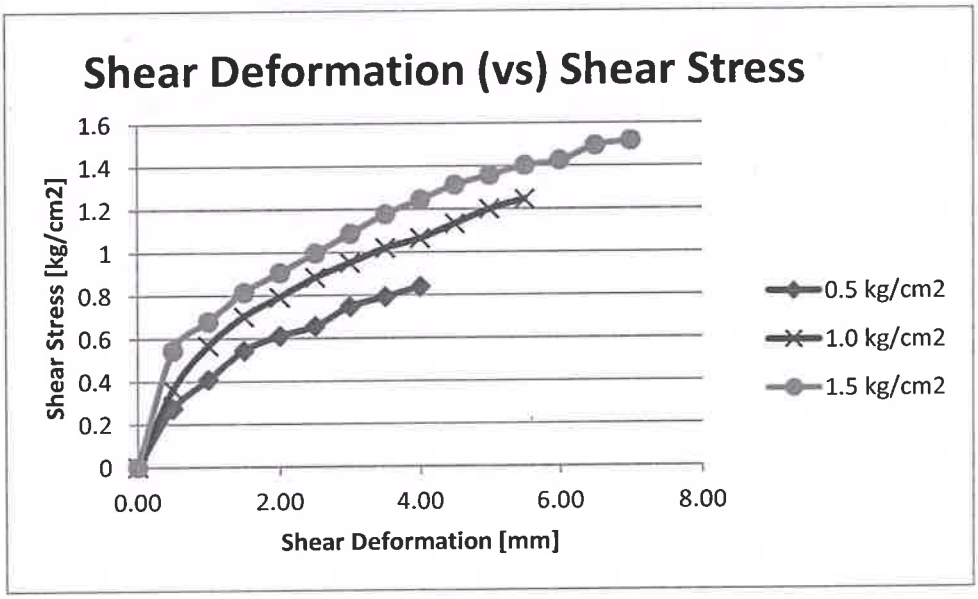
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Normal Stress	**1.5**	**kg/cm2**
Proving Ring Constant	**0.81421**	
Area of Specimen	**36**	**cm2**

Horizontal Gauge Reading	Proving Ring Reading	Shear Deformation (mm)	Shear Stress (kg/cm2)
0	0	0.00	0
50	24	0.50	0.542807
100	30	1.00	0.678508
150	36	1.50	0.81421
200	40	2.00	0.904678
250	44	2.50	0.995146
300	48	3.00	1.085613
350	52	3.50	1.176081
400	55	4.00	1.243932
450	58	4.50	1.311783
500	60	5.00	1.357017
550	62	5.50	1.402251
600	63	6.00	1.424868
650	66	6.50	1.492718
700	67	7.00	1.515335



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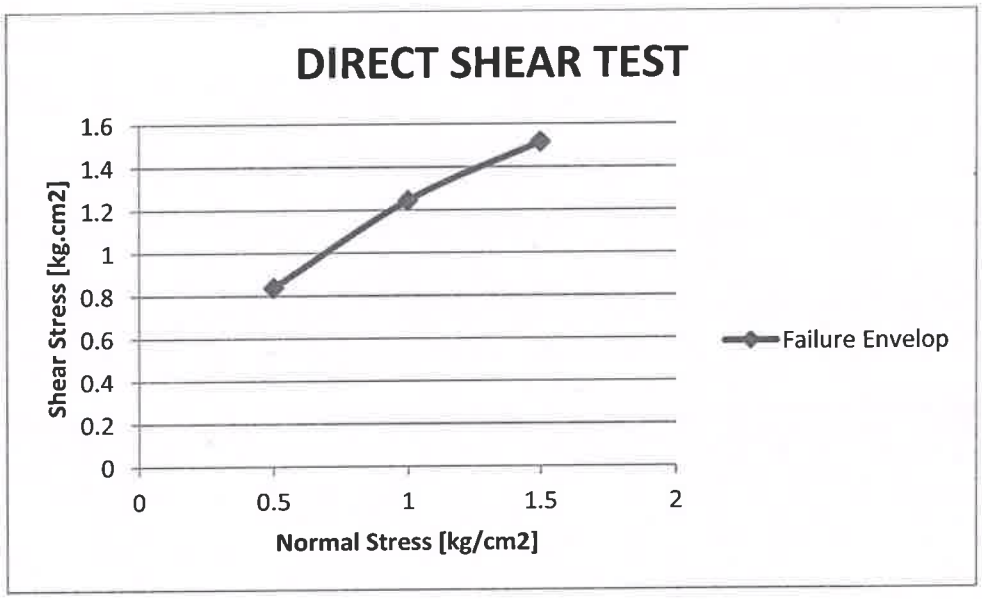
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Normal Stress (kg/cm2)	Proving Ring Reading at Failure	Shear Stress at Failure (kg/cm2)
0.5	37	0.836827
1.0	55	1.243932
1.5	67	1.515335



Angle of Internal Friction (ϕ) = **33.0 degree**

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PILE LOAD CAPACITY CALCULATIONS

DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-20.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	17.92	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m

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Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	78.78	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata,I_c:	5.70	m
Effective overburden pressure over the top of strata,σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	259.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata,I_c:	5.10	m
Effective overburden pressure over the top of strata,σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	403.25	kN

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(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.5 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	121.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	110.33	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	426.01	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.3.0 **Ultimate Skin Resistance,q_s: 1185.50 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**742.4**	**kN**

(Qp=Ap*q*Nq)

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**1927.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**771.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**770.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-25.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	17.92	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	78.78	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	259.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	403.25	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

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Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1144.71	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1904.20 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**928.0**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**2832.1**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1132.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1130.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-30.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	17.92	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	

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	Skin Resistance of the pile,q_s:	78.78	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata,I_c:	5.70	m
Effective overburden pressure over the top of strata,σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	259.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata,I_c:	5.10	m
Effective overburden pressure over the top of strata,σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	403.25	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3

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Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-26.80	m
Average Thickness of Strata,I_c:	10.50	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	164.82	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	131.75	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1443.68	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-26.80	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	3.20	m
Effective overburden pressure over the top of strata,σ_{top}:	164.82	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	184.34	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	174.58	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	544.09	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2747.26 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.1	

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Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1079.2**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**3826.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1530.6**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1530.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-20.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	25.09	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	110.30	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	363.35	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	564.55	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

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Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	121.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	110.33	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	596.42	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1659.70 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**1455.0**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**3114.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1245.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1245.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-25.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	25.09	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	110.30	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	363.35	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	564.55	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

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Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1602.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2665.88 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**1818.8**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**4484.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1793.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1790.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-30.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	25.09	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	110.30	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	363.35	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	564.55	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

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Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1602.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	153.48	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	183.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	168.73	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1232.65	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 3898.52 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-30.00	

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Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**2115.3**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**6013.8**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2405.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2405.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-20.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	32.26	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	141.81	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	467.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	725.84	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	121.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	110.33	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	766.83	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2133.90 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**2405.3**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**4539.1**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1815.7**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1815.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-25.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	32.26	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	141.81	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	467.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	725.84	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2060.48	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3427.56**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**3006.6**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**6434.1**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2573.6**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2570.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-30.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	32.26	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	141.81	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	467.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	725.84	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2060.48	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	153.48	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	183.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	168.73	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1584.83	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 5012.39 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-30.00	

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Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**3496.7**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**8509.1**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3403.6**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3400.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-20.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	35.84	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	157.57	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	519.07	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	806.49	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	121.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	110.33	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	852.03	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2371.00 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**2969.4**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**5340.4**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2136.2**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2135.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 1)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-25.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	35.84	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	157.57	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	519.07	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	806.49	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2289.43	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3808.40**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp)	**3711.8**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**7520.2**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3008.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3000.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.000	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-30.00	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-2.80	m
Average Thickness of Strata,I_c:	2.40	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	14.64	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	7.32	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	35.84	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Kankur	
Average SPT of the strata,N:	40	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	38.75	Deg.
R.L of top of Strata:	-2.80	m
R.L of bottom of Strata:	-5.50	m
Average Thickness of Strata,I_c:	2.70	m
Effective overburden pressure over the top of strata,σ_{top}:	14.64	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	31.65	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	23.15	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	157.57	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Clayey sand	
Average SPT of the strata,N:	11	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.3	Deg.
R.L of top of Strata:	-5.50	m
R.L of bottom of Strata:	-11.20	m
Average Thickness of Strata, I_c:	5.70	m
Effective overburden pressure over the top of strata, σ_{top}:	31.65	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	67.56	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	49.61	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	519.07	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-11.20	m
R.L of bottom of Strata:	-16.30	m
Average Thickness of Strata, I_c:	5.10	m
Effective overburden pressure over the top of strata, σ_{top}:	67.56	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	98.67	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	83.12	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	806.49	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	8.70	m
Effective overburden pressure over the top of strata,σ_{top}:	98.67	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	153.48	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	126.08	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2289.43	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	22	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	33.6	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	153.48	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	183.98	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	168.73	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1760.92	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 5569.32 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-30.00	

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Minimum SPT-value of the Bearing Strata	22	
Angle of Shear Resistance, ϕ:	33.60	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	29.13	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**4316.9**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**9886.2**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3954.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3950.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	38.79	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	195.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	343.00	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	427.68	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	1.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	119.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	116.62	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	116.25	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1121.52 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**651.2**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**1772.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**709.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**705.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	38.79	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	195.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	343.00	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	427.68	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	791.72	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1796.99 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**814.0**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**2611.0**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1044.4**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1040.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	38.79	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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CHAPTER-6

RECOMMENDATIONS

Based on the SBC and settlement calculations, site investigations the recommendations for foundation are as follows:

i. The recommended foundation is bored cast in-situ PILE FOUNDATION.

ii. **The pile having a load carrying capacity of 110.50 tons with a dia.of 500mm and minimum length of 30m from the ground level is recommended. The cut off level of the piles is 1m from the average ground level.**

iii. **The supporting is structure on pile foundations irrespective of location of the structure. For the Nine storied structure and soil condition of the area bored cast in-situ pile foundation is a suitable choice. The pile with minimum length of 30m is considered suitable. The cut of level of pile recommended is 1m from the average ground level. The recommended capacities of piles of various diameters are below the bore Hole Tables 1,2,3 & 4.**

iv. Care shall be taken so that the ultimate bearing strata are none other than Soft Disintegrated Rock / Weathered Rock type.

v. Safe bearing capacity presented is computed considering any rise in the ground water table at or above the level of footing.

vi. Special provisions to contain any lateral collapse of soil from the walls excavated foundation pits are required.

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vii. In case, the ground water table is encountered within the recommended depths of foundation system, the same shall be bailed out continuously to keep the sub-grade well consolidated.

viii. The Design Engineer may choose an alternate foundation for the building structure and load.

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	195.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

Layer-III

1.2.1.1

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	343.00	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

Layer-IV

1.2.1.1

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	427.68	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	791.72	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.1

Layer-V

Type of Strata:	Sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	151.27	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	181.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	166.52	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	829.98	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

Ultimate Skin Resistance,q_s: 1796.99 kN

1.3.0

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-30.00	

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Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	194.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**976.8**	**kN**

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**2773.8**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1109.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1105.0**	**kN**

23/5/22.

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 **Layer-I**

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	54.30	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

1.2.1.1 **Layer-II**

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	274.12	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

Layer-III

1.2.1.1

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	480.19	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

Layer-IV

1.2.1.1

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata,I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	598.75	kN

(q_s:σ*k*tanϕ*pi()*d*Ic)

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	1.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	119.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	116.62	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	162.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1570.12 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**1276.4**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**2846.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1138.6**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1135.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	54.30	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	274.12	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	480.19	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	598.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1108.41	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**2515.78**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**1595.5**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**4111.3**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1644.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1640.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	54.30	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	274.12	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	480.19	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	598.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1108.41	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	151.27	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	181.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	166.52	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1161.98	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2515.78 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-30.00	

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Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	194.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1914.6**	**kN**
Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**4430.4**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1772.2**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1770.0**	**kN**

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23/5/22.

Staff In-charge & Principal Consultant

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	69.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	352.44	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	617.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	769.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	1.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	119.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	116.62	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	209.26	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2018.73 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**2110.0**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**4128.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1651.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1650.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	69.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	352.44	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	617.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	769.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1425.10	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3234.58**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**2637.5**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**5872.0**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2348.8**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2345.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	69.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	352.44	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	617.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	769.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1425.10	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	151.27	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	181.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	166.52	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1493.97	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 3234.58 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2

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R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	194.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**3164.9**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**6399.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2559.8**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2555.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	77.58	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	391.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	685.99	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	855.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	1.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	119.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	116.62	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	232.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s: 2243.03 kN

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	129.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**2604.9**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**4847.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1939.2**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1935.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	77.58	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	391.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	685.99	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	855.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1

Layer-V

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1583.45	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3593.97**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	162.25	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**3256.1**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**6850.1**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2740.0**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2740.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 2)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.300	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.70	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	12	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.6	Deg.
R.L of top of Strata:	-0.30	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	22.57	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	11.29	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	77.58	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	8	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.6	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-9.50	m
Average Thickness of Strata,I_c:	5.50	m
Effective overburden pressure over the top of strata,σ_{top}:	22.57	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	57.22	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	39.90	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	391.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-III**

Type of Strata:	Kankur	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-9.50	m
R.L of bottom of Strata:	-14.50	m
Average Thickness of Strata, I_c:	5.00	m
Effective overburden pressure over the top of strata, σ_{top}:	57.22	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	88.72	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	72.97	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	685.99	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-14.50	m
R.L of bottom of Strata:	-19.00	m
Average Thickness of Strata, I_c:	4.50	m
Effective overburden pressure over the top of strata, σ_{top}:	88.72	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	113.47	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.10	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	855.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.1 **Layer-V**

Type of Strata:	Kankur	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.00	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	113.47	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	151.27	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	132.37	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1583.45	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.1 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-25.00	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	5.00	m
Effective overburden pressure over the top of strata,σ_{top}:	151.27	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	181.77	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	166.52	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1659.97	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 3593.97 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2

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R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.3	
Effective Overburden Pressure, q:	194.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**3907.3**	**kN**
Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**7501.3**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3000.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3000.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	122.11	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	345.38	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	242.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	155.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5	**Layer-V**		
	Type of Strata:	Sand	
	Average SPT of the strata,N:	13	
	Bulk Density of the strata,γ:	16.1	kN/m^3
	Angle of Shearing Resistance,ϕ:	30.9	Deg.
	R.L of top of Strata:	-17.90	m
	R.L of bottom of Strata:	-19.20	m
	Average Thickness of Strata,I_c:	1.30	m
	Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	133.82	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.2.1.5	**Layer-VI**		
	Type of Strata:	Kankur with sand	
	Average SPT of the strata,N:	18	
	Bulk Density of the strata,γ:	16.4	kN/m^3
	Angle of Shearing Resistance,ϕ:	32.4	Deg.
	R.L of top of Strata:	-19.20	m
	R.L of bottom of Strata:	-20.00	m
	Average Thickness of Strata,I_c:	0.80	m
	Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	118.58	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	116.02	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	92.52	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.3.0	**Ultimate Skin Resistance,q_s:**	**1091.74**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	

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Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**661.3**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**1753.0**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**701.2**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**700.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	122.11	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	345.38	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	242.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	155.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	133.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	616.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 1615.61 kN**

Computation of End Bearing Resistance:

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Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	164.75	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**826.6**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**2442.2**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**976.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**975.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	122.11	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	345.38	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	242.16	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	155.75	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	133.82	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5

Layer-VI

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	616.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5

Layer-VI

Type of Strata:	sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-24.00	m

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R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata, I_c:	6.00	m
Effective overburden pressure over the top of strata, σ_{top}:	144.18	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	182.58	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	163.38	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	977.20	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 Ultimate Skin Resistance, q_s: 2592.81 kN

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile, Ap:	0.196	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata, γ:	16.4	
Effective Overburden Pressure, q:	197.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**991.9**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**3584.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1433.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1430.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	170.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	483.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	339.02	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	218.06	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5	**Layer-V**		
	Type of Strata:	Sand	
	Average SPT of the strata,N:	13	
	Bulk Density of the strata,γ:	16.1	kN/m^3
	Angle of Shearing Resistance,ϕ:	30.9	Deg.
	R.L of top of Strata:	-17.90	m
	R.L of bottom of Strata:	-19.20	m
	Average Thickness of Strata,I_c:	1.30	m
	Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	187.34	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.2.1.5	**Layer-VI**		
	Type of Strata:	Kankur with sand	
	Average SPT of the strata,N:	18	
	Bulk Density of the strata,γ:	16.4	kN/m^3
	Angle of Shearing Resistance,ϕ:	32.4	Deg.
	R.L of top of Strata:	-19.20	m
	R.L of bottom of Strata:	-20.00	m
	Average Thickness of Strata,I_c:	0.80	m
	Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	118.58	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	116.02	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	129.53	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.3.0	**Ultimate Skin Resistance,q_s:**	**1528.44**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	

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Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1296.1**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**2824.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1129.8**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1125.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	170.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	483.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	339.02	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	218.06	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	187.34	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	862.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2261.86 kN**

Computation of End Bearing Resistance:

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Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	164.75	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1620.1**	**kN**
Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**3881.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1552.8**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1550.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	170.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	483.53	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	339.02	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	218.06	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5

Layer-V

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	187.34	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5

Layer-VI

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	862.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5

Layer-VI

Type of Strata:	sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-24.00	m

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R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata, I_c:	6.00	m
Effective overburden pressure over the top of strata, σ_{top}:	144.18	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	182.58	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	163.38	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1368.08	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 Ultimate Skin Resistance, q_s: 3629.94 kN

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile, Ap:	0.385	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata, γ:	16.4	
Effective Overburden Pressure, q:	197.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**1944.1**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**5574.0**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2229.6**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2229.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	219.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	621.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	435.88	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	280.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5	**Layer-V**		
	Type of Strata:	Sand	
	Average SPT of the strata,N:	13	
	Bulk Density of the strata,γ:	16.1	kN/m^3
	Angle of Shearing Resistance,ϕ:	30.9	Deg.
	R.L of top of Strata:	-17.90	m
	R.L of bottom of Strata:	-19.20	m
	Average Thickness of Strata,I_c:	1.30	m
	Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	240.87	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.2.1.5	**Layer-VI**		
	Type of Strata:	Kankur with sand	
	Average SPT of the strata,N:	18	
	Bulk Density of the strata,γ:	16.4	kN/m^3
	Angle of Shearing Resistance,ϕ:	32.4	Deg.
	R.L of top of Strata:	-19.20	m
	R.L of bottom of Strata:	-20.00	m
	Average Thickness of Strata,I_c:	0.80	m
	Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
	Effective overburden pressure over the bottom of strata,σ_{bottom}:	118.58	kN/m^2
	Effective overburden pressure at the middle of the strata,σ_{middle}:	116.02	kN/m^2
	Coeff. Of Earth Pressure, k:	1.00	
	Skin Resistance of the pile,q_s:	166.54	kN
	(q_s:σ*k*tanϕ*pi()*d*Ic)		
1.3.0	**Ultimate Skin Resistance,q_s:**	**1965.14**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	

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Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**2142.5**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**4107.6**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1643.0**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1640.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	219.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	621.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	435.88	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	280.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	240.87	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1109.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2908.10 kN**

Computation of End Bearing Resistance:

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Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	164.75	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**2678.1**	**kN**
Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**5586.2**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2234.5**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2230.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	219.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	621.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	435.88	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	280.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	240.87	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1109.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-24.00	m

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R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata, I_c:	6.00	m
Effective overburden pressure over the top of strata, σ_{top}:	144.18	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	182.58	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	163.38	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1758.96	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance, q_s: 4667.06 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile, Ap:	0.636	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata, γ:	16.4	
Effective Overburden Pressure, q:	197.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**3213.7**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**7880.8**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3152.3**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3150.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	244.22	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	690.76	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	484.32	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	311.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	267.63	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata,I_c:	0.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	118.58	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	116.02	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	185.05	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2183.49 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand

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Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**2645.0**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**4828.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1931.4**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1930.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	244.22	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	690.76	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 Layer-III

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	484.32	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 Layer-IV

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	311.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	267.63	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1232.79	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 3231.23 kN**

Computation of End Bearing Resistance:

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Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-25.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	164.75	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**3306.3**	**kN**
Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**6537.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2615.0**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2610.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 3)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.600	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.40	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	4	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	28.8	Deg.
R.L of top of Strata:	-0.60	m
R.L of bottom of Strata:	-7.30	m
Average Thickness of Strata,I_c:	6.70	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	42.21	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	21.11	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	244.22	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-7.30	m
R.L of bottom of Strata:	-13.30	m
Average Thickness of Strata,I_c:	6.00	m
Effective overburden pressure over the top of strata,σ_{top}:	42.21	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	78.81	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	60.51	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	690.76	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	17	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.1	Deg.
R.L of top of Strata:	-13.30	m
R.L of bottom of Strata:	-16.10	m
Average Thickness of Strata, I_c:	2.80	m
Effective overburden pressure over the top of strata, σ_{top}:	78.81	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	96.73	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	87.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	484.32	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	15	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	31.5	Deg.
R.L of top of Strata:	-16.30	m
R.L of bottom of Strata:	-17.90	m
Average Thickness of Strata, I_c:	1.60	m
Effective overburden pressure over the top of strata, σ_{top}:	96.73	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	105.53	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	101.13	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	311.51	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.5 **Layer-V**

Type of Strata:	Sand	
Average SPT of the strata,N:	13	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	30.9	Deg.
R.L of top of Strata:	-17.90	m
R.L of bottom of Strata:	-19.20	m
Average Thickness of Strata,I_c:	1.30	m
Effective overburden pressure over the top of strata,σ_{top}:	105.53	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	113.46	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	109.50	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	267.63	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-19.20	m
R.L of bottom of Strata:	-24.00	m
Average Thickness of Strata,I_c:	4.80	m
Effective overburden pressure over the top of strata,σ_{top}:	113.46	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	144.18	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	128.82	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1232.79	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.5 **Layer-VI**

Type of Strata:	sand	
Average SPT of the strata,N:	18	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	32.4	Deg.
R.L of top of Strata:	-24.00	m

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R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata, I_c:	6.00	m
Effective overburden pressure over the top of strata, σ_{top}:	144.18	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	182.58	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	163.38	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1954.40	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 Ultimate Skin Resistance, q_s: 5185.63 kN

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile, Ap:	0.785	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	18	
Angle of Shear Resistance, ϕ:	32.40	Deg.
Bulk Density of the strata, γ:	16.4	
Effective Overburden Pressure, q:	197.70	kPa
Bearing Capacity Factor(Nq)	25.55	
Ultimate End Bearing Resistance (Qp)	**3967.5**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**9153.2**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3661.3**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3660.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	37.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	151.70	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	73.94	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata, I_c:	9.80	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	122.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	91.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	870.27	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.3.0	**Ultimate Skin Resistance,q_s:**	**1133.52**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**615.0**	**kN**
Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**1748.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**699.4**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**695.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	37.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	151.70	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	73.94	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1188.12	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	2.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	154.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	146.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	356.80	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**1808.16**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-22.50	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	141.53	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp)	**660.4**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**2468.5**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**987.4**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**985.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**500.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	37.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	151.70	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	73.94	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1188.12	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	7.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	186.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	162.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1243.54	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2694.90 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.196	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	20	
Angle of Shear Resistance, ϕ:	33.00	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	27.34	
Ultimate End Bearing Resistance (Qp)	**1013.0**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**3707.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1483.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1480.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	52.64	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	212.37	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	103.52	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata, I_c:	9.80	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	122.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	91.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1218.38	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.3.0	**Ultimate Skin Resistance,q_s:**	**1586.92**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1205.4**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**2792.3**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1116.9**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1160.0**	**kN**

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Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	52.64	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

	Clayey	
Type of Strata:	Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	212.37	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	103.52	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1663.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4 **Layer-IV**

Type of Strata:	Sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	2.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	154.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	146.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	499.52	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 2531.42 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-22.50	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	141.53	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp)	**1294.3**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**3825.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1530.3**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1530.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**700.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	52.64	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	212.37	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	103.52	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1663.36	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	7.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	186.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	162.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	1740.95	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0 **Ultimate Skin Resistance,q_s: 3772.85 kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.385	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	20	
Angle of Shear Resistance, ϕ:	33.00	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	27.34	
Ultimate End Bearing Resistance (Qp)	**1985.4**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**5758.3**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2303.3**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2300.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	67.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	273.05	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	133.10	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata, I_c:	9.80	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	122.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	91.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1566.49	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.3.0	**Ultimate Skin Resistance,q_s:**	**2040.33**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**1992.6**	**kN**
Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**4032.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1613.2**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1610.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	67.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	273.05	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	133.10	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	2138.61	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	2.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	154.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	146.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	642.24	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3254.69**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-22.50	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	141.53	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp)	**2139.6**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**5394.3**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2157.7**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2150.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**900.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	67.69	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	273.05	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	133.10	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	2138.61	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	7.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	186.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	162.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2238.37	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**4850.81**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.636	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	20	
Angle of Shear Resistance, ϕ:	33.00	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	27.34	
Ultimate End Bearing Resistance (Qp)	**3282.1**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Q_u=Q_s+Q_p$)	**8132.9**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3253.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3250.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**20.000**	m
R.L. of Bot. of Pile	-19.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	75.21	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	303.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	147.89	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-20.00	m
Average Thickness of Strata, I_c:	9.80	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	122.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	91.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	1740.55	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.3.0 **Ultimate Skin Resistance,q_s:** **2267.03** **kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Kankur with sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-20.00	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.4	
Effective Overburden Pressure, q:	131.80	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp) (Qp=Ap*q*Nq)	**2459.9**	**kN**

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**4727.0**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**1890.8**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**1890.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**25.000**	m
R.L. of Bot. of Pile	-24.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	75.21	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	303.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	147.89	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	2376.23	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-25.00	m
Average Thickness of Strata,I_c:	2.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	154.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	146.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	713.60	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s:	**3616.32**	**kN**

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-22.50	
Minimum SPT-value of the Bearing Strata	16	
Angle of Shear Resistance, ϕ:	31.80	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	141.53	kPa
Bearing Capacity Factor(Nq)	23.76	
Ultimate End Bearing Resistance (Qp)	**2641.5**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity (Qu=Qs+Q_p)	**6257.8**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**2503.1**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**2500.0**	**kN**

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DESIGN OF PILE FOUNDATION (Ref.BH 4)

Refer, IS:2911(Part I/Sec 2)-1979, Reaffirmed 1997

1.0 Type of Installation of Pile — **Bored Cast in Situ**

1.1 Geometrical Data

Assumed Diameter of pile(D):	**1000.0**	mm
Assumed R.L of E.G.L:	0.400	m
Length of pile below E.G.L.(l) :	**30.000**	m
R.L. of Bot. of Pile	-29.60	m

1.2 Design of Pile for Vertical Compression

1.2.1 Computation of Skin Resistance:

1.2.1.1 Layer-I

Type of Strata:	Sand	
Average SPT of the strata,N:	14	
Bulk Density of the strata,γ:	16.1	kN/m^3
Angle of Shearing Resistance,ϕ:	31.2	Deg.
R.L of top of Strata:	-0.40	m
R.L of bottom of Strata:	-4.00	m
Average Thickness of Strata,I_c:	3.60	m
Effective overburden pressure over the top of strata,σ_{top}:	0.00	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	21.96	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	10.98	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	75.21	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.2 Layer-II

Type of Strata:	Clayey Sand	
Average SPT of the strata,N:	6	
Bulk Density of the strata,γ:	16.3	kN/m^3
Angle of Shearing Resistance,ϕ:	29.2	Deg.
R.L of top of Strata:	-4.00	m
R.L of bottom of Strata:	-8.70	m
Average Thickness of Strata,I_c:	4.70	m
Effective overburden pressure over the top of strata,σ_{top}:	21.96	kN/m^2

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Effective overburden pressure over the bottom of strata, σ_{bottom}:	51.57	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	36.77	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	303.39	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.3 **Layer-III**

Type of Strata:	Sandy Clay	
Average SPT of the strata,N:	7	
Bulk Density of the strata,γ:	15.5	kN/m^3
Angle of Shearing Resistance,ϕ:	29.4	Deg.
R.L of top of Strata:	-8.70	m
R.L of bottom of Strata:	-10.20	m
Average Thickness of Strata, I_c:	1.50	m
Effective overburden pressure over the top of strata, σ_{top}:	51.57	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	59.82	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	55.70	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	147.89	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.2.1.4 **Layer-IV**

Type of Strata:	Kankur with sand	
Average SPT of the strata,N:	16	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	31.8	Deg.
R.L of top of Strata:	-10.20	m
R.L of bottom of Strata:	-22.50	m
Average Thickness of Strata, I_c:	12.30	m
Effective overburden pressure over the top of strata, σ_{top}:	59.82	kN/m^2
Effective overburden pressure over the bottom of strata, σ_{bottom}:	138.54	kN/m^2
Effective overburden pressure at the middle of the strata, σ_{middle}:	99.18	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile, q_s:	2376.23	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

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1.2.1.4

Layer-IV

Type of Strata:	Sand	
Average SPT of the strata,N:	20	
Bulk Density of the strata,γ:	16.4	kN/m^3
Angle of Shearing Resistance,ϕ:	33	Deg.
R.L of top of Strata:	-22.50	m
R.L of bottom of Strata:	-30.00	m
Average Thickness of Strata,I_c:	7.50	m
Effective overburden pressure over the top of strata,σ_{top}:	138.54	kN/m^2
Effective overburden pressure over the bottom of strata,σ_{bottom}:	186.54	kN/m^2
Effective overburden pressure at the middle of the strata,σ_{middle}:	162.54	kN/m^2
Coeff. Of Earth Pressure, k:	1.00	
Skin Resistance of the pile,q_s:	2487.07	kN
(q_s:σ*k*tanϕ*pi()*d*Ic)		

1.3.0

Ultimate Skin Resistance,q_s: 5389.79 kN

Computation of End Bearing Resistance:

Type of Bearing Strata	Sand	
Cross-Sectional Area of pile,Ap:	0.785	m^2
R.L of bottom of pile:	-30.00	
Minimum SPT-value of the Bearing Strata	20	
Angle of Shear Resistance, ϕ:	33.00	Deg.
Bulk Density of the strata,γ:	16.1	
Effective Overburden Pressure, q:	188.70	kPa
Bearing Capacity Factor(Nq)	27.34	
Ultimate End Bearing Resistance (Qp)	**4051.9**	**kN**
(Qp=Ap*q*Nq)		

Ultimate Load Carrying Capacity ($Qu=Qs+Q_p$)	**9441.7**	**kN**
Safe Load Carrying Capacity (Qsafe =Qu/2.5)	**3776.7**	**kN**
However, limit Q_{safe} to the structural capacity of pile:	**3770.0**	**kN**

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Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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