

Study of Allowable Bearing Capacity Using Standard Penetration Test

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Abstract-

By using an excavated pit of varying depths, the study and research aim to determine the Allowable Bearing Pressure and the profile of soil according to the required depth for the selected site. In fact, it is a field method for collecting soil samples beneath ground at varying depths to analyze soil properties within a laboratory. collected soil samples from excavated pit for shorter depth and bore hole for great depth maybe disturbed or undisturbed in nature. soil samples obtained using a split spoon sampler and the standard penetration test as per IS 2131-1981. There are many distinct kinds of soils are available on Earth, and each one has its unique properties. the safe bearing capacity or allowable soil pressure is very useful while deciding the type of foundation to Structural designer. The soil's SBC value is incredibly beneficial to structural designers. The SBC value is calculated in this study using the Teng's method, Peck Hazen Method and IS 2131.

KEYWORDS- Allowable soil pressure, Soil Bearing Capacity, Liquid & Plastic Limit. Soil Sample Peck & Hazen Method, Teng's Method

Introduction-

The term "bearing capacity of the soil" refers to the earth's ability to support structural loads that originate from the foundation. The ultimate bearing capacity of the soil is defined as the gross pressure of the soil at the foundation's base that causes the structure to fail. The safe bearing capacity of soil is determined by dividing the ultimate bearing capacity by a specific safety factor.

Significance of Bearing Capacity of Soil

Whether a foundation is deep, shallow, or machine-based, its bearing capacity is a key consideration. The structural designer determines the structural load that the soil can support based on the soil's bearing capacity. This determines the kind of foundation. If the type of foundation is chosen at the outset, the project's financial status is determined.

Scope of Test-

1. test pits observation and preparation of ground profile.
2. Sample Collection on Test pit -1
3. Determination of Soil properties like field density, specific gravity, water content, Atterberg's limits, shear strength parameters

Methodology-

Engineering analysis of the subsoil was performed to determine safe bearing capacity of soil. Parameters obtained are based on **visual observations, field** and laboratory **tests**.

The field and laboratory work were executed generally in accordance with the I.S. specifications listed below.

- IS - 1498: Classification and identification of soils for general engineering purpose.
- IS – 2720 (I): Preparation of Dry Samples for various Tests.
- IS – 2720 (II): Determination of Water Content.
- IS – 2720 (III): Determination of specific gravity of soil
- IS – 2720 (IV): Grain Size Analysis
- IS – 2720 (V): Determination of Liquid and Plastic Limit.
- IS – 2720 (XIII): Determination of shear strength parameters of soil by Direct Shear Test.
- IS – 2131 : Method for standard penetration test for soil

The proposed construction of a building is at Taluka Shirpur District- Dhule. The primary goal is to collect soil samples from different depths below the earth surface. Testing pits were excavated using power Shovel to understand the characteristics of the ground strata in accordance with the required depth of the selected location at site, which ranges in depth from 3.0 to 6.0 meters. At one of the test pit, both Undisturbed as well as Disturbed Samples, were collected. Undisturbed soil samples are collected using a Split Spoon Sampler at depths of 2.50 and 3.50 meters on bore holes.

A sample of disturbed soil was taken in the bore hole at two different depths: 4.00 and 6.00 meters. No soil strata are disturbed when the undisturbed soil sample is taken using the split spoon sampler, and the disturbed soil sample collected in airtight containers.

Field test of soil -

The Standard Penetration Test (SPT) as per the Indian Standard (IS) refers to the IS 2131:1981

1. Equipment:

The equipment used for the SPT in accordance with the Indian Standard typically includes the following:

- a. **Split-spoon sampler:** This is a thick-walled tube that is split lengthwise and is attached to a drill rod. It has a cutting shoe at the bottom to aid in penetration.
- b. **Drive hammer:** A hammer with a specific weight (usually 63.5 kg) is used to provide the blows for driving the sampler into the ground.
- c. **Drill rig:** A drilling machine is used to create a borehole in the soil.

2. Procedure:

- a. A borehole is drilled into the ground to the desired depth having diameter 150 mm.
- b. The split-spoon sampler is attached to the bottom of the drill rod.
- c. The sampler is lowered into the borehole, and the drill rod is driven into the ground using the drive hammer. The number of blows required to drive the sampler a specific distance (usually 150 mm) is recorded. These blows are provided by the weight of the hammer falling freely under gravity.
- d. The test typically continues until the sampler has been driven a total depth of 450 mm. The number of blows is counted for each 150 mm of penetration.

3. Data Analysis:

- a. The Standard Penetration Number (N-value) is determined by counting the total number of blows required for the last 150 mm of penetration.
- b. The Number of blows were counted for each 15 cm penetration. sampler was penetrated within ground for 45 cm, out of which first 15 cm neglected as a sitting blow then further 30 cm is considered for analysis and blow count measured for 0-15 cm, 15-30 cm and 30 to 45 cm.
- c. The N-value can be corrected for Dilatancy and overburden pressure if necessary.

As per the measured number of blows, the safe bearing capacity of soil was calculated using Peck's Method and Teng's equation. In Peck method, calculation of Safe Bearing Capacity (SBC value) by using the following relation

$$Q_s = 1.025 \times N_n \times C_w \text{ ton/m}^2$$

C_w = Water table Correction

N_n = Corrected N value.

Teng (1962) based on the work of Terzaghi and Peck gave a relationship for allowable bearing capacity for a given permissible settlement. In this method, calculation of Safe Bearing Capacity (SBC value) by using the following relation

$$q_{ns} = 35(N-3)\left\{\frac{(B+0.3)}{2B}\right\}^2 R_w R_d$$

Where,

q_{ns} = Net safe bearing pressure, kN/m²
 N = SPT value corrected for overburden pressure
 R_w = Water table correction factor
 R_d = Depth correction factor = $1 + 0.2D_f/B \leq 1.2$

Site Observations

Mixed soil were present at ground surface

1. Up to pit termination level, ground profile seems to be same throughout showing presence of moisture.
2. Collected soil sample shows presence of Clay with low compressibility
3. Undisturbed Soil Sample was collected at the depth of 2.50 meter & 3.50 meter.
4. The Total N Value observed at the depth of 2.50 meter & 3.50 meter was 12 & 16.
5. Disturbed Sample was collected at the depth of 4.00 meter & 6.00 meter respectively.

Result

Test pit 1 depth (m)	Bulk Density g/cc	Overburden pressure t/m ²	Blow count N	Correction factor C _n	Corrected N _n	Safe bearing Pressure t/m ²	Tengs allowable pressure t/m ²
2.50	1.76	4.4	12	1.2	14.4	14.76	20.65
3.50	1.75	6.125	16	1.15	18.4	18.86	27.85

Conclusion

Based on the site as well as laboratory observation, it is concluded that

1. Soil strata is classified CL.
1. bulk density and natural moisture content of soil strata are 1.76 tonne/ m³ and 12.80 % respectively.
2. The Safe allowable pressure is 14.76 tonne/m² which considered as safe allowable pressure and
3. Compaction is must at site. Medium compaction suitable for this type of the soil
4. SBC report submitted to structural Engineer for the purpose of further design. As Proposed building is G +2 shallow foundations will serve the purpose of load transmission to soil beneath foundation

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