Study of Geotechnical Properties of Soil Collected from a Proposed Construction Site of a Residential Building

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Abstract—The objective of Sub-soil investigation work is to determine the physical and engineering properties of sub-soil horizon underlying the site, for a safe plan and proper design of any civil engineering structure. It is an essential requirement for a civil engineer, Architect and contractors to have a "Geotechnical Report" for structural safety, Design, Estimation and economy of proposed construction. Proper evaluation of Geotechnical properties for a particular site helps safe and economic design of the substructure which is the prime concern for every civil engineering project.

This report has been prepared pertaining to the foundation design of a proposed R.C.C G+2 Building for Residential purposes at Birubari, Guwahati, Assam.

1. INTRODUCTION

Foundation, part of a structural system that supports and anchors the superstructure of a building and transmits its loads directly to the earth. To prevent damage from repeated freezethaw cycles, the bottom of the foundation must be below the frost line. The foundations of low-rise residential buildings are nearly all supported on spread footings, wide bases (usually of concrete) that support walls or piers and distribute the load over a greater area.

1.2 Foundation

The foundations of the building transfer the weight of the building to the ground. While 'foundation' is a general word, normally, every building has a number of individual foundations, commonly called footings. Usually each column of the building will have its own footing.

1.3 Foundation Design

Foundations are designed to have an adequate load capacity with limited settlement by a geotechnical engineer, and the footing itself may be designed structurally by a structural engineer.

The primary design concerns are settlement and bearing capacity.





2.1 Historic Foundation Types:

1. Earthfast or Post in Ground Construction

Buildings and structures have a long history of being built with wood in contact with the ground Post in ground construction may technically have no foundation.

2. Padstones

Perhaps the simplest foundation is the padstone, a single stone which both spreads the weight on the ground and raises the timber off of the ground. Staddle stones are a specific type of padstone.

3. Stone Foundations

Dry stone and stones laid in mortar to build foundations are common in many parts of the world. Dry laid stone foundations may have been be pointed with mortar after construction.

4. Rubble Trench Foundations

Rubble trench foundations are a shallow trench filled with rubble or stones.

2.2 Modern Foundation Type:

1. Shallow foundations

Shallow foundations, often called footings, are usually embedded about a metre or so into soil. One common type is the spread footing which consists of strips or pads of concrete (or other materials) which extend below the frost line and transfer the weight from walls and columns to the soil or bedrock.

3. DEEP FOUNDATIONS

A deep foundation is used to transfer the load of a structure down through the upper weak layer of topsoil to the stronger layer of subsoil below.

3.1 Sub Surface Investigation:

The objective of the exploration work was to determine the probable sub surface conditions such as stratification, denseness or hardness of the strata, position of ground water table etc. and to evaluate probable range of safe load bearing capacity for the structure.

3.2 Standard Procedure for Standard Penetration Test:

Concept: The Standard Penetration test (SPT) is a common in situ testing method used to determine the geotechnical engineering properties of subsurface soils. It is a simple and inexpensive test to estimate the relative density of soils and approximate shear strength parameters.

Equipments

- 1. Drilling Equipment: Casing or Drilling Mud
- 2. Split Spoon Sampler:
- 3. Drive Weight Assembly

3.3 Standard Penetration Test (Performed on Field):

The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil.

Location: R.K Mission road, Birubari, Guwahati.

Equipments

- 1. Drilling equipment
- 2. Drive-weight assembly
- 3. Sampling rods
- 4. Split-barrel sampler
- 5. Pulley Assembly
- 6. Tripod stand 5 meter long.

4.1 Test Performed

Various test are performed for investigation of geo technical properties of soil from the sample getting from the SPT for the design purpose. The test which we did in our project are described below.

4.2 Moisture Content

4.2.1 By Oven Dry Method

Scope: Determination of the moisture content of soil by the Oven Dry Method by using Thermostatically controlled oven.

Apparatus

- 1. Thermostatically controlled oven
- 2. Containers
- 3. Balancing Weight

4.2.2 By Infrared Moisture Meter Method:

Sl. No.	Trial no.	1	2	3
1.	No. of blows	33	23	18
2.	Weight of container + wet soil (g)	26.5	32	28
3.	Weight of container + dry soil (g)	23	27	24
4.	Weight of water (2)-(3) (g)	3.5	5	4
5.	Weight of container. (g)	10.2	10.3	11.9
6.	Weight of dry solids $(3) - (5) (g)$	12.8	16.6	12.1
7.	Moisture content, m = (4)/(6)	.27	.30	.33
8.	Moisture content(%) m x 100	27	30	33

Scope: Determination of the moisture content of soil by the Infrared Moisture Meter

Apparatus

1. Infrared Moisture Meter

4.3 Liquid Limit and Plastic Limit of Soils

Scope: This test method covers the determination of the liquid limit, plastic limit and plasticity index of soils. The liquid and plastic limits of soils are often referred the as the Atterberg's limits.

4.4 Compaction Properties of Soil (Modified Proctor Test)

Scope: This laboratory test is performed to determine the relationship between the moisture content and the dry density of a soil for a specified compactive effort. The compactive effort is the amount of mechanical energy that is applied to the soil mass.

Apparatus Used

- 1. Metal Rammer: 2.6Kg, with free drop of 310 mm
- 2. IS Seive: 20mm and 4.75mm IS Seive
- 3. Balance
- 4. Water Content Containers
- 5. Measuring Cylinder 100ml

4.5 Unconfined Compressive Strength

Scope: The unconfined compression test is used to measure the shearing resistance of cohesive soils which may be

undisturbed or remolded specimens. An axial load is applied using either strain-control or stress-control condition. The unconfined compressive strength is defined as the maximum unit stress obtained within the first 20% strain.

Apparatus: The compression device is a hydraulic-actuated loading piston, electronically controlled, with the Capability of infinite rates of strain and stress loads. A load cell of 44.5 KN or 222.5 KN capacities is fastened to the piston to measure load on specimen. Test data are displayed on control panel board readouts.

Sl.	Trial no.	1	2	3
No.				
1.	Mass of container + wet soil	19	15.5	18.5
	(g)			
2.	Mass of container + Oven dry	18	14.5	17.5
	soil (g)			
3.	Mass of water (g)	1	1	1
4.	Mass of container (g)	11.5	9.5	11.5
5.	Mass of dry soil (g)	6.5	5	6
6.	Water content(%) m x 100	15.35	20	16.667
7.	Plastic Limit	17.351		

Result: Hence the plastic limit is found as 11.11%

Sample ejector, dial gauge, stopwatch, oven, and balance.etc.

5.1 Observations and Calculations for Liquid Limit

Result: The liquid limit is found to be 30%

5.2 Observations and Calculations for Plastic Limit

5.3 Observations and Calculations for UCS test

For 3m Depth

Graph







For 6 m

Graph



4. CONCLUSION

We can conclude that there is a difference between the theoretical knowledge obtained from the classroom and the practical work done at site. As the scope of understanding will be much higher when practical work is done. Practical work embraces our knowledge regarding a work and provides us with better understanding. In this project we have performed the sub soil investigation and collected the soil samples at different depths using Standard Penetration Test. The soil samples obtained were subjected to various tests in order to determine the characteristics of the soil. The different tests performed on the soil were plastic limit, liquid limit, unconfined compressive strength and proctor test.

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