A Study of Subsoil Investigations in Barishal City Corporation, Bangladesh

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Abstract- *A reasonable accurate conception about the subsoil parameters of any project site is essential priority for proper planning and designing the foundation of concerned structure, so that the structure after its construction would remain safe and stable during the life span of the structure. As a result we need soil data. So we are using borehole drilling to analysis the soil. The aim of this study is to provide a good view of soil analysis of Barishal City Corporation that lies on the bank of Kirtankhola River in south-central Bangladesh. The topics of discussions about physical properties and direct shear stress of soil in Barishal City Corporation.*

Keyword: Borehole, Borehole Drilling, Subsoil Parameters, Foundation, Structure, Construction

1. INTRODUCTION

A borehole is a narrow shaft bored in the ground, either vertically or horizontally. Boreholes may be drilled with a variety of rigs. The method used is dictated by the need for penetration in to soil, rock or both and required samples or core recovery. A borehole may be constructed for many different purposes, including the extraction of water, other liquids (such as petroleum) or gases (such as natural gas), as part of a geotechnical investigation, environmental site assessment, mineral exploration, temperature measurement etc. The borehole drillings is used in this study to investigate soil analysis of Barishal City Corporation. We took total 7 places of Barishal City Corporation. Then we average the total result. The study area is given in Fig-1

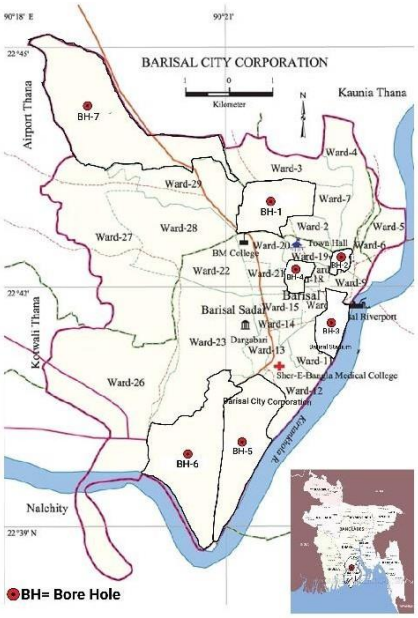

Fig-1: Study area

2. METHODOLOGY

2.1 Scope of Work

The main scope of this investigation work are:

(a) Execution of exploratory borings, recording of sub-soil, stratification and positioning of ground water table.

(b) Execution of standard penetration test (SPT) at an interval of 5ft. depth with collection of disturbed soil samples up to the final depth exploration of each boring.

(c) From field tests and laboratory test, scope of calculation for bearing capacity.

2.2 Field Works

(a) Extraction of soil sample

Disturbed soil sample were collected at 5 ft. intervals and at every change of soil strata by split spoon sampler. These soil samples were studied visually and the soil classification were done to prepare strata chart of soils up to the explored depth. Before collection of samples, the hole is wasted and cleaned the drill pipe with help of an adapter and is lowered into the hole. The sample is then pressed down the ground in one rapid continuous top is filled with soil sample.

(b) Standard penetration Test

Standard penetration tests(SPT) have been executed in all the bore holes at 5 ft. interval of depth up to the final depth of boring. In this test, a split spoon sampler of 2"out diameter and 1-3/8" inner weighing 140 lbs. failing freely for a height of 30-inch length of the sampler is recorded. The number of blows for the last 12-inch penetration of the total 18 inch is known as the standard penetration value (N-Values) as specified by ASTM and is plotted SPT value of the particular depth.

(c) Exploratory Boring Drilling

Drilling was executed by wash boring method. A hole was started by driving vertically a 4 in. diameter steel casting into the ground to some depth and then the formation ground casting was broken up by repeated drops of a chopping bit attached to the lower and of drilling pipe. The upper end of the same was forced at high pressure through pores of the chopping bit, and returned to the surface through the annual space between drilling pipe and the side of the casing or hole, carrying with it the broken-up soils. In this way drilling is advanced up to a level of 6in. above the depth, where SPT-N value has to be executed.

2.3 Laboratory test

(a) Particle size distribution

The object of grain size analysis is to determine the size of the soil grains, and the percentage by weight of soil particles of different particles size, comprising a soil sample. The process consists of either sieve analysis or hydrometer analysis or both. The hydrometer analysis is adopted for sample passing sieve No. 200. For hydrometer analysis, 50 gm. of the oven dry sample is thoroughly mixed with required quantity of water in a calibrated glass cylinder. In order to avoid flocculation, a little dispersing agent is adding. The density of the suspension is measured at specified time intervals, by means of a hydrometer or special design. At any particular time, the size of largest particle remounting in suspension at the level of the hydrometer can be computed by means of Stocks law, where as the weight of the particles finer then size, can be computed from the density of the suspension at the sample level. The mixture is washed through U.S standard sieve No. 200 and the fraction retained is dried. The fraction retained of each sieve is weighted for calculation of the percentage of different fraction.

(b) Direct Shear Test

Direct Shear test can be Performed for both cohesion less and cohesive soil to determine shear strength, angle of internal fraction, cohesion c, volume change etc. The test is done in a direct shear machine which consists of a normal loading device, shearing device having diameter 6.35 cm and height 2.54 cm, circular box, etc. The rate on shearing displacement of sample approximately 10 mm per minute is determined. The results of a direct shear test on a cohesion less and cohesive soil can be presented stress-strain curve. A stress- strain curve normally consists of shear stress; various shear displacement for both the undisturbed and the remolded tests under a specified normal load. The normal load usually varies from 1/3 kg/cm^2 to 1 kg/cm^2. Another curve of normal stress verses shearing stress will give angle of internal friction and cohesion for cohesive soil.

(c) Natural Moisture Content

The water content of a soil sample is the ratio of the weight of the water in the sample to its dry weight. It is usually expressed as a percentage. The soil sample is weighed both in natural state and in oven dry state and the moisture content is calculated by dividing the loss of weight of the sample by its dry weight.

(d) Atterberg Limits

Physical properties of clay are greatly influenced by water content. A given soil behaves as a fluid or a soil, as plastic materials, depending on how much water it contains. The water contents that correspond to the boundaries between the states of consistency are called as the Atterberg limits. Liquid limit is the minimum water content at which a clay soil just starts behaving like a fluid. It is determined with the help of a standard liquid limit device. The plastic limit is the minimum water content at which a soil is just plastic and is determined by rolling out a soil sample at a slowly decreasing water content until, the desired water content is reached, at which a thread of 1/8 inch diameter just begging to crumble. The thread is rolled on glass plate with hand.

3. RESULTS

The physical properties of soil we obtained from the laboratory test is given bellow.

(a)Values of approximate unconfined compressive strength based on N-values for cohesive soil (After

K. Terzaghi and R.B. Peck) data is given in Table-1

Table-1

N Values	Condition	Unconfined compressive strength, Tsf
Bellow 2	Very soft	Bellow 0.25
2-4	Soft	0.25-0.50
4-8	Medium	0.50-1.00
8-15	Stiff	1.00-2.00
15-30	Very Hard	2.00-4.00
Over 30	Hard	Over 4.00

In the above table the shear strength of cohesive soil is equal to ½ of unconfined compressive strength and the angle of shearing resistance of that soil is equal to zero. It should be remembered that the correlation for cohesive soil is always much reliable.

(b) Values of Unit Weight and Angle of Internal Friction of Non-Cohesive soil based on N-values (1948 K. Terzaghi and R.B. Peck) data is given in Table-2

N-Values	Condition	Relative density%	Angle of internal friction	Moist unit Wt. in gm./cc
0-4	Very loose	0.0 - 0.20	25^0 - 30^0	1.12 - 1.60
4-10	Loose	0.20 - 0.40	30^0 - 35^0	1.44 - 1.84
10-30	Medium	0.40 - 0.60	35^0 - 40^0	1.76 - 2.08
30-50	Dense	0.60 - 0.85	40^0 - 45^0	1.76-2.24
Over 50	Very dense	1.00	45^0	2.08-2.40

Table-2

The tabulated values apply for dry/moist cohesion's sand. For silts sands the bearing capacity values must be reduced by study of grain size classification and applying judgment. Collection for water table close to bottom of foundation the bearing values should be reduced to half. The bearing values are, however, not affected by the water table to a depth greater than 1.5 bearing capacity bellow foundation level, bearing capacity being least dimension of the table may be reduced by linear interpolation.

(c) Bore log soil graph is given in Fig-2 [1]

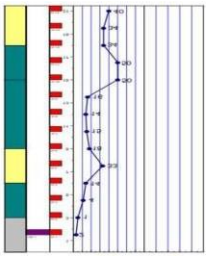

Fig-2: Bore log graph of Soil

(d) The SPT value and graph is given Fig-3

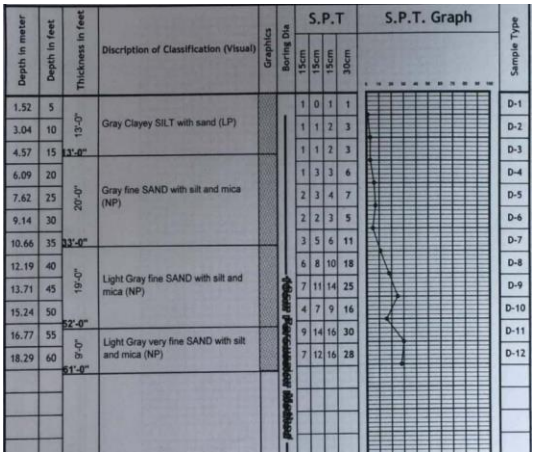

Fig-3: SPT value and Graph

(e) Shear stress and normal stress graph is shown in Fig-4

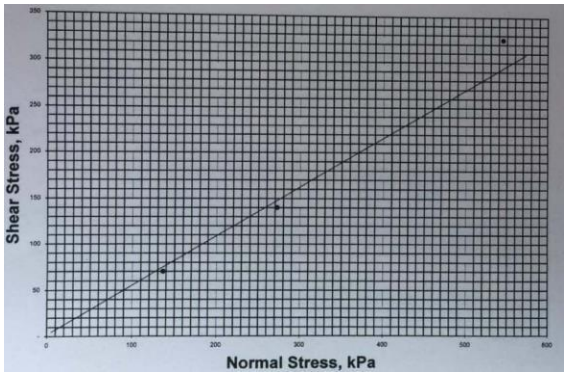

Fig-4: Shear stress and normal stress graph

Here Cohesion " C " (Kpa) is 0 (zero) and angle of internal friction is 31^0 (Degree)

4. CONCLUSION

Soil investigation is fundamental to any construction. It is the most underrated and often ignored in Bangladesh, but this is the first step in initiating any construction project. It brings out the hidden dangers a building might face in the future. The multistoried building will rest and stand on the soil throughout its lifespan. Checking whether the ground is capable of holding the building is the most vital part of the process. It is impossible to design a layout of a building foundation without knowing the sustainability of the soil. Be it a bridge, rail lines or culverts; a soil analysis can prevent unwanted future accidents and destruction. The aim of the analysis of soil is to know whether the soil suitable or not for construction. The soil is not be suitable for construction if the % of moisture content is higher. In the determination of texture of soil, it can be concluded that soil sample of seven places of Barisal City Corporation has the average percentage of sand (68.43%) and slit & clay (31.65%) component and no gravel. Above the result the physical properties of soil is standard to build high rises building. In Barishal City Corporation there exists maximum 11 storied building. [8]

5. ACKNOWLEDGEMENTS

We like to give special thanks to ABIR Design Engineers & Architectural Consultant for providing the Data.

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