THE EFFECT OF GEOTECHNICAL PROPERTIES ON CIVIL ENGINEERING STRUCTURES IN CROSS RIVER STATE, SOUTH-SOUTH REGION OF NIGERIA

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Abstract: Statistics of structures such as roads, buildings, dams and bridges have increased throughout Nigeria in particular Cross River State in the South-South region.Foundation failures is becoming a menance hence these studies becomes a necessity,Virtually all construction by civil engineers are placed on foundation within the soil. The soil may be in-situ or brought in as fill material. Soil samples were obtained from forty locations, ten each for the four coordinated points of Akpabuyo and Bakassi local government areas of the state. However major geotechnical properties were obtained through sieve analysis, consistent test, moisture content, shear strength, consolidation and compaction tests, Analysis of test results shows a wide variation between the four coordinates : Point1-Ikot Effio-Anang;Point2-Ifhang King Duke;Point3-Ekpri Ikot Eyo Edem and Point4- Ikot Oyom,Point1 and Point3 shows relatively safe bearing capacities of 159KN/M2 and 207,27KN/M2 compared to Point2 and Point4 with 68.83KN/M2and 65.8KN/M2 considered being unsuitable for shallow foundations.

Keywords: Sieve Analysis, Shear strength ,consolidation, moisture content, compaction test ,Bearing capacity

INTRODUCTION

Foundation study usually provides subsurface information that normally assists Civil engineers in design of foundation of civil engineering structures,[2]. Virtually all constructions by civil engineers are placed on foundations within soil. The soils may be in-situ or brought in as fill materials. The soils are usually utilized as construction materials such as dams, embankment and pavements (flexible). When construction are to be undertaken within the in-situ soil, the properties of the soils in the undisturbed state will be required for the determination of the bearing capacity and settlement characteristics in the case of fills, dams, embarkment and pavement etc. The original properties of the soils are obliterated during the course of excavation, loosening and spreading out at the new sites.

New properties are then imparted through compaction. Under these circumstances the properties of the soils in the compacted state will be required and therefore important[1]. The high water contents imparted into the soils by inundation is bound to cause probably drastic changes in some geotechnical properties of the soil.

Their strength and consolidation characteristics will certainly be affected. These changes will in turn affect the bearing capacities of the soil. The eventual manifestation may be in terms of excessive settlement, slope and foundation

failure[3].There have reported cases of building collapse in these areas under study .Swollen/Expansive soils are the principal cause of damages to building structures and other construction works. Possible damages that can be caused by expansive soils include foundation cracks, severe structural damage such as collapse, heaving and cracking of sideway.Surface and sub-surface water are other causes of structural failure [5]. Other causes of foundation failure are: Soil type (especially expansive clay soil),Poorly compacted fill materials, Slope failure mass wasting, Excess Underground Water, Erosion and Poor construction.

AIMS:

Aim of the study is to obtain reasonably representative values of the soil properties that are reliable and have direct and significant bearing upon the solution of the practical problems involving civil engineering structures in the study areas.

OBJECTIVES:

To access the geotechnical properties of the soil by means of laboratory investigation. To assess the bearing capacity for soils of different locations in

Akpabuyo Local Government Area, Cross

River State. To determine suitable foundation

depth. To determine the subsoil and ground

water condition for the selected areas.

To provide the lead to the understanding of the various types of soil and their properties.

SCOPE OF STUDY

The project is aiming at evaluating the

properties of the soils in the five areas of study

Ikot effio Anang, Ifiang King Duke, Ekpiri

Ikot Eyo Edem, Ikot Oyom and Esuk Ekpo Eyo

all in Akpabuyo. Local Government Area,

Cross River State, and comparing their

properties to know the different types

of foundations that may suit these areas and

their implications.

2 Materials and Methods: The investigation range in scope from a simple examination of surface soils with a few shallow trial pits, to a detailed study of the soil to a considerable depth of (2m) below the surface by means of digging out undisturbed samples for necessary laboratory tests i.e the disturbed and undisturbed samples. Soil samples were obtained from five different locations, in the study areas. The undisturbed soil samples were collected at a depth of 2.0m from the ground level.

Major geotechnical properties of the various soil samples were tested and they include; Sieve Analysis, Specific Gravity, Consistency Test,

Moisture Content, Shear Strength (Undrained Triaxial Compression), Consolidation (Oedometer test) and Compaction Test.

Table 1 Locations and Coordinates

S/N0 :	SAMPLE LOCATION	NORTHINGS	EASTINGS	ELEVATION
1	IKOT EFFIO ANANG	444847	538168	57
2	IFIANG KING DUKE	445364	543339	60
3	EKPRI IKOT EYO EDEM	440089	543996	29
4	IKOT OYOM	436435	545918	59

3 RESULTS AND DISCUSSION

All the laboratory results are shown in the summary of table 2.The results are deducted from the moisture content, consistency limits ,Specific gravity, compaction, shear strength, and consolidation test..

All analyses were carried out in accordance with the British Standard Institutio

Plasticity Index Chart for the Four Locations

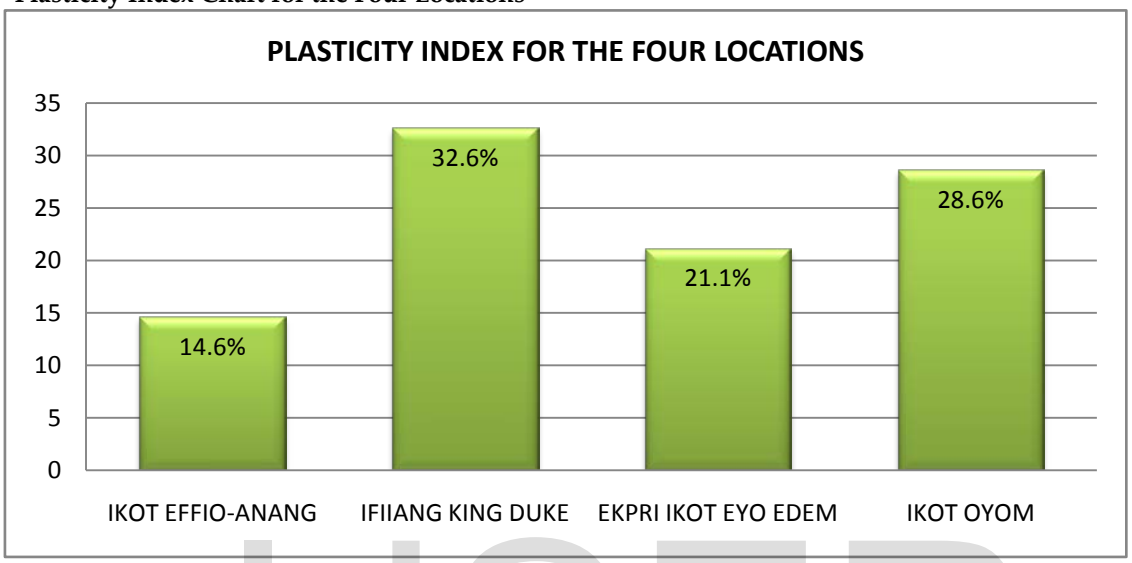

Figure 1.0 Plastic Index chart.

Bearing Capacity Chart for the Four Locations

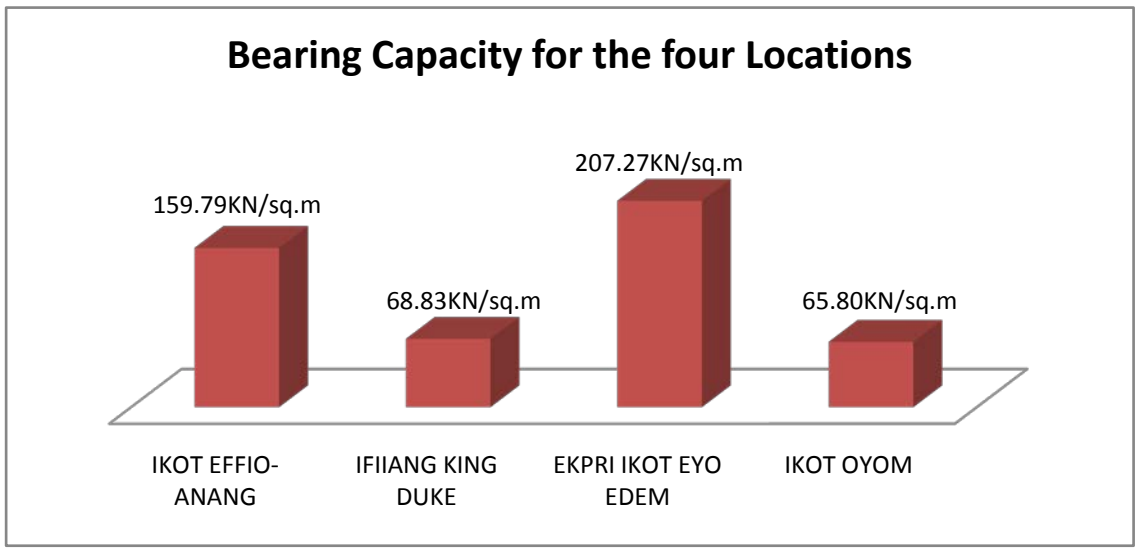

Figure 2.0 Bearing Capacity chart.

Natural Moisture Content and Optimum Moisture Content Chart for the Four Locations

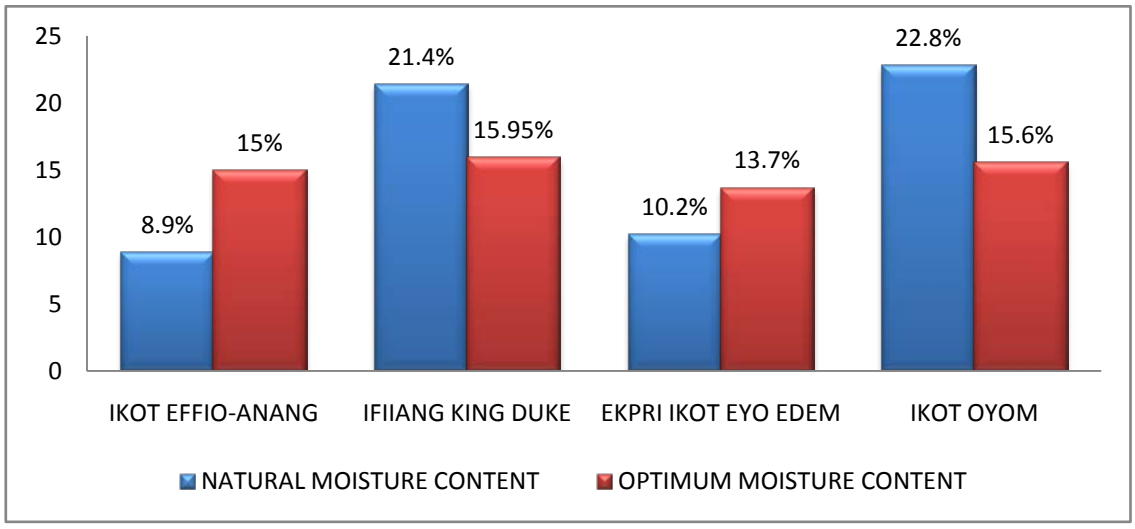

Figure 3.0 Natural and Optimum Moisture Content Chart

4. Conclusion

The following conclusions were deduced from the summary of laboratory tests results.

(1) sThere is high shrinkage limit at Ifiang King Duke and Ikot Oyom due to excess plasticity caused by large silty materials in the soil which indicates high volumetric change, and as a result makes the soil not good for construction. The other two locations Ikot Effio – Anang and Ekpri Ikot Eyo were of low shrinkage limit which indicates low volumetric change. Hence, they are good for construction exercise.

(2) The allowable safe bearing capacities of the various locations, further confirms the suitability and stability of the soil at Ikot Effio – Anang and Ekpri Ikot Eyo as a good soil for shallow foundations within the depth of the laboratory

Table 2.0 Summary of Results

S/NO.	SOIL PARAMETERS	IKOT EFFIO-ANANG (POINT 1)	IFIANG KING DUKE (POINT 2)	EKPRI IKOT EYO EDEM (POINT 3)	IKOT OTOM (POINT 4)
1	Moisture Content(MC) %	8.9	21.4	10.2	22.8
2	Liquid Limit (LL) %	39	56.25	53.5	49
3	Plastic Limit (PL) %	21.4	22.65	32.3	20.4
4	Plasticity Index (PI) %	14.6	32.6	21.1	28.6
5	Shrinkage Limit (SL) %	5	19.71	3.5	12.86
6	Specific Gravity (SG) g/cm^3	2.77	2.79	3.1	22.8
7	Optimum Moisture Content (OPC) %	15	15.95	13.7	15.6
8	Maximum Dry Density (MDD) g/cm^3	1.99	1.8	1.93	1.83
9	Coefficient of Uniformity(C_u)		4.24	6	3.44
10	Coefficient of Curvature (C_c)		0.12	1.57	1.6
11	Group	A – 2	A – 7	A – 2	A – 7
12	Cohesion (C)	22	11	21	20
13	Internal Frictional Angle ø (º)	12	18	18	3
14	Bearing Capacity	159.79KN/m^2	68.83KN/m^2	207.27KN/m^2	65.8KN/m^2
REMARK		Good	Poor	Excellent	Poor
FOUNDATION TYPE		Shallow	Deep	Shallow	Deep

analysis, while the other two locations Ifiang King Duke and Ikot Oyom exhibit low safe bearing capacity which indicates that shallow foundation is not possible for building structure of high loading.

(3) The cohesion for each site shown on the Mohr's circle graph indicates that Ifiang King Duke and Ikot Oyom have very weak soil formation making it unsuitable for construction work, whereas the other two are firm.

(4) The field investigation revealed that the subsoil generally comprises of clayey soil. Only reasonable light structures may be situated in these areas (Ifiang King Duke and Ikot Oyom) utilizing shallow foundation.

However from the aforementioned development, it can be concluded Ifiang King Duke and Ikot Oyom soil exhibits poor foundation properties while other two locations Ikot Effio – Anang and Ekpri Ikot Eyo exhibit good foundation properties of moderate to high and moderate volume compressibility potential.

5 RECOMMENDATIONS

Based on the laboratory test and analysis, soils at Ifiang King Duke and Ikot Oyom can safely tolerate light structures of two to three stories on raft foundation but structures with high magnitude load will involve the use of deep foundation (pile foundation) , while for other two locations (Ikot Effio – Anang and Ekpri Ikot Eyo) sites can moderately accommodate deep foundation depending on the type of structure. Also buildings of two to five stories can effectively sit on this soils using shallow foundation (pad foundation).

Finally it should be noted that the geotechnical investigation was carried out at 2m depth, hence erection of structures with foundation depth beyond 2m would require further investigation.

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