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Investigation of Soils and Bearing Capacity in Selected Construction Sites

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Considering the importance of soil and foundation in the construction of engineering structures, it is important to investigate the bearing capacity of engineering soils. The purpose of this study was to examine the soils' carrying capacity in southwest Nigeria's Ife-East Local Government Area. Samples of soil were taken from a few chosen construction sites in the research region. Preliminary and geotechnical tests, including triaxia, Atterberg limits, specific gravity, natural moisture content, and particle size measurement, were performed on the soil samples using standard protocol. The bearing capacity of the soil samples was computed for different footing types (circular. square and strip footings) using Terzaghi's bearing capacity equations. Results showed that all the soils fell into A-2-4 group, according to American Association of State Highway and Transportation Officials (AASHTO) classification standard. Also, using Unified Soil Classification System (USCS), it was observed that 75 % of the samples were well-graded sand (SW) and 25 % were poorly graded sand (SP). For square footing, the bearing capacity values ranged from 269.12 KN/m^2 to 3340.85 KN/m^2; for circular footings, the values ranged from 267.90 KN/m^2 to 3313.47 KN/m^2; and for strip footings, the values ranged from 221.58 KN/m^2 to 2700.54 KN/m^2.

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It was concluded that all the tested samples were c-ϕ soils, and all the soils could be described as excellent to good foundation materials. The study confirms the fact that the values of bearing capacity are influenced by the nature of foundation soil and shape. and circular footing was found to have intermediate magnitude in all cases.

Keywords: Bearing capacity; construction engineering; engineering soil; foundation; structural stability.

1. INTRODUCTION

"The magnitude of loading that causes shear failure to occur beneath a foundation is termed the bearing capacity of the soil. This capacity is governed by the fabric of the rock and soil beneath the foundation. Bearing capacity failure occurs as the soil supporting the foundation fails in shear, which may involve either a general, local or punching shear failure mechanism" [1]. "The bearing capacity of soil is an important consideration in construction projects. Dams, bridges abutment and temporary support structures (false work) during construction are all examples of structures that can be supported by underlying soils" [2].

"The bearing capacity of soil is the maximum average contact pressure between the foundation and the soil which should not produce shear failure in the soil. For different failure mechanisms different methods of analysis are used. Estimation and prediction of the ultimate bearing capacity of a foundation is one of the most significant and complicated problems in geotechnical engineering. The soil must be capable of carrying the load from any engineering structure placed upon it without a shear failure and with the resulting settlement being tolerate for that structure" [1].

"The study of engineering behaviour of different types of soils is extremely important to Civil Engineers because every engineering structure such as a building, a road, a bridge, and monuments will have to be rested and founded on foundations in such a manner that the structure does not get settled or tilted, or damaged due to some kinds of failure of the foundation" [3]. "The strength of the soil to withstand loads under different site conditions, therefore, becomes an important factor in designing safe foundation for the structure" [4].

"In construction engineering, it is paramount that knowledge of the soil and its properties (especially bearing capacity) be acquired so as to avoid failure of structures which could lead to loss of materials, money and sometimes even lives" [3]. This has necessitated investigation of bearing capacity of soils.

Studies have been conducted on the bearing capacity of soils in different locations [5,6]. Waghmare and Patil [7] investigated some soils and their bearing capacity at some different construction sites. They conducted the geotechnical investigation for the study and construction based on the foundation depth and using standard procedure. They also obtained the necessary input for design of foundations from the record of trial pits bore hole and testing of soils collected from different site locations and depths.

Alawode et al. [8] carried out "the assessment of bearing capacity of soils in Ile-Ife town, Osun state, southwestern Nigeria. They found that 80% of the tested soil samples belonged to A-2-7 class, according to American Association of State Highway and Transportation Officials (AASHTO) classification; while 70% of the samples were well-graded sand (S. For strip footings, the bearing capacity values ranged from 83.15 kN/m^2 to 2697.08 kN/m^2; for circular footings, the values ranged from 105.14 kN/m^2 to 2791.83 kN/m^2; and for square footings, the values ranged from 105.20 kN/m^2 to 2932.06 kN/m^2. They concluded that all the tested soils were c-ϕ soils, and could be described as excellent to good foundation materials". Similarly,

Muhammad et al. [9] investigated "the bearing capacity of soil for for building and structural foundation design using the case study of Polo Area, Maiduguri, Nigeria. The authors investigated the soil in the study area using direct shear laboratory analysis on twenty representative soil samples across virgin area where future development is approaching. They adopted foundation widths of 0. 5 m, 1 m and 2 m. They found that the safe bearing capacity values for the soils ranges from 44.95 kN/m^2 to 411.11 kN/m^2 and 75.27 kN/m^2 to 397.31 kN/m^2 for 1 m and 1.5 m depths respectively. They concluded that the minimum footing size that could be used is 1800 mm × 1800 mm using 400 kN/m^2 safe bearing capacity".

Adunoye et al. [10] investigated "the bearing capacity of soils in Ayedaade Local Government Area, Osun state, southwestern Nigeria. They observed that majority of the soils were well-graded and could also be classified as A-2-4. The soils were all c-ϕ soils. For each of the soil samples, square footing had the highest bearing capacity while strip footing had the lowest. It was also concluded that the tested soils are all excellent to good foundation materials.

There is a growing need to document the values of bearing capacity for specific areas, for the purpose of easy reference for engineering construction purposes". The record is not presently available for the chosen study area; hence, this study.

This study aimed at investigating the bearing capacity of selected soils at Ife East Local Government Area, Osub state, southwestern Nigeria, with a view to updating the body of knowledge on bearing capacity in selected locations. The specific objectives of the study were to: (i) characterize selected soil samples; (ii) determine the shear strength parameters of selected soil samples; and (iii) compute and assess the ultimate bearing capacity of soil samples.

2. MATERIALS AND METHODS

2.1 Materials and Equipment

The main materials used for this study were soil samples collected from selected construction sites within Ife East Local Government Area, Osun State, southwestern Nigeria. The equipment used for laboratory analyses were: moisture content apparatus, set of BS sieves (for sieve analysis), specific gravity apparatus, plastic limit apparatus, liquid limit apparatus, ccompaction apparatus and triaxial machine (for determination of shear strength parameters). Hand auger was used for sample collection.

2.2 Soil Sampling and Preparation

A total of 20 disturbed soil samples were collected fr0m 20 identified construction sites (One sample from each location) in the study area. The depth of sample collection varied between 0.5m and 1m [8,10]. "About 25 kg of each sample was collected with the aid of a hand auger and placed in a polythene bag, well sealed, and immediately taken to the Geotechnical Engineering Laboratory of the Department of Civil Engineering, Obafemi Awolowo University (OAU), Ile-Ife, Nigeria. At the laboratory, representative samples were taken for natural moisture content determination (using the oven method), while the remaining soils were air-dried for subsequent laboratory tests/analyses" [11].

2.3 Classification and Engineering Tests

Using standard procedure as outlined in BS 1377 [12] the following classification and engineering tests were conducted on the soil samples: grain size analysis, specific gravity, Atterberg limits, compaction and triaxial.

Particle size characteristics were also determined from the particle size curves which were plotted from the grain size analysis, using equations (1) and (2). Plasticity index was also obtained using equation (3)

$$\mathrm{Cu} = \frac{D_{60}}{D_{10}} \qquad (1)$$

$$Cc = \frac{D_{30}^2}{D_{10}\ x\ D_{60}} \qquad (2)$$

$$\mathrm{PI} = \mathrm{LL} - \mathrm{PL} \qquad (3)$$

Where,

C_u = Coefficient of uniformity
C_c = Coefficient of gradation
D_{10} = diameter corresponding to 10% finer
D_{30} = diameter corresponding to 30% finer
D_{60} = diameter corresponding to 60% finer
PI = plasticity index
LL = liquid limit;
PL = plastic limit

2.4 Computation of Bearing Capacity

The shear strength parameters (cohesion, *c* and angle of internal friction, ϕ) obtained from the triaxial tests were employed in Terzaghi's [13] bearing capacity equations (4) to (6), for circular footing, square footing and strip footing respectively, to compute the bearing capacity of the soil samples for different footing geometry – square footing, circular footing and strip footing, respectively. The values of bearing capacity factors were obtained from Das [14] using the corresponding values of angle of internal friction (ϕ) obtained from the triaxial tests. According to Das [14], the factor of safety should be at least 3 in all cases. Therefore, a factor of safety value of 3 was adopted. Unit width and unit depth were also adopted for each of the footings.

$$Qu=1.3cNc+ \gamma DNq+ 0.3\gamma BN\gamma \quad (4)$$

$$Qu=1.3cNc+ \gamma DNq+ 0.4\gamma BN\gamma \quad (5)$$

$$Qu= cNc+ \gamma DNq+ 0.5\gamma BN\gamma \quad (6)$$

Where,

Qu = ultimate bearing capacity (kN/m²);
c = cohesion (kN/m²);
γ = effective unit Weight of soil (kN/m³);
D = depth of footing (m);
B = width of footing (m);
Nc, Nq and Nγ are bearing capacity factors, which depend on the values of angle of internal friction ϕ.

3. RESULTS AND DISCUSSION

3.1 Description of Sample Locations

Fig. 1 presents the locations of the sampling points, while the Geographic Position System (GPS) locations of the sampling points are presented in Table 1.

3.2 Results of Preliminary Tests

The results of the preliminary and classification tests conducted on the soil samples are presented in Table 2.

Sample IELGA19 had the highest natural moisture content of 16.64 % while Sample IELGA2 had the lowest natural moisture content of 4.04 %. 50% of the soil samples had their moisture content values higher than 10 % and the remaining 50 % had their moisture content values lower than 10 %.

Sample IELGA5 had the highest specific gravity of 2.87 while Sample IELGA19 had the lowest specific gravity of 2.50. According to Bowles (1996), the specific gravity of clayey and silty soils may vary from 2.6 to 2.9 while organic soil ranges from 1.0 - 2.60. It is clear from Table 2 that, only 25 % of the soil samples had their specific gravity lower than 2.60 while the rest had theirs greater than or equal to 2.60. It can therefore be deduced that majority of the soil samples collected are silty-clayey soils in nature.

Results of grain size analysis (Table 2) showed that sample IELGA11 had the highest fines content (0.95 %) and sample IELGA2 had the lowest value of fines content (0.19 %). Also, sample IELGA6 had the highest coefficient of uniformity value of 25.768 while sample IELGA10 had the least coefficient of uniformity value of 0.992. Sample IELGA8 had the highest coefficient of curvature (1.785) while the lowest coefficient of curvature was 0.20 (for sample IELGA10). According to Jumikis [15], on the average, a soil is sandy if C_u is between 10 and 20; silty, if C_u is between 2 and 4 and clayey if C_u is between 10 and 100. It could therefore be concluded that 90% of the soil samples are silty-sandy in nature.

Fig. 1. Locations of sampling points

Table 1. GPS location of sample collection points

	Collection of Samples		
S/N	**Sample ID**	**Latitude**	**Longitude**
1	IELGA1	7°28'46.2"N	4°31'39.4"E
2	IELGA2	7°28'43.5"N	4°30'20.5"E
3	IELGA3	7°28'20.1"N	4°30'48.0"E
4	IELGA4	7°27'11.5"N	4°31'09.7"E
5	IELGA5	7°28'41.6"N	4°31'48.6"E
6	IELGA6	7°29'23.4"N	4°31'13.5"E
7	IELGA7	7°29'19.1"N	4°31'14.5"E
8	IELGA8	7°29'07.0"N	4°31'20.0"E
9	IELGA9	7°29'08.5"N	4°31'27.0"E
10	IELGA10	7°29'17.5"N	4°31'28.2"E
11	IELGA11	7°27'44.5"N	4°31'37.2"E
12	IELGA12	7°28'08.3"N	4°32'18.7"E
13	IELGA13	7°28'24.8"N	4°32'47.5"E
14	IELGA14	7°28'15.0"N	4°32'32.9"E
15	IELGA15	7°28'59.8"N	4°32'01.8"E
16	IELGA16	7°28'17.5"N	4°31'08.4"E
17	IELGA17	7°28'35.1"N	4°31'25.0"E
18	IELGA18	7°28'24.3"N	4°31'23.3"E
19	IELGA19	7°28'47.9"N	4°32'49.5"E
20	IELGA20	7°28'54.0"N	4°31'04.9"E

Table 2. Results of preliminary tests

Sample ID	Natural moisture content, w (%)	Specific gravity, Gs	Fines Content (%)	D_{10}	D_{30}	D_{60}	C_u	C_c	LL (%)	PL (%)	PI (%)
IELGA1	8.59	2.51	0.24	0.276	0.784	3.672	13.3	0.606	23	23	0
IELGA2	4.04	2.73	0.19	0.357	0.673	2.281	6.389	0.556	20	36	-16
IELGA3	5.32	2.69	0.33	0.352	0.458	1.851	5.259	0.322	23	23	0
IELGA4	11.02	2.69	0.43	0.175	0.658	4.452	25.44	0.556	19	33	-14
IELGA5	4.31	2.87	0.68	0.278	0.572	0.875	3.147	1.345	14	33	-19
IELGA6	6.39	2.6	0.51	0.125	0.731	3.221	25.77	1.327	16	34	-18
IELGA7	9.57	2.54	0.45	0.117	0.137	0.693	5.923	0.231	26	25	1
IELGA8	14.52	2.68	0.56	0.115	0.413	0.831	7.226	1.785	21	23	-2
IELGA9	13.54	2.52	0.57	0.196	0.473	0.968	4.939	1.179	19	19	0
IELGA10	12.42	2.67	0.59	0.983	0.438	0.975	0.992	0.2	17	35	-18
IELGA11	9.29	2.63	0.95	0.483	0.974	4.385	9.079	0.448	17	23	-6
IELGA12	4.8	2.8	0.57	0.372	0.869	3.279	8.815	0.619	17	28	-11
IELGA13	10.37	2.69	0.31	0.391	0.862	3.194	8.169	0.595	19	24	-5
IELGA14	14.35	2.69	0.61	0.365	0.816	3.793	10.39	0.481	20	34	-14
IELGA15	5.74	2.56	0.77	0.328	0.794	3.274	9.982	0.587	22	25	-3
IELGA16	9.1	2.74	0.65	0.384	0.916	4.19	10.91	0.521	25	36	-11
IELGA17	14.19	2.77	0.5	0.279	0.728	3.281	11.76	0.579	22	25	-3
IELGA18	13.02	2.64	0.63	0.283	0.842	3.632	12.83	0.69	23	33	-10
IELGA19	16.64	2.5	0.66	0.228	0.739	3.491	15.31	0.686	19	37	-18
IELGA20	14.44	2.7	0.86	0.593	0.983	3.741	6.309	0.436	25	31	-6

The highest value of liquid limit that was obtained was 26 %, for sample IELGA7 while the least value was 14 %, for sample IELGA5. Also, the plastic limit had a maximum value of 37 % (for sample IELGA19) and the minimum of 19 % (for sample IELGA9). The mean liquid limit and plastic limit for the soil samples were 20.35 % and 29.00 % respectively. According to Whitlow [16], a soil having liquid limit less than 35 % has low plasticity, between 35 % and 50 % has intermediate plasticity, while 50 % - 70 % liquid limit indicates high plasticity and 70 % - 90 % shows very high plasticity in a soil. The tested soil samples could therefore be described as having low plasticity.

Soil classification, using the obtained index properties and adopting the American Association of State Highway and Transportation Officials (AASHTO) and Unified Soil Classification System (USCS) standards is presented in Table 3. AASHTO classification showed that all the soil samples were A-2-4. In the same vein, USCS classification showed that 75 % of the soil sample were well graded sand, fine to coarse (SW) while 25 % were poorly graded sand (SP). The soils could therefore be regarded as excellent to good foundation materials [14].

3.3 Results of Compaction Tests

The variation of the maximum dry density (MDD) and optimum moisture content (OMC) is shown in Fig. 2. The highest OMC of the soils tested was 25.0 % (for sample IELGA12) while the lowest OMC was 12.5 % (for sample IELGA15); and the highest and lowest MDD values of 2005 kg/m^3 (for sample IELGA19) and 1450 kg/m^3 (for sample IELGA3, respectively.

90 % of the soil samples had OMC within the range 10 % - 20 % while the remaining 10 % had OMC within 20 % - 30 %. Only 15 % of the soil samples had MDD within the range 1000 kg/m^3 – 1600 kg/m^3 while 85 % of the samples had MDD within 1600 kg/m^3 – 2000 kg/m^3. According to Murthy [17], the more the soil is compacted, the greater is the value of cohesion and the angle of shearing resistance and thus soils compacted with high moisture become saturated with a consequent loss of strength; that is, the greatest shear strength is attained at a moisture content lower than the optimum moisture content for maximum dry density. It could therefore be predicted that majority of the soils would have high bearing capacity values, considering the fact that most of the samples had low moisture content before attaining their MDD.

3.4 Results of Triaxial Tests

The values of the shear strength parameters (c and ϕ) obtained from unconsolidated undrained triaxial tests, and computed bearing capacity (for different footing geometry) are presented in Table 4. The soils are of different shear strength parameters from one location to another. Sample IELGA7 had the highest cohesion (78 kN/m^2) while sample IELGA13 had the lowest cohesion of 11 kN/m^2. The highest internal friction angle was 33^o (for sample IELGA13) while the lowest internal friction angle was 11^o (for samples IELGA11). According to Murthy [17], the internal friction angle is within 26^o and 48^o for granular soils while internal friction angle less than 26^o is for fine soils. Therefore, 25 % of the soil samples, with internal friction angle ranging between 26^o and 48^o, could be classified as granular soils; while the remaining 75 % could in turn be classified as fine soils.

3.5 Bearing Capacity Values

The computed values of bearing capacity (for circular, square and strip footings) and the adopted bearing capacity factors are presented in Table 4.

Results showed that higher values of ϕ imply higher bearing capacity for the samples for all the footing types. It was observed that the shape of footing was an important factor which governs the bearing capacity of the soils. The square footing was found to have the highest bearing capacity, followed by circular footing, while strip footing had the lowest bearing capacity for all the soil samples. This could be attributed to the combined effects of different values of bearing capacity factors, that is, the coefficient of each term for each case differs from one another. Considering the square footing, the highest bearing capacity was 3340.85 kN/m^2 (for soil sample IELGA12), while soil sample IELGA16) had the lowest bearing capacity of 269.12 kN/m^2. In the case of circular footings, sample IELGA12 also had the highest bearing capacity of 3313.47 kN/m^2 while sample IELGA16 had the least value (267.90 kN/m^2). For strip footing, sample IELGA12 had 2700.54 kN/m^2 as the highest bearing capacity while sample IELGA16 had 221.58 kN/m^2 as the lowest bearing capacity [18-21].

Table 3. Soil classification

Sample ID	AASHTO	USCS
IELGA1	A-2-4	SW
IELGA2	A-2-4	SW
IELGA3	A-2-4	SP
IELGA4	A-2-4	SW
IELGA5	A-2-4	SP
IELGA6	A-2-4	SW
IELGA7	A-2-4	SP
IELGA8	A-2-4	SW
IELGA9	A-2-4	SP
IELGA10	A-2-4	SP
IELGA11	A-2-4	SW
IELGA12	A-2-4	SW
IELGA13	A-2-4	SW
IELGA14	A-2-4	SW
IELGA15	A-2-4	SW
IELGA16	A-2-4	SW
IELGA17	A-2-4	SW
IELGA18	A-2-4	SW
IELGA19	A-2-4	SW
IELGA20	A-2-4	SW

Table 4. Results of triaxial test and bearing capacity computation

Sample ID	Cohesion, *c* (kN/m^2)	Internal friction angle, £ (°)	N_c	N_q	N_γ	γ (kN/m^3)	Bearing capacity (kN/m^2)		
							Square footing	Circular footing	Strip footing
IELGA1	39	15	12.86	4.45	1.52	17.2	739	736.39	591.2
IELGA2	21	29	34.24	19.98	16.18	17.49	1397.4	1369.1	1210
IELGA3	47	23	21.75	10.23	6	14.5	1512.1	1503.4	1214
IELGA4	29	12	10.76	3.29	0.85	17.52	469.25	467.76	377.1
IELGA5	32	18	15.12	6.04	2.59	18.4	759.19	754.42	618.8
IELGA6	39	20	17.69	7.44	3.64	19.9	1073.9	1066.7	874.2
IELGA7	78	19	16.56	6.7	3.07	19.5	1833.8	1827.8	1452
IELGA8	55	21	18.92	8.26	4.31	17	1522.5	1515.2	1218
IELGA9	23	29	34.24	19.98	16.18	14.7	1412.6	1388.8	1200
IELGA10	25	31	40.41	25.28	22.65	15.98	1862.1	1825.9	1595
IELGA11	34	13	11.41	3.63	1.04	17.24	574.08	572.28	459.5
IELGA12	65	29	34.24	19.98	16.18	16.92	3340.9	3313.5	2701
IELGA13	11	33	48.09	32.23	31.94	20.02	1588.7	1524.8	1494
IELGA14	47	21	18.92	8.26	4.31	18.45	1340.2	1332.3	1081
IELGA15	24	22	20.27	9.19	5.09	20	856.94	846.76	721.2
IELGA16	16	11	10.16	2.98	0.69	17.75	269.12	267.9	221.6
IELGA17	35	18	15.12	6.04	2.59	17.3	810.37	805.89	656.1
IELGA18	48	17	14.6	5.45	2.18	18.2	1026.1	1022.1	819.8
IELGA19	43	18	15.12	6.04	2.59	20.05	987.08	981.89	797.2
IELGA20	21	16	17.69	7.44	3.64	16.68	631.32	625.25	526

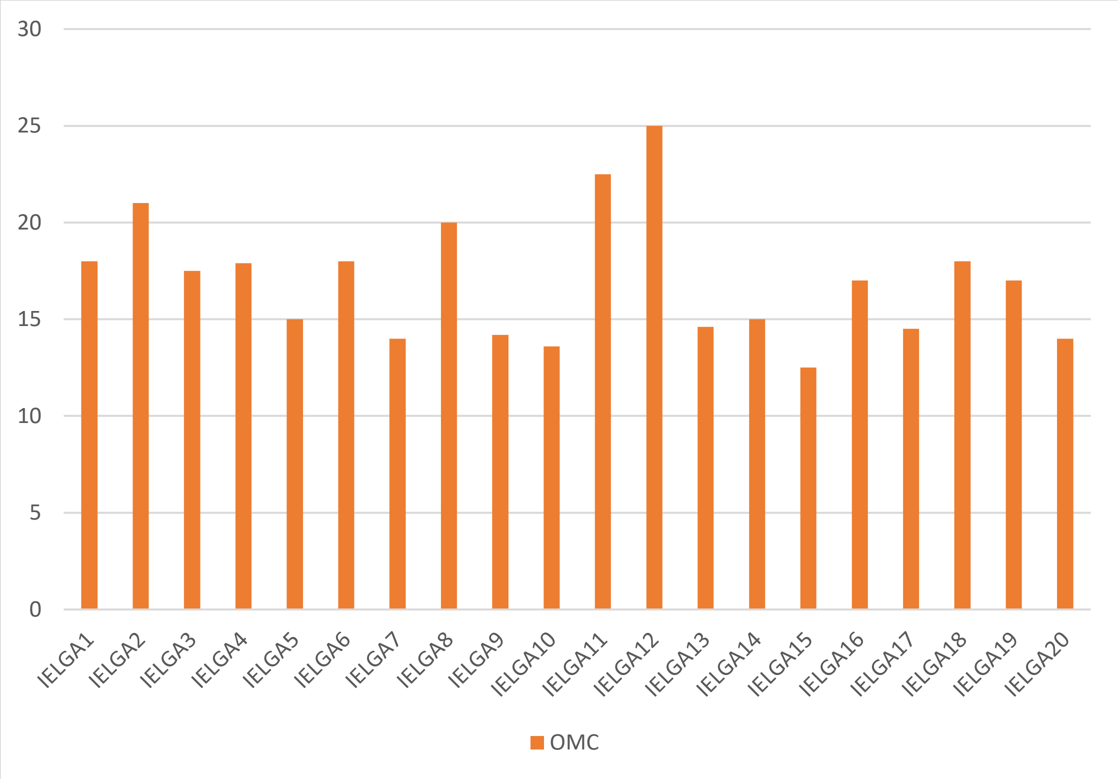

Fig. 2. Variation of MDD and OMC

4. CONCLUSION

Bearing capacity of soils in Ife East Local Government, Osun state, Nigeria have been investigated. In line with the set objectives, the following conclusions are made: all the soils are of A-2-4 class, majority are well graded sand (SW); the soils are all *c*-ϕ in nature; for each of the locations, square footing has the highest value of bearing capacity while strip footing has the lowest value, which confirms the fact that the values of bearing capacity are influenced by the nature of foundation soil and shape. and circular footing was found to have intermediate magnitude in all cases.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bowles JE. Foundation analysis and design, 5th ed. MC graw-hill companies, Inc. 1997;213.
2. Jeffrey RH, Andrew O. Solid Ground Measuring Soil Bearing Capacity; 2006. Available:<http://www.sciencebuddies.org/sciencefair-project/project-ideas/CE-p009.Shtml>8 March, 2021
3. Adunoye GO, Kareem SP, Odetola HM. experimental investigation on the bearing capacity of selected soils in ayedaade local government AREA, Osun State, Nigeria. International Journal of Civil Engineering, Construction and Estate Management. 2023;11(1):45-57.
4. Ayininuola GM, Ayodeji IO. Influence of sludge ash on soil shear strength. Journal of Civil Engineering Research. 2016;6(3):72-77.
5. Adeyemi AO, Amototo JO, Kaigama WB, Odeyemi SO. Determination of the ultimate bearing capacity of soils in offa community. Epistemics in Science, Engineering & Technology.2014;2 (4):168 – 174.
6. Adunoye GO, Agbede OA. Bearing capacity determination by multipleregression. Journal of Multidisciplinary Engineering Science and Technology. 2014;1(5):285 – 286.
7. Waghmare UN, Patil KA. Investigation of soil and bearing capacity in different site, IOSR Journal of Mechanical and Civil Engineering. 2012;3(4):37-43.

8. Alawode AA, Adunoye GO, Obitayo LO, Omisakin AO. Assessment of bearing capacity of soils in Ile-Ife, African Journal of Environment and Natural Science Research. 2020;3(5):10 – 20.
9. Muhammad IS, Alkali AM, Bulu K. Investigation of soil bearing capacity for building and structural foundation design: A case study of polo area, Maiduguri, Nigeria. Arid Zone Journal of Engineering, Technology and Environment. 2022; 18(1):15-22.
10. Adunoye GO, Kareem SP, Odetola HM. Experimental investigation on the bearing capacity of selected soils in; 2023.
11. Alawode AA, Adunoye GO, Obitayo LO, Omisakin AO. Assessment of bearing capacity of soils in Ile-Ife. African Journal of Environment and Natural Science Research. 2020;3(5):10-20.
12. BS 1377. 'Methods of test for soils for civil engineering purposes. Classification tests'; 1990.
13. Terzaghi K. Theoretical Soil Mechanics, Wiley, New York; 1943.
14. Das BM. Principles of geotechnical engineering, 7th ed. Cengage learning, USA; 2015.
15. Whitlow R. Basic soil mechanics. 3rd ed. Addison Wesley Longman Limited, Edinburgh Gate; 1995.
16. Jumikis RA. Soil Mechanics. D. van Nostrand company Inc; 1962.
17. Murthy VNS. Principles of soil mechanics and foundation engineering, UBS Publishers' Distributors Ltd., New Delhi; 2002.
18. Ayedaade Local Government Area, Osun State, Nigeria, International Journal of Civil Engineerring Construction and Materials, 11(1):45-57.
19. BS 1377-4: 1990. 'Methods of test for soils for civil engineering purposes. Compaction-related tests'; 1990.
20. BS 1377-7: 1990. 'Methods of test for soils for civil engineering purposes. Shear strength tests (total stress)'; 1990.
21. Terzaghi K, Peck RB. Soil mechanics in engineering practice, 2ed. John Wiley and sons, NY. 1967;729.

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