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Strength Properties of Commercially produces Sandcrete Blocks in Ado Ekiti, Akure and Ile Ife Nigeria

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ABSTRACT: *This study was carried out to investigate the strength properties of Sandcrete blocks in Ado-Ekiti, Akure and Ile-Ife, Nigeria. Eighteen commercially produced Sandcrete blocks were picked randomly from each of the selected states, three (3) blocks from each state. Also, soil samples were simultaneously obtained along with the blocks from each of the industries and transported to the laboratory in Akure. The tests carried out are sieved analysis, silt clay analysis and organic content tests on the soil samples. Bulk density determination, water absorption test and compressive strength of the individual blocks were done on the selected samples of Sandcrete blocks. Test results indicate that the aggregates are relatively suitable for block making. On crushing the Sandcrete blocks it was discovered that the compressive strength of the blocks are below the standard recommended by Nigerian Institute of Standards (NIS) 87.2000. The compressive strength of the individual blocks was between 0.310N/mm2 and 1.35N/mm2. A careful selection of the constituent materials and proper curing was suggested to improve the quality of commercial Sandcrete blocks.*

KEY WORD: *Sandcreteblocks, silt clay, Soil, Sieve, Compressive strength,*

I. INTRODUCTION

Sandcrete blocks are composite material made up of cement, sand and water, mould into different sizes (Barry 1969). It is widely used all over the world, including Ghana, and so on. The quality of blocks produced however, differs from each industry due to the different methods employed in the production and the properties of the constituent materials.Blocks are those building unit used in the construction of wall and partitions. They are produced in various sizes and weights; they can be easily handled by the bricklayer compared with brick. Sandcrete blocks are available for the construction of load bearing and non-load bearing structures (Hodge 1971). Load bearing blocks must conform to building by law as regard to their crushing and to the amount of solid mineral contained in section e.g. the total width of block. Sandcrete blocks also participate mainly in the task of transforming the actual load from the overlaying structural element to the foundation. In this case the load bearing wall are those walls acing as supports for the whole structure to transmit the weight to the ground surface underneath if for stability (N/S87:2000). Sandcrete blocks possess an intrinsic low compressive strength making them susceptible to any tragedy such as seismic activity.

For a long time in Nigeria, sandcrete blocks are manufacture in many parts of the country without any reference to suit local building requirements or good quality work (Oyekan&Kamiyo, 2008). Sandcrete blocks are the commonest and most masonry walling units in Nigeria. The most essential and expensive constituent of the block is cement needed to give acceptable quality required by various standards. (F.O.Okafor&Ewa, 2012).

The Word ‘Sandcrete has no standard definition; what most workers have done was to define it in a way to suit their won purpose. The word for it in some local dialect means brick earth and the name ‘Sandcrete is merely a translation solely to the use to which these blocks are put. Though sandcrete varies within wide limit one feature remains constant; the same amount of combined silica in proportion to the alumina present, and it is in this respect that sandcrete differ from days (Baiden and Tuuli 2004). It appears increasingly difficult to give a purely physical definition of sandcrete. Sandcrete covers a wide variety of aspects of tropical soil formation.In view of the fact that no general agreement has been reached on the definition and what materials should be classified as sandcrete, the trend at present is to lay emphasis on the grading i.e sieve analysis, specific gravity test and bulk density, without much regard for mode of formation, geological and geo-morphological condition. (Ezeji 1993).

II. PROBLEM STATEMENT

The recent conflict of building collapses in Nigeria building and construction has been dramatic. In an attempt to gain insight into the problems associated, the study explores the question of the extent to which quality sandcrete blacks are produced. In order to clarify these problems the study is directed toward testing the

strength ofsandcrete blocks; to see whether sandcrete blocks can be improved to achieve good quality of sandcrete blocks in the building and construction industry.

2.1 Project Objectives

As a result of these considerations, an attempt will be made to explore soil properties and determine the strength of commercially produced concrete blocks in three selected location i.e. Akure, Ado-Ekiti and Ile-Ife.
In order to achieve these objectives, the study attempted to:

1. To determine the bulk densities of the different blocks obtained from different industries. This is important because the more closely packed the particles are, the higher the density of the materials.
2. To determine the weight of water a block unit absorbs when immersed in water at normal day temperature for a stated duration of time. The absorption rate is defined as the weight of water absorbed when the unit is immersed/min in water.
3. To determine the compressive strength of each of the block units when they have completely cured and are in city state. The compressive strength is defined as the ability of a unit block to withstand an axially applied load whether on the edge or bed face of the block.

2.2 Justification

In the last couple of years, the construction industry has witnessed a high level of criticism and controversies over the issue of building all over the country. The critical problem is the issue of using of sub-standard building materials and applied construction method or process. Although some contractors and engineers use the approved standard laid down in the British and Nigerian institutes codes, other deviate from this largely due to their own selfish aim for the purposes of maximizing their profit to use sub-standard materials in construction projects. As much as economical use of materials is important, it is noteworthy that the safety of structures remains the most important. It is noteworthy that the safety of safety of structures remains the most important. It is noteworthy that the safety of structures choice or otherwise of consecution materials.

III. MATERIALS AND METHODS

The research methodology is designed specifically to determine how to improve commercially produced sandcrete blocks for construction industry. Samples of sandcrete blocks industries were selected from Ile-Ife, Akure and Ado-Ekiti.

3.1 The Sample

This research project employs the random probability cluster sampling technique. In cluster sampling, the population is divided into segments from each of which a sample is chosen. The advantage of random sampling technique is that precision is not necessarily lost by observing less than the complete population. This saves labour and computing time and cost. In random sampling every possible individual in a sample of a given size has exactly the same chance of being chosen. However sampling errornmay occur if only a fraction of the population has been observed. Although different samples give different results, sampling errors become less important as sample size increases. Non-sampling errors may arise if the sampling procedure is not a representative of the total population. Such errors do not necessarily decrease as sample number increases. Before the sandcrete blocks selection from the blocks industries, their names and address were unavailable until the actual selection from them was done randomly. These were approached and the sample blocks (three from each) manufacturer was bought and sand sample was also taken from each block industry without disclosing the objective to them. The Sandcrete blocks firms selected were in Akure, while the others are in Ado-Ekiti and Ife respectively. It would be observed that all these are within the same geographical location and are exposed to similar environmental conditions.

3.2 Experimental Procedure

The test types conducted on the block samples ere of two types; the first was on the fine aggregates collected from the block molding industries and the other test was on the Sandcrete blocks. The tests carried out using the natural sand samples from the block production industries are as follows:

1. Grading by sieve analysis
2. Silt/clay content analysis, and
3. Organic content analysis

Three blocks from each block industry, eighteen (18) blocks from each of three states.

3.2.1 ***Fine Aggregates Testing***

3.2.1.1 Sieve Analysis

The experiment was undertaken for each sand sample collected from each of the industries. The samples were spread out in the sun to dry for a period of 24 hours before the actual test was carried out. The experiment was carried out using the sieve sizes for grading purposes according to BS882 (16). One kilogram of each of the sample was weighted using digital weighing apparatus. Empty pan was first weighed and the reading on the weighing machine was adjusted to zero in order to include the pan's weight. The pan was later removed and filled with sand. For each sample it was weighed again and the weight recorded. Some amounts of sand was removed or added depending on whether the weight recorded was below or above required. The outlined procedure for sieve analysis is found in BS 812(16).

Silt clay content Test

In accordance to BS 812 (16 and 18), 1 litre measuring cylinder washed in each case, cleaned and dried. 50ml of a 1% sodium chloride (NaCl) solution was then poured into the 250ml BS measuring cylinder. Sand is then added to reach the 100ml mark and more solution of the salt added, and the cylinder filled up to the 150ml for their total volume. The addition of sodium chloride was for it to act as a catalyst for silt separation from sand. Each cylinder is then hand-covered tight and shaken rigorously for about 15minutes vigorously after which the mixture was left to stand for 3 hours. The appearance of a clear solution (or clear yellow solution) signifies a completion to the test. The silt which became dispersed on shaking will now settle in a layer can be expressed as a percentage of the height of the sand below (Neville, 2000).

3.2.1.3 Organic Content Test

A solution of sodium hydroxide (NaOH) was used for this test. One transparent and clean cylinder was filled with the soil sample in each case, and reasonable quantity of the sodium hydroxide (NaOH) solution was added. The cylinder was covered tightly with the hand, shaken vigorously for about five (5) minutes and allowed to stand for 24hours. The presence of organic matter is indicated by discoloration of the resulting suspension that would be on sand. Presence of acids is revealed by the formation of a reddish brown or darkish red solution. The best result would be a clear yellow solution which indicates sand that is suitable for construction. A darker coloration than the clear yellow may not be harmful (Neville, 2000).

3.2.2 Sandcrete blocks testing

3.2.1.1 Bulk density determination

Each sample of the blocks that were acquired from different block production industries for the test purpose was labeled and numbered, and they were each weighed in their dry states; during which their masses was read and recorded. The mass scale used was of 50kg capacity and has 500g graduations. The dimensions i.e the length, breadth and height of each block were then taken from this, the volume, and thereafter, the bulk densities were calculated using the results.

3.2.2.2 Water Absorption

Each sample of the purchased blocks, whose weights had been taken in the dry state and noted, was then fully immersed in water. The time taken for full immersion was noted, and period of twenty-four (24) hours was allowed to elapse. After the 24hours, the wet block samples were the removed and weighed. The difference between the dry and wet weights of each block was the calculated by subtracting the dry weight from the wet weight. From this the water absorption capacity can then be expressed as a percentage i.e.

$$\frac{\text{Wet Weight (Ww)} - \text{dry Weight } (W_D)\ X100\%}{\text{Volume of Block } (V_B)}$$

3.2.2.3 Compressive Strength

For the compressive strength test, the compression testing machine was used. Twenty –four (24) samples of the labeled blocks produced from the different block industries were crushed in order to obtain the crushing loads. From the compressive loads, and with the gross sectional area of the blocks know; the compressive strength of each block was then calculated.

IV. RESULTS AND DISCUSSION

4.1.1 Sieve Analysis

The results for the sieve analysis are shown is TableM

	Sieve size(mm)	5.00	3.35	2.00	1.18	0.85	0.60	0.425	0.3	0.150	0.075	PAN
S/No	Location of block industry			Percentage finer (%)								
1	Ilara-Mokin	98.46	97.46	95.09	88.09	80.19	64.64	36.71	15.94	11.95	1.23	0.68
2	Oda RoadAkure	95.98	92.81	84.58	70.68	62.59	52.84	43.32	35.86	21.25	7.35	0.00
3	Road Block Junction Akure	96.11	93.01	85.02	71.45	63.58	54.06	43.77	36.49	22.23	8.76	0.55
4	Ijare-Elewe obi, Akure	99.90	99.09	95.84	86.82	78.13	64.64	49.25	36.14	19.67	11.08	0.08
5	Akure south Local Govt. Area Akure	97.90	96.25	90.83	82.47	67.48	51.62	36.44	20.71	12.83	5.52	0.03
6	Aliu Street, Ijoka, Akure	97.63	90.87	75.02	61.26	53.25	42.77	29.69	20.33	11.67	2.93	0.00
7	Odo-AdoAdo-Ekiti	99.69	98.53	92.49	88.85	62.85	44.03	25.53	12.84	5.80	1.88	0.02
8	Agric RoadOpp Gate	95.34	93.50	88.81	81.58	73.27	66.48	49.07	33.69	24.33	14.84	0.41
9.	Iworo Rd Adebayo, Ado Ekiti Ado-Ekiti	98.02	94.11	79.05	56.62	45.08	34.54	27.13	20.74	6.48	0.00	0.00
10.	Coca-colaAjilosun, Ado-Ekiti	96.55	94.88	91.94	86.29	78.98	64.17	40.08	21.63	4.40	1.72	0.02
11.	Poly Road Ado-Ekiti	98.05	95.12	87.59	78.17	67.19	56.11	42.03	31.96	20.70	11.26	8.09
12	Irona AreaAdo-Ekiti	95.88	91.29	85.61	79.51	69.89	59.89	46.59	30.18	20.2	11.33	0.00
13	IyanaIgboya, Ile-Ife	98.11	93.85	82.34	66.00	55.10	43.60	33.95	27.42	13.40	2.80	0.00
14	Eleyele Ile-Ife	95.89	92.45	85.09	76.12	63.91	52.76	42.06	31.07	21.78	10.25	0.00
15	Arugbidi Deeper life Ile-Ife	93.45	86.99	78.21	68.12	57.13	46.91	36.88	27.50	17.68	7.66	0.08
16	Phase 2 Teaching Hospital Ile-Ife	99.24	96.57	91.28	80.26	62.58	55.32	41.36	29.53	14.21	12.03	0.00
17	Aladanla, Ile-Ife	96.51	94.83	92.45	87.89	61.81	54.03	46.20	26.15	13.89	4.32	0.02
18	Opa Bus-Stop Ile-Ife	98.18	95.31	90.95	83.55	69.03	52.46	39.48	27.62	12.45	6.52	0.06

4.1.2 Silt/clay content test

The table below shows the result of the silt/clay content test

S/No	Location of lock industry	Height of sand (mm)	Height of silt/clay(mm)	Height of silt x 900% Height of sand
1	Ilara-MokinAkure	98.5	0.5	0.51
2	Oda Road, Akure	94.0	5.0	5.32
3	Road Block Junction Akure	91.5	6.0	6.56
4	Ijare-Elewe-ObiAkure	89.5	9.0	10.05
5	Akure South Local Govt	95.5	3.0	3.14
6	Aliu street Ijoka, Akure	96.5	2.5	2.59
7	Odo-Ado, Ado-Ekiti	97.5	2.0	2.05
8	AgricRoad OppChurch Ado-Ekiti.	84.5	13.0	15.39
9	Iworoko Road, Adebayo, Ado-Ekiti	97.5	1.0	1.02
10	Coca-colaAjilosun Ado-Ekiti	98.0	1.0	1.02
11	Poly Road Ado-Ekiti	87.5	9.5	10.86
12	Irona Area, Ado-Ekiti	87.0	9.5	10.91
13	IyanaIgboya, Ile-Ife	97.0	1.5	1.55
14	Eleyele, Ile-Ife	88.5	9.0	10.17
15	Arugbidi, Deeper life, Ile-Ife	85.0	12.5	14.7
16	Phase 2 Hospital, Ile-Ife	85.0	12.5	14.7
17	Aladanla, Ile-Ife	95.5	2.0	2.09
18	Opa Bus Stop Ile-Ife	93.5	5.0	5.35

On examining Table results above, it is seen that soil samples whose ratio of silt/clay to sand exceeds the maximum specification of Bs 882 1992 are samples 3,4,8,11,12,14,15 and 16, with percentages being 6.56%, 15.39%, 10.86%, 10.91%, 10.17% and 14.7%. the presence of silt/clay in this high percentage would affect such properties as the affinity for water and thus, promote rapid evaporation upon drying that would leave numerous pores and thus produce a weaker block (Neville, 2000) With this the initial and final setting times are affected and strength therefore will be affected. Local stresses, which affect shrinkage crackingare also increased due to the incineration of clay to expand on absorbing water. As stated in BS 3148.

4.1.3 Organic Content Test

The result for the organic analysis are shown in table O below

Table NOrganic Content analysis of soil samples

Sample No	Location of Block Industry	Test Result
1	Ilara-Mokin, Akure	Clear solution
2	Oda Road, Akure	Clear solution
3	Road Block Junction	Clear solution
4	Ijare-Elewe-Obi, Akure	Slightly Coloured solution
5	Akure South Local Govt. Office, Akure	Clear solution
6	Aliu Street, Ijoka, Akure	Clear solution
7	Odo-Ado, Ado-Ekiti	Coloured solution
8	Agric Road, Opp church gate Ado-Ekiti	Slightly coloured solution
9	Iworoko Road, Adebayo, Ado-Ekiti	Clear solution
10	Coca-cola, Ajilosun, Ado-Ekiti	Clear solution
11	Poly Road, Ado-Ekiti.	Clear solution
12	Irona Road, Ado-Ekiti.	Clear yellow solution
13	IyanaIgboya, Ile-Ife	Clear solution
14	Eleyele, Ile-Ife	Clear solution
15	Arugbidi, deeper life,m Ile-Ife	Clear solution
16	Phase 2 teaching Hospital, Ile-Ife	Slightly coloured solution
17	Aladanla, Ile-Ife	Clear solution
18	Opa Bus-stop, Ile-Ife	Clear yellow solution

Nearly all the samples gave a clear solution except for samples 4, 8 and 16 that gave a slightly coloured solution, and 7 that gave a coloured solution, a clear solution indicates the absence of acids, organic materials and other chemical compound that might affect the strength of the blocks. Thus, from the test results, a slightly quantity of these unwanted materials could have been in samples 4, 8 and 16, and a more considerable amount in soil sample 7.

4.2.1 Bulk Density

The test results for the determination of the bulk densities of the sandcrete blocks in accordance with (BS 2028 96) is shown in table 4.4 below.

Table O Bulk densities of sandcrete blocks from Akure

Location of Block industry	Block No	Actual Volume of Block $(m)^3$	Weight of Dry Block before Immersion (kg)	Weight of Block after immerse	Change weight (9kg)	Bulk density (kg/m^3)	Averse Bulk density (kg/m^3)
Ilara-Mokin Akure	1	0.0078975	16.90	18.10	1.20	2139.92	2174.53
	2	0.0078975	17.42	10.92	1.50	2205.76	
	3	0.0078975	17.20	18.50	1.30	2177.90	
Oda Road, Akure	4	0.0078975	17.10	18.20	1.10	2165.24	2198.16
	5	0.0078975	17.58	18.93	1.35	2226.02	
	6	0.0078975	17.40	18.65	1.25	2203.23	
Road Block Junction Akure	7	0.0078975	16.70	17.80	1.10	2114.59	2243.75
	8	0.0078975	17.12	18.60	1.50	2167.78	
	9	0.0078975	17.25	18.90	1.65	2184.24	
Ijare Elewe Obi, Akure	10	0.0078975	17.90	19.20	1.30	2266.54	2243.75
	11	0.0078975	17.86	19.11	1.25	2261.48	
	12	0.0078975	17.40	18.40	1.00	2203.23	
Akure South Local Govt Akure.	13	0.0078975	17.75	18.60	0.85	2247.55	2247.55
	14	0.0078975	18.00	19.06	1.06	2279.20	
	15	0.0078975	17.50	18.30	0.80	2215.89	
Ijoka, Akure	16	0.0078975	17.65	19.15	1.50	2234.89	2241.64
	17	0.0078975	17.36	18.69	1.33	2198.16	
	18	0.0078975	18.10	19.80	1.70	2291.87	

Table P Bulk densities of Sandcrete blocks from Ado-Ekiti.

Location of Block industry	Block No	Actual Volume of Block $(m)^3$	Weight of Dry Block before immersion (kg)	Weight of Block after immersion (kg)	Change weight (9kg)	Bulk density (kg/m^3)	Averse Bulk density (kg/m^3)
Odo-Ado Ado-Ekiti	1 2 3	0.0078975 0.0078975 0.0078975	16.65 16.80 17.10	18.10 1.60 18.90	1.45 1.60 1.80	2108.26 2127.26 2165.24	2133.59
Agric Road, Opp Church Ado-Ekiti	4 5 6	0.0078975 0.0078975 0.0078975	17.00 17.20 17.80	18.65 19.00 19.85	1.65 1.80 2.05	2152.58 2127.26 2165.24	2194.79
Iworoko Road, Opp church Ado-Ekiti	7 8 9	0.0078975 0.0078975 0.0078975	17.85 17.60 18.02	18.90 18.60 18.22	1.05 1.00 1.20	2260.21 2228.55 2281.73	2256.83
Coca-cola, Ajilosun Ado-Ekiti	10 11 12	0.0078975 0.0078975 0.0078975	17.00 16.40 16.85	18.80 17.80 18.40	1.80 1.40 1.55	2152.58 2076.61 2133.59	2120.93
Poly Road, Ado-Ekiti	13 14 15	0.0078975 0.0078975 0.0078975	17.50 17.80 17.85	17.67 19.00 19.10	1.17 1.20 1.25	2215.89 2253.88 2260.21	2242.33
Irona Road, Ado-Ekiti	16 17 18	0.0078975 0.0078975 0.0078975	17.10 16.60 16.45	18.85 18.20 18.00	1.75 1.60 1.55	2165.24 2101.93 2082.93	2116.70

Table Q Bulk densities of Sandcrete blocks from Ile-ife.

Location of Block industry	Block No	Actual Volume of Block $(m)^3$	Weight of Dry Block before immersion (kg)	Weight of Block after immersion (kg)	Change weight (9kg)	Bulk density (kg/m^3)	Averse Bulk density (kg/m^3)
Iyanaigboya, ile-ife	1 2 3	0.0078975 0.0078975 0.0078975	17.50 18.00 17.80	18.90 19.80 19.35	1.40 1.80 1.55	2215.89 2279.20 2253.88	2249.66
Eleyele, Ile-Ife	4 5 6	0.0078975 0.0078975 0.0078975	17.70 17.55 17.32	19.00 18.65 18.32	1.30 1.10 1.00	2241.22 2222.22 2193.10	2194.79
Arugbidi, Deeper-life Ile-Ife	7 8 9	0.0078975 0.0078975 0.0078975	17.43 17.60 17.90	18.68 19.10 19.60	1.25 1.50 1.70	2207.03 2227.85 2266.54	2233.81
Phase Teaching Hospital Ile-Ife	10 11 12	0.0078975 0.0078975 0.0078975	18.10 18.20 18.00	19.65 20.00 19.50	1.55 1.80 1.50	2291.86 2303.80 2279.20	2291.62
Aladanla, Ile-Ife	13 14 15	0.0078975 0.0078975 0.0078975	17.75 18.10 17.80	18.95 19.40 19.00	1.20 1.30 1.20	2247.55 2291.14 2253.88	2264.19
Opa, Ile-Ife	16 17 18	0.0078975 0.0078975 0.0078975	17.50 17.60 17.20	18.80 19.00 18.30	1.30 1.40 1.10	2215.89 2227.85 2177.90	2207.21

The results above show that bulk densities of the blocks exceeded the BS 2028(7) minimum limit of 1920Kg/m^3 for individual block and 2020kg/m^3 for an average of three (3) blocks. The least bulk density being sample 11 from Ado-Ekiti of 2076.61kg/m^3 and the highest being from Akure having a bulk density of 2291kg/m^3 samples from Akure and a highest average of bulk densities being 2291kg/m^3 is being for samples for Ado-Ekiti. This reveals proper compaction which is within acceptable limits.

4.2.2 Water Absorption

The test results of the water absorption capacities of the sandcrete blocks samples as determined from the immersion are shown in Table R, Table S and Table T.

Table R Water Absorption capacities of blocks from Akure

Location of Block industry	Block No	Actual volume of Block Material V_B (m^3)	Weight of Dry Block before immersion (kg)	Weight of Block After Immersion (Ww) (kg)	Change weight (W_w-W_D) (kg)	Water Absorption $\frac{Ww - WD}{VB}$ (kg/m^3)
Ilara-MokinAkure	1	0.0078975	16.90	18.10	1.20	151.95
	2	0.0078975	17.42	18.92	1.50	189.93
	3	0.0078975	17.20	18.50	1.30	164.61
Oda-Road, Akure	4	0.0078975	17.10	18.20	1.10	139.29
	5	0.0078975	17.58	18.93	1.35	170.94
	6	0.0078975	17.40	18.65	1.25	158.28
Road Block junction, Akure	7	0.0078975	16.70	17.80	1.10	139.29
	8	0.0078975	17.12	18.60	1.50	189.93
	9	0.0078975	17.25	18.90	1.65	208.93
IjareElewe-Obi Akure	10	0.0078975	17.90	19.20	1.30	164.61
	11	0.0078975	17.86	19.11	1.25	158.28
	12	0.0078975	17.40	18.40	1.00	126.62
Akure south Loca Govt. Akure	13	0.0078975	17.75	18.60	0.85	107.63
	14	0.0078975	18.00	19.06	1.06	134.22
	15	0.0078975	17.50	18.30	0.80	101.30
Ijoka, Akure	16	0.0078975	17.65	19.15	1.50	189.93
	17	0.0078975	17.36	18.69	1.33	168.41
	18	0.0078975	18.10	19.80	1.70	215.26

Table S Water Absorption capacities of blocks from Ado-Ekiti

Location of Block industry	Block No	Actual volume of Block Material V_B (m^3)	Weight of Dry Block before immersion (kg)	Weight of Block After Immersion (Ww) (kg)	Change weight (W_w-W_D) (kg)	Water Absorption $\frac{Ww - WD}{VB}$ (kg/m^3)
Odo Ado-Ekiti	1	0.0078975	16.65	18.10	1.45	183.60
	2	0.0078975	16.80	18.40	1.60	202.60
	3	0.0078975	17.10	18.90	1.80	227.92
Agric Road, Opp Church, Ado-Ekiti	4	0.0078975	17.00	18.65	1.65	208.93
	5	0.0078975	17.20	19.00	1.80	227.92
	6	0.0078975	17.80	19.85	2.05	259.58
Iworoko Road, Adebayo, Ado-Ekiti	7	0.0078975	17.85	18.90	1.05	132.95
	8	0.0078975	17.60	18.60	1.00	126.62
	9	0.0078975	18.02	19.22	1.20	151.95
Coca-cola, Ajilosun Ado-Ekiti	10	0.0078975	17.00	18.80	1.80	227.92
	11	0.0078975	16.40	17.80	1.40	177.27
	12	0.0078975	16.85	18.40	1.55	196.27
Poly Road Ado-Ekiti	13	0.0078975	17.50	17.67	1.17	148.15
	14	0.0078975	19.00	19.00	1.20	151.95
	15	0.0078975	19.10	19.10	2.25	158.28
Irona Road, Ado-Ekiti.	16	0.0078975	17.10	18.85	1.75	221.60
	17	0.0078975	16.60	18.20	1.60	202.60
	18	0.0078975	16.45	18.00	1.55	196.27

Table T Water Absorption capacities of blocks from Ile-Ife

Location of Block industry	Block No	Actual volume of Block Material V_B (m^3)	Weight of Dry Block before immersion (kg)	Weight of Block After Immersion (Ww) (kg)	Change weight (Ww-W_D) (kg)	Water Absorption $\frac{Ww - WD}{VB}$ (kg/m^3)
Iyana Igboya Ile-Ife	1	0.0078975	17.50	18.90	1.40	177.27
	2	0.0078975	18.00	19.80	1.80	227.92
	3	0.0078975	17.80	19.65	1.55	196.27
Eleyele, Ile-Ife	4	0.0078975	17.70	19.00	1.30	164.61
	5	0.0078975	17.55	18.65	1.10	139.29
	6	0.0078975	17.32	18.65	1.00	126.62
Arugbidi, Deeper life Ile-Ife	7	0.0078975	17.43	18.32	1.25	158.28
	8	0.0078975	17.60	18.68	1.50	189.93
	9	0.0078975	17.90	19.60	1.70	215.26
Phase 2 Teaching Hospital, Ile-Ife	10	0.0078975	18.10	19.65	1.55	196.27
	11	0.0078975	18.20	20.00	1.80	227.92
	12	0.0078975	18.00	19.50	1.50	189.93
Aladanla, Ile-Ife	13	0.0078975	17.75	18.95	1.20	151.95
	14	0.0078975	18.10	19.40	1.30	164.61
	15	0.0078975	17.80	19.00	1.20	151.95
Opa, Ile-Ife	16	0.0078975	17.50	18.80	1.30	164.61
	17	0.0078975	17.60	19.00	1.40	177.27
	18	0.0078975	17.20	18.30	1.10	139.29

The water absorption capacities for all the blocks reveals that almost all the sandcrete blocks were lower than the maximum limit recommended in ASTMC (140) of 240kg/m^3 except sample 6 from Ado-Ekiti that had a water absorption capacity of 259.58.The others were low enough from the maximum limit; while samples 2 and 9 from Ile-Ife, samples 3, 10 and 16 from Ado-Ekiti and samples 18 from Akure were within close range to 240kg/m· Thus, these later mentioned samples are only slightly satisfactory for standard recommendation and samples 6 from Ado-Ekiti is not fit for use. The reason for this high absorption is probably due to high percentages of fines.

4.4.3 Compression Strength

The results of the tests performed on the sandcrete blocks to determine the compression strengths are as shown in Table U, Table V and Table W below

Table U Compressive strengths of sandcrete blocks from Akure

Location of Block industry	Block No	Surface area of block material	Crushing load (KN)	Compression strength of blocks (N/mm^2)	Mean compressive strengths (N/mm^2)
Ilara-MokinAkure	1	35100	18.5	0.53	0.656
	2	35100	14.0	0.40	
	3	35100	36.7	1.04	
OdaRoaAkure	4	35100	16.5	0.47	0.40
	5	35100	13.3	0.38	
	6	35100	12.5	0.36	
Road Block Junction, Akure	7	35100	28.0	0.08	0.96
	8	35100	47.3	1.35	
	9	35100	26.0	0.74	
IjareElewe-Obi, Akure	10	35100	16.6	0.47	0.52
	11	35100	20.0	0.57	
	12	35100	18.6	0.53	
Akuresouh Local Govt. Akure.	13	35100	11.0	0.31	0.41
	14	35100	13.9	0.40	
	15	35100	18.0	0.51	
Ijoka ,Akure	16	35100	15.2	0.43	0.6
	17	35100	26.4	0.75	
	18	35100	21.6	0.62	

Table V. Compressive strengths of sandcrete blocks from Ado

Location of block industry	Block No	Surface Area of block material	Crushing load (KN)	Compressive strength of block (N/mm2)	Mean compressive strengths (N/mm^2)
Odo-Ado,	1 2 3	35100 35100 35100	11.1 18.4 15.3	0.32 0.52 0.44	0.43
Agric Road, Ado-Ekiti.	4 5 6	35100 35100 35100	17.2 13.2 21.4	0.49 0.38 0.61	0.49
Iworoko Road, Ado-Ekiti	7 8 9	35100 35100 35100	21.4 21.4 29.0 18.1	0.83 0.52 0.57	0.64
Coca-cola, Ado-Ekiti	10 11 12	35100 35100 35100	20.1 28.2 34.2	0.57 0.80 0.97	0.78
Poly Road, Ado-Ekiti	13 14 15	35100 35100 35100	13.0 14.7 19.4	0.37 0.42 0.55	0.45
Irona Road, Ado-Ekiti	16 17 18	35100 35100 35100	25.3 19.6 30.2	0.72 0.56 0.86	0.71

Table W. Compressive strengths of sandcrete blocks from Ile-Ife

Location of block industry	Block No	Surface Area of block material	Crushing load (KN)	Compressive strength of block (N/mm2)	Mean compressive strengths (N/mm^2)
IyanaIgboya, Ile-Ife	1 2 3	35100 35100 35100	29.2 21.4 16.5	0.83 0.61 0.47	0.64
Eleyele, Ile-Ife	4 5 6	35100 35100 35100	11.4 17.5 13.0	0.32 0.50 0.37	0.40
Arubidi, Ile-Ife	7 8 9	35100 35100 35100	14.2 13.0 18.2	0.41 0.37 0.52	0.43
Phase Hospital, Ile-Ife	10 11 12	35100 35100 35100	38.4 21.6 28.9	1.09 0.62 0.82	0.84
Aladanla, Ile-Ife	13 14 15	35100 35100 35100	19.3 32.3 16.1	0.55 0.92 0.46	0.64
Opa Bus-stop Ile-Ife	16 17 18.	35100 35100 35100	18.4 39.2 26.4	0.52 1.12 0.75	0.80

The results from the test above are an indication that the compressive strength of the individual sandcreteblocks range between $0.31N/mm^2$ and $1.35N/mm^2$. These compressive strengths fall far below that which is recommended by Nigerian industrial Standard (NIS 87:2000) for individual block which it stipulates should be $2.5N/mm^2$; BS 2028 recommends that the compressive strength of five (5) blocks shall not be less than $3.25N/mm^2$ it is observed from the results that the highest strength attained for individual blocks is $1.35N/mm^2$ for sample 8 Akure. The average compressive strength for three (3) blocks had a highest value $0.96N/mm^2$ and $0.40N/mm^2$ for the least compressive strength. The manner in which these compressive strengths vary for each block for an industry for some of the industries indicate poor quality control.

V. CONCLUSIONS

This study has shown that the compressive strength of sandcrete blocks in circulation in Ado-Ekiti, Ile-Ife and Akure, Nigeria is very low with a high degree of variability. On the bases of observation and control tests the poor quality has been associated with the selection of poor quality sand, poor mix, 100 level of compaction, inadequate currying methodology and lack of technical knowledge of the producers. Since the control tests showed better results as compared to specified values, it is thereforerecommended that for better block production, issues relating to sand cement mix ratio, sand selection, and level of compaction and curring processes should be adequately addressed. The sand must be tested to be of the appropriate quality (slit and organic contents) before being used to produce sandcrete blocks. The aggregate grading of the soils used for the manufacture of sandcrete blocks are within the limit specified by BS882 1992 and therefore suitable for block making. The compressive strength of the sandcrete blacks was for to be below standard.The compressive strength of individual block tested was between0.31N/mm^2 and 1.35N/mm^2. The study suggested improvement on the selection of materials and curing.

VI. RECOMMENDATIONS

From the conclusions, the following recommendations are apt.

1) Improved curing practice, use of appropriate method of curing and maintaining the moulding moisture content of at least seven days should be enforced by NSE and COREN on the block producers.
2) Constant training should be provided by the Government in collaboration with COREN to the block makers demonstrating the improvement in block quality resulting from good curing practice.
3) The presence of cracks in walls of buildings is widely believe to be an indication of poor quality of blocks which will eventually result to building structural failure or worse still building collapse as is being experienced in Nigeria over the years (Anosike, 2011). To improve on the situation, it is suggested that the Federal Government of Nigeria should empower the NIS to enforce the sanctions on violators as this will serve as a deterrent to others.
4) Furtherance to any change in price of cement random crushing test should be conducted for the blocks samples in circulation to know the effect of the price changes on the compressive strength of the blocks.
5) Structural engineer should be encouraged to carry out more research on the methodology of sandcrete block production and to produce more paper on the topic.
6) Effective supervision must be exercisedon theproduction site to ensure these of appropriate mix ratio and adherenice to right compaction time. Government should enforce it in the manufacturers, stating the penalty of noncompliance with the rule.
7) Government should also assign some ministry Engineers on compulsory and impromptu visitation to all the block factories to give room for effective compliance with the instruction.
8) Correct use of simple testing procedures outlined in this paper should be employed prior to any change in the type of sand used. It will allow the most appropriate use of the available materials and identify unsuitable sand that should not be used.
9) The minimum sand/cement mix ratio recommended in this paper for the production of sandcrete blocks is 1:12 provided the blocks are well compacted and properly cured for 28days using water cement ratio of 0.6 andprovided that all the above outlined recommendations are properly followed.

Thus good quality control should be continuously exercised on the curing practice, production methodology, Sand/Cement mix ratio, sand selection and the level of compaction cost for the block producers.

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