



CHARACTERISTIC OF HOLLOW SANDCRETE BLOCKS IN KADUNA SOUTH LOCAL GOVERNMENT AREA

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Abstract

Characteristic of hollow sandcrete blocks of some selected block producer in Kaduna south local government area. A total of five (5) block producers were visited and aggregates used in the production of sandcrete block collected, a total of 5 blocks per producer was collected and transported to the laboratory of Airforce Institute of Technology where it was cured for a total of 14 days. The test carried out on the aggregates used for the production of sandcrete blocks includes: sieve analysis, specific gravity and bulk density. And the test conducted on the sandcrete blocks includes Dimension and compressive strength test. The mix composition of each of the block producer was also determined. The test result obtained from the physical properties of sand from the various block producers revealed that sand used by the selected block producers in Kaduna state do comply with the specified standard of grading of aggregates, the mix proportion used by the selected block producers is generally between one part of cement to twelve or sixteen parts of sand by volume (1:12 or 16), In terms of dimension, most of the blocks did not meet up the required dimension, the average compressive strength of the blocks ranged from 0.18 N/mm² to 0.44 N/mm². The study confirmed that mix ratio, quality, and mixing of the constituent materials affected the quality of sandcrete blocks.

Keywords: *sand, Sandcrete Blocks, Compressive Strength, Material Composition, Curing*

Introduction

Sandcrete blocks are results of fine aggregate, Portland cement and water in a recommended blend proportion extent. The strength of sandcrete blocks rely on

two main considerations, specifically: blend extent (mix ratio) and curing method (Aiyewalehimi and Tanimola, 2013). Different elements incorporate the nature of the constituents utilized and the method of production (manual and machine) as indicated by NIS 87 (2000). The nature of blocks produced varies with one maker then onto the next because of various techniques or ways utilized in the creation and properties of the constituent materials.

Ajibola Ibrahim Quadri et al (2020) stated that Previous works of research have indicated that quality standards are being ignored by actors in Nigerian Construction industry, and as such investigated and reported the strength properties of sandcrete blocks produced in Akinyele Local Government Area of Oyo State, Nigeria. Where they found out that the compressive strength of all the blocks was below standard requirement as their values range between 0.22 N/mm^2 and 0.46 N/mm^2 for the (9") blocks, 0.3 N/mm^2 , and 0.6 N/mm^2 for the (6") blocks. They concluded that sandcrete blocks from the selected industries in the Local Government Area did not meet 2.1 N/mm^2 , which is the minimum strength required for non-load bearing walls. Therefore, they should not be used as non-load bearing units. They recommended that professional bodies and government agencies responsible for quality assurance of building units should enforce compliance of block industries with the minimum required specifications.

It is as a result that this study aims to investigate the characteristic of hollow sandcrete blocks in Kaduna south local government area which has coordinates $10^{\circ}28'4.80''\text{N}$ $7^{\circ}25'15.60''\text{E}$. The total land area is 46.2 km^2 . It is located at the northern part of Nigeria.

Literature Review

Aderibigbe et al (2017) researched determine properties of sandcrete hollow blocks produced by block industries in Nigeria, particularly in Idah, Kogi State by assessing the compressive strength and water absorption properties of sandcrete block from four different producers, The test results revealed that the fine aggregates used are suitable for block making. Test results also indicate that the least unit compressive strength of the 150mm (6") sandcrete blocks was 0.99N/mm^2 while the average compressive strength of the blocks (150mm) blocks was 1.12 N/mm . Similarly, the least unit compressive strength of the 225mm (9") sandcrete blocks was 0.63N/mm^2 while the average compressive strength of the 225mm (9") blocks was 0.94 N/mm^2 these values fall below the standard prescribed for load bearing sandcrete blocks.

The mechanical properties of sandcrete block greatly influenced the durability of structures built from it, the study carried out by Akpokodje et al (2021) assessed the compressive strength of sandcrete blocks produced in two major developmental and rapidly urbanizing zones of Delta State, Nigeria. Where 6'' and 9'' sandcrete blocks were sampled from 18 blocks moulding factories in Ndokwa East and Ughelli North Local Government Areas of Delta State, Nigeria. The results of compressive strength test showed that the compressive strengths of the blocks, regardless of the block size ranged from 0.61 to 16.19 MPa. Analysis of the results revealed that apart from the customized blocks, the compressive strengths of all the other blocks fell below the Nigerian Industrial Standard (NIS) recommendations of 2.5 MPa for non-load bearing walls.

Investigation carried out by O.S. Oladeji and O.A. Awos (2013) showed that the grading curves obtained from the representative soil samples used in the production of sandcrete blocks contains wide range of grain sizes. The ranges of values obtained for compressive strength are 0.26 - 1.62 N/mm² and 0.35 - 1.66 N/mm², for 6- and 9-inches blocks respectively, compared to the required regulatory standard of between 2.5 and 3.45 N/mm². Factors which include profit orientation, mix ratio, period of curing, and level of literacy, appear to have been responsible for the observed sub-standard products.

Ibukun Gabriel Awolusi et al (2014) investigated the quality of machine vibrated hollow sandcrete blocks used on construction sites in Lagos metropolis. A total of sixty (60) units of machine-vibrated sandcrete blocks were sampled from ten (10) manufacturers within Lagos Mainland. Three (3) samples of 450mm x 225mm x 225mm blocks and another three (3) of 450mm x 150mm x 225mm blocks were selected from each of the ten (10) manufacturers to make the total of sixty (60) blocks. Also, a total of forty (40) units of machine-vibrated sandcrete blocks were produced based on the requirements of the NIS 87:2004 standard for sandcrete blocks. The results obtained revealed that the compressive strength of the blocks obtained from manufacturers ranged from 0.21N/mm² to 1.26N/mm² for 225mm thick blocks and from 0.28N/mm² to 0.95N/mm² for 150mm thick blocks which are far below the minimum standard requirements of 3.45N/mm² and 2.5N/mm² respectively.

Methodology

Study Area

The study area for this research is Kaduna south a local government area in Kaduna central Kaduna state; it has an area of 46.2 km² with an estimated population of

402,731 in the 2010 (NPC) and located in northern Nigeria. It is one of Nigeria's 36 states with coordinates 10°28'4.80"N 7°25'15.60"E.

Sampling method

Observations carried out include the batching process and appearance. Five (5) samples of 9-inch blocks were obtained from five (5) block producers (A, B, C, D, E) then transported to Civil and Environmental Engineering Laboratory, Airforce Institute of Technology Kaduna, Kaduna state.

Experimental method

For the purpose of the work, laboratory test was conducted to determine the properties of sand used for the production of sandcrete block by the various block producers. In the laboratory work, the following tests were carried out, sieve analysis of sand, dimensional checks, and compressive strength test.

Aggregate characteristics

The aggregates were tested for their physical properties such as: specific gravity, Particle distribution (sieve analysis) test, bulk density, and moisture content.

Sieve analysis test

The particle size analysis carried out was done in accordance to BS 1377 (1990), the method employed for the determination of particle size distribution is the dry sieve analysis.

Specific gravity test

This test was carried out in accordance with BS 1377 (1990), method of sampling and testing of mineral aggregate, sand and fillers.

Compressive strength test

This test was conducted in accordance to specification given in NIS 584:2007 code for methods of testing sandcrete blocks.

Production of Sandcrete Block

The processes used in the manufacturing of sandcrete block include; Batching, mixing, moulding, drying and curing, storage. The production of the selected blocks from the various block industries was of motorized vibration machine.

Batching

The process of mixing of composite materials (cement, sand and water) was based on the method employed by the various block industries.

Drying of Sandcrete Block

The blocks were dried by means of air and sunlight.

Curing of Sandcrete Block

The sandcrete blocks were cured for 14 days. The curing of the blocks was done by spraying or sprinkling of water in an open place.

Results and Discussion

Sieve Analysis Test (Particle Size Distribution)

The sieve analysis carried out shows that the aggregate (sand) used by all the selected block manufacturers were well graded. The well graded soil which are suitable for production of sandcrete blocks as it falls within the limit required by BS 882:1992 and that of NIS: 587 (2007). This thus implies that the quality of aggregate used for block production in the selected block manufacturing company within Kaduna south LGA, are of good quality in terms of grading.

Table 1.0: combine Sieve analysis result of aggregate; Industry A-E

<i>SIEVE SIZE</i>	<i>% Passing</i>				
	A	B	C	D	E
5	87.20	95.48	95.96	93.36	95.64
3.35	83.24	92.94	91.56	90.30	91.80
2.36	78.70	85.06	87.06	82.42	87.10
2	75.28	80.00	83.70	76.66	84.22
1.18	65.12	60.42	69.94	55.20	71.06
850	55.50	48.06	61.56	42.84	61.94
600	40.52	34.02	49.38	29.80	49.38
425	26.92	23.68	36.72	20.88	36.50
300	16.94	16.52	22.94	14.76	23.14
150	5.00	7.18	6.88	7.24	7.30
75	1.28	2.48	2.78	2.02	3.06
PAN	0.65	0.27	0.15	0.24	0.79

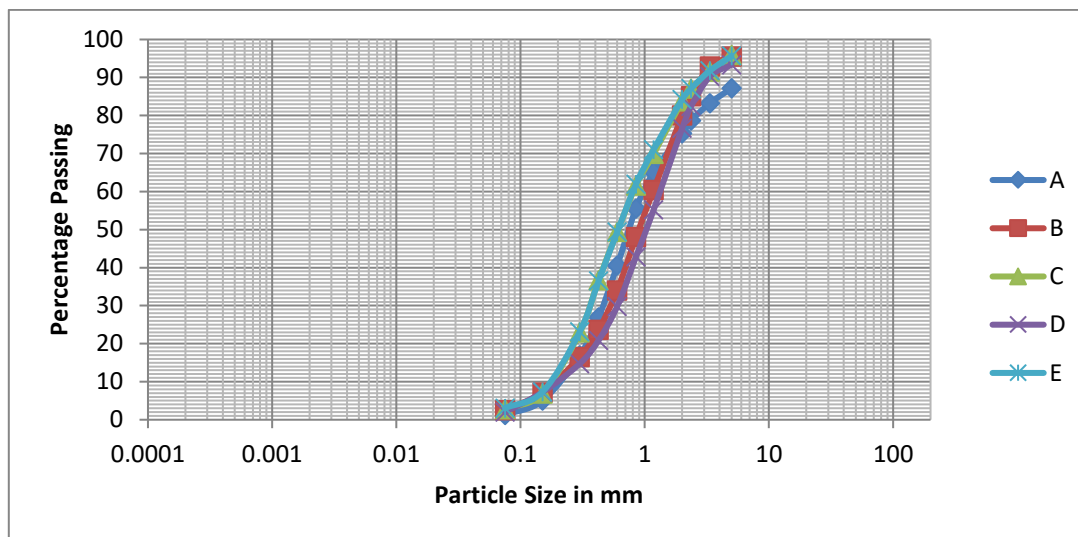


Figure 1.0: Combine Particle Size Distribution Curve of Aggregate; Industry A-E

Bulk Density of Soil Samples

The result for the bulk density of soil samples are shown in Table 2. The uncompact bulk density of the aggregate is between 1315 kg/m³ to 1380 kg/m³ and that of the compacted bulk density are between 1501 kg/m³ to 1668 kg/m³. With all of the soil samples falling within the required range for compacted and Un-compacted bulk density of sand, which as a result corresponds to BS requirement of 1300 to 1800kg/m³ for coarse aggregate.

Table 2.0: Bulk Density of Soil Samples from Producer A-E

Producer	Sample (kg/m ³)	
	Uncompact	Compacted
A	1380	1650
B	1320	1556
C	1363	1589
D	1392	1668
E	1315	1501

Specific Gravity Test of the Aggregate

Table 3 shows the result of specific gravity of the various sand used for sandcrete block production

Table 3 Specific Gravity of sand Samples

<i>PRODUCER</i>	<i>Sample</i>
<i>A</i>	2.65
<i>B</i>	2.66
<i>C</i>	2.68
<i>D</i>	2.67
<i>E</i>	2.64

The values of the specific gravities range between 2.51 to 2.76. All of the values are in agreement with the BS 41 requirement of 2.4 to 2.8 for coarse aggregate.

Dimensional Test

The average dimensions of the hollow block from the five (5)-block producer are as shown in Table 4. five (5) 9-inch blocks per block producer was measured and the average taken.

Table 4. Average Dimension of sandcrete blocks for producer A-E

<i>PRODUCERS</i>	<i>AVERAGE (mm)</i>			
	<i>L</i>	<i>H</i>	<i>B</i>	<i>W</i>
<i>S/N</i>				
<i>A</i>	460	220	225	50
<i>B</i>	455	210	230	45
<i>C</i>	450	230	220	48
<i>D</i>	460	215	220	40
<i>E</i>	455	222	225	40

Note: L= Length, B= Breadth, H= Height, and W= Web

From the table it can be seen that the average length ranges from 450 mm to 460 mm, with only one of the block producers (C) maintain the required length of 450 mm as specified by NIS. It can also be seen that the breadth of the block ranges from 220 mm to 230 mm, with only two (Producer A and E) maintaining the require breadth of 225 mm as specified by NIS. The required height of sandcrete as specified is 225mm, from the table the height ranges from 215 mm to 230 mm, with none of the producers maintaining the required height. Finally, the web, with measurement ranging from 40 mm to 50 mm, with only producers (A) maintaining the require thickness of 50mm as specified by NIS.

Compressive Strength

NIS 87:2007 stipulates recommended standard minimum values of crushing strength for load bearing not less than 3.45 N/mm². From the table the average compressive strength ranges from 0.18 N/mm² to 0.44 N/mm², with none of the sandcrete block of all the block producers attaining that strength. The poor quality of block could be attributed to poor mix ratio of the sandcrete blocks. The NIS 87:2007 standard specifies the use of mix ratio 1:8 cement sand proportion to achieve the minimum compressive strength value of 2.5N/mm² for non-load bearing or 3.5N/mm² for load bearing walls as well as 0.45 water: cement ratio.

Table 5: Crushing Strength/mix ratio of Sandcrete blocks

Producer	Average Dimension (mm)				Mix Proportion	Average Compressive strength (N/mm ²)
	L	H	B	W		
A	460	220	225	50	1:12	0.44
B	455	210	230	45	1:16	0.18
C	450	230	220	48	1:14	0.28
D	460	215	220	40	1:14	0.26
E	455	222	225	40	1:14	0.29

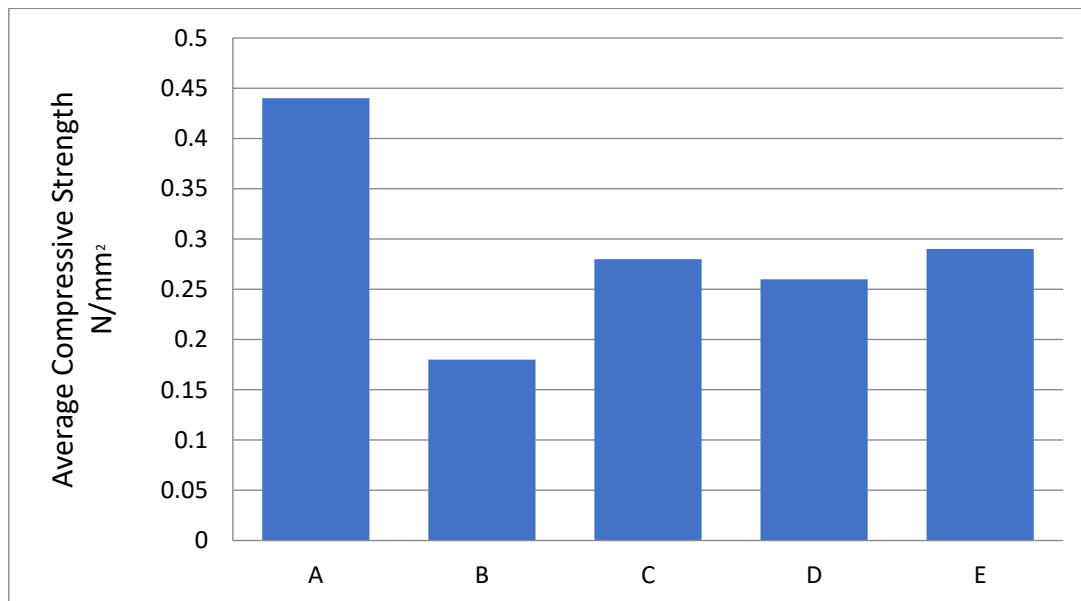


Figure 5: Compressive strength of collected sandcrete block samples at 14 days curing age.

Conclusion

The sand used by the selected block producers in Kaduna south local government area do comply with the specified standard of grading of aggregates used for block production as it's within the limit specified in NIS 87:2007, the aggregates therefore are suitable for block making.

The mix proportion used by the selected block producers in Kaduna south is generally between one part of cement to twelve or sixteen parts of sand by volume (1:12 or 16) as against one part of cement to eight parts of cement by volume (1:8) as recommended by NIS 87:2007.

The average compressive strength of the blocks was below the NIS recommended value of 3.5N/mm^2 , with the blocks having compressive strength ranging from 0.18N/mm^2 to 0.44N/mm^2 . In terms of dimension, all the block producers did not meet up the required dimension of $450\text{mm} \times 225\text{mm} \times 225\text{mm}$.

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