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ASSESSMENT OF THE QUALITY OF SANCRETE BLOCKS PRODUCED IN NIGERIA: A CASE STUDY ILORIN EAST LOCAL GOVERNMENT AREA, KWARA STATE.

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Abstract
Over 90% of physical infrastructures in Nigeria are constructed using non load bearing sandcrete block due to its moderate compressive strength which makes it to withstand any tragedy such as seismic or vibrating activities, if produced based on the standard requirements. The quality of sandcrete blocks produced by block making industries in Ilorin East Local Government in which block samples were collected from 5 different block industries. Five samples each of size 450mm x 225mm x 225mm per factory were tested .laboratory tests such as Dimension tolerance test, Density test, Water Absorption rate test and Compressive strength test were conducted. Based on the result of the findings, majority of the block industry have their dimension tolerance test for the external and internal value not accurate, the density of the blocks varies which may be due to the level of compaction or vibration time during production; water absorption were found to be above the specified standard of 12% and the compressive strength does not comply with the required standard of 2.5 – 3.5 N/m^3. It was recommended that quality control on the construction materials should be carried out before production and that regulatory body such as Standard Organization of Nigeria (SON) and Nigerian Industrial Standard (NIS) should deem it fit to make sure that every block industries comply strictly with the lay down regulations.

Keywords: *Sandcrete block, Compressive strength, Water absorption, Cement.*

INTRODUCTION

Food, clothing and shelter are the three basic necessities of life. But, it is rather unfortunate that human settlement condition in many developing countries is deteriorating as a result of low level of investment in the construction sector. In Nigeria today, there is an increase in the cases of building collapse where many lives were lost and properties were destroyed. One of the reasons for this is the lack of quality of materials being used for human settlements. Sandcrete blocks forms a significant component in building structures and in the building industries.

Generally, Sandcrete blocks may be defined or describe as walling unit produced from composite materials made up of cement, sand and water, moulded into different shapes and sizes. They are widely used in Nigeria and virtually all African countries as walling unit. 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.

Sandcrete blocks possess a moderate compressive strength that make them to withstand any tragedy such as seismic or vibrating activities, if produced based on the standard requirement. Substandard blocks results into irregular cracks and improper finishing in buildings. Sandcrete blocks are available for the construction of load bearing and non-load bearing structure

Over 90% of physical infrastructures in Nigeria are constructed using sandcrete blocks. Materials used in making sandcrete blocks include sharp sand, soft sand, stone dust, cement and water. Sandcrete block can be classified into three basic form; solid, hollow and cellular thus proving versatility to block work construction both in style and function. The properties of sandcrete block depends to a varying degree on the type and proportions of the constituent materials, the process of manufacture, the mode, duration of curing and the form and size of block itself . The global concern across the world and particularly in Nigeria demands that materials used for construction of buildings meet minimum requirement. In the year 2000, the Standard Organization of Nigeria (SON) developed a reference document which prescribed the minimum requirement and uses of different kinds of sandcrete blocks and other products, to prescribe the quality of materials; methods and procedure to be applied for production and testing of the final product in order to ensure compliance to prescribed standard. This first standard is known as NIS 87: 2000 and had been

subsequently reviewed in 2004 and 2007. The properties of sandcrete hollow block include density, strength, dimensional change, durability, thermal conductivity, movement and chemical attack. B. Imam & S. Mohammed (2015) stated that sandcrete has a high compressive strength and this strength increases with density. The range of minimum strength specified in NIS 87:2007 is between 2.5N/mm^2 - 3.45N/mm^2. Materials used for building construction should meet minimum standard to address the issue of sudden building collapse which was attributed partly to the quality of sandcrete blocks used for walling units.

Abdullahi (2005) investigated the strength characteristics of Sandcrete blocks in Bosso and Shiroro areas in Minna, Nigeria. Compressive strength tests were conducted on the blocks and sieve analysis was also conducted on the soil samples. The test results revealed that the aggregates used were suitable for block making. The compressive strength of the Sandcrete blocks was found to be below standard recommended by Nigerian Industrial Standard (NIS) 87: 2000. The compressive strength of individual blocks was between 0.11N/mm^2 and 0.75N/mm^2 and the average compressive strengths of the blocks were between 0.14N/mm^{2}and 0.66N/mm^2. Proper curing and suitable selection of constituent materials was suggested to improve on the quality of sandcrete blocks.

Afolayan, Arum and Daramola (2008) reported the compressive strengths and the statistical characteristics of sandcrete blocks collected from twenty five (25) different block industries in Ondo State, Nigeria. The results showed that the 450mm x 150mm x 225mm Sandcrete blocks in circulation and had an average strength of 0.55N/mm^2 while those of 450mm x 225mm x 225mm had an average compressive strength of 0.45N/mm^2. It was observed that the values were lower than those stipulated by the relevant codes and standards. Although, the statistical analysis showed that the compressive strength of these blocks followed a normal distribution, the overall coefficient of variation stood at 0.54 for the 450mm x 150mm x225 mm blocks and 0.71 for the 450mm x 225mm x 225mm blocks. It was concluded that the values were high and therefore indicated poor quality control in the production processes.

Odeyemi S.O et al (2018) worked on the quality assessment of sandcrete blocks produced in Adeta, Kwara State. In the process, eight block factories were selected from the study area and the quality of their blocks were measured for

their water absorption ratios and compressive strengths and compared with the Nigerian Industrial Standards (NIS) specifications. Six samples each of size 450mm x 225mm x 225mm per factory were tested. The compressive strengths of the blocks which ranges from 0.19N/mm^2 to 0.40N/mm^2 fall below the minimum specification of 2.5N/mm^2. From the results obtained, it was concluded that the blocks produced in Adeta did not comply with the minimum standard requirement compressive strength value of 2.5N/mm^2 for non-load bearing or 3.45N/mm^2 for load bearing walls as well as maximum specified 12% water absorption. Inadequate mix ratio is a factor that resulted in the poor quality sandcrete blocks produced in the area.

Ajao A.M et al (2018) also contributed to the assessment of Sandcrete blocks manufacturers in Compliance to Minimum Standard Requirements by Standard Organization of Nigeria in Southwest, Nigeria by obtaining 54 sandcrete blocks comprising 225mm and 150mm gotten from blocks production sites within three states; Oyo, Ondo, and Lagos State. Samples of their fine aggregates were gotten for proper examination. In order to compare the outcome of the tested results with standards, 18 numbers of controlled experimental units which comprised 225mm and 150mm were also produced. The results for sieve analysis of the three Samples gotten from the Southwest along with Laboratory sample satisfied the requirement for BS 882: 1992. The results of compressive strength values gotten from blocks suppliers within South West failed to meet up the requirements stipulated for non load bearing sandcrete blocks by Nigerian Industrial Standard (NIS 87: 2000) and also indicated shoddy control practice because strength results justified low standards due to non-adherence to stipulated mix-ratio 1:8 of cement and sand. The study concluded, that the outcomes of compressive strength (0.77N/mm and 1.33N/mm) of the sandcrete blocks gotten from manufacturers were far behind the minimum standards required while the average compressive strength of sandcrete blocks produced under similar condition in the Laboratory were between 2.77 N/mm^2 and 4.12N/mm^2 and this controlled masonry units met the standards required. Therefore this study suggested that compliance to already stipulated mix proportion of composite materials and improvement on curing process also regulatory bodies should be saddled with responsibility of enforcing the use of registered stamp on their sandcrete block to differentiate the low quality ones.

Ibukun G.Aet al (2017) also worked on assessment of sandcrete blocks used for construction in Lagos Motropolis by collecting a total of sixty units of machine-vibrated sandcrete blocks sample from ten different manufacturers within Lagos Mainland. Three samples of 450mm x 225mm x 225mm blocks and another three of 450mm x 150mm x 225mm blocks were selected from each of the ten manufacturers to make the total of sixty blocks. Also, a total of forty units of machine-vibrated sandcrete blocks were produced based on the requirements of the NIS 87:2004 standard for sandcrete blocks. The blocks obtained from manufacturers as well as those produced were tested to determine their quality in terms of three parameters which were the compressive strength, density and dimensional tolerances. The results obtained revealed that the compressive strength of the blocks obtained from manufacturers ranged from 0.21N/mm^2 to 1.26N/mm^2 for 225mm thick blocks and from 0.28N/mm^2 to 0.95N/mm^2 for 150mm thick blocks which are far below the minimum standard requirements of 3.45N/mm^2 and 2.5N/mm^2 respectively. It was concluded that, the densities of these blocks were found to be satisfactory with the requirements of the standard while the dimensions were found to be inaccurate in terms of web thicknesses. It was recommended that the regulatory and enforcement bodies should be empowered to check and control production processes and the quality of sandcrete blocks.

Arimanwa J.I et al (2014) also make research on the assessment of the quality of sandcrete blocks use in Owerri, Imo State, South-East Nigeria by also visiting ten different commercial sandcrete block manufacturing industries in the state and its environs. In the process, Ten sandcrete block samples with nominal dimensions of 450mm x 225mm x 225mm were randomly obtained from each of the manufacturers for a period of four consecutive weeks. Sand samples used in producing the blocks were also collected for laboratory analysis while the source of water for each industry was noted. Compressive strength and density tests were conducted on the blocks while grain size distribution analysis was conducted on the sand samples. The test results revealed that the sand aggregates used are substantially suitable for block making. The average compressive strengths of the sandcrete blocks for all ten block manufacturing industries investigated fell below the standards recommended by the Nigerian Industrial Standard (NIS) 87: 2000 and BS 6073-1: 1981 which are 2.76N/mm^2 and 2.8N/mm^2 respectively. Only two out of the ten industries satisfied the

requirements of the National Building Code (2006) of Nigeria, which requires the average strength of six blocks to be not less than 2.0N/mm^2 and the lowest strength of individual blocks should be not less than 1.75N/mm^2. The compressive strength of individual blocks was between 0.55N/mm^{2}and 2.43N/mm^2 and the average compressive strength of the blocks was between 0.62N/mm^{2}and 2.35N/mm^2. Therefore, Standardization of block manufacturing processes and strict supervision of the manufacturers by the Council for the Regulation of Engineering Practice in Nigeria were recommended as measures to improve the quality of sandcrete blocks.

Abdullahi M. (2015) suggested that improvement in the selection of materials and curing techniques as remedy for enhancement of the quality of sandcrete blocks. This paper focused on the compressive strength of 450mm x 225mm x 225mm hollow sandcrete blocks obtained from the selected manufacturing industries. It is intended to draw the attention of government and the engineering profession to the possible danger in the nearest future.

Fig 1.0: walling unit made of sandcrete blocks

RESEARCH METHODOLOGY

Five machine-vibrated block samples were collected from ten selected block manufacturing indusries in Ilorin East Local Government Area of Kwara State. The areas selected were Oke-oyi, Oke-ose, Sango, akerebiata and Elekoyangan. The samples were collected and then labeled as A to J in order to examine whether their production is in conformity with recommended standard to

forestall building collapse. They were carried to the Soil and Concrete Laboratory , Institute of Technology, Kwara State Polytechnic, Ilorin for tests .The areas covered is shown on the map in Figure 2.0 ;

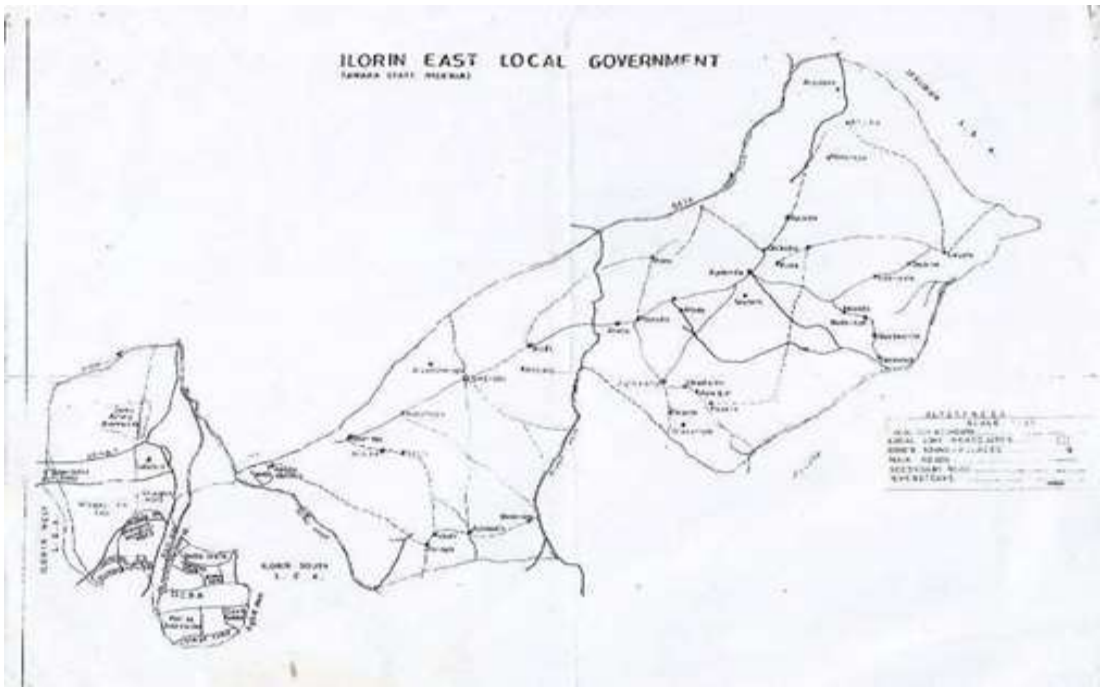

Figure 2.0: Map of Ilorin East Local Government Area

SITE VISITATION.

Site visitations were made to five block industries in Ilorin East local Government Areas of kwara state. Oral interview was conducted with manufacturers.

LABORATORY TESTS

The following tests were carried out on the samples collected;

- Dimension (thickness) Tolerance Test,
- Density test,
- Water Absorption test
- Compressive Strength Test.

The quality of blocks made from different manufacturers in Ilorin East local government was determined by means of laboratory tests mentioned above on

the block samples. Result from the Dimension Test was used to determine the form and shape of the blocks, Density Test was used to know the weight of the blocks, Water Absorption Test was used to determine the water absorption level of the block while Compressive Strength test was considered for the determination of the strength properties of the blocks produce for building construction.

RESULTS AND DISCUSSION

Mix proportion obtained from various block industries revealed that most of the industry produced between 35 – 45 blocks of 225mm (9' inches) blocks with 3 barrows of sharp sand, 2 barrows of soft sand and 1 bag of cements while some produced same number of 225mm (9' inches) blocks with 2 barrows of sharp sand, 6 barrows of loamy soil and 1 bag of cement. Non-adherence to stipulated mix-ratio 1:8 of cement and sand was observed in the various block industries. Also grain size test on the fine aggregate and quality control test on the produced sancrete blocks were not carried out by manufacturers..

DIMENSION TOLERANCE TEST RESULTS

Table 1.0: Average Dimension tolerance test results.

Samples	Thickness (mm)	Dimension of blocks			Hole (mm)
		Length (mm)	**Breadth (mm)**	**Height (mm)**	
A	50	460	235	225	155 x 140x220
B	50	455	230	225	150 x 135x210
C	45	450	230	225	147 x 140x220
D	50	455	230	225	168 x 137x 225
E	45	455	235	225	155 x 137x215

Table 1.0 show that the dimension of the collected block samples varied in thickness, length, breadth and hole. Sample C and E were of the same thickness value (45mm), sample B, D and A also have the same length value of 455mm, sample B, C and D have the same breadth value of 230mm while hole of sample A and E were 155mm x 140mm respectively. However, those samples were not in conformity with SON standard for hollow sandcrete blocks which stated that

the dimension of 9" blocks should be within acceptable limit of 450mmx225mmx225mm

DENSITY TEST RESULTS

Table 2.0: Average Density Test Results

Samples	Mass 1 (kg)	Mass 2 (kg)	Mass 3 (kg)	Average Mass (kg)	Volume (m3)	Density (kg/m3)
A(225mm)	22.70	22.75	23.60	23.02	24322.5	9.47 x 10-4
B(225mm)	24.30	21.40	23.70	23.13	23546.3	9.82 x 10-4
C(225mm)	22.45	22.20	22.25	22.30	23287.5	9.58 x 10-4
D(225mm)	22.00	21.75	23.50	22.42	23546.3	9.52 x 10-4
E(225mm)	22.50	23.10	22.25	22.62	24058.1	9.40 x 10-4

The average value of the block sample's density has shown in Table 2.0 above revealed that sample A, and B has a corresponding value of 23.00kg while sample C, D and E has a value of 22.00kg .It was observed that the block samples collected differs slightly in density therefore, the difference in the values of density of the blocks were still within tolerable limit. These differences could be due to some notable factors such as level of compaction of blocks, mix proportion ratio and vibration time during production.

WATER ABSORPTION RATE TEST

Table 3.0: Average Water Absorption Rate Test Results.

Samples	Time intervals (hrs)	Values (kg)	Water absorption (%)	Average Water Absorption (%)
A (225mm)	24	27.40	17.15	18.33
	48	27.70	18.05	
	72	28.30	19.79	
B (225mm)	24	24.60	13.00	14.05
	48	25.00	14.40	
	72	25.10	14.74	
C (225mm)	24	25.65	12.48	13.75
	48	25.95	13.49	
	72	26.50	15.28	

D (225mm)	24	25.00	12.00	13.26
	48	25.40	13.39	
	72	25.70	14.40	
E (225mm)	24	26.25	14.29	15.09
	48	26.45	14.93	
	72	26.80	16.04	

Table 3.0 presented the average water absorption rate of the block samples for different time intervals of 24hrs, 48hrs and 72hrs respectively. Sample A has the highest average water absorption of 18.33% and sample D (13.26%) has the lowest value. However, those values were high as compared to maximum value of 12% specified by Nigerian Industrial standard NIS.

COMPRESSIVE STRENGTH

Table 4.0: Average Compressive Strength Test Results

Samples	Size (mm)	Mass of Samples (kg)	Comp. Strength (KN)	Comp. Strength (N/mm2)	Average Compressive Strength (N/mm2)
A	225	22.70	26.00	0.51	0.55
		22.75	30.00	0.59	
B	225	24.30	29.00	0.57	0.52
		23.70	24.00	0.47	
C	225	22.45	28.00	0.55	0.53
		22.25	26.00	0.51	
D	225	23.53	34.00	0.67	0.59
		22.00	26.00	0.51	
E	225	22.50	24.00	0.47	0.54
		23.10	31.00	0.61	

As recommended by Nigeria Industrial Standard (NIS 87:2004), the compressive strength of industries blocks ranges from 2.5N/mm^2 to 3.45N/mm^2 for 225mm (9" inches) blocks. Table 4.0 has shown that none of the samples comply with the standard required by the Nigerian Industrial standard.

CONCLUSIONS

In this study, the selected block production industries produced between 35 – 45 moulds of 225mm (9' inches) blocks under same regulated mix proportion standard for sandcrete blocks production expected to be 30 moulds of 225mm (9" inches) has agreed by Nigerian Industrial Standard (NIS).

It was observed that the dimension of the blocks has shown in Table 1.0 were found to be inaccurate as the dimensions varies in thickness, length and breadth. The density of the blocks has shown in Table 2.0 varied and was observed that it may be due to the level of compaction, inclusive mix proportion ratio or vibration time during production.

Water absorption rates were above the specified standard as the maximum specified standard for water absorption by Standard Organization of Nigeria (SON) was 12%. Compressive strength of the blocks produced has shown in table 4.4 does not comply with the required standard ($2.5N/m^3$ – $3.5N/m^3$) has recommended by the Nigeria Industrial Standard (NIS). This study made it cleared that most block making industries does not obeys the designated standards for the production of sandcrete blocks which has resulted to structural fauilure.

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