Journal of Sustainable Development Studies
ISSN 2201-4268
Volume 8, Number 2, 2015, 252-259

Evaluation of the Quality of Hand Moulded Sandcrete Block in Owerri, Imo State, Nigeria

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Abstract: The durability of a building is to a great extent determined by the quality of materials used of which sandcrete block is one of the materials. This paper looks into the quality of blocks produced by block industries in Owerri, Imo state, Nigeria to ascertain its water absorption ratio and compressive strength. A Total of fifteen block industries were visited and five samples from each were collected and subjected to laboratory test. The analysis of results obtained was compared with the Nigerian industrial standard (NIS). The absorption rate of the sandcrete blocks was found to be higher than the 12% minimum requirement of the NIS; 2007. The compressive strength values of the sandcrete blocks ranges from 0.81N/mm^2 and 1.25N/mm^2 which when compared with NIS, was found to be below the minimum requirement of the NIS; 2007. Inadequate mix ratio was observed to be one of the factors of poor quality sandcrete block production in the area. This paper recommends for compliance monitoring by the various regulatory body to ensure good quality of sandcrete block production.

Keywords: Compressive Strength, Curing, Sandcrete blocks, Water Absorption.

1.0 INTRODUCTION

Sandcrete blocks are masonary units predominantly used as walling materials in construction of shelter which is one of the basic needs of man and other infrastructures (Onwuka *et al* ; 2013). Sandcrete block comprise of sand, water and Cement (Omopariola, 2014). According to Hamisu and Mohammed (2014), Sandcrete hollow block is made from a mixture of sharp sand, cement in the ratio of 1:6 with the minimum amount of water, in some cases with admixture, moulded and cured in a control environment. In Nigeria over 90% of physical infrastructures are being constructed using sandcrete blocks (Anosike and Oyebade, 2012 ; Alohan, 2012 ; Oladeji and Awos, 2013).

Anosike and Oyebade, (2012); Omopariola, (2014) define quality as fitness for purpose or compliance with specification. The quality of sandcrete blocks are influenced by so many factors such as the constituent materials, the process adopted in manufacture, duration of curing, form and size of blocks (Akeem and umar, 2013). Omopariola, 2014 from his research on the position of an appraisal of the quality control practices of sandcrete blocks production in yewa south of Ogun State, Nigeria, was of the view that commercial block producers are ignorant of the existence of any relevant code or specifications relating to block production and properties. He further stated that standard process of sandcrete block production and quantity control are not ensured which its consequence is the production of low quantity blocks. According to Alohan (2012), the majority of sandcrete blocks used in the Nigerian building industry fall short of minimum specification. Akeem and Umar (2013) confirmed it by stating that the production of low quality blocks may have led to the increase in collapsed buildings in recent times. Authors including Anosike and Oyebade (2011) ; Akeem and Umar (2013) ; Aladeloba *et al*, (2015) ; Omopariola (2014) ;Hamisu and Mohammed (2014) ; as well as Onwuka *et al* ; 2013 have worked on the quality of sandcrete block production in various states of Nigeria like Lagos, Ogun, Katsina, Gombe and eastern part of Nigeria.

The results showed that the strength of the commercial sandcrete blocks do not measure up to recommended value by the Nigerian industrial standard (NIS: 2007). NIS recommends that the lowest crushing strength of individual load bearing blocks shall not be less than 2.5N/mm^2 for machine compacted and 2.0N/mm^2 for hand compacted sandcrete blocks. Omopariola (2014) sated that the rapid increase in the cost and demand for cement has untold effect on the cost of building blocks, this has led to many commercial block producers to compromise the standard of production in an attempt to maximize profit.

The aim of this paper is to evaluate the quality of sandcrete block production in Owerri, Imo state, Nigeria with its compliance to NIS 2007. Specifically to determine the water absorption rate of hand moulded sandcrete block produced by block making industries, evaluate the compressive strength of the hand moulded sandcrete blocks and to compare the laboratory test result with the NIS 2007 minimum standard specification from the fifteen block industry in owerri, Imo state Nigeria.

2.0 MATERIALS AND METHODS

2.1 Materials

The sandcrete blocks used for this study were made from the mixture of cement, fine aggregate (sharp sand) and water based on the field observation. The cement used was ordinary Portland cement while the fine aggregate were mostly river sharp sand from Otamiri River and the major source of water is bore hole.

2.2 Method

Fifteen (15) block industries were visited and five (5) samples each with dimensions of 450mm x 225mm x 225mm were collected. The samples collected were subjected to laboratory test to determine the water absorption rate and compressive strength test. The samples collected were labeled accordingly in other to differentiate them.

During production of the blocks, it was observed that most block industries batch their materials by volume using wheelbarrow. Some others, there was no standard measure for batching of the materials as it was seen that they just create a heap of sharp sand using eye gauge and add cement to it as against the standard mix proportion of 1:8 prescribed by NIS 2007. Some of the laborers claim that with their years of experience, that batching by volume slows the production process so they prefer the eye gauge. None of the site visited used water-cement ratio, they only sprinkle water during mix.

They use manual mixing and manual mould, with this attitude, there will be inconsistent mixing and poor vibration of the block leading to poor quality of blocks as cracks appear on some of the fresh blocks. The blocks are de-moulded and cured by sprinkling water on the block after 24 hours of de-molding. The curing takes 2 to 3 days before they are being sold out. It was observed that on the average of 45 blocks of 450mm x 225mm x 225mm were produced from 50kg of cement. The cost of each block ranges between 120-130 naira in various industries visited.

3.0 LABORATORY TEST

Water absorption and compressive strength test are the two major characteristics requirements specified by NIS for testing and verifying the quality of sandcrete blocks.

3.1 Water absorption rate

According to Anosike and Oyebade (2012), water absorption is the ratio of the decrease in mass of dry sample. He further stated that the rate of water absorption of aggregate influence the bond between aggregates and the cement paste, the resistance of concrete to freezing and thawing, chemical stability, resistance to abrasion and specific gravity.

Water absorption rate is determined by measuring the decrease in mass of saturated block and surface dry sample.

$$Water\ absorption\ rate(\%) = \frac{M_2 - M_1}{M_1} \times 100 \qquad (1)$$

Where M_1=*Weight of dry block,* M_2= *Weight of the wet block after 24 hours in water.*

3.2 Compressive strength

Compressive strength in this context is the ratio of the crushing load (force) a sample can sustain to its Net area.

The instrument used for this experiment is compression testing machine with a maximum load capacity of 1500KN

$$Compressive\ strength\ (N/mm^2) = \frac{Crushing\ load}{Net\ area\ of\ block} \quad (2)$$

BLOCK SIZE	=450mm x225mm x 225mm
HOLLOW SECTION 2(150 X 150)	=45,000mm
GROSS AREA OF BLOCK	=450mm x 225mm=101250mm
NET AREA OF BLOCK	=Gross area of block - Hollow section

4.0 RESULTS AND DISCUSSIONS

The water absorption rate of the blocks is presented in table 1 while the average compressive strength results obtained from the crushed sandcrete blocks is presented in table 2.

4.1 Water absorption rate

The absorption rate from the result obtain as shown in Table 1 reveals that the blocks has higher percentage of absorption rate when compared with the maximum absorption rate of 12% recommended in the NIS 87: 2007.

The result shows a considerable range of variations and values with a minimum of 12.53% from sample N and maximum of 16.32% from sample J as shown in Table 1. This could be as a result of poor mix ratio, inadequate curing and compaction of the

sandcrete blocks which results to poor quality sandcrete block. The effect of this blocks when exposed to persistent flooding, a highly porous block could absorb water, consequently become weakened and eventually fail.

4.2 Compressive strength of block

Table 2 shows the result values of the compressive strengths of the selected sandcrete blocks which ranges from 0.84N/mm^2 and 1.23N/mm^2. From the result, none of the blocks measure up to the required minimum of 1.75N/mm^2 as stipulated by the National Building Code (2006) neither are the values up to those specifield by the NIS 87:2007 of 2.5N/mm^2 for non-load bearing nor 3.5N/mm^2 for load bearing walls. The poor quality of block could be attributed to poor mix ratio and inadequate curing 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/mm^2 for non-load bearing or 3.5N/mm^2 for load bearing walls as well as 0.45 water:cement ratio and maximum specified 12% water absorption.

TABLE I: SHOWING THE AVERAGE WATER ABSORPTION RATE OF SAMPLE FROM THE SANDCRETE BLOCK INDUSTRIES WITHIN OWERRI, IMO STATE.

BLOCK INDUSTRIES	ABSORPTION RATE % SAMPLE 1	ABSORPTION RATE % SAMPLE 2	ABSORPTION RATE % SAMPLE 3	ABSORPTION RATE % SAMPLE 4	ABSORPTION RATE % SAMPLE 5	AVERAGE ABSORPTION RATE %
A	15.85	15.89	15.57	15.79	15.21	15.66
B	14.24	14.34	14.13	14.28	14.36	14.27
C	14.68	14.98	14.45	14.96	14.62	14.73
D	14.54	14.74	14.30	14.51	15.03	14.62
E	15.94	15.84	16.16	15.79	15.80	15.99
F	14.90	14.40	15.19	14.38	13.85	14.54
G	13.09	13.29	13.26	13.17	13.19	13.20
H	13.21	13.01	13.24	13.03	13.46	13.19
I	14.28	14.48	14.44	14.41	13.81	14.28
J	16.47	16.66	15.96	16.63	15.90	16.32
K	12.55	12.63	12.43	12.59	12.49	12.68
L	13.19	13.17	13.34	13.15	13.03	13.17
M	14.44	14.48	14.59	14.42	14.52	14.49
N	12.51	12.54	12.62	12.50	12.49	12.53
O	15.15	15.20	15.05	15.16	15.19	15.15

TABLE II: SHOWING THE AVERAGE COMPRESSIVE STRENGTH OF 9'' HAND MOULD SANDCRETE BLOCK PRODUCED AND CURED FOR 28 DAYS FROM BLOCK INDUSTRIES WITHIN OWERRI, IMO STATE.

BLOCK INDUSTRIES	COMPRESSIVE STRENGTH SAMPLE 1	COMPRESSIVE STRENGTH SAMPLE 2	COMPRESSIVE STRENGTH SAMPLE 3	COMPRESSIVE STRENGTH SAMPLE 4	COMPRESSIVE STRENGTH SAMPLE 5	AVERAGE COMPRESSIVE STRENGTH N/mm^2
A	0.90	0.89	0.94	0.91	0.96	0.92
B	1.05	1.03	1.01	1.02	1.00	1.02
C	1.04	0.98	0.96	0.95	1.01	0.98
D	0.96	0.90	0.93	0.89	1.05	0.94
E	0.82	0.84	0.86	0.88	0.90	0.86
F	0.99	1.01	0.98	0.99	0.98	0.99
G	1.11	1.09	1.03	1.06	1.10	1.07
H	1.00	1.03	1.04	1.05	0.97	1.01
I	1.02	0.97	1.01	1.00	1.05	1.01
J	0.84	0.79	0.88	0.80	0.91	0.84
K	1.29	1.19	1.25	1.20	1.27	1.04
L	0.96	0.92	1.03	1.00	1.03	0.98
M	0.95	0.97	0.99	0.94	0.96	0.96
N	1.22	1.23	1.21	1.23	1.26	1.23
O	0.95	0.91	0.95	0.94	0.91	0.93

5.0 CONCLUSION

The investigation has revealed that the hand moulded sandcrete blocks did not meet the NIS 87:2007 minimum standard requirement compressive strength value of $2.5N/mm^2$ for non-load bearing or $3.5N/mm^2$ for load bearing walls as well as maximum specified 12% water absorption. The evidence of poor quality block could be linked with block producer's ignorance of the existence of standard requirement for block production and their desire to maximize profit without considering quality of the blocks. The research findings will assist regulatory bodies in the building industries to enforce strict compliance to the quality of sandcrete block production in Nigeria.

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