1st INTERNATIONAL ENGINEERING CONFERENCE (IEC 2015)

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA

Theme:

Security and Environmental Challenges: The Engineering Perspectives

1st - 3rd September, 2015

Edited by:

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QUALITY ASSURANCE OF HOLLOW SANDCRETE BLOCKS: A CASE STUDY OF HOLLOW SANDCRETE BLOCK INDUSTRIES IN MINNA, NIGER STATE, NIGERIA

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ABSTRACT

This paper presents study into construction hollow sandcrete block quality assurance of the block industries in Minna, Niger State, Nigeria. Construction hollow sandcrete blocks are more widely used among other walling materials in Minna and Nigeria in general. However, there have been instances of construction failure due to the fact that the hollow sandcrete blocks used for the construction do not meet construction qualities in terms of material strength. Hence, the mean compressive and characteristic strengths, production and usage of these blocks need to be investigated. Laboratory, work study and field survey methods were used in this research. The Laboratory analyses of the construction sandcrete blocks were carried out on a total of sixteen (16) block producing industries randomly selected. One hundred and sixty (160) in number of six inches (6-inches) and nine inches (9-inches) blocks of dimensions 450 x 225 x 150m and 450 x 225 x 225mm respectively, obtained from the block industries were deployed to the laboratory and considered for water absorption and strength requirements. The water absorption value for 6-inches block were between 15.17 – 18.04% and that of 9-inches, 14.32 – 19.94% which are above 12% as recommended by Nigerian Industrial Standard (NIS) 87:2007. This was due to large volume of fines content. The mean compressive and characteristic strengths of these blocks in the range of 3-14days age, were between 0.45 – 62 N/mm^2 and 0.28 – 0.45N/mm^2 for 6-inches blocks and 0.99-0.62N/mm^2 and 0.29 – 0.42N/mm^2 for 9-inches block respectively. When these values are compared with the recommended standard minimum values for 6-inches of 2.5N/mm^2 and for 9-inches of 3.45N/mm^2 respectively, do not meet the required minimum strength. Therefore, these blocks are not fit to be used for construction purposes. Work study and field survey carried-out through questionnairing administered to the personnel in the sandcrete block production and usages, results reveal that 87% of block industries studied are owned and managed by non-professional and workers are inadequately educated, and so do not test these blocks to ensure standard practice in production. The mixed proportion was found to be between 1: 16-1: 18 as against 1:8 recommended by NIS 87:2007. 95% of the block-end users do not care to demand for strength requirements at the point of purchase. Professionals are recommended to own or manage the block industries and the relevant authorities to ensure quality control so that blocks produced can effectively be use as load bearing walling material and to avoid construction failures.

Keywords: *Construction, Hollow sandcrete block, Block industry, Walling material, Water absorption, strength, Quality*

1. INTRODUCTION

Hollow sandcrete blocks are block made of a mixture of cement and sand (fine aggregate) of mix ratio 1:8 with a varying percentage of water added to the mixture to be able to produce the specified standard (Jackson and Dhir, 1998; Hamza and Yusuf, 2011; NIS 87:2007; Vallenger, 1971). Hollow sandcrete blocks are rectangular in shape of sizes measuring 450mm x 225mm x 225mm with web thickness of 50mm regarded as 9-inches and 450mmx 225mm x 150mm with web thickness of 37.5mm regarded as 6-inches blocks respectively (Barry, 1969; NIS 87:2007). The 9-inches blocks are used as load bearing block wall while the 6-inches blocks are used as non-load bearing block walling material (NIS 87:2004).

Load bearing units must conform to building by-law as it participates mainly in transforming the actual load of the structure to the foundation. In this case the load bearing wall are those walls acting as a supports for the whole structure to transmit the weight to the ground surface underneath it for stability (Alutu and Oghenejobo, 2006; NIS 87:2000). For a long time in Nigeria, hollow sandcrete blocks are manufacture in many parts of the country without any reference to suit local building requirements or good quality work (Oyekan and Kamiyo, 2008).

Hollow sandcrete blocks are widely used in Nigeria, Ghana and virtually all African country as walling unit, and the quality of these blocks produced differs due to the different methods employed in the production and properties of the constituent materials. Over 90% of physical infrastructures in Nigeria are being constructed using sandcrete blocks making it a very important material in building construction worldwide (Aguwa, 2011; Anosike and Oyebade, 2012; Baidan and Tunlo,2004; Gooding and Thomas, 1995; Oyekan and Kamiyo, 2008)).

The hollow sandcrete blocks produced by the block industries in Nigeria, and Niger State, Minna in particular are below the standard resulting into construction failure (Tsado and Yewa, 2013). This may be due to various reasons of mix proportion and production process not carried out in accordance to the specification by the NIS 87:2007.

In the year 2000, and in an attempt to enhance the best materials and manufacturing practice, the Standard Organization of Nigeria (SON) prescribed compressive strength and water absorption properties standard required for different kind of sandcrete blocks (Alufsayo, 2013). Among the objectives of this Nigerian

Industrial Standard (NIS) document are to ensure that all block manufacturers meets a minimum specified standard, as well as to control the quality of blocks produced by these manufacturers. The Nigerian Industrial Standard (NIS) for sandcrete block is a standard reference document developed by the Standard Organization of Nigeria (SON) which prescribes the minimum requirement and uses of sandcrete blocks. These requirements include the quality of materials, the methods and procedure to employ for production and testing of the final products to ensure compliance to prescribed standard. The first standard for sandcrete block in Nigeria was developed in 2000 and known as NIS 87:2000..

In 2004, the document was reviewed and NIS 87:2004; Standard for Sandcrete blocks became the country's standard reference document for sandcrete block. The last review was done in 2007 and known as NIS 87:2007 which emerged as the latest standard reference document for sandcrete block production in Nigeria.

Abdullahi, (2005) investigated the strength characteristic of hollow sandcrete block in Bosso and Shiroro areas Minna, Nigeria. The result revealed that not all type of the fine aggregates used are suitable for block making. The compressive strength of the sandcrete blocks were below standard as recommended NIS 87: 2000. The study suggested improvement on the selection of materials and curing.

Oyininuola and Olalusi, (2004) reported that a great number of buildings collapse weekly in the country, but did not receive public or official notice and some of those Collapsed building showed that their load bearing walls were not of adequate strength to withstand the applied load on them (Tsado and Yewa, 2013). Over 200 lives were lost in Nigeria due to building collapsed between 1974 and 2006 (Ewa and Ukpata, 2013)

The collapse of several buildings in Minna, the Talba Estate along Minna – Bida road in particular is partly attributed to the use of poor quality blocks in the construction (Tsado and Yewa, 2013). Figure I show hollow block wall failure (Tsado and Yewa, 2013). The authors did not carry-out quality assurance of the hollow blocks used for the construction to ascertain the quality standard of the blocks used for the construction. Frequent collapse of buildings globally calls for proper quality control measures into production of sandcrete blocks especially hollow blocks as walling materials.

Fig. I. Hollow Block Wall Failure

This research investigate among block manufactures in Minna and metropolis area of Niger State the level of conformity to the quality assurance and standard specification, evaluate the production process employed in the production of hollow sandcrete blocks.. The water absorption properties and the compressive strength of various hollow sandcrete blocks with respect to their mode of manufacture were tested using compressive strength machine to crush the block samples in accordance to BS 2028. Secondly, the compressive strength of various sandcrete blocks was compared to NIS 87: 2004 and 2007, so as to assess the quality of sandcrete blocks produced in Minna and metropolis are of, Niger State, Nigeria.

2. METHODOLOGY

Laboratory experiments, work study and field survey were adopted to carry out this study. The field survey involves collection of hollow sandcrete blocks specimen from randomly selected block manufacturing industries in Minna and its environs area of Niger State for laboratory test. Minna and its environs were considered due to large volume of block manufacturing industries and being the capital of Niger State large volume of dwellings are required which involve the use of hollow sandcrete block. The study case area was zone into four (Maikunkele, Chanchaga, Kpankungu and Maitunbi). The water absorption capacity and compressive strength tests were the properties tested on the blocks sample collected. The singular reason being that water absorption percentage and compressive strength are the two major characteristic requirements specified for testing and verifying the quality of sandcrete block apart from appearance and dimension (NIS 87:2007) .

Six inches (6-inches) of 450 x 225 x 150mm and nine inches (9-inches) of 450 x 225x 225mm block sizes were obtained and utilized in evaluating the block sample in accordance to NIS: 87:2004 and 2007. Ten pieces of hollow sandcrete blocks were sampled randomly per block industry among a total of sixteen (16) block producing industries randomly selected. One hundred and sixty (160) in number of six inches (6-inches) and nine inches (9-inches) blocks of dimensions 450 x 225 x 225mm and 450 x 225 x 150m obtained from the block industries were taken to the laboratory and considered for quality assurance test in terms of water absorption and strength requirement parameters

The date of cast and age of the block samples obtained were within 3 -14days. The main objective of sampling the blocks was to evaluate its quality and compare the results obtained with the recommended minimum standard specification for high quality and performance of sandcrete block by the NIS 87:2007.

Work study and field survey were carried out by direct observation of the techniques employed among block manufactures at the selected sampled industry sites in the production process. Site operation observation includes the batching method and mix ration, placing, compaction, and off course curing and personnel. A well structure questionnaire was prepared and administered to these selected block manufacturing industries, individuals and organizations that use such blocks for construction works to elicit further information on their operation in order to give credibility to some of the observation made during site visits. The well structured questionnaire administered covers areas such as: Experience; Personnel Qualification; Number of Operating team; Management team; Mix proportion; Test of Materials and Age of Blocks.

The block-molding machine generally in use by the sample industries is the Roascometta type, which vibrates the block during filling and compaction, and one block is produced at a time.

Water Absorption Capacity

Each specimen of the deployed block sample was first weigh in a dry state to obtain its dry mass (M_1) and then fully immersed in water for 24hours when the samples were completely wetted, they were removed and the trace of water were wipe off with a damp cloth and then weigh again to obtain wet weight (M_2). This procedure was repeated on other samples and the water absorption capacity was computed from equations 1:

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

Where:

M_1 = Weight of dry block before immersion and
M_2 = Weight of wet block after immersion

The average of the results obtained was regarded as the water absorption of the block and shall not exceed 12% (NIS 583:2007).

Compressive Strength

This test was conducted in accordance to specification given in the NIS 87:2000 code for the production of hollow sandcrete blocks, The compressive strength of the sandcrete blocks was determined through the crushing of the hollow sandcrete block, this was carried out on all the forty (40) samples of label blocks produced from different industries. The blocks were weighed and a wooden plank was placed underneath the block and carefully placed between the center of the plates of the crushing machine, another wooden plank was placed on top of the block. .This is to enable uniform transfer of the load around the surface of the block. The machine was then switched on and operated to crush the block. During crushing, the machine pointer rose gradually until it drops indicating failure. The reading at this point was noted and recorded. The compressive strength in N/mm^2 of each block was then calculated from the equation 2:

$$\text{Compressive Strength} = \frac{\text{Maximum load at failure(N)}}{\text{Cross sectional Area (mm}^2\text{)}} \quad (2)$$

The average results obtained was taken as the crushing strength of the blocks and shall not be less than $3.45N/mm^2$ for load bearing hollow sandcrete blocks and $2.5N/mm^2$ for non-load bearing hollow sandcrete blocks produced mechanically (NIS 87:2007).

3. RESULTS AND DISCUSSIONS

Water Absorption Capacity

Tables 1 presents water absorption capacity of all the specimens collected from various commercial hollow block manufacturing industries as determine using the relationship, and Figure 1 shows the relationship between the water absorption rate of the hollow sandcrete blocks rate and the sample hollow sandcrete block industries.

Table 1: Mean Values for Water Absorption of all Specimens

Industry	6" Average Absorption capacity (%)	9"Average Absorption capacity (%)	Overall mean Absorption capacity (%)
Maikunkele	18.04	19.94	
Chanchaga	15.78	16.87	
Kpankungu	16.77	16.16	16.63
Maitunbi	15.17	14.32	
Average Absorption capacity	16.44	16.82	

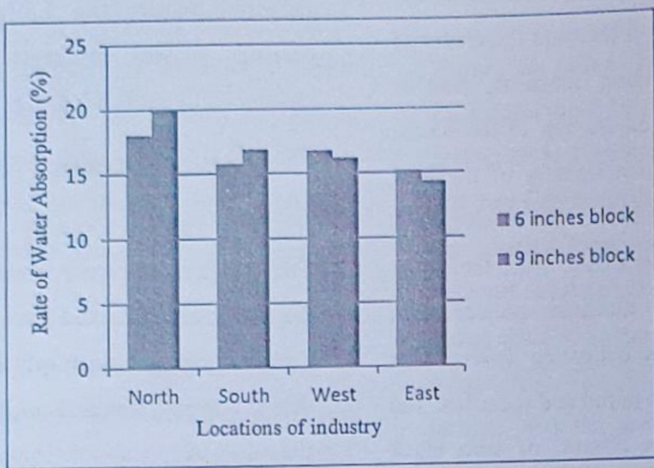

Fig 1: Mean Values for Water Absorption of all Specimens Chart.

From Table 1 and Figure 1 the water absorption capacity values of 6-inches hollow sandcrete block obtained from the four sample zones area of the case study are in the following order with Maikunkele having the highest vale follow by Kpankungu, Chanchaga and Maitunbi (18.04, 16.77, 15.78 and 15.17%) respective . For 9-inches block the order are Maikunkele, Chanchaga, Kpankungu and Maitunbi (19.94, 16.87, 16.16 and 14.32%) respectively. The water absorption capacities value obtained from all the blocks (6- and 9-inches) are above the maximum specified vale of 12% by NIS: 87:2007. The reason for this high absorption is due to high percentages of fines.

Compressive Strength of 6- and 9-inches Hollow Sandcrete Block

Tables 2 and 3 shows the compressive strength of the 6- and 9-inches blocks respectively.

Table 2: Compressive Strength of 6-inches Hollow Sandcrete Block

Sample No	Area of Study	Mean Strength (N/mm^2)	Characteristic Mean Strength (N/mm^2)
A-6	Maikukele	0.62	0.45
B-6	Chanchaga	0.45	0.28
C-6	Kpankungu	0.50	0.40
D-6	Maitumbi	0.49	0.41

Table 3: Compressive Strength of 9-inches Hollow Sandcrete Block

Sample No	Area of Study	Mean Strength (N/mm^2)	Characteristic Mean Strength (N/mm^2)
A-9	Maikukele	0.37	0.29
B-9	Chanchaga	0.39	0.33
C-9	Kpankungu	0.65	0.42
D-9	Maitumbi	0.43	0.35

The Compressive Strength of both 6"and 9" blocks are presented in Tables 1 and 2. From Table 1 it can be observed that the 6-inches block has a mean strength of between 0.45 – 0.62N/mm^2 with characteristic mean strength of between of 0.28 - 0.45N/mm^2. The Sample from Maikunkele area or zone has the highest mean strength value of 0.65N/mm^2, while that of Chinchaga has the lowest value of .45N/mm^2, and also Maikunkele has the highest characteristic mean strength value of 0.45N/mm^2 while Chinchaga has the lowest value of 28N/mm^2

Similarly, from Table 2, the 9-inches block has a mean strength value of between 0.39 – 0.65N/mm^2 and characteristic mean strength of between 0.29 - 0.42N/mm^2.The highest mean strength and the characteristic mean strength values of 0.65N/mm^{2}and 0.42N/mm^{2}were from Kpankungu The lowest mean strength and characteristic mean strength were from Maikunkele with the values of 0.37N/mm^2 and 0.29N/mm^{2}respectively.. These when compared with the recommended standard minimum values by the NIS 87:2007 of 2.5N/mm^2 for non–load bearing blocks (6-inches) and 3.45N/mm^2 minimum for load bearing (9-inches) blocks reveals that the hollow sandcrete block from the sample industries did not meet the required minimum strength. Therefore, are not fit to be used for the construction purposes.

2.1 Work study and Field Survey

Tables 4 and 5 presents observations and the responses from the hollow block manufacturing industries and construction companies and /individuals that use these blocks for constructions purpose

Table 4: Response from Block Industries

S/No	Qualified Personnel	Operating Team	Test of materials	Mix Ratio	9-inches Block per bag	6-inches Block per bag	Damage block
1	No	5	No	1:16	40	62	R
2	No	10	No	1:16	42	64	R
3	No	9	No	1:14	45	60	R
4	No	10	No	1:16	43	66	S
5	No	5	No	1:18	44	64	R
6	No	10	No	1:14	45	60	S
7	No	13	No	1:18	40	66	S
8	No	5	No	1:18	43	66	R
9	No	9	No	1:16	42	66	R
10	No	10	No	1:16	40	62	R
11	No	13	No	1:16	44	64	R
12	No	10	No	1:18	45	64	R
13	No	5	No	1:16	45	64	S
14	No	17	No	1:14	42	60	R
15	Yes	15	No	1:16	45	62	R
16	No	5	No	1:18	46	64	R
17	No	8	No	1:18	44	66	R
18	No	10	No	1:18	45	66	R
19	Yes	14	No	1:18	44	66	R
20	No	10	No	1:18	43	64	R
21	No	5	No	1:16	40	62	R
22	No	13	No	1:16	40	64	S
23	Yes	9	No	1:18	41	66	R

24	No	5	No	1:18	44	66	R

Table 5: Response from Construction Companies and Individuals

S/No	Location	Area of purchase	Testing of block	Damage block (Average 200)	Demand for Age	Age
1	G/Kwanu	Kpankungu	No	5	No	-
2	G/kwanu	Kpankungu	No	4	No	-
3	G/kwanu	Kpankungu	No	3	No	-
4	G/Kwanu	W/by pass	No	6	Yes	7
5	G/Mangoro	Chanchaga	No	5	No	-
6	G/Mangoro	W/by pass	Yes	2	No	-
7	G/Mangoro	W/by pass	No	4	No	-
8	Gurara	W/by pass	No	7	No	-
9	Gurara	E/by pass	No	4	No	-
10	Gurara	Maikukele	No	3	No	-
11	Gurara	Maitumbi	No	2	No	-
12	Fadukpe	W/by pass	No	5	Yes	7
13	Fadukpe	W/by pass	No	6	No	-
14	Fadukpe	E/by pass	No	3	No	-
15	Fadukpe	Maikunkele	No	4	No	-
16	Sauka	W/by pass	No	8	No	-
17	Sauka	E/by pass	No	3	No	-
18	Sauka	W/by pass	No	4	No	-
19	Sauka	Kpnakungu	No	6	Yes	14
20	Chachaga	Chanchaga	Yes	4	No	-
21	Chachaga	Chanchaga	No	4	No	-
22	Chachaga	W/by pass	No	5	No	-
23	Chachaga	E/by pass	No	7	No	-

24	Tuga	W/by pass	No	8	No	-
25	Tuga	E/by pass	Yes	4	Yes	7
26	Kwaso	W/by pass	No	4	Yes	3
27	Kwaso	E/by pass	No	6	No	-
28	Kwaso	W/by pass	No	3	No	-
29	Kwaso	Chanchaga	No	3	Yes	14
30	Bosso	E/by pass	No	3	No	-
31	Bosso	W/by pass	No	7	No	-
32	Bosso	W/by pass	No	6	No	-
33	Maikunkele	W/by pass	No	5	No	-
34	Maikunkele	E/by pass	No	5	Yes	7
35	Maikunkele	W/by pass	No	3	No	-
36	Maikunkele	Kpankungu	Yes	4	No	-
37	Tayi	E/by pass	No	8	No	-
38	Tayi	W/by pass	No	10	No	-
39	Tayi	Maitumbi	No	4	No	-
40	Tayi	W/by pass	No	5	No	-
41	Maitumbi	Maitumbi	No	7	No	-
42	Maitumbi	Maitumbi	No	4	No	-
43	Maitumbi	W/by pass	No	3	No	-
44	Maitumbi	Kpankungu	No	4	Yes	3
45	D/Kura	Chanchaga	No	10	No	-
46	D/Kura	Maitumbi	No	10	No	-
47	D/Kura	W/by pass	No	7	No	-
48	Shango	Chanchaga	No	9	No	-
49	Shango	W/by pass	No	8	No	-
50	Shango	W/by pass	No	4	No	-

Moulding method

It was observed that all the four manufacturing industry visited uses vibrating machine of Roascometta type to compact and produce their blocks

Batching method

Batching by volume with the use of the wheel barrow was used in almost of the industries visited to measure the sand (fine aggregate) to an extent referred to as full.

Mix ratio

During the field survey it was observed that specified standards mix ratio of 1:8 cement sand proportion and water cement ratio of 0.6 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 (NIS 87: 2007) are being undermined by the manufacturers. Majority of the block industries investigated used a ratio of between 1:16 to 1:18 to produced 42-45 number of 450mm x 225mm x 225mm Blocks and 64-70 number of (450mm x225mm x150mm) blocks respectively. A bag of cement and a wheel barrow full of sand is equivalent to three head (3) pan and eight (8) head pan respectively. These result to an average mix proportion of 1:18 by Volume used by most block industries.

Mixing method

It was observed that manual mixing with the help of shovel is used to mix the fine aggregate and cement in all the industries visited. .

Addition of water

In all the industries visited there was no specific volume of water for mixing, but was done at the discretion of the operator depending on the moisture condition of the sand. Water is added arbitrarily to make a paste for the production of the block. The type of water use across the study area ranges from Pipe bone and Borehole water free from impurities' and some well stream water which may contain some impurities (Ewa and Ukpata, 2013).

Curing method and duration

The blocks were observed to be cured by spraying method twice daily for just two to three days which is against the specified 7-day curing (NIS 87: 2007). The blocks are usually left in the open air.

Quality Assurance

There is no quality assurance as it was observed that the manufacturers do not carry out any test on finished blocks before stacking. And poor quality of blocks causes cracks in the walls of buildings which will eventually result to building structural failure or worse still building collapse as is being experienced in Nigeria over the years (Anosike and Oyebade 2011).

Personnel

Personnel used in most of the block industries are known professional. Majority of the Managers, operators and labourers are either secondary leavers or those that do not attend School at all.

Cement

The cement used is whatever brand is available in the market, while the sand used are sharp and plaster sand.

At the backdrop of the forgoing, about 5-10 blocks out of an average of 200blocks are usually lost either during delivery or in the processes of production. The damage blocks are in most Industries re-used. The industries are not organized as a body and individually do not organized any training for their staff. Prices of the blocks are fixed at individual discretion. The Organizations and Individuals that used the blocks do not necessary purchase the blocks from the nearby block industries. The damage blocks of a maximum of 8 blocks from an average of 200blocks on site are used as filling materials and those damage during delivery are returned and replaced. The construction companies and individual who used the blocks do not care to test the blocks before usage. Only a few do care to ask of the age of the blocks before even buying. From Tables 4 and 5, 87% of block industries studied are owned and managed by non-professional and workers are inadequately educated, and so do not test these blocks to ensure standard practice in production. The mixed proportion was found to be between 1:16-1:18 as against 1:8 recommended by NIS`:587:2007. 95% of the block-end users do not care in demand for strength requirements at the point of purchase.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusions

The water absorption capacities value obtained from all the blocks (6- and 9-inches) were above the maximum specified vale of 12% by NIS: 87:2007. The reason for this high absorption is due to high percentages of fines, and this results into low compressive strength of the blocks.. The maximum Characteristic strength of the sandcrete block tested was 0.45N/mm^{2}for the load bearing blocks and 0.53N/mm^2 for the non-load bearing blocks. This is far below the minimum required strength of 3.45N/mm^2 and 2.5N/mm^2 for the bearing and no bearing blocks respectively as specified by NIS 78:2007. The mix proportion used is as high as 1:18 in the production of the blocks. The number of 9-inches and 6-inches blocks produced from a bag of cement is as high as 45blocks and 70blocks respectively. There is lack of constant monitory of the block industries by the appropriate organisation. The block industries produces blocks without carrying out any test and the users also buy without testing before usage or demand for a test result. The management of the production of the blocks seems to be left in the hand of quacks that are less educated in the blocks production. The blocks produced are not properly cured before selling to buyers and end-users. The damaged blocks are usually re-cycled or sold by the block industries and in most cases used as filling material by the users.

4.2 Recommendations

Based on the assessment carried out on the sandcrete produced, there is an urgent need for the authorities (Standard Organization of Nigeria (SON), Nigeria Society of Engineers (NSE) and Council for the Regulation of Engineering in Nigeria (COREN) concerned to monitor the block industries. Block industries should employ the services of professionals. The industries should organize training for their staff from time to time. Construction Companies and individuals who use the blocks should also ensure that they buy matured blocks or use the services of professionals. They should also test or demand the test result of the blocks before buying.

ACKNOWLEDGEMENTS

The authors duly acknowledge published or unpublished sources that were used in getting qualitative information in the achievement of the aim and objectives of the study. Besides we thank the block industry owners, construction industries and individuals for providing the necessary information required in course of the study. We greatly appreciate the department of Civil Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Minna for the use of the facilities in the laboratory.

REFERENCE

Abdullahi, M. (2005). Compressive Strength of Sandcrete Blocks in Bosso and Shiroro Area of Minna, Niger State, Nigeria. *AU Journal of Technology*, 9(2), 126-132.

Aguwa J.I. (2010). Performance of Laterite-Cement Blocks as Walling Units in Relation to Sandcrete Blocks, *Leonardo Electronic Journal of Practices and Technologies* 16, 190-197.

Aguwa J.I. and Tsado T.Y. (2011). Effect of Mixing Water Content on the Compressive Strength of Laterite Cement Blocks as Walling Units in Buildings. *Environmental Technology and Science Journal (ETSJ)*, 4(1), 60-67.

Alutu O.E. and Oghenejobo A.E. (2006). Strength, durability and cost effectiveness of Cement-Stabilized laterite hollow blocks, *Journal of Engineering Geology and Hydrogeolog.* 39(1), 65-72

Anosike M.N. and Oyebade A.A. (2012). Sandcrete Blocks and Quality Management in Nigeria Building Industries, *Journal of Engineering, Project and Production Management*, 2(1), 37-46.

Baidan B.K, and Tuuli M. M. (2004). Impact of Quality Control Practice in Sandcrete Blocks Production, *Journal of Architectural Engineering*, 10(20), 35-46.

British Standard Institution, BS 2028 (1970): Precast concrete blocks. Her majesty Stationary office. London, England.

Ewa D. E. and Ukpata J. O. (2013). Investigation of the compressive strengths of commercial sandcrete blocks in Calabar Nigeria. *International Journal of Engineering and Technology,* 3 (4), 477-482.

Gooding D. E. and Thomas T. H. (1995). The potential of cement stabilized building Blocks as an urban building material in developing countries. Working Paper No. 44. Development Technology Unit. University of Warwick.

Hamza A. A and Yusuf S. (2011): Comparing the compressive strength of six and nine inches hand moulded sandcrete block. *Journal of Engineering and Applied Sciences.* 3(4), 64-66

Jackson N. and Dhir R. K, (1998), Civil Engineering Material, Macmillan Education Ltd, Hong Kong.

Nigerian Industrial Standard (NIS 87: 2000). Standards for Sandcrete Blocks Approved by Standard Organization of Nigeria (SON), Lagos, Nigeria

Nigerian Industrial Standard (NIS 87: 2004). Standards for Sandcrete Blocks Approved by Standard Organization of Nigeria (SON), Lagos, Nigeria

Nigerian Industrial Standard (NIS 87: 2007). Standards for Sandcrete Blocks Approved by Standard Organization of Nigeria (SON). Lagos, Nigeria

Okpalla D. C. and Ihaza J. O. (1987). Quality of Sandcrete blocks produced in Benin City, Proceedings of the first UniBen Conference on Engineering and Technological Developments. University of Benin, Nigeria.

Olufsayo A. A. (2013). The strength properties of Sandcrete blocks in Ado-Ekiti, Akure and Ile-Ife, Nigeria. *International Journal of Engineering Science Invention.* 2, 25-34

Oyekan G. L. and Kamiyo O. M. (2008). Effect of Nigeria Rice Husk-Ash on some Engineering properties of Sandcrete Blocks, *Research Journal of Applied Sciences*, 3 (5), 345-351.

Oyetola E. B. and Abdullahi M. (2006). The use of Rice Husk Ash in low-cost Sandcrete block production. *Leonardo Electronic Journal of practices and Technologies.*

Oyininuola G. M. and Olalusi O. O. (2004). Assessment of building failure in Nigeria. Lagos and Ibadan Case Study. *African Journal of Science and Technology . Science and Engineering Series,* P: 75-78.

Tsado T.Y. and Yewa M. (2013). An Investigation into Building Structure Failure – Management Perspective: A Case Study of Talba Housing Estate, Mina .Niger State, Nigeria, Proceedings of .3rd Binomial Engineering Conference, School of Engineering and Engi8neering Technology, Federal University of Technology, Minna, Niger State. 508- 514

Vallenger (1971). Construction Industry Hand Book. Medical and Technical Publishing Co. Limited, Aylesbury, PP.45