WebsJournals
Epistemics in Science, Engineering and Technology, Vol.3, No.2, 2013, 272-277
5111-6005, © WebsJournal Inc
Epistemics in Science, Engineering and Technology

Quality Assessment of Sandcrete Blocks in Ibadan – A review

W.O. Ajagbe[1], A.A. Ganiyu[2], and A.A. Adeniji[1]
[1]Department of Civil Engineering, University of Ibadan, Ibadan, Nigeria,
[2]Department of Civil & Environmental Engineering, Kwara State University, Malete,
P.M.B 1530, Ilorin, Kwara State, Nigeria, abideen.ganiyu@kwasu.edu.ng

Abstract

Sandcrete blocks have been widely used for modern building construction in Nigeria; however cases of incessant building collapse are rampant. The usage of substandard sandcrete blocks is a contributing factor. This research was carried out to assess the engineering properties of sandcrete blocks produced in Ibadan and its environs. Two blocks each of size 450 x 225 x 225mm were purchased from selected block industries at eight sampled locations within the study area. Few units of blocks (450 x 225 x 225mm) conforming to the Nigerian Industrial Standard (NIS 87:2007) were also produced to serve as control samples. The 28th day dry compressive strength test result obtained for the sampled blocks ranges between 0.39-2.34N/mm^2. For the control block samples, the average 28th day dry compressive strength of the three tested blocks was 3.02N/mm^2. Conclusively, it was observed that the sandcrete blocks produced in major parts of Ibadan were of low quality and substandard; while the control samples were of adequate strength.

Keywords Sandcrete blocks, compressive strength, Ibadan.

1. Introduction

Housing is one of the basic requirements of man; the ambition of all people to own or have access to decent shelter is not a luxury but a necessity (Nneka, 2004). Different materials are used around the globe for housing and especially for walling. Sandcrete blocks are composite material made from cement, sand and water (Barry, 1999) and are used for both load bearing and non-load bearing walling units (Anozike and Oyebade, 2012). Over 90% of physical infrastructures in Nigeria are made using sandcrete blocks (Baiden and Tuuli, 2004). Ibadan (7°22'N, 3° 58'E) is the capital of Oyo State of Nigeria; the largest city in West Africa and the third largest city in Africa. It is one of the fastest growing cities in Nigeria and this growth is characterized by countless construction of buildings, roads and other infrastructures throughout the city.

The Nigerian Industrial Standard (NIS) for Sandcrete block is a standard reference document developed by the Standard Organisations of Nigeria 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. It was reviewed in 2004 and the latest review was done in 2007 from which NIS 87:2007; Standard for sandcrete blocks emerged as the latest standard reference document for sandcrete block production in Nigeria (NIS, 2007).

Previously in Nigeria, there was no such standard reference guide for block manufacturers to control the quality of blocks produced and ensure the suitability for the intended use, hence it was observed that the blocks were made in uncontrolled conditions and the products did not meet the local building requirements (Oyekan and Kamiyo, 2008). The usual primary requirement of a good sandcrete block is its satisfactory compressive strength, however, the study by Anozike and Oyebade (2012) on sandcrete blocks produced in Abuja (Federal Capital Territory), Ota (Ogun state) and Umuahia (Abia state) and the studies by Banuso and Ejeh (2008), Abdullahi (2005), Mahmoud et al (2010) and Afolayan et al (2008) on sandcrete blocks produced in Kaduna state, Bosso and Shiroro areas of Minna (Niger state), Yola (Adamawa state) and Ondo state respectively revealed that the compressive strength of the blocks were below the standard recommended by the Nigerian Industrial Standard.

The objective of this study is to investigate the level of conformance of block manufacturers in Ibadan and its environs with the NIS standard specifications via the determination of the compressive strength of blocks manufactured and the quality of the manufacturing process.

2. Sandcrete Blocks

Sandcrete blocks are building units used in the construction of wall and partitions; they are composite material made up of cement, sand and water mixed in the proportion of one part of cement to six part of sand

(BSI, 1974). They are masonry units which when used in its normal aspect exceeds the length or width or heights specified for bricks, the blocks can be in solid and hollow rectangular types for normal wall or decorative and perforated in different designs, shapes, sizes, patterns and types for screen wall (NIS, 2000).

Sandcrete blocks are available for the construction of both load bearing and non-load bearing structures and the quality of blocks is a function of the method utilized in the production process and the properties of the constituent materials (Raheem et al., 2012). The quality of sandcrete block is of high importance in load bearing walls because the walls serve as structural components that transfer the applied load safely to the foundation.

Baiden and Tuuli (2004) observed that the quality of sandcrete block is affected by quality of constituent materials, batching of aggregates, mixing of constituent materials, method of molding/production, curing, transportation and storage, mix ratio and water content. BS 6073 (1981) provide guidelines on mix ratio, curing and quality of constituent materials for producing quality blocks which in hardened state will have a high compressive strength, low shrinkage, low moisture movement, low thermal movement and be dense and durable. Sandcrete block is fully matured after 28 (twenty eight) days of production.

The minimum 28 days dry compressive strength of 450 x 225 x 225mm sandcrete block as specified in NIS 87:2007 is 2.5 N/mm^2 and 3.45 N/mm^2 for non-load bearing and load bearing walls respectively. Compressive strength is the maximum stress sustained by the specimen i.e. the maximum load registered on the testing machine divided by the cross sectional area of the specimen. Compressive strength is affected by the mix ratio (Raheem et al. 2012), level of quality control employed (Afolayan et al, 2008), good selection of materials and adequate curing method (Abdullahi, 2005) among other factors.

2.1 Materials used in the manufacturing of sandcrete blocks

Cement

Cement is obtained by burning together, in a definite proportion, a mixture of lime, silica, alumina and iron oxide at high temperatures. It is an extremely ground material having adhesive and cohesive properties, it is the active portion of the binding medium and the only scientifically controlled constituent of Sandcrete blocks (Nevile and Brooks, 2010). Ordinary Portland Cement (OPC) is the most common type of cement while OPC Type I is a general purpose Portland cement suitable for all uses where the special properties of other types are not required i.e. not subjected to sulphate attack from soil or water, or to an objectionable temperature rise (ASTM, 2004). The cement to be used in manufacturing of blocks must have certain qualities such as fineness, soundness, compressive strength, setting time, heat of hydration, loss of ignition and specific gravity in order to play its part effectively (Gambir, 2008). NIS 87:2007 specified the requirements of cement to be used for the manufacturing of Sandcrete blocks in Nigeria.

Sand

Sand is the product of natural or artificial disintegration of rocks and minerals. Sand is an important constituent of most soil and is extremely abundant as a surface deposit along the course or rivers, on the shores of lakes and the seas and in arid regions. The quality of sand has a great influence on the quality of blocks as they constitute between 75 – 90% of blocks by weights (Anozike and Oyebade, 2012). The quality of sand is affected by the source of sand, its grading and storage condition. Sand for sandcrete blocks should be clean and free from deleterious matters and comply with other requirements of BS 882.

Water

Water is required for mixing cement and sand, to wash aggregates and for curing of blocks after manufacturing. It actively participates in the chemical reaction of cement and sand and helps to form strength resulting in cement gel. Potable water, free of suspended particles, inorganic salts, acids and alkalis, oil contamination and algae is recommended for use in the production of Sandcrete blocks (BSI, 1980).

3. Method of manufacture of sandcrete blocks

3.1 Batching

Batching is the process of weighing or volumetrically measuring and introducing into a mixer the ingredients for batch of the sandcrete blocks. To produce a uniform quality concrete mix, the ingredients are measured accurately for each batch. Specification generally requires that materials be measured in individual batches with a tolerance of +/- 1%. There are 2 types of batching: weight and volume, batching by weight is

preferred as it is not affected by bulking (increase in the total volume of moist over the same dry mass) of sand (Chudley and Greeno, 2006).

3.2 Mixing

Mixing of materials can be done manually or mechanically, manual mixing is used for small number of blocks while mechanical mixing is recommended for large number of blocks. Firstly, the cement and sand are mixed in dry form and water is added in sprays and should be enough to make the cement hydrate. Excess water in the mix causes shrinkage and distortion of block on drying (Baiden and Tuuli, 2004).

3.3 Mix ratio

BS 6073 recommends that the mix used for Sandcrete blocks should not be richer than 1:6 i.e. one part by volume of cement to six parts by volume of sand while a 1:8 (cement: sand) mix ratio is specified for manufacturing of sandcrete blocks in Nigeria (NIS, 2007). However it was affirmed that a mix ratio of 1:9 (cement: sand) will still produce sandcrete blocks that meet the minimum 28 days compressive strength stipulated by NIS 87: 2007 and a lower compressive strength are observed from sandcrete blocks with leaner mix ratio (Raheem et al, 2012).

3.4 Water content

The strength, workability and setting time of sandcrete blocks depend largely on the amount of water used in mixing. Strength of sandcrete blocks increases with decreasing water: cement ratio, while blocks made from too dry mix fracture during discharge (Baiden and Tuuli, 2004). A water:cement ratio of 0.45 is specified by NIS 87: 2007 for manufacturing of sandcrete blocks in Nigeria.

3.5 Moulding

Various machines are used for this purpose; the simplest form of this machine is called a lift-close-weighted press. Some block producers are still using manual moulds. Different qualities of blocks are produced by the various machines due to the different level of compaction attained by each. Electric vibrating machine is recommended for higher strength and quality blocks (Baiden and Tuuli, 2004).

3.6 Curing

Curing is employed to maintain satisfactory moisture content and allow proper hydration and hardening of sandcrete blocks. This can be achieved by covering the blocks with wet materials such as polythene sheets, spraying the blocks with water (or steam), using curing compounds etc. The method of curing employed can greatly affect the properties (strength and shrinkage) of sandcrete blocks, since the blocks are laid over a wide surface; wetting is the appropriate curing method (Yusuf and Hamza, 2011). According to NIS 87: 2007, sandcrete blocks are to be cured in a covered area for 7 days.

4. Methodology

4.1 Research methods

Field survey, work study and laboratory experiments were utilized in this research. A survey of sandcrete blocks industries in Ibadan was carried out to identify the location of all manufacturing and selling points of sandcrete blocks in the city. Representative sampled locations including Olorunsogo, Iwo Road, Ashi, Sango, Ojoo, Ijokodo, 110 area and Challenge were chosen to represent other areas and districts of Ibadan land. Work study was deployed by direct observation of the techniques utilized by block manufacturers at selected sites in the production process. Site operations observed included the batching and mix ratio, method of mixing, addition of water and curing.

Two (2) blocks each of size 450 x 225 x 225mm were purchased from selected block industries at eight sampled locations within the study area. Control sandcrete block samples of the same size were moulded according to BS 6073 at a selected block industry, Three (3) of the control samples were randomly selected for the experiment. The specimens were subjected to laboratory test for compressive strength using the Avery 600kN Universal Testing Machine, located at the Mechanical Engineering Department laboratory, The Polytechnic Ibadan.

4.2 Production of control sandcrete block samples

These samples were carefully moulded according to BS 6073, the sandcrete blocks were produced mechanically using a vibrating moulding machine, mechanical method of inducing vibration and compaction was used. The mix ratio was 1: 6 (cement: sand), curing was by manual means. This was done four times daily within the first seven days and later reduced to twice a day till it reaches 28 days.

4.3 Test procedure for compressive strength

The sandcrete blocks were tested on 28th days of their production. The bearing surface of the testing machine (Avery 600kN Universal Testing Machine) was wiped clean, loose sand and other materials were removed from the end of the specimen. The specimen was then placed in the machine and its axis carefully aligned with the center of thrust of the spherically seated plate with a 20mm thick metal plate on the block to be tested in other to spread the load on the Sandcrete block. The machine was then put on and the applied load was gradually increased with a close observation of load and corresponding compression. As the load was being increased, it gets to a point where the increment of load leads to a disproportionate compression. The load was further increased and there was a corresponding increase in the compression till a point where the specimen fractures and break. The broken specimen was then removed from the machine with the aid of head pan, the machine was stopped and reading of the crushing load of the block was taken. The compressive strength of the sandcrete block was calculated from:

Compressive Strength= Crushing Load (N)/ Effective Surface Area. The effective surface area of the block = Total Surface Area – Area of Hollow. This is given by [(450 x 225) – 2(165 x 150)] = 51,750 mm^2.

5. Results and Discussions

The process of manufacturing sandcrete blocks is similar in all the industries selected. The batching method was by volume using wheel barrow to measure the sand, expectedly what is considered "full" varies from one batch to another and varies considerably from one operator to another. The mix ratio (cement: sand) used by the selected manufacturers are 1:16 (5%), 1:20 (45%), 1:24 (45%) and 1:28(45%), these ratios are too lean and are remarkably less than 1:8 specified by NIS 87: 2007 and that of 1:6 specified in BS 6073. In addition, the manual method of mixing was employed in all the selected manufacturing sites, considering the fact that the volume of materials being mixed is large, machine mixing supposed to be used because it will produce a more homogenous materials.

Since volume batching was used by all the selected manufacturers, no consideration was given to bulked sand and this will affect the water content of the mix. Also, no scientific basis was used for the addition of water to the mix, hence it can be easily concluded that the water: cement ratio of 0.45 recommended by NIS 87: 2007 was not considered at all by all the manufacturers. The blocks were also cured in open places for only 2 days instead of 7 days in a covered area as specified by NIS 87: 2007. In addition, blocks that were less than 28 days of age were sold out for usage.

Table 1 shows the compressive strength test result of the control samples, alongside with other samples taken from the selected sandcrete block manufacturers. It was observed that the compressive strength of the control sandcrete blocks ranged between 3.48N/mm^2 and 3.63N/mm^2 which exceeded the minimum compressive strength of 2.5 N/mm^2 and 3.45 N/mm^2 for non-load bearing and load bearing walls respectively as specified by NIS 87: 2007. It also exceeded the 2.8N/mm^2 stated in BS 6073.

However, the average compressive strength results of the samples from the sampled sandcrete block manufacturers (0.42N/mm2, 0.73N/mm^2, 2.75N/mm^2, 1.20N/mm^2, 0.83N/mm^2, 0.50N/mm^2, 0.60/mm^2 and 0.46N/mm^2) were far below the specified minimum values. The results indicated that the extremely lean mix ratio utilised by sandcrete block manufacturers in Ibadan, inadequate curing and the general poor quality control of the manufacturing process were responsible for the low compressive strength of the sandcrete blocks produced, it is believed that these blocks are substandard and are not recommended for construction purposes.

6. Conclusion and Recommendation

This research work considered the compressive strength test of sandcrete block produced in Ibadan. Based on the results of tests and other inquiries it is concluded that the blocks produced in Ibadan environment are substandard because the sandcrete block manufacturers did not comply with the NIS standard specifications and did not utilize international standards like BS 6073.

Table 1 Compressive strength test result of selected block samples in ibadan metropolis

S/N	Name of Block Industry	Selection Point	Crushing Load (N)	Compressive Strength (N/mm^2)	Avg. Compressive Strength (N/mm^2)
1	Control Sample		180	3.48	3.56±0.08
			188	3.63	
			184	3.56	
2	Olaoluwa Samog Blocks	Ojoo	27	0.52	0.42±0.11
			16	0.31	
3	Akinola Blocks	Iwo Road	39	0.75	0.73±0.02
			37	0.71	
4	Onileayo Blocks	Challenge	101	1.95	2.75±0.81
			184	3.56	
5	Kenimak Blocks	Bodija Ashi	68	1.31	1.20±0.12
			56	1.08	
6	Joyous Blocks	110 Area	44	0.85	0.83±0.02
			42	0.81	
7	Ogo Oluwa Blocks	Ijokodo	19	0.37	0.50±0.14
			33	0.64	
8	Christ The King	Sango	27	0.52	0.60±0.08
			35	0.68	
9	Alh. Akinbola Blocks	Olorunsogo	23	0.44	0.46±0.02
			25	0.48	

It is recommended that Engineers should always test for compressive strength of Sandcrete blocks at site before recommending or allowing it for usage. In addition, the Government should enforce the strict compliance with NIS 87:2007 guidelines by all block manufacturing outlets in the city

References

Abdullahi, M. 2005. Compressive Strength of sandcrete blocks in Bosso and Shiroro areas of Minna, Nigeria, AUJT, 9(2), 126-131.

Afolayan, J. O, C. Arum and C. M. Daramola. 2008. Characterisation of the compressive strength of sandcrete blocks in Ondo State, Nigeria, Journal of Civil Engineering Research and Practice, 5(1), 15-28.

American Society for Testing Materials (ASTM) C150:04. 2004. Standard specification for portland cement.

Anozike, M. N and A. A. Oyebade. 2012. Sandcrete blocks and quality management in Nigeria building industry, Journal of Engineering, Project and Production Management, 2012, 2(1), 37-46.

Baiden, B.K and M. Tuuli. 2004. Impact of quality control practices in sandcrete blocks production, Journal of Architectural Engineering, 10(2), 55-60.

Banuso, O. R. and S. P. Ejeh. 2008. Assessment of quality of sandcrete blocks in Kaduna State-Nigeria, Journal of Construction 2(1), 11-14.

Barry R. 1999. The construction of building, 1, pp 54-55, 7th edition, Blackwell Science, London.

British Standards Institution (BSI). 1980. Methods of test for water for making concrete, BS 3148, British Standards Institution, London.

British Standards Institution (BSI). 1981. Precast concrete masonry units, BS 6073, British Standards Institution, London.

British Standards Institution (BSI). 1996. Specification for aggregates from natural sources for concrete, BS 882, British Standards Institution, London.

British Standards Institution (BSI). 1974. Specification for clay bricks and blocks, BS 3921, British Standards Institution, London.

Chudley, R. and R. Greeno. 2006. Building construction handbook, 6th Edition, Elsevier, Oxford.

Gambhir, M.L. 2008, Concrete technology, 3rd edition, Tata McGraw-Hill, New Delhi.

Mahmoud, H., H. A. Hamma and H. A. Abba. 2010. Compressive strength of marketed sandcrete blocks produced in Yola, Nigeria, Journal of Engineering and Applied Sciences, Vol. 2, pp 74-81.

Neville, A.M and J. J. Brooks. 2010. Concrete technology, Second Edition, Pearson Educational Books.

Nigerian Industrial Standards NIS 87:2007. 2007. Nigerian industrial standard: standard for sandcrete blocks, Standards Organisation of Nigeria, Lagos.

Nigerian Industrial Standards (NIS). 2000. Nigerian industrial standard: standard for sandcrete blocks Standards Organisation of Nigeria, Lagos.

Nneka,U.I. 2004. Nigeria: building better lives brick by brick,

http://www.fordifp.org/tabid/116/default.aspx
Oyekan, G. L. and O. M. Kamiyo. 2008. effects of granites fines on the structural and hygrothermal properties of sandcrete blocks, Journal of Engineering and Applied Sciences, 3(9), 735-741.
Raheem, A.A., A. K. Momoh and A. A. Soyingbe. 2012. Comparative analysis of sandcrete hollow blocks and laterite interlocking blocks as walling elements, International Journal of Sustainable Construction & Engineering Technology, 3(1), 79-88.
Yusuf, S. and A. A. Hamza. 2011. Comparing the compressive strength of six and nine Inches hand moulded sndcrete blocks, Journal of Engineering and Applied Sciences, 3, pp 64-69.