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Quality Assessment of Sandcrete Blocks Produced with River Sand in Ogun State, Nigeria

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Abstract. In Nigeria construction industry sandcrete block is an important building material, it is used in the construction of the building and other useful physical infrastructure. Many of the sandcrete blocks are produced at different location and environment using different aggregate materials without resort to the minimum quality standard expected of the sandcrete block. It is on this bases that the study assessed the quality of sandcrete block produced with river sand in order to determine their compliance level to the standard expected of a sandcrete block. Eighteen (18) numbers of sandcrete blocks of size 225mmx225mmx450mm were gotten from three different production locations in Ifo, Ogun state Nigeria. Sieve analyses, bulk density, silt content, and the compressive test was carried out to determine the property quality of aggregate material (river sand) used for the production of the blocks and its strength. The result shows that the aggregate material used was of good quality suitable for the production of the sandcrete block. The result also shows that the average compressive strength of 1.16N/mm2 for sandcrete blocks from different production sites does not meet up with the minimum requirement for sandcrete block compressive strength as stipulated by NIS 2007 and ISO 848492-1994. The study revealed that the quality of the block produced is not affected by the quality of aggregate used but by poor quality control of aggregate and other materials used in the production of the blocks. It further revealed that the block quality is also affected by shoddy/improper curing of blocks produced. The study, therefore, concluded that regulatory and professional bodies should organize seminars for the local producers of sandcrete blocks on the best practice of producing quality blocks in meeting the required quality standard for construction work to avoid structural cracks and collapsing of building.

Keywords: Sandcrete block; Sieve analysis; Bulk density; Silt content; Compressive strength.

1 Introduction

Quality is the characteristic and features expected of a product and its ability to meeting tacit needs [1]. Anosike [2] Opined that quality is falling in line with

specification on the totality of features required by a product. In Nigeria, persistent building collapses have led to the loss of properties and lives of its occupant which is due to the use of substandard building materials [3, 4]. Ewa [5] observed that the outward appearance of the most building is lost to cracks and other defects due to the poor sandcrete blocks quality used as walling units. The word sandcrete has not been assigned with any perfect definition, but it's as always been defined by most workers in a way that conforms to their own purpose [6]. Sandcrete block is used for nearly 60% of building materials in Nigeria and other developing nations in Africa for building products. Oyetola [7] state that in order to minimize construction cost, the sandcrete blocks is widely used among West African populace especially in Nigeria. Ajao[8] observed that low amount of ordinary Portland cement was used in the production of these blocks, which makes the quality of blocks inconsistency due to poor quality control of the materials used. Sandcrete blocks generally are moulded to different shape and sizes using composite material which includes cement, sand, and water [9]. Block as defined by BS6073-Part 2: (1981) is a heterogeneous building material with different unit sizes which its dimension should not exceed 650mm and its length should be greater than its height. Conversely, [10] define sandcrete blocks as the walling unit that exceeds the dimensions specified for brick when laid in its normal position. In Nigeria housing provision over 90% of the building, the structure was constructed using sandcrete blocks and it is the most popular and commonest Mansory walling units [11]. Among the constituent of producing a sandcrete block, cement is the most costly and important material to give suitable quality required by various producers. Commercial producers of these blocks reduce the quantity of cement needed in order to exploit profit and reduce cost [12]. The Standard Organization of Nigeria [13] in assessing the quality of materials use in block production and to control the production process provides a reference document containing minimum requirements for different kinds of sandcrete block and their uses. The document state that the minimum compressive strength of sandcrete blocks should range between 2.5N/mm2 and 3.45N/mm2. Anosike [14]and [11]observed that Inappropriate use of material for the production of these blocks leads to micro cracks on the wall after construction. Ogunbayo [15] state that a component of the building needs a standard designed, that would be managed and controlled by government institutions and construction professionals. Anosike [14] state that sandcrete block is usually a composition of (1:6) mix of cement and sand sprinkled with water and allowed to dry naturally. Users and producers of sandcrete blocks in most cases lack adequate quality information and engineering knowledge on the requirement of sandcrete blocks [5]. Oyekan [4] observed that in many parts of Nigeria manufacturer have continued to produce sandcrete blocks without reference to building requirement or quality as specified by [13] and this makes poor quality control of aggregate used in the production of sandcrete block production affect the strength of the blocks. The study of [6] shown that the compressive strengths of commercial sandcrete blocks sampled in Minna, Nigeria were found to be between 0.11N/mm2 and 0.75 N/mm2 which does not meet the minimum strength as stipulated by NIS 87:2000.The result of the study of [8] Ajao et al (2018) indicated that the compressive strength of sandcrete blocks manufacturers within three States; Lagos, Ondo and Oyo all in Nigeria ranged between 0.95 N/mm2 to 1.33 N/mm2, 0.79 N/mm2 to 1.02 N/mm2, and 0.77 N/mm2 to 1.14

N/mm2. These values gotten from blocks suppliers within South Western Nigerian states were far behind the stipulated minimum standard for sandcrete blocks specified by [13] of 2.5 N/mm2 for individual block and 3.45 N/mm2 for an average of five blocks. The finding of the study of [5] revealed that the compressive strength of sandcrete blocks manufactured within the Calabar city after 28 day ranges from 0.23N/mm2 to 0.58N/mm2, with an average compressive strength of 0.35N/mm2. These values fall below the minimum prescribed value for Loadbearing sandcrete block specified by [13] and [16]. Block quality and its strength could be affected by a different factor such as poor quality control of aggregates, bad mix, improper curing. It is on this bases that this study investigates the property quality of river sand used in the production of sandcrete blocks in order to determine its effect on the strength parameter of the sandcrete block.

2 Methodology and Material.

Three (3) block manufacturing sites were visited and 6 (six) sandcrete blocks were selected randomly from each site. All the blocks selected were produced with vibrating moulding machine using a mix ratio of (1:10). The blocks were cured for 28 days and their compressive strengths determined in accordance with BSI strength testing of sandcrete block. The aggregate material (river sand) used in the production of the blocks were also collected and sieve analyses, bulk density, and silt content was carried out to determine the property quality of aggregate material in accordance with BS EN 933-1:1997. All the block manufacture make use of Dangote cement of (42.5R) which is produced in accordance with BS EN197-1: 2011 cement part 1. Water from the borehole was used in the production of the sampled sandcrete blocks in all the production sites. The safety procedure for the research was in line with the finding of [17].

3 Results

Table 1. Sieve analysis of aggregate (river sand) used for sandcrete block production 1

S/N	Sieve sizes (mm)	% soil passing Production site M1	% soil passing Production site M2	% soil passing Production site M3
1	20	99.31	99.89	99.86
2	10	97.21	97.96	99.72
3	5.0	95.83	89.80	99.58
4	2.0	77.02	73.47	99.16
5	1.0	40.09	33.06	98.31
6	0.5	18.49	19.18	7.36
7	0.25	5.25	12.65	1.70
8	0.1	1.07	1.22	0
9	0.075	0	0	0
10	Pan	0	0	0

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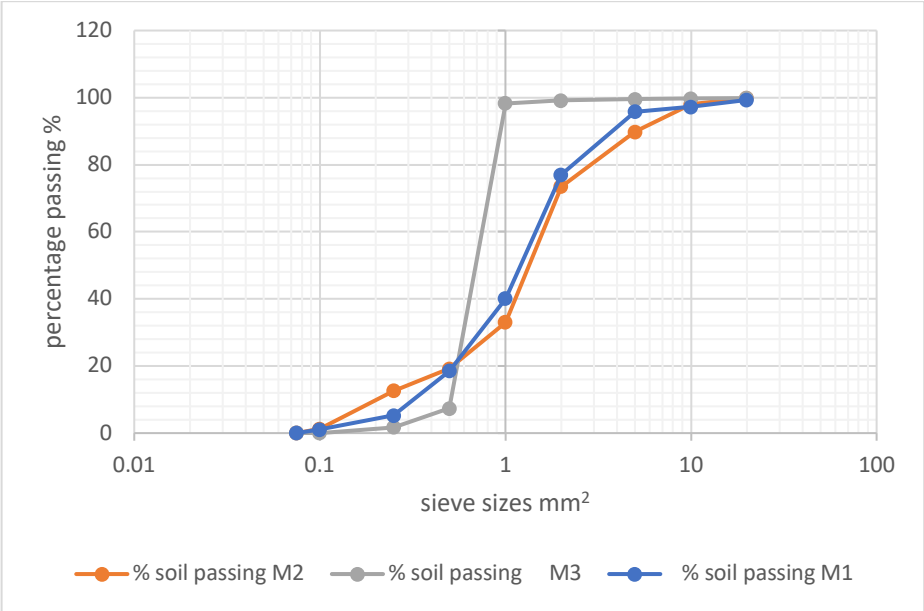

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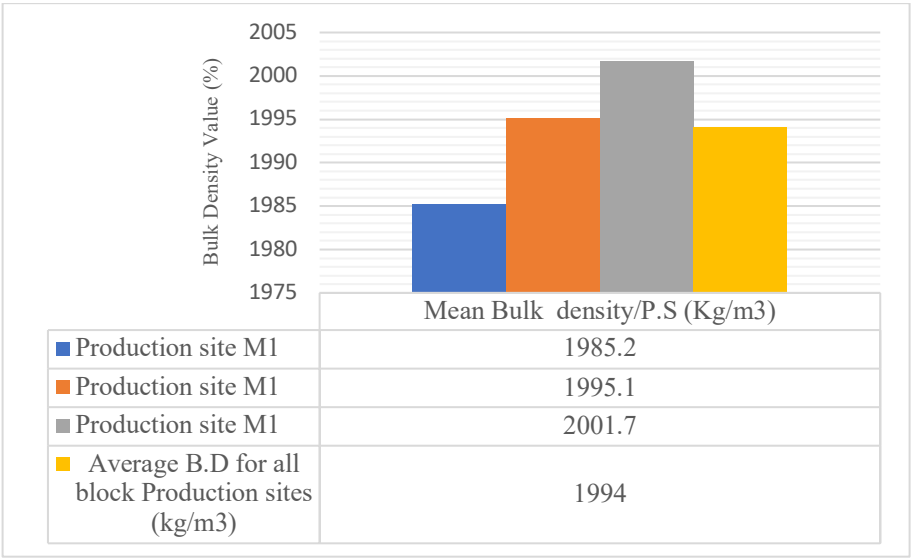
113 **Fig. 1**: Analysis of aggregate (river sand) used in block production sites

114 **Table 2**. Analysis of bulk Density for Manufacturers block sampled

Block production site	Dry Weight (kg) Block size: 225mmx225x450mm	Bulk Density kg/m^3 Block size: 225mmx225x450mm	Mean Bulk Density kg/m^3
	SITE M1		
BLK1	20.8	2047.6	
BLK2	19.8	1949.1	
BLK3	19.9	1958.9	1985.2
	SITE M2		
BLK1	20.1	1978.9	
BLK 2	20.9	2057.4	1995.1
BLK3	19.8	1949.1	
	SITE M3		
BLK1	20.3	1998.3	
BLK2	19.9	1958.9	2001.7
BLK3	20.6	2047.8	



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116 **Fig.2**: Average Bulk density for sandcrete blocks from all block production sites

117 **Table 3**. Analysis of silt content for manufacturer block sampled

	Production site M1			Production site M2			Production Site M3		
Sample	A	B	C	A	B	C	A	B	C
River sand (ml)	100	100	100	100	100	100	100	100	100
Water (ml)	200	200	200	200	200	200	200	200	200
Vol. of R/S retained (ml)	96	93	94	97	94	96	96	97	95
Vol. of salt	1tea spoon	1tea spoon	1tea spoon	1tea spoon	1tea spoon	1tea spoon	1tea spoon	1tea spoon	1tea spoon
Organic mat present (ml)	2	2	2	1	1	2	2	2	2
% Silt content	2	5	4	2	4	2	2	1	3
Ave. silt content (%)		3.7			2.7			3	

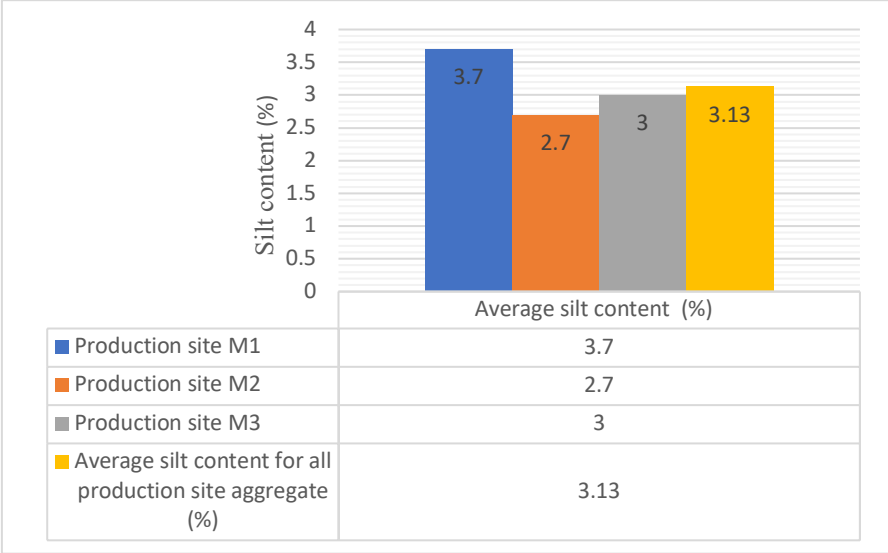
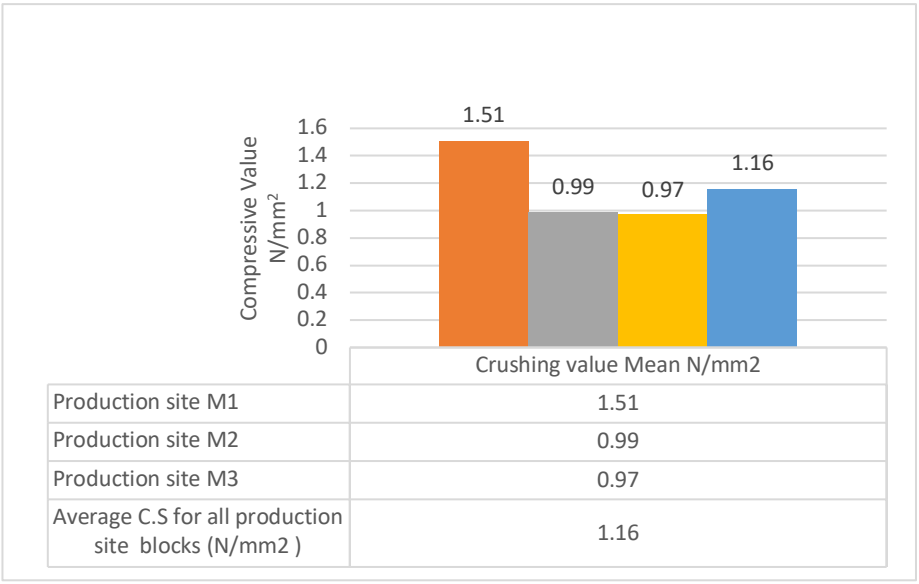


Fig. 3: Average silt content for river sand for all production site

Table 4. Compressive Strength of Manufactured Blocks

S/N	Site	Sandcrete block Size (mm)	Crushing strength (N/mm^2) of sampled blocks						C.S Mean (N/mm^2)
1	M1	225x225x450	1.33	1.44	0.89	1.0	1.22	1.03	1.51
2	M2	225x225x450	1.10	0.84	0.99	1.10	0.93	0.97	0.99
3	M3	225x225x450	0.99	1.10	0.88	1.11	0.77	1.02	0.97



	Crushing value Mean N/mm2
Production site M1	1.51
Production site M2	0.99
Production site M3	0.97
Average C.S for all production site blocks (N/mm2)	1.16

Fig. 4: Average compressive strength for manufacturers block sampled

4 Discussion

The sieve analysis was carried out in accordance with BS EN 933- 1: 1997. The particle size distribution is shown in Table 1 and Figure1. The result showed that the three Samples gotten from the production site of sandcrete blocks within the study area satisfied the particle size requirements of BS EN 933- 1: 1997. The result is similar to [6] and [18]

Bulk density analysis was carried out on sandcrete blocks sampled from the production sites. The result from Table 2 showed that production site M1 blocks as the lowest density value of 1985.2kg/mm3, followed by production site M2 with 1995 kg/mm3 while the production site M3 has the highest density value of 2001.7. The result from the table showed that bulk density values for individual sandcrete production sites meet required values 1920 kg/mm3 for an individual block as stipulated by [13].

The result from figure 2 showed the average density value of 1994kg/mm3 for sandcrete block taken from all production sites .the result from the table and the figure showed that bulk density values for individual sandcrete production sites and the means for all sandcrete block production site meet required values of 2010kg/mm3 for means of two or more blocks as stipulated by NIS 87:2000. The result is similar to [19].

Silt content analysis was carried out on aggregate (river sand) samples taken from sandcrete block production sites. The result from Table 3 showed that aggregate from production site M2 as the lowest silt content of 2%, followed by production site M3

with 3% silt content while the aggregate of production site M3 has the highest silt content of 3.7%.

The result from figure 3 showed average Silt content of 3.13% for aggregates in all block production sites. The result from figure 3 showed that aggregate used by the production sites is suitable for sandcrete block production. The result is similar to [20] and [21].

Compressive strength test was carried out on sandcrete blocks taken from the three block production sites. The result from Table 4 showed that sandcrete block from production site M2 as the lowest compressive mean value of 0.99N/mm2, followed by production site M3 with 0.97N/mm2 while production site M1 has the highest compressive strength of 1.51N/mm2.

The result from figure 4 showed the average compressive strength value of 1.16N/mm2 for all block production sites sandcrete blocks sampled. And this value does not fall within the stipulated minimum strength for blocks by NIS 2007 and ISO 848492-1994. The result is similar to [19], [14], and [6].

5 Conclusions

The study investigates the quality of blocks produced using fine aggregate (river sand), cement and water. From the result of the study, it can be deduced that aggregate material used in the production of the sandcrete block falls within the specific requirement by EN933-1 2012 and is suitable for block production. The blocks produced with the aggregate have a bulk density that is in alignment with the required stipulated values by NIS 87:2007. The result shows that the aggregate contains an average silt content of 3%, which shows further that the aggregate is a good material for block production. The result of the study shows that blocks produced with the aggregates have a compressive strength mean of 1.51N/mm2(M1),0.99N/mm2(M2) and 0.97N/mm2 and average compressive strength of 1.16N/mm2 for all block production sites which does meet up with minimum requirement for sandcrete block compressive strength as stipulated by NIS 2007 and ISO 848492-1994. The study revealed that the quality of the block produced is not affected by the quality of aggregate used but by poor quality control of aggregate and other materials used in the production. It further revealed that the block quality is also affected through improper curing of blocks produced. The study, therefore, concluded that regulatory and professional bodies should organize seminars for the local producers of sandcrete blocks on the best practice of producing quality blocks in meeting the required quality standard required for construction work to avoid structural cracks and collapsing of building. Future research work can be carried out on compressive strength of solid and hollow sandcrete blocks produced manually using river sand. Furthermore, the comparative strength of sandcrete blocks produced with a machine and manual mould using river sand can be investigated.

References

1. Williamson, A., Rogerson, J.H., Vella, A.D.: Quality system auditors' attitudes and methods: a survey. Int. J. Qual. Reliab. Manag. 13, 39–52 (1996).
2. Anosike, N..: Parameters for good site concrete production management practice in Nigeria, (2011).
3. Fakere, A. A., Fadairo, G., & Fakere, R.A.: Assessment of building collapse in Nigeria: A case of naval building, Abuja, Nigeria. Int. J. Eng. Technol. 2, 584–591 (2012).
4. Oyekan, G. L., & Kamiyo, O.M.: Effect of Nigerian rice husk ash on some engineering properties of sandcrete blocks and concrete. Res. J. Appl. Sci. 3, 345–351. (2008).
5. Ewa, D., and, J.U.-I.J. of E., 2013, undefined: Investigation of the compressive strengths of commercial sandcrete blocks in Calabar Nigeria. researchgate.net.
6. Abdullahi M: Compressive strength of sandcrete blocks in Bosso and Shiroro areas of Minna, Nigeria. AU JT. 9, 126–131 (2005).
7. Oyetola, E., and M Abdullahi: The use of rice husk ash in low-cost sandcrete block production. Leonardo Electron. J. Pract. Technol. 58–70 (2006).
8. Ajao, A. M., Ogunbayo, B. F., Ogundipe, K. E., Bamigboye, G., Ogunde, A., & Tunji-Olayeni, P.F.: Assessment of sandcrete blocks manufacturers 'compliance to minimum standard requirements by standard organisation of Nigeria in Southwest, Nigeria. Int. J. Appl. Eng. Res. 13, 4162–4172 (2018).
9. Barry, R.: The Construction of Buildings,Vol.1. , Blackwell Science, Oxford England.
10. Standard Organization of Nigeria: NIS 87:2007 Nigerian Industrial Standard: Standard for Sandcrete Blocks. , Lagos, Nigeria.
11. Baiden, B.K., Tuuli, M.M.: Impact of Quality Control Practices in Sandcrete Blocks Production. J. Archit. Eng. 10, 53–60 (2004).
12. Okafor, F. O., & Ewa, D.E.: Predicting the compressive strength of obudu earth blocks stabilized with cement kiln dust. Niger. J. Technol. 32, 149–155 (2012).
13. Standard Organisation of Nigeria.: NIS87: 2000. "Standard for Sandcrete blocks". Nigeria Industrial Standard, Lagos Nigeria (2000).
14. Anosike, M., Oyebade, A.: Sandcrete Blocks and Quality Management in. J. Eng. Proj. Prod. Manag. 2, 37–46 (2011).
15. Ogunbayo, B. F., Ajao, A. M., Alagbe, O. T., Ogundipe, K. E., Tunji-Olayeni, P. F., & Ogunde, A.: Residents' Facilities Satisfaction in Housing Project Delivered by Public Private Partnership (PPP) in Ogun state, Nigeria. Int. J. Civ. Eng. Technol. 9, 562–577 (2018).
16. IBC-I Council: International building code. (2006).
17. Ogundipe, K.E., Ogunde, A.O., Olaniran, H.F., Ajao, A.M., Ogunbayo, B.F., Ogundipe, J.A.: Missing Gaps in Safety Education and Practices: Academia Perspectives. Int. J. Civ. Eng. Technol. (IJCIET. 9, 273–289 (2018).
18. Ogunbayo, B.F., Ajao, A.M., Ogundipe, K.E., Joshua, O., Durotoye, T.O., Bamigboye, G.O.: Study of aggregate dormancy and its effects on the properties of aggregates and concrete. Cogent Eng. 5, 1–11 (2018).

https://doi.org/10.1080/23311916.2018.1519944.
19. Ajao, A. M., Ogunbayo, B. F., Ogundipe, K. E., Joshua, O., & Olofinnade, O.M.: Experimental datasets on properties of river sand as an aggregate in replacement of crushed rock for interlocking stones production. Data Br. 20, 20, 602–608 (2018).
20. Ojerinde, A. M., Ajao, A. M., Ogunbayo, B. F., Stevenson, V., & Latif, E.: Plea 2018 Hong Kong. In: plea (2018).
21. Aginam, C. H., Chidolue, C. A., & Nwakire, C.: Investigating the effects of coarse aggregate types on the compressive strength of concrete. International Journal of Engineering Research and Applications. Int. J. Eng. Res. Appl. 3, 1140–1144 (2013).