Proceedings:

The 19th Academic Conference of Hummingbird Publications and Research International on Third World Nations for Development Communities in 21st Century. Vol. 19 No.2, 13th September, 2019 at Baayero University, BUK, Old Side Campus, Kano, Kano State, Nigeria

ASSESSMENT OF THE QUALITY OF SANDCRETE HOLLOW BLOCKS TOWARDS REDUCING BUILDING COLLAPSE IN KADUNA METROPOLIS

OLADAPO ABDULRASHEED, IBRAHIM DAUDA (PhD) AND MOHAMMED ABDULKADIR (PhD)

Department of Industrial and Technology Education, Federal University of Technology Minna, Niger State, Nigeria

Abstract

The paper assesse the quality of sandcrete hollow blocks in some selected Local Government Area, (Igabi, Kaduna North, and Kaduna South) in Kaduna Metropolis. This is with the view of producing quality sandcrete hollow blocks in the Metropolis. Experimental research design was adopted for the study. Twelve (12) sandcrete hollow blocks industries were used for the study using purposive sampling method for the selection. Samples of sand and sandcrete hollow blocks 450mmx150mmx225mm (6") were obtained for laboratory tests on specific gravity and compressive strength analysis. Results obtained were compared with the standard set by the Nigeria Industrial Standard. The specific gravity of sand 2.5–2.7and 28 days compressive strength of the 150mm sandcrete hollow blocks recorded average strength ranging from 1.84 N/mm^2 – 1.95 N/mm^2. The compressive strength of the sandcrete hollow blocks was less than 2.0N/mm^2 in eleven (11) sandcrete hollow blocks industries and one (1) satisfied the NIS specification. The findings revealed among others that the mix ratio used by the sandcrete hollow blocks industries result to low quality blocks. The study therefore, recommended that the importance of adhering to standard specifications should be emphasized and sticks penalties to melt out to erring producers by the Nigeria Industrial Standard Organization.

Index Terms: *Building, Sandcrete Hollow Block, Specific Gravity, Compressive Strength, Collapse and Assessment*

Introduction

The important of building construction to man cannot be over emphasized. This is because, building construction provide shelter for man, his properties and his activities. Oseghale et. al (2015) stated that building construction provides humanity with a great variety of accommodation in form of residence, offices, schools, hospital, industries, commercial and religion activities. For the buildings to function effectively, it must be of the required materials that are capable of withstanding the load imposed upon it and also to satisfy the test of time. Chinwokwu (2000) observed that, in order

to achieve the purpose for which building are constructed, building must be properly planned, designed, and erected with correct material to provide the desired satisfaction from the environment.

Sandcrete hollow block one of the essential materials used in the building construction in Nigeria and particularly in Kaduna metropolis. Nigeria Industrial Standard (NIS) 87 (2004). Stated that sandcrete hollow block are also composite material made up of cement, sand and water added together in the proportion of 1:6 (one part of cement to six part of sand). Sandcrete blocks are either produced as solid or hollow and are available in different sizes, 450mm x 250mm x 250mm (9") and 450mm x 150mm x 250mm (6") blocks in any parts of the country. They can as well be molded manually or mechanically. Sandcrete blocks should be lighter in weight, cheap, having better thermal resistance, accept nail or screw, have keyed surface for application of plastered or rendered finishes, compressive strength, water absorption, durable, moisture movement, sound insulation and fire resistance. Oyekan and Kamiyo (2011) stressed that sandcrete hollow blocks industries must use appropriate sand and determination of the compressive strength of sandcrete hollow blocks.

Sand is one of the major natural resources used in construction as well as essential material in the process of mixing for the production of sandcrete blocks Duggal, (2003). Sand is the product of natural or artificial disintegration of rocks and minerals. Sand for the production of sandcrete hollow blocks must be sharp, clean and should be free from clay soil, loam soil, dirty, organic or chemical matter The specific gravity of sand used for the production of sandcrete hollow block need to be measure in order to produce quality sandcrete hollow block (Aladeloba et al 2015).

The specific gravity explain that, based on its value, if the object will sink or float in our reference substance. Specific gravity is the ratio of the density of a substance to the density of a reference substance; equivalently, it is the ratio of the mass of a substance to the mass of a reference substance for the same given volume. Specific gravity test is done to measure the strength or quality of the materials (Nissa 2015). The qualities of sand used in the production of sandcrete hollow blocks determine the compressive strength of the sandcrete blocks (Aginam et al, 2013).

Compressive strength of sandcrete blocks are required to know the suitability of the blocks. Compressive strength is the ability of a sandcrete hollow block to withstand imposed loads. It can be measured by plotting applied force against deformation in testing machine. The compressive strength is often measured on mechanical testing machine or manual testing machine. The compressive strength of building units plays an important role in the durability, stability and average strength of a building (Otunyo and Okechukwu 2017). Thus will required the assessment of sandcrete hollow block which is one of the materials used in building construction.

Assessment has been used by many scholars on different fields, connotes different meaning with different people. Kennet and Keith (2002) defined assessment as the process by which the value of a building material's performance and quality is

obtained. Assessment can be seen as the systematic process of judging the worth, desirability, effectiveness or adequacy of something according to a given criteria. It was argued that any assessment of the cause of building failures must acknowledge the part played by material with the specifications in the building industry. None compliance may result in partial or total failure of materials in the building (Igwe 2008).

Building collapse is an unexpected structure failure caused by natural occurrences such as earth quake, slide, or by raw materials being used in the building construction. Building failure occurs when there is a defect in one or more elements of the building caused by inability of the material making up the components of such building elements to perform its original function effectively, which may finally lead to building collapse Ayodeji (2011). Building collapse has lead to the death of many people with others sustained higher degree of injuries. The use of inferior sanderete blocks produced by many block industries seems to be the contributory factor as it is not quite certain whether sanderete block industries in Kaduna Metropolis use appropriate sand, as well as identifying the compressive strength of sanderete hollow blocks used for the building construction in Kaduna Metropolis. It is against these backdrops that the researcher intends to assess the quality of sanderete blocks towards reducing building collapse in Kaduna metropolis..

Aim and Objectives of the Study

The aim of this study is to assess the quality of sanderete hollow blocks towards reducing building collapse in Kaduna Metropolis. Specifically, the study seek to achieve the following objectives:

1. Determine the specific gravity of sand used in the production of sanderete block in Kaduna metropolis.
2. Identify the compressive strength of sanderete blocks used for building construction in Kaduna metropolis.

Research Questions

The following research questions guided the study.

1. What is the specific gravity of the sand used for the production of sanderete blocks in Kaduna Metropolis?
2. What is the compressive strength of the sanderete blocks produce used in the construction of building in Kaduna Metropolis?

METHODOLOGY

Experimental research design was adopted for the study. Experimental research design was adopted for the specific gravity of sand and identifying the compressive strength of sanderete hollow block for building construction in Kaduna Metropolis. Jayesh, (2014) stated that experimental design are concerned with examination of the effect of

independent variable on the dependent variable, where the independent variable is manipulated through treatment or interventions and the effect of those interventions is observed on the dependent. Experimental research design is the blue print of procedure which enables the researcher to test hypothesis by reaching valid conclusions about relationship between dependent and independent variables (Patrick 2015). The design is considered appropriate as the present study seeks to produce quality sandcrete hollow block in Kaduna metropolis. The study was conducted in Kaduna Metropolis. Kaduna Metropolis consists of three Local Government Areas, they include; Kaduna North local Government, Igabi Local Government and Kaduna South Local Government. The metropolis is located between Longitude 70 21'and 70 30' East of the Greenwich Meridian and Latitude 100 23'and 100 36' North of the Equator.

The population for this study will comprise 120 450mm x 150mm x 225mm (6") sandcrete hollow blocks from 12 selected registered functional sandcrete hollow blocks industries, 3 from Igabi local, 5 from Kaduna North Local Government and 4 from Kaduna South Local Government. 36 sandcrete blocks will be crushed on the 7^{th} days after curing, 36 sandcrete hollow blocks will be crushed on the 14^{th} days after curing while 36 sandcrete hollow blocks will be crushed on the 28^{th} days after curing the sandcrete blocks. The samples will be labelled A – L respectively. Purposive sampling will be used to choose the 12 registered functional sandcrete block hollow industries. According to Gbenga (2005) purposive sampling focus on particular characteristics of a population that are of interest, which will best enable one to answer the research question.

Three experts validated the instruments. Two experts from Building Section, Departments of Industrial and Technology Education, Federal University of Technology, Minna and one expert from Building Department, Kaduna Polytechnic, Barnawa, Kaduna.

Comparison of Control Specimens

Test	Standard Requirement
Specific gravity of Sand	2.65-2.67
Compressive Strength N/mm^2	$2.0N/mm^2$ non load bearing (150mm)

Source: NIS (2007)

Procedure for Testing the Sandcrete Hollow Block

A mechanical compression testing machine with a maximum load capacity of 500kN will be used for this test. Samples of 450mm x 150mm x 250mm (6") will be purchase and labelled A-L crushed in order to obtain their compressive strengths. The following procedure will be followed: The sandcrete blocks will be crushed on the 7^{th}, 14^{th} and 28^{th} days after their production. The bearing surface of the compressive strength testing machine will be wiped clean. Smooth surface wood (serving as base plate) will be placed at the bottom and top of each specimen block so as to ensure uniform

distribution of load for accurate crushing. The specimen will then be placed in the machine and its axis carefully aligned with the center of thrust of the spherically seated plate with a 20mm thick base plate on the blocks to be tested in order to spread the load on the Sandcrete block. The machine was then put on and the applied load will be gradually increased with a close observation on load and corresponding compression. As the load was being increased, it got to a point where the increment of load led to a disproportionate compression. The load will further be increased and there will 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 will be taken.

Specific gravity is the ratio of for weight in air a unit volume of material to the same volume of water at a stated temperature. Specific gravity depends on the amount of voids and the specific of the materials of which it is composed. Formula $\frac{W2-W1}{(W4-W1)-(W3-W2)}$

Procedure for specific gravity test on sand

Samples of sand was collected from the selected sandcrete hollow blocks industries and will be labeled A-L. The following apparatus will be used to conduct the specific gravity test on the sand.

Where:

W1 = Weight of the empty density bottle.
W2 = Weight of density bottle with 1/3 of sand sample
W3 = Weight of density bottle with 1/3 of sand sample and water density bottle.
W4 = Weight of density bottle with clean water

PRESENTATION OF DATA AND DISCUSSION

Research Question 1: What is the specific gravity of sand used for the Production of sandcrete hollow block in Kaduna Metropolis?

Table 4.1: Summary of result of Specific Gravity of Sand Samples from 12 industries in Kaduna Metropolis

Blocks Industries	W_1	W_2	W_3	W_4	Specific Gravity
A	100	150	230	198	2.75
B	100	170	228	198	1.95
C	100	150	228	198	2.70
D	100	150	228	198	2.50
E	100	150	226	198	2.27
F	100	150	226	198	2.27
G	100	152	230	198	2.60

H	100	152	230	198	2.60
I	100	150	230	198	2.77
J	100	150	230	198	2.77
K	100	152	230	198	2.60
L	100	150	230	198	2.70

NIS Specification: The specific gravity of sand range between 2.65 to 2.67
The result of the specific gravity tests on the sand samples on A - L showed that the sand are within the range the of standard specification of NIS and therefore considered good in quality and suitable for the production of sandcrete hollow blocks. While B fall below the range of standard specification of NIS and therefore considered poor in quality and not suitable for the production of sandcrete hollow blocks.
Research Question 2: What is the compressive strength of the sandcrete blocks produce used in the construction of building in Kaduna Metropolis?

Table 4.2: Summary of results of the compressive strength of the sandcrete blocks from 12 industries in Kaduna Metropolis.

SAMPLES	AVERAGE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	REMARK	AVERAGE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	REMARK	AVERAGE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)	REMARK
A	151.667	2.379	FAIL	153.67	2.41	FAIL	155.67	2.44	FAIL
B	165.000	2.588	FAIL	166.00	2.60	FAIL	167.00	2.62	GOOD
C	142.667	2.238	FAIL	144.33	2.26	FAIL	147.00	2.31	FAIL
D	148.667	2.332	FAIL	150.00	2.35	FAIL	151.67	2.38	FAIL
E	134.333	2.107	FAIL	136.67	2.14	FAIL	139.33	2.19	FAIL
F	135.333	2.123	FAIL	136.00	2.13	FAIL	137.00	2.15	FAIL
G	136.667	2.144	FAIL	138.33	2.17	FAIL	143.00	2.24	FAIL
H	143.667	2.254	FAIL	146.67	2.30	FAIL	149.33	2.34	FAIL
I	136.667	2.144	FAIL	138.00	2.16	FAIL	141.33	2.22	FAIL
J	144.667	2.269	FAIL	147.67	2.32	FAIL	148.00	2.32	FAIL
K	162.000	2.541	FAIL	164.00	2.57	FAIL	166.67	2.61	GOOD
L	145.000	2.275	FAIL	146.33	2.30	FAIL	148.33	2.33	FAIL

NIS Specification: The lowest crushing strength of individual non- load bearing blocks shall not be less than 2.0 N/mm^2 for machine vibrated according to NIS specification (NIS 2007).
The 150mm sandcrete hollow blocks tested showed average compressive strength of 2.33 which is less than the NIS specification. This result shows that the blocks have poor compressive strength.

Findings

Findings on research question 1 showed that, the specific gravity (SG) of the sand (specimen) was good in quality industries A, C, D, E, F, G, H, I, J, K and L, while the specific gravity of sand B was poor in quality.
The findings on research question 2 showed that the specific gravity of the cement (specimen) on industries A, B, C, D, E, F, G, H, I, J, K, L, and I are within the range of the standard specification of NIS and therefore considered good in quality.

Recommendations

Based on the findings of the study, recommendations were proffered

1. Sandcrete Blocks industries should produce quality blocks and ensure a compressive strength of 2.5 N/mm^2
2. Standard mix ratio should be adhered to in the production by the sandcrete hollow blocks industries.

REFERENCES

Aladeloba, E. O., Okesoto, J. & Akerele, A. (2015). Assessment of standardization of sandcrete blocks production in Lagos State. *International journal of development research.* 5 (2) 3428-3434

Aginam, O., & Joel, M. (2013). Use of cement sand admixture in laterite brick production for low cost housing, *Leonardo Electronic Journal of Practices and Technologies,* Issue 12,pp. 163-174.

Ayodeji, E. O. (2011). An examination on the causes & effects of building collapse in Nigeria. Retrieved. 18th, June, 2018. From: https://www.researchgate.net/Publication/264853502

Chinwokwu, G. (2000). The Role of professionals in Averting Building collapse, proceedings of a seminar on Building collapse In Nigeria. The Nigeria institute, Lagos, 12-28

Duggal, S. K. (2003). Building materials, new age international publishers, New Delhi, India.

Gbenga, M. A. (2005). Assessment of building failures in Nigeria Lagos and Ibadan case study. Retrieved 4th May, 2018. From:https://www.researchgate. Net/publication/237374553.

Igwe, C. O. (2015). Assessment of multistorey building failures in Abuja, Nigeria. Department of Industrial and Technology Education, Federal University of Technology, Minna, Niger State.

Jayesh, P. (2012). Definition experimental. Retrieved on the 31st July, 2019. From: https: www. Image. Slideshareedn. Com/experimental research design.130507230811.

Kenneth, D. & Keith, T. (2000). Subjective and Objective quality of assessment. *Journal of information 6 (40), 445-456*

NIS: 87, (2004). Quality standard certification. Nigeria Industrial Standard of Nigeria, Lagos State.

Nissa, G. (2015). Definition, formula, calculation…study.com Retrieved. 6th Jun. 2017. From: https: www.google.com

Oseghale, G. E., IKPO, I. J., & Ajayi, O. D. (2015). Cause & effects of building collapse in Lagos state. Civil & environmental research. Department of estate management, obafemi Awolowo University, ile-ife, osun state, Nigeria.

Otunyo, A. W. & Okechukwu B. N. (2017). Performance of concrete with partial replacement of fine aggregates with crushed waste glass. *Nigerian Journal of Technology, 36, 405-410.*

Oyekan, G. L. & Kamiyo, O. M. (2011). A study on the engineering properties of sandcrete blocks produced with rice husk ash blended cement. *Journal of Engineering and Technology Research.* Vol. 3(3), pp. 88 – 98.

Patrick, A. (2015). Definition of experimental. A step by step guide on how to make one. Retrieved. 5th Jan. 2015. From: https: simplyeducate.me/2015/01/05/experime.