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Comparative Analysis of Load at Failure and Compressive Strengths of 2-Cell and 3-Cell Cavity Sandcrete Hollow Blocks

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ABSTRACT: *The research compared the failure load and compressive strengths of 9 inches sandcrete hollow blocks produced with 2-cell and 3-cell cavity. The aim is to determine which of the types of blocks will give the highest mean failure load and compressive strength after 14 days. The methodology adopted involved experimental moulding of 9 inches sandcrete hollow blocks with 2 and 3-cell cavity moulds, with six different sources of sand obtained within Enugu. The design mix ratio of cement to sand used was 1:8; the water/cement ratio 0.8 was used. 3-block samples were moulded from each sand source for the 2 and 3-cell cavity, making it a total of 36 hollow block samples (18 each for 2 and 3-cell cavity). Sieve analysis Test was conducted on the six sources of sand samples used to determine their particles sizes distributions and grading. The result indicated that 3-cell Cavity sandcrete hollow blocks gave the highest mean failure load and compressive strength in the range of* $3.01 - to - 3.65N/mm^2$ *while 2-cell hollow blocks values are in the range of* $1.6025 - to - 2.0347N/mm^2$ *which is not within the value of* $3.45N/mm^2$ *a load bearing block is expected of. The research concluded that 3-cell cavity blocks gave highest failure load and compressive strength than 2-cell blocks. Nevertheless, the type of mould used in sandcrete hollow block production has effect on the failure-load and compressive strength of blocks. The research recommended the use of 3-cell cavity blocks for construction of structures especially where masonry blocks are part of load bearing elements.*

Key words: *Sandcrete-block, failure-load, cell-cavity, compressive-strength, mould*

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I. INTRODUCTION

Sandcrete blocks are composite materials made up of cement, sand and water, moulded into different sizes (1, in 2). It's usage in construction of houses and masonry wall formations are common especially in Nigeria. It has been reported by some researchers that sandcrete blocks are the major masonry units used in Nigeria's construction industry, accounting for more than 90% of the Country's physical infrastructure (3 and 4) therefore, sandcrete blocks are important components in building construction. The quality of blocks produced however, differs from each industry due to the different methods employed in the production and the properties of the constituent materials (5). They are of different sizes and weights for easily handling by the masons and bricklayer, with the facing surface layer more than that of a brick but conveniently dimensioned. Sandcrete blocks are available for the construction of load bearing and non-load bearing structures (Hodge in 5). The rapid changes in the use of brick to block in Nigeria have encouraged the investigations into the use of sandcrete blocks to be more elaborate and (6) observed that for a long time until perhaps few years ago, these blocks were manufactured in many parts of Nigeria without due reference to any specifications either to suit local building requirements or for good quality work.

1.1 Problem of the Study:

Sandcrete hollow blocks with 2 cells have been in use for the building of houses and walls formation in Nigeria. Most often, the quality of sandcrete blocks used in the construction industry are of poor quality and not up to the standard as specified by many building codes or regulatory bodies like Nigeria Industrial Specification (NIS) of Standard Organisation of Nigeria (SON). During the formation of walls with those hollow sandcrete blocks, masons/bricklayers do complain about their poor quality in strength which leads to damages and wastage of resources. Conversely, during cutting of blocks to get half sandcrete block, the other half of the block will be damaged. Another challenge encountered as a result of poor quality in strength of the sandcrete blocks is that most often, when exposed to rainfall, it washes away the surface and changes the size and shape of the packed blocks or the ones used in wall formation/building. The presence of vertical cracks on the walls formed using sandcrete blocks; as a result of little settlement in foundation indicates poor quality in strength of the blocks. This study proposed as solution to the above challenges, a 3 cell cavity sandcrete hollow block that will give higher failure-load and compressive strength, a perfect halve of blocks without wastages and being able to bear self weight and other loads applied on it.

1.2.1. Aim of the Research:

The aim of this research is to investigate and compare the failure load and compressive strengths of 2 and 3 cell cavity 9 inches hollow sandcrete block units cast with the same parameters (cement-sand ratio, w/c ratio, etc).

1.3.1 Objectives of the Research:

1. To determine the failure-load and compressive strength of 2 cell cavity 9 inch (450*225*225mm) sandcrete blocks molded and crushed after 14 days
2. To determine the failure-load and compressive strength of 3 cell cavity 9 inch (450*225*225mm) sandcrete blocks molded and crushed after 14 days
3. To compare the results obtained from objectives 1 and 2
4. To determine the grading of various sources of fine aggregates/sand used in the production of the sandcrete blocks, through sieve analysis
5. To compare the results obtained

1.4 Research Question:

1. What are the mean failure-load and compressive strengths of 2 cell cavity 9 inch sandcrete blocks molded and crushed after 14 days?
2. What are the mean failure-load and compressive strengths of 3 cell cavity 9 inch sandcrete blocks molded and crushed after 14 days?
3. What are the grades of various fine aggregates used in the production of the sandcrete blocks and does it has effect on the compressive strength of the sandcrete hollow blocks?

1.5 Research Hypothesis: The research hypotheses formulate to test the significance levels of the study at 0.05 or 5% are:

i. there is no significance difference between the mean failure-load and compressive strengths of sancrete blocks with 2 cell and 3 cell units
ii. there is no significance difference between the mean failure-load and compressive strengths of sandcrete blocks produced using different/various sources of fine aggregates
iii. there is no significance interaction effect between the compressive strength of 2 cell or 3 cell blocks and the grades of the fine Aggregates used in the production of the blocks

1.6 Significance of Study:

The study provides information on the possible replacement of 2-celled cavity hollow sandcrete blocks with 3-celled cavity hollow sandcrete blocks which gives higher failure-load and compressive strength, more stable masonry units, as well as reduces wastage and damage of sandcrete hollow blocks during formation of walls and building houses.

1.7 Scope and Limitation of Study:

This study is limited to 9 inch (450*225*225mm) hollowed sandcrete block units. The information here does not cover 6 inch hollow and solid sandcrete block units of any type. However, the study is only for the six various sources of sand obtained within Enugu.

II. LITERATURE REVIEW

2.1. Theoretical Concept:

(7) defined a block as a heterogeneous building material with a unit that is larger in all dimensions than what is required for bricks, but no dimension should be larger than 650mm or the height should be six times the thickness or greater than the length. The quality of blocks produced, however, differs from each manufacturer due to the different methods employed in the production and the properties of the constituent materials (3 and 8). Survey carried out on the production of blocks by various block making industries within Nigeria by

researchers like: (5,9, 10, 11, 12, and 13) have shown that the dimensional geometry of hollow sandcrete blocks vary, as a result of the variation in dimensions such as cell cavity sizes and centre-web to end web ratios. These variations in dimensions could be attributed to craftsmen/welders that forms and constructs the moulds used in block productions.

Compressive Strength: (2) emphasized the importance of understanding the behavior of hollow sandcrete blocks under different hollow (cavity) configurations in order to properly define the compressive strength of blocks considering the unevenness of the as-cast surface of the blocks. In accordance to this, the compressive strength of hollow sandcrete blocks, when as-cast face was the bearing surface at test, is calculated as follows:

$$F_{Za} = \frac{PZ}{L*B}, \quad \ldots 1 \qquad\qquad F_{Zc} = \frac{PZ}{LB-2ab} \ldots \ldots 2$$

The compressive strength when as-cast side was the bearing surface at test is calculated as follows:

$$F_{xa} = \frac{Px}{LH}, \ldots \ldots 3 \qquad\qquad F_{xe} = \frac{Px}{AL} \ldots \ldots 4$$

$\mathrm{P} -$ is load at failure,
$\mathrm{F} -$ is the compressive strength, $\mathrm{L} -$ is the length, $\mathrm{B} -$ the width
$\mathrm{X} -$ the height of the block, a c, and b are the cross section of the cell cavity
$Z - indicates\ the\ as - cast\ face\ was\ the\ bearing\ area\ at\ test$
$X - indicates\ the\ as - cast\ side\ was\ the\ bearing\ area\ at\ test$

Likewise, for 3-cell hollow sandcrete block,

$$F_{Za} = \frac{PZ}{L*B}, \ldots \ldots 5 \qquad\qquad F_{Zc} = \frac{PZ}{LB-bc-2ab} \ldots \ldots 6$$

According to (14), blocks must have a minimum compressive strength of $2.5\mathrm{N/mm^2}$ and $3.45\mathrm{N/mm^2}$ for non-load bearing and load bearing walls respectively.
(14, and in 4) also defined two types of blocks, which have the option of being solid or hollow as follows:
1. Type A- Load bearing blocks
2. Type B- non-Load bearing blocks

2.2.1. Empirical Studies

Many researchers have studied the compressive strength of sandcrete hollow blocks used in construction industry and made recommendations and conclusions.

Research carried out by (2) on the load carrying capacity of hollow sandcrete blocks. They studied two-cells hollow sandcrete blocks with 30%, 40.7%, 50 % and 60 % cavity volumes subjected to compression test on as-cast face and as-cast side. The sand/cement ratio used was 6:1 while the water/cement ratio of 0.7 was used as well. The blocks were hand compacted and cured by sprinkling of water for 7 days in accordance with Nigerian Industrial Specifications for sandcrete blocks. The compressive strength of the blocks was calculated based on the apparent and effective areas of the two perpendicular surfaces. They found out that effective strengths compare more favourably with the control cylinder strength than the apparent strength. And that comparison between the two perpendicular surface strengths showed a linear correlation. They concluded that the plane and smoothness of as-cast side made it a better face to define the strength of blocks by correlating it to the as-cast face strength.

Research carried-out by (16) on the Effects of Orientation and compaction methods of manufacture on strength of properties of sandcrete blocks. They examined the 3-methods of production and assess their effect on strength properties. For any compaction method, different orientation produced different strength properties. Different also exist in the strengths for the same orientation in different compaction modes. They found that vertically oriented blocks in a motorized vibration compaction mode produced the highest consolidation of mix and consequently strength. In the absence of electric power, the hand ramming method produced the desired strength. Manual tamping method should be discouraged as they are unable to consolidate the mix properly and consequently produces blocks of unacceptable strength. They recommended that local industry must explore alternative mode of block manufacture or improve existing ones if the requisist standards and strength properties are to be satisfied.

Researched done by (5) on an appresial of the quality of sandcrete blocks used for construction in Lagos metropolis. The research adopted experimental research approach in investigating the quality of machine-vibrated hollow sandcrete blocks used on construction sites in Lagos metropolis. 60 Units of machine vibrated sandcrete blocks were sampled from 10 manufacturers within Lagos mainland. 3-samples of 450mm*225mm*225mm blocks and another 3-of 450mm*150mm*225mm blocks were selected. 40 blocks were produced using NIS 87: 2004 Standard for sandcrete blocks. The blocks obtained from manufacturers together with the molded samples were tested to determine their quality in terms of 3-parameters which were: the compressive strength, density and dimensional tolerance. The results obtained reviewed that the compressive strength of the blocks obtained from manufacturers ranged from $0.21N/mm^2$ to $1.2\ \mathrm{N/mm^2}$ for 225mm blocks and from $0.21N/mm^2$ to $0.95N/mm^2$ for 150mm thick blocks which are far below the minimum standard requirements of $3.45N/mm^2$ and $2.5N/mm^2$ respectively. The researchers recommended that regulatory and enforcement bodies should be empowered to check and control production processes and quality of sandcrete blocks.

III. RESEARCH METHODOLOGY:

The method used in this research involved experimentally moulding of 36 units of 9 inch (450*225*225mm) sandcrete hollow blocks; 18 units were produced using 2-cell cavity mould and 18 units were also produced using 3-cell cavity mould. Likewise, six (6) sources of fine aggregates/sand (gotten within Enugu) were used in the production of the 36 units of 9 inch sandcrete hollow blocks; three (3) units of blocks were produced per source for the two types of moulds under investigation in this research. Cement to sand ratio of 1:8 was used in the research. The mix was batched by volume using head pan. While the Water-cement ratio of 0.8 was used in the research. The water used for this research work was clean and drinkable water collected from tap water at the Ministry of works, Enugu. This is in line with NIS specification. BUA cement was used in this research;

3.1. Source of fine aggregate/sand

The fine aggregate/sand samples were sourced from the following places in Enugu Urban. The table below indicates the sources of sand/fine Aggregates used in this research.

Table 3.1Sources of Sand/Fine Aggregate

S/N	SOURCES OF SAND/FINE AGGREGATE	TYPE OF SAND
1	Iyi-oku River, Nike	Sand stone
2	Inyama River Akwuke	Sand stone
3	Ekulu River, Agu Abor	Sand stone
4	Iyi-Ukwu River Nike	Sand stone
5	Nsude/Owa Borrow pit	sand
6	UgwuOnyama Borrow Pit	sand

The samples of the sand were collected at their various sources, and then taken to the Ministry of work's Research and Laboratory premises, Enugu where the blocks were molded, with the help of research Assistant, who happens to be a professional in block molding.

3.2 Choice of Fine Aggregate/Sand

Fine aggregate/Sand used in this research came across various kinds; sharp sands collected at the River and those collected from the borrow pit. These sources represent the various points sands were obtained for construction within Enugu.

3.3 Method of Molding and Compacting

The method adopted in this research for the molding of the sandcrete hollow block samples was manual molding with hand. The mixture of Cement and various sand sources respectively, were done with shovel until a consistent/uniform/even mix was obtained. Water was added at the right time of mixing and at the required quantity. After that, the mixed mortar was placed inside the various molds under this research (2-cell mold and 3-cell mold respectively). Then the mold was lifted and dropped on a hard platform (metal-iron ream) and a thick flat metal plate was used to tamper on the mold and to remove excess mortar in order to take level of the mold. After which, the mold was turned upside to lay the blocks and mold was removed. Three (3) samples of 9 inches blocks were produced (with the six (6) various sources of sands collected) using the 2-cell and 3-cell molds, making it a total of 36 block samples.

3.4 Age of Masonary Units and Method of Curing the Samples

The molded sandcrete hollow blocks were cured by sprinkling of water on them twice daily for 7 days through the help of Lab Assistant. The compressive strengths of the sandcrete hollow block samples/specimens were determined after 14 days of moulding with crushing machine.

3.5 Types of Moulds Used and their Respective Dimension are Shown Below:

1. 3 hollow cell cavity 450*225*225mm mould

This has 3 hollow cells cavity each with dimensions:

i. 125mm * 155mm @ top face (cells 1 and 3)
ii. 125mm * 110mm @ bottom face (cells 1 and 3)
iii. 125*55mm @ centre cell (cell 2)

Where cell 1 and cell 3 are equal

Fig. 3.1: A 3-Cell mold

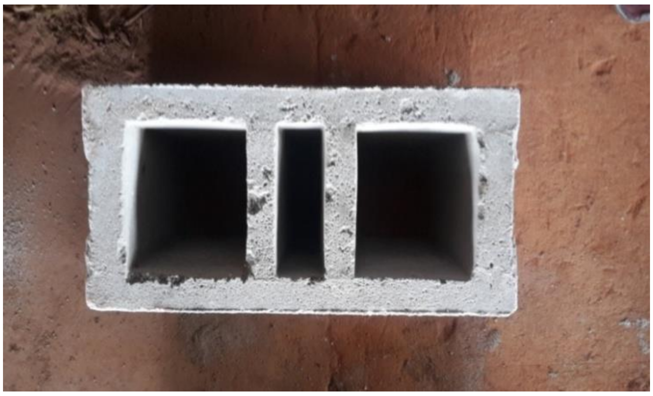

Fig. 3.2: A 3-Cell molded sandcrete hollow block

2. **2 hollow cell 450mm mould.**

This has 2 hollow cell each having dimensions of

i. 165mm x 155mm @ top face
ii. 170mm x 160mm @ bottom face (Cells 1 and 2 are equal).

Fig. 3.3: A 2-Cell mold

Fig. 3.2: A 2-Cell molded sandcrete hollow block

3.6 Compressive Strength Test

The compressive strengths of the sandcrete hollow block samples/specimens were determined after 14 days of moulding with crushing machine.

3.7 Method of Data Collection and Analysis

The data were obtained from the crushing of the sandcrete hollow block samples molded and cured after 14 days. The research data recorded/observed were analyzed using one-way ANOVA F-Test to test the significance at 5%.

IV. PRESENTATION OF RESULTS, ANALYSIS AND DISCUSSION

To validate the accuracy and efficiency of experimental results obtained, compressive strength of nine (9) inches (450*225*225mm) sandcrete hollow blocks molded with 2-cell and 3-cell cavity molds with different sources of sand will be compared with each other and with the Nigeria Industrial Specification (NIS) requirements/specification on minimum compressive strength a sandcrete hollow block should posses.

4.1 Characteristics of Tested Sandcrete Hollow Block Samples

Table 4.1: The characteristics of tested sandcrete hollow block samples molded with 2-cell. Bottom Surface Dimension for Nine (9) Inches Hollow Block Samples

Source of sand	Block size (mm)	Inner web	End web	Shell	Cell size (mm)		Area of Cells (m^2)	Gross Area (m^2)	Net Area (m^2)
		W_i	W_e	S					
Iyi-oku River	450x225x225	40	40	40	170	160	27.200	101.25	74.05
Inyama River	450x225x225	40	40	40	170	160	27.200	101.25	74.05
Ekulu River	450X225X225	40	40	40	170	160	27.200	101.25	74.05
Iyi-Ukwu	450X225X225	40	40	40	170	160	27.200	101.25	74.05
Nsude/Owa	450x225x225	40	40	40	170	160	27.200	101.25	74.05
UgwuOnyama	450x225x225	40	40	40	170	160	27.200	101.25	74.05

Table 4.2: The characteristics of tested sandcrete hollow block samples molded with 3-cell. Bottom Surface Dimension for Nine (9) Inches Hollow Block Samples

Source of sand	Block size (mm)	Inner web	End web	Shell	Cell cavity size (mm)			Area of Cells cavity (m^2)	Gross Area (m^2)	Net Area (m^2)
		W_i	W_e	S						
Iyi-oku River	450x225x225	40	40	40	125	110	55	20.625	101.25	80.625
Inyama River	450x225x225	40	40	40	125	110	55	20.625	101.25	80.625
Ekulu River	450X225X225	40	40	40	125	110	55	20.625	101.25	80.625
Iyi-Ukwu	450X225X225	40	40	40	125	110	55	20.625	101.25	80.625
Nsude/Owa	450x225x225	40	40	40	125	110	55	20.625	101.25	80.625
UgwuOnyama	450x225x225	40	40	40	125	110	55	20.625	101.25	80.625

Tables 4.1 and 4.2 above present the characteristics of tested sandcrete hollow block samples molded with 2-cell and 3-cell cavity for bottom Surface Dimension for Nine (9) Inches Hollow Block Samples. From the table, the dimensions of the cross-section, web thickness and cell sizes are the same for all the samples. This was done to ensure that variations in dimensions of the sandcrete blocks do not interfere in the failure-load and compressive strength of those hollow block samples.

Table 4.3: Experimental Results Obtained from the Tested Sandcrete Hollow Block Samples with 2-cell and 3-Cellcavity: Loads at Failure of the Samples

Sample Name	Sample Number	Dry weight of samples(g)	Load at Failure(KN)	Dry weight of samples(g)	Load at Failure (KN)
		2-cell cavity hollow block		**3-cell cavity hollow block**	
Iyi-oku River	1 2 3	17924 17749 17115	155 152 145	25837 25864 26770	280 270 278
Inyama River	1 2 3	17269 17611 17776	145 138 140	23071 22795 23045	290 295 292
Ekulu River	1 2 3	19256 19540 18994	148 148 150	25379 25864 26877	275 280 278
Iyi-Ukwu River	1 2 3	17898 17857 17793	145 145 155	23216 22995 23145	280 290 250
Nsude/Owa	1 2 3	17717 17547 17606	125 115 120	24071 23795 24049	255 242 258
UgwuOnyama	1 2 3	17248 17126 16889	118 120 118	23271 23795 23445	240 248 252

Tables 4.3 above present the Loads at which the block samples failed as observed from the crushing machine. The failure began when the Sample loaded at the machine developed cracks all over the body, until the sample

could no longer bear the applied load. The table indicates that it takes a higher value of loads to crush the 3-celled cavity blocks (ranging from 242KN –to-295KN) than the 2-cell cavity blocks (ranging from 115KN –to-155KN). This could be as a result of 3-cell cavity blocks contain more net area to bear the loads applied on it than the 2-cell cavity counterpart.

Table 4.4: Compressive Strength of the Nine (9) Inches Hollow Blocks Samples for 2-Cell Cavity

Sample Name	Sample Number	Net Area (mm^2)	Compressive strength (N/mm^2)	Mean Compressive strength (N/mm^2)
Iyi-oku River, Nike	1 2 3	74050	2.0932 2.0567 1.9581	2.0347
Inyama River Akwuke	1 2 3	74050	1.9581 1.8636 1.8906	1.9041
Ekulu River	1 2 3	74050	1.9987 1.9987 2.0527	2.0167
Iyi-Ukwu River Nike	1 2 3	74050	1.9581 1.9581 2.0932	2.0031
Nsude/Owa Borrow pit	1 2 3	74050	1.6880 1.5530 1.6205	1.6205
UgwuOnyama Borrow Pit	1 2 3	74050	1.5935 1.6205 1.5935	1.6025

Table 4.4 presents the compressive strength of the nine (9) inches hollow block samples for 2-cell cavity. From the table, block samples produced with Iyi-Oku River sand gave the highest mean compressive strength of $2.0347N/mm^2$ while block samples produced with UgwuOnyama borrow pit sand gave the least mean compressive strength value of $1.6025N/mm^2$. However, the values of the experimental observed mean compressive strength were subjected to Anova Test at 5% level of significance to check statistical decisions. The results indicated that there was no significance difference between the mean compressive strengths of sandcrete hollow block samples produced with different sources of sand $F_{Cal}(38.04) > F_{Crit}(3.11)$. Nevertheless, the values of the compressive strengths observed from the experiment did not attain the NIS specifications for 450*225*225mm sandcrete hollow block of $3.45N/mm^2$ as reviewed in the Literature.

Table 4.5: Experimental Results Obtained from the Tested Sandcrete Hollow Blocks Samples with 3-Cell Cavity Mold: Compressive Strength of the Nine (9) Inches Hollow Blocks

Sample Name	Sample Number	Net Area (mm2)	Compressive strength (N/mm2)	Mean Compressive strength (N/mm2)
Iyi-oku River, Nike	1 2 3	80625	3.47 3.35 3.45	3.42
Inyama River Akwuke	1 2 3	80625	3.60 3.66 3.62	3.63
Ekulu River	1 2 3	80625	3.41 3.47 3.45	3.44
Iyi-Ukwu River Nike	1 2 3	80625	3.47 3.60 3.10	3.39
Nsude/Owa Borrow pit	1 2 3	80625	3.10 3.00 3.20	3.1
UgwuOnyama Borrow Pit	1 2 3	80625	2.98 3.08 3.13	3.06

Table 4.5 above presents the mean compressive strength of the nine (9) inches hollow block samples for 3-cell cavity mold. From the table, block samples produced with Inyama River sand gave the highest mean compressive strength of $3.67N/mm^2$while block samples produced with Ugwuonyeama borrow pit sand gave the least mean compressive strength value of $3.06N/mm^2$. However, the values of the experimental observed compressive strengths were subjected to Anova Test at 5% level of significance to take statistical decisions. The results indicated that there was no significance difference between the mean compressive strengths of sandcrete

hollow block samples produced with different sources of sand $F_{Cal}(9.55) > F_{Crit}(3.11)$. Nevertheless, values of the compressive strengths observed from the experiment for some samples (Nsude/Owa Borrow pit sand and UgwuOnyama Borrow Pit sand) were not up to NIS specification for the minimum value of compressive strength of $3.45N/mm^2$ a sandcrete hollow block should possess. While samples produced with Iyi-oku River sand, Inyama River sand, Ekulu River sand, and Iyi-Ukwu River sand have an approximately NIS specification values ranging from 3.39 to $3.63\ N/mm^2$. This result indicates that the source of sand has effect on the failure-load and compressive strength of sandcrete hollow block samples.

Table 4.6: Comparative analysis of Experimental results of compressive strengths of 2-cell cavity and 3-cell cavity 450*225*225mm hollow block samples

S/N	Sample Name	Mean Compressive strength (N/mm^2)	
		2-CELL CAVITY	**3-CELL CAVITY**
1	Iyi-oku River, Nike	2.0347	3.42
2	Inyama River Akwuke	1.9041	3.63
3	Ekulu River	2.0167	3.44
4	Iyi-Ukwu River Nike	2.0031	3.39
5	Nsude/Owa Borrow pit	1.6205	3.1
6	UgwuOnyama Borrow Pit	1.6025	3.06
Average Mean Compressive Strength (N/mm^2)		1.8636	3.34
Standard Deviation		0.201	0.240
Avg. mean Difference(N/mm^2)		1.476	

Table 4.6 presents the comparative analysis of Experimental results of compressive strengths of 2-cell cavity and 3-cell cavity 450*225*225mm hollow block samples. From the above table, the mean compressive strengths of 450*225*225mm sandcrete hollow blocks produced with 3-cell cavity gave the highest value in all the different sources of sand than the 2-cell cavity block samples. This may be attributed to the samples with 3-cell cavity having more Web areas (surface area) to distribute the loads applied on it. The average mean difference (Compressive strength) between the two (2) block samples is $1.476N/mm^2$ which is significant enough.

However, sieve analysis Test results indicated that the sand samples fineness moduli are within the range of accepted value of 3.2. However, Oyi-oku River, Ekulu River, Iyi-ukwu River and Inyama River sand samples are in zone 2 while Nsude/Owa and Ugwuonyeama sand samples fell in zone 3. The two zones are within the acceptable range of grades for concrete.

V. CONCLUSION AND RECOMMENDATION

5.1 Conclusions

On the basis of the findings in this research, the following conclusions were drawn:

The 3-cell cavity sandcrete hollow blocks gave the highest load at failure than 2-cell cavity blocks.

The 3-cell cavity sandcrete hollow blocks was significantly better than the 2-cell cavity blocks in compressive strengths for all the sources of sand samples used in the production of the hollow blocks.

The result observed indicated that the source of sand used in this research has no significant effect on the load at failure and compressive strength of sandcrete hollow block samples statistically. Even though sands obtained from riverbed gave higher failure load and compressive strength values.

The Sieve analysis result showed that the samples fineness modulus are within the range of accepted value of 3.2 and that the zones of the particle size distributions are within the acceptable range of grades for concrete work.

5.2 RECOMMENDATION:

From the findings of this present study, the following recommendations are made:

- The use of 3-cell cavity hollow sandcrete blocks should be encouraged and made compulsory for construction of buildings and other masonry units where blocks are part of load bearing elements of the structures.
- The use of sand samples obtained from Riverbeds in the production of sandcrete hollow blocks is highly advised.
- The study recommended further research at optimizing sizes of blocks (like 6 inches hollow blocks)

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