Original Research Article

COMPARISON OF THE STRENGTH OF BLOCKS MADE FROM SHARP SAND CEMENT, LATERITE CEMENT AND RED EARTH CEMENT

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ABSTRACT – Blocks are known to be one of the man-made building materials utilized for different construction purposes. Blocks can be produced using various materials so far it can withstand loads coming to it. The significant sort of block utilized for the construction of walls in numerous structures is the sand crete block which is produced using cement, sharp sand and water. Because of the significant expense of construction materials, for example, cement and sharp sand, this study was focused to research the utilization of other construction materials (laterite and red earth), thusly this study is centered around the utilization of other naturally occurring building materials to substitute the conventional ones in making of masonry blocks that could most likely guide in decrease the expense of creation of blocks to be utilized for construction purposes subsequently likewise causing a decrease in the expense of construction of structures and other engineering designs. Different tests, for example, sieve analysis and specific gravity test were completed on the materials utilized for creation of the blocks. A sum of three (3) sorts of blocks were made with six (6) block samples made for each kind, making twenty-four (24) altogether, every one of the blocks were cured utilizing the open-air curing method and the compressive strength test was done on the 7, 14, 21 and 28 curing day of two (2) distinct blocks from every one of the block types made. All blocks made were 5-inch blocks. The experimental outcome (test result) showed that the materials were reasonable for block making. On crushing the blocks, it was found that the compressive strength of all didn't get together to the minimum suggested standard of 3.45 N/mm^2 for individual blocks as suggested by the Nigerian Industrial Standard (NIS 87: 2000). The general average strength for the block made with cement and sharp sand (sand crete) ranged from 4.83 N/mm^2 to 9.97 N/mm^2, for those made with laterite it went from 3.27 N/mm^2 to 5.16 N/mm^2 while those made with red earth had compressive strength that went from 2.02 N/mm^2 to 3.16 N/mm^2.

Keywords - Comparing, Strengths, Blocks, Made, Different Materials.

I. INTRODUCTION

This research was committed to introduce in one volume of the central and pragmatic data in the field of comparing the strength of blocks produced using: cement and laterite soil, cement and red earth and cement and sharp sand which might be valuable to individuals engaged with civil and structural engineering and especially those that found delight in the plan and construction of buildings, scaffolds and ducts and related structures. Because of significant expense of sharp sand in the market, the comparative analysis of stabilized out laterite blocks, red earth blocks have uncovered that one can substitute the settled laterite blocks and red earth blocks instead of sand crete (sharp sand) blocks to diminish the expense of the whole building or utilized balanced out laterite blocks where there are no sand in such a region where the work will be sited. An extraordinary part has been accomplished all through this work, despite the fact that it is restricted in degree to survey their reasonableness as standard concrete aggregate.

Ill-advised utilization of these blocks' prompts miniature breaks on the wall after construction (Oyediran and Okosun, 2013). As per Bachar *et al*, 2014, in construction, significant expense of building material has been the blight in non-industrial nations of the world because of importation of the vast majority of the building materials. As the costs of building materials is expanding quickly there is need to investigate nearby materials as options or substitutes for the construction of utilitarian however minimal expense underlying buildings and structures. Laterite soil and red earth are one of the significant building materials which is being investigated for the most part since it is promptly accessible and simple to access the nationwide (Nigeria).

This study is essential for the congruity work to examine the attributes of laterite soil and red earth, settled or unsterilized, supported or unreinforced, with the view to working on such qualities. This study is explicitly centered around the impact of replacement of regular fine aggregate with laterite soil and red earth found in IHIALA LGA in the creation of sand crete blocks.

The aim of this study is to look at the strength of block produced using cement with sharp sand, cement with laterite soil, and cement with red earth laterite sand. For this research: Deciding a portion of the geotechnical properties of sharp sand, laterite and red earth and assess its stability for use as a decent building material, Deciding the compressive strength of the blocks from changing fine aggregate, and to impact decrease to the ascent in market cost of fine aggregate (sharp sand), cement blocks to substitute laterite and red earth blocks.

For this research, blocks will be delivered utilizing three varying fine aggregates (sharp sand, laterite and red earth) blended in with cement at a proportion of 1:5. This study centers around comparing the strength as blocks made utilizing the three varying fine aggregate. The Civil Engineering lab of Chukwuemeka Odumegwu Ojukwu College, Uli grounds was utilized for doing sieve analysis, specific gravity test and compressive strength test for 7-, 14-, 21-, and 28-days utilizing molds of 5 inches.

The significance of this research is that it assists with exploring and knowing the strength of blocks from the combination of various materials other than the ordinary ones (that is cement and sharp sand). It gives subjective outcome on the strength of block produced using red earth and cement, laterite soil and cement, so that engineers can know the right endlessly blend proportion in situations where customary materials are not accessible. It will likewise lessen cost of construction when other minimal expense materials like laterite and red earth are accessible and can promptly be utilized.

Only, that this research is restricted to sun dried blocks which are not hollow, they will be unburnt and permitted to dry outside under the sun and dry air. Different kinds of blocks like fly debris block, concrete bricks, and engineering bricks are not concentrated on in this research.

UNDER PEER REVIEW

II. LITERATURE REVIEW

To safeguard and support the climate, the utilization of harmless to the ecosystem building materials, normally alluded to as green building materials should be urged to advance the possibility of reasonable building. One such green building material that fulfills the guidelines of accomplishing supportable lodging advancements is compressed earth blocks. Sustainable building was characterized by Rigassi 1995 as structures that are planned, constructed, redesigned or worked in an asset productive way. It is planned for the most part for the prosperity of the climate as well as the tenants, utilizing assets (energy, water, and other construction materials) in a more successful way. This ought to prompt a decrease of ecological effects without compromising standard and aesthetics. The building business has been accounted for to cause expanded degrees of contamination during the extraction, processing and transportation of unrefined substances. For example, in the Unified Kingdom, it has been reported that abode and family utilization represent 50% of all energy consumed and around 8% (350 PJ each year) is utilized to make and ship building materials. (Adalberth K., 1996). Little, 2009 thought about energy consumed as well as how much fossil fuel byproducts between Compressed Earth Blocks (CEB) and other regular blocks. CEB was accounted for to create around 22 kg CO_2/ton with substantial blocks delivering, 143 kg CO_2/ton, consumed dirt blocks, around 200 kg of carbon dioxide (CO_2) per ton and punctured substantial blocks 280 - 375 kg CO_2 for each ton. This infers that CEB utilizes around 10% of the info energy contrasted with the creation of consumed mud and substantial stone work units. Earth blocks enjoy various benefits both for man and the climate. With the present worldwide worry about the climate and its maintainability, consideration is starting to move to energy proficient and harmless to the ecosystem construction materials. In view of this reality, earth construction stays the best and the best approach to tending to the lodging shortage and at the same time lessen the ecological effect of building construction, as need might arise. Substantially more should be possible in Africa to diminish the expense and increment openness of building materials while saddling their capacity to add to nearby economies and give work valuable open doors. Expanding reasonable lodging supply should similarly be accomplished in a manner that is ecologically practical and doesn't influence nearby, global, and mainland's environments and normal assets in unfriendly way.

Earth blocks, particularly compressed earth blocks, are normally accessible, monetarily feasible, harmless to the ecosystem or more all energy proficient to create. It is an optimal material for feasible construction, however in spite of the ecological benefits and money saving advantages, it is regularly viewed as a building material for the oppressed and frequently thought to be as inferior building material for low-pay workers. This discernment and rejection by legislatures are because of the unseemly use by the supposed destitute individuals. Low-pay networks use earth materials in its most straightforward, normal structure with next to no improvement. This has prompted low worthiness among most gatherings and brought about earth materials not being broadly perceived by experts in numerous nations. Standard building codes and guidelines for the utilization of these normal materials have thusly not been completely evolved. With the new pattern in restoring the utilization of supportable materials in construction, combined with the exploration work in such manner and the forceful advancement of this style of construction by worldwide associations (e.g., UN, UNIDO, WHO) earth material is presently more satisfactory for use in the acknowledgment of fair lodging, particularly in Africa. This is with a point of spanning the lodging deficiency that exists on the planet and this recent fad and tastefully satisfying engineering using earth materials are currently OK as a reasonable construction material in present day lodging improvements. It is currently understood that the previous negative insight isn't really about the material, yet rather, the way things are being utilized by various degrees of society.

III. METHODOLOGY

This section present research methodology used in this study. The section talks about the materials, such as; sharp sand, laterite soil, cement, red earth, and water. Also, the experimental steps taken are described while taking available equipments/apparatus into considerations.

Test such as compressive strength was carried out as workability test while sieve analysis was carried out as preliminary test, since they contributed to the strength development of the block.

a.) Materials Used

Sharp Sand: They are particles that primarily contain silica or quartz, they need cohesion within the presence of water and it additionally limits swelling and shrinkage.

Laterite: Laterite is a layer of soil that contains aluminum and iron oxide minerals.

UNDER PEER REVIEW

Red Earth: It is significantly framed because of the chemical weathering rocks, essentially silicates. Not at all like sharp sand it has strong cohesion within the presence of water and furthermore unreasonable swellings and shrinkage.

Cement: The cement used for this study is an Ordinary Portland Cement from Dangote industry.

Water: Ordinary portable water was used throughout.

b.) Equipments/Apparatus

Table 1: Equipment/Apparatus required

S/N	Apparatus/Equipment Needed	Number Required
1.	Compression machine	1
2.	Weighing balance	1
3	Sieves of different sizes	10
4	Mechanical sieves shaker	1

c.) Experimental Design

Table 2: Experimental design

			Number of Block Moulds				
S/N	Types of blocks	Mix Ratio	For 7 days	For 14 days	For 21 days	For 28 days	TOTAL
1	Cement +Sharp Sand	1:5	2	2	2	2	8
2	Cement +Red Sand	1:5	2	2	2	2	8
3	cement + laterite	1:5	2	2	2	2	8

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d.) **Mix Design (Batching)**

This process was necessary to know the amount of materials that was used for each 5 inches mould.

Where;

Weight of 5 inches (450 mm × 225 mm × 125 mm) mould = 8.25 kg

Weight of mould of over full sand = 27.15 kg

Total weight of sand and cement = 27.15 – 8.25 = **18.9 kg**

Ratio = 1:5

Total ratio = 1 + 5 = 6

Wt. of cement for 1 block = $\frac{1}{6} \times 18.9$

Wt. of cement for 1 block = 3.15 kg

Wt. of cement for 8 blocks = 8 × 3.15 kg

Wt. of cement for 8 blocks = **25.2 kg**

Wt. of sand for 1 block = $\frac{5}{6} \times 18.9$

Wt. of sand for 1 block = 15.75 kg

Wt. of sand for 8 blocks = 8 × 15.75 kg

Wt. of sand for 8 blocks = **126 kg**

e.) **Method**

This incorporates the tests that were completed on the materials to be utilized and furthermore the test that was done on the actual blocks.

- **Sieve Analysis**

The sieve analysis test is utilized to decide the distribution of the coarser, bigger estimated particles; it is generally utilized in the order of soil. The distribution of various grain sizes influences the engineering properties of soil. This analysis was completed on every one of the materials that was utilized aside from cement.

UNDER PEER REVIEW

i. A dry sample of mass 1000g of the soil is measured using the weighting balance and also the weight of each sieve is taken and recorded. The sieve was arranged in ascending order (sieve size of 2mm at the top and 63µm at the bottom with the plan below it). The soil sample was carefully poured into the top sieve.
ii. The sieve is then placed in the mechanical shaker and allowed to shake for 10 minutes.
iii. The stack of sieve is then removed from the shaker and then each sieve with the sample retained on it was weighted and recorded.

- **Specific Gravity Test**

Specific gravity is the proportion of the unit weight of solids to the unit weight of water at any temperature. The point of this test is to decide the specific gravity of the soil fraction passing the 75µm sieve size downward and distilled water.

i. Clean and dry the density bottles thorough and the weight with the stopper in it was taken and recorded as W1, a sample of mass 10 to 20g was measured.
ii. The measured sample of 10g was poured into each density bottle using the funnel, the weight of the bottle with the sample and the stopper was measured and recorded as W2.
iii. 10ml of distilled water was measured using the volumetric cylinder then poured into the bottle; this was done for both density bottles. It was then left for about 2 hours to allow sample soak completely. Again, the bottles were filled completely with distilled water and kept for about 5 minutes. Each bottle with the content and the stopper was weight and recorded as W3.
iv. The content was poured out of the bottles and then cleaned thoroughly. I filled the empty bottle with only distilled water and weighted it, then recorded the weight as W4.

- **Atterberg Limit Test**

The Atterberg limit test comprises of the liquid limit, plastic limit and shrinkage limit test. Atterberg limit can be utilized to communicate the consistency (that is level of immovability) of firm soil like dirt. This test was done on the red earth alone. Liquid limit can be characterized as the water content where the soil changes from plastic to a thick liquid state. Plastic limit is characterized as the water content at which a soil will simply start to crumble when moved into a string roughly 3mm in breadth. Little amount of dried soil was sieved (utilizing 600µmm sieve) and afterward positioned in a porcelain dish, modest quantity of distilled water was added to it until it shaped a glue.

i. For the liquid test: Five empty moisture cans were then weighed and recorded. A portion of the moist soil was placed into the liquid limit device at the point where the cup rests on the base; it was spread through the cup to form a horizontal surface. The grooving tool was then used to make a clean cut. The number of drops was then recorded and a sample was taken and placed into the moisture can. This process was repeated 5 times with little increase in water content. The cans with the soil in it are then weighed and left in the oven for at least 24 hours and afterwards weighed.
ii. For the plastic limit test: Three empty moisture cans weighed. A portion of the moist soil is placed on the glass plate to form an ellipsoidal mass, which was then rolled with the palm into a thread having a uniform diameter until it crumbles. The crumbled thread is then placed into the moisture can. The specimen is weighed and left in the oven for at least 6 hours and afterwards weighed.

UNDER PEER REVIEW

- **Compressive Strength Test**

The Compressive strength of a material is its capacity to endure any step by step applied load following up on it. The compressive strength test was completed on the blocks. The test was done to decide the strength of the blocks. The machine utilized for this test is the compression machine.

i. After the machine is turned on, the area is set and the condition of the machine is checked. The block is then placed in the machine, which is placed between two pieces of plywood in order to spread the effect of the crushing load applied on the block. The machine then starts the crushing process.

IV. RESULTS AND DISCUSSION

This section manages the analysis of data gotten from the different test carried out on the different materials involved and the actual blocks in agreement to the approach explained in chapter 3.

A.) Preliminary Test Result (Sieve Analysis)

a.) Test Results Carried Out on Sharp Sand

Table 3 underneath shows the results for the sieve analysis and the specific gravity test did on a small portion of sharp sand that was utilized for making a portion of the blocks.

Table 3: Result for Sieve Analysis Carried Out on Sharp Sand

Sieve Size (mm)	Sieve mass (g)	Mass of sieve + soil retained (g)	Soil retained (g)	Percent Retained (%)	Percentage Passed
2	538.5	684.5	146	14.6	85.4
1.18	493.5	557	63.5	6.35	79.05
0.6	476	650	174	17.4	61.65
0.425	453.5	591.5	138	13.8	47.85
0.3	437	591	154	15.4	32.45
0.212	407.5	537.5	130	13	19.45
0.150	400.5	500.5	100	10	9.45
0.075	371	432	61	6.1	3.35
0.063	381.5	395	13.5	1.35	2

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Pan	390.5	410.5	20	2	0
Total:			**1000**	**100**	

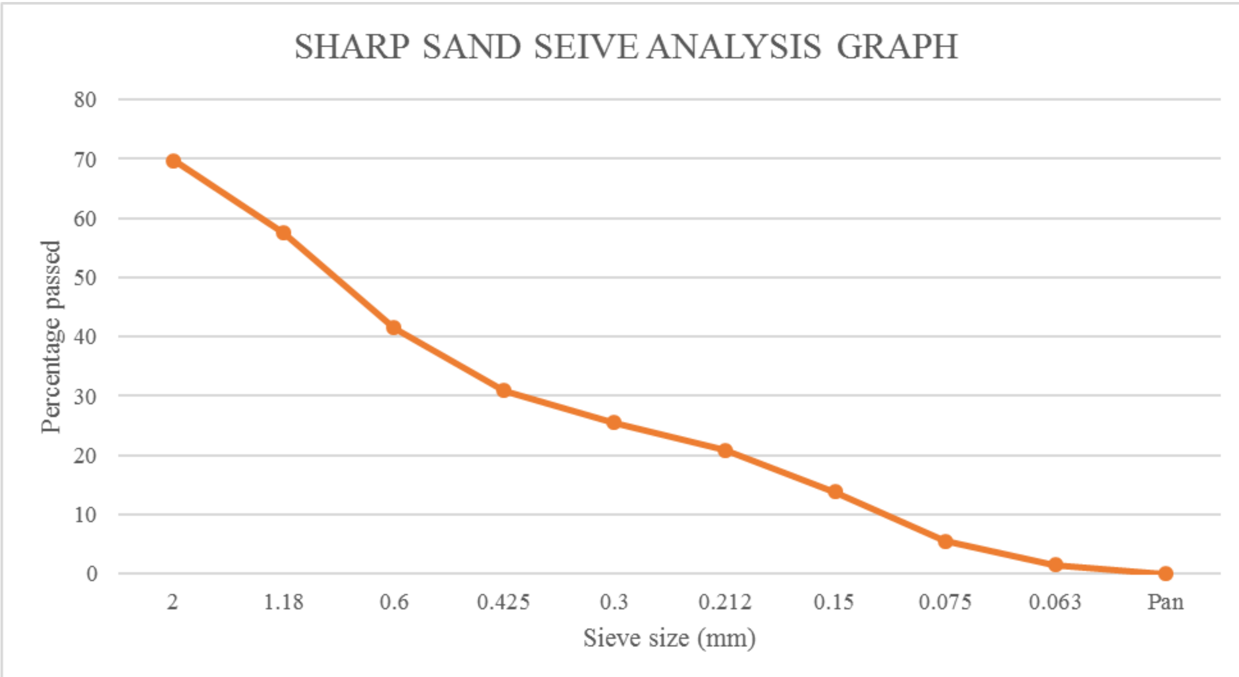

Fig 1: Chart on Sharp Sand Sieve Analysis

Table 4: Result for Specific Gravity Test on Sharp Sand

Specimen Number	**1**	**2**
W1 = Mass of empty wash bottle + stopper (g)	23.0	21.5
W2 = Mass of wash bottle + stopper + dry soil (g)	34.0	31.5
W3 = Mass of wash bottle + stopper + dry soil + water (g)	80.5	77.5
W4 = Mass of wash bottle + stopper + water (g)	74.5	70.5
Specific Gravity (Gs)	2.2	3.3

Specific gravity (Gs) $= \frac{w2-w1}{(w2-w1)-(w3-w1)}$

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Average specific gravity $= \frac{2.2+3.3}{2} = 2.75$

Therefore, the specific gravity of the soil (Gs) = **2.75**

b.) Test Results Carried Out on Laterite

Table 5 beneath shows the result for the sieve analysis and the specific gravity test did on a small portion of the laterite that was utilized for making a portion of the blocks.

Table 5: Result for Sieve Analysis of Laterite

Sieve size (mm)	**Sieve mass (g)**	**Mass of sieve + soil retained (g)**	**Soil Retained (g)**	**Percent Retained (%)**	**Percentage passing**
2	538	1199.5	661.5	66.15	33.82
1.18	491	570.5	79.5	7.95	25.9
0.600	476	564	88	8.8	17.1
0.425	437.5	476.5	39	3.9	13.2
0.300	449.5	486	36.5	3.65	9.55
0.212	419.5	448.5	29	2.9	6.65
0.150	400	425	25	2.5	4.15
0.075	367.5	395.5	28	2.8	1.35
0.063	381.5	384.5	3	0.3	1.05
Pan	390.5	401	10.5	1.05	0
Total			**1000**	**100**	

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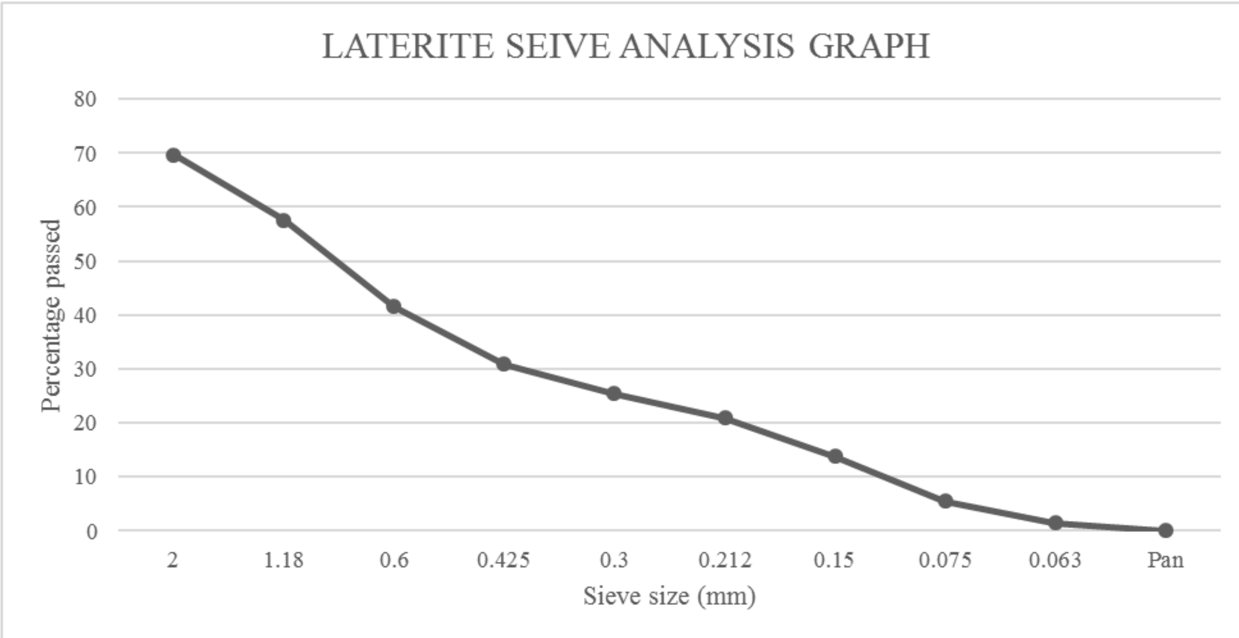

Fig 2: Chart on Laterite Sieve Analysis

Table 6: Result for Specific Gravity Test on Laterite

Specimen Number	**1**	**2**
W1 = Mass of empty wash bottle + stopper (g)	21.0	24.0
W2 = Mass of wash bottle + stopper + dry soil (g)	31.0	34.0
W3 = Mass of wash bottle + stopper + dry soil + water (g)	76.5	79.5
W4 = Mass of wash bottle + stopper + water (g)	71.5	74.5
Specific Gravity (Gs)	2.0	2.0

Specific gravity (Gs) = $\frac{w2-w1}{(w2-W1)-(w3-w4)}$

Average specific gravity = $\frac{2+2}{2} = 2.0$

Therefore, the specific gravity of the soil (Gs) = 2.0

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c.) Test Results Carried Out on Red Earth

Table 7 underneath shows the outcome for the sieve analysis, specific gravity, plastic and liquid limit test did on a small portion of red earth that was utilized for making a portion of the blocks.

Table 7: Results for Sieve Analysis of Red Earth

Sieve size (mm)	**Sieve mass (g)**	**Mass of sieve + soil retained (g)**	**Soil Retained (g)**	**Percent Retained (%)**	**Percentage passing**
2	538.5	841.5	303	30.3	69.7
1.18	493.5	615	121.5	12.15	57.55
0.6	476	636.5	160.5	16.05	41.5
0.425	453.5	559.5	106	10.6	30.9
0.3	437	491.5	54.5	5.45	25.45
0.212	407.5	453	45.5	4.55	20.9
0.15	400.5	471.5	71	7.1	13.8
0.075	371	454	83	8.3	5.5
0.063	381.5	421.5	40	4	1.5
Pan	390.5	405.5	15	1.5	0
Total			**1000**	**100**	

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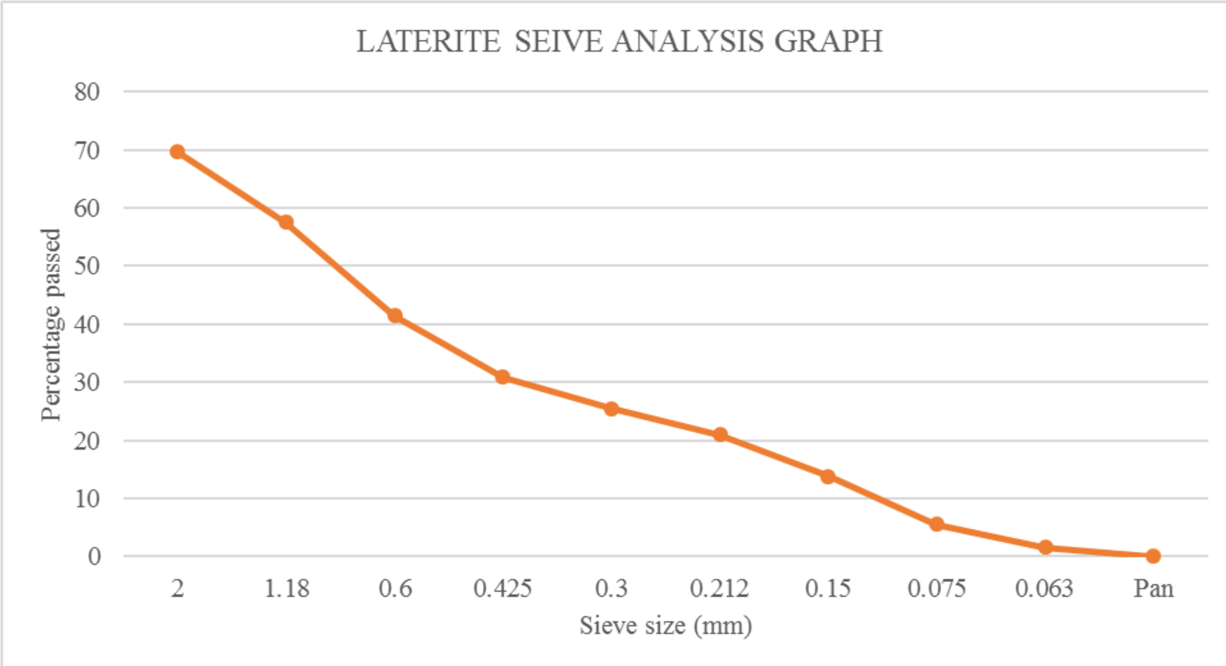

Fig 3: Chart on Red Earth Sieve Analysis

Table 8: Result for Specific Gravity Test on Red Earth

Specimen number	**1**	**2**
W1 = Mass of empty wash bottle + stopper (g)	16.0	16.0
W2 = Mass of wash bottle + stopper + dry soil (g)	33.5	34.0
W3 = Mass of wash bottle + stopper + dry soil + water (g)	81.0	76.0
W4 = Mass of wash bottle + stopper + water (g)	70.0	70.0
Specific Gravity (Gs)	2.7	1.5

Specific Gravity (Gs) = $\frac{w2-w1}{(w2-w1)-(w3-w4)}$

Average specific gravity = $\frac{2.7+1.5}{2} = 2.1$

Therefore, the specific gravity of the soil (Gs) = 2.1

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B.) **Workability Test Result (Compressive Strength)**

The tables and graph underneath show the results of the compressive strength test did on every one of the blocks, it shows the variety in strength of the different kinds of blocks made in view of the materials utilized. For the majority of the blocks the compressive strength falls beneath the recommended minimum value of 3.45 N/mm^2 for individual blocks as recommended by the (NIS 87:2000).

To get the compressive strength in the tables below, it is mathematically expressed as;

Compressive strength = *Crushing force / Area* of 5^I block

Area of 5^I block = Length × Width

Area of 5^I block = 450 mm × 225 mm

Area of 5^I block = 101250 mm^2

Table 9: Compressive Strength of The Blocks After 7 Days of Curing

S/N	Block Type (1:5)	Crushing Force (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	**Cement + Sharp sand**	510.1 508.9	5.04 5.03	5.04
2.	**Cement + Laterite**	370.4 369.3	3.66 3.65	3.66
3.	**Cement + Red earth**	265.5 263.5	2.62 2.60	2.61

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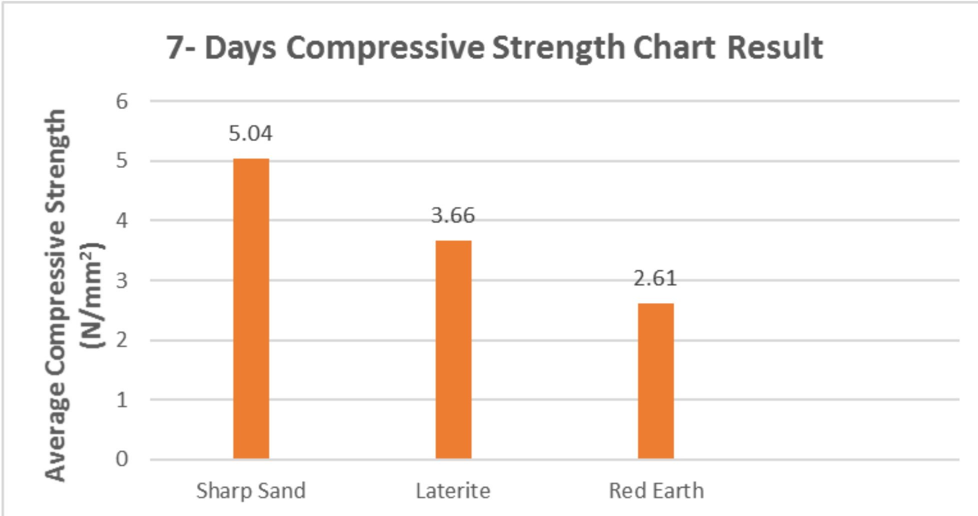

Fig 4: 7- Days curing compressive strength result

After curing the blocks for seven (7) days the block made with Cement and Sharp Sand has the highest average compressive strength of 5.04 N/mm^2 which shows an increase of 46% compared to the standard 3.45 N/mm^2 (NIS 87, 2000). While those made with the mixture of Cement and Laterite is 3.66 N/mm^2 and Red Earth has the lowest average compressive strength of 2.61 N/mm^2, compared to the sharp sand mix, there is a percentage increase and decrease in strength of 6% (increase) and 24% (decrease) between the average compressive strength of the blocks made with Laterite mix and Red Earth, NIS standard respectively.

Table 10: Compressive strength of the blocks after 14 days of curing

S/N	Block Type (1:5)	Crushing Force (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	**Cement + Sharp sand**	511.4 509.3	5.05 5.03	5.04
2.	**Cement + Laterite**	331.9 330.2	3.28 3.26	3.27
3.	**Cement + Red earth**	205.6 202.7	2.03 2.00	2.02

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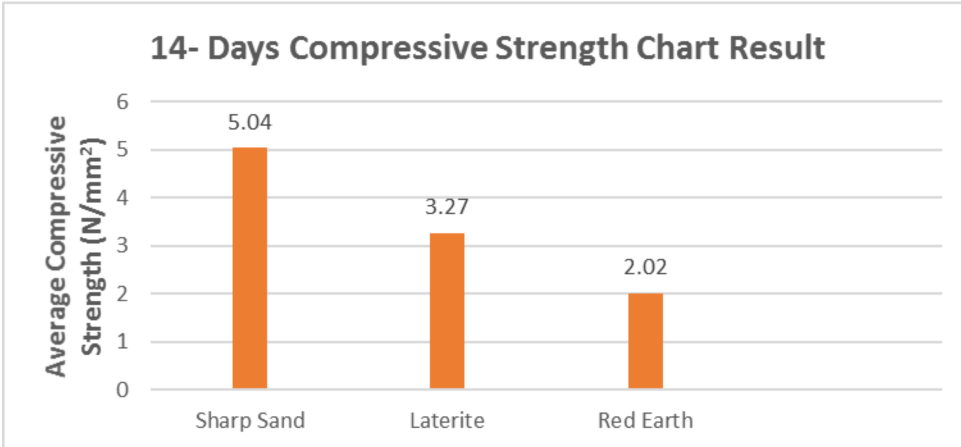

Fig 5: 14- Days Curing Compressive Strength Result

After curing the blocks for fourteen (14) days the block made with cement and sharp sand still has the highest average compressive strength of 5.04 N/mm^2 which shows similar increase of 46% compared to the standard 3.45 N/mm^2 (NIS 87, 2000) like 7 - days. While those made with the mixture of Cement and Laterite is 3.27 N/mm^2 and Red Earth has the lowest average compressive strength of 2.02 N/mm^2. Compared to the sharp sand mix, there is a percentage decrease in strength of 5% and 41% between the average compressive strength of the blocks made with Laterite mix and Red Earth, NIS standard respectively. The blocks made with cement and laterite still has a greater average strength than those made with cement and red earth.

Table 11: Compressive Strength of The Blocks After 21 Days of Curing

S/N	Block Type (1:5)	Crushing Force (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	**Cement + Sharp sand**	487.5 490.0	4.81 4.84	4.83
2.	**Cement + Laterite**	351.3 350.0	3.47 3.46	3.47
3.	**Cement + Red earth**	224.4 222.1	2.22 2.19	2.21

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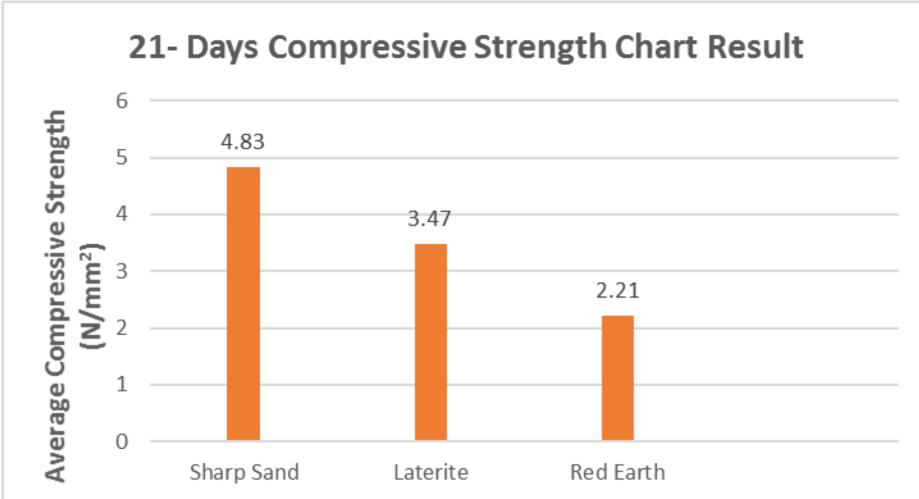

Fig 6: 21- Days Curing Compressive Strength Result

After curing the blocks for 21- days the block made with Cement and Sharp Sand has the highest average compressive strength of 4.83 N/mm^2, which is smaller than the 7 and 14 days curing compressive strength result and shows increase of 40% compared to the standard 3.45 N/mm^2 (NIS 87, 2000). While those made with the mixture of Cement and Laterite is 3.47 N/mm^2 and Red Earth has the lowest average compressive strength of 2.21 N/mm^2. Compared to the sharp sand mix, there is a percentage increase and decrease in strength of 0.58% (increase) and 36% (decrease) between the average compressive strength of the blocks made with Laterite mix and Red Earth, and NIS standard respectively.

Table 12: Compressive strength of the blocks after 28 days of curing

S/N	Block Type (1:5)	Crushing Force (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	**Cement + Sharp sand**	994.8 1022.4	9.83 10.10	9.97
2.	**Cement + Laterite**	524.7 520.8	5.18 5.14	5.16
3.	**Cement + Red earth**	318.9 320.4	3.15 3.16	3.16

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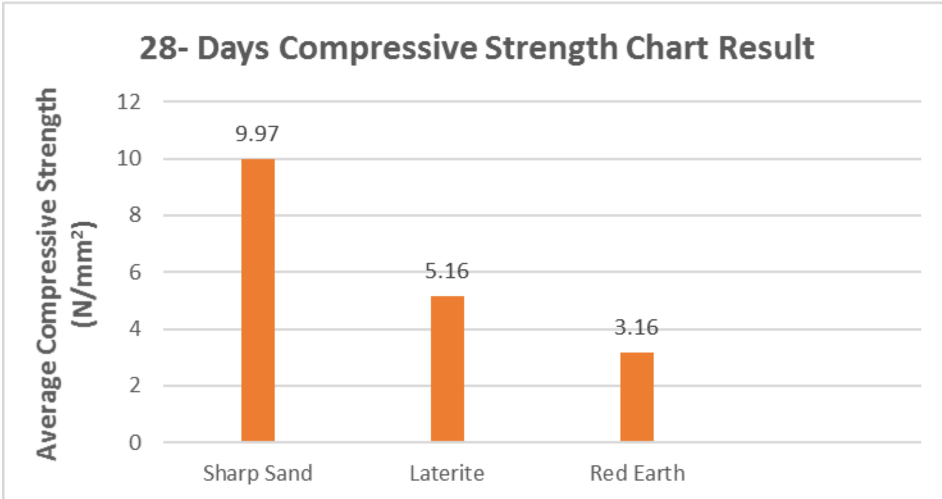

Fig 7: 28- Days curing compressive strength result

After curing the blocks for 28- days the block made with cement and sharp sand still has the highest average compressive strength of 9.97 N/mm^2 compared to the rest, which shows an increase of 189% compared to the standard 3.45 N/mm^2 (NIS 87, 2000). While those made with the mixture of Cement and Laterite is 5.16 N/mm^2 and Red Earth has the lowest average compressive strength of 3.16 N/mm^2. Compared to the sharp sand mix, there is a percentage increase and decrease in strength of 49.5%(increase) and 8% (decrease) between the average compressive strength of the blocks made with Laterite mix and Red Earth, and NIS standard respectively. The blocks made with cement and laterite still has a greater average strength than those made with cement and red earth.

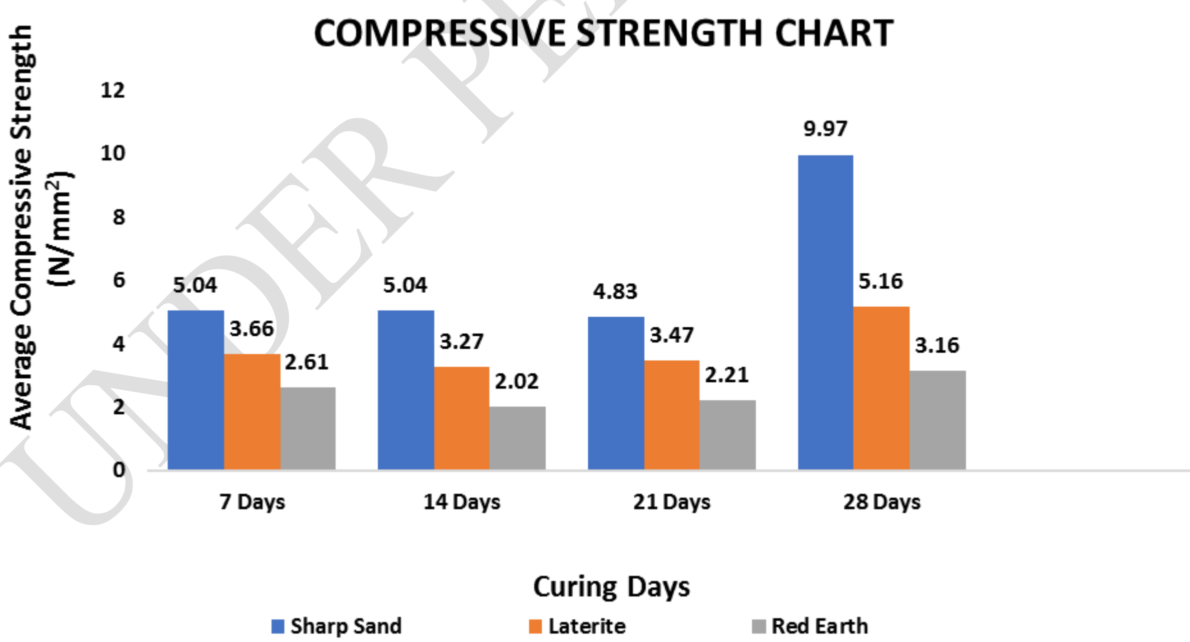

Fig 8: Chart on Compressive strength of Blocks

UNDER PEER REVIEW

During the curing periods, there was insufficient curing of the blocks from the 14th day to the 28th day. The insufficiency of curing the blocks was due to lack of experience. The average strength of the blocks after 28, 21 and 7 days of curing had the best compressive strength with all passing the recommended minimum value of 3.45 N/mm^2 by NIS (87:2000), with only the block made from red earth of the 7- and 21-days curing being below the minimum at 2.61 N/mm^2 and 2.21 N/mm^2 respectively. Unlike the 28-, 21- and 7-days results, the 14 days result was all below 3.45 N/mm^2 except the block made from sharp sand being above at 5.04 N/mm^2. Similar to the 7 days result.

V. CONCLUSION AND RECOMMENDATIONS

The point of this review was to research the creation of blocks with the utilization of the combination of various materials other than the regular ones (i.e., cement and sharp sand) gotten and afterward testing for its compressive strength to be aware in the event that it satisfies up to the guideline of 3.45 N/mm^2 for individual blocks as recommended by the Nigerian Modern Standard (NIS 87:2000). The general typical strength for the block made with cement and sharp sand (sand Crete) went from 4.83 N/mm^2 to 9.97 N/mm^2, for those made with laterite it went from 3.27 N/mm^2 to 5.16 N/mm^2 while those made with red earth had compressive strength that went from 2.02 N/mm^2 to 3.16 N/mm^2. The review shows that the strength of blocks increments with expansion in restoring days, if and provided that relieving is completed appropriately. What's more, of all the block type, the sharp sand (Sand Crete) block had the greatest compressive strength, and those made with red earth and laterite can be utilized as a substitute for sand Crete blocks on the off chance that fitting blend proportion is involved despite the fact that the compressive values for the singular blocks made with red earth, laterite didn't get together the sand crete blocks, they are as yet considered to have sensible strength with legitimate restoring.

From the ends, I subsequently suggest the accompanying;

i. i. Bulk density test ought to be done on blocks made with material other than cement and sharp sand to be aware on the off chance that they can be utilized for non-load bearing partitions.
ii. ii. Improved restoring practice, utilization of proper technique for relieving of somewhere around seven days ought to be upheld by NSE and COREN on the block makers.
iii. iii. Effective oversight should be practiced on the creation site to guarantee these of suitable blend proportion, proper restoring and adherence to right compaction time. Government ought to uphold it in the makers, expressing the punishment of noncompliance with the standard.
iv. iv. Compliance to the utilization of proper and recommended building materials and sensible grouping practice for block creation ought to be firmly authorized by NSE and COREN.

The utilization of fitting blend proportion for block creation so that suitable compressive strength can be accomplished.

UNDER PEER REVIEW

REFERENCES

Adalberth, K. (1996). *Energy demand during the life cycle of a building. CIB Symposium Energy Mass and Flow in the Life Cycle of Buildin*,.Vienna.

Bachar, M., Azzouz, L., Rabehi, M., Mezghiche, B. (2014). *Characterization of a stabilized earth concrete and the effect of incorporation of aggregates of cork on its thermo-mechanical properties: experimental study and modeling. Constr*.

Baligar, V., Fageria, N., Eswaran, H., Wilson, M., He, Z., Wilson, M. J. (2004). *Nature and Properties of Red Soils of the World*. The Red Soils of China: Their Nature, Management and Utilization, Dordrecht: Springer Netherlands.

Giorgis, I., Bonetto, S., Giustetto, R., Lawane, A., Pantet, A., Rossetti, P., Thomassin, J. H., Vinai, R, (2014). *The lateritic profile of Balkouin, Burkina Faso: geochemistry, mineralogy and genesis*. J. Afr. Earth Sci. http://dx.doi.org/10.1016/j.jafrearsci.2013.11.006.

http://dx.doi.org/10.1016/j.conbuildmat.2006.12.003.

Kasthurba, A. K., Santhanam, M., Mathews, M., S. (2007). *Investigation of laterite stones for building purpose from Malabar region, Kerala state, SW India Part 1: field studies and profile characterisation*. Constr. Build. Mater 21, 73e82.

Kasthurba, A. K., Santhanam, M., Achyuthan, H, (2008). *Investigation of laterite stones for building purpose from Malabar region, Kerala, SW India e Chemical analysis and microstructure studies*. Constr. Build. Mater.

Oyediran, I.A., Okosun, J. (2013). *An attempt to improve geotechnical properties of some highway lateritic soils with lime* (pp. 287-296). Poskus izbolj_save geotechnic last no stinekaterih lateritnih tal za ceste z dodajanjem apna 60.

Rigassi, V. (1995). *Compressed earth blocks*, Volume 1 of the BTC Production Manual, CRA Terre-EAG.

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