Journal of Engineering Research and Reports

Volume 24, Issue 7, Page 53-65, 2023; Article no.JERR.96716
ISSN: 2582-2926

Comparison of the Strength of Blocks Made from Sharp Sand Cement, Laterite Cement and Red Earth Cement

Mmeka Paschal Tochukwu [a], Iwenofu Alvin Chisomnazu [a*] and Okoye Odinaka Clive [a]

[a] *Department of Civil Engineering, Chukwuemeka Odumegwu Ojukwu University, Uli, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. 'All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JERR/2023/v24i7831

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/96716

Original Research Article

Received: 01/01/2023
Accepted: 02/03/2023
Published: 13/03/2023

ABSTRACT

One of the man-made building materials used for a variety of construction projects is known as blocks. As long as the blocks can sustain the loads applied to them, they can be made from a variety of materials. The sand crete block, which is made from cement, sharp sand, and water, is a prominent type of block used for the construction of walls in many projects. This study is focused on the use of other naturally occurring building materials to replace the conventional ones in making of masonry blocks that could most likely guide in decreasing the cost of creation of blocks to be utilized for construction because of the significant expense of construction materials, such as cement and sharp sand. This study was focused to research the utilization of other construction materials (laterite and red earth). The materials used to make the blocks were subjected to a variety of tests, such as sieve analysis and specific gravity testing. Six (6) block samples were made for each of the three (3) types of blocks, totaling twenty-four (24) blocks. All of the blocks were cured using the open-air curing method, and the compressive strength test was performed on the 7, 14, 21, and 28 curing days of two (2) different blocks from each of the three (3) block types made.

**Corresponding author: Email: alviniwenofu@gmail.com;*

Every block was 5 inches in length. The results of the experiment (test) indicated that the materials were suitable for constructing blocks. After the blocks were crushed, it was discovered that none of them met the Nigerian Industrial Standard's minimum recommended standard of 3.45 N/mm^2 for individual blocks (NIS 87: 2000). The compressive strength of blocks built with red earth ranged from 2.02 N/mm^2 to 3.16 N/mm^2, those made with laterite from 3.27 N/mm^2 to 5.16 N/mm^2, and those made with cement and sharp sand (sand crete) from 4.83 N/mm^2 to 9.97 N/mm^2.

Keywords: Comparing; strengths; blocks; made; different materials.

1. INTRODUCTION

In order to compare the strength of blocks made with cement and laterite soil, cement and red earth, and cement and sharp sand, this research was committed to presenting key and practical data in one volume. This information may be useful to those working in civil and structural engineering, especially those who find enjoyment in the design and construction of buildings, scaffolds, ducts, and other related structures. Due to the high cost of sharp sand on the market, it has been discovered through comparative analysis of stabilized out laterite blocks and red earth blocks that one can use these materials in place of sand crete (blocks made of sharp sand) blocks to reduce the cost of the entire building [1,2]. One can also use balanced out laterite blocks where there is no sand in the area where the work will be located. Even though the scope of this effort is too little to evaluate their viability as a conventional concrete aggregate, a remarkable portion has been done.

After construction, improper use of these blocks results in small cracks in the wall [3]. According to Bachar *et al.* [4], the fact that the great majority of building materials are imported has made large building material costs a problem in non-industrialized countries around the world. Due to the rapidly rising costs of building supplies, it is necessary to look at local resources as alternatives or solutions for the construction of functional but inexpensive foundational buildings and structures. Due to their widespread availability and ease of access, laterite soil and red earth are among the important building materials that are now being researched (Nigeria).

In order to improve these features, it is crucial for the congruity work to investigate the characteristics of laterite soil and red earth, whether they are settled or unsterilized, reinforced or not. The influence of using laterite soil and red earth from the IHIALA LGA in place of conventional fine aggregate in the production of sand crete blocks is the explicit focus of this investigation [5,6].

Examining the strength of blocks made with cement and sharp sand, cement and laterite soil, and cement and red earth laterite sand is the goal of this study. Using some of the geotechnical characteristics of red earth, laterite, and sharp sand to determine its stability for use as a good building material, Cement blocks can replace laterite and red earth blocks by altering the fine aggregate, which will also have an effect on the rise in the market price of fine aggregate (sharp sand).

For this study, blocks will be delivered using a mixture of cement and three different fine aggregates (sharp sand, laterite, and red earth) at a ratio of 1:5. This study focuses on contrasting the strength of blocks constructed with three different types of fine aggregate. Using molds of 5 inches, the civil engineering lab at Chukwuemeka Odumegwu Ojukwu University in Uli conducted tests on compressive strength, specific gravity, and sieve analysis over periods of 7, 14, 21, and 28 days.

This study's importance lies in its contribution to understanding the strength of blocks made from combinations of materials other than the usual ones (that is cement and sharp sand). It provides a subjective assessment of the durability of blocks made from laterite or red earth and cement, allowing engineers to determine the ideal ratio for continuous mixing in the absence of standard building materials. When other inexpensive materials like laterite and red earth are readily available and usable, it will also lower construction costs [7,8].

The only difference is that this study is limited to sun-dried blocks that are not hollow; they will be left unburned and allowed to dry outdoors in the sun and dry air. The focus of this study is not on various types of blocks, such as fly debris blocks, concrete bricks, and engineering bricks.

2. LITERATURE REVIEW

The use of eco-friendly building materials, sometimes referred to as "green building materials," should be promoted in order to advance the possibility of reasonable building in order to protect and support the climate. Compressed earth blocks are one such environmentally friendly building material that complies with the requirements for achieving sustainable lodging improvements. Rigassi defined sustainable building as being planned, built, modified, or worked in a way that is asset productive in 1995. Most of the time, it is designed with the tenants' well-being and the health of the environment in mind, making better use of resources like electricity, water, and other building materials. This should lead to a reduction in ecological effects without sacrificing quality and aesthetics. It has been predicted that the construction industry will contribute to greater levels of contamination during the extraction, processing, and transportation of raw materials. For instance, it has been stated that in the United Kingdom, 50% of total energy consumption is used for housing and supporting a family, whereas only 8% (350 PJ annually) is used to produce and transport building materials. Adalbert, K. [9]. Little, 2009, evaluated the amount of fossil fuel byproducts produced by Compressed Earth Blocks (CEB) against other standard blocks, as well as the amount of energy consumed. According to estimates, CEB produced about 22 kg of carbon dioxide (CO_2) per ton, with substantial blocks producing 143 kg, consumed dirt blocks about 200 kg, and punctured substantial blocks about 280–375 kg. This suggests that CEB uses less than 10% of the information energy compared to the production of large stone work units and consumed mud. Earth blocks have a number of advantages for people and the environment. Given the current global concern over the climate and its sustainability, attention is beginning to shift to environmentally friendly construction materials that are energy efficient. Given this fact, earth construction continues to be the ideal method for addressing the housing shortfall and reducing the environmental impact of building construction, should the necessity arise. There should be much more that can be done in Africa to lower the cost and increase accessibility of building materials without compromising their ability to boost local economies and provide employment opportunities. Increasing the availability of affordable housing must also be done in a way that is environmentally sound and has minimal negative effects on the local, global, and continental habitats and natural resources.

Compressed earth bricks in particular are typically available, economically possible, eco-friendly, or more energy-efficient to produce. It is the best material for practical construction, but despite its environmental advantages and cost saving qualities, it is commonly perceived as a building material for the downtrodden and as being subpar for low-paid labor. Legislators are being discriminatory and rejecting because of the unsightly behavior of the ostensibly poor people. Low-pay networks employ earth materials in their most basic, conventional form with little enhancement. This has led to a lack of respect among most groups and the underappreciation of earth minerals by many nations' specialists. As a result, the standard construction rules and recommendations for the use of these common materials have not fully developed. Earth material is currently more suitable for use in the recognition of fair housing, particularly in Africa, thanks to the new pattern in restoring the utilization of supportable materials in construction, combined with the exploration work in this manner and the tenacious advancement of this style of construction by international associations (e.g., UN, UNIDO, WHO). This is with the goal of bridging the global housing shortage, and this current craze and aesthetically pleasing engineering employing earth materials are currently acceptable as a reasonable construction material in contemporary housing developments. It is now recognized that the earlier mistaken perception has more to do with how society as a whole uses thing than it does with the actual objects themselves.

3. METHODOLOGY

The research approach employed in this study is described in this section. The section discusses many materials, including water, red earth, cement, sharp sand, and laterite soil. Also, the experimental procedures are detailed while considering the equipment and apparatus that are readily available into account.

Since they helped the block's strength develop, tests like compressive strength were conducted as a workability test and sieve analysis as a preliminary test.

3.1 Materials Used

Sharp Sand: These are silica or quartz-based particles that require cohesiveness when there is water present because it prevents swelling and shrinkage.

Laterite: A layer of soil known as laterite comprises iron and aluminum oxide minerals.

Red Earth: The chemical weathering of the rocks, primarily silicates, has greatly framed it. It is very cohesive when there is water present and exhibits unnatural swellings and shrinking, unlike sharp sand.

Cement: Ordinary Portland Cement from the Dangote industry was the cement used for this study.

Water: The entire time, regular portable water was used.

3.2 Equipments/Apparatus

Table 1. Equipment/Apparatus required

S/N	Apparatus/equipment needed	Number required
1.	Compression Machine	1
2.	Weighing Scale	1
3.	Different-Sized Sieves	10
4.	Mechanical Sieves Shaker	1

3.3 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**

3.4 Method

This includes the testing that were carried out on the materials that was used as well as the tests that were performed on the actual blocks.

3.4.1 Sieve analysis

The sieve analysis test is typically used in the ordering of soil and is used to determine the distribution of the larger, coarser estimated particles. The engineering properties of soil are influenced by the distribution of different grain sizes. With the exception of cement, every material that was used was subjected to this study.

i. Using a weighted scale, a dry sample of 1,000 g of soil is weighed. Moreover, the weight of each sieve is recorded. With a plan below it, the sieve was organized in increasing order, with a sieve size of 2 mm at the top and 63 µm at the bottom. A small amount of soil was gently added to the top sieve.
ii. After that, the sieve is put in the mechanical shaker and shaken for 10 minutes.
iii. The sieve stack is then taken out of the shaker, and each sieve still holding the sample was weighed and recorded.

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

3.4.2 Specific gravity test

The ratio of the unit weight of solids to the unit weight of water at any temperature is known as specific gravity. This test's goal is to determine the specific gravity of the soil fraction that passes through a sieve with a mesh size of 75 m and distilled water.

i. The weight of the density bottles with the stopper in them was taken and recorded as W_1, and a sample of mass weighing between 10 and 20 g was measured.
ii. Using a funnel, the measured sample of 10 g was put into each density container. W_2 represents the weight of the bottle when it contains the sample and the stopper.
iii. The volumetric cylinder was used to measure 10 ml of distilled water, which was then put into each density bottle. The sample was then allowed to fully soak for roughly two hours. Once more, distilled water was added to the bottles to the top and they were allowed to sit for around 5 minutes. Each bottle, complete with its contents and stopper, was weighed and assigned the code W_3.
iv. The bottles' contents were removed, and they were then meticulously cleaned. I weighed the empty bottle after filling it only with distilled water, and I marked the weight as W_4.

3.4.3 Atterberg limit test

The liquid limit, plastic limit, and shrinkage limit tests are all included in the Atterberg limit test. It is possible to express the consistency (i.e., degree of immovability) of hard soil, such as dirt, using the Atterberg limit. On the red soil alone, this test was conducted. The liquid limit is the water content at which soil transitions from a plastic to a thick liquid form. When a soil is moved into a string about 3 mm wide, it will simply begin to crumble at a certain water content, which is known as the plastic limit. A small amount of dry earth was sieved through a 600 mm sieve, then put in a porcelain dish with a small amount of distilled water until it formed a glue.

i. Five empty moisture cans were weighed and recorded for the liquid test. At the point where the cup rests on the base, a portion of the moist soil was added to the liquid limit device and disseminated throughout the cup to create a horizontal surface. Next a precise cut was made using the grooving tool. A sample was then obtained and put into the moisture can after counting the amount of drips. With only a small increase in water content, this process was done five times. The soil-filled cans are then weighed, baked for at least 24 hours, and then weighed again.
ii. Three empty moisture cans were weighed for the plastic limit test. A small amount of the damp soil is spread out on the glass plate to form an ellipsoidal mass, which is then rolled into a thread with a constant diameter and broken into pieces with the palm. The moisture can is then filled with the thread that has crumbled. The specimen is weighed, baked for at least 6 hours, and then weighed again.

3.4.4 Compressive strength test

The ability of a material to withstand subsequent applied loads in stages is known as its compressive strength. On the blocks, the compressive strength test was conducted. To determine the blocks' strength, a test was conducted. The compression machine is the one used for this test.

i. After the machine is turned on, the space is prepared, and the machine's condition is assessed. The machine is then loaded with the block, which is sandwiched between two pieces of plywood to spread the impact of the crushing force. The crushing process is subsequently initiated by the machine.

4. RESULTS AND DISCUSSION

This section covers the analysis of information obtained from various tests conducted on the various materials involved and the actual blocks in accordance with the method described in section 3.

4.1 Preliminary Test Result (Sieve Analysis)

4.1.1 Outcomes of tests done on sharp sand

The findings of the sieve analysis and specific gravity test performed on a tiny sample of sharp sand, which was used to make some of the blocks, are displayed in Table 3.

Table 3. Findings for sieve analysis on sharp sand

Sieve size (mm)	Sieve mass (g)	Mass of sieve + soil retained (g)	Soil retained (g)	Percent retained (%)	Cumulative percent retained (%)	Percent Passed (%)
2	328.4	424.7	96.3	8.13	8.13	91.8
1.18	358.9	431.8	72.9	6.16	14.29	85.71
0.6	370	456.8	86.8	7.33	21.62	78.38
0.425	395	447.5	52.5	4.43	26.05	73.95
0.3	409.6	709.2	299.6	25.3	51.35	48.65
0.212	478.2	701.5	223.3	18.9	70.25	29.75
0.150	596.2	654.5	58.3	4.92	75.17	24.83
0.075	377.4	442.3	64.9	5.48	80.65	19.35
0.063	284	468.8	184.8	15.61	96.26	3.74
Pan	566.9	611.5	44.6	3.77	100.03	0.03
Total			**1184**	**100**		

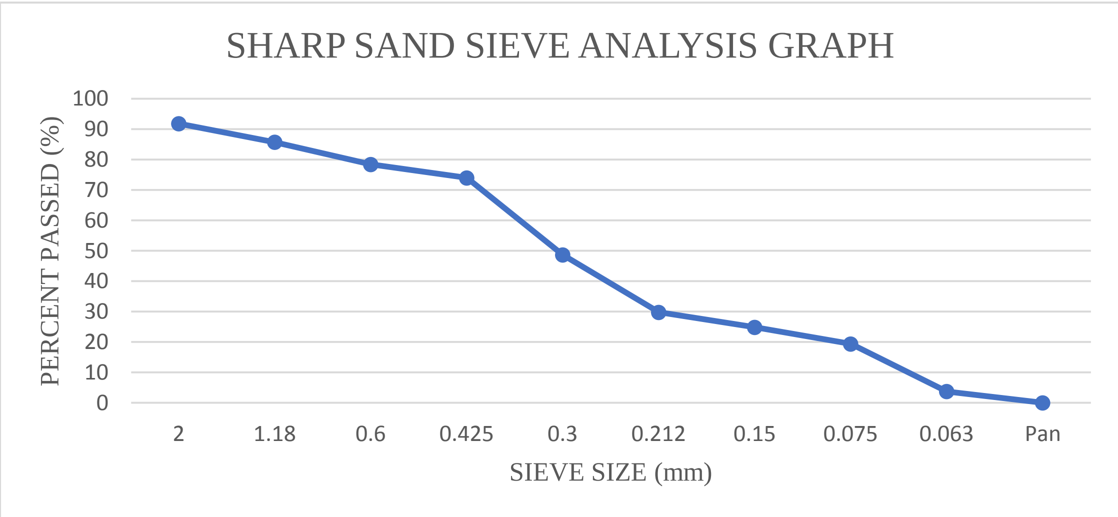

Fig. 1. Chart on sharp sand sieve analysis

Table 4. Findings 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) =$\frac{w2-w1}{(w2-w1)-(w3-w1)}$

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

Hence, the soil's specific gravity (Gs) = **<u>2.75</u>**

4.1.2 Outcomes of Tests Done on Laterite

The results of the sieve analysis and specific gravity test performed on a tiny sample of the laterite that was used to make some of the blocks are displayed in Table 5.

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

Table 5. Findings for sieve analysis on laterite

Sieve size (mm)	Sieve Mass (g)	Mass of Sieve + Soil Retained (g)	Soil retained (g)	Percent Retained (%)	Cumulative percent retained (%)	Percent Passed (%)
2	330.4	430.4	100	7.9	7.9	92.1
1.18	350.9	357.06	80.4	6.35	14.25	85.75
0.6	330	425.6	95.6	7.55	21.8	21.62
0.425	405	458.3	53.3	4.21	26.01	73.99
0.3	510.6	800.2	289.6	22.88	48.89	51.11
0.212	424.5	655	230.5	18.21	67.1	32.9
0.150	665.5	733.8	68.3	5.39	72.49	27.51
0.075	400.4	485	84.6	6.68	79.17	20.83
0.063	270	473.4	203.4	16.07	95.24	4.76
Pan	497.9	558.2	60.3	4.76	100	0
Total			**1266**	**100**		

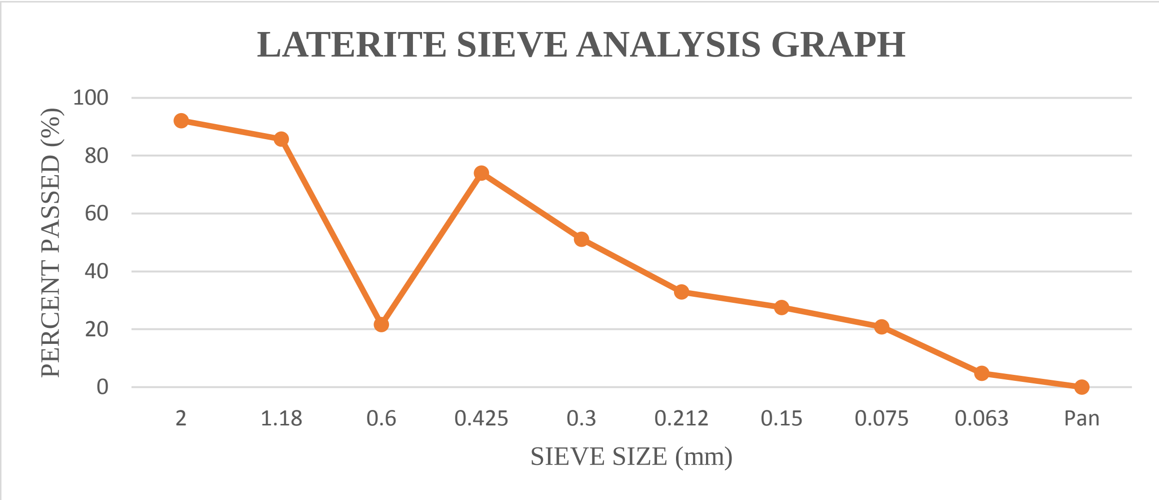

Fig. 2. Chart on Laterite Sieve Analysis

Table 6. Findings 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

4.1.3 Outcomes of tests done on red earth

The results of the sieve analysis, specific gravity, plastic and liquid limit tests performed on a tiny amount of red earth that was used to make some of the blocks are displayed in Table 7.

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.

4.2 Workability Test Result (Compressive Strength)

The tables and graph below show the results of the compressive strength test performed on each block. It demonstrates the strength variations between the various types of blocks constructed in light of the materials used. The compressive strength for the majority of the blocks is below the minimal value of 3.45 N/mm^2 for individual blocks that is advised 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^{l} block

Area of 5^{l} block = Length × Width
Area of 5^{l} block = 450 mm × 225 mm
Area of 5^{l} block = 101250 mm^2

Table 7. Findings for sieve analysis on red earth

Sieve size (mm)	Sieve mass (g)	Mass of sieve + soil retained (g)	Soil retained (g)	Percent retained (%)	Cumulative Percent Retained (%)	Percent Passed (%)
2	150.9	199.5	48.6	6.68	6.68	93.32
1.18	255	313	58	7.97	14.65	85.35
0.6	230	269.9	39.9	5.48	20.13	79.87
0.425	223.8	270.6	46.8	6.43	26.56	73.44
0.3	198.3	319.1	120.8	16.59	43.15	56.85
0.212	223.5	322.1	98.6	13.54	56.69	43.31
0.150	347.9	468.3	120.4	16.54	73.23	26.77
0.075	200.2	230.8	30.6	4.20	77.43	22.57
0.063	135.4	214.2	78.8	10.82	88.25	11.75
Pan	246.4	331.9	85.5	11.74	99.99	0.01
Total			**728**	**100**		

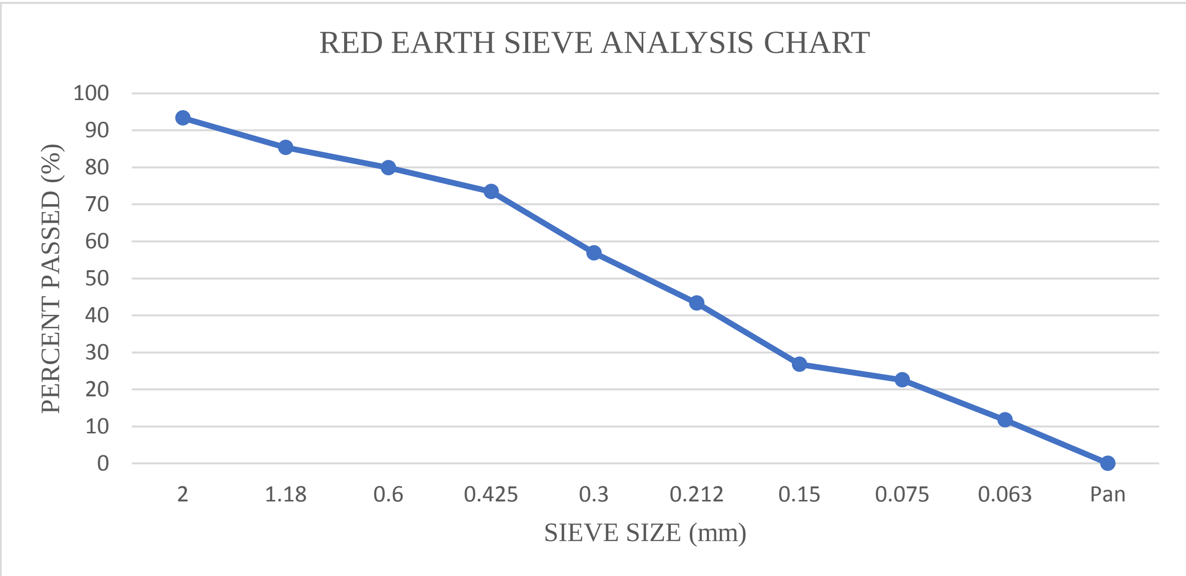

Fig. 3. Chart on red earth sieve analysis

Table 8. Findings 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

Table 9. Block compressive strength 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	5.04	5.04
		508.9	5.03	
2.	Cement + Laterite	370.4	3.66	3.66
		369.3	3.65	
3.	Cement + Red earth	265.5	2.62	2.61
		263.5	2.60	

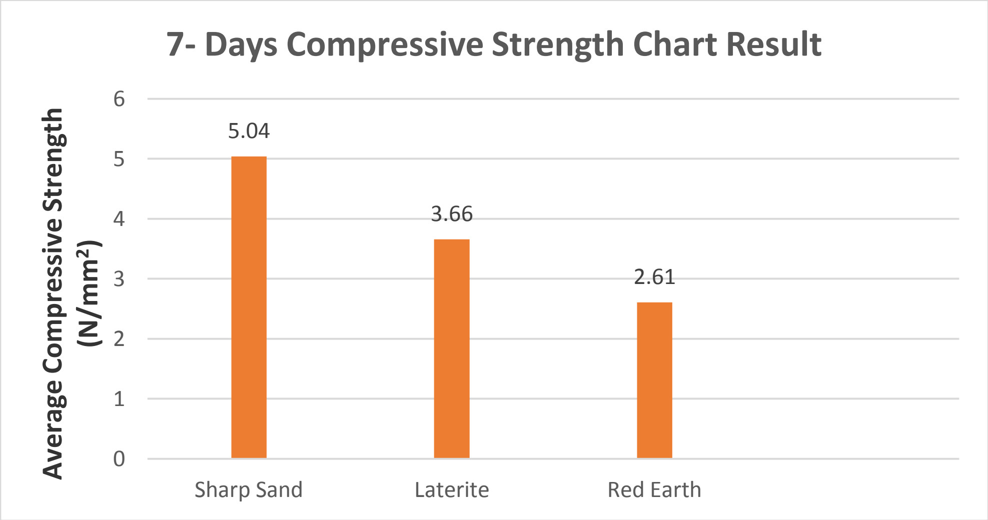

Fig. 4. 7- Days curing compressive strength result

Table 10. Block compressive strength 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	5.05	5.04
		509.3	5.03	
2.	Cement + Laterite	331.9	3.28	3.27
		330.2	3.26	
3.	Cement + Red earth	205.6	2.03	2.02
		202.7	2.00	

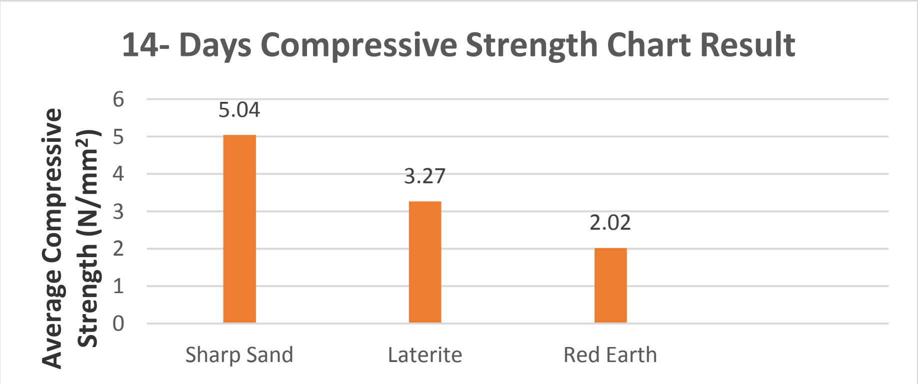

Fig. 5. 14- days curing compressive strength result

The block constructed with cement and sharp sand had the highest average compressive strength after seven (7) days of curing, measuring 5.04 N/mm2, up 46% from the industry standard of 3.45 N/mm2 (NIS 87, 2000). When compared to the sharp sand mix, the average compressive strength of blocks made with Laterite mix and Red Earth, NIS standard, is 3.66 N/mm2 for those made with cement and laterite and 2.61 N/mm2 for Red Earth. However, there is a percentage increase and decrease in strength of 6% (increase) and 24% (decrease) between the two.

The block constructed with cement and sharp sand still has the highest average compressive strength after fourteen (14) days of curing, measuring 5.04 N/mm2, a 46% improvement over the normal 3.45 N/mm2 (NIS 87, 2000) after seven (7) days. Red earth has the lowest average compressive strength of all the materials, with a compressive strength of just 2.02 N/mm2. The average compressive strength of the blocks created with Laterite mix and Red Earth, NIS standard, respectively, decreased by 5% and 41% when compared to the sharp sand mix. The average strength of cement and laterite blocks is still higher than that of cement and red earth blocks.

The block constructed with cement and sharp sand had the highest average compressive strength after 21 days of curing. This result was 4.83 N/mm2, which is higher than the usual 3.45 N/mm2 but lower than the results obtained after 7 and 14 days (NIS 87, 2000). Red earth has the lowest average compressive strength of all the materials, having a compressive strength of 2.21 N/mm2, followed by cement and laterite at 3.47 N/mm2. The average compressive strength of the blocks constructed with Laterite mix, Red Earth, and NIS standard, respectively, increased and decreased in strength by 0.58% (increase) and 36% (reduction) compared to the sharp sand mix, respectively.

Table 11. Block compressive strength 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	4.81	4.83
		490.0	4.84	
2.	Cement + Laterite	351.3	3.47	3.47
		350.0	3.46	
3.	Cement + Red earth	224.4	2.22	2.21
		222.1	2.19	

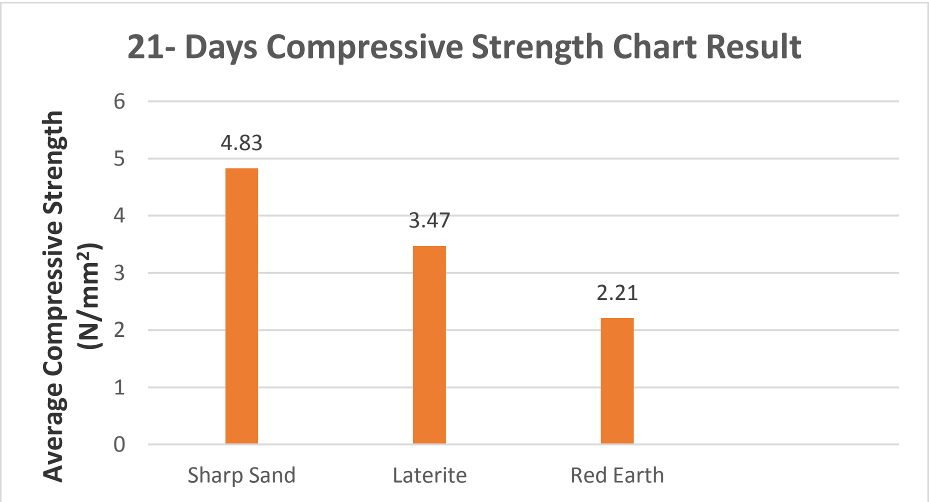

Fig. 6. 21- days curing compressive strength result

Table 12. Block compressive strength 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	9.83	9.97
		1022.4	10.10	
2.	Cement + Laterite	524.7	5.18	5.16
		520.8	5.14	
3.	Cement + Red earth	318.9	3.15	3.16
		320.4	3.16	

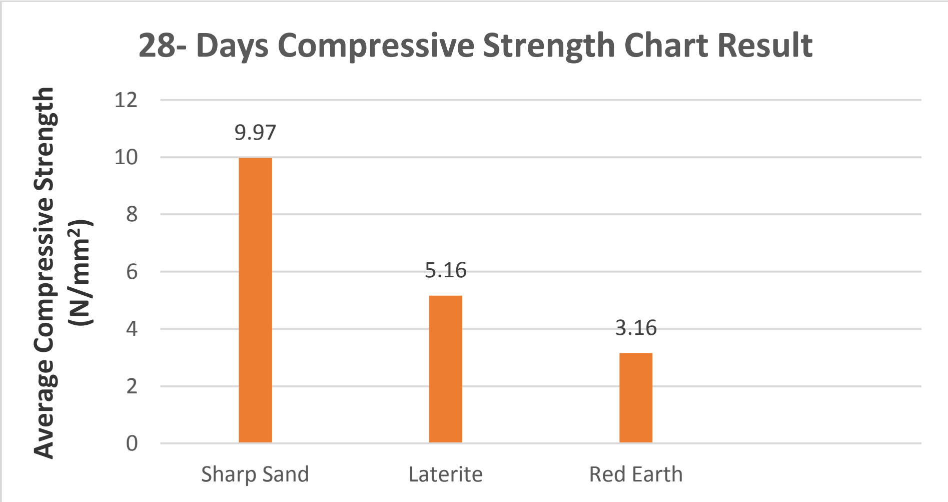

Fig. 7. 28- Days curing compressive strength result

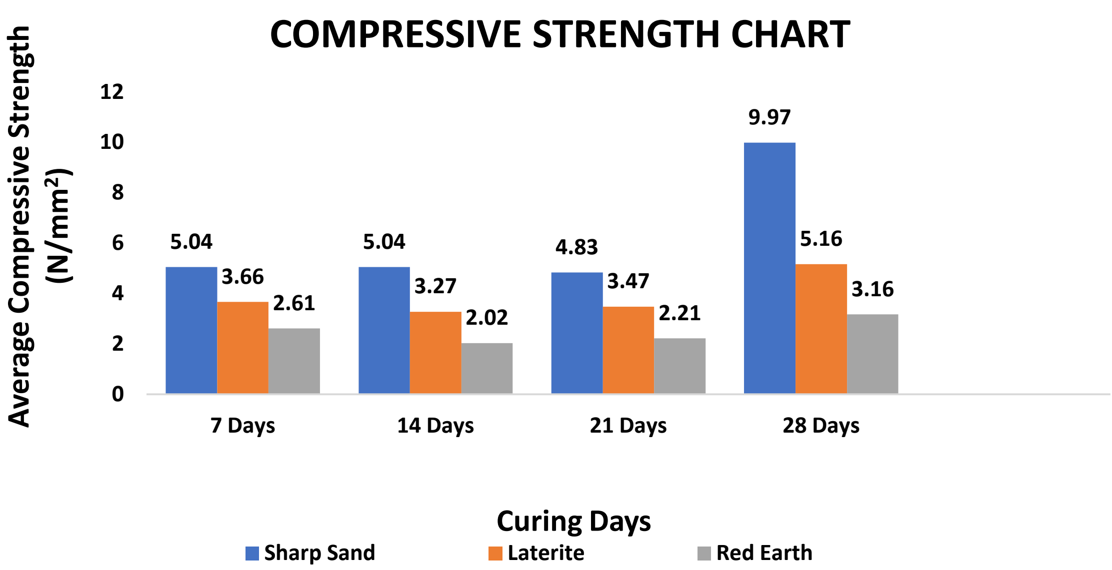

Fig. 8. Chart on compressive strength of blocks

The block built with cement and sharp sand still has the highest average compressive strength of 9.97 N/mm2 compared to the other blocks after 28 days of curing, an increase of 189% over the required 3.45 N/mm2 (NIS 87, 2000). Red earth has the lowest average compressive strength of all the materials, with a compressive strength of just 3.16 N/mm2. The average compressive strength of the blocks created with Laterite mix, Red Earth, and NIS standard, respectively, increased and decreased in strength by percentages of 49.5% (increase) and 8% (reduction) as compared to the sharp sand mix. The average strength of cement and laterite blocks is still higher than that of cement and red earth blocks.

Between the 14th and the 28th day of the curing periods, there was insufficient curing of the blocks. Lack of experience was the cause of the blocks' insufficient cure. The average compressive strength of the blocks after 28, 21, and 7 days of curing was the best, passing the NIS (87:2000) minimum value recommendation of 3.45 N/mm2. Only the red earth block after 7 and 21 days of curing fell short of the minimum at 2.61 N/mm2 and 2.21 N/mm2, respectively. The 14-day findings were all below 3.45 N/mm2, in contrast to the 28-, 21-, and 7-day results, with the exception of the block formed of sharp sand, which was above at 5.04 N/mm2. similar to the outcome from 7 days.

5. CONCLUSION AND RECOMMENDATIONS

The purpose of this study was to investigate the production of blocks using a combination of materials other than the usual ones (such as cement and sharp sand) obtained, and then test those blocks for compressive strength to determine whether they meet the Nigerian Modern Standard's recommendation of 3.45 N/mm2 for individual blocks (NIS 87:2000). The general characteristic strength ranged from 4.83 N/mm2 to 9.97 N/mm2 for blocks built of cement and sharp sand (sand Crete), 3.27 N/mm2 to 5.16 N/mm2 for blocks made of laterite, and 2.02 N/mm2 to 3.16 N/mm2 for blocks composed of red earth. The evaluation demonstrates that, if and when alleviating is done correctly, the strength of blocks increases with expansion in restoring days. Additionally, the sharp sand (Sand Crete) block had the highest compressive strength of all the block types, and those made with red earth and laterite can be used in place of sand Crete blocks if the proper blend proportion is involved. However, even though the compressive values for the individual blocks made with red earth, laterite didn't combine the sand crete blocks, they are still thought to have reasonable strength with legal standing.

From the ends, I subsequently suggest the accompanying;

i. Blocks constructed from materials other than cement and sharp sand should undergo a bulk density test to determine whether they can be used for non-load bearing partitions.
ii. NSE and COREN should support improved restorative practices and the use of appropriate techniques for alleviating of roughly seven days on the block makers.
iii. To ensure the optimum blend percentage, proper restoration, and adherence to the proper compaction time, effective oversight should be used on the construction site.
iv. The punishment for not adhering to the standard should be expressed by the government to the creators.
v. NSE and COREN should firmly approve compliance with the use of appropriate and advised building materials as well as sensible grouping practices for block creation.
vi. The use of an appropriate blend proportion during block construction to achieve the desired compressive strength.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Baligar V, Fageria N, Eswaran H, Wilson M, He Z, Wilson MJ. nature and properties of red soils of the world. The red soils of China: Their nature, management and utilization, Dordrecht: Springer Netherlands; 2004.
2. Giorgis I, Bonetto S, Giustetto R, Lawane A, Pantet A, Rossetti P, Thomassin JH, Vinai R. The lateritic profile of Balkouin, Burkina Faso: geochemistry, mineralogy and genesis. J. Afr. Earth Sci; 2014. DOI:http://dx.doi.org/10.1016/j.jafrearsci.2013.11.006.
3. Oyediran IA, Okosun J. An attempt to improve geotechnical properties of some highway lateritic soils with lime. Poskus izbolj_save geotechnic last no stinekaterih lateritnih tal za ceste z dodajanjem apna 60. 2013;287-296.
4. Bachar M, Azzouz L, Rabehi M, Mezghiche B. 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; 2014.

5. Kasthurba AK, Santhanam M, Achyuthan H. Investigation of laterite stones for building purpose from Malabar region, Kerala, SW India-Chemical analysis and microstructure studies. Construction and Building Materials. 2008;22(12):2400-8. DOI:http://dx.doi.org/10.1016/j.conbuildmat.2006.12.003
6. Rigassi V. Compressed earth blocks, Volume 1 of the BTC Production Manual, CRA Terre-EAG. 1995;1.
7. Kasthurba AK, Santhanam M, Mathews MS. Investigation of laterite stones for building purpose from Malabar region, Kerala state, SW India Part 1: Field studies and profile characterisation. Constr. Build. Mater. 2007;21: 73e82.
8. Kasthurba AK, Santhanam M, Achyuthan H. Investigation of laterite stones for building purpose from Malabar region, Kerala, SW India e Chemical analysis and microstructure studies. Constr. Build. Mater; 2008.
9. Adalberth K. Energy demand during the life cycle of a building. CIB Symposium Energy Mass and Flow in the Life Cycle of Building. Vienna; 1996.

© 2023 Tochukwu et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/96716