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Comparing the Strength of Blocks Made from Different Materials

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ABSTRACT
Blocks are known to be one of the man-made building materials used for various construction purposes. Blocks can be made from different materials as far as it can stand the rest of strength. The major type of block used for the construction of walls in many building is the sandcrete block which is made from cement, sharp sand and water. Due to the high cost of construction materials such as cement and sharp sand, this study was done to investigate the use of other construction materials (quarry dust, laterite and red earth), thereof re this study is focused on the use of other naturally occurring building materials to substitute the conventional ones in making of masonry blocks that could probably aid in reduction the cost of production of blocks to be used for construction purposes thereby also causing a reduction in the cost of construction of buildings and other engineering structures. Various tests such as sieve analysis, specific gravity test and plastic limit and liquid limit test were carried out on the materials used for production of the locks. A total of five (5) types of blocks were made with twelve (12) block samples made for each type making sixty (60) in total, each of the blocks were cured using the open air curing method and the compressive strength test was carried out on the 7, 14, 21 and 28 curing day of three (3) different blocks from each of the block types made. All blocks made were 6 inch blocks. The test result indicated that the materials were suitable for block making. On crushing the blocks it was discovered that the compressive strength of some did not meet up to the minimum recommended standard of 2.5N/mm^2 for individual blocks and 3.45N/mm^2 for five (5) blocks as recommended by the Nigerian Industrial Standard (NIS 87: 2000). The overall average strength for the blocks made with cement and sharp and (sandcrete) ranged from 2.08N/mm^2 to 2.56N/mm^2, for those made with cement and quarry dust it ranged from 1.19N/mm^2 while those made with cement and laterite had compressive strength that ranged from 0.96N/mm^2 to 2.25M/mm^2 and lastly those made with red earth, laterite and sharp sand had the least average compressive strength for every of the curing days and it ranged from 0.75N/mm^2 to 1.58N/mm^2.
Keyword: Comparing, Strengths, Blocks, Made, Different Materials.

INTRODUCTION
In many cases in Nigeria, some people have the problem of providing shelter for themselves and one of the reasons for this is the high cost of the building materials needed for construction. Building material is any material which is used for construction purposes. They are either naturally occurring or man-made products. Materials such as clay, rocks, sand and wood that are used in building constructions are considered as naturally occurring substances. Apart from these naturally occurring materials, many man-made products are also in use. Blocks are one of the man-made products and it is also one of the major materials used in the construction industry. Blocks can be formed in solid or hollow moulds. Blocks formed in hollow molds have lesser weight than the solid ones and they are usually easier to transport. The major type of block used for the construction of walls in many building is the sandcrete block which is a mixture of cement and sharp sand and because of the high demand of sharp sand there has been scarcity of this product leading to its increase in cost, since there is plenty of other naturally occurring materials test of strength was carried out to know if they can serve as substitute to sharp sand.

Strength is the ability of materials to resist failure due to compression, tenson, bending or impact that is caused by loads. The strength of a building material is a very important feature. Durability and strength of concrete blocks, as regards to being used as a construction material, is very relevant as these factors may determine the lifespan and or failure of a structure with time. From the results that was obtained from this project, the performance in terms of the strength of block using various material compositions, such as cement, laterite soil, red earth, sharp sand and quarry dust was known. The main material that was needed in almost the entire block sample that was required for this study is the Cemen and it is a binding material that has the capability of uniting different building materials to form a compacted durable form (Duggal, 2008). Cements used in construction can be regarded as being either hydraulic or non-hydraulic, depending on its ability to set in water. For this study hydraulic cement (such as Portland cement) was used. Hydraulic cements are the types of cement that set and become harden as a result of certain chemical reaction referred to as the hydration of cement between its active components and water. As a result of this chemical reaction the mixture can set and harden in wet condition or underwater. This situation of the high cost of construction of this structures lead to the topic of this project to bring about construction materials that could aid in reducing the cost of production of the blocks to be used and the construction using this blocks.

MATERIALS AND METHODS

Sharp Sand

They are particles that mainly comprise of silica or quartz, the lack cohesion in the presence of water and it also has limit swelling and shrinkage.

Laterite

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

Red Earth

It is majorly formed as a result of the chemical weathering rocks, mainly silicates. Unlike sharp sand it has strong cohesion in the presence of water and also excessive swellings and shrinkage.

Quarry Dust

They are the by-products formed during the crushing process of rocks into smaller sizes.

Cement

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

Water

Ordinary portable water was used throughout

Experimental Design

Table 3.1: Experimental design

S/N	Types Of Blocks	Mix Ratio	Number Of Blocks That Will Be Tested For Replica Each Of The Following Curing Days				
			7	14	21	28	
1	Cement + Sharp Sand	1:4	3	3	3	3	12
2	Cement + Red Earth	1:3	3	3	3	3	12
3	Cement + Laterite	1:3	3	3	3	3	12
4	Red Earth + Sharp Sand + Laterite	2:1:1	3	3	3	3	12
5	Cement + Quarry Dust	1:4	3	3	3	3	12

METHOD

This includes the tests that were carried out on the materials to be used and also the test that was carried out on the blocks itself.

Table 3.1: Lists of Apparatus and the Number Required

S/No	Apparatus/Equipment Needed	Number Required
1	Compression machine	1
2	Weighing Balance	1
3	Sieves of different sizes	10
4	Mechanical Sieve Shaker	1
5	Density bottle of 50ml with stopper	2
6	Funnel	1
7	Volumetrc Cylinder	1
8	Liquid limit device	1
9	Evaporating dish/Porcelain dish	1
10	Moisture cans	8
11	Drying oven	1
12	Glass plate	1

Sieve Analysis

The sieve analysis test is used to determine the distribution of the coarser, larger-sized particles; it is widely used in the classification of soil. The distribution of different grain sizes affects the engineering properties of soil. This analysis was carried out on all the materials that was used except for cement.

- 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.
- The sieve is then placed in the mechanical shaker and allowed to shake for 10 minute.
- 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 ratio of the unit weight of solids to the unit weight of water at any temperature. The aim of this test is to determine the specific gravity of the soil fraction passing the 75μm sieve size downward and distilled water.

- Clean and dry the density bottles thorough and the weight with the stopper in it was taken and recorded as W_1, a sample of mass 10 to 20g was measured.
- 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 W_2.
- 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 was filled completely with distilled water and kept for about 5 minutes. Each bottle with the content and the stopper was weight and recorded as W_3.
- 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 W_4.

Atterberg Limit Test

The Atterber limit test consists of the liquid limit, plastic limit and shrinkage limit test. Atterberg limit can be used to express the consistency (that is degree of firmness) of cohesive soil such as clay. This test was carried out on the red earth alone. Liquid limit can be defined as the water content where the soil changes from plastic to a viscous fluid state. Plastic limit is defined as the water content at which a soil will just begin to crumble when rolled into a thread approximately 3mm in diameter. Little quantity of dried soil was sieved (using 600μmm sieve) and then placed in a porcelain dish, small amount of distilled water was added to it until it formed a paste.

- For the liquid test: Five empty moisture cans was 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 drop 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.
- 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.

Compressive Strength Test

The Compressive strength of a material is its ability to withstand any gradually applied load acting on it. The compressive strength test was carried out on the blocks. The test was carried out to determine the strength of the blocks. The machine used for this test is the compression machine.

- 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.

RESULTS AND DISCUSSION

This chapter deals with the analysis of data obtained from the various test carried out on the various materials used and the blocks itself in accordance to the methodology explained in chapter 3.

TEST RESULTS CARRIED OUT ON SHARP SAND

The table below shows the results for the sieve analysis and the specific gravity test carried out on a small portion of sharp sand that was used for making some of the blocks.

Table 4.1: 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 (%)	Percent Passing (%)
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
Pan	390.5	410.5	20	2	0
		TOTAL =	1000	100	

Table 4.2: Result for specific gravity test on sharp sand

Specimen Number	1	2
W1 = mass of empty wash bottle + stopper (g)	23	21.5
W2 = Mass of wash bottle + stopper + dry soil (g)	34	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) = $\frac{w2-w1}{(w2-w1)-(w3-w4)}$

Average Specific Gravity= $\frac{2.2+3.3}{2}$ = 2.75

Therefore the Specific Gravity of the soil (Gs) = 2.75

TEST RESULTS CARRIED OUT ON QUARRY DUST

The table below shows the result for the sieve analysis and the specific gravity test carried out on a small portion of the quarry dust that was used for making some of the blocks.

Table 4.3: Result for sieve analysis of quarry dust

Sieve Size (mm)	Sieve Mass (g)	Mass of sieve + soil Retained(g)	Soil Retained(g)	Percent Retained(%)	Percent Passing (%)
2	538.5	868.5	330	33	67
1.18	493.5	599	105.5	10.55	56.45
0.600	476	614.5	138.5	13.85	42.6
0.425	453.5	533.5	80	8	34.6
0.300	437.5	526	88.5	8.85	25.75
0.212	407.5	484.5	77	7.7	18.05
0.150	400.5	463.5	63	6.3	11.75
0.075	371	455.5	84.5	8.45	3.3
0.063	381.5	392.5	11	1.1	2.2

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Pan	390.5	412.5	22	2.2	0
		TOTAL =	1000	100	

Table 4.2: Result for specific gravity test on quarry dust.

Specimen Number	1	2
W_1 = mass of empty wash bottle + stopper (g)	23	21.5
W_2 = Mass of wash bottle + stopper + dry soil (g)	33.5	31.5
W_3 - Mass of wash bottle + stopper + dry soil + water (g)	80.5	76.5
W_4 = Mass of wash bottle + stopper + water (g)	73.5	71.5
Specific Gravity (Gs) =	3	2

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

Average Specific Gravity= $\frac{3+2}{2}$ = 2.5

Therefore the Specific Gravity of the soil (Gs) = 2.5

TEST RESULTS CARRIED OUT ON LATERITE

The table below shows the results for the sieve analysis and specific gravity test carried out on a small portion of laterite that was used for making some of the blocks.

Table 4.5: Results for sieve analysis of laterite

Sieve Size (mm)	Sieve Mass (g)	Mass Of Sieve + Soil Retained (g)	Soil Retained(g)	Percent Retained (%)	Percent Passing (%)
2	538	1199.5	661.5	66.15	33.85
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	

Table 4.6: Result for specific gravity test on quarry dust

Specimen Number	1	2
W_1 = mass of empty wash bottle + stopper (g)	21	24
W_2 = Mass of wash bottle + stopper + dry soil (g)	31	34
W_3 - Mass of wash bottle + stopper + dry soil + water (g)	76.5	79.5
W_4 = Mass of wash bottle + stopper + water (g)	71.5	74.5
Specific Gravity (Gs) =	2	2

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

Average Specific Gravity= $\frac{3+2}{2}$ = 2

Therefore the Specific Gravity of the soil (Gs) = 2

TEST RESULTS CARRIED OUT ON RED EARTH

The table below shows the result for the sieve analysis, specific gravity plastic and liquid limit test carried out on a small portion of red earth that was used for making some of the blocks.

Table 4.7: Results for sieve analysis of red earth

Sieve Size Sieve (mm)	Sieve Mass (g)	Mass of sieve +Soil + soil retained (g)	Soil Soil retained (g)	Percent retained (%)	Percent 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	

Table 4.8: Result for specific gravity test on red earth

Specimen Number	1	2
W1 = mass of empty wash bottle + stopper (g)	16	16
W2 = Mass of wash bottle + stopper + dry soil (g)	33.5	34
W3 - Mass of wash bottle + stopper + dry soil + water (g)	81	76
W4 = Mass of wash bottle + stopper + water (g)	70	70
Specific Gravity (Gs) =	2.69	1.5

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

Average Specific Gravity= $\frac{2.69+1.5}{2}$ = 2.095

Therefore the Specific Gravity of the soil (Gs) = 2.1

Table 4.9: Liquid limit test on red earth

No of trials	1	2	3	4	5	
No of trails	45	42	38	31	27	
Weight of empty can (g)		13.5	13.5	13.5	13.5	13
Weight of empty can + wet soil (g)	40	45	47	48.8	40	

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Weight of empty can + Dry soil (g)	28.5	35	35	34	30.5	
Weight of dry soil (g)	15	21.5	21.5	20.5	17.5	
Moisture content (%)		76.7	46.5	55.8	72.2	54.3

Average moisture content $= \frac{76.7+46.5+55.8+72.2+54.3}{5} = 50.0$

Therefore the liquid limit (LL) of the soil sample = 50.0

Table 4.10: Plastic limit test on red earth

No of trials	1		2		3	
Weight of empty can (g)		13.5		13.5		13.5
Weight of empty can + wet soil (g)	33		36		39.5	
Weight of empty can + Dry soil (g)	30.5		34		35.5	
Weight of dry soil (g)	17		20.5		22	
Moisture content (%)		14.7		9.76		18.2

Average moisture content $= \frac{14.7+9.76+18.2}{3} = 14.2$

Therefore the Plastic limit (PL) of the soil sample =14.2

The plasticity index of the soil (PI) = LL-PL =50.0 - 14.2 =35.8

Since the plasticity index is greater than zero(0), the soil is regarded as plastic.

COMPRESSIVE STRENGTH OF THE BLOCKS

The table and graphs below shows the results of the compressive strength test carried out each of the blocks, it shows the variation in strength of the various types of blocks made based on the materials used. The compressive strength of the individual blocks ranged from 1.93N/mm^2 to 2.64N/mm^2 for the cement and sharp sand mixture, the blocks with the cement and quarry dust mixture had the strength that ranged from 1.77N/mm^2 to 2.61 N/mm^2, while the blocks made with the mixture of cement and red earth had the strength that ranged from 0.85 N/mm^2 to 2.04 N/mm^2, the blocks made from the composition of cement and laterite had the strength that ranged from 0.72 N/mm^2 to 2.61 N/mm^2, lastly the block made from the com position of red earth, laterite and sharp sand had the compressive strength that ranged from 0.55 N/mm^2 to 1,75 N/mm^2. The average compressive strength of each of the block type made after 7, 14, 21 and 28 curing days is as shown in table 4.11 to table 4.14. In general the blocks made with red earth, laterite and sharp sand has the lowest compressive strength values. For most of the blocks (majorly those made with mixture of red earth, laterite and sharp sand alone) the compressive strength falls below the recommended minimum value of 2,5 N/mm^2 for individual blocks as recommended by the (NIS 87:2000).

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Table 4.11: Compressive strength of the blocks after 7 curing days

S/No	Block Type	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1.	Cement + Sharp sand (1:4)	2.1 2.2 1.93	2.08
2.	Cement + Quarry dust (1:4)	1.85 2.1 1.77	1.91
3.	Cement + Laterite (1:3)	0.97 0.85 1.2	1.01
4.	Cement + Laterite (1:3)	0.72 0.92 1.44	1.03
5.	Red Earth + Laterite + Sharp Sand (2:1:1)	0.92 0.79 0.55	0.75

Table 4.12: Compressive strength of the blocks after 14 curing days

S/No	Block Type	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1.	Cement + Sharp Sand (1:4)	2.31 2.27 2.23	2.27
2.	Cement + Quarry dust (1:4)	2.33 1.97 2.09	2.13
3.	Cement +Red Earth (1:3)	1.39 1.15 0.95	1.16
4.	Cement + Laterite (1:3)	1.85 1.72 2.06	1.88
5.	Red Earth + Laterite + Sharp Sand (2:1:1)	1.19 1.12 0.66	0.99

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Table 4.13: Compressive strength of the blocks after 21 curing days

S/No	Block Type	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	Cement + Sharp sand (1:4)	2.35	
		2.3	2.27
		2.16	
2.	Cement + Quarry dust (1:4)	2.34	
		2.02	2.29
		2.5	
3.	Cement + Red earth (1:3)	1.49	
		1.42	1.51
		1.62	
4.	Cement + Laterite (1:3)	2.27	
		2.24	2.25
		2.04	
5.	Red Earth + Laterite + Sharp Sand (2:1:1)	1.33	
		1.03	1.15
		1.09	

Table 4.14: Compressive strength of the blocks after 28 curing days

S/No	Block Type	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	Cement + Sharp sand (1:4)	2.48	
		2.56	2.56
		2.64	
2.	Cement + Quarry dust (1:4)	2.54	
		2.61	2.53
		2.44	
3.	Cement + Red earth (1:3)	2.04	
		2.17	1.94
		1.6	
4.	Cement + Laterite (1:3)	2.33	
		2.61	2.24
		1.77	
5.	Red Earth + Laterite + Sharp Sand (2:1:1)	1.75	
		1.43	1.58
		1.56	

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The table 4.15, 4.16, 4.17, 4.18 and 4.19 shows the average compressive strength of the various types of blocks made in relation to the different curing days. From the results obtained it can be shown that the strength of the blocks increased in the increase in curing days. This shows the effect of curing on the compressive strength of blocks, therefore blocks should be cured in order for it to obtain its maximum strength.

Table 4.15: Compressive strength in relation to curing days for cement and sharp sand mixture

Average Curing Age (Days)	Compressive Strength (N/mm²)
7	2.08
14	2.27
21	2.27
28	2.56

Table 4.16: Compressive strength in relation to curing days for cement and sharp sand mixture

Average Curing Age (Days)	Compressive Strength (N/mm²)
7	1.19
14	2.13
21	2.29
28	2.53

Table 4.17: Compressive strength in relation to curing days for cement red earth mixture

Average Curing Age (Days)	Compressive Strength (N/mm²)
7	1.01
14	1.16
21	1.51
28	1.94

Table 4.18: Compressive strength in relation to curing days for cement and laterite mixture

Average Curing Age (Days)	Compressive Strength (N/mm²)
7	1.03
14	1.88
21	2.25
28	2.24

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Table 4.19: Compressive strength in relation to curing days for red earth and laterite and sharp sand mixture

Average Curing Age (Days)	Compressive Strength (N/mm²)
7	1.03
14	1.88
21	2.25
28	2.24

All the types of block made shows significant difference in its average compressive strength after the curing days.

Table 4.20: Average compressive strength of blocks after 7 days

Average Material	Compressive Strength (N/mm²)
Cement + Sharp sand	2.08
Cement + Quarry Dust	1.91
Cement + Red Earth	1.01
Cement + Laterite	1.03
Red earth + Laterite + Sharp sand	0.75

After curing the blocks for seven (7) days the block made with Cement and Sharp Sand has the highest average compressive strength of 2.08N/mm² compared to the rest, the difference between the average compressive strength of the blocks made with Cement and Quarry dust (1.91N/mm²) is not so much. While those made with the mixture of red earth, laterite and sharp sand alone has the lowest average compressive strength (0.75N/mm²).

Table 4.21: Average compressive strength of blocks after 14 days

Average Material	Compressive Strength (N/mm²)
Cement + Sharp sand	2.27
Cement + Quarry Dust	2.13
Cement + Red Earth	1.16
Cement + Laterite	1.88
Red earth + Laterite + Sharp sand	0.99

After curing the blocks for fourteen (14) days the block made with cement and sharp sand still has the highest average compressive strength of 2.27N/mm² compared to the rest, the difference between the average compressive strength of the blocks made with cement and Quarry dust (2.13N/mm²) is not so much. While those made with the mixture of red earth, laterite and sharp sand alone has the lowest average compressive strength (0.99N/mm²). The blocks made with cement and laterite still has a greater average strength than those made with cement and red earth.

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Table 4.22: Average compressive strength of blocks after 21days

Average Material	Compressive Strength (N/mm^2)
Cement + Sharp sand	2.27
Cement + Quarry Dust	2.29
Cement + Red Earth	1.51
Cement + Laterite	2.25
Red earth + Laterite + Sharp sand	1.15

Table 4.23: Average compressive strength of blocks after 28days

Average Material	Compressive Strength (N/mm^2)
Cement + Sharp sand	2.56
Cement + Quarry Dust	2.53
Cement + Red Earth	1.94
Cement + Laterite	2.24
Red earth + Laterite + Sharp sand	1.58

The results as presented above in both tables, graphs and bar chart made with cement and sharp sand has the greatest compressive strength. The list below shows the variation in strength of the blocks made in descending order:

1. Cement + Sharp sand: has the greatest strength compared to othe rest, it is then followed by
2. Cement + Quarry dust: which is followed by
3. Cement + laterite
4. Cement + Red Earth: and lastly
5. Red earth + Laterite + sharp sand

CONCLUSION

The aim of this study was to investigate the production of blocks with the use of the mixture of different materials other than the conventional ones (that is cement and sharp sand) gotten in Omu-Aran and then testing for its compressive strength to know if it meets up to the standard of $2.5N/mm^2$ for individual blocks and $3.45N/mm^2$ for five (5) blocks as recommended by the Nigerian Industrial Standard (NIS 87:2000). The overall average strength for the block made with cement and sharp sand (sandcrete) ranged from $2.08N/MM^2$ to $2.56N/MM^2$, for those made with cement and quarry dust it ranged from $1.91N/MM^2$ to $2.53N/MM^2$, for those made with cement it ranged from $1.01N/MM^2$ to $1.94N/MM^2$ while those made with cement and lateritic had compressive strength that ranged from $0.96N/mm^2$ to $2.25N/mm^2$ and lastly those made with red earth, lateritic and sharp sand had the least average compressive strength for every of the curing days and it ranged from $0.75N/mm^2$ to $1.58n/mm^2$. The study has that the strength of blocks increase with increase in curing days, of all the block type made the sandcrete block had the greatest compressive strength and made with cement and quarry dust and those made with cement and lateritic can be used as a substitute for sandcrete blocks if appropriate mix ratio is used.

Even though the compressive values for the individual blocks made with the mixture of red earth, lateritic and sharp sand did not meet up to the standard required it is still considered to have reasonable strength. Also areas where heat resistance is needed blocks made with the mixture of red earth, lateritic and sharp sand can be used because of the presence of red earth in the mix.

RECOMMENDATIONS

From the conclusions, I therefore recommend the following

1. Bulk density test should be carried out on blocks made with material other than cement and sharp sand to know if they can be used for non-load bearing partitions.
2. Improved curing practice, use of appropriate method of curing of at last seven days should be enforced by NSE and COREN on the block producers.
3. Effective supervision must be exercised on the production site to ensure these of appropriate mix ratio and adherence to right compaction time. Government should enforce it in the manufacturers, stating the penalty of noncompliance with the rule.
4. Compliance to the use of appropriate and recommended building materials and reasonable batching practice for block production should be strongly enforced by NSE and COREN.
5. The use of appropriate mix ratio for block production so that appropriate compressive strength can be attained.

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