Determination of Compressive Strength of Sandcrete Block Made With Sand, Periwinkle Shell, Latrite and Cement

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***Abstract*— This work present the determination of compressive strength of sandcrete block made with sand, periwinkle shell, laterite and cement. The sand was obtained from Otamiri River at Oweri and is free from dirt. Periwinkle shells were as coarse aggregate augment. Laterite was used in partial replacement of the sand. Ordinary Portland cement was used in this study. Twenty five mix ratios were used. Three of them were used as control mixes. The control mixes contain only sand and cement. Four cubes were cast for each mix ratio given a total of hundred cubes. The size of the cubes is 150mm x 150mm x 150mm. mix ratio were based on volume. Mixing and casting were performed manually. Thirty blows were given to each of the three layers of the mixture in the mould during casting. The blocks were allowed to cure for 28 days after demolding. Curing was done by sprinkling water on the blocks morning and evening every day for 28 days. After 28 days, the cubes were crushed at saturated surface dry density. From the result, the minimum and maximum strength of the blocks are 4.98N/mm^2 and11.60Nmm^2. The average SSD density of the block is 2330.074kg/m^3 . The minimum strength was obtained from a mix corresponding to 10% cement content by volume of solid materials.**

***Index Terms*— Saturated surface dry density, compressive strength, lateritic, periwinkle shell sandcrete cubes.**

I. INTRODUCTION

The need to bring down the high cost of building materials and the urge to find alternative materials have been the compelling factor to further research on the use of laterite with a view to investigate their usefulness as a construction materials as a whole or partly as a substitute to fine aggregate component of sandcrete blocks. Lateritic soil has been one of the major building materials in Nigeria for a long time. The main reason is because it is readily available and the cost of procuring it is very low. Sand on the other hand, which is mostly used in all aspects of construction work is being threatened by a number of factors on one hand while its demand is increasing at an alarming rate on the other hand. From observation based on the wide range of availability of laterite, the fact that it is being disposed as waste on sites and scarcely used in construction works except for filling foundations, laterite could be used in some proportions with sand as fine aggregate to produce blocks.

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Laterite has been used in construction of shelter from time immemorial and approximately 30% of world's present population still lives in laterite structures (Cofirman and Auiston, 1990). It has been used extensively for wall construction, particularly in developing countries (Ren and Kagi, 1995). However, because of the scarce and limited technical knowledge of lateritic soils, it is not yet generally accepted in building construction as a material and this has contributed to its limited application in building blocks (Udoeyo,2006). Studies are currently going on in the use of lateritic soil and periwinkle shell in concrete production and in sandcrete block production. Hence, this study is aimed at determining the compressive strength of sandcrete block made with sand, periwinkle shell laterite and cement. It is believed that this work will contribute to the existing data available on the use of lateritic soil in building production, especially in areas where the conventional fine aggregate, sand, is not available

II. MATERIALS AND METHODS

Portable water obtained from open tank at Federal University of Technology, Owerri, Imo State, was used for this work. Dangote brand of ordinary Portland Cement (OPC) that confirms to BS 12(1978) was used as binder. Laterite obtained from a burrow pit at Ihiagwa community, Owerri, was used as fine aggregate along side with river sand from Otamiri River. The laterite had low clay and silt content and was free from physical organic substances and the periwinkle shell was obtained from bayelsa state Nigeria. The sieve analysis of the materials used were carried out and the sieve size were ploted against the percentage passing as shown in fig 1, 2, 3 and 4.

Batching was done by weight and corresponding volumetric ratio was recorded in table 1. Twenty-five mix ratios of water, cement, laterite, periwinkle shell and sand were used. Four standard cubes of 150mm x 150mm x 150mm sandcrete were moulded for each mix, making a total of 100 cubes. Trial mix test was conducted to ascertain the required volume of water for the workability of the mix. The cube molds were oiled to prevent adhesion of the material to the mold and also to aid easy demolding. Compaction was carried out using a standard tamping rod of 16mm. Each layer received 30 blows making a total of 90 blows per cube. After compaction, the cubes were demolded immediately and labeled for easy identification. The process was repeated for continuously till the whole mixes were complete. The various mixes are shown in table 1. The cubes were cured by sprinkling water on them twice a day for a period of twenty-eight (28) days. At the climax of the twenty-eighth day, the cubes were immersed in water for a period of 24 hours to be saturated with water. At the elapse of the time, the cubes were brought out and allowed to surface

dry for another 30mins. Compressive cube strength and saturated surface dry (SSD) density tests were conducted in conformity with BS 1881: Part 115 (1986). The values of the saturated surface dry densities and the compressive cube strengths are tabulated in table 2.

III. RESULTS AND DISCUSSIONS

The results of the compressive cube strength and saturated surface dry (SSD) density tests for all the twenty-five mix ratios are presented in table 2. The result shows that the average SSD density of the sandcrete blocks is approximately 2330.074Kg/m³, This value exceeds the density of dense blocks made with dense aggregates, which include natural sand and crushed rocks as stipulated by BS 1881: Part 115 (1986).with a densities of 1920 to 2080Kg/m³ and may be solid or hollow. Also, the compressive strength of the cubes increases with increase in the saturated surface dry density as shown in tabl 2. from the same table 2; the compressive cube strength ranges from 4.98N/mm² to 11.6N/mm² which is higher than the minimum compressive strength of sandcrete block by NIS 87:2007 ranging from 2.5N/mm² to 3.45N/mm² and. Therefore, on the basis of the compressive strength, sandcrete with laterite as part of the fine aggregate could be suitable for construction as load bearing blocks provided a suitable mix ratio such as used in this research will be used. The laterite content and the corresponding compressive cube strength is tabulated in table1and 2 and the graph shown in fig 4, and it can be deduced that with increase in the content of laterite there is a corresponding decrease in the compressive strength of the cube but with lower laterite content, the compressive strength increases even beyond that in control mixes.

IV. CONCLUSIONS

Considering the inferences drawn from the experimental test for this work, lots of information were gathered and threw more light on how best laterite and periwinkle shell can be used in the production of block for partitioning and other building element. Readily available and affordable laterite has been used successfully to produce Sandcrete blocks. It also threw a challenge to our local periwinkle shell and laterite industries and also to the government to use our abundant natural resources for our own maximum benefit. With this, there will be reduced dependence on river sand which is costly, scarce and unavailable in some places. Also many might be deceived by a mere look or physical appearance of an aggregate, as some might look qualitative at sight but in actual sense they are impure and not hard while others might look light yet posses enough strength to be used in civil works. The compressive strengths of the laterite sandcrete blocks are usually greater than those of sandcrete blocks. Laterite sandcrete blocks are more economical building materials for walling units than the sandcrete blocks. Laterite sandcrete blocks has densities that are higher than their sandcrete counterparts and they may likely provide more solid and durable walls in buildings.

Table 1. Mix ratios

S/N	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15
CEMENT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RIVER SAND	2.4	2.7	3	3.3	3.6	3	3.375	3.75	4.125	4.4	3.6	4.05	4.5	4.95	5.4
LATERITE	1.8	1.65	1.5	1.35	1.2	2.25	2.0625	1.875	1.6875	1.5	2.7	2.475	2.25	2.025	1.8
PERIWINKLE	1.8	1.65	1.5	1.35	1.2	2.25	2.0625	1.875	1.6875	1.5	2.7	2.475	2.25	2.025	1.8

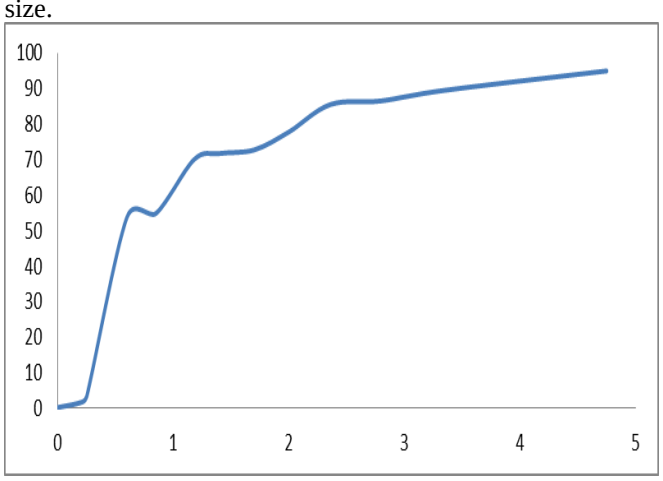
Mixes fort control

S/N	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
CEMENT	1	1	1	1	1	1	1	1	1	1
RIVERSAND	2.55	3.15	3.3	3.563	4.313	3.825	4.725	6	7.5	9
LATERITE	1.725	1.425	1.725	1.96875	1.59375	2.5875	2.1375	0	0	0
PERIWINKLE	1.725	1.425	1.725	1.96875	1.59375	2.5875	2.1375	0	0	0

Table 2. Values of saturated surface dry density (SSDD) and compressive cube strength

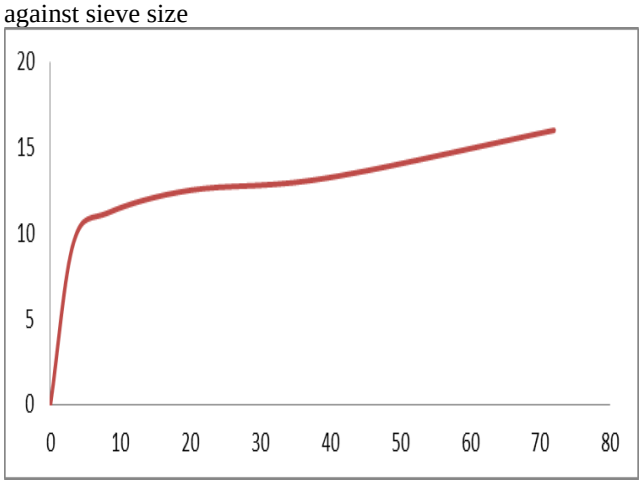
S/N	Avg.mass of cubes(Kg)	SSDD(Kg/m³	Avg compressive forces(KN)	Cube strength N/mm²
N1	7.4	2192.59	122	5.42
N2	7.6	2251.85	192	8.53
N3	7.7	2281.48	198	8.8
N4	7.9	2340.74	188	8.36
N5	8.0	2370.37	262	11.6
N6	7.3	2162.96	148	6.58
N7	7.5	2222.22	138	6.13
N8	7.7	2281.48	260	11.6
N9	7.8	2311.11	160	7.11
N10	8.0	2370.37	120	5.33
N11	7.3	2162.96	112	4.98
N12	7.5	2222.22	142	6.31
N13	7.6	2251.85	182	8.09
N14	7.8	2311.11	180	8
N15	8.0	2370.37	160	7.11
C1	7.5	2222.22	170	7.56
C2	7.8	2311.11	228	10.1
C3	7.7	2281.48	230	10.2
C4	7.6	2251.85	200	8.89
C5	7.9	2340.74	168	7.47
C6	7.4	2192.59	128	5.69
C7	7.7	2281.48	150	6.67
C8	9.3	2755.56	200	8.89
C9	9.3	2755.56	230	10.2
C10	9.3	2755.56	168	7.47
		Total 58251.85		
		Average 2330.074		

Fig. 1. A graph of percentage passing of sand against sieve size.



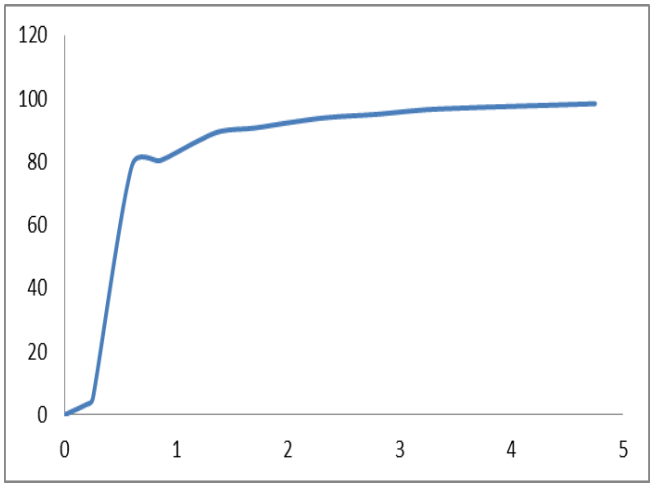
% passing

Fig.2 A graph of percentage passing of periwinkle shell against sieve size



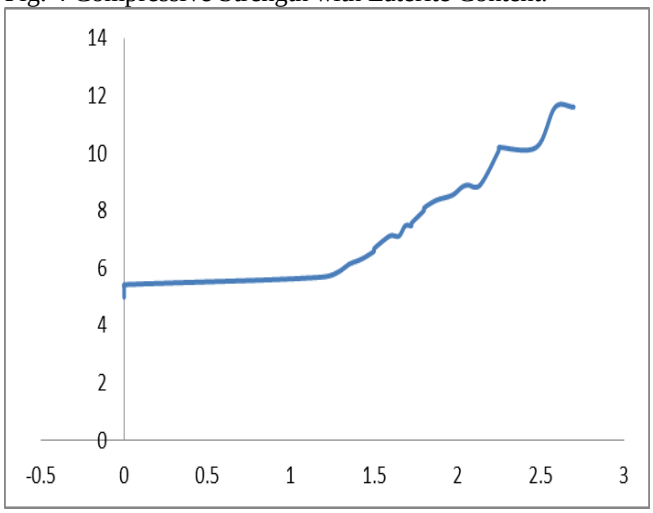
% passing

Fig. 3. graph of percentage passing of latrite against sieve size



% passing

Fig. 4 Compressive Strength with Laterite Content.



latrite

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