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ASSESSMENT OF LATERIZED QUARRY DUST AND CRUSHED BRICKS AS ALTERNATIVE CONCRETE MAKING MATERIALS

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Abstract: The research was conducted to study the suitability of using laterite soil, quarry dust and the crushed brick as alternative aggregates for concrete production for low cost housing since it is clear that the rising cost of concrete materials coupled with environmental degradation has impaired the construction industry. The following tests were carried out to determine the physical properties of these materials; density tests, silt content, water absorption, sieve analysis, specific gravity, flakiness index and aggregate crushing value. The research was conducted by testing concrete cylinder and cubes specimens at ages of 7, 14 and 28days concrete with concrete mix ratios 1:1.5:3 with a target strength of 25N/mm2 and 1:2:4 with a target strength of 20N/mm2. Samples of concrete specimens were made using varying contents of quarry dust and laterite as fine aggregate. The quantity of quarry dust was varied from 0 to 100% against laterite at intervals of 25%. The samples were cured for specified periods, i.e., 7, 14 and 28 days and tested in the laboratory for compressive strength and split tensile strength. Compressive strength at 28 days ranged from 17.5- 19.9N/mm2 for mix ratio 1:1.5:3 and 14.7-17.6N/mm2 for mix ratio 1:2:4. Split tensile strength at 28 days ranged from 1.9-2.5N/mm2, 1.4-2.5N/mm2 respectively These results are slightly lower as compare to those of conventional concrete

The results revealed that a combination of 50% quarry dust against 50% laterite and 75% quarry dust against 25% laterite attained higher compressive strength and that these materials are ideal for making concrete to be used where high strength of concrete, i.e., strength exceeding 20N/mm2 is not required

I. INTRODUCTION

Concrete is a versatile engineering material consisting of cementing substance, aggregates, water and often controlled amount of entrained air. It is initially a plastic, workable mixture which can be moulded into a wide variety of shapes when wet. The strength is developed from hydration due to the reaction between cement and water. The products, mainly calcium silicate, calcium silicate hydrate, calcium aluminates and calcium hydroxide are relatively insoluble which bind the aggregate in a hardened matrix. Concrete is considerably stronger in compression than in tension; for structures required to carry only compressive loads such as massive gravity dams and heavy foundations, reinforcement is not required and the concrete is consequently called plain concrete. When the structure is to be subjected to tensile stresses, steel bars are embedded in the concrete. Since 70-80% of concrete is made up of aggregates, its types, quality and general properties determine the quality of concrete (Khatita et al., 2009). These materials are fast becoming rare and expensive commodities. Uncontrolled sand mining from river beds leads to problems like bank erosion lowering of water Table and other adverse effects to the environment. Likewise, quarrying of granite which is the main source of coarse aggregate has also led to similar problems.

Experimental Work:

Sieve analysis test for laterite, quarry dust and crushed bricks aggregates

Sieve analysis is the process of screening a sample of aggregate into size fractions each consisting of particles of the same range size i.e. particle size distribution. This test was carried out according to the requirements of BS812: Part 1; 1975. The entire fine aggregates i.e. laterite, quarry dust and coarse aggregates used in this study were subjected to this test.

b). Determination of silt content in fine aggregates

Silt content in fine aggregates was determined according to the standard procedures required by BS812: Part 2 of 1996 and KS-02-95 of 1984.

Silt content information is important in determining the suitability of a particular material in concrete production and the water requirement of the concrete mix.

c). Density tests

Bulk density is used for proportioning material mix design; this test was carried out according to the standard procedures required by BS812: Part 2 of 1996. The bulk density measurements were done in two states of the aggregates: loose and compacted state. In both cases, the aggregates were oven dried.

Apparent specific gravity test was carried out according to the standard procedures required by BS812: Part 2 of 1996.

Apparent specific density, oven dry specific density and saturated specific density were carried out according to BS 812 Part 2 1996, in the civil engineering lab at room temperature (20-27) ˚C, using an oven capacity 350˚C, electronic weighing balance accuracy 0.5g.28

Tests for both saturated and oven dry quarry dust and laterite samples for the test of oven dry density and saturated dry density were performed using a standard pycnometer, the original sample of 500g was poured in the filled pycnometer and water filled stirring to remove entrapped air the cover was screwed to seal tightly finally water refilled with a wash bottle and swirled carefully to remove bubbles the weight was recorded. The sample was carefully poured in a calibrated metal tray and dried in the oven at 105˚C, After

emptying the contents the pycnometer was filled screwed to seal tightly and refilled to the brim and the weight taken, after the drying each oven dry sample was recorded and the oven dry density and saturated dry density computed.

d). Water absorption test

Water absorption tests were conducted on all the fine and coarse aggregates. The water absorption is defined as the ratio of the increase in weight to the weight of the dry sample, expressed as a percentage. The test was carried out according to BS 812: Part 2 of 1975 requirements.

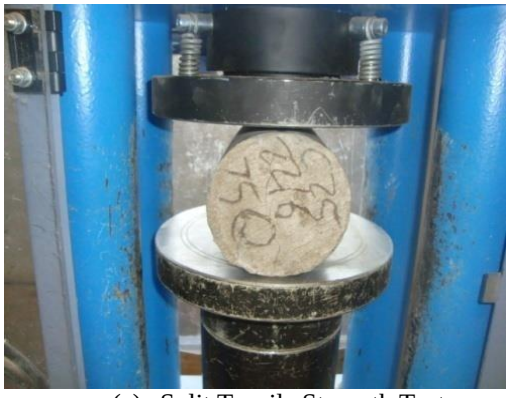
3.2.2 Data Collection Procedure a). Sieve analysis test

The results of sieve analysis were represented graphically in grading curves/charts. By using these charts, it is possible to see at a glance if the grading of a given sample conforms to that specified or it is too fine or coarse or deficient on a particular size. In the curves, the ordinates represent cumulative percentages passing and the abscissa the sieve sizes plotted in a logarithmic scale.

Split Tensile Strength Test table

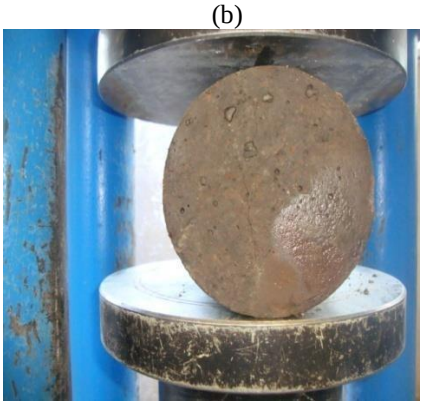
Table 1: Split Cylinder Test results Class 25 Table of Results Split Cylinder Test results Cyl.25- 0%,25%, 50%, 75%, 100% replacement (N/mm2)

Age Days	0%	25%	50%	75%	100%
0	-	-	-	-	-
7	1.1	1.3	1.4	1.2	1.1
14	1.6	1.8	1.8	1.5	2.1
28	1.9	2.3	1.9	2.2	2.5



(a) Split Tensile Strength Test

(b)



(b) Crack pattern Failure

II. CONCLUSIONS

From the results of this study it can be established that the combination of laterite, quarry dust and crushed clay bricks to replace the conventional aggregates in the production of concrete results in structures with reasonable structural characteristics should be encouraged where there is comparative cost advantage.

The following conclusions can be made from this study;

i. The physical properties of laterite, quarry dust and crushed clay bricks investigated were; specific gravity, density and particle size distribution. The specific gravities for laterite, quarry dust and crushed cay bricks were found to be 2.392, 2.62 and 2.273, respectively.

ii. The 28 - day compressive strength of laterized quarry dust and crushed brick concrete was found to range from 14.7 – 17.6N/mm2 and 17.5-19.9 N/mm2 for class 20 and class 25 concrete mixes, respectively, for different mixes. The above strength properties were found to compare closely with normal concrete. The concrete mix with a proportion of 0% laterite to 100% quarry dust produced higher values of compressive strength.

Future Work

Further work is required to get data for structural properties of reinforced concrete produced with laterized quarry dust as fine aggregates and crushed bricks as coarse aggregates. The knowledge of all properties concerning the use of alternative aggregates in production of concrete will greatly assist engineers, builders and designers when using these materials for construction works

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