Yield Characteristics of Hybrid Clay Bricks from Interlocking Machine.

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ABSTRACT

This paper presents the yield characteristics of hybrid clay bricks from an interlocking machine. The mixture of clay and cement at varying proportions was loaded into the mould compartment, mechanically rammed and hydraulically controlled.

The raw clay was sourced from Ilesa and Akure in the south-western part of Nigeria. The results showed that the Ilesa hybrid bricks parade better yield resistance than the Akure counterpart in all the available proportions.

The optimum yield value was obtained in Ilesa hybrid bricks with 6% cement ratio. Ilesa hybrid bricks possess greater load sustaining capacity in service condition than the Akure bricks.

(Keywords: hybrid bricks, yield characteristics, clay, cement, interlocking machine)

INTRODUCTION

Compressive strength is a mechanical property used in brick specifications, which has assumed great importance for two reasons. Firstly, with a higher compressive strength, other properties like flexure, resistance to abrasion, etc., also improve. Secondly, while other properties are relatively difficult to evaluate, the compressive strength is easy to determine (Adeola, 1977). Generally, compressive strength decreases with increasing porosity but strength is also influenced by clay composition and firing. Recently, Kenai *et al.,* (2007) examined the possibility of using crushed brick as coarse and fine aggregate for a new concrete. Results showed that it is possible to manufacture concrete containing crushed bricks (coarse and fine) with characteristics similar to those of natural aggregates concrete provided that the percentage of recycled aggregates is limited to 25% and 50% for the coarse and fine aggregates, respectively.

Due to the high heterogeneity of clay bricks, it is very difficult to develop a general model to predict their mechanical properties. Some attempts were made to obtain mechanical information from other properties or by using nondestructive techniques. Flat-jack testing is a very adequate *in situ* technique for the determination of the state of stress of the masonry or the masonry compressive strength; however it is not appropriate to characterize the compressive strength of masonry units alone and represents a costly investigation technique. The compressive strength of clay bricks is usually related to other properties, such as porosity and firing temperature, which are key parameters for durability (Cultrone et al. 2000).

The aim of this research is evaluate the yield characteristics of hybrid bricks from 8-mould interlocking brick making machine.

MATERIALS AND METHODS

Materials

The samples were collected from certain locations in Ilesa and Akure in the southwestern part of Nigeria. The Ordinary Portland Cement (OPC) was obtained commercially.

Method

The clay sample was mixed with water to desired consistency. Ordinary Portland Cement (OPC) was added in different percentages ranging from

0% – 14% putting into consideration the volume of each mould. The OPC was thoroughly mixed with the clay sample for even distribution and homogeneity. The aggregate was loaded into the eight moulds of the interlocking machine. After sometime, the hydrid bricks were hydraulically lifted out of the moulds. The interlocking machine used for this research was the 8-Mould Interlocking Earth Brick Making Machine which was designed, developed and fabricated at Engineering Materials Development Institute Akure Nigeria. Each sample was left for the first 28 days for proper curing and sufficient strength before compression testing was carried out.

COMPRESSION TESTING PROCEDURE

For the compression test, the specimens were cut from the bricks to be tested in the direction of the moulding or perpendicular to bed joints (Figure 1), which is the usual loading direction in building elements (e.g., walls and vaults) subjected to dead load. Generally, very small specimens were obtained, with typical cross sections of 30mm x 30 mm and 30mm of height. All specimens were ground using a rectifying machine, so that the loading faces were properly aligned.

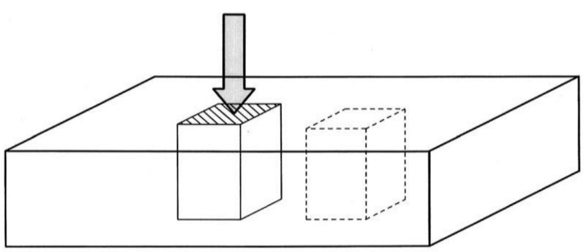

Figure 1: Schematics showing how Specimens were cut from Bricks and Direction of Compression Tests.

The test setup for the compression tests was carried out on Instron Universal Tester model 3369 available at the Engineering Materials Development Institute Akure Nigeria. Its steel frame was equipped with a compression load cell with a maximum capacity of 50 kN and connected to a software- driven computer system. The steel platens were rectified in order to provide a flat surface. The lower platen has a spherical seat made of tempered steel that allows the initial alignment and accommodation of the specimen, thus facilitating the alignment of the applied load with the centre of the specimen as well as preventing any other unfavorable effect due to geometrical imperfection of the specimen. The Instron software was programmed to capture all data during the course of the test.

RESULTS AND DISCUSSION

Figure 2 below represents the compressive stress at yield of hybrid bricks from Ilesa samples. It can be observed that, at the point of yield under compressive forces, the highest compressive strength of 2.29 MPa was obtained at 6% cement ratio. This shows that the resistance ability to give in to fracture under axial loading. This is due to the interlocking network formed by the particles of cement and clay at 6% ratio after mechanical ramming. At other cement proportions, the hybrid bricks started yielding at much lower compressive loads.

Compressive stress at yield of hybrid bricks from Akure samples is bar charted in Figure 3. It can be observed that the highest stress of 1.25 MPa under yield was obtained at 8% and followed by 6% cement ratio with compressive stress of 1.09 MPa. This value is lower than the compressive stress obtained from the Ilesa sample counterpart. This may be due to differential clay compositions or constituents.

Figures 4 and 5 are bar charts of compressive load at yield of hybrid bricks from Ilesa and Akure samples. In the Ilesa samples, it was observed that it is 6% cement that could withstand the highest compressive load of 2,520 N before fracture. However, among the bricks from Akure samples, 8% cement ratio produced 1,570 N compressive load at yield. This is much lower than Ilesa counterpart.

Figure 6 is a bar chart of energy at yield of hybrid bricks from Ilesa samples. It can be observed that the highest energy absorbed of 11.64 J was obtained at 6% cement. This is one of the reasons for the highest corresponding compressive stress and load at yield as seen in Figures 2 and 4. Due to the fact that the energy needed to cause yield is high, hence, the high compressive load and stress experienced.

Figure 7 is a bar chart of energy at yield of hybrid bricks from Akure samples. The highest energy absorbed before yield to compressive loading was produced by 6% cement at 4 J.

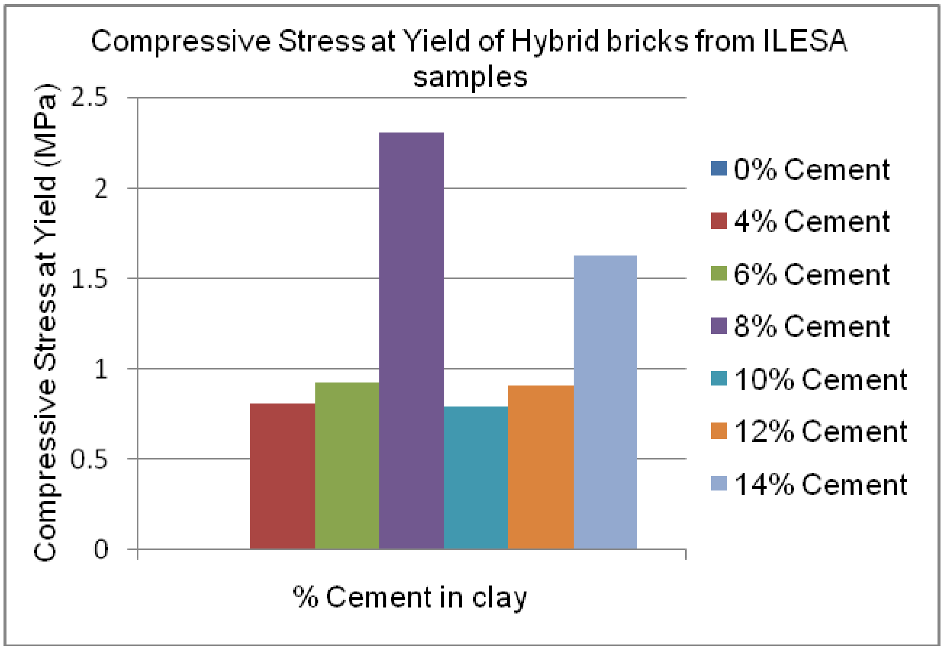

Figure 2: Compressive Stress at Yield of Hybrid Bricks from Ilesa Samples.

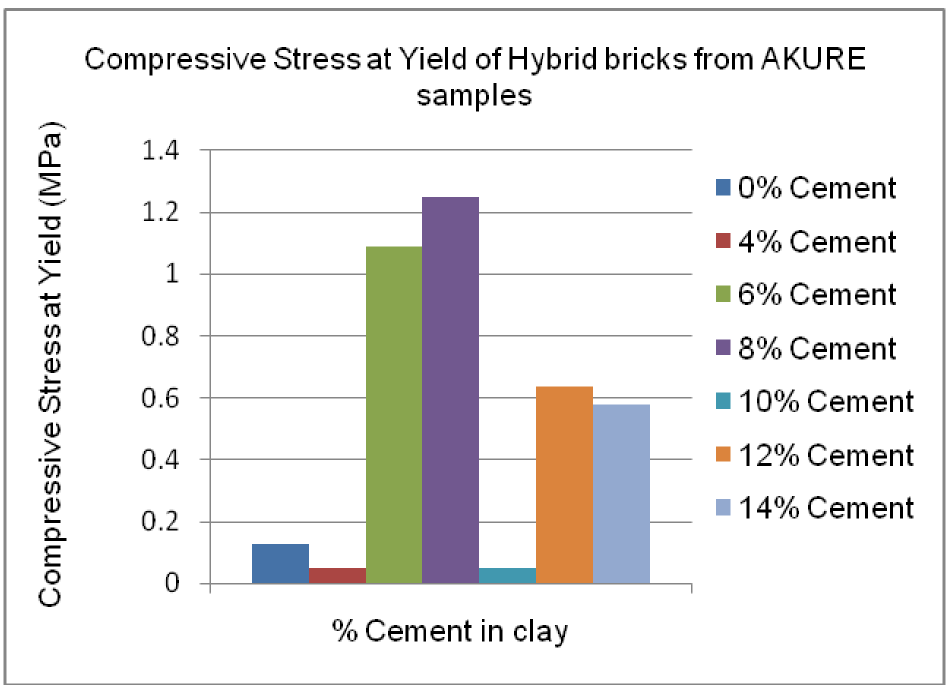

Figure 3: Compressive Stress at Yield of Hybrid Bricks from Akure Samples.

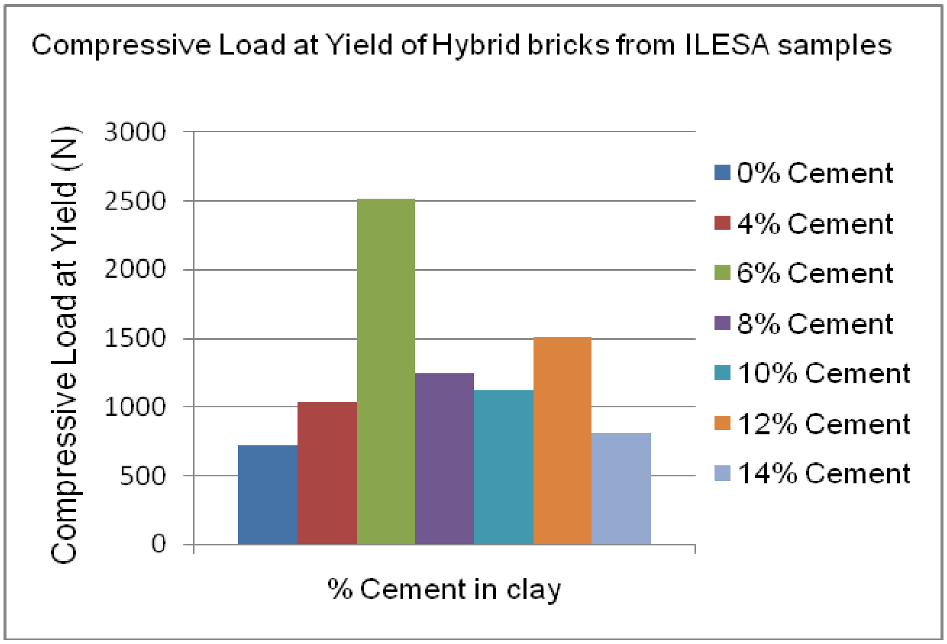

Figure 4: Compressive Load at Yield of Hybrid Bricks from ILESA Samples.

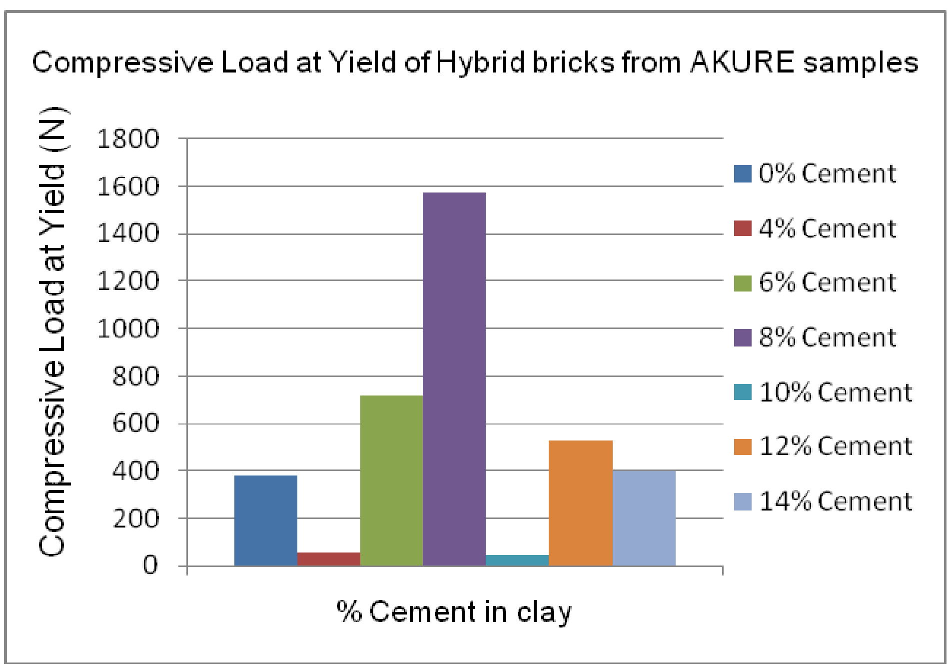

Figure 5: Compressive Load at Yield of Hybrid Bricks from AKURE Samples.

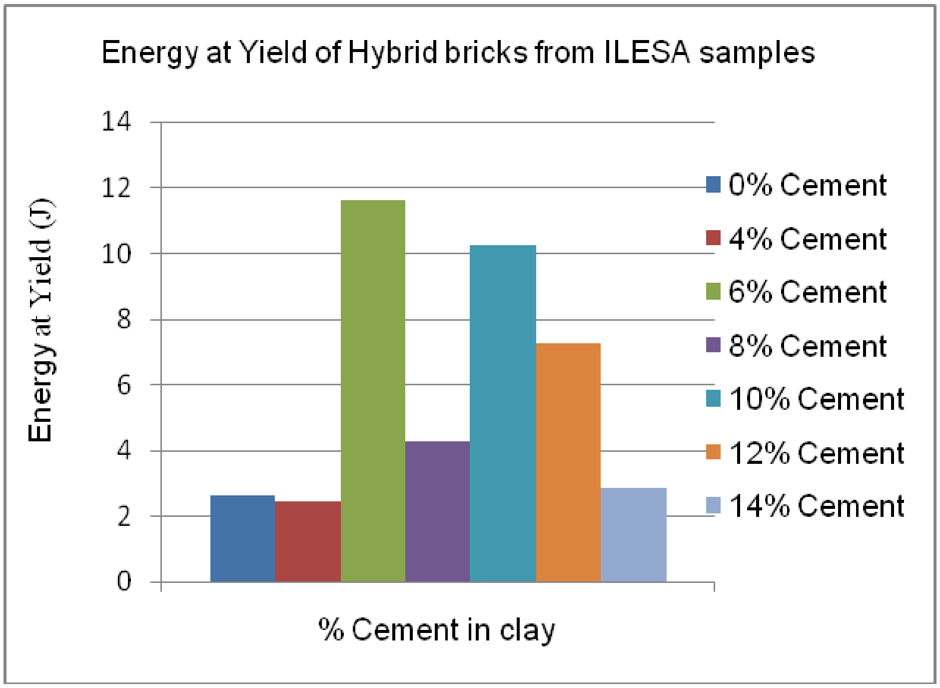

Figure 6: Energy at Yield of Hybrid Bricks from ILESA samples.

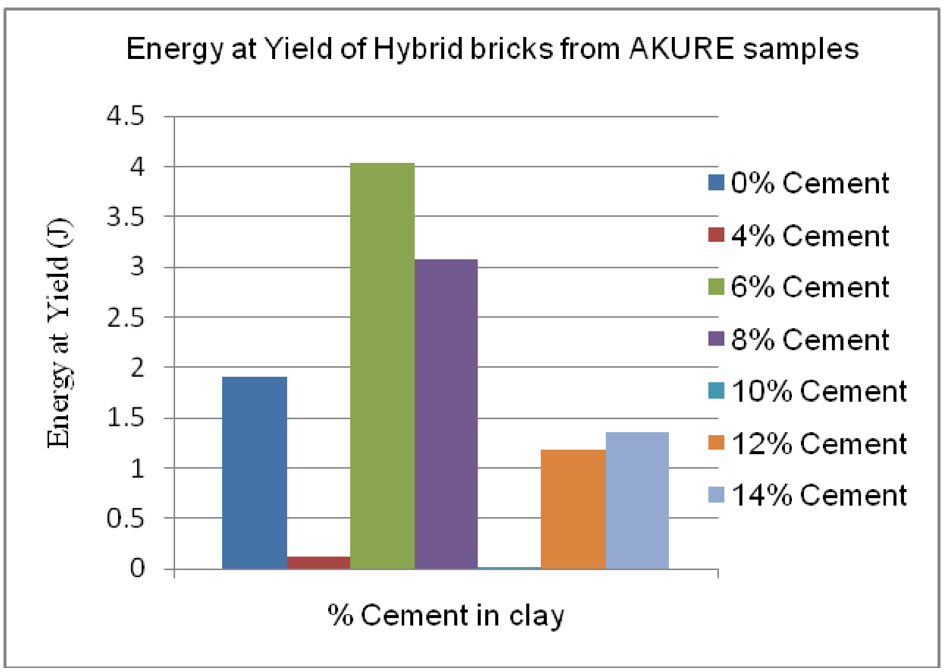

Figure 7: Energy at Yield of Hybrid Bricks from AKURE Samples.

This is not in support of the highest compressive load and stress at yield produced by 8% cement as previously shown in Figures 3 and 5.

CONCLUSION

It can be concluded from this study that:

1. The Ilesa hybrid bricks parade better yield resistance than the Akure counterpart in all the available proportions.

2. The optimum yield value was obtained in Ilesa hybrid bricks with 6% cement ratio.

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SUGGESTED CITATION

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