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Compressive Strength of Unfired Composite Bricks Made of Same Clay and Natural Fiber of Tanzania

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Abstract - ***Compressive strength is the important parameter when considering the design of bricks. Brick is among of materials which are tested their compressive strength .Therefore, the objective of this study is to the compressive strength of unfired and compressed clay bricks (UCCB) made from Same clay reinforced with sisal and coir as natural fibers. The samples of UCCB composite prepared at varying proportions compressive pressure. Then, the UCCB samples are cured for 28 days before compressive strength test of composite bricks. The compressive strength values of the reinforced or non-reinforced fiber mud bricks tested in this study increases from 1.74 to 6.85 N/mm². Therefore, UCCB composite is desirable in traditional construction because compressive strength values are within the specified standard from 1 to 7 N/mm².***

Key Words: *Compressive strength, Clay, Sisal, Coir, Unfired bricks*

1. INTRODUCTION

Brick is one of the important materials for construction industry[1].It may be fired or unfired. Fired brick have been adopted in building constructions for millennia. Adopting unfired clay brick has been reported as one of the alternatives for energy consumption reduction [2]. Currently, there is increase in interest in unfired clay brick that would meet strength requirement [3]. Brick is among of materials which are tested their compressive strength. Compressive strength is the important parameter when considering the design of bricks. The loads acting on brick while in service are compressive in nature, and their ability to withstand such loads without failure is a measure of their reliability[4]. The quality of bricks depends on the compression strength of which bricks can withstand load applied on it [5].

Reinforcement is among things that would improve shrinkage rate, crack propagation, strength and stiffness combined with lightness [6, 7]. The common natural fibers that are normally used to reinforce unfired clay bricks include; sisal, coir, bagasse, and rice husk. Currently, the agro-wastes which are either burnt or land filled causes environmental concern by emitting greenhouse gas, and air pollution [4].There have been reports that sisal and coir reinforced clay bricks increase in the compressive strength[8, 9].

The aim of this study is to evaluate the compressive strength of unfired compressed bricks made from Same clay reinforced with sisal and coir as natural fibers.

1.1 Experimental Procedure

The raw clay was sourced from Same deposit located in Kilimanjaro region. Also, the sisal and coir fiber were collected from Tanga region located at northern Tanzania. The Same clay was crushed by manually by pounding in suck and passing in 5 mm sieve. Each type of natural fibers was trimmed to the length of 30 mm because of the length aspect ratio between fiber and brick. Furthermore, the volume percentage of reinforcing natural fiber added to the clay matrix range from 1vol. % to 5 vol. %.

The clay was mixed with 15% of water for about 2 minutes until it becomes consistency. Then sisal or coir fiber was added to the mixture of clay and water and mixed for additional 3 minutes. Then mixture was loaded to the single mould press machine and uniaxial pressed to the various pressures 4, 6, and 8 MPa. Oil were used before filing the mould to reduce friction between UCCB composite and mould during ejecting and removing of fresh UCCB on pressing machine. The dimension of UCCB composite reinforced with or without sisal or coir fibers is 15 x 7.5 x 5.0 cm. The 99 composite bricks samples were produced for this experimental study. The UCCB composite bricks was ejected and placed on top of plastic sheet in laboratory wait 28 days for curing.

1.2 COMPRESIVE STRENGTH TEST

For the compression test, the UCCB specimens were subjected to the load acting perpendicular to the specimens as usual loading direction in building elements subjected to dead load. The dimension of UCCB specimens were 15 x 75 x 30 cm. The test setup for the compression tests was carried out on Control Universal Tester model 50-04642 available at the Civil engineering department laboratory Mbeya University of Science and Technology in Tanzania. It is made of steel frame equipped with a compression load cell with a maximum capacity of 2000 kN, and crushing rates 0.4 MPa/s. The steel platten were rectified to provide a flat surface. The upper platen has a spherical seat made of steel allows the alignment and accommodation of the UCCB specimens. Also, the steel platten facilitate the alignment of applied load with the centre of the UCCB specimens as well as preventing unfavourable effect due to geometrical imperfection of the UCCB specimens.

a) b)

Fig -1: Compressive strength test a) before b) after

2. RESULTS AND DISCUSION

Chart 1 shows the compressive strength of UCCB specimen reinforced with sisal fiber after 28 days of curing. The mixing of sisal fiber in different percentages and pressing pressure has revealed the different compressive strengths. The UCCB compressive strength increases with increase of sisal fiber content. UCCB pressed at 4 MPa with 0 vol. % shows lowest compressive strength value of 1.74 N/mm^2.Whereas, the UCCB pressed at 8 MPa with 5 vol. % indicates the maximum compressive strength of 6.76 N/mm^2.

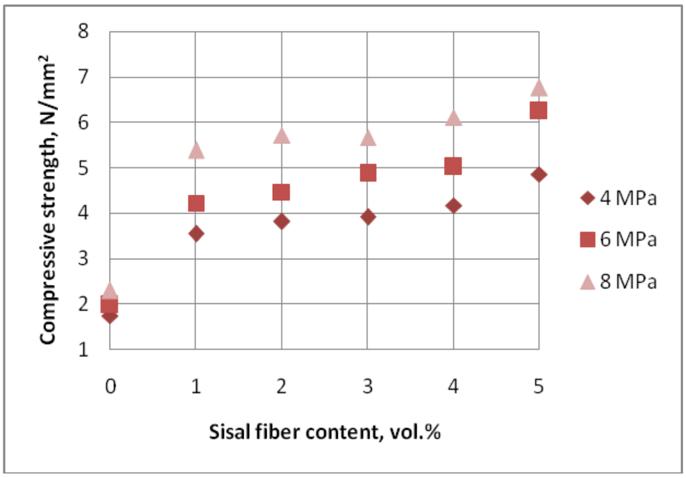

Chart -1: Compressive strength of UCCB reinforced with sisal fiber after 28 days of curing

Chart 2 shows compressive strength of UCCB reinforced with coir fiber after 28 days of curing. The UCCB specimen non-reinforced with coir pressed at 4MPa shows the lowest compressive strength value of 1.74 N/mm^2.Whereas, the UCCB reinforced with 5 vol. % coir fiber and pressed at 8 MPa shows the highest compressive strength value of 6.59 N/mm^2.The results show compressive strength of UCCB samples increases as coir and pressing pressure increase.

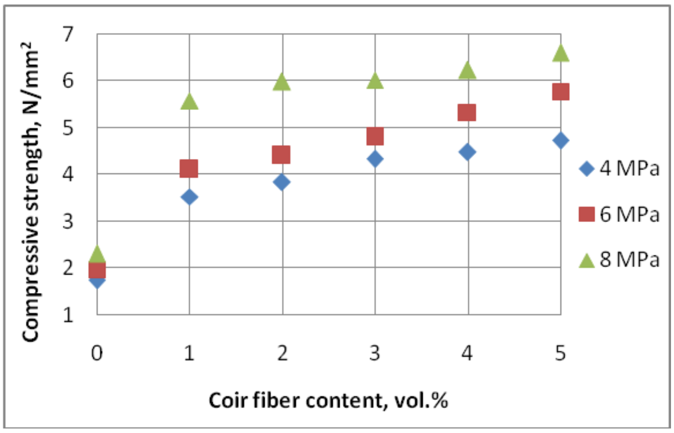

Chart -2: Compressive strength of UCCB reinforced with coir fiber after 28 days of curing

The results of compressive strength carried out on the UCCB at different percentage of sisal and coir fiber presented in Figure 6 and 7.Results show as the fiber content from 1 to 5 vol. % and compressive pressure increasing from 4, 6, and 8 MPa on UCCB the compressive strength increases. This is because of additional sisal or coir fibers content and increasing of compressive pressure makes densification of UCCB. Increasing compressive pressure from 4, 6, and 8 MPa and 1 to 5vol. %of sisal or coir fiber volume reduces the pores inside the UCCB. The compressive strength values of the reinforced or non-reinforced fiber mud bricks tested in this study increases from 1.74 to 6.85 N/mm². According to the Turkish standard TS 2415, the traditional mud brick which is 0.5-1 N/mm².However this result is raised from 1-7 N/mm² for mud brick reinforced with waste natural fiber [10].Therefore, the results of UCCB present in this study are within the specified standard.

3. CONCLUSIONS

The compressive strength for UCCB increases as increasing of sisal or coir fibers from 1to 5 vol. % and compressive pressure from 4, 6, and 8 MPa. This is due to densification of UCCB as compressive pressure increases. Also, the amount of sisal or coir fiber content is increasing strength and toughness on UCCB. The compressive strength values of UCCB are increasing from 1.74 to 6.76 N/mm².Therefore, UCCB composite is desirable in traditional construction because compressive strength values are within the specified standard from 1 to 7 N/mm².

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