EFFECTS OF PLASTER MIX-RATIO ON STRENGTH AND WATER ABSORPTION OF COMPRESSED LATERITE BRICKS

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ABSTRACT

This study focused on investigating the compelling mix – ratio for plastering compressed laterite bricks to improve on its durability. Soil sample obtained from within Tadurga town was stabilized and used in the production of bricks. Water absorption and compressive strength test were performed on the brick samples. It was found that plastering has little or no effect on the strength of the brick but serves as a protection against water absorption and that, the strength of compressed laterite brick is inversely proportional to the water content of the brick. It was recommended that 5mm thick plaster of 1:2 mix-ratio cement/sand should be used for practical purposes when compressed laterite brick is to be used. Similarly, further research should be carried out on other factors that will enhance quality and specification of the materials used for brick molding.

Keywords: Brick, compressed Laterite, Plaster, Tadurga, Water absorption.

INTRODUCTION

Provision of adequate shelter is a yard stick for measuring any meaningful development of any Nation. In Nigeria, the dwindling economy has negatively affected all sectors including the construction industry. As a result of this, the policy of providing shelter for all becomes difficult due to cost. With this prevailing situation, any attempt to providing alternative materials to minimize the cost of erecting a building will be highly appreciated by the populace.

Laterite and lateritic bricks have been used in making houses in the rural areas for quite a long time, but the biggest problem is that the building does not last as it is washed away by rain. Compressing the laterite soil into bricks makes it easier to build the walls while plastering the walls will make it more durable (Fola, 2012).

This research work is directed towards investigating practical measures for improving the durability of compressed laterite brick particularly regarding the elimination of conditions favouring water action on laterite bricks since it varies in quality as the building earth from which it is made differs from pit to pit. Thus, the aim of this study is to investigate the effect of different plaster mix – ratios on the strength and water absorption of compressed laterite bricks.

Laterite as a Building Material

According to Sowers and Sowers (2010), laterite soil is the oldest of construction materials man found possible to be molded into blocks which can be dried in the sun and laid up in walls. Despite the facts that the techniques for the execution of Mansory works have improved through mechanization, the basic design has changed a little during the last millennium, a tribute to the ingenuity of the early builders as well as the integrity of this method of construction. Some of the structures built on laterite soils having a high value as pointed out

by Dmochowski (1990) are Zaria Masallacin Juma'a (1837) and Kano palace. He further said Kano palace (Emir's residence) built with red earth was accurate to give a small idea of the imposing character of these structures, the best of which is, with supervision, capable of resisting for centuries the action of the weather.

Newell and Dowling (2011) have shown that the properties of laterite soils that will influence its rate and ease of mixing includes its plastical, chemical stability, chemical composition, density, the degree of fitness, specific gravity and particle shape. Mebude (2013), highlighted that the art of building with laterite bricks is not new to the culture of Nigerian people, but it was less practiced with the introduction of cement in the 1950s and the construction boom of the oil era when cement importation far exceeded the local production level. He further explained that a lot of interest had been shown by builders, architects, etc. in the use of bricks made from laterite soils that occur abundantly and all over Nigeria. A handbook of Bollyn Construction Company on cement stabilized soil blocks (2008) established that laterite bricks are a low cost, durable and attractive building materials.

Furthermore, Nigerian Building Research Institute (2009) in the outcome of their research work revealed that laterite bricks had been proven to be the most suitable building material for the tropical climate. Similarly, Akinnayajo (2010) explained that laterite soil could be stabilized with cement for making Mansory blocks. Ebenezer (2012) also explained that cement stabilized laterite bricks have shown to be feasible as alternative building materials and recommend that it should be produced on a large scale similar to sandcrete blocks since they require little technical know – how for their production. Thus, this study investigated the effect of different plaster mix – ratios on the strength and water absorption of compressed laterite bricks.

OBJECTIVES OF THE STUDY

The primary objectives to be achieved in any structure are the stability before aesthetics, and other secondary features are considered. For a structure to attain balance, the materials from which it is constructed must be given some due considerations which must not be too costly.

The objectives of this research are:-

1) To examine the strength and water absorption capacity of unplastered compressed laterite bricks.
2) To test the strength and water absorption capacity of laterite bricks plastered with different mixes. That is, cement/sand of 1:2, 1:3 and 1:4
3) To assess the effect of different plaster mix – ratios on the water absorption capacity of compressed laterite bricks.
4) To recommend practical measures for improving the quality of compressed laterite blocks.

MATERIALS AND METHODS

Production of Bricks

To achieve the desired objectives, compressive strength tests were performed. A sample of lateritic soil obtained from within Tadurga town was stabilized with cement at the ratio of 1:10 cement/laterite by volume and a total number of 150 bricks were produced.

Mixing Procedure

Laterite was measured and mixed with cement until uniformity was achieved. Water was then added gradually to the mix while the mix was turned continuously until the wet mix pass through a drop test (i.e. breaking into three reasonably sized lumps) when dropped at raveled height.

Curing of Bricks

The bricks were cured under polythene sheets for the first three days after molding as a primary curing while water was sprinkled on them every morning. Also, a further open air curing was done for 14 days (2weeks)

Plastering of Bricks

A total number of 60 bricks were plastered to produce samples of varying plaster – mix-ratio. 20 bricks were plastered with a particular mix – ratio serving as a sample and four different mix – ratios were varied as:-

Sample B = 1:2 mix cement/sand
Sample C = 1:3 mix cement/sand
Sample D = 1:4 mix cement/sand
Meanwhile, 5mm thick plaster was maintained throughout.

Curing of Plastered Bricks

The plastered bricks were open air cured while water was sprinkled on them for three days after plastering is made.

Water Absorption Test

To determine the water absorption of various samples, the samples were soaked in water viz: 30 minutes, 3 hours and 24 hours respectively. The initial weights of dry brick (W_b), as well as the final weights of block and water (W_T) total weights, were also recorded accordingly and hence the weight of water was calculated using the following relationship.

$$W_W = W_T - W_b$$

Where, W_W = weight of water (kg)
W_b = weight of dry brick (kg)
W_T = total weight of dry brick + water (kg)

RESULTS AND DISCUSSION

The results obtained from the compressive Strength test as well as water absorption tests were analyzed regarding mean compressive Strength and mean water content and translated into graphical from as tabulated below

Table 1**:** Average Compressive Strengths and Average Water Contents after 30 minutes Soaked of various Samples

Samples	Soaking Time (mins)	Average Compressive Strength (N/mm^2)	Water Content (%)
A	DRY	1.24	0.00
B	30	0.92	6.66
C	30	0.72	9.05
D	30	0.62	15.20

Source: *Field Work, 2016*

Compressive Strength Test

After the water absorption capacity of each brick within a sample had been examined by comparing the weights of various samples with their corresponding soaking times, a test for the compressive strength determination was conducted using a destructive crushing method.

The compressive strength values were calculated from the relationship Cs = F / A

Where Cs = Compressive Strength (N/mm^2)

F = Failure Load (N)

A = Cross-sectional Area (mm^2)

Water Absorption Test

The basis for the discussion of result under this sub – head was to compare between the controlled experiments i.e. sample A (unplastered) and the respective plastered sample viz: B, C, and D regarding water content determined at varying conditions.

At 30 minutes soaking result showed that the mean water content of 6.66% for 1:2 ratio but when plastered with 1:3 mix – ratio, the water content increased to 12.60% while when coated with 1:4 mix – ratio, it increased to 15.20%.This shows that to achieve a better result in protecting the brick from water absorption, 1:2 mix – ratio should be considered while 1:4 mix – ratio proved to be more unsafe for use than the other ratios.

From the preceding, it could be seen that plastering serves as protection against the permeability of lateritic brick to water.

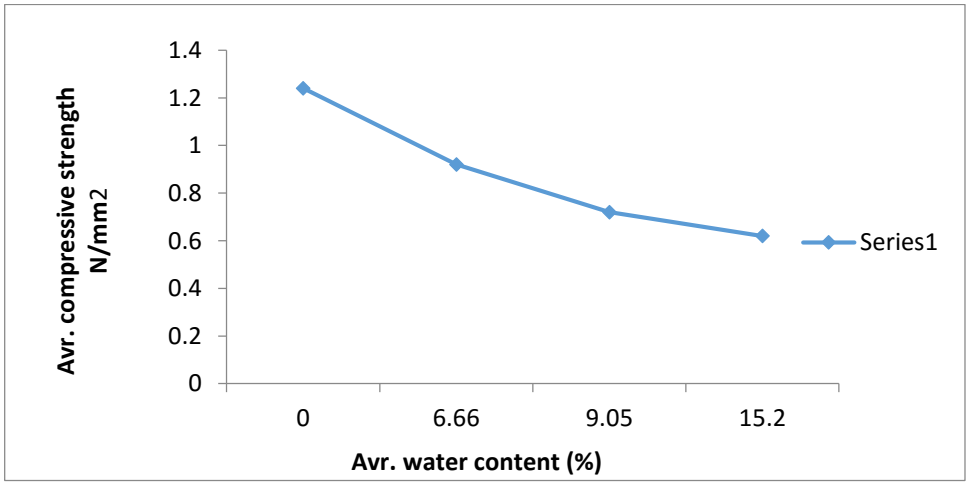

Figure 1: Effect of Water Absorption on Compressive Strength

DISCUSSION OF RESULTS

After the Samples were soaked in Water for 3o minutes, the result shows that the average compressive Strengths and water content were 0.92(N/mm^2) and 6.66% respectively for Sample B, 0.72(N/mm^2) and 9.05% for Sample C as well as 0.62(N/mm^2) and 15.20% for Sample D.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the findings from this study; Effects of Plaster Mix-Ratio on the Strength and Water Absorption of Compressed Laterite Bricks; the following conclusions were drawn:

- Plastering has little or no effect on the power of compressed laterite brick.
- Plastering affects the water absorption capacity of compressed laterite bricks.
- The degree of protection on the compressed laterite brick against its water absorption depends on the plaster mix – ratio.
- Water absorption of compressed laterite brick is directly proportional to the soaking time among other things.

Recommendations

Based on the findings from this study; the following recommendations were drawn:-

- Compressed laterite bricks should not be used in construction until it is completely dried to prevent the risk of collapse.
- Compressed laterite bricks should be protected from the moist condition using plaster. A plaster of 5mm thick of 1:2 mix – ratio cement/sand should be used for practical purposes when compressed laterite brick is to be used.
- Since the moist condition is not the only factor affecting the durability of the brick, research should be carried out by identifying and studying the quality and specification of the materials used for brick molding.
- Builders should ensure that at least, a minimum thickness of plaster is used in protecting the brick from water absorption.
- Consultants (designers) should design for a minimum thickness of plaster to reduce the cost of executing the project since plaster has little or no effect on the strength of the brick.
- To avoid the risk of the building collapse, in the long run, clients should comply with the designers' specifications and not specify their design based on their pockets.

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