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Clay Burnt Interlocking Bricks using additives

N.Seshan [1], R. Krishnakumar [2], A. Purushothaman [3], G.Rajkamal [4], K.Aravind [5]
[1]Assistant Professor, [2,3,4,5] UG Students
Department of Civil Engineering
Sri Muthukumaran Institute of Technology,
Chennai 600069

***Abstract*:**

Bricks made of clay have been used as a building material for many thousands of years. Bricks were also used in arches, pavements, both for vehicular traffic and pedestrian traffic, lining bricks in glass and refractory industries, as decorative facing bricks and other applications. This paper discusses about additives which modify the properties of clay burnt bricks which contain interlocking features by providing nib at one end and recess at the other end. The bricks are sampled and tested as per IS standards and found to be satisfactory for the bricks made with glass powder as additive whereas the bricks made with lime has failed. Walls constructed using this feature will reduce the use of cement mortar, increase the speed of construction, thus contributing to an overall economy in cost and time to the construction of brick walls. The use of cement will also reduce the carbon footprint, thus improving the green house effect.

Keywords—interlocking bricks; mortorless bicks; green house effects;

I. INTRODUCTION

Bricks made of clay have been used as a building material for many thousands of years. Bricks are further used in arches, pavements, lining bricks, decorative bricks and other applications.

One of the following methods is used to manufacture bricks (the process of drying, placing in a kiln, burning to the required temperature, cooling and stacking in the yard are common for all types of bricks during brick manufacture).

- Extruded bricks made by forcing clay through an opening in steel die with very consistent shape and size.
- Wire cut to size after extrusion with a standard tensioned wire which may leave drag marks.
- Machine molded clay is forced into moulds using pressure
- Dry mix and is compressed with great force, pressed mud, similar to soft mud method, but processed with a much thicker clay mix and compressed with great force.

The brick wall construction is used mainly in two types of structures, one being load bearing walls, where the loads from the slab and roof are transferred to the brick walls and the other being brick walls used as in-fill panels for concrete framed structures. One of the reasons for the limitation of using bricks for the load bearing walls is that the same do not resist seismic loads. The strength of the walls is considerably improved by providing designed reinforcement, which resist the seismic loads to a considerable extent.

The bricks are manufactured with interlocking holes and provision for reinforcement. The first type of bricks is manufactured without any additives, the second type with glass powder as additive and the third type with lime powder as additive. However the bricks from this category deteriorated during the process of burning of bricks.

II. METHODOLOGY

A. *Testing Process*

Tests are carried out in both types of bricks manufactured thus above and compared with the standard bricks manufactured, as per the tests proposed as follows:

TABLE I. CODAL PROVITION FOR TESTING

Sl. No	IS code	Test for
1	IS 3495-Part 1	Determination of Compressive strength
2	IS 3495-Part 2	Determination of water absorption
3	IS 3495-Part 3	Determination of efflorescence
4	IS 3495-Part 4	Determination of warpage

B. *Determination of Compressive strength*

The testing is carried out as per IS 3495 (Part 1). The dimensions shall be measured to the nearest 1 mm. All apparatus and testing equipment shall be calibrated at frequent intervals. The number of specimens for the test shall be

selected according to IS 5454: 1976. A compression testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the centre of which coincides with the centre of the plate, shall be used. Immerse the specimen in water at room temperature for 24 hours. Remove the specimen from water and drain out any surplus water. No mortar shall be filled in perforations and no mortar capping shall be provided. Place the perforated faces of the brick betweentwo 3-ply plywood sheets each of 3 mm thicknessand carefully centred between the plates of thetesting machine. Apply the load axially atuniform rate of 14 N/mm^2 (140 kgf/cma) perminute till the failure occurs and note themaximum load at failure. The load at failureshall be the maximum load at which the specimenfails to produce any further increase in theindicator reading on the testing machine.

C. *Determination of water absorption*

The testing is carried out as per IS 3495 (Part 1). The dimensions shall be measured to the nearest 1 mm. All apparatus and testing equipment shall be calibrated at frequent intervals. The number of specimens for the test shall be selected according to IS 5454: 1976. A sensitive balance capable of weighing within 0.1percent of the mass of the specimen; and a ventilated oven. Dry the specimen in a ventilated oven at a temperature of 105 to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight (M_1). Immerse completely dried specimen in clean water at a temperature of 27°$\pm$2°C for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after the specimen has been removed from water (M_2). Water absorption, percent by mass, after24-hour immersion in cold water is given by the following formula:

$$\frac{(M_2 - M_1)x100}{M_1}$$

D. *Determination of Efflorescence*

The testing is carried out as per IS 3495 (Part 1). The dimensions shall be measured to the nearest 1 mm. All apparatus and testing equipment shall be calibrated at frequent intervals. The number of specimens for the test shall be selected according to IS 5454: 1976. A shallow flat bottom dish containing sufficient distilled water to completely saturate the specimens. The dish shall be made of glass, porcelain or glazed stoneware and of size 180 mm x 150mm X 40 mm depth for square shaped and 200mm diameter X 40 mm depth for cylindrical shaped. Place the end of the bricks in the dish, the depth of immersion in water being 25 mm. Place the whole arrangement in a warm (for example, 20to 30°C) well ventilated room until all the water in the dish is absorbed by the specimens. and the surplus water evaporates. Cover the dish containing the brick with suitable glass cylinder so that excessive evaporation from the dish may not occur. When the water has been absorbed and bricks appear to be dry, place a similar quantity of water in the dish and allow it to evaporate as before. Examine the bricks for efflorescence after the second evaporation and report the results.

E. *Determination of Warpage*

The testing is carried out as per IS 3495 (Part 1). The dimensions shall be measured to the nearest 1 mm. All apparatus and testing equipment shall be calibrated at frequent intervals. The number of specimens for the test shall be selected according to IS 5454: 1976. A steel rule graduated from one end in 0.5 mm divisions. Alternatively, a steel measuring wedge 60 mm in length, 15 mm in width and 15 mm in thickness at one end and tapered, starting at a line 15 mm from one end to zero thickness at the other end. The wedge shall be graduated in 0.5 mm divisions and numbered to show the thickness of the wedge between the base AB and the slope AC. A flat surface of steel or glass, not less than 300 mm **x** 300 mm in area and plane to 0.02 mm. Remove any dirt adhering to the surface of brick. Place the flat surface along the surface to be measured selecting the location that gives the greatest departure from straightness. Measure the greatest distance of the brick surface from the edge of straightness by a steel rule or wedge. Place the brick on the flat surface with the convex surface in contact with the flat surface. Measure the distance from that surface to the four corners of the brick, and take the maximum of four measurements.

III. RESULTS

A. *Compressive strength*

The results of compression test is reported below for glass powder as additive for glass powder as additive:

TABLE II. RESULT OF COMPRESIVE STRENGTH

Test No.	1	2	3	4	5	Av.	IS requirement	Interpretation of result
Compressive strength without additives (N/mm^2)	3.87	3.87	4.73	4.30	2.58	3.87	3.50	Pass
Compressive strength with glass powder as additive (N/mm^2)	4.30	5.59	4.73	3.87	3.87	4.46	3.50	Pass

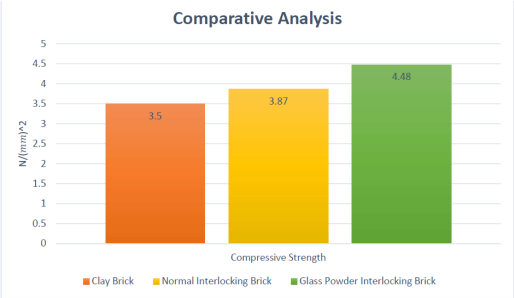

Fig. 1. Strength Comparitive Analysis

B. *Water Absorbtion*

The results of water absorption are tabulated below:

TABLE III. RESULT OF WATER ABSORBTION

Test No.	1	2	3	4	5	Av.	IS requirement	Interpretation of result
Water absorption without additives (%)	11.4	10.1	11.4	11.2	11.6	11.1	12	Pass
Water absorption with glass powder as additive (%)	12.4	12,9	12.4	12,9	13.3	12.8	12	Value is slightly over 12% and can ve accepted

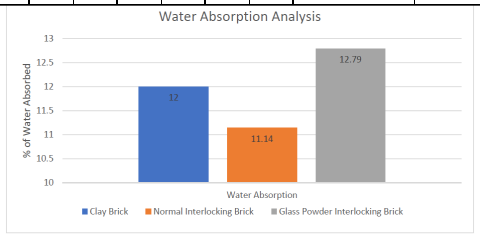

Fig. 2. Water Absorption Comparitive Analysis

C. *Efflorescence*

The liability to efflorescence shall be reported as'nil', 'slight', 'moderate', 'heavy' or 'serious' inaccordance with the following definitions:

a) *Nil* - When there is no perceptible depositof efflorescence.

b) SIight - When not more than 10 percentof the exposed area of the brick is coveredwith a thin deposit of salts.

c) *Moderate* - When there is a heavier depositthan under 'slight' and covering up to 50percent of the exposed area of the bricksurface but unaccompanied by powderingor flaking of the surface.

d) *Heavy* - When there is a heavy deposit ofsalts covering 50 percent or more of theexposed area of the brick surface butunaccompanied by powdering or flaking ofthe surface.

e) *Serious* - When there is a heavy deposit of salts accompanied by powdering and/orflaking of the exposed surfaces.

TABLE IV. RESULT OF EFFLORESCENCE

Test No.	1	2	3	4	5	IS requirement	Interpretation of result
Efflorescence without additives	Nil	Nil	Nil	Nil	Nil	Nil	Pass
Efflorescence with glass powder as additive	Nil	Nil	Nil	Nil	Nil	Nil	Pass

D. *Warpage*

TABLE V. RESULT OF WARPAGE

Test No.	1	2	3	4	5
Warpage without additives	2.5	1.5	1.0	0.5	2.5
Warpage with glass powder as additive	2.0	1.0	0.5	0.5	2.0
Remarks	Concave	Concave	Concave	Convex	Concave

IV. CONCLUSION

Clay burnt interlocking bricks manufactured using glass powder as additive has performed well when compared with interlocking bricks without additives. The optimum percentage of glass powder was found to be around 27%. The holes can be provided with reinforcement and self-compacting concrete around the reinforcement, which will make the walls to resist seismic loads

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