VARIATION IN ENGINEERING PROPERTIES OF MECHANIZED BRICKS WITH FLY ASH BRICKS

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Abstract: Our country needs huge amount of bricks every year for the construction of various types of buildings. Lots of research works are going on to find other alternate materials to replace the clay bricks. In this study an attempt has been made to prepare bricks from fly ash and mechanized bricks to study the engineering properties. Fly Ash is a fine powder that is a by-product of burning pulverized coal in electric generation power plants. To perform this research a varieties of tests were conducted i.e., compressive strength, water absorption, unit volume weight, and impervious pore in the laboratory. The outcome of this paper can serve as a common reference for practitioners and researchers attempting to seek out solutions for further improving overall quality of mechanized bricks and fly ash bricks in the development of more sustainable wall material based on the current brick production process.

Index Terms: **Mechanized Brick, Fly Ash Bricks, Compressive Strength, Water Absorption, Shear Strength.**

I.INTRODUCTION:

An improvement in quality of construction materials has taken centre stage due to some factors such as natural disasters and uncertainty of materials availability. Many countries have focus on replacement of manual clay brick to create sustainable development. Wall materials are one of the crucial elements of a building and cover the majority of the surface area that is exposed to the outer environment. Because bricks constitute the wall system, the focus should be on enhancing the performance in all respect. Performances in terms of bearing capacity should be more, water absorption should be low, and unit weight should be high and dimensional stability. The simplest way to achieve these is to reduce the presence of voids in the mass of brick block.

Fly ash causes severe pollution of air and water, and its disposal gobbles up large tracts of land. Well-planned programs for proper management of fly ash are therefore being undertaken to enhance the use of fly ash in various applications, so that our already perilously imbalanced environment can be protected.

Lots of studies have been done to analyse or identify the main reason of damages in masonry structures. When the clay brick is in dry condition the water absorption capacity will be higher because of presence of voids, which reduce the unit weight and increase the water absorption capacity. In case of mechanized bricks it is found that the unit weight is much higher than the ordinary mechanized bricks. In addition, it is also observed that the extra soil or lime into the mortar mix improved the masonry flexural bond strength. But more use of rich mortar without any other earthquake resistance measure is not adequate to prevent collapse of structures.

II. SELECTION OF MATERIAL USED IN EXPERIMENTAL WORK:

The research work was aimed at evaluating the physical and elastic properties of mechanized bricks also to compare these properties with Fly Ash bricks. The experimental work was, therefore, carried out using the laboratory facilities. The locally available materials were used for this work.

2.1. Soil Sample:

In IS: 2117-1991, the guidelines are provided to select the actual proportion of clay, silt and sand for manufacturing of bricks. It was found that the soil sample collected from the Industry was very effective for manufacturing of bricks.

2.2.Fly Ash:

In IS:12894-2002, the guidelines are provided to select the actual proportion of materials for manufacturing of bricks. Fly ash, cement, and sand are manually fed into a pan mixer where water is added to the required proportion for homogeneous mixing.

2.3. Mortar:

Mortar is a plastic mixture of materials used to bind masonry unit into a structural mass. IS 4326:1993 has recommended mortar mixture used in masonry construction in seismic areas for various categories of building. Recommended mortar mixture for A categories of construction type building are M2 (cement: sand) 1:6. It was, therefore, decided to use the same mortar in this experimental work.

Fig.1:Sample of Mechanized Clay Brick and Fly Ash Brick

III. EXPERIMENTAL RESULT AND DISCUSSION:

3.1.Water Absorption Test:

- In this test, the samples were placed in a water tank for 24 hours after getting the dry weight of the specimen to obtain the water absorption. The samples were weighed using a digital balance model that can be readable up to 2.0g. The absorption of material (total water absorption) is defined as the increase in the weight of a material due to moisture in air, and can be calculated using equation.
- $w\ (\%) = \frac{W_2 - W_1}{W_1} \times 100$

Where, w = moisture content of specimen (%)
w_2 = weight of wet sample after 24 hours.
w_1 = weight of oven dry sample.

Table-1: Water absorption of Bricks

Sr. No.	Length (mm)	Width (mm)	Height (mm)	Water absorption (%) of Mechanized Brick	Water absorption (%) of Fly Ash Brick
1	95	45	45	7.50	8.20
2	95	45	45	8.20	8.45
3	95	45	45	9.12	9.35

3.2. Masonry is typically a non elastic, non homogeneous and anisotropic material composed of two materials of quite different properties stiffer bricks and relatively softer mortar. Under lateral loads, masonry does not behave elastically even in the range of small deformations. Masonry is very weak in tension because it is composed of two different materials distributed at regular intervals and the bond between them is weak.

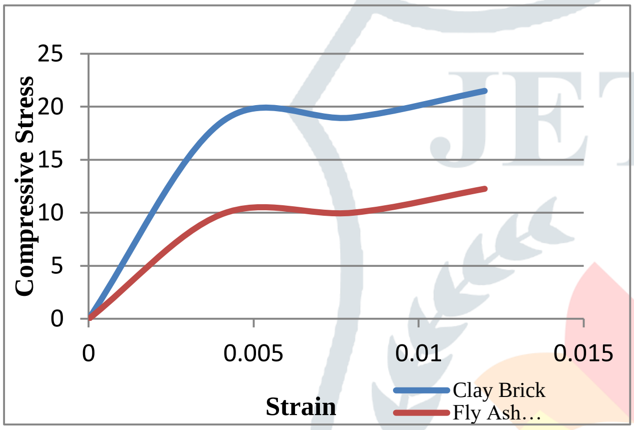
Fig.2:Failure Mechanisms of Masonry Prisms

Table-2: Strength of Mechanized Brick Prism. (Mortar 1:6, Average strength 4.1 N/mm2):

Brick compressive Strength (N/mm^2)	Brick work compressive Strength (N/mm^2)	Elastic modulus of masonry (N/mm^2)
18.50	4.9	2695
19.00	6.1	3355
21.50	5.2	2860

Table-3: Strength of Fly Ash Brick Prism. (Mortar 1:6, Average strength 4.1 N/mm2):

Brick compressive Strength (N/mm^2)	Brick work compressive Strength (N/mm^2)	Elastic modulus of masonry (N/mm^2)
9.82	3.25	1457
10.00	3.25	2514
12.25	4.85	1500



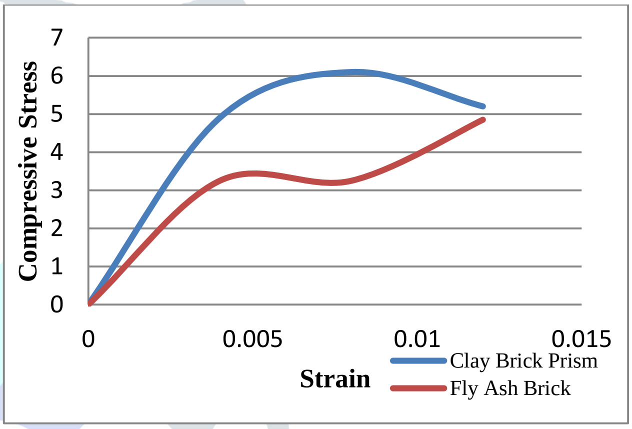


Fig.2: Graphical Presentation of Compressive Stress Variation g Clay Brick and Fly Ash Brick

IV. CHARACTERISING OF MASONRY IN SHEAR:

4.1. Shear Strength Along Joint:

- A small sample is made for testing by three specimens of bricks. The lateral movements are prevented in both directions by providing some horizontal reaction frame. Two bearing blocks are provided below first and last specimen excepting the middle one. Then in the middle specimen downward vertical load is applied by hydraulic jack and load cell.

Fig.3: Failure Mechanisms of Masonry Prisms in Shear

Fig.4: Diagonal Shear Failure Mechanisms of Masonry Prisms

Shear Strength:

$\tau = \tau_0 + \mu f_n$ [Agarwal, P. et al.(2011)] (1)

τ = ultimate shear strength of the brick work in N/mm^2.

μ = coefficient of internal friction of brick work = varies from 0.2 to 0.84 .

τ_0 = cohesion strength between the mortar to brick in N/mm^2.

The shear strength of masonry is calculated by using above equation

μ = 0.68 and τ_0 = 0.3 is a reasonable value.

Shear strength (τ) = 1.27 N/mm^2

4.2.Elastic Properties of Brick Masonry:

The ASTM (2010) test standards specify two test methods for determining the Diagonal tension (shear) in Masonry Assemblages. The diagonal tensile stress may be calculated from the equation as per ASTM (2010) standards

$$f_t = 0.707 \frac{P}{A} \qquad (2)$$

where,

P = applied load (N).

A = average of the gross area along the bed and head joints in mm^2.

The modulus of rigidity or shear modulus (modulus of elasticity in shear) may be calculated as (ASTM).

$$G = \frac{f_t}{\gamma} \qquad (3)$$

where,

G = modulus of rigidity, Mpa.

f_t = diagonal tensile stress.

γ = shear strain calculated as $\frac{\Delta V + \Delta H}{g}$

ΔV = vertical shortening in mm

ΔH = horizontal elongation in mm

g = vertical gauge length

Shear modulus:

$$G = \frac{E}{2(1+V)} \tag{4}$$

V = Poisson's ratio.

E = modulus of elasticity in compression.

G = shear modulus of brick masonry.

Using above equations:

Modulus of rigidity (G) = 3.7 N/ mm^2.

Poisson's ratio (V) = 0.25.

Typical value for the shear strength (τ) for the brick masonry ranges from 0.41 N /mm^2 to 4.69 N/ mm^2 from the literature survey. The value of τ is comparatively higher than ordinary clay manual bricks. The value of Modulus of rigidity is almost same as the result discussed by Mohammad Javed (2009) in his paper.

V. CONCLUDING REMARKS:

The present study focused on the implementation of mechanized bricks for improving the strength of structures and to mitigate the structural failures A set of experiments were carried out for studying the physical properties of mechanized bricks, elastic properties of masonry assemblage. It is concluded that;

1. From the experimental study it is found that mechanized bricks show low water absorption as compare to manual bricks.

2. Compressive strength for mechanized bricks shows almost 10% increase over Fly Ash bricks. The compressive strength of mechanized brick prism is also increased over the Fly Ash brick.

VI. REFERENCES

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