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UTILIZATION OF MECHANISED BRICKS FOR ENHANCING THE QUALITY OF MASONRY STRUCTURE

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ABSTRACT

In view of the environmental regulations, practitioners have been inclined to use bricks with higher capability. This is a comparative study of various physical properties of the manual clay burnt bricks and clay mechanized bricks. A series of experimental tests are conducted on two different types of bricks in laboratory. Locally available materials are used for that work. First the physical properties of soil sample that is the percentage of clay, silt and sand have been identified to examine its suitability for manufacturing of clay bricks. The study shows significant reduction of water absorption and a overwhelming increase of compressive strength for mechanized bricks over manual bricks. The masonry unit of mechanized bricks also shows significant improvement in terms of compressive strength then manual brick.

The outcome of this paper can serve as a common reference for practitioners and researchers for further improving the overall quality of bricks.

***Key Words*: Mechanised Bricks, Soil Sample, Physical Properties, Elastic Modulus.**

I INTRODUCTION

1.1 General

As per the Census 2001, masonry housing units constitute 84.7% of the total 249 million housing units in India whereas concrete and other units constitute only 15.30% [2]. Observations in all the past earthquakes in the country have shown that masonry buildings are the most vulnerable to damage and collapse under earthquake Intensities. In the last few decades, a dramatic increase in the losses caused by natural catastrophes has been observed worldwide.

Clay brick is the first man made artificial building material and one of the oldest building materials known. Its durability and aesthetic appeal also contribute to its extensive application in both load bearing and non-load bearing structures. The properties of clay units depend on the mineralogical compositions of the clays used to manufacturing brick units.

1.2 IS Code Provisions

In India, there has not been much progress in the construction of tall load bearing masonry structures, mainly because of poor quality of masonry workmanship and materials such as clay bricks that are manufactured even

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today having nominal strength of only 7 to 10MPa. Until 1950's there were no engineering methods of designing masonry for buildings and thickness of walls was based on Rule-of- Thumb tables given in Building codes and Regulations. As a result walls used to be very thick and masonry structures were found to be very uneconomical beyond 3 or 4 stories. Since 1950's intensive theoretical and experimental research has been conducted on various aspects of masonry in advanced countries. However, recently mechanized brick plants are producing brick units of strength 17.5 to 25N/mm2 and therefore it is possible to construct 5 to 6 storied load bearing structures at costs less than those of RC framed structures. The researcher [8] performs the tests on existing clay bricks and compressed earth blocks. They found that Major usage in the world for construction is clay bricks. According to their study the size of earth block are more proper than clay brick, this reduces the wastage of materials, with this the cost, and transportation cost is also get reduced.

II EXPERIMENTAL PROCEDURE

2.1. General

The research work was aimed at evaluating the physical properties of mechanized bricks. The experimental work was, therefore, carried out using the laboratory facilities. The locally available materials were used for this work. In IS: 2117-1991, the guidelines are provided to select the actual proportion of clay, silt and sand for manufacturing of bricks, all the tests are carried out to finalize the correct sample for study.

2.2. Physical properties of clay

2.2.1 Liquid Limit Test:

Liquid limit is the water content corresponding to the arbitrary limit between the liquid and plastic state of soil. The liquid limit is determined in the laboratory with the help of the standard liquid limit apparatus designed by Casagrande. After getting the entire values plot a graph between number of blows and respective water content, from that we get the value of Liquid Limit.

2.2.2. Plastic Limit Test:

To determine the plastic limit the soil specimen should be passing 425 micron sieve. The soil mixed thoroughly with distilled water until the soil mass becomes plastic enough to be easily moulded with fingers. The soil is rolled between the fingers until a diameter 3 mm is reached. These are kept for the water content determination.

2.2.3. Hydrometer Test:

In the sedimentation analysis, only those particles which are finer than 75 micron size are included. Hence soil sample is washed through a 75 micron sieve. In this test the volume of suspension is 1000 ml thus the volume of dry soil is double. To have the proper dispersion of soil, the dispersion agent is added to the soil. IS: 2720 (Part IV)- 1965 recommends the use of dispersing solution sodium-hexametaphosphate and sodium carbonate in distilled water to make 1000 ml of solution. The sedimentation jar is shaken vigorously and then kept vertical over a solid base. The stop watch is simultaneously started. The hydrometer is slowly inserted in the jar and readings are taken1 and 2 minutes time interval.

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2.3. Properties of Clay Bricks

2.3.1. Water Absorption:

In this test, the samples were placed inside a porcelain crucible and then dried in an oven at a temperature of 105oC for 24 hours to obtain the dry weight. The samples were weighed using an digital balance model that can be readable up to 2.0g. The adsorption of material (total water adsorption) is defined as the increase in the weight of a material due to moisture in air, and can be
calculated using equation -1

$$w\ (\%) = \frac{W2-w1}{w1} X\ 100 \qquad (1)$$

Where,

w = moisture content of specimen (%)

w2 = weight of wet sample after 24 hours.

w1 = weight of oven dry sample

Figure:1- Manufacturing process of Mechanized bricks and Manual Bricks

2.3.2. Efflorescence in Bricks:

The dish used for brick test should be made of glass, porcelain or glazed stone ware. Place the end of the bricks in the dish, the depth of immersion in water being 25 mm. Place the whole arrangements in a warm (for example, 20 to 30^{o}C) well ventilated room until all the water in the dish is absorbed by the specimen and the surface water evaporate. Cover the dish with suitable cover, 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.

2.3.3. Stress- Strain Characteristics of Clay Brick:

This is one of the most important characteristics of any structural component. In lab this test is done by using the strain measuring gauges, the hydraulic jack and load cell. 30 mm strain gauges are used, one is at test sample and another is on dummy. The test arrangement is shown here.

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Figure:2- Experimental setup for strain measurement of clay brick.

2.3.4. Compressive Strength and Elastic Modulus of Brick Prism:

Compressive strength plays an important role in load bearing structures. Compressive strength of masonry is often used as the basis of assigning design stress and in some cases as a quality control measure. The compressive strength of brick unit is done by making a pillar of bricks with cement: sand mortar ratio 1:6. After 28 days the test was performed. A number of authors have correlated the Modulus of Elastic (E_m) to its compressive strength (f_m) on an empirical basis. FEMA306 (FEMA 1999), which Proposes $Em \approx 550\ fm$.,while Paulay and Priestley (1992) suggest conservatively higher values of $Em \approx 750$ and 1,000 times fm , respectively.

Here, E_m is taken as $\approx 550\ fm$. (1)

The modulus of elasticity of brick prism is calculated using equation (1)

Figure:3- Experimental setup to find Elastic Modulus of Brick Prism

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II EXPERIMENTAL RESULT AND DISCUSSION

Table -I. Properties of Soil Used for Brick:

Sl. No	Number of blows	Water Content (%)
1	36	20.23
2	31	23.28
3	24	34.27
4	20	41

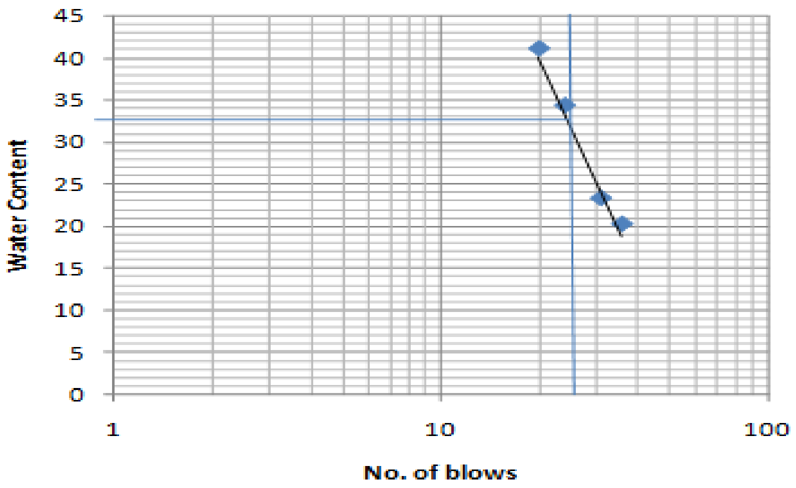

Figure : 4 Liquidity Index

Liquid Limit = 32.7

Plastic Limit = 14.89 %.

Table -II. Composition of Soil:

Sl. No	Composition	Values	Recommended values as per IS:2117-1991
1	Clay	27.50	20 – 30 %
2	Silt	32	20 – 35 %
3	Sand	47.50	35 – 50 %

From these experiments it is found that the soil sample have proper Liquidity Index, Plasticity Index and percentages of clay, silt and sand presents in soil sample are appropriate according to IS: 2117-1991. The sizes of the manual and mechanised bricks are same but there is difference in unit weight. This is because, the compactions of soil sample in case of mechanized bricks are much more than manual bricks, and this reduces the number of pores in the soil mass. So in mechanized bricks there is less space for voids, which increase the unit weight. But in manual bricks labourers are not so much able to reduce these voids, which reduce the unit weight of bricks. Due to good compaction the water absorption capacity of mechanised bricks are less than manual bricks.

Water, if it finds access to brick, moves along its pores by capillary action and carries with it dissolved salts. As the solution evaporates from the exposed surface of the brick, the salts are left as deposit on the surface or on layers just below it. Disintegration or flaking of the brick surface is caused by the mechanical force exerted by salts as these crystallize just below the exposed surface.

Table-III. Various Properties of Manual and Mechanised Bricks:

Length (mm)	Width (mm)	Height (mm)	Dry weight (Kg)		Water Adsorption %		Efflorescence %		Compressive Strength (N/mm^2)	
			Manual Brick	Mechanised Brick	Manual Brick	Mechanised Brick	Manual Brick	Mechanised Brick	Manual Brick	Mechanised Brick
254	126	75	2.97	3.28	15.00	7.50	Slight	Slight	10.50	21.50
252.5	125	74	2.30	2.89	22.00	9.12	Moderate	Slight	7.00	18.50
252	125	75	2.49	3.00	21.25	8.20	Slight	Slight	8.50	19.00

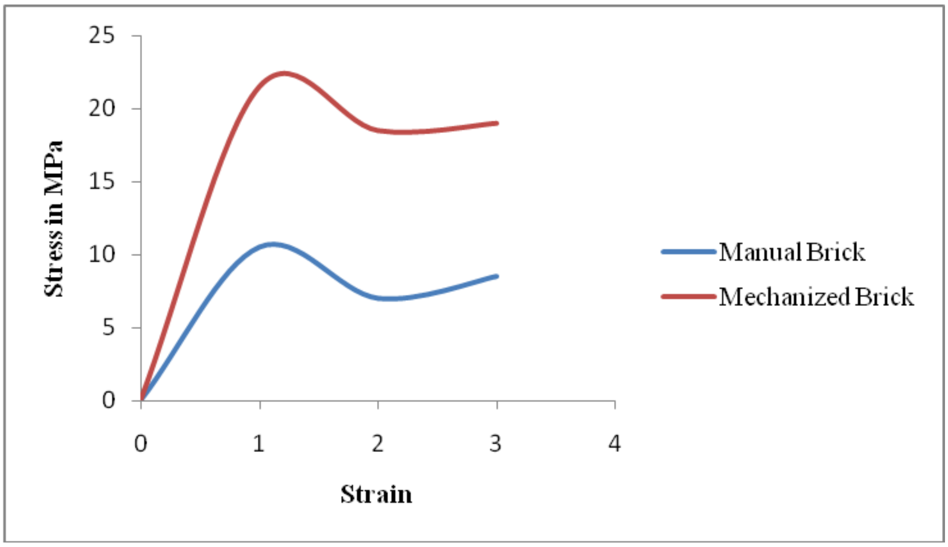

Figure :5 Comparison of compressive strength Manual bricks Vs Mechanised brick

Table-IV. Elastic Property of Mechanized Brick Units:

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

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The average compressive strength of mechanized bricks assemblage is 6.06 N/mm^2 which is more than 4.1 N/mm^2 as per Hemant B. Kaushik et. al.(2007) with brick size 230 mm, 110 mm, and 75 mm, also the Elastic Modulus increased by 29.13 % over the result discussed by the Hemant B. Kaushik et. al. (2007) in their paper.

III CONCLUSION

The present study focused on the implementation of mechanized bricks for improving the strength of masonry structures and to mitigate the structural failures and to assess the response of the buildings made by mechanized bricks.

From the experimental study it is found that mechanized bricks show low water absorption as compare to manual bricks. The minimum water absorption for manual bricks is 14% for first class bricks and for mechanized bricks it is 7.5%.

Compressive strength for mechanized bricks increase over manual bricks. The compressive strength of mechanized brick prism increased by 47. 80% over the ordinary manual bricks. The modulus of elasticity is increased by 29.13 % over the manual bricks and shear strength of mechanized bricks is also increased.

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