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BEHAVIOUR OF FLYASH BRICK MASONRY COLUMNS

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ABSTRACT

In this experimental work, relate the individual brick strength to that of the masonry strength. In this study flyash bricks have been considered, considering its common use in masonry work. 15 nos. of Flyash bricks of size 230mm*110mm*75mm were tested on its face(230mm*110mm)(5 nos.), side(230mm*75mm)(5 nos.) and edge(110mm*75mm)(5 nos.) under compression in UTM(Universal Testing Machine) and strength has been calculated and correlation has been established. Then 5nos. of flyash brick masonry cubes of size 230mm*230mm*230mm were prepared and their strength compared with the individual brick. Then 3 nos. of brick masonry columns of height-1800mm and cross section (230mm*230mm) were prepared under various eccentric loads. And then the strength of the columns were predicted using the strength obtained from individual brick and brick masonry cube.

KEYWORDS: Flyash Brick Masonry Columns

INTRODUCTION

Under various stress conditions, structural design in masonry required to understand the behaviour of the composite unit – mortar material. Compressive stress is the predominating factor in design as the masonry walls are vertical load bearing elements. Masonry is a structural material having a higher safety factors as compared to that of concrete. For designing and constructing in masonry, the factors of workmanship are very much important in order to develop a specified strength. It is important for masonry to be properly built in the first instance and the time spent by the engineers will explain the importance of point outlined below to brick.

The compressive strength of brick masonry column depends on the strength of the units used i.e, bricks and the mortar, the slenderness ratio and the cross-sectional area.

LITERATURE REVIEW

Nagarajan *et al.* in (2014)[2] gave "an experimental approach to investigate the behaviour of brick masonry for different mortar ratio". In order to make a comparative study of the material behaviours, bricks are tested in both dry and wet condition under compression along all the three axes. The results shows that the compressive strength of dry brick is more than that of wet brick. Mortar cubes and cylinders with different mortar ratio are tested to evaluate and compare the compressive strength and bond strength. This research is carried out in order to evaluate the behaviour of an unreinforced brick masonry under shear and compression loading by using numerical simulations.

Tiwari and Choubey in (2014)[1] gave a brief conclusion on "flyash brick masonry under cyclic load". They form the stress-strain curve of flyash brick masonry having various H/T ratio under cyclic loading. They were cast various brick masonry of size 800mm*100mm*200mm, 800mm*100mm*400mm, 800mm*100mm*600mm and 800mm*100mm*800mm in 12 nos. and cured for 28 days. And then tested under monotonic and cyclic loading in order to

study stress-strain relationship of flyash brick masonry. The strength of masonry is 40% to 45% of that of strength of brick. Stress –strain curve of all specimen for different H/T ratio maintained a parabolic relationship upto failure. They conclude that the peak of the stress-strain curve obtained under cyclic compressive loading approximately coincides with the stress-strain curve obtained under monotonic loading.

Basha and Kaushik in (2014)[3] gave a brief conclusion on " Evaluation of Nonlinear Material Properties of Flyash brick Masonry under Compression and Shear". They shows the non linear stress-strain charactertics and failure mechanism of flyash brick masonry obtained under compression and shear. Based on the experiment, to evaluate the modulus of elasticity of flyash brick masonry prisms they proposed a relations in terms of compressive strength of masonry prism. They conclude that the compressive strength of masonry prism and flyash brick was less than that of mortar cube.

Malek in (1987)[4] gave a brief conclusion on "the compressive strength of brick and their variation of strength." According to H.Malek the compressive strength of various types of masonry been derived from the wall strength relationship by applying a correction to allow the effect of the slenderness ratio keeping it with respect to that of the reduction factors. He also conclude that the bearing capacity under the partial loading can be increased by increasing the strength of the unit. Masonry strength is always influenced by the brick and the mortar strength. The bearing strength is also influence by the masonry thickness and the loaded area ratio.

MATERIALS

Cement

As per IS code -1489 part 1 Ultratech (ppc) was used in my brick masonry.

Flyash Brick

Flyash Bricks are building materials containing class c flyash and water. Owing to high concentration of calcium oxide in class c flyash. The brick is considered as "self - cementing"

Composition of Flyash Bricks

- Flyash – 55to 60 %
- Water – 20 to 25 %
- Sludge Lime – 15 to 22 %
- Gypsum – 5 %

Chemical Composition of Flyash

- Silicon Dioxide (SiO2) – 35 %
- Aluminium Oxide (Al2O3) – 18%
- Iron Oxide (Fe2O3) – 6%
- Calcium Oxide (CaO) -21%

Advantages of Flyash Bricks

- High Compressive strength.

- Lower Water Absorption.
- Consume less Mortar in construction.
- Light weight and less porous.

Water

Water has a significant role to play in making of concrete, in mixing of fresh concrete and curing of hardened concrete. Clean potable water was used for mixing and curing of concrete.

Mortar

General

Mortar is a binding materials that binds building blocks such as stones, bricks and concrete masonry units together. It also help in maintaining the irregular gap between them

Properties of Good Mortar

- It should be capable of developing good adhesion with the building units.
- It should be capable of resisting penetration of rain water.
- It should be cheap and durable.
- It should be easily workable.
- It should not affect the durability of materials used.

EXPERIMENTAL PROGRAMME

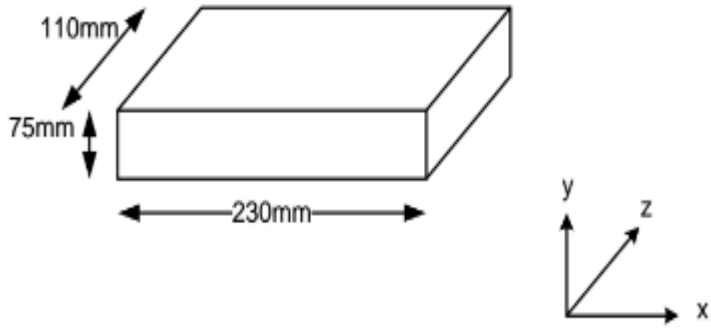
Test on Individual Flyash Bricks

First the flyash brick of size 9"*4"*3" were taken. Then the individual Flyash bricks were tested. Weight of individual flyash brick was measured and then it was taken under curing chamber for 1 day. And again the weight was taken to see the water absorption of the brick. The hollow part of the brick was filled up with mortar mix i.e. cement: sand ratio as 1:6 before testing it on its face. After that the brick was put inside the UTM (Universal Testing Machine) and it was kept on its face for testing

Serial No	Axis of Testing	No of Specimens	Average Compressive Strength of Individual Bricks N/mm^2
1	X- axis	5	8.382
2	Y-axis	5	8.1096
3	Z-axis	5	5.054

(a) (b) (c)

Figure 1: Compression Test on Individual Brick (a) Along X-axis, (b) Along Y-axis & (c) Along Z-axis



Bricks along X-axis are found to be giving more compressive strength as compared to the other two axes.

Test of Flyash Brick Masonry Cube

For the cube to be tested the major part is the ratio of the cement : sand in mortar mix. The brick were first cured for a day and the taken for construction of cube. For the construction of cube, the mortar mix was made with cement :sand ratio as 1:6.The cube was made with dimension of 230*230*230 mm with the brick and the mortar. So three layer of bricks were made to achieve the above dimension. After the cube is ready, it was cured for 28 days so that it can attain its maximum strength. After 28 days the weight of cube will be measured and tested in UTM (Universal Testing Machine). Then the load is applied and the peak load will be noted. The peak stress or the strength of the cube will be calculated.

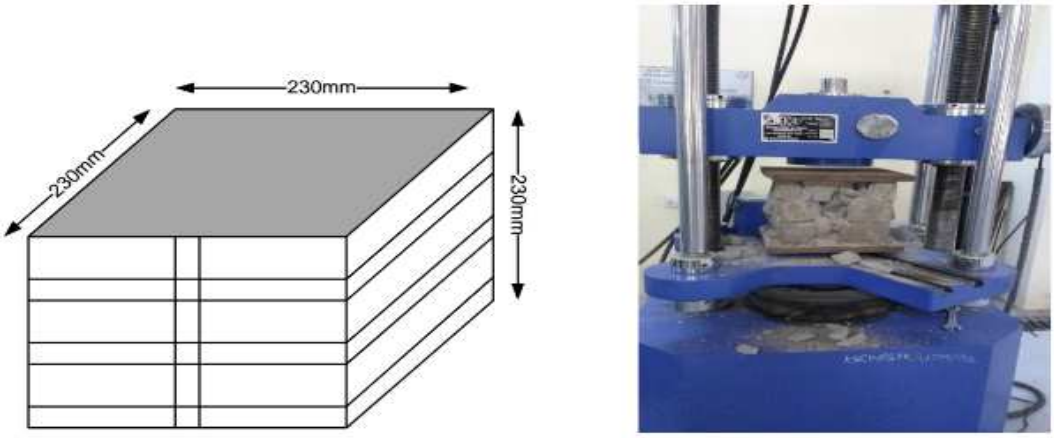


Figure 2: Compression Test on Flyash Brick Masonry Cube

Serial No	Size of the Specimen	No of Specimen	Average Compressive Strength (N/mm^2)
1	230mm ×230mm×230mm	5	2.244

The compressive strength of brick masonry cube is found to be smaller than the strength of individual bricks along all the three axes.

Test of Flyash Brick Masonry Column

First, we have to measure the height from the jaw of the compression machine to that of the ground including the size of proving ring and the plate. Approximately the height of the column we need to construct was 1800mm. so the column exactly constructed under the centre of the jaw so that the load will be equally distributed on the column. Again the mortar mix was taken as 1:6 (cement :sand). After the column was made it was undergone the process of curing for 28 days. After 28 days it was taken for the test. On both the side of the column dial gauge was set to measure the deflection and the probing ring was kept between the column and the jaw of compression. Load is applied from the hydraulic pumping machine and the jaw releases the load onto the column. When the hairline cracks appears we need to note down the load. When the column get completely cracked, the final load is noted and then the strength of the column is calculated.

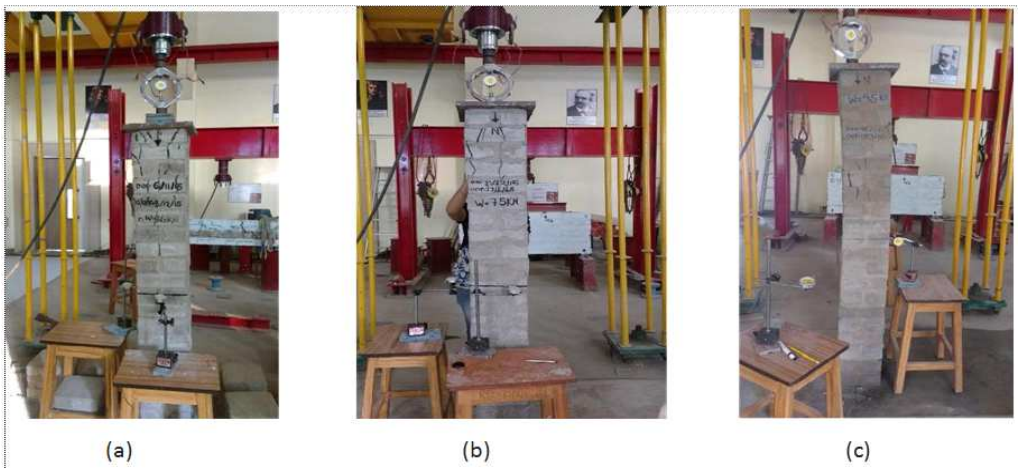


Figure 3: Compressive Strength with Different Eccenticity from East (a) 0 mm (b) 25mm (c) 76mm

Serial No	Eccentricity Provided from East (mm)	Average Compressive Strength (N/mm^2)
1	0	1.631
2	25	1.485
3	76	0.7831

The compressive strength of brick masonry column under concentric load is found to be greater than that of strength under different eccentricity i.e; 25mm and 76mm from East.

CONCLUSIONS

- The strength of individual brick on its side and edge are 96.75% and 60.29% of the average strength of individual brick on its face respectively.

- The strength of brick masonry cube is 26.77%, 27.67% and 44.40% of the average strength of individual brick on its face, side and edge respectively.
- The strength of column with zero eccentricity is 72.68% of the strength of the brick masonry cube and is approximately equal to 19.45%, 20.11 % and 32.27% of the average strength of brick on its face, its side and its edge respectively.
- The maximum stress of column with 25mm eccentricity is 66.27% of the strength of the brick masonry cube and is approximately equal to 17.74%, 18.34% and 29.42% of the average strength of brick on its face, its side and its edge respectively.
- The maximum stress of column with 76mm eccentricity is 35.049% of the strength of the brick masonry cube and is approximately equal to 9.38%, 9.69% and 15.56% of the average strength of brick on its face, its side and its edge respectively.

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