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Experimental Examinationof Hollow Brick Masonry Wallwith Reinforcement

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Abstract: The research aims at conducting a quality research with Reinforcement of a hollow brick wall. The empty internal sections significantly lower the dead load. With a better surface finish, the side of the block was cast, minimizing the cost of plastering. Several sample mixes are tested to achieve a finished surface. The respective frames were cast with and without reinforcement and the test results were compared. The blocks were used to build masonry walls and ' load-bearing strength ' of the walls was tested. It is possible to use the reinforced hollow block as a load-bearing wall. Nearly 75 percent of the deaths related to the earthquake in the last century,Buildings have collapsed, the majority of which (more than 70 percent)is due to the collapse of buildings made of masonry. Most of the properties in India are Unreinforced Masonry (URM) buildings that are weak and vulnerable even under moderate earthquakes and that function on the wall due to high wind forces, causing severe damage to high wind loads and it is recognized that Reinforced Masonry Building has many advantages over unreinforced masonry building.The use was very limited in Indian building practices and there are still no approved codes and shear walls were used in most constructions, even in mild earthquakes, instead of reinforced masonry walls.

Keywords: Reinforced masonry; Unreinforced masonry; Masonry wall; Seismicperformance

I. INTRODUCTION

One of the human being's basic needs for living in the world is shelter. The need for shelter meant for security arises after human evolution. In ancient times, man began to take refuge in caves, excavated below ground level and under hanging mountain cliffs, and this form of shelter provided a safe place from the extremes of the climate. The definition of stability and security as per shelter's structural features was out of mind. With the growth and sophistication of the human mind, man began to change the structural shelter structure to meet the increasing needs and facilities possessed by an optimal shelter layout.

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After a feat by using easily available material such as mud in construction walls and then the technique of burnt clay brick masonry to form structural part of shelter, there was still a long way to go for the best material possible to build stable and safe structures for concrete units. Due to the economy of the entire structure, the desire to find safe and stable structural materials paved the way for the use of hollow bricks.

Hollow Bricks has become very popular for a couple of days now. Such bricks were commonly used in the construction of residential buildings, factories and multi-story buildings. These bricks are commonly used in compound walls due to their low cost.Because of their lightweight and easy ventilation, these bricks are more useful. The bricks are a combination of concrete, sand and stone chips. The design of hollow bricks requires electrical conduits, water and soil pipes concealing structures. The economy of the system is one of the fundamental aspects underlying every project based on any model. Stability plays an important role, but one that comes out with layout that gives the framework of stability and economy is the best designer.

II. EXPERIMENTALPROGRAM

In the present study, we are going to deal with the compressive behavior and other characteristics of local hand molded burnt clay bricks, mortar, unreinforced and reinforced masonry walls.

- Wall specimens (Reinforced &Unreinforced)
- Mortar cube specimens
- Specimens of masonryprisms.
- Specimen of diagonal shear test.

In addition, water absorption of bricks will be determined by standard tests. Along with water absorption test, laboratory tests are conducted.

2.1 Compression test on masonry brickwall

A vertical load is applied on the specimen to know the compressive strength of it. The test is conducted on specimens using loading frame. Reference **IS 3495 Part 1 (1992)**. Total 3 unreinforced specimens are constructed,

- First specimen is tested after 7 days ofcuring.
- Second specimen is tested after 14 days ofcuring.
- Third specimen is tested after 28 days of curing.

Dimensionsofspecimensare**(0.75mX0.5mX0.105m)**with an average water cement ratio of 0.5(Generally Used). The model is prepared by using English bond. For the reinforced wall specimens, the reinforcement is placed foralternatecourse.

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Then after curing process is started and it should be cured for specified time period. Testing is carried out on 5 reinforced specimens with Ladder type reinforcement. Dimensions are same as unreinforced specimens. Fig. 2.1 shows the model of masonry brickwall

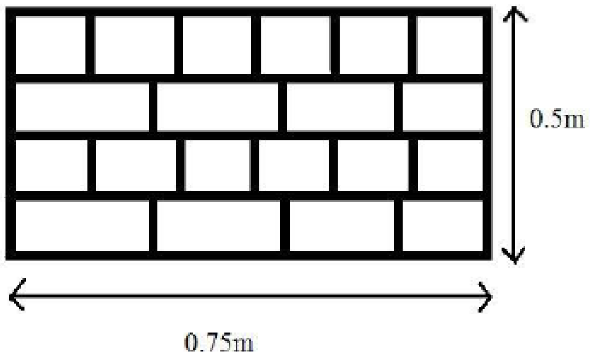

Fig.2.1 Wall for compression test

2.2 Diagonal shear test on masonry brickwall

Similar to the compression experiment, the load is applied horizontally to the sample, but the specimen is mounted diagonally. The load applied to it affects bonded mortar & bricks, so that its shear strength is obtained. The sample size is (0.5 m X 0.5 m X 0.105 m).

Total 3 unreinforced & 5 reinforced samples are built; in alternative course reinforcement is given.The dimensions of specimens for compression & shear test are shown in table 1.

Testing	Length (mm)	Breadth (mm)	Thickness (mm)
Compression test (Reinforced & Unreinforced)	750	500	105
Diagonal shear test (Reinforced & Unreinforced)	500	500	105

Fig 2.2 Test for Diagonal Shear

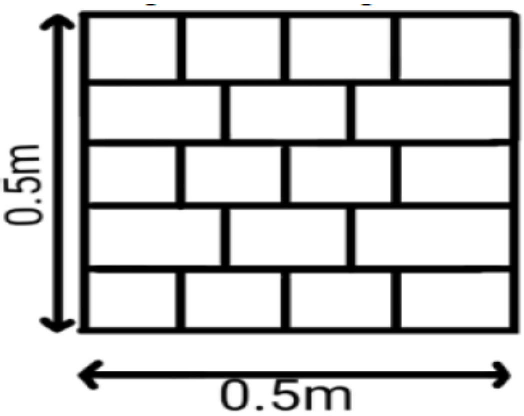

Fig 2.2 Test for Diagonal Shear

2.3 Masonry prism test

The sample is assembled systematically by combination of mortar & concrete to "one on one."

The mounted specimen shall be at least 40 cm long and shall have a height-to-thickness ratio (h / r) of at least 2 but not more than 5.

The assembly strength of units & mortar bond is obtained by performing compression test on this specimen. IS1905-1987 referred to. In these cases, as packing is applied, the mortar at the bed joint undergoes more compressive forces. Total 3 laboratories are installed,

- After 7 days of watering, the first sample is tested.
- After 14 days of watering, second specimen is tested.
- After 28 days of watering the third sample is checked. The test is conducted on UTM. The sample of specimen is figure 2.3(a).

2.4 Reinforcement details

For all specimens, the longitudinal reinforcement was not the same, 3 specimens were provided with reinforcement of the plane and & 2 as reinforcement of the ladder form. Description of reinforcement for samples shown respectively in table (ii).Fig.2.4(a) shows the parallel placement reinforcement details that have no connection in it.Fig.2.4(b) demonstrates the ladder style reinforcement information that are related to the longitudinal bars. The 8mm bars are used as reinforcement.

Table (ii) – Dimensions of reinforcement

Testing	Reinforcement type	Length(mm)	Diameter (mm)
Compression test	Ladder reinforcement	750	8
Diagonal shear test	Ladder reinforcement	500	8

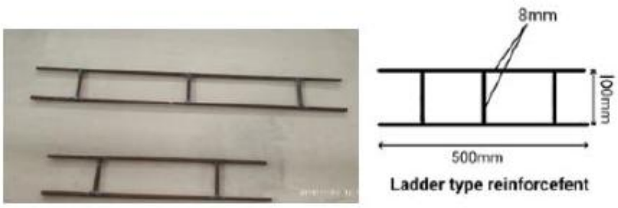

Fig 2.4Reinforcement Bars

2.5 Water absorption test

Bricks are dry and flexible, so it is capable of extracting and retaining moisture from the weather / mortar / concrete naturally. If the brick dry, when laid, absorbs water moisture, the mortar becomes weak and poor. Because of inadequate liquid, it fails to make the bond between bricks and mortar for the hydraulic reaction of cement in the mortar and decreases the building strength overall. Additionally, if the brick consumes more water than the required result, it will adversely affect the brick's strength as well as the structure's toughness. The porous bricks would allow rainwater to be absorbed, resulting in humidity in the wall. This can't even be grouted like concrete. Water absorption of bricks is therefore an important and useful brick property. Water absorption is determined by the bricks ' water absorption test. A brick with less than 10 percent water absorption provides better damage tolerance by freezing. Water absorption analysis can obtain the degree of compactness of bricks as water is absorbed by pores in bricks.

Water absorption = $[(W_2 - W_1) / W_1] \times 100$

- W_1 = Weight of dryspecimen
- W_2 = Weight of wetspecimen

Water Absorption of Brick =7.97%

Fig 2.5 Specimens for water absorption test

III. RESULTS ANDDISCUSSION

3.1 Diagonal shear test on masonry brickwall

The load in the in-plane direction borne by the wall depends on the shear intensity of the masonry and needs to be simulated.

The shear stress for samples is determined from the experimental test according to the ASTM [ASTM, 2002] standard. The shear strength can be determined by fallowing equation(3.3.1).

$$\tau = \frac{0.707 \times p}{A_n}$$

Where, p is the maximum applied Load

$A_n$is the net Area of the specimen

A_n can be calculated by the fallowing equation

Calculation Sample 1: (Unreinforced)

$$A_n = (\frac{w+h}{2}) \times t$$

$$= (\frac{0.5+0.5}{2}) \times 0.105$$

=0.0525 m^2

$$\tau = \frac{0.707 \times p}{A_n}$$

$$= \frac{0.707 \times 42.183}{0.0525}$$

$$= 568.06 \text{ KN/m}^2 = 0.568 \text{ N/mm}^2$$

Calculation Sample 2: (Reinforced)

$$A_n = (\frac{w+h}{2}) \times t$$

$$= (\frac{0.5+0.5}{2}) \times 105$$

=0.0525 m^2

$$\tau = \frac{0.707 \times p}{A_n}$$

$$= \frac{0.707 \times 55.5}{0.0525}$$

$$= 747.4 \text{ KN/m}^2 = 0.747 \text{ N/mm}^2$$

Shear strength for unreinforced and reinforced brick masonry is obtained through diagonal shear test as 0.568 N/mm^2 and 0.747 N/mm^2.

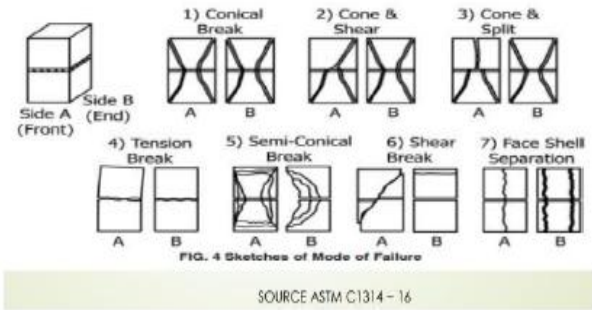

Fig 3.1 Diagonal Shear test

3.2Masonry Prism test

It is a laboratory test to calculate compressive strength of masonry prism. The prism can be received from the site or as a represented site modal can be assembled in the laboratory. It is used to check whether the masonry is providing sufficient strength or not.

Fig 3.2.1 Modes of failure

$A_n = (\frac{w+h}{2}) \times t$......................(i)

Where, w is the specimen **width**,

h is the specimen height,

t is the specimenthickness

3.2 **Masonry** Com

3.3 pression test

At a load of 122.625 KN, 129.492 KN and 135.475 KN, the unreinforced wall collapsed. At 156.96 KN ,161.86 KN and 175. 75 KN respectively, reinforced walls failed. Through this review of result the reinforcement gives higher load bearing capacity. The dimension of Specimen is 0.75m*0.5m*0.105m.

Fig 3.2.2 Masonry Prism Test

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The strength of the masonry is obtained as

= Correction Factor X Strength of Prism

Correction factor can be obtained by from the figure 3.2.3.

TABLE 12 CORRECTION FACTORS FOR DIFFERENT *h/t* RATIOS

(*Clause* B-1.1)

Ratio of height to thickness (*h/t*)	2·0	2·5	3·0	3·5	4·0	5·0
Correction factors for brickwork*	0·73	0·80	0·86	0·91	0·95	1·00
Correction factors for blockwork*	1·00	—	1·20	—	1·30	1·37

*Interpolation is valid for intermediate values.

Fig 3.2.3 Correction Factor Values

Masonry Prism Strength Calculation

= Correction Factor X Strength of Prism h/t Ratio = 430/105 = 4.09

Correction Factor = 0.975; through Interpolation.

No. of days	Compressive strength (Kgf/cm^2)	
	Unreinforced	Reinforcement
7 days	31.46	35.61
14 days	32.29	38.09
28 days	33.54	39.33

Table 3.2.3 Compressive strength of prism

For without reinforcement:

Masonry Prism Strength = 0.975*32.43= 31.61 kgf/cm^2 = 3.16 N/mm^2

For with Reinforcement:

Masonry Prism Strength = 0.975*37.67= 36.73 kgf/cm^2 = 3.67 N/mm^2

Fig 3.3.1 Masonry Compression test

COMPRESSIVE TEST OF THE SPECIMENS (MPa)

No. of days	Unreinforced	Reinforcement
7 days	1.55	1.99
14 days	1.64	2.05
28 days	1.72	2.23

Table 3.3.2 Compressive strength in MPa

IV. CONCLUSION

The present investigation focused on the axial load carrying capacity of Reinforced hollow Brick Masonry based on the experimental investigation the following broad set of conclusions may be drawn:

[1]. Water Absorption of Hollow brick is found to be 7.97%

[2]. Consistency of cement is found to be 33%.

[3]. Compressive strength of hollow brick is found to be 10 N/mm^2.

[4]. Efflorescence of a hollow brick is found to be less than 10%.

[5]. Specific gravity of fine aggregate is found to be 2.54.

[6]. Bulk density of fine aggregate is found to be 1.52 g/cc.

[7]. Fineness modulus of fine aggregate is found to be 2.32.

[8]. Compressive strength of mortar is found to be 15.3 N/mm^2.

[9]. Shear strength of masonry wall is found to be:

- For without reinforcement = 0.568 N/mm2
- For reinforcement = 0.747 N/mm2

[10]. Compressive strength of masonry prism wall is found to be:

- For without reinforcement = 3.16 N/mm2
- For reinforcement = 3.67 N/mm2

[11]. Compressive strength of masonry wall is found to be:

- For without reinforcement = 1.63 N/mm2
- For reinforcement = 2.09 N/mm2

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