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Study of Compressive Strength Of brick Assemblage having different grades of mortar

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Abstract : Brick masonry is bonded into an integral mass by mortar and grout, it is considered to be a homogeneous construction. It is the behavior of the combination of materials that determines the performance of the masonry as a structural element. However, the performance of a structural masonry element is dependent upon the properties of the constituent materials and the interaction of the materials as an assemblage. It is customary to relate the compressive strength of the masonry to that of its components: mortar and units. The correlation between solid unit compressive strength, mortar type and assemblage compressive strength is well documented, and is generally independent of unit coring. The relationships of prism components and prism dimensions to assembly compressive strength brick are presented in this paper.

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Key Words :

Introduction : Masonry construction is one of the oldest and common building technique in construction. The word "masonry" encompasses technique which may differ substantially depending on type and shape of material and construction method. A screening of the historical masonry heritage shows that the wide variety of construction systems which falls under the name of "masonry". Brick masonry is composite material consist of brick and mortar, to be able to predict the behavior of this composite material under various state of stress. The relevant characteristics of brick and mortar will be discussed in term that how they affect masonry behavior in general and the properties of the material used in the experimental program.

It is a common practice to determine the compressive strength of brick masonry under gradually increasing axial loading (known as monotonic loading) thus we generally ignore the effect of cyclic loading, which the real masonry structures experience during earthquakes. On the other hand, experimental work carried out by researchers on masonry walls indicate that brick masonry is very sensitive to cyclic loading and undergoes relatively more damages under the action of cyclic loading compared to monotonically increasing static loading. Behavior of brick masonry will change and there will be a definite effect on its mechanical properties. Due to this contrast behavior of brick masonry under monotonic loading and static cyclic loading, it becomes a matter of concern to investigate the influence of loading types on mechanical properties of masonry. The aim of this experimental work was to study the Influence of static cyclic load on the Compressive strength and Modulus of Elasticity of Brick masonry constructed in cement, sand and khaka mortar.

Materials : Materials used in the experimental work were bricks, sand, khaka and cement, which are very commonly used.

Testing Machine : The specimens will be tested in 38 tonne Universal Testing Machine (UTM) in the Structural Testing laboratory, as shown in figure 3.6, thick steel plate will be used at the top between upper platen of UTM and the specimen The specimens will be tested in 38 tonne Universal Testing Machine (UTM) in the Structural Testing laboratory, as shown in figure 3.6, thick steel plate will be used at the top between upper platen of UTM and the specimen

Laboratory-based tests on sampled mortars :

The compressive strength of masonry prism is calculated by dividing maximum load over the plan area of the prism. ASTM C1314 standard requires multiplying the masonry prism strength by correction factor. The modulus of elasticity will be determined as specified in the ASTM C1314, that is, secant modulus of elasticity between 1/20th and 1/3rd of the maximum compressive stress of the prism. The compressive strength of masonry from the equation proposed by Miha Tomazevic (Miha Tomazevic 1999) is as follows:

$$f_k = k f_b 0.65 f_m 0.25 \ (MPa) \ldots\ldots\ldots\ldots\ldots (5)$$

$$= 5.39 \ MPa \ or \ 781 \ psi$$

Where:
f_b = Normalized compressive strength of unit in MPa
f_m = Compressive strength of mortar in MPa
k is a constant and its value depends on the classification of masonry unit. In this case k is 0.5.

Fig 1 : Stricter face of sample undergoing compression

Fig 2 : sample undergoing compression

Experimental results, which were obtained in this experimental campaign, showed that all specimens have similar failure patterns.The failure patterns for specimens having different grades of mortar are shown in be in figures.

Fig 3: Failure pattern of 1.3 mortar grade sample after 7 days

Fig 4: Failure pattern of 1.2 mortar grade sample after 7 days

Fig 5: Failure pattern of 1.6 mortar grade sample after 7 days

Fig 6: Failure pattern of 1.3 mortar grade sample placed submerged

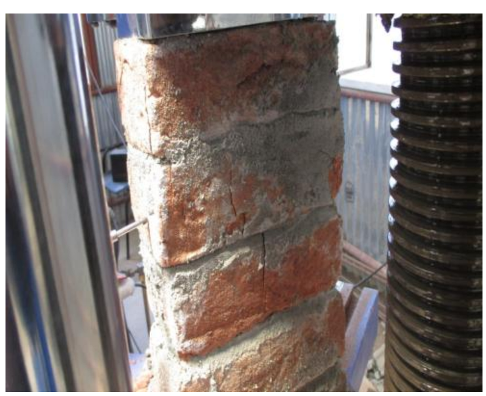

Fig 7: Failure pattern of 1.2 mortar grade sample placed submerged

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Fig 8: Failure pattern of 1.6 mortar grade sample placed submerged

RESULTS OF COMPRESSION TESTS.

1.1 Mortar ratio 1:2 and subjected to testing after 7 days.

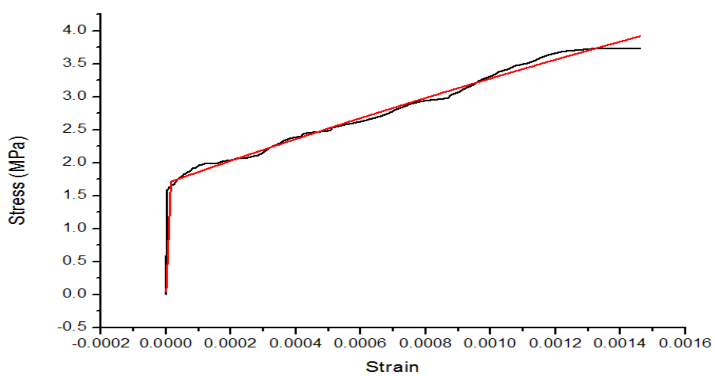

Fig 9: stress strain variation

Red curve indicates fitted curve given by
y = y0 + A1*exp(-(x-x0)/t1) + A2*exp(-(x-x0)/t2)
Black curve indicates actual curve.
The curve shows that the curve is initially straight but up to a small value of stress and then the strain increases without appreciable increase in stress. The various properties related to the sample are summarised in the table 1

Table 1

S.No	Property	Value (MPa)
01	Tangent Modulus	631111
02	Secant Modulus	4000
03	Ultimate Stress	3.72

1.2: Mortar ratio 1:2 and subjected to testing after 28 days.

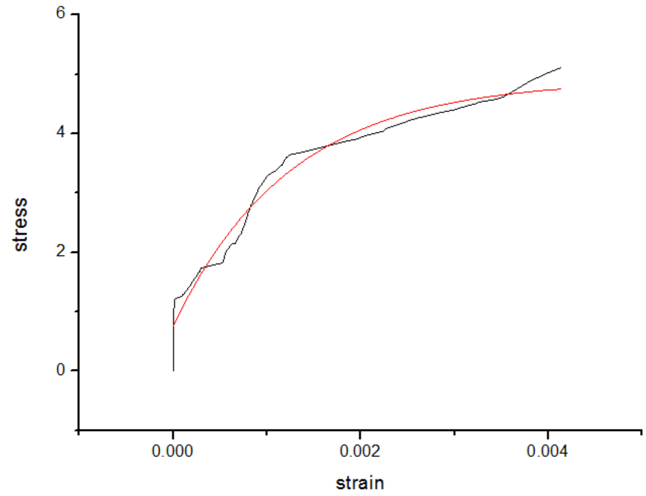

Fig 10: stress strain variation (1:2 compressions)

The fitted curve is given by

y = y0 + A1*exp(-(x-x0)/t1) + A2*exp(-(x-x0)/t2) + A3*exp(-(x-x0)/t3)

The various properties are given in the table4.2

Table 2

S.No	Property	Value (MPa)
01	Tangent Modulus	118518
02	Secant Modulus	2658
03	Ultimate Stress	5.11

1.3: Mortar ratio 1:3 and subjected to testing after 7 days.

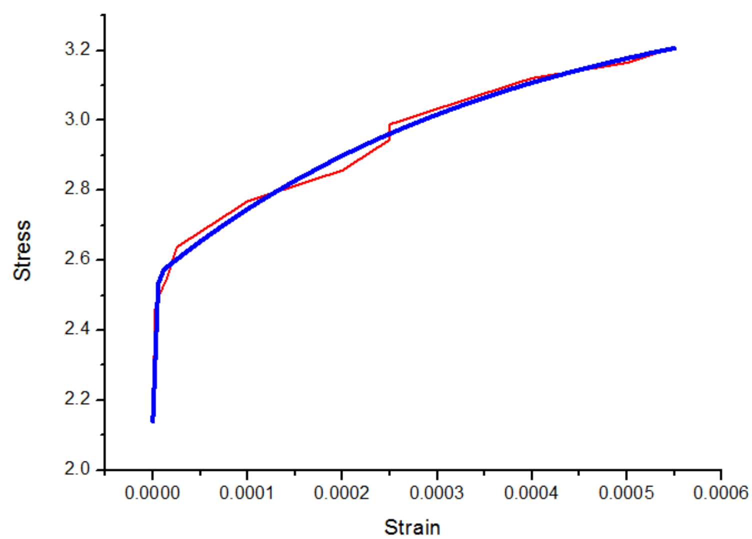

Fig 11: stress strain variation (1:3 compression)

Red line indicates fitted curve.
Blue curve indicates actual curve.
The best fit curve is given by
y = y0 + A1*exp(-(x-x0)/t1) + A2*exp(-(x-x0)/t2)
And the various properties are shown in the table 4.3

Table 3

S.No	Property	Value (MPa)
01	Tangent Modulus	32000
02	Secant Modulus	566.6
03	Ultimate Stress	4.44

1.4: Mortar ratio 1:3 and subjected to testing after 28 days.

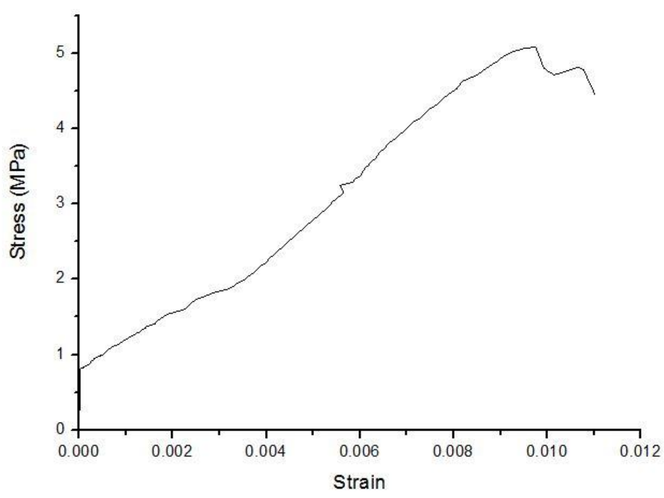

Fig 12: stress strain variation (1:3 compression)

No curve could be fitted for the above stress strain variation and the curve is to be kept as it is and the properties are summarised in the table below 4.4

Table 4

S.No	Property	Value (MPa)
01	Tangent Modulus	12659
02	Secant Modulus	703.05
03	Ultimate Stress	3.2

1.5: Mortar ratio 1:6 and subjected to testing after 28 days.

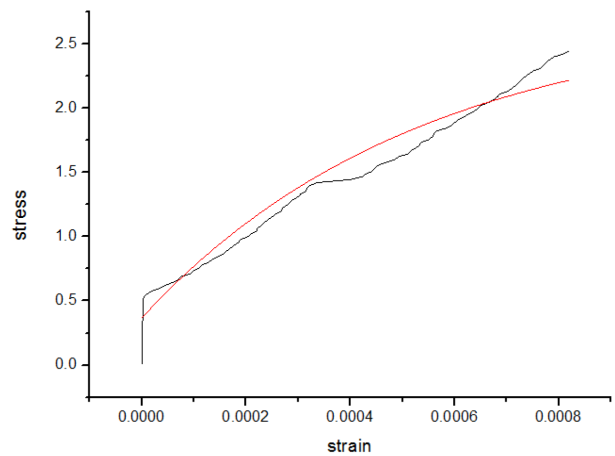

Fig 13: stress strain variation (1:6 compression)

The best fit curve is given by
y = y0 + A1*exp(-(x-x0)/t1)
the respective properties are given in the table 4.5

Table 5

S.No	Property	Value (MPa)
01	Tangent Modulus	186666
02	Secant Modulus	4607.5
03	Ultimate Stress	2.44

1.6: Mortar ratio 1:6 and subjected to testing after submerged for 24 hours.

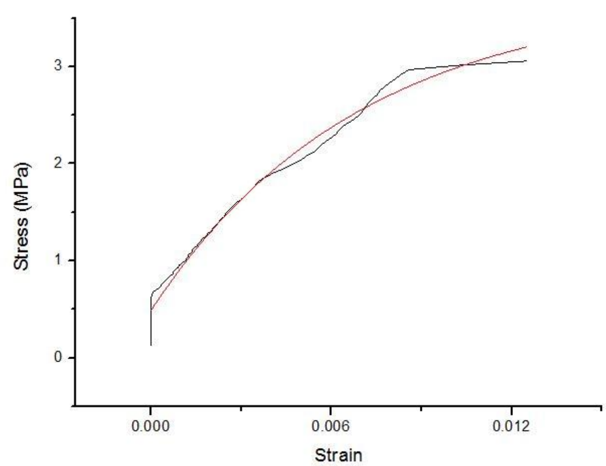

Fig 14: stress strain variation (1:6, submerged).

The best fit curve is given as

y = A1*exp(-x/t1) + y0

The properties are listed in the table below 4.6

Table 6

S.No	Property	Value (MPa)
01	Tangent Modulus	25697
02	Secant Modulus	546.6
03	Ultimate Stress	3.05

Results : The results obtained above were used in developing stress strain relationship. Experimental results, which were obtained in this experimental campaign, showed that all specimens have similar failure patterns.The failure patterns for specimens having different grades of mortar are shown in be in figures

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