

Strengthening of Brick Masonry with Welded Wire Mesh

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Abstract

Unreinforced brickwork (URM) is the most established development method. URM being weak can't withstand the parallel burdens amid a seismic region. Consequently, it is important to locate an appropriate low-cost technique to fortify existing brickwork structures. In this paper flexural bond strength test was conducted on the rectangular brick masonry prisms with two types of welded wire meshes (epoxy coated mesh with the spacing of 12mm and galvanized iron wire mesh with the spacing of 15mm). Masonry prisms were cast and tested as per the guidelines are given in ASTM E518 /E518-15 standards. The results of the flexural bond strength embedded masonry prism show greater when comparing the prisms with no mesh embedment.

1. Introduction

Unreinforced masonry work (URM) is among the most normally utilized building materials in India and numerous other creating nations. The significant offer of the loss of human lives and property amid past quakes has been ascribed to inadequately developed URM structures. Welded-wire networks (WWM) made of chilly drawn support offer huge favorable circumstances to the industry; commonly it lessens the cost of steel fortification. WWM is used as concrete reinforcement in walls, elevated slabs on ground, pavements, etc. It is used in agricultural, industrial, transportation, horticultural and food procuring sectors. This paper presents the flexural bond strength test on masonry prism having 370x220x100 mm size with and without mesh embedment. Shermi et al. investigated that strengthening of masonry using WWM enhanced the flexural strength and ductility of masonry [1]. Andreas Triwiyono et al. have studied that the strengthened walls of flexural strength and ductility give 5 to 16 times higher values than non-strengthened walls [2], the flexural strength was increased by steel reinforcement [3]. S.B. Singh et al. investigated the stress-strain curves of brick masonry and mortar [4], from that curve five control points have been identified which would be useful for the design performance of masonry [5]. Sachin B. Kadam et al. have examined that the fortifying utilizing Ferro-bond brings about a critical upgrade in shear quality and flexibility of unreinforced stone work [6]. M.A. Najafgholipour et al. explored that the joined in-plane and out-of-plane limit in full-scale dividers with various perspective proportions were dictated by numerical models as it were [7], this aspect ratio will be considered in masonry design [8]. Hasim Ali Khan et al. have studied that using geo synthetic increases the load carrying capacity, shear strength, in-plane strength and stiffness, geo synthetic can be used to protect the brick buildings in seismic areas [9]. Ismail M.I. Qeshta et al. investigated that hybrid wire mesh epoxy carbon- fibre composite's concrete beam has more energy absorption when compared with carbon fibre only [10]. Y. Lin et al. have studied that the use of Engineered Cementitious Composite (ECC) shotcrete and near surface mounted steel

reinforcing bars is used as a seismic strengthening for unreinforced masonry [11], the application of ECC on unreinforced masonry walls can improve the out-of-plane capacity [12].

2. Experimental Program and Technique

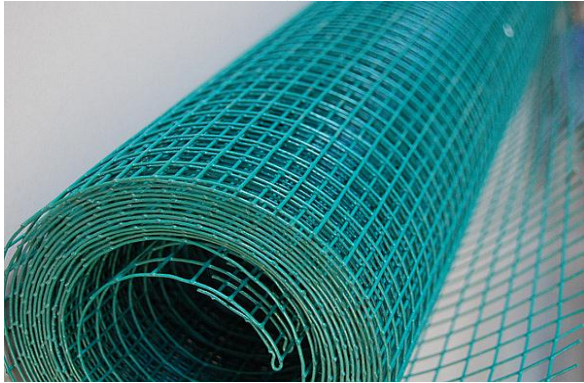
Tests were performed to characterize the material quality of cement sand and bricks. The masonry prisms with and without embedment mesh were developed. To strengthen the masonry prisms, the flexural bond strength was carried out.

Materials used

For mesh embedded prism the cement mortar, bricks and two types of mesh galvanized iron wire mesh and epoxy coated welded mesh were used. Welded wire mesh is commonly available material, and it is economical to use. Ordinary Portland cement 53 grade was used. River sand used as fine aggregate and the specific gravity of the sand was found 2.60 g/cc. coarse aggregate 12.5mm size was used. Common burnt clay bricks are used for the masonry prism. The compressive strength of brick was 3.67MPa calculated as per the guidelines are given in IS3495 PART-1 1992[13]. The water absorption test of brick was 11%. The galvanized iron wire mesh is having a thickness of 0.84mm, and the epoxy coated welded mesh having a thickness of 1mm.



(a)



(b)

Fig. 1: G.I (15mm spaced) and Epoxy coated (12mm spaced) locally available mesh

Flexural Bond Strength of Masonry Prism

Testing of masonry prisms was carried out as per ASTM E518-10 standard guidelines to study the flexural strength (out-of-plane behavior) of prisms. 9 numbers of specimens were cast in that six specimens were cast with embedded mesh (FSE1-E3 & FSG1-G3) and three with no mesh. The masonry mortar proportion 1:3 was maintained for nine specimens. The mesh was placed on both sides of the specimen with concrete. Curing was done for 7 days at room temperature. The prisms were tested under three-point loading as shown in fig 2. The entire test was carried out with 100 tone capacity.



Fig. 2: Experimental set up of masonry prism without mesh embedment



(a)



(b)

Fig. 3: Experimental set up of masonry prism with embedded mesh

Construction technique

Masonry mortar 1:3 (cement: sand) used in the masonry prism. In practical this type of mesh bonding construction can be extended for a critical portion of the masonry wall, many previous research works was discussed only sticking GFRP mesh or fibres on the masonry, but in this paper, the EM was placed with concrete.

3. Results and Discussion

Flexural bond strength test of prism

Flexural bond strength test of nine masonry prisms was determined as per the ASTM standards. The cracks were observed in all the prisms with and without mesh. Table 1 shows the results of flexural strength of prisms. The modulus of rupture is calculated as per the following formula with third point loading $R = (P + 0.75Ps) L / bd^2$

Table 1: Flexural strength of masonry prisms

Specimen	Mesh	Maximum load 'kN'	Average	Weight Ps 'N'	Span L 'm'	'R' 'Pa'
FSE1(Epoxy)	EM	11.8			0.252	1.612
FSE2	EM	12.8			0.262	1.74
FSE3	EM	10.7	11.76		0.262	1.465
FSG1(GI mesh)	EM	10.35			0.262	1.418
FSG2	EM	9.8			0.262	1.344
FSG3	EM	9.35	9.84	269.68	0.262	1.28
FSN1(control)	NM	8.80		265.16	0.250	1.209
FSN2	NM	8.45			0.250	1.162
FSN3	NM	7.85	8.37		0.250	1.081

Table 2: Ductility values of masonry prisms

Specimen	Yield Py (kN)	Δy (mm)	Ultimate Pu (kN)	Δu (mm)	Ductility factor $\mu\Delta = \Delta u / \Delta y$
FSE1	9.8	3.4	11.8	3.7	1.088
FSE2	8.5	3.48	12.8	4.6	1.321
FSE3	9.7	2.60	10.7	2.85	1.096
FSG1	9.5	16.5	10.35	18	1.09
FSG2	8.2	1.8	9.80	3.7	2.05
FSG3	8.5	5.8	9.35	7	1.206
FSN1	8.2	1.5	8.8	1.58	1.053
FSN2	7.9	1.85	8.45	2	1.081
FSN3	7.3	1.75	7.85	1.80	1.028

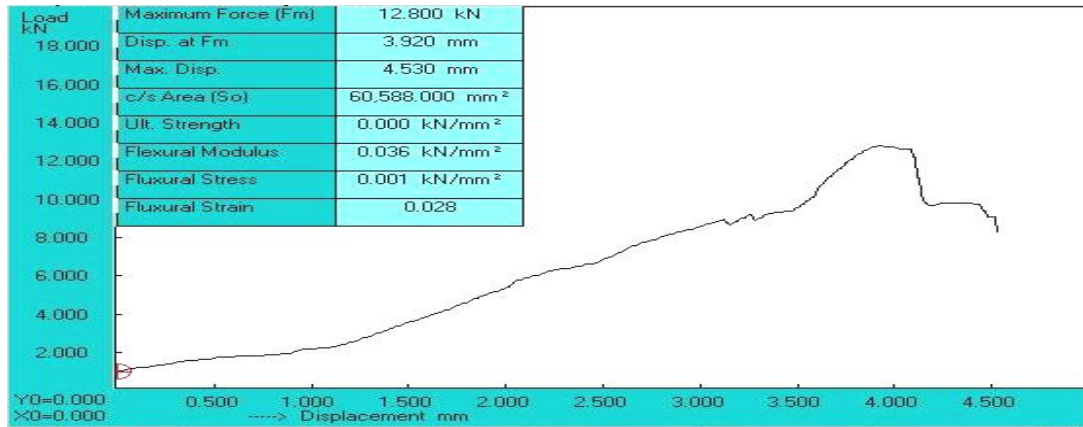


Fig. 5: Load Vs Displacement curve with epoxy coated mesh prisms

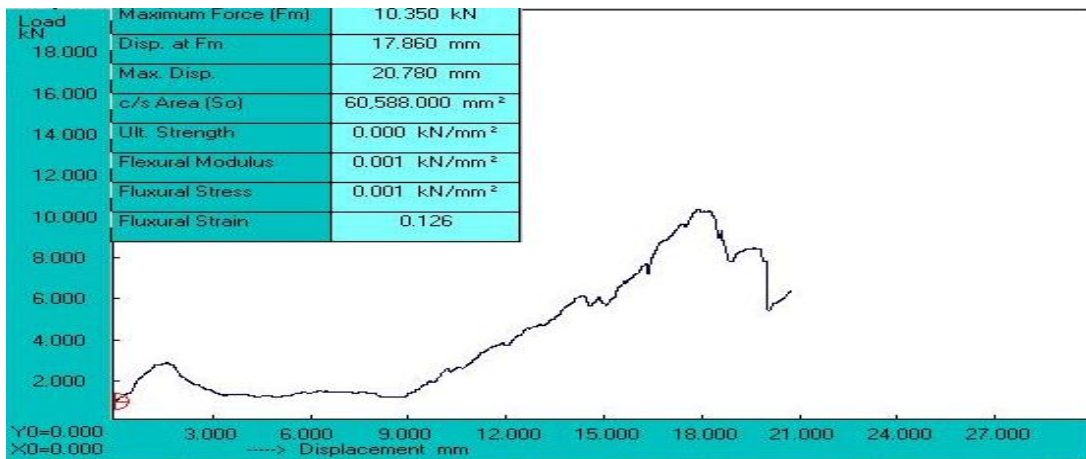


Fig. 6: Load Vs Displacement curve with galvanized iron wire mesh prisms

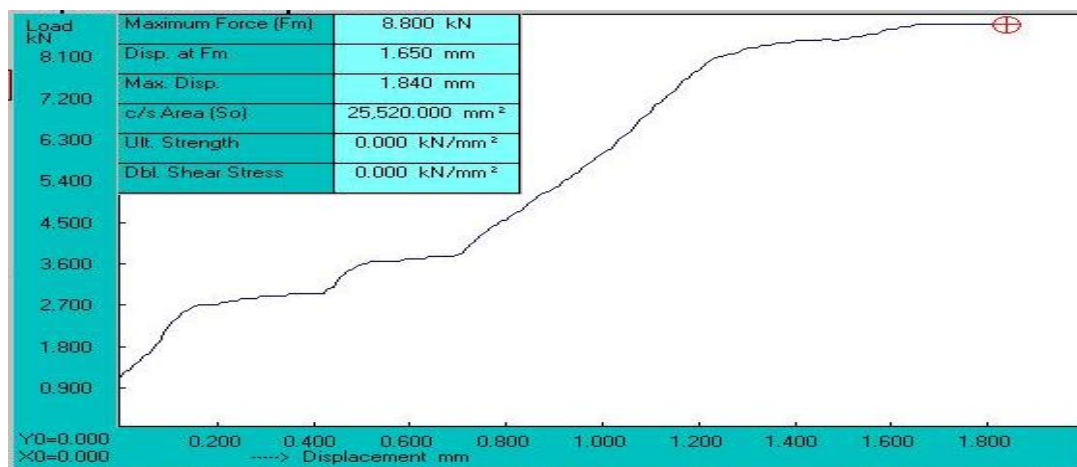


Fig. 7: Load Vs Displacement curve with no embedded mesh prisms

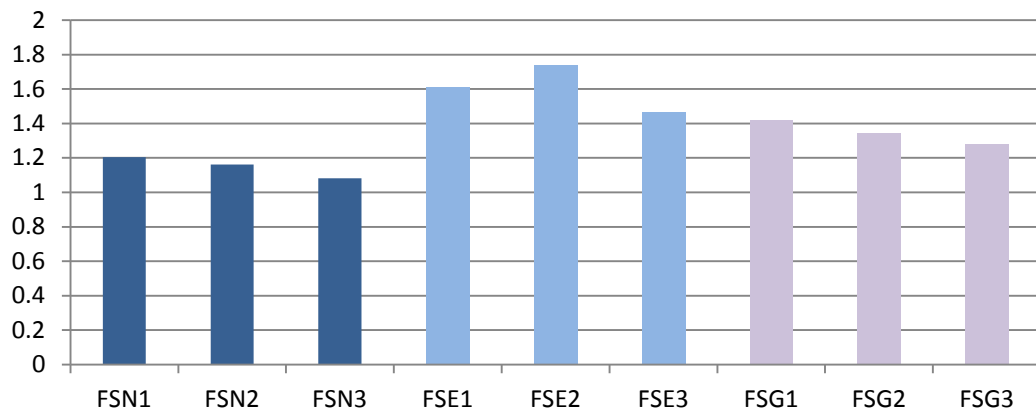


Fig. 8: Modulus of rupture values of prism with and without mesh

4. Conclusion

The flexural bond strength of masonry prisms testes was carried out as per guidelines are given in the ASTM. The test results as follows

The significant flexural bond strength improvement was noted in all Epoxy coated mesh and G.I wire embedded masonry prism. The epoxy coated mesh prisms achieved 18% (average) higher value than GI wire mesh, and the G.I wire mesh embedment increased 41% FBS to the masonry prism.

Modulus of rupture of masonry prism and its energy absorption capacity is reached better value than the control specimen.

The ductility factor values are considerably improved, and apparently, it shows the durability of the masonry prism.

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