EXPERIMENTAL INVESTIGATION ON THE SHEAR-SLIDING BEHAVIOR OF MASONRY, RETROFITTED BY ENGINEERED CEMENTITIOUS COMPOSITES

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Keywords: ECC mortar, Triplet test, Brick masonry, Shear strength, Retrofitting

In this research, the effect of Engineered Cementitious Composites (ECC) on the shear behavior of brick masonry materials was investigated via triplet static tests. The specimens were tested with a constant confining pressure of 1.0 MPa. The results indicated that the retrofitted specimens shear strength and ductility capacity increased.

INTRODUCTION

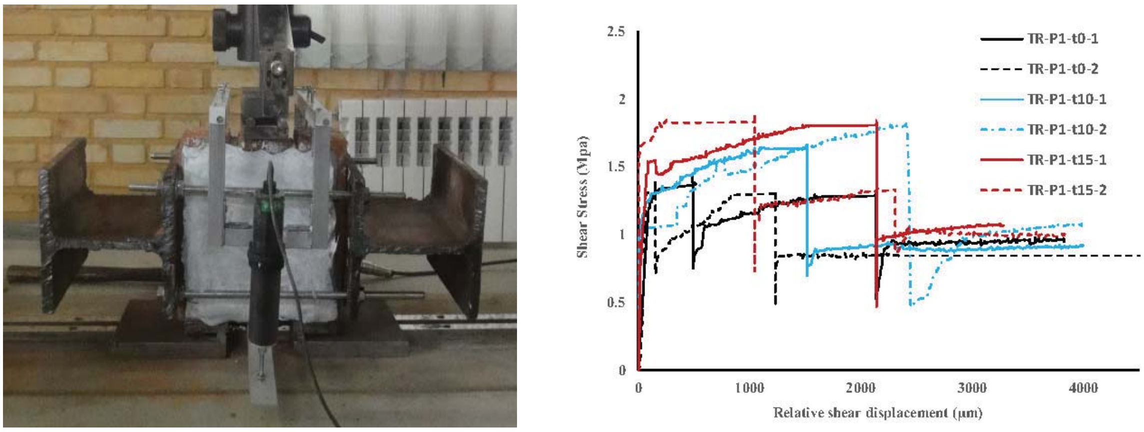
Bond strength and friction of joints lead to bed-joint shear strength. The low mortar quality or low compressive stress can reduce the bed-joint shear strength. Many studies have been conducted on the post-peak behavior and the deformations associated with pre-peak and post-peak responses. This information indicates that the amount of pre-peek slip triplet and the post-peak triplet hardening behavior are negligible (Rahman, 2013). Engineered Cementitious Composites (ECC) are a special class of Fiber-Reinforced Cement-based Composite materials (FRCC), typically reinforced with polyvinyl alcohol (PVA) fibers (Kesner, 2004). In previous studies, the effect of this type of materials on the performance of structures has been investigated. Generally, it has been shown that ECC has a significant role in improving the behavior of retrofitted structures (Deng, 2018). This paper focuses on the behavior of brick masonry materials before and after retrofitting by using an ECC mortar.

EXPERIMENTAL PROGRAM AND RESULT

In this study, thirteen triplet specimens were tested. The specimens' characteristics are presented in Table 1. The specimens' numbering is in the form of TR-P-t-n, where P is compressive stress, t is thickness of the ECC layer and n is the number of each specimen. These tests were performed according to BS-EN1052-3 (British Standard, 2002). The ECC material used in this study consisted of ordinary Portland cement, fly ash, fine silica sand, water, superplasticizer and 2% of PVA fibers by volume. Portland type II cement and sand passing 4 mm sieve were used to prepare the cement mortar. As shown in Figure 1-a, at first, a triplet specimen is compressed through the pre-tension of four steel rods, then the ECC mortar is applied. The shear load was applied by the universal testing machine with a rate of 0.5 mm/min. Shear displacement was measured by means of two LVDTs attached to the specimens' two opposite sides. The results of the experiments including the curve of shear stress versus shear deformation and the ductility parameters have been presented in Figure 1-b and Table 2, respectively.

Table 1. Specimens' characteristics.

P (MPa)	0			1		
t (mm)	0	10	15	0	10	15
number	1,2,3	1,2	1,2	1,2	1,2	1,2



(a) Test setup and instrumentation (b) Shear stress versus shear deformation

Figure 1. Test setup and shear stress of pre-compressed specimens.

Table 2. Shear strength and ductility parameters from triplet shear test.

Specimen	τ_u (MPa)	C (MPa)	μ_f	d_e (μm)	d_u (μm)	μ
TR-P0-t0-1	0.25	0.25	-	-	-	-
TR-P0-t0-2	0.20	0.20	-	-	-	-
TR-P0-t0-3	0.29	0.29	-	-	-	-
TR-P0-t10-1	0.38	0.38	-	-	-	-
TR-P0-t10-2	0.42	0.42	-	-	-	-
TR-P0-t15-1	0.32	0.32	-	-	-	-
TR-P0-t15-2	0.39	0.39	-	-	-	-
TR-P1-t0-1	1.37	-	0.93	156	514	3.3
TR-P1-t0-2	1.38	-	0.82	95	147	1.55
TR-P1-t10-1	1.63	-	0.89	95	1520	10.5
TR-P1-t10-2	1.7	-	0.98	295	2400	8.1
TR-P1-t15-1	1.83	-	1.02	290	2143	7.4
TR-P1-t15-2	1.78	-	1.01	182	1048	5.8

Note: τ_u= ultimate shear strength; C= interface cohesion; μ_f= residual friction coefficient; d_e= displacement corresponding maximum shear strength; d_u= ultimate displacement; μ= d_u/d_e (ductility factor).

CONCLUSION

The failure mode of all retrofitted specimens was the debonding of the ECC layer from the brick surface. Therefore, changes in the thickness of the ECC layer did not have a significant effect on the specimens shear strength. The shear strength of retrofitted uncompressed and precompressed specimens increased by about 27% and 55%, respectively. The ductility capacity of retrofitted precompressed specimens was significantly higher than that of the unretrofitted compressed specimens (about 240%). However, this feature was not observed for uncompressed specimens.

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