In-Plane Behavior of UnReinforced Masonry Walls Retrofitted with Natural Fiber Reinforced Cement Mortar

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Research Background

A huge loss of lives due to the big earthquakes has occurred in the developing countries, such as Indonesia, India, Pakistan, Iran and so on, are due to the falling objects, especially from unreinforced masonry houses.

Regarding this condition, there is a need to strengthen a masonry house. Some retrofitting materials, such as FRP, steel mesh cage, and seismic wallpaper have been investigated, but these synthetic materials are expensive and are not available in many parts of the world.

Therefore, a new retrofitting material which is abaca fiber reinforced cement composites is proposed in this research. Abaca is a natural fiber which is local available and has high tensile strength.

Objective of Research

To develop a new retrofitting material which have high strength, ductility, energy dissipation capacity, durability, locally available, easy to apply and low in cost.
Tensile test of seven samples of abaca fiber was performed to investigate the tensile strength of the fiber (Fig. 2). From the test, the average tensile strength and strain were 957 MPa and 4.3%, respectively (Fig. 3).

The in-plane diagonal compression test was carried out to evaluate the effect of retrofitting masonry walls by fiber reinforced cement composite, using masonry wallets with and without retrofitting in order to assess their seismic performance. The wallet dimensions were $292.5 \times 290 \times 50$ mm$^3$ and consisted of 7 brick rows of 3.5 bricks each (Fig. 3). The mortar joint thickness was 5 mm. A mortar mix of cement:lime:sand = 1:7.9:20 and cement/water ratio = 0.14 was used.
The average strength of unretrofitted wallets is 2.7 MPa, while retrofitted wallets with 30 mm fiber length, 80 mm fiber length and 100 mm fiber length have an average strength of 3.3 kN, 4.0 kN and 3.6 kN, respectively. Based on the test, composites with longer fibers (fiber length 80 mm and 100 mm) shows a slightly higher strength and bigger deformation compared to composites with shorter fibers and URM wallets. Even, there is no significant difference of the load by using different fibers length, it has showed that abaca fiber contributes to bigger deformation capacity in cement composites.

Fig. 5. Result of diagonal compression test, URM (a), FRM 30 mm (b), FRM 80 mm (c), FRM 100 mm (d)
Acknowledgement

Thank you!