IN-PLANE AND OUT-OF-PLANE STATIC FAILURE TEST OF MASONRY WALLETS RETROFITTED WITH ABACA FIBER REINFORCED MORTAR (FRM) AND ABACA ROPE MESH (ARM)

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1.Background

An enormous loss of lives due to the big earthquakes 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 shotcrete, FRP, and steel mesh cage 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 Mortar (FRM) and Abaca Rope Mesh (ARM) are proposed in this research. Abaca is a natural fiber which is local available and has high tensile strength.

2. 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 Abaca Fiber

Tensile tests of seven samples of Abaca fiber were performed to investigate the tensile strength of the fiber (Fig. 1). From the tests, the average tensile strength and strain were 957 MPa and 4.3%, respectively (Fig. 2).

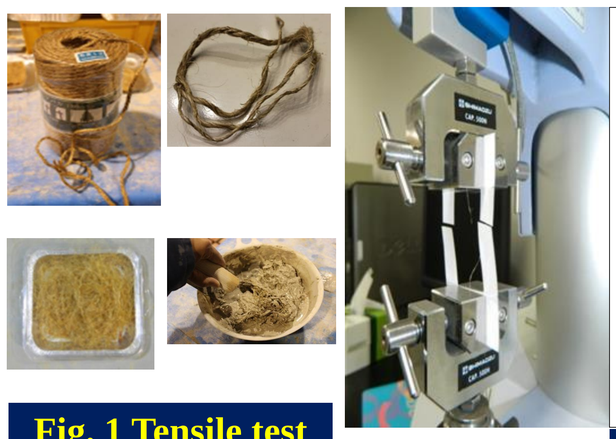

Fig. 1 Tensile test

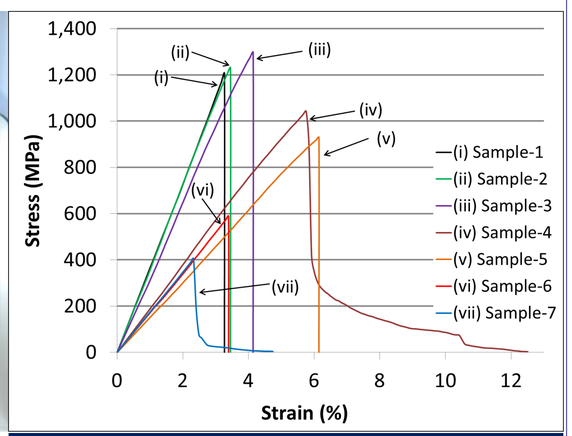

Fig. 2 Tensile test result

Fiber Reinforced Mortar (FRM) and Abaca Rope Mesh (ARM)

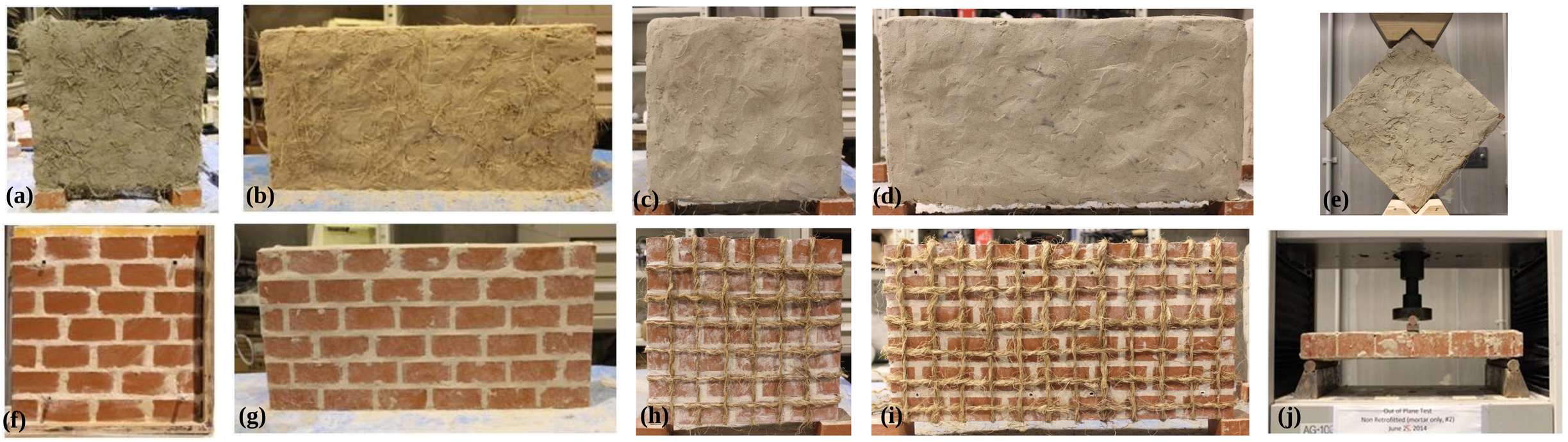

Fig. 3 Photos of wallet specimens with (a, b) and without FRM (f, g), after (c, d) and before plastering ARM (h, i), in-plane test (e) and out-of-plane test (j)

The in-plane diagonal compression test and out-of-plane test were 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 performances. The wallet dimensions were $275 \times 275 \times 50$ mm^3 and consisted of 7 brick rows of 3.5 bricks each (in-plane) and 475x235x50 mm^3 and consisted of 6 brick rows of 6 brick each (out-of-plane) as shown in 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. Specimens were tested 28 days after construction under displacement control condition. The loading rate was 0.15mm/min and 0.25mm/min for unretrofitted and retrofitted cases, respectively.

In-plane and out-of-plane test results of masonry wallets retrofitted with Abaca Fiber Reinforced Mortar (FRM) and Abaca Rope Mesh (ARM)

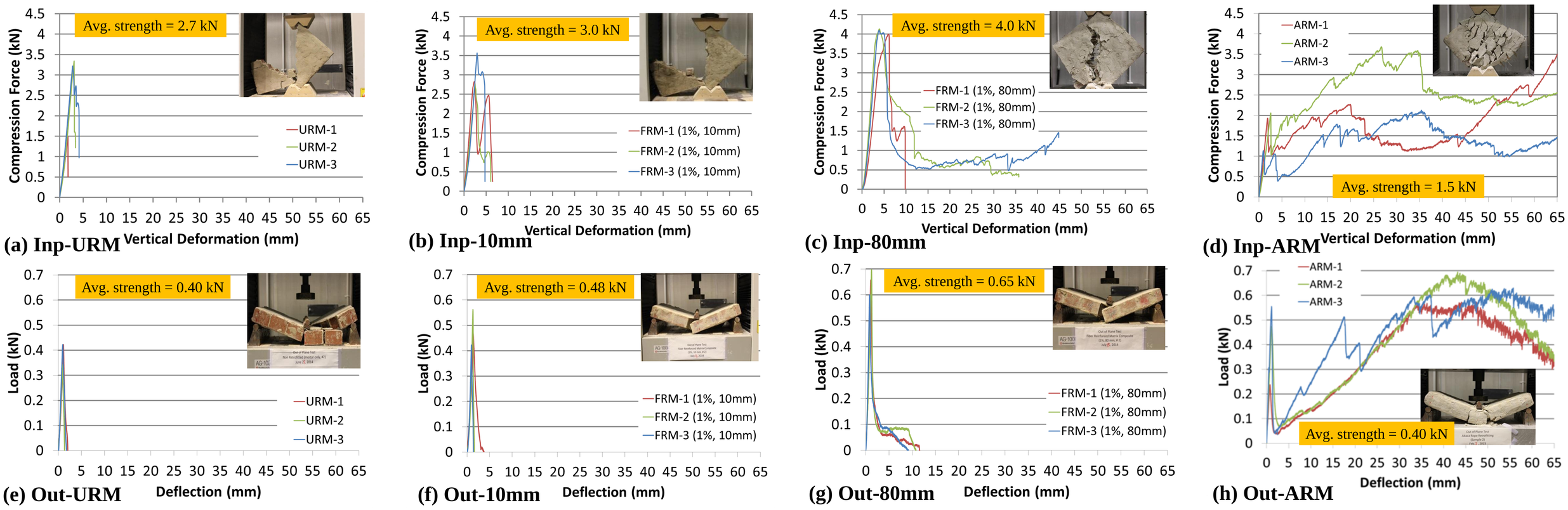

Fig. 4 Test results of URM, FRM, and ARM in-plane and out-of-plane test

Three samples for each condition (unretrofitted named URM and retrofitted named Abaca Fiber Reinforced Mortar (FRM), and Abaca Rope Mesh (ARM)) were tested to investigate the in-plane and out-of-plane behavior. As it is presented in Fig. 4 (a), URM wallets split into two pieces after the diagonal initial crack occurred and no residual strength was left. The average strength of URM for the in-plane test is 2.7 kN (a), while FRM wallets with 10 mm, 80 mm and ARM wallets have an average strength of 3.0 kN (b), 4.0 kN (c) and 1.5 kN (d), respectively. From the out-of-plane test, the average strength of URM, fiber length 10 mm, 80 mm, and ARM wallets are 0.40 kN (e), 0.48 kN (f), 0.65 kN (g), and 0.4 kN (h), respectively. Based on the test, composites with longer fibers (fiber length 80 mm) shows a slightly higher strength and bigger deformation compared to composites with shorter fibers (fiber length 30 mm) and URM wallets. ARM retrofitting showed a lower initial peak strength than those of FRM, but it has a higher residual strength due to the confining effect of Abaca rope mesh on both sides of wallets. ARM wallets showed a higher residual strength than their initial peak strength almost two times per each specimen. It also contributed to the bigger deformation capacities up to 65 mm.