Shake Table Tests on One-Quarter Scale Models of Masonry Houses Retrofitted with PP-Band Mesh

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This paper introduces a technically feasible and economically affordable retrofitting option for seismically vulnerable masonry structures in developing countries using polypropylene bands (PP-bands). The results of the basic material tests and shake table tests on building models show that the PP-band retrofitting technique can enhance the safety of both existing and new masonry buildings, even during severe ground motions, for instance an earthquake with a Japan Meteorological Agency (JMA) seismic intensity of 7. Therefore, the proposed method is an optimum solution for promoting safer building construction in developing countries and can contribute to earthquake disaster mitigation in the future. [DOI: 10.1193/1.3675357]

INTRODUCTION

More than 60% of people in the world are living in masonry buildings that are made by piling up bricks, sun-dried mud bricks (unburnt brick, generally called adobe), stone, or concrete blocks. Population statistics show that this ratio is rather high, especially in developing countries. Masonry buildings without earthquake reinforcement have claimed scores of victims in all parts of the world. The results of earthquake damage investigations and studies conducted in earthquake-prone regions of the world have revealed that masonry buildings can collapse after just a few seconds of earthquake shaking, thus they are a major cause of human fatalities during earthquakes.

Based on post-earthquake damage surveys, the major types of masonry failure modes have been identified as: (1) out-of-plane wall collapse, (2) separation of adjacent walls, (3) in-plane diagonal cracking, and (4) cracking due to stress concentrations around openings (doors and windows).

Figure 1 shows examples of out-of-plane damage in unreinforced masonry houses. This failure mode is common when the main direction of the seismic motion is perpendicular to the masonry walls and they have insufficient transversal supports. Figure 1a shows examples of structures with flexible roofs. In the first case, the roof is a wooden truss supported on two of the house walls. The other two walls do not have any support at the top and as a result the upper portions collapsed. Figure 1b shows an unreinforced masonry house with a reinforced concrete (RC) roof that is not supported by all of the walls. As a result, the walls that were not restrained by the roof collapsed. Failure of the connections between walls can

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Earthquake Spectra, Volume 28, No. 1, pages 277–299, February 2012;