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Effect of Roof and Diaphragm Connectivity on Dynamic Behaviour of the PP-band Retrofitted Adobe Masonry Structures

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RESEARCH ARTICLE

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Abstract

This paper discusses the shaking table test results of three PP-band (Polypropylene band) retrofitted quarter scale one-story masonry house models with different roof conditions. Better connections between masonry wall and roof connection are one factor to improve the seismic safety of the masonry houses. Past studies show that PP-band retrofitting improves the integrity of structural components and prevent the collapse of masonry structures during an earthquake. Although the effect of masonry unit type, surface plastering, the pitch of the PP-band mesh, PP-band connectivity in mesh and tightness of the mesh attachment to walls were studied by experiment program, the effect of the roof and its diaphragm connectivity on PP-band retrofitted masonry structure is non-existent. Therefore, an experimental program was designed and executed for an understanding the effect of the roof and its connection on the dynamic behavior of the PP-band retrofitted box-shaped masonry house models. Results reveal that the PP-band retrofitted models with proper roof diaphragm improves the seismic behavior with respect to lateral drift, shear resistance and ductility.

Keywords

PP-band retrofitting, adobe masonry, roof diaphragm, earthquakes

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1 Introduction

Most of the human fatalities during earthquakes in developing countries occur due to the collapse of low earthquake-resistant masonry houses [1]. Therefore, retrofitting of these types of masonry structures is the key issue for earthquake disaster mitigation in developing countries to reduce the casualties significantly. A number of retrofitting techniques have been developed for low earthquake-resistant, non-engineering masonry structures. However, people living in these types of houses have limited resources in the sense of financial support, construction technology and manpower. Therefore, when proposes a retrofitting technique, it should be low cost with the locally available material, applicable with low technical knowledge and culturally acceptable. Retrofitting masonry structures using PP-band (polypropylene band) meshes satisfies these requirements. PP meshing uses common PP packaging straps (PP bands) to form a mesh, which is then used to encase masonry walls by fixing to both faces of walls. The mesh prevents the separation of structural elements and the escape of debris, maintaining sufficient structural integrity to prevent collapse [2]. Past studies show that PP-band retrofitting improves the integrity of structural components and prevent the collapse of masonry structures during an earthquake [3–7].

Experimental programs on PP-band retrofitting technique for in-plane and out-of-plane test on masonry wallets [3,8], shaking table test on a reduced scale masonry house models [4–6] and shaking table test of full-scale house models [7] have shown that PP-band retrofitting improves the seismic performance of the unreinforced masonry structures. These studies have also shown that, during moderate earthquakes, PP-band meshes can provide enough seismic resistance to guaranty limited and controlled cracking. Also, during strong earthquakes, they are expected to prevent or delay the collapse of the masonry structures. PP-band mesh retrofitting has had applications in China, Nepal, Pakistan, and Indonesia [9]. Past studies show that the performance of the PP-retrofitting structure is influenced by the pitch width of the mesh, tightness of the mesh attachment, materials used for surface plastering [10], the strength of the masonry unit [11] and PP-band mesh