RESPONSE OF CONCRETE BLOCK MASONRY WALLS SUBJECTED TO IN-PLANE SHEAR AND FLEXURAL LOADS

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Unreinforced concrete block masonry (URCBM) bearing wall building is currently the most common form construction in southern regions of Iran. These buildings are commonly constructed by local masons without following any engineering design principles or seismic code recommendations. As a result, during recent earthquakes in south Iran, such as Kaki and Borzjan earthquakes, URCBM bearing wall structures have suffered severe damage, in many occasions leading to collapse, and therefore resulting in significant loss of life and property.

In order to recognize the behavior of brick walls, many experimental and numerical work have been performed. Maheri et al. (2011) investigated the effect of mortar head joints and pre and post-construction moisture content of masonry units on the in-plane capacity of brick walls. Also, Najafgholipour et al. (2013) studied the in-plane shear and out-of-plane bending capacity interaction in brick walls. However, no experimental studies on the behaviour of URCBM walls can be found in the literature.

In this paper, results of some experiments on small-scale concrete block masonry walls are first used to develop and calibrate advanced numerical models for numerical analysis of the wall's response. Three dimensional full-scale URCBM walls with different aspect ratios (height/length) of 0.5, 0.7, 1 and 2, having two different boundary conditions; cantilever (purely shear behaviour) and fixed (flexural behaviour), are then investigated using nonlinear static analyses. The numerical analyses are conducted using simplified micro-models and by means of ABAQUS FEM software. The pushover load-displacement curve obtained from the numerical analysis of the URCBM under in-plane loading is compared with that obtained from the experiment in Figure 1. It is observed that the numerical curve matches the experimental curve well, both in term of initial stiffness and the maximum lateral strength.

After verifying the numerical models against experiments, the nonlinear static pushover responses of full-scale walls having different height/width ratios were evaluated and compared. The pushover capacity curves of different walls are compared in Figure 2. Similarly, lateral capacity, initial stiffness and the mode of failure of the walls are determined and compared. The results show that the walls aspect ratio has a profound effect on the mode of failure of concrete block masonry wall. As the aspect ratio increases, the behavior of the wall moves away from a shear response towards a flexural response, therefore, the shear capacity decreases. On the other hand, with increasing aspect ratio, the ductility of the wall increases. The failure mechanism of walls with lower aspect ratios is predominantly diagonal shear, whereas, failure in walls with higher aspect ratios is generally due to rocking.

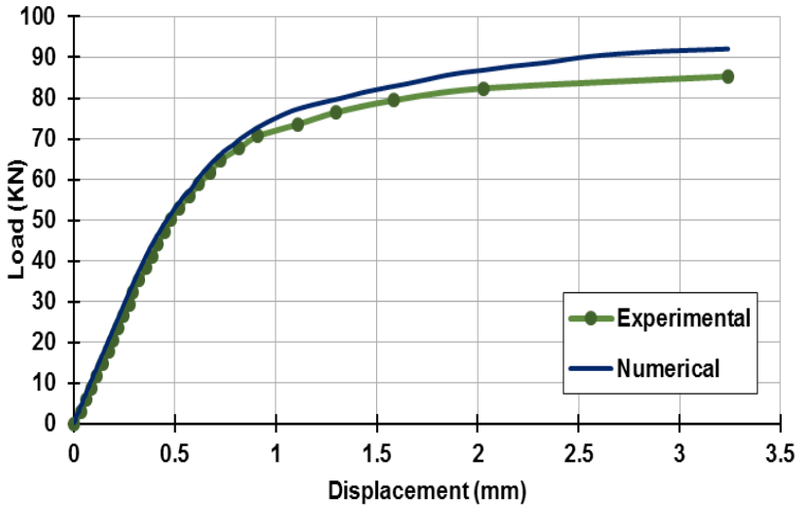

Figure 1. Comparison between experimental and numerical results

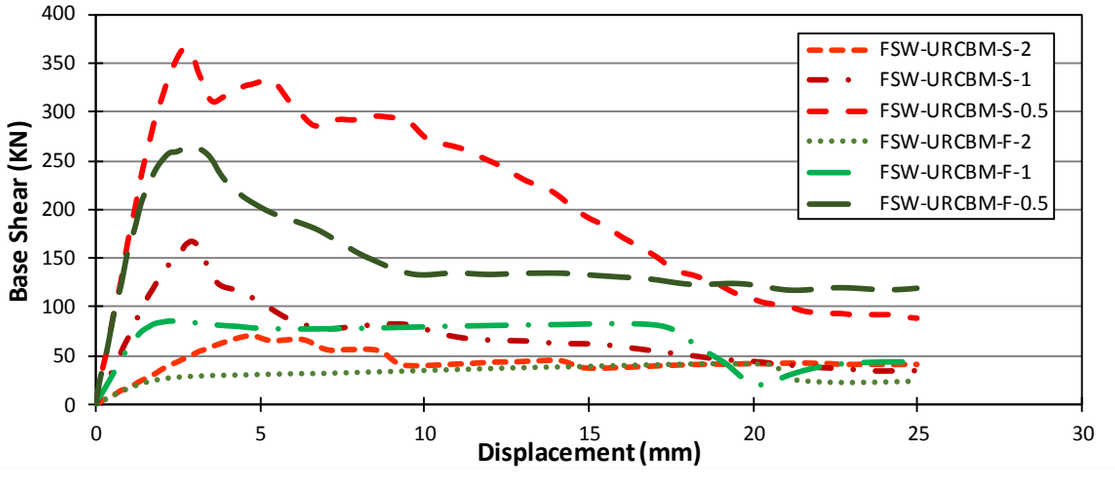

Figure 2. Force-displacement curve of URCBM walls with different aspect ratios

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