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

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ABSTRACT

This paper presents the results of a study onthe in-plane seismic performance of full-scale unreinforced concrete block masonry (URCBM) walls, commonly constructed in Iran, using numerical simulation. Considering limited studies in this field, an experimental research with the objective of investigating the behaviour of these walls under in-plane lateral loading, is first performed on small-scale masonry wall. The numerical modeling based on micro-modeling, is then developed and calibrated to present similar inelastic load-displacement response and failure mode to those of the tested specimens. After verifying the numerical model, a parametrical study is performed on 3D,full-scale dimensions URCBM wallshaving different aspect (height/length) ratios of 0.5, 0.75, 1, 1.5 and 2, and also with two different boundary conditions; cantilever (flexural behaviour) and fixed (purely shear behaviour). The nonlinear static (pushover) analyses results show that the walls boundary conditions have a profound effect on the lateral behaviour and mode of failure of masonry walls. The failure mechanism of fixed ends walls is predominantly shear, whereas, failure in cantilever walls is generally due to rocking.Also, the lateral capacity of walls decreases with increase of aspect ratio.

INTRODUCTION

Unreinforced concrete block masonry (URCBM) bearing wall building is currently the most common form of 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 of 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.

The behaviour of Iranian type of brick walls under seismic loading has been the subject of many experimental and numerical works. 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.

Generally, limited experimental studies on the behaviour of URCBM walls can be found in the literature. As one of the earliest experimental work, Drysdale et al.(1979) investigated the tensile strength of blockwork as the main parameter for concrete block wall in-plane failure and its relation to the angle between the load and the direction of the bed joints. Rahman and Subhash (1994) proposed failure criterion, with empirical Mohr-Coulomb relation, to calculate the modified values of shear bond strength for concrete block-mortar joints. They noted that important parameters other than the elastic moduli of the blocks and