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NUMERICAL MULTI-SCALE APPROACH FOR MASONRY INFILLED FRAME

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ABSTRACT

The first goal of this study is to introduce a numerical procedure to model the effective viscoelastic properties of fractured masonry based on the periodic multi-scale approach. The Modified Maxwell model is chosen to predict the creep of micro-cracked mortar while bricks are supposed to be safe with a linear elastic behavior. Analytical solution proposed by (Cecchi and Tralli, 2012) in safe case is used to evaluate the exact of the results at the local scale. Then, the connection between the masonry and the frame using contact elements is proposed. Finally, the influence of masonry with or without opening on global response of RC frames is discussed.

Keywords: masonry, interface, numerical methods, multi-scale, viscoelastic, fractured, infilled frame.

INTRODUCTION

In recent year and in developing countries (for example in Vietnam), more and more high buildings are being constructed. These structures are explicitly required to withstand the movement induced by earthquake, wind or damage. They are also expected to avoid the occurrence of severe damage to the non-structural elements which entails risks for people and for the main structure. Masonry infill is known as the building envelope with load-bearing function or not. The effect of masonry infill on the global response of RC frames is widely recognized but in current practice, it is often neglected and the structure is designed as a pure frame. That is because of lack of effectively technique for modelling masonry infill. The complexity is attributed to the existence of crack, the nonlinear behaviour of masonry as well as the interaction between the frame and the masonry.

RESULTS AND CONCLUSIONS

In order to illustrate the application, a two-dimensional masonry infilled RC frame under vertical and horizontal loads is considered. Three types of frame are also studied: RC frame with infilled masonry non opening (a), RC frame with infilled masonry with opening (b) and Bare RC frame (c). To simulate the gravity load of upper story, a constant compressive stress q_1 equal to 0.3 MPa is applied on the top of the frame and constant concentrated vertical force P_1 = 100 KN was is applied on the top of two columns (see Figure 1). The structure is tested for lateral top load P_2 or displacement Δ=12.7mm (0.5 inch). Material properties corresponding to reinforcing concrete assumed for the design are: E_{cr} = 200000 MPa,

$\nu_{cr} = 0.2$. The effective modules of masonry are given in Table 1 with damage parameter d_c = 0.1.

Figure 2 shows the maximum lateral displacement Ux of the modeled frame for three cases of frame. As can be seen, due to the presence of infill masonry (even in case with opening), the displacement is much reduced.

Table 1 - The effective modules of masonry

Time (days)	$\tilde{E}_1$ (MPa)	$\tilde{E}_2$ (MPa)	$\tilde{G}_{12}$ (MPa)	$\tilde{\nu}_{12}$	$\tilde{\nu}_{21}$
0	9761	9257	3821	0.196	0.186
1	8823	7250	2914	0.191	0.156
7	8312	6066	2405	0.186	0.136
11	8305	6060	2403	0.185	0.135

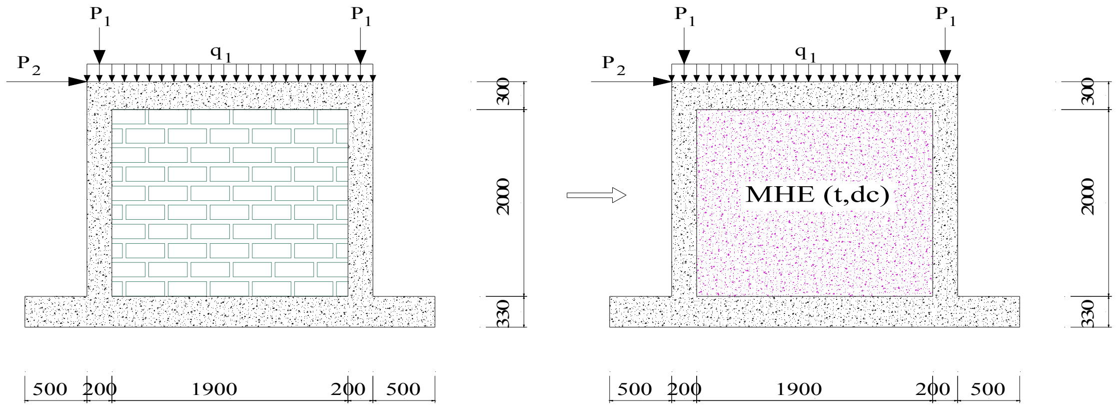

Fig. 1 - Geometry of the masonry infilled RC frame (a) and numeric model (b)

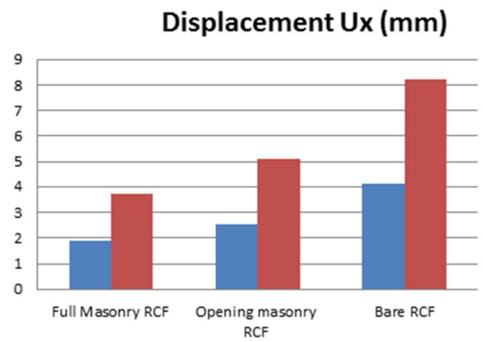

Fig. 2 - Comparison of maximum displacement in direction x (Ux) among three types of frame

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