SEISMIC INVESTIGATIONS OF MASONRY INFILLED REINFORCED CONCRETE FRAMES

Farhad AKHOUNDI
PhD Student, ISISE, University of Minho, Guimaraes, Portugal
farhad.akhoundi@civil.uminho.pt

Paulo B. LOURENÇO
Professor, ISISE, University of Minho, Department of Civil Engineering, Portugal
pbl@civil.uminho.pt

Graça VASCONCELOS
Assistant Professor, ISISE, University of Minho, Department of Civil Engineering, Portugal
graca@civil.uminho.pt

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Masonry infills are assumed as non-structural elements and are not considered in the design process of the buildings while their presence considerably changes the behaviour of the buildings. Its presence could have positive or negative effect on the behaviour of the buildings. When it is positive it means that the presence of masonry infills improves stiffness and lateral strength of the buildings to resist seismic actions. The negative influence relates mainly to the formation of soft story and short column phenomena, which can result in the global or local failure of the structure. In other words, negative influence of infills are related to the non-uniform distribution of the infills along height of the structure or when the masonry infills leave a short portion of the column clear, leading to the shear collapse of the columns , see Figure 1, which are not the scope of this study.

Figure 1. Negative effects of infill within structure; soft storey mechanism, Kusumastuti (2009) (left), short column mechanism Guevara and García (2012) (right)

Behaviour of typical South European masonry infilled reinforced concrete frames under seismic actions were studied by testing five half-scale specimens under in-plane and out-of-plane loading. Information about geometry and reinforcement scheme of those structures constructed in 1980s was obtained by Furtado et al. (2014). Masonry infills were constructed as double leaf without any connection between them.

Two of the specimens were tested in the in-plane direction to investigate how presence of the infill affects in-plane behaviour of the reinforced concrete frames. Its influence on the dynamic properties of the system was also investigated by putting different accelerometers on the frame and infill. In-plane loading was applied cyclically in the plane of the panels in both positive and negative orientations by increasing the levels of the imposed horizontal displacement up to a pre-defined value of lateral drift. For each lateral drift three cycles of loading and unloading were performed. This methodology of applying quasi-static load is proposed by many researchers to simulate the response of the structure under seismic actions, Vasconcelos and Lourenco (2009).

Three specimens were tested in out-of-plane direction to investigate the out-of-plane behaviour of infilled frames. In the first and second specimen, only exterior leaf of masonry infill was constructed; one with solid infill and another with central opening; since studies have confirmed the vulnerability of exterior leaf under seismic actions without any interaction with interior leaf Braga et al (2009). Third specimen was constructed with double leaf infill to investigate how connecting those leaves together improves the out-of-plane behaviour.

Out-of-plane loading was applied by airbag to exactly simulate earthquake action. It was applied in one direction by different loading and unloading cycles as shown in Figure 2. Important challenge was inputting pressure to the airbag in a way that the desired load pattern to be obtained. This issue was done by using Labview software that controls the input and output pressure of the airbag to obtain the defined load pattern.

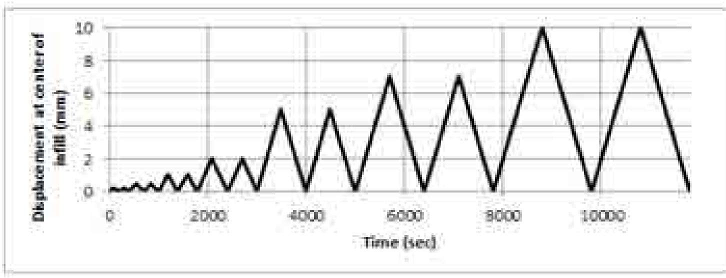

Figure 2. Loading of the infilled frame

Out-of-plane results show that at first levels of loading, masonry infill deforms symmetrically. This deformation leads to formation of arching mechanism which is the main cause for enhancing the behaviour of infill in out-of-plane direction. By increasing the load, upper horizontal boundary condition in conjunction with RC upper beam slides and masonry infill collapses as shown in Figure 3.

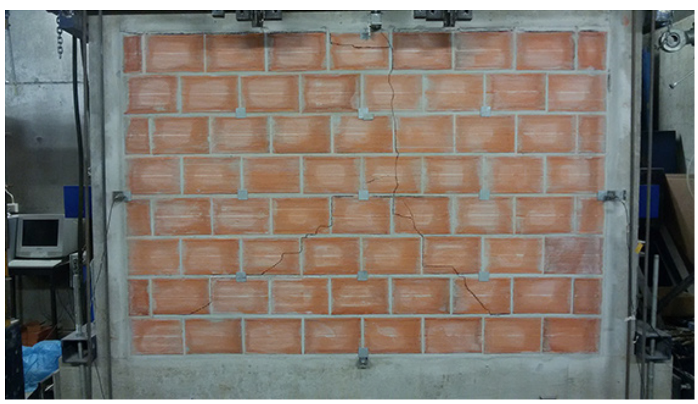

Figure 3. Cracking pattern of the infill in out-of-plane loading

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