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ANALYTICAL EVALUATION OF INFILLED MASONRY RC FRAMES UNDER DIFFERENT LEVELS OF AXIAL LOADS

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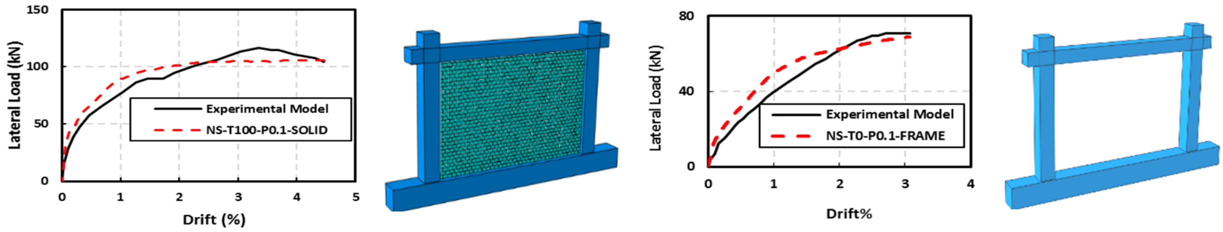
Current concrete structures having the most concrete frame system with masonry infill, are located in the middle and surrounding parts of the buildings. So that, more than 35 percent of the world population lives in these masonry buildings, therefore, due to numerous use of concrete infilled frames, studying the effect of masonry infill on structure behavior during an earthquake is an important subject. Nowadays, the impact of the frame and infill on structure is one of the major challenges in engineering researches; because engineers ignore infill in designing the building; and consider it as non-structural part and just consider its weight. Due to the damages that has been observed in recent earthquakes of Iran, such as the Sarpol-e Zahab which occurred in 2017, it is clear that existence of infill can have both positive and negative impact on the structure Figure 1.

Figure 1. Damages of observed to masonry infill-frame, Sarpol-e Zahab earthquake in 2017.

When the masonry infill is placed in the concrete frame, significantly changes its mechanical properties, the stiffness and strength of the structure increase and ductility of the concrete frame reduce. There is interaction between masonry infill and its frame, so, the frames with infill behave differently than those frames without infill. Disregarding the effect of masonry infill, they can be safe and reliable in terms of resistance in design, since the increasing strength around frame has a positive effect on earthquake strength and overall structural stability; however, it should also be considered that masonry infill will increase the stiffness of the infill-frame and larger portion of the lateral load would attracted by frames. This can be a negative factor when ignore the infill masonry in the design (Furtado et al., 2019).

The purpose of this paper is to investigate the analysis of seismic performance of infills which located in reinforced concrete frames with seismic and non-seismic details under different levels of axial loads. For this purpose, single-story and single-bay reinforced non-seismic concrete frame and non-seismic masonry infill-frame by scale of 1:2 were used for verify this matter which constructed and tested under in-plane lateral load in the laboratory by Mansouri et al. (2014) (Figure 2). In this paper, six specimens of reinforced concrete frame and six specimens of masonry infill-frame with seismic and non-seismic details under different levels of axial loads of 0.1, 0.2 and 0.3 of the ultimate axial capacity of the columns have been modeled and analyzed in ABAQUS finite element software (ABAQUS, 2011). The dimensions of the masonry infill placed inside the concrete frame are equal to 2100 × 1300 × 110 mm means that length × height × thickness and the dimensions of brick units were 106 × 49 × 31 mm. The three specimens of the non-seismic concrete frame were modeled under different levels of axial load 0.1, 0.2, and 0.3 and the three specimens of the seismic concrete frame were designed and modeled based on seismic criteria of the 9th issue of national regulations. In reinforced concrete frame with masonry infill, the first three specimens are under different levels of axial loading of 0.1, 0.2 and 0.3 and masonry infill thickness of 100 mm and concrete frame is non-seismic. The second three specimens are under different levels of axial loading of 0.1, 0.2 and 0.3 and masonry infill thickness of 100 mm and concrete frame is seismic Table 1. After analyzing the specimens in ABAQUS finite element software, the force-displacement graph was extracted and by bilinear FEMA356 method (Prestandard, 2000), the ultimate strength, effective stiffness and ductility was obtained.



a. Masonry infill-frame b. Concrete frame specimen

Figure 2. Verification of laboratory model with FE model (Mansouri et al., 2014).

Table 1. Introduction of finite element models.

Infill-Frame Specimens			Concrete Frame Specimens	
Specimens	**Thickness (mm)**	**Lateral load (N/mm²)**	**Specimens**	**Lateral load (N/mm²)**
NS-T100-P0.1-SOLID	100	2.19	NS-T0-P0.1-FRAME	2.19
NS-T100-P0.2- SOLID	100	4.38	NS-T0-P0.2-FRAME	4.38
NS-T100-P0.3- SOLID	100	6.57	NS-T0-P0.3-FRAME	6.57
S-T100-P0.1- SOLID	100	2.19	S-T0-P0.1-FRAME	2.19
S-T100-P0.2- SOLID	100	4.38	S-T0-P0.2-FRAME	4.38
S-T100-P0.3- SOLID	100	6.57	S-T0-P0.3-FRAME	6.57

Results indicate that when frame have infill, its members does not have any flexure. The nonlinear behavior of masonry infill and the increase stiffness and ultimate strength can be considered as other behavioral differences of frames with masonry infill frame and concrete frame without infill which results in different mechanisms of failure and indicates the type of interaction in the behavior of the components of the masonry infill-frame. When masonry infill is placed inside a reinforced concrete frame, the ultimate strength and effective stiffness toward the concrete frame increase 60% and 98% respectively. Seismic concrete frame compared with non-seismic concrete frame under different levels of axial loading of 0.1, 0.2 and 0.3 and column load capacity bearing respectively 5.5%, 7.15%, 2.5% increase in ultimate strength and of 4.28%, 1.7%, 0.68% increase in effective stiffness and 0, 0, 6% decrease in ductility. The percentage difference between the seismic infilled frames compared with the non-seismic masonry infilled frames under different levels of axial loading 0.1, 0.2, and 0.3 with thickness 100 mm, had been ultimate strength of 4.7%, 2.4, 6.6% respectively, with average of 4.5% increase in it. The percentage difference of effective stiffness is 9.44%, 1.7%, 10%, respectively. The percentage difference of ductility of is 9.75%, 1.7%, 4.5% respectively. The results show that increasing the axial load on the concrete frame and the masonry infill-frame cause to increases the ultimate strength and effective stiffness and decreases the ductility.

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