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Numerical Modeling of Infilled Reinforced Concrete Frame and Its Verification

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Abstract- Infill walls in reinforced concrete buildings produce a strong effect on the strength and deformation capacity of the buildings. In practice, a partial or full absence of infill walls at the first stories may become one of the reasons for vertical irregularity and result in the soft story and short column mechanisms. Where infills fail by in-plane or out-of-plane loading, soft/weak stories can occur, leading to highly localized story drift demands. Different story heights and infill wall arrangements also affect the failure mechanism and create localized damages. Such effects include increased axial forces on columns due to overturning, concentrated shear forces at the ends of beams and columns, and localized deformations in columns surrounded by discontinuous infills. Infill walls may also cause severe damage if the surrounding frame is not well designed for earthquake forces. Failure mechanisms may change drastically and cause collapse before the real capacity is reached

In this study, a 3 story infilled frame was studied. This frame is tested by Ezzatfar et.al. (2014). They used PsD testing method and applied three synthetic earthquake motion with changing amplitudes. To be able to investigate the effect of infill walls, a reliable and accurate infill wall model that simplifies modeling and decreases computational effort is needed. The infill walls can be modeled both with micro and macro modeling techniques. In this study, macro modeling technique was preferred and recent studies in the literature were examined. Multiple strut model was preferred in the modeling of the infill walls to include the effect on the surrounding frame. OpenSEES is used for modeling and comparison of the numerical model with experiment is carried out. CONCRETE02 and Steel02 material models are used for concrete and steel properties. A bond slip was modeled at the end of ground floor columns. A material model for infill wall was modified by using uniaxial hysteretic material model. Shear behavior is aggregated into the fiber section via section aggregator option. Nonlinear time history analysis and pushover analysis were performed to compare the numerical analysis results with the experimental one. The results of the numerical model match with the experimental one with an acceptable accuracy. It is observed that the macro modeling approach with the state-of-art hysteretic material model definition can estimate the dynamic behavior.

Keywords- Infill Wall, RC, Experimental, Dynamic, Nonlinear.