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Vulnerability of Steel Moment-Frame Buildings with Pinned and, Alternatively, with Semi-Rigid Connections

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Abstract : Steel frames have been used in building construction for more than one hundred years. Beam-column may be connected to columns using either stiffened or unstiffened angles at the top and bottom beam flanges. Designers often assume that these assemblies acted as “pinned” connections for gravity loads and that the stiffened connections would act as “fixed” connections for lateral loads. Observation of damages sustained by buildings during the 1994 Northridge earthquake indicated that, contrary to the intended behavior, in many cases, brittle fractures initiated within the connections at very low levels of plastic demand, and in some cases, while the structures remained essentially elastic. Due to the damage presented in these buildings other type of alternative connections have been proposed. According to a research funded by the Federal Emergency Management Agency (FEMA), the screwed connections have better performance when they are subjected to cyclic loads, but at the same time, these connections have some degree of flexibility. Due to this situation, some researchers ventured into the study of semi-rigid connections. In the present study three steel buildings, constituted by regular frames are analyzed. Two types of connections are considered: pinned and semi-rigid connections. With the aim to estimate their structural capacity, a number of incremental dynamic analyzes are performed. 3D structural models are used for the analyses. The seismic ground motions were recorded on sites near Los Angeles, California, where the structures are supposed to be located. The vulnerability curves of the building are obtained in terms of maximum inter-story drifts. The vulnerability curves (which correspond to the models with two different types of connections) are compared, and its implications on its structural design and performance is discussed.

Keywords : steel frame Buildings, vulnerability curves, semi-rigid connections, pinned connections
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