Robustness performance of seismic resistant steel moment connections

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Abstract: Steel frames are widely used for multi-story buildings, providing the strength, stiffness, and ductility that are required to resist the effects of the gravity, wind, or accidental/seismic loads. Among other structural components, beam-to-column connections play a decisive role in the capacity of the structure to develop alternate load paths when local damage occurs. Generally considered to produce robust structures, seismic design philosophy has been seen as an appropriate tool for providing the resistance against collapse for other extreme hazards for example blast or impact. However, there are specific issues that should be considered to limit the effects of localized failures, particularly of columns, for example the capacity to develop large catenary forces in beams. The study presented in the paper investigates the influence of seismic design requirements on the progressive collapse resistance of multi-story steel frame buildings following a column loss event. Four connection typologies commonly used in practice, detailed to fulfil specific demands for seismic resistant systems, were tested experimentally. Numerical models were calibrated against experimental data. By using these connection typologies, six story structures, designed for three levels of seismic intensity, were analysed against column loss events. The interplay between the seismic design requirements and progressive collapse resistance was assessed, identifying the key connection components in resisting the complex loading states (combined axial force and bending moment, small and large deflection stage).

Keywords: steel frame, extreme loading, progressive collapse, seismic design, column loss, catenary action

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