INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Masonry infilled (MI) reinforced concrete (RC) buildings are commonly constructed in many places across the world. Infills contribute large lateral strength and stiffness to the building, but their influence on the lateral load behavior during a seismic event depends greatly on their distribution in the building. MI-RC frames with an open ground storey (OGS) is a typical case of irregular distribution of infills along the height of a building frame, where infills are provided only in the upper stories. This renders the ground storey relatively flexible and weaker compared to the stiffer upper stories leading to an undesirable column-sway failure mechanism in OGS buildings subjected to earthquake excitations. The issue becomes more complex socially as there appears to be a belief among various stakeholders that openings present in the infill walls on upper stories of OGS buildings offset the soft storey effect, and thus, reduces the seismic vulnerability. Failure of the OGS buildings during past earthquakes reveals that the global failure of such buildings is entirely defined by the ground storey column failure. This necessitates consideration of an engineering demand parameter (EDP) that defines the component level failure of the OGS buildings. Large uncertainties are usually associated with the estimation of these EDPs needing proper consideration. Further, a large-scale fragility assessment of building stocks in an area requires a simple and rapidly applicable method. Thus, the primary objective of the present study is to quantify the seismic performance and fragility of low- to mid-rise OGS frames with due consideration to various sources of uncertainties associated with EDPs, and to assess their seismic vulnerability in comparison with corresponding fully infilled and bare frames. These objectives are met by carrying out a parametric study involving nonlinear static and dynamic analyses of representative RC frames with different infill configurations. Sensitivity of EDPs owing to the uncertainty in several input parameters is studied and the most influencing parameters for fragility assessment of all the frames are highlighted. Total uncertainty in estimation of seismic performance is estimated for the three frame configurations. This is followed by seismic fragility estimation using the frame responses and uncertainty obtained. The assumption that seismic vulnerability of OGS frames reduces due to increase in opening size in infill walls is found to be flawed. By multiple linear regression of several parameters, a two-level seismic demand model is developed for rapid assessment of seismic displacement demand on the frames. Finally, fragility flow plots (FFP) are developed where the damage is represented in a continuous form without any discretization of damage states. FFPs can relate several building parameters required for rapid quantification of the fragility of buildings for a given level of uncertainty and seismic demand. FFPs can be further used in fragility-based seismic design of the frames.