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Seismic Vulnerability of Structures Designed in Accordance with the Allowable Stress Design and Load Resistant Factor Design Methods

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Abstract : The method selected for the design of structures not only can affect their seismic vulnerability but also can affect their construction cost. For the design of steel structures, two distinct methods have been introduced by existing codes, namely allowable stress design (ASD) and load resistant factor design (LRFD). This study investigates the effect of using the aforementioned design methods on the seismic vulnerability and construction cost of steel structures. Specifically, a 20-story building equipped with special moment resisting frame and an eccentrically braced system was selected for this study. The building was designed for three different intensities of peak ground acceleration including 0.2 g, 0.25 g, and 0.3 g using the ASD and LRFD methods. The required sizes of beams, columns, and braces were obtained using response spectrum analysis. Then, the designed frames were subjected to nine natural earthquake records which were scaled to the designed response spectrum. For each frame, the base shear, story shears, and inter-story drifts were calculated and then were compared. Results indicated that the LRFD method led to a more economical design for the frames. In addition, the LRFD method resulted in lower base shears and larger inter-story drifts when compared with the ASD method. It was concluded that the application of the LRFD method not only reduced the weights of structural elements but also provided a higher safety margin against seismic actions when compared with the ASD method.

Keywords : allowable stress design, load resistant factor design, nonlinear time history analysis, seismic vulnerability, steel structures
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