

Seismic Behavior and Loss Assessment of High-Rise Buildings with Light Gauge Steel-Concrete Hybrid Structure

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Abstract : The steel-concrete hybrid structure has been extensively employed in high-rise buildings and super high-rise buildings. The light gauge steel-concrete hybrid structure, including light gauge steel structure and concrete hybrid structure, is a new-type steel-concrete hybrid structure, which possesses some advantages of light gauge steel structure and concrete hybrid structure. The seismic behavior and loss assessment of three high-rise buildings with three different concrete hybrid structures were investigated through finite element software, respectively. The three concrete hybrid structures are reinforced concrete column-steel beam (RC-S) hybrid structure, concrete-filled steel tube column-steel beam (CFST-S) hybrid structure, and tubed concrete column-steel beam (TC-S) hybrid structure. The nonlinear time-history analysis of three high-rise buildings under 80 earthquakes was carried out. After simulation, it indicated that the seismic performances of three high-rise buildings were superior. Under extremely rare earthquakes, the maximum inter-storey drifts of three high-rise buildings are significantly lower than 1/50. The inter-storey drift and floor acceleration of high-rise building with CFST-S hybrid structure were bigger than those of high-rise buildings with RC-S hybrid structure, and smaller than those of high-rise building with TC-S hybrid structure. Then, based on the time-history analysis results, the post-earthquake repair cost ratio and repair time of three high-rise buildings were predicted through an economic performance analysis method proposed in FEMA-P58 report. Under frequent earthquakes, basic earthquakes and rare earthquakes, the repair cost ratio and repair time of three high-rise buildings were less than 5% and 15 days, respectively. Under extremely rare earthquakes, the repair cost ratio and repair time of high-rise buildings with TC-S hybrid structure were the most among three high rise buildings. Due to the advantages of CFST-S hybrid structure, it could be extensively employed in high-rise buildings subjected to earthquake excitations.

Keywords : seismic behavior, loss assessment, light gauge steel-concrete hybrid structure, high-rise building, time-history analysis

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