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Abstract A new robust method for optimal damper placement is presented for building structures under the critical double impulse. Oil dampers are treated here as representative supplemental dampers to control the seismic response of high-rise buildings. Such oil dampers usually obey a bi-linear force-velocity relation in controlling the maximum damping force through a relief mechanism to avoid the occurrence of excessive design forces in surrounding frames. The influence of uncertainty in characteristics of those bi-linear oil dampers on building structural safety is investigated. For the efficient evaluation of dynamic performance, the resonant critical double impulse is used as the base input instead of actual earthquake ground motions. Since the critical double impulse is determined to maximize the input energy to the objective building by changing the second impulse timing, uncertainties in input ground motions can be taken into account in a robust manner. To consider these various uncertainties, the robustness function based on the Info-Gap model is used in the robust optimization to assess structural performance variations caused by various uncertainties in the structural design phase. In this paper, a new innovative objective function in the robust optimal damper placement problem is proposed to enhance the robustness of structural performance under the variation of structural parameters by comparing the robustness function of the robust design with that of an ordinary optimal damper placement without considering uncertainties. Numerical examples of the robust optimal design of linear and bi-linear oil damper placements are shown for 10-story and 20-story planar building frame models. Structural performances of the robust optimal design to the conventional design earthquake ground motions are examined to investigate the validity of using the critical double impulse in the structural design under uncertainties.

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