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The Effect of Mathematical Modeling of Damping on the Seismic Energy Demands

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Abstract : Modern earthquake engineering and design encompass performance-based design philosophy. The main objective in performance-based design is to achieve a system performing precisely to meet the design objectives so to reduce unintended seismic risks and associated losses. Energy-based earthquake-resistant design is one of the design methodologies that can be implemented in performance-based earthquake engineering. In energy-based design, the seismic demand is usually described as the ratio of the hysteretic to input energy. Once the hysteretic energy is known as a percentage of the input energy, it is distributed among energy-dissipating components of a structure. The hysteretic to input energy ratio is highly dependent on the inherent damping of a structural system. In numerical analysis, damping can be modeled as stiffness-proportional, mass-proportional, or a linear combination of stiffness and mass. In this study, the effect of mathematical modeling of damping on the estimation of seismic energy demands is investigated by considering elastic-perfectly-plastic single-degree-of-freedom systems representing short to long period structures. Furthermore, the seismicity of Vancouver, Canada, is used in the nonlinear time history analysis. According to the preliminary results, the input energy demand is not sensitive to the type of damping models deployed. Hence, consistent results are achieved regardless of the damping models utilized in the numerical analyses. On the other hand, the hysteretic to input energy ratios vary significantly for the different damping models.

Keywords : damping, energy-based seismic design, hysteretic energy, input energy
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