Numerical Investigation of Floor Response Spectrum Considering Nonlinear Behavior of Shear Walls in Nuclear Power Plants

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Abstract: The floor response spectrum (FRS) of a nuclear power plant (NPP) structure considering nonlinear behavior of shear walls is numerically investigated. The *Hysteretic Material* from OpenSees program is applied to a lumped-mass model to consider the nonlinear hysteretic behavior of the element representing the shear wall. Parameters that determine the hysteretic behavior are changed to examine the effects of the parameters on the resulting FRS. The pinching effect, damage due to ductility and energy, and degraded unloading stiffness can be considered with changes in parameter values. The hysteretic behavior of the structure with different parameter values was analyzed. Elements in the lower part of the model showed more nonlinear behavior. The peak shift and broadening as well as the amplification or reduction of the amplitude of the resulting FRS are studied. According to the numerical simulation results, the FRS in the lower part representing the nonlinear behavior was amplified in the high frequency range; on the other hand, the FRS in the higher part showing almost-linear behavior had a frequency shift rather than an amplification. Also, the results showed that the parameter accounting for the pinching behavior and the stiffness degradation have a meaningful effect on the FRS. For example, the pinching effect results in the significant amplification of the FRS in the high frequency range. The parameters should be carefully adjusted to account for the realistic nonlinear behavior of the shear wall in an NPP structure.

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