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Speeding up Nonlinear Time History Analysis of Base-Isolated Structures Using a Nonlinear Exponential Model

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Abstract : The nonlinear time history analysis of seismically base-isolated structures can require a significant computational effort when the behavior of each seismic isolator is predicted by adopting the widely used differential equation Bouc-Wen model. In this paper, a nonlinear exponential model, able to simulate the response of seismic isolation bearings within a relatively large displacements range, is described and adopted in order to reduce the numerical computations and speed up the nonlinear dynamic analysis. Compared to the Bouc-Wen model, the proposed one does not require the numerical solution of a nonlinear differential equation for each time step of the analysis. The seismic response of a 3d base-isolated structure with a lead rubber bearing system subjected to harmonic earthquake excitation is simulated by modeling each isolator using the proposed analytical model. The comparison of the numerical results and computational time with those obtained by modeling the lead rubber bearings using the Bouc-Wen model demonstrates the good accuracy of the proposed model and its capability to reduce significantly the computational effort of the analysis.

Keywords : base isolation, computational efficiency, nonlinear exponential model, nonlinear time history analysis
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