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Seismic Risk Assessment of Base-Isolated Liquid Storage Tanks with Friction-Pendulum System using Vector-Valued Intensity Measures

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Abstract

In the context of performance-based earthquake engineering (PBEE), seismic risk assessment of structures is performed considering various uncertainties in the input excitation and the structural system. Generally, the seismic risk is expressed in terms of the mean annual rate of exceeding a specified limit state for an assumed performance measure. Herein, seismic risk assessment of cylindrical liquid storage tanks with broad and slender configurations is evaluated when base-isolated with a friction pendulum system (FPS) considering different friction coefficients (μ). Efficiency analysis is performed to obtain suitable vector-valued intensity measures (vIMs) that ensure minimum deviation in seismic risk assessment. Fragility analysis is performed using stripe analysis, considering a defined damage state, in terms of the peak base shear ($V_{b,p}$) which is related to the elastic buckling of the tank wall, for a range of friction coefficients of the FPS. The annual joint probability of occurrence of the intensity measures (IMs) at the selected site is evaluated using vector-valued probabilistic seismic hazard analysis (VPSHA) and it is convoluted with the fragility functions for obtaining the seismic risk. The results are expressed in terms of the mean annual rate of exceedance of the base shear demand ($V_{b,d}$), λ_{EDP}, for the considered tanks at the selected site. It is observed that there is a sudden drop in the computed λ_{EDP}, which strongly depends on the friction coefficient.

Keywords: Base-isolated liquid storage tanks, Friction pendulum system, Vector-valued intensity measures, Seismic-risk assessment