Seismic Analysis of Elevated Water Storage Tanks Subjected to Six Correlated Ground Motion Components

In this work, rotational components of ground motion acceleration were defined according to improved method from the corresponding available translational components based on transversely isotropic elastic wave propagation in the soil. With such improvement, it becomes possible to consider frequency-dependent wave velocities on rotational components of ground motion. For this purpose, three translational components of El Centro earthquake (4 January 1952) were adopted to generate their relative rotational components based on SV and SH wave incidence by Fast Fourier transform with 6904 discrete frequencies. The translational and computed rotational motions were then applied to the concrete elevated water storagetanks with different structural characteristics and water elevations. The finite element method is used for the nonlinear analysis of water storage tanks considering the fluid-structure interaction using Lagrangian- Lagrangian approach and the concrete material nonlinearities have been taken into account through William-Warnke model. The nonlinear response of these structures considering the six components of ground motions showed that the rotational components of ground motion can increase or decrease the maximum displacement and reaction force of the structure. These variations are depending on the frequency of structure and predominant frequencies of translational and rotational components of ground motion.

Keywords: Elevated water storage tank Six correlated components Fluid-structure interaction Lagrangian approach

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