

Seismic assessment method for RC elevated water tanks

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The seismic response of elevated reinforced concrete (RC) water tanks depends on the geometry of the tank, material properties, and earthquake characteristics such as frequency content, peak-ground acceleration, and duration of the earthquake. Model analysis and response spectrum analysis as linear analysis and pushover analysis and time history analysis as nonlinear analysis methods can be employed to study the seismic response. In this study, lateral deformation characteristics of a RC Intz type elevated water tank with a 1200m³ capacity was examined using model analysis and nonlinear pushover analysis with the help of a finite element model developed using MidasFea program. Natural periods of the tank were extracted from the model analysis. The first three natural periods were found to be 1.8 sec in translational mode, 0.44 sec in vertical mode, and 0.35 sec in local mode. The lateral load-deformation relation of the tank was obtained using pushover analysis of a three dimensional finite element model developed incorporating both large deformation and material nonlinearity. Material nonlinearity of concrete was simulated using total strain crack model, which has been developed based on the modified compression field theory proposed by Vecchio and Collins. And Von Mises plasticity model was employed to simulate steel material behavior. The concrete mass and embedded reinforcements were modeled using the solid elements and reinforcement bar elements respectively. A lateral displacement of 450 mm was applied incrementally at the top level of the stem of the tank and the total lateral load carried by the tank was monitored. The stresses on solid elements along the tank walls were checked at different levels of lateral displacements. The results showed that the steel bars are about to yield at displacement levels of around 100 mm and concrete crushing does not occur at this displacement level. When the displacement exceeds around 100 mm, nonlinear behavior could be clearly observed. The analyses were carried out until lateral displacement reached 450 mm. At this level, concrete crushing was observed and stresses exceeded yield stress of steel.

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