Optimal finite element modelling for modal analysis of liquid storage circular tanks

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Abstract:

Model analysis of liquid storage vertical tanks is a complex task due to fluid-structure-soil interaction. Analysis of tanks subjected to earthquake excitations using finite element modelling (FEM) has become a preferred technique. The FEM is validated by comparing its results with experimental and theoretical results in the literature. However, most finite element studies in literature do not provide enough details on the selection of the elements used. The objective of this study is to provide optimal FEM options of parameters such as element types and number of elements which best predict the tank dynamic characteristics, natural frequencies and principal mode shapes. Coupled natural frequencies in sloshing modes were obtained for various tank height-to-diameter ratios, various tank wall thicknesses and various liquid depths. The FEM predictions compared well with literature available experimental and numerical results. A set of FEM options of parameters is recommended for elastic and inelastic analysis of such tanks.