## SEISMIC BEHAVIOR OF TANKS CONSIDERING FLUID- STRUCTURE-SOIL INTERACTION

By

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#### ABSTRACT

Liquid storage tanks are essential structures in water, oil and gas industries, and their seismic safety is of great importance. There has been an increased attention focused on the seismic safety of lifeline structures such as liquid storage tanks in seismic regions in recent years. The failure of these critical structures during earthquakes can potentially lead to shortage of drinking water, difficulty in putting out fires, and substantial economic losses. Thus, the reliability of these structures against failure under seismic loads is of critical concern. Several tanks were damaged or collapsed during past earthquakes. Therefore, the seismic behavior of tanks should be known and understood, and they should be designed to be earthquake resistant.

The present research deals with the dynamic behaviour of tanks considering fluid-structure-soil interactionunder the effects of ground motion excitations. The finite element (FE) structural analysis program, ANSYS is selected to carry out the analysis.The finite element technique provides a powerful tool that helps in obtaining the tank response taking into account the fluid-structure-soilinteraction.

The thesis presents a literature review on the dynamic behaviour of liquid storage tanks.Different methods for modeling fluidstructure interaction (FSI) and soil structure interaction (SSI) were illustrated.The available element types to characterize fluid and tank wall in the commercial finite element program ANSYS are presented. Three different verification examples of liquid storage tanks are presented. Those verification examples include both 2D and 3D models of liquid storage tanks.Different finite element idealizations for the tank in fluid structure interaction problems were developed. A parametric analysis is performed to examine the effect of geometrical parameters (i.e., radius, height and thickness)on the dynamic chacteristics (natural frequencies, and mode shapes) of cylindrical tanks. Moreover, the numerical results are compared with those obtained from closed forms relations provided by several international seismic codes.

The research also investigates the simplified model of SSI, the effect of soil on dynamic characteristics of elevated tanks using modal analysis and seismic performance of elevated tanksconsidering fluid-structure-soil interaction (FSSI) under different ground motion using time history analysis. A database containing a total of 33 components of earthquake records from 13 earthquakes events is presented. The database is categorized according to the frequency content of each component into Low, Medium, and High frequency content. Four different subsoils are used to study the seismic behaviour of elevated tanksconsidering FSSI.

**Keywords:**Liquid storage tanks, Fluid structure interaction,Soil structure interaction, Seismic.