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Numerical Simulation of Fluid-Structure Interaction of LNG Prestressed Storage Tank under Seismic Influence

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Summary

Abstact: Aim of this paper is to simulate the fluid-structure interaction of liquefied natural gas (LNG) prestressed storage tank under seismic influence. The coupled Eulerian-Lagrangian (CEL) analysis technique is used to simulate the hydrodynamic interaction between LNG and the cylinder of LNG prestressed storage tank. The 3-D model of LNG has been dispersed by Eulerian mesh which is different from traditional added mass analysis method. Meanwhile, both of the 3-D models of prestressed rebar and concrete structure are dispersed by Lagrangian mesh. Following conclusions are obtained: 1) Natural frequency of the whole model has been obtained by using the Block Lanczos algorithm in Abaqus; 2) According to the local seismic fortification intensity, seismic waves of El centro and Taft have been selected for the time history analysis, and curves of displacement, stress and acceleration have been plotted under two seismic waves respectively. When El centro wave is imported, the maximum values of displacement and tension stress of concrete structure are 7.729mm and 2.16MPa, and when Taft wave is imported, the maximum values of displacement and tension stress of concrete structure are 9.4mm and 0.2MPa. 3) By comparing the time when the maximum displacement, stress and acceleration were occurred to the phenomenon of violent splash of LNG, numerical results can fit the splash phenomena of LNG very well, which is indicated that different from traditional added mass method, the analysis of fluid-structure interaction of LNG prestressed storage tank under seismic influence by using CEL analysis technology is available and reasonable.

Key Words:Fluid-Structure Interaction, CEL analysis, LNG Tank, Finite Element Method, ABAQUS