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MULTI-PHYSICS COUPLING METHOD AND APPLICATIONS OF FLUID-STRUCTURE INTERACTION ON LNG STORAGE TANKS

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ABSTRACT

The LNG is stored in specially engineered and constructed double-walled storage tanks which are essential for receiving and safe storage of the liquid gas. The 160000m^3 LNG (Liquefied Natural Gas) storage tank has 800mm thick post-tensioned concrete walls on the exterior and the inner tank is made of a special steel/nickel alloy to accommodate cold LNG. In this study, a finite element modeling method for fluid-structure interaction (FSI) is proposed and the multi-physics coupling method of the fluid and structure is used to investigate the aseismic behavior of the 160000m^3 LNG storage tanks. By using this modeling method of FSI, a finite element model for the tank is established mainly by the FLUID80 elements and SHELL181 elements based on software ANSYS. The characteristics of natural vibration for the LNG tank is obtained by taking the reduced method for modal analysis. The results show that there are generally three kinds of model types including convective mode, circular multi wave mode and impulsive mode. Several published experimental results have been used to verify the multi-physics coupling method and the results are almost identical with the computational results. As one of the applications of the FSI method, the dynamic responses of the LNG tank structures under seismic excitation can be obtained considering the influences of pile-soil interaction, liquid level of LNG, the site classification, direction and intensity of earthquake, and the leakage of LNG liquid. The results of research can provide a reference for the design and construction of LNG tank structures.

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