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EARTHQUAKE PROTECTION OF LIQUID STORAGE TANKS BY SLIDING ISOLATION BEARINGS

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Liquid storage tanks are critical components of industrial facilities since damage to such structures may cause spreading of hazardous material and environmental pollution. Tanks exhibit mainly two different seismic response patterns, one of which is the long-period movement due to sloshing of the liquid, the other is the impulsive and fluid structure interaction vibration at higher frequencies. Total base shear is induced from the combination of these two. The seismic base isolation aims to control the force from impulsive loading pattern as it has appreciable amount of contribution to the total base shear. Among various types, the curved surface sliding bearings (FPS) are commonly used in liquid tanks since the isolation period of the tank is independent of the tank weight (liquid height).

A number of researchers performed numerical analyses on the seismic analyis of conventionally constructed liquid storage tanks. Originally Housner G.W. (1963) developed a mathematical model in which the mass of the liquid portion that accelerates with the tank is called as the "impulsive" and the mass of the liquid portion that causes sloshing motion of the free surface near the tank roof is called as the "convective. Haroun M.A. (1983), modified Housner's model and took into account the flexibility of the tank wall in the seismic analysis.

In this paper a parametric analysis has been made to investigate the efficiency of FPS bearings in protecting storage tanks from earthquake ground motions. The numerical model is based on the Haroun and Housner's simplified lumped parameter model in which the sloshing and fluid-tank interactions are modeled by convective and impulsive masses, respectively. Effectiveness of the isolation system was investigated under a series of ground motions, isolation periods and tank aspect (slenderness) ratios. Results indicated that depending on the characteristics of the ground motion, the response of the isolated tank can be reduced in appreciable amount as compared to the fixed base case. On the other hand, some detrimental effects are also observed in lower isolation periods (T=2s) particularly in medium slender tanks under near fault ground motions. This undesirable situation is avoided by using higher isolation periods (Tb=3s) without much affecting the bearing displacements.

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