SEISMIC ANALYSIS OF CONCRETE RECTANGULAR CONTAINERS ISOLATED BY DIFFERENT ISOLATION SYSTEMS

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The liquid storage containers are one of the most important structures of the lifeline and industrials facilities in all over the world. These structures can be used as grounded, pneumatic and embedded containers. The grounded concrete tanks are widely used for the long-term storage of nuclear spent fuel assemblies. Hence, protection of these structures against severe seismic events has become crucial. Numerous studies have been done for the seismic analysis of fluid containers. Most of them are concerned with cylindrical or rectangular tanks with fixed-base. However there is only a documentary experimental study of isolated rectangular tanks by high damping rubber-bearing and it was rendered by Park et al. (2000).

This paper focuses on analyzing the results of seismic responses of flexible rectangular tanks isolated by three types of outstanding isolation systems. The considered systems are high damping rubber-bearing (HDRB), lead-rubber bearing (LRB) and friction pendulum bearing (FPB). In order to measure the effectiveness of the isolation system, the earthquake response of isolated tanks is also compared with non-isolated tanks. An equivalent mechanical model of rectangular tanks is used in this paper which contains three lumped masses known as: sloshing mass, impulsive mass and flexible mass. This model was shown in figure 1. The values of rigid, flexible and convective masses, stiffness and damping constants were have been extracted from the presented diagrams and equations in study of Hashemi et al. (2013). As an input motion in horizontal excitation the N-S component of the 1940 El Centro earthquake records is used.

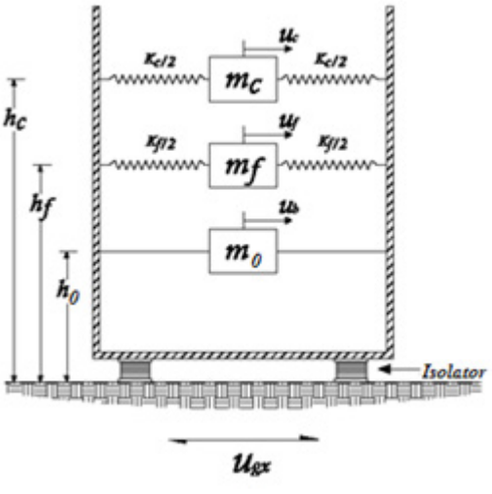

Figure 1. Equivalent mechanical model of base-isolated flexible rectangular containers

Consequently, from the trends of the results of this study the following conclusions may be drawn:

1- Seismic base isolation can be an efficient way to reduce seismic responses, such as base shear and hydrodynamic pressure, but an increase in displacements for all isolation systems in horizontally isolated tanks seems to be inevitable and this factor increase as the isolator becomes more flexible.

2- The seismic isolation systems found to have adverse effects on the sloshing height. This seismic response is amplified more by usage of elastomeric systems and is not greatly influenced due to sliding system.

3- The effectiveness of seismic isolation of the liquid storage containers increase with the increase of the flexibility of isolation systems.

4- There is an optimum value for the friction coefficient of FPS system at which the base shear response of the tank reaches its minimum value. For the specific tank and seismic excitation used in this study, this optimum value is determined to be about 0.04.

Eventually, a careful selection of isolators with a certain limit on the mechanical properties of isolators is required for the optimal seismic isolation design of rectangular containers.

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