EXPERIMENTAL EVALUATION OF CODE PROVISIONS FOR HYDRODYNAMIC WALL PRESSURE OF A RECTANGULAR STORAGE TANK

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ABSTRACT

One of the most important key factors in designing liquid storage tanks is the design of wall thickness to provide sufficient resistance and rigidity against critical loads. The hydrodynamic pressure on tank wall shells is considerable in determination of a tank wall thickness. The motivation for this study is to carry out a wall pressure comparison between experimental tests results and values suggested by the ACI-350 code. This comparison could lead to a better understanding of ACI code provisions. In this regard, a series of experimental tests are conducted using a rectangular liquid tank excited by different earthquake oscillations. The experimental results agree well with those calculated by the code in most cases. The reason of minor deviation in some cases will be discussed and justified.

INTRODUCTION

Liquid sloshing in tanks is one of the key issues of tank design.With continuous increase of tank volume due to the industry demand, liquid sloshing becomes more important in engineering.

Extensive analytical, numerical and experimental studies have been performed in the past decades. Early studies of sloshing focused on linear problems in two dimensional simple geometrical containers, which can be solved by analytical methods (Ibrahim RA, 2005). Linear potential-flow theory does not account for damping, so that the response near the lowest natural frequency is infinite, which is not consistent with the physical phenomenon *(*Zhijun Wei, 2012). Then based on potential-flow theory, nonlinear models with viscous damping were developed to describe the sloshing in both 2D and 3D containers well. Faltinsen (1974) developed third-order perturbation method to study 2D sloshing.

There are a number of numerical approaches for modeling the sloshing effects, too (e.g. Wu *et al.* 1998, Faltinsen and Rognebakke 2000). Kim *et al.* (2001, 2004) developed a numerical scheme based on the finite difference method and extended the investigation to geometries that are more complicated (e.g. three-dimensional prismatic tanks). The method concentrates on the global motion of sloshing flows, adopting the concept of a buffer zone (Fabrizio Pistani, 2012). Other numerical techniques that have been widely used for modeling the sloshing problems are known as Smoothed-Particle-Hydrodynamics (SPH) and consistent particle method (CPM). The SPH method has been applied to various free-surface problems, especially for