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Seismic isolation of elevated steel storage tanks by sliding concave bearings

Liquid steel storage tanks are strategic structures for industrial facilities and have been widely used both in nuclear and non-nuclear power plants. Typical damage to tanks occurred during past earthquakes such as cracking at the bottom plate, elastic or elastoplastic buckling of the tank wall, failure of the ground anchorage system and sloshing damage around the roof, etc. Due to their potential and substantial economic losses as well as environmental hazards, implementations of seismic isolation and energy dissipation systems have been recently extended to liquid storage tanks. Although the benefits of seismic isolation systems have been well known in reducing seismic demands of tanks; however, these benefits have been rarely investigated in literature in terms of reduction in the probability of failure. In this paper, a vulnerability-based design approach of a sliding concave bearing system for an existing elevated liquid steel storage tank is presented by evaluating the probability of exceeding specific limit states. Firstly, nonlinear time history analyses of a three dimensional stick model for the examined case study are performed using a set of ground motion records. Fragility curves of different failure modes of the tank are then obtained by the well-known cloud method. In the following, a seismic isolation system based on concave sliding bearings is proposed. The effectiveness of the isolation system in mitigating the seismic response of the tank is investigated by means of fragility curves. Finally, an optimization of design parameters for sliding concave bearings is determined based on the reduction of the tank vulnerability or the probability of failure.

Biography

Fabrizio Paolacci graduated in Civil Engineering in 1992 at the University of Rome "La Sapienza" and completed his PhD in Structural Engineering in 1997. He is currently working as an Assistant Professor in Structural Engineering at University Roma Tre, Department of Engineering. He gained a long standing experience in the management of research projects about experimental assessment of the seismic response of structures. He is currently PI of many European projects. From 2008 to 2013, he assumed the role of Scientific Coordinator of the Laboratory of Testing Materials and Structures of the Department of Structures of the University Roma Tre. He has received a Fellowship provided by CNR (National Research Council) for a research activity of six months at the Department of Civil and Environmental Engineering of University of California at Berkeley from September 1999 to February 2000 as a Visiting Scholar. He is author of more than 100 publications on international peer-reviewed journals and conferences.

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