

MMI Engineering has performed seismic assessments of over two thousand fluid storage tanks located in areas of moderate to high seismic activity. The materials of these tanks has ranged from reinforced concrete (circular and rectangular) to pre-stressed concrete, welded steel, bolted steel and polyethylene. Sizes have ranged from 1,000 gallons to as large 260 million gallons.

MMI has special expertise in seismic assessment and retrofit design of fluid storage tanks. We have an in-depth understanding of the dynamic behaviour of water storage reservoirs and have served on codes and standards committees for tanks. We have also documented the performance of tanks in past earthquakes and created an extensive database of the results, which was published in the National Institute of Standards and Technology (NIST) publication "Reliability and Restoration of Water Supply Systems for Fire Suppression and Drinking Following Earthquakes". The publication was authored by Mr. Don Ballantyne, a Senior Consultant at MMI, with contributions from Mr. Ahmed Nisar and Mr. Paul Summers (also of MMI). Mr. Nisar and Mr. Summers also contributed to the American Society of Civil Engineers (ASCE) publication on seismic design and evaluation of petrochemical facilities. Mr. Summers authored the chapter on seismic assessment of fluid storage tanks, which included detailed descriptions of typical tank assessment methodologies, such as the API 650 Appendix E (similar to the AWWA D100 and D110) methods as well as alternative methodologies, such as the Modified Manos approach for the assessment of existing steel tanks. MMI has used nonlinear dynamic analysis techniques to study the behaviour of unanchored tanks and have used such techniques to capture the highly nonlinear elephant foot buckling behaviour of steel shell and in-plane membrane action of base plate.

Some of our major U.S projects include:

- Hundreds of tanks for the Chevron Richmond refinery
- 17 steel storage tanks (up to 18MG) for the Sonoma County Water Agency
- 42 tanks (steel and concrete) located throughout California for the Southern California Water Company
- 14 (steel and concrete) tanks and reservoirs for the City of Salem, Oregon (up to 10MG)
- 16 steel tanks for the Marin Municipal Water District (up to 3MG)
- 46 steel and concrete tanks and reservoirs (circular steel and concrete, rectangular concrete and two large reservoirs of over 200MG) for the City of Makkah, Saudi Arabia
- Multiple steel and concrete tanks located in close proximity of the Hayward fault for the City of Hayward

