Metamaterial concepts and Multiple-tuned mass dampers for effective seismic isolation

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Total time: 4h:00m

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Abstract

This mini-course shows the concept of locally resonant materials that are able to attenuating seismic waves at wave lengths much greater than the dimensions of their unit cells. Based on this concept, we propose the so called finite locally resonant metafoundation (FLRM) lattice able to protect fuel storage tanks subjected to seismic records. The design and optimization procedure of the coupled system foundation and tank is described for both slender and broad tanks. Then, we consider the randomness of the seismic response modeling the earthquake as a filtered Gaussian white noise process and take into account the influence of the soil filter on the structural response of the coupled system. Finally, the effectiveness of the optimized coupled system is evaluated although time history analysis considering sets of natural accelerograms corresponding to Operating Basis and Safe Shutdown Earthquake in a very active earthquake-prone zone. The mini-course consists of 4 hours dedicated to both theory and applications.

Lecture Plan

1. Background and motivation. Scope (0h:10 m)
2. Tuned mass damper and seismic isolation concepts (00:20 m)
3. Metamaterials concepts and negativity (00:30m)
4. Fuel storage tank modelling, metafoundations and coupled dynamic systems (00:20 m)
5. Frequency optimization procedures and performance indices (00:10m)
6. Random vibrations and hazard modeling (00:15m)
7. Applications to slender and broad tanks (00:15m)