

Dynamic Analysis of a Roller Compacted Concrete Dam

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Abstract

The U.S. Army Engineer Research and Development Center (ERDC) is currently exploring the use of infrasound sensors to monitor the health of structures of interest. Infrasound is acoustic energy below 20 Hz and is capable of propagating many kilometers from the source with little attenuation. One type of infrasound source is large infrastructure, such as dams, bridges, and buildings, emit such signals at their natural or driven frequencies of vibration, providing an indication of their structural condition.

Field investigations have been completed at the Portugues Dam in Ponce, Puerto Rico. This dam is the first single-centered, roller compacted concrete (RCC), thick arch dam constructed by the U.S. Army Corps of Engineers. A cold-gas-thruster (CGT) was used to induce broadband, transient behavior in the dam-foundation-reservoir system.

Measurements included accelerations along the crest, at varying elevations on the downstream face, along the dam-foundation interface. Infrasound array responses were collected at remote locations 0.2 km, 1 km and 6 km from the dam. The tests completed at Portugues Dam were the first ever performed on a RCC dam, and present a unique opportunity for assessing an infrasound array's ability to capture information at remote locations that infer (pre and post event) structural response characteristics.

A finite element (FE) model was developed for the dam. This model was used to investigate the eigenfrequencies of the dam under the CGT loadings. The output of the vibrational response was used as an input to an acoustic finite element (FE) model to determine which vibrational modes radiated infrasound. The results showed that the acoustic power radiated from the dam intensified with increasing of the CGT loading. Results from COMSOL Multiphysics analyses agree with the field experimental data.

Figures used in the abstract

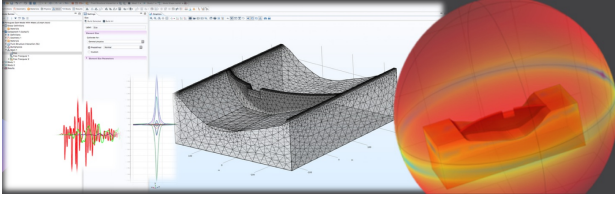


Figure 1: Portugues Dam acoustic model