Infrasound Assessment of the Roller Compacted Concrete Dam: Case Study of the Portugues Dam in Ponce, PR

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Abstract

The U.S. Army Corps of Engineers is currently investigating the use of infrasound sensors to monitor the health of structures of interest. Infrasound is low-frequency (2-20 Hz) acoustic energy and is capable of propagating many kilometers from the source structure. Mature infrastructure requires frequent inspections to assess their structural integrity. However, the large amount of existing infrastructure, and the distance between these structures present significant challenges to inspectors. Acoustics-based technologies represent a simple, and relatively inexpensive, technique to monitor the integrity of a structure. To develop these techniques, designers must understand the frequencies and sound pressure levels that develop from a typical dam structure. Large infrastructure, such as dams, bridges, and buildings emit such signals at their natural or driven frequencies of vibration, providing an indication of the 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 Corps in the United States. A cold-gas-thruster (CGT) was used to induce broadband, transient behavior in the dam-foundation-reservoir system. A dynamic analysis of the RCC dam was conducted in COMSOL Multiphysics® software to calculate the eigenfrequencies of the dam and to study the mode shapes of the dam.

Measurements included accelerations along the crest, at varying elevations on the downstream face, along the dam-foundation interface, and on the adjacent foundation. Infrasound array responses were collected at remote locations near and away from the dam. The tests completed at Portugues Dam were the first ever performed on a RCC dam, and present a unique opportunity for evaluating an infrasound array's ability to capture information at remote locations that infer (pre and after event) structural response characteristics. Results from COMSOL Multiphysics analysis agree with the field experimental data. The responses measured from these tests contain both broadband (accelerations approaching 1kHz) and low frequency (infrasound to 20Hz) behavior that will be used to identify common characteristics.

Reference

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