THRU-DAM SEISMIC TOMOGRAPHY: LEVERAGING GEOPHYSICAL TECHNIQUES FOR CONDITION ASSESSMENT OF A THIN ARCH CONCRETE DAM

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Halligan Dam is a 112-year-old 70 foot tall concrete thin-arch dam located 25 miles northwest of Fort Collins, Colorado. The Halligan Water Supply Project by the City of Fort Collins proposes to expand the dam height by 25 feet to expand the potential storage of Halligan Reservoir by 8,100 acre-feet. As part of the design process for the dam expansion, condition assessment of the existing dam was performed. In addition to traditional coring and sampling techniques, a method was developed that could provide insight into the internal condition of the dam that would bridge the gap between point sampling methods. Crosshole Seismic Tomography (CST) is a seismic geophysical method used to image the distribution of seismic compressional-wave velocity (Vp) of geologic material between two parallel or sub-parallel boreholes. This method was adapted to image the Vp distribution of Halligan Dam using the upstream and downstream faces of the dam itself as analogs to the boreholes in the CST method. Using rope-access techniques, sensor arrays (comprised of both hydrophones and geophones) were installed on the upstream face, and hammer-impact sourcing was performed along the downstream face. This "Through-Dam Seismic Tomography" (TDST) technique was performed at three regularly spaced intervals along the length of Halligan Dam. Tomographic sections through the dam structure were computed using the Vp travel times recorded for all active source-receiver pairs for each source location. Results successfully show Vp trends and variations within the imaged sections of the dam. These measurements, alongside traditional concrete coring, provide key information for dam assessment and expansion design.