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Role of Hydrodynamic Forces on the Seismic Response of a Dam

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Abstract

The static and seismic response of dams is always a serious concern in the design and construction phases of these massive manmade structures. The gravitational stability of these structures is continually challenged by various forces acting on the dam structure, including the upstream water. But the role of hydrodynamic forces on the seismic response of dams is not been much studied in the past. Moreover, the hydrodynamic forces vary with the depth and shape of a dam, leading to an underestimation of its effect on the seismic response of a dam. This paper studies the seismic response of a concrete gravity dam using finite element analysis, considering the hydrodynamic effects. The hydrodynamic impact on the dam structure is simulated using two methods, the inertial mass concept and water as a structure. Three natural seismic motions, Koyna, Kobe and Chi-Chi, are used to study the influence of seismic motions on the hydrodynamic effects on the dam. The study shows that the hydrodynamic forces contribute to stresses on the dam structure in seismic activity, and the hydrodynamic forces acting on the dam are proportional to the shaking intensity. Moreover, the study also reveals the underestimation of hydrodynamic forces in the inertial mass approach with the help of modelling water as a continuum.

Keywords: Concrete dams, Seismic response, Hydrodynamic forces, Inertial mass concept, Finite element modelling