ABSTRACT

The assessment of response of an aged concrete dam is important for the prediction of its behavior during earthquakes, so that remedial measures can be taken at the right time to withstand future earthquakes. The assessment is necessary, as the analyses procedures may become obsolete and the state of the art may change since the time of construction and the structural material may deteriorate due to harsh environmental conditions. At the same time, the sediment will be accumulated at the reservoir bottom on the upstream side of the dam. The decision of retrofitting or strengthening the aged dam necessitates accurate analysis of the same in the presence of accumulated sediment. In the present work, an approach to include the time dependent degradation of concrete owing to environmental factors and mechanical loading in terms of isotropic degradation index is developed. The absorption of pressure waves at the bottom of the reservoir due to the presence of sediments has been incorporated in the hydrodynamic pressure equation. Both the aged dam and the infinite reservoir with sediments are modeled and analyzed by finite element technique. A novel far-boundary condition is developed which can be truncated at a relatively closer distance away from the dam face for the finite element analysis of infinite reservoir. Both the aged dam and absorptive reservoir are analyzed separately with the interaction effects at the dam-reservoir interface enforced by an iterative scheme, in which both the pressure in the reservoir and displacement in the dam are converged simultaneously. The dynamic response of an aged concrete dam in the presence of sediment layers in the reservoir is studied. The encouraging outcome of the present investigation reveals the advantages of the proposed truncation boundary condition for the infinite reservoir domain and the iterative scheme for the solution of the coupled aged dam-reservoir system.

KEYWORDS:

Concrete Gravity Dam, Degradation, Truncation boundary condition, Dam-reservoir interaction, Infinite reservoir, Hydrodynamic pressure, Reservoir bottom absorption, Finite element method, Iterative scheme