

ABSTRACT

Dams are essential infrastructures for water storage, flood control, irrigation, and hydropower generation, among other purposes. The substantial dimensions of dams and the massive volume of water stored in their reservoirs necessitate that these structures be capable of safely withstanding powerful earthquakes, as their failure could lead to disastrous consequences. A concrete gravity dam is a solid structure that resists the external loads through its weight. This dissertation aims to evaluate the seismic performance of an existing concrete gravity dam by performing pseudo-static and response spectrum analyses using 3-D finite element method. The Idamalayar dam in Kerala was selected as the case study for this investigation. A detailed 3-D finite element analysis was conducted using the engineering simulation software MIDAS GTS NX in static and dynamic conditions. Two types of analyses were performed: (i) pseudo-static analysis with the dam fixed at base, (ii) response spectrum analysis considering both a fixed base and a dam resting on a massless foundation.

A typical non-overflow block, comprising elevator shaft, inspection gallery and foundation gallery, is modelled. The dam block and the rock foundation below are modelled using solid elements. The massless foundation model is used to represent the stiffness properties of the rock foundation, but ignoring the wave propagation and soil-structure interaction effects. The hydrodynamic effect due to reservoir water is considered by applying added mass on the face of the dam body. Dynamic analysis is performed using the response spectrum provided in IS 1983-2016. Different loads and load combinations are considered as given in IS 6512-2019 and IS 1893. The seismic performance of the dam is assessed based on safety criteria and permissible stress limits as specified in IS 6512 and NCSDP Guidelines, respectively.