

Cracking development prediction in concrete gravity dams considering the effect of reservoir and foundation

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Abstract

Dams are often subjected to earthquakes due to their localization in seismic zones. So, their behavior must be studied carefully. dynamic analysis of a concrete gravity dam is a complex problem since The response of a dam subjected to dynamic loading is a combined effect of the interaction among dam, reservoir and foundation systems. The study is conducted using a non-linear analysis for finite element model. The profile of the Koyna dam has been adopted for the study of this investigation. Nonlinear concrete properties have been taken into account through concrete damaged plasticity model to simulate the damage induced in the dam body under a real-time earthquake motion. The study indicates that tensile damage and stiffness degradation of the dam structure occurred during the earthquake motion.

Key words: concrete gravity dam, crack prediction, effect of reservoir and foundation, damage plasticity model, concrete fracture mechanic, koyna dam, koyna earthquake

1. Introduction

It is known that many concrete structures, for instance concrete gravity dams, are placed in seismic zones. Engineers should guarantee the good performance of concrete gravity dams along its service life, because the failure of this kind of structures could have catastrophic consequences for human life. For that reason, it should be check if they can resist dynamic loads typically associated with earthquake occurrences. The Koyna hydro-electric project is situated in Maharashtra, India, approximately 200 km from Mumbai, Fig 1. This project primarily predicts generation of power, with some irrigation on the banks of river Krishna. the Koyna dam, was subjected to an earthquake of magnitude 6.5 on the Richter scale on December 11, 1967.

In order to define the damage configuration in the dam, which allows identifying the possible cracks formation zones, nonlinear models simulating crack propagation within the dam body need to be employed. The nonlinear material behavior of concrete can be