Journal of Civil Engineering and Materials Application
Journal home page: http://journals.rpp.co.ir/jcema

Received: Received: 24 June 2018 • Accepted: 19 October 2018

Research

doi: 10.xxxxx/J.JCEMA.12020404

Evaluation of Seismic Performance of Concrete Gravity Dams Under Soil-structure-reservoir Interaction Exposed to Vertical Component of Near-field Earthquakes During Impounding (Case study: Pine Flat Dam)

Farzad Naseri[1], Ahad Bagherzadeh Khalkhali[2*]

[1] Department of Civil engineering, Islamic Azad University-Electronic Branch, Tehran, Iran

[2] Department of Civil Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran

*Correspondence should be addressed to Ahad Bagherzadeh Khalkhali, Department of Civil Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran; Tell: +989121023519; Fax: +9888944857; Email: A-bagherzadeh@srbiau.ac.ir.

ABSTRACT

Given the current water crisis in the world and the fact that dams are superstructures for water conservation in agricultural and domestic uses, the seismic performance of Pine Flat Dam is evaluated under the soil-structure-reservoir interaction exposed to vertical component of near-field earthquakes in this study. Hence the dam is modeled in the plane strain space under the foundation-structure-fluid interaction using Abaqus finite element software in order to consider the effects of foundation flexibility and hydrodynamic forces. The reservoir is modeled in 3 full, half-full and empty conditions and the results are assessed and presented for each condition. The results of analysis show that when the dam is in use and the entire volume of reservoir is filled with water and the conditions of near-field earthquakes are predominated, more displacement is applied to the dam, which may make it enter the nonlinear region.

Key words: Water crisis, Concrete dam, Effect of vertical component, Soil-structure-reservoir interaction, Near-field fault.

Journal of Civil Engineering and Materials Application is published by *Raika Pajuhesh Pars*; Journal p-ISSN xxxx-xxxx; Journal e-ISSN 2588-2880.

1. INTRODUCTION

Water supply has been always in the forefront of human's mind as the most crucial need for living (1). Today this need has also appeared in the policies of different nations around the world, so that geopolitical experts predict many wars to achieve water supplies (2). Meanwhile, the Middle East is one of the main centers of the crisis, facing a severe water scarcity (3). Moreover, dams are among the most important structures in today's industrial life, which are constructed for a variety of purposes, e.g. hydroelectric power generation, water storage for agricultural and industrial uses, flood control and drinking water supply. According to the reports of Iranian Bulletin of Water Research, the average annual rainfall is about 252 mm in Iran, which equals about one-fourth of the average rainfall in the world and one-third of the average rainfall in Asia. Therefore, Iran is known as a dry region in the world. On the other hand, Iran is one of the countries exposed to numerous severe earthquakes. Since most dams are constructed in high seismic risk areas in Iran, it is of particular importance to achieve adequate safety of dams against earthquakes (4). Numerous studies were carried out for seismic assessment of the dams under a variety of accelerograms. The occurrence, type and direction of seismic waves and frequency content are all factors which play an essential role in the dynamic response of dams (5-9). In the studies, different mechanisms were considered for support conditions and its impact on seismic performance of concrete dams; the main incompetence of these models was due to the dramatic difference between the motions in lower soil layers and the reality (10). In a modeling in China, the allowable stress under seismic stimulation and elastic modulus were increased by 30% for a damping ratio of 0.05 and it was concluded that the foundation flexibility changes the motion frequencies and dam-foundation movement modes (11). The dynamic analysis of dam and reservoir was conducted considering the