Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 1, No. 2, December, 2015

Seismic Assessment of Arch Dams Using Fragility Curves

Vandad Kadkhodayan[a], S. Meisam Aghajanzadeh[b], and Hasan Mirzabozorg[c*]

[a]*Msc Graduated student, Civil Engineering Department, K.N. Toosi University of Technology, Tehran, Iran*

[b]*PHD Candidate, Civil bEngineering Department, K.N. Toosi University of Technology, Tehran, Iran*

[c]*Associate Professor, Civil Engineering Department, K.N. Toosi University of Technology, Tehran, Iran*

Received 25 November 2015; Accepted 22 December 2015

Abstract

In the present paper, the IDA approach is applied to analyzing a thin high arch dam. The parameters of Sa, PGA and PGV are used as intensity measure (IM) and the overstressed area (OSA) is utilized as engineering demand parameter (EDP) and then, three limit states are assigned to the considered structure using the IDA curves. Subsequently, fragility curves are calculated and it is showed that the PGA is a better parameter to be taken as IM. In addition, it is found that the utilizing the proposed methodology, quantifying the qualitative limit states is probable. At last, having the fragility curves and considering their slope in addition to the other routine data which can be extracted from these curves, one may be able to conclude that in what performance level the considered dam body seems to be weak and needs retrofitting works.

Keywords: Arch Dam, Fragility Curve, IDA Approach, Overstressed Area;

1. Introduction

Arch dams as mega structures are built to store water for various purposes like as irrigation, flood control, recreation and development of nations. If these structures fail to tolerate imposed loading, drastic human and financial losses are caused due to release of their reservoir large amount of water. Therefore, it can be deduced seismic assessment of such structures is a major challenge. There are various approaches to show safety plus practicality of arch dams.

One of the recent known methods is forming fragility curves. In general, a fragility curve indicates the corresponding performance against any random variable; whether be the ground motion acceleration or the dam water level.

Several researchers have investigated seismic performance of structures by fragility curves. Rota et al. (2010) proposed an approach to derive fragility curves for masonry buildings. They obtained analytical fragility curves for masonry buildings from some detailed series of 3D nonlinear dynamic analyses of these structures [1]. Shinozuka et al.(2001) expressed fragility curves in analytical method for Memphis bridges considering new criteria for steel yielding and concrete strength [2]. Kim and Shinozuka (2003) and Padgett and Roches (2008) surveyed the effect of retrofitting on concrete columns of bridges by fragility curves [3, 4]. Iichii (2003) developed the fragility curves for offshore walls to study their seismic performance [5]. Karim and Yamazaki (2007) developed the fragility curves for studying the effect of using base isolation to improve the behavior of columns under seismic loading [6].

Some researchers have investigated on the seismic performance of concrete dams. Ellingwood and Tekie (2001) presented quantitative methods to evaluate failure probabilities of Bluestone concrete gravity dam. In their study, several stages (limit states) of the dam behavior were investigated under progressively increasing levels of the flood [7]. In addition, Tekie and Ellingwood (2003) developed fragilities of Bluestone concrete gravity dam to evaluate its performance under seismic loading. Based on their study, sliding the dam-foundation interface and simultaneously

* Corresponding author: mirzabozorg@kntu.ac.ir