DYNAMIC ANALYSIS OF LINEAR VIBRATIONS OF THE RUBBER DAM USING "ANSYS"

Ehsan Safaei[1], Mahmoud Shafaei-Bejestan[2]
1- Department of Design, Pars Mokhtasat Design Engineering Company (PMDEC), Shiraz, Iran
2- Department of Water Structures, Shahid Chamran University (SCU), Ahwaz, Iran

ehsan_safaei2006@yahoo.com
m_shafai@yahoo.com

Abstract

Dynamic characteristics of a rubber dam, such as vibration frequencies and the corresponding mode shapes are computed by using finite element software produced by ANSYS, Inc. A three-dimensional model is utilized to compute the vibration modes and the frequencies of a double-anchor rubber dam by ANSYS software both in presence and the absence of external water and the results are compared with other results which were obtained previously. Natural frequencies of the vibrations of a single-anchor rubber dams in the cases without external pressure, with external water pressure and with parallel flow pressure are considered. A computer simulated model of these structures is analyzed and then the effect of the internal pressure, external water head and parallel flow velocity on the vibrations of the rubber dam is studied the results are compared with the case that the dam is not impounding water and finally after comparing these results with the previous analytical and numerical results, the reasons of some little differences have been expressed.

Keywords: rubber dam, vibration, frequency, mode shape, external parallel flow.

1. INTRODUCTION

Rubber dams are cylindrical membrane structures which are attached to a rigid foundation along two of their generators and are inflated with water, air, or a combination of water and air (Zhang *et al*, 2002). They are basically simple and portable barriers made of rubberized material and are used for various purposes such as irrigation, control flood, tidal defense, water supply and recreational purposes (Chanson, 1997). This type of structure is considered as more economical compared with the rigid type of control structures constructed from concrete, masonry and steel (Tam, 1998). Some studies of their cross-sectional static profiles have been carried out in the past, both for cases when the dam impounds water and when overflow occurs (Wu and Plaut, 1996). After obtaining the equilibrium configurations, Small vibrations have been observed on actual dams and on the physical models about this configuration (Mysore *et al*., 1997; Ergin *et al*., 2002 and Plaut and Cotton, 2005). To analyze the static and dynamic behaviors of such structure, using the numerical methods such as finite element method and handling the computer analysis procedures based on these methods is enough suitable (Mackerle, 2000). ANSYS uses Newton-Raphson's method as a numerical technique for solving the nonlinear equilibrium equations. The basic idea is to reduce the set of nonlinear equations into a set of linear equations to solve equilibrium equations at small increments, the size of which depends on nonlinearity of the problem (Mackerle, 2000). In present study, the finite element package ANSYS is used to perform dynamic analysis of the linear vibration of these dams when impounding hydrostatic and parallel flowing water and without external water.

From viewpoint of anchored system, rubber dams are categorized to single-anchor rubber dams and double-anchor rubber dams (Dakshina Moorthy *et al.*, 1995). Although most recently-built rubber dams utilize the single-anchor system which have fin at two attached ends of rubber sheets to facilitate smooth overflow (Chanson, 1997), but for the dams with high height due to more stability of double-anchor rubber dams against different loads, in this paper in addition to studying the effect of various parameters in dynamic nonlinear behaviors of a single-anchor dam in various conditions the results which are obtained from analyzing a computer model of double-anchor dam are presented and compared with the research of Dakshina Moorthy *et al.* (1995) and the reasons of the percentage changes of the results in two compared research have been mentioned but because of the little difference between results due to increasing accuracy