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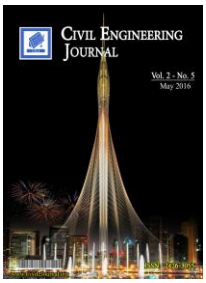

Effect of Foundation Nonlinearity on Seismic Response of an Existing Arch Dam

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Abstract

In the present paper, the effect of foundation nonlinearity on the seismic response of an existing arch dam is investigated. Luzzone arch dam in Switzerland is selected as a case study. The foundation nonlinearity is originated from opening/slipping of joints between a potential wedge at the left abutment and remaining foundation. Reservoir's water is assumed compressible and the coupled system is solved simultaneously. Also, the foundation is assumed massed medium via viscous boundary on the far-end truncated boundary. Two cases are considered in the analyses; the system applying reservoir pressure on the foundation; the system with no reservoir pressure applied on the foundation. The results reveal that the ignoring reservoir pressure on the foundation overestimates the response of the dam body. Finally, based on the conducted analyses, considering foundation nonlinearity has no significant effect on the results in the considered case due to special design of the body shape.

Keywords: Concrete Arch Dam; Foundation Nonlinearity; Massed Foundation; Seismic Analyses.

1. Introduction

The landslide sustained by some dam abutments i.e., Malpasset Dam in France and Vajont dam in Italy, altogether have attracted considerable research interest in the stability analysis of arch dams over past fifty years [1-4]. The safety evaluation of an arch dam should identify all factors in analyses to ensure that the structural stability of the dam is sustained. The stability of a concrete arch dam is strongly dependent on foundation and abutments on which the dam rests. In this regard, the stability against wedge sliding of arch dam-foundation has been subject of many researches. In 1965, Londe [5] proposed a fast approach to evaluate stability of rock wedges under thrust and uplift forces in dams. In 1999, Boyer and Ferguson [6] studied important factors to be considered in evaluating sliding stability of rock foundations for dams. Noble and Nuss [7] studied nonlinear seismic behaviour of Morrow Point dam considering a left abutment wedge. Their results revealed that the contraction joint openings are more severe when the wedge is not restricted or tied to the dam or foundation. At the same time, She [8] carried out numerical analysis of deformation and stability as well as effectiveness of the reinforcement at the right abutment of an arch dam. The results showed that the abutment might slide along the intersection of a fault. In 2005, Yu et al. [9] evaluated stabilities of sliding blocks on the abutments of a gravity arch dam by incorporating the results of finite element method analyses.

Some researchers have examined seismic responses of arch dams including rock wedges on the abutments by different approaches. Wang and Li [10] considered seismic responses of a high arch dam by experimental model. The system included the arch dam, contraction joints, and some parts of a reservoir, partial foundation and potential rock wedges on the abutments in which the mechanical properties including uplift on the kinematic planes were carefully simulated. In 2008, Mills-Bria et al. [11] investigated seismic nonlinear analyses of arch dams considering potential

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