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SEISMIC EVALUATION OF AN EARTH DAM

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Abstract

In this paper dynamic analysis of Golestan earth dam considering dam-foundation interaction under normalized Manjil and Elcentro earthquakes, as input motions, are discussed. In order to assess the effect of foundation on dam response, two models of the dam with and without foundation are analyzed by Plaxis, a finite element package for solving geotechnical problems. Results indicate that the seismic response of dam-foundation coupled model is considerably different from that of the uncoupled model.

Keywords: Earthquake, earth dam, seismic evaluation

1. INTRODUCTION

The behavior of embankment dams, as one of the most important structures, under earthquake loading has attracted the attention of many researchers and dam designers. In the last decade, improvements in the different numerical methods have resulted in widespread use of these methods to study dynamic behavior of earth dams; and using dam-foundation coupled model has revealed various aspects of dam response to seismic shaking [1,2].

In simplified dynamic analyses of structures, it is normally assumed that the structure is fixed at the ground level and subjected to a base motion. The base motion represents the ground motion anticipated at the proposed site and is influenced by the nature and extent of the soil deposit at the site. In addition, the presence of the structure could also influence this base motion. This mutual influence of the structure and the foundation on their responses is commonly referred to as soil-structure interaction. When the response at the base of the structure is essentially identical to that with no structure present, there is no interaction between the soil and the structure. On the other hand, when the response at the base is significantly different for the two cases, strong interaction exists between the soil and the structure. For cases where the interaction is strong, the soil and structure systems should be analysed together using a coupled system. For cases where the interaction is insignificant, the soil and structure systems can be uncoupled and each analysed separately [3].

Earth dams on flexible foundations represent such a soil-structure system [3].

Very little work has been done regarding the seismic response of dams on flexible foundations. Most of the research has been directed toward the analysis of dams on rigid foundations.[3], [4], [5], [6], [7], [8], [9], [10]. Ambraseys [11] extended previous work for dams on rigid foundations to dams on flexible foundations, but did not discuss the aspects of interaction. Chopra and Perumalswami [12] presented an analysis for dams on a semi-infinite medium subject to periodic excitations. Their studies covered both damping and the ratio of the elastic modulus of foundation soils to elastic modulus of the dam as they affect interaction. Wilson [13] utilized the finite element method to study the seismic response of an earth dam on a flexible foundation. The cases he presented indicated a high degree of interaction. Finn and Khanas [14] also evaluated the response of an earth dam on a flexible foundation using the finite element method of analysis. Their results indicated strong dependence of the response on the ratio of the fundamental periods of the dam and the foundation layer. Finn and Reimerg [15] considered the interaction problem between the dam and the underlying foundation layer. They analysed both the coupled and the uncoupled dam-foundation systems and showed significant differences in the response depending on the period of the systems compared to the fundamental period of the base input motion. Seed et al. [16] showed that the interaction effects cannot be uniquely related to either the ratio of the period of the dam to the period of the foundation layer, or to the material properties of the dam and foundation layer. However, for the limited number of cases investigated,