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Seismic analysis of dam under different upstream water levels

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Abstract. The present paper describes the results of numerical modeling of a dam founded on loose liquefiable deposit using PLAXIS-3D finite element software. Effect of a different dam water level on parameters like displacements, Excess Pore water pressures, Liquefaction potential and Accelerations is studied. El- Centro earthquake motion is applied as input earthquake motion. The results of this study show that different upstream dam water level greatly affects the displacements, excess pore pressure and displacement tendency of the underlying foundation soils and the dam.

Keywords: seismic analysis; earthen dam; excess pore pressure; acceleration; displacements

1. Introduction

Damage or failure of structures such as highway/railway embankments, river dikes, and earth dams has been reported around the world during various earthquakes. When the foundation soils liquefied, damage to embankments have been particularly destructive (Yamada 1966, McCulloch and Bonilla 1967, Adalier and Aydingun 2000), resulting in cracking, settlement, lateral spreading, and slumping of the embankments. The recent 1995-Kobe earthquake emphasized the importance of foundation liquefaction as a potential source of destruction to earth embankments. Such earthquake liquefaction vulnerability necessitates the development of appropriate remediation countermeasures (Marcuson *et al*. 1996, Adalier *et al*. 1998). Applying finite element method, Latha *et al*. (2009) simulated the behavior of strip footings resting on sand beds, with different density of soil, reinforced with geocells of different dimensions. Taiebat *et al*. (2007) worked on numerical analyses of liquefiable sand using critical state two-surface plasticity model and densification model for bounded soil domain. Dewoolkar *et al*. (2009) discussed seismic effects on retaining walls with liquefiable backfills using coupled approach. Sarkar and Maheshwari (2012) discussed the response of geogrid sheet, geosynthetic fiber, and natural coir fiber on liquefaction resistance of Solani sand. Taiyab *et al*. (2014) demonstrated the efficiency of a mitigation technique to prevent damage to quay walls, which involves densification of loose sand around the toe. In this paper, the seismic effect on dam is studied when different water levels exist on its

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lower on the upstream side for higher water level. Thus vertical and lateral displacements follow opposite trends. The highest foundation excess pore pressures on downstream side are also observed when the dam water level is high. On the upstream side high dam water level inhibits the development of Excess Pore water pressures. The strongest and weakest embankment acceleration responses (relative to base excitation) were observed in the compaction. Parameters of base input motion such as maximum acceleration and time duration has significant impact on the response.

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