Effect of Near- Field Ground Motions on the Stability of Embankment Dams

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In the past two decades, near-field problems became an important topic for civil engineers. The two characteristics of near-field ground motions, i.e., the forward directivity effect and permanent displacement effect, result in long period and large velocity pulse in the velocity time history and large step pulse in the displacement time history. As a result, many aspects related to civil engineering will be influenced by changes of the type of load in the near-field ground motions. Some effects of near- field ground motions on buildings and bridges have been studied and considered in few building design codes but there is not any fundamental study in this regard for embankment dams. In this paper, the "Masjed Soleyman embankment dam" with height of 177.0 m and 3km far from the "Andica fault" is chosen for investigation of effects of near and far-field time histories on embankment dams. For this propose a numerical method is chosen and several near- field and far-field time histories are applied for carrying out nonlinear analysis. The results indicate to the influence of near- field ground motions on stability of embankment dams that create larger permanent displacement and decrease slope satiability safety factor than far-field ground motions and can affect on excess pore pressure. So, it should be considered in analyses and designs of embankment dams.

Key words: near-field; far-field; characteristics of ground motions; embankment dams

1-Introductions

The characteristics of near-field ground motions and their influences on civil structures became a problem which was considered and worried by lots of researchers for a long time. In the recent years some famous earthquakes, provide unprecedented research opportunities to advance the state of knowledge about near-field problems

Far-fault ground motions have been observed as differing dramatically from their near-field counterparts recorded within a few kilometers of the fault rupture plane. The response of structures to near-field ground motions can be categorized into two distinct displacement history patterns that depend on the rupture process and corresponding directivity effect. When the rupture propagates forward toward the site, and the direction of slip on the fault is aligned with the site, ground motions oriented in this forward directivity path may follow certain radiation patterns and generate long-period, short duration, and large-amplitude pulses (Somerville 1998). Forward directivity occurs where the fault rupture propagates with a velocity close to the shear-wave velocity. Displacement associated with such a shear-wave velocity is largest in the fault-normal direction for strike-slip faults. Records may also exhibit backward directivity, yet they are typically less severe, and do not have distinctive velocity pulses (Somerville et al. 1997).On the other hand, a unidirectional large-amplitude velocity pulse and a monotonic step in the displacement time history generally characterize fling step, being a result of the evolution of residual ground displacement due to tectonic deformation associated with rupture mechanism. Fling step occurs in the direction of fault slip and therefore is not strongly coupled with the forward directivity (Abrahamson 2001). It arises in strike-slip faults in the strike parallel direction as in the Kocaeli and Duzce earthquakes (Kalkan et al. 2004), or in the strike-normal direction for dip-slips faults as in the Chi- Chi earthquake (Mavroeidis and Papageorgiou 2003).Large displacements (permanent ground deformations in the case of fling motion) would be of little consequence if they happen slowly, unless a structure straddled the fault (Hall et al. 1995). However, the duration of these displacements is closely related to the characteristic slip time of