8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

THE EFFECTS OF SUBSURFACE HOLES ON DYNAMIC RESPONSES OF EARTH DAM (CASE STUDY: TANG-E SORKH EARTH DAM)

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Keywords: Site effect, Sinkhole, Tang-e Sorkh, Dam, Karst

INTRODUCTION

Ground motions resultant to an earthquake response are the seismic source, the wave travelling path, the site conditions and the rupture process. The characteristics of soil layers in the vicinity of an active fault significantly effect on site response. It is different in soil specification, dip and strike of slopes, fault characteristics and near-field or far-field earthquake condition. The earth dam founded on the soft soil deposit respond has different behavior if supported on a stiff rock (Bertero et al., 1978; Davoodi, 1388; Seed et al., 1977). One of the parameters that effect on site response is subsurface discontinuity such as crack, holes, Karst and sinkholes (Shahnazari H., 2009). Therefore, it is necessary to assess the effect of these complications. This research has carried out to aim the effect of the holes on the dynamic behavior of earth dams, and their impact on increasing the deformation and instabilities. In order to determine the cavities condition on the embankment response, the situation of Tang-e Sorkh Earth Dam has been considered.

DATA AND DATA PROCESSING

The Tang-e Sorkh Earth Dam is sited in the northwest of Shiraz. This dam will be constructed in Barf- Forooshan area that an active fault passes from it. Dam, large building and a lot of urban facilities are constructing near this active fault. This region is affected by another active fault known as Karebas, which is located about 35 kilometers far from the site.

Tang-e Sorkh Earth Dam has an anisotropic section with clay core which will found on an alluvial bed with a 20 m thickness. The core consists of fine gravel (C=30°, φ=22, γ=19.5 kN/m^3), and the shell is involved of coarse aggregate (C=0°, φ=38, γ=20 kN/m^3). Figure 1 shows the schematic section of studied dam. Alluvial layer consists of marl layers, in which the gypsum streaks are found to be abundant. These gypsum layers have been dissolved during the age, resulting in a lot of voids in the alluvium. In addition, the limestone layers have also been dissolved over the time, and the karst cave has been appeared in it. The presence of these holes in the soil layers, changes the dynamic soil-structure-interaction behavior of the dam components. Following, the effect of holes and sedimentary discontinuity is presented.

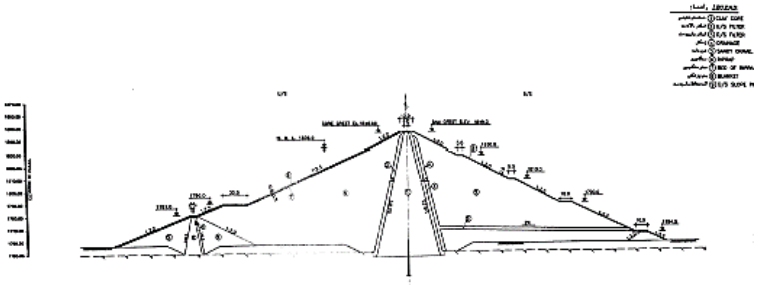

Fig 1. The schematic section of Tang-e-Sorkh Dam

RESULTS AND DISCUSSION

The behavior of designed Tang-e Sorkh Dam has been illustrated in Figure 2 to 5. This section discussed the response of dam under the near-field earthquake excitation. The effect of distance, depth, diameter and amount of cavity on the dam response has been analyzed respectively. As shown in Figure 2, in case of cavity formation in the sedimentary bed, the deformation rate of the dam is increases. The deformation rate is reduced by increasing the cavity distance from the dam downstream. The displacements of core and crust of dam are decreasing gradually up to 200 m distance. The hole position has no significant impact on the dam displacement after 200 m, because the earthquake leads to the concentration of deformation in the areas around the cavity, and extend it to the surface. It is also observed that the displacements of the crust are more significant compared to the core.

In Figure 3, it can be seen that with increasing the depth of the cavity, the deformation of the dam increases, which extends up to 40 m depth of holes from the surface of the earth. Increasing the depth of the cavity position gradually caused increasing the seismic displacement.

Figure 4 shows that the expansion of the cavity leads to more change in dam response, this variation, is more significant where the diameter of the cavity is greater than 10 m. The rate of the deformation of the dam increases in case of hole diameter increasing. Figure 5 illustrated that increasing the number of cavities increases the displacement of the core and the crust of the dam. As the number of cavities increases by more than 2, the displacement rate and eventually seismic displacement of the dam gradually increase.

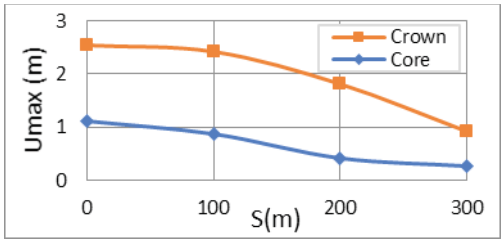

Figure 2. The effect of the hole's location on the displacement of the dam crust and core (h=20 m ,D=20 m ,N=1).

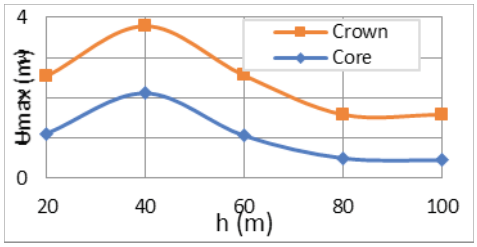

Figure 3. The effect of the holes depth on the displacement of the dam crust and core (S=0 , D=20 m,N=1).

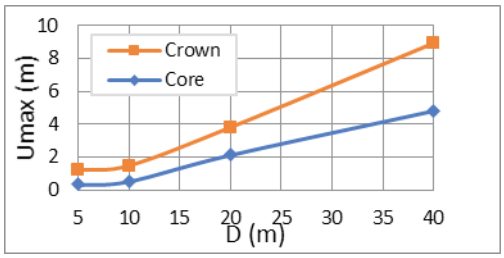

Figure 4. The effect of the cavity Diameter on the displacement of the dam crust and core (S=0 m ,h=40 m ,N=1).

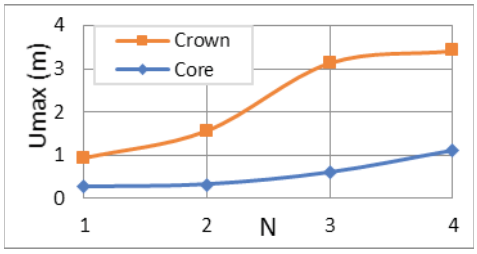

Figure 5. The effect of amount of cavity on the displacement of the dam crust and core (h=20 m ,D=20 m).

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