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SEISMICALLY TRIGGERED LANDSLIDE POTENTIAL IN THE RESERVOIR OF GOTVAND DAM, IRAN

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Moderate to large earthquakes can trigger landslides, and these landslides commonly cause a significant proportion of total earthquake damage. The ability to predict slope stability during earthquakes is especially important for seismic hazard analysis of dam projects. Earthquakes having magnitudes greater than about 4 can trigger landslides on very susceptible slopes near the epicenter (Keefer, 1984). The situation will be more critical if the landslide prone body is saturated. The Gotvand dam is the highest rock-fill dam of Iran with a clay core and was constructed over the Karun River, in Khuzestan Province. The Gotvand dam region was basically a geohazard-prone area prior to the construction of the Gotvand Dam Reservoir (GDR) due to the wide exposure of Gachsaran Formation and closeness of Lahbari and Pir-Ahmad active faults (Barjasteh, 2018).

The occurrence of an exposure of salt piercement in its reservoir known as Ambal salt pillow or ridge (Figure 1) imposed some problems to the project including subsidence and land sliding of highly soluble layers within the dam reservoir regarding its neotectonic setting (Barjasteh, 2017). The piercement is accompanied by eleven landslides (Ls1–Ls11) with an estimated cumulative volume of 20−70 mcm. The highly elongated N–S-oriented landslide Ls3 is related to the collapse of the over steepened western flank of the Ambal ridge associated with the Karun River, where the strata have a dominant strike parallel to the valley (Gutiérrez and Lizaga, 2016).

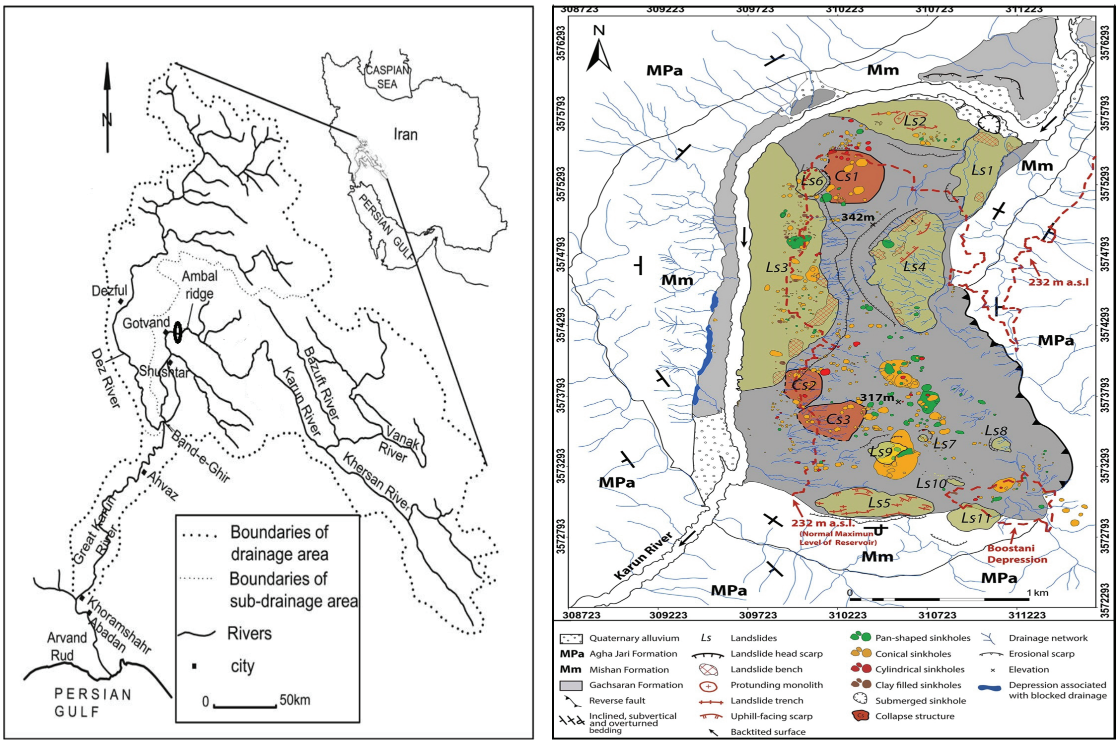

Figure 1. Geographical location of the Gotvand Dam (left) after Aghdam et al. (2012), and geomorphological map of the Ambal ridge showing landslides and ground instabilities induced by the reservoir impoundment after Gutiérrez and Lizaga (2016) (right).

Periodic field investigations show that Ambal salt pillow or ridge in the left bank of the reservoir is continuously sliding into the reservoir since its impounding (Barjasteh, 2017). Here, based on the Newmark method (1965) as noted by Equation 1, slide potential of the largest (Ls3) landslide body on the western flank of the Ambal piercement within the reservoir region based on a four year field observation was calculated (Equation 1) and discussed regarding to partial saturation of it during March 2019 flooding of Karun River.

$$a_c = (FS - 1)g \sin \alpha, \tag{1}$$

In the Newmark method, the dynamic stability is related to static stability and the static factor of safety can be obtained by the following relationship (Jibson et al., 1998; Jibson, 2009) as shown below (Equation 2). The Newmark (1965) showed that the critical acceleration of a potential landslide block is a simple function of the static factor of safety and the landslide geometry (Equation 2).

$$FS = \frac{C'}{\gamma t \sin\alpha} + \frac{\tan\varphi'}{\tan\alpha} - \frac{m\gamma_w \tan\varphi'}{\gamma \tan\alpha} \tag{2}$$

With regard to the available values for geomechanical parameters of the Gachsaran Formation at Ambal ridge and considering relevant saturated values for rock, FS was conservatively estimated to be equal to 1.086. After computing the static factor of safety (FS), the critical acceleration which can trigger initial sliding was estimated as 0.042 g that is much lower than the DBL value (0.27 g) of the dam site (Maleki and Behnam, 2005). Accordingly, Ls3 landslide body show highly critical condition during earthquake loading that could be harmful for the dam body, as well.

REFERENCES

Aghdam, J.A., Zare, M., Capaccioni, B., Raeisi, E., and Forti, P. (2012). The Karun River waters in the Anbal ridge region (Zagros mountain Range, southwestern Iran): mixing calculation and hydrogeological implications. *Carbonates Evaporites*. DOI 10.1007/s13146-012-0083-8.

Barjasteh, A. (2017). The impact of active faulting on the geotechnical properties of the Upper Gotvand dam, southwest Iran. *Bulletin of Engineering, Geology and Environment*. DOI: 10/1007/s10064-017-1163-8, 1-14.

Barjasteh, A. (2018). Neotectonic features of Gotvand-Lali region, southwest Iran. *1st Int. and 3rd National Quaternary Congress.* 13-14 Feb. 2018, Tehran, Iran, 10p.

Jibson, R.W., Harp, E.L., and Michael, J.A. (1998). *A Method for Producing Digital probabilistic Seismic Landslide Hazard Maps: An Example from the Los Angeles, California Area*. Open-File Report, 98-113.

Jibson, R.W. (2009). Methods to Model Co-seismic Landslide Movement. The Next Generation of Research on Earthquake-induced Landslides: *An International Conference in Commemoration of 10th Anniversary of the Chi-Chi Earthquake,* 13p. National Central University, Taipei, Taiwan, 128-140.

Keefer, D.K. (1984). Landslides caused by earthquakes. *Geological Society of America Bulletin*, *95*, 406-421.