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**INSTABILITY INVESTIGATE OF GOHARKOUH DAM ABUTMENTS, AFTER
DEWATERING AND UNDER SEISMIC LOADING CONDITIONS**

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ABSTRACT

Goharkouh artificial recharge dam in Sistan-Baluchistan province, about 65 km northwest of Khash, is under construction. The construction of the dam, Goharkouh plain surface runoff is stored. The study, conducted field visits and joint explorations of the dam, the critical areas of the abutments and karst areas were identified. Evaluation of potential landslides around the reservoir and dam abutment, if sad, because of saturation of the soil and rocks, it is possible. Thus, physical and mechanical properties of soil and rock, will be modified and cause instability. The results of this study, using Rockpack software, showed that the wall of the right, the left wall, the stability is less. Right abutment, a potential slip plane and slip wedge, but the left abutment, sliding wedge is only potential. Also, none of the abutments aren't susceptible to reversal. In normal circumstances, the fulcrum of the right and left Goharkouh dam, with a slope of 20 and 40 degrees, with a safety factor of 2.54 to 1.69 are stable. In the event of an earthquake, abutments with a slope of 20 degrees, before and after dewatering operations, will be unstable. The slope of 40 degrees, before and after stable dewatering is prone to landslides.

Keywords: Slide, Runoff, Goharkouh , Abutments , Seismic Loading

INTRODUCTION

Dams, as hydraulic structures, with the aim of collecting surface water for various uses, the used (Rahnamarad et al., 2013). There are many dams, which must be taken into

consideration. Some of the issues related to the selection of dam site. Studies on geological phenomena in the construction of dams, dikes and tectonic instability, with

water, drain, or earthquake, they exacerbate the instability domain (Zhang et al. 2003). Stability of slopes under seismic loading on a regular trend, topography around the world as part of the evolutionary process occurs (Harp & Jibson 2002). A large number of landslides caused by earthquakes occur in natural and synthetic roofing (Harp et al. 2003). Gable roofs are very durable and can be divided into the roof of the slide threshold (Rahnamarad et al., 2013). When an earthquake occurs, the effects of vibration caused by the earthquake will be enough to slip into the roof of the stable medium to weak (Ismailzaei, 2013). Generally, the factors that cause slope

instability can be divided into two groups, are material factors that increase the shear stress and shear strength are factors that decrease. The target of slopes and landslides confidence coefficient for the slope of the slide in terms of changes in groundwater levels and earthquake (Dorzadeh and Kongi, 2013).

2. Study area

Goharkouh Dam, about 65 km northwest of Khash is under construction (Regional Water Sistan and Baluchestan, 1389). The achievement of the study area, through the Zahedan-Khash asphalted road, then the road to the West is possible (Figure 1).



Figure 1. access roads to the study area

3. Geological Area

Study area, geologically part of Flysch Zone, East and South-East of Iran. The structural unit, a general trend north-south. The study area has ophiolitic basement, belonging to the Cretaceous, the dam Goharkouh, deposits of Eocene outcrops, the age of the flysch series of Upper Cretaceous to Eocene variable

(Aghanabati, 2004). These deposits, influenced by tectonics, have been folds (Berberian and King, 1981). The rock formations in the area, generally consisting of Paleogene formations, which Auliny limestone layers series, and lime is made, the greater the mass, or facies; and in some areas, clay this increased limestone and marly

limestone, marl or have become. For example, in the right tank, between the Goharkouh and Aspytk mountains, karst cavities, the argillaceous limestones are indicated. The unit, due to nummulites fossils, belonging to the Eocene.

The main fault zone and create shear zones, creates a network of fractures, which in many processes, are observed in the study area. Much of the other polymorphism in this region appears to be broken, and the

boundaries of rock units, as the fault. Most of these fractures, a vertical gradient in terms of the direction and amount of displacement, the two series of right-lateral strike-slip and normal, divided, and often has a horizontal component of motion. Frequency fault, right, because of their relevance to the main fault zone, have a right of action. The main trend for these fractures, a north-south and North West - South East (Pourkermani and Zomorodian, 1993).

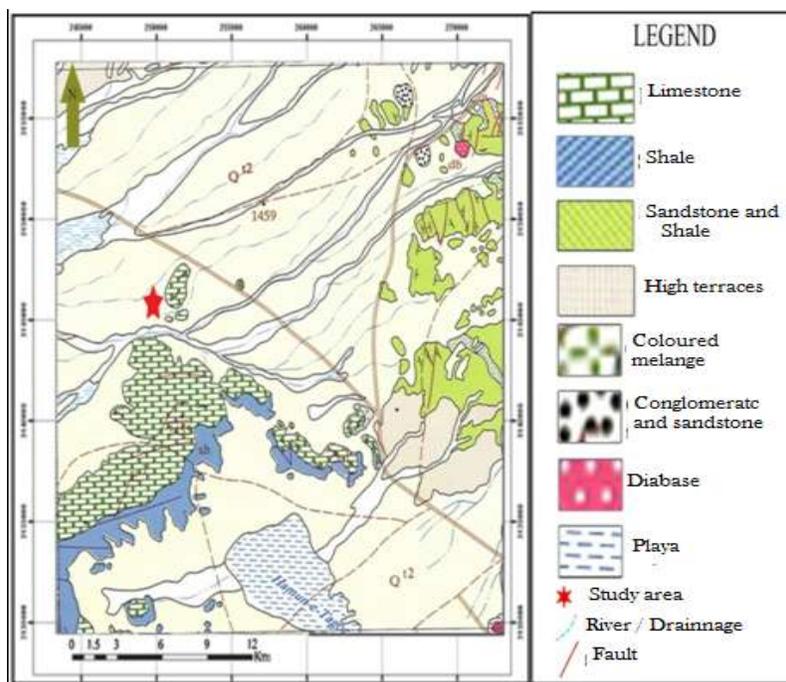


Figure 2: Geological map of the study area

The field study

The purpose of field studies, the characterization of those joints, layered, split zones, faults, surface layers of rock discontinuities and gender in the study area.

Discontinuities in the rock, according to field observations, such as spacing, opening, filling, expansion joints and surface roughness, is studied. From the geological point of view, the existence of limestones, the

dam and karst cavities in the ground represents a karst sinkholes that causes water in the channels is running. In this study, removal of discontinuities at two stations (one

on left and one on the right abutment abutment) was performed. Geometrical characteristics of each joint set in support of the tables (1, 2) are listed.



Figure 3: karst cavities in limestone marl (left) and normal fault at the left abutment of the Goharkouh dam

Table1: Characteristics of the joints of the right abutment of the Goharkouh dam

Joint sets	Dip	Dip dir.	Filling	Continuity Av. (m)	Spacing Av. (cm)	Opening (mm)	Surface describe	Damp
A	65	271	Calcite	1	5	2-4	Smooth and soft	Dry
B	75	344	Sand	0.5	8	3-7	Rough	Dry
C	68	221	Sand and silt	1.25	6	2-5	Rough and Wavy	Dry
D	80	150	-	1.75	4	8-10	Rough	Dry
E	70	244	Silt	2	10	5-7	Smooth and soft	Dry

Table 2: Characteristics of the joints of the left abutment of the Goharkouh dam

Joint sets	Dip	Dip dir.	Filling	Continuity Av. (m)	Spacing Av. (cm)	Opening (mm)	Surface describe	Damp
A	76	275	Sand	0.75	5	15-25	Rough and Wavy	Dry
B	65	294	-	2	10	2-10	Rough and Wavy	Dry
C	68	159	Calcite	1.75	8	46-69	Rough and Wavy	Dry
D	80	330	Iron oxide	3	9	16-59	Rough and Wavy	Dry

5. Studies Software

5.1. stability analysis support, to help STERIONET

Usually Astryvgrafyk method for exploratory analysis of the stability of rock slopes are used. In this way, the main joint sets and other discontinuity in the set, then the Rock pack v. III software were analyzed. Along topographic gradients and internal friction angle of the input data to the software are mentioned. The next step, using Marklnd (Markland 1972), the failure was stereographic. Upon diagnosis of failure, safety factor and the weight of the rock mass was calculated (Grenon and Hadjigeorgiou, 2008). Diagram of the analysis indicate that due to the geometry of fractures and bedding surfaces, there is a potential slip plate and wedge (Antonioni and Lekkas, 2010), that the results in Table (3) is presented, and shown in

Fig. 4, left and right abutment of the dam analyzed a sample of Goharkouh.

5.2. Analysis of simple circular cutting surface slip

Roof slip condition, which is caused by shear stress, shear strength on some pages equal to or greater than the potential, based on their (Faheem 2004). Difference between normal and shear forces, in each of the components were calculated and determined the stability of slopes (Agliardi and Crosta, 2003). To estimate the safety factor of the earth, the software slide (Slide V. 5. 0) is used. Analysis of left and right abutment of the dam site, with a slope of 20 ° and 40 °, in normal conditions and with two of the four components of the horizontal component Qaym0.1 and 0.16 and 0.13, 0.19, 0.21, and 0.23 was calculated. The results of this analysis (Table 4) are listed.

Table 3: Evaluation of landsliding in Goharkouh dam site rock mass

Analysis	Safety factor	Slide type
Right abutment	1.28	Plate
	1.01	wedge
	4.41	Taplyng
Left abutment	1.62	Plate
	1.12	wedge
	3.64	Taplyng

Table 4: Analysis of left and right abutments of the dam Goharkouh by Slide software

Safety factor		Right abutment		Left abutment		
With seismic loading	befor dewatering	Slope 20 degrees	1.288	1.074	1.296	1.074
		Slope 40 degrees	1.827	1.45	1.831	1.474
	after dewatering	Slope 20 degrees	1.26	1.03	1.130	0.945
		Slope 40 degrees	1.54	0.82	0.191	0.166
Without seismic loading	In normal conditions	Slope 20 degrees	1.69	-	1.665	-
		Slope 40 degrees	2.542	-	2.502	-

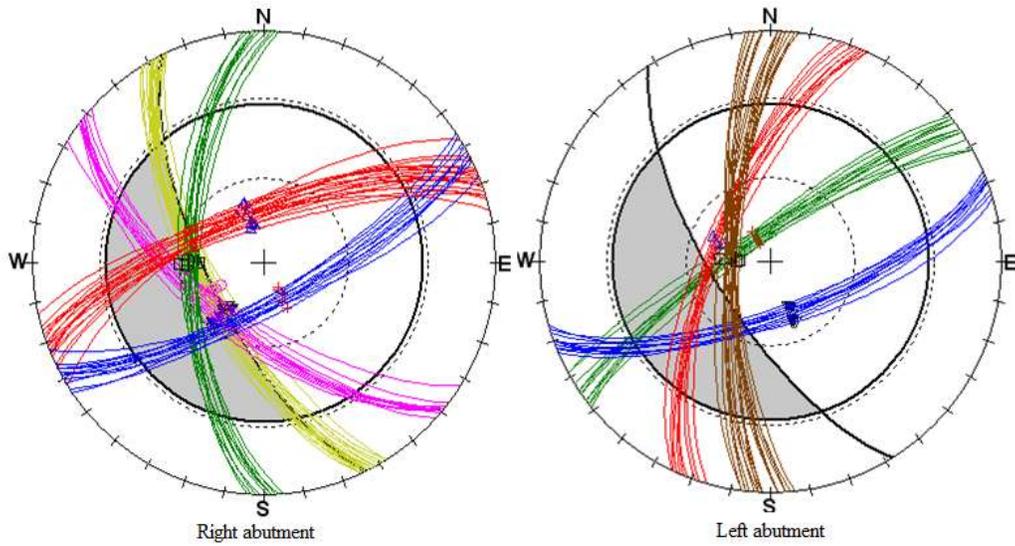


Figure 4: The joint sets of rock masses left and right abutments Goharkouh dam site

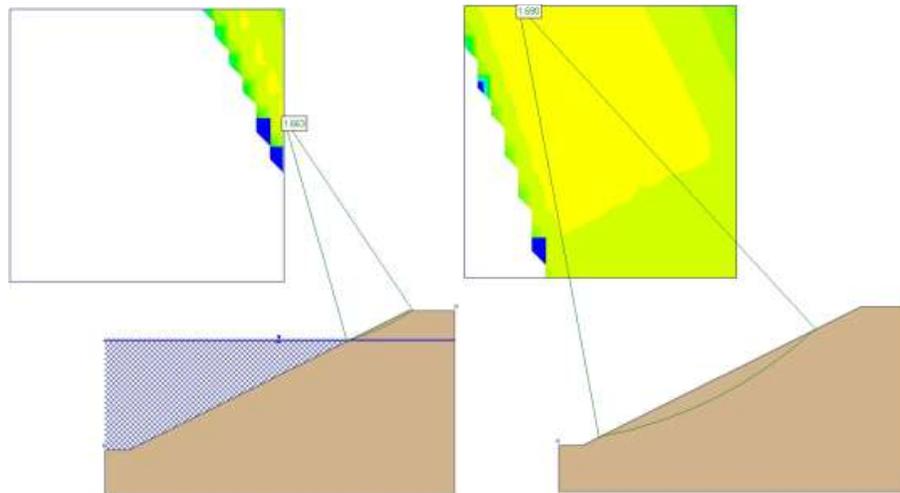


Figure 5: Cut surface circle, right at the foot of the dam, no seismic loading (with a slope of 20 degrees)

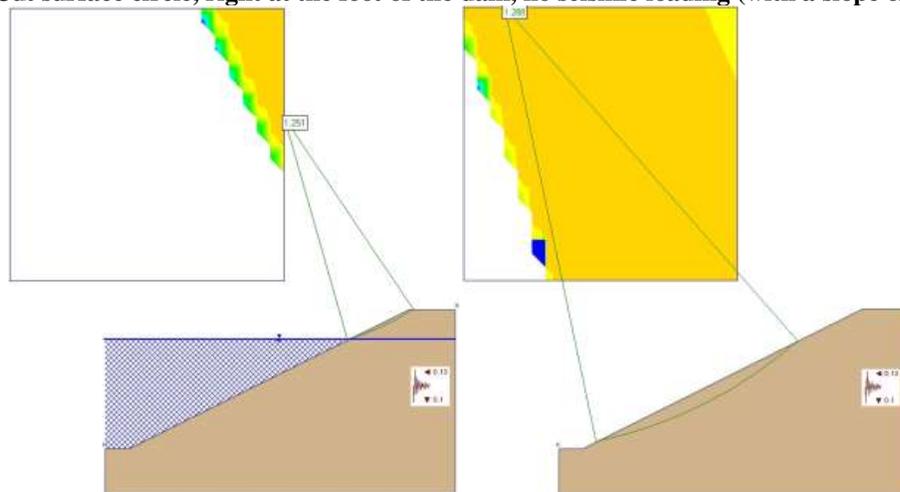


Figure 6: Cut surface circle, right at the foot of the dam, with load (with a slope of 20 degrees)

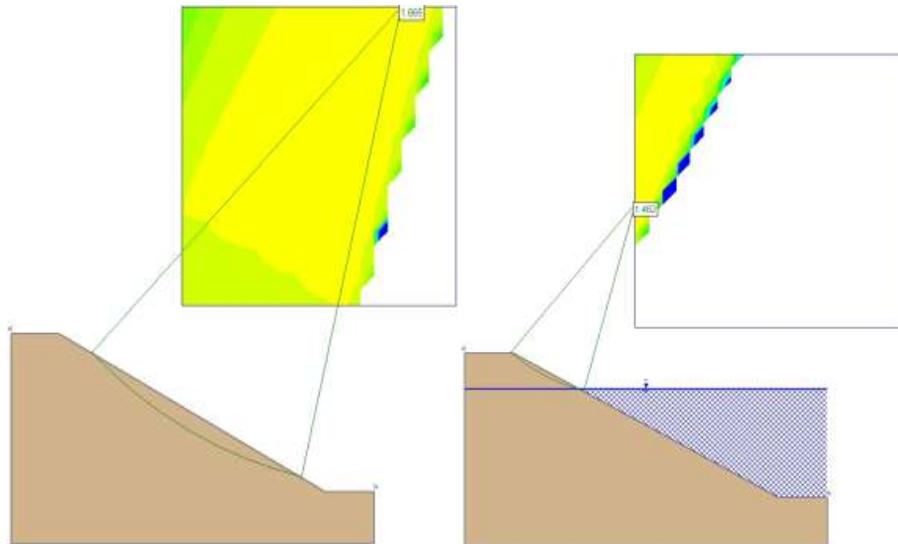


Figure 7: Cut surface circle at the left of the dam, no seismic loading (with a slope of 20 degrees)

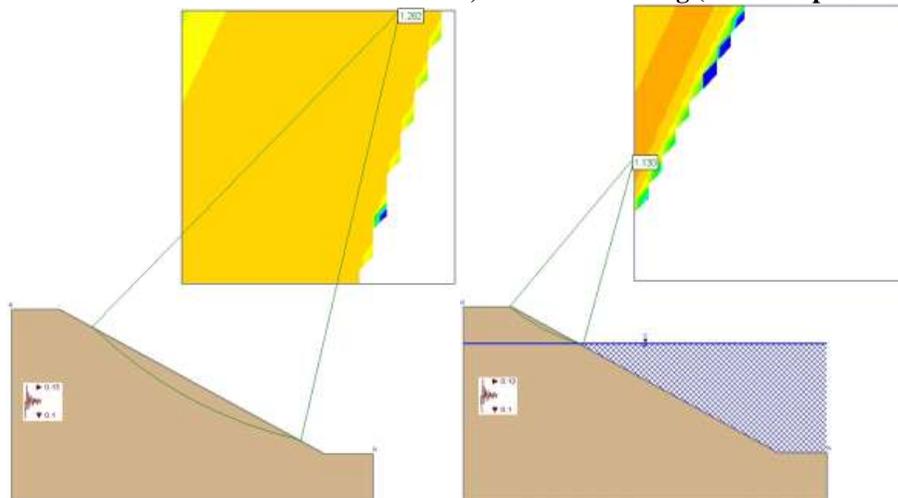


Figure 8: Cut surface circle at the left of the dam, with seismic loading (with a slope of 20 degrees)

CONCLUSIONS

Because of the thick layer of alluvial deposits in the river bed, foundation condition, suitable for artificial recharge. Allowing water to escape through geological events such as karst, faults and fractures are showing that less attention to geology, geotechnical and geophysical been. Goharkouh dam, according to the limestones at the site, it is possible karst cavities, in the depths of the earth; there is a

dam site and reservoir, which drain water from the karst channels.

Diagram Analysis in Rockpack software, indicates that, due to the geometry of the joint sets, the safety slide plate to the right abutment of the dam safety factor of 1.28 was obtained and sliding wedge, 1.01 was calculated. The safety factor prone to instability, with the right support and the possibility of sliding plate and wedge, which

is great. But the left abutment, safety, and the safety factor for slip sliding wedge plate was 1.62, 1.12, respectively. The backrest, sliding wedge is only likely to occur. Taplyng safety, support for right to left abutment 4.41 and 3.64 were calculated. As a result, both the backrest, are not susceptible to reversal. Analysis of dam abutment Goharkouh, software (slide), with a slope of 20 ° and 40 °, in a natural state, are stable.

In the event of an earthquake, the fulcrum of the dam, with a slope of 20 degrees, before and after dewatering operations are unstable. Right abutment slope of 40 degrees, before dewatering, with a safety factor of 1.82 to 1.45 and after dewatering, the safety factor of 0.82 to 1.54 will be. Goharkouh left abutment of the dam, in the event of an earthquake, with a slope of 40 degrees, before dewatering, with a safety factor of 1.32 to 1.47 and after dewatering, the safety factor will be between 0.16 to 0.19 and The result left abutment, with a slope of 40 degrees, before dewatering, stable and after dewatering, are prone to landslides.

REFERENCES

Aghanabati, A., (2004), Geological Survey of Iran, published by the Geological and Mineral Survey of Iran, p. 586, (in Persian).

Antoniou, A. A. & Lekkas, F. (2010). Rock fall susceptibility map for Athinios port, Santorini Island, Greece.

Geomorphology, 118, 152–166.

Agliardi, F. and Crosta, G. B. (2003) "High resolution three-dimensional numerical modeling of rockfalls", *Int. J. Rock. Mech. Min. Sci.*, 40 (4): 455–471.

Berbrian M., King G.C.P., (1981), "Towards a paleogeography and tectonic evolution of Iran", *Canadian Journal of Earth Sciences* 18, pp.210-265.

Dorzadeh, H., Kangi, A., (2014), Analysis of instability in the wedge anchor and Khalifeh dam reservoir using Rockpack v.III software, thirty-second Congress, and the first international gathering of Earth Sciences, Geological Survey mineral Survey of Iran.

Faheem, H., Cai, F., & Ugai, K., (2004), "Three-dimensional base stability of rectangular excavations in soft soils using FEM.", *Comput., Geotech.*: 67-74.

Grenon, M., Hadjigeorgiou, J.(2008). A design methodology for rock slopes susceptible to wedge failure using fracture system modeling. *Eng Geol* 96, 78–93.

Markland, J. T., (1972), "A Useful Technique for estimating the stability of rock slopes when the rigid wedge sliding type of failure is expected", *Imperial College Rock Mechanics Research Report* (19): 10

- Harp, E. L. & Jibson, R. W., (2002),** "Anomalous concentration of seismically triggered rock falls in Pacomia Canyon: are they caused by highly susceptible slopes or local amplification of seismic shaking", Bull., Seismological Soc., AM., 92 (8): 3180-9.
- Harp, E. L., Jibson, R. W., Kayen, R. E., Keffer, D. S., Sherrod, B. L., Collins, B. D., Moss, R.E.S., & Sitar, N., (2003),** "Landslides and Liquefaction triggered by the M 7.9 Denali Fault **earthquake of 3 November, (2002)**", GSA Today (Geological Society of America). August: 410
- Ishihara, K., (1985),** "Stability of natural deposits during earthquakes", Proc. 11th Int., Conf., On Soil Mech., And Found. Engrg., Vol. 1, San Fransisco, August: 321-376.
- Ismaelzaee, M., (2013),** earthquakes powerful effect on the instability of Zirdan Dam Reservoir (Chabahar), thirty-second Congress, and the first international gathering of Earth Sciences, Geological and Mineral Survey of Iran.
- Zhang, Yu, Y., Hou, B., (2003),** "Based stability an analysis of Nuozhadu high earth-rock fill dam", Proceedings of the ninth Chinese national conference of soil mechanics and geotechnical **engineering, Beijing: 1015-18.**
- Pourkermani, M., Zomorodian, M. G., (1993),** discussion of the geomorphology of the Sistan and Baluchestan Province, Geographical Research Quarterly, published by Astan Quds Razavi, Mashhad, Vol III, pages 172-159.
- Rahnamarad, J., Yaghubifeyzabadi, M.R., Enayat, M.A., Ansarifar, M., (2013),** investigating the causes of the instability in parts of the Daroongar dam (North East of Iran), eighth Association conference Engineering Geology and Environment, of Iran, Ferdowsi University of Mashhad.
- Sistan and Baluchestan Regional Water Company, (2010),** report of Geology and Geological Engineering Goharkouh dam.