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Investigate the Geological Conditions of Eyvashan Reservoir Dam Site and the Reasons for Choosing the Best Type of Dam Building

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Abstract: The under construction eyvashan dam site in Lorestan Province is located in 57 km Northeast of the Khorramabad city on Hored River. The site of this dam, from geological point of view is in bedrock ranging that is composed of conglomerate rocks. Conglomerate rocks of abutments range have protrusions. Young alluvial deposits covered the bedrock surface in valley floor. The aim of this study is to investigate the geological parameters of eyvashan dam site and the reasons for choosing the best type of dam building and also the stability of the structure in order of size motechnique. The study method has done based on research, data collection in library studies, field and laboratory ways. After identification and evaluation of geological and geotechnical of dam structure, litho logy and tectonic characteristics were studied by using satellite data. In choosing the type of dam issues and several factors such as the shape of the valley, engineering geological conditions and results of exploration drilling and geotechnical studies, site conditions, the situation tectonics and seismicity, appropriate credit sources and barrier height are ruling. According to the above-mentioned conditions and by summarizing information and impartial obtained investigations, construction of dam earthen gravel type with clay core is the best option. Also the analysis of liquids and permeability and its fulcrum in order to design appropriate sealing curtains were detected.

Key words: Eyvashan dam, earthen-gravel construction, permeability, geology, geotechnical, permeability

INTRODUCTION

The study area is known as the Draught of Eyvashan dam in Lorestan Province, the geographic coordinates of the under construction Eyvashan dam is bound between the lengths of 48°, 37', 30 and 48°, 52', 30" East and width of 33°,25',00" and 33°,37',30" North. Herod is the only important river in this area that flows from South East to the North and North West. In order to make maximum use of stream flow and water supply requirements of different regions of Lorestan Province, Eyvashan Dam is under construction on the Herod River (Fig. 1) (Faraz, 2001, 2003).

Definition of the problem: In terms of geology the metamorphic zone in the North East of this region with the face of a dark gray to black, organized from the hills and low post. Included rocks are mainly metamorphic and injected intrusive rocks in them (such as Broujerd intrusive) are sometimes seen as a building ridge have been exposed so spectacular (Fig. 2). Eyvashan dam site from the new perspective on a range of tectonic and seismic tectonic is located aggressive. Including new signs of tectonic movement can mentioned the present and active faults in the quaternary on a regional scale such as part-fault of Dorood and fault Peace in the mountains (BHRC, 1999).

Fig. 1: Cofferdam upstream of eyvashan is building

Fig. 2: A view of mountains surrounding the Eyvashan dam site

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MATERIALS AND METHODS

In this study, the research methodology and data collection has done based on library studies, field, field work, laboratory operations, collect and evaluate all the relevant reports and the previous work done, use and study satellite images and use the Auto CAD Software.

Conglomerate unit P^{LQC}: Most of the outcrops of rock units of the region study is from Conglomerate. The litho logy characteristic of the conglomerate is as follows. A heterogeneous conglomerate that more than 85% of its elements are lime and other elements are consisted of radio lariat parts, slate and are types of metamorphic and igneous rocks. The stone pieces of these conglomerates are semi-circular with poorly sorted and dimensions of its parts is between 1 and 30 cm and in some areas range up to 60 cm. Its cement is sand type with medium to low hardening. Conglomerates are consisting of layers and layers slope is between zero and 40°. Among the conglomerates layers, the layers of marl and sandstone are also seen in limited and scattered. Conglomerates colors are cream to gray. The above description has been drilled according to the field investigation and the study of Eyvashan core axis dam. According to the above description, the conglomerates are very similar to the Bakhtiari conglomerate. If Fig. 3-9 considered, respectively an attrition in their sequence can be seen in a way that in conglomerate of Fig. 3-9 stability and appearance of the conglomerate rock show the very poor erosion of them and the color is dark cream (ICOLD, 1986).

Tectonic: In this study, in order to identify the tectonic and seismic tectonic range of designs, features of ground-build are provided on a large scale. In this regard, rely on the new tectonic features of this country and tectonic characteristics of the area around the site have been reviewed (Abda, 2002).

Faults have been studied as the most important source of earthquake. For this purpose, the most fundamental features of faults design such as Zagros Fault and especially part-fault of Dorud that is passed from a distance of about 5.14 km of North of Eyvashan dam site have been described (Fig. 10) (Tqabny, 2005).

These studies show that among the detected faults, the North of Safarabad fault (with a length of 12 km

Fig. 3: Pleistocene conglomerate in the place of Eyvashan dam site on Herod river in the Southern village of Eyvashan

Fig. 4: View of the under construction dam site conglomerate of Eyvashan

Fig. 5: The pleistocene conglomerate

Fig. 6: Close view of polio pleistocene conglomerate protrusions in the south of the case study area in the picture the texture of the conglomerate and litchis fragments are visible

Fig. 7: Conglomerate walls with a slope of 40 with a series of closed joint linear that their path is determined by herbaceous plants that is visible on the riverbank of Herod

Fig. 8: View of South East conglomerates that are very similar to the Bakhtiari conglomerate

Fig. 9: The progress and fine-grained sedimentary cover of antiquity (Qt) on the conglomerate (PLQc) on the right-hand edge of khoram Abad-Brojerd road not far from the bridge Herod

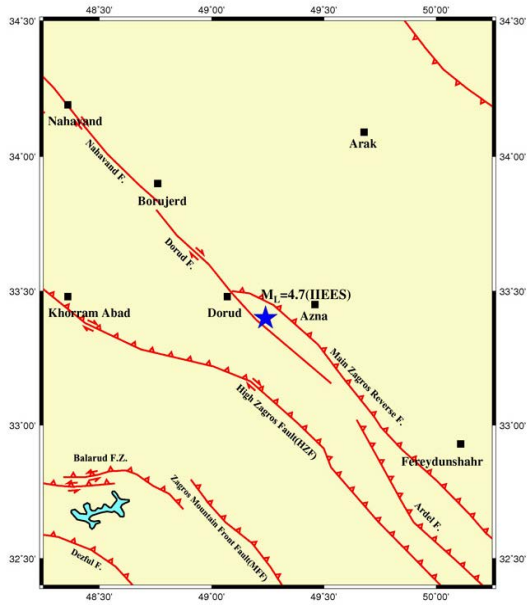

Fig. 10: The position of the fault Dorud approximately 100 km to under construction Eyvashan dam (International Institution of Seismology and Earthquake Engineering)

at a distance of 5.8 km along the linear part of the site) and Dorud part-fault (with a length of about 100 km at a distance of 14.5 km site), will have the greatest impact on ground motion parameters of structure and the role of other faults is relatively low (Tqabny, 2005).

Required condition for dam selection: According to morphology conditions, the Herod River must cross the river gorge at a site and in the upstream and downstream of the site; there is no competitor option in terms of morphology. On the other hand the suitable and engineering geology condition of the site even cause the axis of the multiple-choice, the axis of which has at least the canopy or in other words the smallest body size and morphology of lakes to store water is good as the centerpiece of its consideration. According to the unchangeably of dam and choice to determine the type of structure and the axis of the dam, Ayush dam site was investigated to determine the most suitable type of dam in terms of barrier technical, administrative and economic conditions. But generally, the determines parameters including geo-mechanical properties of the rock foundation, the quantity and quality of credit resources, existing technology, weather conditions, morphology and shape of the valley and must be seen side by side (Fathi, 2004).

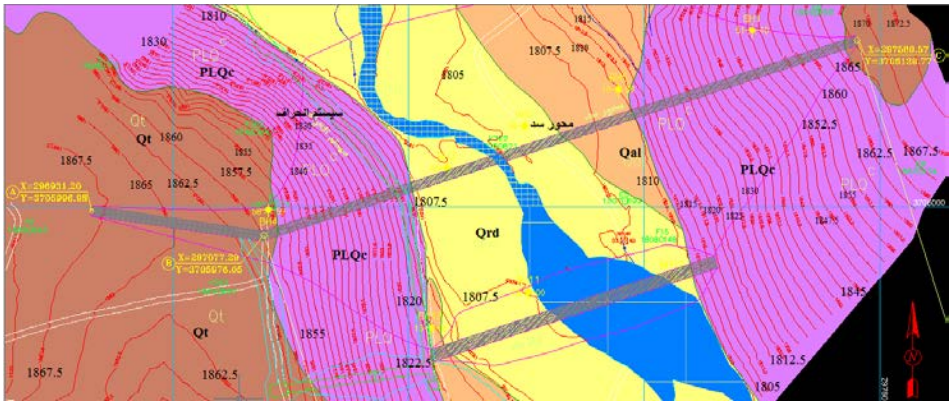

Fig. 11: Geological of Eyvashan dam

Fig. 12: View of the sediments of the surface of Herod River

RESULTS AND DISCUSSION

Topography: In terms of topography of the oriented area and the beginning of the Eyvashan dam in conglomeratic hills, Bakhtiari sediments are located to the present time. The V-shaped of lake is relatively open access to credit resources and dam lakes without the least way is possible. The shape of the hills of the area, waterways nervous system such as springs on both sides of the lake at the height of the dam are the appropriate indicators.

Eyvashan dam site geology: Young conglomerate reservoir with parts of limestone about 85% and pieces of radio lariats, sandstone, metamorphic rocks and in some igneous rocks with silica matrix and sometimes salty sand have formed the central position and the lake dam. The thickness of this unit will be assessed about 500 m. The sediments were distinguished. These change with a slope of about 0 and 25°. The sediment is the creature of depositional environment torrential-river. On the deposits at the fulcrum of the dam in the highlands sometimes up to 30 m of clay deposits type of CL have been sitting (Fig. 11).

These deposits are the creature of a lacustrine environment because fossils and ear of fish can be seen in them; these fine-grained sediments as a source of credit are studied. The way of Eyvashan river is covered by sediments of sand and boulder up to a diameter of about 1 m (Fig. 12). The maximum thickness of the sediments in the area around the dam and in the lake is about 6 m. The deposits are predominantly made of limestone but parts of igneous, metamorphic consists of Andesite, basalt, slate can be seen in them. The sediments are the source and aggregate gravel shell of Eyvashan dam.

Tectonic position of eyvashandam: Lake dam in the range of axes and position Eyvashan any aspect of active tectonic faults including China-corrosion due to sediments being young is observed. In summary, it can be said central position and Eyvashan Lake Dam is a natural concrete mass that only for layering just by changing these deposition is determined.

The risk of foundation failure: Cosmos satellite image survey conducted Seismo tectonic range centered, do not show the evidence of the presence of faulting below the dam axis. Since, the dam on the conglomerate ayush young and Bakhtiari is recovered from pleistocene conglomerate, if faulting is present in more depth, so the fault is not active under the definitions of the International committee on large dams and hence the risk of faulting below axis is not expected.

Sealing axis: Based on the studies in the area of Eyvashan dam axis in the bedrock the maximum measured Lvzhan in the sediments is 2 Lvzhan that represents the permeability of approximately 10^{-7}-0^{-9} m per second. These types of sediments have closed enough and do not need to be injected but because the zone of weathering the bottom of the shaft sealing must be removed partly based

Table 1: Geo mechanical parameters of stone foundation of Eyvashan

	Geological legend		
Period of era	Epoches	Parameters	Discription
Cenozoic			
Quaternary	Holocene	Q_{rd}	River coarse sediment, Boulder-sand, moldpartsof limestone(GP to GW with Boulder)
	Pliocene	Q_{al}	Silty fine sediment, clay witha percentage of part of sand with vegetation
		Q_t	Fine sediments, Clay (CL) with vegetation
Tertiary	Pleistocene	P^{LQc}	Cement conglomerate with some silt and clay with moderate to weak hardening, over 85% Parts oflime, other componentsinclu detypes of rocks adrianand metamorphic, grain sizefrom1-60 cm, semi-circular pieces of stone poorly sorted, light gray

Table 2: Geo mechanical parameters of stone foundation of Eyvashan dam

Factors	Values
Saturation density	$\rho_{Sat} = 2.55$ g/cm^3
Dry density	$P_{dry} = 2.5$ g/cm^3
Water absorption	$\omega = 1.4\%$
Porosity	$n = 5.5\%$
Durability	$I_Q = 88\%$
Massif	RMR = 87 (good quality rock mass)
Fiction angle of the rock mass	$\Phi = 35$ (deg)
Adhesion of the rock mass	C = 30 kg/cm^2
Elastic modulus of the rock mass	E = 2.5 Gpa
Poisson's ratio	$\nu = 0.26$
Allowable bearing capacity of the rock mass	Qal = 100 kg/cm^2

floor grouting will need. Notably, due to the lower penetration depth of grouting conglomerate may even be reduced the depth of <5 m and the only role of it is to fills seams and cracks of the weathered zone in withdrawn.

Rock mass characteristics of conglomerate of Eyvashan dam. Abstract geo mechanical parameters of stone foundation of Eyvashan dam is as follows (Table 1 and 2).

Tectonics situation and seismicity of the region: Although, in the geological and engineering geological studies of major or many faults are not seen in project area but seismicity and Earthquake Engineering studies indicate that the range and Eyvashan Lake Dam site is part of the whole region of earthquake-prone area. Eyvashan dam location is by the horizontal distance of <23 km from Doroud (center Silakhor) which has been hit by big earthquake in 1909. Thus, the problems associated with the selection of Eyvashan dam seismicity of the region should seriously be considered.

The existences of such special circumstances determine that during designing consider important aspects and safety necessary precautions. The operation of dams influenced by earthquake have shown that earthen gravel dams and concrete dams during earthquakes has numerous strengths and weaknesses points. This is the way that the selection of suitable dam locations, regardless of seismicity and fault identification is not possible. Including the impact of these dams can be mentioned liquefaction, the risk of asymmetric meeting in the dam and thus the occurrence of piping and hydraulic fracturing.

In concrete dams can also be widened to include reversal, landslides, cracks in the dam and the possibility of water leakage, meeting dams and catastrophic failure of the dam and the risks be dealt with. According to studies of earthquake engineering seismology Eyvashan the amount of DEB = 0.16 g and amount of MCE = 0.2 g is evaluated. Obviously the amount of time the design basis earthquake requires that the construction of rigid structures within the site should be avoided as much as possible.

CONCLUSION

Plio Pleistocene conglomerate is absolutely impenetrable and as the stone floor cause the emergence of contact springs. Young and river alluvial deposits have good permeability but limited development. Old alluvial deposits permeability is less than young alluvial deposits and the expansion of the range is as well.

Genesis probe spring mechanism study area due to tectonic function and style with Cretaceous limestone is considered a permanent hydraulic connection and a variety of springs. Valley has high permeability but conglomerate bedrock, devoid of any tectonic effects such as joints, discontinuities, etc and based on test results Lvzhan, the maximum amount of hydraulic conductivity measured in the borehole-drilling has been 2 Lvzhan.

In Eyvashan dam, due to high permeability of alluvial materials, the most appropriate way to sealing it, due to the low thickness of the alluvial deposits in the area around the seal is using the trenches (Cutoff Trench). In the range of 100 and 150 km during the useful life of the dam, earthquakes as large as 6.2 and 6.4 Ms occur.

Increasing the probability of earthquake occurrence comparable to the devastating 1909 event Silakhor in the range of 150 km is estimated 0.93 g. Based on morphological characteristics, environmental conditions and the existence of the credit resources in relation to the types dam concludes that central position of Eyvashan dam accept the earth-gravel dam option.

SUGGESTIONS

Based on the recommendations of the International Committee of Large Dams, it is advisable before the first dewatering tank, the operation of a local network of seismic micro-seismic short period with high interest in the area around the lake to begin. It should be noted that the features and goals of the National Seismic Network to identify Micro seismicity near the dam axis Eyvashan is not adequate.

To provide real accelero grams and regional indicators for designing and stability control dam and related structures, according to the tectonic setting of the dam Eyvashan, recommended an acceleration of Journalists (preferably digital) for free field one of the two supports or is in the downstream installation and operation.

Due to the high seismicity and seismic coefficient of Ayush Reservoir Dam Project Design (near the fault Silakhor, active, etc). Basically, any type of concrete dam structure similar to this species in our country is not recommended.

According to a study of research on the dams can be noted that one of the reasons for the choices Run Dam, Lack of knowledge of new dams as well as the ability of contractors to build the dam in the implementation of the traditional barriers by studying the behavior of dams which can be more precise and more concrete and RCC dams in the region, paving the way for the implementation of this type.

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