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Investigation of tectonics and statistical analysis of earthquake hazard in Tange Sorkh dam

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Abstract. Today, most understood the importance of the risk of earthquakes with the intensification of the country's development, the rise in urbanization, the concentration of population and material and intellectual capital and increased vulnerability of the capital in the Iran seismic zone. Iran, as one of the most seismic countries in the world, in recent years has witnessed the devastating earthquake, for example can be pointed to earthquakes of Rudbar - Manjil, Bojnoord, Zir Kouh Ghaenat, Bam, Zarand, Silakhor and each of which have enormous human and financial toll. The experience of many countries, that same Iranian plateau are at risk of major earthquakes, but incur losses and lower losses shows that with careful study from past earthquakes data and taking advantage of the studies on the construction of structures can be reduced the damage caused by earthquake. In this study, presented investigation tectonics and statistical analysis of earthquake hazard in Tange Sorkh dam

Keywords: Tectonics, geology, Zagros, depth of focus, statistical analysis

1. INTRODUCTION

Iran located on the belt seismic Alps - Himalayas and is under pressure from the Arabian tectonic plates, India, Eurasia and Turkey [1]. This country was the earthquake the most prolific of the world and more than 70 percent of which are seismic areas. On average, occurs the 3000 earthquake every year and every 5 years, once the severe earthquake, that last of them was the Bam earthquake in 2003 would be killed tens of thousands. Range of studies Sorkh Tange Dam located in the sub-zones of the Zagros folded - driven. Arabian Shield tectonic movements to the north and its combined approach to shield Iran are to pressure on the Iranian shield and in particular in the study area. Depending on the Arabian Shield towards to Iran, which is under a drift of the rate of rise in the earth in place on the shores of the Persian Gulf, is about 0.5 cm. Therefore, the area of the dam always faced with weak and strong ground motions around several active fault lines in this region.

Structural Geology and Tectonics

In the global context, the Iranian plateau located at the confluence of pages Saudi Arabia (Saudi Arabia - Africa), India (India-Australia) and Eurasia (Europe - Asia) (Figure 1). Intersection of these pages has so transformed the shell of the Iranian Plateau, in general is the weaker of the pages mentioned and surrounded by folding and mountain ranges, such as the Zagros in the West, Alborz and Kopet Dagh in North and North East, and the East Mountains of Iran and Makran, respectively in the East and Southeast. [2]. Mountains and skin folds on the plateau of Iran have not yet reached their steady state, therefore, continues to move pages, we are also seismic activity in most regions of Iran, especially in mountainous areas.

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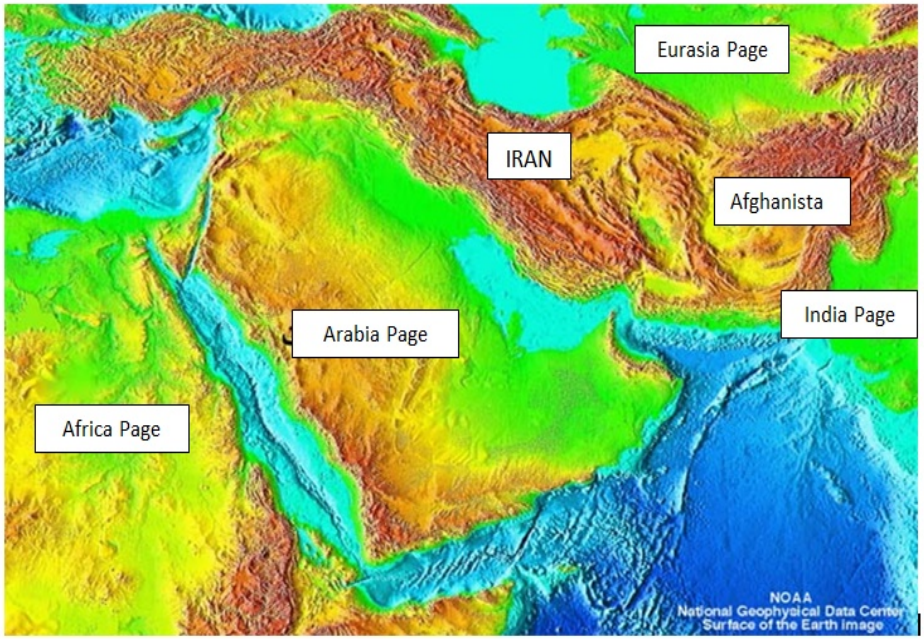

Figure 1. Location of the Iranian plateau.

The occurrence of earthquakes, such as the 1968 earthquake in Tabas is a reminder that even regional close to central Iran, because of the entered forces are at risk of earthquakes. Parts of Iran, because of the different conditions do not show similar seismic behavior. In the Zagros Mountains, that in fact is the region of the Arabian plate with Iran is a compressive force. Existence of layers of evaporate formation, such as salts of Hormuz in the region has led to earthquakes, often show a short return period and as a result, due to the short time interval between earthquakes the accumulated energy is not enough that cause earthquakes with magnitude. In this way, the Zagros earthquakes are often abundant with a large average and more raised due to the presence of low evaporative constructors and surface fractures (faults). Zagros folded belt of the northeast to the southwest is divided into five units morph tectonic, which has been represented five of the indicators with varying degrees of thrust, folds, uplift, weathering and sedimentation, and each unit is a features and style of its own deformation. In other words, the geological structure of morph tectonic and Seism tectonic Zagros are affected by the high pressure of the five units, which consist of five parallel processes in the southwest of the earth in the Zagros. Morph tectonic units from the North West to the South East include:

- Driven the High Zagros belt

- Simple folded belt

- Former embayment of Zagros

- The coastal zone of the Zagros

- Low-lying lands of the Persian Gulf and Mesopotamia

That bordered this units is determined based on topographical features, morph tectonic surface, the deformation, deformation of the surface buildings, underground geological information and seismic characteristics. These borders, in fact, are consistent with the fundamental thrusts deep and discontinuous that during the development phase, as parallel normal faults formed on continental disabled margins, and reverse the polarity of the disruption have been driven to deep

faults, as well as parts of them come to the surface. The study area, which consists of the following morph tectonic:

Simple folded belt

Simple fold belt of Zagros is limited in the north-east by the High Zagros fault and in the southwest by the fault of the mountain front. This area, in the territory of Iran is the length of about 1375 kilometers with a width of about 250 kilometers to the southeast and 120 kilometers north-west. A simple fold belt is consists of large anticlines and extended in the form box (Hugh Beck). In this zone, limestones of Eocene - Oligocene ASMARI, and Mesozoic formations constitute the majority of the region's topography. Process of structures in this area is included in NW-SE in Lorestan and Fars, E-W in LARESTAN, and ENE-WSW in the north of Bandar Abbas. In this belt is estimated thickness of sediments about 12 km, and the formation of Hormuz salt and evaporating of Gachsaran play a role in the separation of the lower and upper sedimentary cover.

Former embayment of Zagros

Former embayment of Zagros, which is limited in the north - northeast to the mountain front fault (MFF) and in the southwest to the Zagros fault forehead (ZFF), and covered at the north-eastern coastal area of Persian Gulf as already promised by alluvial deposits. Morph tectonic unit, which includes the buildings down and symmetrical anticline with exposed gachsaran, Mishan, Aghajari, Lahbary part, and formation Bakhtiari. Morph tectonic in this unit, there is a thick sequence of mollase in same time, with the orogenic lower Miocene to Pleistocene, which is folding and angular discontinuities in them indicate that the buildings available Anticline in the former embayment Zagros was active before the Pliocene and still continue to grow. In Figure (3-4) is shown a simplified cross section of the folded active belt - driven of Zagros and geomorphic units and thrust deep of separating this units Berberian (1995).

Study of important and effective formation in the destruction of water resources

Using satellite images and aerial photographs along with studies and joint field visit of area Dasht Palang dam was conducted geomorphic survey to identify important structural elements. Beyond the range of mainly sedimentary series related to Cretaceous and younger, including formation of Aghajari, Mishan, Gurpi, Gachsaran, Asemary, Bangestan, Pabdeh, Bangestan Group, series of Hormuz and Bakhtiari Formation. Study of characteristics of lithology, stratigraphy and hydrodynamic and different formations outcrop in the project area, which was studied in detail in the stratigraphy shows that the series of Hormuz salt, gypsum and salt evaporate layers formation of Gachsaran, gypsum marls of Mishan Formation, Formation Aghajari, but one of the most important factors alter the chemical quality of the water and because the characteristics of lithology and hydrodynamic are having negative effects on the quantity and quality of groundwater and surface water range plan. These formations are widespread in the region and are exposed in vast areas of the region, that this had a great impact on the degradation of water quality in the river of Dasht Palang. These formations, due to a significant amount of salt, gypsum and solubility of these salts are easily damaged by the water quality, which are in contact with this sediment and clearly see the effect, especially in the summer, when there is less water content and precipitation.

Deposits and sediments present age (Quaternary)

In the range of detectable are several categories of deposits present age. First category is alluvial deposits, the second category is gone mountain deposits, the third category are deposits of ancient terraces and the fourth category are the remaining deposits.

Soil Science Studies

Resources of Soil, water, plants, human beings are divine blessings. Improper use of these resources, such as over-grazing, deforestation, lack of attention to the development of roads, causes destruction of farms, creating ditches, flood prevention, flow in the dry season and followed a waste product and sedimentation tanks and canals. These problems will increase, due to the high rate of population growth and therefore to higher demand for food, feed, fuel, fiber, and manure and will be uncertain exploitation of natural resources. Soil different factors including the effects of other conditions and is effective on the nature and potential of the area, and so specifies on land capability for a variety of applications.

Seismicity

Tectonic Evolution of the Zagros Mountains, which are located in this area, in which, today, in the light of the theory of plate tectonics (plate - tectonic) has taken a clear face, so that on a global scale in the series Mountains is often mentioned as a classic example of the collision of continent - continent, which was aimed at the continental margin of the Pacific Ocean. [3]. Zagros is one of the most active seismic regions in Iran. Seismicity of the state is a result of movements diagnosed, on the one hand, takes shape as a result of moves of north - northeast of the Arabian plate towards central Iran, on the other hand, is the effect of the moving to the north oceanic plates (Indian Ocean) along the Makran coast, which is driven in part under the continental plate central Iran (Lot block). Because in Zagros and especially in the western part of them, the continent-continent collision is in a more advanced stage, of course, as well as their seismicity that is the intensity and the frequency lower and vice versa, the eastern part of them is more active in terms of seismicity. This activation increases to the common denominator of the two Indian Ocean and the Arabian plate. The study area is in the eastern part of the Zagros.

Historical earthquakes

In principle, it is not possible to evaluate different areas of seismic activity using data for a short period, as some of the most destructive earthquakes in recent years occurred in areas where in centuries past or low activity of the earthquake or did not work at all. [4]. Therefore, based on the data of historical earthquakes and poor information system can be limited, that opinion in this case.

I0 = 1: Complete destruction of all man-made structures including houses, cisterns with the death of a large number of people including prominent citizens, the loss of livestock.

I0 = 2: All the houses are destroyed and many public buildings, many casualties and the elimination of some animals.

I0 = 3: Destroyed many houses and killed a small number of people.

I0 = 4: A small number of homes destroyed, split up, public buildings without casualties.

I0 = 5: Feel the vibration in a large range, and is a concern, and in some places, is causing public panic.

r0: Radius of the metropolitan area in terms of kilometers of seismic.

Signs used in this table are as follows:

M: wave magnitude I0: intensity

1 = I0 2 = I0 3 = I0 4 = I0 5 = I0

Table 1. Provided historical earthquakes hit in project area, and around it, during the years 978 to 1894 AD.

R0	M	I0	Y	X	Date
	5.3	3	27.7	52.3	June 27, 978
	6.5	2	27.7	52.3	1008
	5.8	3	30.7	50.3	1085
	7.1	1	28.4	53.1	1440
		4	29.6	52.5	1506
	5.9		29.8	52.4	1591
		3	29.9	52.9	1623
		5	29.6	52.5	1752
		4	29.6	52.5	1765
		4	29.5	52.4	1784
		4	29	50.8	1806
		3	29.8	52.4	1812
15		3	29.7	52.6	June 2, 1824
14	6.4	2	29.8	52.4	June 25, 1824
		4	29.8	52.4	August 28, 1824
		5	29.8	52.4	December 30, 1824
		4	29.6	52.5	October 1825
		5	29.6	51.6	June 14, 1826
12	6.2	2	29.6	52.5	May 5, 1853
12	6.2	2	29.5	52.5	December 21, 1826
	6	2	29.6	53.1	June 1865
6	5.6	2	27.2	53.1	1865
20	5.8	3	27.7	52.3	October 16, 1883
14	6.4	2	28.8	53.5	March 25, 1890
6		3	29.9	51.6	December 14, 1891
7		3	29.1	52.7	August 15, 1892
12	5.9	2	29.5	53.3	February 26, 1894

Device Earthquakes

Presented a list of device earthquakes within a radius of 300 km of the project (2008-1973) based on AD the coordinates of the center, the focal length and magnitude earthquake within the review. In this list is presented the history of AD coordinates Macro seismic, focal length and a major earthquake within the study. It is extracted from the list of US international site data files.

Relationship between earthquakes magnitude with the distance from the project area

According to Chart 2, which shows the magnitude of earthquakes distribution system in relation to their distance from the study area, have occurred the earthquake occurred in a radius of 300 km with a magnitude of 7.5 Richter and 180 km area. The largest earthquake occurred in a radius of 80 km of the project (in the period 1973 to 2008) and the Richter magnitude 2.5, and is located in 69 km project area. Nearest earthquake recorded in the region of the earthquake has been magnitude 4.9 Richter and occurred at a distance of 9 km (2003).

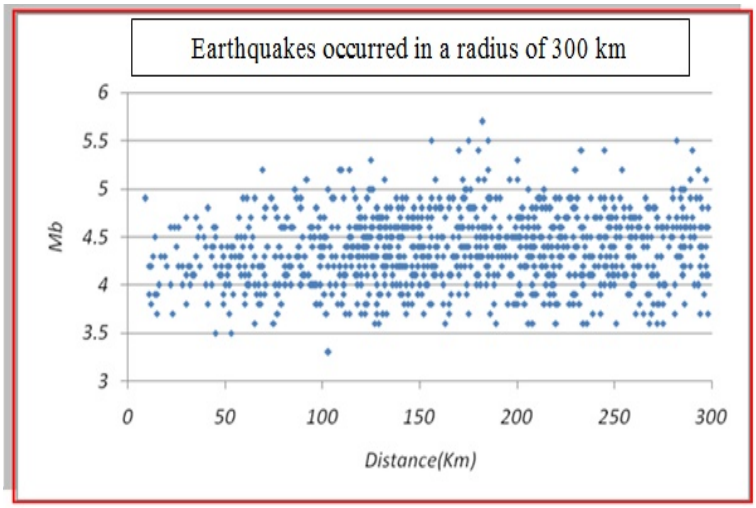

Figure 2. Relationship between earthquakes magnitude whit their distance to project area.

Focal depth distribution of earthquakes

Information about to epicenter of an earthquake depth is shown in Figure 3. It is certain that, for many earthquakes due to lack of information and lack of computing, focal depth of the stations and seismic centers attributed to approximate and imprecise. As a result, focal depth statistical analysis to be based on such information, alone, cannot be a major criterion in the diagnosis of focal depth means or major earthquakes in the study area. Therefore, in order to find the most appropriate depth for the earthquakes occurred in the area of design is given more weight to studies and seismic data, and seism tectonic. Based on these studies with perspective conservative and expert judgment can be considered, mean focal depth of 40-31 km for the earthquakes occurred in the region.

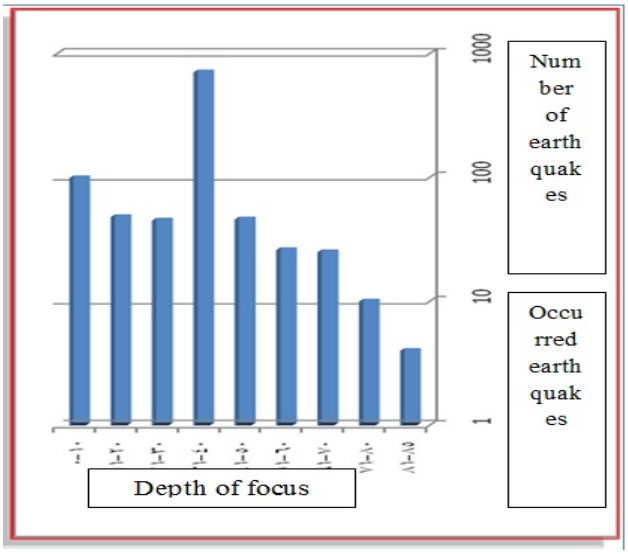

Figure 3. The number of earthquake in the region, based on the depth of focus.

Characteristics of seismic data a range of 300 km radius of the project area

In this section of the report by using data from earthquakes from (2008-1973) in a range of 300 km radius of the Dasht Palang dam has been the statistical analysis and distribution of time and the number of earthquakes occurred in the years study to the statistical distribution of its

distribution in the year 2008-1973, and magnitude of earthquake. In Figure 4, shown the number of earthquakes occur each year. In Figure 5, shown the number of earthquakes that have magnitude based on surface wave, in the Dasht dam Palang, earthquakes with magnitude 2.4 Richter (110 earthquakes) and 3.4 Richter (110 earthquakes) have the highest number to it.

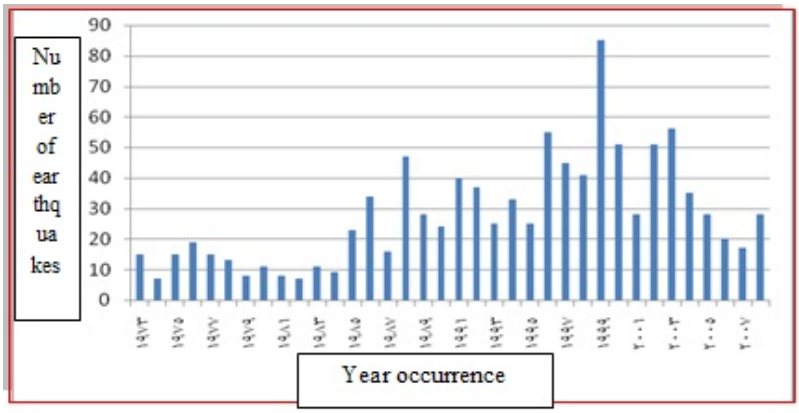

Figure 4. The number of earthquake in the study area, based on years occurrence.

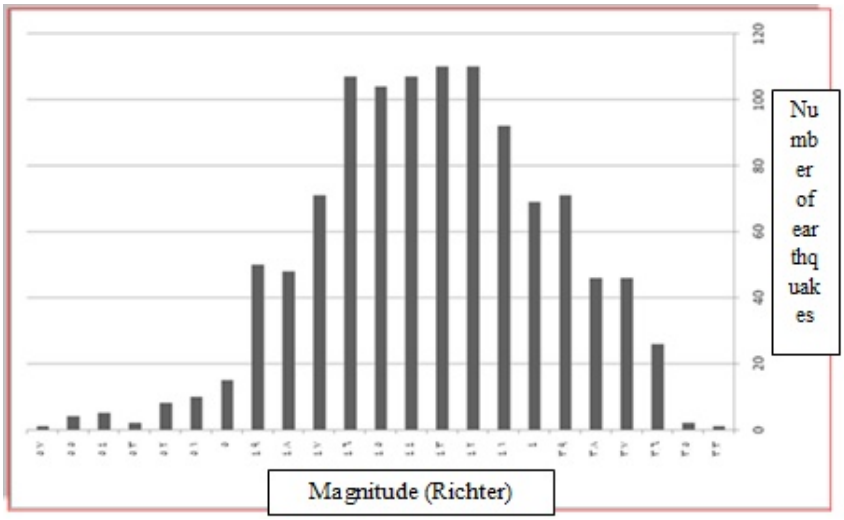

Figure 5. The number of earthquake in the study area, based on surface wave magnitude.

Design Earthquakes

Based on geological evidence and earthquakes, and studies are showing the seismic activity of the region. Therefore, the calculated risk of earthquakes, on site, is inevitable, so that thereby is reduced injuries and damage caused by earthquakes with consideration to economic issues to the minimum. With the combination of seismic and geological site are calculated by the possible amount of acceleration that may occur with probability during the life of the structure that the results of which are shown in Table 2. [5].

Table 2: Final parameters for the range of Dasht Palang dam

Maximum acceleration(g)				Return period (years)	The seismic design	Row
0.84		0.5				
Vertical	Horizontal	Vertical	Horizontal			
0.15	0.25	0.07	0.13	1000	DBL	1
0.21	0.35	0.11	0.2	2000	MDL	2
0.4	0.54	0.23	0.34	-	MCL	3

2. CONCLUSION

Geological structure of the Iranian plateau related to the folded belt system in the Tertiary geological that about the mineral and economic resources is a positive potential and in terms of seismic shaking is a negative factor. Across Iran in the middle of orogenic belts and seismic Alps - Himalayas is one of the most seismically active regions in the world. Plate tectonic models for the fact that is the Arabic shield to line with North, to the tune of 40 to 50 mm per year is moving towards the Eurasian plate. The result of this integration is causes shortening crust of Iran land created the Zagros Mountains Alborz, and relatively large earthquakes in Iranian plateau. Check the size of the regional tectonics shows in this area, there are active faults and large each of which have a high potential seismic and is indicative of the occurrence of large earthquakes in the past and the future. The maximum horizontal and vertical earthquake acceleration using different attenuation relationships, such as Campbell, Gutenberg Richter for return the period 1000 and 2000 years in foundation stone of the Dasht Palang dam, estimated respectively, 0.25, 0.15 and 0.35,0.21 gravity.

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