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Research Article

STUDY OF BASE GEOMECHANICAL PROPERTIES OF EYVASHAN DAM, KHORRAMABAD NORTH, IRAN

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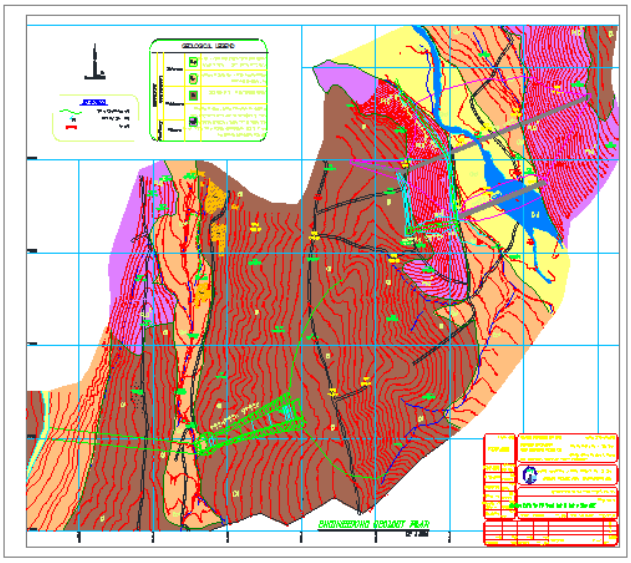
ABSTRACT
Eyvashan dam in lorestan state, is located in the north of khorramabad and in the west of Iran country. Geologically, some geological unit such as old allurial sediments, conglomerate new allurial sedimens are considered. Water pass characteristic in axis surroundings and lake, monoaxial pressure resistance-triaxial pressure resistance-streching solidity-dynamic parameters (cutting and pressuring waves) have been used to study geomechanical characteristic and reaction of dam. To improve the study some basic characteristics such as dry density, saturation and water absorption percentage and stability index were used at last dam base has been classified by rock mass RMR system. Results showed that dam base is new and mixed conglomerate according to desert consideration, there is no important tectonic in this region. Water current characteristic in axial area and lake showed that the base conglomeratical mass is not porous at axis and lake according to lugeon tests with (CR) and (RQD) quantities, it is possible to present there is perfect water tight of conglomeratical materials on dam axis region. Result showed that eyvashan dam foundation is water tight under axis, so is not necessary to provide some processes for water tight as inject sheet. Monoaxial pressure resistance showed low resistance water absortion percentage. Rock mass porosity of the dam base is low, so it is useful point. RMR classification led to RQD and distance had so suitable discontinuity of rock and it is dry due to water condition. Also, rock mass class is on normal class. Finally, we can conclude that eyvashan dam base is perfectly water tight as porous aspect and it is safe certainly with due to geomechanical parametres for all kind of flexible dam (sand-soil).

Key Words: *Geomechanical, Propertices, Eyvashan Dame, Khorram Abad*

INTRODUCTION
Iran is a dry land with inadequate atmospheric descending, annual rainfall is approximately 250 mm that is less than Asian average and is approximately one-third of rainfall average in the word. So, use of underground water resources have been considered for many years (Khonlari and Malmir, 2009). Mking Dam is a way to trap water (Asadinia and Mirzeynali, 2009). Rock mass quality is one of the most important parameter in designing and constructing of dam (Rahmannejad and Mohammadi, 2007). Lorestan state has move rain desending for its mountioainous area (zagros) so it has potential for dam constructing the porpose of this article is to study geomechanocal characteristics of eyvashan dam base. In addition to RQD, Ewert in 1977 proposed to porous amount must be estimate to seams. In this article we studied them perfectly for rock mass classification (Bieniawski, 1989) was used.

Geologic Setting
From geologic setting view, studied region in zagros zone or high zagros (Allochtone) is in chaghalvandi area is vast area. It is 50 km distance of the east of khorramadad-broujerd road it's surrounded by calcareous high mountion. The scope of this mountion and plain border is covered by some rising ground of conglomerate materials. Infact, sourrouded mountions of this plain are water current basin them osteparts of chaghalvandi plain are covered by new alluviumas sediment material is sand-clay and gravel. These sediments with high thickness of clay and silit (some place 30meters) are aplace for agriculture. Sedimentary unit at studied region old to new are calcareous and gray colur or bitolian (middle cretaceous period), mix conglomerate, low solidity and sand cement with light gray colur (Paleocene epoch-paleocen

eepoch), old alluviums, high stand (Paleocene) new alluvium, low trace plain (Holocene) river large grain sediment (Holocene). The most parts of area are covered by new sediment and only some border areas are covered by cretaceouse calcareous sediment. Plan1 shows studied area and eyvashan dam base. Seasonal and permanent rivers on their current related topography of area caused some low allurium traces according to consideration of clay wall wrinkle and geological consideration and desert studying on eyvashan dam region and with due to results, hydrological and expertise views, it is possible to say underground external currents on natural condition to riveral sediments and alluvium are related to right now period or present era because of low thickness, in excavation process, performing, axis and body of dam are on unpenetrable conoglomerate so hydrolical conection among underground current have been closed or obstracted.



Map 1: Map of the study area

Seismologic Settings

Eyvashan dam base with due to modern view of geology and seismology located pnmorable or shakable region we can refer to following case:

1) Surface and depth break establishment in the estern south of foult in doroud from basic new fault of zagros during earth quick in silakhor in 1909 (Ms=7.4)
2) Presence of new faults and movement in quartz such as Doroud fault, hatam tower fault and Varkooh fault.
3) Step faults formation in quartz ditch
4) Movement (shaking) running in 20 century
5) Earth shakes expansion for instance in the south of Rahband village, Pahlevandkal and soon.
6) Earth structure subsides of sedimentary plain in silakhor on direction of Doroud fault.

Fault has been studied as the most important source of earth quick. So, the most important basic faults of plan region such as newgreat fault of zagros and expecially small fault of Doroud have been explained by this new great fault that is in 14/5km distance of eastern north of eyvashan dam base. In addition to, for recognition of earth construction process in near by base aerial figure (photo) of plan has been interpreted and with due to geological maps, geologic map of region plan pn to pographical plan with scale of 15000 were provided and were presented to report shaking or movement. These studied region showed that from all recognized fault, north fault of Safar abad (with 12km length on direction of its linear part at 5.8 km distance of base) and Doroud small fault (with 100 length at 5.14 km distance of base) had the most effect

on power fulorstrong movement parameters of earth in base by reaction other faults have less effect. Aerial phtographs with 14000 scale and satellite photographs of region plan, doesn't show its fault under the axis. With due to eyvashan dam base is on new conglomerate reworked from Pleistocene epoch conglomerate of bakhtiari so if its fault go more depth according to internation commeitte of great dam won't define as movable dam. So there is no danger of fault under axis, then there is no danger under axis of dam during its life. Earthquicks datas from different and up to dated resources in 2002 have beencollected, analyzied to calculated earth quick danger (risk). Samll and pre earth quick was omitted from low statistics of earth quicks to provide base shakes. Shake parameters M max for 100,150,200km region around of base has calcaulate (chart 2-6) results showed that at 100km and 150km region will occure earth quick Ms6/4-Ms6/2 during its life. According to international committee order of large dam (ICOLD, 1986) tips, strong movement parameters of earth in eyvashan dam base has calculated for probabilistic method analysis of point resources. Linear and regional of earth quick have been calculate result showed that probility of extra movement comparable to disaster of 1909 in Silakhor region in 150 km area 93% will calculate. Probabilistic methods have calculated for returning of 500,1000,1500,2000 years. Chart one shows the results of earth movemeny in this chart delerministic method results have related to long returning period (< 2000 year).

Table 1: Seismic profile of the study area

No	Surface seismic in design	Return earthquake (Year)	Maximum horizontal acceleration (g)	Maximum vertical acceleration (g)
1	(DBL)	500	0.31	**0.23**
2	(MDL)	1000	0.40	**0.29**
3	(MCL)	> 2000	0.51	**0.50**

MATERIALS AND METHODS

Methodology

To provide tectotic study, region has been visited several times and their results were noted for water pass (current) characteristic assessment on dam base region and lake, 13 exploratory diving rods (dowse) on dam axis region in per5 meters advance, lugeon water pass test were done on different pressure degrees (steps). Lugeon test results have been shown at (2) (3) (4) (5) and (6) charts exploratory diving rod (dowse) were shown als, at (1), (2), (3), (4), (5), (6), (7)and (8) pictures. To study konglomoral rock charactenstic under side pressure, sometriaxial resistance tests were done on intact sampel of rock in saturated condition. This test was done on ten samples of conglomerate rock materials of Eyvashan dam axis Some cylindrical sampel were tested by wave speed test for cutting and pressure waves speed measurement in Eyvashan dam base. Score calculation was done by five parameters in thismethod.

Figure (1), (2): Exploratory boreholes of depth meters1 to 8 meters

Figure (3), (4): Exploratory boreholes of depth meters9 to17 meters

Figure (5), (6): Exploratory boreholes of depth meters18 to27 meters

Figure (7), (8): Exploratory boreholes of depth meters 25 to 34 meters

Following pictures shows exploratory diving rod (dowse) from one to thirty four depths. Eyvashan dam base is on conglomerate sediments with almost 500km thickness with due to new sediment effected by alpian tecnotic phase, it cause by coming up of lower calcareous sediment grade from horizontal condition in right pack that has been changed to 25 degree on left pack. So, it is possible to express that slow grade of steps in some spots were caused by were caused by tectonic phase. There is no trace of conglomerate wrinkle except conglomerate sediments of local grade. The most well known method to calculate penetration (porous) of rock foundation is water pressure test that was supposed by lugeon penetration test in 1993 and it was nominated by this name according to lugeon penetration test86 percent.

RESULTS AND DISCUSSION

Results

Datas, with less than one lugeon, 9 percent has 1to2 lugeon amount and 5 percent has between 2 to 3 amount (2),(3),(4),(5) and (6) chart,(1),(2),(3),(4) and (5) graphs, monoaxial pressure resistance of 9/5 rock mass.

Table 2: Results 12 to 17 m deep testLUGEON

			Water Pressure Testing (LUGEN) – 12 To 17 m			
Min	**Initial**	**Final**	**Reading**	**D**	**LIT/ Min /M**	**LUGEN**
5	0	0	213	225	12	
5	0	1.5	225	233	8	
5	1.5	1.5	-	239	6	0.8
5	1.5	1.5	-	245	6	
5	1.5	3	245	255	10	
5	3	3	-	266	11	0.93
5	3	3	-	276	10	
5	3	5	276	292	16	
5	5	5	-	311	19	1.14
5	5	5		329	18	
5	5	3	329	343	14	
5	3	3	-	356	13	1.20
5	3	3	-	370	14	
5	3	1.5	379	381	11	
5	1.5	1.5	-	389	8	1
5	1.5	1.5	-	396	7	

Elasticily of inact rock is equal to 4/2 Gpa,andpoisson coefficient of intact rock is equal to 0.25 cutting resistance parameters (Hoke and Brown) are 20 = m s = 1 and cutting resistance parameters of mohr and coulomb are 4s and 230 kg/cm=c. Streaching solidity average of conglomerate rock sampel at natural and saturated conditions are 0.56 Mpa and 0.53 cutting and pressure wave speed average in tested intact rocks of conglomerate are 2595m/s,1460 water absorption percentage is 71/3 on fifth cycle. Chart (7) shows the following result with RMR classification geomechanical charactenstics of rock mass of dam base are on chart (8).

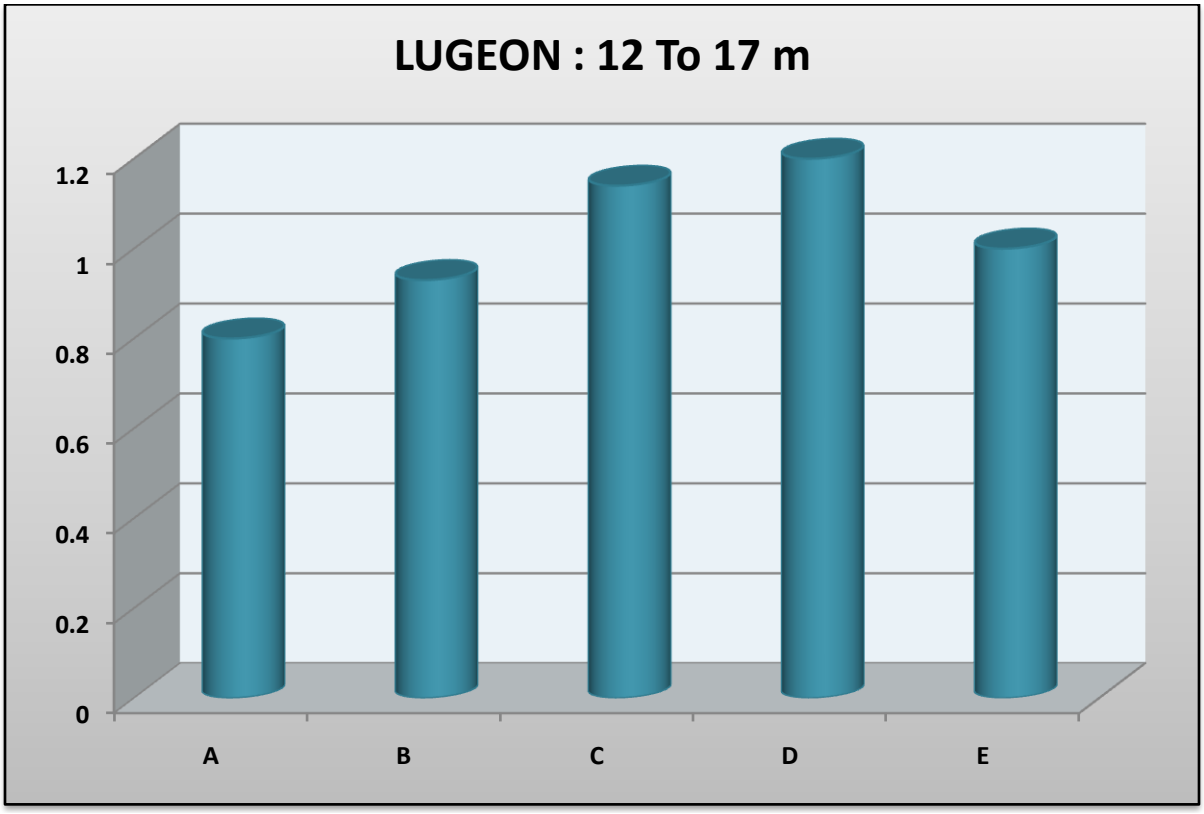


Figure 1: Results 12 to 17 m deep test LUGEON

Table 3: Results 17 to 22 m deep test LUGEON

			Water Pressure Testing (LUGEN) – 17 To 22 m			
Min	**Initial**	**Final**	**Reading**	**D**	**LIT/ Min /M**	**LUGEN**
5	0	0	824	843	16	
5	0	6	840	843	3	
5	6	6	-	844	1	0.025
5	6	6	-	844	0	

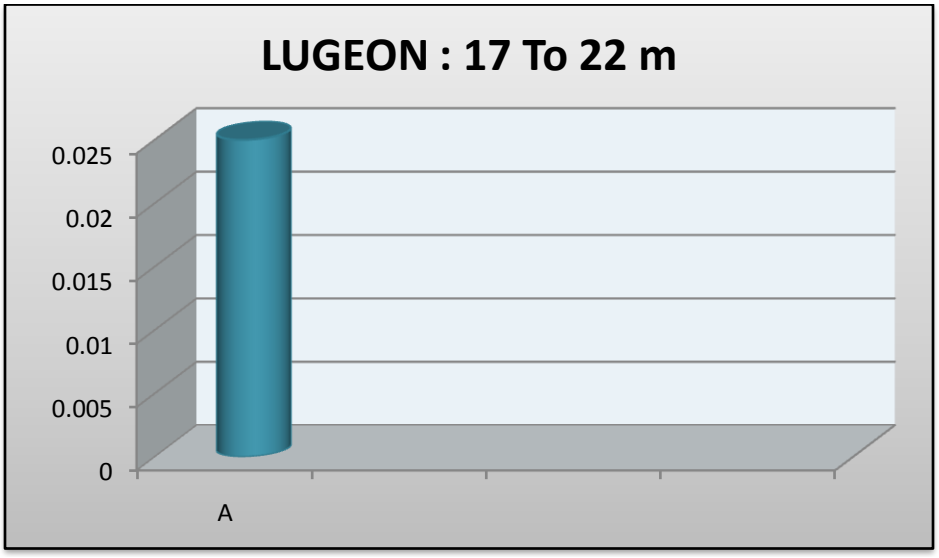


Figure 2: Results 17 to 22 m deep test LUGEON

Table 4: Results 22 to 27 m deep test LUGEON

			Water Pressure Testing (LUGEN) – 22 To 27 m			
Min	**Initial**	**Final**	**Reading**	**D**	**LIT/ Min /M**	**LUGEN**
5	0	0	185	196	11	
5	0	7.5	196	203	7	
5	7.5	7.5	-	206	3	0.12
5	7.5	7.5	-	209	3	

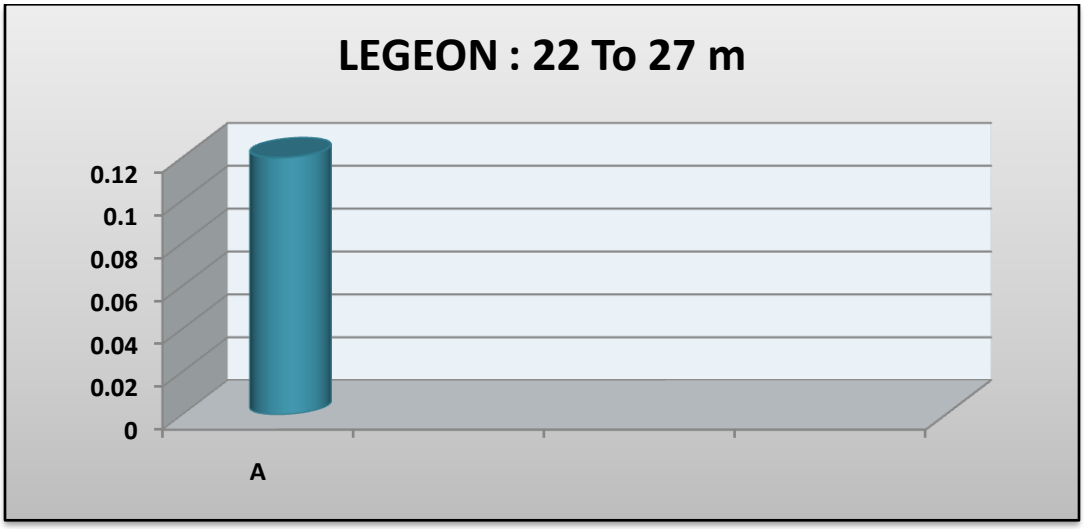


Figure 3: Results 22 to 27m deep test LUGEON

Table 5: Results 24 to 29 m deep test LUGEON

Water Pressure Testing (LUGEN) – 24 To 29 m							
Min	**Initial**	**Final**	**Reading**	**D**	**LIT/**	**Min /M**	**LUGEN**
5	0	0	155	163		8	
5	0	6	163	166		3	
5	6	6	-	167		1	0.12
5	6	6	-	168		1	

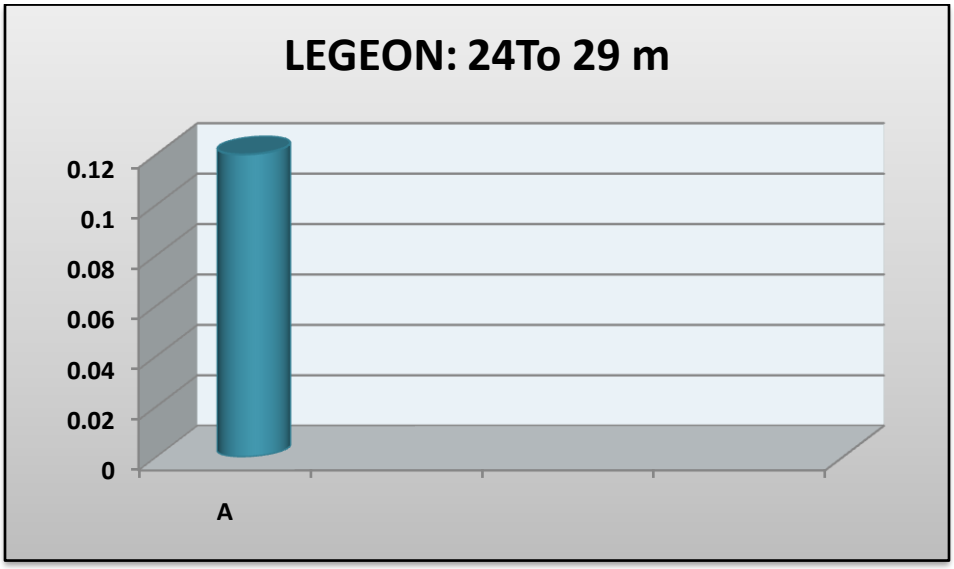


Figure 4: Results 24 to 29m deep test LUGEON

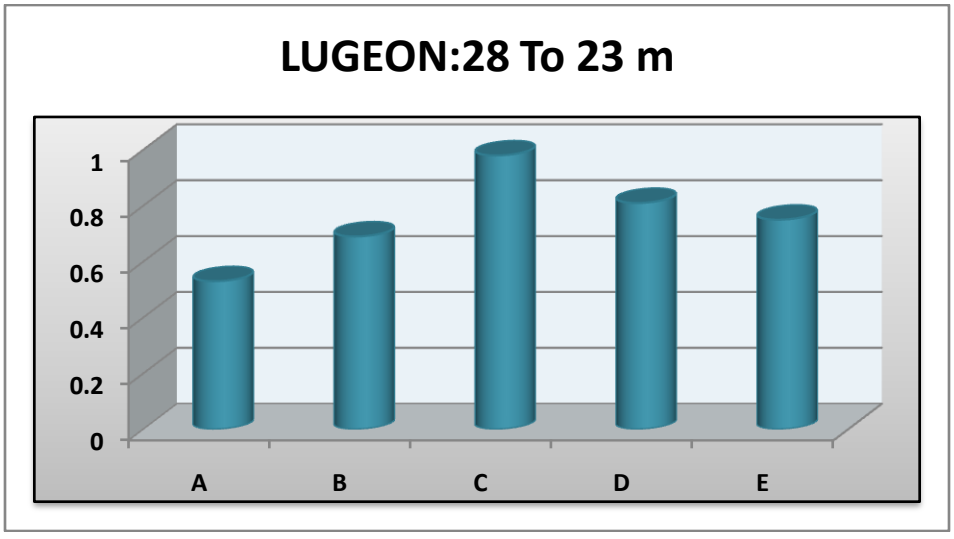


Figure 5: Results 23 to 28m deep test LUGEON

Table 6: Results 23 to 28 m deep test LUGEON

Water Pressure Testing (LUGEN) – 28 To 33 m						
Min	**Initial**	**Final**	**Reading**	**D**	**LIT/ Min /M**	**LUGEN**
5	0	0	550	557	7	
5	0	2.5	557	568	11	
5	2.5	2.5	-	575	7	0.53
5	2.5	2.5	-	583	8	
5	2.5	5	583	596	13	
5	5	5	-	610	14	0.69
5	5	5	-	624	14	
5	5	7.5	624	646	22	
5	7.5	7.5	-	671	25	0.98
5	7.5	7.5	-	698	27	
5	7.5	5	698	716	21	
5	5	5	-	736	17	0.81
5	5	5	-	752	16	
5	5	2.5	752	765	13	
5	2.5	2.5	-	776	11	0.75
5	2.5	2.5	-	786	10	

Table 7: Geomechanical Classification of Rack Mass Eyvashan Dam Base Based On RMR System

Parameter	**Descriptions or quantity**	**Score**
UCR (Mpa)	9.5	2
RQD	(Map E-104) > 90	20
Distance (m)	No joint	20
Condition of Joints	--	30
Water status	Rack Mass No Water	15
Tend of Layering and Joints Than Loading Level	Very Good	0
Class of Rock Mass	Very Good	7

DISCUSSION

Because there are no tectonic features such as seam at source and dame base region. So, it is possible to express that geomechanical characteristics of base rock originate of intact rock mass characteristics geological studies showed that except local grade of conglomerate sediment, there are no trace of wrinkle in conglomearte steps because there is no seam system or foult according to surface and under surface studies. So, there is no effect of tectonic phase on this sediments so, wecant say that wrinkle and tectonical features caused by tectonic power actions in eyvashan dam lake and axis region. Morphological

condition on lake and axis region of dam show that there are no tectonic features in but hydrological condition showed conglomerate mass of lake and axis base aren't penetrable because pressure resistance monoaxial of rock is less than 25Mpa and 9.5 so, it is on the low rank. Lugeon penetration tests results show that this amount by their correlation with rock quality dimension (RQD) and recycle percentage of rock core (CR) are because of water tigh of conglomerate materials in dam axis region. Elasticity for base rock mass shows suitable number and amount of C shows adhesiveness of rock grain of dam base. The result of stretching solidity is also con firmable

Table 8: Rack Mass Geomechenical Propertices and Virgin rock Eyvashan Dam Base

Lithological Description		**Conglomerate With Calcitic Cement and Sometimes Silicate - Clay**
Properties Of Hydraulic and Gullies basic characteristics		Rock Mass = Impervious Dry Density = 2.5 gr/cm^3 Saturation Density = 2.55 gr/cm^3 Water absorption(%) = 1.4 Porosity (%) = 5.5 Sustainability Index (Second Cycle) = 87.5
Rock Virgin	**Rock Mass**	Virgin Rock Mecanical Propertices and Rock Mass
UCS = 9.5 Mpa		Rock Mass at Saturation
E = 5 Gpa	E = 2.5 - 3	
γ =0.26	υ = 0.26	
To =-0.53 Mpa	φ = 35	
To=-0.56 Mpa	C = 30 kg/cm3	
M = 20	RMR= 87	
s = 1/0	M_R = 10.8	
A = 1/13	S_R = 0.13	
B = 0/699	A_R = 0.949	
φ = 45	B_R =0.706	
C = 30 kg/cm2	100 kg/cm^2 >$q_{allowable}$	

result of cutting and pressure waves that are important to engineering purposes it is possible to express that differences between them are confirmable about base and physical characteristic of rock, is possible to say that this mass has low absorption so it is suitable to build a dam because high absorption percentage is dangerous. According to bell 2000, rock mass is on low porosity and density low prosity is so useful. Stability index also showed suitable number. Geodynamical classification of rock according to RMR or CSIR classification was studied by (Bieniawoski, 1984) UCS amount shows show sunsuitanle number. RQD shows%90 that is acceptable number it is highest number with due to scoring system and shows the high quality of dam base rock because there is no seam at studied region so it is possible to devote 20 numbers to this parameter that it is so important. Rockmass doesn't have water and it is dry related to low percentage of rock. Nonexistence of water in rock mass is one of the potentials to construct a dam in this region for loading is so suitable and number for rock class is 87 so rock mass is in the class one. According to hydrolical and water pass characteristics we can express that the most of results of lugeon tests are less than one. So rock mass is not penetrable according to some seam or clear techtonical features in lake and dam axis region results. Water tight lugeon amount (is equal to zero) of this kongolom are sediment showed nonexistence of techtonical features. Loading coefficient according to test is more than 2100 kg/cm so, it is possible to express in this article that eyvashan dam base is water tight

and impenetrable it is suitable for all kinds of flexible dam (sand and soil) by geomechanical parameters view and it is so security condition or safety.

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