

Research Article

Geomechanical Characteristics of the Rock Mass of Giladeh Mine

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Abstract: Those properties that directly affect the mechanical behavior of the rock mass and stability of the mining and drilling, they also affect the ability to call Geomechanical features. In this research, the stability of rock masses of Giladeh construction mine Astara city is investigated. For this three classification of rock masses RMR, Q and GSI method are used. The results showed that the stability of the rock mass is good and capable of drilling in rock mining based on the Weaver (1975) is difficult and very difficult. It is anticipated that the impact of earthquake ground shaking is only included on mine. Slip into local ground failure phenomena may also affect the scope of the stairs.

Keywords: Classification GSI, category Q, classification RMR, giladeh mining, ore reserve estimation

INTRODUCTION

Giladeh village functions Astara in Gilan province and the city. A Giladeh village about 5 km from the border with Azerbaijan and directly about the same perplexity pass away (Mehdipor, 2013). Giladeh mining, mineral used in construction industry as well as rubble and sand mining has to be broken. To do this step by bulldozer construction and mineral extraction can be easily extracted. The field study was three steps, each of length 150 m and a width of about 6 meters with a gradient of 60 to 70 degrees in order to remove the wall of the mine construction and mineral extraction has been done. Depending on the degree of stability of the mines, the importance of engineering geology and Geotechnical studies and vary according to the time of permanence. Because mine Giladeh to permanent and long-term operation is planned. Due to the very high costs, which in total will be spent to implement different parts of projects and also, given the fact that the problems in each part of the project, project performance will suffer, engineering, geological studies designed to provide important data and identify potential hazards and problems during implementation and operation are clear. Hence, engineering, geological studies in the study area, to determine the engineering characteristics of different units and evaluate the mechanical behavior of the rock mass are of course very important. In this study, physical properties, mechanical strength of rock outcrops, surface area and the field evaluation on engineering judgment is determined.

General geology of the area: Alborz heights of nearly 1600 km and along approximately east-west in the south central part of the curvature change with regard to tectonic zone, tectonic zone that matches the name of the block in the northern part of the plateau of Iran's Alborz be remembered (Nazari *et al.*, 2007). Sedimentary basin-including the long northern Alborz Iran's Page is a composite anticline in a direction east-west, stretching from Azerbaijan to Khorasan. Consistent with the range of the northern hills composed of Tertiary deposits of the Caspian coastal plain south of the central plateau of Iran are limited. Marine sediments on land, the construction of the Paleozoic, Mesozoic and Cenozoic are. This is the last area in the late Pliocene Alpine orogeny-Early Pleistocene to the present landscape has occurred. Eocene sediments of the Alborz range, including the formation of pilgrimage and Karaj are slow. Pilgrimage limestone formation, limestone Nummolities is a single indicator that is based on the fossils of animals such as Nummolities, Alveolinids, remains of mollusks, algae and Bryozoa age is determined. Tuffites Karaj Formation sediments contain a relatively thick sequence, of green and rarely evaporate sedimentary rocks and lava, which is called the Green series of different layers of green, green Tuffite, etc. it is mentioned. These are based on animal fossils, including foraminifera and Radiolarians determine the age of artifacts and the remains of fish have been (Alimi *et al.*, 2010).

Morphology and geography: The Talesh Mountains region is the mountain trail with the North-South part of

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the area is covered with vast local and names, including Boghrodagh, are named. Boghrodagh mountain views of the morphology of the body of an anticline, the anticline and Syncline emerging from some, has emerged. Vicinity of the Caspian Sea and the eastern slopes of the field having sufficient moisture, covered with dense forests and therefore the erosion of river beds and streams are more limited. The department has a range of morphological rough and very steep mountain slopes and in valleys with vertical walls is very tight. These rivers, all ending in the Caspian Sea. On the west side of high mountains with heights postal morphology is gentler than the eastern part, mountains and valleys with gentle slopes are relatively flat plain that they all accept the Ardebil. Gharehsou River west slope of the mountain derives effort and after joining other rivers in the region, to the west is flowing. Astara road-Ardabil is the most important way of communication, dirt roads radiating from the road that leads to the rural areas, access to forest areas is possible only by way of Malraux.

Geomechanical properties of rock masses: Those properties that directly affect the mechanical behavior of the rock mass and stability of the mining and drilling, they also affect the ability to call Geomechanical features. In addition to these properties that reflect the behavior of rock material are largely dependent on the conditions of discontinuities. Properties of the rock material can include cases such as uniaxial compressive strength, tensile strength, shear strength parameters, M. Young, abrasive, hardness, etc., he said. The determination of these properties requires accurate sampling of all units of laboratory tests on the same sample is, however, using some preliminary field tests are also estimated. To determine the condition of discontinuities in the rock mass is also necessary act Profile discontinuities in different parts of the study area, using the method of harvesting or sporadically examined at different stations. This profile includes the differences, spacing, continuity, opening the filler material, insert weathered surfaces of the joints, etc. is discontinuity between roughness and wave have systematically been picked and are being analyzed. In this project we investigate the properties of rock masses for different number of stations with respect to changes in the rock mass characteristics were selected and the parameters picked up. The report examines the characteristics of rock outcrop geology is presented at each station. Finally, to summarize data at each station designed to provide geological and engineering geology of each species will be discussed.

MATERIALS AND METHODS

Although geologist's day-to-day office, laboratory and become more dependent on computers, but are still

collecting data, Lithology, structure and morphology of field work are required (Karami *et al.*, 2012). Geology and Engineering Geology lot of information applicable in the design of various structures such as mine are, Surface impressions can be produced. In the land of the most important features that are to be removed, including properties of rock units, structural features, morphological, stratigraphic unit boundary, detected faults, folds and other structures, geological conditions and extraction characteristics of discontinuities in such cases, that the extraction Surface discontinuities are considered. Surface withdrawals of this project have received special attention during the visits, the action picked up in mine geology and engineering geology of the surrounding area is. Based on field surveys, to study the engineering properties of the rock mass through field tests and discontinuities properties were withdrawn. It is worth mentioning that the average distance between the profiles of 10 meters and gravity ore 2.8 is considered.

Calculation of ore reservw estimation giladeh:

Reserve estimates, particularly in the mining operation, one of the most important parameters of mine design and production scheduling (Keshmiri *et al.*, 2004). Also, be aware of the quantity of each mineral exploration and mining work, the more obvious is the need for reserve estimation. Due to the regular Quarry Mine Giladeh steps with equal intervals of about 10 meters will be built, so the determination of mineral reserves of Cross-Section is used. If S_1 and S_2 cross-section profiles are stored in two consecutive h is the distance between two profiles, while assuming continuity of mineral-based information to prove discontinuity of the ore (such as a fault) there is between these, the volume of mineral between the two profiles can be calculated in one of the following methods: In the first method, if the difference is less than 30% of S_1 and S_2 compared with the volume of a prism with a base equal $\frac{S_1+S_2}{2}$ and height h , the desired volume relationship $V = \left(\frac{S_1+S_2}{2}\right) \times h$ otherwise, it is calculated and if the difference between the two levels higher than 30%, the volume between two consecutive levels of a relationship based on frustum:

$$v = \left(\frac{S_1 + S_2 + \sqrt{S_1 \times S_2}}{3} \right) \times h$$

Is calculated. A deposit is required to calculate the total volume between any two consecutive volumes is calculated and then added together and the total volume is calculated by multiplying the volume density and grade of mineral reserve is calculated. Discontinuities analysis by DIPS softw, are were analyzed.

RESULTS AND DISCUSSION

Mechanical behavior of rock discontinuities strongly influenced by the characteristics of the system and the number of joint sets are. The mechanical behavior of the rock mass has a big effect on the instability (Antoniou and Lekkas, 2010; Grenon and Hadjigeorgiou, 2008). Therefore, careful analysis and review of field joints and fracture system properties of the rock slope stability analysis is the most crucial (HedaiatiTaloki *et al.*, 2011). The study is based on classification Anon (1981) attempts to determine the categories and methodically BGD ISRM (1978) standards (Table 1). Based on the studies carried out on site visits to the region, a total of a species can be identified and distinguished from each other engineering geology in the mine (Table 1). In most cases of engineering, geological boundaries coincide with the boundaries of engineering, geological units are

separated by a single stone and earthen unit. Folding of the units given in Table 1 match folding zone with no effort and a lot of change is usually very small folds in it does not. But they can be extended to a general north-south considered. Layering outcrops of these units often have low to moderate slope (between 10 and 35 degrees), respectively.

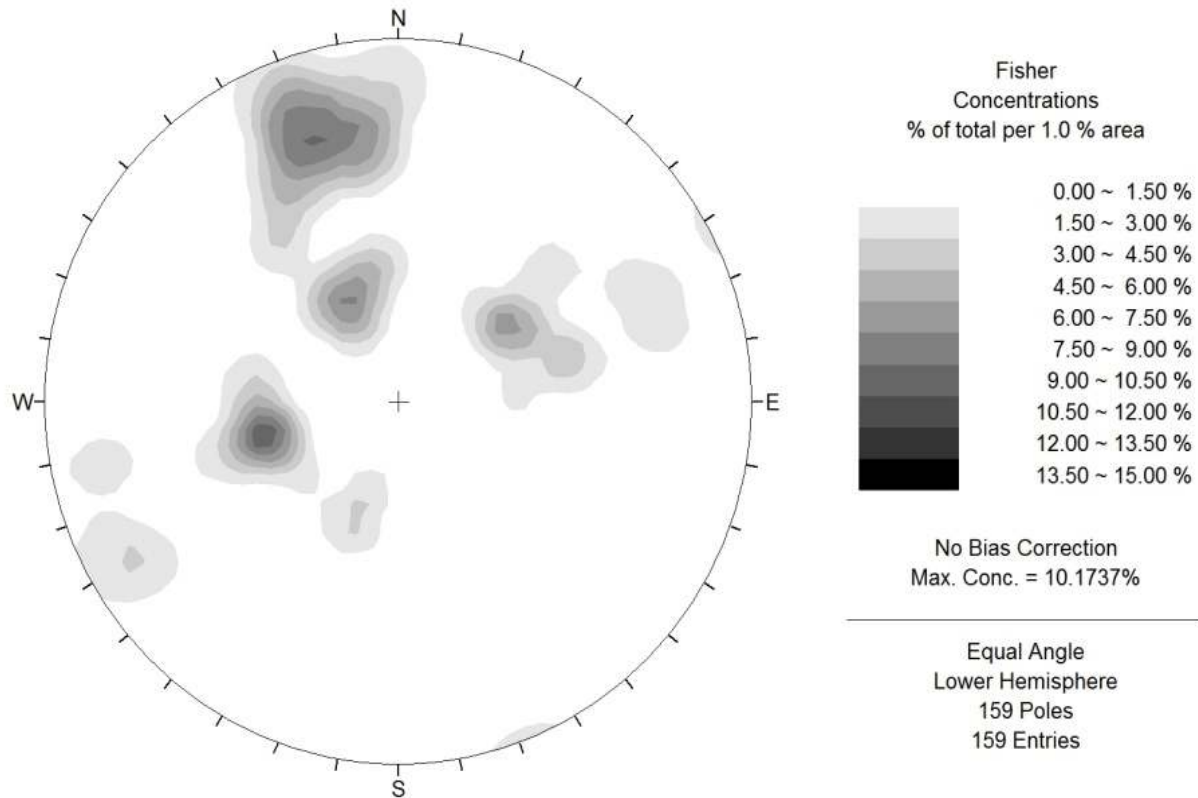
In this study, to evaluate the shear strength of discontinuities nonlinear Barton and Choubey (1977) is used (HedaiatiTaloki *et al.*, 2011). Discontinuities features including distance, length, weathering, separation, JRC parameter, the average spacing, filling at a stone quarry unit Giladeh were examined (Table 2). The JRC is based on field evaluation and comparison with standard charts are evaluated against 10-12 (Table 2). Some surface characteristics of the rock mass discontinuities in surface outcrops and deep rock mass were somewhat different. Particularly weathering and

Table 1: Species identified in the engineering, geological mine Giladeh

Row	Species of engineering geology	Stratigraphic units/equivalent	BGD class	Lithology
1	Kv	L ₂ .F ₁ .S ₂ .A ₁	Volcanic rocks	Cuts and shear volcanic
6	Q		Quaternary	Varies with soil gradation of sand and silt and clay

Table 2: Characteristics of the different categories of discontinuities in the rock unit Giladeh mine

No	Eng. Geological type	Discontinuity sets	Average spacing (m)	Discontinuities condition							JRC (Borton 1977)
				Length (m)	Seferation (mm)	Filling	Roughness	Waviness	Weather eg		
1	Kv	4 joints sets	1	>2	<10mm	CLAY	Rough	Undulating	Mw	10-12	



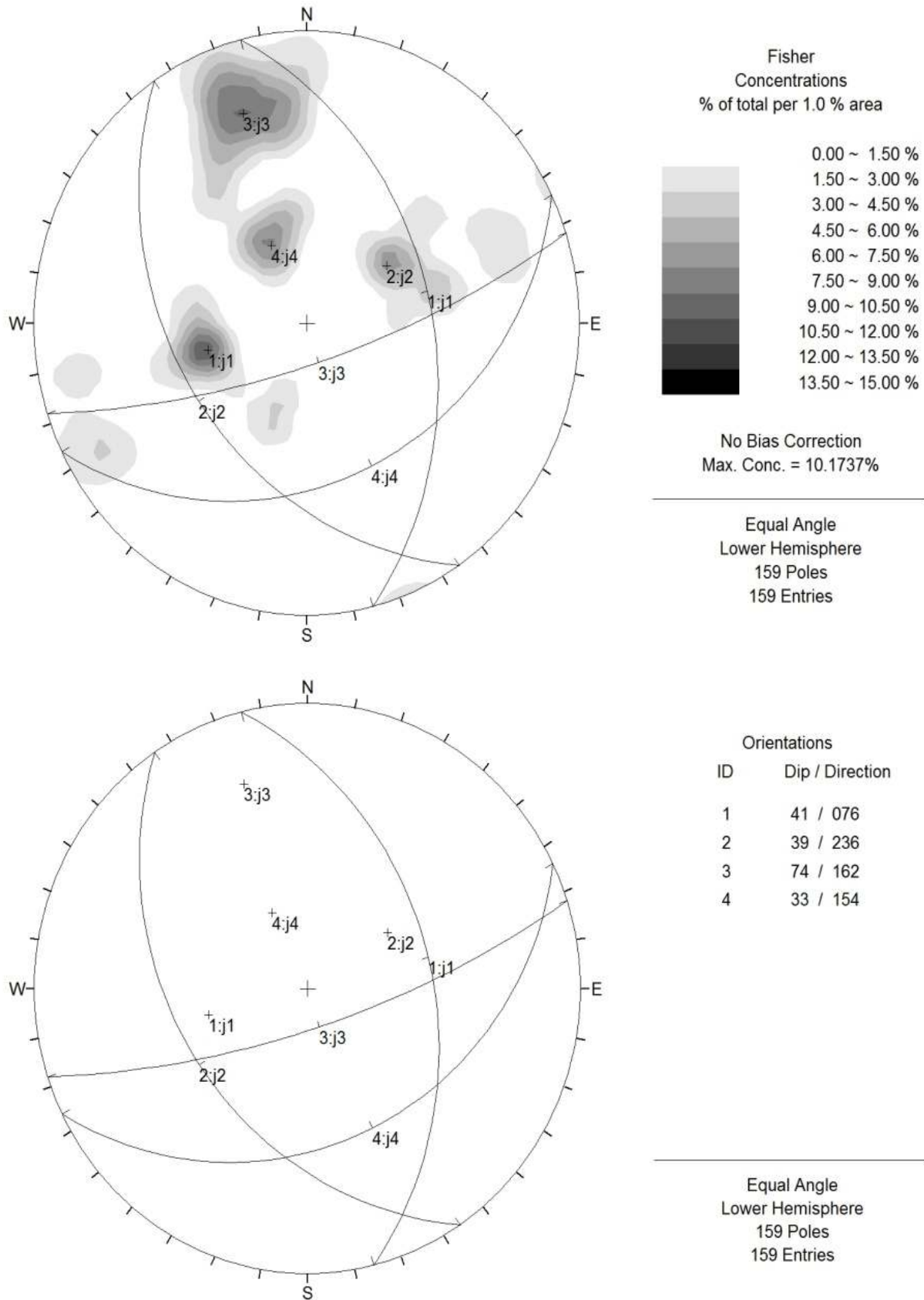


Fig. 1: Analysis of discontinuities in the Giladeh mine

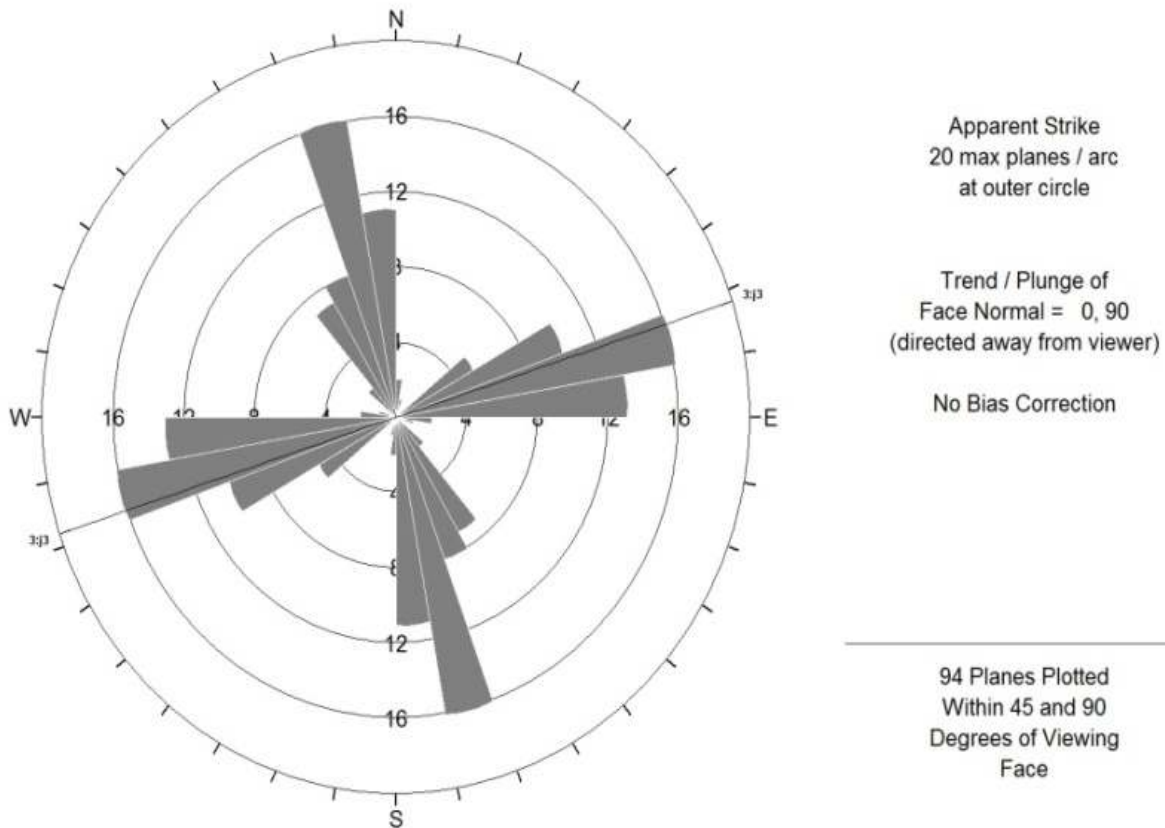


Fig. 2: Rose diagram analysis of discontinuities in the Giladeh mine

Table 3: Results of the analysis of discontinuities

Discontinuity	Slope	Slope direction
Joint sets 1	41	076
Joint sets 2	39	236
Joint sets 3	74	162
Joint sets 4	33	154

Table 4: Results of the average RQD to estimate the mass of ore Giladeh

Kv	Unit	RQD (%)
65	Priest diagram	
70	Proposed number	
Good	Description	

opening up two depth discontinuities in the rock mass conditions were completely different level.

In the next step we analyzed regional unconformity system and image discontinuities. Stereo Graphic and Rose diagram of polar graphs and structural forms in Fig. 1 and 2 are presented. According to the obtained results in Table 3 discontinuities within volcanic formations with a total of 159 joints.

Engineering classification of rock masses: Access to complete information about the values of the parameters involved in the design of a stone structure of the basic requirements in performing engineering activities. In general the preliminary stages of a project designed, limited information regarding the

Geotechnical properties of the rock mass, the amount of stress and other factors is available in the design. Several methods exist to determine the characteristics of the rock mass, such systems can be classified as ore. Use one or more types of classification systems simultaneously considering the fact that some systems than any other in the calculation of the parameters are preferable, it can help in determining the optimum parameters of the rock mass track (Palmstrom, 1996). In order to classify the rock mass in Giladeh mine three common methods of Rock Mass Quality index (RQD), Geomechanics rock mass classification (RMR) and Q system is used (SamadiSofi and AjaLoian, 2011).

RQD classification: To determine the mass RQD rocks, the average spacing of discontinuity with statistical studies of Palmstorm (1982) in Engineering Geology unit set and then use the comparison chart Priest and Hudson (1976) values were determined. Table 4 shows the RQD of the rock mass.

Geomechanical classification (RMR): To determine RMR of Giladeh mine rock mass classification provided by Bieniawski (1989) is used. The classification of six factors: 1- axial compression strength of rock material, 2- rock quality index, 3- joint spacing, 4-the joint surfaces, 5-ground water conditions

Table 5: Summary of RMR calculated the mass of ore Giladeh

No	Eng. Geological type	RQD (%)	UCS (M gu)	Discontinuities Condition	Coround water condition	Oriendaition	Basic RMR	Adi RMR	Description	Cohesion of rock mass (kpa)	Friction analog rock
1	Kv	70	120	25	Wet	Good	57	52	Fair rock	200-300	25-35
		13	12		7	-5					

Table 6: Summary of Q calculated lump ore Giladeh

No	Eng. Geological type	RQD (%)	Jn	Jr	Ja	Jw	SRF	Q	Class
1	Kv	70	Four joint	Rough-page	Moderate	Dry	Deficit-nearly	5.6	Fair
			12	3	1	1	2.5		

Table 7: Classification capability of drilling in rock mining (based on the proposed Weaver, 1975)

Description of the drilling	Total Points	Slopes and along	Disruption (mm)	Continuity (m)	Spacing (mm)	Degree of weathering	Hard rock	Shear wave velocity (m/s)	Unit
Very hard ripping	63	Favorable	< 1 m	Continuous- not gouge	1000- 3000	Weathered	Soft rock	1500-1850	Kv
		5	4	3	25	5	1	20	

6-no discontinuities to determine the mass Geomechanical the stone is considered. If the RMR calculated from the geometric relationship between discontinuity and it is regardless of the trenches, RMR obtained RMR Basic is called (SamadiSofi and AjalLoian, 2011). The R MR system to each of these factors based on the factor or parameter values, certain points awarded. Total points above the RMR value is considered. RMR was calculated results indicate that the mass of rocks in rock masses Giladeh mine is located in a good amount of basic RMR equals 57 criteria (Table 5).

Q classification system: Q system based on numerical evaluation of rock mass quality using six parameters is done. These parameters are: the rock quality index (RQD), the number of joint sets (Jn), the most jarring discontinuity roughness (Jr), the degree of weathering or filling the most critical discontinuities (Ja), ground water conditions (Jw) and stress conditions (SRF). Q value is determined using the following equation:

$$Q = \frac{RQD J_r J_w}{J_n J_a SRF}$$

The results of various parameters related to the classification and calculation of Q in Table 6 has been inserted.

GSI classification system: Strength index GSI rock mass classification system based on field observations of rock mass characteristics will be evaluated by Hoek *et al.* (1998) is presented. To determine the engineering activities to be proposed by GSI (Hoek and Brown, 1997), we used the following equation:

$$GSI = RMR_{89-5}$$

Based on the proposed GSI ranges for different rock mass range studied, respectively (Table 7) will be.

The ability to estimate the mass excavation of ore giladeh: One of the most important parameters of rock

Table 8: Results of Geological Strength Index GSI of ore Giladeh

No	Eng. Geological type	RMR	GSI
1	Kv	57	52

mass classification of operations, availability of drilling and excavation in them. This parameter, depend on several factors such as the physical and mechanical properties of intact rock, the rock mass discontinuities and the total correlations are Geomechanical conditions. Rock mass classification in terms of their ability to dig far and methods Several proposals have been presented by several researchers each is based on a combination of factors that have been empirically rock mass classification. Grading scheme that uses two categories Geomechanical changes and corrections in the RMR and Q and they are designed order by Weaver (1975) and Kirsten (1982) are presented. All the above methods have been proposed for excavation and surface excavations and objective evaluation of their offers the ability to create a pit mine is excavated in the rock mass. Wearer method uses seven factors: 1- shear wave velocity, 2-hard rock, 3-degrees of weathering, 4-spacing, 5-Continuity, 6-opening 7-to no discontinuities in the rock mass ratings share. Each of the aforementioned factors based on the rock mass condition specified points awarded. Total-point drilling capability of the rock mass can be determined. Excavation of rock mass is divided into five different categories of Easy rips to Extremely hard ripping and requires Demolition Blasting changes. This classification is based on the category of the rock mass, rock excavation machinery requirements have been introduced. The results of the above-mentioned classification of rock units in the mine Giladeh in Table 8 are presented. As you can see the volcanic geologic unit capable of drilling in the category of difficult and very difficult to be in other units. Bulldozers of the proposed excavation units have been determined based on the classification of D9 and D8.

CONCLUSION

The results from the engineering classification of rock masses Giladehmine, degree of weathering and

filling medium, has four joint sets, a total amount of 159 Joints discontinuities within volcanic formations, dry ground conditions and the wet weather, low stress condition-near the earth's surfaced is continuities between 200-300, quality index 70% and were rated as good in rock masses. The JRC (joint surface roughness index) based on field evaluation and comparison with standard charts are evaluated against 10-12. Likelihood of structural collapse in limestone and Anhydrite units of Gachsaran grave nature of the block and jointed rock masses is possible. Important not so high fracture spacing and thus is composed of small blocks. This means that the availability of other conditions (kinematic condition) for the occurrence of the structural collapse of the trench walls, block many potential dimensions falling blocks with dimensions of less than 30 cm and it rarely is 100 cm. Based on studies done in Giladeh mine, is predicting the effect of earthquakes on the mine will only include ground shaking. Slip into local ground failure phenomena may also affect the scope of the stairs. According to the values obtained in the classification table indicated that RMR rock mass classification weaker than the Q is evaluated and data obtained from Bieniawski (1989) (RMR) with a conservative vision and ensuring higher margins offered. If the data obtained from Hoek (GSI) to be more realistic (Dadkhah *et al.*, 2005) which was consistent with the results of this experiment. Powered number per million tons of ore Giladeh 9.52, respectively, of which approximately 30% of the recoverable reserves have been calculated in order.

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