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Estimation of Static Young Modulus and Uniaxial Compression Strength Based on Physical and Dynamic Characteristics of Aghchagil Limestone Formation in Caspian Basin

H. Khakzad suchelmaei [1], N. Hafezi moghaddas*[2], M.Ghafoori[3], M. Zafari[4]

Abstract

Static parameters are one of the most important parameters in estimating geomechanical properties. Determining these data is very costly in field studies, so they are not normally available and are limited in scope. Hence, many researchers have tried to provide empirical relationships to estimate these parameters from other characteristics. The aim of the present study is to evaluate the parameters of the Young static modulus and the uniaxial compressive strength of Aghchagili limestone based on physical and dynamic properties using multiple regression. For this purpose, 10 blocky samples from the surface outcrops of the formation were prepared, and 18 cores were obtained from them. Then various physical, mechanical and ultrasonic tests were carried out on this cores. The results shows that three variables of density, compressive velocity and dynamic Young modulus have a better relationship with uniaxial compressive strength than the other physical and dynamic parameters. Also, porosity variables and dynamic Young modulus yield more acceptable results to estimate the static Young modulus.

Keywords: *Aghchagill Formation, Static Parameters, Physical and Dynamic Properties, Multiple Regression, SPSS Software*

1. Ms Student, Department of Engineering Geology, Ferdowsi University of Mashhad, Iran.
2. Professor, Department of Engineering Geology, Ferdowsi University of Mashhad, Iran, nhafezi@um.ac.ir.
3. Professor, Department of Engineering Geology, Ferdowsi University of Mashhad, Iran
4. Industrial Consultant, National Iranian Oil Company, Khazar Oil Company, Iran.

*** Corresponding Author**

Extended Abstract:

1. Introduction

Several experimental relationships have been introduced to relate static and dynamic properties of rocks by researchers. Basically, physical, resistivity and dynamic parameters are interrelated, so estimating the static Young's resistance or modulus based on only a single parameter can be associated with a significant error, which is why the regression coefficient of such relationships is not very high. In this context, the determination of empirical relationships using multiple parameters and regressions can be very effective. One of the other advantages of this method is that it needs less data than the other relationships because of using several effective parameters instead of one to estimate compressive strength and static Young's modulus. In this research, an attempt has been made to find a suitable experimental relationship between static, dynamic and physical parameters in the formation of Aghchagil limestone in Golestan province using experiments performed on samples taken from Aghchagil limestone formation.

2. Method

10 blocks from different sections of the outcrop of Achchagil Formation were taken and transferred to the Rock Mechanics Laboratory of Ferdowsi University of Mashhad. In the laboratory, 18 cores were prepared from blocks and then physical, mechanical and dynamic tests were performed on samples according to ASTM standard.

3. Results

In multiple linear regression we seek to predict the changes of more than one independent variable on a dependent variable in which all variables must be of a quantitative type. Matrix methods should be used to fit and analyze a multiple linear regression model. In this research, backward method was used in SPSS software, so that all variables are entered in the first step of modelling. The values of R2 (coefficient of variation) and Sig (level of significance or type II error) are evaluated. Variables with Sig values higher than 0.05 have been ignored in the modelling until the best possible model was obtained. It should be noted that the Sig value should be considered for each parameter separately, since the Sig of overall model may be less than 0.05. Some parameters have a Sig value more than 0.05, so aren’t suitable for the presence in the modelling.

4. Conclusion

The aim of this study is to evaluate the geomechanical characteristics of the Aghchagil Formation, which is one of the important reservoir rocks in the north of the country (Iran). The results indicate that the Aghchagil Formation has low resistance and modulus, so is classified in the category of engineering of rocks late Dieer and Miller of very resistant stone. The multivariable relationship between physical and dynamic properties with the dependent parameter of the elastic modulus of the studied rock showed a good predictive accuracy. In the relationship between porosity variables and dynamic Young modulus, the variation coefficient of the relationship is 0.74 and error its RMSE is 0.77, which indicates a good accuracy of the relationship. For the uniaxial compressive strength parameter, physical and dynamic variables of density parameters, compressive velocity, and dynamic

Young modulus are included in the final model, the variation coefficient of the mentioned relationship is 0.60 and its RMSE error is 0.013. Comparison of results with other empirical relationships shows that the suggested link error in the present study is less than the existing empirical relationships and it can be reliably use in estimating of the static properties of Acghchagil Formation in geomechanical studies.

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