5th JUBILEE BALKAN MINING CONGRESS

PROCEEDINGS

18th-21st September 2013 Ohrid, Macedonia

ELEM
MACEDONIAN POWER PLANTS

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BALKANMINE 2013

Ohrid, Republic of Macedonia

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contact**@**balkanmine.mk

Photos on the title-page:
Track-type loader excavator at work
- Dmitry Kalinovsky
Miner in a pit
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CORRELATION BETWEEN SEISMIC VELOCITIES AND GEOTECHNICAL PARAMETERS OF CARBONATE DEPOSITS

Gorgi DIMOV[1]
Blagica DONEVA[1]
Marjan DELIPETROV[1]
Todor DELIPETROV[1]

Faculty of Natural and Technical Sciences, University "Goce Delcev" Stip, Republic of Macedonia

[1] *gorgi.dimov@ugd.edu.mk*

[2] *blagica.doneva@ugd.edu.mk*

[3] *marjan.delipetrev@ugd.edu.mk*

[4] *todor.delipetrov@ugd.edu.mk*

ABSTRACT

This paper presents the research of several carbonate deposits with seismic measurements and assessment of their geotechnical parameters on the field and in the laboratory.

The importance of this type of geophysical exploration should be seen by the fact that these methods cheaper the process of defining the real model of the rock complex and getting on parameters that are relevant for the whole investigation area.

Geotechnical measurements on the samples conducted in laboratory are very important, but received data are relevant only for certain point, not for the whole area.

Real model for the area will be made if geophysical data are combined with the data from the investigative drilling and laboratory geotechnical research.

This paper will have important impact in the interpretation of the carbonate complexes if velocities of the seismic waves are known and according to them to be defined geotechnical parameters, without laboratory investigations. Also, vice versa, if geotechnical parameters are known, the seismic velocities could be defined.

Keywords

Carbonate Deposits, Geophysical Exploration, Geotechnical Research

1. INTRODUCTION

For resolving the correlated parameters defining the model of the rock mass quality of the geological, geotechnical and geophysical data, applied a method of regression analysis. Wishing to discover, define and analyze the relationship between two or more parameters must at the same time be sent simultaneously and compare variations of both parameters and to measure the relationship between these variations. Therefore this method is called the correlation method (method of exploring the mutual relations).

With the detailed analysis of all parameters it is possible to adopt correlation models which further will be used in the process of modeling of the environment. Until now commonly in geotechnical were made correlative dependencies between the values of the parameters of the static tests (conducted with different methods), with speeds of propagation of elastic waves Vp. In this paper we will try to work out correlation dependencies between the values of rock mass quality (RMR, RQD and ERMR) the speed of elastic waves Vp.

2. CORRELATION BETWEEN SEISMIC VELOCITIES AND GEOTECHNICAL PARAMETERS

In this particular case results are taken from the geophysical surveys finds the limestone Sloestica - Demir Hisar and Rasanec - Ohrid and are correlated with the results of a survey of qualitative parameters of rocks.

In figures 1 and 2 shows the dependence of RQD parameter (parameter by cracking) with velocities of elastic waves. There is a logarithmic dependence of the parameters and the factor of determination R^2 is quite high. Factor of determination in Sloestica is 0.79 and in Rasanec even 0.84 which suggesting a strong connection to the examined parameters.

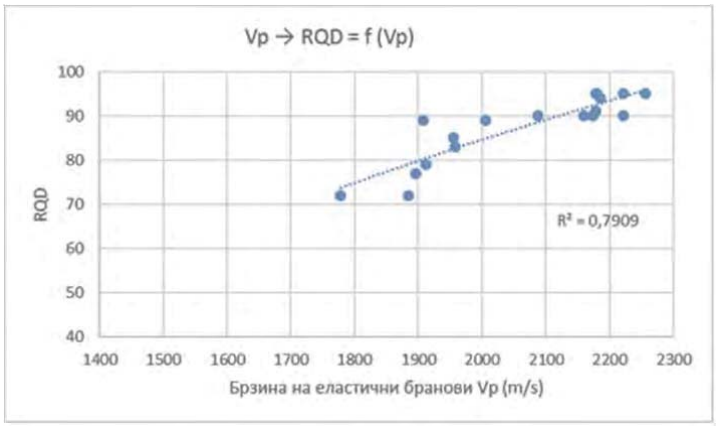

Figure 1. Correlation between RQD parameter and speeds of the elastic waves Vp → RQD = f (Vp) in the site Sloestica

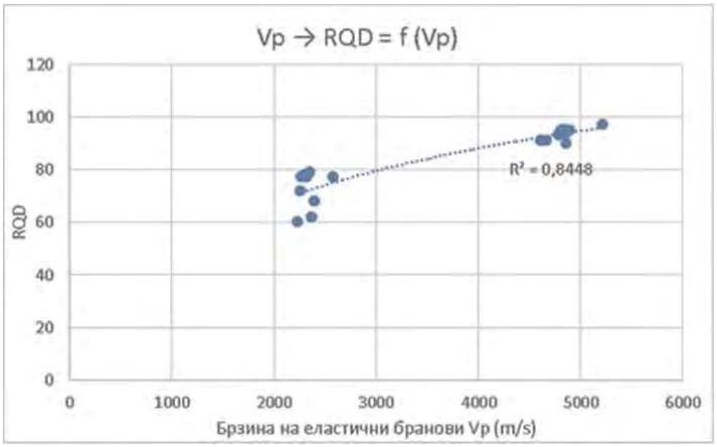

Figure 2. Correlation between RQD parameter and speeds of the elastic waves Vp → RQD = f (Vp) in the site Rasanec

The images 3, 4, 5 and 6 are shown the dependencies of the quality of the rock mass classification defined by Bieniawski - RMR and Jovanovski (2001) - ERMR, as the sum of points with velocities of elastic waves Vp. From the displayed can see that in the first two cases (Sloestica) is established logarithmic dependence of the parameters, and the second two (Rasanec) polynomial dependence, whereas factor determination of parameters R^2 is high (0.81 or 0.83 in the site Sloestica and 0.72 and 0.74 in Rasanec), suggesting a strong connection to the examined parameters. Moreover displayed logarithmic and polynomial dependence also good results are obtained and during establishment of linear or exponential dependence, giving you nearly identical curves and very close values of factor determination.

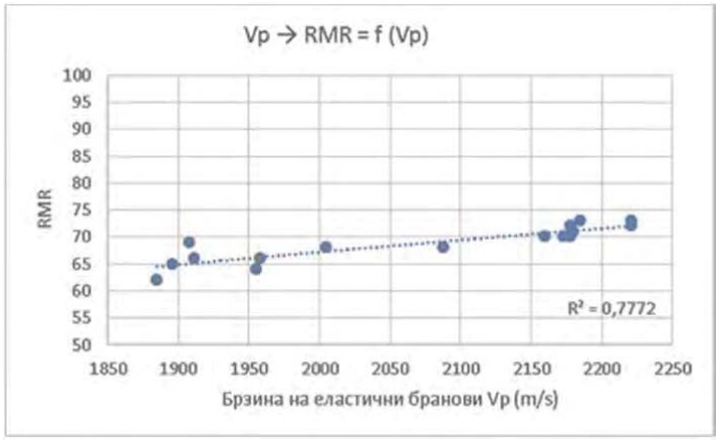

Figure 3. Correlation between RMR parameter and speed of elastic waves Vp → RMR = f (Vp) for Sloestica

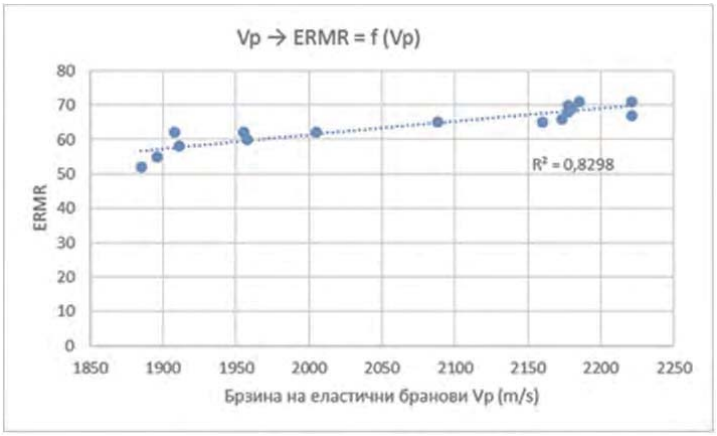

Figure 4. Correlation between ERMR parameter and speed of elastic waves Vp → RMR = f (Vp) for Sloestica

From the upper images for the site Sloestica we can conclude that occur two groupings of values. The first group in principle refers to the values of RMR of 61-69 and ERMR by 51-61 points and speeds lower than 2000 (m/s) that are specific to the category of favorable rock mass, and the second set of values and the parameters corresponding to good rock mass (70-74 RMR and 65-72 ERMR with speeds of elastic waves greater than 2150 (m/s)).

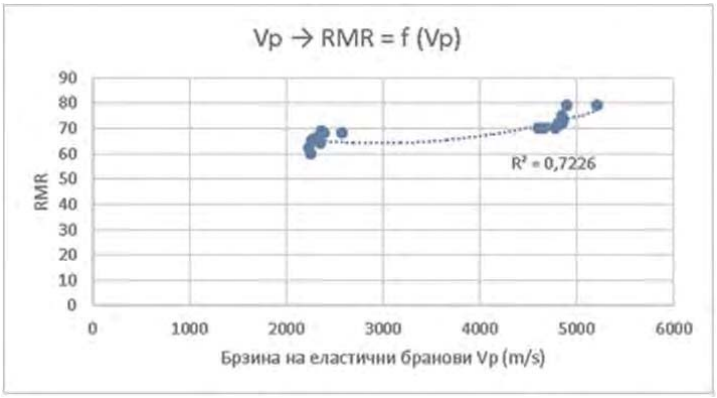

Figure 5. Correlation between RMR parameter and speed of elastic waves Vp → RMR = f (Vp) for Rasanec

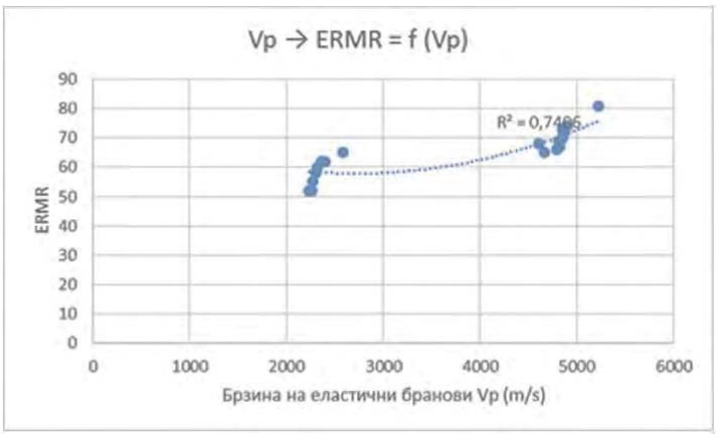

Figure 6. Correlation between ERMR parameter and speed of elastic waves Vp → RMR = f (Vp) for Rasanec

The above mentioned which largely applies to the site Rasanec in that grouping the values is much stronger here because here there are two elastic environments. It should be noted that both elastic environments refer to the same lithological environment - limestone, but with varying degrees of cracking (damage), which can be attributed to the effects of massive mining in the upper elastic zone.

That is why we have two groups of qualitative values. The first group refers to the RMR values of 58-69 and ERMR by 50-61 points and speeds lower than 2900 (m/s) which are specific to the category of favorable rock mass, and the second set of parameter values corresponding to good rock mass (68-80 RMR and 65-81 ERMR the speed of elastic waves greater than 4700 (m/s)).

3. CONCLUSION

From the data presented in this paper, where the main goal was to define the correlation depending on the speed of seismic waves and geotechnical parameters of rock mass, we can extract the following findings:

- from the theoretical point, higher speed of seismic waves in principle implies greater compactness of the rock mass for the same type of rocks;
- the obtained degree of correlation ranges (R^2) is from 0.74 to 0.84;
- high index of correlation confirms the theoretical dependence;
- The application of seismic methods is the representative parameter for determining the quality of the rock mass
- Due to extensive blasting in parts of carbonate surface complex registered significant reductions in speed of seismic waves in terms of speeds of fresh parties are in the deeper parts of the field.

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