DETERMINATION ROCK PARAMETERS FOR EFFECTIVE BLASTING USING GSI

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Abstract

Fragment size distribution is controled by rock structure, quantity of explosive and its distribution within the rock mass. Results of engineering-geological research are significant for the optimization of blasting parameters. These data are showing a real picture of rock mass: statistics of density of discontinuities and their orientation, determination of GSI, criteria for strength of rock mass and in situ determination of mechanical rock mass parameters. This paper presents one of posibbilities using GSI for improving efficiency of blasting and getting desired fragmentation.

Keywords: *rock parameters, blast design, GSI*

1. INTRODUCTION

Effective blast monitoring and blast design tools, geophysical exploration of rock masses, rock mass mapping and advanced modeling system have been rapid developed in the last then years and now can be applied to the problem of more effective blasting [1]. Pre-blast assessment of rock mass, appropriate geometry and diameter of boreholes, explosive characteristics and blasting control are the most important parameters for blasting results. Fragment size, volume and mass of blasted rock are fundamental variables for evaluating the quality of a blast. Size and shape of blasting fragment give a very important information for development of effective and optimal blasting. Geological strength index (GSI) is a very useful criterion for description of rock mass behaviour in blasting process [2].

2. EXPERIMENTAL

For the optimization of blasting parameters, results of engineering-geological research are significant. The deformability of rocks depend of joints orientation. The strength of rock mass increases with the decrease in frequency of joints. Rock state properties like weathering, block size and joint characteristics are also investigated.

Based on structural geological definitions, following sets of major discontinuities in rock masses could be obtained [3]:

- Bedding and interbedding cleavage;
- Axial plane cleavage;
- Fractures normal to local or regional structural axis b;
- Other fractures and cleavage more or less in connection just with neotectonics.

These data are showing a real picture of rock mass (Figure 1): statistics of density of discontinuities and their orientation, determination of GSI, criteria for strength of rock mass and in situ determination of mechanical rock mass parameters. Rock mass as they occur are heterogenous and anisotropic and even on small scale the homogeneity varies [4].

Figure 1 – Rock mass on the area of the highway route

Interaction between the rock mass and stresses generated due to explosion, may produce favorable or harmful blasting results. From the aspect of rock mass data collection and resulting blast design, definition of engineering-geology data is very important. Field and laboratory tests rock mass properties giving collection of necessary data for geomechanical and GSI classification. In case of ground water, its effect and exact water table must be determined. Ground water influence on blasting parameters and chosen methods and explosive type [5]. Also is important to determine thickness of humus layer and clay components, because that can make difficulties at drilling and load blastholes.

Graphic presentation of Rock mass characteristics research, including structural feature recognition and pre-blasting fragmentation size distribution is presented on Figure 2.

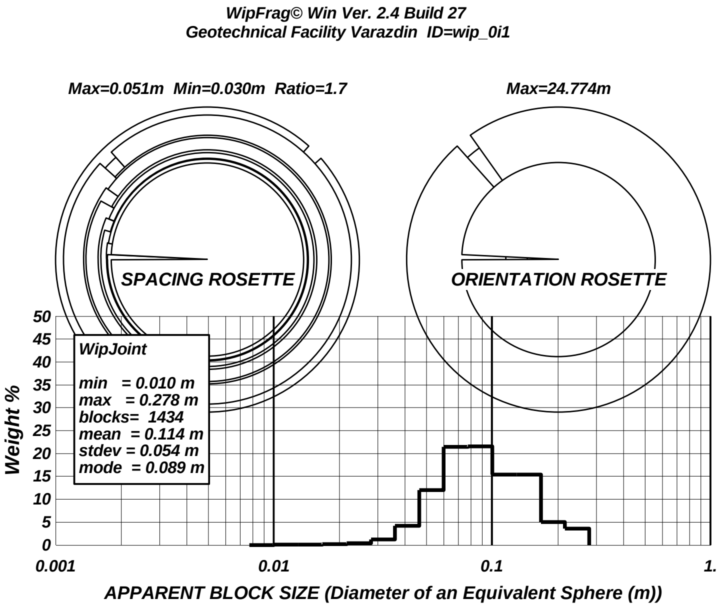

Figure 2 – Rock mass characteristics including structural feature recognition and fragmentation size distribution with the use of WipFrag software –WipJoint module

Geometry of boreholes, blastholes angles and depth of drilling must be correspond with project solutions. Any anomalies noticed while drilling, like caverns, fissures, changes in soil properties and other, should be noted in drilling logs and accepted while loading blastholes.

Blastholes should be well cleaned with compressed air and checked for properly depth. Inclination of the blastholes lower seismic effects of blasting because most part of the explosive power is used on crushing and fragmentation and less on seismic disturbance. For obtaining desired slope along the cut is used presplitting method. That method is represented by line of boreholes following the contour of future cut with burden smaller than burden in production line of boreholes [6].

3. RESULTS AND DISCUSSION

Empiric prediction of the desired fragmentation is usually implemented using Kuz-Ram model. This model is based on the Rosin-Rammler theory that offers very good description of the fragmentation and grade of the blasted material.

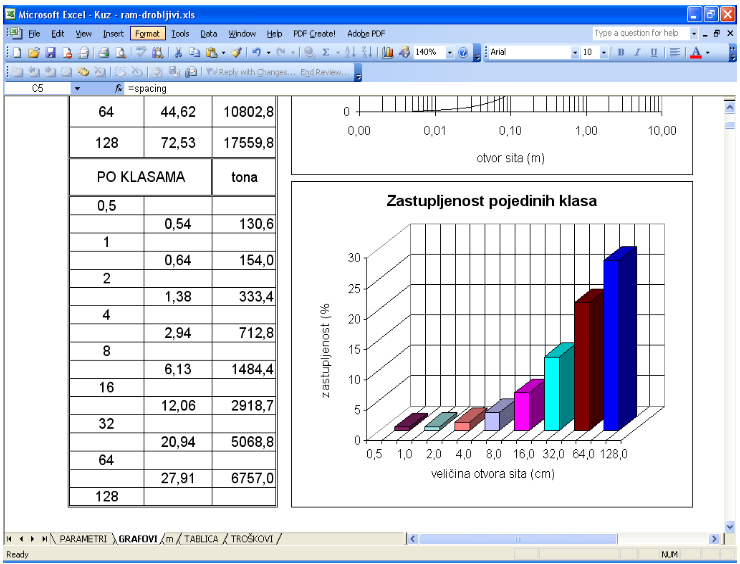

Figure 3 – SB-application for Blasting optimization

SB-application, based on Kuz-Ram model (Figure 3) is developed by Ph.D. Strelec on the Faculty of Geotechnical Engineering from Varazdin [7] and used in many drilling and blasting projects in the last few years. In this application the rock mass can be defined as silty, blocky or massive. For using GSI values in this application is necessary to use empirical correlations between rock mass categorization in SB-application and GSI values, given in Table 1.

Table 1 – Empirical correlation between SB parameter and GSI value

SB rock mass parameter	*GSI value*
silty	41 – 55
blocky	56 – 70
massive	71 – 85

GSI is giving a real picture of rock mass properties and indirect definiton of this parameter in SB-application could bring precisely prediction of fragment size of blasted rock mass.

4. CONCLUSION

Defining engineering-geology data is very important for rock mass data collection and resulting blast design. The rock fragmentation and blasting effect can be improved by determination of optimal geometry of minefield.

Interaction between the rock mass and stresses generated due to explosion, may produce favorable or harmful blasting results. Quantity of explosive charges, drilling geometry, delay patterns and design of initiating are defined by drilling and blasting projects.

Pre-blast assessment of rock mass, appropriate geometry and diameter of boreholes, explosive characteristics and blasting control are the most important parameters for blasting results.

Empiric prediction of the desired fragmentation is usually implemented using Kuz-Ram model. Using software based on Kuz-Ram model with GSI as input parameter, which gives real picture of rock mass, could bring precisely prediction of fragment size of blasted rock mass.

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