Effect of Blast Loading on Stability of Ghareh Changool Ramp in Zehabad Lead and Zinc Mine

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Extended Abstract

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Introduction

Unsystematic execution of blasting process may result in serious damages. Blasting is a very complex process and almost all of blast designs are made based on empirical relations resulting from trial and error. In recent decades, considerable development of numerical methods has been made possible to achieve high accuracy study of blast effects on surface and subsurface structures. Among these methods are boundary element method, finite difference method and finite element method. It should be mentioned that there is currently no software which might be able to completely simulate blast process. But the UDEC software is able to simulate different aspects of this phenomenon through simplification and focusing on each aspect. Therefore, the UDEC software was selected. In the present study, the modeling has been performed for Ghareh Changool ramp of Zehabad Zinc and Lead Mine against blast loads.

Material and methods

Zehabad Ore deposit is located around 2 km south of Zehabad Village of Tarom Sofla County, 56 km to northwest of Qazvin at 49˚ 25' east longitude and 36˚ 28' north latitude.

The formation surrounding the ore deposit is generally made up of pyroclastics, lavas and sedimentary rocks of Eocene age (Karaj Formation) which have been divided into 22 stratigraphic units. Lithological composition of the tuff units are often rhyolithic to dacitic and the lava units are consisted of rhyolite, dacite and andesite.

To accomplish this study, we took rock blocks from Ghareh Changool ramp. Then, the blocks were cored in the laboratory to provide cylindrical samples for doing uniaxial compressive, triaxial, Brazilian and direct shear tests. Physical and mechanical properties of the tuff samples were determined according to ISRM standards.

In the present study, field studies were done to calculate strength parameters and properties of the joints. Based on these studies, three major joint sets were determined. In order to obtain the shear strength parameters of the joints, the cylindrical samples of andesitic tuff were molded by concrete and direct shear test was done on all of the joints according to ASTM D 4554.

Results and discussion

To simulate the complex conditions of blast process, we used the discrete element software of UDEC for numerical modeling considering the discontinuity of the medium. To do a dynamic analysis, first the model should come to equilibrium in the static state. The space considered to be modeled in the study was a horse-shoe-shaped ramp with 4 m base, 4 m height and 1.5 m arc radius which was located in rocky medium consisting of tuff. The height of overburden above the roof of the ramp was about 190 m. The dimensions of the model in UDEC was 20*20 m^2. The behavioral model considered for the rock blocks and discontinuities were the elastic isotropic and surface contact of the joint (elasto-plastic) associated with Coulomb sliding failure, respectively. After defining the absorbing boundary conditions, the dynamic loads were applied to the model based on the defined time period. In mines stability and blasting process, the dynamic load resulting from the blast is often applied to a model as a pulse. By application of dynamic load and considering the other mentioned variations with respect of static analysis, the dynamic response of underground space could be estimated under vibration load of blast or earthquake. To do this, the blast impact wave was applied to the left side of the model as exponential pulse with maximum pressure of 4.41 MPa and time width of 0.7 to 7 msec. The results of the numerical modeling in static analysis indicated that no block would fall (Fig. 1). After application of the blast load, the results showed that there was no falling around the ramp (Fig. 2).

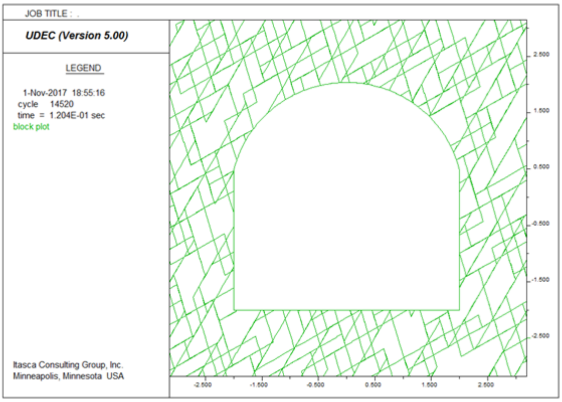

Figure 1. The magnification plot of the blocks after static analysis

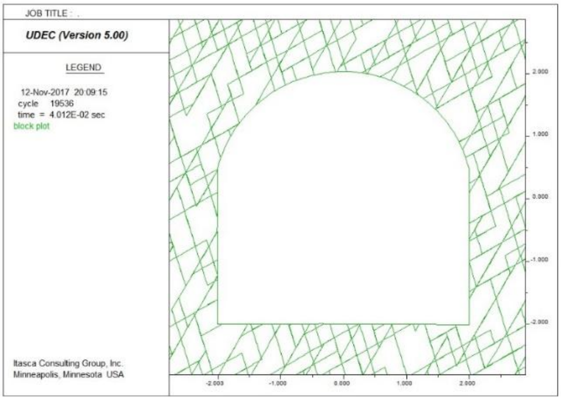

Figure 2. The magnification plot of the blocks after application of the blast load

Conclusion

1. In static condition, after initial equilibrium no block was fallen into the ramp, regarding the blocks' magnification plots, as a result the ramp was stable in the static loading.
2. In dynamic loading case, considering the displacement plots around the ramp and the low values of these displacements, as well as, magnification plot of the blocks 40 msec after the blast it can be said that no block was fallen into the ramp. Therefore the ramp was stable in the dynamic loading case and there was no need to install support system.

Keywords: Zehabad lead and zinc mine, Ghareh Changool ramp, blast loading, stability, dynamic analysis, numerical modeling.

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