ABSTRACT

This thesis focuses on determination of stability of rib and crown pillars below an open-pit mine due to quasi-static and dynamic blast loading. In the present study, three-dimensional finite element models of an underground mine are developed with aid from data generated from laboratory and field investigation. An extensive numerical modeling work has been undertaken to understand the behavior of rib and crown pillars with large diameter blast hole transverse method of mining considering elastic perfectly plastic condition. The concept of two novel parameters, i.e. "plastic damage index η" and "strength reduction ratio κ" are introduced to predict the damage in the rib and crown pillars. Parametric studies are also carried out to determine η based on variation of four independent parameters, i.e. material properties, crown pillar thickness, sequence of extraction and depth of working. Multi-variate regression and artificial neural network models have been developed based on the data generated from numerical models. A damage classification table is determined based on the η and κ obtained for the rock in post-failure regime of uniaxial compression test.

The blast and charge pattern of ring hole blasting is proposed for the underground mine considering powder factor approach. Powder factor obtained from differential charging is compared with the case where differential charging is not adopted. The study is extended in the field to monitor the blast vibration due to production blast. Variable/flexible scaling law is used to determine the blast vibration predictor equation for estimating the peak vector sum in the underground mine. The damaged induced in the roof and sidewalls are also monitored at different locations to record the effect of the stope blast. This study has been further extended to simulate full scale blasting events and shows a way to model delay and sequence of blasting events for large scale mines. Two-dimensional finite element analyses of an underground mine under dynamic loading condition have been carried along the longitudinal section to simulate the effect of ring pattern stope blast, considering three variations in material properties, two variations in blast location and three variations in adjacent stope condition.

Keywords: *Stability of rib and crown pillars, Plastic damage index, Strength reduction ratio, Multi-variate regression, Artificial neural network, Ring hole stope blast*