Comparison of Two Failure Criteria for the Assessment of Haulage Drift Stability Using Stochastic Analysis and Numerical Modelling

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Abstract:

Mine haulage drifts are the primary access to the mining blocks of an orebody in a multilevel mining system of a tabular ore deposit. The stability and functionality of haulage drifts are thus crucial to the success of a mining operation. Drift instability could lead to serious consequences such as injuries, production delays and higher operational cost. In this paper, the performance of the haulage drift stability is evaluated on the basis of the primary rock support system comprising 1.8 m resin grouted rebars in the drift walls and 2.1 m long bolt in the back. Two failure criteria namely the extent of Mohr-Coulomb yield zones around the drift, and linear elastic brittle shear failure are adopted and compared, with respect to lower level and same-level mining and filling sequence in the vicinity of the haulage drift. The case study is one of the #1 Shear East zone of the Garson Mine in Sudbury, Ontario. Random Monte Carlo (RMC) technique, which has been previously established to assess the haulage drift stability, is employed in this investigation. The RMC technique is used in conjunction with finite difference modelling software FLAC for random assignment of model input parameters in the FLAC grid. Deterministic model results reveal the drift behaviour in terms of deformation (convergence) and mining-induced stress distribution. Comparison between the two different criteria is carried out to determine which method is most suitable in evaluating unsatisfactory drift performance. The results are presented in terms of probability of instability and categorized with respect to failure condition and mining step. It is shown that the brittle shear failure condition based on linear elastic response calls for enhanced support system at a later mining step than what Mohr-Coulomb yielding condition does. The paper presents a detailed discussion of the stochastic analysis results.

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