Open stope design; beyond the Stability Graph

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ABSTRACT

The Australian Centre for Geomechanics (ACG) held two workshops in 2019, one in Australia and one in Canada, to discuss processes and methods currently used in the mining industry for stope design and reconciliation. This work strives to optimize stope performance and, in practice, aims to maximise ore recovery (underbreak) while minimising dilution (overbreak). One of the key findings from the workshops was that current stope design practices, almost exclusively, rely on some versions of the empirical stability graph methods developed in 1980's. Although robust and useful at the feasibility study stage, there are a number of inherent shortcomings with this approach.

The stability graph limitations first lie in that it cannot assess underbreak which is a very important measure of performance. Furthermore, the method doesn't consider a number of factors such as drilling and blasting or the presence of faults, which often have a critical influence on stope stability. Given the current industry standards, there is a great opportunity to re-invent the stope design process to optimize performance.

A finding of the workshops was that every mine quantifies stope performance in terms of volume reconciliation with a focus on qualifying dilution and ore losses, and reconciling metal tonnes recovered from the mill. Many mines further investigate stope performance by looking at individual stope faces and what causes the deviations between the planned stope shape and the measured cavity.
Recent research at the ACG has shown that investigating overbreak and underbreak at a higher resolution is a powerful way to identify the root causes of overbreak and underbreak. Finer scale assessment is achieved by an 'octree analyses', which effectively divides the relevant stope volume into a metre cubes and produce many tens of thousands of data points. The octree analysis underpins a data driven stope design methodology.

The ACG is currently developing a design approach based on multi-variate modelling methods that can account for a large number of variables which influence stope performance and forecast stope overbreak and underbreak results. The octree back analyses reconciliation provides a rich database for training the model. Once the model can achieve reliable forecasting of overbreak and underbreak, an interactive drill and blast design allows for the assessment of different firing strategies on stope performance.