

ABSTRACT

The commonly used phrase, “*we are only as strong as our weakest links*” adequately describes the role of rock mass structures in the stability of open pit benches. The modelling of these structures has always been challenging due to the high degree of variability and uncertainty. Therefore, methods that would more realistically represent these structures would produce results that are more readily observed in nature. This is evident with bench design methods, as the traditional methods involving stereographic kinematic analysis and limit equilibrium analysis are based on conservative assumptions that can be regarded as unrealistic. Although these traditional methods are valuable, quick, and easy to use, the economic impact of their conservatism on bench design is significant enough to warrant the need for a more realistic approach. Therefore, this research involved the application of the discrete fracture networks to rock slopes at bench scale. Discrete fracture network modelling is a methodology used to generate three-dimensional stochastic representations of rock mass structures from statistical distributions that describe their characteristics (e.g., orientation, spacing, size, aperture).

A case study Mine X was selected to consider the implications of the traditional bench design methods and DFN approach. FracMan was used to generate the bench-scale DFN model, and SWedge and DIPS was used to complete the traditional methods. The DFN model generated from sampled field data (i.e., 1D/2D discontinuity data collected from variably oriented rock exposures and boreholes) share the sample statistics and allow for explicit modelling of an individual fracture or simplified fracture sets (Elmo, et al., 2015). The results of this study suggest that the DFN approach using FracMan produces more optimal slope designs as compared to the traditional deterministic and pseudo-probabilistic methods. The traditional method assumes continuous structures and predicts the maximum sized wedge formed from the combination of two joint sets. However, the FracMan rock wedge algorithm results in a higher accuracy of block shape and volume, which is considered more appropriate for the kinematic assessment of block stability.

The DFN approach represents rock mass structures better and can produce more optimal bench designs however it is important to note that the full potential of a DFN model to capture stochastic variability is only achieved if the generated DFN geometry is statistically the same or at least similar (within some tolerance) to the actual fracture network it is meant to simulate. If this is not the case, then this would perhaps be the most inefficient and overly complicated alternative approach to the traditional bench design approach (Poropat & Elmouttie, 2011).