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GM-051

DISCRETE FRACTURE NETWORK (DFN) MODELING AND SYNTHETIC ROCK MODELING FOR MINE CAVING ASSESSMENT —NORTHPARKES (2)

Purpose(s): Preliminary study on discrete fracture network (DFN) modeling for additional Synthetic Rock Mass (SRM) modeling (*PFC3D*), and undercutting and caving assessment. Application to the Northparkes site.

Client: SMI (Sustainable Mineral Institute) University of Queensland, Brisbane Australia

Date: 2005-2006

Location: Northparkes Mine

Partners: Itasca Consulting Group

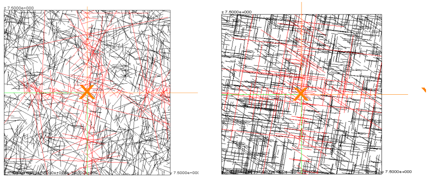
Project executive manager: Caroline DARCEL

Code(s) used: *3FLO*, (*DIPS* 5.0, Origin 7.1), *PFC3D*

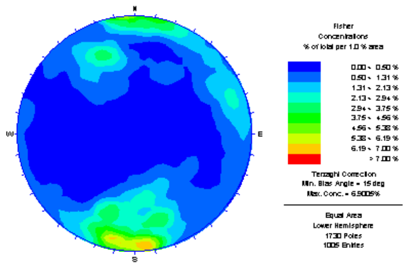
As part of the MMT (Mass Mining Technology) project, Itasca was put in charge of the modeling aspect of **DFN**. In short, the MMT project tests the validity of **using Synthetic Rock Mass (SRM) samples as a means to predict how a given rock mass will respond to undercutting and caving**. Tri-dimensional (3D) SRM samples simulating the rock mass are modeled with *PFC3D* as cubes, 10 meters in edge size, embedded with a **discrete network of disc-shaped flaws** (joints).

The available fracturing data cover several lithologies (Volcanic, BQM, Diorite and QMP). However, the samples are limited in size to 1 m, and further limited to **observations of fracture orientation and intensity in one and two dimensions**. The only information available on the lengths of fractures is obtained during sampling along scanlines and through differentiation of fractures (joints) defining the blocks (BDJ) and other fractures.

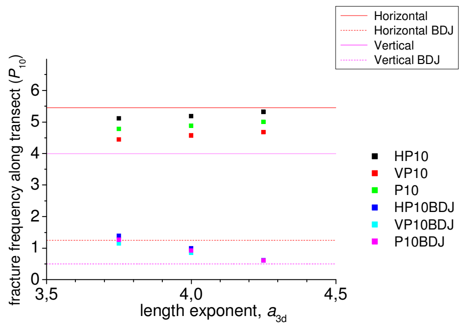
Little information is available to derive a **fracture size distribution** model properly, which, nevertheless, is a critical element of DFN modeling. Therefore, to supplement the calibration of a 3D model with 1D and 2D data, DFN modeling relies on the following additional assumptions: 1) **fracture lengths that follow a power-law distribution**, and 2) BDJ fractures assumed to be equal or greater than 4 meters in length.



Simulated DFN trace maps (side = 15 meters) on tunnel walls. Illustration of the sampling process through vertical and horizontal traverses (red traces): Left) fracture orientations distributed around maximum values; right) only the peaks of orientations (see stereonet to the right) considered.



Stereonet (contour plot, Schmidt projection lower hemisphere) associated to the whole site (lithologies: Volcanics, BQM - Biotite Quartz Monzonite, Diorite and QMP - Quartz Monzonite Porphyry).



(opposite) Fracture intensities simulated on vertical and horizontal transects in galleries according to several different fracture length distributions (exponent from - 3.75 to - 4.25).

KEYWORDS:
- Discrete Fracture Network
- Joints
- Scaling Model
- Borehole, Fracture trace map
- Stereological analysis
- SRM (Synthetic Rock Mass)
- Mine, Caving, undercutting

RESULTS:

- Only small variations of fracture intensity and orientations are observed from one lithology to the other. Thus, a single base-case DFN is produced that is a representative combination of all four lithologies (Volcanics, BQM, Diorite and QMP).
- A fracture-size distribution length exponent equal to 4 is consistent with the fracture intensity measurement ratio between BDJ and not BDJ fracture along horizontal and vertical traverses from the tunnel walls.
- A DFN model, not unique but consistent with all data provided, thus is derived.

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