

# FRACMAN<sup>®</sup>

*The leading fracture modeling software for:*

## Mine, Slope and Tunnel Fracture Geology

- ▶ Analysis of Faults and Fractures
- ▶ Fracture Analysis from Geophysics
- ▶ 3D Discrete Fracture Network Simulation
- ▶ Mine Scale Fracture Extrapolation
- ▶ Fracture Data Analysis
- ▶ Structural Geologic Modeling

## Kinematic and Fragmentation Analysis

- ▶ Kinematic Slope and Tunnel Stability
- ▶ Fragmentation Analysis
- ▶ Block Size and Shape Analysis
- ▶ Fracture Porosity Analysis
- ▶ Stress/Permeability Coupling
- ▶ Anisotropy and Heterogeneity
- ▶ Uncertainty Analysis
- ▶ Risk Assessment

## Geomechanical Simulation

- ▶ ELFEN<sup>®</sup>, DDA, UDEC<sup>®</sup>, FLAC<sup>®</sup>, PLAXIS<sup>®</sup> and 3DEC<sup>®</sup> Linkage
- ▶ Subsidence and Settlement Analysis
- ▶ Fault Slip Simulation
- ▶ Induced Seismicity Assessment
- ▶ Microseismic Simulation
- ▶ Earthquake Risk Analysis

# FRACMAN<sup>®</sup>

## GEOMECHANICS EDITION

Golder Associates is a global company operating in the areas of the earth and the environment. Employee-owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of our clients' needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.



▶ Canada +1 604 296 4200 USA +1 425 883 0777 UK/Europe +44 1628 586200

▶ [fracman@golder.com](mailto:fracman@golder.com)

## Fractured Rock Modeling Solutions

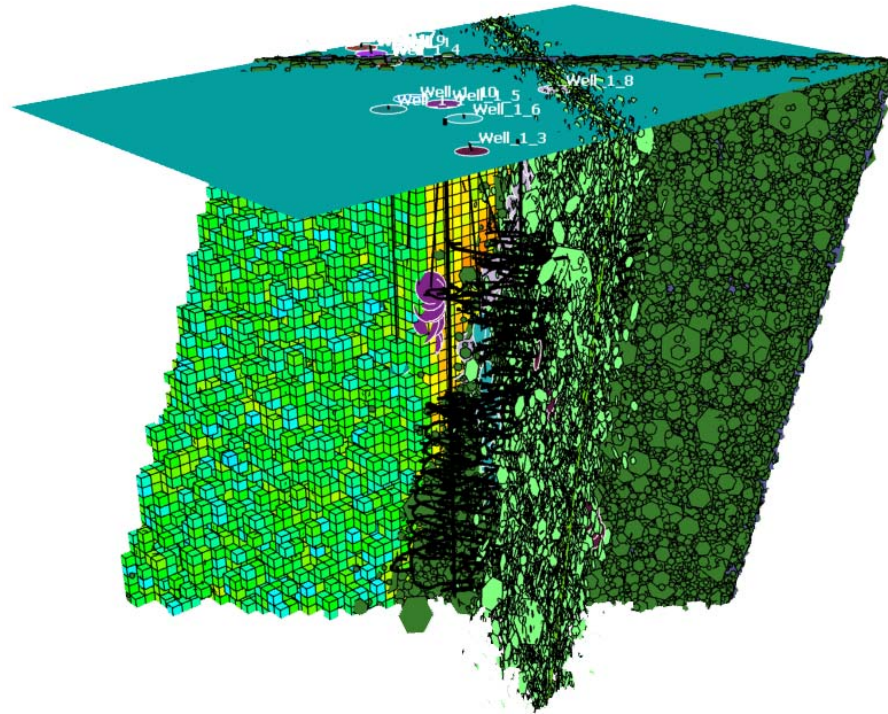


# FRACMAN GEOMECHANICS EDITION

## The leading discrete fracture network analysis tool

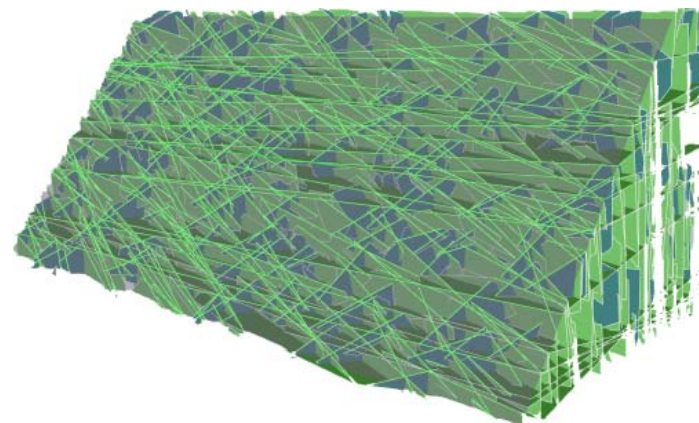
### KEY FEATURES

- Analyse televiewer logs, oriented core, bench and face mapping, and photogrammetric surveys, to derive fracture orientation properties, fracture size and intensity
- Interpret fracture intensity logs from boreholes to derive 3D fracture intensity patterns
- Generation of geologically realistic fracture networks based on structural, geomechanical and geological principles
- Calculate surface curvature from interpreted horizons for guiding fracture generation
- Sample the DFN model with simulated boreholes, pit slopes, tunnels, stopes and shafts, determining fractures that are intersecting these samples
- Condition to borehole observations including rock mechanics and hydraulic properties
- Generation of multiple stochastic realisations for uncertainty management through automatic Monte Carlo simulation and analysis
- Convert the DFN model into equivalent grid properties including fracture rock mass properties and directional stiffness
- Provide constrained fracture input into numerical simulations such as Elfen®, UDEC®, or FLAC®
- Easy to use macro language to automate virtually all tasks including data analysis, model building, grid operations, visualisation and exporting



Fracman allows you to model the rock mass fracture system explicitly by building 3D networks of both deterministically mapped larger structures and stochastically generated smaller fractures. Calibrate your models against borehole information, underground scan lines, drift mapping, outcrops and bench mapping to ensure a good match between field data and the model. Once developed, these models can be used for critical rock mechanics analyses.

FracMan gives you the flexibility to build DFN models ranging from simple volumes for data exploration, local scale analysis or Synthetic Rock Mass (SRM) testing to complex mine scale



Bench scale slope model showing simulated trace map

# FRACMAN DFN WORKFLOWS

The key to success with fractured rock mass characterisation is data integration – geological, geomechanical, geophysical and petrophysical, plus well test and other hydrogeological data. FracMan helps you characterize the fracture network through a three-stage approach:

### Fracture Quantification

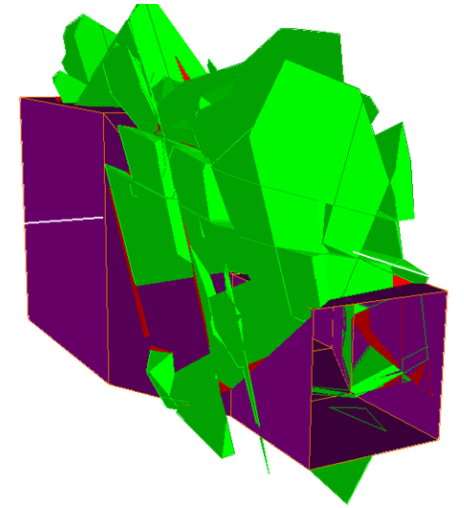
FracMan has a range of tools that allow you to quantify the properties of your fracture network including the distribution, orientation, size and intensity of fractures.

### Model Generation

FracMan generates geologically realistic discrete fracture networks (DFN) based upon a range of properties including geostatistical or structural modeling, mechanical layering, curvature analysis, strain fields conditioning and outcrop.

### Validation of the Model

Test your model by simulating borehole drilling, and trace mapping to compare the actual and modelled fracture properties.



Mapping stable and unstable of blocks around an excavation

# DFN APPLICATIONS IN MINING & GEOTECHNICAL ENGINEERING

### Excavation Design:

Use FracMan's kinematic engine to identify and assess the stability of probable rock wedges in slopes, tunnels and shafts without the highly conservative assumptions of conventional kinematic analysis. Run Monte Carlo simulations to quantify the probability of adverse wedge formation and optimise support requirements.

### Fragmentation Assessment:

FracMan allows the mapping of *in situ* block size and shape for fragmentation assessment. Integrate these models with numerical codes to determine primary and secondary fragmentation evolution during block and panel caving. Evaluate the effectiveness of pre-conditioning strategies on fragmentation distribution in block caving.

### Engineering Optimisation:

Use FracMan to optimise borehole and drift orientation with respect to the fracture network to improve the efficiency of drainage systems, probe hole investigations or grouting systems.

### Input to Numerical Models:

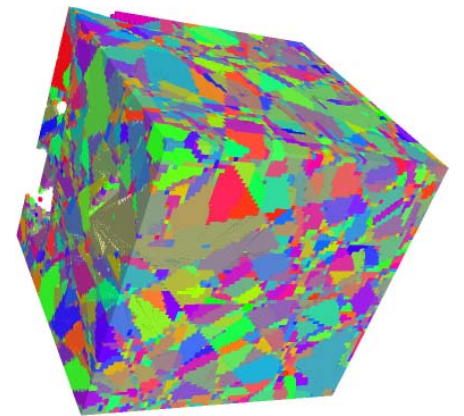
Integrate DFN models with advanced numerical codes such as Elfen®, Flac3D® or PFC® for synthetic rock mass testing and advanced rock breakage simulations.

### Mineral Resource Evaluation:

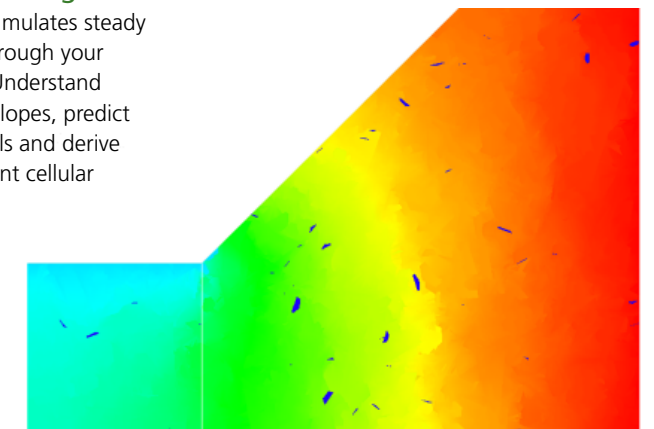
Use FracMan's modeling power to estimate the volume of mineralisation with vein hosted deposits. Determine likely dilution through hanging wall instability following ore removal.

### Hydrogeological Investigations:

Golder's Mafic flow code simulates steady state and transient flow through your fracture network model. Understand groundwater heads in pit slopes, predict fracture inflows into tunnels and derive accurate upscaled equivalent cellular permeabilities.



DFN block mapping analysis



3D distribution of groundwater head through a DFN slope model