

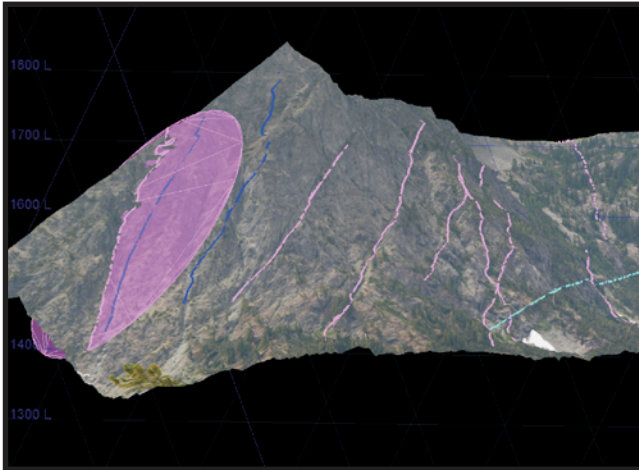
ROCK MASS CHARACTERIZATION ROCK MECHANICS PROBABILISTIC ROCK DESIGN INSTRUMENTATION / MONITORING

Zostrich Geotechnical's focus is solely premium rock mechanics engineering and rock mass characterization work. Founded in 1995, Zostrich has provided consulting expertise, primarily for the mining industry, for over 13 years.

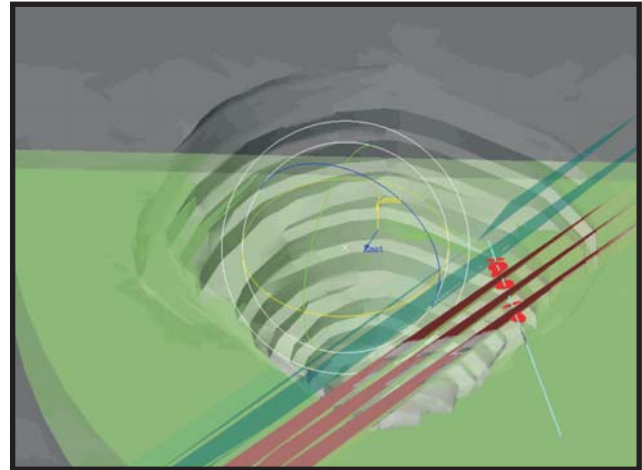
Zostrich Geotechnical has conducted primary design work for some of the largest mining companies in the world. Amongst these are BHP Minerals, BHP Billiton Diamonds, Kennecott, and Barrick Gold.

The work conducted by Zostrich Geotechnical includes a variety of rock types and excavation techniques/experiences. Characterization of rock masses for excavation, pre-feasibility analyses, and final designs comprise 100% of the company's workload at present. Zostrich Geotechnical's work experience has spanned very massive rock to very poor rock, both on surface and underground.

Whatever the situation you encounter, the cutting edge techniques employed and developed by Zostrich Geotechnical will provide an optimal solution. An increase of 1 or 2 degrees on a slope can have enormous cost savings implications given high operating costs and low commodity prices.



Major structure interpretation from photogrammetric mapping



Major structure interpretation from drillhole and pit wall photogrammetric mapping

Rock mass characterization

As engineers, we require knowledge regarding the characteristics of the rock in which we are designing excavations. However, rock is a natural substance, created and modified over millions of years. As geotechnical engineers we are unique amongst the engineering branches in that we must design our works utilizing the grab bag of properties that nature provides, rather than specifying design properties.

It is this concept that makes rock mass characterization so very important for any engineered excavation in rock. Without a detailed and accurate model of the material in which we are conducting our design, our engineering efforts are wasted.

Zostrich Geotechnical specializes in this unique area. Our statistical rock mass characterizations provide engineering descriptions of the rock mass, allowing a true engineering evaluation of the design in question to be conducted. We conduct:

- **Statistical rock fabric characterization** The rock mass contains innumerable discontinuities that impact design, this "fabric" is characterized using our proprietary techniques and software. Presently, most of the fabric mapping is conducted using photogrammetric techniques and reduced in our program Z Fabric. The resulting statistics feed directly into Z Fabric's bench face design module.
- **Major structure characterization** Mapping of pit walls, underground openings, drill core, and natural terrain, photogrammetrically together with ground truthing and interpretative work of drill core allows detailed major structure models to be created for design work. These can be created such that the actual structures are utilized in design, or as required in some cases, utilized to predict the frequency and characteristics for a population. The analysis is then conducted statistically;
- **Rock material property characterization** This includes descriptions of design statistics for a variety of rock material properties, including discontinuity shear strength, rock mass strength, triaxial strength, etc. These are based on laboratory testing, field back analyses, and empirical analyses. Statistical description of these values allows them to be incorporated in probabilistic models;

Educational courses detailing some of the above noted areas of expertise are available at <http://www.edumine.com>. A major structure modelling course, hosted by Edumine, is being held in Vancouver, 1-2 December, 2008.

All concepts and methodologies presented herein are considered proprietary information and technology of Zostrich Geotechnical



ZOSTRICH GEOTECHNICAL

110 W. 6th Ave #180
Ellensburg, WA 98926 USA
Telephone: (888) 412-5901

e-mail: zostrich@zostrich.com
website: <http://www.zostrich.com>

Rock slope engineering

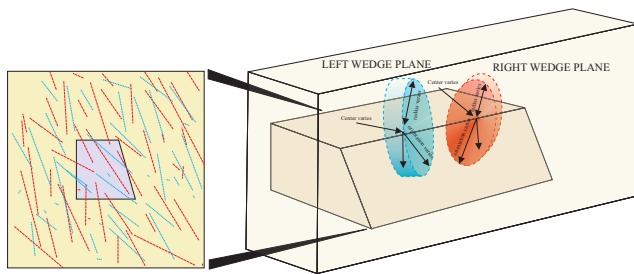
One of our specialties is rock mass characterization. Determining how the rock mass arrived in its present state and how this will impact on any planned or existing excavation is an enjoyable challenge. We think we're among the best in the world at this task. Being able to describe the rock mass accurately and in a statistical fashion gives us a tremendous advantage when it comes to designing rock slopes. For example, we can:

- statistically describe bench failure modes;
- incorporating strengths and rock fabric, accurately determine bench face angles;
- determine safe, effective catch bench widths and appropriate profiles;
- determine, statistically, interramp and overall slope stability. Our detailed major structure models provide a tremendous advantage in this area;
- provide recommendations, install, and monitor slope deformation instrumentation

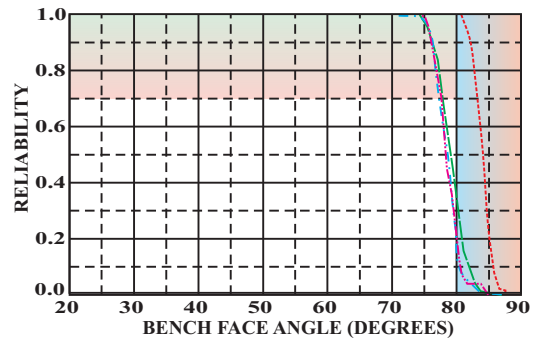
We can also evaluate, or provide the operator with means of evaluating, present rock slope performance

Whatever we do, we do to the best of our capabilities. If there is a solution, we will find it!

Our bench stability course is available at <http://www.edumine.com>



Statistical bench face design (wedge failure)



Design versus attained bench face angles

Underground rock mechanics

Underground rock mechanics requires, as for all geotechnical work, a sound characterization of the rock mass. As rock mass characterization is our forté, this gives us an excellent base to build on.

With our statistical knowledge of the rock mass, we can:

- Provide guidance regarding opening size and orientation;
- Conduct rock support designs, providing accurate estimates of both support and failure modes;
- Provide fragmentation analyses for caving and induced caving designs;
- Dimension pillars, including geologic structural effects;
- Analyze existing failure situations and provide insights regarding failure mechanisms and potential support

More detailed information regarding our methods of determining ground support is available at our shotcrete ground support course (<http://www.edumine.com>).

Geotechnical monitoring

TDR and OTDR allow relatively inexpensive, real time, detection of shear displacement in almost any rock or soil slope. The installation of coaxial or fiber optic cables in geotechnically sensitive areas allows detection of sub-surface shear prior to failure of the rock or soil mass. This includes road cuts, dam abutments, pipeline alignments, open pit highwalls, landslides, etc. In addition, TDR/OTDR can be utilized in areas subject to undercutting and collapse such as over pre-historically mined areas, areas subject to sinkholes, and active underground mining.

TDR/OTDR's real time, digital nature provides for remote application of the technique with telemetry communication of the data from the monitoring area to a central site for near instantaneous analysis. This provides real time warnings for subsurface rock or soil displacement.

Zostrich's services include providing general assistance in system selection, pre-fabricated cables, system design and installation, and monitoring oversight including complete data collection and analysis.

Location of subsurface motion, coupled with the superior major structure and fabric models produced by Zostrich Geotechnical provides an excellent overview of the failure geometry, and the wherewithal to efficiently address the situation at hand.

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