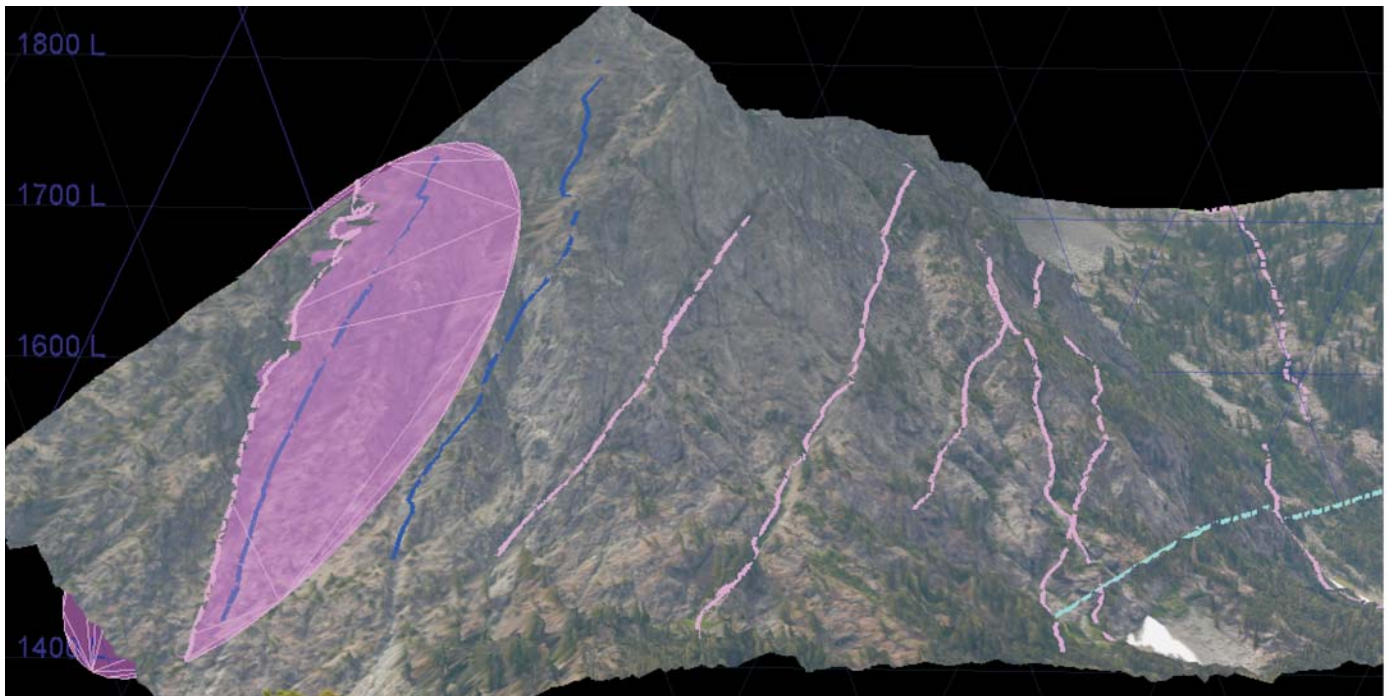


# GEOLOGIC STRUCTURE INTERPRETATION FROM MAPPING AND DRILL HOLE DATA

The goal of the course is to provide instruction in collection of geologic data using conventional and photogrammetric methods, compilation of the collected structural data for analysis, and analysis of the compiled data such that geologic structural frameworks may be completed. These structural frameworks, or models, can be utilized for a variety of end purposes.

Participants will be provided training regarding the necessary data collection and reduction processes for typical bench and traverse rock face mapping. Instruction will also be provided as to how to characterize structural data, including the orientation of fault zones from drill core. The information collected from face mapping and drill hole orientation and logging will then be utilized to determine, or interpret, major structure locations and orientations.

The course is of interest to geologists and geotechnical engineers, especially those that require detailed structural geologic models for design purposes.



The collection and compilation of structural geologic information from the field is the basis for a proper understanding of the rock mass as seen from a geologic structure perspective. Whether this is done using conventional techniques or with cutting edge technologies, the requirements are the same. Data must be collected consistently, thoroughly, and with as few biases as possible.

The advent of powerful computer programs allowing 3D visualization of geologic structures properly oriented and located in real space has the potential to revolutionize geologic structural interpretation. While not a “silver bullet”, photogrammetry is an exceptionally useful tool in that it allows mapping of areas that are inaccessible and/or dangerous, as well as perspective views and coverage that cannot be obtained with conventional mapping. Orientation, location, and continuity of a structure can generally be obtained much more rapidly, accurately, and economically using photogrammetry as compared to conventional mapping. However, photogrammetry does not replace conventional mapping. Conventional mapping is required to confirm physical characteristics of the geologic structure that can only be ascertained from physical examination as well as to verify photogrammetric interpretations.

Additionally, developments in drilling and core orientation, especially using downhole viewers, now permits reliable interpretation of the location, and orientation, of major geological structure at depth.



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If the data from these disparate data sets (general surface mapping, detailed surface mapping, oriented core, and structurally interpreted oriented core) are properly combined, sorted by specific characteristics (orientation being foremost), and represented in a 3D model, the location of structural zones can become readily apparent.

The resulting models are of import for any geotechnical endeavor requiring the location and orientation of such geologic structures. While primarily utilized by the author for pit slope and underground opening design, the models have applicability in a variety of fields, including resource definition.



The course is presently scheduled to span 4, approximately 12 hour, days.

Day 1- general course outline, introduction to photogrammetric mapping in the field, field cell mapping, data reduction of collected information;

Day 2- continued reduction of cell mapping information, field collection of pit wall information, including traverse mapping and photogrammetry

Day 3- data collection from pit wall photogrammetry, drillhole data collection and interpretation

Day 4- data compilation an interpretation of the previous three days' work (by instructor). This will require access to Maptek's Vulcan software with the Geotech module installed, or similar software with which the participant is familiar

Note that only sufficient training will be provided in photogrammetry, primarily using Admatech 3DM Analyst, such that the participant can accomplish the tasks within the framework of this course. It is not a photogrammetry course. Courses have been arranged where Adamtech directly participates in the course. This would require cooperation and arrangement with Adamtech.

This is an intense course with long days expected. It has been suggested that the course be expanded to 5 days. This is recommended if the course participants intend to conduct data compilation (Day 4, above) and/or if Adamtech is participating.



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The course will require that the participants have access to a relatively high quality PC running in the Windows environment. Sufficient RAM is required to run Adamtech's 3DM Analyst and Maptek's Vulcan. Suggested computer minimums are available upon request.

A timed dongle (USB software lock) will be provided for use of Adamtech's software during the course. This dongle will expire, and must be returned, at the end of the course.

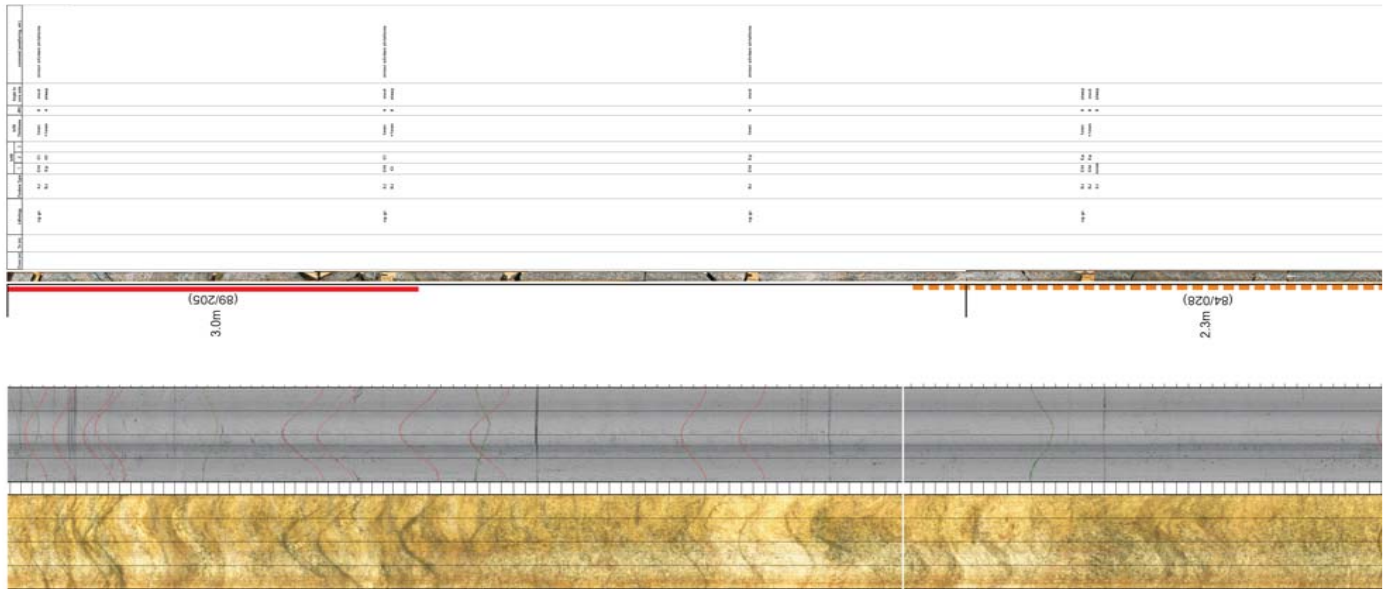
The course will require access to geology modeling software. This is not supplied with the course. The instructor utilizes Maptek's Vulcan software with the Geotech module installed. If the participants wish to use other software, they must be fully aware of its capabilities and how to import the collected data.

Development of stereographic plots will be required of the collected data. Presently, all such work is done with Z-Fabric. Participants may utilize other programs, such as Rocscience's DIPS, if they are fluent in its use.

Instruction will be held in both the field and the classroom. As such participants must be prepared for, and capable, of doing both. Mapping exercises will be conducted in the field, requiring a compass, notebooks, spray paint, as well as the standard PPE. Inclement weather can cause rearrangement of scheduling as photogrammetry requires that the rock face be visible (haze, dust, fog, rain/snow not obscuring the face) and that high winds are not blowing such that the camera is either vibrating or being blown by high winds onto the adjacent property.

The course requires that the hosting company provide a suitable area for both classroom instruction and field mapping. Computers, software licenses, etc. are the responsibility of the hosting company. Zostrich Geotechnical provides only an instructor, a classroom version of Z-Fabric, and timed dongles for Adamtech usage.

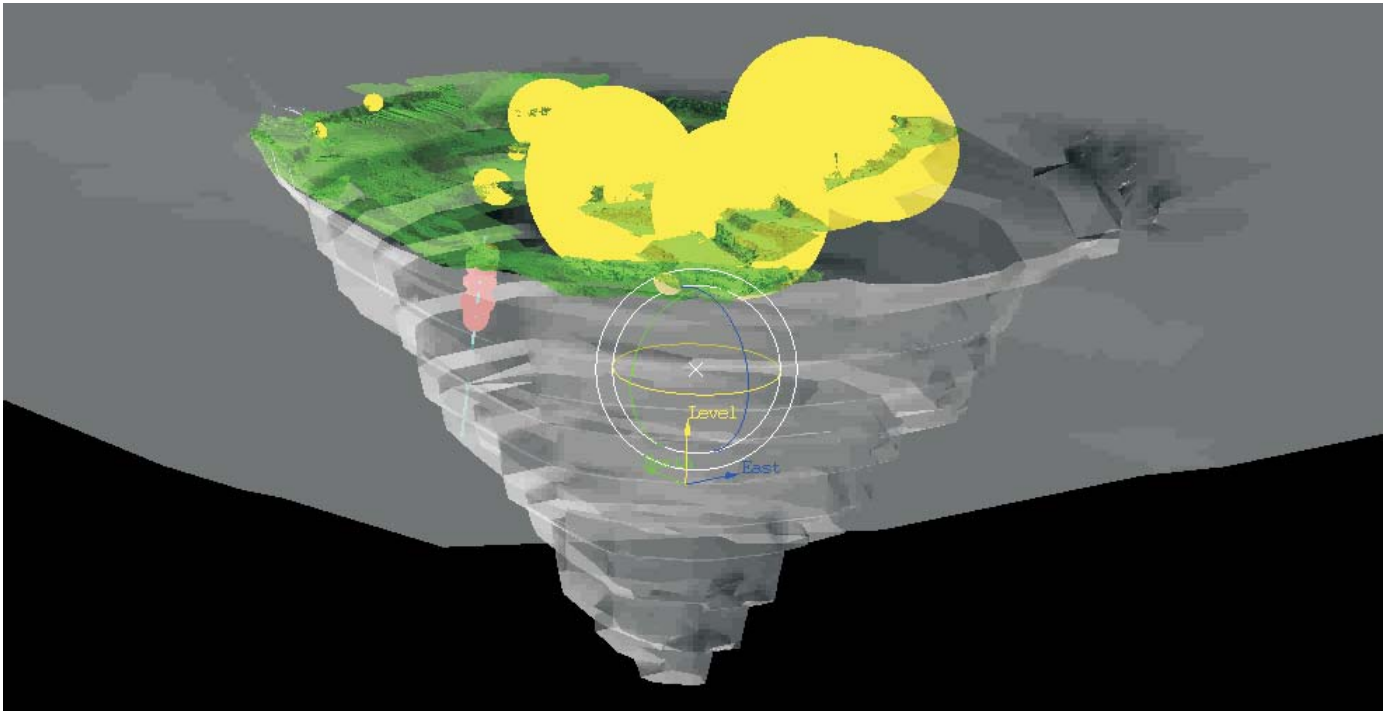
Preparation for the course on the client's side is not trivial and requires complete involvement and backing of the host site in order for the course to be a success.



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# GEOLOGIC STRUCTURE INTERPRETATION FROM MAPPING AND DRILL HOLE DATA



The instructor for the course is James Mathis (Zostrich Geotechnical).

Dr. Mathis received his B.Sc. in Mining Engineering from the University of Nevada Reno and a Doctorate in Rock Mechanics Engineering from the Högskolan i Luleå, Sweden. He has over 25 years of engineering consulting experience in rock mechanics. He holds professional engineering registration in Arizona (USA), Washington (USA), Northwest Territories (Canada), and British Columbia (Canada). One of his primary specialties is rock mass characterization, with emphasis on definition and inclusion of discontinuities in statistical assessment of opening designs for rock. His research has been practically applied in a wide range of mining operations, both surface and underground. A complete resume may be found at <http://www.zostrich.com/jimathis.pdf>

## Costs

Quotation available upon request . Costs are generally based on:

- 1 day of office preparation work
- 1 day of field prep work
- 2 days of travel
- 4-5 days of instruction.

All days are charged at 12 hours/day. These can vary as a function of location and work required.

Travel costs, accommodation, and other expenses are charged at cost.

Charges are estimated and must be paid in advance.

Simultaneous translation service from English to Spanish is available at extra cost.



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## **STRUCTURE INTERPRETATION FROM MAPPING AND DRILL HOLE DATA**

### **Key topics**

#### **Rock fabric mapping**

- Definition of rock fabric
- Purposes for and uses of fabric mapping
- Practical – field application of cell (window) mapping
- Practical – photogrammetric cell mapping
- Practical - cell data reduction using Z-Fabric (stereonet usage)
- Comparison of field and photogrammetric cell mapping results
- Fabric data reduction methodologies utilized in Z-Fabric

#### **Major structure mapping**

- Definition of major structure
- Concepts regarding major structure data collection
- Practical – field traverse mapping
- Practical – photogrammetric mapping
- Practical – major structure data reduction using Adamtech 3DM Analyst (includes input of field data and comparison of photogrammetric results with field work)

#### **Drill hole interpretation of major structure**

- Bias in drill hole data
- Brief overview of core orientation methods
- Potential errors in planning drill holes (methodology, orientation, orientation methods)
- Data sources and compilation techniques for drill hole analysis
- Overview of major structure delineation in drill core
- Practical – major structure logging in drill core
- Practical – data reduction to determine major structure in drill core (utilizes Z-Fabric)

#### **Structural Modelling**

- Overview of and compilation of fabric, major structure and drillhole interpretation (if compilation to be done by participants, add one day of classroom time)
- Transfer of compiled Z-Fabric database to model development in Maptek Vulcan
- Overview of the Geotech module in Vulcan
- Practical - plotting mapped structural features by discontinuity set in Vulcan
- Practical – structure creation using Vulcan (structural planes)