



WEBINAR

Dips to RocSlope – Integration and Beyond

Q1: How can I download this software?

A1: You can request for a 15-day free trial or a purchase a software license through the RocPortal:
<https://www.rocscience.com/portal>

Q2: Can we stabilize the wedge and planar failure that how much shortcrete and rock bolt is used to stabilize the failure?

A2: RocSlope can provide results for the support pressure required to achieve the input design factor of safety, along with values for the block face area and failure depth that could be informative for support design. Within the program, the user may apply rock bolts, shortcrete, and/or support pressures to further analyze the effects of these support systems on block stability.

Q3: Will the results be able to provide statistics/estimates of back break on the bench crests?

A3: As RocSlope models joints with finite size and location, the computed blocks and failure extents would be indicative of the back break distance. If randomizing synthetic joints in RocSlope, then each iteration of the joints would form a different set of blocks and back breaks. Randomizing multiple times would provide a range of possible back break distances.

If the purpose of the analysis is bench design and optimization, then SWedge would be recommended. The Bench Design feature in SWedge can analyze for the likely occurrence of back break distances by fixing either the bench width or the interramp angle.

Q4: What's the radius in joint data entry?

A4: RocSlope assumes a circular shape for all joints. If using measured joints where the joint locations and sizes are mapped, then an entry for the radius determines a circle's size, and an entry for the (x, y, z) determines a circle's center location.

Q5: Is it possible to import a 3D fault model in .dxf or mapped plans from photogrammetry directly in RocSlope? Photogrammetry in .obj

A5: A fault or any form of defect in .dxf (or in any common geometry file type) can be imported and then assigned with the appropriate properties.

For a list of accepted geometry file formats:

<https://www.rocscience.com/help/rocslope/documentation/geometry/import-export/import-geometry>

<https://www.rocscience.com/help/rocslope/documentation/geometry/surface-triangulation-tools/add-surface-from-points>

Mapped plans from photogrammetry can be handled as follows. While RocSlope can import files of the .obj format, it cannot directly extract the joint data needed to model the joints in RocSlope (which are orientation, location, and size). This means the mapped photogrammetry should be processed first, to extract tabulated data for the joint dip, dip direction, x, y, z, and observed length. These values can then be imported into RocSlope as a .csv or a Dips file.

Q6: In the last example there were blocks shown with FoS lower than unity, but they were not failed. Would you adjust the phi to unity FoS to correct?

A6: In the last example, a probabilistic analysis was conducted using 100 simulations. A factor of safety was computed for every block in each simulation, and a probability of failure (PoF) was computed for each block over all simulations. Perhaps it was the PoF that was seen to be less than unity. A block could have a PoF that is non-zero and less than unity.

Q7: Can you show how seismic loading can be included in analysis?

A7: Seismic loadings are modeled using seismic coefficients via a pseudo-seismic analysis. A seismic force is applied either in the direction of block sliding, or in a user-specified Trend/Plunge.

Seismic force = seismic coefficient * block weight

Q8: Both of these examples were engineering rock slopes, how have you found the performance on natural rock slopes?

A8: RocSlope was recently released end of June 2023, with a clientele mainly in the mining sector at the moment. Please contact grace.huang@rocscience.com if you would like to publish/collaborate on a case history analysis, be it for a natural or engineered rock slope.

Q9: Should slope direction be 80 to 200?

A9: Yes, thanks for the correction. The second example used a slope dip direction ranging from 80 deg to 200 deg.

Q10: Would application of Terzaghi weighting affect the distribution of joints as shown on the pit face (in example 1)?

A10: Terzaghi weighting is used to correct orientation bias in joints observed along a traverse, so that apparent spacings can be converted to true spacings. The webinar example 1 used the mapped locations and orientations of defects, with input data required for dip, dip direction, x, y, z, and observed length. The orientation inputs did not need to be corrected for bias.

Q11: The joint orientations from RS3 DFN don't appear to be randomized?

A11: The RS3 DFN inputs for dip and dip direction are currently deterministic, while other input parameters are stochastic. This was to reduce complications for the first release of DFN in RS3. However, randomizations for the dip and dip direction are on the roadmap, as we would like to offer a fully stochastic DFN.

Q12: How do you decide when to use deterministic or probabilistic analysis?

A12: This would depend on factors such as project requirements, design code requirements and/or industry standards, and the uncertainties present in the analysis, etc.

Q13: What are the numbers in column H and I?

A13: The numbers in column H and I of the Measured Joints dialog in RocSlope were for the observed strike and area of the mapped joints. The values were carried over from Dips and are not needed for computations in RocSlope.

Q14: Is the radius also the persistence?

A14: The radius pertains to the observed length of the joints, expressed in units of length. Persistence is typically expressed as a fraction.

Q15: Can you briefly comment how joint location is defined in RS3 through the DFN tool?

A15: In RS3, the joint distribution can be defined using stochastic or deterministic parameters such as Joint spacing, length and the joint persistence.

The joint network can be assigned to a whole volume(s), specific material(s), or using a control volume to apply it to the specific zone of your model.

To set the location for the joints, the user needs to uncheck the initial seed (by default it's a random location in the external) in the DFN tool, and when assigning the joint network to the model, set the desired placement for it. The details regarding the placement is provided [here](#).

Q16: For the base case where persistence is assumed to be equal to the radius of the disc, does that mean that we're assuming the size of the disc is double what was measured (since diameter, $d=2r$)?

A16: For the base case I assumed the radius to be equal to the measured joint length, which means the diameter would be double that length. Whether to assign the mapped length as the radius or the diameter is an assumption, as the true joint size is an unknown and this value would change in a sensitivity analysis.

Q17: Can RocSlope be used for evaluating block mobilization in tunnels/caverns as well?

A17: RocSlope is designed for above-ground block stability analysis. We have a new software under development (RocTunnel) that is intended for underground block stability analysis. The anticipated release is mid-year 2024.

Q18: If case support has been used in upper slopes while excavating the pit, is there a way to introduce it in the joint data?

A18: Supports can be modeled via application of bolts, support pressures, and shotcrete to specific sections of the slope. If the analysis is intended to target block stability for the portions of the slope being excavated, then the slope geometry could include the slope sections that are supported and the excavated sections, with supports being applied to the upper slopes.

Q19: Is the disk diameter equivalent to the persistence?

A19: As the true joint size is an unknown, the joint disk size, as defined by the input radius, could be equal to the mapped length or 50% of that. The effect of the joint size on block formation can be analyzed via a sensitivity analysis.

Q20: What are the strike and area in the dips file?

A20: These values came from the field mapping but were not used in the Dips or RocSlope analysis.

Q21: Would you provide a reference on how to estimate the strength of the joints?

A21: References can be found here:

<https://link.springer.com/article/10.1007/BF01261801>
<https://static.rocscience.cloud/assets/resources/learning/hoek/Practical-Rock-Engineering-Chapter-4-Shear-Strength-of-Discontinuities-Remediated.pdf>
<https://isrm.net/download/media.file>

Q22: How does RocSlope help in defining the length of anchor to stabilize blocks? Does this require us to define anchors pullout resistance?

A22: RocSlope provides results for the failure depths of blocks, which are indicative of the minimum required anchor lengths to reach competent rock. Users may also define and add anchors in RocSlope, which would require inputs for the support type (grouted dowel, mechanically anchored, etc.), the force application method (active vs. passive), bolt orientation efficiency, tensile capacity, plate capacity, anchor capacity, shear capacity, bond strength, etc. Users could then investigate the effect of the support system on the stability of the blocks.

Q23: Can RocSlope capture sliding surfaces which are partly in intact rock and partly on a joint surface(s)?

A23: Rock bridging is currently not accounted for in RocSlope, and all failures are assumed to occur through the joints. We are researching methods to handle rock bridging.

Q24: How to define the traverse and what is the - or + degree added to the traverse?

A24: A synthetic joint set requires a traverse, along which joint disks are stochastically distributed given input distributions for the joint orientation, spacing, and size.

The traverse in RocSlope is defined by a polyline, which can be drawn or imported as a .txt or .csv with (x,y,z) coordinates. There is not a required entry for +/- degree added to the traverse.

Q25: In the first example, if you see joints overlap, can you combine them?

A25: RocSlope currently does not have this capability. Combining overlapping joints would require finding the joint entries of interest and eliminating one or more entries. Perhaps the joint search could be performed using the Dips filtering tool.

Q26: Is there an ability to undertake a joint weighting to allow for orientation of the cut slope from which defects have been collected. This is a standard operation used for joint data in DIPS. Can this same weighting method also be undertaken in RocSlope? Slope orientation from which defect data is collected will bias the resultant defect et.

A26: When importing joint orientation data from Dips into RocSlope for the definition of synthetic joints, users have the option to choose whether to import the weighted or unweighted orientation data. In addition, while working with RocSlope synthetic joints, the user may indicate whether the input spacing is the apparent spacing or the true spacing. Apparent spacings are internally corrected for bias using the input traverse data.

Q27: Is it possible to perform comparison analysis of the influence of joint shear strength in the program? Different word sensitivity analysis of joint strength?

A27: The effect of joint strength on block stability can be investigated via a probabilistic assessment. Run a probabilistic analysis with many simulations, assign a statistical distribution to the joint strength parameters (e.g., phi, cohesion), such that a different value for the strength is used in each simulation. Interpretation for the effect of joint strength can then be conducted using scatter plots, histograms, and cumulative plots.

Q28: Rather than running multiple iterations with randomized joints, can you run a monte-carlo simulation to complete a probability analysis?

A28: This is on the roadmap. We hope to automate the process of randomizing joints, such that each probabilistic simulation can fully utilize stochastic joint orientation, spacing, size, and strength. Currently, the automation applies to rock unit weight and joint shear strength parameters, whereas the joint location, orientation, size must be manually randomized.

Q29: Will this example be available in RocSlope library with the Dips data in which we can use and practice properly?

A29: Example 1 which imports Dips grid data is a real case study that we have permission to use for illustrative purposes only. However, our library of tutorials includes practice examples for defining measured joints and synthetic joints. We can also add more examples to this library as needed.

Q30: Can we use more complicated slope geometries for RocSlope? If so, can the slope progressing and increase the runtime exponentially?

A30: More complicated slope geometries can be used in RocSlope, as well as an unlimited number of joint surfaces, as the program can determine blocks for any geometry. The only limitation is the user's machine capability. Note that surface resolution should be decreased to reduce the total number of mesh tetrahedra in the model and to expedite runtimes. Surface resolution matters little for block stability analysis, which is mainly influenced by block weight and joint strength.

Some recommendations for geometry complexity and computer spec:

- 32 GB RAM recommended minimum
- 64 GB RAM for 100,000+ triangles
- 100 GB SSD recommended minimum
- 500 GB SSD preferred
- Discrete Nvidia brand graphics cards preferred for optimal experience
- Windows 10 64-bit recommended minimum
- Windows 11 64-bit preferred

Q31: You have discussed joints - can you model a fault with infinite persistence?

A31: A defect with infinite persistence can be modeled using a geometric surface that extends the entirety of the slope volume.

Q32: Can geometry be imported by civil3d xml file? Or is it required to be imported as dxf?

A32: For the full list of accepted geometry formats, please see the following links:

<https://www.rocscience.com/help/rocslope/documentation/geometry/import-export/import-geometry>

<https://www.rocscience.com/help/rocslope/documentation/geometry/surface-triangulation-tools/add-surface-from-points>

Q33: Can we check results from individual blocks and reproduce the same results in SWedge or RocPlane?

A33: Individual blocks in RocSlope can be selected for detailed results viewing. If the block shape, number of joint surfaces forming the intersections, block weight, and joint strengths are the same as those in a SWedge or RocPlane model, then the results should be the same.

Q34: Can the analysis recognize "synthetic" forms of failure not consisting of only one type of kinematic mode?

A34: RocSlope uses the 3D limit equilibrium method, which calculates a factor of safety assuming a single kinematic failure mode (i.e., block sliding). To examine more complex failures that may consist of a combination of different modes, then the finite element or finite difference method would be used.

Q35: Perhaps a question you can answer later by email, can you provide some recommendations for tools to derive the geomechanical parameters (dip, dip-dir, persistent etc) from LiDAR or Photogrametric Data? I am using CloudCompares Facets add on but wonder if there are others.

A35: Thanks for reaching out. I will email once I find out.

Q36: Will I be able to export my blocks to CAD? Can you export the failed blocks out as a solid?

A36: After computing, any blocks formed can be exported via a common geometry file format:

File > Export > Export blocks

File > Export > Export slope with failed blocks removed

Q37: Is it possible to have statistics on probability of failure for several realization of randomized synthetic joint sets?

A37: Synthetic joint sets currently need to be manually randomized for generating different realizations, which means that a probability of failure heatmap that accounts for the different joint realizations cannot be automatically generated. This feature is on the roadmap.

Q38: Could you explain how you determine X, Y, Z of joint?

A38: Joints were mapped (i.e., photogrammetry, LiDar) and then processed to get the dip, direction, x, y, z.

Q39: Is it possible to import different lithologies with different unit weight?

A39: Yes, this is possible. Rock unit weight is a material property parameter, which can be assigned to material regions. Material regions can be defined via 1) the in-program borehole manager, where material stratification would be interpolated based on borehole inputs; 2) assigning material properties to different slope regions (divide slope volume into appropriate sections, then assigning material properties to the sections); and 3) Slope Wizard, where different materials can be assigned to a user-defined slope geometry.

Q40: Is it possible to import real 3D mapping data from photogrammetry in RocSlope?

A40: 3D mapping data would require some processing before they can be imported into RocSlope. For example, data from photogrammetry could be used to derive the joint dip, dip direction, x, y, z, and observed length.