RocSupport 4.0

Support Estimation Using Ground Reaction Curves

rocscience software tools for rock and soil

RocSupport is a fast and easy to use program for estimating the deformation of circular tunnels in weak rock and visualizing the tunnel interaction with various support systems. This analysis method is commonly referred to as rock-support interaction or convergence-confinement analysis.
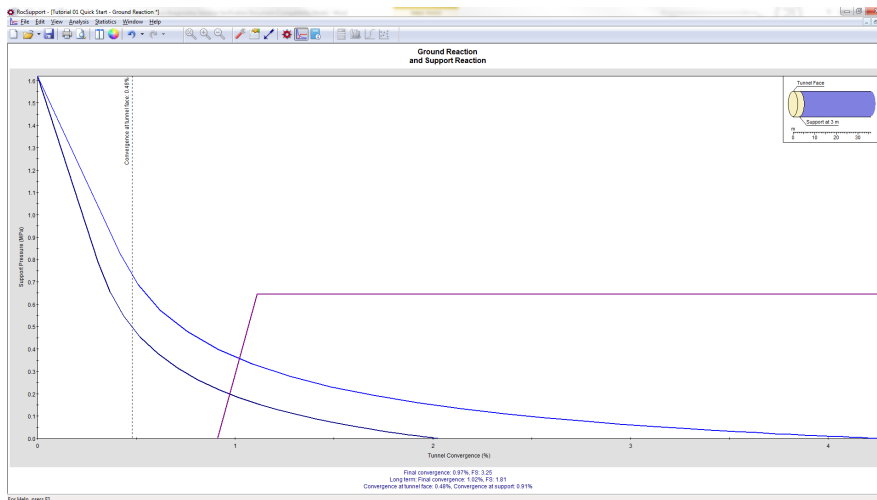
Ground reaction curves (short term and long term) and support reaction.
The intersection of these curves determines the safety factor of the support.

Support Parameters dialog.

Ground Reaction Curve

The ground reaction curve is based on the analytical solution for a circular tunnel in an elasto-plastic rock mass under a hydrostatic stress field. Given the tunnel radius, in-situ stress conditions, rock parameters and support parameters, the ground reaction and support reaction curves are calculated. The intersection of these curves determines a factor of safety for the support system. Rock mass strength can be defined in terms of either Mohr-Coulomb or Hoek-Brown parameters.

Support Options

RocSupport allows you to simulate the application of rockbolts, steelsets or shotcrete around the circumference of the tunnel. Within each support category, you may select from one of several predefined support types (e.g. 34 mm rockbolts, 203 mm flange I section rib steelsets, or 50 mm thick shotcrete), or create a custom version. Different support types can be easily combined (e.g. rockbolts and shotcrete) and the properties of the combined support system will be used to determine the overall support reaction curve.

Probabilistic Analysis

RocSupport has powerful yet easy-to-use probabilistic analysis features. All tunnel and rock parameters can be assigned statistical distributions. Using Monte Carlo or Latin Hypercube sampling, this results in a distribution of safety factors from which a probability of failure for the support system is calculated. Histograms, cumulative plots and scatter plots can be viewed. Results can be exported to Excel with a single mouse click.

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Technical Specifications

Analysis Options

- Duncan Fama solution for ground reaction curve
- Carranza-Torres solution
- Vrakas and Anagnostou solution
- Lee and Pietruszczak solution
- Barbosa solution
- plot long term ground reaction curve (specify strength reduction factor)
- deterministic (safety factor) or probabilistic (probability of failure) analysis

Tunnel Parameters

- tunnel radius
- in-situ stress

Rock Parameters

- elastic properties – Young's modulus, Poisson's ratio
- strength properties – Mohr-Coulomb or Generalized Hoek-Brown
- equivalent Mohr-Coulomb parameters can be calculated from Hoek-Brown parameters (GSI, mi, intact UCS, D)

- built-in charts and tables to help estimate suitable values of GSI, mi, intact UCS and D
- peak and residual strength parameters for Generalized Hoek-Brown criterion
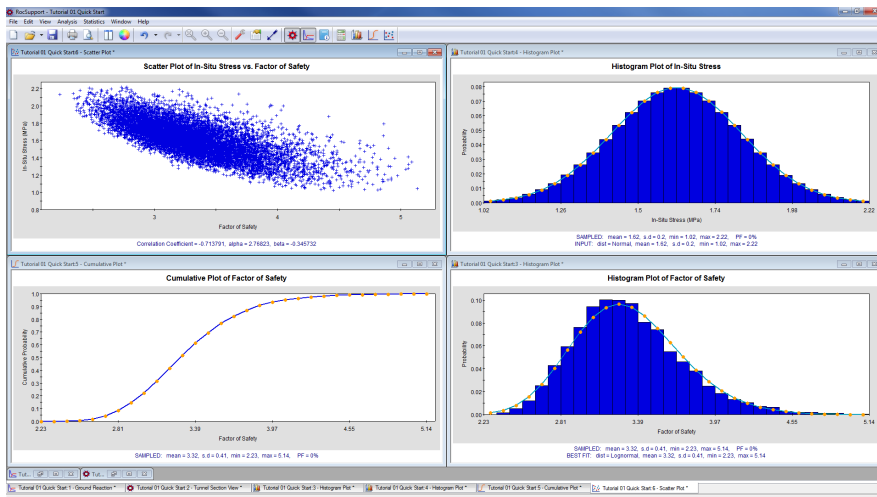
Support

- pre-defined support types for rockbolts, steel sets and shotcrete
- combine multiple support types (e.g. rockbolts and shotcrete)
- simple parametric analysis – add, change or remove support with a few mouse clicks
- user-defined support
- support installation – specify distance from face or tunnel convergence
- interactive positioning of support
- longitudinal deformation profile – built-in or user-defined function
- custom support option for each of the 3 supports
- a steelset reinforcement database is available

Probabilistic Analysis

- Monte Carlo or Latin Hypercube simulation
- random or pseudo-random sampling
- random variables – all tunnel and rock parameters can be defined as random variables
- statistical distributions – normal, uniform, triangular, beta, exponential, lognormal, gamma
- histogram, cumulative and scatter plots
- user defined plot variables
- best fit distribution, regression line
- highlight support failure on histogram and scatter plots
- one-click export of charts to Excel

Viewing Options

- ground reaction view, support reaction
- tunnel section view, plastic zone radius
- customize display options
- export image files
- Info Viewer summary of analysis results

Display of probabilistic analysis results – histogram, cumulative and scatter plots.