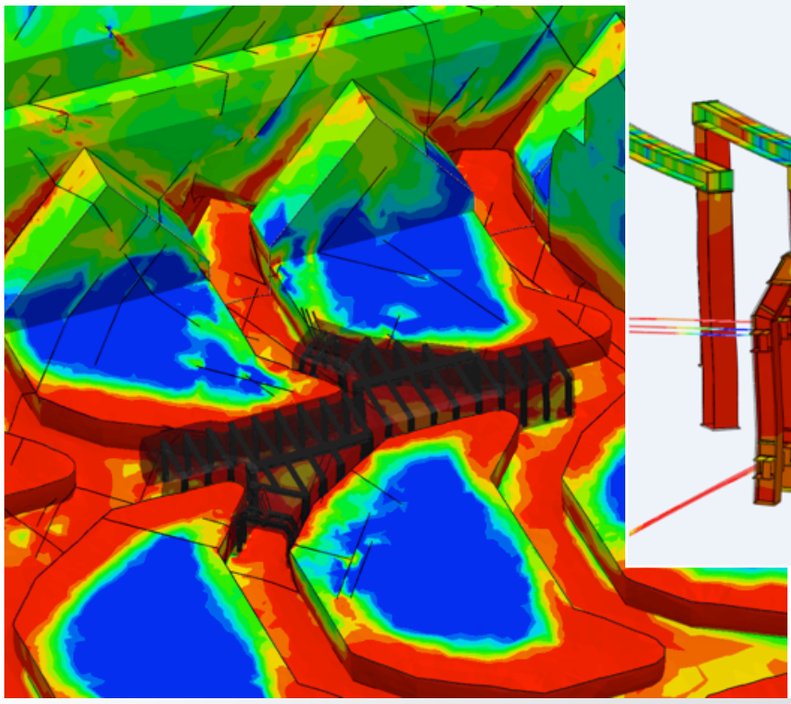
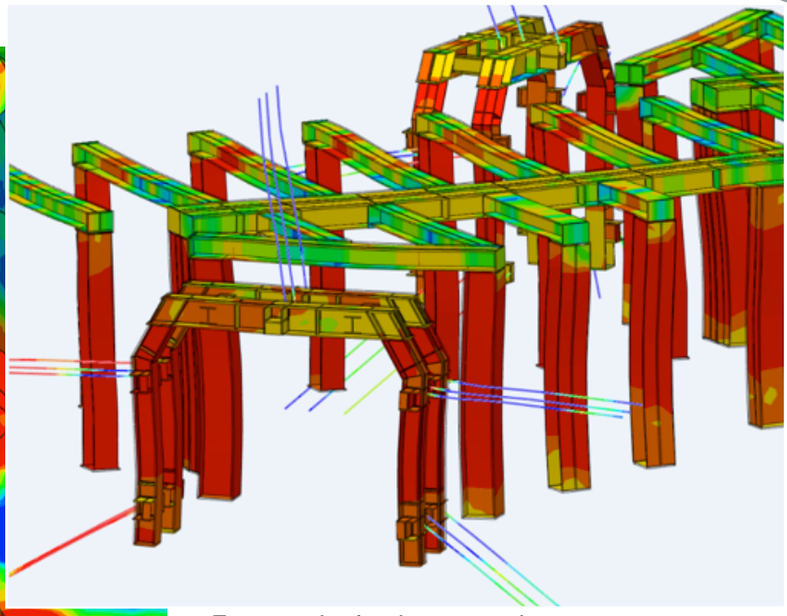
BECK
ENGINEERING





To properly simulate ground support response, the ground deformation in the surrounding rock mass must correctly represent the mechanisms of deformation.

GROUND SUPPORT

AT BECK ENGINEERING WE UNDERSTAND THE IMPORTANCE OF A WELL ENGINEERED GROUND SUPPORT SYSTEM FOR A SAFE AND COST EFFECTIVE WORK ENVIRONMENT.

CONVENTIONAL ANALYSIS OFTEN FOCUSES ON INDIVIDUAL GROUND SUPPORT ELEMENTS RATHER THAN A COMBINED GROUND SUPPORT SYSTEM.

TO RELIABLY SIMULATE THE GROUND SUPPORT RESPONSE, GROUND DEFORMATION MUST BE CAPTURED ACCURATELY ON THE CORRECT LENGTH SCALE.

Beck Engineering uses multi-scale multi-physics simulations as these are the most efficient approach for assessing a ground support system's capacity and demand over a range of different environments.

This approach also enables the ground support system to be tested to failure, improving the understanding of the maximum capacity of the system.

The Simulation Aided Engineering workflow allows clients to efficiently test different designs and sequences over a range of conditions. The result is a more accurate quantification of geotechnical performance.

Beck Engineering have been world leaders in physics based rock mechanics simulations for over 15 years.

We have applied this methodology of ground support systems including rock bolts and cable bolts, mesh reinforced shotcrete, precast concrete liners and steel sets. This approach has been applied in excavations ranging from individual tunnels to complex excavations such as block cave extraction levels and crusher chambers.

Speak to one of our engineers about improving your understanding of the performance of your ground support system.

Beck Engineering is an Australian-based engineering firm that specialises in mining and rock mechanics analysis for the global mining industry.

We apply realistic physics-based simulations to forecast the geotechnical performance of underground and open pit mines, across a broad range of mining methods, geotechnical conditions and commodities. Our experienced mining engineers work with our clients to integrate these performance forecasts into practical mine designs, schedules and operating plans.

BECK ENGINEERING SHARES A COMMON GOAL WITH OUR CLIENTS: TO DESIGN, PLAN AND OPERATE SAFE, PRODUCTIVE AND RELIABLE MINES.

GROUND SUPPORT

OUR APPROACH

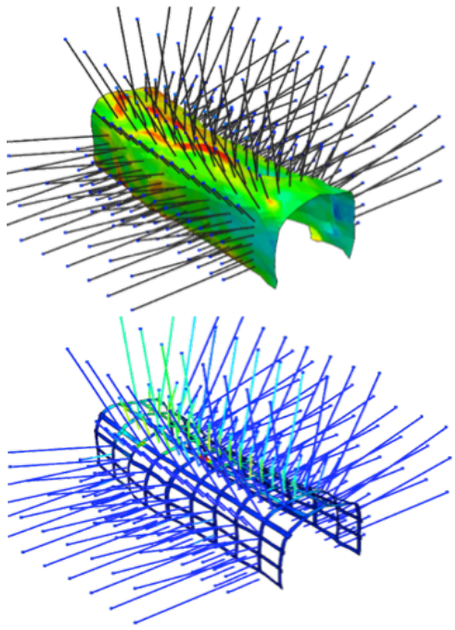
- Beck Engineering's own rock mechanics specific numerical code generates large scale, 3D Finite Element models.
- Our simulations use non-linear, strain softening, dilatant material models for each geotechnical domain.
- Faults are built explicitly to match the geotechnical structural interpretation. Slip, separation and accumulation of damage is realistically represented along faults.
- Ground support elements are represented individually in the simulation
- The full extraction history and planned mining sequence is built into the model.
- Beck Engineering's simulations can be coupled multi-physics models. For example, hydrogeological models or particle flow codes (for simulating cave propagation).

WHAT YOU GET

- Powerful, non-biased, physics based predictive tool for:
  - Geotechnical Engineers
  - Mining Engineers
  - Geologists
  - Managers
- Full 3D results database available for site engineers to use for ongoing confirmation, analysis and refinement of mine design.
- Full transparency: We will assist you how to get the most out of the results, what information would improve the forecasts and work with you to continually improve your mine.
- Quick turnaround time between iterations.

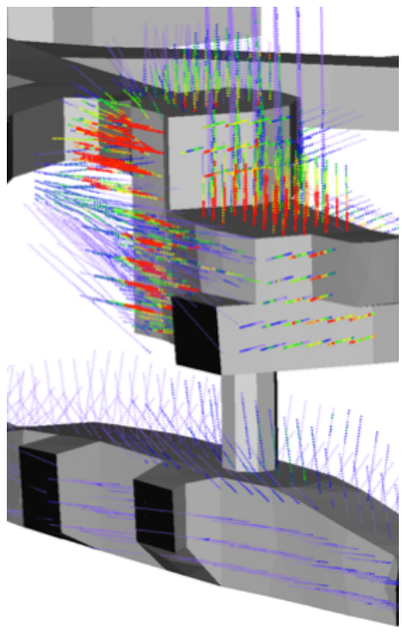
CASE STUDY 1

Simulation of a ground support systems in a highly seismic environment. This project investigated the performance of the ground support system when loaded by a nearfield seismic event. The ground support system is presented as individual elements of fibrecrete, steel tendons and mesh straps.



CASE STUDY 2

The scope of this project was to assess the performance of the existing and proposed ground support systems. The excavation shown is part of a much larger geometrically complex underground mining operation. This simulation assisted in determining the serviceability limits and life span of the excavation.



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