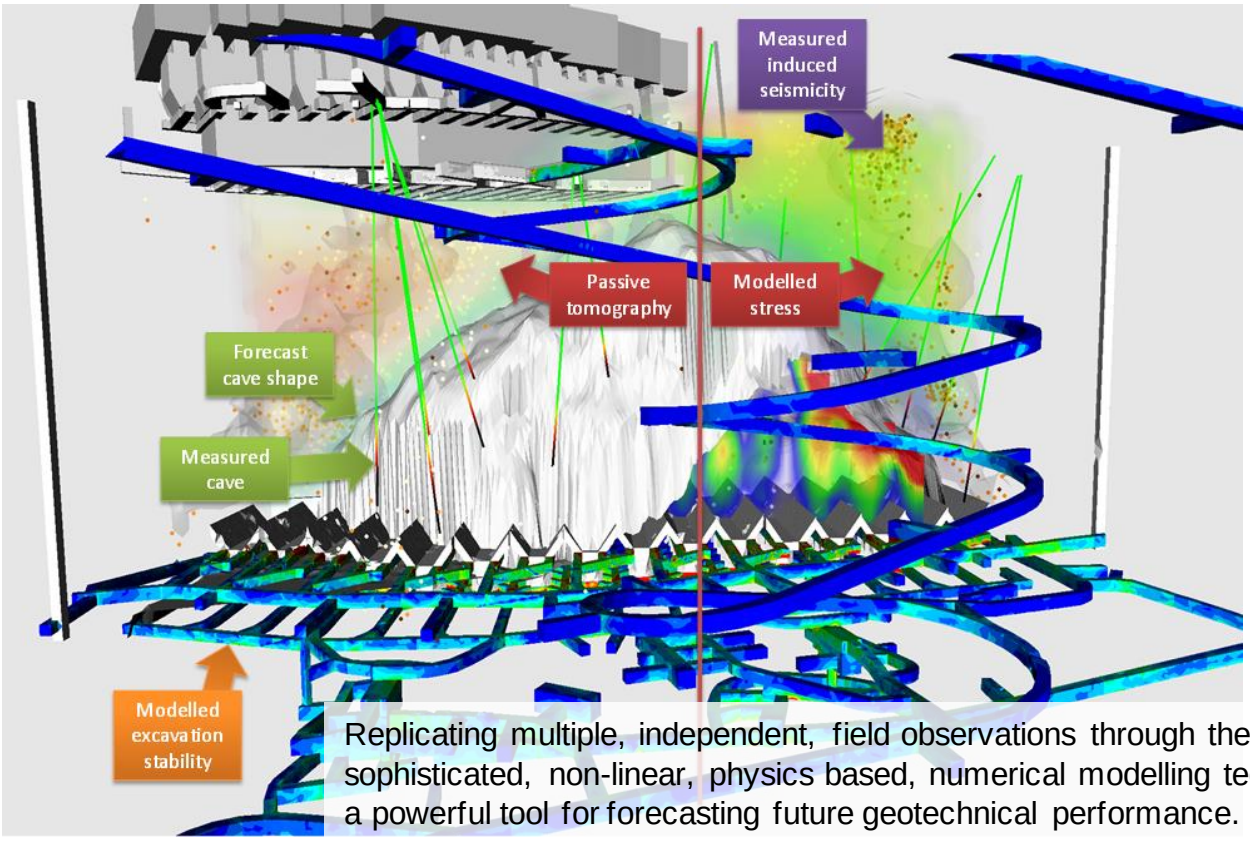
BECK ENGINEERING



Replicating multiple, independent, field observations through the use of sophisticated, non-linear, physics based, numerical modelling techniques is a powerful tool for forecasting future geotechnical performance.

SIMULATION AIDED ENGINEERING

AT BECK ENGINEERING WE BELIEVE THAT A SAFE, PRODUCTIVE AND RELIABLE MINE COMES ABOUT FROM A WELL-ENGINEERED MINE PLAN.

TO ENGINEER SUCH A PLAN REQUIRES A CLEAR INSIGHT INTO THE INTERACTIONS AND MECHANICS BETWEEN THE MINING OPERATION AND PHYSICAL ENVIRONMENT OVER THE MINE'S LIFE. SIMULATION AIDED ENGINEERING IS A WORKFLOW THAT PROVIDES THIS INSIGHT, CHALLENGING CONVENTIONAL METHODS THROUGH THE USE OF NON-BIASED, PHYSICS BASED SIMULATIONS.

Conventional methods simplify the complexity of geotechnical environments, greatly limiting the functionality of the results and the accuracy of the forecast.

Simulation Aided Engineering limits the need for this simplification, thereby reducing assumptions, delivering a much closer replication of results to observations, and an improved forecast.

The Simulation Aided Engineering workflow allows clients to efficiently test different designs, sequences and to quantify geotechnical performance.

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

We have applied this methodology on over 250 projects encompassing a wide range of geotechnical environments.

Speak to one of our engineers about incorporating Simulation Aided Engineering into your mine design process.

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.

SIMULATION AIDED ENGINEERING

OUR APPROACH

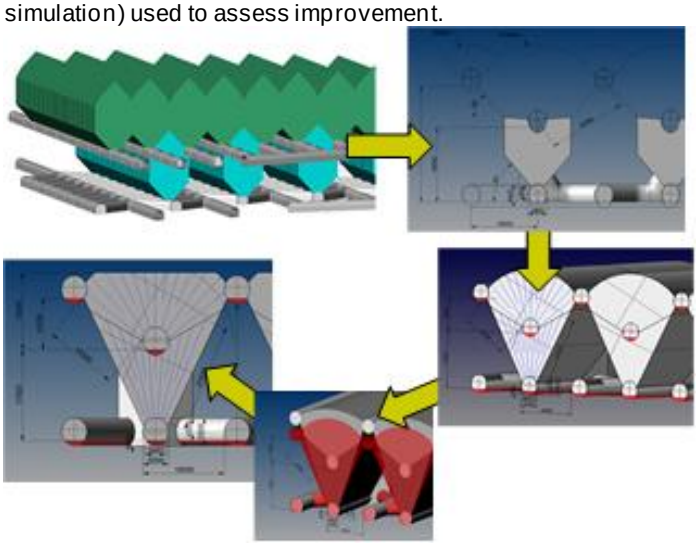
- Beck Engineering's own rock mechanics specific numerical code generate large scale, 3D Finite Element models.
- Our simulations use non-linear, strain softening, dilatant material models for each geotechnical domain.
- Faults are built explicitly to match the geotechnical structural interpretation. Slip, separation and accumulation of damage is realistically represented along faults.
- 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.

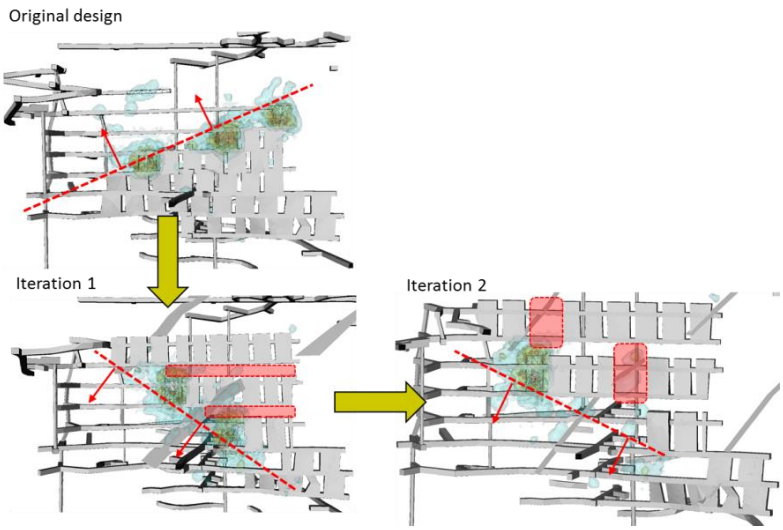
CASE STUDY 1

An example of pre-feasibility stage design optimization using Simulation Aided Engineering: The figures shows key design milestones in the evolution of a potentially feasible concept. At each indicated step, a vulnerability was identified that was targeted in a subsequent design iteration, with strain softening, dilatant Finite Element modelling (stress and deformation simulation) used to assess improvement.



CASE STUDY 2

An example of design evolution of a narrow vein stoping operation using Simulation Aided Engineering. Iteration 1 reversed the mining direction and included sill pillars. The final design added rib pillars across major structure. This final design resulted in a reduction in exposure to moderate and high seismic potential, a reduction in deformation in work areas and the potential for improved recovery due to better ground conditions. With current capabilities, multiple iterations can be completed within a 24-48 hour period.



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