

## VULCAN ENGINEERING MODULES

Empower your operation with additional modules which provide further engineering functionality.

### OPEN PIT MINE DESIGN

#### All the tools needed for open pit mine design.

- > Easy single, double and triple bench open pit design.
- > Multiple pit access types from ramp to security berm; toe and crest lines.
- > Ramps with applied grade can be designed on any side of the pit.
- > Switchback and multiple ramp system pits can be designed.
- > Multiple pushback design options and generation of intersection volumes with previous pushbacks or phases.
- > Automatic or manual modification of existing designs by moving walls or adding ramps.
- > Waste dump design tools (radial dumps and benched dumps according to criteria of tonnage, etc.)
- > Automatic generation of expansions according to criteria of tonnage or benefit by working directly with the block model.
- > Automatic generation of pit solids.
- > Access to the block modelling module allows quick evaluation of designs against the resource model.
- > High productivity in the pit, dump and leach pad design stage, with the flexibility to evaluate various design alternatives in a short amount of time.
- > Rapid Pit Design tool for strategic mine design evaluation.
- > Save the design sequence and replication different strips (stratigraphic pit design).
- > Automatically generated triangulated surface of the highwall profile (stratigraphic pit design).

EASE OF CREATING AND EDITING DESIGNS IS KEY TO QUICKLY EVALUATING SEVERAL OPTIONS, ALLOWING SELECTION OF THE OPTION WITH THE BEST ECONOMIC OR OPERATIONAL RESULTS.

### UNDERGROUND MINE DESIGN

#### Design mining structures such as declines, shafts, cross cuts, pillars, stopes and levels.

- > Automatic creation of a ramp between two points based on geometric constraints.
- > 3D design allows viewing and measuring the impact of design.
- > 3D and graphical alerts warn of certain situations such as proximity of drilling, colour gradients, etc.
- > Easily run cost/benefit analysis.
- > Design can be triangulated for accurate volume calculations and creation of 3D geological intersections.
- > Interactive stope design tools allow calculation of reserves from a block model during the design process.
- > Costing options can be used to generate summaries of excavation advances, volumes, times and costs involved in a mine development.
- > In coal mines, seams can be interrogated for reporting underground reserves.
- > Preview designs before applying settings.
- > Design declines with intermediate access points using the automatic Ramp tool.
- > Interactive ramp editor allows independent modification of ramp sections.
- > Transition gradient can be specified at the start, middle or end of the ramp.

CREATE AND MODIFY ALTERNATIVE DESIGNS QUICKLY TO SELECT ONE THAT DELIVERS THE BEST ECONOMIC OR OPERATIONAL RESULTS.

## PIT OPTIMISER

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### **Integrates with Vulcan block modelling tools.**

- > Uses Lerchs & Grossman algorithm; uses block models with a previously calculated economic value, as well as parameterised evaluation with one or more products and processes.
- > Evaluation and calculation tools in Vulcan block modelling allow the use of complex expressions and routines for any of the parameters involved in the calculation of the economic value.
- > A series of pit strings can be used as a final pit determination tool or as an aid to define mining phases or pushbacks.
- > The geotechnical environment is specified by varying slope angles in different regions; these can have any shape and can be specified as polygons, complex 3D triangulations or from the block model itself.
- > Geological contaminants can be used to improve the optimisation process in complex deposits.
- > Extraction rates can be used to incorporate the effects of time during design optimisation.
- > Two options, allowing optimisation of one product and process, or multiple products and processes.
- > Powerful analysis tools, with charts and reports created in Excel.

INTEGRATED WITH VULCAN TO HELP ENGINEERS WITH THEIR PLANNING DECISIONS.

## STOPE OPTIMISER

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### **Processes resource block models to create optimised mineable volumes which are displayed as polygons and 3D triangulations.**

- > Evaluate and quickly run multiple alternative mining scenarios, changing mining method, cutoff-grade, stope dimension or orientation.
- > Multiple scenarios can be set up and visually compared using section and/or plan polygons, and solid stope triangulations.
- > Minimum pillar dimensions or exclusion zones can be considered for a more accurate design.
- > Integration in the Vulcan 3D environment allows quick 'what-if' analysis for underground production prefeasibility studies.
- > Detailed output includes the stope optimisation report, reserve tonnage and grade for each stope.
- > Flexible configuration means optimisation can be applied to both steep and near horizontal orebodies.
- > Accuracy that cannot be achieved using traditional methods.
- > Pre-feasibility runs identify the best design parameters for final feasibility.
- > Integrated with Vulcan's design and scheduling tools.
- > Create or specify irregular frameworks.
- > Variable cutoffs based on position or stope size.
- > Ability to use head grade in the evaluation.
- > Splitting, smoothing and merging options allow for fine tuning the desired stope shapes.

WHAT-IF ANALYSIS OPTIMISATION RUNS CAN BE PERFORMED IN MINUTES, COMPARED TO DAYS OR WEEK USING CLASSICAL METHODS.

## SURVEY

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### **Collected survey information is imported into Vulcan for review, manipulation and update.**

- > Download / upload to industry standard data collectors and total stations.
- > Reduce raw instrument files in either radiation or coordinate form directly into graphical objects on the screen.
- > Perform survey network adjustments using the least squares variation of coordinates method.
- > Automatically apply graphical attributes to feature-coded raw data.
- > Calculate end area and triangulated volumes.
- > Generate 3D drives from survey strings.
- > For underground topography, allows reconstruction of the profiles for developments and tunnels.

DIRECT COMMUNICATION WITH TOTAL STATIONS AND DATA COLLECTORS ALLOWS EASY TRANSFER OF DESIGNS AND SURVEY UPDATES.

## DRILL & BLAST DESIGN OPENPIT

**Specialized tools for designing drill patterns on pit benches.**

- > Create rectangular, triangular and equilateral patterns using vertical or inclined holes on flat, inclined or undulating surfaces.
- > Create pre-split holes. Tools provided to relocate or add holes manually.
- > Design the detonation sequence and produce a blast plot for the operators.
- > Create basic explosives analysis and cost reports for each design.
- > Updated pit surveys can be imported into the blast design.
- > Drill locations can be exported to the survey instrument for proper loading.
- > Integrated with the Vulcan 3D design environment.

INFORMATION IS ALWAYS UP TO DATE SO BLAST DESIGN IS AS ACCURATE AS POSSIBLE.

## DRILL & BLAST DESIGN UNDERGROUND

**Fast, accurate and flexible blast pattern design.**

- > A parameter wizard allows users to specify drill bit sizes, capping information and explosive properties for several types of explosives.
- > Four methods allow users flexibility to define radial drill spacing.
- > Equipment and rig dimensions can be added, allowing on the fly drill template creation, giving instant representation of the equipment for blast hole clearance checks.
- > Option to copy drilling templates between sections.
- > Automatic dump angle and number of ring sections
- > Flexible naming feature
- > Primers and deck charging definition

EFFICIENT CREATION OF DESIGNS, DETAILED REPORTS AND PLOTS FOR THE OPERATORS.

## CUTOFF GRADE OPTIMISER

**Optimizes the grade of material that maximizes the NPV of a mining scenario.**

- > Uses Lane's algorithm to calculate the value at different cutoff grades for a deposit.
- > Uses consecutive iterations to obtain the final result.
- > Easy to use.
- > Exports the results into charts, as well as into reports directly in Excel, allowing creation of high quality output.

ABILITY TO WORK WITH DIFFERENT ELEMENTS PROVIDES THE FLEXIBILITY TO WORK WITH POLYMETALLIC DEPOSITS.

## HAULAGE PROFILE

**Calculate truck cycle times, total fuel costs, distances to destinations by bench and truck/equipment productivity.**

- > Requires user defined equipment library and haulage routes digitised in Envisage.
- > Define tonnages for each truck including a further breakdown by material.
- > Results are printed in the Envisage Console and also directly exported to Excel and CSV files.
- > The library contains inputs such as: loading time, dumping time, spot time at the loader, spot time at the dump/crusher/stockpile, average delays for intersections, slow down areas etc., loader capacity, loader cycle time and different loaded and empty speeds by road grades, as well as fuel costs for the different scenarios.
- > Model Route Estimation option allows users to store distances, productivity and cycle times by material type to block model variables.
- > Apply information to reserving and scheduling.
- > Applicable to open pit and underground operations.
- > Use rimpull curves to calculate cycle time.
- > Better estimation for distances based on actual bench geometry at the time of mine haulage.
- > Insert nodes and segments between multiple routes for running different scenarios.

WORKS ON ROUTES DESIGNED ON AN ACTUAL TOPOGRAPHY, CAPTURING BEST SLOPES AND GETTING A BETTER ESTIMATE OF THE CALCULATIONS MADE.

## DRAGLINE

**Creation, manipulation and reporting of section based range diagrams.**

- > Support for grids, triangulations and Envisage objects to develop surface profiles.
- > Utilise a cross-section with the designed mine plan to create insitu block layouts.
- > Full control over highwall angles, bench offsets, material swell and repose angles, and all functional dragline dimensions.
- > Detailed reporting functions, automatic generation of operation plots.
- > Simulate the operation of a dragline.
- > Simulate cast blasting, bulldozing, truck & shovel operation or any other kind of material movement.
- > Create detailed post-mine topography designs and range diagrams.

OPTIMISE THE MINE PLAN TO FIT EQUIPMENT AND MATERIAL PARAMETERS.



## > IMPROVE EFFICIENCY WITH VULCAN

Vulcan software provides the user with the world's best 3D interactive modelling and planning package. It is the total solution of choice for the largest and best mining companies in the world. From geology to mine planning and scheduling, Vulcan delivers functionality, efficiency and improved productivity to Maptek customers worldwide.

### INTERACTIVE ROAD DESIGN

**Create roads using civil engineering design criteria.**

- > Using a digital terrain model, create roads, railways and pipeline alignment.
- > Intersection points are defined in plan and section for the desired road.
- > Use maximum and minimum curvatures, chainage increments and gradients.
- > Control over horizontal and vertical alignments.
- > Road profiles are applied to the alignment, and the resultant cross sections are created to define the cut and fill volumes for the road.
- > Mass haul diagrams and curvature diagrams can be viewed interactively and plotted along with normal plans, long sections and road sections.
- > Summaries of the cut and fill volumes for each chainage section of the road are reported and written to a file for plotting.

FULL 3D VISUALISATION FEATURES ARE AVAILABLE THROUGHOUT THE ENTIRE DESIGN PROCESS WITHIN ENVISAGE.

### INTERACTIVE POLYGON RESERVER

**Short-term interactive scheduling and continuous reserve calculations alongside creation of scheduled polygon mining blocks.**

- > Incorporates onscreen display of cumulative results.
- > Enables data from multiple block models to be stored and displayed.
- > Calculates continuous scheduling reserves and polygon mining blocks.
- > Ability to create and change, remove and re sequence scheduled polygons.
- > Dynamically report output to MS Excel.
- > Scheduling allows users to simply create new mining blocks of polygons or adjust existing ones.

SCHEDULE THE RIGHT AMOUNT OF PRODUCTION, IN TERMS OF TONNAGE, MATERIAL TYPE AND GRADE.