MINE PLANNING AND DESIGN SERIES
Simultaneous Spanish Translation

Location – North/South America Time Zones
Online Series – Five Courses

Dates
May 25th – August 13th, 2021

Time
Mountain Time, Americas 8:30AM-5:00PM

Registration Options
Participants can register in a single course, combination of courses, or all the five courses in the series based on their interests. Please take note of the registration closing dates. We need to courier the sentinel dongle for the software to you. Considering the possible delays in the international shipments, we need sufficient lead-time to assure you would receive the parcel in time.

Instructor
Hooman Askari is a professor of mining engineering in the School of Mining and Petroleum Engineering at the University of Alberta, Canada. He teaches and conducts research into mine planning & design and simulation of mining systems. Hooman is a registered professional mining engineer with 25 years of operational, consulting, research, and teaching experience in the area of open pit mine planning and design. He consults as the Principal Engineer through OptiTek Mining Consulting Ltd.

OptiTek Mining Consulting Ltd. is an educational partner of Dassault Systèmes.

Registration
For the registration forms, Please contact: registration@optitek.ca
For more information, contact Hooman Askari at: hooman@optitek.ca
Phone: +1 (780) 893-9365

Software
GEOVIA Whittle™, GEOVIA Surpac™, GEOVIA MineSched™, and SIMULIA Isight™ evaluation licenses will be provided to the attendees for educational purposes. Fees include all instructions, course material, and software evaluation licenses for one month.

Courses
- Course 1 – 4 days - Strategic Mine Planning and Optimization – GEOVIA Whittle™ Core.
- Course 2 – 4 days - Robust Strategic Mine Planning - Advanced GEOVIA Whittle™ and SIMULIA Isight™.
- Course 3 – 4 days - Open Pit Mine and Waste Dump Design – GEOVIA Surpac™.
- Course 4 – 4 days - Surface Mine Production Scheduling – GEOVIA MineSched™ Core.
- Course 5 – Compliance of Strategic and Tactical Mine Plans – Advanced GEOVIA MineSched™ and SIMULIA Isight™

Mine Planning and Design Series - Australia Time Zone Schedule

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Component</th>
<th>Dates</th>
<th>Registration Closing Date</th>
<th>PD Hours</th>
<th>Single Course Fee</th>
<th>Combined Course Fee</th>
<th>Five Weeks Series Fee</th>
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</thead>
<tbody>
<tr>
<td>Robust Strategic Mine Planning and Optimization</td>
<td>Course 1-Whittle Core</td>
<td>Week 1 - May 25-28, 2021</td>
<td>April 26</td>
<td>32</td>
<td>$3,200</td>
<td>$5,750</td>
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<td>Course 2-Whittle + Isight - Advanced</td>
<td>Week 2 - June 8-11, 2021</td>
<td>April 26</td>
<td>32</td>
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<td>Open Pit Mine and Waste Dump Design</td>
<td>Course 3-Surpac - Open Pit Design</td>
<td>Week 3 - June 22-25, 2021</td>
<td>May 24</td>
<td>32</td>
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<tr>
<td>Surface Mine Production Scheduling - Tactical Planning</td>
<td>Course 4-MineSched Core</td>
<td>Week 4 - July 20-23, 2021</td>
<td>June 28</td>
<td>32</td>
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<td>$5,750</td>
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<tr>
<td></td>
<td>Course 5-Advanced MineSched + Isight</td>
<td>Week 5 - Aug 10-13, 2021</td>
<td>June 28</td>
<td>32</td>
<td>$3,200</td>
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*All fees in Canadian Dollars $CAD
Who Should Attend
The Mine Planning, Optimization, and Design series is a comprehensive program which consists of five courses designed for mining and resource industry professionals including mine planners, mining engineers, geoscientists, geologists, managers, metallurgists, financial analyst, and decision makers from exploration to operations who are in charge of Resources and Reserves. It is ideally suited to those from industry who wish to gain a more in-depth and hands-on knowledge of modern strategic mine planning, optimization, pit design, and tactical mine planning software tools and theory.

Cancellation Policy
Notification of cancellation received in writing by closing date of registration will incur a 20% cancellation fee. No refund will be made after this time.

Course Delivery
- Fully interactive audio and visual environment to deliver the course online.
- Lectures on theoretical concepts – average of 200 pages PDF file for each course
- Step-by-step computer labs instructions – average of 250 pages PDF file for each course
- Participants require two monitors or a laptop and a monitor. One monitor to be used for web conferencing and the other for Whittle/Isight
- Participants can share their computer screens and control with the instructor for model debugging and feedback.
- Hands on incremental exercises and project work with iron ore, gold-copper, and polymetallic data.
Course 1 – Strategic Mine Planning and Optimization
GEOVIA Whittle™ Core

Capital Investment, Operating Costs, Discount Rate

Maximize NPV, DCF, IRR

Courses 1 & 2
Robust Strategic Mine Planning

Resource Model

Pit Limit / Practical Push-Backs

Life of Mine Strategic Plan

SIMO Stockpiles/Cut-off / Blending

Managing Impact of Uncertaintiy

Parametric Design-Hill of Value Climbing

GEOVIA WHITTLE and SIMULIA ISIGHT
Course 1 – Strategic Mine Planning and Optimization
GEOVIA Whittle™ Core

Course 1 – Strategic Mine Planning and Optimization – GEOVIA Whittle™ Core

Strategic mine planning optimization process is the backbone of mining operations. In mining projects, deviations from optimal mine plans will result in significant financial losses, future financial liabilities, delayed reclamation, and resource sterilization. In this course, principles and fundamental concepts involved in strategic mine planning and optimization are presented.

Subjects covered are block value calculations; mining revenues and costs; open pit limit optimization using manual method, floating cone, and 2D & 3D Lerchs and Grossmann algorithms; Pseudo Flow algorithm, life-of-mine production planning; mine-life estimation. Buffer stockpiles and its impact on mining and processing operations are presented. Blending problems are setup and solved. The course complements theory with comprehensive instructions, step-by-step documentation, and hands-on experience completing two projects including iron ore and gold-copper deposits using GEOVIA Whittle™ strategic mine planning software. Comparative analysis of different mine planning strategies, stockpiling, and their impacts on the bottom line of the mining business is illustrated.

Outcomes of the course include:

- Understand concepts of strategic mine planning
- How optimization improves economic performance
- Complete a strategic mine planning study in Whittle
- What costs should be included in pit optimization
- Resources and Reserves classification in Whittle
- Pit limits optimization with practical push-backs
- Generate optimal shells, reports and schedules
- Push-back design with a minimum mining width
- Advanced techniques with mining direction control
- Buffer stockpiles, blending and strategic stockpiles
- Extractive blending and bulk blending
- Iron Ore, Gold-Copper project work

Day 1

Pit Limits Optimization

- Introduction to Strategic Mine Planning & Optimization
- Pit Limits- Floating Cone, 2D Lerchs & Grossmann
- Optimal Pit Limit- 3D Lerchs & Grossmann
- Optimal Pit Limit - Pseudo Flow algorithm
- Concept of parcels and undefined waste
- Block Value Calculations
  - Revenue calculation assumptions
  - Dilution and mining recovery
  - Extra cost of mining material as ore
  - Mining and processing costs adjustments
- What Costs to Include in Pit Optimization?
  - Fixed costs
  - General and administrative costs
  - Time costs
  - Overhead costs
  - Mill limited or mining limited operations
- Geotechnical consideration and overall safe pit slopes
  - Rectangular slope regions
  - Slopes within rock-types
  - Slopes with zone numbers
  - Slope with profile numbers
- Block Model File Format (*.MOD, *.RES, *.MSQ)
- Concept of Revenue Factor (RF)
- Nested pit shells and RF parameterization
- Fixed and geometric RF
- Ore Selection by Cut-off and Cut-off Calculation
  - By marginal cut-off
  - By breakeven cut-off
  - By cash-flow
  - Formula for a cut-over
- Cut-offs with multiple elements
- Display of cut-offs and cut-overs and cut-off Scaling
- Ore selection by cash flow
- How cut-offs are affected by minima and maxima
- The effects of raised and lowered cut-offs
- Ore selection by Value Mode and Profit Mode
- Modeling nonlinear processing recoveries
- Resources and Reserves classification in Whittle

Whittle Lab01 - Open Pit Limit Optimization Iron Ore

- Project data exploration history and field campaign
  - Rock-types and elements
- Project costs calculation
  - Waste and ore mining costs
  - Ore processing costs and recoveries
  - General and administrative costs
  - Mining or mill limited operation
- Open Pit Limit Optimization
  - Grade-tonnage curve
  - Re-Blocking node
  - Slope Set node and Pit Shells node
  - Choose 3D LG or Pseudo Flow algorithm
  - Operational scenario node and revenue factors
  - Ore selection discussion
  - Non-linear recoveries
  - Pit Shells node running an optimization
  - Compressed revenue factors
  - Schedule graph and bench schedules
  - Block size and selective mining unit (SMU)
  - Pit by Pit Graph – Nested Pit Shells
  - Choosing push-back manual, auto, semi-auto
  - Practical push-back selection criteria
  - Skin analysis

Day 2

Life-of-Mine Production Scheduling

- Production Scheduling Concepts
Course 1 – Strategic Mine Planning and Optimization
GEOVIA Whittle™ Core

• Benchmark schedules
• Choose the ultimate pit
• Choose push-backs
• Sensitivity analysis
• Taylor’s rule
• Benchmark Production Schedules
  • Worst case scenario
  • Best case scenario
  • Concepts of lags and leads
  • Milawa NPV algorithm
  • Milawa balanced algorithm
  • How Milawa algorithm works
• Effect of Scheduling
  • Discounting and time value of money
  • Sensitivity analysis
  • Cost positioning
  • NPV vs Reserves
  • Payback period
  • Internal rate of return
  • Costs of not using the full mining capacity

Whittle Exercise 1 – Gold-Copper – Pit Optimization

Whittle Lab02 – Open Pit Production Scheduling
• Schedule graph and bench schedules
• Mine-life estimation and sharing time related costs
• Push back chooser
• Milawa NPV and Milawa Balanced algorithms
• Push-backs with minimum mining width
  • Mining width node with/without the outer pit expansion
  • How the minimum mining width works
• Benchmark schedules and optimized schedules
• Sensitivity analysis using spider graph
• Hiring Contractors
  • Decide on contractors hiring strategy and costs
• Transfer the schedule to excel
• Bench-mark schedule meeting tonnes and grade constraints
• Improve schedules using NPV as a metric
  • Impact of operational constraints on NPV
  • Trade-off between operational mine plans and NPV
  • Trade-off between mine plan flexibility vs. NPV
• Document comparative analysis of new scenarios

Whittle Lab03 - NPV Practical Pushbacks
• How NPV Practical Pushbacks works
  • Integrating mining with and scheduling
• Fixed and variable lead and lag
• Hiring contractors improving the schedule
• Compare NPV Practical Pushbacks vs Min Mining Width
• Interim push-back design
• The impact of geo-metallurgy/ore hardness
• Truck-hours constraint

Whittle Exercise 2 – Gold-Copper – Production Scheduling

Day 3
Whittle Lab04 – Control Mining Direction & Pre-stripping
• Constrain the direction and growth of pit shells
• Producing directional shells using expressions
• Defining Mining Distance Factor (MDF) as expression
• Specify directional shells on the Optimization tab
• Implementing and evaluating mining direction
• Mining Direction Control
• Oils Sands deposit exercise
• Pre-stripping without stockpiles
• Pre-stripping with stockpiles
• Controlling waste reject
• Impact of directional constraints on NPV
• How to compound mining directions

Day 4
Whittle Lab05 - Buffer Stockpiles
• Store economic ore in stockpiles
• Supply ore to the mill in periods that the mill is not fully fed
• Supply ore to the defined processes once mining has stopped
• Allow pre-stripping and stockpiling of economic ore
• Use buffer stockpile to balance mining and processing limits
• Grade-tonnage curve analysis for stockpile grades
• Legacy stockpiles - tonnage and grade
• Cost associated with stockpiles
• Treatment and re-handling costs
• Stockpile cut-off calculation
• Stockpile input-output grade and tonnes analysis
• Multi-element stockpiles, low, medium, and high grade
• Use data selector to plot customized charts and graphs

Whittle Lab06 – Blending Stockpiles – Extractive Blend
• Bulk blend vs Extractive blend
• Blending stockpiles
• Blend targets and definitions
• Blend bins concept
• Fixed blend bin size
• Automatically adjust bin size
• Control the head-grade by blending constraints
• Improve process throughput
• Variable penalties on contaminant thresholds
• Blending desired ratio of rock types into processes
• Rehabilitation cost for stockpiles

Whittle Exercise 3 – Gold-Copper – Blending
Course 2 – Robust Strategic Mine Planning and Optimization
Advanced GEOVIA Whittle™ and SIMULIA Isight™

Capital Investment, Operating Costs, Discount Rate

Maximize NPV, DCF, IRR

Courses 1 & 2
Robust Strategic Mine Planning

Resource Model
Pit Limit / Practical Push-Backs
Life of Mine Strategic Plan
SIMO Stockpiles/Cut-off / Blending
Managing Impact of Uncertainty
Parametric Design-Hill of Value Climbing

GEOVIA WHITTLE and SIMULIA ISIGHT
Course 2 – Robust Strategic Mine Planning and Optimization
Advanced GEOVIA Whittle™ and SIMULIA Isight™

Outcomes of the course include:
- How to carry out strategic mine plan within designed final pit limits, push-backs, and year-end designed pits.
- Understand cut-off optimization
- Understand Lane’s Theory
- Carry out cut-off optimization using strategic stockpiles and cut-off Type II in Whittle
- Advanced simultaneous optimization (SIMO)
- CAPEX optimization
- Calculate sensitivities to develop risk reduction strategies
- Understand and execute Sim-flow in Isight
- Visualize Sim-flow results
- Evaluate design alternatives
- Create Sim-flow to capture a process, by integrating various software (Whittle and Isight)
- Perform design optimization
- Gain Design Space understanding
- Use various techniques such as DOE, Optimization, Monte Carlo etc. in Isight
- Robust strategic mine planning - Simulia Isight
- Integrate Simulia Isight and Geovia Whittle
- Hill of value climbing concepts
- How to control highly variable input parameters
- Multi-mine production scheduling
- Feeding multi-process plants
- Managing the risk associated with grade uncertainty
- Quantify the Impact of geological and grade uncertainty on pit limits and production scheduling
- Allowing for underground mining
- Surface and underground transition
- Iron Ore, Gold-Copper, poly-metallic projects work

Day 1
Whittle Lab07 - Cut-off Grade Optimization
- Cut-off Optimization - Lane’s Theory
  - Mining, mill, and market limited cut-offs
  - Cut-off optimization to balance mining and processing
  - Cut-off optimization to balance mining and market
  - Cut-off optimization to balance processing and market
- Cut-off Optimization – Maximizing NPV
  - Maximize the difference between present values of the remaining reserves
  - Concept of increments in cut-off optimization
  - Compaction of grades, tonnage, and increments
  - Defining grade ranges for strategic stockpiles
  - Multi-element stockpiles
  - Use of Profit mode in cut-off optimization
- Revisit: how to decide on ore selection methods
- Section A: Cut-offs
  - Ore Selection by Cut-off and Cut-off Calculation
  - The Formula for a Cut-over
  - Multiple Processing Methods
  - Cut-offs with Multiple Elements
  - Ranked Cut-offs
  - Cut-offs, Cut-overs, and Cut-off Scaling
- Other methods: Cash-Flows, Value Mode, Profit Mode

Whittle Lab08 - Simultaneous Optimization (SIMO)
- Introduction to simultaneous optimization
- How SIMO works
- Integrating scheduling, blending, stockpiling, and cutoff
- Advanced optimization control
  - Optimization tab
  - Blend bins tab
  - Manual versus automatic bins
Course 2 – Robust Strategic Mine Planning and Optimization
Advanced GEOVIA Whittle™ and SIMULIA Isight™

Day 2

ISIGHT Lab09 – Introduction to Isight
- What is Isight?
- The Design gateway
- The Runtime gateway
- Using post-processing tools
- Accessing the design gateway
- Adding an Excel component to the sim process flow
- Adding a loop component to the model
- Configuring the executable
- Publishing a component
- Automate a series of functions to create a sim-flow
- Add components to a sim-flow
- Set up the core component
- Configure components to pass data to/from each other
- Execute a Sim-flow
- Visualize Sim-flow results
- Evaluate design alternatives
- Handling files in Isight
  - Configuring file parameters
  - Isight results database

- Stockpiles tab
- Comparative analysis of value generated by SIMO
- Simultaneous Optimization
  - CAPEX Optimization process
  - Use additional capacity at a set cost per unit
  - Purchase additional mining and processing capacity
  - Use period validation to control additional limits
  - Simultaneous Reporting
  - Report CAPEX limits and costs
  - SIMO spreadsheet reports
  - SIMO with Mining Recovery and Dilution
  - Specific errors and warnings

- Create a Sim-flow to capture a process
- How to control highly variable input parameters into projects
- Integrate GEOVIA’s Whittle SIMO with SIMULIA’s optimization toolbox
- Assure stability of results using controllable variables against uncertain environmental variables
- Controllable variables
  - Push-back selection
  - Mining direction
  - Mill capacity
  - Mining capacity
- Environmental variables
  - Commodity price
  - Mining costs
  - Recoveries
  - Processing costs
  - Slope stability
  - Resources
- Determine robust & optimal values for numerous schedules
- Whittle SIMO – Final optimization of schedule using output of Isight Analysis
- Production scale that reacts well to changing parameters

Heavy blocks and pit optimization
- Exclusion polygons and pit optimization

Day 3

Whittle Exercise 4 – Gold- Copper – Cut-off Optimization

Whittle Exercise 5 – Gold- Copper – SIMO

Whittle Lab10 - Managing Risk and Grade Uncertainty
- Grade and Geological uncertainty
- Use Isight and windows command line for process automation and simulation

- Reduce design cycle time through integrating workflow
- Establishing a final pit-shell under grade uncertainty
- Equi-probable realizations of grade within the orebody
- Optimal pit for Krig, E-type models
- Optimal pit for P90 & P10 realizations
- Impact of grade uncertainty on the final pit limit
- Quantifying the Impact of grade uncertainty on scheduling
- Final pit limit in the presence of grade uncertainty

Day 4

Whittle Lab11 - Multi-Mine Multi-Process Optimization
- Introduction multi-mine multi-process optimization
- Creating a Multi-Mine Model
- Merging multiple block models in one project
- Mining limits applied to multiple mines
- Advanced mine scheduling
- Mining limits on individual mines
- Prioritize sequence of mines
- Prioritize sequence of mines
- Multi-mine multi-process optimization
- Dry and wet separation stream processes
- Complex processing methods
  - Separation
  - Element extraction different stages
  - Different selling costs
- Redirect ore to processes that are not full
- Multiple/alternative processing streams
- Multiple/alternative products
- A complex mine logistics example
- Manipulate the multi-pit sequences
- Maximize NPV by multi-process profit mode
- Lessons learnt from optimizing multi-mine
- Wrap up and conclusion for the course
Course 3 – Open Pit Mine and Waste Dump Design
GEOVIA Surpac™
Course 3 – Open Pit Mine and Waste Dump Design – GEOVIA Surpac™

Open Pit Mine and Waste Dump Design is a four-day course designed for mine planners, mining engineers, and geologists who are responsible for activities that require them to design and manage pits, ramps, switchbacks, slots, and waste dumps. It is ideally suited to those from industry who wish to gain a more in-depth knowledge of modern mine planning and design theory and software tools.

The participants will complete a pit-design project during the course. The course covers open pit design terminology, impact of loading and hauling equipment on pit and waste dump design, working bench and safety berm geometry, haul road parameters and geometric pit design.

Prior to engaging in pit design, the course reviews principles and fundamental concepts in creating points, strings, and triangulations; generations of plans and sections and tools required in pit design. In addition, surface and solid modeling for the purpose of open pit design is reviewed and practiced.

The course includes a project for top-down and bottom-up pit design guided by year-end surfaces generated in a life-of-mine Whittle project. The project starts from the final optimal pit shell, intermediate pits shells, and the long-term schedule generated in Whittle. It covers topics on how to choose the required parameters such as berm width, variable pit slope angle, and batter angle to achieve a desired pit and dump design. The project continues with creating surface triangulations from the pit design, obtaining volumes, tonnages and grades reported by bench, rock type and grade range from the designed pit.

Outcomes of the course include:
- Understand pit design parameters & components
- Understand pit design theory
- Create detailed pit and dump designs
- Use optimal pit shells in pit design
- Determine bearing and distance between two points
- Select mode to break, join, and renumber segments
- Use String/Object/Cloud mode to delete and clean strings
- Use String/Object/Cloud to renumber a string
- The Move tool
  o Move data along an axis
  o Move data in a plane
  o Move data in three dimensions
- Create a simple pit design
  o Managing data in layers
  o Creating a boundary string between two DTM
  o Calculating cut and fill volume using DTM surfaces
  o Calculate a volume for a solid model
  o Clip data by a boundary
- Produce a plot of a pit using Auto-plot

Day 1
Introduction to SURPAC for pit design
- SURPAC data types
- Function-centric and data-centric operations
- Strings
  o String data hierarchy
  o Description fields
  o Data numbering and ranges
  o String directions
  o String file structure
- Planes
  o Active plane
  o Planes projection distance
  o Moving between planes
  o Moving between planes in reverse view
  o Changing the viewing corridor
- Block model tonnage and grade calculations
- Cut and fill volume calculations
- Design based on loading and hauling equipment
- Define Bench geometry as a function of equipment specs
- Design of toes, crests, ramps, switchbacks and slots
- Define berm width, pit slope angle and batter angle
- Create final pit designs and surfaces from the designs
- Obtain volumes, tonnages and grades reported by bench
- Design variable pit slopes
- Handle multi-benching
- Manage single-pit splitting to multi-pits
- Design variable pit slopes based on rock-types
- Design waste dumps

Day 2
Pit Geometry
- Basic bench geometry
- The pit expansion process
- Pit slope geometry
- Final pit slope angles
- Plan representation of bench geometry
- Geometric sequencing
  o Frontal cuts
  o Drive-by cuts
  o Parallel cuts
  o Minimum required operating room for parallel cuts
  o Cut sequencing
- Open Pit Terminology & Calculations
  o Bench Face, Crest, Toe
  o Bench Height and Width
  o Berm, Batter Angel, Bank Width
Course 3 – Open Pit Mine and Waste Dump Design

GEOVIA Surpac™

SURPAC Tools for Pit Design

- Open Pit Design
  - How many benches?
  - Deepest bench?
  - Single pit splitting into multiple pits
- Pit design parameters
  - General design parameters
  - Define bench parameters
  - Define ramp slot parameters
- Display the mine design toolbar and menu bar
- Creating a simple pit
- Pit design data preparation
  - Create ore outlines
  - Import LG practical optimal push-backs
  - View Whittle long-term mine plan
  - Add slope values
- Pit design project set up
  - Modify toe/crest string profiles
  - Create new toe/crest strings
  - Define the starting string
  - Define the slope method
  - Define a new ramp entrance
  - Ramp generation and automated pit design
  - Expand by bench height and berm width
  - Expand single bench
  - Expand multiple benches
  - Edit a pit design
- Pit design methods
  - Bottom to top design
  - Top to bottom design
- Additional Pit Design Tools
  - Restart a pit design
  - Design a switchback
  - Create slot entrance & switchbacks
  - Create line for opposite ramping
- Creating a DTM of a pit design
  - Clean pit design strings
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  - Create slot entrance & switchbacks
  - Create line for opposite ramping
- Creating a DTM of a pit design
  - Clean pit design strings
- Course 3 – Open Pit Mine and Waste Dump Design
- GEOVIA Surpac™

Day 3

Life-of-mine pit design exercise

Waste Dump Design

- General dump design parameters
- Define bench parameters
- Set current bench/toe
- Create new toe/crest lines
- Create ramp entrance
- Expand single bench
- Expand multiple benches
  - Design a waste dump
  - Calculate dump volume

Haul Road Design Concepts

- Haul road geometric design parameters
  - Design of a spiral road-inside the wall
  - Design of a spiral ramp - outside the wall
  - Design of a switchback
- The volume represented by a road
- Road section design
- Straight segment design
- Curve design
- Conventional parallel berm design
- Median berm design
- Key road planning and alignment factors
- Haul truck stopping distance
- Sight distance and vertical curves
- Road Width for curves
- Turning circle of large haul trucks
- Super-Elevation
- Super-Elevation Runout
- Inflection point
- Spiral or transition curve
- Vertical curve
- Optimal and maximum sustained grades
- Road Geometrical Design Process
  - Integrating design methodology with mining plan
  - Including haul roads in the ultimate pit design
  - Integrating roads through the mine schedule
  - Safety berms, ditches and drainage
  - Intersection design
- Road Surface
  - Traction
  - Rolling resistance
  - Typical rolling resistance values
- Haul Road Design
  - Designing roads using string editing tools
    - Design a road using CURVE END
    - Design a road using CURVE TANGENT
  - Design a road at a Constant Gradient Along Contours
  - Create a variable width road outline
- Using the road design module
  - Create horizontal curves
  - Drape centreline over DTM
  - Create longitudinal profile
  - Create vertical inflection points
  - Create vertical curves
- Apply longitudinal profile
- Create road outline
- Calculating road design volumes
- Calculate road cut volume
- Calculate road fill volume
Course 4 - Surface Mine Production Scheduling

GEOVIA MineSched™ Core

Surface Mine Scheduling is a four-day course designed for mine planners, mining engineers, geologists, and technical managers who are responsible for activities that require them to generate or oversee monthly and weekly mine production schedules. The course is designed to provide theory through lectures, complemented by a hands-on production-scheduling project using GEOVIA MineSched. The project covers all the required steps from a long-term yearly schedule generated within a designed pit to a monthly production schedule taking into account mining and processing capacities, truck-shovel hours, drilling and blasting, blending, and stockpiles management constraints. Learn how to model and manage stockpiles and processes, block modeled waste dumps followed by automated filling strategies and waste scheduling. Also, reporting and 3D visualization of a spatial database of the materials within the waste-dump, which is critical for both long-term waste dump management and reclamation. The course covers the following topics:

- Medium/short-term planning concepts
- Alignment of short-term plans with strategic plans
- Parameters: rates, delays, priorities
- Quantity and quality targets
- Defining mining locations
- Defining process streams
- Period polygons: tonnage/grades
- Reporting: Excel, Access, MS Project
- Animations & presentation tools

Outcomes of the course include:

- Schedule from block, polygonal and grid models with any number of elements, material types, and qualities
- Calculate polymetallic Net Smelter Return (NSR)
- Graphically sequence mining blocks
- Control all aspects of the schedule or use target-based scheduling algorithms.
- Incorporate mining directions, bench lags/leads, face geometry, location limits, and other mining constraints to ensure practical schedules.
- Schedule ancillary activities such as drilling, blasting, and back filling.
- Include material movement to stockpiles, processes, and spatially modeled waste dumps.
- Blend material from mines, stockpiles, processing plants, and waste dumps.
- Visualize Mine Schedules with 2D and 3D Graphics.
- Display tonnage and grade attributes.
- View colored period and production data.
- Generate intermediate mining surfaces.
- Animate mining sequence as a movie or frame-by-frame.
- Validate and communicate the sequence of activities.
- Generate reports with production tonnage and grade data.
- Produce polygon and bench reports.
- Obtain a detailed understanding of the schedule.
- Communicate the results to management.
- Create reverse vertical lag or constant face distance.
- Design cut polygons on specific layers
- Apply geometry rules to create new polygons.
- Attach attributes to the mine cut polygons.
- Sequence the mine polygons.

Day 1

- Data storage and familiarization
  a) Setup data management hierarchy
  b) Data review
- Data editing and management
  o Block model reporting
  o Determine the tonnes and grades in rock types
  o Polygons for graphical results
- Block model material classes
  o Assign material classes for the schedule
- Quantity of elements report average or aggregate
- Define user parameters
- Define user calculations for mining cost, NPV, NSR
- Validate material type quantities
- Scenario management
  o Creating and opening scenarios
- Navigating the scenarios
  o Data grids & Charts
  o Dashboard & Spreadsheet views
- Scenario parameters – geological model data
  o Defining geological models
  o Add the model for scheduling
  o Assign material classes for the schedule
  o Validate model & check the model for errors
- Define mining locations for scheduling constrained by
  o Surpac constraints file
  o Surfaces/Solids
  o Block/Polygon
  o X, Y,Z planes
- Define mining method
  o Benches/Polygons
  o Whole/Bench-polygons
- Define mining directions by
  o Direction/Azimuth
  o Radial/roaming
- Consolidate blocks into larger units

Polymetallic Net Smelter Return (NSR)

- NSR Calculations
  o Recovery factor of the metal at the mill
  o Concentrate grade / Transport cost
  o Payable metals
  o Treatment charges / Penalties
  o Price participation / Refining charges
  o Calculate the NSR factors ($/unit of product)
- Estimate the value of a mining sector
- Calculate the revenues of mine plans
- Calculate the value of broken mineralization in the plan
Course 4 - Surface Mine Production Scheduling
GEOVIA MineSched™ Core

Day 2
- Production - mining constraints
  o Define mining resources / diggers
  o Allocation of resources to locations
  o Production rates
  o Resources capacities
  o Resources availabilities
  o Physical location constraints
  o Precedence of mining based on date/event
  o Delays between mining locations
- Create schedule
  o Define a timeline for the schedule
  o Define units of time for periods
  o Create the schedule
  o Add reports and charts to the dashboard
- Publishing results
  o Create graphical results & animations
  o Standard and custom reports
  o Gantt charts
  o Block model schedule
  o Analyzing the schedule
  o Production charts by material type
  o Stockpile balances
  o Detailed production reports
  o Production animation
- Adding calendars to resources
  o Preventive maintenance for shovels
  o Preventive maintenance for mill
  o Working days and holidays
  o Duration and frequency
  o Start and end date
- Sequencing the stages
  o Sequencing the stages using precedences
  o Sequencing the stages using production priorities
  o Production priority changes after date/event
  o Graphically sequencing polygons
- Perform quick metal price sensitivity studies

Day 3
- Targets
  o Quality and Quantity targets
  o Add a quality target to the schedule
  o Add flexibility to the schedule
  o Explore the options for meeting the targets
  o Minimize the rehandling
  o Material ratio and strip ratio targets
  o Effects of material classes on capacities
  o Create a schedule that has a constant ore production
  o Create a schedule that pre-strips waste
  o Variable throughputs
- Fill locations
  o Add the block-model that will be used for filling
  o Dump location modeling
  o Change the waste stockpile to two waste dumps

Make the schedule more practical
- Production parameters
  o Mining direction
  o Investigate the different mining directions
  o Investigate vertical and horizontal-lag
  o Investigate maximum-lag
  o Maximum active benches
  o Maximum active groups
  o Maximum bench drop per period
  o Maximum benches per period
  o Maximum and minimum capacity
  o Recalculate active location at period start
  o Swell factor
  o Number of active benches per period
  o Production rate modifiers
- Precedence parameters
  o Blocks in sequence
  o Block precedences constrained by group
  o Groups in defined sequence
  o Horizontal lag all directions
  o Maximum lag distance
  o Vertical lag all directions/specific direction

Day 4
- Selection of Loading & Hauling Equipment
  o Shovel size selection
  o Bucket capacity selection
  o Theoretical cycle time
  o Fill factor, efficiency, and availability
  o Determination of shovel geometry
  o Dumping radius and height
  o Shovel Selection from OEM literature
  o Haulage truck selection
- Bench Geometry and Equipment Specifications
  o Shovel working range specifications
  o Haul truck OEM specifications
  o Working bench width calculations
  o Safety bench width calculations
- Haulage and Tonne Km calculations
  o Adding Haulage to the schedule
  o Create haulage route strings
  o Reporting TKM
- Short-term polygons
  o Creating short-term polygons within the long-term schedule
  o Bench plans
  o End of period surfaces
  o Polygon mining vs. Bench Polygon mining
  o Polygon constraints
  o Polygon mining to a seam boundary
  o Polygon mining a single bench
  o Different polygons on separate benches
  o Polygon mining a single bench by flitches
- Polygon sequencing
  o Adding a polygon sequence
  o Apply the correct sequence for this schedule
- Ancillary activities
  o Drilling and blasting activity
  o Graphically animating the activities
  o Production activities (optional)