Deformation-Based Support Design and Rockburst Hazard Assessment

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Date and time: Sunday, 23 June 2024, 8:00 am – 5:00 pm
Cost: $500; includes lunch.

Overview:
This course focuses on support design for excavations in brittle rock, where displacements induced by sudden stress fracturing may consume much of the support’s capacity. It deals with the functionality of the support in violently deforming ground and with the consequences of mining-induced support damage. It offers quantitative means to estimate the capacity of integrated support systems and a systematic approach to compare it with the static and dynamic demands imposed on the ground support. Because gradual and sudden stress fracturing not only loads the support, but also deforms it, part of its load and energy-dissipation capacity is gradually consumed, leaving less and less remnant capacity at the time when the support is needed, i.e., during a rockburst. If the support capacity can be consumed by deformation, it can also be restored by preventive support maintenance (PSM).

This concept for cost-effective ground control is introduced and supported with operational evidence. Accounting for capacity consumption and integrating PSM into the mine development and operation schedule provides means for prudent asset management and opportunities for cost optimisation. Sudden stress fracturing of excavation walls emits seismic waves that can be used to identify the depth of strainbursting and the duration of the related rock mass bulking process. This provides essential input for support design in strainburst-prone ground, which is a new focus of this course. The rockburst hazard in strainbursting ground depends on the stress level (stress at mining stages and strength in geological domains), the amount and rate of sudden stress fracturing, intensity of ground motion, and consumed support capacity (co-seismic and mining-induced strain). These and other factors are used to establish the current and to forecast the anticipated rockburst hazards. This is another new focus of this course.
This course presents an integrated approach of deformation-based support design (DBSD) using support demand and support capacity-assessment tools, and an innovative approach developed in collaboration with Newcrest Mining for rockburst hazard assessment (RBHA) using geological, stress, mining sequence, ground support and seismic data. We plan to restructure the delivery sequence but cover the following sub-topics:

1. Deformation-Based Support Design
   1.1 Deficiencies of common support design approaches
   1.2 Overview of strainburst process and DBSD principles
   1.3 DBSD steps to overcome limitations of common ground-motion-centric design approach
   1.4 Motivation and justification of change in design method and need for change management
   1.5 Estimation of support demand
   1.6 Estimation of remnant capacity of integrated support systems
   1.7 Assessment of effectiveness of integrated support systems using the displacement safety margin concept

2. Rockburst Hazard Assessment
   2.1 Terminology – shakedown and strainbursting damage mechanisms, rockburst potential and rockburst hazard
   2.2 Input of rockburst hazard assessment – rock mass properties, geometry of excavations, stress model, seismic data, ground support
   2.3 Utilisation of seismic data – assessment of strainbursting depth and duration of bulking, probability and percentage of the dynamic realisation of extreme depth of failure, increase in the depth of failure and consumption of ground support capacity
   2.4 Calculation and presentation of results – mapping of parameters and results to tunnel nodes, displacement versus energy plot of ground support capacity and demand, safety margin of displacement, annual rate of exceedance of R0, R3 and R5 damage
   2.5 Utility of RBHA for forensic analyses and forecasting on future hazard.