MNGN516 Advanced Underground Mine Design
A student led group project based approach to graduate learning

BACKGROUND

In the past, the graduate level course MNGN516 Advanced Underground Mine Design was taught together with the undergraduate course MNGN314 Underground Mine Design. Although grad. students in the combined class were given some advanced material, the course was essentially an undergraduate course.

In 2015, the two courses were split, with MNGN516 intended to be a true graduate level course.

The Department accepts students into its graduate program with engineering backgrounds other than mining engineering. All graduate students are required to take two graduate level courses in the three areas of:

- Rock mechanics,
- Surface mine design, and
- Underground mine design (MNGN516).

Underground mine design involves the complex interaction of many factors such as deposit geology, geotechnical factors, desired production rates, depth below the surface, the mining method, rock haulage system, mining equipment sizes and capacities, etc.

Mine design decisions are often based on incomplete information and understanding of the interactions of the various design components.

Rather than an optimal design with a true “correct answer”, an industry project may instead require an evaluation of various design alternatives with a “recommendation” for a particular design alternative.

The structure of the MNGN516 class attempts to move student thinking toward such industry project work and toward independent student research.

WHAT IS CHANGING

Rather than a passive learning strategy with a traditional lecture/homework/exam format the course is organized to provide students with active learning opportunities designed to increase student learning, and retention of the course material.

To achieve active learning, the course material is divided in major content areas. Each content area is then divided into sub-topics suitable for student group project work.

Each student group design team will determine possible design alternatives, evaluate these alternatives, recommend the most suitable alternatives, and justify their recommendation.

For each design topic, the objective is to:

- Identify possible design alternatives,
- Benchmark similar design alternatives at operating mines,
- Evaluate the possible design alternatives, and
- Recommend the most suitable alternative(s) for the conditions of a particular project, and
- Justify their recommendation.

Group project deliverables are:

- An oral presentation to the class.
- A written report outlining the design alternatives, benchmarking, evaluations, and recommendation.

Each group will also lead a class question and answer session and class discussion during oral presentations.

In addition to active participation in their group projects, each student is also expected to take part in class discussions, and to provide feedback to each group and project by indicating what the group did well, and identifying opportunities for improvement.

INTENDED OUTCOMES

In this course, students will:

- Analyze the various activities conducted in the mine planning process including the role of the underground mine design in the planning process.
- Analyze the development of a mine plan through the various stages of: conceptual, prefeasibility, feasibility, and final bankable design. Compare the relative degree of effort (time and cost), uncertainty and risk.
- Investigate major design components for five modern underground mining methods: block caving, sublevel caving, sublevel stopping, cut & fill, and room & pillar.
- Benchmark design and operational considerations for several operating mines using each mining method.
- Analyze the role of geology and geotechnical factors in mining method selection and mine design.
- Rank the suitability of mining methods for a project. Recommend and justify the mining method.
- Evaluate and compare alternative excavation types, excavation methods, costs, and scheduling required for the mine development stage of a mine plan.
- Evaluate and compare major types of underground mine equipment suitable for a particular task. Develop a recommendation and justification for equipment selection based on production rates, maintenance requirements, fleet size considerations, and overall equipment operating and ownership costs.
- Analyze and compare the major underground rock haulage systems consisting of trucks, rail, conveyor, and hoisting. Design, evaluate, and rank the suitability of rock haulage system alternatives given production rates (tons per day), deposit depths from the surface, and maximum excavation gradients.

Typical Group Project

Goal: Evaluate design alternatives for an underground rock haulage system accounting for deposit depth below the surface, required production rates, haulage distances, and required excavation sizes.

Each group of four students selects one of the four major rock haulage systems:
- haul trucks,
- hoisting,
- conveyors, or
- rail.

Each group is to evaluate their rock haulage system, and to recommend a design option.

The group projects are combined into an overall class project that include the evaluation of all four rock haulage systems and recommendation for a range of design alternatives.

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