Teaching Rock Engineering Effectively in the 21st Century

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AND HERE WE HAVE L
With the exact same facial expression as me when I'm in a difficult lecture.
THINK
About how you teach rock mechanics or rock engineering and why you teach that way

PAIR
Discuss with the person next to you

SHARE
Share your perspective with the audience
Echo360 platform for student participation

What behaviour will be important for tunnel design?

- Resilience to fractures, hydraulic properties
- Ability to react with water (absorption, expansion etc.)
- Existing joints, porosity, weathered state, dip of beds, strength
- Drilling for the tunnel shouldn't damage the rock around it as much as it'll result in a failure/collapse in the tunnel.
- Competence of the rock, weathering depth, structural components, clay content, porosity and permeability, water table depth, response of the rock to the change in stress regime around the tunnel, rock type.
- The cohesion or fracture planes on its surrounding rock and conformity's between different rock groups, high water and snow in Arthur's pass.

7/39 submissions
KEY CONCEPTS

MASTERY
Aim for student mastery of the course material

STUDENT VERSUS CONTENT FOCUSED
Focus on student learning outcomes

THINKING SKILLS
Aim for higher order thinking skills

ENGAGEMENT
Develop teaching and learning activities that enhance student engagement

TEACHING MODES
Use multidirectional teaching modes
MASTERY

Aim for student mastery of the course material
STUDENT VERSUS CONTENT CENTERED

Focus on student learning outcomes

Use Verbs

Aim for higher order thinking skills

Link to curriculum and graduate attributes
THINKING SKILLS

Aim for higher order thinking skills

CREATE

- Design, assemble, construct, develop, formulate, author, investigate

EVALUATE

- Appraise, argue, defend, judge, select, support, critique, weigh

ANALYSE

- Differentiate, organize, compare, contrast, distinguish, examine

APPLY

- Implement, solve, use, demonstrate, operate

UNDERSTAND

- Classify, discuss, explain, describe, identify, locate, recognize

REMEMBER

- Define, duplicate, list, memorize, repeat, state
Conventional Delivery Methods

**Lectures** – passively deliver content

**Laboratories** – practice skills (visual and hands-on)

**Tutorials** – practice skills (interpretation, computation)

**Assessment** – measure student achievement (??)
Alternative Delivery Methods

**Assessment** – use skills to solve authentic problems

**Practicals** – practice skills in the field and laboratory

**Blended lectures/tutorials** – learn and practice skills using relevant content
Use these action verbs to describe & frame the learning

Bloom’s Taxonomy

Mastery
Student Focussed
Thinking Skills
Engagement
Teaching Modes

Creating
Hangatanga

Evaluating
Arotake

Analysing
Wetewete Whakaaro

Applying
Whakamahi

Understanding
Maramatanga

Remembering
Matauranga - Whakamahara

Poutama Version
Goals for this Course

At the end of this course you should be able to:

1. **Apply** concepts of stress, strain, elasticity and plasticity to intact rock and rock masses
2. **Collect** rock mechanics data in the field, **combine** it with laboratory test data and **assess** the stability of excavations
3. **Determine** likely rock mass behaviours under different excavation and loading conditions and **propose** mitigation solutions
ENGAGEMENT

Develop teaching and learning activities that enhance student engagement
ENGAGEMENT

Ensure that students recognize the value of each teaching and learning activity.
TEACHING MODES

Use multidirectional teaching modes

Learning does not only have to be from the teacher to the student

Give students opportunities to discover and grow
Drilling Engineer introduction

Role model: Marlene

Marlene is your role model for the drilling engineer role. Other than tramping through rivers in gumboots, she squashes and blows up rocks to prepare the site for drilling.
TEACHING MODES

Use multidirectional teaching modes

Provides the opportunity to use higher order thinking skills and develop professional skills
Roughness

There are many ways to describe roughness, these three are a simple way to assign words to the basic roughness types.

- Rough
- Smooth
- Slickensided
Wedge Failure - an introduction

Now that we’ve plotted our structures and our slope let’s work on the kinematic analysis. In order for wedge sliding to occur there are a couple of requirements that need to be met.

There needs to be:
- a steep slope
- two discontinuities (or sets) whose intersection line trends nearly parallel to the steep slope dip and is less steep than the steep slope
- a discontinuity (or set) that defines a tension crack at the back of the sliding wedge.

Luckily for us we have exactly that in our outcrop. The slope defined by the orange great circle is very steep, the green square represents the intersection of two discontinuities, which trends nearly parallel to the steep slope dip and is less steep than the steep slope, and the purple great circle represents a discontinuity that defines a tension crack at the back of the sliding wedge. Hover your cursor over the structures plotted in the stereonet to re-familiarise yourself with each of these features.
CHALLENGES

Does it work?

What's in it for me?
What was the most valuable aspect of the virtual field trip?

"Being able to have an idea of the area and preparing before physically going. Going through the field data collection process before actually doing it in the field so that all group members were on board with what was needed. Able to review again the rock mass post-field trip."

- Student feedback
  Scanline mapping VFT
One change at a time

Seek or build a community of academic developers

Make your expectations clear