CE 310 ROCK MECHANICS

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Status: Elective half-module (must be taken with Engineering Geology CE309)

Lecturer: Dr J.P. Harrison (JPH)

Structure: 25 contact hours. Lectures, tutorials and project work.

Links: CE309 : Compulsory

Introduction

Engineering rock mechanics is the study of rock mechanics and rock engineering and is concerned with all structures that are built in or on rock. This includes structures formed from the rock itself, such as slopes and caverns, as well as engineering structures such as dams and foundations. The subject has existed since time immemorial, but as an explicit engineering discipline in its own right is about 30 years old. During that time there have been various changes in emphasis and this module will provide the most up–to–date information and thinking.

Aims

This module is an introduction to engineering rock mechanics, and aims to introduce students to the principal concepts and techniques used in the discipline, whilst indicating more advanced issues. Through a series of weekly worksheets, students have the opportunity to apply the analysis and design fundamentals presented in the lectures to typical engineering problems.

SYLLABUS

The module material is presented in a series of 22 lectures, covering the following topics.

1) Introduction: rock engineering, books.
2) Stress: two dimensional stress, stress transformation, constitutive relations.
3) Strain: two dimensional strain, strain transformation, compatibility equations.
4) *In situ* rock stress. Measurement techniques and results, Kirsch equations. Engineering ramifications.
5) Elementary hemispherical projection.
6) Discontinuities: geometrical characteristics, RQD, mean spacing and frequency, hemispherical projection techniques.
7) Intact rock: mechanical properties of intact rock, complete stress-strain curve, stiff and servo-controlled testing machines, simple failure criteria.
8) Rock masses: properties of rock masses, deformability, single plane of weakness theory, failure criteria.
9) CHILE vs. DIANE: inhomogeneity, anisotropy, index tests, scale effects.
10) Rock mass classification schemes: Q and RMR, practical implementation, relations with rock mass properties
11) The complete rock mechanics problem: interactions & coupled mechanisms.
12) Blasting and mechanised excavation: mechanism of blasting, pre- and post-splitting.
13) Rock reinforcement and rock support: underlying principles, similarities and differences, particular methods and materials.

14) Foundations and slope stability: foundations on discontinuous rock, slope instability basic mechanisms and static equilibrium solutions.
15) Design of surface excavations: kinematic methods, hemispherical projection, overlay methods.
16) Underground excavations in discontinuous and stratified rock: stability of tetrahedral rocks, kinematic methods.
17) Underground excavations in continuous rock: approximate analytical methods.
18) Ground response curve and subsidence: rock-support interaction, subsidence prediction methods.
19) Mining applications: optimal orientation, pillar strength, mining methods.
20) Environmental & petroleum applications: underground storage, radioactive waste isolation, contaminant transport in fractured rock masses.
21) Computer methods in rock mechanics and rock engineering: principal stability methods.
22) Module Review

Coursework and submission dates
None

Assessment
Assessment is by means of a single 3 hour examination. *Rubric :* Answer 5 questions (from a total of 8).

Recommended Textbooks/Reading
HUDSON, J.A. & HARRISON, J.P. (1997). Engineering Rock Mechanics: an Introduction to the Principles. *Elsevier*
HARRISON, J.P. & HUDSON, J.A.(2000). 'Engineering Rock Mechanics: Illustrative Worked Examples'. *Elsevier.*

Learning Outcomes
At the conclusion of this module, it is expected that students will be able to:
- appreciate that rock mechanics is very different from soil mechanics;
- perform simple rock mechanics and rock engineering analysis;
- understand the fundamentals of rock engineering design; and
- confidently apply the material to which they have been exposed.