DIPARTIMENTO DI INGEGNERIA
STRUTTURALE E GEOTECNICA

SAPIENZA
UNIVERSITÀ DI ROMA

MECCANICA DELLE ROCCE – ROCK MECHANICS AA 2023-24

LM Ingegneria Civile/LM Ingegneria per l'Ambiente e il Territorio

a. Learning Objectives

The course is devoted to illustrate the mechanical behaviour of rock masses with the aim: a) to design a plan of investigations; b) to carry out the mechanical characterization of rock masses; c) to identify the instability mechanisms of rock slopes; d) to analyse the stability conditions of slopes; e) to plan the design of stabilization measures.
Specific skills. At the end of the course successful students, not only they acquire key competences (knowledge and understanding), also acquire the ability to independently handle the complexity of geotechnical problems (applying knowledge and understanding). In addition, for the recognition of instability phenomena and for the choice of methods and models of stability analyses, students have to make technical choices having reduced information, which is typically encountered in geotechnical problems (making judgements). Finally, for the design of stabilization measures, students have to take responsibility for assuming technical decisions (making judgements).
Since the required engineering project is based on real cases, students have to turn complex reality into possible simplified models. Then students are called to: define the gaps of information provided in the real case, identify additional requests for improving knowledge, independently address any further studies intended for his/her learning (learning skills).

b. Pre-requisites

Basic knowledge of the disciplines:
Theory of structures, Geology Applied to Engineering, Mechanics of Fluids, Fundamentals of Geotechnics

c. Program

QUANTITATIVE DESCRIPTION OF ROCK MATERIALS, DISCONTINUITIES AND ROCK MASSES (9 + 8 h)

Rock material: Index properties and classification systems
Rock mass: geometry, orientation (stereographic projections) and spatial distribution of discontinuities.
Technical classifications of rock masses (RQD, RMR, GSI, Q-Index)

MECHANICAL PROPERTIES OF ROCK MATERIAL, DISCONTINUITIES AND ROCK MASSES (19 +6 h)

Rock materials: Laboratory tests. Strain-softening behaviour of rocks. Mohr Coulomb and Hoek Brown strength criteria. Strength criteria for anisotropic rocks. Influence of pore pressure on strength.
Deformability of isotropic and anisotropic rocks. Influence of microfessuration. Dynamic properties of rock materials and rock masses.
Discontinuities: Laboratory shear tests. Peak and ultimate shear strength. Barton-Bandis strength criterion. Deformability and dilation. Scale effects.
Rock masses: Strength of systematically and irregularly jointed rock masses. Deformability of rock masses. Anisotropy of layered/schistose rock masses. In situ tests for evaluating deformability. Estimate of strength and deformability on the basis of rock mass indexes. Dynamic properties of rock masses. In situ investigation for the

measurement of dynamic properties. Rock mass quality from dynamic properties. Permeability of rock masses with systematic jointing. Influence of the state of stress/strain on permeability. Lugeon tests for permeability measurement.

STABILITY ANALYSIS OF NATURAL AND CUT SLOPES: SLIDING (9 + 4 h)

Typical mechanisms of instability with reference to the rock mass structure. Sliding instability of 2D wedges. Sliding instability of 2D multiple wedges. Sliding instability of 3D wedges. Influence of hydraulic conditions.

ROCK SUPPORTS (3 + 2 h)

Mechanism of reinforcement systems with anchors and active/passive bars. Design of the reinforcement project to stabilize rock masses.

d. Frequency & Frontal Teaching

Lectures will be presented on the blackboard and, occasionally, via PowerPoint.
Students are expected to attend the class and take notes, as this is one of the best ways to acquire new competences, followed by regular individual review outside the classroom.

e. Mode of evaluation

The structure of the course provides that part of the classroom time will be devoted to the carrying out of about 12 complex exercises, which will be illustrated and partly solved during the classroom time but require an individual working time. It is suggested to practice the exercises in groups of two or three students, with the aim to: develop communicative skills, argue personal technical choices, accept different technical choices from others, experience personal ability to lead a group.
The completion of each of the complex exercises is attested by a document per group containing the elaborations and a technical report. Some exercises will be devoted to planning the design of remedial measures for the stability of rock slopes.
The exam consists of the presentation of the technical reports carried out during the current semester. The reports must be sent to the teacher one week before the oral test and produced in print form during the exam session. Alternatively, student carries out a written test without submitting the technical reports.
The oral exam typically includes two questions related to topics covered during the complex exercises and a third theoretical question. During the exam, the student has to declare his/her personal contributions given in the reports, which will be evaluated by the teacher. The evaluation takes also into account: the autonomy of making judgment in dealing with the complexity of geotechnical problems, the acquired learning skills and the ability to deepen critical knowledge that lead to constant learning during professional life.

f. Textbook

Ribacchi et al. (2018) - Meccanica delle Rocce. Dalla Teoria alle Applicazioni nell'Ingegneria - Efesto Edizioni

g. References

Brady B.H.G., Brown E.T. - Rock Mechanics for Underground Mining - George Allen & Unwin Franklin J.A., Dusseault M.B. - Rock Engineering - McGraw-Hill Publishing Company Goodman R.E. - Introduction to Rock Mechanics - John Wiley & Sons
Hudson J.A., Harrison J.P. - Engineering Rock Mechanics. An introduction to the principles - Pergamon Priest S.D. - Discontinuity Analysis for Rock Engineering - Chapman & Hall