Slope Stability (250521)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA DEL TERRENY (pla 2015)
Course	2024/25

Main teaching language at each group

- Group 10ES2 Spanish (Q2)

Faculty

Responsible Faculty: Jose Moya Sanchez
Faculty: Jose Antonio Gili Ripoll, Jose Moya Sanchez

Objectives of Education

- Ability to identify signs of instability of slopes and natural slopes as well as the type of broken mechanism.
- Knowledge of the procedures and tests to evaluate the resistance of soils and rocks.
- Ability to characterize the spread of landslides and landslides.
- Ability to analyze the stability of a natural hill or slope.
- Knowledge of instrumentation and auscultation techniques for landslides as well as stabilization, containment and protection measures.
- Ability to carry out quantitative risk assessment.

Competencies

Especific

The ability to address and solve advanced mathematical problems in engineering, from the scope and context of the problem to its statement and implementation in a computer program. In particular, the ability to formulate, program and apply advanced analytical and numerical calculation models to the design, planning and management of a project, as well as the ability to interpret the results obtained in the of mining engineering.
Ability to conduct land management studies, including the construction of tunnels and other underground infrastructures.
Adequate knowledge of modelling, assessment and management of geological resources, including groundwater, mineral and thermal resources.

Transversal

SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Topic 1. Landslide movements: definition and typology

Phases of slope movements. Strength parameters associated with movement phases. Landslide behavior: failure conditions and post-failure movement (propagation). Classification of slope movements: differentiating characteristic features.

Topic 1. Strength properties of soils and rocks

Short and long term strength. Residual strength. Progressive failure. Measurement of strengthparameters: laboratory and in situ tests. Strength properties of rock joints.

Topic 3. Identification and recognition of unstable slopes

Recognition objectives. Most frequent patterns of instability: torrential basins, steep slopes in hard rocks, slopes with moderate slopes in soft rocks. Landslide identification criteria and techniques. Recognition of large active landslides. Reconstruction of the geometry of the failure surface in inactive landslides.

Contingut Lab

Practice 1. Recognition of large landslides: real cases (2 h) Practice 2. Methods of remote capture of geological data (3 h)

Topic 4. Stability Analysis

Simple cases: sands and clays in the short and long term. infinite slope General methods.

Contingut Lab

Practice 3. Tutoring limit equilibrium methods. Using Slide2. (2 h) Practice 4. Stability analysis: study of real cases. (3 h)

Topic 5. Dynamics of movements I: mechanisms of propagation and strength loss of large landslides.

Mechanism of movement, speed of movement and risk. Propagation mechanisms. Strength loss mechanisms. Compound slides. Geometry and strength of failure surfaces. Characteristics of large landslides and their speed. (3 h)

Contingut Lab

Workshop 5. Mobility analysis of large slides: real cases (2 h)

Topic 6. Analysis of the propagation and runout of rockfalls

Geomorphological approach. Empirical methods: shadow angle, reach angle. Reach angle: friction coefficient, volume dependence, reach dependence, mechanism influence. Mobility of large landslides. Shadow and reach angles: probabilistic analysis. (2 hours)

Topic 7. Instrumentation and monitoring

Surficial topographic and geodesic techniques. Geotechnical techniques. Remote sensing.

Topic 8. Estabilization and protection techniques

Stabilization and reinforcement of slopes and cuttings. Protective structures.

Topic 9. Suceptibility and aazard analyses

Basic concepts of danger and risk.
Need for susceptibility analysis. Analysis of susceptibility to breakage: “Knowledge driven” methods (heuristics), “data driven” methods, physically based methods.
Hazard analysis. Slip event and MORLEs. Probability of occurrence: estimation methods. Construction of magnitude - frequency curves. Dating of landslides. Preparation of hazard maps. Hazard assessment. (2 h)

Contingut Lab

Practice 6. Hazard analysis of real cases (3 h)

Topic 10. Quantitative risk analysis (QRA)

Landslide intensity Descriptors. Hazard matrix: intensity – frequency relationship. Vulnerability to slope movements. Risk zoning: zoning levels and map scale. Work scale and recommended techniques. Risk reduction. Risk management. (2 hours)

Contingut Lab

Practice 7. Risk analysis of real cases (2 h)

Activities

Tutorial case study

Tracking coursework

Dedication

6h

Teaching Methodology

The course consists of 3 hours a week of lectures in the classroom.

55% of the time is devoted to theoretical contents, when the teacher explains the basic concepts and discuss real cases of slope instability.

30% of the time is devoted to exercises aimed at solving practical problems and to field work having more interaction with students.

There are also planned activities for mentoring, supervision and assessment of the Case Study

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

The assessment has three components:
1) Evaluation of two practices delivered and a subsequent test, with a total weight of 20%.
2) Practical exam on the stability analysis of a hillslope, with a weight of 30%, to be carried out towards the middle of the academic period.
3) Practical work on a real case of slope instability involving risk analysis and its mitigation. Both the written report and the oral presentation, to be presented at the end of the semester, are assessed. Its weight is 50%.

Office Hours

José Moya: Mondays from 12:00 to 14:00 and other days by previous appointment.
Josep Gili: to be agreed with the profesor.

Bibliography

Basic

- Hoek, E.; Bray, J. Rock slope engineering. Rev. 3rd ed. London: The Institution of Mining and Metallurgy, 1981. ISBN 0419160108.
- Turner, A.K.; Schuster, R.L. (Editors). Landslides: investigation and mitigation. Washington, DC: National Academy Press, 1996. ISBN 030906208X.
- Highland, L.M.; Bobrowsky, P. The Landslide Handbook-A Guide to Understanding Landslides. Reston, Virginia, U.S: US Geological Survey, 2008. ISBN 9781411322264.