Course guides
250813 - 250813 - Quaternary Geology

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Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2020 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE MOYA SANCHEZ

Others: JOSE MOYA SANCHEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13308. To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
13309. To characterize the geological environment and its interaction with civil works.
13310. To interpret laboratory tests and field observations so as to identify the mechanisms responsible for soil response. To propose laboratory testing programmes.
13312. To analyze, discriminate and integrate geological and geotechnical information in studies and projects.
13322. To realize studies of land management and urban spaces, including construction of tunnels and other underground infrastructures. (Specific competence of the specialization in Geotechnical Engineering).

Generical:
13300. To apply advanced knowledge in sciences and technology to the profesional or research practice.
13303. To evaluate the impact of Geo-engineering on environment, sustainable social development and the significance of working within reliable and consciensous profesional environment.
13304. To incorporate new techncologies and advanced tools in Geo-engineering into profesional and research activities.
13305. To conceive Geo-engineering as a multi-disciplinary field that includes relevant aspects from geology, sismology, hydrogeology, geotechnical and earthquake engineering, geomechanics, physics of porous media, geophysics, geomatics, natural hazard, energy and climate interactions.
13306. To promote innovation for the development of methodology, analyses and solutions in Geo-engineering
13307. To tackle and solve advanced mathematical problems in engineering from the drafting of the problem to the development of formulation and further implementation in computer programs. Particularly, to formulate, code and apply analytical and numerical advanced computational tools to project calculations in order to plan and manage them as well as to interpret results in the context of Geo-engineering and Mining engineering.

TEACHING METHODOLOGY

Three types of activities are performed: lectures (16 hours), practical sessions for solving problems (9 hours), field trips (11 h),

The teaching material is provided by the virtual campus Athena.

LEARNING OBJECTIVES OF THE SUBJECT

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
To characterize the geological environment and its interaction with civil works.
To interpret laboratory tests and field observations so as to identify the mechanisms responsible for soil response. To propose testing programmes.
To analyze, discriminate and integrate geological and geotechnical information in studies and projects.
To apply the knowledge on soil and rock mechanics to the development of the study, design, construction and exploitation of foundations, excavations, embankments, tunnels and other constructions on or through the soils, regardless of their nature and state or the finality of the works under study (Specific competence of the specialties in Geotechnical Engineering and Earthquake Engineering and Geophysics).
To analyze, from the perspective of an expert, cases of failure in Geotechnical Engineering. To report the evidences, identify the mechanisms responsible for the failure and verify using back- analysis models.Eventually provide solutions to risk reduction. (Specific competence of the specialization in Geotechnical Engineering).
To realize studies of land management and urban spaces, including construction of tunnels and other underground infrastructures. (Specific competence of the specialization in Geotechnical Engineering).
To use, in a discriminate manner, commercial software for numerical calculations in order to design and eventually monitor geotechnical structures. (Specific competence of the specialization in Geotechnical Engineering).

* To identify and characterize the materials and forms resulting from current and quaternary geological processes (flooding, flash floods, slides, fault activity), to determine the mechanisms operating, to estimate the intensity and frequency of the processes.
* To know the instrumentation and ground movement auscultation techniques and to correctly use the auscultation results.
* To be able to analyze the stability of an excavation or natural slope.
* To know the measures of stabilization, containment and protection of slope movements.
* To be able to carry out the quantitative evaluation of the risk of instability of slopes and excavations.

-External Geodynamics and controlling factors.
- Determination of the frequency of geological processes.
- Processes and sedimentary deposits: properties, geometry and morphology of colluvial, fluvial, torrential, glacial and coastal deposits.
- Weathering and auchtoctonous and para autochtonous surface formations.- Processes of recent and active deformation and associated geological structures: neotectonics, collapses and subsidence.

The design of works of civil engineering requires knowledge of the superficial formations and of the geological processes that may occur during the life of the works. The subject provides tools for predicting the geometry and properties of the surperficial formations and intensity and temporal activity of these processes. Identification and solving of problematic cases of reconnaissance of quaternary deposits and processes is stressed in the subject.

The objectives are:

- Identify and characterize the materials and landforms resulting from active and quaternary geological processes (floods, torrential floods, landslides, displacement in tectonic active faults) and determine the operating mechanisms.

- Reconstruct the geometry of the superficial formations and predict their mechanic behavior. Planning of efficient campaigns of reconnaissance superficial formations.

- Quantify the intensity and frequency of recent or active geological processes.

- Identify of problematic cases for civil engineering linked to the reconnaissance of quaternary deposits and active geological processes (tunnel entrances, soil/rock ratio in tunnel support assessment, fluvial erosion in bridges and roads, reactivation of old landslides, karstific

STUDY LOAD

Type	Hours	Percentage
Hours large group	19,5	15.59
Self study	80,0	63.95
Guided activities	6,0	4.80

Type	Hours	Percentage
Hours small group	9,8	7.83
Hours medium group	9,8	7.83

Total learning time: 125.1 h

CONTENTS

Introduction to Quaternary Geology

Description:
Geological processes in the Earth surface. Time scale of geological processes. Driving factors of the recent geological activity. Quaternary, Holocene and present climate changes. Causes and consequences of climate changes.
Scales of instrumental record, the historical record and the geological record. Basic dating techniques: relative dating, numerical dating, calibrated dating and dating by correlation. Dating of deposits and surfaces.

Specific objectives:
Determine the frequency, duration and extent of the climate changes occurred during the Quaternary and present, and its causes and consequences on geological processes.
Fundamentals of dating geological processes and soils.

Full-or-part-time: 6h
Theory classes: 2h 30m
Self study : 3h 30m

Geomorphological processes. Landforms and associated deposits

Description:
Types of colluvial processes. Morphology, texture and structure of colluvial deposits. Assessment of the state of activity of landslides by means of geomorphic indicators. Identification of old landslides. Numerical dating of landslides and assessment of their frequency.
Location and mapping of a landslide in aerial photography. Identifying of the mechanism. Inference of the state of activity by geomorphological criteria. Analysis of the possible mechanisms of reactivation and its reactivation potential by a method of limit equilibrium.
Identification of deposits col.luvials methods for dating landslides, geomorphological recognition of the casting floor La Coma and mechanisms of displacement.
Types of river channels. Geometry, texture and internal structure of deposits. Analysis of the dynamics erosion-aggradation. Relationship between morphological units, depositional units and lithological units. Geometry of the bedrock- alluvial fill contact. Geomorphic effects of floods. Frequency of floods and its variation with climatic oscillations. Determination of non-gauged major floods and paleohidrology.
Preparation of a geological cross-section of a simple system of fluvial terraces and deposits from a geomorphological map and borehole data. Defining the geometry of the depositional units and interpretation of its chronology from dating results.
Preparing a geological corss-section of a complex system of terraces and fluvial deposits from borehole data. Defining the geometry of depositional units, morphological units and lithological units.
Conventional methods for determining the
Types of torrential processes. Features and differentiation of torrential deposits. Pyerenean examples: Senet, the Beach BarLa Guingueta and Biescas. Frequency of torrential phenomena and their controls.
Analysis of basins susceptible to torrential phenomena. Determination of frequency. Identifying the factors determining the frequency and the process type.
Types of glaciers. Glacier dynamics and glacial sub-environments. Mechanisms of erosion and deposition. Depositional and erosional landforms. Texture and geometry of the glacial deposits.
Location of the contact in the ground surface. Location of the contact in boreholes. Preparation the geological cross-section.
Weathering processes and weathering degrees. Texture, structure and properties of weathering materials: weathered rocks , residual soils, pedogenic soils. Pedogenic development index. Use of pedogenic soils for dating of surfaces.

Specific objectives:
- Identify and characterize the materials and landforms caused by landslides and identify the operating mechanisms.

- Infer the landslide geometry and the mechanical behavior of landslide materials. Planning of efficient campaigns for landslide reconnaissance.

- Quantify the intensity, the state of activity and the frequency of landslides.

- Analyse the reactivation of large landslides by excavation works and reservoir operation.
Identification of old landslides and analysis of their reactivation potential
Reconnaissance of colluvial deposits. Landslide dating. Behaviour of earthflows.
- Identify and characterize the fluvial materials and landforms.
- Reconstruct the geometry of fluvial deposits. Planning efficient campaigns recognition fluvial deposits.
- Know the river dynamics and mobility of channels. Role of the floodplain during floods.
- Determine the frequency and magnitude of floods by different methods.
Rebuild geometry and a simple chronology of fluvial deposits.
Reconstruction of the geometry of a complex system of fluvial terraces and deposits
Introduction to the paleohydrological methods for estimating magnitude-frequency curve of floods.
- Identify and characterize the torrential deposits and landforms and identify thetorrential processes.
- Reconstruct the geometry of torrential formations and their mechanic behaviour.
- Quantify the intensity and frequency of torrential processes.
Determination of susceptibility and frequency of torrential processes
- Identify and characterize the glacial deposits and landforms.
- Reconstruct the geometry of the glacial formations and infer their mechanical behavior.
- Understand and identify problem cases of recognition glacial deposits in civil works.
Location of the contact between and quaternary deposits in an old glacial valley
Characterisation and reconnaissance of weathering soils and pedogenic soils.

Full-or-part-time: 73h 12m
Theory classes: 11h 30m
Practical classes: 8h
Laboratory classes: 11h
Self study : 42h 42m

Recent and active deformation processes

Description:
Morphological evidences of recent and active faulting. Evolution of fault escarpments. Development and evolution of mountain fronts. Morphological indices of activity. Examples of recent tectonics.

Specific objectives:
Identify and determine the activity in faults.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Workshops and evaluation activities

Description:
Discussion of the questionnaire of the course
Oral presentation of the bibliographic report

Specific objectives:
Discussion of questions and problems of Quaternary geology, prior to the exam.
Oral presentation of the bibliographic report

Full-or-part-time: 9h 36m
Practical classes: 3h
Laboratory classes: 1h
Self study : 5h 36m

GRADING SYSTEM

The evaluation consists of three activities:

- Four years delivered during the year (40% of the final mark).

- Bibliographic work, done in groups, with oral presentation (5%) and delivery of written report (15%).

- Individual examination (40%).

EXAMINATION RULES.

All evaluation activities are required.

BIBLIOGRAPHY

Basic:
- Ritter D.F, Kochel R.C.; Miller J.R. Process geomorphology. 5th ed. Long Grove, Ill: Waveland Press, 2011. ISBN 9781577666691.
- Lowe, J.J.; Walker, M.J.C. Reconstructing quaternary environments. 2nd ed. London [etc.]: Longman, 1997. ISBN 0582101662.
- Bell, F.G. Engineering properties of soils and rocks. 3rd ed. Oxford ; Boston: Butterworth-Heinemann, 1992. ISBN 0750604891.
- Fookes, P.G.; Lee, E.M.; Milligan, G. Geomorphology for engineers. Caithness: Whittles, 2005. ISBN 1870325036.