Course guides
250420 - PROJCONSGE - Geotechnical Design and Construction

Last modified: 06/10/2020

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

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN GEOLOGICAL AND MINING ENGINEERING (Syllabus 2013). (Compulsory subject).
MASTER'S DEGREE IN GEOTECHNICAL AND EARTHQUAKE ENGINEERING (Syllabus 2009). (Optional subject).
MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).

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

LECTURER

Coordinating lecturer: MARCOS ARROYO ALVAREZ DE TOLEDO

Others: MARCOS ARROYO ALVAREZ DE TOLEDO, ANTONIO GENS SOLE, ANTONIO LLORET MORANCHO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
8200. The ability to apply knowledge of soil and rock mechanics to the study, design, construction and operation of foundations, cuts, fills, tunnels and other constructions over or through land, whatever its nature and state, and whatever the purpose of the work.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. 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.

8561. 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.

TEACHING METHODOLOGY

The course consists of three hours per week (on average 1.5 of theory and 1.4 problems addressed to the solution of real cases). Two assessments are conducted throughout the year, one in an intermediate stage and one at the end.

Support material is used for the detailed teaching plan through the virtual campus ATENEA: content, programming and evaluation activities, directed learning and recommended literature.

LEARNING OBJECTIVES OF THE SUBJECT

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

This course has two objectives: to learn to develop a complete geotechnical project (using an actual case) and to know the most important techniques of geotechnical construction including: instrumentation, soil improvement, geosynthetics and soil structure interaction.

STUDY LOAD

Type	Hours	Percentage
Guided activities	6,0	4.80
Laboratory classes	9,8	7.83
Theory classes	19,5	15.59
Practical classes	9,8	7.83
Self study	80,0	63.95

Total learning time: 125.1 h

CONTENTS

Geotechnical project

Description:
Presentation of the course. Introduction to the Geotechnical project. Presentation of the "case of the foundation of the Water Treatment Plant of Baix Llobregat."
1: Analysis of previous geological information. Analysis of "in situ" tests. Critical analysis of the results of laboratory tests.
Activities in groups: Proposal for site investigation. Proposed geological model. Proposed laboratory testing campaign. Parameters obtained from laboratory tests.

2: Continuation of the case study: the initial model. First estimate of the behavior (total settlements and evolution over time).
Preload test. Test design. Analysis of results.
Activities for groups: Proposed Model (parameters and stratigraphy). Calculating the primary settlements. Predicting the evolution of the deformation of the soil as a function of depth. Predicting the effect of partial unloading in the evolution of settlements with time.

3: Continuation of the case study: Profiles of effective stress and of the degree of overconsolidation. Analysis of effect of pumping and preload. Effect of preload on the secondary consolidation. Proposed Model. Calibration of the model. Predictions of settlements. Construction of the treatment plant. Conclusions. Activities for groups: Obtaining the degree of overconsolidation before and after the preload. Development of an EXCEL spreadsheet. Parameters obtained from strain measurements "in situ".

Full-or-part-time: 21h 36m
Theory classes: 3h
Practical classes: 6h
Self study : 12h 36m

Soil-structure interaction

Description:

Winkler model. Elastic models. Solutions for simple cases of soil-structure interaction. Approximate numerical methods. Determination of parameters related to the deformability.
Activities for groups: Develop a spreadsheet to an infinite beam with various loads using the Winkler model. Calculation of the elastic modulus from the results of a load plate test.

Finite elements. Commercial programs. Brief description of use of PLAXIS program. Relations between the elastic modulus and subgrade modulus.
Activities for groups: Using PLAXIS program for calculating the settlements of a circular plate with different constitutive models. Computing teh subgrade modulus from the numerical results for variousplate sizes.

Full-or-part-time: 14h 23m
Theory classes: 3h
Practical classes: 3h
Self study : 8h 23m

Evaluation

Full-or-part-time: 14h 23m
Laboratory classes: 6h
Self study : 8h 23m

Instrumentation

Description:
Introduction. Objectives of the instrumentation. Monitoring systems: strength and stresses, water pressures, displacements and deformations. Characterisitcs and limitations. Development of a geotechnical instrumentation project. Tips for good practice. Typical instrumentation examples.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

Ground improvement

Description:
Introduction. Preloading and prefabricated vertical drains. Vibro-compaction and dynamic compaction. Stone columns. Deep soil mixing. Freezing. Grouting in rocks and soils. Jet grouting. Compensation groutingion. Advantages and limitations of the various methods. Examples of application.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

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Geosynthetics

Description:
Main types of geosynthetics: charactersitics and manufacturing processes. Main functions of geosynthetics and applications in which these functions are most relevant. Principles of design with geosynthetics. Most important geosynthetics characterization tests.

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Engineering case

Description:
The construction design of a real geotechnical case is developed interactively. The case integrates, in a structured manner, elements of instrumentation, soil improvement, geosynthetics and soil-structure interaction.

Full-or-part-time: 7h 11m
Practical classes: 3h
Self study : 4h 11m

GRADING SYSTEM

There will be two exams: one in an intermediate stage of the course (Note: Nint) and at the end of the course (Note: Nend).

The screening tests consist of a part with questions on concepts associated with the learning objectives of the course to assess knowledge and understanding, and another part with application exercises.

The rating is obtained from the maximum of: nEnd or (0.4 *Nint + 0.6 * Nend)

EXAMINATION RULES.

In the final exam, all the course matter will be considered regardless of the grade in the intermediate examination.

BIBLIOGRAPHY

Basic:
- Dunnicliff, J.. Geotechnical instrumentation for monitoring field performance. New York: John Wiley & sons, 1993. ISBN 0471005460.
- Koerne, R.M. Designing with geosynthetics. 6th ed. Indianapolis: Xlibris, 2012. ISBN 9781462882892.