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250145 - ENGGEOTEC - Geotechnical Engineering

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering

Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)

ECTS credits: 4,5 Teaching languages: Spanish

Teaching staff

Coordinator: JEAN VAUNAT

Others: ANTONIO GENS SOLE, JEAN VAUNAT

Opening hours

Timetable: To be arranged

Degree competences to which the subject contributes

Specific:

3029. Knowledge of soil and rock geotechnics and mechanics and the ability to apply this knowledge in carrying out studies, projects, constructions and exploitations in which earthmoving, foundations and retention structures are necessary.

3046. Students will acquire the skills needed to build geotechnical works.

Generical:

3104. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.

3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.

3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.

3110. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact of the processes and techniques used, and conducting economic analyses of human and material resources.

3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise specifications and planning documents, and apply a systematic design process to the implementation and operation

phases. Students will learn to write progress reports for a design process, use a range of project management tools and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.
3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the design, execution and operation phases and to use the knowledge and tools covered in each subject area to the design and execution of their own projects. Finally, students will assess the impact of national, European and international legislation applicable to engineering projects.

Transversal:

585. ENTREPRENEURSHIP AND INNOVATION - Level 1. Showing enterprise, acquiring basic knowledge about organizations and becoming familiar with the tools and techniques for generating ideas and managing organizations that make it possible to solve known problems and create opportunities.
586. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.
589. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
594. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course consists of three hours per week (on average 2 hours of theory and 1 hour of exercises). Two evaluations are conducted throughout the course, one in an intermediate stage and one at the end.

Learning objectives of the subject

Students will learn to apply knowledge of geotechnical engineering, soil mechanics and rock mechanics in studies, projects, construction work and operations that require earthworks, foundations or retaining walls. They will also develop the skills to carry out geotechnical construction projects.

Upon completion of the course, students will have acquired the ability to: 1. Design a shallow foundation structure on the basis of a geological-geotechnical study. 2. Design a deep foundation structure on the basis of a geological-geotechnical study. 3. Design a retaining wall and carry out a stability and in-service performance analysis.

Site-investigation techniques; Behaviour of shallow foundations, calculation of bearing capacity and settlement, design and checking; Behaviour of deep foundations, calculation of bearing capacity and settlement, design and checking; Lateral earth pressure theory and its application to the calculation of pressure coefficients in retaining walls; Behaviour of rigid and flexible retaining walls including drainage, stability monitoring, anchorage elements, and stability and in-service performance analysis; Selection of methods for analysing, designing and checking geotechnical structures in foundations and retaining structures and carrying out road-related tasks such as analysing the stability of slopes, embankments, earthworks and underground work on the basis of geological/geotechnical studies

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Study load

Total learning time: 112h 30m	Theory classes:	26h	23.11%
	Practical classes:	13h	11.56%
	Laboratory classes:	6h	5.33%
	Guided activities:	4h 30m	4.00%
	Self study:	63h	56.00%

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Content

Introduction

Learning time: 2h 24m

Theory classes: 1h
Self study : 1h 24m

Description:
Introduction to the course

Site investigation

Learning time: 7h 11m

Theory classes: 3h
Self study : 4h 11m

Description:
Preliminary documentation
Density and depth of investigation
Surface investigation
Deep investigation
Trenches and boreholes
Piezometric observations
Sampling
Soil properties and parameters
Laboratory tests

In situ tests

Learning time: 14h 23m

Theory classes: 3h
Practical classes: 3h
Self study : 8h 23m

Description:
Standard penetration test (SPT)
Cone penetration test
Dynamic penetration test
Vane test
Pressuremeter test
Plate load test
Seismic tests
Permeability tests

In situ testing exercises

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Shallow Foundations

Learning time: 4h 48m

Theory classes: 2h
Self study : 2h 48m

Description:
- Introduction
- Bearing capacity
-Settlements
- Design criteria
Factor of safety against failure
Admissible settlements
- Design of a shallow foundation empirical
Allowable pressure
In situ tests

Deep foundations

Learning time: 16h 48m

Theory classes: 4h
Practical classes: 3h
Self study : 9h 48m

Description:
Preliminaries. Classification
- Methods of pile construction
- Mechanisms of resistance of piles
- Bearing capacity of an isolated pile
Tip resistance
Shaft resistance
Special cases: gravel, rock
- Bearing capacity of a pile group
- Settlements of a single pile
- Settlements of a pile group
- Piles subjected to lateral loads
- Negative friction
Foundation exercises

Test

Learning time: 14h 23m

Laboratory classes: 6h
Self study : 8h 23m

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Calculation of earth pressures	Learning time: 9h 36m Theory classes: 2h Practical classes: 2h Self study : 5h 36m

Description:
- Coefficient of earth pressure at rest
- Rankine active and passive states
- Limit equilibrium
- Method of Coulomb
- Additional earth pressures due to surcharges

Earth pressure exercises

Gravity structures	Learning time: 14h 23m Theory classes: 4h Practical classes: 2h Self study : 8h 23m

Description:
- General

oDifferent types of structure (gravity walls, rockfill walls, walls in L)
o Assessment process for geotechnical stability
- Gravity walls
o Evaluation of the stability (sliding, overturning and bearing capacity failure)
o structural stability
o global stability
o Pre-design
o drainage. Constructive aspects
- Discussion exercises
- Rockfill walls
o morphology
o Evaluation of the stability
o Drainage
or commissioning work
- Cantiliever wall
o types of structure
o Evaluation of earth pressure
o Evaluation of stability
o Design
o Construction aspects

Gravity structures exercises

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Reinforced earth	Learning time: 12h Theory classes: 4h Practical classes: 1h Self study : 7h

Description:
- Reinforced Earth
- Green Walls
- Bolts
- Anchors

Reinforced earth exercises

Diaphragm walls	Learning time: 12h Theory classes: 3h Practical classes: 2h Self study : 7h

Description:
- Introduction
- Construction aspects
- Distributions of pressure on diaphragm walls)
o cantilever wall
o wall with a row of anchors
o calculation with subgrade coefficient
o three-dimensional aspects
- Drainage around an excavation
o flow net and stability against piping
o Methods of drainage and control of ground ater (pumping, injection, jet grouting)
- Proppping
o distribution of earth pressures
o Verification of stability
- Surface settlements

Diaphragm wall execises

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Qualification system

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

Exams consist of a part with questions on concepts related to the learning objectives of the course and some exercises.

The final grade is obtained from the maximum of Nfin or (0.4*Nint + 0.6*Nfin).

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

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

Bibliography

Basic:

Jimenez Salas, J.A.; De Justo Alpañes, J.L.; Serrano, A.A. Geotecnia y cimientos. Vol. 2: Mecánica del suelo y de las rocas. 2a ed. Madrid: Rueda, 1975-1981. ISBN 84-7207-003-4 (V.2).

Jiménez Salas, J.A.; Justo Alpañes, J.L. Geotecnia y cimientos: v. III: cimentaciones, excavaciones y aplicaciones de la geotecnia. Partes 1 y 2. Madrid: Rueda, 1980. ISBN 84-7207-017-4.

Peck, R.B.; Hanson, W.E.; Thornburn. T.H. Ingeniería de cimentaciones. 2a ed. Mexico: Limusa, 1990. ISBN 968-18-1414-2.