



Course guide

250140 - ESTFOR - Concrete Structures

Last modified: 01/10/2023

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

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

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: JESÚS MIGUEL BAI RÁN GARCÍA

Others: JESÚS MIGUEL BAI RÁN GARCÍA, ALBERTO DE LA FUENTE ANTEQUERA, NOEMI DUARTE GOMEZ, ANTONIO RICARDO MARI BERNAT, JUAN MURCIA DELSO, EVA MARIA OLLER IBARS, DAVID VERGES COLL

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

- 3024. Ability to apply knowledge of construction materials to structural systems. Knowledge of the relation between the structure of materials and the mechanical properties resulting from them.
- 3031. Students will acquire a basic awareness of the behaviour of reinforced concrete and metal structures and the capacity to conceive, design, build and maintain these types of structures.
- 3032. Students will acquire the ability to select the most appropriate methods for calculating and dimensioning structural (reinforced and prestressed) concrete structures and metal structures to which European regulations apply.
- 3037. Knowledge of the different types and basis for calculating prefabricated items and its application to the manufacturing processes.
- 3038. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.

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 5 hours a week and is taught for 1 semester.

The teaching methodology will be based on the work and development of the student guided by questions, works, and guided projects. Theoretical classes and practical activities are developed, mostly synchronously, in person or remotely, and activities with the support of asynchronous sessions. There will be workshops in which students develop the conceptual design, pre-dimensioning, and design of a structure.

Whenever possible, there will be complimentary training activities consisting of a visit to a construction site, precast plant, or the Structural Technology Laboratory.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

Students will acquire a basic understanding of the behaviour of concrete structures and develop the capacity to conceive, design, build and maintain structures of this type.

Upon completion of the course, students will have acquired the ability to: 1. Define the actions and combinations of actions to be considered in the design of a concrete structure. 2. Design and/or check the strength of sections under different kinds of stress, as well as the interaction of multiple stresses. 3. Determine the type of reinforcement, anchorage length and lap length required in the design of a framework. 4. Design and/or check concrete structural elements in the presence of instability phenomena. 5. Design the most common types of concrete structures (slabs, rigid foundations and flexible foundations). 6. Design active reinforcements in isostatic prestressed concrete structures. 7. Check the serviceability limit states for cracking and deformation. 8. Make decisions about the pouring of concrete (placement, compaction, concrete joints, curing, stripping of formwork) and quality control (quality of materials tests and control levels).

Mechanisms that enable reinforced and prestressed concrete structures to withstand stress; Specific aspects related to the materials, design and construction of structures, such as durability strategy; Criteria for selecting the appropriate structural type, pre-design criteria, and methods for thoroughly checking and organising isostatic and hyperstatic reinforced concrete beams and isostatic prestressed concrete beams, as relates to adequate reinforcement and structural viability; Behaviour and cross sections of common types of concrete structures such as slabs, girders, beams, pillars and foundation elements

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	24.00
Hours medium group	15,0	8.00
Hours small group	15,0	8.00
Guided activities	7,5	4.00
Self study	105,0	56.00

Total learning time: 187.5 h

CONTENTS

Introduction to reinforced concrete

Description:

The reinforcement concept
History of concrete

Full-or-part-time: 4h 48m

Theory classes: 2h

Self study : 2h 48m

Concrete manufacture and placing

Description:

Manufacturing, transport
Sunset at work and curing

Full-or-part-time: 4h 48m

Theory classes: 2h

Self study : 2h 48m



Basis of design

Description:

States limit
Structural safety
Actions
Practice combinations of actions
Rods and straps

Full-or-part-time: 16h 48m

Theory classes: 5h
Practical classes: 2h
Self study : 9h 48m

Durability

Description:

Environments. Materials and coatings
Practice durability

Full-or-part-time: 4h 48m

Theory classes: 1h
Practical classes: 1h
Self study : 2h 48m

Materials: Basis of design

Description:

Components and concrete. Mechanical characteristics
Rheological properties of concrete
Steels. Passive Armor
Practice materials BC

Full-or-part-time: 9h 36m

Theory classes: 3h
Practical classes: 1h
Self study : 5h 36m

ULS bending and axial forces

Description:

Theory classes
Classes Practiq

Full-or-part-time: 28h 47m

Theory classes: 9h
Practical classes: 3h
Self study : 16h 47m



ULS instability and second order effects

Description:

Theory classes
Practical classes

Full-or-part-time: 4h 48m

Theory classes: 1h
Practical classes: 1h
Self study : 2h 48m

ULS shear loads and torsion

Description:

ELU chopper. Theory classes
ELU chopper. Practical classes
ELU torsion. Theory classes
ELU torsion. Practical classes

Full-or-part-time: 21h 36m

Theory classes: 6h
Practical classes: 3h
Self study : 12h 36m

ULS bond and development length

Description:

Arrangement of reinforcement
Theory class
Practical class

Full-or-part-time: 7h 11m

Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m

SLS cracking

Description:

Theory class
Practical class

Full-or-part-time: 7h 11m

Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m



SLS deformations

Description:

Theory class
Practical class

Full-or-part-time: 4h 48m

Theory classes: 1h
Practical classes: 1h
Self study : 2h 48m

Structural elements

Description:

Foundations, floors, walls

Full-or-part-time: 7h 11m

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

Introduction to prestressed concrete

Description:

The concept of prestressing. History of prestressed concrete
Technology prestressed

Full-or-part-time: 4h 48m

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

Basis of design II

Description:

Structural analysis of prestressed. Share. Design in prestressed
Practical actions
Prestressing force. Losses and Deferred snapshots
Practice losses

Full-or-part-time: 14h 23m

Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

SLS Cracking

Description:

Decompression
Sizing prestressing force. Track
Practice sizing

Full-or-part-time: 7h 11m

Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m



ULS. in prestressed

Description:

Flexion. Checking
Cutting
Practice bending and shear
Anchorage

Full-or-part-time: 9h 36m

Theory classes: 3h
Practical classes: 1h
Self study : 5h 36m

Block 1

Full-or-part-time: 4h 48m

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

Block 2

Full-or-part-time: 4h 48m

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

Block 3

Description:

Site visit

Full-or-part-time: 12h

Laboratory classes: 5h
Self study : 7h

GRADING SYSTEM

The final mark is obtained from continuous evaluation and the corresponding laboratory and/or computer room activities.

The continuous evaluation consists of performing different activities, both individually or in groups, which are additive, and implies both training skills and evaluation. These activities are programmed during the course.

The laboratory grade is the average of such the obtained marks on these activities.

The evaluation exams and tests may include both conceptual questions, exercises, and problems, associated with the learning objectives of the course.

The final grade will be obtained as:

$$NF = 0.7 E + 0.3 T$$

where:

E: weighted mark of exams (40% midterm and 60% final).

T: weighted mark of homeworks and workshops.

The minimum mark to pass is 5.0 over 10.0.

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.

EXAMINATION RULES.

Any activity or exam not presented in the expected period will imply a zero score in that evaluation concept.

There is a special call at the end of the course exclusively for presenting midterm examinations that were not performed for justified reasons.



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Basic:

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