Course guide
2500039 - GECFPRETEN - Prestressed Concrete

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 2020). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Spanish

LECTURER

Coordinating lecturer: JUAN MURCIA DELSO

Others: JESÚS MIGUEL BAIRÁN GARCÍA, ALBERTO DE LA FUENTE ANTEQUERA, JUAN MURCIA DELSO, EVA MARIA OLLER IBARS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14410. Knowledge of the typology and calculation bases of prefabricated elements and their application in manufacturing processes. (Specific technology module: Civil Construction)
14411. Knowledge about the project, calculation, construction and maintenance of building works in terms of structure, finishes, facilities and own equipment. (Specific technology module: Civil Construction)
14415. Ability to apply construction procedures, construction machinery and construction planning techniques. (Specific technology module: Civil Construction)

Generical:
14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.
14383. Ability to project, inspect and direct works, in their field.
14386. Capacity for maintenance, conservation and exploitation of infrastructure, in its field.
14389. Knowledge of the history of civil engineering and training to analyze and assess public works in particular and construction in general.
14390. Identify, formulate and solve engineering problems. Pose and solve construction engineering problems with initiative, decision-making skills and creativity. Develop a systematic and creative method of analysis and problem solving. (Additional school competition).
14391. Conceive, project, manage and maintain systems in the field of construction engineering. Cover the entire life cycle of an infrastructure or system or service in the field of construction engineering. (Additional school competition).

TEACHING METHODOLOGY

The course consists of 1.5 hours per week of classroom activity (large size group) and 1.5 hours weekly with half the students (medium size group).

The 1.5 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.5 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

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.

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

Fundamental knowledge for the project and calculation of prestressed concrete structures. Technological aspects. Project Bases of prestressed concrete structures. Calculation of the prestressed force and the prestressing layout. Verification of serviceability and ultimate limit states.

1 Ability to identify the different prestressing systems and the behavior of the materials used.
2 Ability to establish the basis of calculation of prestressed structures and to evaluate the prestressing force considering both instantaneous and long-term losses.
3 Ability to assess the limit states of prestressed structures, and the criteria and distribution of passive and active reinforcement.

Fundamental knowledge for the project and calculation of prestressed concrete structures with the aim of satisfying safety, durability and serviceability requirements. Technological aspects associated with the construction of these type of structures. Project Bases of prestressed concrete structures. Structural analysis of the prestressed force. Calculation of the prestressed force and the prestressing layout. Calculation of instantaneous and long-term losses. Verification of Serviceability limit state of deformability. Verification of ultimate limit states. Reinforcement details. Anchorage Area.

Acquire fundamental knowledge for the design and calculation of prestressed concrete structures in order to meet the requirements of safety, durability and functionality; as well as knowing the technological aspects associated with their construction.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	22,5	20.00
Hours large group	22,5	20.00
Guided activities	4,5	4.00
Self study	63,0	56.00

Total learning time: 112.5 h

CONTENTS

Introduction

Description:
Introduction to prestressed concrete

Full-or-part-time: 7h 11m
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h 11m

Prestressing technology

Description:
Prestressing technology

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

Behavior of materials

Description:
Instant and delayed response of the concrete
Instantaneous and delayed response of reinforcing and prestressing steels
Calculation of deformations and stresses in concrete and steel

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

Bases for calculating prestressed concrete structures

Description:
Safety and durability. Limit state method.
Prestressing actions. Effects on isostatic and hyperstatic structures.
Example of structural analysis of the prestressed.

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

Evaluation of prestressing force

Description:
Instant prestressing losses
Elongation of active reinforcements and tensioning order.
Deferred prestressing losses.
Example of prestressing losses and active armature elongation

Full-or-part-time: 12h
Theory classes: 3h
Practical classes: 2h
Self study : 7h

Exam

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

Limit states

Description:
Criteria for Cracking Limit States
Sizing of the prestressing force
Example of sizing of the prestressing force
ELS of deformations
ELU Flexocompression
Example ELU Flexocompression
ELU Shear
ELU shear lag
Example ELU shear lag
Prestress anchorage
Example design anchorage area

Full-or-part-time: 42h
Theory classes: 10h 30m
Practical classes: 7h
Self study : 24h 30m

Criteria and arrangement of reinforcement

Description:
Aspects of constructive details and arrangement of reinforcements

Full-or-part-time: 2h 24m
Theory classes: 1h
Self study : 1h 24m

Applications of prestressed concrete

Description:
Prefabrication
Applications of prestressed concrete in bridge engineering, public works and construction

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

Exam

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

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

In the course of Prestressed Concrete, the continuous evaluation consists on the following activities:

a) 2 individual tests (E1 and E2) to be presented along the course. These tests will be conducted within class time.

b) Practical course work (T) consisting in the design of a prestressed concrete structure.

c) Participation in activities developed in class (P). These activities will be developed in class.

The final grade of the course, over 10 points, will be obtained as: $FG = 0.25 \cdot E1 + 0.35 \cdot E2 + 0.35 \cdot T + 0.05 \cdot P$

In order to pass the course a final grade greater than or equal to 5.0 is needed.

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.

BIBLIOGRAPHY

Basic:

- Comisión Permanente del Hormigón. EHE-08: instrucción de Hormigón Estructural: con comentarios de los miembros de la Comisión Permanente del Hormigón [on line]. Madrid: Ministerio de Fomento, Secretaría General Técnica, 2008 [Consultation: 27/01/2020]. Available on: http://www.ponderosa.es/docs/Norma-EHE-08.pdf. ISBN 9788449808999.
- Marí, A.R.; Molins, C.; Bairán, J.M.; Oller, E. Formigó armat i pretensat: exercicis curts de bases de càlcul i estats límit, adaptat a la instrucció EHE-08 [on line]. 2a ed. Barcelona: Edicions UPC, 2009 [Consultation: 25/02/2021]. Available on: http://hdl.handle.net/2099.3/36837. ISBN 9788498803907.
- Murcia, J.; Aguado, A.; Marí, A.R. Hormigón armado y pretensado. Barcelona: Edicions UPC, 1993. ISBN 847653356X.
- Marí, A.; Aguado, A.; Agulló, L.; Martínez, F.; Cobo, D. Hormigón armado y pretensado: ejercicios: adaptado a la instrucción EHE [on line]. Barcelona: Edicions UPC, 1999 [Consultation: 08/03/2021]. Available on: http://hdl.handle.net/2099.3/36182. ISBN 8483013029.