250245 - FORMPRET - Prestressed Concrete

**Coordinating unit:** 250 - ETSECCPB - Barcelona School of Civil Engineering  
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering  
**Academic year:** 2017  
**Degree:** BACHELOR'S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
**ECTS credits:** 4.5  
**Teaching languages:** Catalan, Spanish

### Teaching staff

**Coordinator:** EVA OLLER IBARS  
**Others:** ANTONIO AGUADO DE CEA, JESÚS MIGUEL BAIRÁN GARCÍA, ALBERTO DE LA FUENTE ANTEQUERA, ANTONIO RICARDO MARI BERNAT, EVA OLLER IBARS

### Opening hours

**Timetable:** Prof. Eva Oller: Wednesday from 12:00 to 14:00. Building C1, room 201. Fix appointment: eva.oller@upc.edu

### Degree competences to which the subject contributes

**Specific:**

- 3079. Knowledge of the different types and basis for calculating prefabricated items and its application to the manufacturing processes  
- 3080. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.

**Generic:**

- 3105. 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.  
- 3111. 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
250245 - FORMPRET - Prestressed Concrete

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:

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, divided into theoretical and practical lectures. Several practical activities are developed along the course, both in the classroom and as assignments. The students have to develop, in small groups, a course work consisting on the design of a prestressed concrete structure.

Learning objectives of the subject

Adquirir coneixements fonamentals per al projecte i càlcul d'estructures de formigó pretensat amb vista a satisfar els requeriments de seguretat, durabilitat i funcionalitat; així com conèixer els aspectes tecnològics associats a la construcció d'aquestes. Adquirir conocimientos fundamentales para el proyecto y cálculo de estructuras de hormigón pretensado de cara a satisfacer los requerimientos de seguridad, durabilidad y funcionalidad; así como conocer los aspectos tecnológicos asociados a la construcción de las mismas. Fundamentals knowledge needed for the of analysis and design of prestressed concrete structures in order to satisfy the requirements of safety, serviceability and durability. Knowledge of technological aspects related to the construction of this type of structures.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Theory classes: 27h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical classes: 9h</td>
<td>8.00%</td>
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<tr>
<td>Laboratory classes: 9h</td>
<td>8.00%</td>
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<tr>
<td>Guided activities: 4h 30m</td>
<td>4.00%</td>
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<tr>
<td>Self study: 63h</td>
<td>56.00%</td>
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</table>
# Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 1h</td>
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<tr>
<td></td>
<td>Self study: 4h 11m</td>
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**Description:**
- Introduction to prestressed concrete
- Behaviour of reinforced concrete and prestressed concrete structures

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 4h 48m</th>
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<tbody>
<tr>
<td><strong>Prestressed concrete technology</strong></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 2h 48m</td>
</tr>
</tbody>
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**Description:**
- Prestressing systems

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 9h 36m</th>
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<tbody>
<tr>
<td><strong>Material behaviour</strong></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 5h 36m</td>
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**Description:**
- Instantaneous and long term behaviour of concrete
- Instant and delayed behaviour of reinforcing and prestressing steels
- Calculation of strains and stresses in the concrete and steel

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<thead>
<tr>
<th>Topic</th>
<th>Learning time: 9h 36m</th>
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<tbody>
<tr>
<td><strong>Basis of analysis and design of prestressed concrete structures</strong></td>
<td>Theory classes: 3h</td>
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<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 5h 36m</td>
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</tbody>
</table>

**Description:**
- Structural safety and durability. The limit states method.
- Prestressing loads. Effects on isostatic and statically indeterminate structures.
- Example of structural analysis of prestressed structures
## Evaluation of the prestressing force

### Description:
- Instantaneous prestressed losses
- Elongation of the prestressing and order of prestressing
- Long-term prestressed losses.
- Example of prestressed losses and active reinforcement elongation

### Learning time: 12h
- Theory classes: 3h
- Practical classes: 2h
- Self study: 7h

## Exam

### Learning time: 12h
- Laboratory classes: 5h
- Self study: 7h

## Limit states

### Description:
- Service Limite State of Cracking
- Design of prestressing force
- Example: Design of prestressing force
- S.L.S. of deflections
- U.L.S. bending and axial forces
- Example U.L.S. Bending and axial forces
- U.L.S. Shear forces
- U.L.S. flange-web shear forces
- Example U.L.S. Shear forces and flange-web shear forces
- Prestressing anchorage
- Example of design anchorage zones

### Learning time: 42h
- Theory classes: 10h 30m
- Practical classes: 7h
- Self study: 24h 30m

## Detailing

### Description:
- Constructions and detailing aspects

### Learning time: 2h 24m
- Theory classes: 1h
- Self study: 1h 24m
Applications of prestressed concrete

<table>
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<th>Description:</th>
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<tr>
<td>Precasting</td>
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<tr>
<td>Applications of prestressed concrete in bridge engineering, public works and building</td>
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Learning time: 6h
- Theory classes: 2h 30m
- Self study: 3h 30m

Qualification system

The mark of the course is obtained from the ratings of continuous evaluation and their corresponding laboratories and/or classroom computers.

Continuous evaluation consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

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

a) 2 individual tests (E1 y 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) Activities developed in class (AC). These activities will be developed in class and some of them will be related to the practical course work.

The final grade of the course, over 10 points, is obtained as follows:

Nota final = 0.35*(0.4*E1+0.6*E2)+0.35*T+0.30*AC

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.

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
250245 - FORMPRET - Prestressed Concrete

Bibliography

Basic:


Complementary:


ACI Committe 318. Building code requirements for structural concrete (ACI 318-08) and commentary. Farmington Hills, Michigan: American Concrete Institute, 2007.


Naaman A. Prestressed concrete analysis and design. New York: McGraw Hill,