250473 - DISAVESTFO - Advanced Design of Concrete Structures

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2015
Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (RESEARCH TRACK) (Syllabus 2007). (Teaching unit Optional)
MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional)
MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional)
MASTER'S DEGREE IN CIVIL ENGINEERING (RESEARCH TRACK) (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits: 5

Teaching staff
Coordinator: JESÚS MIGUEL BAIRÁN GARCÍA
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. Jesús Bairán: Thursdays from 10.00h to 14.00h, or other hours by appointment. Office C1-201b
Other professors of the course: by appointment.

Degree competences to which the subject contributes
Specific:
8162. Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.
8228. Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

Teaching methodology
The course consists of 3 hours per week of classroom activity.

In the classroom activity, the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises 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.
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.

The course Advanced design of concrete structures intend to supplement a basic course of reinforced and prestressed concrete structures and provide a structural specialist level of knowledge. One of the objectives is to strengthen the capacity of students to design by introducing concepts related to project and construction systems. A particular emphasis is given to the struts and ties model as a general method of design, especially suitable for areas of discontinuity. This method is applied to the study of structural elements with geometric or mechanical discontinuity, such as corbels, deep beams.

In the structural analysis, some aspects are studied such as the effects of prestressing in statically indeterminate structures as well as long term behaviour, nonlinear behaviour, construction effects, and the design of structures partially prestressed, taking into account the service and ultimate limit states.

Limit states not studied in a basic course, such as shear-friction, punching or fatigue are taught. Finally, a chapter is dedicated to earthquake design of concrete structures, dealing with ductility, confinement, structure of buildings, structural calculations and arrangements of reinforcement to ensure the proper behaviour of the resisting mechanisms.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 19h 30m</th>
<th>15.60%</th>
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<tbody>
<tr>
<td></td>
<td>Practical classes:</td>
<td>9h 45m</td>
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<td></td>
<td>Laboratory classes:</td>
<td>9h 45m</td>
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<td></td>
<td>Guided activities:</td>
<td>6h</td>
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<td></td>
<td>Self study:</td>
<td>80h</td>
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# Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Basis of design and structural reliability</strong></td>
<td>7h 11m</td>
<td><strong>Description:</strong> Semi-probabilistic methods. Accidental actions. Bases of reliability of structures.</td>
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<tr>
<td><strong>Analysis of concrete structures</strong></td>
<td>19h 12m</td>
<td><strong>Description:</strong> Structural analysis of prestressed Structural analysis of prestressing. Exercise</td>
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<tr>
<td><strong>Nonlinear Analysis. Redistributions</strong></td>
<td></td>
<td>Nonlinear analysis. Redistributions. Exercise</td>
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<tr>
<td><strong>Limit states</strong></td>
<td>19h 12m</td>
<td><strong>Description:</strong> Ultimate limit state of instability Ultimate limit state instability. Exercise</td>
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<tr>
<td><strong>Partially prestressed</strong></td>
<td></td>
<td>Partially prestressed</td>
</tr>
<tr>
<td><strong>Partial prestressing</strong></td>
<td></td>
<td>Partial prestressing. Exercise</td>
</tr>
<tr>
<td><strong>Fatigue</strong></td>
<td></td>
<td></td>
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- **Theory classes:** 2h
- **Practical classes:** 1h
- **Self study:** 4h 11m

**Description:**
- Structural analysis of prestressed
- Structural analysis of prestressing. Exercise
- Nonlinear Analysis. Redistributions
- Nonlinear analysis. Redistributions. Exercise

- **Theory classes:** 4h
- **Practical classes:** 4h
- **Self study:** 11h 12m

- **Theory classes:** 6h
- **Practical classes:** 2h
- **Self study:** 11h 12m

- **Description:**
  - Ultimate limit state of instability
  - Ultimate limit state instability. Exercise
  - Partially prestressed
  - Partial prestressing. Exercise
  - Fatigue
### Method of struts and ties

**Learning time:** 12h  
- Theory classes: 2h  
- Practical classes: 1h  
- Laboratory classes: 2h  
- Self study: 7h

**Description:**  
- Struts and ties  
- Struts and ties. Exercise  
- Laboratory scale test

### Structural Elements

**Learning time:** 19h 12m  
- Theory classes: 7h  
- Practical classes: 1h  
- Self study: 11h 12m

**Description:**  
- Corbels and deep beams  
- Short corbels and beams of great depth. Exercise  
- Anchors in prestressed elements  
- Plates  
- Shells

### Seismic design

**Learning time:** 7h 11m  
- Theory classes: 2h  
- Practical classes: 1h  
- Self study: 4h 11m

**Description:**  
- Seismic design  
- Practice

### Course Work

**Learning time:** 9h 36m  
- Laboratory classes: 4h  
- Self study: 5h 36m

**Description:**  
- Partial homework 1  
- Partial Homework 2
The evaluation will be continued through a series of short practical works (P), one course work (T) and a final exam (E). Practical works (P) may be proposed to be carried out in the classroom or as homeworks. No more than 8 short works will be proposed. The mark P will consist on the average grade obtained in all proposed works. The course work (T) consists of a design to be developed along the course as a case study where a significant number of the course contents are applied. The final exam (E) will be held at the end of the course consisting on short conceptual problems, but require analysis and demonstrate ability to apply concepts. The final mark (F) of the course will be a weighted score according to the following formula:

$$F = 0.4 \text{P} + 0.3 \text{T} + 0.3 \text{E}$$

To pass the course, a final mark (F) equal to or greater than 5 and noted on the exam (E) greater than 3.5 are necessary.

### Bibliography

#### Basic: