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: 2019
Degree: 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 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 languages: Spanish, English

Coordinator: ANTONIO RICARDO MARI BERNAT
Others: JESÚS MIGUEL BAIRÁN GARCÍA, ANTONIO RICARDO MARI BERNAT, EVA OLLER IBARS

Opening hours
Timetable: Prof. Antonio Marí: Wednesday from 12.00h to 13.00h, or other hours by appointment. Office C1-201
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.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
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**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 on "Advanced design of concrete structures" intends to supplement a basic course of reinforced and prestressed concrete structures and provide a knowledge at the level of structural specialist. One of the objectives is to strengthen the projectual capacity of students by introducing concepts related to design and construction systems. Particular emphasis is made on the "Strut and tie" 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 or anchorage zones.

Related to structural analysis, some aspects studied are the effects of prestressing in statically indeterminate structures as well as long term and 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 punching, instability or fatigue are taught.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 19h 30m</th>
<th>15.60%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 9h 45m</td>
<td>7.80%</td>
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<tr>
<td></td>
<td>Laboratory classes: 9h 45m</td>
<td>7.80%</td>
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<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.80%</td>
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<tr>
<td></td>
<td>Self study: 80h</td>
<td>64.00%</td>
</tr>
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## Content

<table>
<thead>
<tr>
<th>Analysis of concrete structures</th>
<th>Learning time: 24h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 3h</td>
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<tr>
<td></td>
<td>Self study : 14h</td>
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</tbody>
</table>

**Description:**  
Secondary prestressing moments. Concordant tendon layout  
Structural analysis of prestressing. Exercise  
Time dependent effects of creep, shrinkages and construction process. Forces redistributions  
Time dependent analysis. Exercise  
Nonlinear Analysis. Redistributions  
Partially prestressed  
Partial prestressing. Exercise

<table>
<thead>
<tr>
<th>Method of struts and ties</th>
<th>Learning time: 7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study : 4h 11m</td>
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</tbody>
</table>

**Description:**  
Struts and ties  
Struts and ties. Exercise

<table>
<thead>
<tr>
<th>Limit States</th>
<th>Learning time: 28h 47m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 5h</td>
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<tr>
<td></td>
<td>Self study : 16h 47m</td>
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</tbody>
</table>

**Description:**  
ULS of Shear and Punching  
ULS shear and punching. Exercises  
Ultimate limit state of instability  
Ultimate limit state instability. Exercise  
Fatigue  
Exercise of fatigue strength verification  
Fatigue. Exercise
The evaluation will be continued through one or several course works or exercises (T) and a final exam (E).

The course works (T) will consist of the design or verification of a structure of limited entity, where the course concepts are applied. The final exam (E) will be held at the end of the course consisting on short conceptual questions and/or problems, that allow to demonstrate the ability to apply the structural concepts developed along the course.

The final mark (F) of the course will be a weighted score according to the following formula:

\[ F = 0.5 \, T + 0.5 \, E \]

To pass the course, a final mark (F) equal to or greater than 5 is necessary.

### Qualification system

#### Structural Elements

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Corbels and deep beams</td>
</tr>
<tr>
<td>Short corbels and beams of great depth. Exercise</td>
</tr>
<tr>
<td>Anchors in prestressed elements</td>
</tr>
<tr>
<td>Plates</td>
</tr>
<tr>
<td>Shells</td>
</tr>
</tbody>
</table>

**Learning time:** 24h
- Theory classes: 8h
- Practical classes: 2h
- Self study: 14h

#### Laboratory

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Virtual analysis Lab and Tests at the LTE</td>
</tr>
</tbody>
</table>

**Learning time:** 4h 48m
- Laboratory classes: 2h
- Self study: 2h 48m

#### Evaluation

<table>
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**Learning time:** 4h 48m
- Laboratory classes: 2h
- Self study: 2h 48m

### 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.
Bibliography

Basic:


