250727 - Performance Based Seismic Design and Assessment of 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 STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Teaching unit Optional)  
ECTS credits: 5  
Teaching languages: English

Teaching staff
Coordinator: JESÚS MIGUEL BAIRÁN GARCÍA  
Others: JESÚS MIGUEL BAIRÁN GARCÍA, CLIMENT MOLINS BORRELL, LUCA PELA, MAURO POLIOTTI

Opening hours
Timetable: Tuesdays and Thursdays from 15:30 to 17:00. Office: C1-201

Degree competences to which the subject contributes

Specific:
13364. To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.
13365. Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).
13366. To evaluate, maintain, repair and strengthen existing structures, including the historic and artistic heritage.
13369. To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

Generical:
13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.
13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.
13362. To define construction processes and methods of organization and management of projects and works.

Teaching methodology
The course consists of 3 hours lectures per week during one semester, where concepts are discussed together with problems, exercises and other supervised activities.
Along the course, the students will perform deliverable coursework or seminars. The students will require approximately 60 hours of personal work along the semester for personal study and development of deliverable work.
Classes may be complemented with laboratory practices (physical or virtual simulation of tests) and visits to the Structural Technology Laboratory of the UPC to assist to experimental testing, according to availability.
Support material will be available through ATENEA, as the guide of the course, the lectures programed schedule, content, evaluation, supervised activities material, bibliography and other support material.

Learning objectives of the subject
Projecte i disseny conceptual d'estructures en entorns d'alta sismicitat.
Habilitats per al projecte sísmic estructures d'edificació, ponts i altres estructures comunes en enginyeria civil, aplicant diferents classes de ductilitat i disseny per capacitat.
Capacitat per comprendre i aplicar diferents codis de disseny sísmic internacionals.
Aplicar procediments de disseny basat en prestacions, definir nivells prestacionals i verificar els seus compliment.
Aplicar procediments de disseny basats forces, desplaçaments i en control de dany.
Conèixer mètodes d'avaluació sísmica mitjançant anàlisi no lineal estàtic i dinàmic.
Nocions sobre l'ús de nous materials i dispositius anti-sísmics.

Projecto y diseño conceptual de estructuras en entornos de alta sismicidad.
Habilidades para el proyecto sísmico estructuras de edificación, puentes y otras estructuras comunes en ingeniería civil, aplicando diferentes clases de ductilidad y diseño por capacidad.
Capacidad para comprender y aplicar diferentes códigos de diseño sísmico internacionales.
Aplicar procedimientos de diseño basado en prestaciones, definir niveles prestacionales y verificar su cumplimiento.
Aplicar procedimientos de diseño basados fuerzas, desplazamientos y en control de daño.
Conocer métodos de evaluación sísmica mediante análisis no lineal estático y dinámico.
Nociones sobre el uso de nuevos materiales y dispositivos anti-sísmicos.

Study load

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Learning time</th>
<th>Theory classes</th>
<th>Practical classes</th>
<th>Self study</th>
</tr>
</thead>
</table>
## Seismic design of buildings

### Learning time:
- Theory classes: 3h
- Practical classes: 1h
- Self study : 5h 36m

### Description:

## Seismic design of concrete structures

### Learning time:
- Theory classes: 3h
- Practical classes: 1h
- Laboratory classes: 1h
- Self study : 7h

### Description:

## Seismic design of steel structures

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

### Description:
Sections features and elements. Design systems porches. Ductile connections. Concentric and eccentric systems frameworks. Training

## Facilities and non-structural elements

### Learning time:
- Theory classes: 1h
- Self study : 1h 24m

### Description:
## Foundations and retaining walls

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

**Description:**  
Training

## Seismic design of bridges

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

**Description:**  

## Retrofitting techniques

**Learning time:** 2h 24m  
Theory classes: 1h  
Self study: 1h 24m

**Description:**  
Strengthening methods. Improved strength, stiffness or ductility. Concrete enlargement. Use of metal and FRP laminated plates. Failure modes. Foundations strengthening. Examples

## Tests

**Learning time:** 4h 48m  
Laboratory classes: 2h  
Self study: 2h 48m
The course will be assessed continuously by performing work deliverables and seminars (approximately 2 papers and 2 seminars will be held) and a written test at the end of the course.

The course grade will be computed as follows:
60% Exercises and coursework.
40% Exam

The minimum mark to pass is 5 over 10.

**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:**


**Complementary:**


