310403 - Building Structures

Coordinating unit: 310 - EPSEB - Barcelona School of Building Construction
Teaching unit: 753 - TA - Department of Architectural Technology
Academic year: 2018
Degree: MASTER’S DEGREE IN ADVANCED BUILDING CONSTRUCTION (Syllabus 2014). (Teaching unit Compulsory)
ECTS credits: 5

Teaching staff
Coordinator: Lorente Monleón, Sandokán
Others: Lorente Monleón, Sandokán
Yubero Cambra, Eduardo

Opening hours
Timetable: Sandokán Lorente Monleón: Fridays from 11 to 12 and from 14:30 to 15:30
Eduardo Yubero Cambra: Fridays from 18:30 to 19:30.

Prior skills
The student must have basic knowledges in the calculation of structures; mainly, the student must be able to:
- Obtain the stresses in any section of a structure, isostatic or hyperstatic.
- Formulate the stresses laws of a rod and draw the corresponding diagrams.
- Measure and test reinforced concrete elements.
- Measure and test structural steel elements.
- Know the soils classification.

Degree competences to which the subject contributes

Basic:
2. Possess and understand knowledge which provide a basis or opportunity to be original in the development and/or application of ideas, usually in a context of research.
3. The students must be able to apply the acquired knowledges and their ability of resolution of problems in new or little known environments inside more wide environments (or multidisciplinary) related with their study field.
4. The students must be able to integrate knowledges and front to the complexity to formulate opinions from an information which, being incomplete or limited, includes reflections about the social and ethical responsabilities linked to the application of their knowledges and opinions.
5. The students must be able to communicate their conclusions and the knowledges and ultimate reasons which support to specialised and non-specialised audiences in a clear mode and without ambiguities.
1. The students must possess the learning abilities which allow them to continue studying in a way which should be to a large extent self-directed and autonomous.

Specific:
6. Describe phenomenons of exchange of heat, thermic perception, quality of the interior air, ventilation, illumination conditions and propagation and control of noise.
7. Design climatization objects, lifts, security systems and surveillance, domotic installations and network of communication and information.

Generical:
8. Prepare to communicate with efficiency, orally but also in written.
At the end of the course, the student should be able to:
- Propose and define an active reinforcement with post-tensioned steel.
- Verify compliance with ultimate limit states and service of a wooden structure.
- Verify compliance with ultimate limit states and service of a masonry wall structures.
- To analyse the behaviour of the foundation soil of a building structure.
- To analyse the behaviour of a building structure under earthquake action.

Transversal:
9. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
10. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Teaching methodology
Master class: Exposition of knowledges by the faculty.
Exposition participative class: Organised from the exposition of the faculty and the involvement of the students around questions or topics suggested by the faculty.
Tutorials and questions: Supervision of the student work.
Guidance of works and autonomous practices: resolution of exercises at class; exposition at class of an activity fulfilled at class individually or in small groups.
Evaluation tests: Fulfilment of written activities of evaluation, individually and in-person.

Learning objectives of the subject
At the end of the course, the student should be able to:
- Propose and define an active reinforcement with post-tensioned steel.
- Verify compliance with ultimate limit states and service of a wooden structure.
- Verify compliance with ultimate limit states and service of a masonry wall structures.
- To analyse the behaviour of the foundation soil of a building structure.
- To analyse the behaviour of a building structure under earthquake action.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 17h 30m</th>
<th>14.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 5h</td>
<td>4.00%</td>
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<tr>
<td></td>
<td>Hours small group: 5h</td>
<td>4.00%</td>
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<tr>
<td></td>
<td>Guided activities: 7h 30m</td>
<td>6.00%</td>
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<tr>
<td></td>
<td>Self study: 90h</td>
<td>72.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 26h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 2h</td>
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<td>Self study: 18h</td>
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</tbody>
</table>

### C1 POST-TENSIONED STRUCTURES

**Description:**
In this content the students work:
- Concept of pre-tensioning, types, structural effects, application.
- Pre-tensioning with post-tensioning reinforcement: components, design of the active steel frame, pre-measuring of the tensioning stress, loss of the tensioning stresses, lengthening of the active steel frame.

**Related activities:**
There will be done the activities 1 and 4 which correspond to the oral exposition of a work done in group and the final evaluation test.

**Specific objectives:**
Propose and pre-measure an active reinforcement with post-tensioning steel framework.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 24h 45m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 0h 45m</td>
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<td></td>
<td>Self study: 18h</td>
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### C2 WOOD STRUCTURES

**Description:**
In this content the students work:
- Resistant features of the wood: Resistance class, characteristic values and calculation values.
- Verification of sections, stability and deformations,
- Verification of fire situations.
- Structural typologies and connections.

**Related activities:**
There will be done the activities 2 and 4 which correspond to a continuous evaluation test and the final evaluation test.

**Specific objectives:**
Verify the compliance of the Ultimate and Serviceability Limit States of a wooden structure.
C3 MASONRY STRUCTURES

Description:
In this content the students work:
- Resistant features of the masonry structures.
- Structures of brick masonry walls: Resistant diagram, methods of analysis and determination of stresses, verification of their carrying capacity.

Related activities:
There will be done the activities 2 and 4 which correspond to a continuous evaluation test and the final evaluation test.

Specific objectives:
Verify the compliance of the Ultimate and Serviceability Limit States of a structure of brick masonry walls.

C4 SOIL MECHANICS

Description:
In this content the students work:
- Influence of the water in the soils.
- Compressibility and theory of the consolidation.
- Calculation of the settlements.
- Lateral pressure of the terrain.

Related activities:
There will be done the activities 3 and 4 which correspond to the resolution of a practical exercise and the final evaluation test.

Specific objectives:
Analyze the behaviour of the foundation terrain of a construction structure.
C5 SEISMIC BEHAVIOUR OF STRUCTURES

**Learning time:** 24h
- Theory classes: 4h
- Practical classes: 2h
- Self study: 18h

**Description:**
In this content the students work:
- Basic concepts of structural dynamics: dynamic action; structures and structural models; dynamic modelling.
- Spectrum analysis: Vibration modes, answer spectrum, maximum acceleration and shift, equivalent static forces, effective modal mass, base shear strength, maximum total answer.

**Related activities:**
There will be done the activity 4 which corresponds to the final evaluation test.

**Specific objectives:**
Analyze the behaviour of a construction structure suppressed to seismic efforts.
### Planning of activities

<table>
<thead>
<tr>
<th>A1 GROUP WORK</th>
<th>Hours: 21h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Practical classes: 1h</td>
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<tr>
<td></td>
<td>Guided activities: 2h</td>
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<td></td>
<td>Self study: 18h</td>
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**Description:**
The work consist in solving a practical exercise related with the content 1. This work is done in small groups, of 3 students, out of class (autonomous work). There will be scheduled one day, out of the schedule of the subject, to expose orally the work done, the results and the conclusions of each group.

**Support materials:**
- Wording of the work.
- Summary of the topic, available in Atenea.
- Basic bibliography corresponding to the content 1.

**Descriptions of the assignments due and their relation to the assessment:**
- 1 printed copy of the work in paper, for each group.
- Oral exposition of the work, the results and the conclusions. Maximum time 12 minutes. All the members of the group must participate in the oral exposition. This activity marks over 10 points (5 points for the printed work and 5 points for the oral exposition) and has a weight of 20% in the final mark of the course.

**Specific objectives:**
- At the end of the activity the student should be able to:
  - Propose and pre-measure an active reinforcement with post-tensioning steel framework.

<table>
<thead>
<tr>
<th>A2 EXAM</th>
<th>Hours: 30h 30m</th>
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<tr>
<td></td>
<td>Guided activities: 1h 30m</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 27h</td>
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**Description:**
Individual and in-person test. Consists in a theoretical-practical exercise which collect the learning objectives of the contents 2 and 3. Maximum time available: 90 minutes.

**Support materials:**
- Wording of the test.
- Summary of the contents 2 and 3, available in Atenea.
- Basic bibliography corresponding to the contents 2 and 3.

**Descriptions of the assignments due and their relation to the assessment:**
- Resolution of the test in writing. This activity is marked over 10 points and has a weight of 20% of the final mark of the course.

**Specific objectives:**
- At the end of the activity the student must be able to:
  - Verify the compliance of the Ultimate and Serviceability Limit States of a wooden structure.
  - Verify the compliance of the Ultimate and Serviceability Limit States of a brick masonry wall structure.
### A3 PRACTICAL EXERCISE

**Description:**
Resolution of a practical exercise which collects the learning objectives of the content 4. Individual and in-person fulfilment out of the schedule (directed activities schedule). Maximum time available: 90 minutes.

**Support materials:**
- Wording of the exercise.
- Summary of the content 4, available in Atenea.
- Basic bibliography corresponding to the content 4.

**Descriptions of the assignments due and their relation to the assessment:**
Solved exercise. This activity is marked over 10 points and has a worth of 20% of the final mark of the course.

**Specific objectives:**
- At the end of the activity the students should be able to:
  - Analyze the behaviour of the foundation terrain of a construction structure.

### A4 FINAL EXAM

**Hours:** 29h  
- Practical classes: 2h  
- Self study: 27h

**Description:**
Individual and in-person test. Theoretical-practical exercise which collects the learning objectives of all the contents of the subject, with different parts. Includes aspects of practical application, as well as aspects related with the comprehension of theoretical concepts. Maximum time available: 120 minutes.

**Support materials:**
- Wording of the test.
- Notes, bibliography and crib sheet which the student brings.

**Descriptions of the assignments due and their relation to the assessment:**
Resolution of the test, in writing. This activity is marked over 10 points and has a weight of 40% in the final mark of the course.

**Specific objectives:**
- At the end of the activity the student should be able to:
  - Propose and pre-dimensionate an active reinforcement with post-tensioning steel framework.
  - Verify the compliance of the Ultimate and Serviceability Limit States of a wooden structure.
  - Verify the compliance of the Ultimate and Serviceability Limit States of a brick masonry wall structure.
  - Analyze the behaviour of the foundation terrain of a construction structure.
  - Analyze the behaviour of a construction structure in front of seismic efforts.
The final mark is the arithmetic mean of the partial marks, according to this expression:

\[ N_{\text{final}} = 0.2 \ A_1 + 0.2 \ A_2 + 0.2 \ A_3 + 0.4 \ A_4 \]

The scheduled dates for the fulfilment of each activity are:
- A2 (Evaluation test, individually and in-person): week 11.
- A3 (Practical exercise, individually and in-person): week 7.
- A4 (Final Evaluation Test, individually and in-person): January 19th of 2015 (according to the schedule established by the EPSEB).

The student who does not do the Final Exam will be marked as NP (Non Presented).

**Regulations for carrying out activities**

If some of the evaluation activities is not done, it will be considered as non-marked.
Bibliography

Basic:


Complementary:

Rodríguez Ortiz, José María ; Serra Gesta, Jesús ; Oteo Mazo, Carlos. Curso aplicado de cimentaciones. 7a ed. Madrid: Colegio Oficial de Arquitectos de Madrid, 1996. ISBN 8485572378.