Course guide
310715 - 310715 - Steel and Concrete Structures

Unit in charge: Barcelona School of Building Construction
Teaching unit: 753 - TA - Department of Architectural Technology.
Degree: BACHELOR’S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019). (Compulsory subject).
Academic year: 2022 ECTS Credits: 4.5 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: Sanabra, Marc
Others: Sanabra, Marc Palmero, Maria Fabiana

PRIOR SKILLS

The students must be capable of:
Identify the type of load that is present in a section of a bar and calculate his value, according to the loads and links of the bar.
Formulate the laws of tension and deformations in a section, according to the load that is present.
Calculate resistant capacity to compression, traction, flexion, cutting and torsion of a section, under the hypothesis of an elastic and linear performance of the material.
Calculate the maximum deflection of a bar subjected to bending.
Describe the differences between the resistant plastic moment and the resistant elastic moment of a section.

REQUIREMENTS

It is recommended to have passed the subjects of Mechanics and Structures I

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. FE-15 Aptitude for the pre-measuring, design, calculation and verification of structures and manage its materials execution.

Transversal:
2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
TEACHING METHODOLOGY

The guided learning consists in:
- Lectures - allowing the participation of students (large group):
The instructor explains the theoretical contents. The instructor uses solved exercises to clarify theoretical concepts.
Teaching material is made available to students through ATENEA.
- Workshop (mid-size group):
Students, in pairs or individually, solve during each session an exercise posed by the instructor, and the exercise is graded during the same session.
- Laboratory (large group):
The students, guided by the instructor, attend to a session where tests are performed on real specimens in laboratory. Students compare the results of tests with the results that they reached analytically.
- Guided activities (assignments):
Students solve exercises and prepare a report related to the tests they watched in the laboratory. The document is turned in through Atenea, to be graded.

Students attend to a technical lecture conducted by a structures consultant or read a scientific or technical paper on a specialized journal. They write a report synthesizing the content of the lecture (or paper). In their report, they also suggest a research subject related to the contents of the lecture (or the paper); including bibliographic references to start the mentioned study.

The time of learning outside of class consists in:
- Reading of the bibliography.
- Study of the theoretical concepts.
- Resolution of the exercises that complement the study of theoretical concepts.
- Resolution of the exercises proposed in the workshop.
- Doing assignments.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, students should be able to:
- Differentiate between a 1st and a 2nd order analyses.
- Check the strength of cross-sections of hot rolled steel versus the most common forces in building structures.
- Check the strength of members of hot rolled steel under the most common forces in building structures.
- Check the strength of cross-sections of reinforced concrete and prestressed concrete versus the most common forces in building structures.
- Check the strength of members of reinforced concrete under the most common forces in building structures.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,8</td>
<td>14.03</td>
</tr>
<tr>
<td>Self study</td>
<td>67,5</td>
<td>59.95</td>
</tr>
<tr>
<td>Hours large group</td>
<td>22,5</td>
<td>19.98</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>6,8</td>
<td>6.04</td>
</tr>
</tbody>
</table>

Total learning time: 112.6 h
C1 STEEL STRUCTURES: STRENGTH OF CROSS-SECTIONS

Description:
1.1. Plastic analysis of steel cross-sections
1.2. Classes of cross-section (after CTE)
1.3. Section modulus and neutral axis in elastic and in plastic regime
1.4. Types of steel and partial coefficients of security for material (after CTE)
1.5. Strength of cross-section under axial force (N), under axial force and one moment (N, M), and under axial force and biaxial moments (N, Mx, My)
1.6. Introduction to buckling
1.7. Strength of cross-section under shear force (V) and under the interaction of shear force and bending moment (M, v) [This lesson is taught at the end of steel lessons, after the lessons on strength of members]

Related activities:
Graded exercises, done during the workshop sessions. (Pa)
Exam on steel. (Na)

Related competencies:
FE-15. FE-15 Aptitude for the pre-measuring, design, calculation and verification of structures and manage its materials execution.
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Full-or-part-time: 30h
Theory classes: 7h 30m
Practical classes: 3h 45m
Guided activities: 0h 45m
Self study: 18h
C2 STEEL STRUCTURES: STRENGTH OF MEMBERS

**Description:**
2.1. Strength of members under compression (N)
2.2. Strength of members under fleure (M)
2.3. Strength of members under compression and uni-axial moment (N, M) and under compression and bi-axial moment (N, Mx, My)
2.4. Buckling length of a steel column

**Related activities:**
Graded exercises, done during the workshop sessions. (Pa)
Assignment 1. (Ad1)
Exam on steel. (Na)

**Related competencies:**
FE-15. FE-15 Aptitude for the pre-measuring, design, calculation and verification of structures and manage its materials execution.
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

**Full-or-part-time:** 22h 30m
Theory classes: 5h 30m
Practical classes: 2h 45m
Guided activities: 0h 45m
Self study: 13h 30m
C3 REINFORCED AND PRESTRESSED CONCRETE: ANALYSIS FUNDAMENTALS. ANALYSIS OF SECTIONS AND LINEAR ELEMENTS UNDER NORMAL STRESSES

Description:
3.1. Name and description of the material features.
3.2. Stress-strain diagrams for reinforceent steel.
3.3. Stress-strain diagrams of the reinforced concrete.
3.4. Factored strength of the materials; partial security factors for materials.
3.5. Basic hypothesis; Deformation domains.
3.6. Dimensioning and strength check of reinforced and prestressed concrete cross-sections under pure bending (M).
3.7. Dimensioning and strength check of reinforced concrete cross-sections under pure compression (N), and under compression and uni-axial (N, M) and compression bi-axial bending moments (N, Mx, My).

Related activities:
Graded exercises, done during the workshop sessions. (Pa)
Assignment 2. (Ad2)
Exam on concrete. (Na)

Related competencies:
FE-15. FE-15 Aptitude for the pre-measuring, design, calculation and verification of structures and manage its materials execution.
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Full-or-part-time: 45h
Theory classes: 11h
Practical classes: 5h 30m
Guided activities: 1h 30m
Self study : 27h

C4 REINFORCED CONCRETE: SECTIONS AND LINEAR ELEMENTS UNDER SHEAR STRESSES

Description:
4.1. Forces and stresses in a reinforced concrete linear element under a shear force.
4.2. Check of a member under a shear force.
4.3. Check of a member under a torque force.
4.4. General criteria for reinforcement design; Minimum steel amounts.

Related activities:
Graded exercises, done during the workshop sessions. (Pa)
Exam on concrete. (Na)

Related competencies:
FE-15. FE-15 Aptitude for the pre-measuring, design, calculation and verification of structures and manage its materials execution.
07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Full-or-part-time: 15h
Theory classes: 4h
Practical classes: 2h
Self study : 9h
GRADING SYSTEM

The final grade is the geometric mean of the grades of each of the two parts of the course; having each of the part of the course the same weight in the geometric mean:

\[
N_{\text{final}} = \left[ (0.70 \, Na + 0.20 \, Pa + 0.1 \, Nad1) \times (0.70 \, Nf + 0.20 \, Pf + 0.1 \, Nad2) \right]^{0.5}
\]

- \(N_{\text{final}}\) : final grade.
- \(Na\) : grade of the exam on Steel
- \(Pa\) : average grade of the grades of the workshop exercises on Steel
- \(Nf\) : grade of the exam on Concrete
- \(Pf\) : average grade of the grades of the workshop exercises on Concrete
- \(Nad1\) : grade of assignment 1
- \(Nad2\) : grade of assignment 2

EXAMINATION RULES.

If some activity of continued evaluation is not done, it will be considered as non graded.

The exam on Steel (\(Na\)) and the exam on Concrete (\(Nf\)) will be held during the weeks scheduled in the Semester for the partial exams (Steel) and for final exams (Concrete). (The exam on Concrete may include some exercise on Steel, specially if those contents on steel were taught after the exam on Steel).

To examson Steel (\(Na\)) and on Concrete (\(Nf\)), besides to the writting tools, students may only bring: a non-programmable calculator, one sole manuscript sheet with formulas, and those tables and abacus specifically authorized by the instructor.

The average grades of the workshop exercises (\(Pa; Pf\)) will be, for each of the subjects (Steel and Concrete, separately), the average of the best grades, excluding the 2 worse grades (or non-excused absences). In case of more than 3 non-excused absences, the grade of the subject (\(Pa \text{ or } Pf\)) will be nil.

Copying is graded very negatively in any kind of exam or exercise. It may mean a nil grade in the exercise including copy, or a nil grade in the whole exam.

This course offers re-evaluation exams (second-chance exams) for the students that have failed the course.

BIBLIOGRAPHY

Basic:

Complementary: