

Course guide

310715 - 310715 - Steel and Concrete Structures

Last modified: 06/02/2024

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: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: EDUARDO GALEOTE MORENO

Others: EDUARDO GALEOTE MORENO
JOSÉ VILANOVA GABARRÓ

PRIOR SKILLS

The students must be capable of:

Identify the type of load at a section of a bar and calculate its 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, shear and torsion of a section, under the hypothesis of an elastic and lineal 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 hours of guided learning consist in:

- Lectures - allowing the participation of students (large group):

The teacher 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 an exercise posed by the instructor during each session, which is graded during the same session.

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

Type	Hours	Percentage
Self study	67,5	59.95
Hours small group	15,8	14.03
Hours medium group	6,8	6.04
Hours large group	22,5	19.98

Total learning time: 112.6 h

CONTENTS

C1 STEEL STRUCTURES: STRENGTH OF CROSS-SECTIONS

Description:

- 1.1. Plastic analysis of steel cross-sections
- 1.2. Classes of cross-section (in accordance with CE)
- 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 (in accordance with CE)
- 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, M_x, M_y)
- 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]

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.

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.

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.

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 flexure (M)
- 2.3. Strength of members under compression and uni-axial moment (N, M) and under compression and bi-axial moment (N, M_x, M_y)
- 2.4. Buckling length of a steel column

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.

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.

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.

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 characteristics of the material.
- 3.2. Stress-strain diagrams for reinforcing steel.
- 3.3. Stress-strain diagrams of 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, M_x , M_y).
- 3.8. Strength of members under axial force and bi-axial bending moments: buckling of columns.

Related activities:

Graded exercises, done during the workshop sessions. (Pf)

Exam on concrete. (Nf)

Related competencies :

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

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.

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.

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. (Pf)

Exam on concrete. (Nf)

Related competencies :

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

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.

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.

Full-or-part-time: 15h

Theory classes: 4h

Practical classes: 2h

Self study : 9h

GRADING SYSTEM

The final grade takes into consideration the grades of each of the two parts of the course; having each part of the course the same weight:

$$N_{\text{final}} = (0,40 N_a + 0,10 P_a) + (0,40 N_f + 0,10 P_f)$$

N_{final} : final grade.

N_a : grade of the exam on Steel

P_a : average grade of the grades of the workshop exercises on Steel

N_f : grade of the exam on Concrete

P_f : average grade of the grades of the workshop exercises on Concrete

EXAMINATION RULES.

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

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

For exams on Steel (N_a) and Concrete (N_f), besides the writing 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.

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:

- Montfort Lleonat, J. Estructuras metálicas para edificación: adaptado al CTE. Valencia: Universidad Politécnica de Valencia, 2006. ISBN 84-8363-021-4.
- Marco García, Jaime. Fundamentos para el cálculo y diseño de estructuras metálicas de acero laminado : comportamientos del material y esfuerzos básicos, aplicados al Eurocódigo 3, Normas AISC, normativa española (EA95). Madrid: McGraw-Hill, 1998.
- Espanya. Código Técnico de la Edificación (CTE) (DB-SE; DB-SE-A). 2a ed. Madrid: Ministerio de Vivienda, 2008.
- Espanya. Ministerio de Fomento. EHE-08 : instrucción de Hormigón Estructural : con comentarios de los miembros de la Comisión Permanente del Hormigón. 2a ed. Madrid: Ministerio de Fomento, 2009.
- Jiménez Montoya, P. ; García Meseguer, A. ; Morán Cabré, F. Hormigón armado. 15a ed. Barcelona: Gustavo Gili, 2009. ISBN 978-84-252-2307-5.
- Calavera Ruíz, J. Proyecto y cálculo de estructuras de hormigón : en masa, armado y pretensado : [de acuerdo con la nueva instrucción EHE-08 : de acuerdo con el EUROCÓDIGO EC-2]. 2a ed. Madrid: Intemac, 2008.
- Calavera Ruiz, J. ; García Dutari, L. ; Rodríguez Escribano. Cálculo de flechas en estructuras de hormigón armado : forjados, losas, vigas de canto, vigas planas, forjados sin vigas. 2a ed. Madrid: Intemac, 2009.

Complementary:

- Alonso Durá, A. ... [et al.]. Introduccion a las estructuras de edificacion. Vols I y II. Valencia: Universidad Politécnica de Valencia, 2007.
- Ballio, G. ; Mazzolani, F.M. Theory and design of steel structures. Chapman-Hall, 1983.
- Marco García, J. Curso básico de cálculo y diseño de estructuras metálicas en ordenador : adaptado al Eurocódigo 3 y al LRFD (AISC). Madrid: McGraw-Hill, 2000.
- Rodríguez-Borlado, R. ; Martínez Lasheras, C. ; Martínez Lasheras. Prontuario de estructuras metálicas. 6a ed. Madrid: Ministerio de Fomento, 2002.