



Course guide

320054 - ECI - Structures and Industrial Construction

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 9.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Ernest Bernat Masó

Others:

PRIOR SKILLS

Knowledge about Strength of materials and elasticity

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. MEC: Knowledge and capability for design and calculation of structures and industrial buildings.

TEACHING METHODOLOGY

The subject is organized in the following way:

- Theory sessions, where theoretical concepts will be developed. They will be carried out in class using expositive method. Blackboard and digital presentations will be also used.
- Practical sessions, where theoretical concepts will be applied in order to solve practical examples. They will be carried out in reduced groups in comparison with theory sessions.
- Activities, where different aspects are dealt. They are done individually or in group and at classroom or at home.

LEARNING OBJECTIVES OF THE SUBJECT

The subject has two parts that are combined along the course:

First part: calculation of structures :

- Representing structures by using the common symbols and identifying the boundary conditions and load configurations
- Typing the analytical formulation of the internal efforts distribution (axial, shear and bending) along the structure
- Calculating the movements (displacements and rotations) at any point of a framework using the energetic theorems (Castigliano) and the formulation by Navier-Bresse
- Calculating the reactions at the supports of externally hyperstatic frameworks using the force method and the displacement method
- Calculating structures using direct stiffness method.

Second part: industrial construction:

- Listing and describing the different steps in the construction process of an industrial building and the job positions that an engineer can develop in this process.
- Designing the structure of an industrial building. Identifying and describing the most common typologies of framed structures and their component elements.
- Sizing and/or checking the stress level of the structural elements of an industrial building (steel structures) accordingly with the current standard. Using the plasticity hypothesis and taking into account the instability processes.
- Analysing and interpreting the documentation which is commonly used for sizing the structural elements (codes, catalogues,')

STUDY LOAD

Type	Hours	Percentage
Hours medium group	30,0	13.33
Hours large group	60,0	26.67
Self study	135,0	60.00

Total learning time: 225 h

CONTENTS

Module 01: Previous knowledge

Description:

- Review of elasticity and strength of materials.
- Review of geometric characteristics of flat sections.
- Review of calculation of tensions in flat sections.
- Review of calculation of laws of efforts and movements.

Full-or-part-time: 9h

Theory classes: 1h

Practical classes: 3h

Self study : 5h

Module 02: Design and execution of an industrial building

Description:

- Steps of the industrial buildings constructive process.
- Engineers in construction
- Standards and construction codes

Full-or-part-time: 7h

Theory classes: 2h

Self study : 5h



Module 03: Urban planning

Description:

- a) Territory organisation
- b) Urban codes

Full-or-part-time: 8h

Theory classes: 2h

Practical classes: 1h

Self study : 5h

Module 04: Typology of an industrial building.

Description:

- a) Vocabulary and terminology.
- b) Structural functions.
- c) Typologies of frames.
- d) Metal profile.

Full-or-part-time: 7h

Theory classes: 2h

Self study : 5h

Module 05: Introduction to metallic structures.

Description:

- a) Metal structures: advantages and disadvantages
- b) Phases of construction.
- c) The material: steel.

Full-or-part-time: 12h

Theory classes: 4h

Self study : 8h

Module 06: Projection and calculation of steel structures.

Description:

- a) General.
- b) Project bases: execution classes
- c) Limit State Design
- d) Loads

Related activities:

Full-or-part-time: 19h

Theory classes: 4h

Practical classes: 3h

Self study : 12h

Module 07: Deformation calculations

Description:

- a) Navier formulation
- b) Theorems of Castigliano.

Full-or-part-time: 25h

Theory classes: 7h

Practical classes: 6h

Self study : 12h

Module 08: Hyperstatic restrains reaction calculation

Description:

- a) Basis of methodologies.
- b) Calculation of one-dimensional hyperstatic structures using the compatibility method.
- d) Calculation of two-dimensional hyperstatic structures using the compatibility method
- c) Calculation of one-dimensional hyperstatic structures using the equilibrium method.
- e) Calculation of two-dimensional hyperstatic structures using the equilibrium method.

Related activities:

Full-or-part-time: 26h

Theory classes: 10h

Practical classes: 4h

Self study : 12h

Module 09: Serviceability Limit State (SLS)

Description:

- a) Bases.
- b) Vertical deformation.
- c) Horizontal deformations.

Full-or-part-time: 7h

Practical classes: 2h

Self study : 5h

Module 10: Ultimate Limit State (ULS).

Description:

- a) Concept of plastic hinge.
- b) Buckling and dent.
- c) Classification of sections
- d) Strength of sections.

Full-or-part-time: 35h

Theory classes: 10h

Practical classes: 4h

Self study : 21h

Module 11: Instability of prismatic pieces.

Description:

- a) Concept of buckling length.
- b) Real parts.
- c) Normative treatment.
- d) Methodology.

Full-or-part-time: 14h

Theory classes: 4h

Self study : 10h

Module 12: Structural design and checking

Description:

- a) Integrating ELS and ELU cheking
- b) Comparing elastic and palstic design
- c) Influence of buckling in design

Full-or-part-time: 21h

Theory classes: 2h

Practical classes: 3h

Self study : 16h

Module 13: Direct stiffness method

Description:

- a) Stiffness matrix
- b) Connectivity
- c) Global boundary conditions
- d) Local boudary conditions
- e) Other boudary conditions (elastic, thermal)
- f) Internal hinges

Full-or-part-time: 30h

Theory classes: 10h

Practical classes: 4h

Self study : 16h

Module 14: Precast concrete structures

Description:

- a) Description of precast concrete structrues
- b) Precasting systems
- c) Assessment of precast system

Full-or-part-time: 5h

Theory classes: 2h

Self study : 3h

GRADING SYSTEM

Students' knowledge acquisition is assessed as follows:

- First examination (N.E.1): 25%
- Second examination (N.E.2): 35%
- Resolution of Problems at classroom (N.P.): 20%
- Home activities (N.A.C.): 20%

- Final qualification (N.F.):

$$N.F. = 0,25*N.E.1 + 0,35*N.E.2 + 0,20*N.P. + 0,20*N.A.C.$$

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

EXAMINATION RULES.

- Depending on the case, lecturer-directed activities will be carried out in a group or individually.
- Lecturer-directed activities developed in class should be carried out in the specified time.
- Lecturer-directed activities developed outside class should be delivered at time specified in the wording.

BIBLIOGRAPHY

Basic:

- Arnedo Pena, A. Naves industriales con acero. Madrid: Asociación para la Promoción Técnica del Acero, 2009. ISBN 9788469222744.
- Cervera Ruiz, M.; Blanco Díaz, E. Fundamentos de resistencia de materiales y cálculo de estructuras. 2ª ed. Barcelona: Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos. Universidad Politécnica de Catalunya, 1995. ISBN 8460092313.
- Cervera Ruiz, M.; Blanco Díaz, E. Mecánica de estructuras [on line]. 2ª ed. Barcelona: Edicions UPC, 2002 [Consultation: 12/05/2020]. Available on: <http://hdl.handle.net/2099.3/36196>. ISBN 848301517X.
- Quintero Moreno, F.; Cudós Samblancat, V. Estructuras metálicas. Vol. 1, La pieza aislada: flexión, torsión. 2ª ed. Madrid: la Escuela, 1991.
- Quintero Moreno, F.; Cudós Samblancat, V. Estructuras metálicas. Vol. 2, La pieza aislada: inestabilidad. 2ª ed. Madrid: la Escuela, 1991. ISBN 8486957095.

Complementary:

- Argüelles López, R. [et al.]. Estructuras de acero. Vol. 1, Cálculo, norma básica y eurocódigo. Madrid: Bellisco, 1999. ISBN 8493000280.
- Argüelles Álvarez, R. La estructura metálica hoy. 2ª ed. Madrid: Bellisco, 1975-1993. ISBN 8460056724.
- Miquel Canet, Juan. Cálculo de estructuras [on line]. Barcelona: Edicions UPC, 2000 [Consultation: 12/05/2020]. Available on: <http://hdl.handle.net/2099.3/36158>. ISBN 8483013983.
- Quintero Moreno, F.; Cudós Samblancat, V. Estructuras metálicas: uniones. Madrid: la Escuela, 1988. ISBN 8486957648.
- Manual para el cálculo de estructuras metálicas: prontuario ENSIDESA. 7ª ed. Madrid: ENSIDESA, 1990. ISBN 8487405053.

RESOURCES

Other resources:

Profile Celsa is a program that provides access and management of a chart of hot rolled steel profiles supplied by CELSA-Compañía Española de Laminación, S.L.

<http://www.celsa.com/Productos.mvc/PerfilesComercial?=Prontuario> />

The Computer Program of Metallic and Mixed Structures is a freely distributed tool for the analysis, calculation and design of metallic and mixed structures.

<https://goo.gl/Fvktuh> />

The Structural Steel Instruction (EAE) aims to establish the requirements to be met by structural steel structures related to structural



safety, fire safety and environmental protection, and to provide a procedure to comply with them, which affects Design, implementation and control of steel structures; All with the ultimate aim, within the framework of the structural reliability laid down in the structural Eurocodes, to ensure adequate safety.

<https://goo.gl/cZlu0y> />

The Basic Document (DB) is designed to establish rules and procedures to meet the basic requirements of structural security.

<https://www.codigotecnico.org/images/stories/pdf/seguridadEstructural/DBSE-AE.pdf>