Course guide
295450 - 295TM011 - Design and Calculation of Industrial Constructions

Last modified: 09/10/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.

Degree: MASTER'S DEGREE IN MECHANICAL TECHNOLOGIES (Syllabus 2024). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: DANIEL DI CAPUA

Others: Primer quadrimestre:
DANIEL DI CAPUA - Grup: T1
VICTOR MARTINEZ VALVERDE - Grup: T1
FERRAN PRATS BELLA - Grup: T1

PRIOR SKILLS

Basic knowledge of Strength of Materials and calculation of structures.

LEARNING RESULTS

Knowledges:
K.06. Identify the most appropriate techniques, components and materials for the development of advanced applications in mechanical engineering.
K.01. Critically interpret the physical principles governing the behaviour of systems and advanced applications in the fields of mechanical design, manufacturing processes, strength of materials, fluid mechanics, thermodynamics and heat transfer.
K.04. Correctly interpret technical documentation related to the design of facilities, processes and products in the context of research and development projects in the mechanical engineering field.
K.03. Recognise the process and product design principles and methods that apply to smart manufacturing systems.
K.07. Define appropriate analytical, experimental and/or computational models to study relevant problems in mechanical engineering.

Skills:
S.08. Integrate knowledge from different areas of the mechanical field in the design and development of projects, systems and engineering solutions.
S.05. Critically examine the results of the analysis of a process or product, taking into account the limitations of the techniques used.
S.01. Comprehensively apply experimental techniques, calculations, evaluations, appraisals, expert reports, studies, work plans and related tasks in the development of mechanical engineering projects, applying compulsory specifications, regulations and standards at each stage of the process.
S.06. Efficiently manage information collected during analytical, numerical and/or experimental studies and automate its analysis to facilitate knowledge extraction.

Competences:
C.03. Manage the acquisition, structuring, analysis and visualisation of data and information in the mechanical field and critically evaluate the results of this process.
C.02. Work as part of a multidisciplinary team, whether as a team member or in a leadership role, to contribute to the development of projects with pragmatism and a sense of responsibility, undertaking commitments with due regard to the resources available.
C.04. Ensure, within the limits of one's professional competence, compliance with ethical standards, professional guidelines and current legislation regarding fundamental rights, taking into account the goal of reducing inequalities, the gender perspective, and the principles of accessibility, inclusion and non-discrimination in the design of technical solutions and in the management of projects and teams.

TEACHING METHODOLOGY

The course uses an expository methodology, with a theoretical presentation of each topic, accompanied by real practical cases to connect the theory with the professional world. At the end of each topic, practical exercises will be presented that must be solved in groups and that will form part of the course project. The course project will consist of the structural design of an industrial warehouse. At the end of the course, an oral presentation of this project will be made.

LEARNING OBJECTIVES OF THE SUBJECT

The objective of the subject is to provide students with the basic knowledge to be able to tackle a project for the structure of an industrial warehouse in a comprehensive manner. This is why the topics to be covered must have a direct relationship with the phases of a
structural project. In the most general sense, these phases are:

1. Generation of a need.
2. Definition of the functional program.
3. Pre-dimensioning.
4. Sizing and calculation.
5. Checking the results.
6. Drafting the project.
7. Execution.
8. Reception of the structure.
9. Maintenance.
10. Reuse. Recycling. Dismantling.

A structural project is born when a new demand appears requiring a structure. It is then that the figure of the client with a need is created. This client has no choice but to turn to a specialist, whose first mission is to gather the information necessary to fully satisfy the client's demand. In many cases, the client is not aware of his real needs, and therefore it is the designer who must guide him to sufficiently define the functional program. This is vital to optimize the structure, since the lack of definition in this phase of the project leads to errors in the sizing of spaces that are very difficult to redirect later. Once the functional program has been defined (relation of surfaces linked to different uses) it is time to make a pre-dimensioning: a first indicative design. Guidance for the client: approximate budget, structural typology, formalities. The acceptance of these premises must mark a point of no return.

The next step is the calculation of the structure to size each and every one of the elements that form it. Once this process is finished, it is necessary to critically review it to check that the entire structure is fully defined, and defined correctly. With the information generated, the executive project must be drawn up. This project must be complete and must consist of all the necessary documents: report, plans, specifications, measurement status and budget. It is important that each and every document contains the essential information to understand the structure and define it unequivocally and be able to build it without any room for interpretation. In addition, the project must comply with current regulations and must consider aspects that are not purely structural, such as the fire protection of the structure.

Next, it is time to execute the project and build the structure. The designer must have the basic notions of construction that he must use, firstly when providing the project with sufficient constructability and secondly when ensuring that the execution is based on "good practices" and that there are no "hidden defects". At the end of this phase, sufficient criteria must be available to receive the work with the necessary guarantees. Once the structure has been delivered to its end users, it is necessary to ensure that it functions as planned during its useful life. This is why rigorous maintenance must be carried out, and it is the designer who must define what these maintenance actions should be. Finally, the structure stops fulfilling its functions and must be given a new meaning, either by reusing it for another, less demanding use, or by recycling it to build new structures, and if neither of these two alternatives is possible, it must be dismantled and removed from the circuit.

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	27.00
Hours small group	13,5	9.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION

Description:
Basic characteristics of industrial buildings. Typologies. Key design aspects. Choice of structural type. Applicable legislation. Typically used construction materials. Phases of structural analysis. Idealization of the structure. Classification of cross sections. Consideration of the shear drag effect. Lateral stability. Translational and intranslational structures. Imperfections. Methods of analysis of the overall stability of structures. Regulatory aspects.

Specific objectives:
Understand the comprehensive concept of a structure project. Know the most commonly used material, steel, and its main features. Know the regulatory framework: current regulations, and recently repealed regulations. Understand the concept of functional program, and know the types of actions to which the structures are subject.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

TOPIC 2: ACTIONS ON INDUSTRIAL WAREHOUSES

Description:
Self-weight and overload loads. Snow loads. Wind loads. Earthquake loads. Fire actions. Combination of actions.

Specific objectives:
Know the different types of actions that affect an industrial warehouse and how to combine them.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

TOPIC 3: ENVELOPES

Description:
Envelope requirements and materials summary. Roofs. Side walls. Estimation of enclosure strength. Contribution of enclosure materials to the strength and stability of the structure. Purlin design. General and calculation considerations for purlins.

Specific objectives:
Know the different parts that make up the envelope of an industrial building. Know the design criteria for each of these parts.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

TOPIC 4: TRANSVERSAL FRAMES

Description:
Introduction. Gabled frames with simple profiles on pillars and lintels. Gabled frames with simple profile pillars with solid web and truss and lattice girder lintel.

Specific objectives:
To understand the structural behaviour of the transverse porticos of an industrial warehouse. To understand their design criteria.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

Topic 5: BRACING, FRAMING AND WIND BEAMS

Description:
Conceptual approach to bracing in ships. Functions of bracing. Wind beams and trusses. Loads that wind beams must withstand. Estimation of stresses received by truss bars. Construction provisions.

Specific objectives:
To know the structural behaviour of the bracing, trusses and wind-supporting beams of an industrial building. To know the design criteria for them.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

Topic 6: STRUCTURES UNDER THE ACTION OF FIRE

Description:
Introduction. Specific regulations and standards. Legal compliance requirements. Mechanical actions. Structural verification process in a fire situation. Determination of the design fire. Calculation of the temperature inside the structural elements. Calculation of the mechanical behaviour of the structure exposed to fire. Protective materials.

Specific objectives:
Know the regulations applicable to the calculation of a metal structure under the action of fire..

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

TOPIC 7: CONCRETE FOUNDATIONS

Description:
Geotechnical reports. Allowable ground stress. Properties of concrete. Basis for calculating reinforced concrete structures. Different types of foundations. Isolated footing. Eccentric footing. Combined footing. . Piles.

Specific objectives:
Know the design criteria for the foundations of an industrial warehouse. Understand the application cases of the different types of foundations and their respective calculation procedures.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

TOPIC 8: METAL JOINTS

Description:
Importance of metal joints. Regulatory bases for the calculation of metal joints. Type of unions. Uses and advantages of screwed joints. Types of screws: ordinary, calibrated and prestressed. Construction provisions. Shear resistance. Crush resistance. Tear resistance. Slip resistance. Tensile strength. Tensile and shear resistance. Puncture resistance. Determination of stresses: Force contained in the median plane of the connected plates, force contained in the plane perpendicular to the connecting plate. Uses and advantages of welded joints. Welding procedures. Welding type: butt, angle, plug. Welding classification / Homologation of welders. Throat width.

Specific objectives:
Know the two most common types of joints: screwed and welded. Know the types of screwed joints. Sizing joints with ordinary and/or prestressed screws against the different failure mechanisms: shear resistance, crushing, tearing of the sheet, sliding, traction, traction and shear interaction, and punching. Determine the calculation requests. Know welding procedures and types of welds: fillet and butt. Sizing the throat width of a weld. Calculate the length of lateral and/or frontal weld beads.

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

GRADING SYSTEM

Exercises and problems: 33%
Midterm exam: 33%
Final project: 33%

The subject has re-evaluation test.

BIBLIOGRAPHY

Basic:
- Fernández Diezma, Jesús; Argüelles Bustillo, Ramón; Arriaga Martitegui, Francisco. Naves industriales. Madrid: Bellisco Ediciones Técnicas y Científicas, [2023]. ISBN 9788412590852.
- Reyes Rodríguez, Antonio Manuel. Manual imprescindible de CYPE 2010 : cálculo de estructuras metálicas con Nuevo Metal 3D. Madrid: Anaya Multimedia, 2010. ISBN 9788441526570.
- Ministerio de Vivienda. Código Técnico de la Edificación : (C.T.E.). Madrid: Ministerio de Vivienda, 2006. ISBN 8434016311.
- El-Reedy, Mohamed A. Advanced materials and techniques for reinforced concrete structures. 2nd ed. Boca Raton: CRC Press, cop. 2016. ISBN 9781498724708.

RESOURCES

Other resources:
Classroom with projector cannon
Practice classroom with CYPE