

Academic Year/course: 2022/23

## 30153 - Reinforced and Prestressed Concrete

### Syllabus Information

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**Academic Year:** 2022/23

**Subject:** 30153 - Reinforced and Prestressed Concrete

**Faculty / School:** 179 - Centro Universitario de la Defensa - Zaragoza

**Degree:** 563 - Bachelor's Degree in Industrial Organisational Engineering

**ECTS:** 6.0

**Year:** 4

**Semester:** First semester

**Subject Type:** Optional

**Module:**

## 1. General information

### 1.1. Aims of the course

- Ability to understand the mechanisms load transmission of structures.
- To know the concrete dosification and the influence on its behaviour and its durability.
- To understand the concrete, steel and reinforced concrete behaviour.
- To learn to design, calculate and check of reinforced concrete structures according to the Spanish rule, with constructive solutions of sustainable architecture.
- Knowledge to execution of concrete structures.
- Ability to analyze and assess the social and environmental impact of solutions, acting with ethics, professional responsibility and social commitment.

Specialization in Defence: These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 agenda (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree.

- ODS7: Affordable and clean energy. Compliance with goal 7.3 is encouraged: "By 2030, double the global rate of improvement in energy efficiency", providing information on materials used for cement with lower energy consumption and CO2 emissions in its generation process. Will be provided information about the possible use of recycled materials and on the recycling process of the available materials.
- ODS 9: Industry, innovation and infrastructure. The fulfillment of two goals is encouraged:

9.1 "Develop reliable, sustainable, resilient and quality infrastructure..." Structural design parameters will be provided that allow structures to be built with the minimum amount of material. If we add this factor to the use of non-polluting, recycled and recyclable materials mentioned in goal 7.3, the student will be able to calculate and execute structures that are not only reliable and resilient, but also sustainable.

9.4. "By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities." Its fulfillment is strengthened with the objective indicated in goal 7.3, closely related.

- ODS 11: Sustainable cities and communities. Specifically, with the development of the subject, compliance with goal 11.6 is favored: "By 2030, reduce the negative environmental impact per capita of cities, including paying special attention to air quality and municipal waste management and of another type", taking into account recycling and designs, that promote the use of less polluting materials and therefore less waste.

### 1.2. Context and importance of this course in the degree

The subject is included in the Structures and Materials specialty of IOI, together with "Steel Structures" and the "Structural Calculation" subjects. It's a fundamental subject in the in the training of Engineers

Arm of the Earth Army. Previously, the student has studied the “strength of materials” subject, which lays the bases for understanding the equations to define the behaviour of structures against external stresses. Also knowledge learned in the “General Construction Procedures” subject is used.

This subject contributes to the training in values of the Army Officers, provides knowledge about the behavior of the structures that will allow them to find and evaluate solutions to real problems related to the construction or the passage of obstacles and support infrastructures. This knowledge is necessary for Army Officers to carry out their mission, and thereby contribute to reliable and sustainable construction and infrastructure.

### 1.3. Recommendations to take this course

It's a Structures and Materials specialty of IOI included in the 4<sup>o</sup> course. It's recommended to have approved the “Strength of Materials” subject. It's necessary to be enrolled in the “Structural Calculation” subject.

## 2. Learning goals

### 2.1. Competences

When the student approves the subject, he will be able to:

- Ability to plan, budget, organise, manage and monitor tasks, people and resources. (C2)
- Ability to solve problems and take decisions with initiative, creativity and critical reasoning. (C4)
- Ability to communicate knowledge and skills in Spanish (C6)
- Ability to work in a multidisciplinary group and in a multilingual setting (C9)
- Ability to continue learning and develop self-learning strategies (C11)
- Knowledge of the theoretical and technological specifications involved in projecting and calculating reinforced concrete and pre-stressed structures in conditions that ensure safety (C59)
- Gaining the necessary competence to calculate elementary architectural constructions (C60)

### 2.2. Learning goals

To approve the subject, the student must demonstrate the following goals...

- To define qualitatively the resistant response mechanisms that occur in reinforced concrete elements.
- Project and execute reinforced concrete structures according to Spanish regulations.
- Describe in a basic way the behavior of prestressed concrete structures.
- Describe in a general way the characteristics of other types of special concrete and its applications.

Students will be able to apply all these learning goals within sustainability parameters in their professional future, promoting the reduction of the use of materials, as well as the use of less polluting materials, in line with compliance with the SDG of the subject

### 2.3. Importance of learning goals

The learning goals are part of the competences that students must acquire as part of their training in their fundamental specialty. The ability to design the most appropriate structural solution for each project design, needs and uses, is a fundamental competence of an engineer.

## 3. Assessment (1st and 2nd call)

### 3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

#### FIRST CALL

**Continuous assessment:** The students will be able to pass the total of the subject by the continuous assessment procedure. To do this, they must demonstrate that they have achieved the expected learning outcomes by passing the assessment instruments indicated below, which will be carried out throughout the semester:

- Two Midterm exams about theoretical and practical aspects, based on problem solving. Its weight in the final grade is 50%.
- Presentation in class of the analysis of an existing structure, in which the transmission mechanisms and load distribution are indicated. Its weight in the final grade is 10%.
- Coursework: in pairs, a reinforced concrete industrial warehouse will be designed. Its weight in the final grade is 10%.
- Course dissertation: in pairs, calculate the industrial warehouse designed above, with Cype Ingenieros program, according to the requirements of the Building Technical Code. Its weight in the final grade is 25%.
- Presentation and defense of the results of the practices in English and brief report of the work. its weight in the final grade is 5%.

The final continuous evaluation grade (100%) will be calculated according to the specific weight of each continuous evaluation test. The minimum mark of the evaluation of each of the midterm exam, works, presentations and practices must be 3.5 to mediate in the continuous evaluation. To pass the subject, the student must obtain a final grade greater than or equal to 5.

The evolution of the acquisition of knowledge throughout the course will be taken into consideration, as well as the active participation in class and the quality of the works.

The value of each section and the way to correct it will be indicated in each exam and work.

**Final exam:** The students who do not pass the subject by continuous assessment or who would like to improve their grades, will have the right to take the Final Exam set in the academic calendar, prevailing, in any case, the best of both grades. This global test will have a weight of 100% in the final grade. It will consist of the calculation of a column, a beam and a footing of a frame of a reinforced concrete structure. To pass the subject, the student's final grade must be equal to or greater than 5.

## SECOND CALL:

Final Exam: The students who do not pass the subject in the first call may take the Final Exam set in the academic calendar for the second call. This Final Exam will consist of the calculation of a column, a beam and a footing of a frame of a reinforced concrete structure. To pass the subject, the student's final grade must be equal to or greater than 5.

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

**The approach, methodology and assessment of this course is prepared to be equivalent in any teaching scenario. It will be adjusted to the socio-sanitary conditions of each moment, as well as to the indications given by the competent authorities.**

**It is a continuous learning process where the student plays an important participatory role.**

Different methodologies are alternated along the course and complement each other: Participatory theory classes, problem solving classes, cooperative problem solving with invert classroom, computer practices based on project-based learning, and oral presentations. Student participation in their own training is encouraged.

### 4.2. Learning tasks

The learning activities will be:

1. Participatory lectures. Consisting in exhibition of concepts and theoretical developments of the subject, always accompanied by real examples that help understanding thereof. The student will participate in the reasoning and deduction of the concepts, to reinforce learning a theoretical and practical way. Photographs of various works will be shown to the student to visualize the whole construction process.
2. Learning based on problem solving: Problems of different resistant elements with different sections and reinforcements will be solved. The calculation process and the reasoning followed in the decisions made will be explained. The student will learn to solve from start to finish the main structural typologies that he will find in his professional activity.

3. Cooperative problem solving and inverted classroom: the classroom will be divided into groups of students and by groups they will solve a problem in parts, with the support of the teacher. Each group will go out to explain the resolution of one of the parties, as progress is made.
4. Computer practices. Project-based learning: The student will be taught one of the most common structural calculation programs in the field of engineering: CYPE structures, also used in Army engineering units. Throughout various practical computer sessions, he will introduce a previously designed industrial warehouse, and learn to calculate and optimize the structure. He will be able to get the plans, budget and memory of the project.
5. Visit a work: Whenever possible due to available hours and resources, students will visit a reinforced concrete work when it is in the placement process of reinforcement in slabs, to understand which elements composes the different parts of the structure and how they work in situ. Will show them the plans used for construction and its interpretation will explain.
6. Oral presentations: The students will make an oral presentation of 10 minutes about the results of his final works in English
7. Moodle interactive platform: the student will be encouraged to put up videos, photographs and interesting facts about the topics covered in class, to share thereof with the other students. Discussion forums to resolve doubts are created by the professor or among them.
8. Tutorials in which the student is helped to resolve the doubts raised during learning.

### 4.3. Syllabus

**The program that the student is offered to help achieve the expected results is**

- 1 Main structural response mechanisms of concrete structures. Active section, slabs and active form. Design parameters
- 2 Construction process of concrete structures.
- 3 Concrete dosification and properties. Constituents.
- 4 Concrete and Reinforced concrete. Behavior.
- 5 Calculation bases. Deformation domains.
- 6 Limit states and verifications. Calculation of beams and columns:  
Normal stress~resultants  
Tangential stress~resultants
- 7 Reinforcement. Disposition, overlaps and anchors
- 8 Shallow foundations.
- 9 Behavior basis of prestressed concrete.
- 10 Life cycle of structures

### 4.4. Course planning and calendar

The calendar of the theory classes and problems, as well as the computer practice sessions, will have the schedule established on their website. The deliveries of work and midterm exams will be shown to the student at the beginning of the course in the presentation of the subject, so that they can plan their study hours. The calendar will be available in moodle throughout the course. Class schedules and exams can be found on the official website. Within the hours assigned to the subject are the practice schedules, which will be related in detail during the course of the subject.

### 4.5. Bibliography and recommended resources

Bibliography available in <http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30153>