

# Structural Management (250474)

## General Information

<b>School</b>	ETSECCPB
<b>Departments</b>	Departament d'Enginyeria Civil i Ambiental (DECA)
<b>Credits</b>	5.0 ECTS
<b>Programs</b>	MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
<b>Course</b>	2024/25

## Main teaching language at each group

- Group 10ES1 Spanish (Q1)

## Faculty

Responsible Faculty: Juan Ramon Casas Rius

Faculty: Vicente Alegre Heitzmann, Juan Ramon Casas Rius, Seyedmilad Komarizadehasl

## Objectives of Education

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

Knowledge regarding the correct performance of the structure in the service life, ie, all those aspects that arise once the structure has been built and put into service. Define the concepts that allow a good durability and appropriate management of this structure given the progressive deterioration of materials and the variation of the imposed actions

## Competencies

### Especific

Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.

Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

### Transversal

ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.

**SUSTAINABILITY AND SOCIAL COMMITMENT:** Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

**TEAMWORK:** Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

## Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

## Contents

### Inspection of structures

Definitions, justification and objectives. Concepts of safety and service life. Standards of structural safety: minimum, optimum and acceptable. Steps in the management of structures: inventory, inspection and assessment, diagnoses and decision. Concept of condition state and methods of evaluation (condition index).

Definition and concept of defect. Classification and significance: Structural and functional defects. Most common defects according to material and structural type: retaining walls, building structures, hydraulic works. Mapping of cracks. Classification and quantification of defects in concrete structures.

Mechanisms of deterioration in concrete. Physical Processes: cracking, frost and thaw, erosion. Chemical processes: acid attack, sulphate attack, alkali-silica reaction. Biological Processes. The particular case of degradation in the aluminous cement. Degradation mechanisms in reinforcing and prestressing steels.

Models for prediction in structural concrete and steel. Protection mechanisms in front of corrosion.

Tests on concrete. Non-destructive testing and semi-destructive. Description of tests. Most commonly used tests: theory, calibration and interpretation. Reliability, limitations and applications. Criteria for selecting the type of test: durability, concrete strength, and comparative trials. Interpretation of results: variability of the properties, reliability of test methods, confidence intervals. Tests in structural steel: visual inspection, ultrasonic, dye penetrant, radiography, acoustic emission. Extent of cracking.

Structural tests. Load testing of structures in service. Information obtained and utility. Advantages and disadvantages compared to materials testing.

### Specific Objectives

To introduce students the concepts that are part of the subject relating to inspection, maintenance, evaluation and repair of existing structures

Students learn the major defects that appear on the structures and their causes, taking into account the material, type of structure and phases where the problem originated (design or execution). To learn how to assess the importance of a defect or damage in the serviceability and safety of the structure

Once considered the most frequent defects in the structures in the class above, the objective is to know which are the mechanisms that lead to these defects. Showing the most used theoretical models for the modeling of degradation of structural materials

Description of the methods of inspection of existing structures. Scope. Provide criteria for proper decision on the most appropriate method to apply.

### Structural assessment

Definition and justification. Principles and philosophy of structural assessment. Objectives and methods of the structural assessment. Sources of uncertainty. Differences between design and assessment. Concept of structural safety. Quantification of structural safety. Types of evaluation: deterministic and probabilistic.

Phases of the evaluation. Assessment methods: deterministic and probabilistic. Advantages and disadvantages.

Description of evaluation methods based on structural reliability. Concept of reliability index. Definition and concept of the limit state function. Methods for calculating the probability of failure or reliability index: simulation methods, approximate methods (FOSM, FORM, SORM).

Statistical models of structural steel strength: yield strength, modulus of elasticity. Statistical models of concrete: compressive strength, ultimate strain, ... Statistical models of reinforcing and prestressing steel: yield strength, modulus of elasticity, ultimate strain. Statistical models of structural response. Statistical models for loads: permanent and variable loads, live load, ...

Illustrate through real examples the application of advanced methods for structural assessment.

### **Specific Objectives**

Show students the concepts and methods of structural assessment, by comparing them with the concepts and methods used in the design of new structures

Provide the necessary information for the student to carry out a probabilistic assessment

### **Repair and strengthening of structures**

Jacketing methods for strengthening elements in compression and bending as well as other methods of flexural reinforcement

Formulation of the general principles of structural strengthening by adding forces (external prestressing) and composite materials (FRP)

Technical maintenance and repair of concrete pavements. Repair of cracks. Repair of joints. Calculation of thickness of the reinforcement

Most common damages and defects in concrete bridges, steel or masonry. Examples of bridges with structural and durability problems and proposals for strengthening

### **Teaching Methodology**

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,8 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

### **Test Rules**

Failure to perform a continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

### **Office Hours**

Thursday from 16.00 to 18.00

### **Bibliography**

#### **Basic**

- Calavera Ruiz, J. [Patología de estructuras de hormigón armado y pretensado](#). 2a ed. Madrid: INTEMAC, 2005. ISBN 8488764219.
- Schneider, J.; Vrouwenvelder, T. [Introduction to safety and reliability of structures](#). 3rd. rev. ext. ed. Zürich: International Association for Bridge and Structural Engineering, 2017. ISBN 9783857481512.
- Melchers, R.E.; Beck, A.T. [Structural reliability: analysis and prediction](#). 3rd ed. Hoboken, NJ: John Wiley & Sons, 2018. ISBN 9781119266105.
- GEHO-ATEP. [Reparación y refuerzo de estructuras de hormigón: guía FIP de buena práctica](#). Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 1994. ISBN 8438000797.
- Colegio Ingenieros de Caminos, Canales y Puertos ; Grupo Español del Hormigón (GEHO-CEB). [Durabilidad de estructuras de hormigón: guía de diseño CEB](#). 2a ed. Madrid: GEHO-CEB, 1996. ISBN 8474931835.

## Complementary

- Dirección General de Carreteras. [Guía de inspecciones básicas de obras de paso: red de carreteras del estado](#). Madrid: Centro de Publicaciones, Ministerio de Fomento, 2009. ISBN 9788449808616.
- Casas, J.R. La enseñanza de la gestión de estructuras: una necesidad. Barcelona: Colegio de Ingenieros de Caminos, Canales y Puertos, 1999.
- Ministerio de Obras Públicas y Transportes (MOPT), Dirección General de Carreteras. [Inspecciones principales de puentes de carretera](#). Madrid: MOPT, 1988. ISBN 8474335469.
- Task Group 5.6. [Model code for service life design](#). Lausanne: International Federation for Structural Concrete (fib), 2006. ISBN 2883940746.