

## Course guide

### 2500047 - GECINTGEST - Introduction to Structure Management

**Last modified:** 01/10/2023

**Unit in charge:** Barcelona School of Civil Engineering  
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering.

**Degree:** BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Optional subject).

**Academic year:** 2023    **ECTS Credits:** 4.5    **Languages:** Spanish

#### LECTURER

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**Coordinating lecturer:** JUAN RAMON CASAS RIUS

**Others:** VICENTE ALEGRE HEITZMANN, JUAN RAMON CASAS RIUS

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

14411. Knowledge about the project, calculation, construction and maintenance of building works in terms of structure, finishes, facilities and own equipment. (Specific technology module: Civil Construction)

**Generical:**

14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.

14383. Ability to project, inspect and direct works, in their field.

14386. Capacity for maintenance, conservation and exploitation of infrastructure, in its field.

14389. Knowledge of the history of civil engineering and training to analyze and assess public works in particular and construction in general.

14390. Identify, formulate and solve engineering problems. Pose and solve construction engineering problems with initiative, decision-making skills and creativity. Develop a systematic and creative method of analysis and problem solving. (Additional school competition).

14391. Conceive, project, manage and maintain systems in the field of construction engineering. Cover the entire life cycle of an infrastructure or system or service in the field of construction engineering. (Additional school competition).

#### TEACHING METHODOLOGY

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The course consists of 3 hours per week of classroom activity (large size group).

The 3 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.

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.

## LEARNING OBJECTIVES OF THE SUBJECT

Introduction of the aspects related with the lifetime and with the serviceability behavior of the civil engineering structures. Main pathologies and degradation processes in structures throughout the lifetime. Non-destructive inspection and testing techniques for concrete and steel structures. Repair and strengthening materials and techniques.

- 1 Ability to identify the main pathologies in concrete structures, and steel, foundations and pavements from inspection, and definition of tests.
- 2 Ability to establish both static and dynamic load tests.
- 3 Ability to define structural strengthening solutions based on the different materials of the original structure.

Introduce the student to aspects related to the lifetime and serviceability behavior of civil engineering structures (inspection, maintenance and repair of existing structures). The objective is to complement the previous aspects of planning, project and construction that have been seen in other subjects of the degree. Identification of pathologies. Inspection techniques, destructive tests and non-destructive tests on concrete and steel structures. Definition of load tests. Techniques for strengthening structures, foundations and pavements.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	22,5	20.00
Self study	63,0	56.00
Hours medium group	22,5	20.00
Guided activities	4,5	4.00

**Total learning time:** 112.5 h

## CONTENTS

### Main defects and damages structures

#### Description:

Critical analysis of the main defects and pathologies most common in civil engineering and building structures through real examples. Most important points to take into account when doing the first visual inspection of a damaged structure  
The most common ways of reflecting the results of an inspection report are presented, including an initial diagnosis of the possible causes of the damage. To this end, helpful bibliographic materials are presented  
Defects in the project phase (design of the structure, calculation and dimensioning)  
Defects in the quality of materials.  
Defects in execution phase: falsework, formwork, construction detailing

**Full-or-part-time:** 21h 36m

Theory classes: 9h

Self study : 12h 36m

### Inspection and testing of concrete structures

**Description:**

Principles of operation of the most common non-destructive testing techniques in concrete structures and their accuracy and field of application.

Core drilling of samples: main applications and influence of various parameters on the result of the compression test of samples  
Methods for estimating the compressive strength of concrete based on the measurement of surface hardness, mainly focusing on the main factors that may influence the test result

Ultrasonic methods for determining the resistance and modulus of deformation of hardened concrete are presented. The main factors that may affect the results and their interpretation are also discussed.

Tests to determine durability: carbonation, chloride content, porosity

**Full-or-part-time:** 24h

Theory classes: 10h

Self study : 14h

### Inspection and testing of steel structures

**Description:**

Main methods of non-destructive testing of steel structures: penetrating liquids, magnetic particles, ultrasound, radiography, acoustic emission.

**Full-or-part-time:** 4h 48m

Theory classes: 2h

Self study : 2h 48m

### Summary of non-destructive testing of concrete and steel structures

**Description:**

Synthesis. Comparison and criteria of applicability of the different non-destructive testing methods

**Full-or-part-time:** 2h 24m

Theory classes: 1h

Self study : 1h 24m

### Load tests

**Description:**

Objectives and types of load tests. Static load test. Verification of structural models. Loading tools. Measuring instruments. Interpretation of results. Dynamic test. Means of dynamic excitation of structures. Main vibration measuring instruments. Interpretation of results.

**Full-or-part-time:** 8h 24m

Theory classes: 2h

Laboratory classes: 1h 30m

Self study : 4h 54m

### Repair and strengthening

**Description:**

Objectives of surface preparation. Mechanical, thermal and chemical methods

Inorganic-based, organic-based mortars and concretes (organic polymers) and additives with thermoplastic and thermoset polymers

**Full-or-part-time:** 4h 48m

Theory classes: 2h

Self study : 2h 48m

### Reinforcement with reinforced concrete

**Description:**

Introduction to the reinforcement of structures. Variables to consider in structural repair and strengthening

Wrapping methods for strengthening members in compression and bending , as well as other bending reinforcement methods are studied.

**Full-or-part-time:** 7h 11m

Theory classes: 3h

Self study : 4h 11m

### Reinforcement with structural steel

**Description:**

Explanation on how changes in the structural scheme of load transmission should be taken into account

Reinforcement of compressed elements. Angles and clips. Wrapping of compressed members. Execution. Reinforcement of bending elements. Specific details

**Full-or-part-time:** 7h 11m

Theory classes: 3h

Self study : 4h 11m

### Reinforcement with prestressing and composites

**Description:**

Introduction to exterior prestressing. Main application problems: construction of deviators and anchorages. Measures for cable protection. Calculation problems

Introduction to composite materials. Main types of composite materials. Methods of application of reinforcement in compressed and bending elements. Modes of failure. Failure by delamination and peeling

**Full-or-part-time:** 7h 11m

Theory classes: 3h

Self study : 4h 11m

### Pathologies and reinforcement of foundations

**Description:**

Shallow reinforcement acting on the foundation structure. Shallow reinforcement acting on the foundation ground. Improvement of ground conditions, superficial and deeper

Terrain sewing techniques

Concept of deep strengthening. Micropiles. Jet grouting. Load transfer mechanisms from the actual structure to the reinforcement

**Full-or-part-time:** 9h 36m

Theory classes: 4h

Self study : 5h 36m

### Pathology and pavement reinforcement

**Description:**

Loads considered. Types of joints and pins

Typical defects in the execution phase: poured thicknesses, reinforcement and position. Characterization of concrete. Work stresses to consider

Techniques for maintenance and repair of concrete pavements. Crack repair. Joint repair. Calculation of required thickness

**Full-or-part-time:** 10h 48m

Theory classes: 3h

Laboratory classes: 1h 30m

Self study : 6h 18m

## GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment.

Continuous assessment consist in 2 written examinations and an assignment carried out during the semester (both in and out of the classroom) in a group with maximum 2 components. The written exams have a weigh of 80 % in the final grade, and the assignment the remaining 20 %

The evaluation tests consist of a series of questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding.

Criteria for re-evaluation qualification and eligibility: Students that failed the continuous evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

## EXAMINATION RULES.

If any of the continuous assessment activities is not carried out in the scheduled period, it will be considered as a zero score in this activity.

## BIBLIOGRAPHY

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### Basic:

- Calavera Ruiz, J. Patología de estructuras de hormigón armado y pretensado. 2a ed. Madrid: INTEMAC, 2005. ISBN 8488764219.
- 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.
- Bungey, J.H.; Millard, S.G. Testing of concrete in structures. 4th ed. London: Taylor and Francis, 2006. ISBN 0415263018.
- Byars, E.A.; McNulty, T. Management of concrete structures for long-term serviceability. London: Thomas Telford, 1997. ISBN 9780727726544.
- Perkins, Philip Harold. Repair, protection and waterproofing of concrete structures [on line]. 3rd ed. London: E & FN Spon, 1997 [Consultation: 01/12/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=167184>. ISBN 0419202803.
- ACHE. Evaluación de estructuras de hormigón armado. Monografía 33. Madrid: ACHE, 2019. ISBN 9788489670082.
- 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:

- Mallett, G. P.. Repair of concrete bridges. London: Thomas Telford, 1994. ISBN 0727720074.
- Federation Internationale du Beton. Model code for service life design. Lausanne: FIB, 2006. ISBN 2883940746.
- Fédération Internationale du Béton (fib). Externally bonded FRP reinforcement for RC structures. 2001. Lausanne: International Federation for Structural Concrete, 2001. ISBN 2883940541.