

## Course guide

### 250716 - 250716 - Durability of Structures

**Last modified:** 28/03/2024

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

**Degree:** MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).

**Academic year:** 2023    **ECTS Credits:** 5.0    **Languages:** Spanish

#### LECTURER

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**Coordinating lecturer:** MARILDA BARRA BIZINOTTO

**Others:** VICENTE ALEGRE HEITZMANN, DIEGO FERNANDO APONTE HERNÁNDEZ, MARILDA BARRA BIZINOTTO, SUSANA VALLS DEL BARRIO

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

13367. To apply innovative and sustainable technological aspects in the management and implementation of projects and works.  
13370. To analyze the multiple technical and legal conditions arising in the construction of public works, and use proven methods and proven technologies with the aim of achieving greater efficiency in construction while respecting the environment and protecting the safety and health of workers and users of public works.

**Generical:**

13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.  
13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.  
13362. To define construction processes and methods of organization and management of projects and works.  
13363. To design plans for safety, quality and environmental and socioeconomic impacts related to the construction process.

#### TEACHING METHODOLOGY

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The course consists of 3 hours a week of classes in a classroom (large group) is dedicated to lectures 2 hours in a large group, in which he exposes the teaching materials and basic concepts of the subject, and presents examples performs exercises. Devotes one hour (Intermediate), solving problems with greater interaction with students. Practical exercises are conducted in order to consolidate the general and specific learning objectives. The rest of weekly hours dedicated to studies and homework.

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

Subject to introduce to the engineer the basic concepts that govern the behaviour of concrete in front of aggressive environments

- Knowledge of the basic concepts that govern the concrete behavior under aggressive environments .

Durability and lifespan concepts. Main causes of materials deterioration. Concrete structures. Deterioration of concrete: design errors , construction defects , damage from external causes. The transport mechanisms in the concrete. Steel corrosion in concrete. In situ tests. Laboratory tests: microscopy, strength, transportation parameters, XRD, cement composition. Real case studies of structures affected by phenomena related to durability.

Knowledge of the basic concepts that govern the behavior of concrete deal with environmental damage. Concepts durability and service life. Main causes of deterioration of materials. The concrete and its structure. Deterioration of concrete: errors in project, construction defects, damage from external causes. Transport mechanisms in concrete. Corrosion of steel in concrete. Tests in situ. Laboratory tests: microscopy, resistance, transport parameters, DRX, composition of cement. Case studies of structures affected by phenomena durability.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	25,5	20.38
Self study	80,0	63.95
Hours medium group	9,8	7.83
Hours small group	9,8	7.83

**Total learning time:** 125.1 h

## CONTENTS

### Durability and sustainability.

#### Description:

Durability concepts. Durability and Sustainability.

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

Theory classes: 2h

Self study : 2h 48m

### Bases for the formulation of a durable concrete.

#### Description:

\* Hydration of cement \* Genesis and features of the microstructure of the hydrated cement paste. \* Additives and additions.

\* The porous structure and transport mechanisms \* Shrinkage, creep and cracking.

Durability of concrete in: \* Natural waters \* acids environment. Preventive actions.

**Full-or-part-time:** 28h 47m

Theory classes: 9h

Laboratory classes: 3h

Self study : 16h 47m

### Endogenous expansive reactions

**Description:**

Endogenous reactions attributable to the aggregates. Diagnosi. Preventive actions.

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

Theory classes: 3h

Self study : 4h 11m

### Physical deterioration of concrete

**Description:**

Physical deterioration of concrete \* Fire Action. \* freezing and thawing. \* cavitation and abrasion.

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

Theory classes: 3h

Self study : 4h 11m

### Durability of concrete in chemically aggressive media

**Description:**

Durability of concrete in Sulfàtic and Marine environment.

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

Theory classes: 3h

Self study : 4h 11m

### Carbonation and chloride penetration

**Description:**

Carbonation and chloride penetration

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

Theory classes: 3h

Self study : 4h 11m

### Corrosion and durability of reinforcement

**Description:**

Corrosion and durability of reinforcement

Practice steel corrosion

**Full-or-part-time:** 14h 23m

Theory classes: 3h

Laboratory classes: 3h

Self study : 8h 23m



#### Calcium aluminate cements - CAC

**Description:**

Durability of concretes with calcium aluminate cements

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

Theory classes: 3h

Self study : 4h 11m

#### Durability prediction models

**Description:**

Durability models for predicting the behavior of the concrete. Life cycle

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

Theory classes: 3h

Self study : 4h 11m

#### Deterioration. Case studies.

**Description:**

Studies case. Diagnosis. Repair proposals.

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

Theory classes: 3h

Self study : 4h 11m

#### Diagnosing causes of deterioration

**Description:**

Diagnosing causes of deterioration of the concrete structure

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

Practical classes: 3h

Self study : 4h 11m

#### Repairs

**Description:**

Repairs. Material and methods.

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

Theory classes: 1h

Self study : 1h 24m

## GRADING SYSTEM

Continuous assessment will formulate written questions on the subject of the class will be delivered on paper at the beginning of the next class. All deliveries will be described and its absence a qualified zero. The course will approve the average ongoing assessments, which represent 25% of the note, a test will represent 40% of the final and will represent 35% of the note. The final work will be delivered on paper and will be presented orally in class (20 minutes).

## EXAMINATION RULES.

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

## BIBLIOGRAPHY

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### Basic:

- Ollivier, Jean-Pierre; Vichot, Angélique. La Durabilité des bétons : bases scientifiques pour la formulation de bétons durables dans leur environnement. 2<sup>o</sup>. Paris: Presses de l'école nationale des Ponts et chaussées, 2008. ISBN 9782859784348.