

# Durability of Structures (250716)

## General Information

<b>School</b>	ETSECCPB
<b>Departments</b>	Departament d'Enginyeria Civil i Ambiental (DECA) Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports de Barcelona (ETSECCPB)
<b>Credits</b>	5.0 ECTS
<b>Programs</b>	MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015)
<b>Course</b>	2024/25

## Main teaching language at each group

- Group 10ES2 Spanish (Q2)

## Faculty

Responsible Faculty: Marilda Barra Bizinotto

Faculty: Vicente Alegre Heitzmann, Diego Fernando Aponte Hernández, Marilda Barra Bizinotto, Susana Valls Del Barrio

## Objectives of Education

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.

## Competencies

### Especific

To apply innovative and sustainable technological aspects in the management and implementation of projects and works.

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.

### Generic

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

## 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

### Durability and sustainability.

Durability concepts. Durability and Sustainability.

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

\* 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.

### Endogenous expansive reactions

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

### Physical deterioration of concrete

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

### Durability of concrete in chemically aggressive media

Durability of concrete in Sulfatic and Marine environment.

### Carbonation and chloride penetration

Carbonation and chloride penetration

### Corrosion and durability of reinforcement

Corrosion and durability of reinforcement  
 Practice steel corrosion

### Calcium aluminate cements - CAC

Durability of concretes with calcium aluminate cements

### Durability prediction models

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

## **Deterioration. Case studies.**

Studies case. Diagnosis. Repair proposals.

## **Diagnosing causes of deterioration**

Diagnosing causes of deterioration of the concrete structure

## **Repairs**

Repairs. Material and methods.

## **Activities**

### **Practices**

Fabricate concrete, prepare specimens, condition them and subject them to an accelerated process of degradation: Penetration of chlorides, carbonation and sulfuric attack. Assess deterioration as a function of time. Prepare a technical report. Present the work done

### **Dedication**

6h

## **Teaching Methodology**

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.

## **Grading Rules**

*(\*) The evaluation calendar and grading rules will be approved before the start of the course.*

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).

## **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**

- 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 chaussés, 2008. ISBN 9782859784348.

