Inspection, Analysis and Restoration of Historical Constructions (250710)

General information

School:	ETSECCPB
Departments:	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits:	5.0 ECTS
Programs:	MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ, pla 2015 - (codi pla 1140)
Course:	2015/2016
Course language:	English

Faculty

Responsible faculty: Luca Pela

Teachers: Climent Molins Borrell, Luca Pela, Pedro Roca Fabregat

Generic objectives

Subject to know the materials and typological features of heritage buildings, modern heritage conservation criteria, structural analysis of masonry or wood, inspection techniques and strengthening

Capacity for analysis of structures masonry or wood using traditional and advanced methods . Ability to design applicable to the conservation and enhancement of historic buildings solutions.

Criteria for the conservation and restoration of heritage buildings. Presentation of international regulations and codes . Main features (materials, components , types) of historical buildings. Criteria, classical and historical methods for analysis and structural design. Static and kinematic limit analysis. Mechanics of masonry, stone and wood. Introduction to computational methods for the analysis of historic structures. Seismic behavior. Specific techniques of inspection and monitoring. Intervention. Stabilization, repair and strengthening.

• Apply modern criteria of conservation and restoration of architectural heritage structures in accordance with regulations and international documents.

• Analyze the characteristics of materials and typologies of heritage buildings.

• Analyze the behavior of existing timber structures, brick and stone masonry structures, under static and seismic actions, by means of classical and advanced methods.

• Conceive and design specific activities of non destructive and minor destructive inspection. Applying modern techniques for the monitoring of historical structures.

• Develop design solutions applicable to the conservation, repair, stabilization and strengthening of heritage buildings.

Skills

Specific skills

To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.

Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).

To evaluate, maintain, repair and strengthen existing structures, including the historic and artistic heritage.

To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

Generic skills of subject

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.

ECTS credits: total hours of student work

		Dedication	
		Hours	Percent
Supervised Learning	Theory	27.00	60.0%
	Assignments	14.00	31.1%
	Laboratory	4.00	8.9%
	Supervised activities	5.00	11.1%
Self-Learning		105.00	

Contents

Basic concepts and criteria of Conservation and Restoration

Dedication

3.0h. Theory + 1.0h. Assignments

Description

Introduction to the criteria for the conservation and restoration of heritage buildings. Presentation of charts, documents and international regulations.

Examples

Structural analysis methods

Dedication

12.0h. Theory + 6.0h. Assignments

Description

Methods Classics: Graphic Statics

Problems of graphic statics

Classical Methods: Kinematic Analysis

Problems of kinematic analysis

Seismic behavior of masonry structures

Advanced methods: introduction to computational methods

Structural behavior of traditional materials

Dedication

3.0h. Theory

Description

Behavior of masonry structures

Behavior of timber structures

Damage and collapse mechanisms

Dedication

3.0h. Theory + 3.0h. Assignments

Description

Mechanisms of damage and collapse

Examples

Group work - Case studies

Dedication

3.0h. Assignments + 4.0h. Laboratory

Description

Workshop 1 - Historic and Visual Inspection. Damage Diagnosis

Examples of integrated studies of historical structures

Workshop 2 - Structural analysis and design of interventions

Inspection and monitoring techniques

Dedication

3.0h. Theory + 1.0h. Assignments

Description

Inspection and monitoring techniques

Examples

Intervention

Dedication

3.0h. Theory

Description

Repair and strengthening

Activities

Static Limit Analysis

Dedication

1.0 h. Supervised activities

Description

Calculation of a masonry structure with the method of Graphic Statics (Static Limit Analysis)

Kinematic Limit Analysis

Dedication

1.0 h. Supervised activities

Description

Calculation of a masonry structure with the method of kinematic analysis limit.

Seismic analysis of local collapse mechanisms

Dedication

1.0 h. Supervised activities

Description

Seismic analysis of local collapse mechanisms of masonry structures using kinematic analysis limit

Group Work

Dedication

1.0 h. Supervised activities

Description

Study of a historical structure: inspection, analysis and intervention

Final test

Dedication

1.0 h. Supervised activities

Grading rules (*)

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

The grade is obtained from continuous assessment and final exam.

Continuous assessment involves different activities, both individual and in group, made during the year (in the classroom and outside of it).

The evaluation tests consist of questions on theorethical concepts and practical exercises.

The final grade is defined by adding the contributions of each activity performed by the student, according to the weights listed below:

- Individual assignments: 40%

- Group work: 25%

- Final exam of theory: 35%

Test rules

If one of the activities scheduled during the period is not done, it will be considered with zero grade.

Teaching methodology

The teaching method combines educational sessions about the basic concepts with practical sessions on the methods presented (for analysis, inspection and intervention) and critical discussion of case-studies.

An essential aspect of the teaching method relies on the realization by groups of students of a study of a real building, including the analysis of previous studies, the diagnosis, the project of inspection and monitoring activities, the structural analysis and the design of interventions. The proposals by the students are presented and discussed regularly during scheduled sessions, where the participation of teachers and students is important to assess the accuracy of the diagnosis and the adequacy of the proposal interventions.

Office hours

Email the lecturer of the course.

Basic bibliography

- ICOMOS/ISCARSAH Committee. **Recommendations for the analysis, conservation and structural restoration of architectural heritage**. 2005.
- Italian Ministry for Cultural Heritage and Activities. **Guidelines for evaluation and mitigation of seismic risk to cultural heritage**. Gangemi. Rome. 2011.
- European Committee for Standardization. **EN 1996-1-1:2005. Eurocode 6: Design of masonry structures**. 2005.
- European Committee for Standardization. **EN 1995-1-1:2004. Eurocode 5: Design of timber structures**. 2004.
- Giuffrè A. **Sicurezza e conservazione dei centri storici. Il caso Ortigia (in Italian)**. Laterza. 1993.

Complementary bibliography

- Como M.. **Statics of Historic Masonry Constructions**. Springer. Berlin. 2013.
- Hendry A.W.. **Structural Masonry**. Macmillan. 1990.
- Porteous, J., & Kermani, A.. **Structural timber design to Eurocode 5**. Wiley. 2013.