

## Course guide

# 250710 - 250710 - Inspection, Analysis and Restoration of Historical Constructions

Last modified: 20/06/2024

<b>Unit in charge:</b>	Barcelona School of Civil Engineering	
<b>Teaching unit:</b>	751 - DECA - Department of Civil and Environmental Engineering.	
<b>Degree:</b>	MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).	
<b>Academic year:</b> 2024	<b>ECTS Credits:</b> 5.0	<b>Languages:</b> English

## LECTURER

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<b>Coordinating lecturer:</b>	LUCA PELA
<b>Others:</b>	ANASTASIOS DROUGKAS, LUCA PELÀ, PEDRO ROCA FABREGAT

## TEACHING METHODOLOGY

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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.

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

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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.

## STUDY LOAD

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

**Total learning time:** 125.1 h

## CONTENTS

### Basic concepts and criteria of Conservation and Restoration

#### Description:

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

Examples

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

Theory classes: 2h

Practical classes: 1h

Self study : 4h 11m

### Structural analysis methods

#### Description:

Methods Classics: Graphic Statics

Problems of graphic statics

Classical Methods: Kinematic Analysis

Problems of kinematic analysis

Seismic behavior of masonry structures

Examples

Advanced methods: introduction to computational methods

**Full-or-part-time:** 40h 48m

Theory classes: 10h

Practical classes: 7h

Self study : 23h 48m

### Structural behavior of traditional materials

#### Description:

Behavior of masonry structures

Behavior of timber structures

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

Theory classes: 3h

Self study : 4h 11m

### Damage and collapse mechanisms

**Description:**

Mechanisms of damage and collapse  
Examples

**Full-or-part-time:** 12h

Theory classes: 2h  
Practical classes: 3h  
Self study : 7h

### Group work - Case studies

**Description:**

Workshop 1 - Historic and Visual Inspection. Damage Diagnosis  
Examples of integrated studies of historical structures  
Workshop 2 - Structural analysis and design of interventions

**Full-or-part-time:** 26h 24m

Practical classes: 1h  
Laboratory classes: 10h  
Self study : 15h 24m

### Inspection and monitoring techniques

**Description:**

Inspection and monitoring techniques  
Examples

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

Theory classes: 2h  
Practical classes: 1h  
Self study : 4h 11m

### Intervention

**Description:**

Repair and strengthening

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

Theory classes: 3h  
Self study : 4h 11m

## GRADING SYSTEM

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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 theoretical 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%

## EXAMINATION RULES.

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

## BIBLIOGRAPHY

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### Basic:

- ICOMOS/ISCARSAH Committee. Recommendations for the analysis, conservation and structural restoration of architectural heritage [on line]. Charenton-le-Pont, France: ICOMOS, 2003 [Consultation: 11/06/2020]. Available on: [https://ancientgeorgia.files.wordpress.com/2012/04/recommendations\\_icomos-principles-and-guidelines.pdf](https://ancientgeorgia.files.wordpress.com/2012/04/recommendations_icomos-principles-and-guidelines.pdf).
- Italian Ministry for Cultural Heritage and Activities. Guidelines for evaluation and mitigation of seismic risk to cultural heritage. Rome: Gangemi, 2007. ISBN 9788849212693.
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- Giuffrè A. Sicurezza e conservazione dei centri storici. Il caso Ortigia (in Italian). Laterza, 1993. ISBN 9788842042501.

### Complementary:

- Como, M. Statics of historic masonry constructions [on line]. 3rd ed. Cham: Springer International Publishing, 2017 [Consultation: 28/04/2020]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-54738-1>. ISBN 9783319547381.
- Hendry, A.W. Structural masonry. 2nd ed. London: Macmillan, 1998. ISBN 9780333733097.
- Porteous, J.; Kermani, A. Structural timber design to Eurocode 5 [on line]. 2nd ed. Chichester, West Sussex: Wiley-Blackwell, 2013 [Consultation: 28/04/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1174133>. ISBN 9781118597286.
- Lourenço, P.B.; Gaetani, A. Finite Element Analysis for Building Assessment. Advanced Use and Practical Recommendations [on line]. Abingdon, Oxon: Routledge, 2022 [Consultation: 14/03/2023]. Available on: <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9780429341564/finite-element-analysis-building-assessment-paulo-louren%C3%A7o-angelo-gaetani>. ISBN 9781032228396.
- Roca, P.; Lourenço, P.B.; Gaetani, A. Historic Construction and Conservation. Materials, Systems and Damage. New York: Routledge, 2020. ISBN 9780367145743.
- Dizhur, D. Structural Performance. Auckland: Dmytro Dizhur, 2021. ISBN 9780473564322.