

Course Unit	Rehabilitation and Maintenance		Field of study	Technology and Construction Materials	
Master in	Construction Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	1	Level	2-1
Type	Semestral	Semester	2	ECTS credits	6.0
Code	5024-419-1203-00-22				
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Eduarda Cristina Pires Luso

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Understand conceptual terms, such as maintenance, rehabilitation, conservation and pathologies;
2. Understand the behaviour in service of a building, identify needs for maintenance of buildings and of the infrastructures;
3. Perform the survey and the diagnosis of anomalies of any construction;
4. Understand the processes of maintenance of buildings and infrastructure, the policies of maintenance and rehabilitation, the economic analysis and application of maintenance methodologies;
5. Know the available rehabilitation technologies and develop skills to implement the processes of rehabilitation of buildings;
6. Promote the research work, investigation and implementation of solutions in the field of technology of new building materials.

### Prerequisites

Before the course unit the learner is expected to be able to:

Understand general concepts of mechanics of materials and also, building physics.

### Course contents

The building in service. Behavior and degradation of buildings. Diagnosis and surveying of pathologies in construction. Building management. Technologies of maintenance and rehabilitation.

### Course contents (extended version)

1. History of restoration in Portugal and Europe. Conservation Theories. Intervention in heritage.
  - Letters of restoration. List of UNESCO heritage;
  - Revision of terminology: rehabilitation, restoration, conservation, modernization, recovery, etc.;
  - The problematic of the degraded buildings and the construction sector in Portugal;
  - Traditional building materials and techniques. Arches and vaults. Earth construction;
  - The vernacular architecture and bio constructive diversity in Portugal;
  - Conservation and rehabilitation practices. The recommendations of ICOMOS.
2. Maintenance and management of buildings.
  - Factors of degradation of buildings. Deterioration agents;
  - The maintenance of the building like a way to prolong its useful life;
  - Maintenance terminology (EN 13306 - 2007);
  - Maintenance types and strategies: preventive, condition based, scheduled and predetermined;
  - Management of Buildings. Technical, social and economic management of a building.
3. Anomalies and pathologies. Identification of cause-effect and main consequences.
  - The enemies of the wood. The degradation of structural and non-structural elements of wood;
  - Main pathologies in masonry walls made of stone and brick;
  - Pathology of ceramic coatings, plasters and paints;
  - Reinforced concrete. The problem of armor oxidation and other chemical reactions;
  - Moisture in buildings. Forms of manifestation. Diagnosis;
  - Cracking. Microcracks, cracks and crevices. Origin, active or non-active.
4. Diagnosis and surveying of pathologies in construction.
  - Systems and methods of inspection and diagnosis. Approach to different methodologies;
  - Equipment for the diagnosis of moisture problems;
  - Testing equipment to support the diagnosis of various materials and components;
  - In situ tests, destructive, semi-destructive and non-destructive in reinforced concrete elements;
  - Monitoring and numerical simulations;
  - Laboratory tests. Models and prototypes;
5. Rehabilitation of Ancient Buildings
  - Conservation and reinforcement of wooden structures. Traditional and conventional techniques;
  - Consolidation and reinforcement of old masonry. Intervention techniques recommended by ICOMOS;
  - Artistic heritage. Restoration techniques. The art of lime. Fresh paint;
  - Preservation and renovation of wall coverings (renderings and paints).
6. Rehabilitation of Contemporary Buildings.
  - Structural reinforcement of elements in reinforced concrete;
  - Non-structural repair of reinforced concrete elements. Repair products;
  - Renovation and reinforcement of waterproofing;
  - General strategies for the rehabilitation of ceramic tiles.
7. Solutions for repairing anomalies caused by dampness.
8. Repair of cracks and crevices. Repair techniques and commercial products.
9. Thermal Rehabilitation of Buildings.
  - Thermal Rehabilitation of Facades;
  - Thermal Rehabilitation of glazing;
  - Thermal Rehabilitation of an Old Building - Case study.
10. Portuguese regulation n95 / 2019
  - The new regime applicable to the rehabilitation of buildings;
  - Main changes introduced by DL no. 95/2019.

### Recommended reading

1. Wood, B. J. (2009). Building maintenance. John Wiley & Sons.
2. Appleton João, (2011). Reabilitação de edifícios antigos: patologias e tecnologias de intervenção, Publicação Alfragide: Edições Orion;
3. Córias, Vitor, (2009). Inspeções e ensaios na reabilitação de edifícios, IST Press.
4. Córias, Vitor, (2004). Guia prático para a conservação de imóveis: manual para a utilização durável e económica da habitação, através de uma adequada manutenção, Editora: Dom Quixote

**Recommended reading**

5. Coles, D. , Bailey, G. , & Calvert, R. E. (2012). Introduction to building management. Routledge.

**Teaching and learning methods**

Theoretical lessons will be taught using expository lectures, employing, as much as possible, a methodology of dialogue and discussion of issues. Practical classes will be occupied, mainly, with the resolution and analysis of practical cases. The students will have the opportunity of deal with diagnostic equipment and analyse some materials and repair processes.

**Assessment methods**

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Laboratory Work - 10%
  - Presentations - 10%
  - Work Discussion - 10%
  - Final Written Exam - 70%
2. Alternative 1 - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%

**Language of instruction**

Portuguese, with additional English support for foreign students.

**Electronic validation**

Eduarda Cristina Pires Luso	Jorge Pedro Lopes	Manuel Teixeira Brás César	José Carlos Rufino Amaro
27-02-2023	10-03-2023	10-03-2023	17-03-2023