ELARCH Master **C**ourse in:

Structural Analysis of Monuments and Historical Constructions – Heritage & Intervention Design

The Master in Structural Analysis of Monuments and Historical Constructions – Heritage & Intervention Design is an education programme on the engineering of conservation of structures, with a focus on architectural heritage and on the application of scientific principles in the analysis and practice of conservation of monuments and historical constructions worldwide. Two "Special Edition" of existing Master Courses (**SAHC** and **P&P**), addressed to the thematic fields of the ELARCH project, are coordinated by offering an integrated programme based on theoretical and on-site education and research activities on case studies.

It addresses the issue of existing buildings, but with an emphasis on buildings with cultural value. Europe is the world leader in the generation of knowledge, methodology and technology applicable to the conservation and restoration of the architectural heritage.

The Master is addressed to Latin American students offering them a unique opportunity for studying at two European universities, belonging to the ELARCH Partnership, the Universidade do Minho and the University of Basilicata. It provides students with advanced theoretical and practical knowledge on the mentioned subjects combining the diversity of expertise offering education oriented to a multidisciplinary understanding of structural conservation through the involvement of experts from complementary fields, in a research oriented environment.

Master Venue and Accommodation

The Master lasts 20 months and is held in two locations: the Universidade do Minho in Portugal and the Università degli Studi della Basilicata in Italy.

Although students can stay at the Halls of Residence of the Universities of Minho and Basilicata, many students prefer to look for private apartments, for which the courses secretariats provide all the necessary assistance.

Degree Awarded

The degree awarded is a Master's degree, provided as a double degree counting 120 ECTS credits from the institutions involved. The degree awarding institution are as follows:

- University of Minho, Portugal: ***Mestrado em Análise Estrutural de Monumentos e Construções Históricas*** (60 ECTS)
- University of Basilicata, Italy: **Master Universitario in *Patrimoni & Progetto: tutela, conservazione e recupero del Patrimonio Architettonico e del Paesaggio*** (60 ECTS)

PROGRAM STRUCTURE AND CONTENT

The master programme is a full-time programme lasting 20 months and places students within two universities: the Universidade do Minho in Portugal and the Università degli Studi della Basilicata in Italy.
The didactic plan counts in total 120 ECTS credits, of which 60 ECTS credits at the University of Minho, Portugal and an equal number of credits at the University of Basilicata, Matera Campus, Italy.
Attendance is obligatory (at least 90% of the course) and it requires students mobility between the two universities as scheduled below:

- from ***September 2016 – June 2017*** at the **Universidade do Minho,** Guimaraes Campus **–** Portugal;
- from ***June 2017 – April 2018*** at the **Università degli Studi della Basilicata**, Matera Campus – Italy.

An internship will take place in Madrid, at the Universidad Politecnica de Madrid, at the end of the Master Programme.
Final dissertation can be written in English, Portuguese, Spanish or Italian. It will be performed jointly, part at the University of Minho and part at the University of Basilicata and will be discuss in Matera.

The study programme consists of:

- seven sequential units (U1 to U7) at University of Minho in Guimaraes (*Mestrado em Análise Estrutural de Monumentos e Construções Históricas* - 60 ECTS), with six technical units and one project-based unit;
- four sequential units (U8 to U11) at University of Basilicata in Matera (*Patrimoni & Progetto: tutela, conservazione e recupero del Patrimonio Architettonico e del Paesaggio* - 60 ECTS), with four technical units;
- one unit entirely dedicated to the final dissertation developed jointly, part to the Univ. of Minho and part to the Univ. of Basilicata.

The units are as follows:
U1: History of Construction and of Conservation
U2: Structural Analysis Techniques
U3: Seismic Behaviour and Structural Dynamics
U4: Repairing and Strengthening Techniques
U5: Inspection and Diagnosis
U6: Restoration and Conservation of Materials
U7: Integrated Project
U8: Knowledge and Protection of the Heritage
U9: Legislation and Marketing for the Management of the Heritage
U10: Interventions on the Heritage
U11: Laboratory of training and Architectural Practice within the “Matera Sassi”
U12: Dissertation including an internship in Madrid

Units U1 to U6 are arranged as a mix of theory and application, in a context of a project-led education. Lectures are held from 9:30h to 12:30h and individual/group work is carried out at University of Minho

from 14:00h to 19:00h. Each of these units correspond to 5 ECTS. Units U1 to U4 are taught in Spanish while units U5 and U6 are taught in Portuguese.
The Integrated Project (U7) is a project-based course and includes a mini group project to solve a real engineering problem, with site visits. This unit has 9 ECTS credits and is taught in Portuguese.

The Units U8 to U11 addressed to the Heritage through practice and theoretical lessons relevant to historical, architectonical, structural, and management issues (Unit U8 has 13 ECTS, Unit U9 has 6 ECTS, and U10 has 21 ECTS). Lectures, taught in Italian (sometimes in Spanish), are held from 9:30h to 13:30h and individual/group works are carried out at University of Basilicata from 15:00h to 19:00h. The practice, that is the main aspect of these units, will be performed in real construction sites with the cooperation of specialized enterprises. The sites are chosen within the old city centre of Matera, “Matera Sassi” (from Unit U8 to Unit U10, and entirely the 6 ECTS of Unit U11).

The Dissertation (Unit U12 of 35 ECTS - 21 ECTS at Univ. of Minho and 14 ECTS at Univ. of Basilicata) aims at developing research and/or professional competences in the field of conservation and restoration of architectural heritage structures. It consists of a project of recovering, restoration and protection of real case studies. The dissertation can be written in English, Portuguese, Spanish or Italian.

LEARNING OUTCOMES

U1: History of Construction and of Conservation

- Identify and describe construction materials and techniques.
- Identify and interpret the main structural elements (foundations, walls, columns, arches and vaults, pavements and roofs).
- List and illustrated history of conservation.
- Identify, describe and justify the general methodology for structural analysis.
- Identify, describe and interpret the principal damage in monuments and collapse mechanisms.

U2: Structural Analysis Techniques

- Identify and explain the principles of finite element analysis
- Describe and apply advanced material models (continuum and discontinuum)
- Use and interpret non-linear structural analysis

U3: Seismic Behaviour and Structural Dynamics

- To understand the seismic phenomenon, to describe the basic concepts of seismology and to identify the main characteristics of earthquakes;
- To describe and to characterize the dynamic and seismic responses of structures equivalent single and multiple degrees of freedom;
- To apply and to compare the different methodologies for the seismic analysis of structures;
- To identify and to describe the damage and collapse mechanisms in ancient masonry structures.

U4: Inspection and Diagnosis

- To identify and to describe the methods for inspection and diagnosis applicable to historic structures
- To identify and to explain the working principals of the methods and tests for inspection and diagnosis
- To elaborate inspection and diagnosis works
- To use and interpret the results from the inspection and diagnosis works for structural analysis

U5: Repairing and Strengthening Techniques

- Identify and propose suitable techniques for repairing/strengthening concrete structures
- Identify and propose suitable techniques for repairing/strengthening steel structures
- Identify and propose suitable techniques for repairing/strengthening masonry structures
- Identify and propose suitable techniques for repairing/strengthening timber structures

- Define and compare traditional and innovative material/techniques

U6: Restoration and Conservation of Materials

- Identification of the main laboratorial techniques for characterization of materials.
- Describe the main agents for chemical, physical and biological degradation of materials.
- Describe the main repair and restoration of historical materials: stone, bricks, wood, metals and masonry.

U7: Integrated Project

- Consolidation of the acquired knowledge during the past UCs of the course.
- Integrated project aiming at evaluation the structural safety and proposal of remedial measures of a case study previously selected.

U8: Knowledge and Protection (*Lectures and On-Site School*)

- To identify and to describe the architectonic, cultural, and landscape heritage
- To study the historical iconography of cities and landscapes
- To know the advanced techniques of heritage survey
- To analyse the materials, techniques and constructive traditions of heritages
- Educational in-situ inspection and assessment of real case studies

U9: Legislation and Marketing for the Management of the Heritage (*Lectures and On-Site School*)

- Territorial and urban strategic planning of heritages
- Marketing and management of heritages

U10: Interventions on Heritage (*Lectures and On-Site School*)

- To plan the adequate design methodologies on the heritages
- To identify the historical urban fabric: case studies
- Chemical identification of the constructive materials
- To assess the energetic sustainability of the built heritage
- To evaluate the safety of structural interventions on the built heritage

U11: Laboratory of training and Architectural Practice within the "Matera Sassi" (*On-Site School*)

- To identify, to diagnose, to plan an integrated project for conserving and protecting the built heritage (analysis of the case study for the final dissertation)

U12: Dissertation including an internship in Madrid

- To develop and to present the dissertation work.

Minimum Requirements for the Admission

The admission requirements for students wishing to enroll in the ELARCH Master Programme are a good quality degree in Civil Engineering and Architecture or equivalent qualifications. Architects wishing to apply should have a solid background in structures. Typically, students are expected to have a higher education degree with four or five years. Exceptionally, a higher education degree with three years will be accepted.

Admission is subjected to the approval of the ELARCH Committee, and is based upon the applicant's ability and motivation, recommendation letters and language skills.

You may not enroll onto a Master's and other university courses. If you are already enrolled onto a university course, you may suspend your studies, if permitted by the applicable regulations, for the entire duration of the Master's, pursuant to the "pre-enrolment" procedures laid down by the University.