

Title of BIP: Combined Structural and Energy upgrade of buildings in rural areas

2024-1-IT02-KA131-HED-000227430-1

General information

Objectives and Description:

The course, which, in the physical phase, will be held between Brescia and a mountain village in Valcamonica (BS), will investigate, first of all, the historical stratification of the village, the construction and strengthening techniques, the types of materials and their origin, the state of conservation of the buildings and the most frequent structural systems used. Knowledge of the characteristics of the historical buildings will highlight the main critical issues of the construction heritage. Lectures will be completed with in-depth studies on structural behavior of wooden floors, wooden roofs, vaults, arches and masonry walls topics.

The use of innovative materials for the rehabilitation of masonries will be one of the main subjects of the program. The strengthening technologies based on the use of Textile Reinforced Mortar (TRM) will be deeply discussed to provide students with an overview of the compatible and effective solutions for the protection of the historical centers.

Another goal of the subject will be to propose energy renovation solutions based on the use of geo and bio-based insulating materials, renewable energies such as solar energy, and innovative energy solutions such as heat pumps or polygeneration.

Hence, one of the main goals of the Programme is to offer an innovative background on existing structures.

Participants, through laboratory activities, will be able to investigate real case studies refining their ability to read and interpret historical buildings, using the most appropriate intervention techniques. The intervention projects designed have the goal of guaranteeing the maintenance continuity of mountain rural architectural heritage, encouraging its reuse by improving its energy efficiency, usability conditions and structural performance.

The remote meetings will help students in identifying critical issues related to the structural and energy efficiency perspective to be applied to real cases.

Methods and outcomes:

The BIP workload will be equivalent to 3 ECTS and will consist of a total 39 hours in which students will attend lectures, laboratory and supervised work in groups: 30 physical hours and 9 hours of virtual activity.

The following methodologies will be used during the course: challenge-based learning, participatory learning, cooperative learning, problem-based learning, flipped classroom, work group and case study presentation.

As a result, participants are expected to obtain:

- an overview of the main critical issues in existing building in rural and mountain areas, comprising materials, structural safety and energy efficiency
- an overview of some of the advanced strategies to implement and retrofit these buildings in a combined and synergic way.

- an overview of the innovative strengthening technologies based on the use of composite materials characterized by inorganic matrices.

- an overview of technologies for improving energy efficiency of buildings

Field of Education:

Civil Engineering, Architectural Engineering, Energy, Mechanical Engineering, Architecture

Target audience / Participants profile:

The course is designed for undergraduate, master and PhD students of Civil Engineering, Architectural Engineering, Energy, Mechanical Engineering, Architecture who are interested on building's rehabilitation from different points of view: historical, materials, structural or energy. They should be interested not only in theoretical issues but also in practical application on site. Besides, the focus is made on buildings in rural areas, in particular in a mountain village. Besides, the course is open to students from different disciplines of the above Fields, which provides an enriching perspective for tackling the same issues from different points of view.

No of ECTS issued: 3

A certificate of attendance will be issued for students who actively participate in at least 75% of the course and develop properly the tasks proposed by lecturers.

Language of instruction and requirements:

English (minimum level B2)

Dates for physical activity:

Sept 8-12, 2025

Location of physical activity:

University of Brescia (Sept 8-10) Department Civil, Environmental, Architectural Engineering and Mathematics (DICATAM), Via Branze 43, Brescia (Italy);

mountain village in the Province of Brescia (Sept 11 and 12)

Dates for virtual component:

N.B.: The time reference should be intended as Central European Summer Time (C.E.S.T., UTC +2)

- 4th September 2025: 3 hours (5-8 PM C.E.S.T.) by UNIBS

- 5th September 2025: 3 hours (10 AM-1 PM C.E.S.T) by UNIZAR

- 18th September 2025: 3 hours (5-8 PM C.E.S.T.) by USMB

Virtual Component Description:

The virtual activities will be based on the analysis of historical buildings from a structural, material and energy efficiency point of view.

Theoretical fundamentals on structural aspects and energy efficiency and upgrade will be presented and discussed. Conventional, advanced techniques and practices will be also presented as a basis for the physical meeting.

Presentation and discussion of case studies will be also provided.

Organizing Board

Receiving/Host university:

University of Brescia, Italy (Fausto Minelli, fausto.minelli@unibs.it)

University of Brescia, Italy (Luca Facconi, luca.facconi@unibs.it)

Sending/Partner universities:

P1. Université Savoie Mont Blanc, France (Mickaël Pailha, mickael.pailha@univ-smb.fr)

P2. Universidad de Zaragoza, Spain (Sergio Usón Gil, suson@unizar.es)

Detailed programme

1. Planned activities during virtual component:

UNIBS Thursday **4th September 2025**: 3 hours (**5-8 PM C.E.S.T.**)

- Opening and presentation of BIP program and modules
- Introducing people (professors and students) and getting to know each other
- 2 professors from UNIBS giving seminars on masonry in general and applications on mountain areas. (types of masonry, masonry behavior, arches and vaults, wooden floors, wooden roofs, steel ties, principal mechanisms and failure modes)

UNIZAR Friday **5th September 2025**: 3 hours (**10 AM-1 PM C.E.S.T.**)

- Seminar on fundamentals of renewable energy and energy efficiency (general energy context, energy sources, fundamentals of energy conversion technologies and efficiency).

USMB Thursday **18th September 2025**: 3 hours (**5-8 PM C.E.S.T.**)

- Seminar on fundamentals of innovative materials for the rehabilitation of masonries. Strengthening technologies based on the use of Textile Reinforced Mortar (TRM)

2. Planned activities during physical component:

1st day:

Monday 8 th September

09:00 – 09:30: Participant registration and welcome

09:30 – 10:00: Presentation of the course (F. Minelli)

10:00 - 10:30: Coffee break

10:30 – 11:30: Properties and pathologies of historical masonry (F. Minelli)

11:30 – 13:00: Mechanical behavior and failure mechanisms of historical masonry structures (L. Facconi)

13:00 - 14:00: Lunch

14:30 - 17:00: Masonry Rehabilitation - Module I (C. Caggegi)

Social event

2nd day:

09:00 - 10:00: Terminology (C. Messonnier)

10:00 - 10:30: Coffee break

10:30 - 13:00: Renewable energy in buildings and in small villages (S. Usón)

13:00 - 14:00: Lunch

14:30 - 17:00: Masonry Rehabilitation - Module II (C. Caggegi, M. Pailha)

3rd day:

09:00 - 10:00: Terminology (C. Messonnier)

10:00 - 10:30: Coffee break

10:30 - 13:00: Energy efficient technologies for buildings: heat pumps and polygeneration (S. Usón)

13:00 - 14:00: Lunch

14:30 - 17:00: Transfer to the village and visit-inspection of the buildings/case studies (C. Caggegi, M. Pailha, C. Messonnier, L. Facconi, F. Minelli, S. Usón)

4th day:

09:00 - 10:00: Terminology (C. Messonnier)

10:00 - 10:30: Coffee break

10:30 - 13:00: Strengthening techniques applied to case studies (F. Minelli)

13:00 - 14:00: Lunch

14:30 - 17:00: Group work / laboratory (C. Caggegi, M. Pailha, C. Messonnier, F. Minelli, S. Usón)

Dinner - Mountain experience

5th day:

09:00 - 10:00: Terminology (C. Messonnier)

10:00 - 10:30: Coffee break

10:30 - 13:00: Strengthening techniques applied to case studies (C. Caggegi, M. Pailha). Energy upgrade applied to case studies (S. Usón,)

13:00 - 14:00: Lunch

14:30 - 17:00: Group work / laboratory (C. Caggegi, M. Pailha, C. Messonnier, F. Minelli, S. Usón)

Return to Brescia

Program at a glance.

	Sept MONDAY 8	Sept TUESDAY 9	Sept WEDNESDAY 10	Sept THURSDAY 11	Sept FRIDAY 12
09.00-10.00	Registration Opening and presentation (UNIBS)	Terminology (USMB)	Terminology (USMB)	Terminology (USMB)	Terminology (USMB)
10.00-10.30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10.30-13.00	Masonry UNIBS: pathologies and mechanisms (failure modes) (UNIBS)	Renewable Energy in small Villages (UNIZAR)	Renewable Energy; Heat Pumps and Polygeneration; Small Energy community: Module II (UNIZAR)	Strengthening techniques applied to case studies (UNIBS)	Strengthening techniques applied to case studies (USMB) Energy upgrade applied to case studies (UNIZAR)
13.00-14.30	Lunch	Lunch	Lunch	Lunch	Lunch
14.30-17.00	Masonry Rehabilitation – Module I (USMB)	Masonry Rehabilitation – Module II (USMB)	Transfer to the village and visit-inspection of the buildings/case studies	Group Work/laboratory (UNIBS, UNIZAR, USMB)	Group Work/laboratory (UNIBS, UNIZAR, USMB)
			Visit of the village		Return to Brescia
	Social Event			Dinner- Mountain Experience	

[Application procedure](#)

Students send the applications to their home university.

Home university nominates the students at UNIBS by **30th June 2025**.

Facilities provided to participants:

- Social Event (September 8th) and Dinner of September 11th