

Doctoral course on Earthen construction

Date and location: 22 August 2024, Hanoi, Vietnam

Overview of the course

In collaboration with the RILEM technical committees BEC, MAE and PEM, this doctoral course aims to present a multi-disciplinary approach to research on earth construction. The program of this course will cover a large variety of topics, from vernacular practices to the latest developments in the scientific community. It will also gather experts in material sciences, processing and structural design.

This course is based on recent scientific data in the literature and the recognised skills of researchers involved in these topics.

Objectives

The aim is to deepen students' knowledge in:

- the applications of earthen materials in construction
- their hygrothermal and mechanical behaviour
- the structural design, especially in seismic zones
- their durability and bio-stabilisation as a means of improvement

Target audience

The courses are aimed at doctoral/post-doctoral students in the field of construction materials and Civil Engineering.

Prerequisites

Basic knowledge in civil engineering or geotechnics.

Program

FRIDAY (22 Aug.)

MORNING

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| Lecture 1 | Building with earth Earthen construction: heritage and techniques. Unsaturated soil mechanics applied to earthen construction | Prof. Chris Beckett |
| Lecture 2 | Mechanical performances of earthen structures • Structural design and seismic behavior | Prof. Quoc Bao Bui |

AFTERNOON

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| Lecture 1 | Durability assessment and modeling • Identification of main durability problems • Modeling water dynamic with phase change in earthen materials | Prof. Antonin Fabbri |
| Lecture 2 | Bio-stabilisation • Bio-stabilisation and durability enhancement of earthen materials | Prof. Céline Perlot |

Topic 1: Building with earth

- Introduction and presentation of earthen construction techniques
- Give general formulation principles
- Analysis of the hydromechanical performance based on unsaturated soil mechanics

Topic 2: Mechanical performances of earthen structures

- Basic structural design for current loads: load-bearing and non-load bearing cases
- Longterm behaviour of load-bearing earthen walls: creep and buckling phenomena
- Dynamic behaviour of earthen buildings
- Seismic design for earthen buildings
- Reinforcement methods for earthen buildings

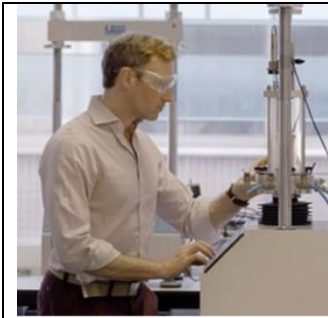
Topic 3: Durability

- Describe the main durability issues
- Provide some theoretical backgrounds for modelling it
- Present methods and approaches for assessing the durability

Topic 4: Bio-stabilisation

- Describe the mechanisms of bio-stabilisation
- Classify the bio-stabilisers and bio-stabilisation methods based on the origins and effects.
- Understand how bio-stabilisation could improve durability.
- Give practical examples.

Speakers



Christopher Beckett is a Senior Lecturer at The University of Edinburgh, Deputy Director of Civil and Environmental Engineering, the deputy Chair of the RILEM Technical Committee 319-MAE: Mechanical performance and durability assessment of earthen elements and structures, and chairs the Standards Australia Committee BD-083: Australian Earth Building. He has secured over £1M in funding to support earthen construction research, which explores the hydromechanical, thermal, embodied energy/carbon, and architectural use, behaviour, and characterisation of earthen construction materials around the world.



Quoc-Bao Bui received his PhD in 2008 at ENTPE (Ecole Nationale des Travaux Publics de l'Etat) Lyon, France, and his HDR (Habilitation) in 2023 at University Lyon 1, France. From 2011 to 2016, he worked as Associate Professor at Polytech Annecy-Chambery, University Savoie Mont-Blanc, France. Since 2016, he has joined Ton Duc Thang University (Vietnam) as Senior Lecturer. His research interests cover from materials to structures: non-conventional materials (soil-based materials, recycled materials, geopolymers, graphene-based nanosheets), energy-efficiency buildings and structural analyses (static and dynamic behaviour). He has published more than 60 articles in international journals, several books and book chapters. He has been coordinator or member of several international and national projects. He is Editorial Board member of two international journals.



Antonin Fabbri got his PhD in 2006 on physics and mechanics of freezing-thawing behavior of porous media at "Laboratoire Navier". During his post-doctoral position at the "Ecole Normale Supérieure," he investigated the supercritical carbonation of oilwell cements. From 2007 to 2011, he managed projects related to CO₂ geological sequestration at the French Geological Survey (BRGM). Since 2011, as a research professor at ENTPE, he has focused on the hydrothermal and hydromechanical behaviors of earthen materials such as rammed earth and earth plasters, as well as their durability. He is Chair of the RILEM TC on Mechanical Performance and Durability Assessment of Earthen Elements and Structures. He serves as an executive board member of the French National Project on earthen construction.



Prof. Céline Perlot is a full professor at the University of Pau (France) and, PhDs in Civil Engineering from the University of Toulouse (France) and the University of Sherbrooke (Canada). As a specialist in the physical chemistry of construction materials, she conducts research into microstructural characterization and transfers in earthen materials. She is the head of a scientific innovation chair of the Institut Universitaire de France on the effect of raw earth biostabilization on indoor building comfort, and deputy chair of the TC BEC "Bio-stabilised earth-based construction".