

PhD offer

Topic : Durability of Earthen Constructions A Microstructural and Mineralogical Approach

Scientific and Societal Context

Earthen construction is an ancestral and ecological building material currently experiencing renewed interest due to its environmental and hygrothermal advantages. It accounts for nearly 15% of France's historic built heritage and still houses about one-third of the world's population. However, despite its recognized qualities, its durability remains poorly understood, particularly regarding alterations caused by water, salts, or microorganisms. Understanding these phenomena is a major challenge for both heritage conservation and the development of sustainable contemporary building practices.

This PhD is part of a consortium between Université Gustave Eiffel and Université de Poitiers, supported by the Fondation MAIF and Université Gustave Eiffel. It aims to deepen the understanding of earthen material alteration mechanisms at the microscopic scale, using innovative mineralogical analysis methods.

PhD Objectives

The thesis will develop and apply non-destructive sampling protocols on heritage buildings made of rammed earth, cob, and adobe, and characterize the microstructure and the mineralogical and textural evolution of clay minerals in earthen materials in relation to observed degradations. This work will establish a reference database and an atlas of microscopic pathologies, and propose adapted recommendations for both new construction and renovation of historic earthen buildings.

Methodology

The three-year PhD project will first carry out an assessment of existing pathologies in earthen buildings and a survey of heritage buildings that are of particular interest for the study. Following on-site sampling, the materials will be preserved and analyzed using innovative methods developed at the University of Poitiers. The PhD candidate will then relate the modifications observed at the microscopic scale to the data collected in the field, linked to the degradation of the existing built heritage.

Scientific Supervision

Scientific supervision will be provided by Dr. Fionn McGregor (Université Gustave Eiffel), specialist in transfers and durability in earthen materials, and Dr. Baptiste Dazas (Université de Poitiers), specialist in clays and X-Ray diffraction.

The PhD candidate will benefit from an interdisciplinary research environment and collaborate with partners from the Projet National "Terre Crue" and the RILEM MAE Technical Committee. The PhD will take place within two partner laboratories:

- **Université Gustave Eiffel** (GPEM Laboratory – Granulates and Material Processing) – expertise on material durability and hygrothermal behavior.
- **Université de Poitiers** (IC2MP – HydrASA Team: Hydrogeology, Clays, Soils and Alterations) – expertise in mineralogy and advanced analyses (2D X-ray diffraction, mineralogical mapping).

Candidate Profile

Applicants should hold a Master's degree or an engineering diploma in materials science, civil engineering, geosciences, or related fields. The candidate should have solid knowledge in mineralogy, porous materials, or material durability, as well as a strong interest in built heritage and ecological materials. Experimental skills in sampling, specimen preparation, and laboratory analyses are required, as well as motivation for interdisciplinary and consortium-based work. A good command of scientific English, both written and spoken, is also necessary. Knowledge in X-ray diffraction, microscopy, or microstructural modeling would be an asset, as would strong scientific writing and communication skills for publications and conference presentations.

PhD Conditions

- **Duration:** 3 years
- **Funding:** guaranteed by Fondation MAIF and Université Gustave Eiffel
- **Start date:** between December 2025 and March 2026
- **Location:** mainly Université Gustave Eiffel (Bouguenais, 44), with occasional missions at Université de Poitiers (86).

Application

Send a detailed CV, a motivation letter, Master's transcripts (or equivalent), and possibly a recommendation letter to:

-  fionn.mcgregor@univ-eiffel.fr
-  baptiste.dazas@univ-poitiers.fr