Course guide
310790 - 310790 - Earthen Construction: Technique, Innovation, and Decarbonization

Last modified: 29/07/2026

Unit in charge: Barcelona School of Building Construction
Teaching unit: 753 - TA - Department of Architectural Technology.

Degree: BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019). (Optional subject).

Academic year: 2026 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Rivera Vidal, Amanda Catalina

Others: Rivera Vidal, Amanda Catalina
Corominas Gonzàlez, Andreu

PRIOR SKILLS

To successfully achieve the knowledge of this optional subject, it will be essential to have taken and passed the materials subjects: Fundamentals of materials, chemistry and geology, Stone materials and Non-stone and construction materials; the introduction to construction and workshop 1- Learning about traditional construction.

TEACHING METHODOLOGY

The course is developed through an active and applied methodology that closely combines conceptual theory with practical laboratory and workshop experimentation, as well as problem-based or case-study learning. It is structured into the following methodological formats:
• Theoretical and conceptual sessions: Interactive lectures in a standard classroom with multimedia support, where the geological, mechanical, historical, regulatory, and environmental foundations of raw earth materials are introduced.
• Laboratory practices: Sessions where students interact directly with earth material, performing physical and mechanical characterization tests (sedimentation, Atterberg limits, etc.).
• Prototyping and construction workshops: Practical work in outdoor spaces or EPSEB workshops aimed at manufacturing and implementing small, full-scale components (compressed earth blocks, panels, rammed earth samples, or hand modeling).
• Digital sessions: Computer-based analysis using life cycle assessment (LCA) software, alongside energy and hygrothermal simulation tools.
• Site and production plant visits: Guided visits to manufacturing facilities or production centers of industrialized earth products, as well as to contemporary or historical buildings utilizing the material in the Barcelona metropolitan area.

LEARNING OBJECTIVES OF THE SUBJECT

In the current context of climate emergency and the pressing need to introduce new skills in sustainability, decarbonization, and circular economy at EPSEB, the main objectives of this course are:
• Understand the nature of the material: Accurately identify and characterize different types of soil suitable for architectural construction, using simple field tests and standardized laboratory techniques.
• Master construction techniques: Know, analyze, and classify both traditional and heritage techniques (rammed earth, adobe, wattle and daub, renders) and contemporary, industrialized solutions.
• Assess environmental impact: Quantify the environmental benefits of building with earth in terms of low embodied energy, deep decarbonization, and hygrothermal regulation of indoor spaces.
• Explore innovation and future trends: Analyze and discuss the potential of advanced prefabrication and robotic 3D printing in earth, opening new fields for digital transition and low-carbon robotics.
• Apply regulatory frameworks and quality control: Familiarize students with current standards (such as Spanish UNE 41410 for CEB and international references) to enable material specification, on-site reception, and legal compliance in building projects.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	10,0	13.33
Hours medium group	20,0	26.67

Total learning time: 75 h

CONTENTS

Soil Science

Description:
Introduction to geology and soil science applied to earth construction. Studying soil not merely as a foundation base, but as a building material. Physical analysis of components (gravel, sand, silt, and clay). Chemical and mineralogical behavior of clays as a natural binder. Key parameters for soil suitability: grain size distribution curve, Atterberg plasticity limits, density, optimum compaction moisture content, and mechanical compressive strength of raw earth.

Related activities:
Practical work at the EPSEB Materials Laboratory to perform visual-manual field tests (odor, shine, cohesion) and standardized laboratory tests (sedimentation test, wet sieving, and determination of Atterberg limits).

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Guided activities: 6h

Traditional and cContemporary Construction Systems

Description:
Historical and technical study of earth architecture worldwide, focusing on the context of Catalonia and the Barcelona metropolitan area (the tradition of rammed earth, adobe, and mixed timber-earth structures). Analysis of typical pathologies in raw earth associated mainly with water exposure and erosion. Principles of maintenance, conservation, and rehabilitation of heritage and traditional earth systems.

Related activities:
Urban walks and/or guided tours to examine preserved examples of rammed earth or adobe architecture in the local region. Diagnosis and repair proposal project targeting a real pathology in an existing earth structure.

Full-or-part-time: 25h
Theory classes: 8h
Practical classes: 2h
Guided activities: 15h

Industrialization and Prefabrication

Description:
The transition from low-processed artisanal materials to high-tech, industrially controlled products. Detailed study of Compressed Earth Blocks (CEB), prefabricated light-earth panels or wood-earth systems, and commercial clay plasters and paints. Legal safety and regulatory framework: application of the UNE 41410 standard for CEB, alongside foreign references (German DIN standards, French quality guidelines). Protocols for quality control and on-site reception of materials.

Related activities:
Practical workshop on mechanical manufacturing of Compressed Earth Blocks (CEB) using manual or hydraulic presses in the school's workshop or in collaboration with local manufacturers, followed by mechanical compressive and flexural strength tests in the laboratory. Technical visit to industrialized earth production plants.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Guided activities: 12h

Architecture of the Future

Description:
Exploring the avant-garde in the use of earth as a key material for climate mitigation and digital transition. Study of robotic 3D printing and computational design using stabilized or natural local earth pastes (km 0). Life cycle assessment (LCA) strategies to compare and measure real decarbonization compared to conventional materials such as concrete or steel. Biophilic properties and indoor temperature/humidity regulation capacity of earth walls.

Related activities:
Computational calculation or modeling work using LCA software and thermal/acoustic simulation tools, analyzing the carbon footprint of an earth wall section (e.g., orinted earth, CEB or contemporary rammed earth) compared to a conventional wall construction.

Full-or-part-time: 20h
Theory classes: 2h
Practical classes: 6h
Self study : 12h

GRADING SYSTEM

Work with continuous assessment and development of group work.
THERE WILL BE NO EXAMS.

EXAMINATION RULES.

Depending on the number of students and the topics chosen by the students when doing the work, it can be done in groups.

BIBLIOGRAPHY

Basic:
- Dethier, J.. Arquitecturas de tierra: El arte de construir con tierraâ□¯: pasado, presente y porvenir. Blume, 2019.
- Ben-Alon, L., Loftness, V., Harries, K. A., DiPietro, G., & Hameen, E. C.. "Cradle to site Life Cycle Assessment (LCA) of natural vs conventional building materials: A case study on cob earthen material". Building and Environment [on line]. Available on: https://doi.org/10.1016/j.buildenv.2019.05.028.- Correia, M., & Duarte Carlos, G. (2021).. "Introduction: Earthen architecture, an endangered vernacular heritage". Built Heritage [on line]. Available on: https://doi.org/10.1186/s43238-021-00046-6.- CRAterre; Doat, P; Hays, A; Houben, Hugo; Matuk, S; Vitoux, F. Construire en terre . Paris : Editions Alternatives, 1979. ISBN 2862270091.
- Houben, Hugo; Guillaud, Hubert. Earth construction : a comprehensive guide . London : Intermediate Technology Publications, 1994. ISBN 185339193X.
- Houben, Hugo; Guillaud, Hubert. Traité de construction en terre . 3e ed. Marseille : Parenthèses, cop. 2006. ISBN 9782863641613.
- Fabbri, A., Morel, J.-C., Aubert, J.-E., Bui, Q.-B., Gallipoli, D., & Reddy, B. V. V. (Eds.). . Testing and Characterisation of Earth-based Building Materials and Elements: State-of-the-Art Report of the RILEM TC 274-TCE (Vol. 35) [on line]. Cham: Springer Nature, 2022Available on: https://doi.org/10.1007/978-3-030-83297-1.

Complementary:
- Gauzin-Müller, Dominique; Vissac, Aurélie. TerraFibra architectures . Paris : Pavillon de l'Arsenal, novembre 2021. ISBN 9782354870638.
- Le Bihan, Yann; Gauzin-Müller, Dominique; Tric, Zoé. Materia : 40 bâtiments en pierre, terre et fibres végétales = 40 buildings in stone, earth and plant fibres . [Paris] : Pavillon de l'Arsenal, mars 2025. ISBN 9782354870805.