

A case study on the thermal performance of materials in an earthen house in the Anoual region, Morocco: towards smart buildings and durability

Boutahar Laaouar¹, Othmane Horma^{1,2}, Mohammed Drissi¹, Hanane Miri³, Jinane Mejdoubi¹, Mohammed Amine Moussaoui¹, and Ahmed Mezrhab¹

¹Mechanics and Energy Laboratory, Mohammed First University, Oujda, Morocco

²Private University of Marrakech, Marrakech, Morocco

³Applied Geosciences Laboratory, Faculty of Sciences, Mohammed First University, Oujda Morocco

Abstract

Raw earth, an ancient and sustainable building material, has demonstrated its durability and strength through enduring structures, many of which are designated as World Heritage sites. This eco-friendly material not only offers excellent thermal and acoustic performance but also requires significantly less energy to produce compared to modern construction materials. Furthermore, it is fully recyclable, positioning it as a key material in the context of sustainable development. In Morocco, traditional earthen construction techniques such as rammed earth, adobe, and compressed earth blocks are still in use; however, these practices rely on disappearing artisanal knowledge and lack formal technical standards.

This chapter examines an earthen house in the Anoual region of Morocco constructed with compacted earth walls. Indoor temperature measurements were compared with outdoor temperatures using a Testo device to evaluate the building's thermal performance. Additionally, the thermal properties of the soil samples— including thermal conductivity, thermal diffusivity, and specific heat capacity— were characterized to assess the material's behavior under various conditions. Computational Fluid Dynamics (CFD) simulations using ANSYS software were also conducted to validate the experimental results, providing a comprehensive analysis of the thermal efficiency of earthen materials in construction. This chapter highlights the contribution of earthen materials to the development of smart and sustainable buildings.

Keywords:

Raw earth construction; Thermal conductivity; Compacted earth walls; Sustainable building materials; Computational fluid dynamics