GICONSIME – University of Oviedo

Research Group on Sustainable Construction, Simulation and Testing

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Universidad de Oviedo

Giconsime

Who are we?

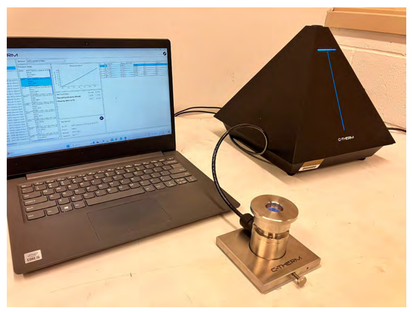
GICONSIME is a research group at the **University of Oviedo** based at the **Polytechnic School of Engineering of Gijón**, which carries out its research activity in the area of Engineering and Architecture. We combine **advanced numerical simulation** and **experimental characterization** to **improve the sustainability** and performance **of construction** materials and systems. Our researchers work across Construction Engineering, Continuum Mechanics and Structural Theory, Applied Mathematics, and Thermal Engineering.

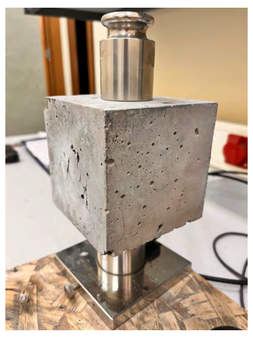
Our TES research focuses on **phase change materials (PCMs)** integrated into **building envelopes** and **cementitious materials**. We combine thermophysical characterization, inverse identification of phase change properties, transient testing of façade components, numerical modeling, and the development of PCM-enhanced mortars and concretes.

1 THERMOPHYSICAL CHARACTERIZATION OF BUILDING MATERIALS

We characterize the thermal behavior of building materials and PCM-based systems under both material-scale and transient conditions. Our work includes measurement of thermal conductivity, effusivity and specific heat capacity, as well as advanced hotbox and climatic-module testing to assess the dynamic response of macroencapsulated PCMs and cementitious materials with PCMs.

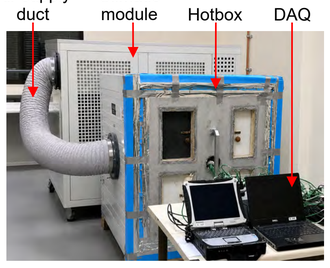
MTPS measurements



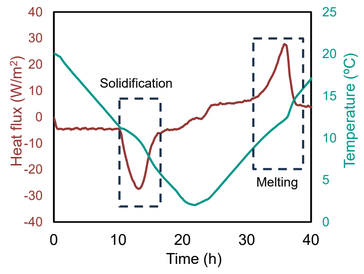


Dynamic characterization of building materials with PCMs

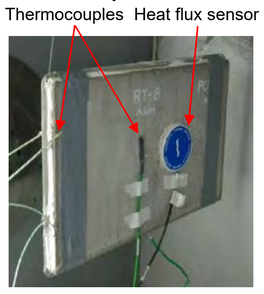
Setup



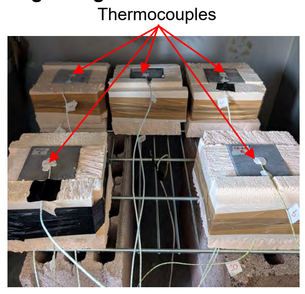
Experimental response



Macroencapsulated PCMs

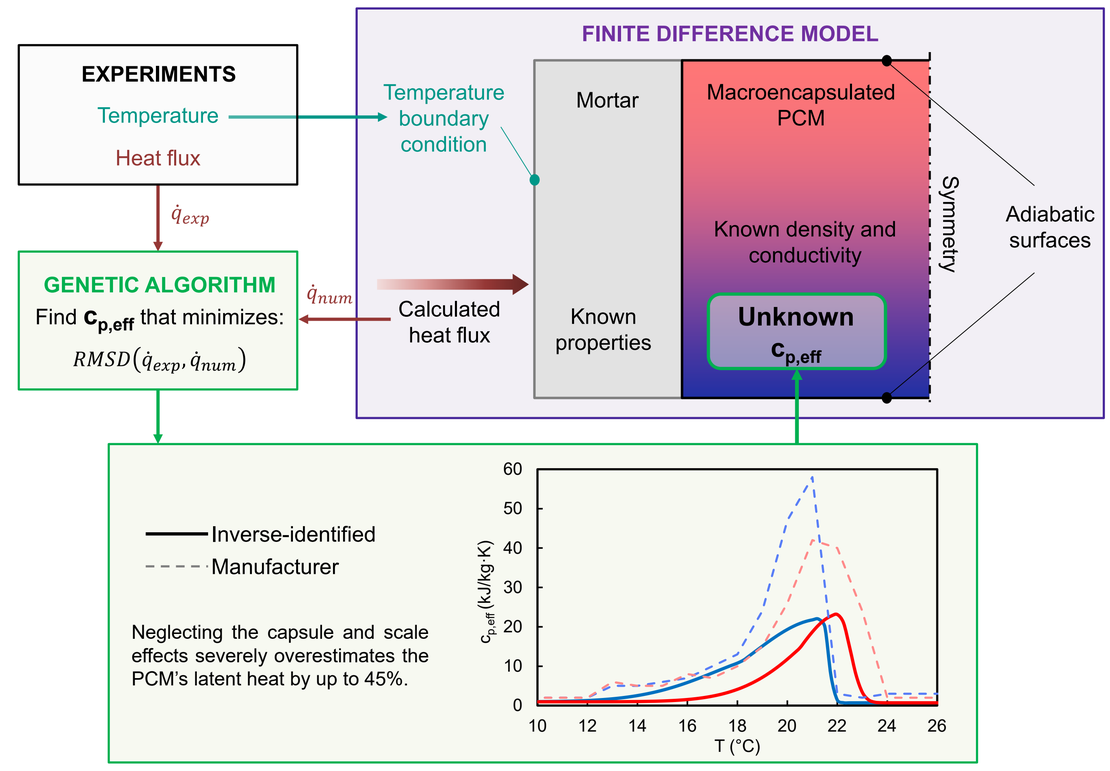


Lightweight mortar with PCMs



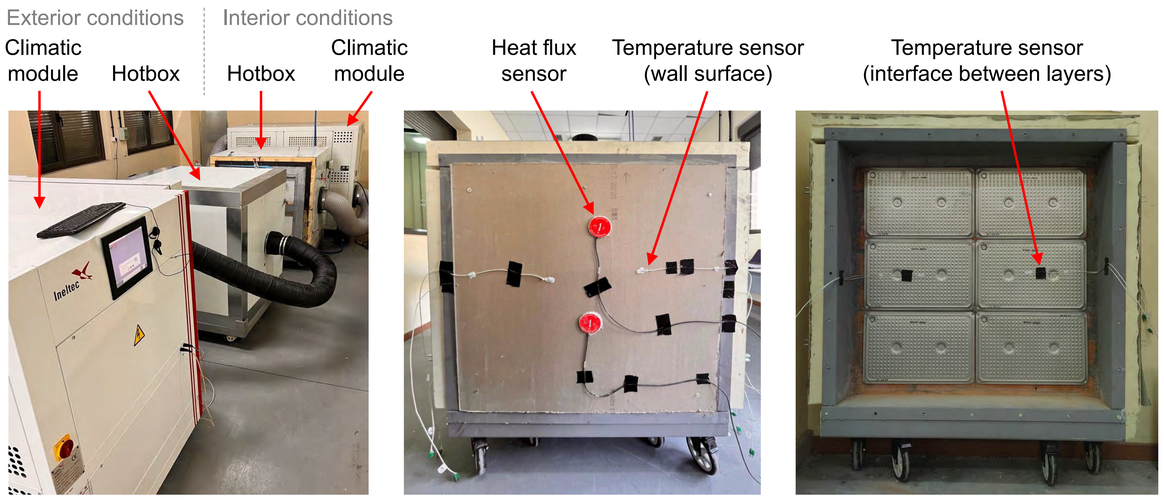
2 INVERSE IDENTIFICATION OF PHASE CHANGE PROPERTIES

We combine experiments with direct transient heat transfer models and optimization algorithms to identify effective phase change properties from measured data. This inverse procedure provides simulation-ready inputs, such as effective heat capacity curves, for PCM systems whose behavior cannot be represented accurately by manufacturer data alone.



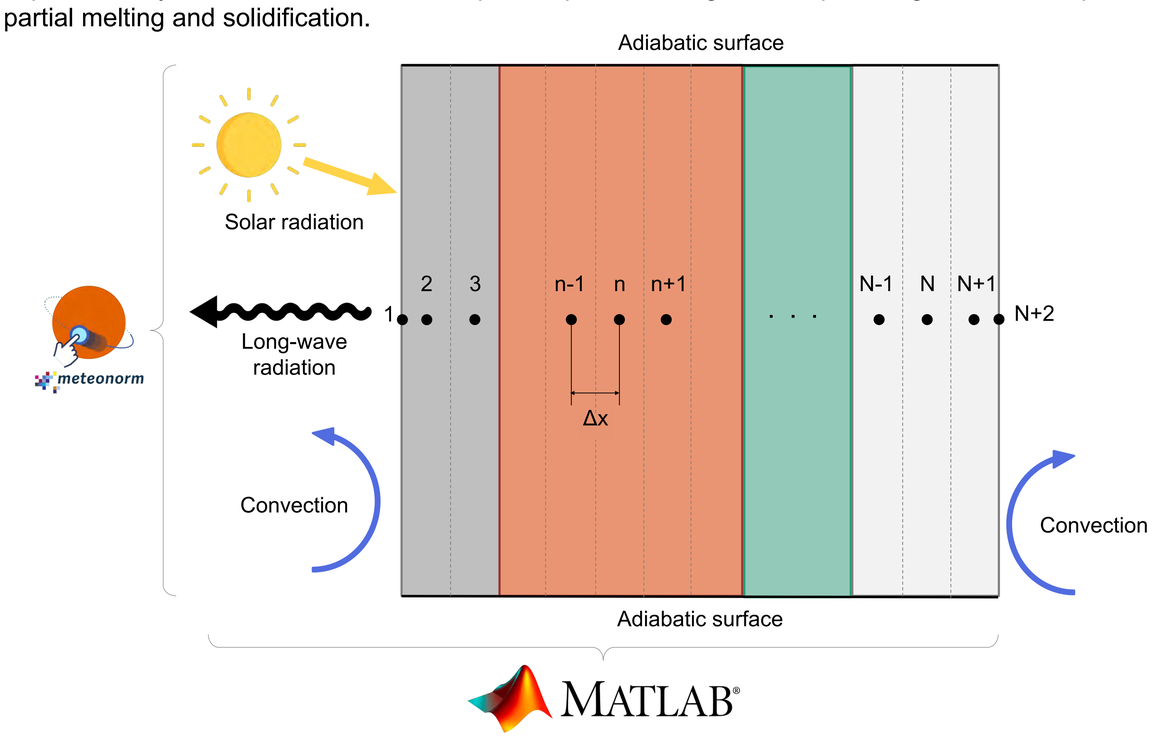
3 FAÇADE-SCALE TRANSIENT THERMAL EXPERIMENTS

We test 1 m × 1 m façade prototypes under controlled dynamic boundary conditions to quantify how PCM integration modifies heat transfer and thermal inertia. Our dual climatic module-hotbox facility allows independent programming of transient temperature and relative humidity profiles on both sides of the prototype, enabling its response to be assessed under different boundary condition scenarios. The data acquisition system includes type-K thermocouples, heat flux sensors and relative-humidity sensors.



4 TRANSIENT THERMAL MODELING OF PHASE CHANGE IN FAÇADES

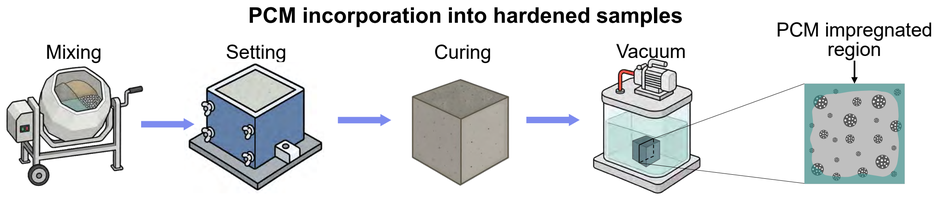
We formulate transient numerical models to analyze heat transfer in façades incorporating PCM layers. These models are used to study the effect of PCM position, transition temperature and boundary conditions, and to support the design of envelope solutions with improved thermal inertia and more effective use of latent heat. The models are implemented in MATLAB and are experimentally validated. We also incorporate phase change interruption algorithms to represent partial melting and solidification.



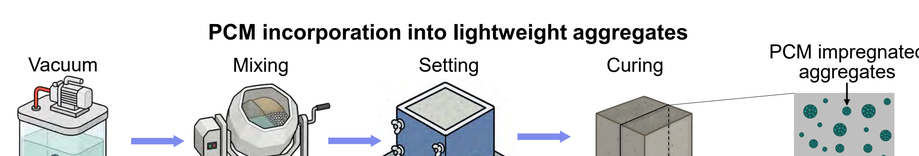
5 DEVELOPMENT AND CHARACTERIZATION OF PCM-ENHANCED MORTARS AND CONCRETES

We develop lightweight-aggregate mortars and concretes incorporating PCM and assess their thermal and mechanical performance. Current work focuses on vacuum-based incorporation, thermophysical characterization and transient thermal response, while also evaluating the implications of PCM addition for strength and their potential application in non-structural building components.

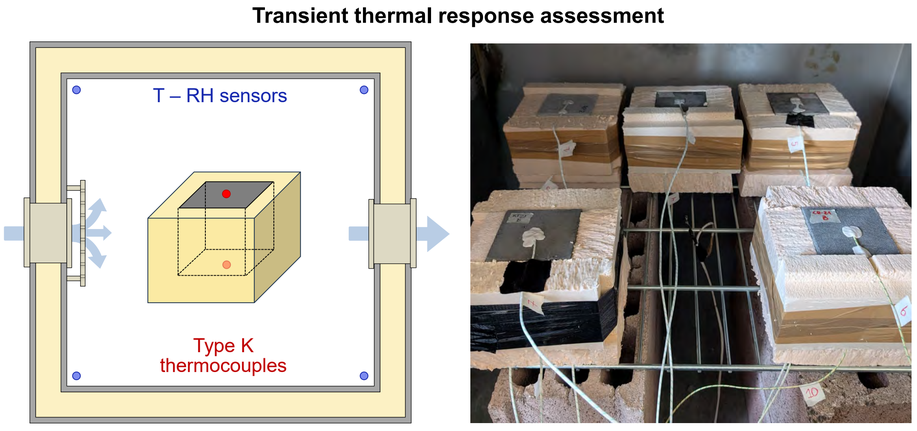
PCM incorporation into hardened samples



PCM incorporation into lightweight aggregates



Transient thermal response assessment



Mechanical characterization

Funding

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SEKUENS

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