XII International Conference on Coupled Problems in Science and Engineering, COUPLED 2027
June 27-30, 2027, Palma de Mallorca, Spain

COMPUTATIONAL MODELING OF COUPLED PROCESSES IN BUILDING MATERIALS: FROM FEM TO AI-ENHANCED APPROACHES

GIANLUCA MAZZUCCO[*], GABRIEL B. BARBAT[†], ZHENHUA WEI[‡] AND BEATRICE POMARO[*]

[*] Department of Civil, Environmental and Architectural Engineering, University of Padova,
Via F. Marzolo 9, 35131, Padova, Italy
E-mail address: gianluca.mazzucco@unipd.it, beatrice.pomaro@unipd.it

[†] Department of Civil and Environmental Engineering, Technical University of Catalonia,
International Center for Numerical Methods in Engineering (CIMNE),
Edificio C1, Campus Norte, Gran Capitán s/n, 08034, Barcelona, Spain
E-mail address: gabriel.barbat@upc.edu

[‡] Department of Ocean Science and Engineering, Southern University of Science and Technology,
1088 Xueyuan Avenue, Shenzhen 518055, P.R. China
E-mail address: weizh@sustech.edu.cn

ABSTRACT

This mini-symposium aims to bring together researchers in computational mechanics focused on the modeling of building materials under coupled conditions, including advanced constitutive frameworks and multi-physics approaches.

Elasto-plasto-damage models with viscous effects provide a comprehensive framework to capture elastic deformation, irreversible plasticity, stiffness degradation, and rate-dependent behavior. Such coupling is essential for materials like concrete, rock, and metals under high stress and varying loading rates, where micro-cracking and void evolution govern the response. These models enable more reliable prediction of failure and structural performance under extreme conditions.

At the same time, modern construction materials exhibit complex behavior governed by the interaction of mechanical, thermal, hygric, and chemical processes, requiring advanced numerical and data-driven approaches.

This session will highlight advances in coupled modeling of quasi-brittle and ductile materials, as well as composites and sustainable materials, with emphasis on multi-scale modeling, nonlinear phenomena, and integration of experimental data into computational frameworks. The role of artificial intelligence and machine learning will also be explored, including surrogate modeling, hybrid physics-informed approaches, and parameter identification.

Topics of interest include, but are not limited to: thermo-mechanical coupling; moisture transport and durability; chemo-mechanical degradation; and fracture and damage, addressed through advanced finite element formulations and/or AI-assisted simulation techniques. Contributions focusing on verification, validation, uncertainty quantification, and real-world engineering applications are especially encouraged.