CERIS Civil Engineering Research and Innovation for Sustainability

PEP_SG WEBER – Efficient Wall Plus Saint-Gobain Weber

Summary

This project aimed to develop a sustainable and energy-efficient multifunctional external wall solution. The solution was made with the following main materials:

- The support (masonry).
- A new thermal block, made with cement, expanded clay aggregates (Leca®) and some mixtures in order to attain a more lightweight concrete (integrated into an optimized geometry) without compromise the mechanical strength.
- The rendering mortars, including the finishing materials - a thermal mortar with improved insulating properties.

The final output was an innovative wall solution, characterized by a low thermal transmittance coefficient, U, equal or lower than 0,35 W/m².K, assuming a masonry with 250 mm of maximum thickness and a thermal insulating mortar with 55 mm of maximum thickness. Once achieved this goal, it was possible to obtain a wall solution aligned with the new thermal legal requirements that contributes to the reduction of energy consumption and resources, and where the mortar presents a CO_2 footprint way below the traditional insulating materials (at least over 50% reduction). This reduction was also achieved by the block itself, either from a formulation with cement reduction, or from the indirect effect in reducing the insulating material need.

To achieve these results, the project team included: Saint-Gobain Weber (SG Weber), the leader, which presents a wide range of skills that covers the whole project and Instituto de Construção (IC), an organization with high technical and scientific skills in developing masonry blocks for external walls of buildings, as well as CERIS from IST, also with high technical and scientific skills in developing advanced thermal renders and also in Life Cycle Assessment of construction products.

Regarding the masonry block, over the last 20 years, SG Weber has developed construction solutions and processes with expanded clay (Leca®) and lightweight concrete that are focused on a quality performance ensured by the accomplishment of the functional requirements and the adequate use in construction works.

IC brings expertise in the development and optimization of lightweight concrete blocks with improved thermal and mechanical behaviour.

For the development of the thermal rendering mortar, made by CERIS - IST, the experiments initiated by using a similar material that is already commercialized by SG Weber, however with new developments / improvements, in particular by adding new insulation aggregates, lightweight aggregates and other mixtures. SG Weber has skills in nanomaterials that can be used as insulating aggregates in thermal mortars, which had a chance to be explored within the project. The resulting thermal mortar can be applied in the new developed block in order to form a wall system with high energy efficiency.

Figure 1. Aspect of the lightweight insulation aggregates used - silica aerogel.

Finally, was developed and investigated materials capable of completing the rendering system robustness and functionality, such as finishing mortars and reinforcement components.

The main contributions from the CERIS-IST team were related to the development and extensive test of different thermal renders compositions in order to improve their performance, mainly related to the thermal conductivity, compressive strength and adhesion. The team tested more than 50 different compositions that allowed the fine-tuning of its performances and studied even more compositions containing different component dosages and characteristics.

The tests made are in line with what the EN 998-1: 2010 states as requisites, analysing the thermal render on its own, and also through what the ETAG 004 defines as requisites, to analyse the thermal render incorporated in a system (ETICS), to allow the future commercialization, in the construction market, of the new thermal render.

Figure 2. Used frames for the initial tests made to the different thermal render compositions studied.

Project Reference

POCI-01-0247-FEDER-017417

Leading Institution

Saint-Gobain Weber (Portugal)

Partners

IC – Construction Institute (Portugal), CERIS was subcontracted by Saint-Gobain.

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CERIS Research Team

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Funding

COMPETE 2020, Portugal 2020

Period

2016-2019

Total

491 845.19€

CERIS

56 150.98€

Project Website

percoat.tecnico.ulisboa.pt/rpcompleted.html

This initial contribution from the team allowed to make initial tests in real-life application, with success, but with some performance parameters needing further development.

At the same time, the CERIS-IST team developed an extensive state of the art regarding the Life Cycle Assessment of the main materials used in the composition of these innovative mortars and thermal block and prepared the field work to gather the data which allowed to complete characterization from the sustainability point of view.

The objectives set for this project were fulfilled in the end of the project. From a scientific point of view, it has been possible to obtain in-depth understanding about (i) the different thermal render components, their reactions and interactions (ii) the different performances obtained as a function of the used components, through the extensive tests made. In addition, the life cycle assessment allowed a new contribution to the construction market, because unfortunately this kind of work is only at this time gaining some interest. With these objectives and results that were gathered, in order to fulfil them, in the development of the project, it was possible capture the main behavioural aspects observed in the extensive experimental campaign, thus constituting reliable tools to support the design of this type of product. From a practical point of view, a thermal render with improved thermal conductivity, compressive strength and adhesion was proposed, together with a simplified finishing system that allows its good application in the construction market. These developments, which were extensively disseminated within the scientific and technical communities, will contribute to increase the use of high performance thermal renders in the regulation of energy consumption in buildings, while demonstrating its sustainable performance.

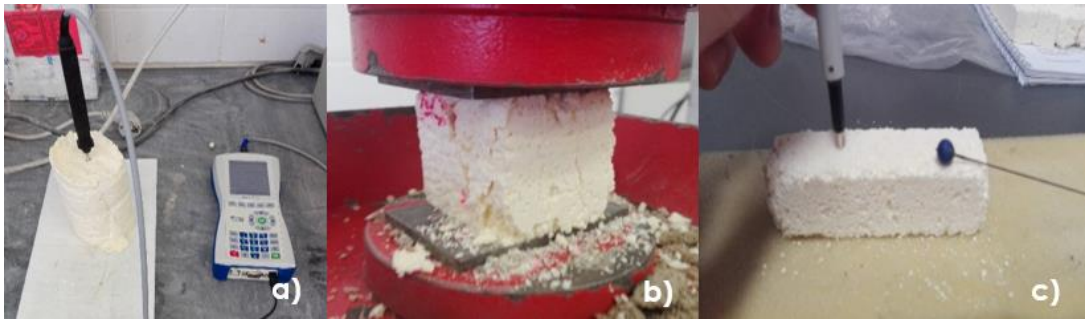

Figure 3. a) General view of the thermal conductivity test setup; b), general view of the compressive strength test setup c) general view of the dynamic elasticity modulus test setup.