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CHARACTERIZATION OF WOOD SAMPLES THROUGH NUMERICAL SIMULATION BASED ON A TEST VALIDATION BENCH PROCEDURE

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Abstract *Nowadays, most of the energy consumption is satisfied through the burning of fossil fuels, which means a great depletion of natural resources with a significant environmental impact. The construction sector in Spain represents more than 30% of the total energy consumption, so building enclosures based on materials with low thermal transmittance are encouraged to be implemented, aiming to reduce energy losses. In this case, the use of wood as a construction material is increasing significantly, due mainly to its insulating properties and relative low environmental impact.*

The setting-up of an experimental prototype through a fully monitored thermal insulated box with a single opening gate, has been designed here to characterize the thermal behavior of specific wood samples, treated with different weather-protection agents. Through a series of tests, with several temperature jumps between the internal and external sides, the thermal performances of such samples were obtained. With all these data, the different hypothesis were properly modeled through the Design builder v 4© software, whose motor Energyplus© is currently fully accepted all over the world for the characterization of buildings.

Finally, taking into account that this material is a relevant part of the whole building enclosure, a further comparative analysis carried out through another numerical model, validated according to the current regulation in Spain (CTE-HE 2013) was finally addressed, whereas former experimental outcomes were used in both models for validation purposes.

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is measurable and depends on both the difference of temperature from inside to exterior and the type of protection agents applied to samples.
The first sample, natural wood without preserving substances, means the lower conductivity when the difference of temperature is only 7 °C.
The second sample, which was treated with copper salts, implies the less pronounced variation in conductivity.
The higher the difference of temperature between the exterior and the interior environment, the better the third solution is, as its conductivity value decreases. This sample is a thermally treated wood.
On one hand, the climate conditions have strong influence in the selection of the best solution. If the gradient of temperature varies often, the wood treated with copper salts, Wolmanit CX-8, can be the best solution as the most constant conductivity is obtained, whereas the wood without any treatment and the thermal treated one are the best solutions when low and high temperature gradients respectively are reached.
On the other hand, if wood is placed outside, exposed to external climate conditions, it is necessary to use a protection barrier in order to preserve its thermal properties but also incrementing its durability against biotic and abiotic agents, so the first sample is obviously not appropriate at all to exterior uses.
In order to validate the conductivity of samples THERM software was used. In this case, both conductivity and boundary conditions were implemented. To validate the data both exterior and interior surface temperatures were compared with the initial hypothesis.
Finally, the Design Builder software was used for the simulating study. This software presents some limitations both in model size and boundary conditions, as it has been specifically designed for buildings. Due to that fact, a scale model is proposed where the boundary conditions are linked to the on-site data, which cannot be changed from the software, so a careful selection of the data, closer to the test conditions was done.
A comparison between the heat lost in simulation and the thermal resistance of the different parts of the box was addressed. In this particular case, the inner air movement and density makes the heat losses vary as there is a higher percentage of lost detected through the ceiling than through the floor. In general terms, the heat lost represented through the sample according to its thermal resistance is very close to the Design Builder results, as the box is highly insulated.
In short, THERM software to validate wood characterization and Design Builder software to simulate the test procedure are helpful tools to understand the heat transfer procedure involved in this study allowing the characterization of wood samples according to their characteristics.

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