CERIS : Civil Engineering Research and Innovation for Sustainability

Hybrid performance-based wood panels for a smart construction

Summary

Cross-Laminated Timber (CLT), a modern trend in timber construction, shows high potential for massive timber construction systems. Compared to traditional systems, the CLT panels' layout (crosswise layers) significantly reduces the anisotropy of the panels, guarantees higher physical stability and allows for easier and more efficient connections between elements and other building components, making these panels a versatile solution to bear both out-of-plane and in-plane loads. This system has also significant advantages with respect to traditional wood light-frame construction, opening a completely new field for the use of timber in construction. On the other hand, as this is a massive wood system, a significant volume of wood raw material is required to produce the panels and this is pointed out as one of the main barriers for CLT implementation, perhaps due to the associated costs.

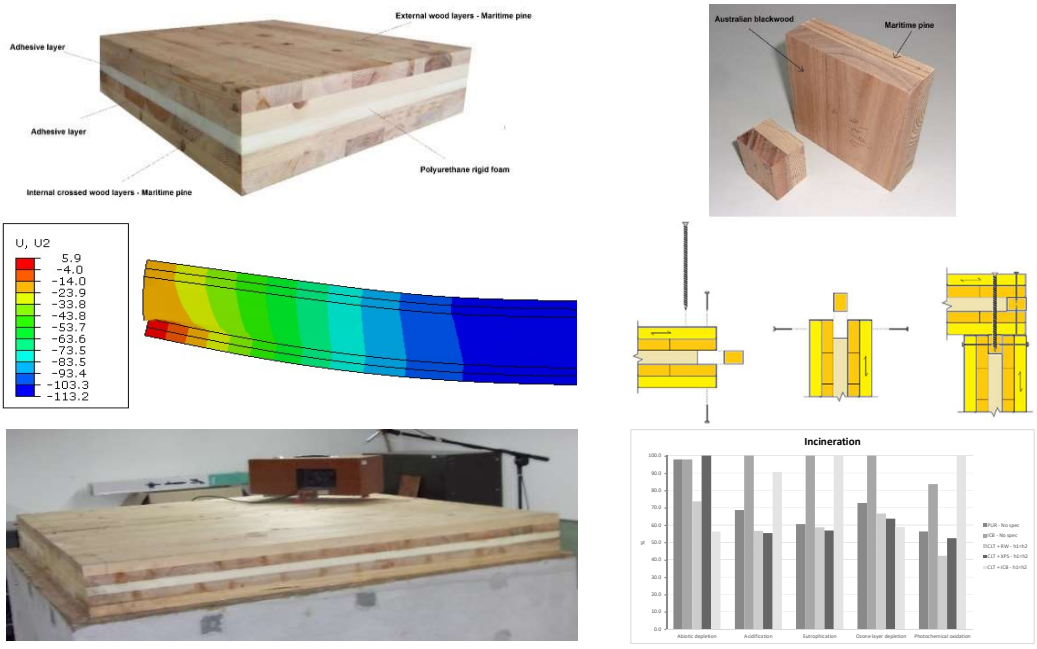
In this context, the objective of the thesis consisted of the development of an alternative, or at least complementary, CLT based panel solution but using less amount of wood, combining mechanical performance with improved thermal insulation and reduced weight. Such solution, named cross insulated timber (CIT), consists of replacing the inner layer of a five-layer CLT panel by an alternative one made of insulation material (polyurethane rigid foam), and thus having some similarities with the structural insulated timber panel (SIP) concept.

The main aspects that were focused for the panel development, included: (i) the definition of the panel layout and potential materials for its constitution; (ii) the characterization of the selected materials for the panel development, including the adhesive layers; (iii) the mechanical characterization of the panels; (iv) the functional and economic optimization of the panels; (v) the evaluation of the environmental impact of the panels; (vi) the acoustic characterization of the panels; (vii) the development of connection systems for the panels.

Overall, the study conducted in this thesis showed that the developed panels have the potential to complement the current CLT systems, namely concerning the elements of the external envelope.

Keywords

Cross-insulated timber, sandwich panels, wood products, material characterization, bonding quality, structural testing, life cycle assessment, acoustic performance, connections.



Panel concept and some aspects of its characterization and development.

PhD student
Pedro Gil Girão dos Santos

PhD program
Civil Engineering (FCT, University of Coimbra)

Supervisor
Luís Cortesão Godinho (FCT, University of Coimbra)

Co-supervisors
João Ramôa Correia (CERIS, IST, University of Lisbon) and Alfredo Geraldes Dias (FCT, University of Coimbra)

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