Improving the service life of Engineered Wood Products

Daniel F. Lima

daniel.asmf.lima@gmail.com

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Supervisor(s): Jorge M. Branco[1], Lina Nunes[2]

1. Civil Engineering Department, University of Minho/ISISE
2. Structures Department, LNEC – National Laboratory for Civil Engineering

MIT Portugal

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Abstract

Recently, there has been a growth of timber buildings driven by the development of Engineered Wood Products (EWP) like Cross-Laminated Timber (CLT) and increasing concerns about sustainable development. However, the durability of these products in various climates is still either questionable or unknown. Therefore, this study will quantify the predictable reduction, due to biological deterioration, in the service life of CLT under Use Class 2 exposure conditions, considering two different softwoods and two different climates in Portugal. Monitoring systems, wetting/drying tests, accelerated biological deterioration tests followed by mechanical tests, Finite Elements Models, and decay numerical models will be developed and applied. Also, climate change effects on the results will be assessed using future climates scenarios. Based on this analysis, preventive measures, and maintenance plans to improve the service life will be defined as Guidelines for EWP durability.

Motivation

Recently, there has been a growth of timber buildings driven by the development of Engineered Wood Products (EWP) and increasing concerns about sustainable development

Despite representing the most valuable forest products, EWP deterioration is often ignored mostly due to its Northern European predominant use, where the cold climate reduces the presence and activity of wood degrading agents

In terms of building performance, climate change is significant not only from a perspective of human comfort and energy savings, but also on the durability of bio-based materials, which are extremely dependent on the local environmental conditions.

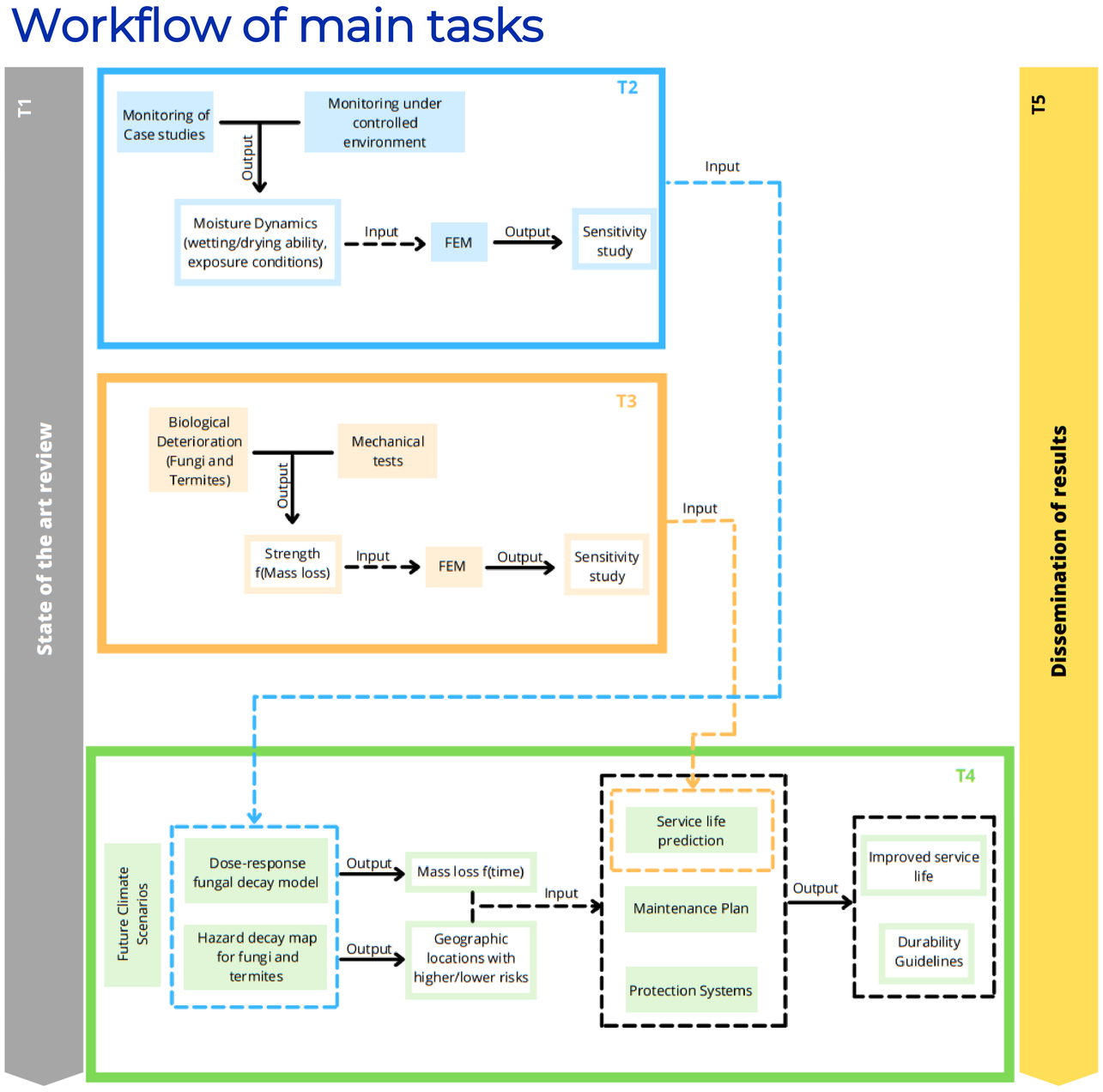
The biological deterioration impacts from simple aesthetic damages to compromising its resistant load capacity, creating a risk to human health and safety, a lower sustainable performance, in addition to an increase of repair and maintenance costs.

Objectives

The main objective of this PhD study is to contribute to the sustainable use of timber in construction by developing guidelines to promote better use of EWPs, considering the main biodeterioration risks in different climates. The work will consider elements used indoor or covered, but with the possibility of accidental humidification (UC2 - Use Class 2), thus subject to the occurrence of deterioration by insects (including termites), mold and decay fungi. To reach the main goals several sub goals were defined as follows:

- ✓ Analyse and define the risk of biological deterioration of CLT in UC2 under two coastal climates in Portugal.
- ✓ Model the moisture dynamics in the laboratory under different humidification schemes of CLT.
- ✓ Test the reduction in the resistance of laboratory degraded CLT joints.
- ✓ Model the possible reduction of service life considering the previously described factors.
- ✓ Assess the influence of climate change on service life, considering future climate scenarios.
- ✓ Define preventive measures and maintenance actions to improve the service life prediction.

Workflow of main tasks



Scientific outputs

- Lima, D.F.; Tenório, M.; Branco, J.M.; Nunes, L., "The wood moisture factor on the biological deterioration of wooden structures," in Construction Pathology, Rehabilitation Technology and Heritage Management, Granada, Spain, 13-16 Sep 2022.
- Lima, D.F.; Branco, J.M.; Nunes, L., "O papel da monitorização na durabilidade de construções com madeira", in 6ª Jornadas Portuguesas de Engenharia de Estruturas, Lisbon, Portugal, 9-11 Nov 2022.
- Lima, D.F.; Branco, J.M.; Nunes, L., "O desafio da durabilidade na construção em altura com madeira" in Congresso Construção 2022, Guimarães, Portugal, 5-7 Dez 2022.

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