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Performance of European Wood Species in Above Ground Situations After 10 Years of Weathering: Evidence of a Positive Impact of Proper Design

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1 Introduction

The majority of European native timber species which are of economic importance for the building sector are regarded as naturally moderately or poorly durable with regards to biological degradation when used for outdoor applications, such as cladding and decking. In geographical areas with high biological risk, they are frequently expected to last less than 10 years when left untreated and exposed to severe environmental conditions such as high humidity. As a consequence, in order to ensure long lasting products architects tend to choose durable tropical hardwoods or native wood with enhanced durability (modified or preservative treated) rather than moderately durable European wood species whose performance over time is doubtful.

However, the importance of design details and the role they play in enhancing wood's service life, especially in the case of outdoor applications, is often neglected. Indeed, premature fungal degradation of wood is frequently a consequence of inappropriate use, poor design or mistakes made during the installation, generating water traps and thus increasing the wood's moisture content up to a level allowing the initiation of decay.

2 Experimental Set-up

To evaluate the impact of proper design on wood's service life, large experimental structures (Figure 1) were constructed from six wood species selected for their economic importance and different natural durability against fungal decay according to EN 350 (2016): spruce, poplar (non-durable); maritime pine, Douglas fir, larch (moderately to poorly durable); oak (durable). The test devices mimicked different wooden constructions used outdoors: cladding, decking, vertical posts, assemblies, and log house outer walls. Each type of construction comprised both water-trapping and water-draining design details (up to six design schemes for the decking modules). The test devices were installed in 2009 in Bordeaux and Charrey-sur-Saône, two French cities with different climatic conditions (oceanic and continental).

Figure 1. Test devices installed in Charrey-sur-Saône, France.

3 Results

Fungal degradation was evaluated in 2019, after ten years of exposure to weathering according to a rating scale from "0" (sound, no evidence of fungal attack) to "4" (structural collapse caused by decay) (for more details see Kutnik and Montibus 2019). The recorded levels of fungal degradation of the spruce and poplar decks is presented in Table 1.

Table 1. Summary of the performance of the test devices.

Wooden structures	Performance with regards to fungal degradation
Cladding (spruce & poplar)	No visible decay, irrespective of the design and exposure (facing or not wind-driven rain)
Decking (spruce)	Best performing designs: draining designs using bottom-screwing of deck boards. No significant impact of the climate type.
Decking (poplar)	No significant difference in performance related to design details. Better performance under continental climate.
Decking (other wood species)	No visible decay (except on residual sapwood), irrespective of the design and climate
Assemblies (poplar)	Decay of water-trapping assemblies. Better performance under continental climate.
Assemblies (other wood species)	No visible decay irrespective of the design and climate
Posts (spruce and poplar)	No visible decay irrespective of the design and climate
Log house walls (all wood species)	No visible decay (except on residual sapwood) irrespective of the design and climate

4 Conclusions

- Significant differences in the ability of wood to withstand decay over time were observed depending on the design details used and the surrounding climatic conditions;
- Wooden structures made of spruce and poplar (classified as non-durable in EN 350) showed a high variability in terms of resistance against fungal decay, but with a high percentage of elements being still sound or below their limit state of use after 10 years;
- The moderately durable heartwood of larch, maritime pine and Douglas fir was unaffected by decay, even under severe conditions of exposure to rain and water accumulation (decking). This suggests that these wood species could be used without any preservative treatment (provided the sapwood has been removed) for manufacturing outdoor structures whose service-life could by far exceed 10 years.

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