Regenerative quality of wood cladding

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Background and goals

Regenerative architecture seeks to go beyond sustainability and insists on the importance of a collaborative relation between built and natural environments. Instead of doing less arm, the act of building can impact positively our social and natural capital in the long-term (Cole 2012).

In ecology, regeneration refers to ecosystems replenishing what is being eaten, disturbed, or harvested. Wood as a construction material offers the opportunity to build in a regenerative and circular way because it is biodegradable and creates habitats where it is grown.

Wood cladding is an optimal platform for reflecting upon regenerative construction materials and methods because it is the interface between a building and its natural environment. It is often referred to as a sacrifice layer because it is among the parts of the envelope the most exposed to degradation mechanisms. Its aesthetic dimension makes it an important architectural element, yet it becomes a paradox that is not expected to last but to which special care is given.

Interest in using wood for cladding has increased dramatically in Europe over the past 20 years (Hill *et al.* 2022). The performance of timber cladding depends on the durability of the wood, defined as the resistance to wood-destroying agents, as well as its permeability to water and the availability of moisture and wood-destroying agents in the end-use application (Kutnik *et al.* 2014). Traditionally, in Scandinavia for example, coating is used to decrease biodegradation and increase dimensional stability (Sivertsen 2010). Anyhow, the use of uncoated wood cladding has become more popular due to its low maintenance requirements (Hill *et al.* 2022). The absence of painting or treatment reduces climate gas emissions (Plesser *et al.* 2013). However, uncoated wood changes aspect over time in a non-uniform way due to the combination of chemical, mechanical and light energies (Feist 1990). Iron sulphate treatments can be used to obtain more controlled weathered aspect.

The European standard EN 350:2016 ranks durability against wood-decay organisms of various species. The ones classified with moderate to low natural durability are nowadays commonly modified to prolongate their technical and aesthetic service life in outdoor use.

As wood from species considered non-durable has been cladding facades, raw or coated with traditional paints, for centuries, the relevance of our modern understanding of durability can be questioned. For example, Black Alder (*Alnus Glutinosa*) is ranked as non-durable in EN 350:2016, meaning that its heartwood is prone to decay by microorganisms. Yet, it has been used as cladding in different places in Europe such as France, Norway and Sweden. Scottish Pine (*Pinus Sylvestris*) was traditionally favoured for cladding in Sweden but appears as a species with highly variable durability in EN 350:2016. This raises the question of the existence of correlations between its growing conditions, anatomical features, processing methods and physical-mechanical properties.

This project has its roots in traditional crafts methods and is based on the assumption that they can inspire more responsible practices in the construction sector. It aims at characterizing the quality of wood panels that can clad facades for longer than it takes for trees to regenerate, without generating wastes, and while making both our natural and built environments resilient.

Approach and methods

A number of studies has been scrutinizing both natural and conferred durability of wood under simulated or controlled conditions. There are proportionally few published studies based on real objects as it is challenging to track the exposure level of wood claddings in-use and thus to define the specific parameters allowing for good performance and long lifespan.

This project is based on the perpetuation of traditional knowledge making, where In-situ evidence informs us of the advantages or disadvantages of methods in the long-term. It bridges traditional knowledge between different countries to develop resilience in a changing climate.

The main research method is the observation of existing objects in Scandinavia and in France, where cladding facades with wood is an early example of a resource-saving measure in areas of scarce timbers or harsh weather (Rentzhog 1986, Godal 2012). Study cases are preserved and damaged traditional claddings, to be understood as cladding types representative of a specific area, manufactured from local resources and in small-scale production chains.

The study of those claddings can be summarized as follow:
- Architectural and technical observations: Typology of the facade, of the cladding and of the claddings' elements including eventual coatings or treatments.
- Crafts based observations: Tool marks and wood features such as growth rings width and knots repartition.
- Scientific inspection: Dendrochronology analyse and wood species identification.
- Complementary information: Interviews, archives, regulations, norms, conditions of the natural habitat of the trees.
- Holistic interpretation based on collected data and literature.

First, a forensic perspective is adopted to conduct investigations and try to "reconstruct the course of events and understand the motivations" (Almevik 2012). Then, complementary information from different sources is gathered. Communication with scientists from other disciplines such as biology and chemistry are valuable for interpreting results. Collaborations with stakeholders in the fields of building and gardening crafts as well as forestry will allow to consider wood quality in a wider picture and from a circular use perspective.

Pre-industrial wood claddings of Scottish Pine are still well represented in Sweden and their characteristics must be better understood to draw conclusions regarding quality requirements for long lifespan. In Champagne in France, there is a tradition of manufacturing "tavillon" claddings from deciduous trees, such as Oak, Populus and Alder. The knowledge of using those different species for cladding, built up through centuries, is relevant to keep alive for helping us developing more resilient constructions methods in symbiose with local ecosystems.

First results

The investigated panel samples present different kind and levels of deterioration. The first analysis showed that rot is not the only cause of degeneration of cladding and that vulnerability to wood-destroying organisms does not necessarily impact the technical performance of cladding (Brun 2023).

In Champagne, preserved ”tavillons” of Alder and Populus, manufactured with circular saw, replaced Oak “tavillons” which were split from log sections with “depertoirs”. The thin and short uncoated “tavillons” dry fast and without much deformation. Alder wood suffers a great mass loss due to fungal attack when in ground contact, but its performance as thin cladding is mainly altered by abrasion around fasteners (Brun, 2023) (Fig.1 and 2). In Sweden, Alder panels are sometimes found among Spruce panels and seem to have been intended as an equivalent. Both in France and Sweden, Alder cladding is attacked by wood boring beetles, but this seems to alter its performance as an aesthetic layer more than as a protective layer (Brun, 2023).

Fig. 1 : West façade of a house built with timber-framing and wattle and daub filling, covered with “tavillons”, in Frampas, Champagne, France.

Fig. 2 : A “tavillon” of Alder from the façade on Fig. 1 is showing a nail hole, which has become bigger and where crack formed from it to the edge.

The gathered samples of Scottish Pine are likely original panels from Swedish edifices built in 1679, 1780 and 1870. They are illustrating the durability difference between heartwood and splint wood but are also showing that deformation can be an important factor to consider for performance of cladding (Brun 2023). The cladding of Kvibergsnäs stable (Fig. 3) is partly issued from trees with an extremely slow growth rate, presenting tight growth rings with relatively low density, which can be identified as “hunger wood” in Swedish. This implies that the fibre walls are thinner than usually, possibly allowing a more even moisture distribution and thus less stress and structural damage under wetting and drying cycles. The studied overboards are 30mm thick, with good form stability and seem to have the ability to dry fast.

Fig. 3 : The east façade of Kvibergsnäs stable built in the 1780s, Gothenburg, Sweden.

Coating

The samples of Scottish Pine are showing traces of traditional red Falu paint. It seems that Falu paint was not used for aesthetic reasons only but that the iron oxide pigment also confers a protection against decay. The alteration of this type of breathable paint does not cause any damage to the cladding since moisture is not trapped inside the wood.

Discussion and tentative findings

Biodegradation is a threat to wood cladding but also a chance to build without creating wastes (Brun 2023). “Tavillons” of Alder either fall off or vanish after long weathering. This illustrates what can be called a sacrifice layer, made from available resource, and designed to last for the time it takes for it to regenerate, which is 60 to 70 years in France. Studied Scottish Pine panels

are suggesting that growth speed can influence wood properties connected to durability and performance. Long rotation periods possibly allow cladding of Scottish Pine to be reliable in the long-term both as an aesthetic and as a protective layer.

Wood cladding can be a platform for implementing innovative strategies of production and maintenance, based on traditional craft rationality. An example is to consider wooden facades as dynamic elements in our landscape, comparable to urban parks or gardens, whose generation, care, and regeneration are entrusted to one dedicated team of craftspersons.

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