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Exhibition article

When Wood Cladding Degenerates

Lessons on durability from traditional wood claddings after long weathering in real conditions

ABSTRACT
For several decades, the mechanisms of deterioration of wood exposed outdoors have been scrutinized to ameliorate the performance of this versatile material when used for purposes such as house cladding. The performance of cladding seems to depend highly on the durability of wood, in turn connected to water uptake, which can vary greatly. How long a cladding can function is particularly complicated to define because of its paradoxical role as a sacrificial and aesthetic layer. However, thanks to reparations and maintenance, many traditional claddings are still preserved. They have been produced and maintained with local resources and show that low-processed wood can be durable in outdoor conditions. The contrast with modern approaches, such as wood modification or importation of durable species, raises the question: what durability of wood is concretely required for cladding purposes? The exhibition shows characteristics of wood weathered for up to hundreds of years, facilitating an understanding of the impact damage can have on the performance of cladding. The samples, issued from traditional French and Scandinavian facades, illustrate how exposure level influences degradation, confirming the role of rot and revealing the ones of erosion and abrasion in the degeneration of wood cladding. Both Alder and Pine seem to have the potential to perform naturally well as cladding for longer than it takes for the trees to regenerate. Traditions might teach us how to use local wood in a durable way if we consider biodegradation as an opportunity to build without creating waste, rather than as a threat.

Keywords:
wood cladding, durability, traditions, weathering, performance

INTRODUCTION

Interest in using wood for cladding has increased dramatically in Europe over the past 20 years (Hill et al., 2022, p. 2). 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, p. 127). "In many cases the ease with which a wood product becomes and remains wet can have a significant effect on performance, as it is the major factor controlling the possibility or not of fungal decay" (SS-EN 350,2016, p. 62).

There are different ways to reduce or delay water uptake in cladding. Traditionally, coating is used to decrease biodegradation and increase dimensional stability (Sivertsen, 2010, p. 8). Wood modifications are known for prolongating the technical and aesthetic service life of non-durable wood. Nevertheless, commercial warranties provided for products such as acetylated wood do not exceed 50 years (www.accoya.com) or 30 years for furfuryl alcohol–impregnated wood (www.kebony.com). These products might function for longer periods, but this is not yet borne out by experience. 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.

The use of uncoated wood cladding has become more popular due to its low maintenance requirements (Hill et al., 2022, p. 2). The absence of painting or treatment reduces climate gas emissions (Plesser et al., 2013, p. 25). However, uncoated wood changes aspect over time in a non-uniform way due to the combination of chemical, mechanical and light energies (Feist, 1990, p. 265). Iron sulphate treatments can be used to obtain more controlled weathered aspect.

This exhibition article focuses on the characteristics of wood claddings after long weathering in real conditions. It is based on an investigation of samples issued from traditional buildings in France and Scandinavia. It presents an analysis of their aspect and possible in-use performance to answer the question: what durability of wood is concretely required for cladding purposes?

EVOLUTION OF A PARADOX

Cladding is an interface between a building and its natural environment and is often called a sacrificial layer because it is a part of the envelope that is highly exposed to degrading 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.

Cladding buildings with wood is an early example of a resource-saving measure. In his book about wooden Swedish towns, Rentzhog writes that panelling of houses' facades first began on the west coast, where timber was a scarce resource, making people wanting to protect them from the weather (Rentzhog, 1986, p. 21). Respectively, the quality of timbers was not a priority for houses built with the idea that they would be clad with panels (Godal, 2012, p. 73).

In the French region of Champagne, there is a tradition of building houses with timber-framing, and wattle and daub filling. Because of the harsh climate, people have been covering exposed facades with wood elements called *tavillons* (Figure 1).

In modern facades, cladding provides climatic and mechanical protection for insulation. If not ventilated, it can become counterproductive by trapping moist inside the building. Its protective role against weather is backed or completed by a breather membrane.

FIGURE 1. The South-East façade of a house built with timber-framing and wattle and daub filling in Outines, Champagne, France. *Tavillons* are thin slices of wood cladding the façade, traditionally the most exposed to rain or, like here, facing the main street. They overlap in a horizontal pattern, held in place by vertical wood battens, and often stop a good distance from the roof where they are not needed. They prevent the porous wattle and daub filling from constantly swelling and retracting, making the construction less and less air- and watertight.

VERSATILE PERFORMANCES OF WOOD CLADDING IN LITTERATURE

Cladding that does not dry for a long period can become dysfunctional because of rot. Repeated cycles of water uptake and drying phases cause swelling and shrinking of cladding boards, favouring the apparition of cracks (Svensson Meulmann et al., 2023). Cracks might trap water in the construction, especially without a ventilated cavity, eventually causing the rot of both cladding and structure.

TABLE 1. Estimation of the lifespan of different wood species without ground contact. It is interesting to note that Alder is among the least durable species, just as in EN 350:2016, and yet it has been used as cladding in both Scandinavia and France. For Pine, roof protection appears to be of great help and might bring expectancy up to 120 years, whereas it does little difference for Spruce and none for Alder. The lifespan of Pine in dry conditions varies from 120 to 1000 years, tending to show that inherent wood properties do not only depend on tree species and that durability can be affected by factors other than water uptake. Source: traguiden.se (in Swedish).

Species	Outdoor, unprotected	Outdoor, under a roof	Always dry
Alder, Birch, Populus	3-20-40 years	3-20-40 years	<400-500 years
Elm	60-80-100 years	80-130-180 years	<1500 years
Ash	15-40-60 years	30-60-100 years	300-800 years
Beech	10-35-60 years	30-60-100 years	300-800 years
Oak	50-85-120 years	100-150-200 years	300-800 years
Pine	40-60-85 years	90-100-120 years	120-1000 years
Spruce	40-55-70 years	50-60-75 years	120-900 years
Larch	40-65-90 years	90-120-150 years	<1800 years

Annexe B of the standard EN 350:2016 ranks durability against wood-decay organisms of selected wood species but only for ground contact, “because fungal degradation in other situations is a product of a complex interaction of parameters which is not fully mastered” (EN 350:2016, p. 18). Ground contact is an extremely adverse condition for wood cladding (Frøstrup, 2016, p. 133; Kutnik et al., 2014, p. 126). The Norwegian Building Research Institute (Byggdetaljer 542.101, p. 22) and Sandberg et al. (2013, p. 3) recommend a minimum distance from cladding to the ground of 300 mm. Under these circumstances, cladding corresponds to use-class 3, as defined in the standard EN 335:2013, p. 6.

The website Traguiden.se gives complementary information for the durability of wood above ground, showing great intervals in lifespan (Table 1).

OBSERVATIONS: DEGRADATION OF TRADITIONAL WOOD CLADDING

The samples gathered in this exhibition represent a variety of traditional claddings to be understood here as representative of a specific area and crafted from local resources.

When in use, they were exposed to different critical in-situ conditions, as described in Gobakken et al. (2008, p. 3). They illustrate the consequences of up to hundreds of years of weathering and were collected during renovation or maintenance (Figures 2 and 3) or found on the ground under degrading facades (Figures 1 and 9). They are made of species that are not among the most durable in EN 350:2016 and are either coated with traditional paint or uncoated.

By observing and manipulating boards presenting diverse types and levels of damages, such as rot (Figure 4), insect holes (Figures 5 and 6), checks (Figure 7), cracks (Figure 10), deformation, abraded wood (Figures 7, 8 and 10) and degraded paint, it is possible to understand how they affect the performance of cladding, in relation with the façade's typology. Typology refers here to the design of the envelope at the overall level, at the cladding and claddings’ elements level, and at the wood level, including both inherent and induced properties.

FIGURE 2. The belfry of Kungslena church in Skaraborg, Sweden, was built in 1679 and renovated several times, most recently in 2023. During this last renovation, most of the cladding of the lower half was replaced, whereas the higher part, protected by the roof, has probably been standing for hundreds of years and is still preserved today.

FIGURE 3. The stable of Kvibergsnäs, Sweden, was built in the 1780s and its East façade tells many stories. Figure 5 shows an exhibited sample from a panel board belonging to this façade.

FIGURE 4. A sample from the South façade of a barn built with log walls in Västra Götalands, Sweden, and clad with standing boards of Alder. It shows rot in the part that used to be close to the ground. There is no trace of paint and it is likely that it has always been uncoated. Most of the boards are still fixed on the walls today, but they present a large number of insect holes (see Figure 6), especially on the north side, and some rot on the lowest parts of the walls.

FIGURES 5 AND 6. Holes caused by wood-boring insects on a board of Pine coated with Falu red paint, from board-on-board cladding of the stable of Kvibergsnäs, Sweden (Figure 5), and on the same sample as in Figure 4 (Figure 6).

FIGURE 7. Checks in the pith area of the tree, on an uncoated board of Pine, from a board-on-board cladding of the South façade of a log house in Örnanäs, Skåne, Sweden, from 1865 to 1880. Erosion of the early wood is also observable, while the hard latewood remains, its fibres standing perpendicular to the weathered surface (Almevik, 2012, p. 115). Erosion is a slow process caused primarily by the photodegradation of lignin (by ultraviolet and visible light) and increased by rain and water (Sell et al., 1986, p. 57).

FIGURE 8. A sample taken from the lower half of the façade on Figure 1, where the uncoated *tavillons* of deciduous tree, likely Populus, are starting to come off after decades without maintenance. It shows less erosion and a different colour, where it was covered by a batten on the right end.


FIGURES 9 AND 10. The West façade of a house built with timber-framing and wattle and daub filling in Frampas, Champagne, France (Figure 9). The façade was covered with uncoated *tavillons* made of Alder, many of which came off, leaving the filling unprotected and washed out by the rain. A sample from this façade is showing a nail hole, which has become bigger and where crack formed from it to the edge of the *tavillon* (Figure 10). The abrasion of wood around the nail is mainly due to small movements between wood and metal combined with erosion. It is obvious here that widening of nail holes eventually makes cladding non-functional as a protective layer.

DISCUSSION: HOW DURABLE SHOULD A SACRIFICIAL LAYER BE?

In this exhibition, the only board presenting severe rot illustrates why there is a tradition of replacing the parts of cladding most exposed to moisture, which is made possible by the fact that similar elements can be created. In this sense, wood offers the opportunity to build in a regenerative way because it is a material that is grown and biodegradable. Biodegradation is a threat to wood cladding as such but also a chance to build without creating wastes.

An important point, even in the actual context of appreciated minimal maintenance requirements, remains to design cladding allowing reparations, as its decline is expected, often local and detectable.

Inducing properties to prolongate the life of cladding can be a resource-efficient action. However, as the inherent properties of wood from species considered as non-durable today can be sufficient for its use as cladding, a long-term strategy could be to make sure that this type of wood will grow and that we have the competence to use it as it should be to obtain satisfying technical and aesthetic performances.

CONCLUSION

This exhibition brings nuances to the prevailing understanding of the durability of wood for cladding purposes. It shows 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.

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 erosion and abrasion around fasteners. Not surprisingly, wood with high permeability, such as early wood and, in general, Alder's wood, appears to function durably as cladding when protected from rain or with good drying possibilities.

The presence of wood-destroying organisms can indicate moisture above the optimal level for wood preservation and can affect the visual aspect of cladding. However, in which grade it might increase water uptake and thus favour rot was not assessed here. Leaving the bark on Alder panels to increase their durability seems a possible hypothesis that should be further analysed.

In this study, both Alder and Pine appear to have the potential to perform naturally as cladding for longer than it takes for the trees to regenerate. However, as the studied samples have been exposed to uncontrolled real in-use conditions, it is impossible to define the specific typological parameters that allow for such good performance.

The whole context of constructive methods, the available quality of wood, and climate is dynamic. Thus, a cladding element made from Pinus Sylvestris and exposed outdoor for the last 100 years on the façade of a log house is not proof that any element made of Pine available today would perform the same on an insulated wall with ventilated cavity in the same location and for the next 100 years of a new climate.

Nevertheless, keeping track of which materials were used in the past and how is important. This is not necessarily because everything was made in the right way but rather because buildings standing for many years provide us a chance to understand what worked and what did not. For that reason, every dead tradition is a missed opportunity to learn and a risk "to be inferior to one's ancestors", which is the meaning of the word degeneratus in Latin.

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