Wooden façade damage and the design of new wooden façades
- Long-term durability of timber façades in Finland

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ABSTRACT

Wooden facings on façades are durable if the boarding and its details are designed and realized to comply with the characteristics of wood. In 1998 – 99 the University of Oulu’s Department of Architecture conducted a broad study on the long-term durability of wooden façades. Supported by information gathered in field work, the study has been used to determine the factors affecting the long-term durability of wooden façades with board facing. The areas examined in the study included 123 wooden façades of different ages. During the study nearly 2300 incidences of damage were recorded and analyzed.

Structural protection is of essential importance to wooden façades. The eaves of the building should be at least 500 mm long. The recommended foundation height is at least 300 mm, preferably over 500 mm. Rainwater should be able to flow freely and exit from the façade surface. Board joints and extensions should also be protected.

To ensure long-term durability, sufficiently thick boards should be used, at least 25 mm, preferably 28 mm thick. To keep the ends of the boards from splitting, they should be nailed far enough, at least 70 mm, from the end. Boards nailed closer than 30 mm to the end nearly always split.

The effect of the size of the ventilation space on rot and paint damage is surprisingly minor. More important than size is the fact that the ventilation space is open and freely ventilated. To avoid damage from rotting, an open ventilation space is recommended. To avoid splitting, the space should be smaller than 16 mm.

With wooden façades, the characteristics of different types of paint should also be examined from the standpoint of repainting. Painting and repainting are the most important methods of protecting a wooden façade. Latex paints should not be used on a wooden façade.

A CORRECTLY DESIGNED WOODEN FAÇADE IS DURABLE

Finland has numerous buildings with façade facing boards dating back to the 1700s or 1800s. They are still in good condition, and their durability has never been a particular problem. It is clear that wooden facings on façades are durable if the boarding and details of a façade are designed and realized to comply with the characteristics of wood.

Wooden façades have traditionally been constructed in such a way that if the wood material becomes wet, it will dry as quickly as possible. The board facing of a building originally had three functions: to protect, seal and beautify. The facing boards of old wooden facings are typically much thicker, often 32 – 48 mm thick, than those used today. The boarding was also traditionally made to avoid leaving any unprotected board ends and joints. In the recent decades since the 1940s, facing boards have become increasingly thinner, only 16 mm at their thinnest. The details of wooden façades and the manner of fastening boards have changed from what they traditionally were. Structural protection, which used to be a matter of course with eaves and high foundations, has had to give way to architectural form and the oddities of style. Paint treatment of board facings has also changed. Traditional paints, such as cooked paint and linseed oil paint, have been replaced by different types of commercial paints, especially dispersion paints like latex paint, whose characteristics are not necessarily well known.

The façade facing was formerly a sacrifice layer intended to protect the structure itself. Even so, board facings have traditionally been very durable. Especially because of painting problems, the reputation of wooden façades has...
deteriorated during the last decades. Today, wooden façades are felt to require considerable maintenance and to be short-lived. This conception has been reinforced by the fact that the theoretical age of wooden façades is held to be 50 years in Finland today.

Interest in timber construction has grown quickly in Europe in the 1990s, and the valuation of wood has improved. To carry the use of wood forward from the frame to the façades, where it is a part of the architecture, and to advance from realized timber construction pilot building projects to extensive use of wood in Finland and elsewhere in Europe, it is necessary to guarantee the long-term durability of wooden façades and avoid the mistakes made in the recent decades.

**LEARNING FROM TRADITIONAL CONSTRUCTION**

The old Finnish construction heritage is a good basis for ensuring the long-term durability of wooden façades. However, everything that is old is not necessarily good, and everything that is new is not necessarily bad. Particularly beneficial, tested knowledge of the factors affecting wooden façade durability should be drawn from this heritage. At the same time, attention should be paid to issues that are problematic from the standpoint of wooden façades.

Structural protection is of essential importance to wooden façades. A wooden building should have eaves, but wooden façades with no eaves or very short eaves are still being constructed. And yet, the significance of eave length to the total amount of damage is indisputable. Buildings with eaves over 500 mm long have considerably less paint and rot damage. The place most susceptible to damage is usually the bottom edge of the façade, which is exposed to moisture stress. The bottom edge of the boarding should be wedge-shaped to function as a drip edge. To avoid damage, molding should not be used at the bottom edge of the wall. If a bottom molding is used, it should be shaped to shed water well and it should be easy to replace. Damage can be minimized by using a sufficiently high foundation. The recommended foundation height is at least 300 mm, which design directives also recommend. Preferably, the foundation should be at least 500 mm high.

Timber construction during the last decades has not taken into consideration the simple fact that a thick façade facing is more durable than a thin one. On the contrary, Finnish design directives recommend the use of thin boards (18 – 21 mm). Damage to thin boards is common, regardless of the type of damage being examined. Accordingly, the boards on façade facings should be at least 25 mm, preferably 28 mm thick.

Current wooden façade design and construction directives emphasize the significance of the size of the ventilation space. Nevertheless, the effect of the size of the ventilation space on rot and paint damage is surprisingly small. More important than size is an open, freely ventilated ventilation space. To avoid splitting, however, the ventilation space should not be larger than 16 mm. With a small space the boards dry reasonably slowly, preventing quick changes in their moisture content.

There are no definite directives or recommendations on nailing distances. Finnish design directives only state that in board extensions, boards often need to be nailed near the ends, and to prevent splitting, holes should be pre-drilled for the nails. In job site conditions, however, nail holes are very rarely pre-drilled. In practice, nailing often causes splitting, because boards nailed closer than 30 mm to the end nearly always split. On the contrary, boards nailed farther than 70 mm from the end rarely split, unless the board is thinner than 20 mm. For this reason, boards should be nailed at least 70 mm from the end. Use of a nailing machine is not recommended. If a machine is used, the pressure should be low enough to leave the nails heads on the surface. Final nailing should be done by hand to prevent the nails from being driven too deep, which would tear the surface of the wood and make the wood susceptible to paint and rot damage.

A mitered corner is always susceptible to damage and should therefore be avoided. If this type of corner is used, this study indicates it should be tight and ventilated. This means the corner boards should be sawed at an acute angle and the facing boards should be thick. This procedure was commonly used in mitered corners of façade facings of old buildings, which have been lasted well.

Modern timber architecture is enthused about the use of lattices on façades, which adds to the beauty of the architecture. However, the battens used in lattices are not very durable. Accordingly, squared timbers should be used instead of battens, and because wood tends to stretch, contract and twist, the timbers should be fastened at sufficiently short intervals. Lattices should be shaped to allow water to immediately flow off the surface. From the standpoint of maintenance, lattices should not be painted. They should be treated with tar or cooked paint, so they can be retreated later without mechanical or chemical cleaning.
Heat-treated wood, which is very resistant to rotting, brings new possibilities to wooden façades. However, its beautiful brown surface is not permanent, and it becomes felt-like and gray just like untreated wood. On the other hand, heat-treated wood is not necessary for long-term durability because a correctly realized spruce (or pine) board façade is durable. An untreated and unpainted board facing loses only about 3 mm of its surface per 100 years.

Elimination of the causes of local damage is an important part of wooden façade maintenance. Neglecting simple maintenance measures can quickly cause extensive damage. Thus, for example, gutters and downspouts should be kept in good condition. Filth and litter on moldings, for example, also gather moisture and make them susceptible to damage.

On the left is a commonly used method of extending vertical boarding. This method is not durable because water is absorbed by the ends of the boards. In the middle is a recommended, previously commonly used method in which the ends of the boards are beveled to allow water to flow away from the extension as quickly as possible and not be absorbed by the ends of the boards. On the right is a recommended method of extending horizontal boarding, where the ends of the boards are ventilated from behind the façade.

On the left is a recommended lower part of a wooden facing, where the lower end of the vertical facing boards / lower edge of the horizontal facing boards is beveled to shed water. In the middle is a detail of a water molding where the end of the facing board is ventilated from behind the façade. On the right is a detail of a water molding where the lower end of the facing board does not come into contact with the water molding, preventing moisture from standing in the structure. In both details the outward sloping top surface of the molding leads moisture away from the structure as quickly as possible, and the bottom surface sheds water. In both designs the molding can be replaced, if necessary.
On the left is a presently commonly used mitered corner that allows moisture to be absorbed by the ends of the boards. In the middle is a corner joint used in the 1800s and the beginning of the 1900s, where the ends of the boards are cut at a sharp angle. This solution ventilates the corner structure and prevents moisture from damaging the corner. The most recommended method of making a corner joint in horizontal boarding is shown on the right. In this solution the corners are protected by vertical boards and the ends of the boards are ventilated from behind the vertical boards.

Because moisture that penetrates boards in the direction of the grain damages the boards quickly, the ends of the boards should always be protected. In the solution shown in the middle, the jamb board protects the ends of the boards, which are ventilated from behind the façade facing. The most recommended method is shown on the right, where the ends of the boards are completely protected.

PAINTING WOODEN FAÇADES

A wooden façade should be designed to last, if necessary, without paint or other maintenance. Façade durability should not be dependent on a paint coating, sealing putty, etc. Because painting is usually postponed or neglected at some point in time, it is important to design and construct a façade with as few easily damaged details as possible, and so that such details are easily replaceable, if necessary. Painting is still the primary method of improving the long-term durability of a wooden façade. Therefore, maintenance of the painted surface and sufficiently frequent repainting are the most important ways of making a façade last long. The better a façade is cared for and maintained, the better it withstands structural errors or solutions that are susceptible to damage.

Rough boards should not be used on façades. Although paint adheres to them well, repainting is difficult because it is almost impossible to clean the old paint surface well. This type of façade also gets dirty quickly.

The characteristics of different types of paint and different types of damage should not only be examined from the standpoint of damage, but especially from the standpoint of repainting. Repainting is of primary importance to the durability and lifetime expense of a façade. Although the recommended interval between paint jobs is shorter for oil paints than for latex paints, oil paint can be applied on top of an old paint surface. The problem with repainting using latex paint is the thorough preparation of the surface that is required. If the old paint surface is not removed correctly, the new coat will quickly begin loosening from the base. Oil paint begins to flake with age, allowing moisture to penetrate the wood. Flaking oil paint does not, however, prevent even evaporation of moisture from the boarding. On the contrary, latex paint is characterized by tearing along the grain and loosening of the paint coat from the base. This allows moisture to gather into "pockets" formed by the loosened paint film, and the impenetrable paint film does not allow moisture to evaporate. This process quickly damages the wood. Because damage caused by latex paint is one of the most typical types of damage in wooden façades, latex paints should be avoided in buildings intended to be permanent. Therefore, paints
should not only be examined when new; it is more important to take into account how the paint will behave several years after painting.

**Wood lasts long if…**

…sufficiently thick material is used; min. 28 mm.
…nails are nailed far enough from the ends of boards; min. 70 mm, preferably 100 mm.
…board joints and extensions, and preferably nailed places, are protected.
…structural protection is used, such as adequate eaves, at least 500 mm, and sufficient distance from the façade to the ground, preferably at least 500 mm.
…rainwater is able to flow freely and exit from the surfaces.
…the correct paint is selected for each location, and impenetrable, thick coats of paint are avoided.
…repainting is taken care of and the paint surface is not allowed to deteriorate.

*A recommended solution based on the results of the study. The facing boards are at least 28 mm thick, nails are nailed 70 mm from the ends of the boards, the ends of the boards are beveled to shed water, and the ends of the boards are at least 500 mm from the surface of the ground. Also, battens are used to reduce the ventilation space to 16 mm.*