Assessment of the condition, cause and possible other defects on the wooden façade of ThermoWood in terms of blackening the entire facade of the family house

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Abstract. The aim of the paper was to provide information about defects and causes of faults on the wooden facade of ThermoWood. The examined failure is the blackening of wooden elements on the entire area of the family house facade. The family house is now in a finished form and is therefore permanently used for housing people. Current damage does not jeopardize the stability of the object. A test sample of the blackened facade from the north-east side of the building at locations available and with a predominant blackening ratio was taken to determine the cause of the failure. The evaluation was based on general technical requirements for carrying out the work related to the implementation of the facade, technological details. Local examination of the facade revealed that the blackening occurs across the surface and shows signs of fungus. For this reason, a sample of the facade was taken from the north-eastern part and the opinion of the Czech Mycological Society was requested based on the photo documentation including the description of the impregnation used. At the end of the paper, we propose a comprehensive solution to the facade failure with the provision of the disposal and elimination of possible sources supporting the mold formation.

1. Introduction
Construction failures are always a problem and it is the work of experts to assess whether they are static, aesthetic or harmful, etc. For structural assessment, a structural and technical survey is required to perform detailed tests, take samples, etc. [1], through which we can find the causes of failures. Subsequently, we can propose a solution - troubleshooting.

In the paper, we describe the process of investigating the faults and their causes caused by the wooden façade of ThermoWood. The examined failure is the blackening of wooden elements on the entire area of the family house facade. The family house is now in a finished form and is therefore permanently used for housing people. A test sample of the blackened facade from the north-east side of the building at locations available and with a predominant blackening ratio was taken to determine the cause of the failure. The evaluation was based on general technical requirements for carrying out work related to the implementation of the facade, technological details.
2. Construction-technical survey

During the construction-technical survey, photo documentation of the failures was carried out and the state of the wooden facade was found (Figure 1). In addition, a test sample of a blackened facade from the north-east side was taken at locations available and predominantly blackened. No destructive probes have been made to detect the blackening state from the back of the facade nor have the thermal insulation state and other layers been probed. All structures (façade grates) were inspected without disassembling the individual elements of the entire façade assembly. At the same time, the tinsmith elements of the building were inspected, especially in the attic level, with a focus on folding, overhangs, etc.

![Figure 1. Damage to the facade in the area the north-east facade](image1.jpg)

The facade examination revealed advanced blackening on all sides of the facade, which is oriented only on three sides (north-east, south-east, south-west). Furthermore, there was a high incidence of both junipers and junipers lining the entire building, where the connection to the black thermowood surface is not excluded.

During detailed inspection and splitting of the samples, the façade measures were determined by unspecified painting. It was found on the site that the owner of the building consulted the possibility of impregnating the wooden façade with the contractor, through which the remediation agent was ordered - glaze oil for wood. This oil was subsequently treated with a wooden façade. Furthermore, the owner of the building told us that the blackening began to occur already at the handover of the building, which is just after its painting a few weeks to months (Figure 2).

The detailed design of the wooden façade in terms of general technical requirements for construction does not show any visible errors and the façade seems to have been carried out perfectly.
3. Results and discussions

Local examination of the facade revealed that blackening occurs across the surface and shows signs of fungus or fungus. For this reason, a sample of the facade was taken from the northeastern part and the opinion of the Czech Mycological Society was requested based on the photo documentation including the description of the impregnation used. Since ThermoWood can be basically labeled as wood that has been subjected to heat treatment during the manufacturing process (range 160 - 215 °C) [2] and this process involves limiting spontaneous ignition by water vapor (autoclaving), then different temperatures, different processing times and different techniques drying (e.g., Microwave) determines the desired Thermowood product as a product with a significantly increased durability and resistance to rot and against attack by wood-destroying fungi. The resistance of ThermoWood can be increased to the level of resistance of exotic, hardwoods. In addition to the chemical changes that occur in the wood during processing, large amounts of nutrients are lost after decomposition of the hemicellulose (sugar chains) to promote the growth of rot-causing fungi. The ability of thermowood to absorb water is greatly reduced (thermowood is hygroscopic), its rot-resistance increases automatically without the use of harmful chemicals or other additives during the process. During the heat treatment, thermowood loses resin. During the treatment, the heat treated wood obtains a uniform brown color. The intensity of the color can be influenced by the application of different processing temperatures or the use of the starting wood species (pine in the case under consideration). Thus, the heat treated wood is not modified in terms of UV protection. This causes the natural loss of the original shade as well as all other woods, whether tropical or domestic. However, these color changes, which are predominantly graying (patina-catching), do not affect the material's resistance to rot, moisture penetration, wood-destroying fungi and pests, and thus to a reported total life of at least 30 years. [3]

Thus, it can be concluded that the use of any impregnation may mean a microorganism for the material. The Czech Mycological Society confirmed by testing the occurrence of mold on the wooden facade and expressed the opinion that the occurrence of mold cannot be clearly underestimated, even though it is occurring on the facade of the family house, ie in the exterior (Figure 3). Furthermore, it is not excluded that molds may not enter the periphery of the RD interior. Furthermore, it eliminates the problem as purely aesthetic, but emphasizes the health aspect and possible negative effects on human
health (toxicity, allergies, difficulty breathing). In the opinion of the Czech Mycological Society, one of the factors influencing the occurrence of molds can be the treatment of the facade with Astraxi transparente. It also suggests disassembling a part of the façade to determine the state of the inner face of the windows, as mold colonies are uniquely formed in the joints and the subsequent appropriate remediation of the façade, for which it is first necessary to know the true extent of mold occurrence.

[4]

Figure 3. instead of taking a sample for mycological examination assault in the north-east facade

Before proceeding with the remediation, it is necessary to decide on how to proceed. In the case of requiring complete mold removal, discard or eliminate possible mold-promoting sources.

Furthermore, it was found:

- This is a reconstruction of the family, which remained the predominant part, including its surroundings.
- There is quite a lot of growth around the object, and junipers causing shading around the object and possible essential oils from these woods can have a potential effect on supporting the growth of microorganisms on the facade. The expert is not a justified fact, but just a presumption, yet consulted on the basis of photographic documentation with the dendrologist.
- Tinsmith elements of the whole building are made of non-corroded titanium zinc sheet, shiny, which, due to oxidation, will be confused and stabilized within a few years. This
aspect of aging influences on both wood and titanium zinc may result in some black components in the blackening of the façade causing the changes to take place.

The above facts cause the gradual blackening of the facade of the building.

4. Conclusions

With regard to the available information and facts obtained on the spot during the local investigation and their evaluation, the reviewer is able to express an expert opinion and answer the questions as follows:

The construction work is not related to the ThermoWood black façade of the family house. The mistake is the use of the oil glaze as impregnation of the wooden façade and it has a direct connection with the black facade and the occurrence of molds according to the assessment of the supplied sample and evaluation of the findings. I recommend dealing with a possible remedy comprehensively with the provision of liquidation and elimination of potential sources supporting the formation of mold.

In order to ensure the perfect use of the ThermoWood façade, the following modifications would have to be made:

- On the basis of the determined extent and facts, it is the whole range of wooden facade, which is necessary to first get rid of mold and eliminate sources supporting possible further creation. I recommend you to remove the mold professionally and then, if necessary, also use the mechanical and chemical agents together with a thorough washing with pressurized water.
- Disassemble a portion of the lining at the windows and see if the mold somehow goes further towards the interior of the building. In the case of mold occurrence, to a large extent also under the cladding or, for example, even in insulation, I recommend contacting an expert or a designer again to design a solution.
- To prune and clean the surroundings of the building from invasive tree species and more to enable the surface sun exposure of the wooden facade.

References

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