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Present trends and potentialities in designing of log-houses external walls

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Summary

The paper deals with designing of log-houses external walls with the viewpoint of thermal material characteristics. Timber is the natural material with the specific properties such as volumetric changes caused by drying-out. That fact has to be taken in account already during the design period. Window, door and stairs claim the correct and elaborated details of horizontal log joints.

One of the chapters refers to the incorrect solved details of log house.

In the contemporary building classification, according to LCA (Life Cycle Assessment), the log houses are ranked in very high position. Energy intensity of the construction life is calculated since the building material production, through the service till the demolition and removal.

The report deals with present trends in designing of the external walls of log houses.

KEYWORDS: log houses, external walls, thermal material properties, volumetric changes, round timbers.

1. INTRODUCTION

Recently, building of the classic log-houses becomes to be famous. This type of construction is typical especially for Scandinavia and Canada, where roughly 85 % of buildings are built from wood or wooden basis materials. In former times, the wooden houses were fully occurring in the area of Czech Republic but later on, wood had been jostled away by new materials, e. g. steel, concrete, glass. Within the years of wood declining, the original traditions and continuity of for centuries forwarding information had been broken and so we can say, building of long-houses is quite new in our regions nowadays.

That is why the research and progress in designing of problematic details and edification of log-house producers and lay public is so important. Many failures that can occur within the log-house service period are caused by specific wooden characteristics neglected when the structure have been constructing.

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Timber is as a natural material sensitive to biotic and abiotic damages. These disadvantages are overcharged by relative source availability of sustainable material source, workability, by pleasant feature, and last but not least, by easy way how to dispose.

Lately, there are all over the world increasing demands for usage of environmental friendly and permanent available materials. Just timber is a material that satisfies these requirements.

2. EXAMPLES OF INCORRECT DETAILS

Figure 1. Left –Incorrect construction and insulation of gable; Right –Incorrect placing of vertical element (an adjusting screw is missing)

Figure 2. Incorrect corner structure (roughly encircled shapes)

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3. DESIGNING OF THE LATERAL GROOVES

3.1. Termal-technical requirements

Recently, still increasing values of thermally technical construction requirements are heavily discussed among the construction specialist. Light framework constructions can be easily insulated by required thickness of insulator. The log-houses have different behavior – timber has a specific ability to accept and eliminate the moisture content in dependence with interior air relative humidity. Against that, totally insulated and closed buildings require to be furnished by forced ventilation system that ensures regular interior air changing and clear the interior air to anticipate the condensation and mould rises at the sensitive places.

Log walls are built up from logs of diameter 350 – 400 mm to meet standard ČSN 730540. The thermal resistance of wall is defined by the log diameter and tree species. However, the lateral grooves are staying the problematic details.

3.2. Insulation material

The lateral joint of two logs has to be designed in such a way to ensure as tight and stable barrier between interior and exterior as possible. The material used for jointing of lateral grooves has to guarantee to thermal-technical properties from the point of view of both thermal resistant and air infiltration. At once, the material has to show shape recovery that means it has to be able to follow the working of wood (swelling and shrinkage). Each log that is inbuilt with moisture content higher than 19 % has to be provided by longitudinal kerf. These kerfs cut on the top of logs show an effective way to control the location of checks as green logs dry. The depth of the kerf shall be at least one-quarter of the log diameter, and shall be no deeper than one half of the diameter.

Primarily, PUR foam was using for sealing of the grooves and notches. This material is shape stable when hardening that means it cannot respond to the woodworking, consequently cracks appear and need to be repair time to time. That is why this material is no more used. Today, two-level insulating is common used; it can be seen on the picture nr.1 - left. The mineral wool is embedded into the continuous lateral groove and protected by joint sealing tapes from both sides. The tapes are made from permanent elastic material on the base of modified rubber foam, which is impregnated to resist UV radiation and eliminate an absorbing power. Such a gasket shall also restrict the water, air and insect infiltration.

Recently, usage of fleece instead of mineral wool is considering in Czech Republic. This natural material has to be necessarily proofed in insect resistance. The subject of further research is a fleece availability and effectiveness within the gaskets problematic.

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For comparison, the incorrect type of groove is shown on the picture nr. 1- right, there is neither notch nor insulation in the groove.

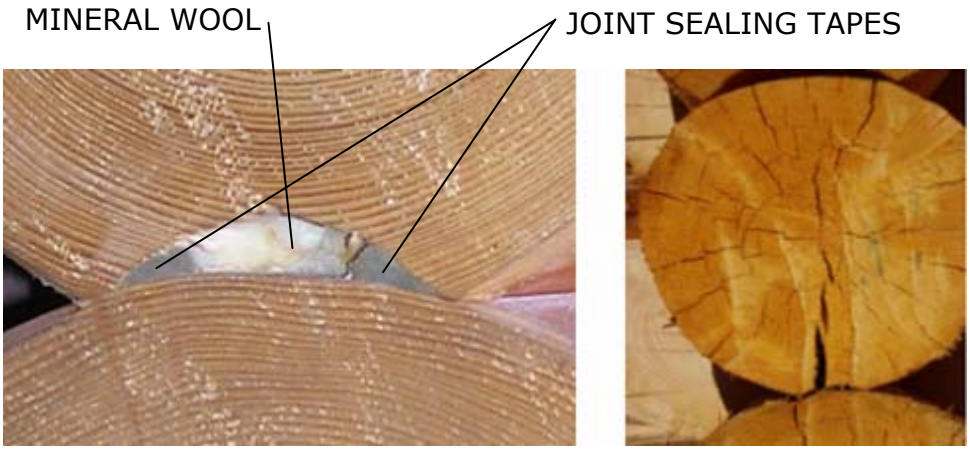

Figure 3. Examples of correct and incorrect groove type

4. MEASUREMENT

To obtain enter values necessary for further design analysis, the thermo vision measurement and surface temperatures measurements of log walls were realized. Shown outputs are from the log wall, where only the pairs of joint sealing tapes protect the grooves. There is no thermal insulation.

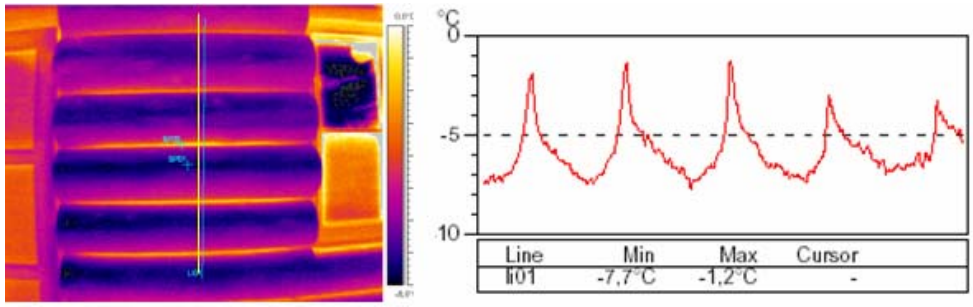

Figure 4. Thermo camera outputs – outside view

From the upper two graphs, the obvious difference between the log surface and groove temperature can be seen.

The subject of further research is an optimization of groove design with the point of view in thermal engineering.

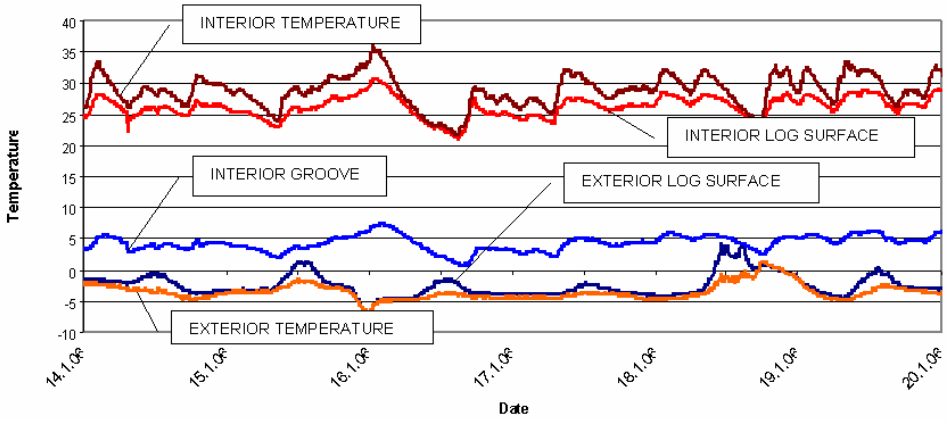

Figure 5. Surface temperature measurement outputs

5. ENVIRONMENTAL CLASSIFICATION

Recently, general attitude towards the environment is changing and also the civil engineering sphere is looking towards to original material base comeback. Also within the construction materials and elements classification, the environmental aspects have rising importance beside the technical and economical aspects. Effects on environment caused by usage of definite material have to be considered during the whole life element period.

The international reputable system for material and buildings classification is so called Life Cycle Assessment – LCA. To be the project certificated as an ISO suitable, the requirements of series ISO 14040 should not be omitted. Standards describe methods needed for Life Cycle Assessment generation. These are especially ISO 14040 Goal and scope, ISO 14041 Life Cycle Inventory Analysis, ISO 14042 Life Cycle Impact Assessment and ISO 14043 Life Cycle Interpretation.

In practice this means that the fossil energy consumption used in building constructions should be reduced. The total fossil energy consumption does not only compose of coal and gas but this is a complex question of choice of particular material types, which had been produced with the aid of fossil energy. For that reason, as much renewable sources should be used for the constructing as possible. Wood is undoubtedly ranked among these low energy renewable materials.

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6. CONCLUSIONS

From the point of view of recently LCA classification, the log houses are ranked among the energy modest construction. That is because wood is an easy available and renewable material, log houses production is easy while the construction details are finished in correct way, their operation is also quite unpretending and last but not least, they cause minimal environment pollution. Wood is a renewable natural source and that is why is so contradistinguished from other construction materials.

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