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RESTARTING OF LONG-TERM MONITORING OF TWO EIGHT-STORY RESIDENTIAL CLT BUILDINGS

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1. Introduction

Construction with timber took up speed when regulations were adapted across Europe in the late 1990s, switching to performance-based regulations. Around the same time, CLT (cross-laminated timber) entered the market which started massive timber construction with prefabricated wall and floor elements. This allowed for new types of timber constructions, similar to the use of prefabricated concrete elements, for apartments and offices as well as for public buildings such as schools.

Nevertheless, the behavior of wood-based buildings was not fully known. Particularly its sensitivity to moisture was of concern – and still is. As a natural, plant-based material, wood is in continuous exchange with its surroundings and taking up water in humid conditions as well as releasing water in dry conditions, respectively. Most material properties are influenced by moisture content, e.g., density, strength, and stiffness, and it is swelling and shrinking with varying moisture content. When wood is exposed for long time to high moisture content, approx. above 16%, there is also risk for fungi to build up which may lead to decay of the material but may also be a health concern.

Long-term loading of wood is also an issue due to creep of the material. The creep compliance across fiber direction has to be taken into account in particular as the material itself is already comparably weak across fiber direction. This becomes an issue in platform-based constructions in tall buildings where a number of floor elements are loaded perpendicular to the fiber direction and experience significant permanent loading at the lower levels.

2. Materials and methods

The buildings at Limnologen in Växjö consist of four apartment blocks with 8 stories each with a total height of approx. 25 m. The bottom floor is made from cast in-situ concrete and the upper floors in timber, including the roof structure. CLT elements with thickness 85 mm are used for the outer and 95 mm for the internal walls. Non-load bearing walls are in a light-weight timber-frame system. The elevator shaft is made from CLT as well. Vertically, prestressing rods were used in the façade walls to stabilize the buildings.

During construction, permanent monitoring systems were installed in two of the houses [1]: in House 2, the vertical displacements along the façade were measured across the floor slabs. From a total of six potentiometers, the vertical movement could be tracked. In addition, temperature and humidity sensors were installed in two positions. In House 3, combined temperature and humidity sensors were installed, at three positions at the 2nd floor, and three at the upper most floor. At each position, the sensors were placed in 6 different depths of the walls to obtain the gradient.

Data were acquired between 2007 and 2017, when the logging system was removed. Analysis of the data was performed regularly and in particular the dry-out process of the wood as well as the vertical displacements along the façade were shown [2]. During 2024, a new logging system was assembled since the old data logger was not available anymore and documentation was rudimentary preserved. In December 2024, the system was installed in the building and permanent measurements are running starting from January 2025.

The temperature and humidity data can be directly continued from the previous measurement series, as it represents absolute data (Fig. 1). However, during the first few months, it must be verified whether all sensors funct as intended and if any drift occurs. For the potentiometer readings, a longer time period is necessary in order to be able to continue the measurement series. Firstly, there is no absolute reading for the potentiometers after restarting; secondly, discontinuing the power supply resets the resistance readings. Therefore, the approach is to compare the long-term trends from both the old and new measurements in order to continue obtaining the offset value for displacements.

3. Results and conclusions

The buildings of Limnologen are approaching twenty years of ageand were one of the first CLT buildings of this size in the Nordic countries. Their intermediate age and exposure to these climatic conditions allows us to learn about the long-term behavior of CLT buildings. The seasonal variation in the vertical displacements is presumably still ongoing and it will be interesting to see if the magnitude remains consistent. Additionally, there is limited information available on creep over long time periods, making the results from Limnologen an important source of information.

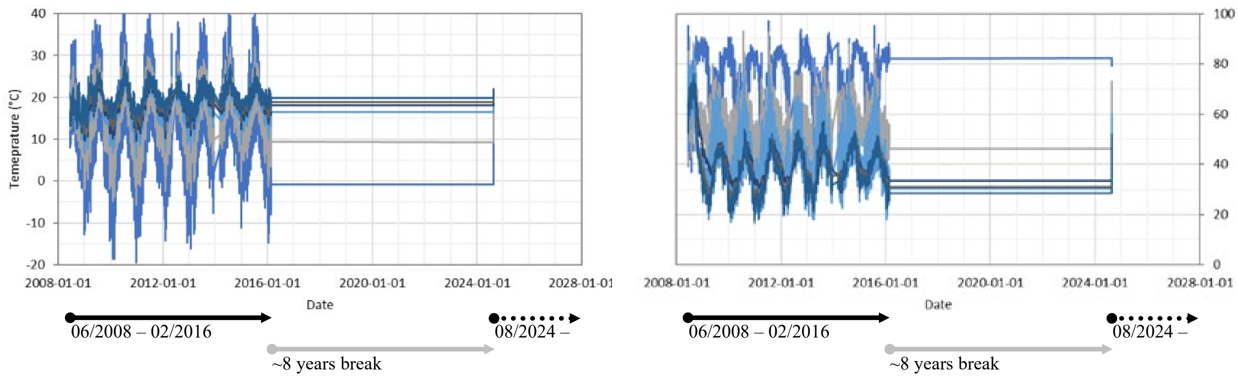

Fig. 1. Variation of temperature (left) and relative humidity (right) in one of the wall sections for the years 2008-2016 as well as momentarily in autumn 2024.

4. Acknowledgements

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5. References

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