XV International Conference on Durability of Building Materials and Components
DBMC 2020, Barcelona
C. Serrat, J.R. Casas and V. Gibert (Eds)

Drying Potential of Wood Frame Walls Subjected to Accidental Water Infiltration

Marijke Steeman, Nathan Van Den Bossche and Klaas Calle

Building Physics research group, Ghent University, J. Plateaustraat 22 B-9000 Ghent, Belgium, Marijke.Steeman@UGent.be

Keywords: *Wood Frame Construction, Measurements, Drying, Water Infiltration.*

1 Introduction

Though masonry is the most common construction method in Belgium, the number of wood frame buildings has grown in the last years: in 2018 over 10% of all new built dwellings were wood frame buildings. This increase can be partly attributed to the growing attention for energy performant buildings with a low environmental impact. However, wood frame is more vulnerable to moisture problems, mould growth and wood rot. An important risk is water infiltration through imperfections in the building envelope as a result of driving rain. Therefore it is important for the design to be resilient and allow drying without consequential damage.

2 Experimental Set-up

In this paper the hygrothermal performance and the drying potential of different wood frame wall constructions subjected to water infiltration is investigated using the test pavilion called "STEAMlab21" (6,60m x 4,37m). The exterior north-west facing wall is replaceable and used as a test wall. The test wall is a wood frame wall with 8 compartments. Each compartment of the test wall measures 34,4 cm width and 266 cm height. The compartments differ in the type of insulation material (mineral wool or cellulose) and the type of vapour retarder (OSB or smart vapour retarder, SVR) that were used. In this way 4 types of compartments were obtained, each having a different combination of insulation and vapour retarder (Figure 1). Water is added from the outside in one of the two identical compartments, mimicking rain water infiltration.

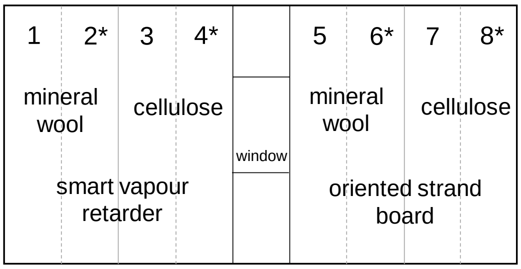

Figure 1. Schematic overview of the test wall with 8 compartments.
Compartments with water injection are marked with *.

Temperature and relative humidity sensors were installed on different locations in the construction: at the inside wall surface, in the service cavity, in the insulation layer (interior and exterior side) and in the ventilated cavity at the outside. In total 92 sensors were used. A convector and a fan were installed to control the indoor climate and to ensure well-mixed air conditions in the test building. Measurements were carried out for 30 days from April 28th to May 27th 2019 every 15 minutes. Water was injected on April 30th 2019 at 2 pm.

3 Measurement Results

The results showed that the RH in the insulation layer increased when water was injected. It was assumed that the injected water mainly runs down at the interior side of the insulation layer, especially for the compartments with mineral wool due to its very low moisture capacity. The drying rate was estimated by comparing the RH of the wet and dry compartment of each construction type (Figure 2). The RH difference increases faster in the compartments filled with mineral wool compared to the compartments filled with cellulose. Similarly, the drying rate of the compartments with cellulose is lower. For the compartment with mineral wool and SVR (comp. 2) and with mineral wool and OSB (comp. 6), the drying period is ± 14 and ± 21 days respectively. For the compartments with cellulose (comp. 4 & 8), the drying period is considered longer than the measurement period (> 27 days).

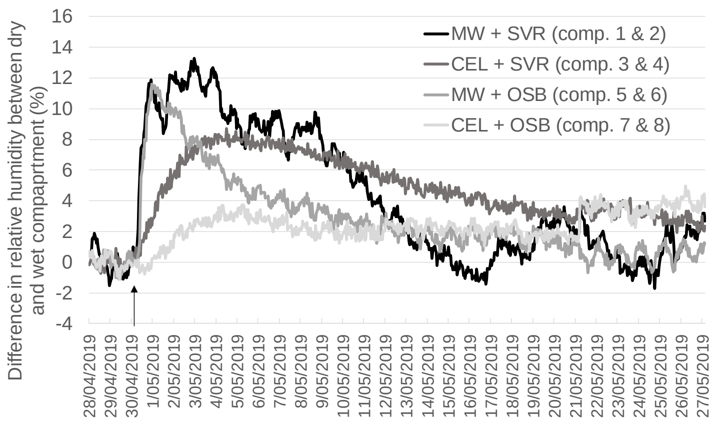

Figure 2. Difference in RH between wet compartment and the dry compartment.

It was also concluded that drying mainly occurs towards the inside of the wall. For the compartments with mineral wool, drying starts immediately after water infiltration, while for the compartments with cellulose drying starts later. The results showed that humidity variations are more damped in the compartments filled with cellulose insulation. This was expected and can be explained by the hygroscopic characteristics of the insulation. The OSB has similar moisture buffering characteristics, but because of the limited thickness (0,015m), the effect is small. Future work should give more insight in the moisture content of the bottom plate and I-joists when water runs down. Also, the impact of a continuous water leakage, of different wall orientations and the moment of adding water (summer/winter) on the hygrothermal performance should be studied in more detail.

ORCID

Marijke Steeman: https://orcid.org/0000-0002-6575-5389
Nathan Van Den Bossche: https://orcid.org/0000-0002-8738-7249
Klaas Calle: http://orcid.org/0000-0001-6736-6662