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

Impact of Climate Change in Building Envelope Design

Klodian Gradeci, Alessandro Nocente, Nathalie Labonnote and Petra Rüther

SINTEF Community, Høgskoleringen 7B, 7034, Trondheim, Norway, klodian.gradeci@sintef.no

Keywords: *Building Envelope, Climate Change, Mould Growth, Performance Evaluation.*

1 Introduction

Mould growth is a biodeterioration phenomenon that jeopardizes the integrity, functionality and durability of building envelopes. The performance to withstand biodeterioration depends on the critical hygrothermal conditions, on the investigated material inside or outside the building envelope, and also on the chosen approach to assess these conditions. The hygrothermal conditions are subject to the configuration of building envelopes on the one hand, and climate exposure, as a combination of the outdoor weather and indoor environments' conditions on the other hand. These critical conditions are likely to intensify in response to the changing climate, and hence, the exposure and strains will increase suggesting that the performance of building envelopes will have to accommodate new exposure. In light of this, modification and adaptation of the envelopes' configuration will be required. The aim of this study is twofold: (i) to understand the implications of climate change in the performance evaluation to withstand mould growth; (ii) to provide recommendation to current building envelope design guidelines regarding the performance evaluation to withstand mould growth.

2 Material and Methods

Three different North American wall assembly configurations are chosen in this study. The hygrothermal simulations are performed by WUFI 6.3 ®. The selected location is Calgary, Canada. Two sets of climate data are implemented: a) 15 historical climate data set, and b)15 climate data set for a climate change scenario in which the global climate temperature change is forecast to be 3.5 ^{o}C. The hygrothermal conditions are retrieved for each case study and then processed in WUFI Model Index VTT 2.1.

3 Results

The simulated mould growth results for the three wall assembly configurations exposed to 15 historic and future outdoor climate are plotted in Figure 3 and Table 4. The maximum simulated mould growth in a period of 30 years has been selected for each case study. For the first wall, the mould growth is simulated for the asphalt impregnated paper with the assumed sensitivity class '*medium resistant - relatively low decline*'. For the second and third wall, the mould growth is simulated for the wood-fibre insulation board with the assumed sensitivity class '*sensitive - low decline*'. As expected from the previous results, the difference between the simulated mould growth under future climate and historic climate is emphasised only for the first wall assembly configuration. Moreover, the results show that the simulated mould growth is sensitive to the uncertainties of outdoor climate for the first wall configuration assembly. Contrarily, the other two walls do not appear to be sensitive to the uncertainties of the outdoor climate.

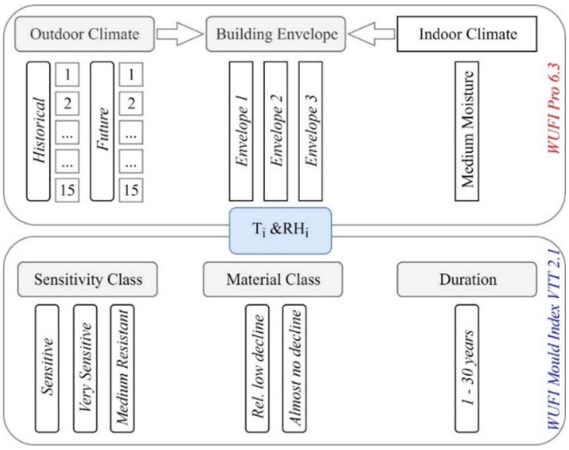

Figure 1. Schematic overview of the simulation process and its parameters.

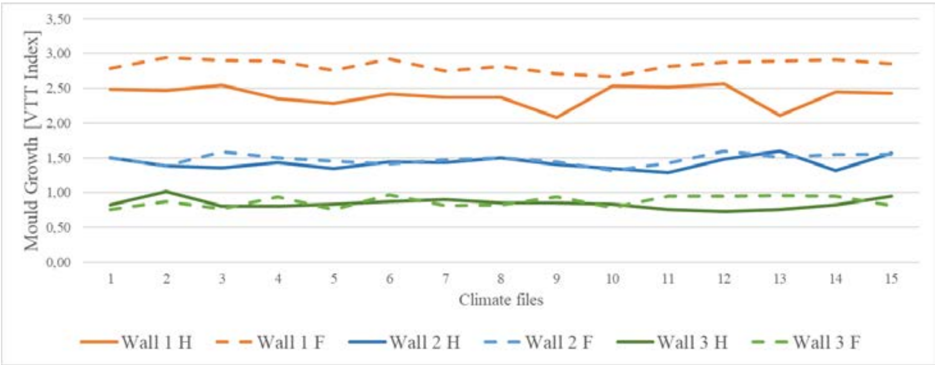

Figure 2. Results of mould growth for three wall assembly configurations simulated under historical and future climate files.

4 Discussion and Recommendations

- The results show that the implication of climate change, as accounted for by the generated climate files, can vary depending on the configuration of the wall assembly.
- Guidelines for building envelope design assessing the performance to withstand mould growth should extend the details regarding the choice of sensitivity class and material class, connect simulation runtime to the performance criteria, and improve the performance criteria that can accommodate the differences in the typology and extension of the building.

Acknowledgements

This study was funded by the project 'TightEN - Durable adhesive airtight solutions for energy efficient building envelopes'. Research Council of Norway; Country: Norway; Grant number: 294894.

ORCID

Klodian Gradeci: https://orcid.org/0000-0002-9837-3512