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Abstract - A Methodology for Assessment of Building Assembly Air Leakage Moisture Response, Condensation Risk, and Expected Durability When Subjected to Projected Future Climate Loads

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1 Introduction

It was determined that the ability to assess the required performance of an air barrier assembly could now be supported using modern computational hygrothermal simulation techniques coupled with historical and future climate data and the new durability methodology developed as part of the updated 2019 CSA S478 *Guideline for Durability of Buildings*.

2 Analysis Methodology

Air leakage and its impact on wall assembly durability related to condensation and mold growth is a relatively function of the following criteria; 1) building occupancy. 2) building height, 3) wall assembly composition, 4) location climate characteristics, and 5) wall assembly air leakage rate. A reference wall was utilized to develop the methodology.

Climate change weather data has been developed by the National Research Council Canada that allows for a balanced assessment of future building design needs (Gaur *et al.*, 2019). Two representative years were selected from the median run of the historical and future climate data.

DELPHIN 5, v5.9.4, was used for hygrothermal simulations.

3 Results

Results focused on relative humidity, with the initial year considered a conditioning year. Only results for the second year are discussed. For this study, the results for the top left surface of the bottom plate were used to compare the impact of air leakage rates and the climate change.

Figures 1 and 2 show the relative humidity profiles for each air leakage rate for the top left surface of the bottom plate for the reference wall (W1), for Historical (Figure 1) and Future (Figure 2) climate scenarios. The lower graphs are a sub-set of the data that allow detailed comparison after the conditioning first year of modelling. Some key observations can be made.

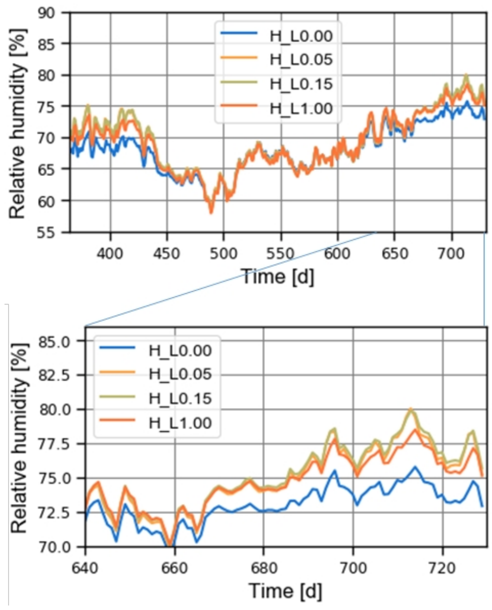

Figure 1. RH profiles, top left surface of bottom plate, reference wall (W1). Historic weather data.

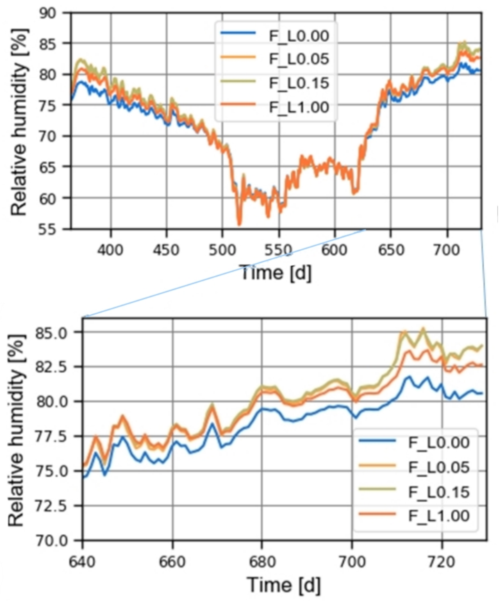

Figure 2. RH profiles, top left surface of the bottom plate, reference wall (W1). Future weather data.

<u>Air Leakage Rate:</u>

- All curves follow the same general profile as the 0.0 air leakage rate
- Air leakage rates of 0.05 and 0.15 have similar results for both climate scenarios.
- The simulation time is insufficient to normalize results to identify moisture load trends

<u>Climate Change:</u>

- Future climate data shows an increase of up to 8% in RH over Historical climate.
- Future climate shows sustained increase in RH versus Historical climate after the 710 day mark in the simulation. Historical climate shows a decrease in RH while Future climate shows sustained increase.
- The simulation time is insufficient to normalize results to identify moisture load trends

Future work must use longer simulation timeframes and analyze different climate zones, different building heights, different building occupancies, different wall assemblies, and formal durability risk assessments to fully understand the importance of air barrier performance selection on long-term durability in a changing climate.

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