Moisture-Related Durability of In-Service High-R Wall Assemblies in Pacific Northwest Climates

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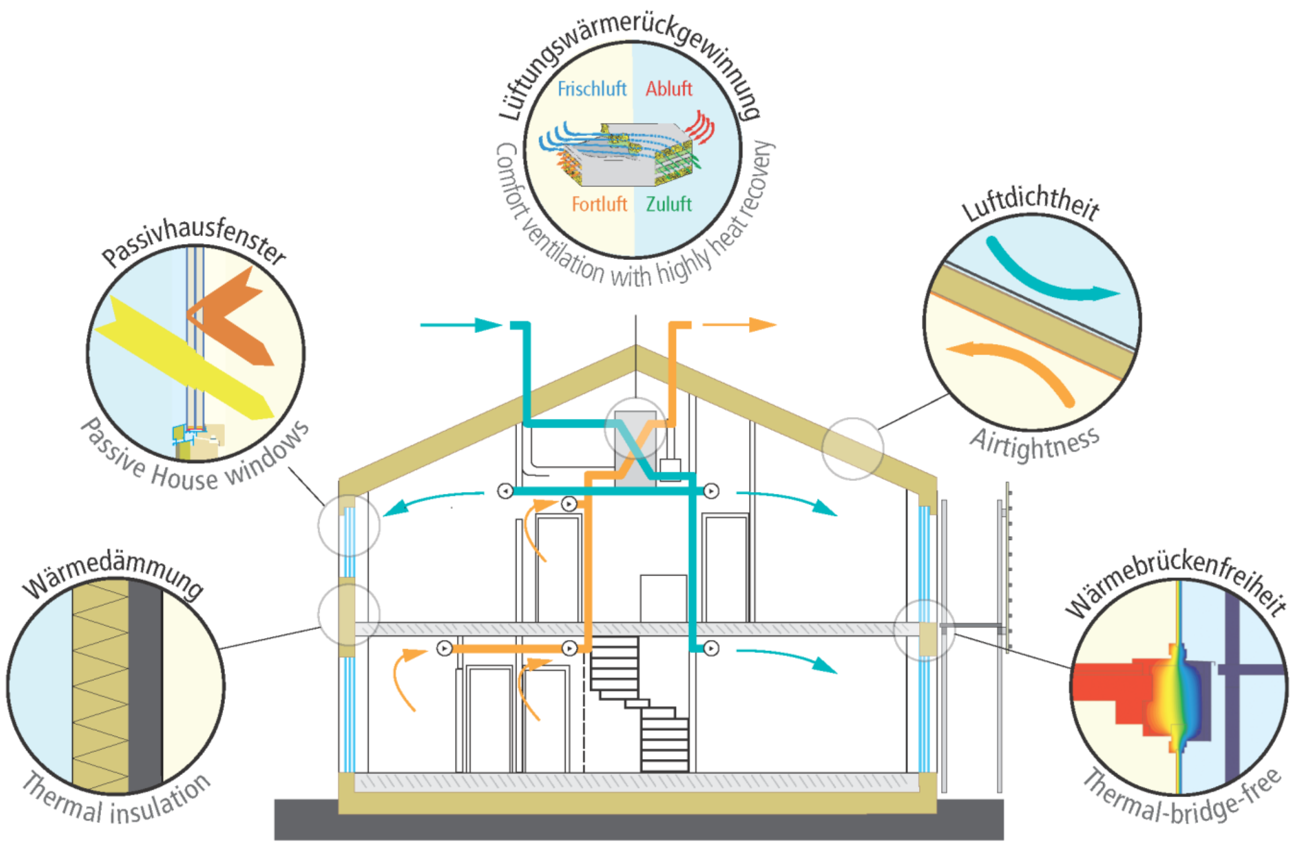
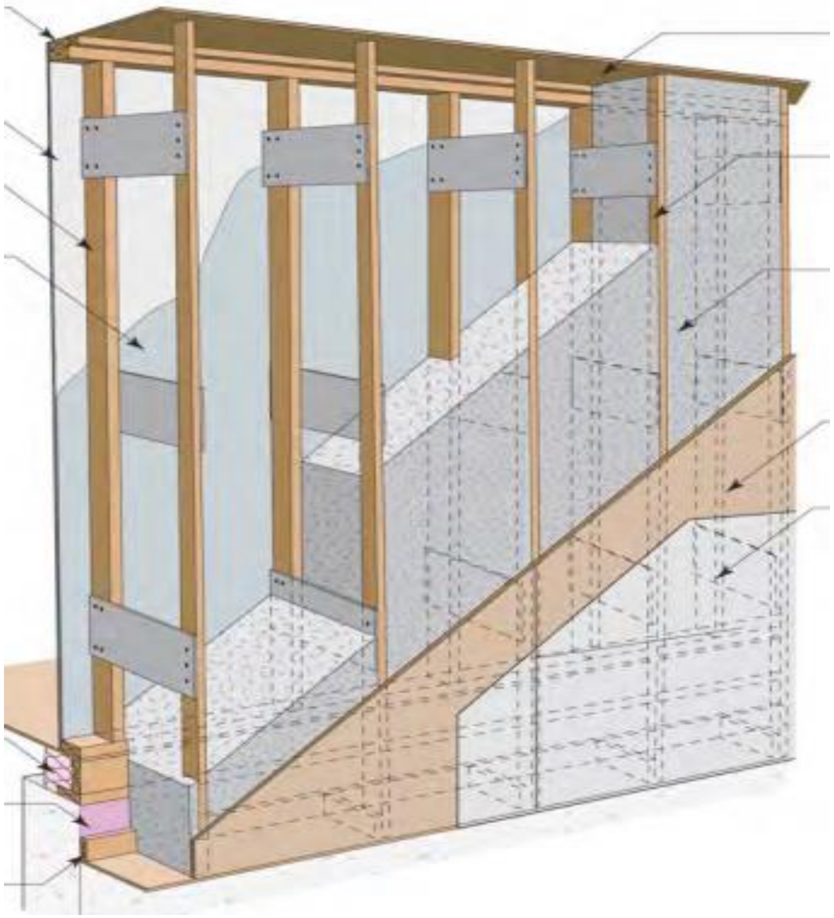
Introduction

Passive House Certification

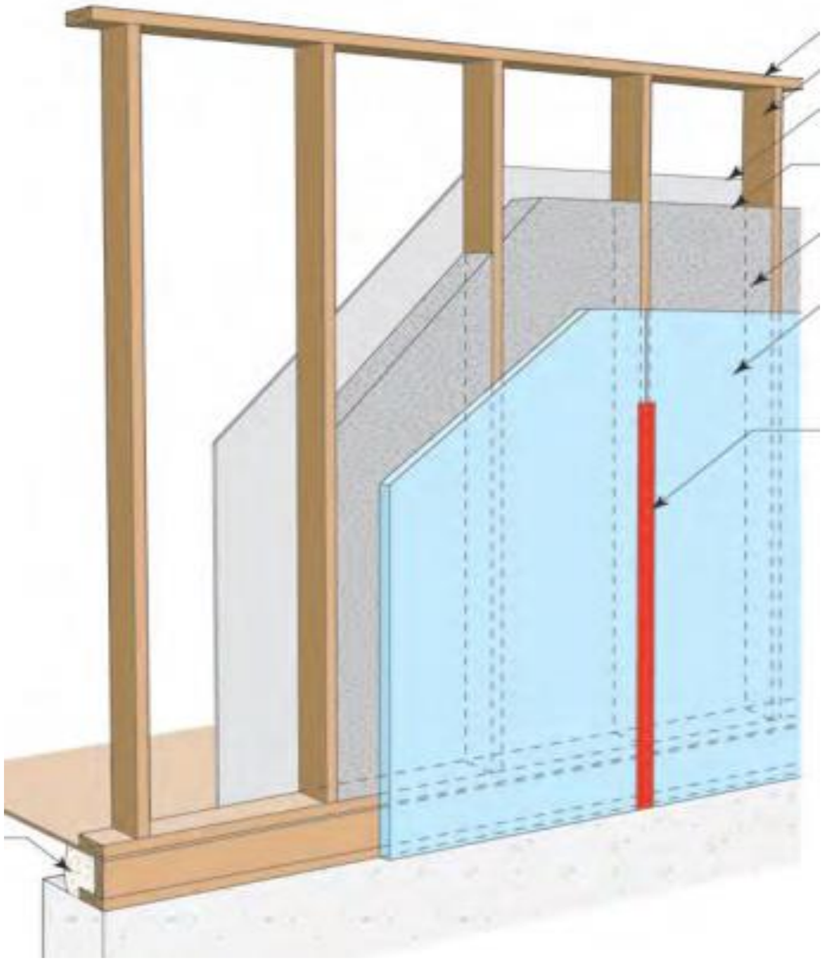


Introduction

Deep Cavity Approach



Exterior Insulation Approach



(Straube and Smegal, 2009)

Literature Review

- Exterior insulation raised the temperature of the condensation plane in cold climates resulting in lower sheathing moisture content levels

- Exterior insulated walls were at a lower risk of moisture accumulation due to vapour diffusion or air leakage condensation

- Only one exception that contradicted the durability risk was in Fairbanks AK, where there was an insufficient amount of low vapour permeance exterior insulation in combination with an interior layer of poly that had experienced air leakage. When the exterior insulation R-value was increased, there were no issues.

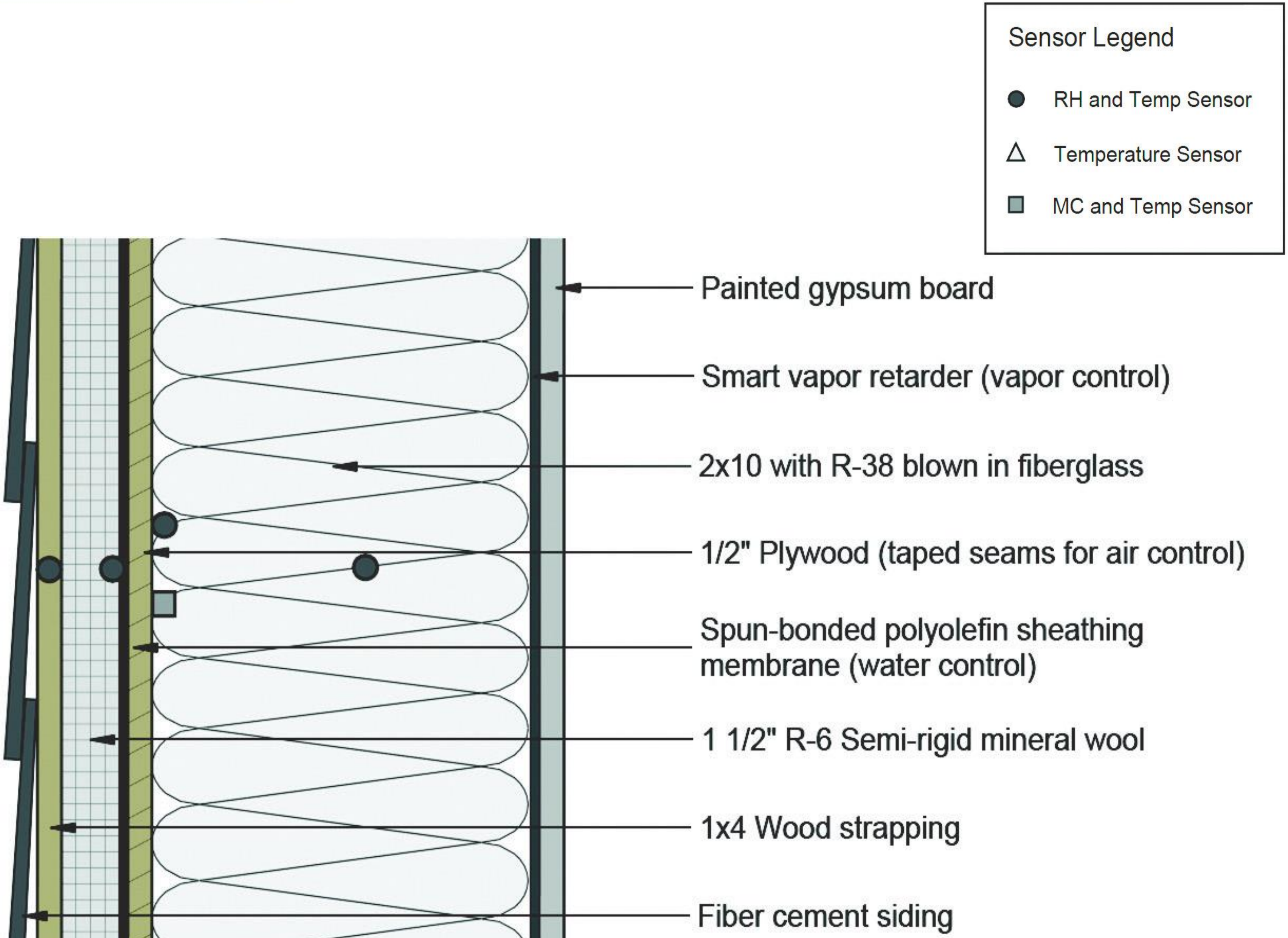
- Deep Cavity walls often showed measured performance that could be considered risky.

Background

- → Comparative Study of moisture risk in two Passive House MURBs
- → Similar Pacific Northwest Climates
  - → Victoria, BC
  - → Portland, OR

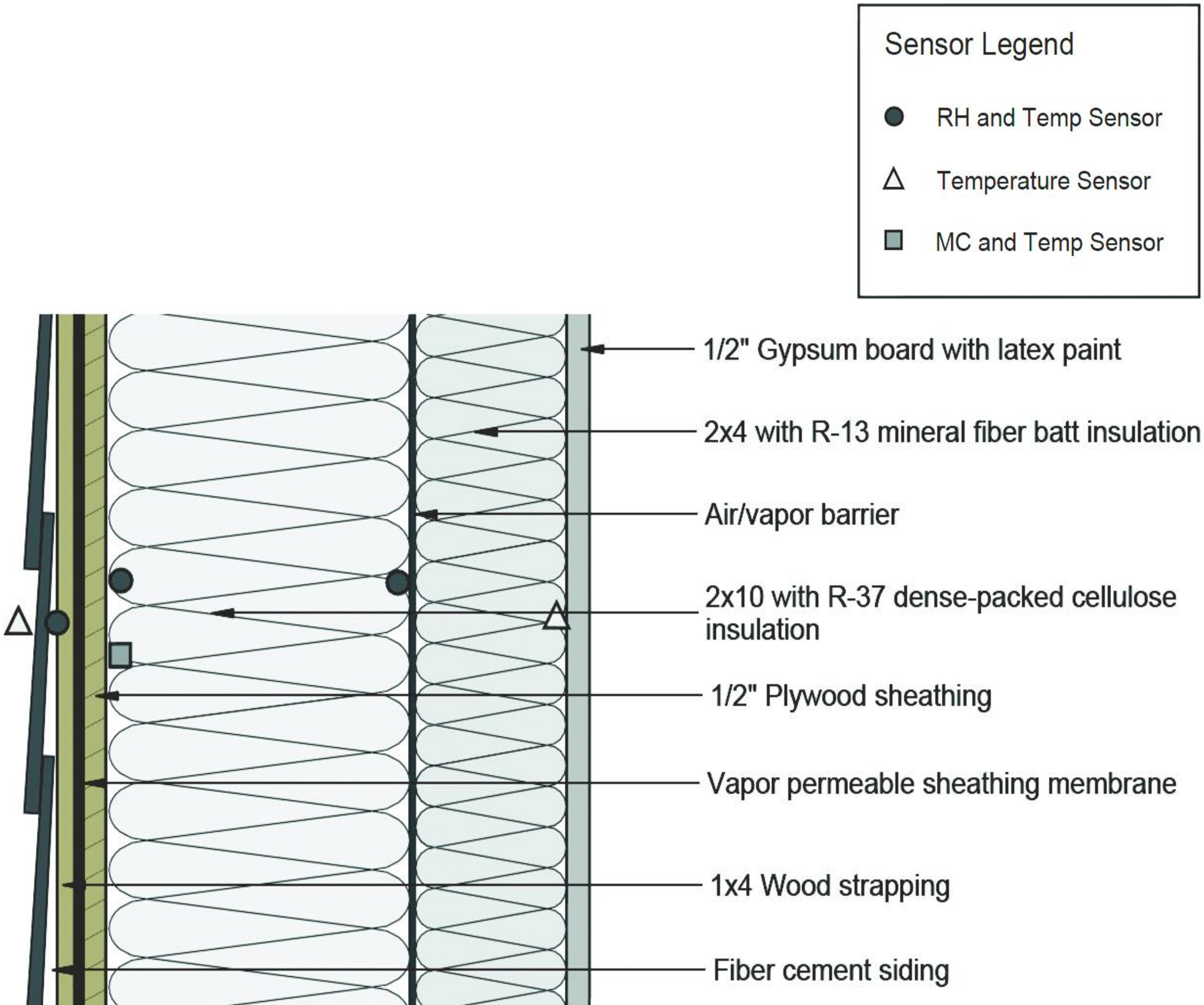
Portland, Oregon

Assembly and Instrumentation - Portland



Victoria, BC

Assembly and Instrumentation: Victoria



Moisture Monitoring Sensors

- Wood Moisture content measurements
  - Electrical Resistance correlated to moisture content – Garrahan equation
- Relative Humidity measurements
- Temperature measurements

Evaluation Criteria

- → Comparing the conditions at the sheathing to the exterior conditions in each location
  - → Temperature and Relative Humidity
- → VTT Mold Index
  - → Greater than a mold index of 3, visual mold and new spores produced

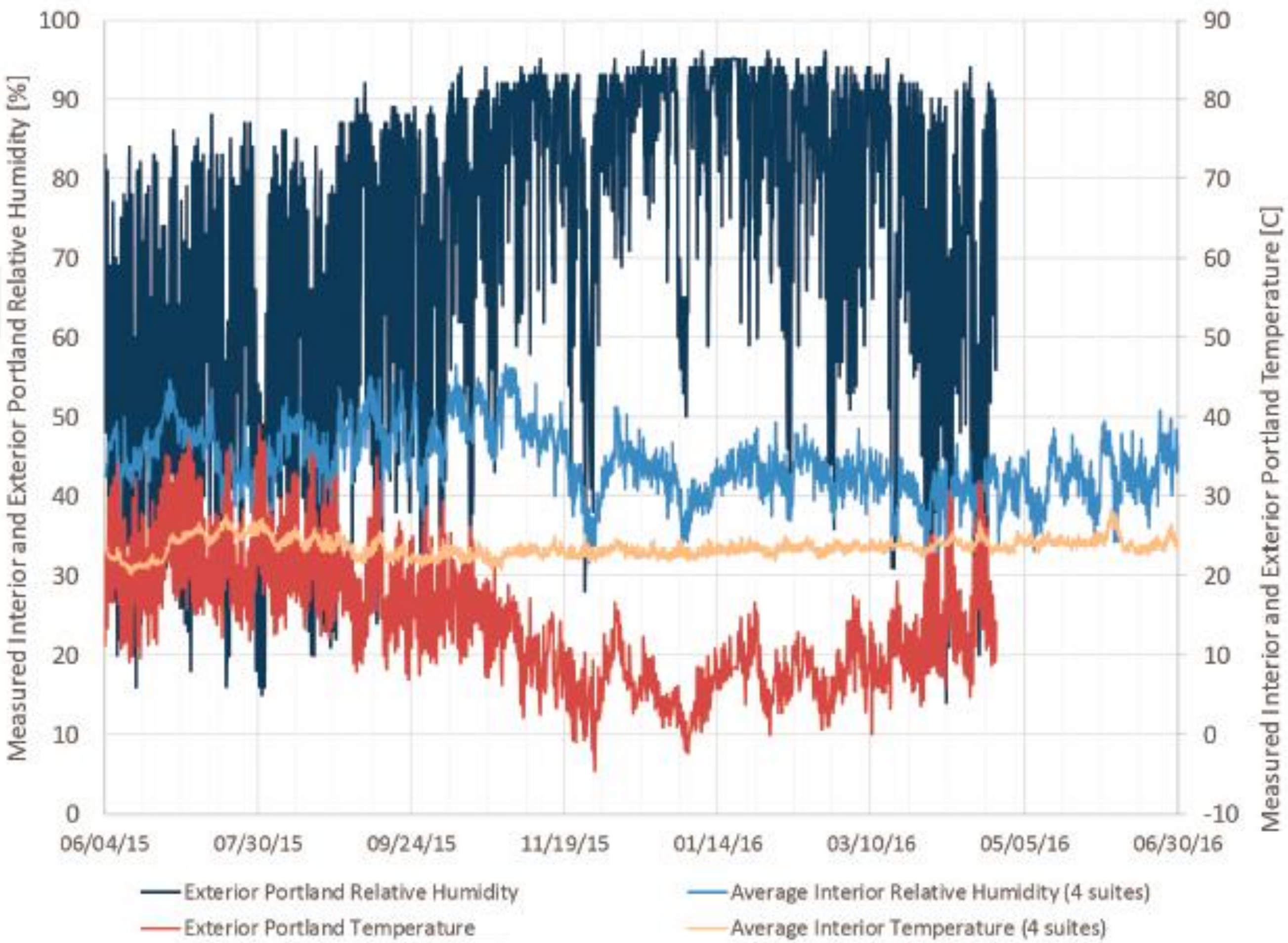
Mold Index Model

- → Developed by Viitanen and Ritschkoff
- → Based on lab studies and regression analysis
- → Uses dynamic temperature and RH measurements at the sheathing to predict the risk of mould growth

Table 1. Mold Index for the VTT Model (Viitanen and Ojanen 2007)

Index	Growth Rate	Description
0	No growth	Spores not activated
1	Small amounts of mold on surface (microscope)	Initial stages of growth
2	<10% coverage of mold on surface (microscope)	—
3	10%–30% coverage of mold on surface (visual)	New spores produced
4	30%–70% coverage of mold on surface (visual)	Moderate growth
5	>70% coverage on mold on surface (visual)	Plenty of growth
6	Very heavy and tight growth	Coverage around 100%

Boundary Conditions: Portland

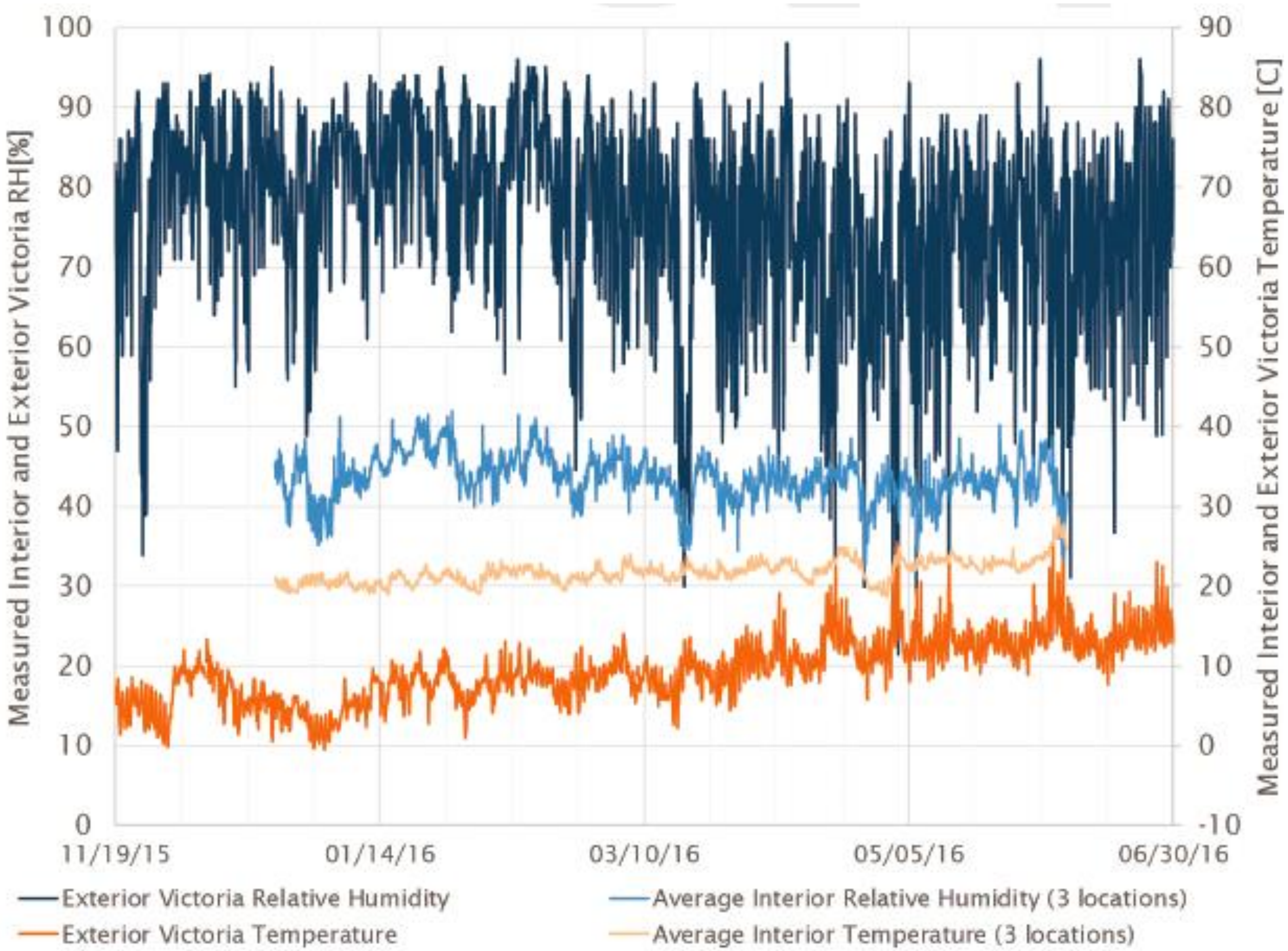


$HDD_{18\ C}$ = 2400
$HDD_{65\ F}$ = 4320

Winter Int. RH
= 38% - 50%

Winter Int. Temp.
= 23˚C (73 ˚F)

Boundary Conditions: Victoria

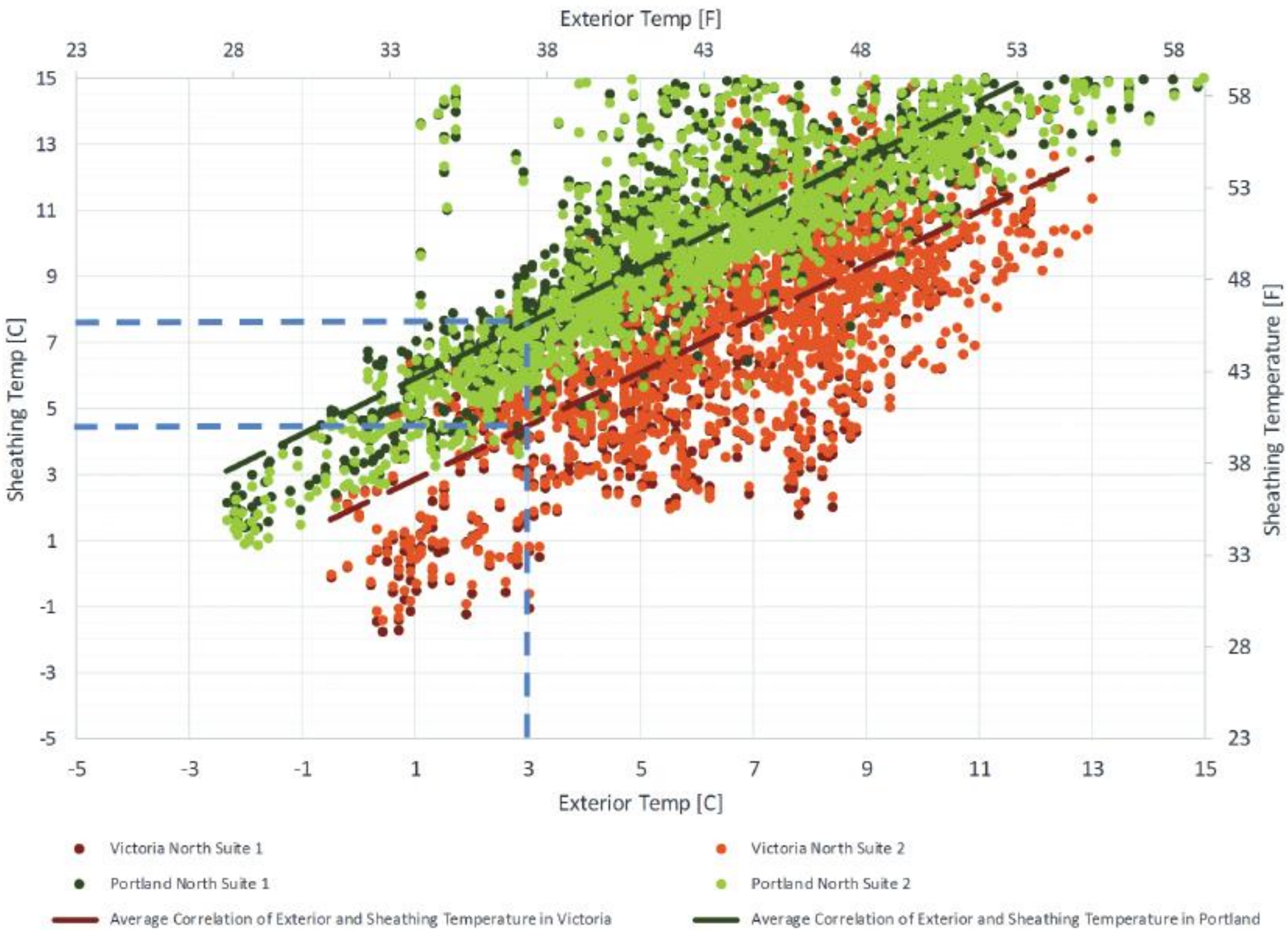


$HDD_{18\ C} = 2900$
$HDD_{65\ F} = 5220$

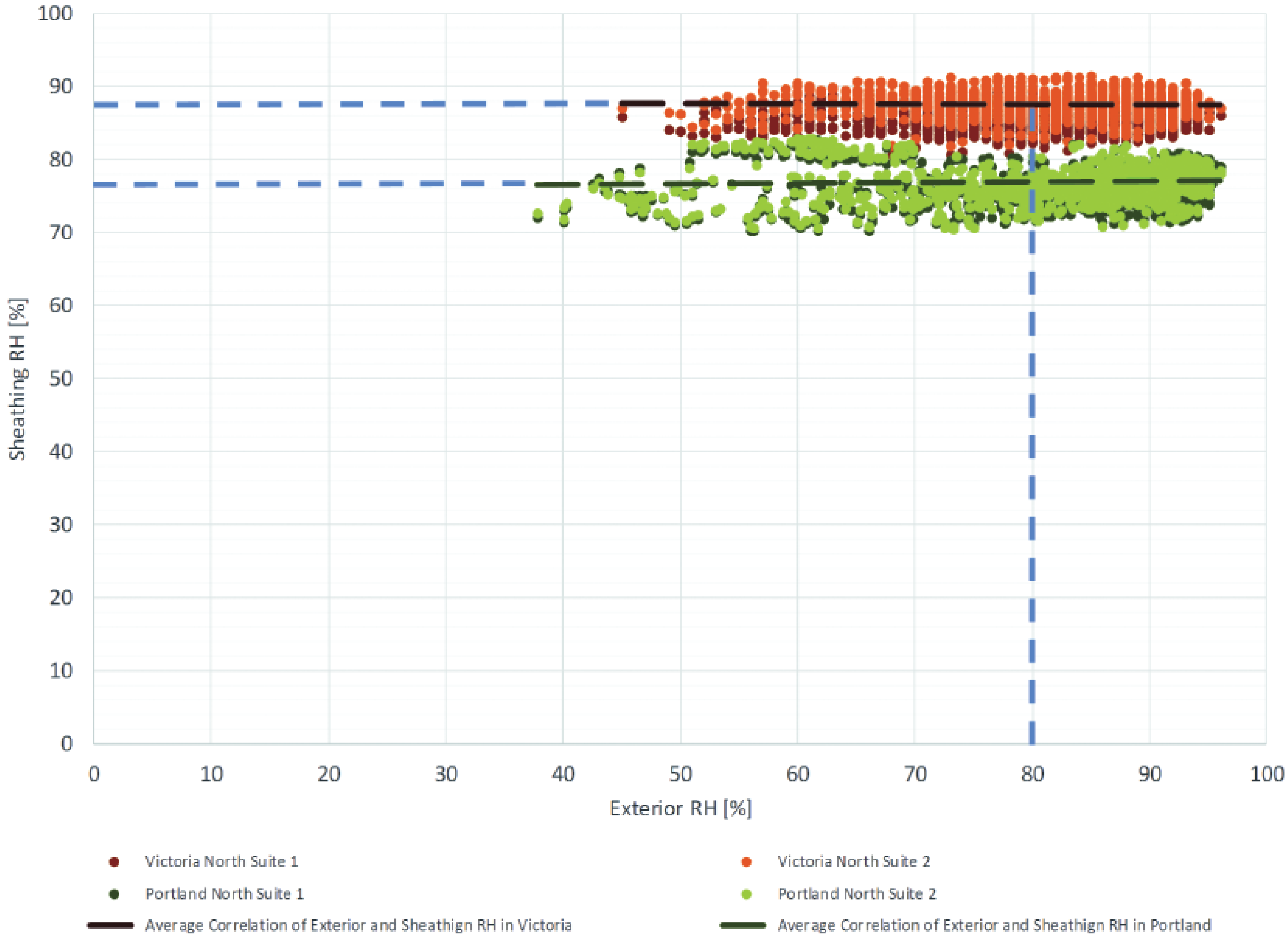
Winter Int. RH
= 40%-50%

Winter Int. Temp.
= 21˚C (70 ˚F)

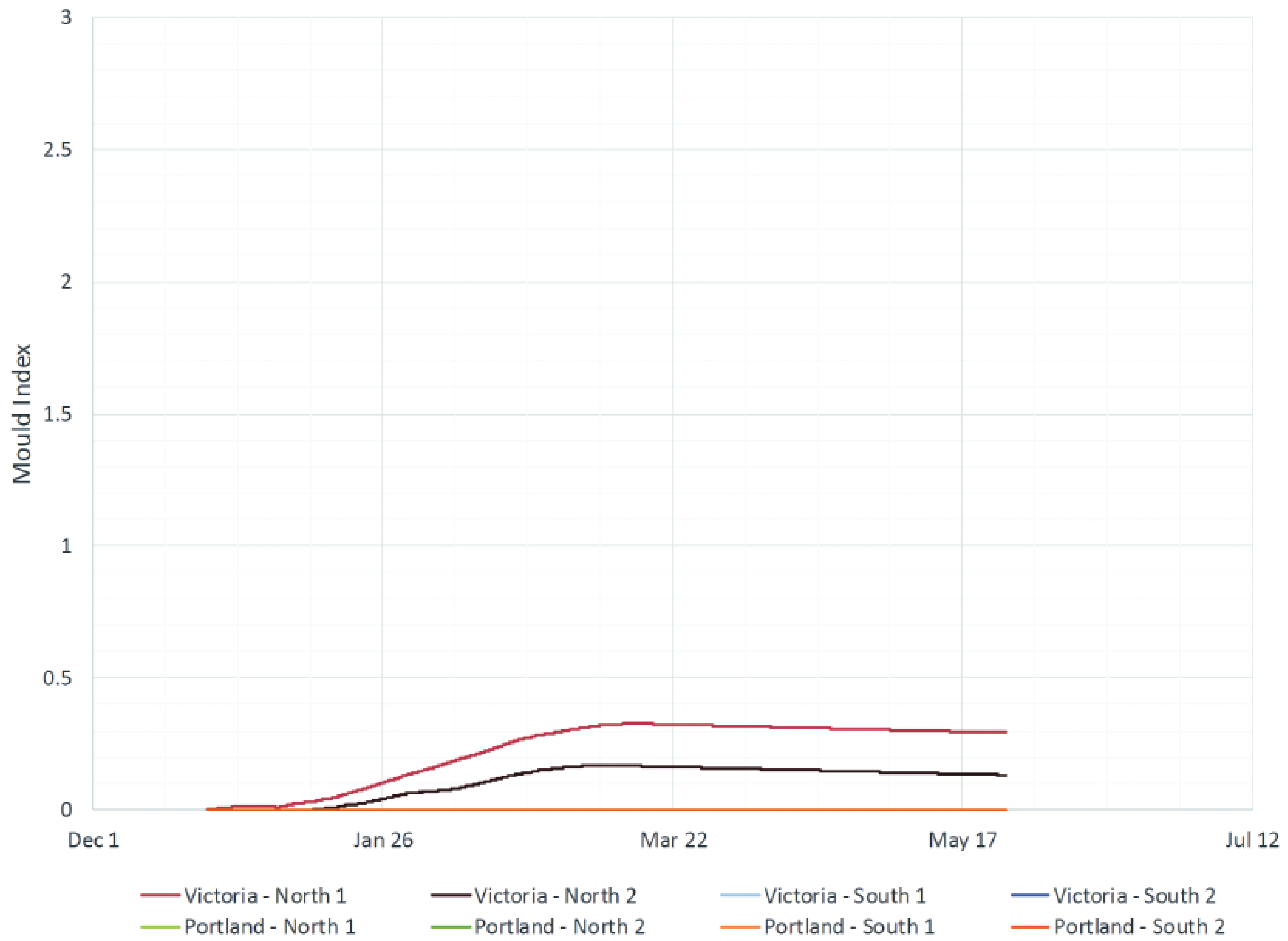
Results:
Exterior Temp. vs Sheathing Temp.



Results:
Exterior RH vs Sheathing RH



Results: VTT Mould Index



Conclusions

- The sheathing of the exterior-insulated wall assembly (Portland) had higher sheathing temperatures and lower sheathing RH for a given exterior temperature and RH, compared to the double-stud assembly (Victoria).
- Analysis using the VTT mold index model showed that neither wall assembly experienced measured conditions that show a risk of mold growth on the sheathing during the monitored period
- The results of this study support the substantial body of research suggesting that exterior-insulated assemblies can be used without increasing moisture-related durability risks.

Questions/Comments?

→ Special thanks to the project sponsors:

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