Passive House Wall Assembly Performance – A Case Study

CCBST XV

PAPER 87

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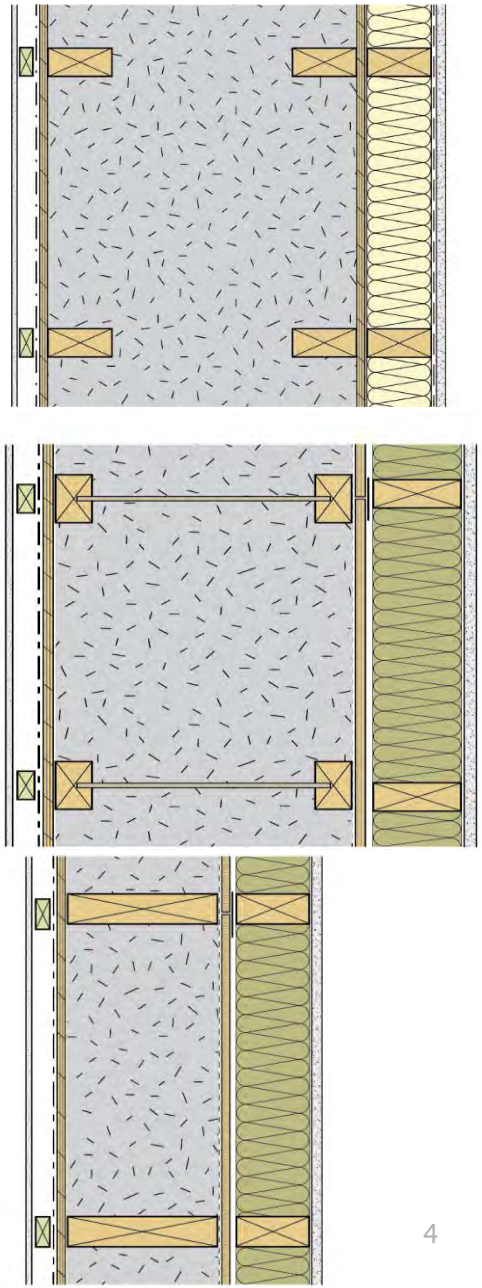
Outline

- → Intro – Passive House, Performance Requirements
- → Lit Review: Concerns with High-R Value Walls
- → Monitoring Methods
- → Monitoring Results
- → Analysis of Results
- → Performance Calculations (VTT Model)

North Park Passive House

High-R Cavity Insulated Walls

- → Many variations: typically thick walls with cellulose insulation
- → Moisture Risks:
  - → Construction Moisture
  - → Bulk Water Leaks
  - → Air Leakage Condensation
  - → Vapour Diffusion (In <u>and</u> Out)
- → Organic sheathing on exterior
- → High-R Value: Decreased Drying (less heat flow)
- → Concern: Risk of Mould



Literature Summary

→ Tsongas (1991): "Walls with more cavity insulation led to increased moisture levels"

→ Arena (2013): Simulations overpredict wall performance. North Walls ~20%MC

→ Lepage (2013): Parametric hygrothermal study, incl. air and water leak. Cavity insulated walls found to be sensitive

→ Ueno (2015): Double-Stud Wall, Sheathing MC ~30% with high interior RH, MC~20% with lower interior RH*

→ Smegal (2016): Comparative case-study on deep-stud walls. Found even nominal exterior insulation improved dryness

→ Trainor (2016): Field exposure test hut, incl. air leakage. Double-stud is at risk of air leakage (MC 30%+)

NPPH Exterior Walls

→ 2x8 wood stud wall 24” OC

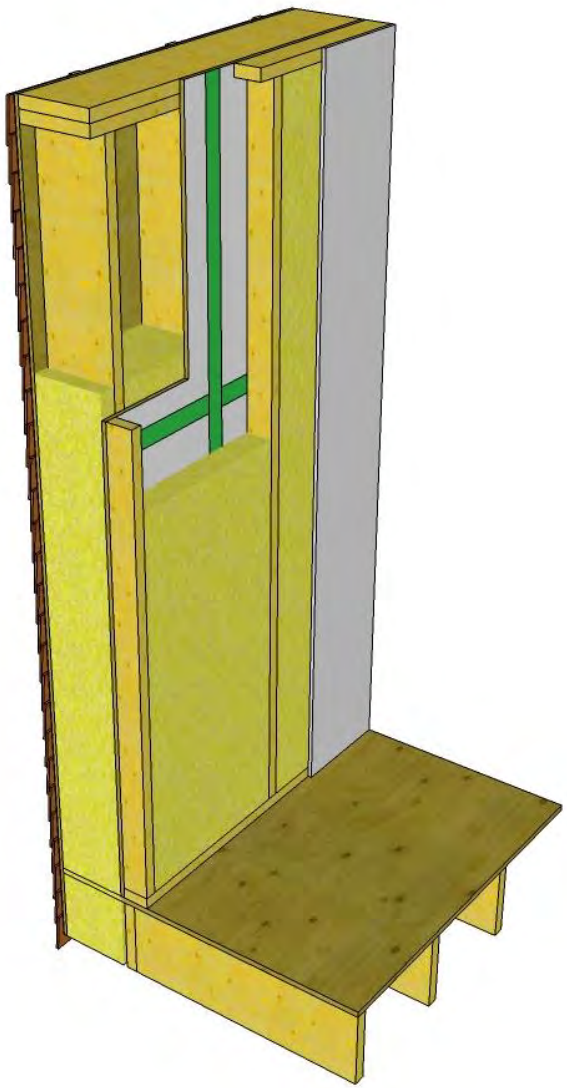
→ Dense pack blown in cellulose

→ Dew-point analysis

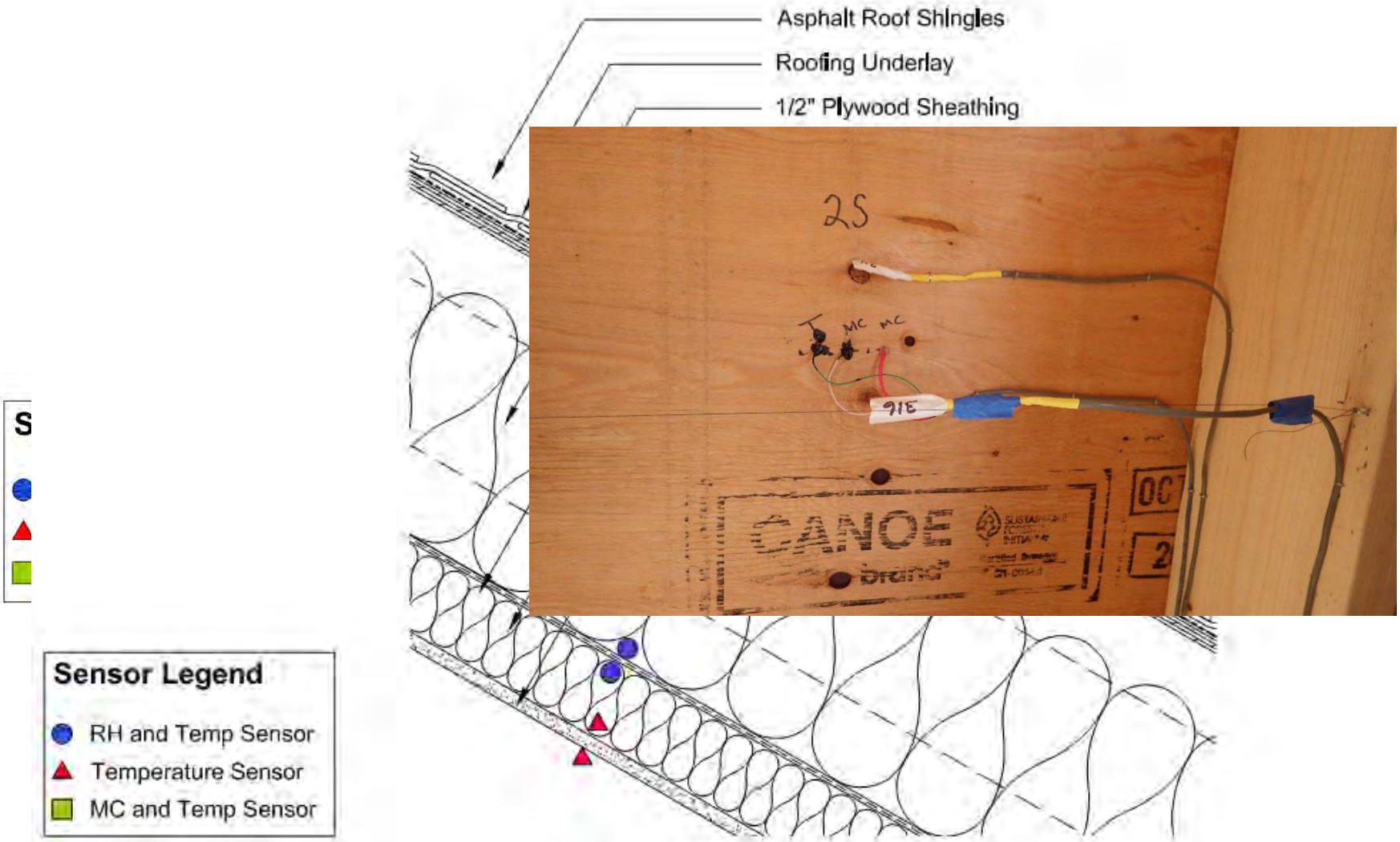
→ 2x4 service cavity filled with rock wool batts.

Monitoring Method

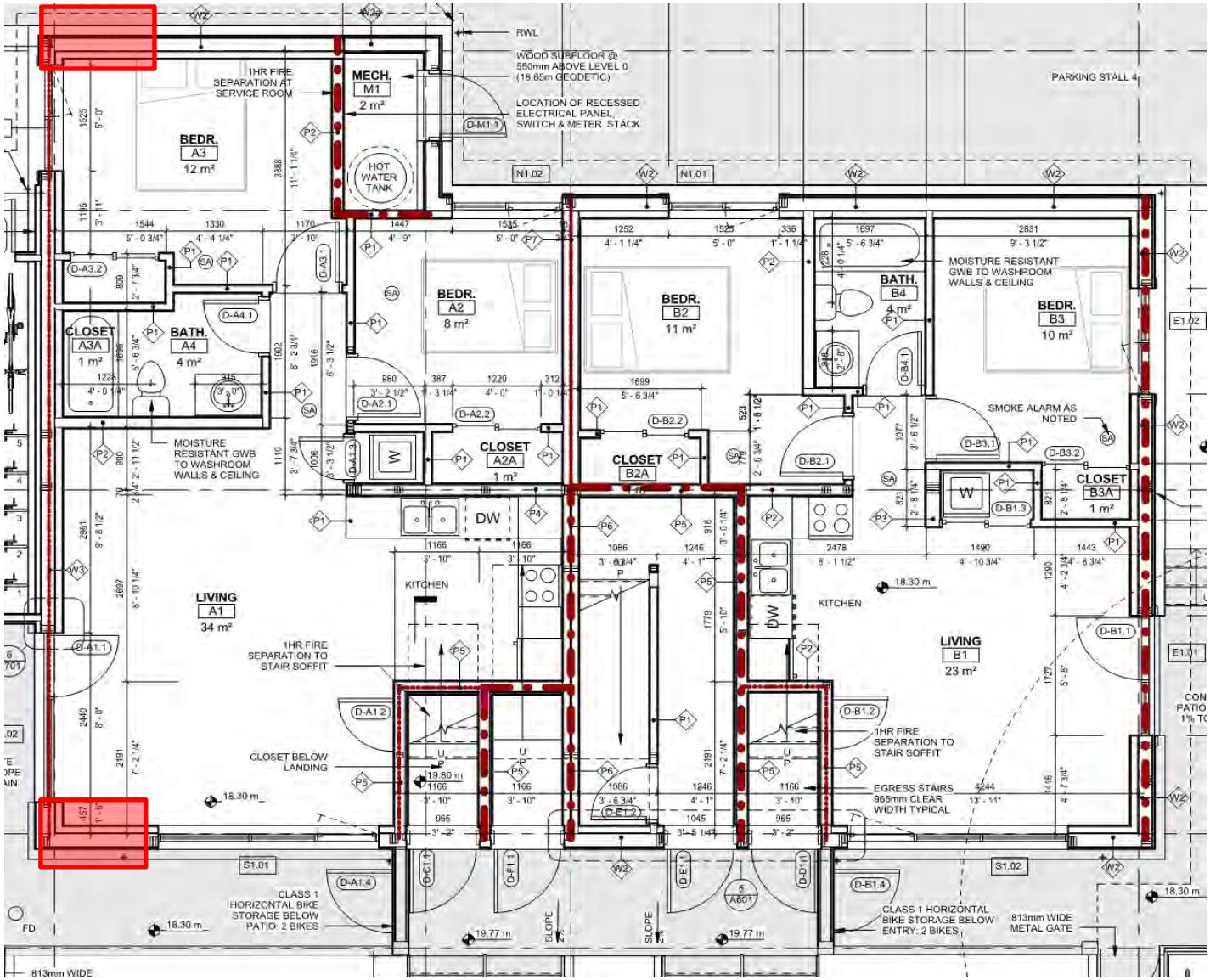
- → Objectives: assess risk from construction, bulk water, air leakage, and vapour diffusion moisture loads
- → Sensors:
  - → MC pins in sheathing
  - → RH&T Sensors
- → Boundary Conditions:
  - → Indoor: T&RH Sensor
  - → Exterior: Local MET tower and drainage cavity sensor



Assemblies and Sensors



Building Layout

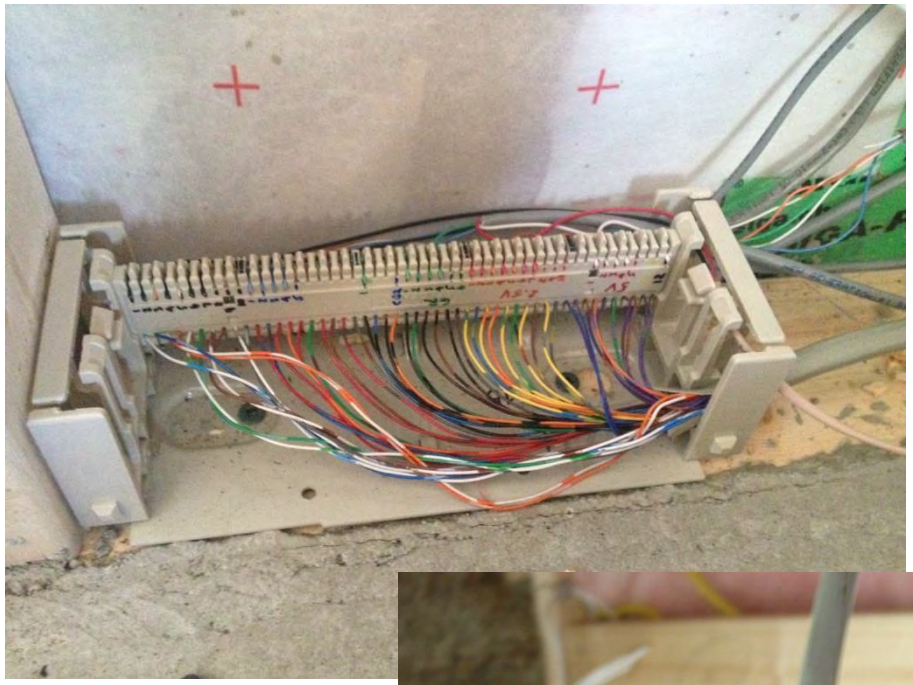


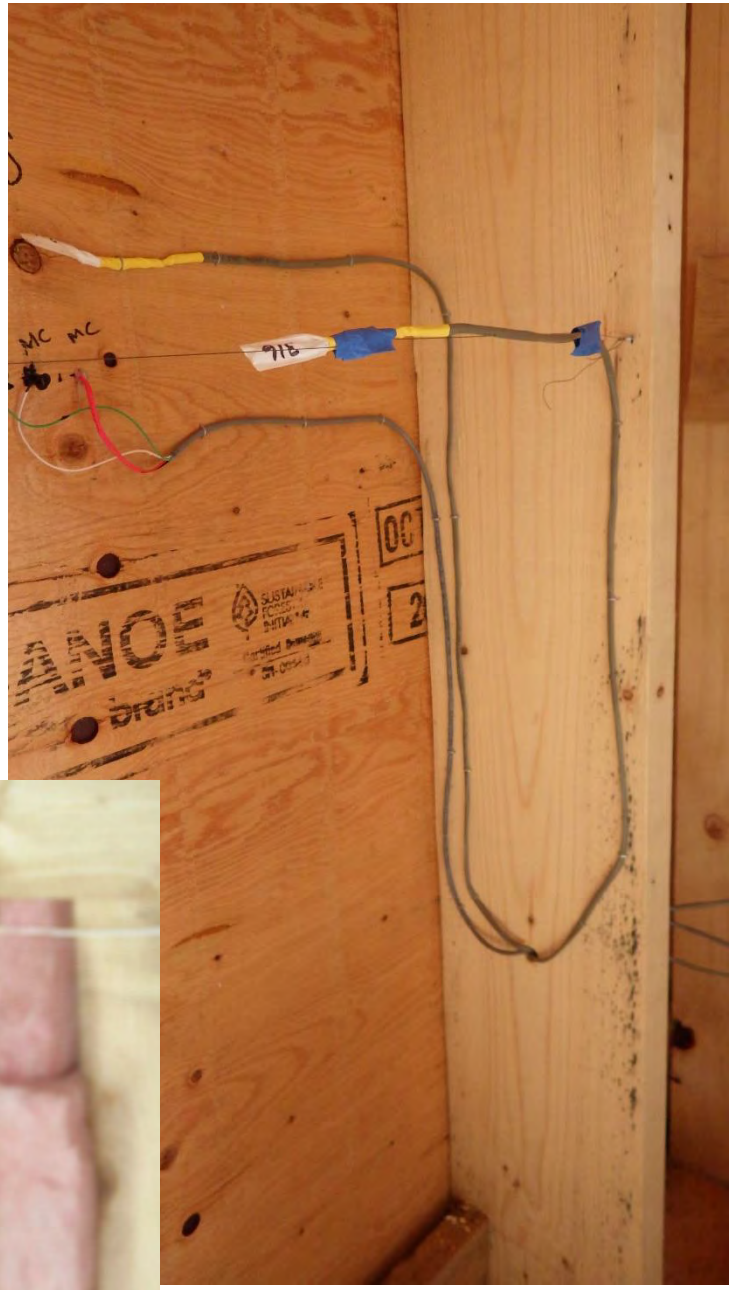
South Elevation

2 SOUTH ELEVATION
1 : 50

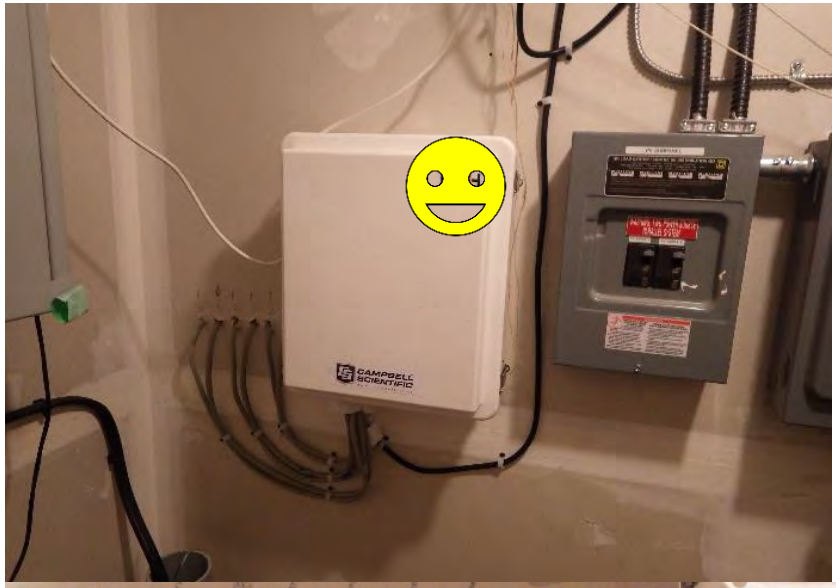
North Elevation

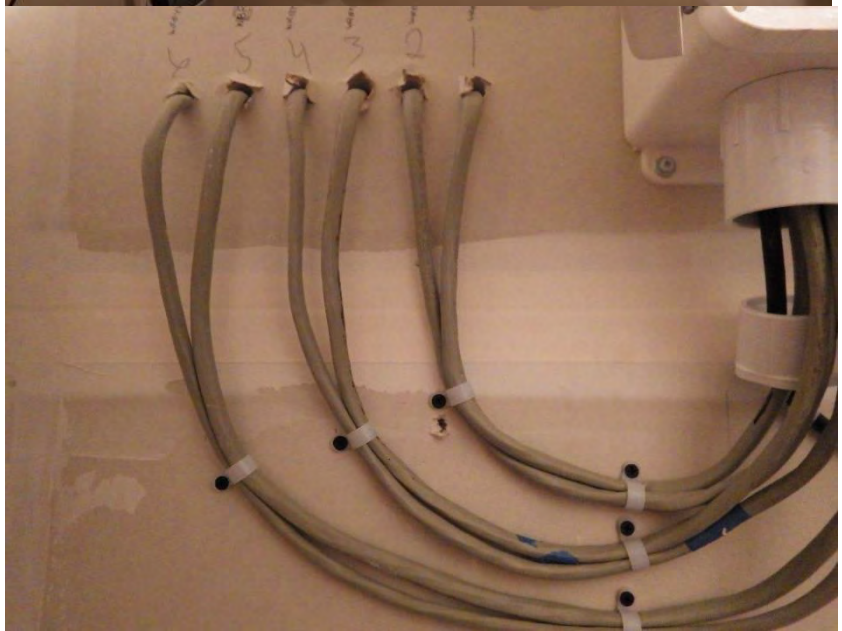
Installation

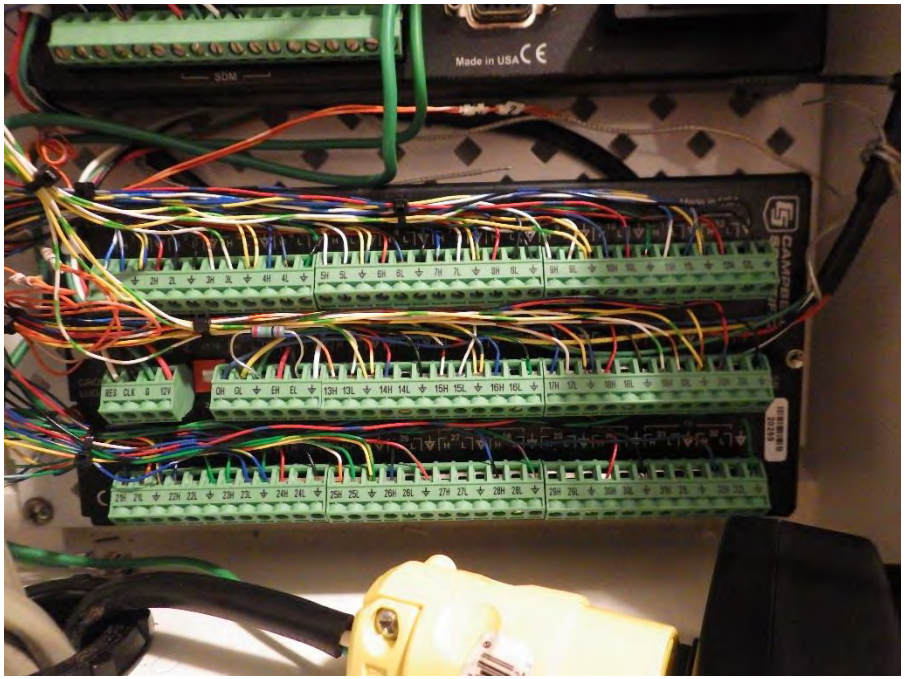




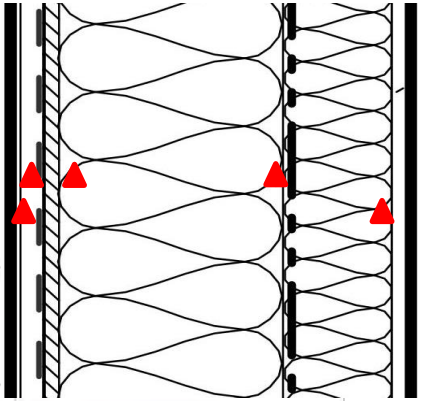
Data Logger

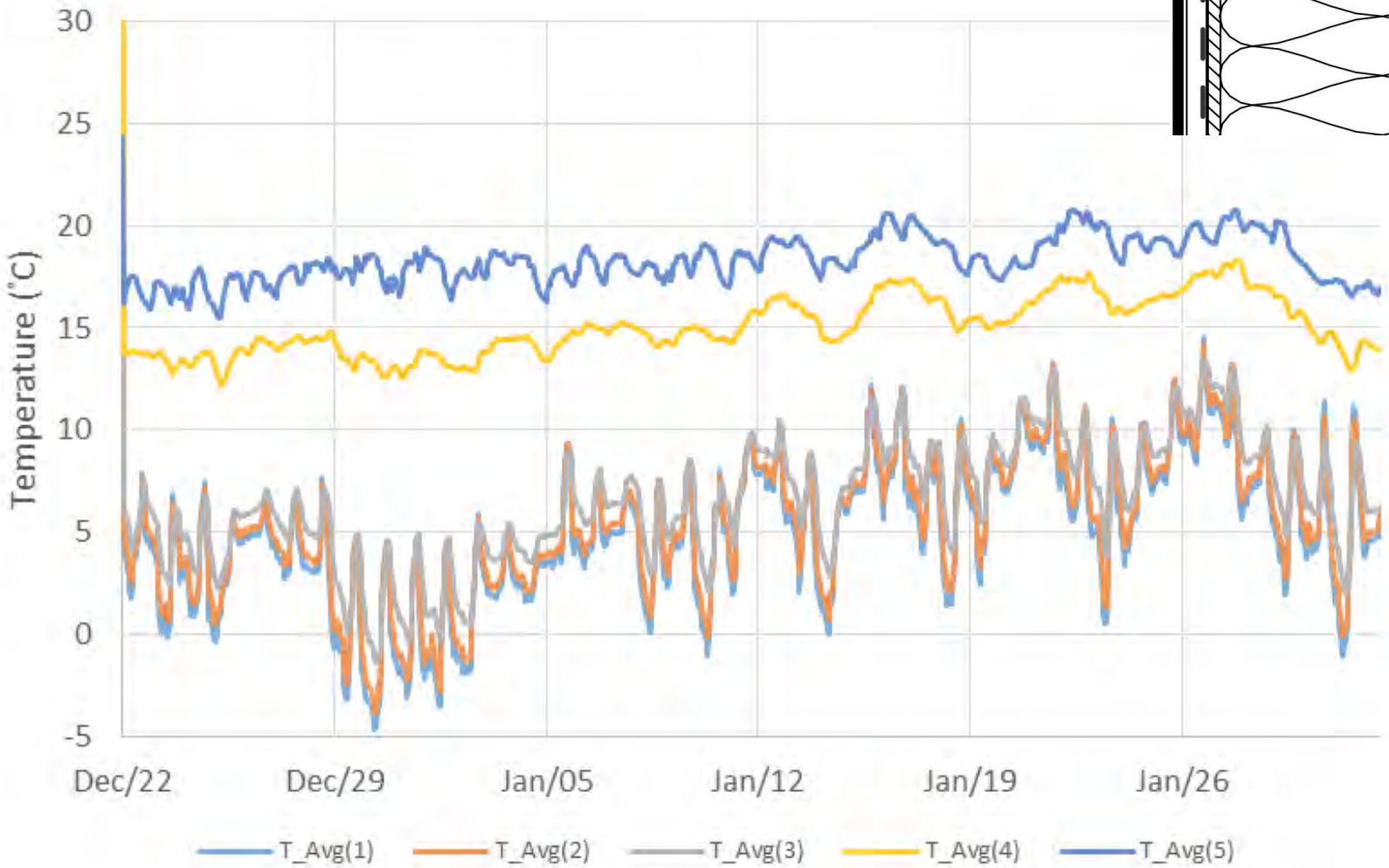




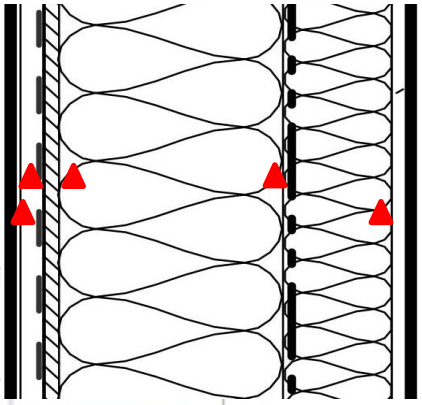


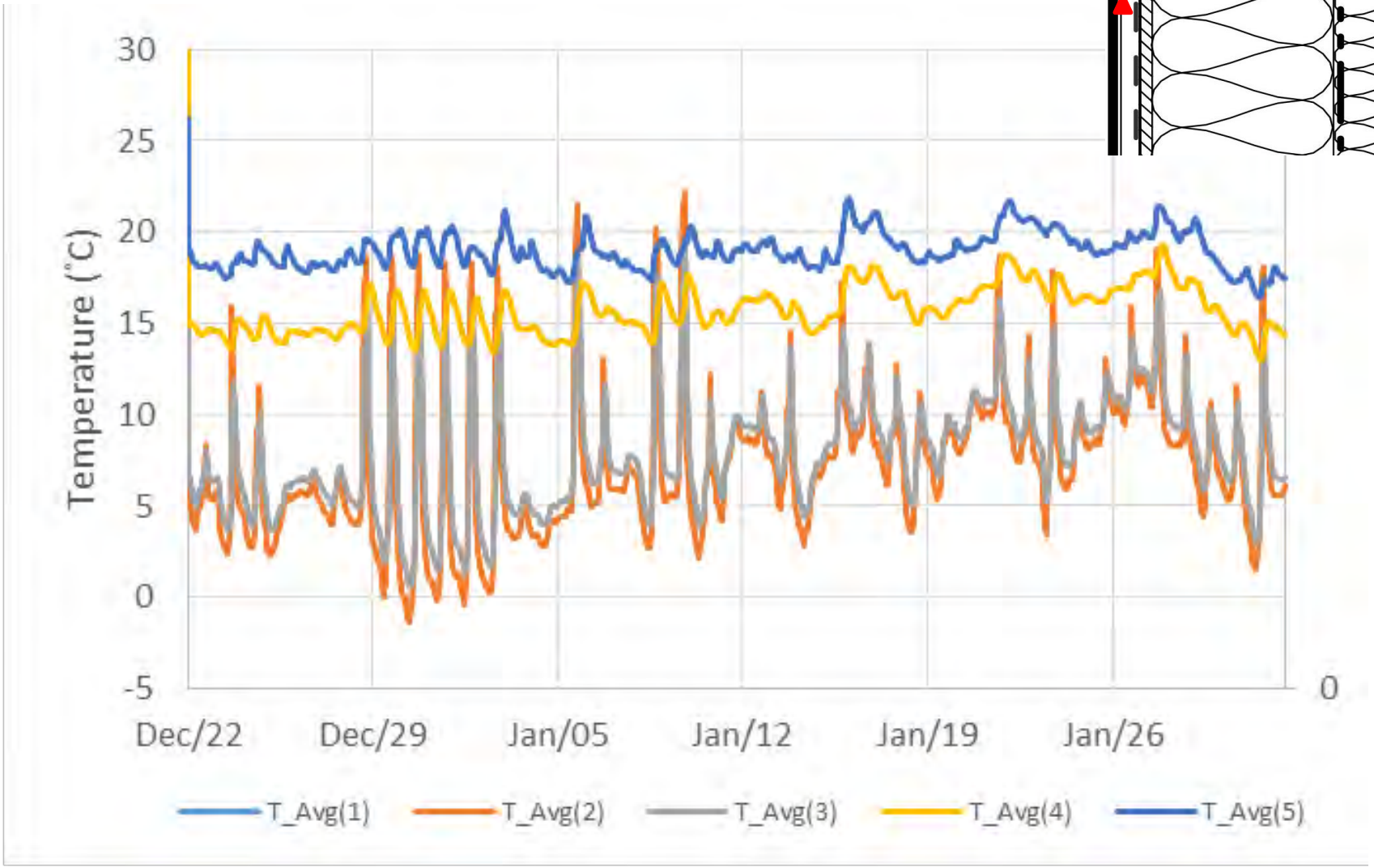
Enclosure Monitoring Data – T – N Wall





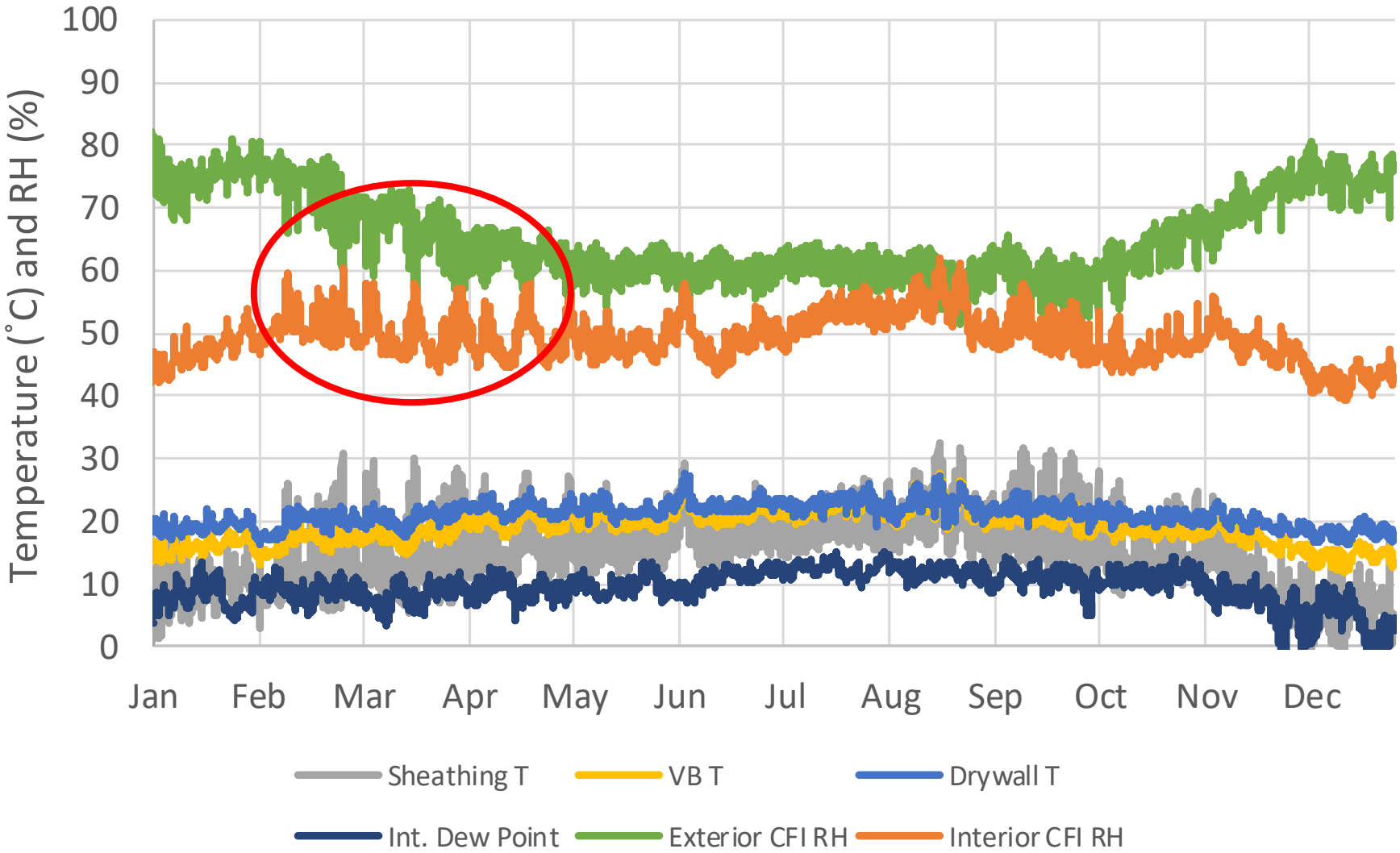
Enclosure Monitoring Data – T – S Wall



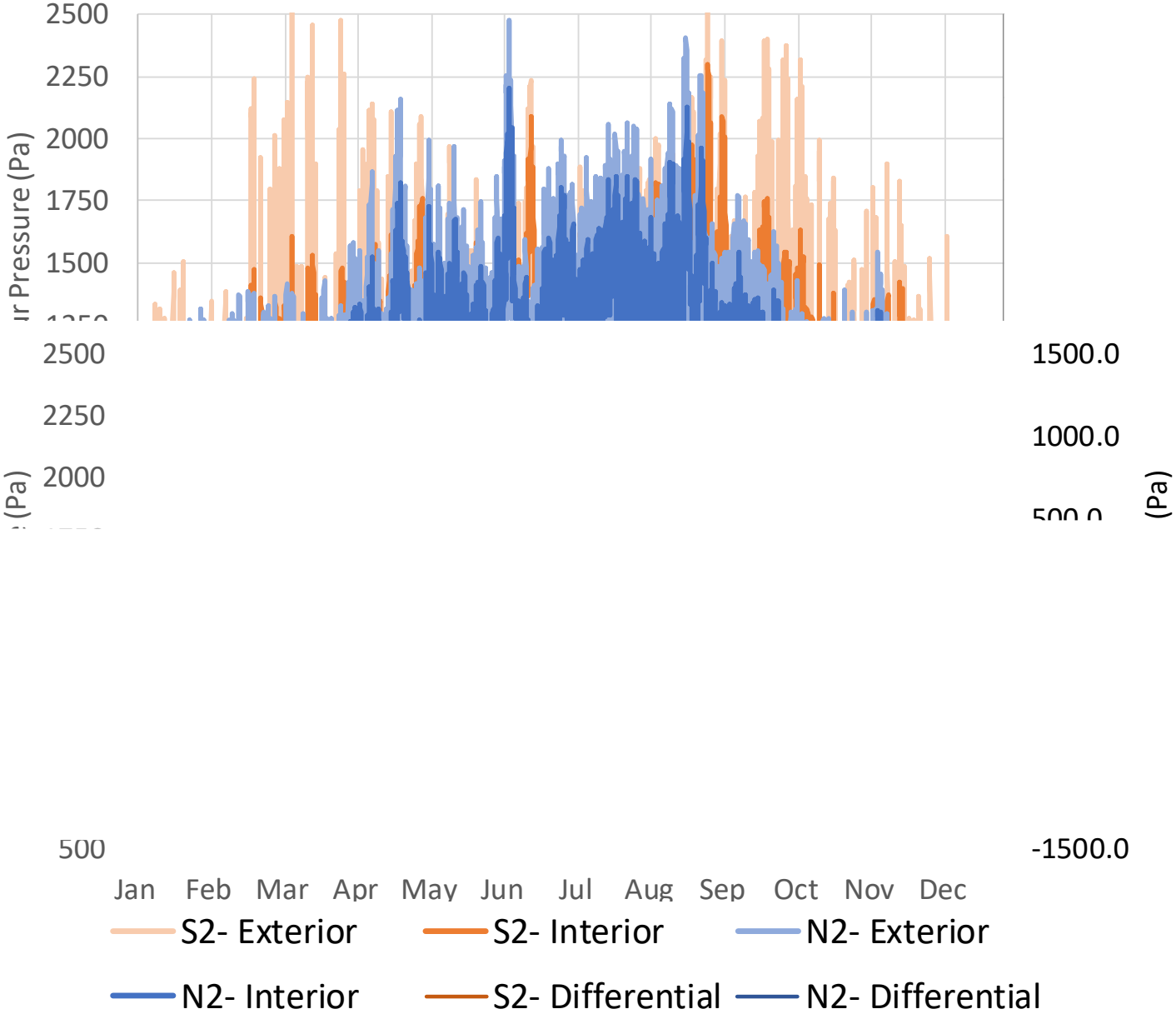


Results – RH & T

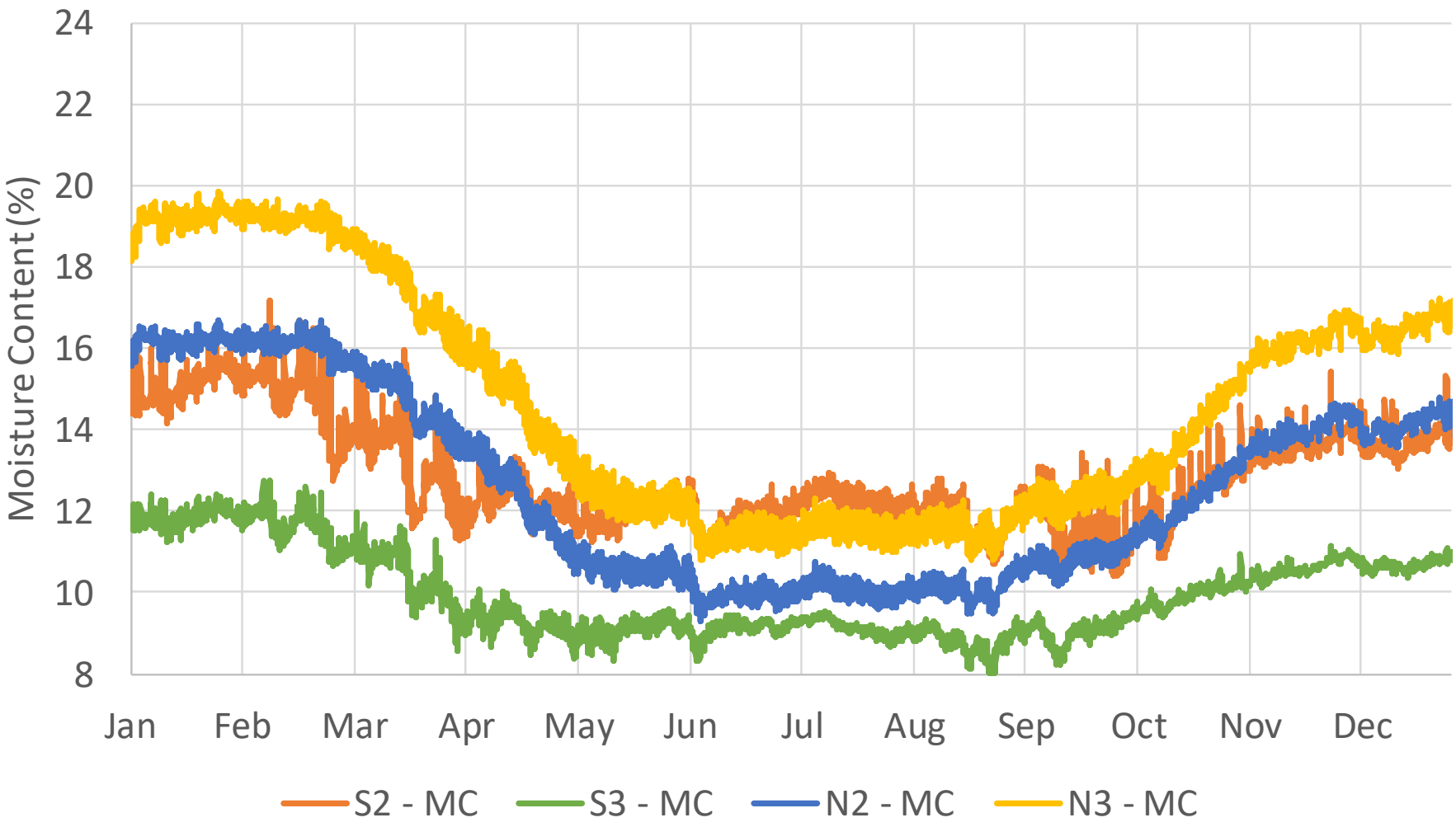
→ South Wall



Vapour Drive



Moisture Contents



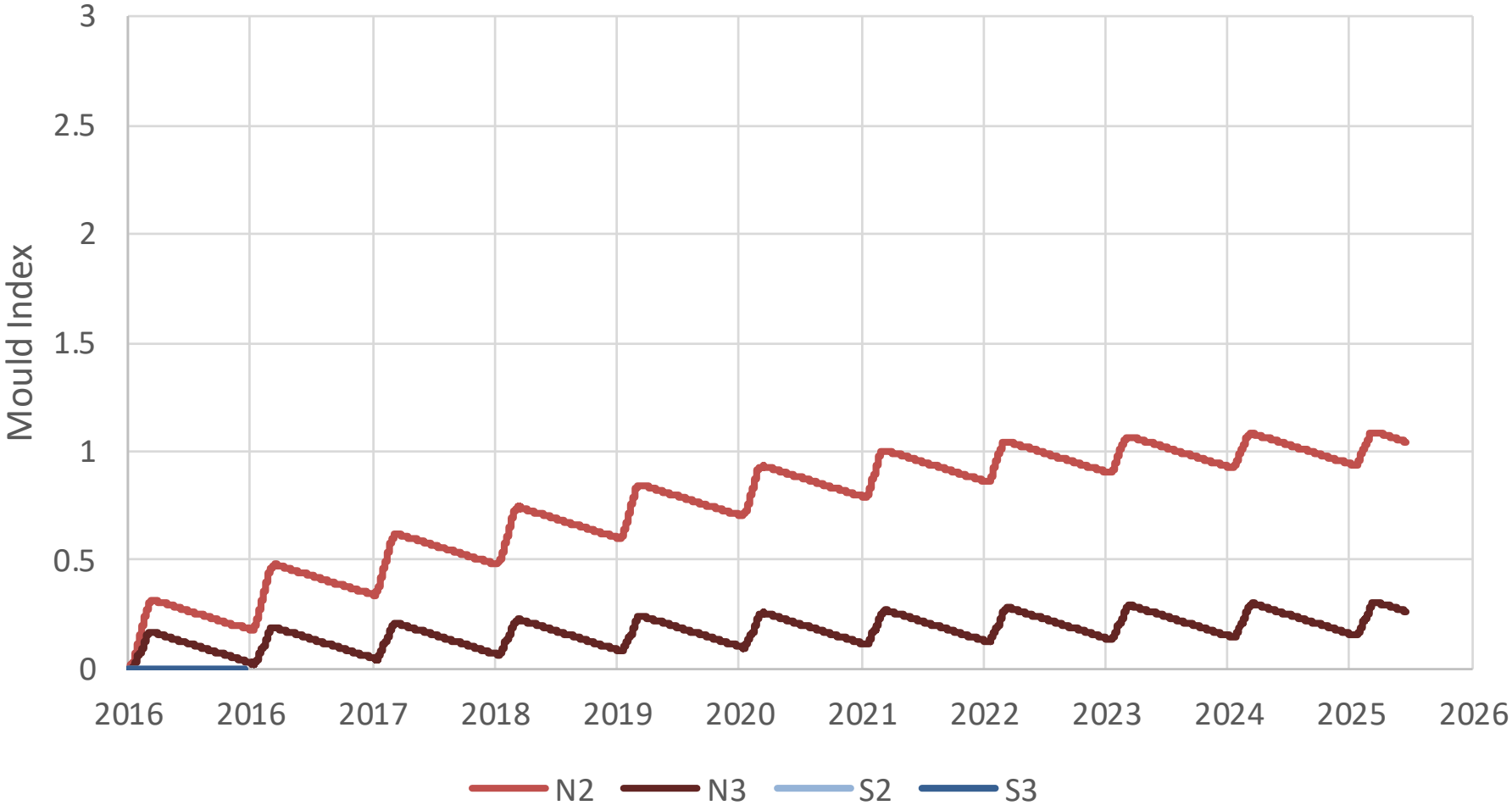
Fungal Models

→ VTT Mould Growth

- → Surface mould
- → Aesthetic and health effects
- → Laboratory regressions

Index	Description of Growth Rate
0	No growth
1	Small amounts of mold on surface (microscope), initial stages of local growth
2	Several local mold growth colonies on surface (microscope)
3	Visual findings of mold on surface, < 10% coverage, or **< 50% coverage of mold (microscope)**
4	Visual findings of mold on surface, 10%–50% coverage, or **> 50% coverage of mold (microscope)**
5	Plenty of growth on surface, > 50% coverage (visual)
6	Heavy and tight growth, coverage about 100%

VTT Mould Model



Conclusion

- → Deep/Double Stud Walls: They can work
  - → Air tightness persnicketiness
- → Slight risk of surface mould
- → Higher safety factor with exterior insulation
  - → Even nominal!

Discussion + Questions

FOR FURTHER INFORMATION PLEASE VISIT

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→ www.buildingsciencelabs.com

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