Controlling Construction Moisture in CLT in Tall Wood Buildings

CCBST XV

PAPER 15

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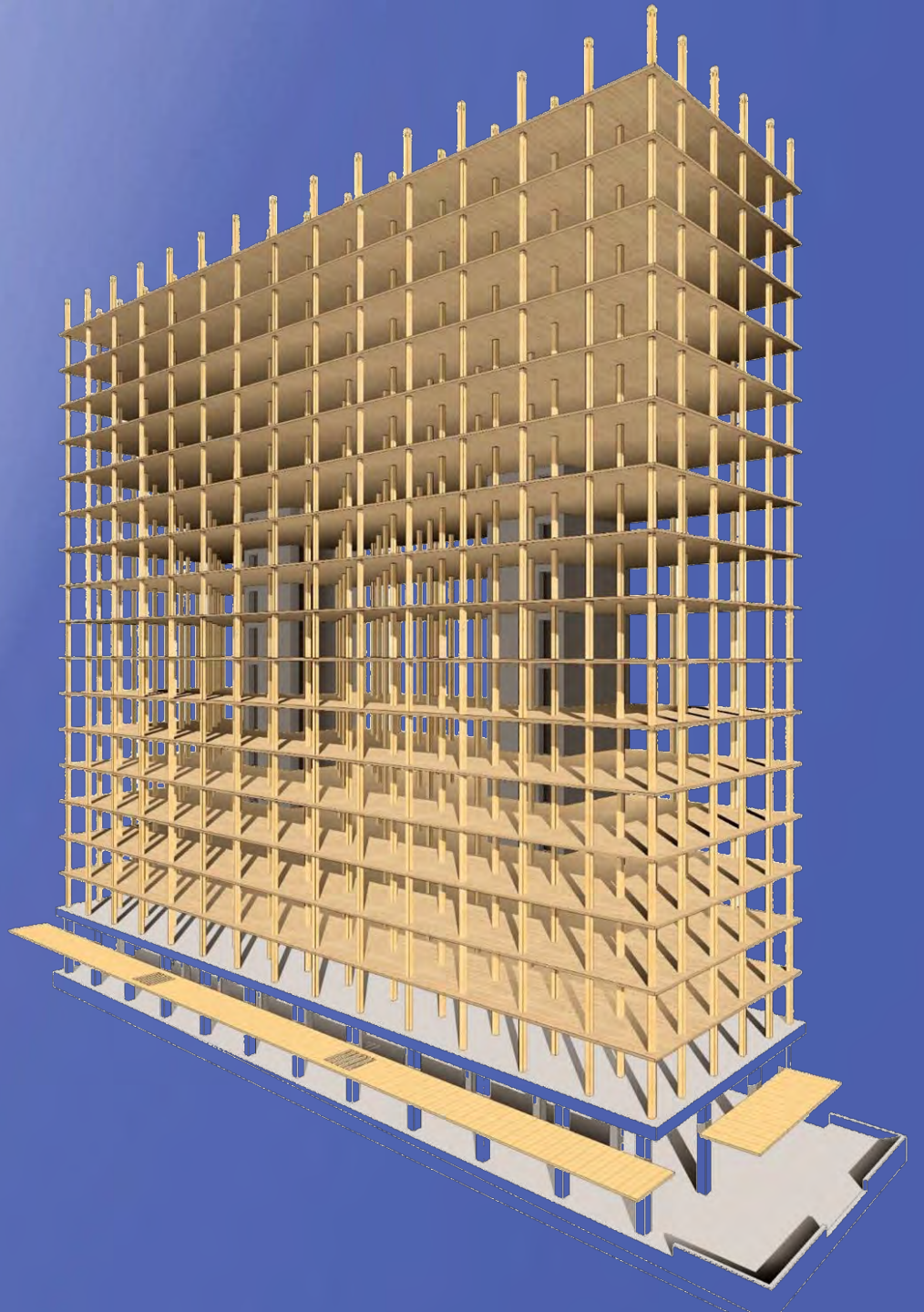
Outline

- → Intro and Concerns
- → Experimental Set-up
- → Experimental Results
- → WUFI Calibration
- → WUFI Projections
- → Recommendations



Risks and Challenges with Mass Timber Building

Structural System

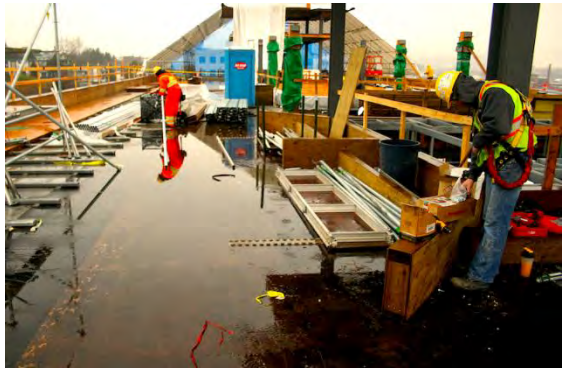
Research Prior to Tall Wood & Key Lessons to Date

→ Uncoated CLT panels should not be exposed to rain during construction for more than a few weeks

- → When exposed to rain, CLT will quickly wet up through end grain, and gaps between boards of panels
- → CLT can also dry quickly under favourable conditions
- → Prolonged cyclical wetting & drying can cause structural damage to CLT
- → North American and European CLT behave differently. Both require protection

Concerns

- → How to protect mass timber during rain
  - → Giant tarps?
  - → Temporary roof lifted by crane?
  - → Waterproof the floors?
  - → Enclose as fast a possible?
- → Can enclosure keep up with pace of structure erection?
- → How long can mass timber get wet for? Do we need to protect it?
- → How do we enclose the walls quickly and not be affected by inclement weather?
- → How could a flood in-service affect the wood-structure?



Experimental Protocols

→ Phase 1 –Sample Testing

- → (1) 400x400mm small sections
- → (2) 1.2x4.5m floor mock-up

→ Phase 2 – Hygrothermal Calibration

- → Calibrate to (1) & (2)

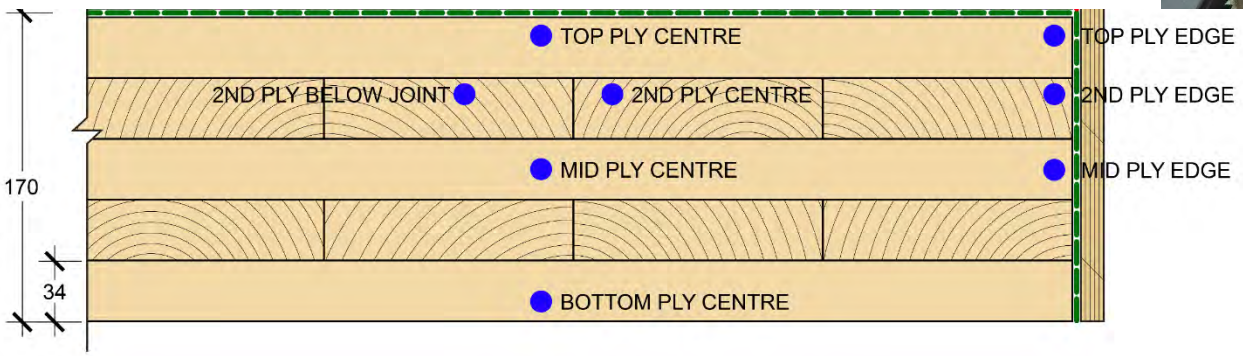
→ Phase 3 – Fungal Contamination

- → VTT Improved Model to Predict Mold Growth (Viitanen, 2007)
- → Dose-Response Relationship for Fungal decay (Brischke and Rapp, 2008)

Phase 1 (1) – Small Scale Testing

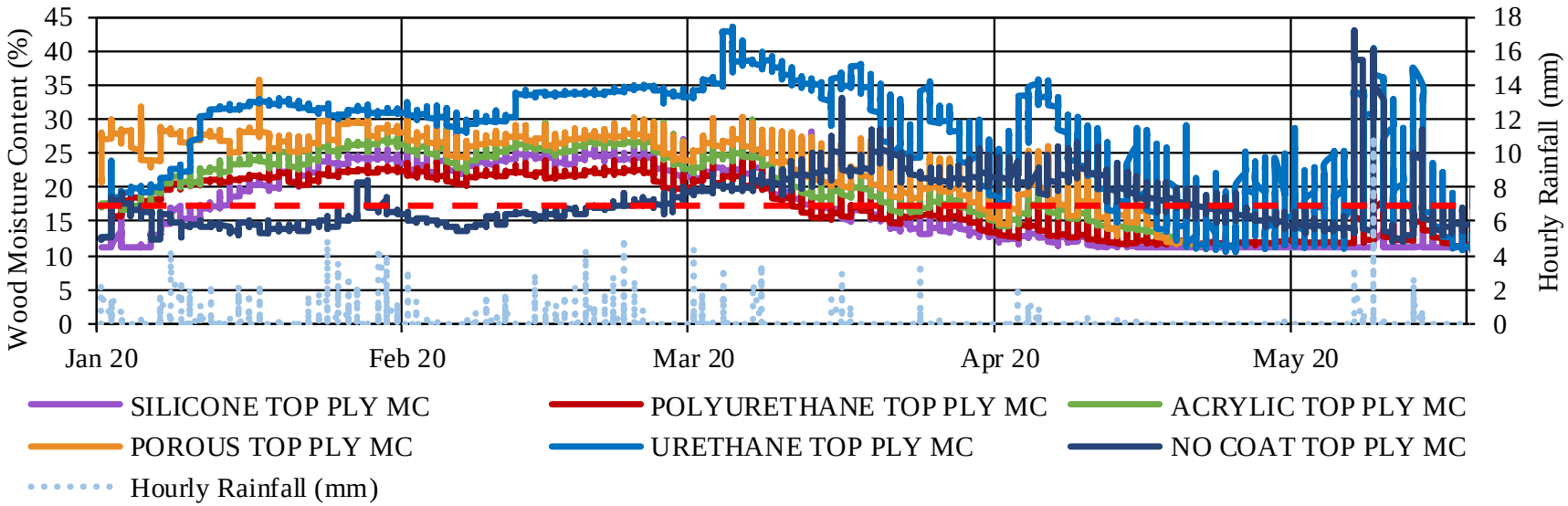
→ 9 different CLT samples with different treatments

→ Instrumented with MC pins



Wood preservative	**Polyurethane primer**
Silicone wood coating	**Porous substrate primer**
Urethane resin wood sealer	**No coating (baseline)**
Impermeable self-adhered membrane (SAM)	**No coating / no screed topping (Baseline)**
Acrylic latex primer	

Phase 1 – 1 Results



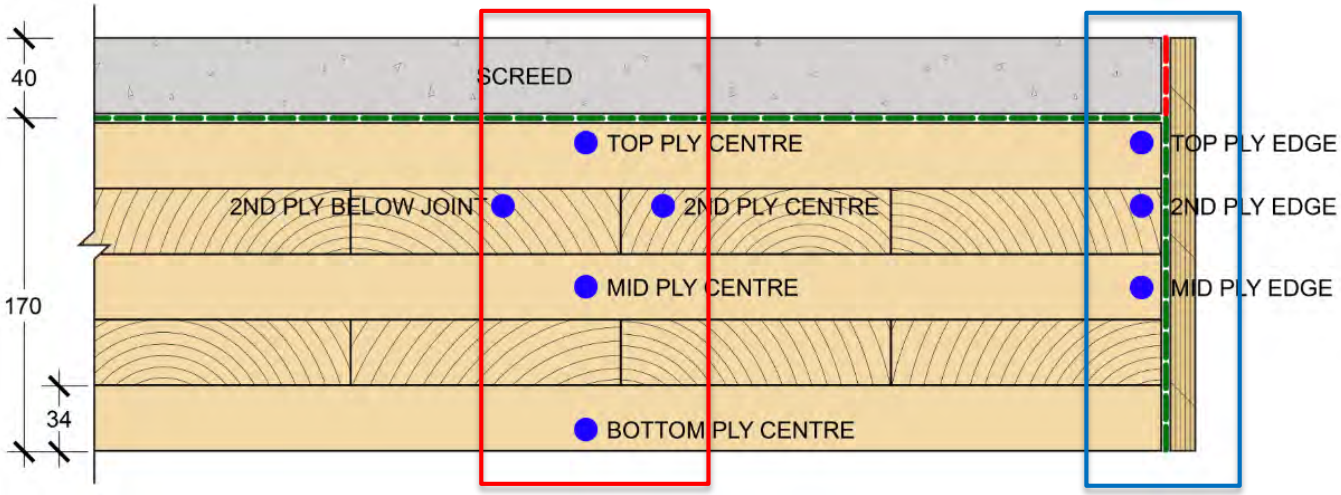
Dye Testing

Phase 1 (2) – Floor Mock-up Testing

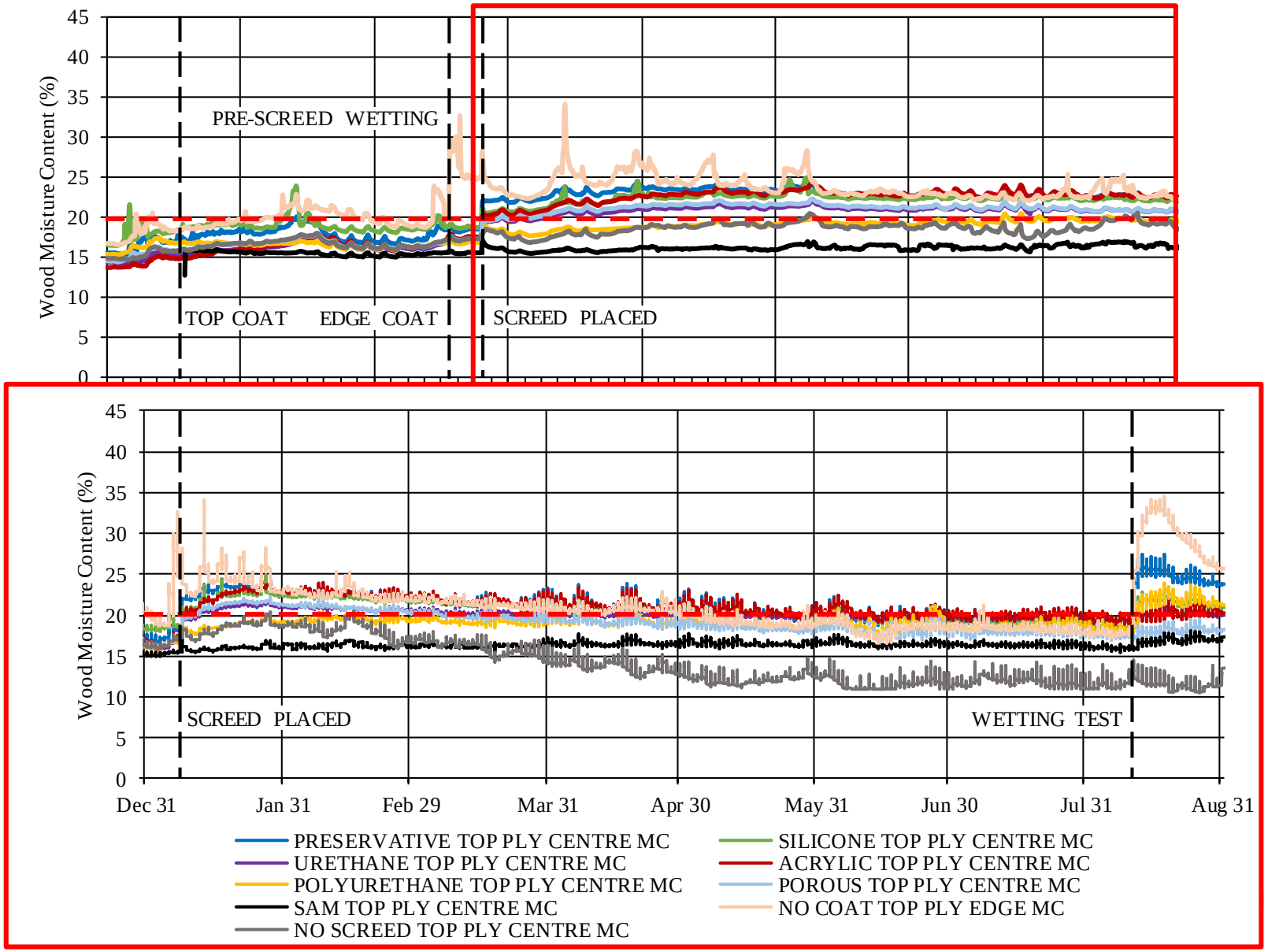
→ 1.2x4.5m CLT floor mock-up

→ Treatments installed in grid

→ Each grid instrumented with MC pins in centre and edge



Phase 1 – 2 Results



Key Findings

→ Exposed CLT can experience MC >25%

→ Screed to **uncoated CLT** panels increases the surface moisture content by **5-10%.**

→ Specific coatings can reduce this, others have no benefit

→ Wetted CLT at greater risk

→ CLT with screed still at risk of precipitation

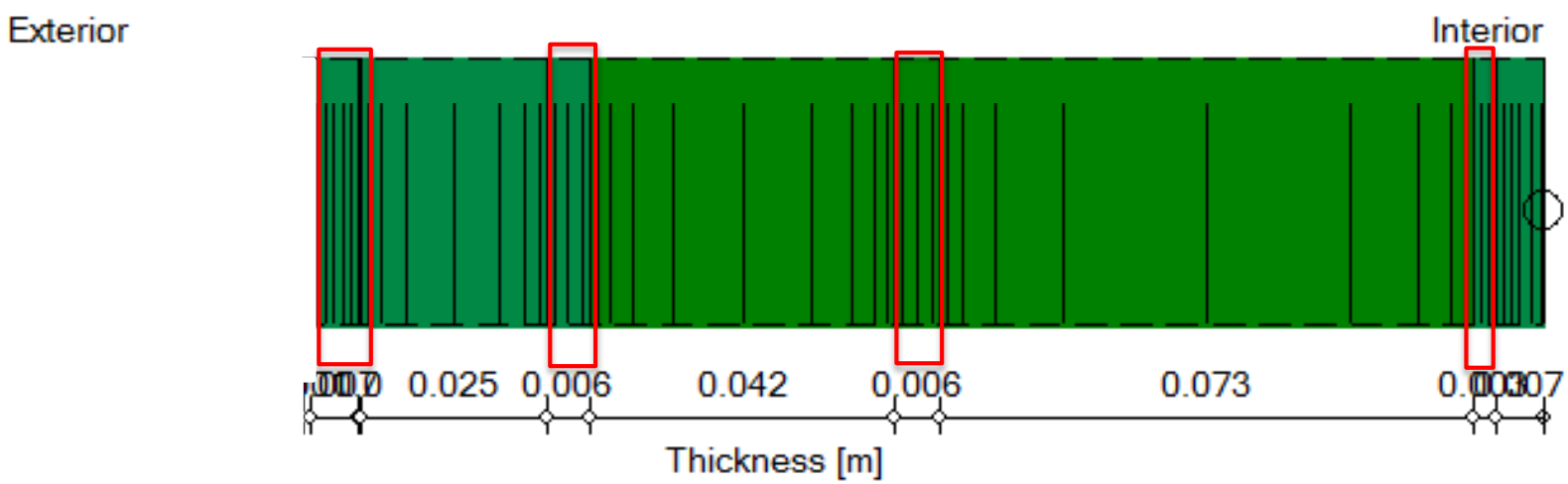
Hygrothermal Analysis

→ Calibrate to untreated samples (Phase 1 – 1)

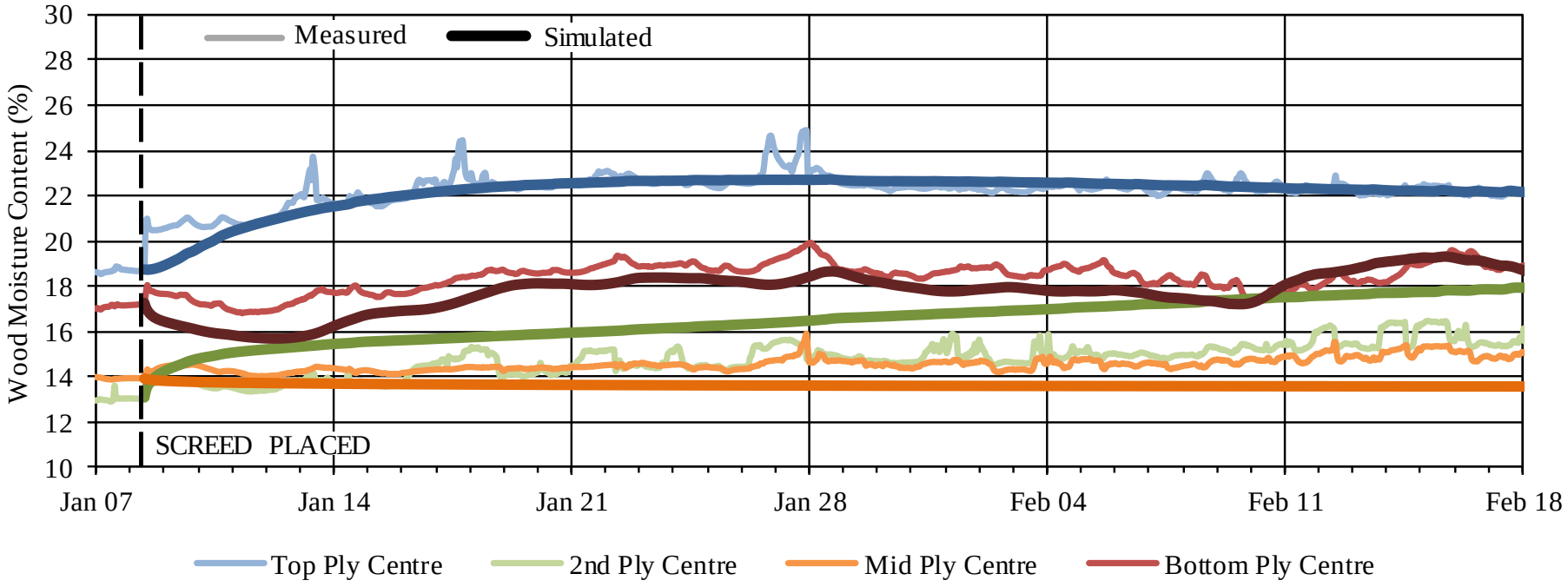
→ Calibrate treated samples (Phase 1 – 1)

- → Vapour permeable hydrophobic sealer (i.e. silicone),
- → Low-permeable hydrophilic sealer (i.e. urethane)
- → Impermeable, waterproof membrane (i.e. self-adhered membrane, SAM)

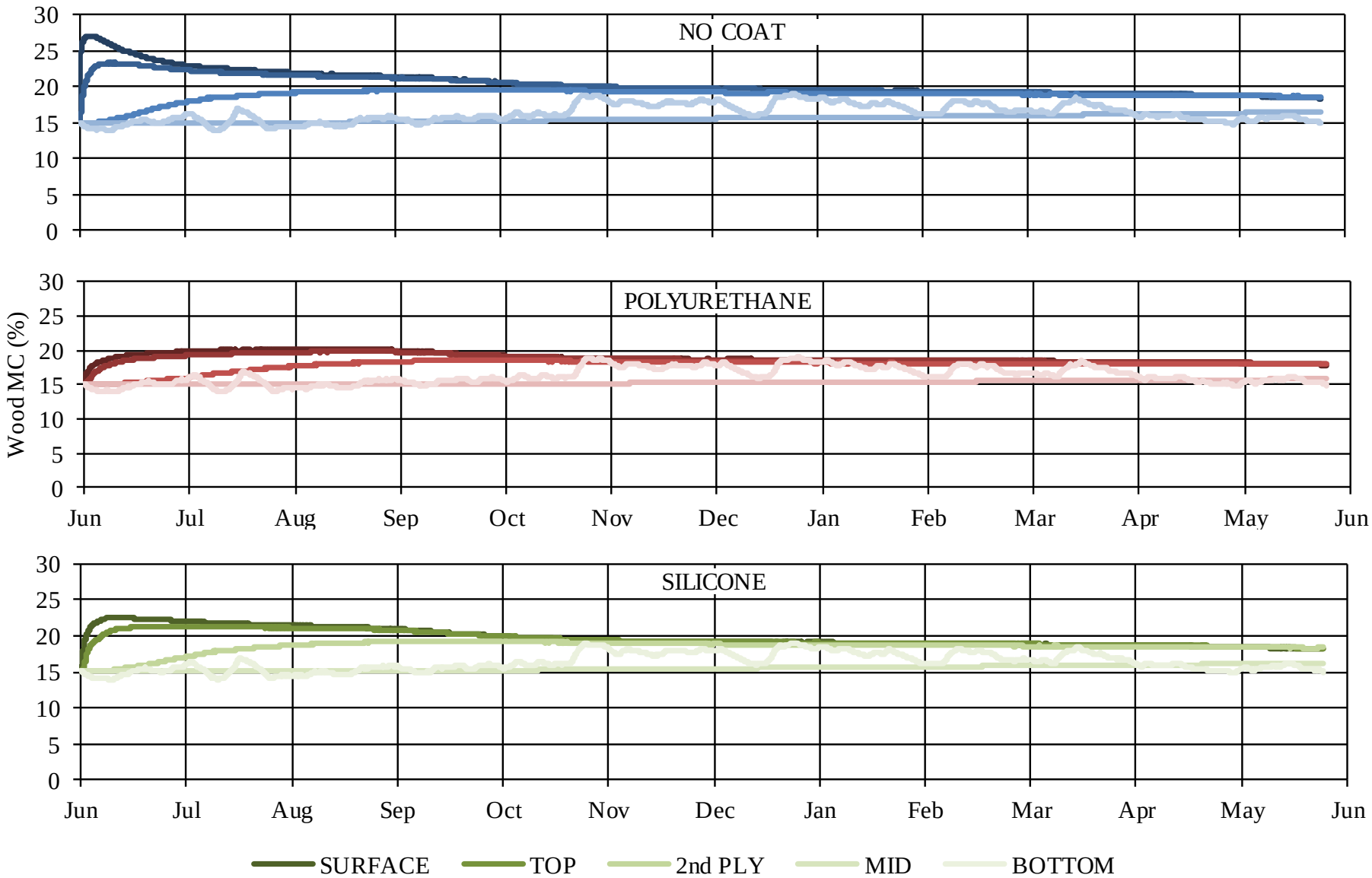
→ Calibrate with screed, with different treatments



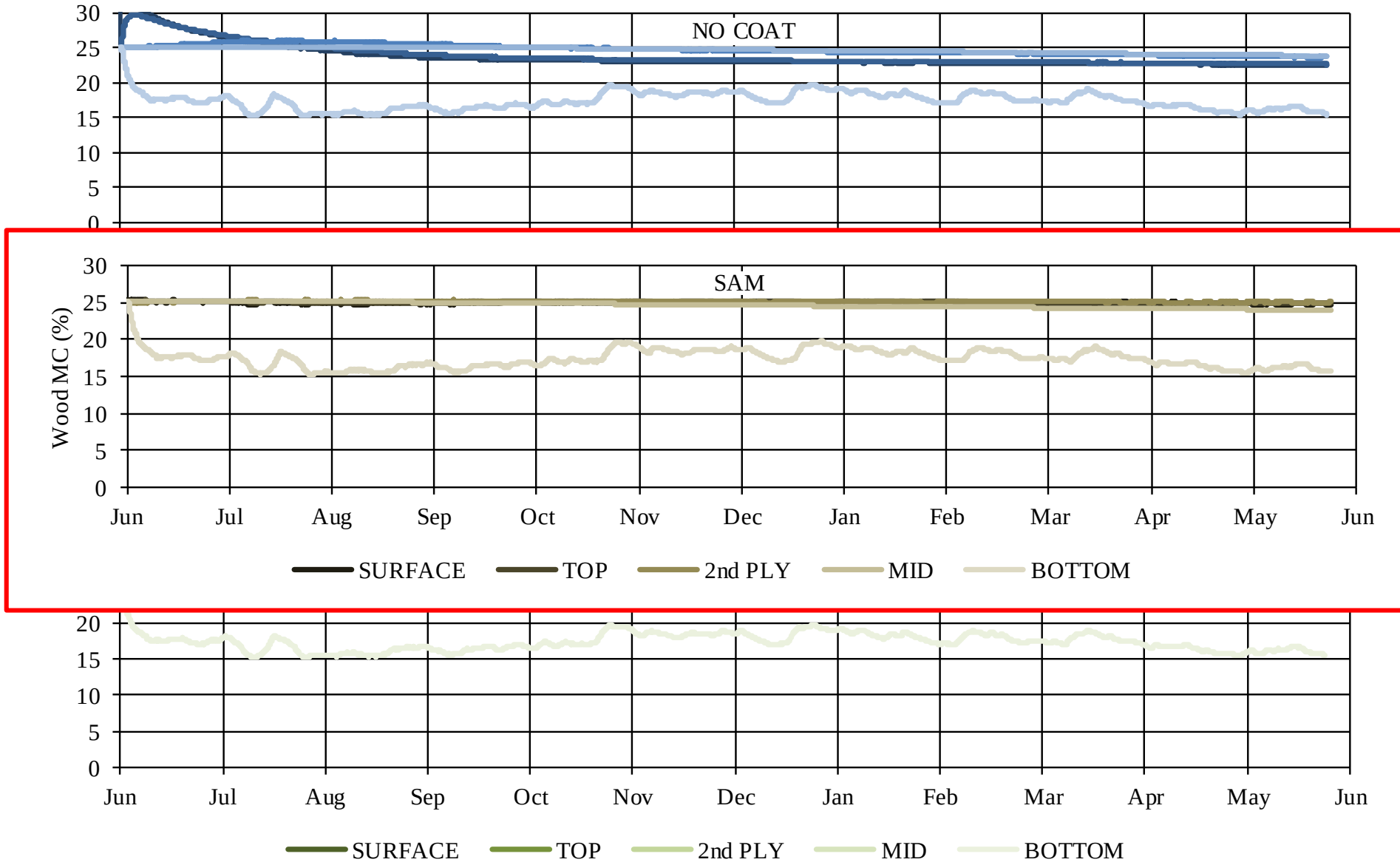
Hygrothermal Calibration



Projections – 15% MC



Projections – 25% MC



Fungal Predictions

→ Rule of Thumb

→ Less than 80% Okay!

→ More Refined:

→ Mould: VTT Model (Viitanen, 2010)

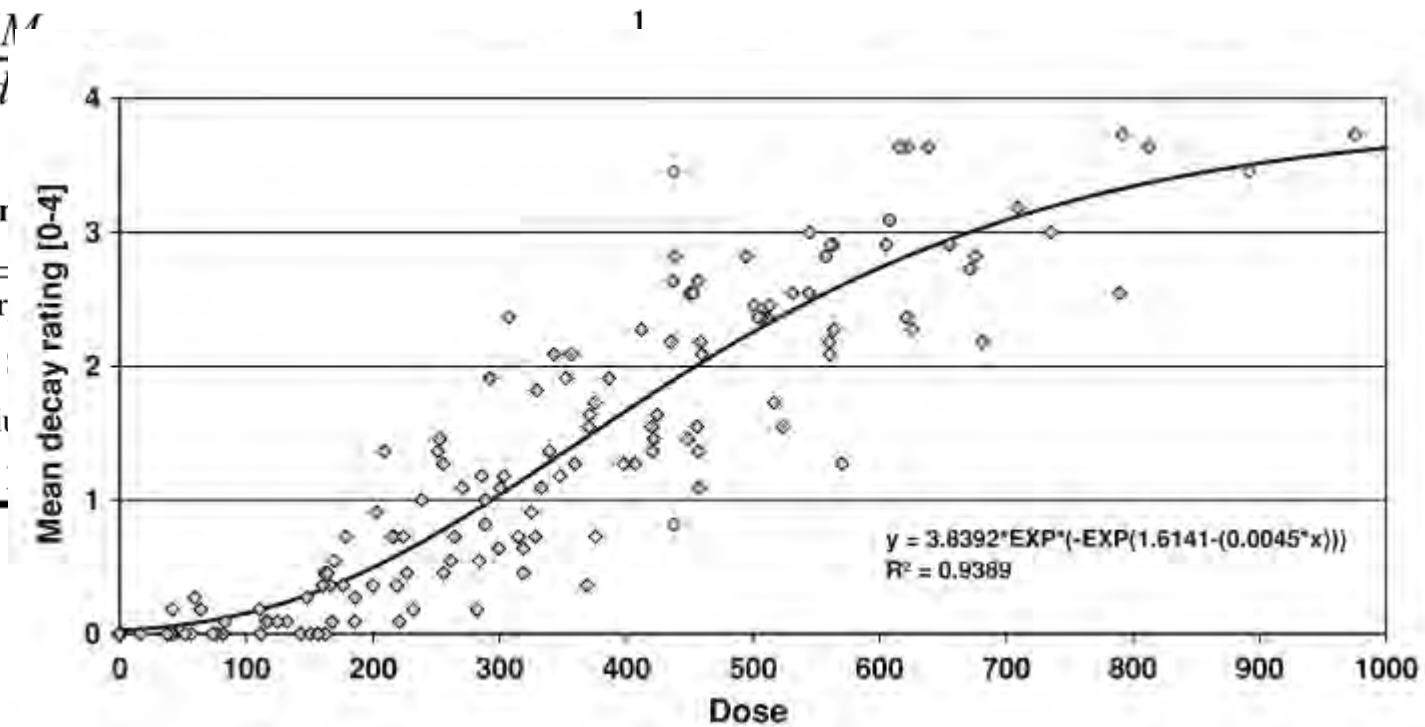
→ Decay: Dose-Response (Brsichke, 2008)

Decay Rating	Rating of Decay	Dose Units
0	Sound-no decay	0-150
1	Slight decay	150-500
2	Moderate decay	250-600
3	Severe decay	350-800
4	Very severe decay	500+
	(stake fails during mechanical bending)	
6	Very heavy and tight growth.	Coverage around 100%

Fungal Models

→ VTT Mould Growth
- → Surface mould
- → Aesthetic and health effects
- → Laboratory regressions

→ Dose-Response
- → Decay and rot
- → Reduction in structural capacity
- → Dose-response in field



Ser	RH_{min}
	%
Ver	80
	80
Medi	85
	85

Fungal Assessment Results

Recommendations

→ Protect the CLT from external moisture during transport and handling

→ Use active moisture management.

→ Passive moisture management strategies are insufficient (e.g. sealing surface). Moisture will find joints/cracks/checks

→ Consider using preservatives for non-CLT elements.

→ Install the screed topping on dry CLT panels

→ Use non-moisture producing heaters (e.g. electric)

→ Ventilate screed after placement to promote drying.

Discussion + Questions

FOR FURTHER INFORMATION PLEASE VISIT

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