The Chip and Shannon Wilson – School of Design

Building Enclosure and Durability Design for Mass Timber Structures

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

MORRISON HERSHFIELD

Speaker

Eric Wood | Mass Timber Façade Specialist

Eric specializes in the prefabrication of Mass Timber to facilitate the early design and detail development rationale leading to optimized supply and constructability. His experience includes design-assist specialty engineering, supply-installation logistics, and infield review of complex prefabricated Mass Timber projects

Introduction

1.0 Mass Timber Building Envelope Durability

2.0 Mass Timber Building Envelope Innovation

3.0 Mass Timber Case Study

1.0 Mass Timber Building Envelope Durability

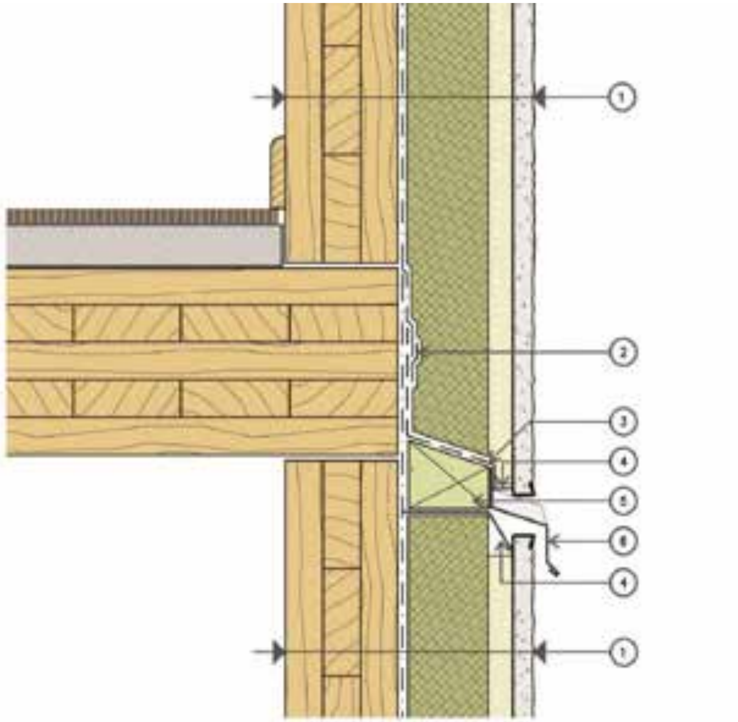
CLT at the Slab Edge

Assemblies are critical for ensuring long-term durability and certainly challenged to increase envelope performance without creating environmental barrier deficiencies

Determine where to use mass timber appropriately for your project. Consider the long-term durability for:

- floor and roof systems
- load-bearing walls
- prefabricated façades

CLT at the Slab Edge



LEGEND

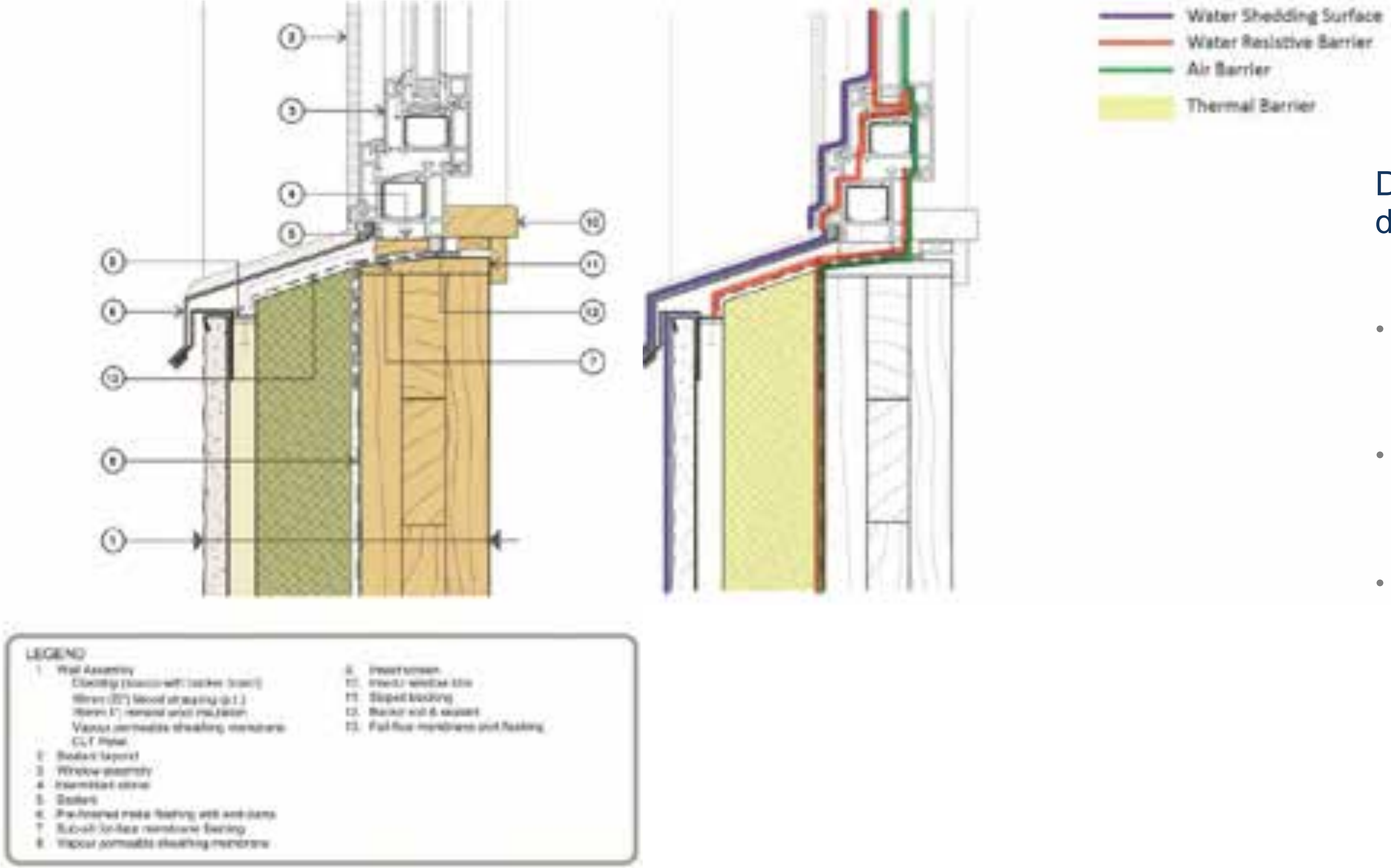
1. Wall Assembly
   Cladding (stucco with backer board)
   Wood strapping (p.t.)
   76mm (3") mineral wool insulation
   Vapour permeable sheathing membrane
   CLT Panel
2. Tape
3. Self adhered membrane flashing
4. Insect screen
5. Sloped wood blocking
6. Pre-finished metal flashing

Detailing is key to long-term durability of the CLT slab edge:

Exterior Structures and Penetrations can significantly reduce R-value, and provide a path for water ingress and air leakage

CLT is not air-tight and can not be relied upon as part of the air-barrier.

CLT at the Slab Edge – Below windows and Doors



Detailing is key to long-term durability of the CLT slab edge:

- Windows and Doors present the most risk for water ingress
- CLT has a much larger storage capacity for moisture.
- If bulk water leaks behind the exterior membrane it is trapped within the CLT structure even when using permeable membranes.

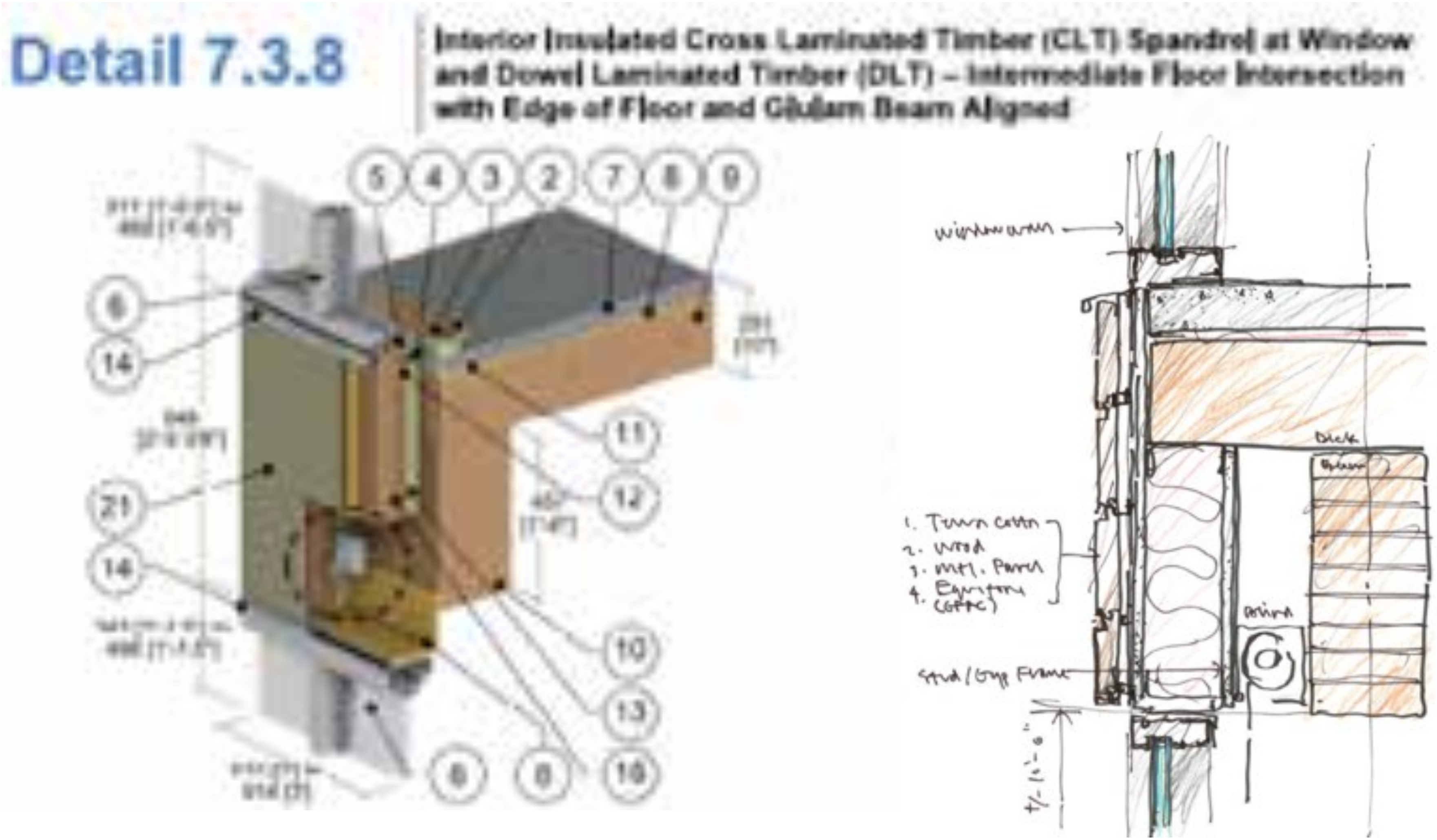
CLT at the Slab Edge – Below windows and Doors

Detailing is key to long-term durability of the CLT slab edge:

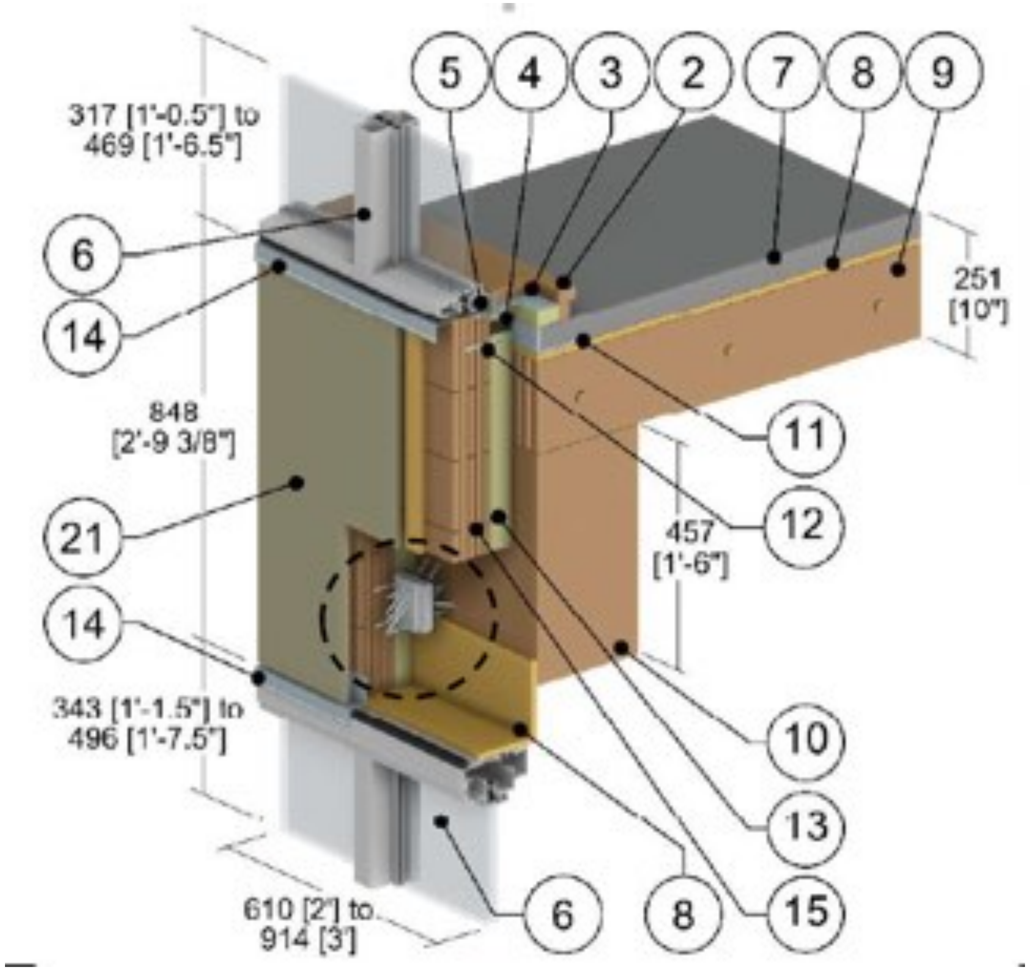
- Structural damage can occur within a short period of time, often unnoticed.
- Can't rely on membranes and detailing alone.
- Avoid designing CLT and Mass Timber at the slab edge where at risk from Window and Door leaks.

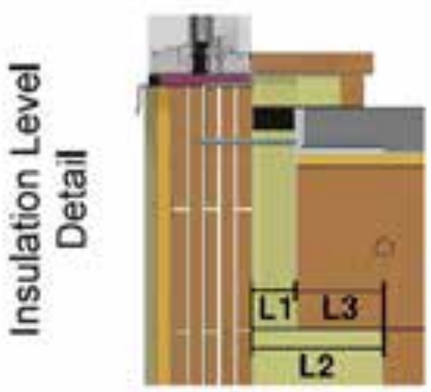
2.0 Mass Timber Innovation

ALTERNATIVES AT THE SLAB EDGE FOR FAÇADE EFFICIENCY



Alternatives at the Slab Edge for Façade Efficiency

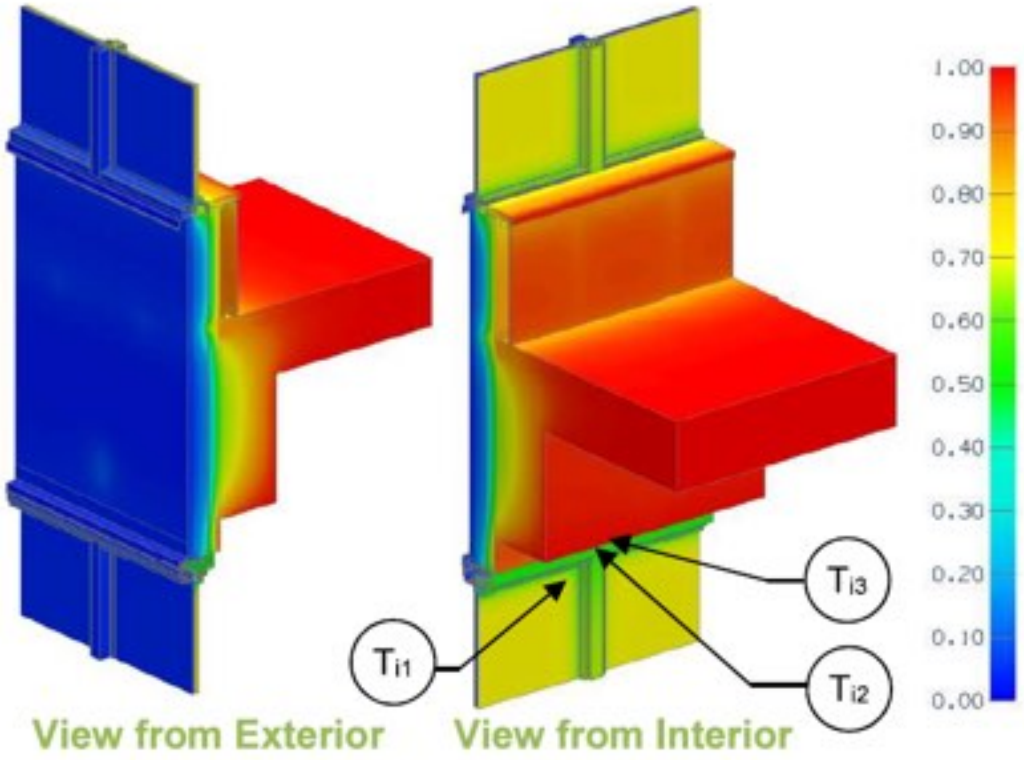




L1 in (mm)	L2 in (mm)	L3 in (mm)
2" (51)	6" (152)	4" (102)
3" (76)	6" (152)	3" (76)
4" (102)	6" (152)	2" (51)

- Pros/Cons of technical options to achieve aesthetic goals
- Durability
- Cost + Availability

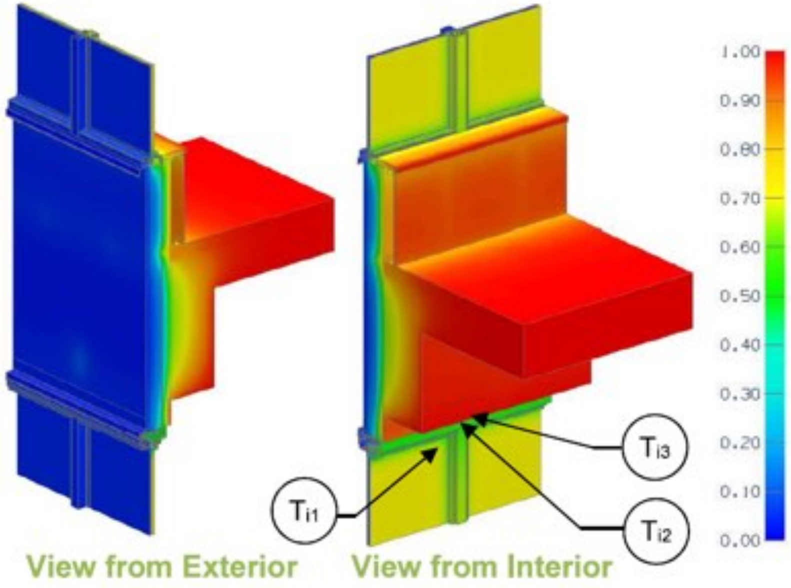
ALTERNATIVES AT THE SLAB EDGE FOR FAÇADE EFFICIENCY



Thermal Performance Indicators

Assembly 1D (Nominal) R-Value at Beam	R_{1D}	R-15.4 (2.71 RSI) + insulation
Transmittance without Anomaly	$U_{g\ top}$ $U_{g\ bottom}$ U_g	U-value for aluminum window including framing g top = sill g bottom = head g = combined sill + head
Transmittance / Resistance	U_o, R_o U_s, R_s U_t, R_t	U and R-values for o = spandrel with floor without glazing s = spandrel including window to wall interface t = combined glazing + spandrel
Linear Transmittance	ψ	Incremental increase in transmittance per linear length of window to wall interface

Alternatives at the Slab Edge for Façade Efficiency



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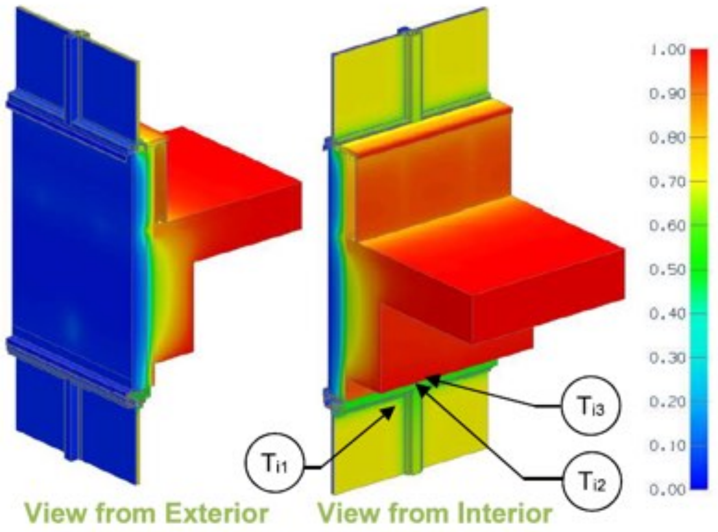
Temperature Indices

	R-8.4	R-16.8	R-25.2	R-33.6	
Ti_1	0.52	0.52	0.52	0.52	Min T on window glass, at top corner of window head
Ti_2	0.53	0.53	0.53	0.53	Min T on window frame, on vertical mullion at deflection header
Ti_3	0.89	0.92	0.94	0.95	Min T on beam, at plywood closure, along connector

ALTERNATIVES AT THE SLAB EDGE FOR FAÇADE EFFICIENCY



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Window to Wall Linear Transmittance

ISO-CONNECT Spacing	Spandrel Insulation 1D R-Value (RSI)	R_{1D} ft²·hr·°F / Btu (m² K / W)	R_o ft²·hr·°F / Btu (m² K / W)	U_o Btu/ft² ·hr ·°F (W/m² K)	R_s ft²·hr·°F / Btu (m² K / W)	U_s Btu/ft² ·hr ·°F (W/m² K)	R_t ft²·hr·°F / Btu (m² K / W)	U_t Btu/ft² ·hr ·°F (W/m² K)	ψ Btu/ft ·hr·°F (W/m K)
36" o.c.	R-8.4 (1.48)	R-23.8 (4.18)	R-13.1 (2.31)	0.076 (0.43)	R-8.5 (1.50)	0.117 (0.67)	R-3.5 (0.61)	0.287 (1.63)	0.008 (0.014)
	R-16.8 (2.96)	R-32.2 (5.66)	R-16.6 (2.93)	0.060 (0.34)	R-10.8 (1.90)	0.093 (0.53)	R-3.6 (0.64)	0.276 (1.57)	0.007 (0.011)
	R-25.2 (4.44)	R-40.6 (7.14)	R-19.2 (3.38)	0.052 (0.30)	R-12.4 (2.19)	0.080 (0.46)	R-3.7 (0.65)	0.270 (1.53)	0.006 (0.010)
	R-33.6 (5.92)	R-49.0 (8.62)	R-21.2 (3.74)	0.047 (0.27)	R-13.7 (2.41)	0.073 (0.42)	R-3.7 (0.66)	0.267 (1.51)	0.006 (0.010)

3.0 Mass Timber Case Study

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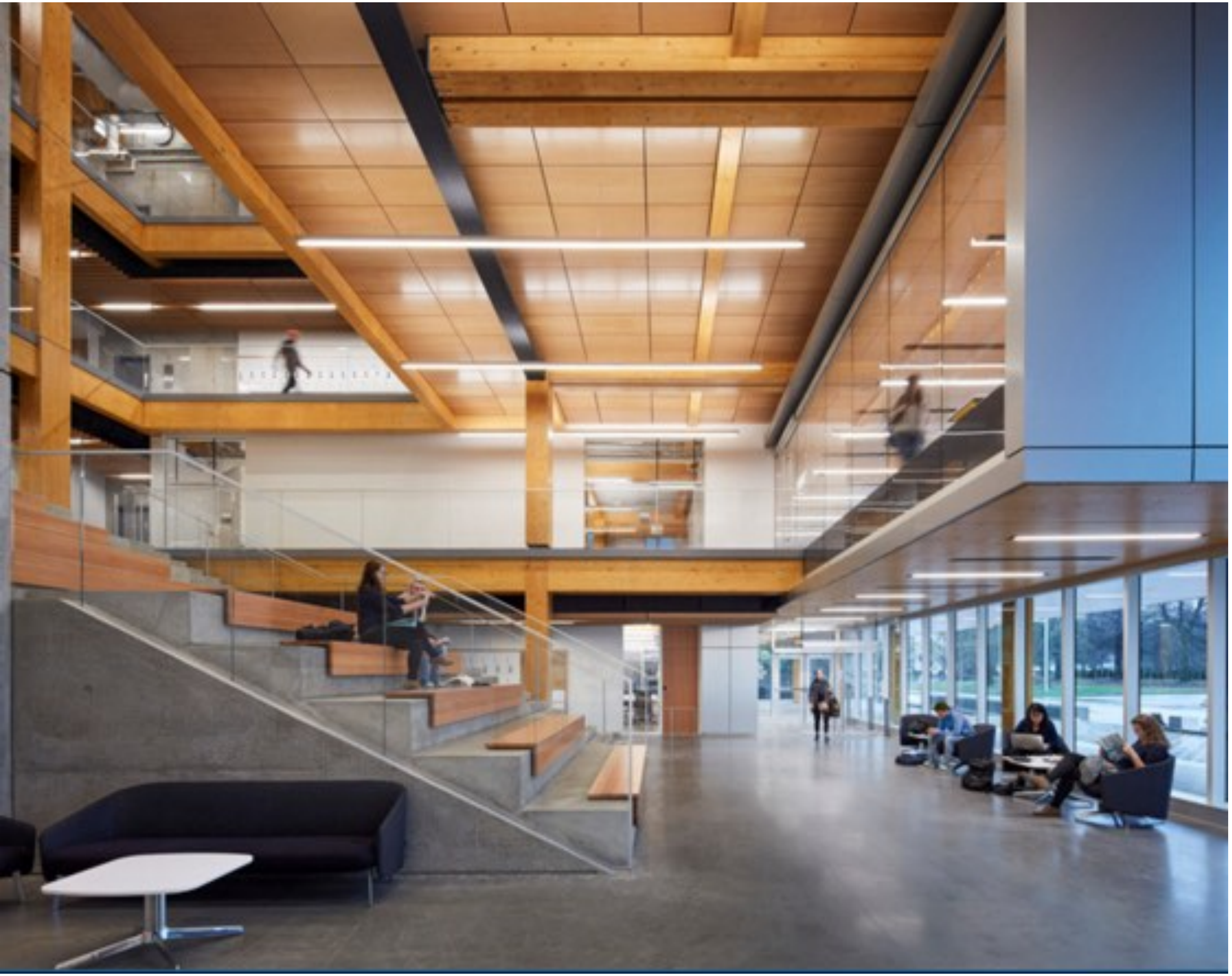
Morrison Hershfield

Largest Glulam beam: 2 ply – 600mm x 1,320mm deep beam x 9,040mm Long @ 7000lbs

Longest Glulam Beam: 14,005mm Long

Longest Spliced Beam: 17,400mm Long

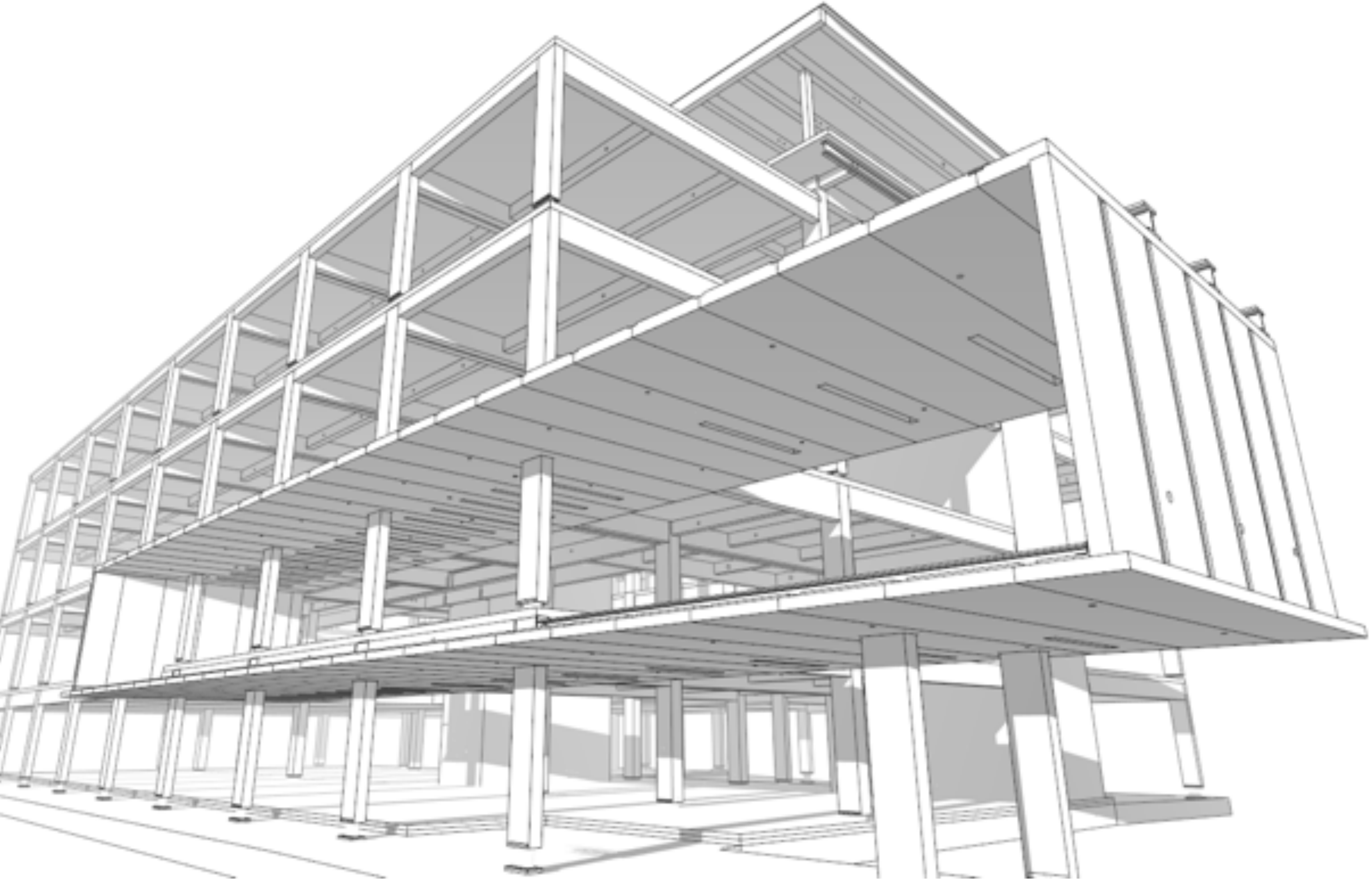


1224 pre-fabricated CLT and Glulam pieces, shipped in 23 containers, fully integrated with Mechanical, Electrical, Sprinkler, and Communication rough-in

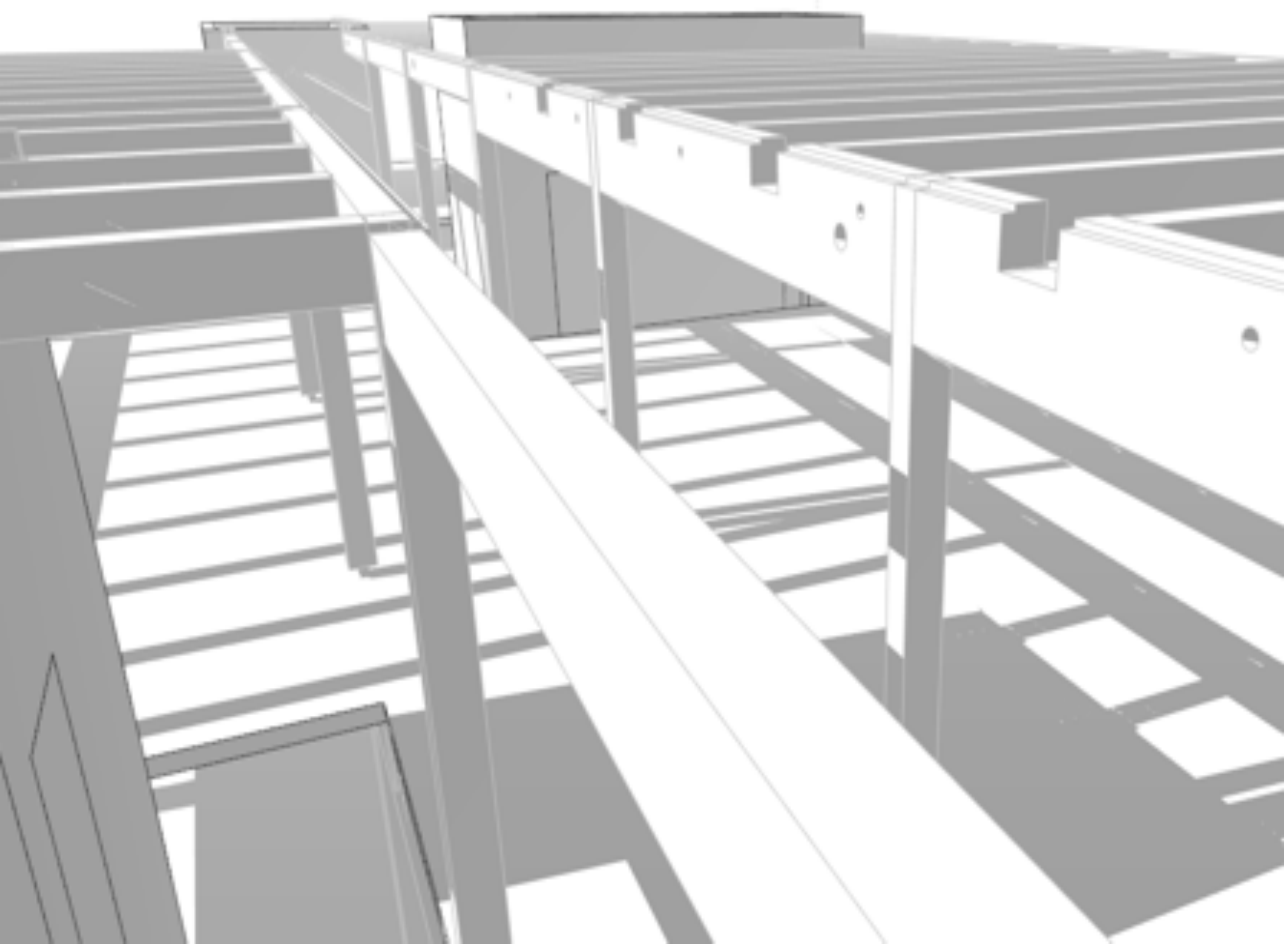

Number of Pitzl pieces installed: 1069

Number of Structural screws installed: 66,725

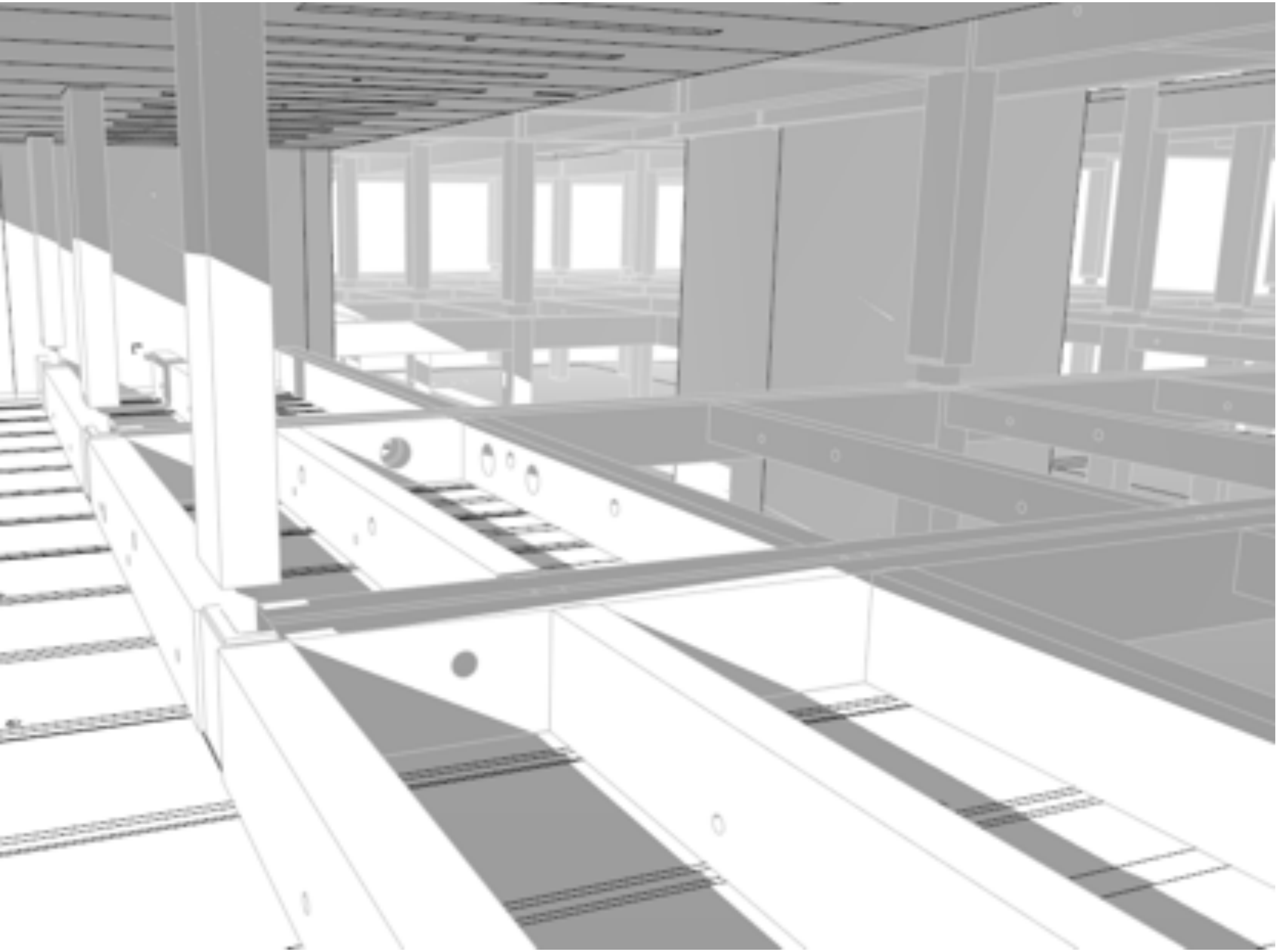
Glulam was installed up to three levels prior to concrete and Q-deck diaphragms installed



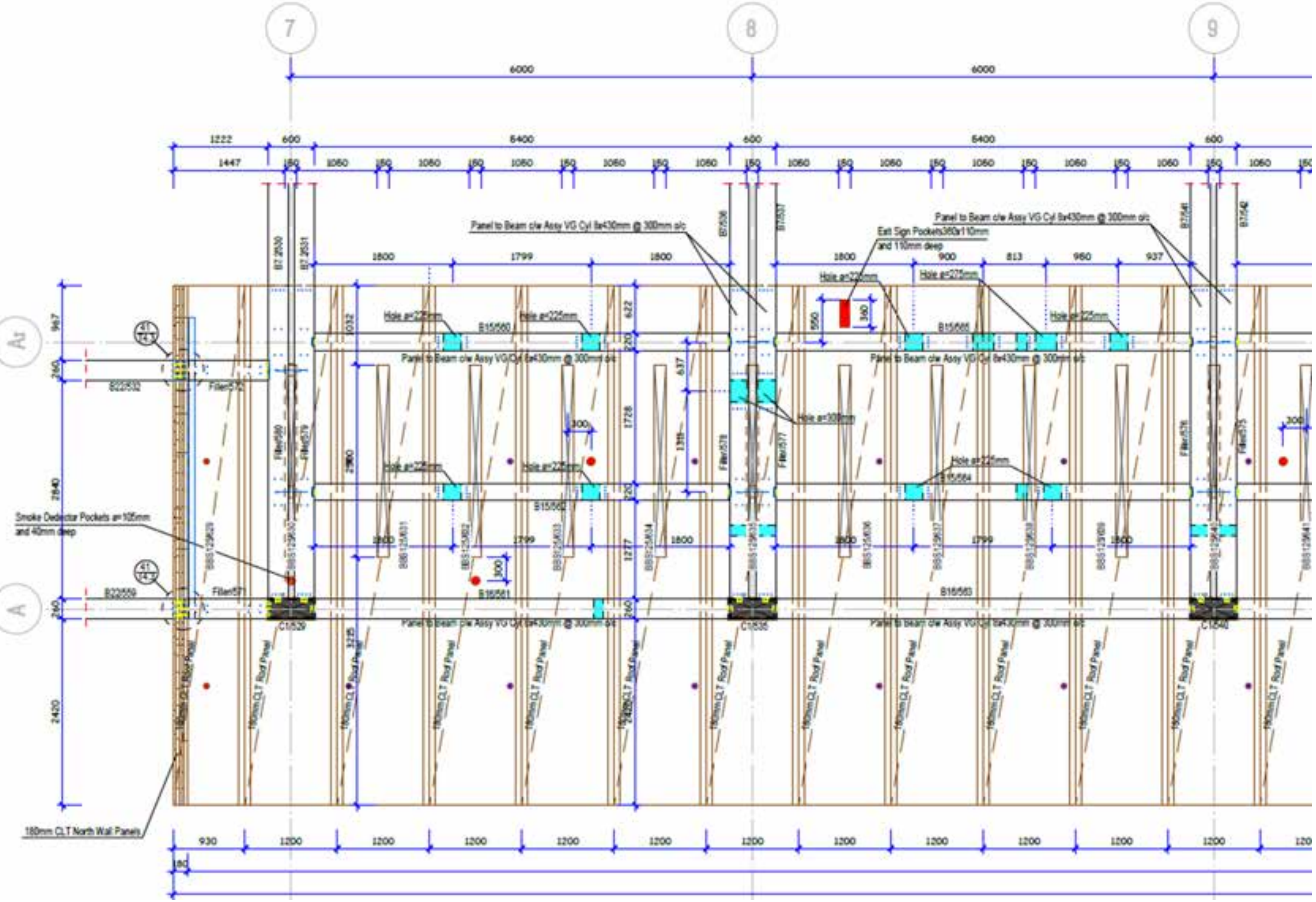
Mass Timber digital design is the solution for proving constructability, predictability of schedule, and sustainability that reduces risk and incentivizes an entirely new market for development.



Mass Timber digital design is the solution for proving sustainability and durability that reduces risk and incentivizes an entirely new market for development.



Mass Timber digital design is the solution for Visualizing building envelope interfaces and developing integrated solutions for thermal, moisture, and air barrier systems



Digital Fabrication provided the collision detection to locate the various holes depending on slope, and elevation not seen in 2D

840 holes ranging in size from 80mm to 600mm.

From Digital Design… to Supply and install. Maximizing the amount of fabrication completed prior to Sansin KP12w Factory Sealer

Interior and Exterior zones were developed to house the Mechanical systems integrated within the Timber

CLT completed, photo in December

Interior and Exterior zones were developed to house the Mechanical systems integrated within the Timber

CLT completed, photo in May

Interior and Exterior zones were developed to house the Mechanical systems integrated within the Timber

Wet and Dry Sprinkler system installed June

Interior and Exterior zones were developed to house the Mechanical systems integrated within the Timber

Storefront Glazing and thermal insulation installed November

Façade is a mixture of thermally broken Curtainwall and Steel stud panel with exterior insulation hung from the slab edge.

Interior view of the Façade Showing exposed Timber frame within

Façade is a mixture of thermally broken Curtainwall and Prefab steel stud panel with exterior insulation at the the slab edge.

Mockup developed at the transition

Thank You!

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