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Enclosure Design for Mass Timber

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Course Description

Larger and taller mass timber buildings are becoming common in North America. These buildings typically utilize CLT or NLT panels, glulam beams and columns, and new engineered timber components to meet the structural and fire requirements associated with greater heights. With these larger wood structures and heavier timber components comes the need for efficient building enclosure assemblies that can be installed quickly on tight sites and are in many cases new and unique to the industry. Prefabricated building enclosure elements are now also commonly used. This presentation shares guidance on building enclosure design and detailing best practices for mass timber buildings. It includes case studies and lessons learned from the design, construction, and monitoring of enclosures for recently completed projects.




Learning Objectives

At the end of this course, participants will be able to:

- Review building science fundamentals and building enclosure design considerations for mass timber buildings.
- Discuss common details used for mass timber wall and roof enclosure assemblies.
- Highlight the potential for increased construction efficiency through the use of prefabricated enclosure assemblies.
- Referencing case studies and details from recently completed mass timber projects, demonstrate lessons learned and best practices associated with enclosure assemblies.

OUTLINE

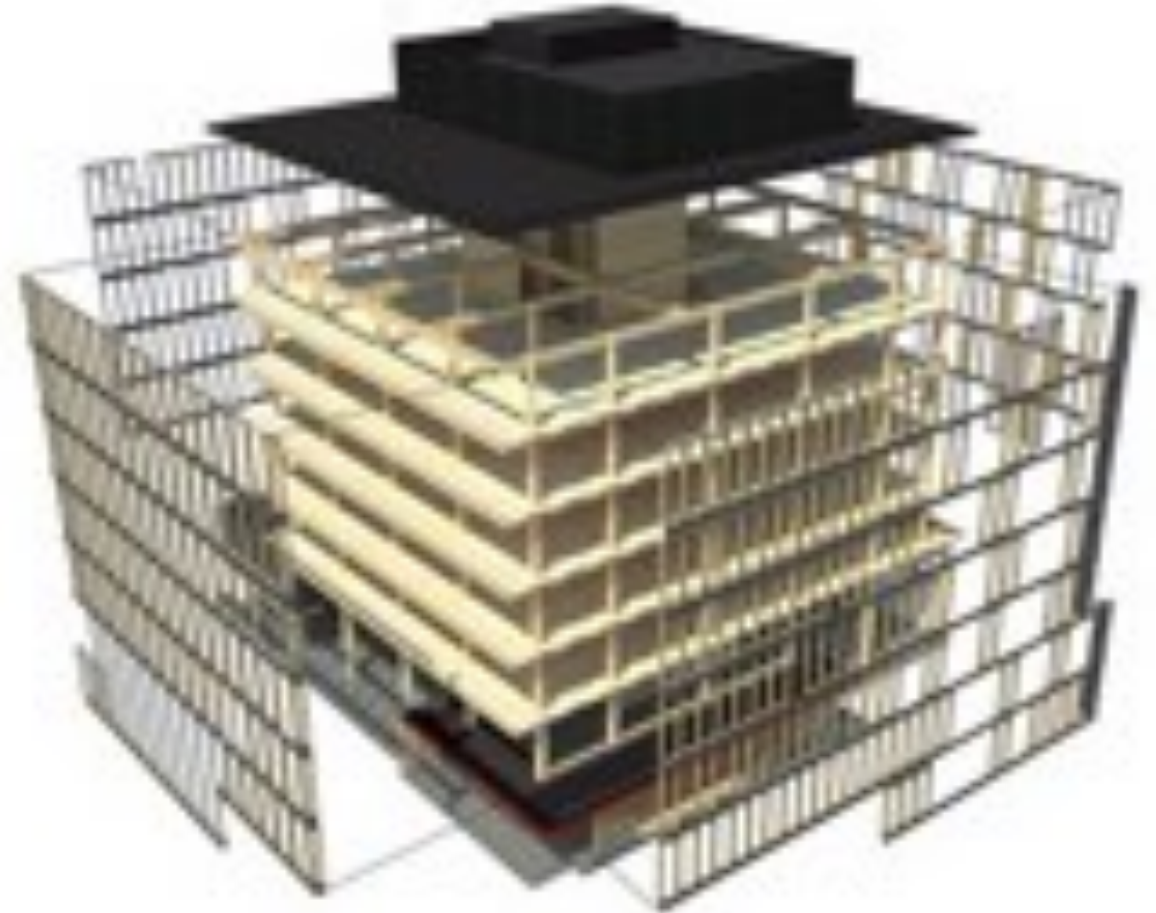
1. Building enclosure design + mass timber
2. Wood + Moisture
3. Case Studies

An aerial photograph of a city street scene. In the foreground, a large building with a flat, light-brown roof is under construction. To its right, another building features a bright green roof. The street below is filled with various construction materials, equipment, and workers. In the background, more city buildings and trees are visible under a clear sky.

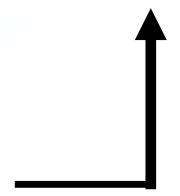
Building Enclosure Design & Construction



Structure



The Building Enclosure



Tall Wood Structures

- Fast
- Sensitive to moisture
- Greater movement – shrinkage
- Code Challenges?
- Mixed steel, concrete, and wood
- Not the same as wood-frame
- Not the same as high-rise



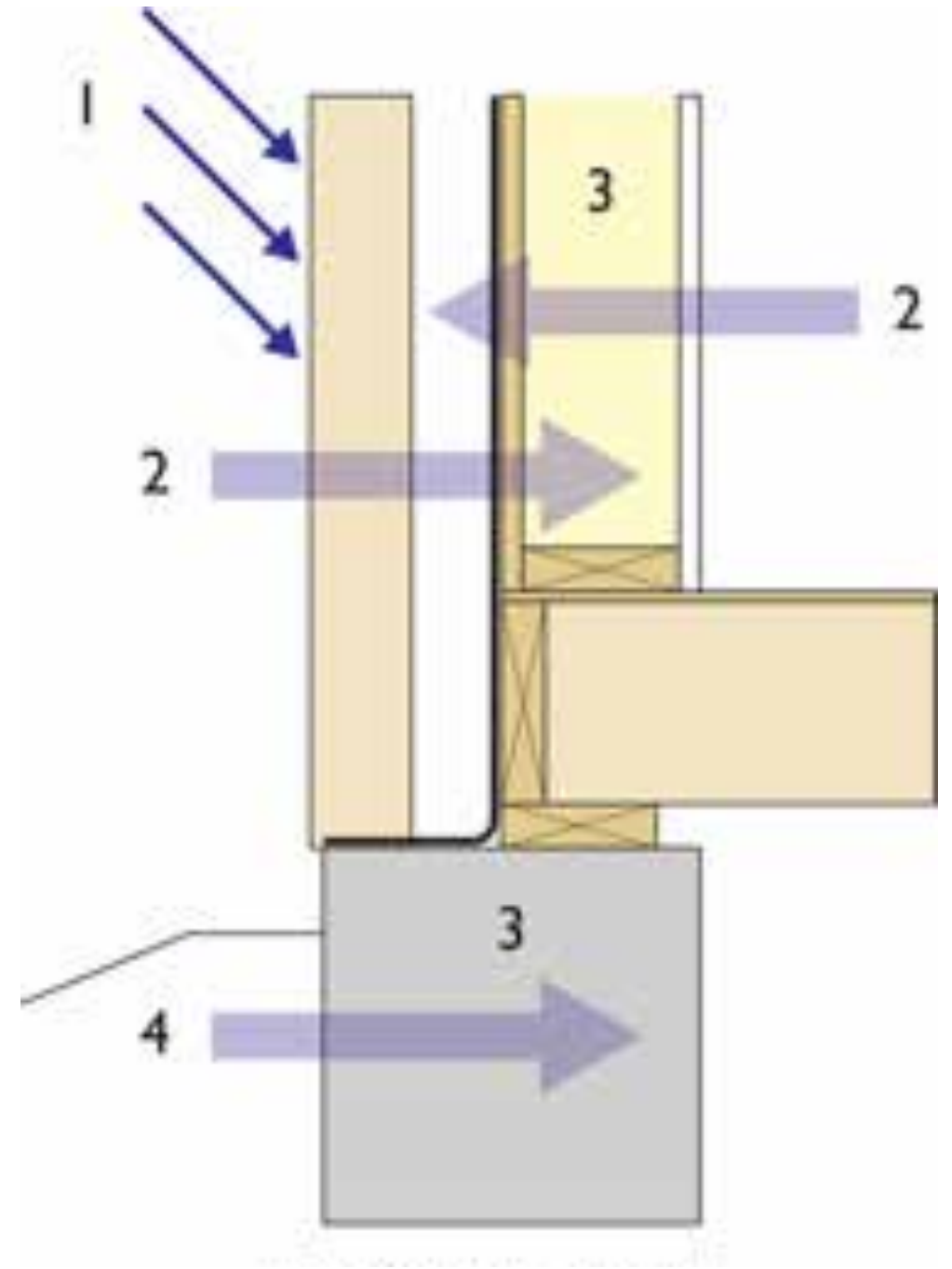
Tall Wood Building Enclosures

- Need for speed
- Protect wood structure from inclement weather
- Robust materials and systems, high-rise appropriate
- Tolerant of movement
- Thermally efficient



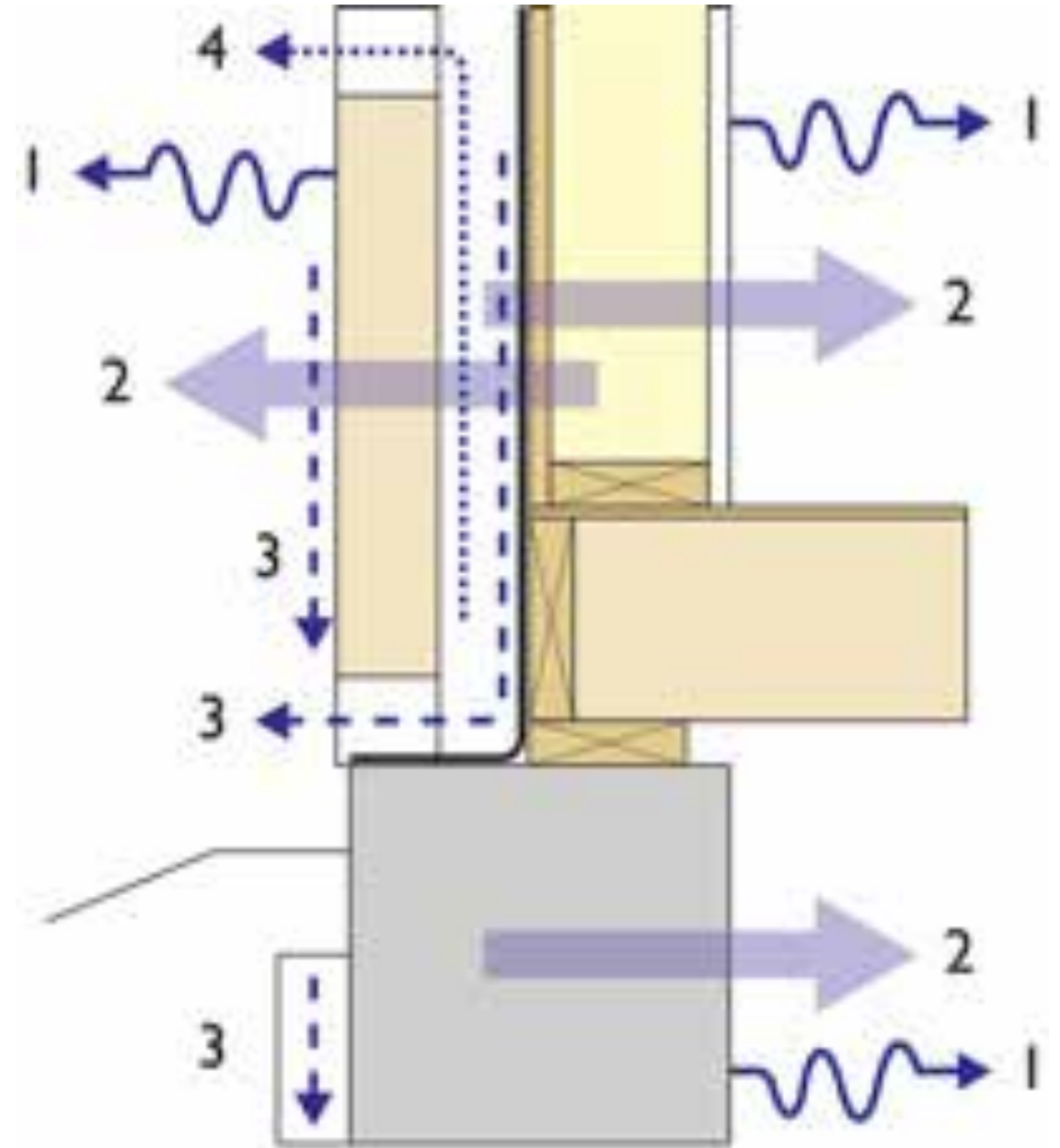
Water Management - Wetting

1. Precipitation
2. Vapor / air movement
3. Construction moisture
4. Groundwater



Water Management - Drying

1. Evaporation
2. Vapor / air movement
3. Drainage
4. Ventilation drying





Vapor Open + Exterior Insulation









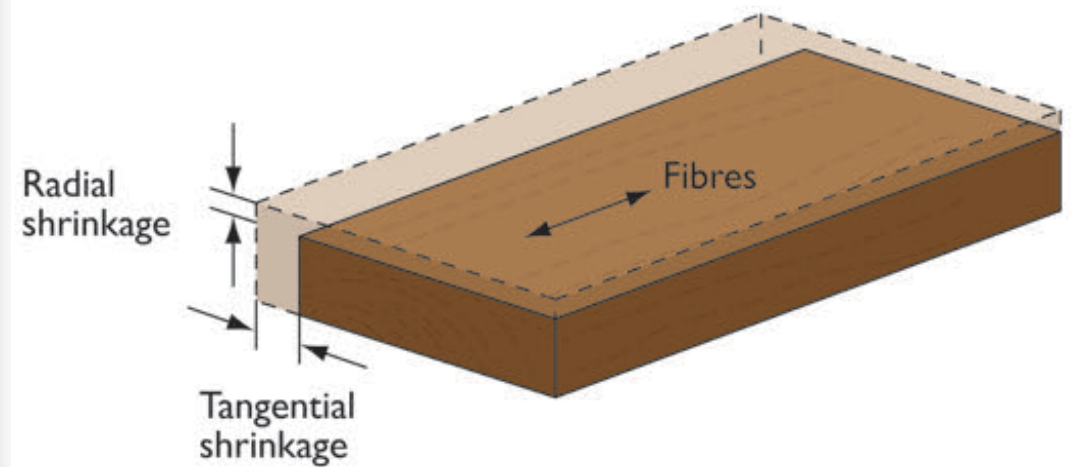
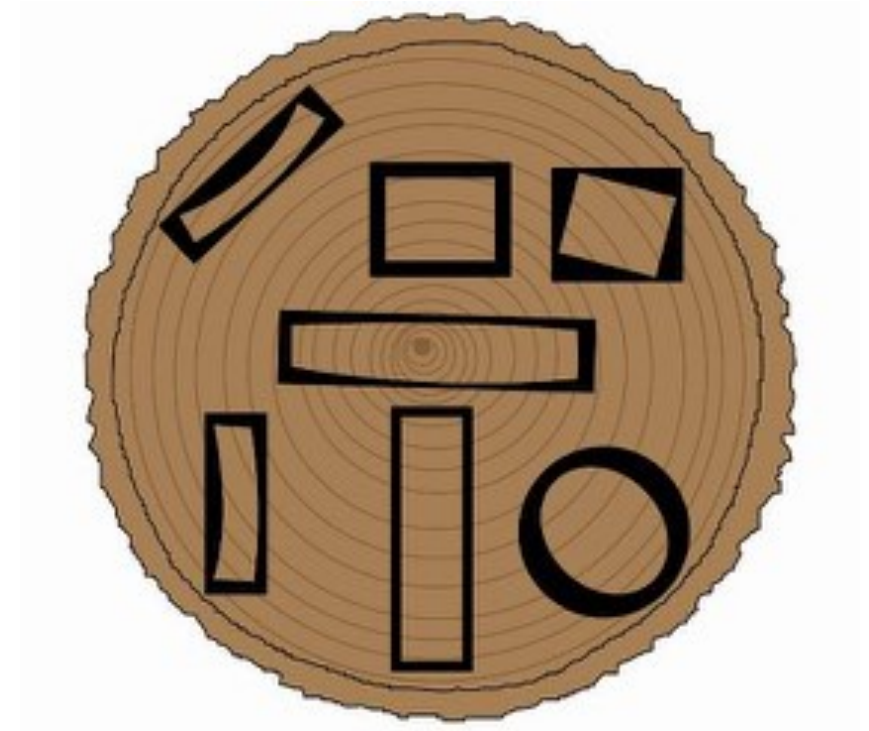
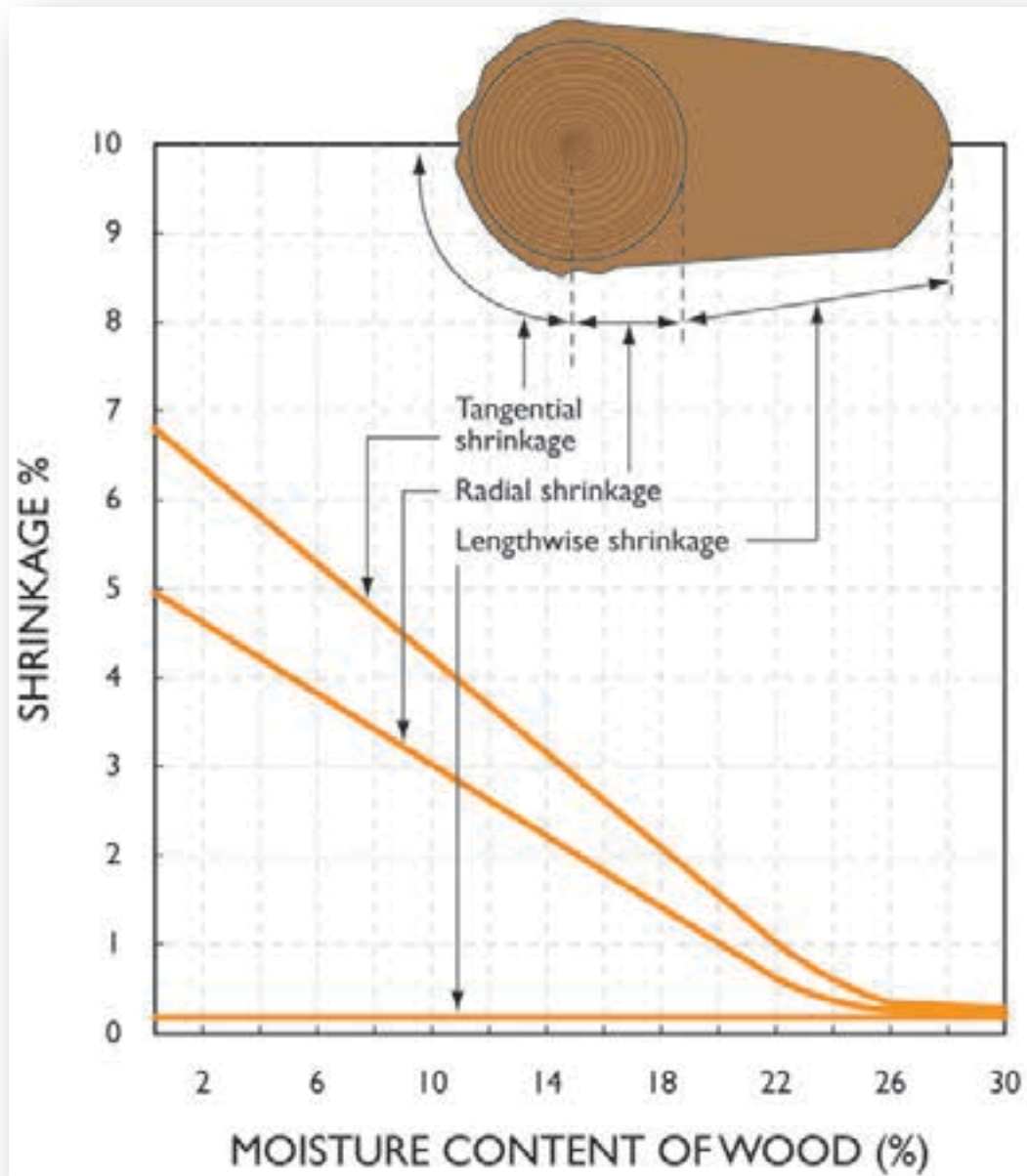
Wood + Moisture

The image shows a large, open interior space of a building under construction or renovation. The ceiling is made of light-colored wooden planks, and the floor is also made of wood, with some areas covered in a grid of wooden panels. The space is supported by several vertical wooden columns. Large windows in the background offer a view of a city skyline with various buildings. The overall atmosphere is warm and natural, emphasizing the use of wood in modern architecture.

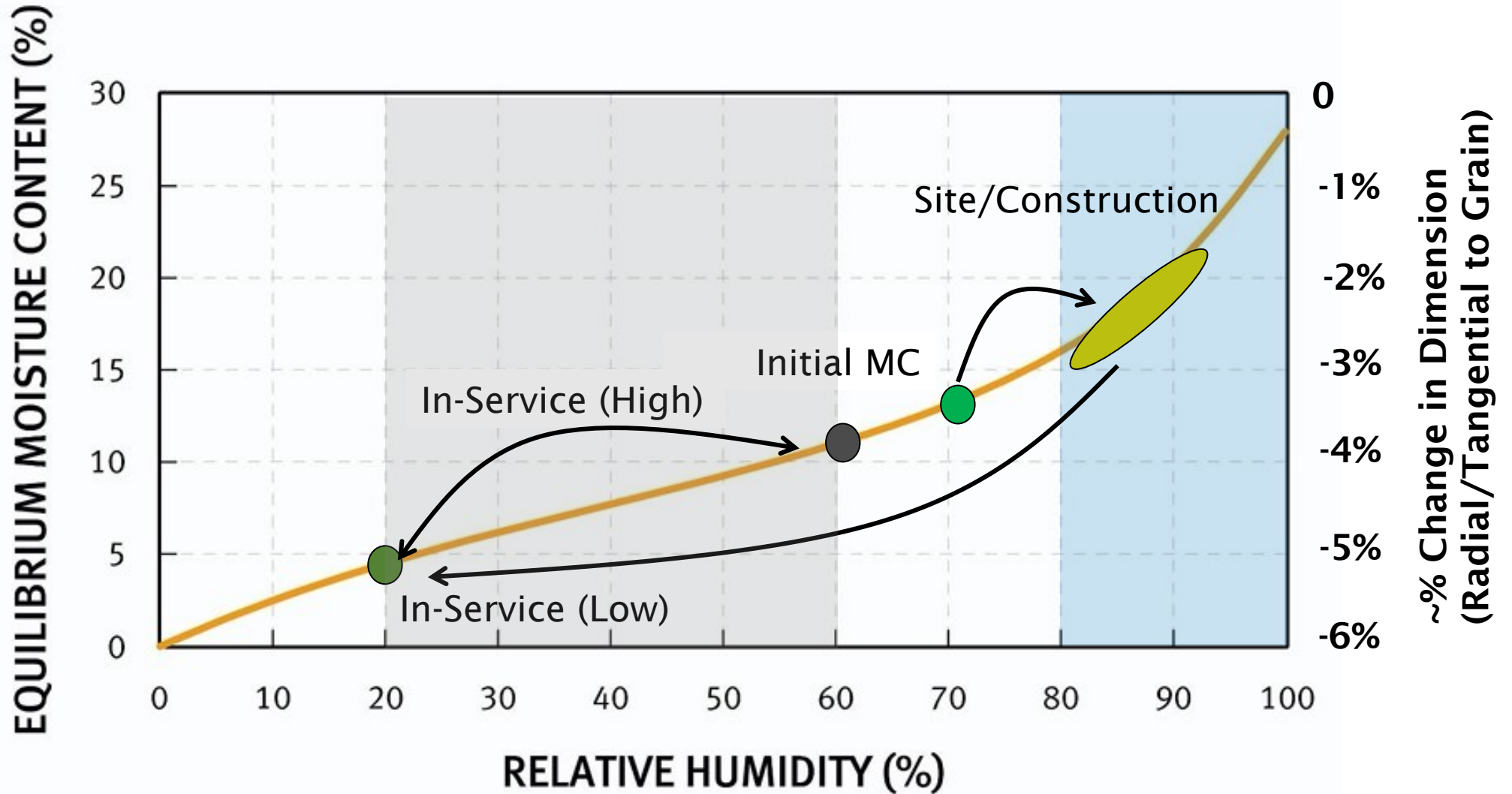


it will dry out right??

Behaviour of Wood in Construction



Wood Moisture Content, Relative Humidity & Movement







Lessons Learned - Roofs

- Protect large wood roofs from rain – but not too late
- Mechanical drying of wetted roofs is slow & causes costly construction delays



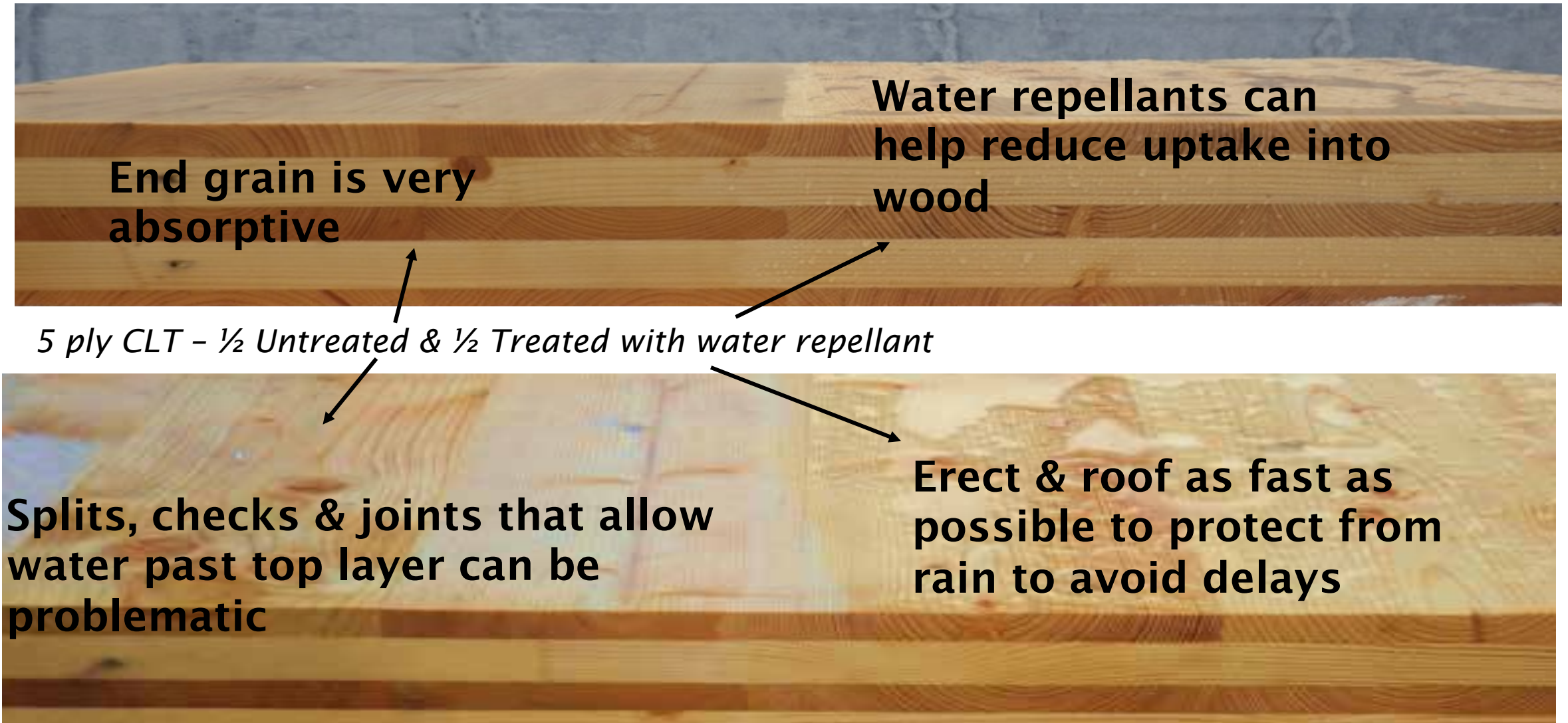











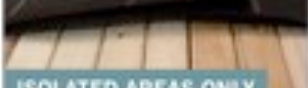




Industry Lessons - Protection





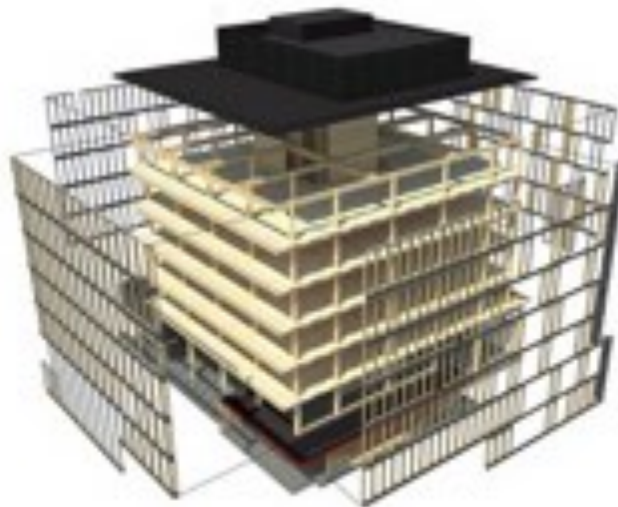
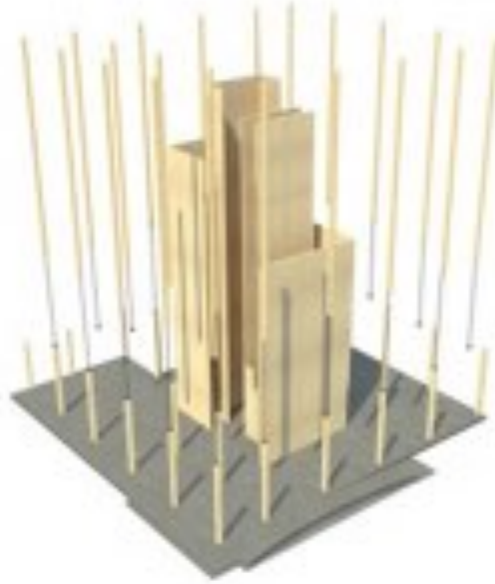
PROTECTION LEVEL	TMMS MEMBRANE / JOINT TREATMENT	BENEFITS	CHALLENGES / LIMITATIONS	RECOMMENDED CLIMATE INDEX / SEASON
 HIGH	Field Membrane: Fully adhered, vapor-impermeable, waterproof membrane on sheathing. Joint Treatment: Fully adhered or welded field membrane laps.	Factory applied field membrane prior to shipping minimizes errors and weather limitations of on-site application. Field membrane may serve as part of permanent roof membrane or flooring underlay. Allows for immediate installation of joint treatment following panel installation (if skilled workers are available). High durability of membrane laps where torched or welded (avoid self-adhered laps).	Requires pre-coordination with subcontractor installing TMMS. Can trap moisture within the NLT assembly and significantly reduce drying should water penetrate the membrane.	All Climate Indices / All Seasons
 MODERATE	Field Membrane: Precast, moisture-resistant bonded water-repellent coating on sheathing. Joint Treatment: Taped and/or sealed (e.g., flexible flashing membrane or tape).	Precast sheathing minimizes need for experienced membrane installers. Sheathing and TMMS field membrane are combined into a single fabrication step. Allows immediate installation of joint treatment following panel installation.	Sheathing attachment penetrates through TMMS field membrane; taped/seal over fasteners. May be susceptible to damage and/or adhesion failure due to trade activities. May have limited exposure time; ponding water may result in water absorption and slow drying.	Climate Index ≤ 70 / All Seasons
 MODERATE	Field Membrane: Fully adhered, vapor-permeable and moisture-resistant membrane on sheathing. Joint Treatment: Taped and/or sealed (e.g., flexible flashing membrane or tape).	Factory applied field membrane prior to shipping minimizes errors and weather limitations of on-site application. Allows for immediate installation of joint treatment following panel installation if field membrane is pre-applied to sheathing.	Requires pre-coordination with subcontractor installing TMMS. TMMS may be susceptible to damage and/or adhesion failure due to trade activities. May require skilled/experienced installer.	Climate Index ≤ 70 / All Seasons
 MODERATE	Field Membrane: None. Exposed plywood or OSB sheathing. Joint Treatment: Taped and/or sealed (e.g., flexible flashing membrane or tape).	Allows for immediate installation of joint treatment following panel installation. Skilled/experienced workers not required for joint treatment installation. Additional applications of water sealer may further increase water resistivity of the sheathing. Cost effective compared to options with field membrane.	Some joint treatment products may not bond to damp or wet sheathing substrate. Joint treatment may be susceptible to damage and/or adhesion failure due to trade activities.	Climate Index ≤ 35 / All Season Climate Index ≤ 70 / Dry Seasons
 LOW	Field Membrane: None. Exposed plywood or OSB sheathing. Joint Treatment: None. Exposed sheathing joints.	Cost effective. May minimize schedule impacts.	System permits water migration between sheathing joints and into the NLT in wet weather conditions.	Climate Index ≤ 35 / All Season
 LOW	Field Membrane: None. Exposed NLT laminations. Joint Treatment: Not applicable.	Accommodates sheathing installation at a later date or following site installation of overframing. May minimize schedule impacts. Cost effective.	Option permits water migration between NLT in wet weather conditions.	Climate Index ≤ 35 / All Season
 ISOLATED AREAS ONLY	Field Membrane: Loose laid sheet over sheathing. Joint Treatment: Taped and/or sealed (e.g., flexible flashing membrane or tape).	Serves as short-term temporary protection for isolated areas.	Low durability. Difficult to seal. Typically slippery and dangerous to walk on. Allows lateral moisture movement beneath membrane.	Isolated Conditions (evaluate for project specific appropriateness)
 ISOLATED AREAS ONLY	Field Membrane: Membrane under sheathing and over NLT laminations. Joint Treatment: Varies.	Sheathing protects membrane from trade damage.	TMMS is inaccessible for quality control review. TMMS is inaccessible for maintenance and repair. TMMS is inaccessible for future waterproofing.	

guidance

Wood Innovation Center

The image shows the interior of a large, modern building with a prominent wood structure. The ceiling is composed of large, horizontal wooden beams and planks. The walls are also made of wood, with vertical panels and horizontal slats. A person is standing in the center of the room, looking out towards a large window on the right side. The floor is made of light-colored wood planks. The overall atmosphere is warm and natural.

WIDC – Structure & Enclosure Systems



Wood Innovation Design Center

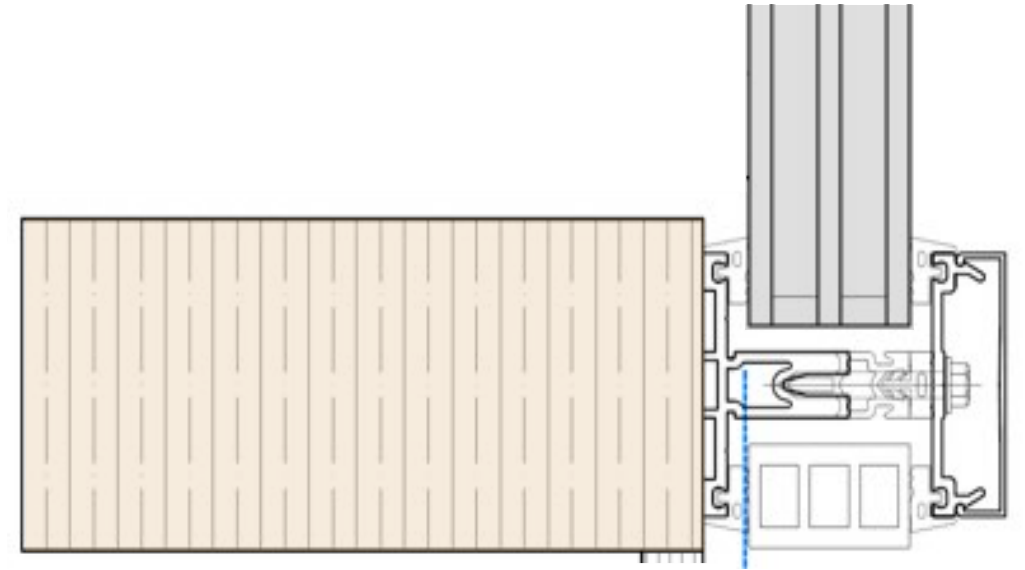
- 6 'tall' levels (equivalent to 8 levels, 98' tall)
- CLT shear walls, glulam columns with glulam beams and staggered CLT floor & roof structure
- Thermal performance design targets
 - R-40 roof
 - R-25 walls
 - R-5 wood curtainwall glazing
- Pre-fabricated design for infill walls and wood curtain wall



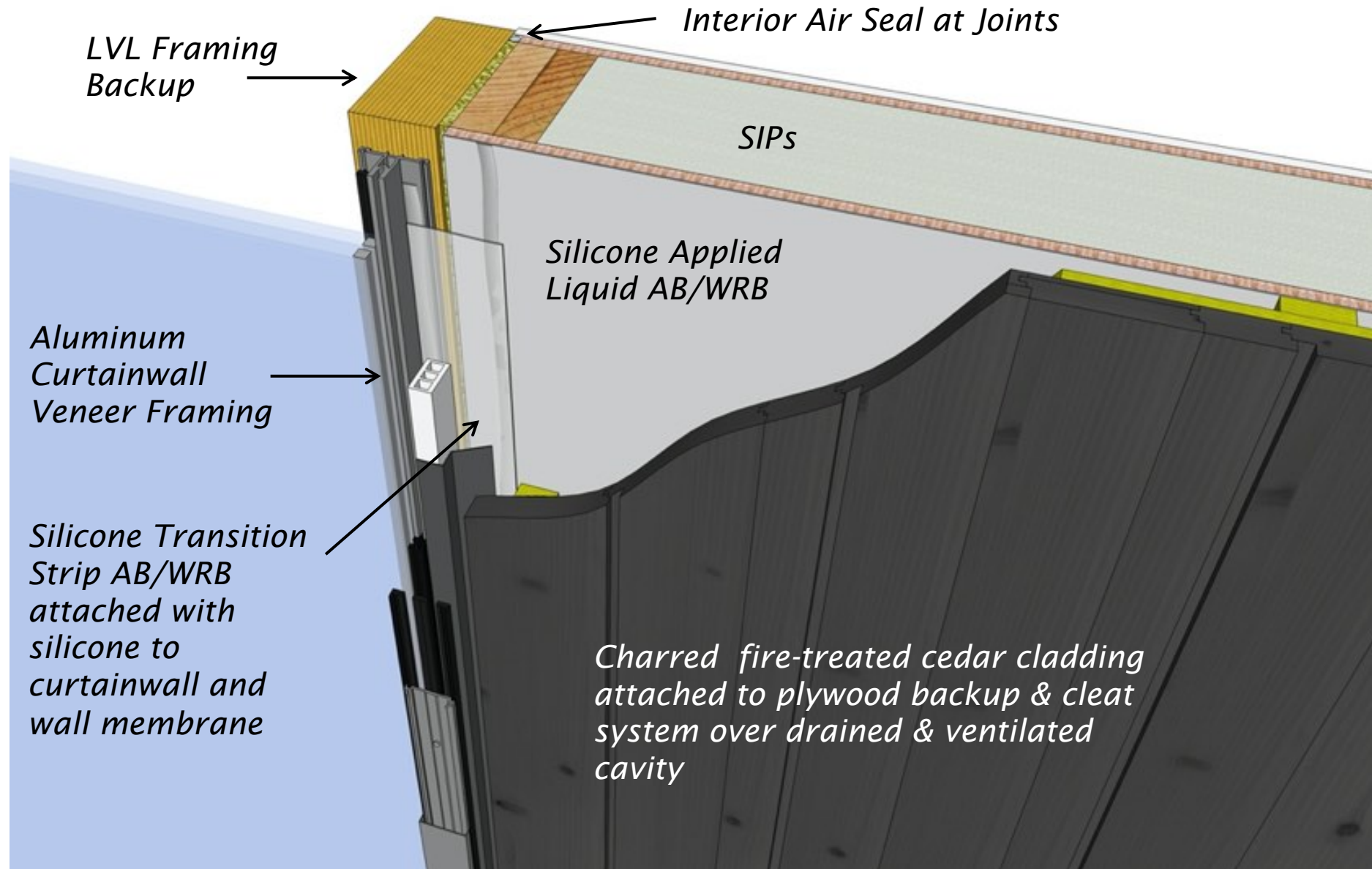
*Michael Green Architecture (MGA) –
Contractor: PCL Construction*

Stick-Built Wood Veneer Curtainwall

- Aluminum veneer curtainwall framing over LVL mullions - installed as individual window units, ground bearing
- Stick built/site glazed with triple glazed IGUs, argon filled, dual low-e coatings (U-0.15)
- R-5 (U-0.20) overall thermal performance



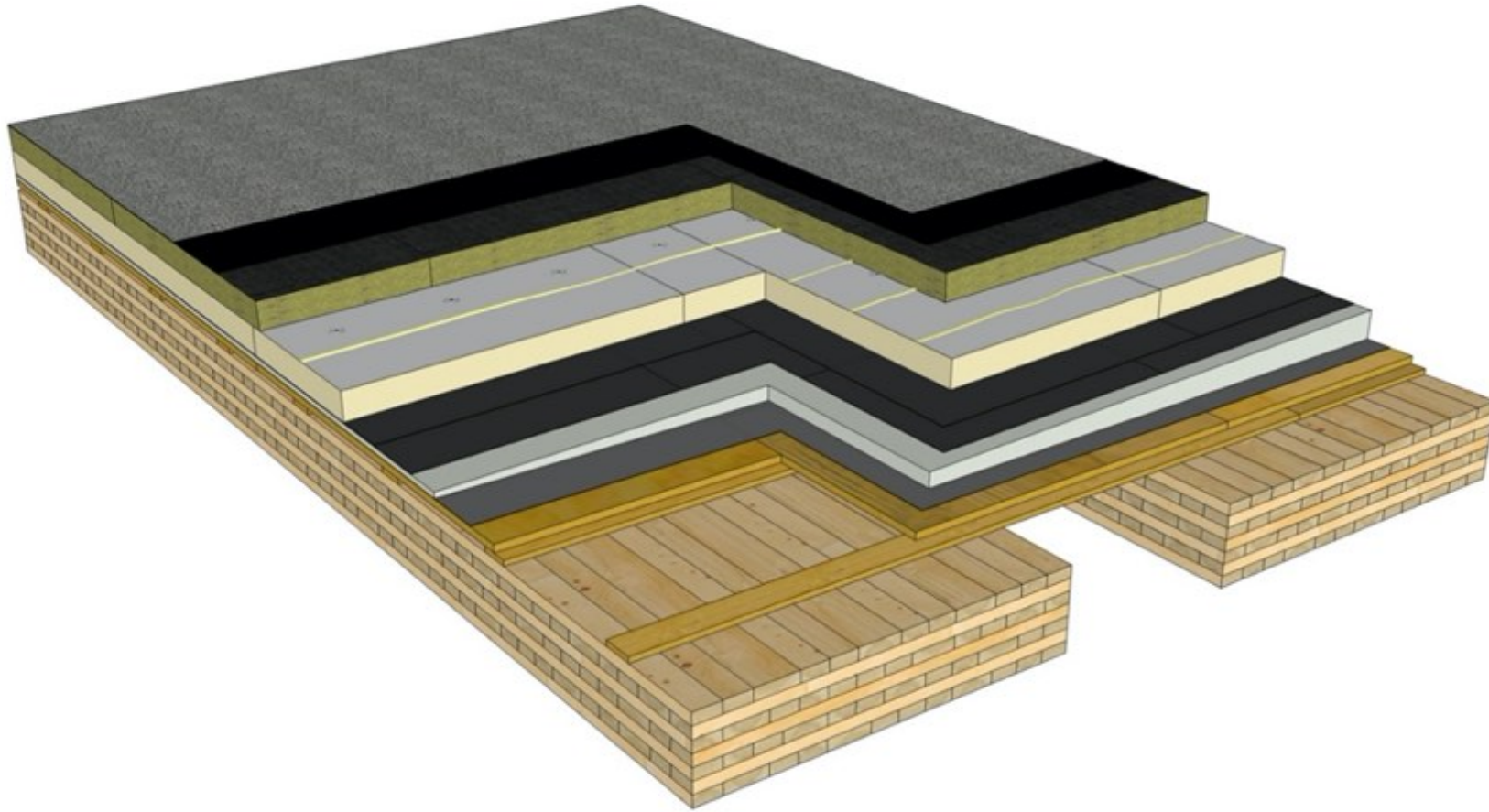
Curtainwall to SIPs Interface







Conventional Roof Assembly



Conventional Roof Assembly





WIDC – Summary

- Durable and energy efficient
- High performance materials and systems
- Small panel pre-fabrication
- Required full exterior access during construction
- Scaffolding, exterior sealants and transition details



A low-angle photograph of a modern building under construction. The building's facade is composed of light-colored panels and dark, rectangular window openings, creating a strong geometric pattern. Two large tower cranes are visible in the background, their lattice structures extending across the upper portion of the frame against a clear blue sky. The text "Brock Commons" is overlaid in the center in a white, sans-serif font.

Brock Commons



Initial Challenges

- Vancouver = Temperate rainforest
- How to protect mass timber from rain during construction in any season?
- Enclosure must keep up with pace of structure
- How to enclose & seal the walls quickly and not be slowed by inclement weather?



UBC Brock Commons- What Wasn't Feasible



Unitized Curtain Wall Option

Problem: Cost, Schedule, Energy

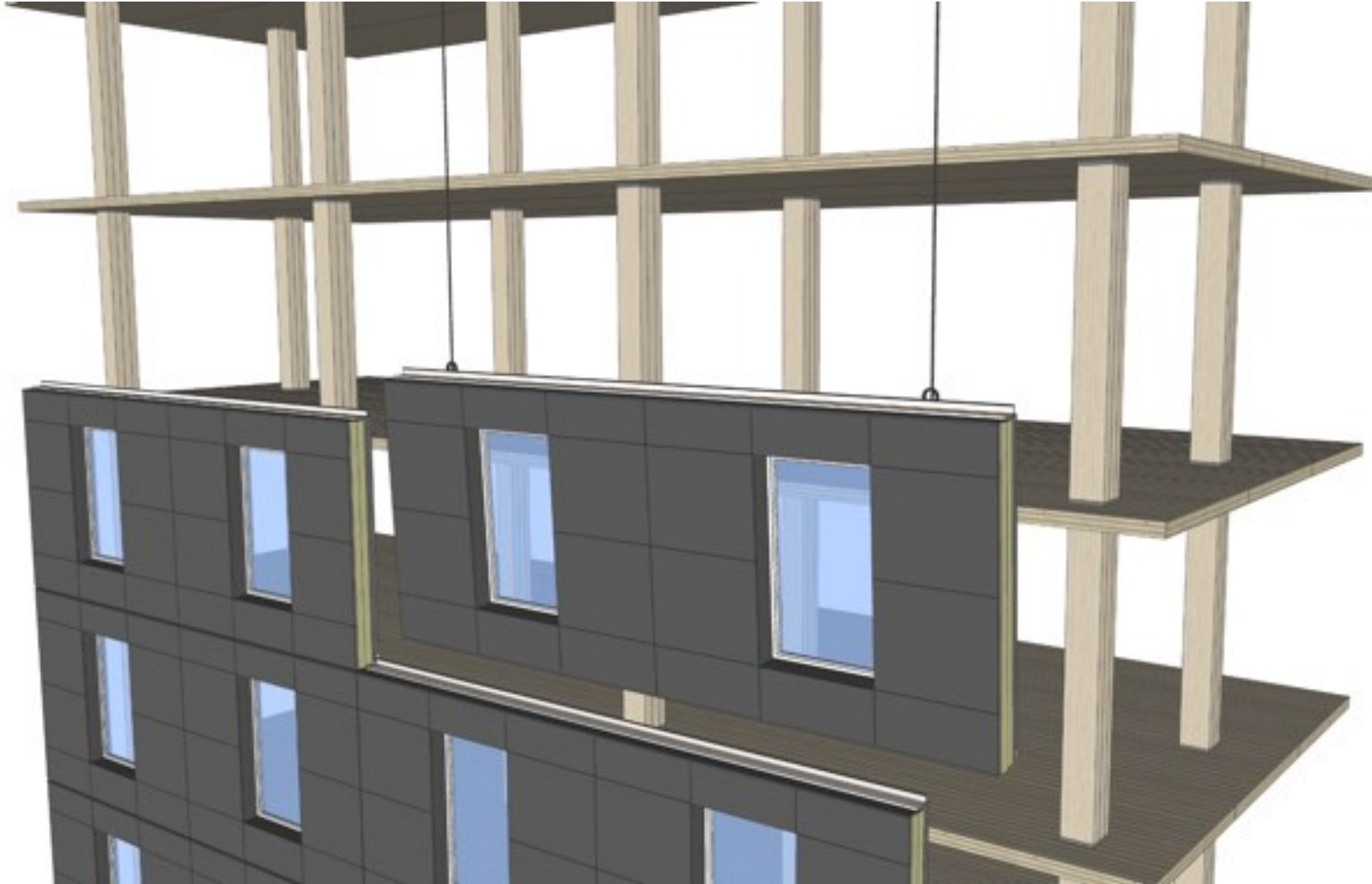


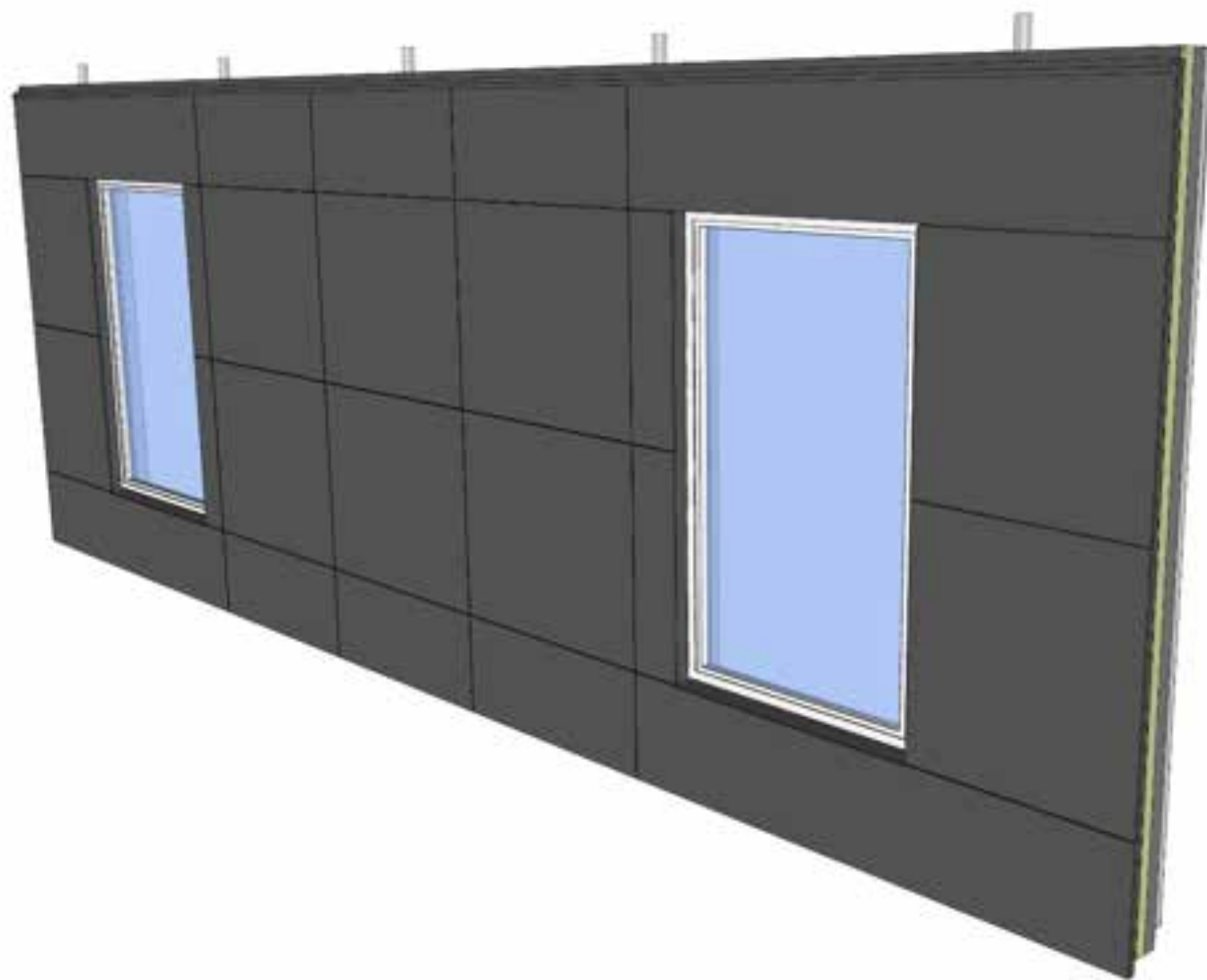
Small Panel Prefabrication Wall – Precedents

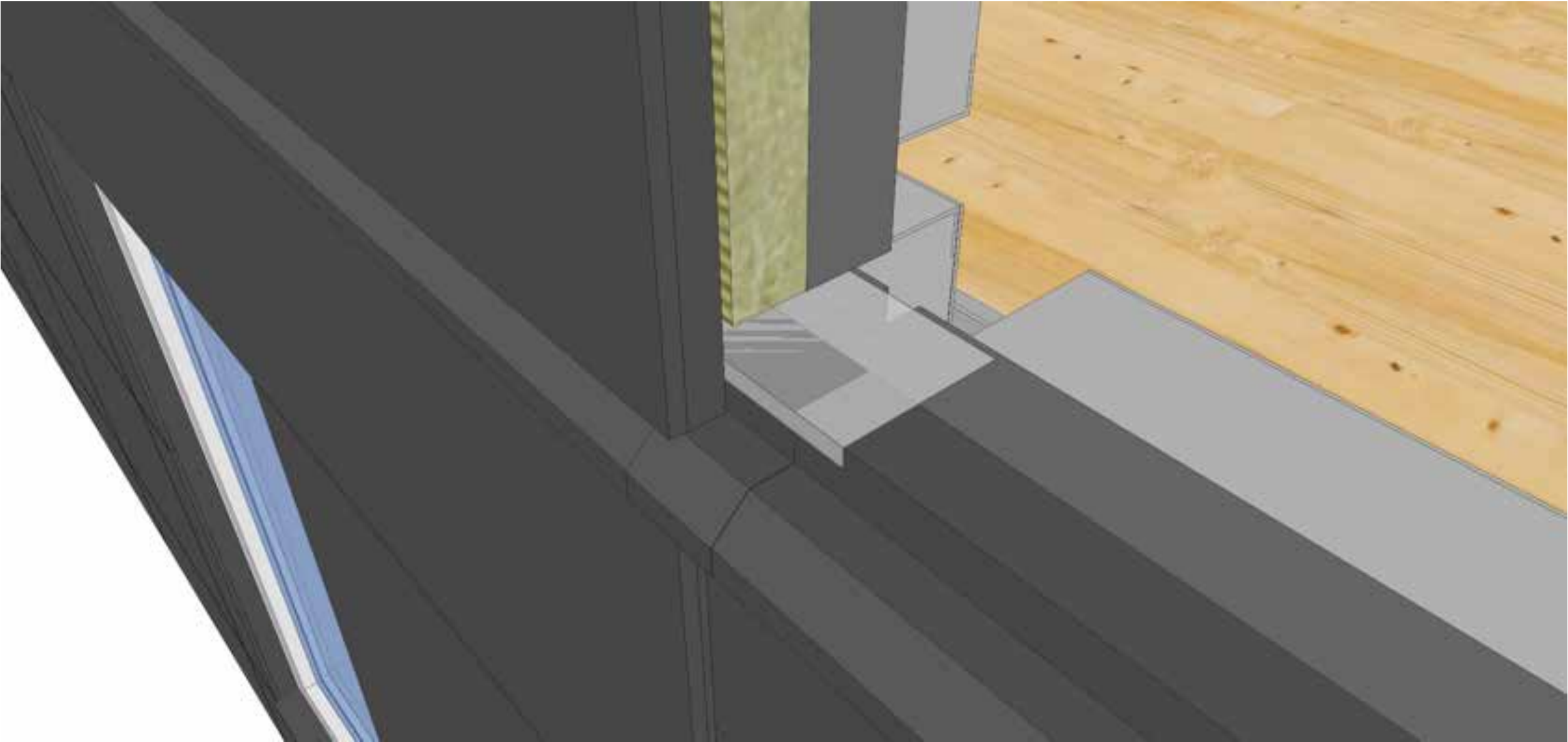
Problem: Schedule

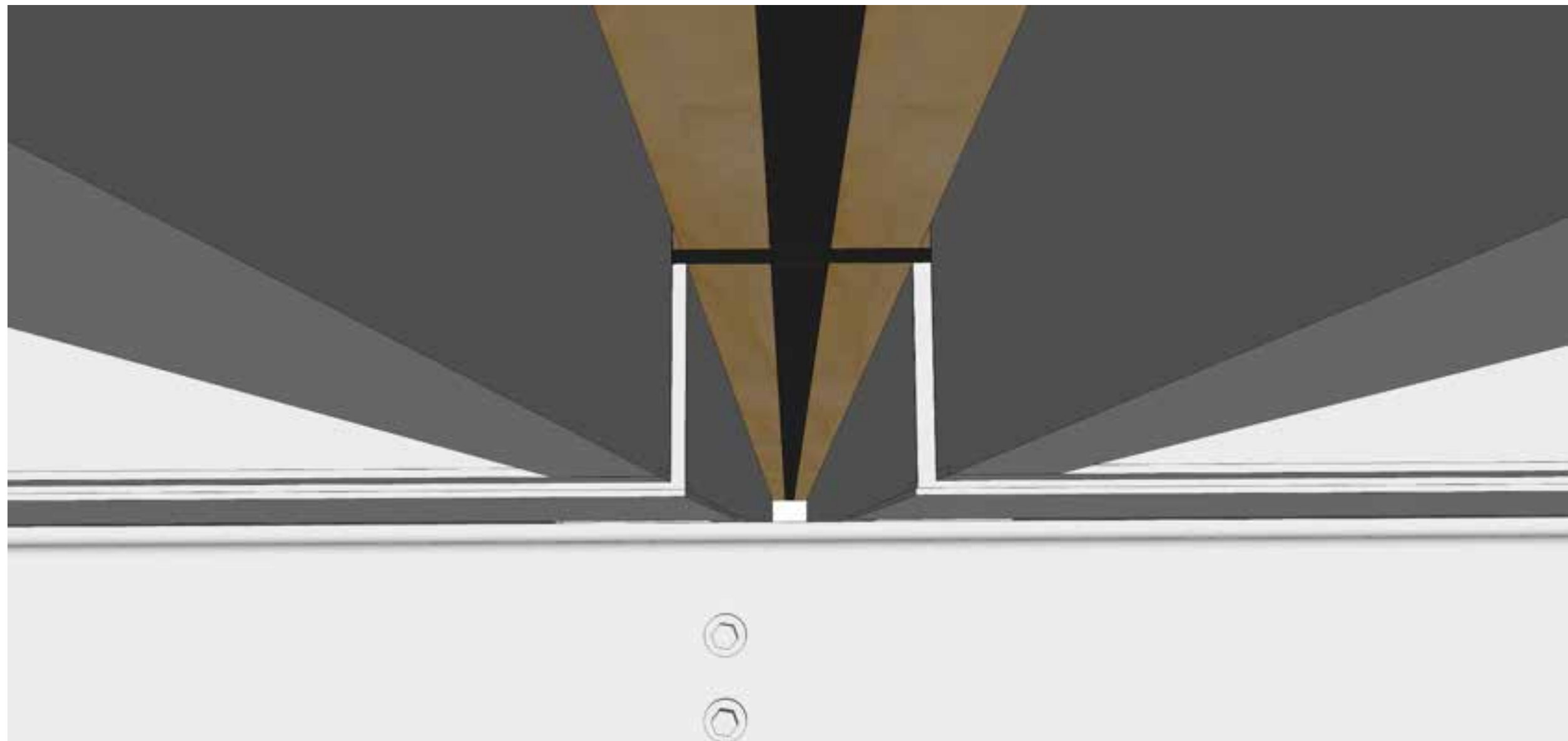


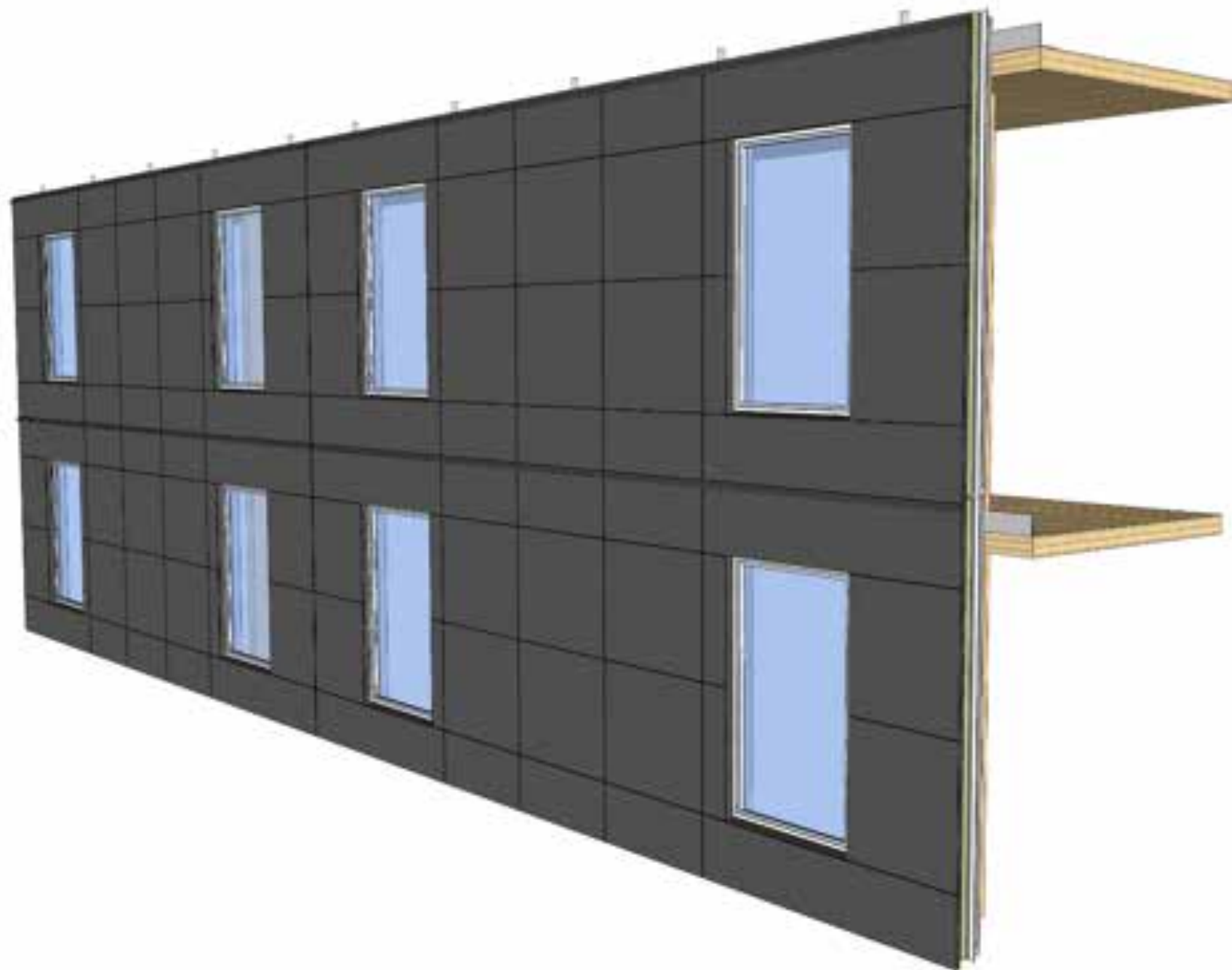
Tall Wood Prefabrication Option – Large Panel with Pre-installed Windows















Laboratory Mockup & Physical Testing




Centura – Factory Floor Prefabrication



Site Installation – at Pace with Structure – 1 floors/day



WEEK: 1 

TIMELAPSE 

UBC
BROCK COMMONS

WOOD 
CONSTRUCTION

STARTS 

JUNE/6

WOOD



A photograph of a modern, multi-story building with a grid of large windows. The building is dark-colored with light-colored window frames. In the foreground, there is a paved walkway lined with young trees and some landscaping. The sky is blue with some clouds. The text "What's Next?" is overlaid in the center of the image.

What's Next?









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