Moisture Protection in Mass Timber Buildings: Design Considerations & Construction Management

MASS TIMBER+ SM

OFFSITE CONSTRUCTION CONFERENCE

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FEA Forest Economic Advisors

Credits: 1.0 AIA/CES HSW LUs, 1.0 PHD credit, 0.10 ICC credit

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

AIA Approved Continuing Education

Course Description

Mass timber buildings have unique moisture-related vulnerabilities during construction, when wood elements are exposed to weather before an enclosure is completed. Additionally, the building assemblies must appropriately control moisture during occupancy.

This course focuses on design development considerations and on-site protection strategies to mitigate moisture-related risks of mass timber assemblies, including proactive coordination between the design and build teams. Participants will explore factors that increase moisture risks, such as climate, construction sequencing, and project-specific conditions.

Designed for architects, engineers, general contractors, and other construction professionals, this course will outline the plan development and moisture risk assessment process—and detail real project examples that illustrate lessons learned and the variety of the moisture management strategies available.

Learning Objectives

1. Explain the importance of moisture protection during the construction phase of mass timber projects and the potential consequences of inadequate protection.
2. Identify factors that increase on-site moisture risks such as assembly design moisture exposure intensity and duration, and construction logistics.
3. Identify common on-site protection strategies and materials used to manage moisture on site, including temporary membranes, taping, hoarding, and drainage systems.
4. Understand the process of developing a construction-phase moisture management plan, including early coordination and completing a moisture risk assessment.

Mass Timber Buildings: Design and Construction Management for Moisture Protection

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Outline

Introduction to the moisture sensitivities of mass timber

How mass timber design and constructions compare to traditional buildings

How design decisions affect the construction phase

Why Mass Timber?

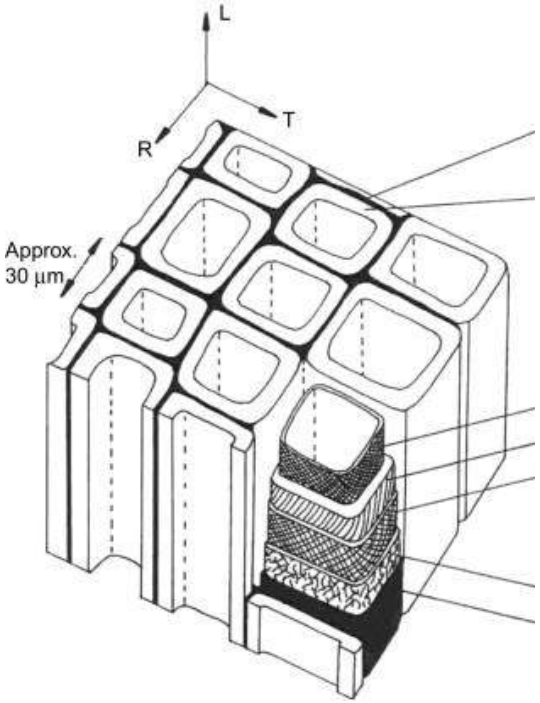
- Aesthetic & Biophilic benefits
- Structural/Seismic performance benefits
- Increased speed of construction
- Compatible with pre-fabricated design processes & machining
- Reduced environmental impact

What is the catch?

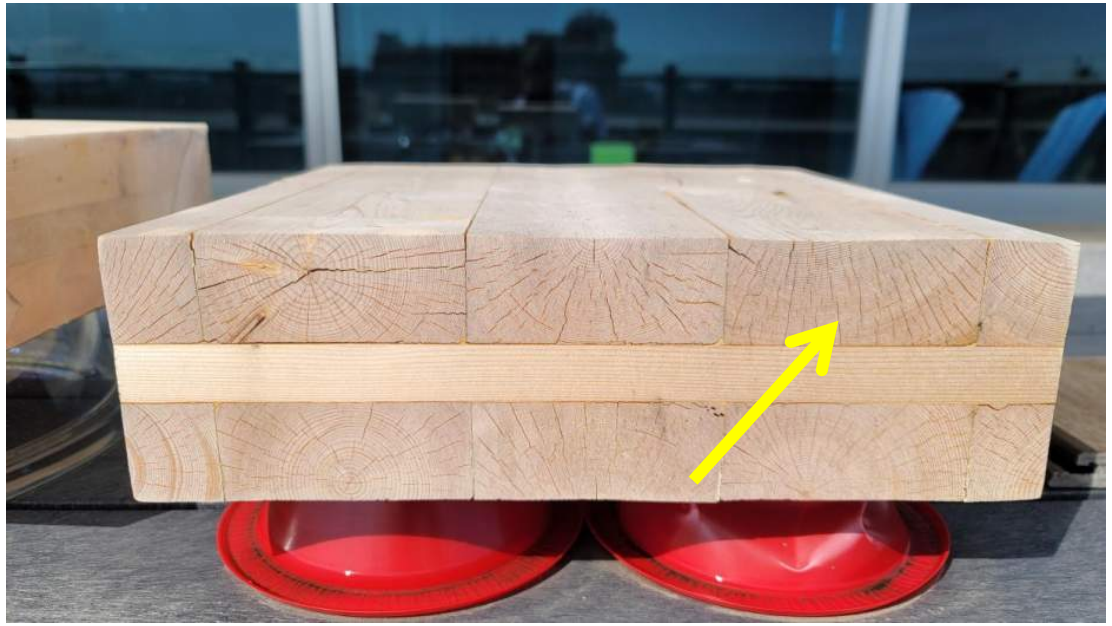
Mass Timber ≠ Concrete

Unique to Mass Timber: Moisture Sensitive

Why is Wood Moisture Sensitive?



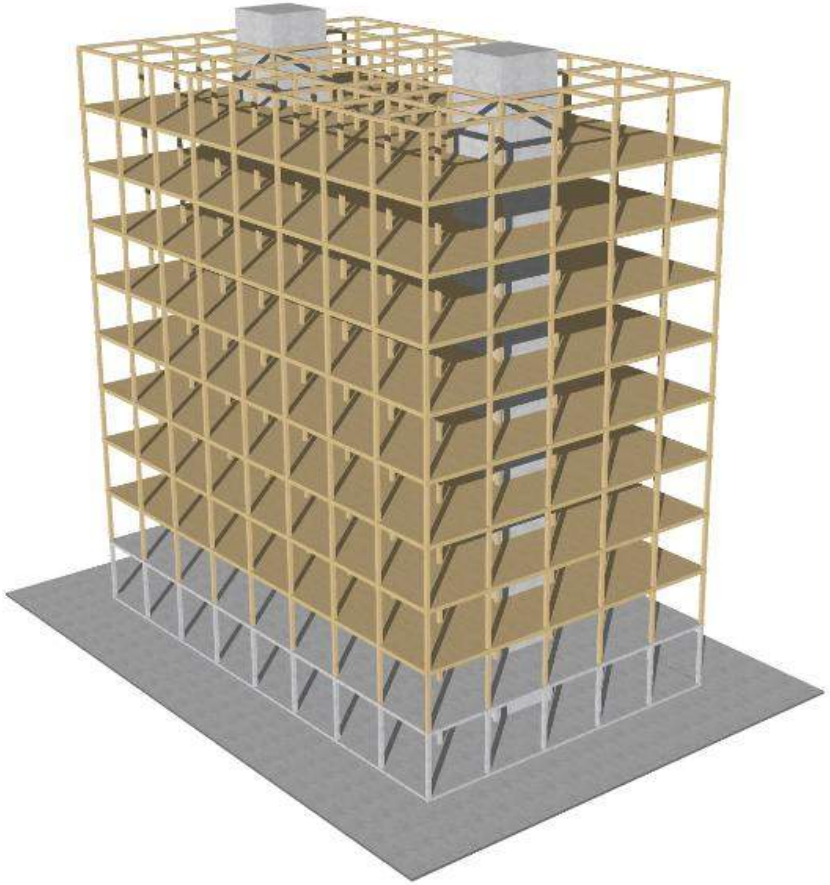
- Wood exchanges moister with environment reach equilibrium moisture content (liquid or vapor)
- The end-grain absorbs water quicker
- Wood swells as moisture content increased.
- Organic material (can stain, mold and decay)

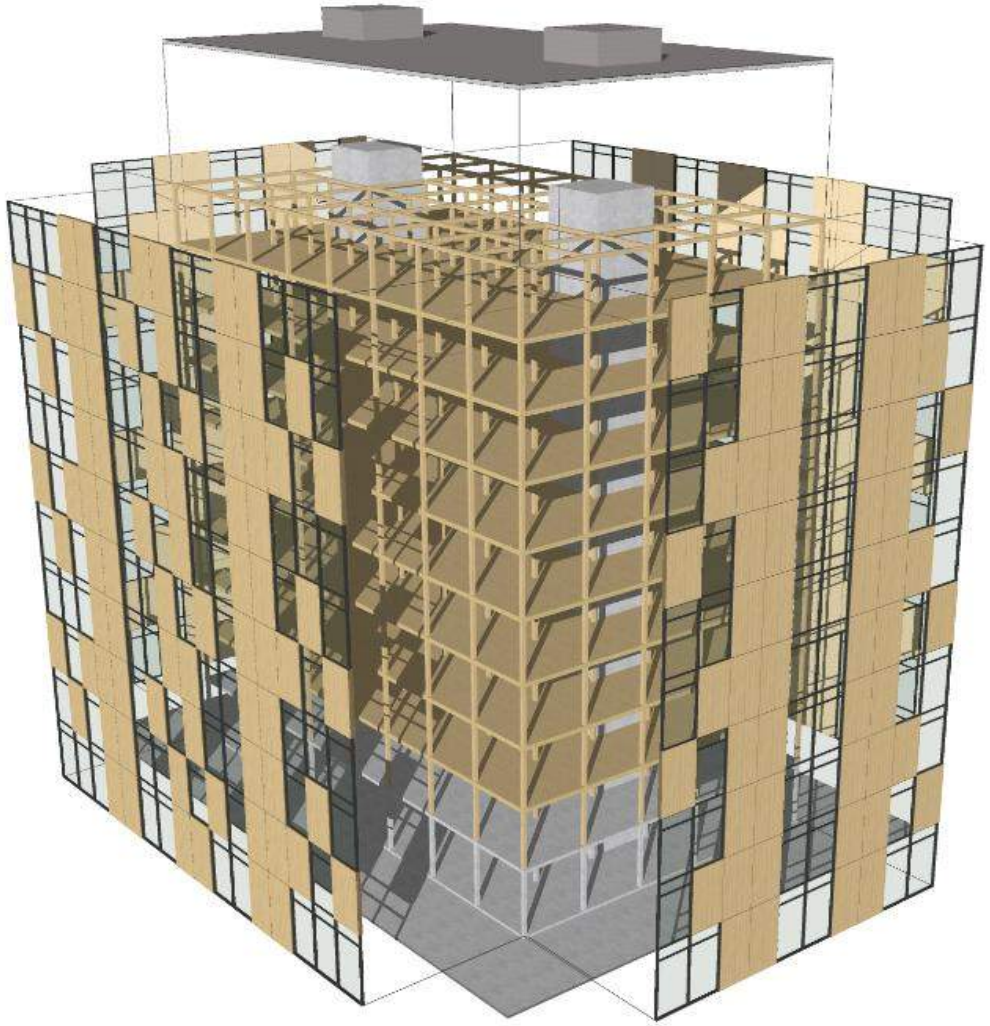


Mass Timber ≠ Light Frame

Unique to Mass Timber: Reduced Drying Ability

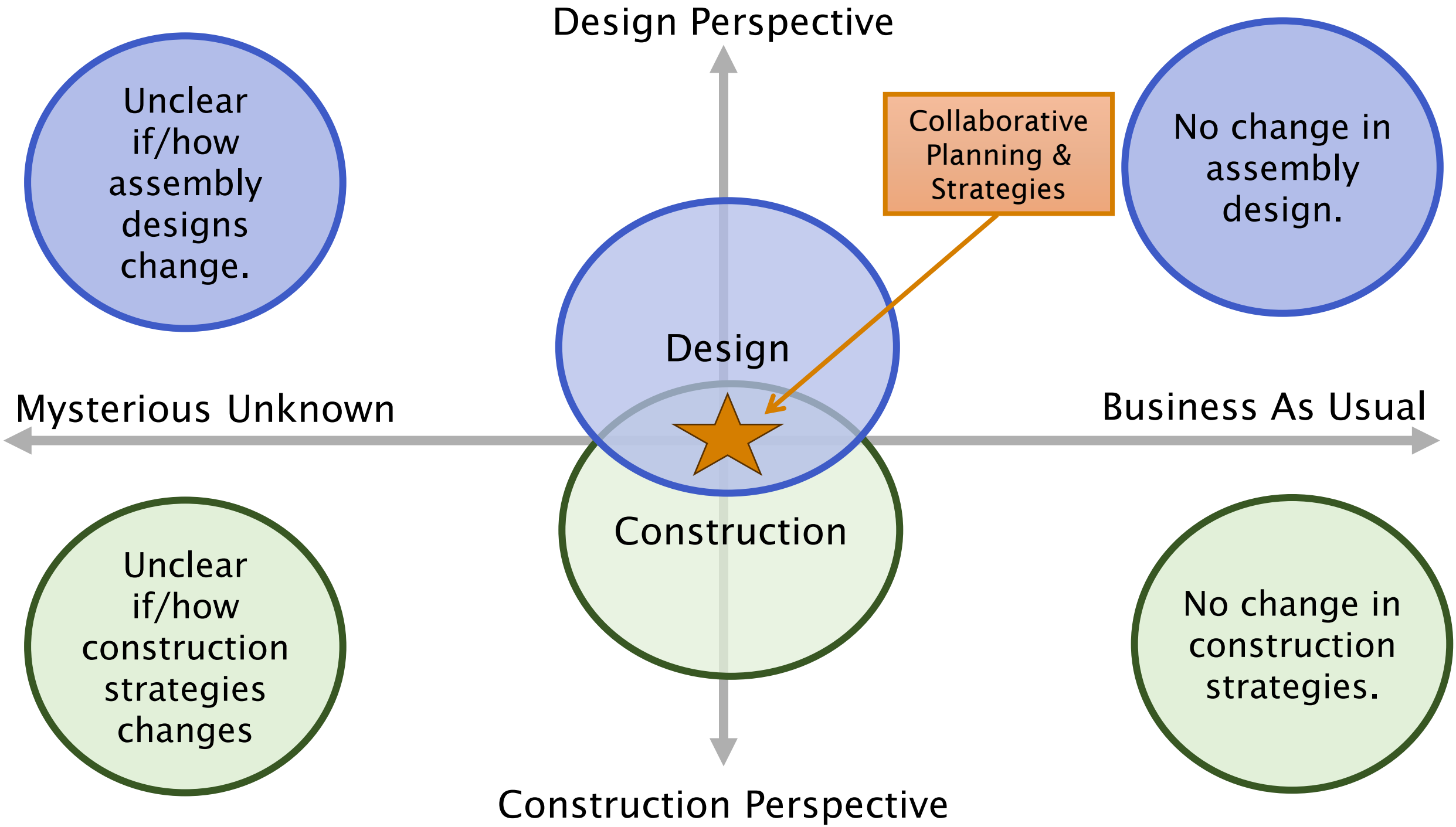
Unique to Mass Timber: Protecting the Structure





Sources of Moisture

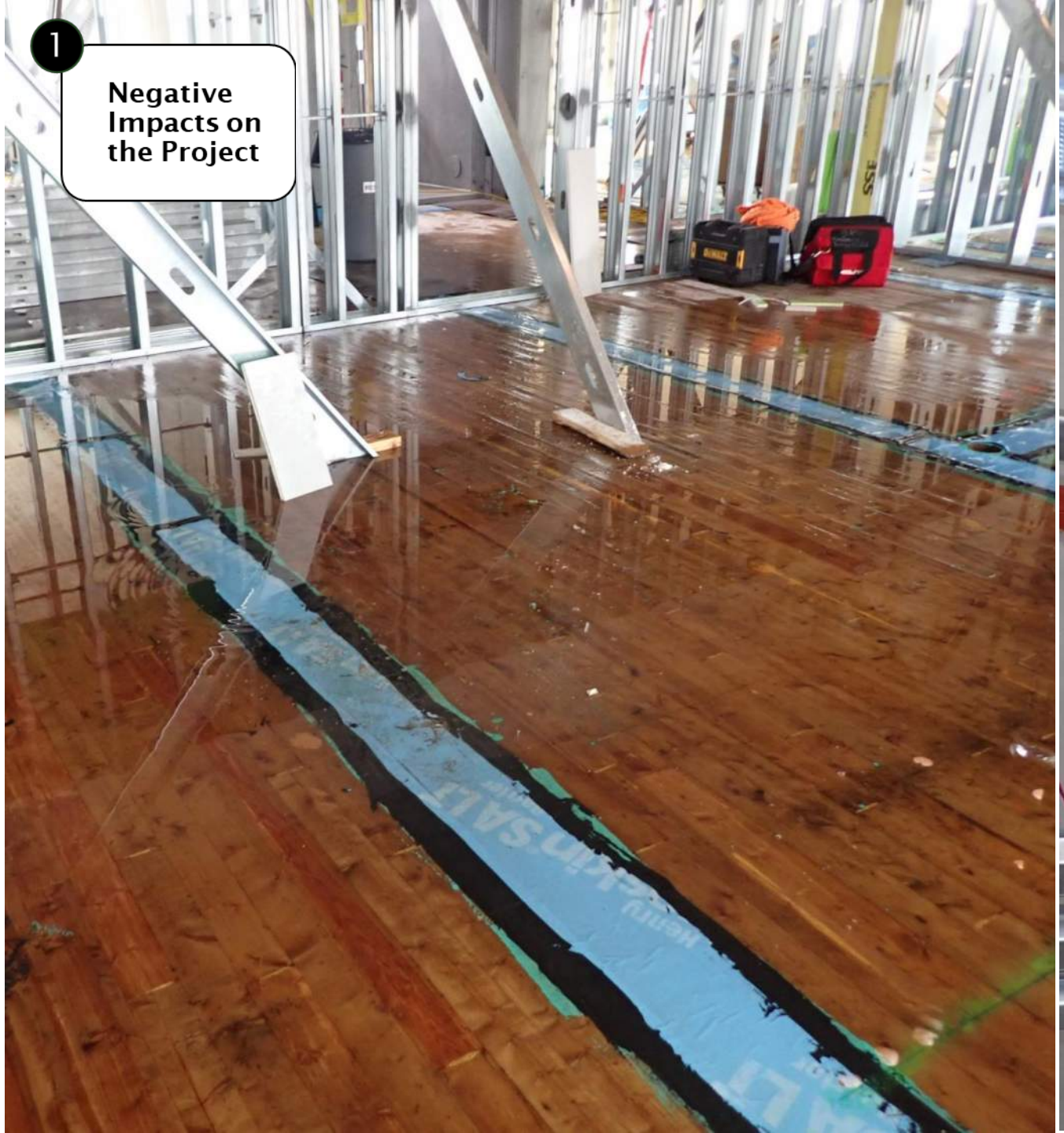
- **During construction**
  - Delivery
  - Storage
  - Construction after installed
- **During operation**
  - Sprinklers/plumbing (large or persistent small leaks)
  - Assembly leaks
  - Humidity


Design Perspective
Unclear if/how assembly designs change.
Collaborative Planning & Strategies
No change in assembly design.
Design
Mysterious Unknown
Business As Usual
Construction
Unclear if/how construction strategies changes
No change in construction strategies.
Construction Perspective

Construction:
Why not business as usual?

1

Negative Impacts on the Project




2
Visible
Defects

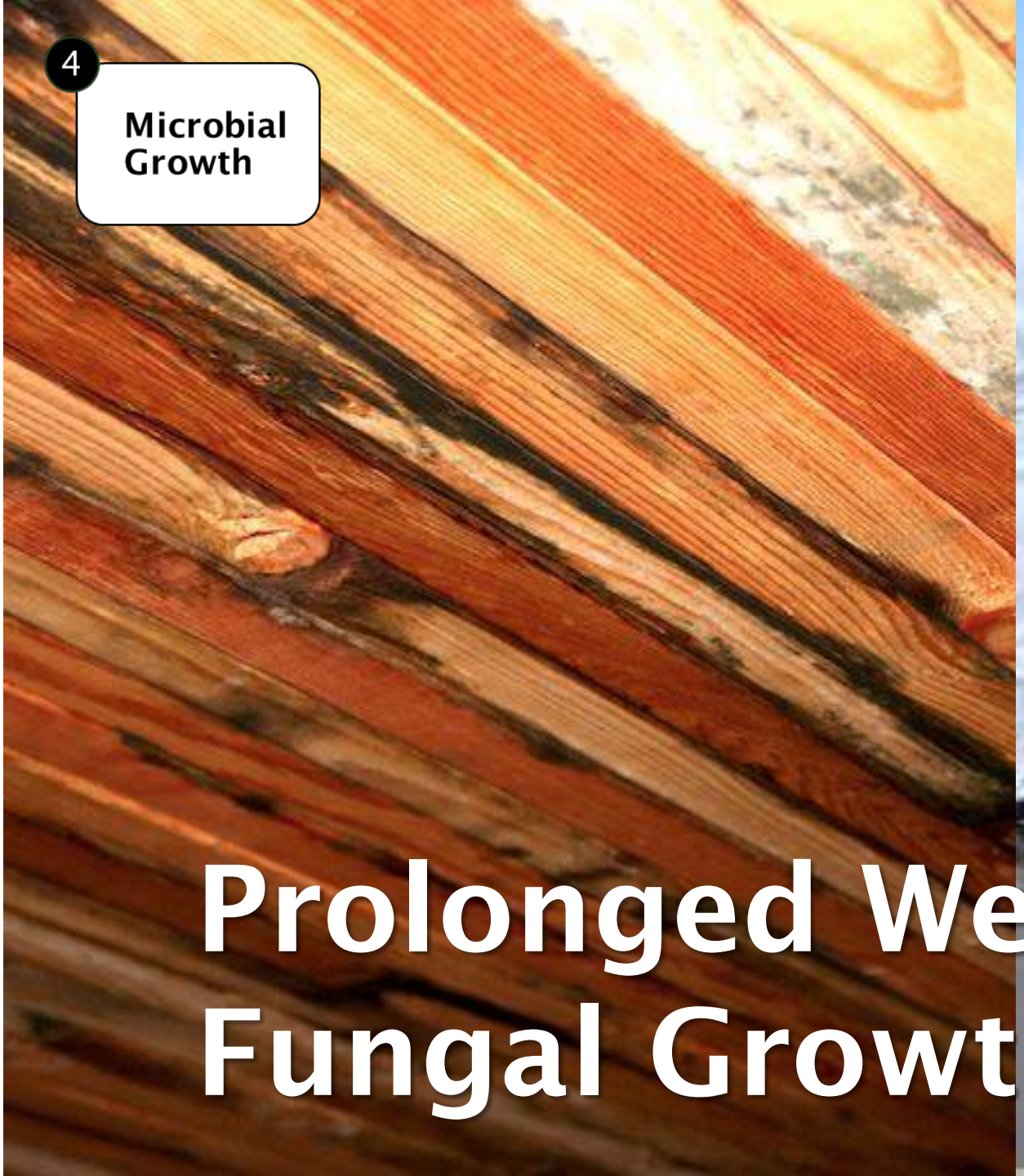

2
Visible
Defects


5
Extensive
Swelling
Movement

Swelling Wood Can Damage Structural Connections

4

Microbial Growth



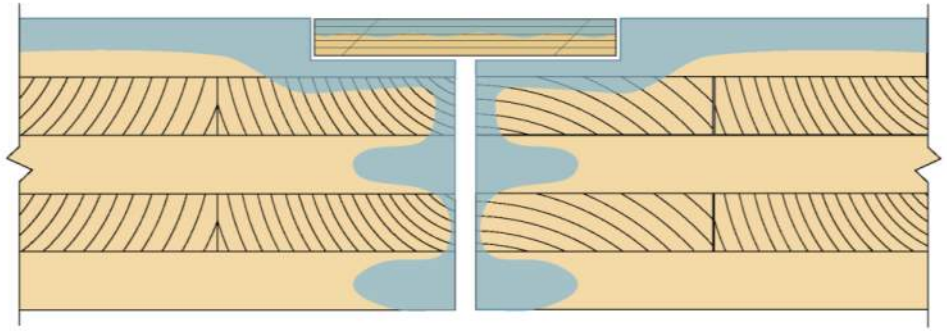
Prolonged Wetting Leads to Fungal Growth

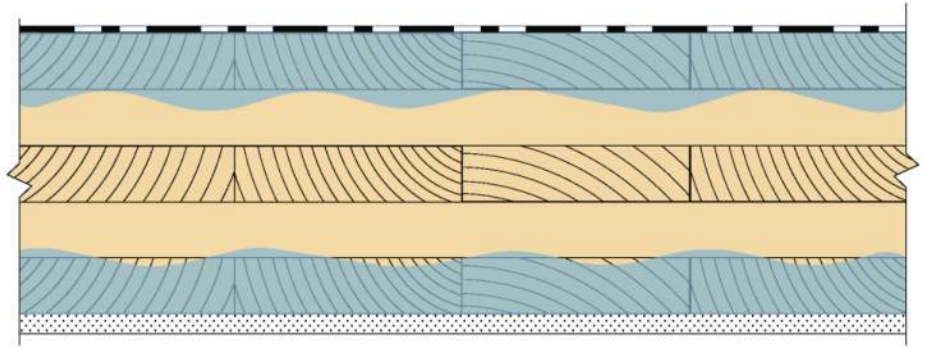

5
Decay

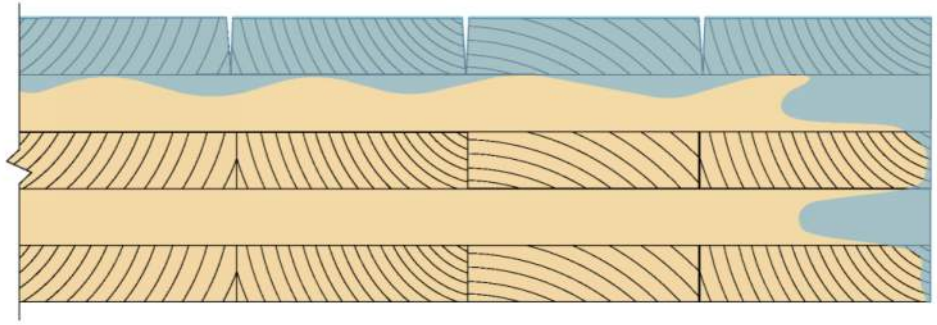
Trapped Moisture is the Biggest Risk of Decay!

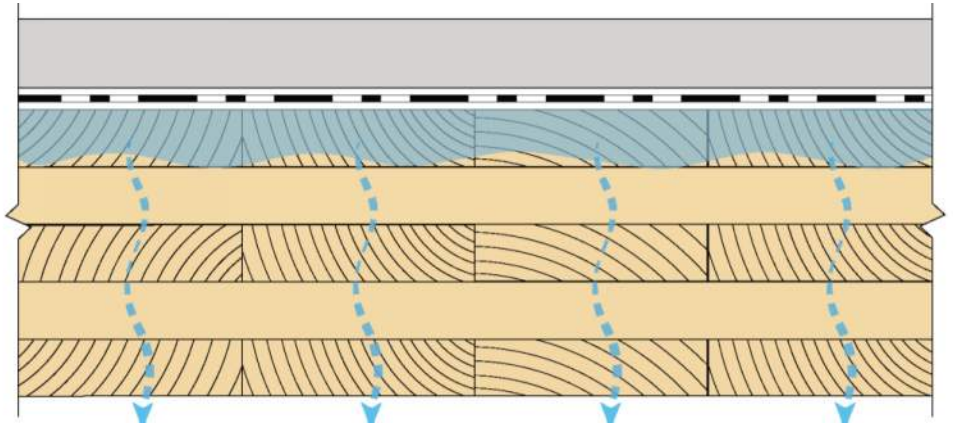
- Drying ability is limited or non-existent
- Mass timber can store and hide a lot of water.
  - Trapped water can go undetected for a long time.
  - Water can be absorbed deep into the panel (End grain absorb water deeply into the panel) so the surface may appear dry.
- Drying through mass timber is very slow (it will rot before it dries)

Trapped Moisture









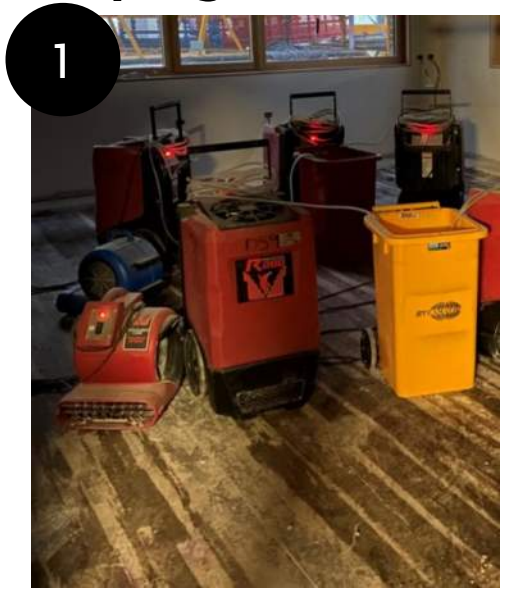
Concrete Topping Risks

- Concert introduces additional moisture.
- Paths for water to travel under the concrete at perimeter edges, column connections, cracks in concrete

Recall the 5 Moisture Risks

Schedule Delays & Remediation & Drying Cost

1



Staining & Visible Checking

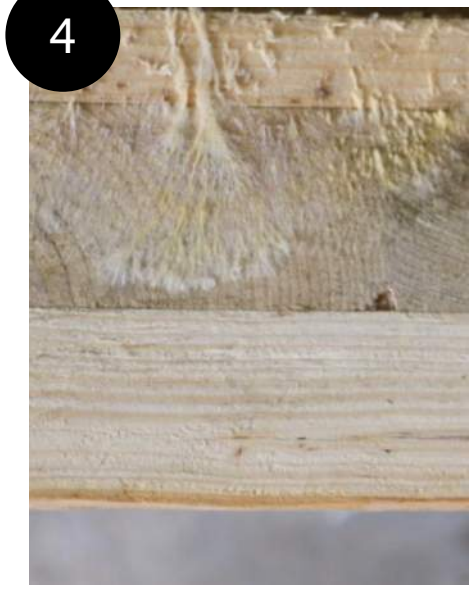
2

Structural Movement

3

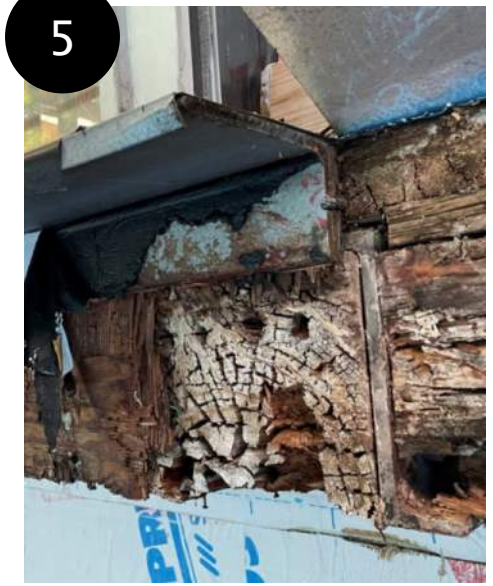
Mold & Remediation

4



Long-Term Decay Risk

5



Tolerable-**ish**

Tolerable-**ish**

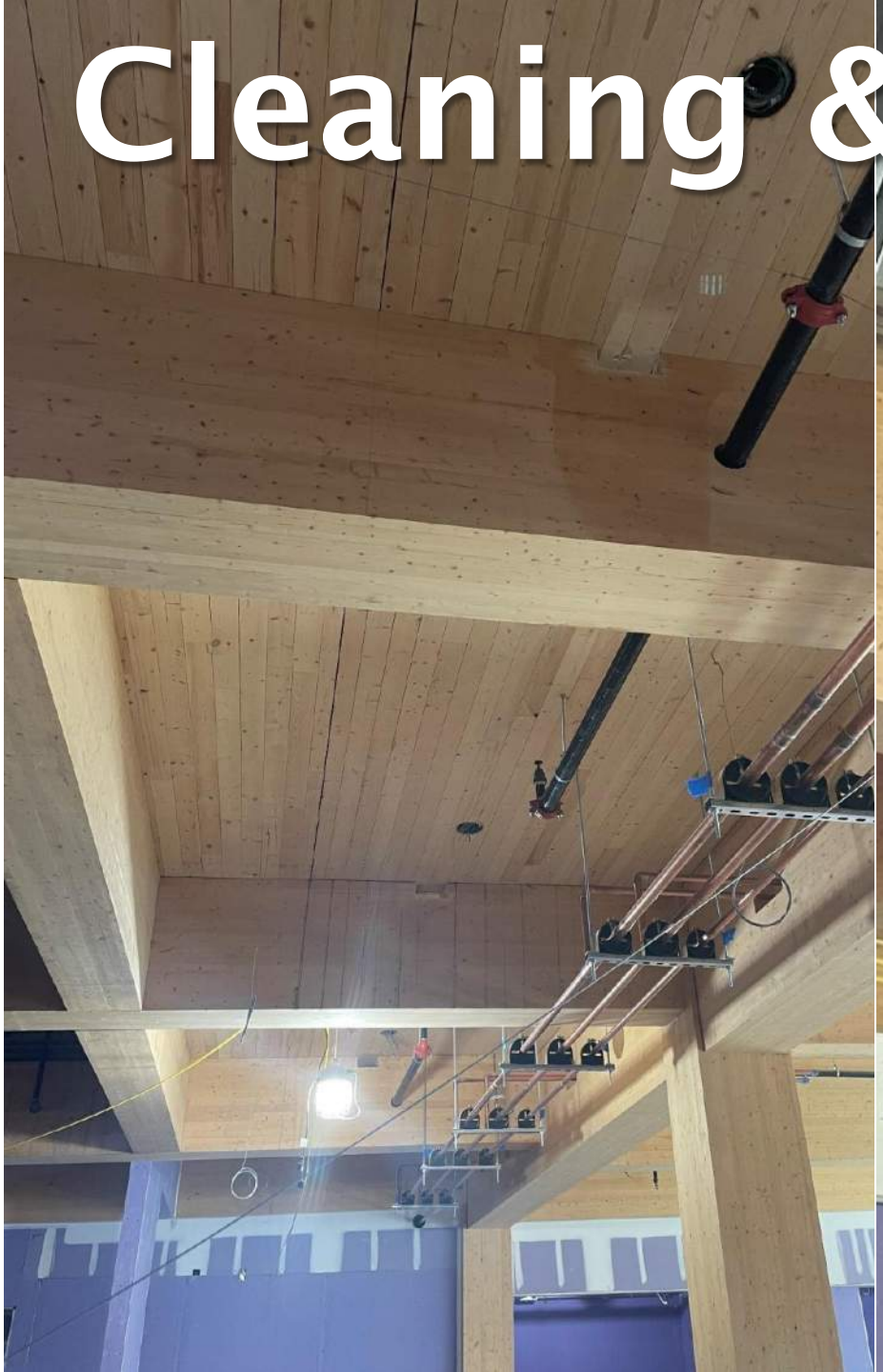
- Some staining okay – depending on visible mass timber.
- Extensive staining = extensive wetting and may be an indicator intolerable risks

Intolerable Risks

Schedule delays & extra cost for drying or added protection should happen before we get to this point

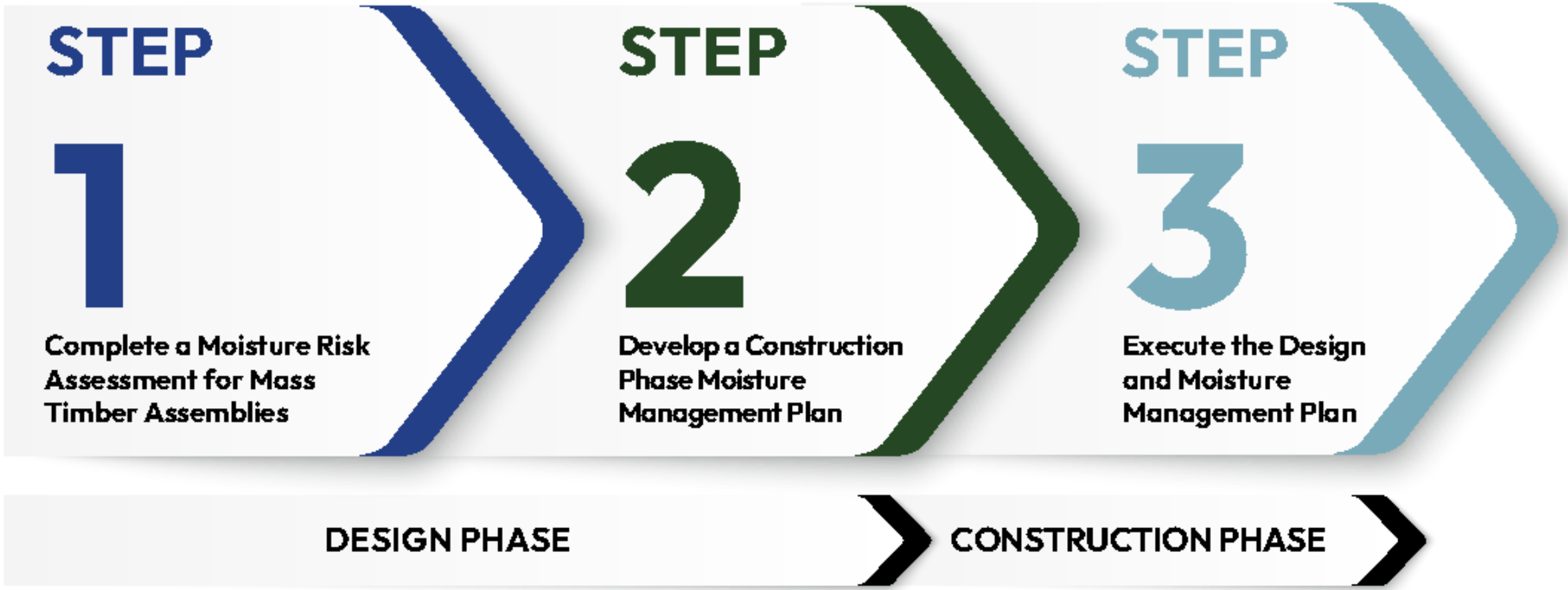
Large Scale Drying & Remediation

Cleaning & Refinishing



Construction: So what do you do?

Construction Moisture Management Planning Process



Step 1: Moisture Risk Assessment

Understand your projects tolerance to risk

Identify scenarios and conditions that increate risks

Evaluate moisture exposure

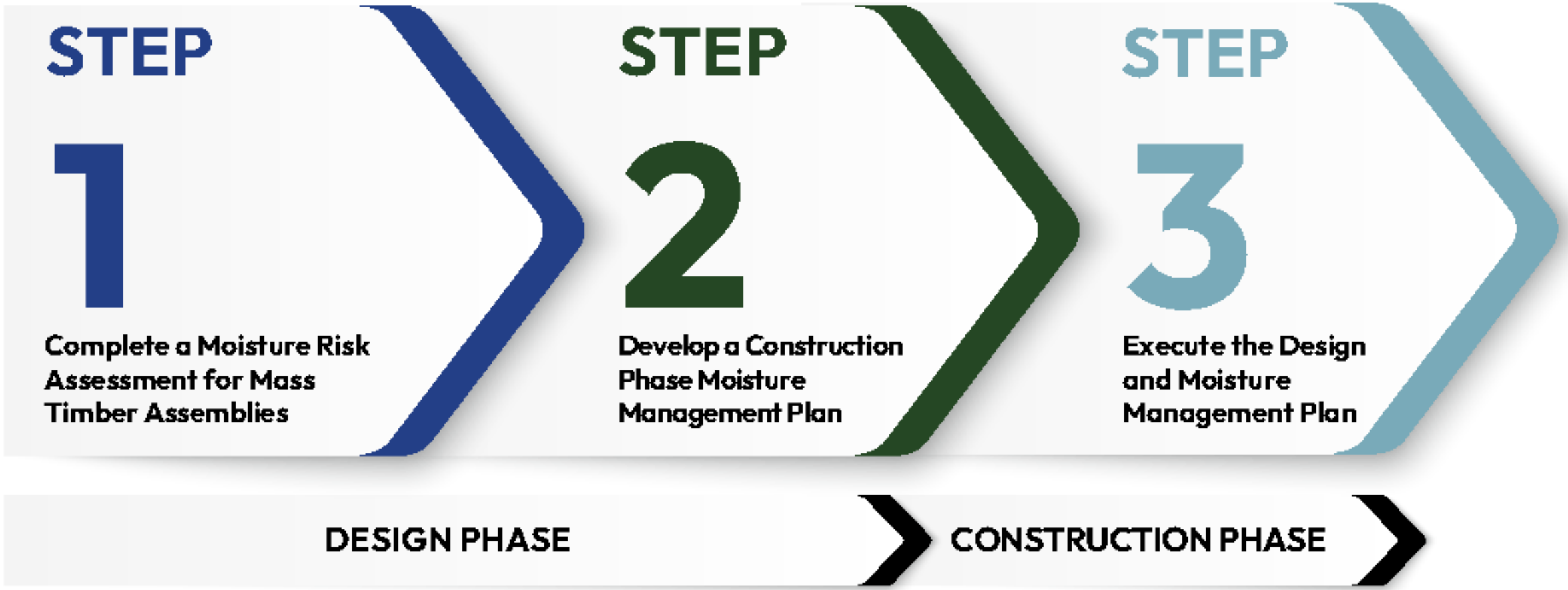
Moisture Exposure

Legend

- Extreme - Over 60" (1500 mm)
- High - 40" - 60" (1000 mm - 1500 mm)
- Moderate - 20" - 40" (500-1000 mm)
- Low - Under 20" (500 mm)

Risks Increases as Moisture Exposure Increases

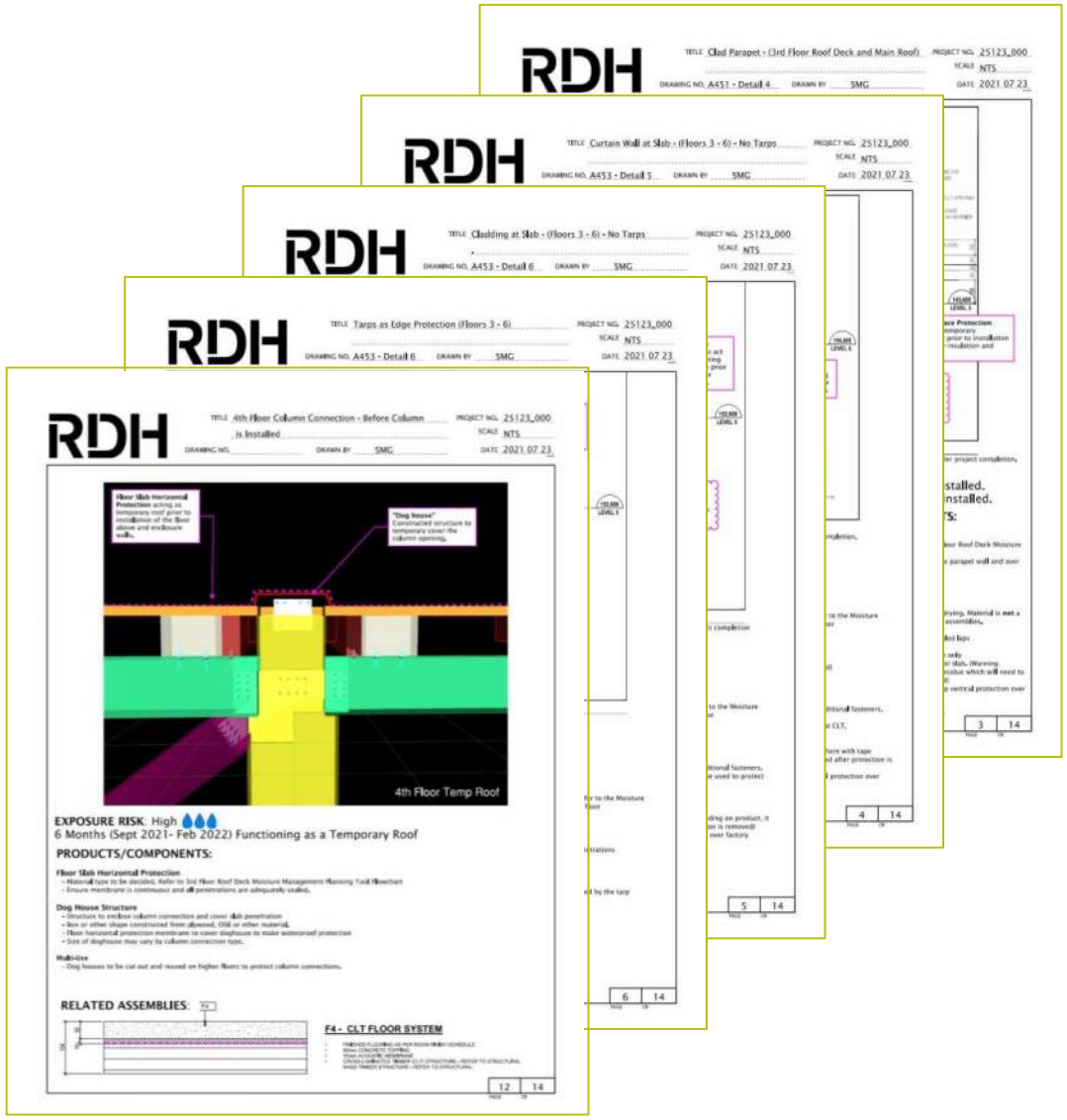
Construction Moisture Management Planning Process



Step 2: Develop a Construction Phase Plan

Written Plan Outlining All Strategies

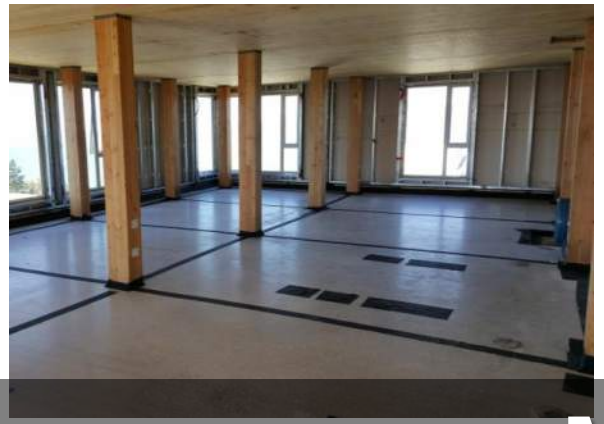
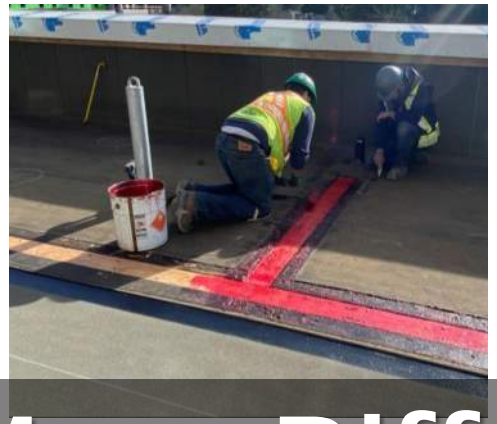
- → Delivery & Storage
- → Moisture Protection Methods
- → Moisture Management Detail Package
- → Water Removal & Drainage Plans
- → QA/QC Checklists & Monitoring Plans
- → Contingencies



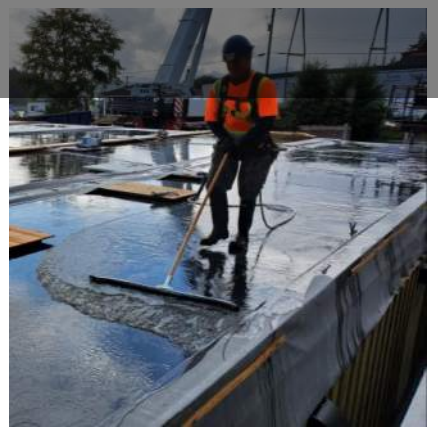
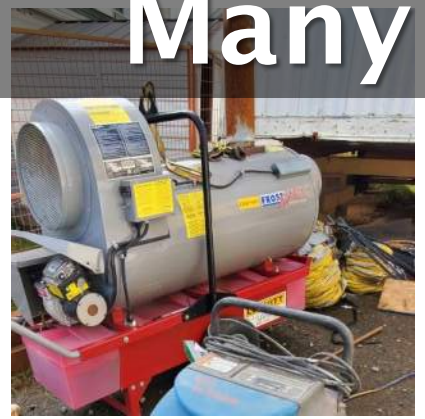
Construction Moisture Management Strategies



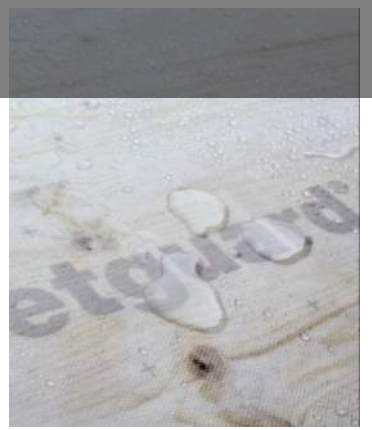



Many Different Strategies






Taped Joints

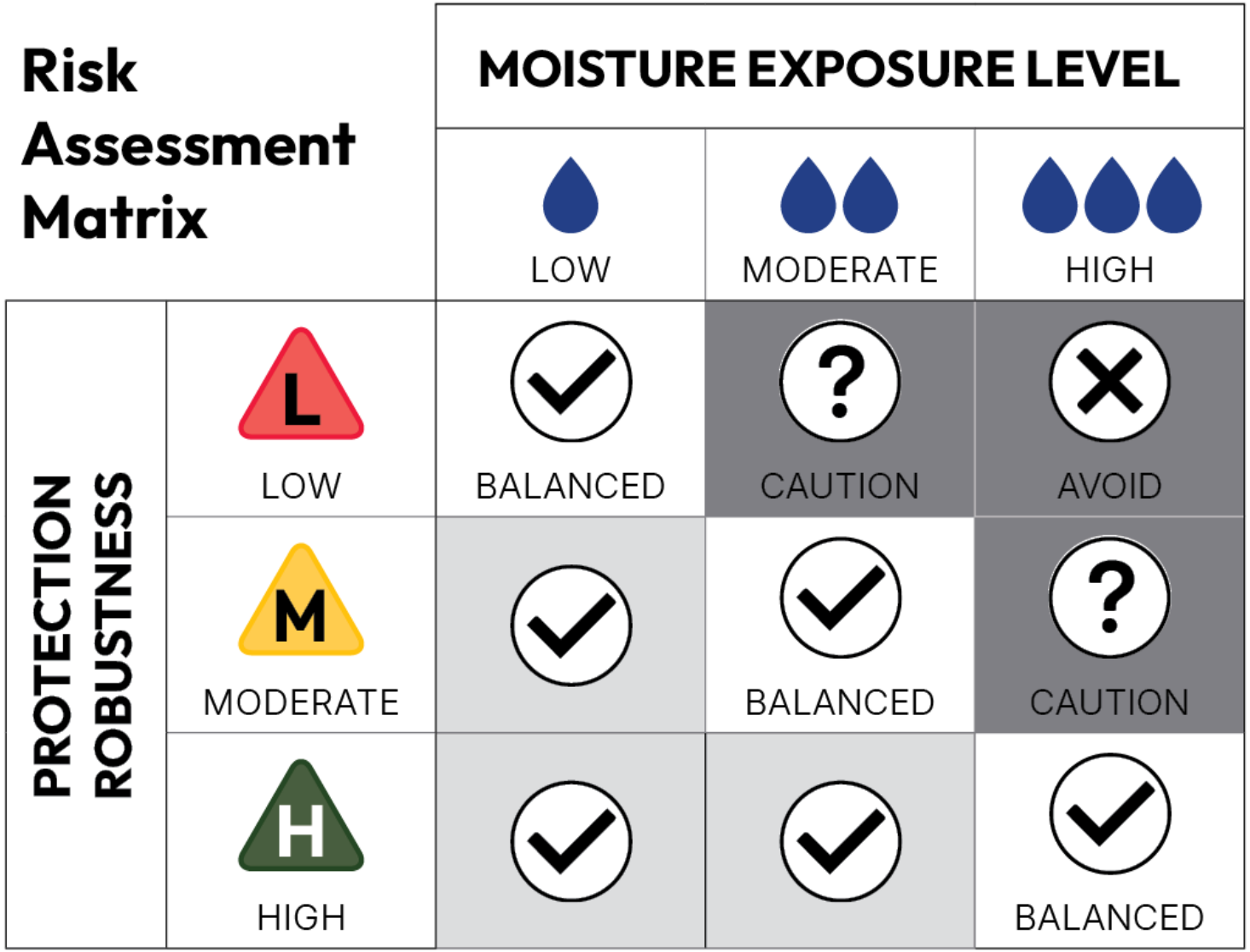
Floor Protection Membranes

Roof Protection Membranes

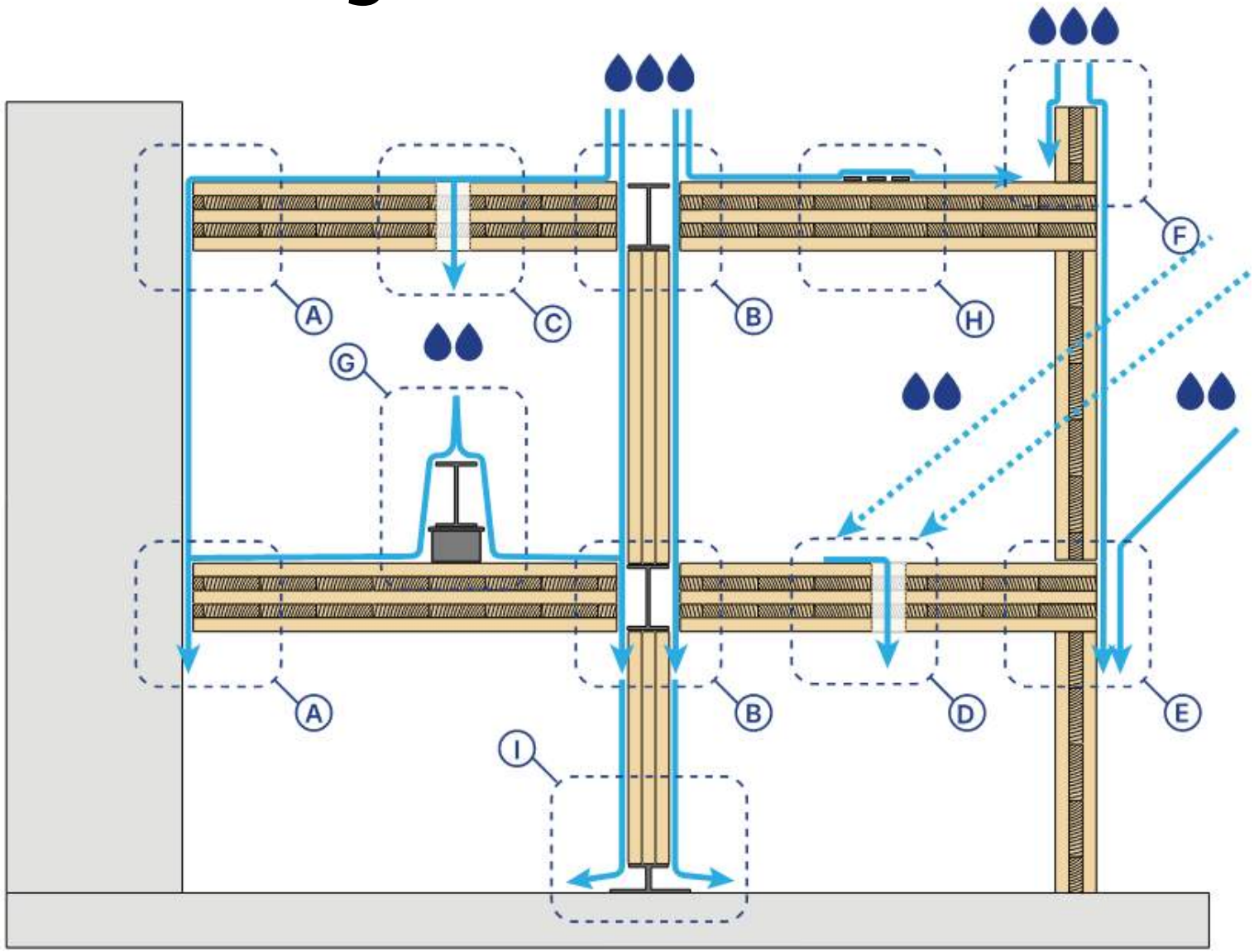
Factory Applied Protection

Factory Applied Temporary = Site Sealing Joints

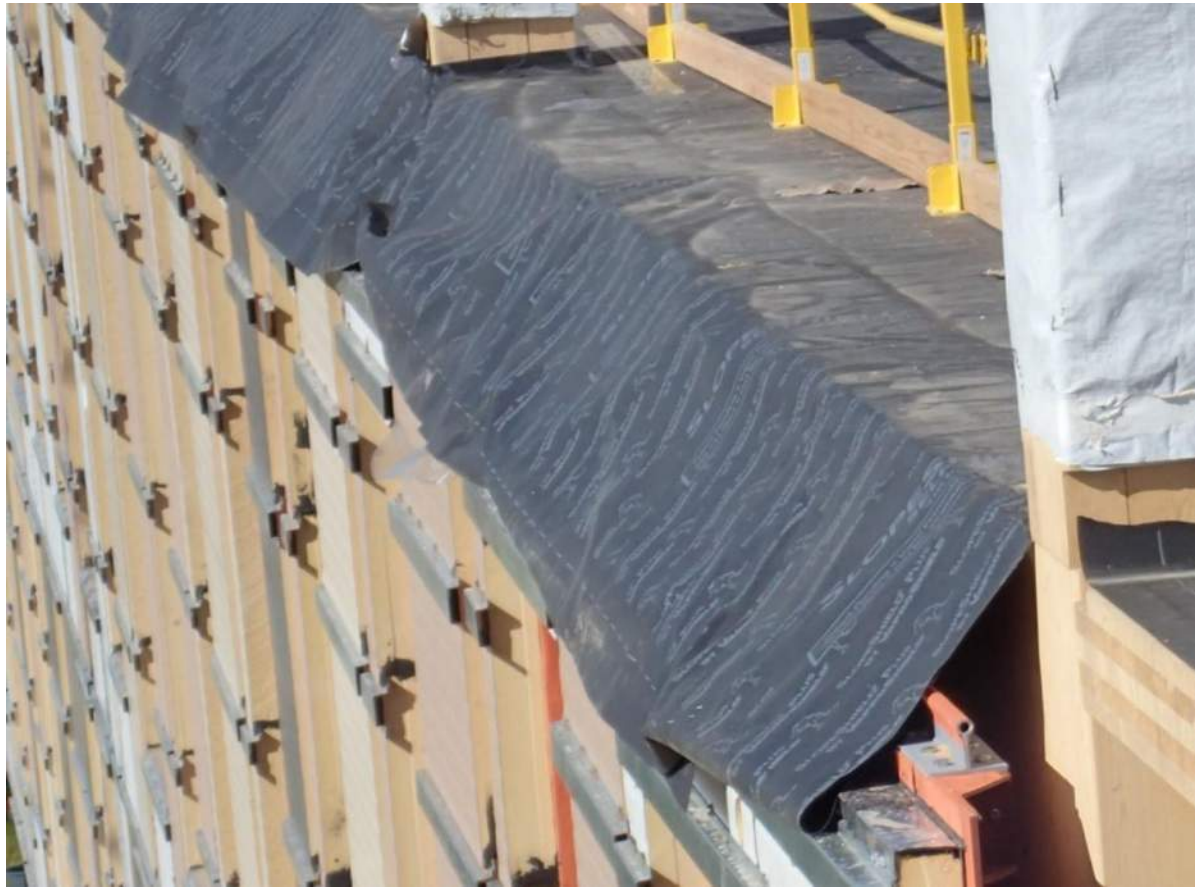
Step 1 Risk Assessment Informs Protection Selection

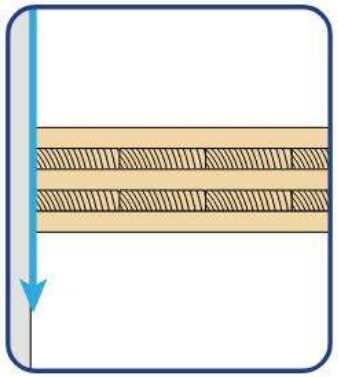
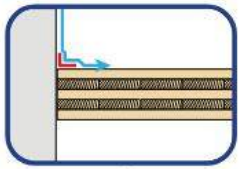
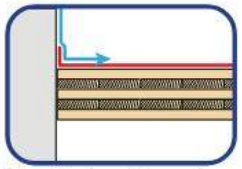
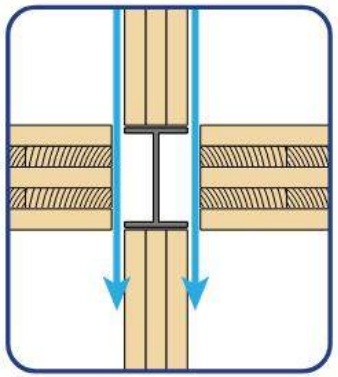
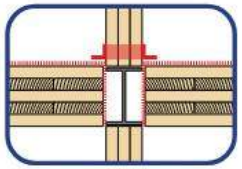
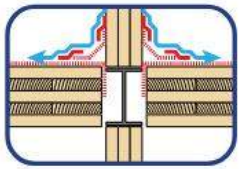
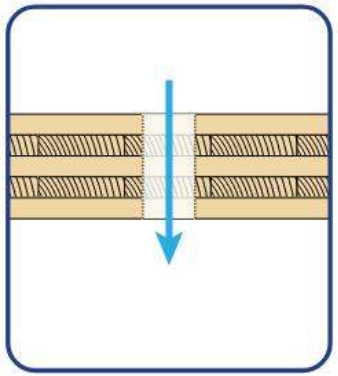
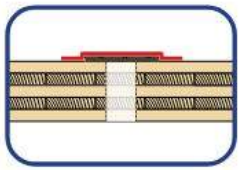


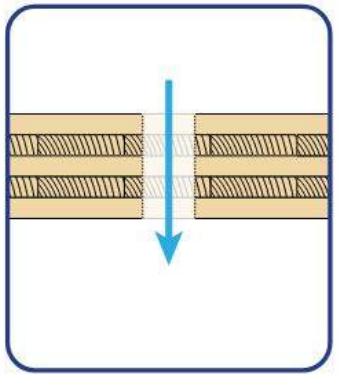
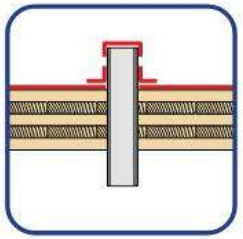
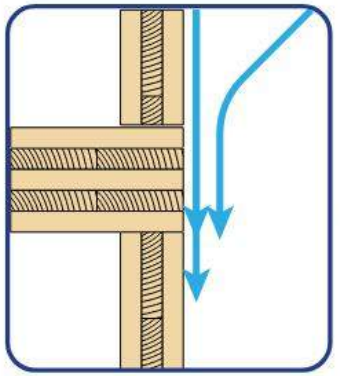
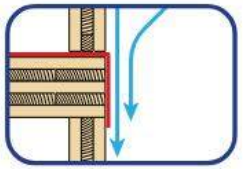
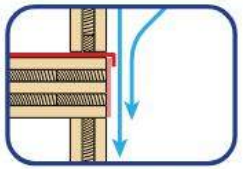
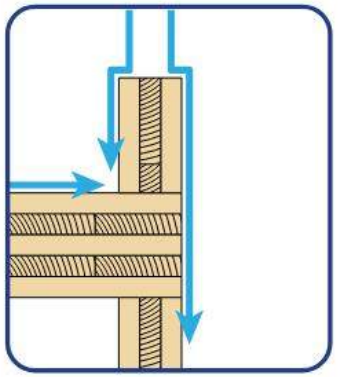
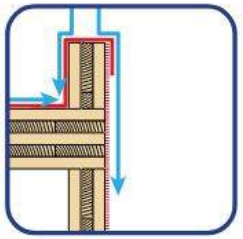
Thorough Planning is All in The Details

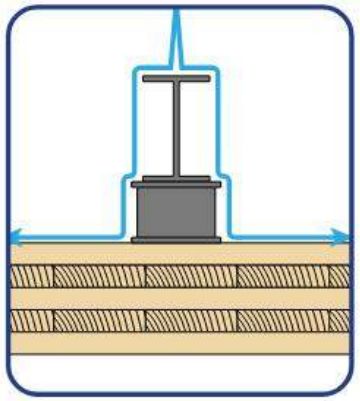
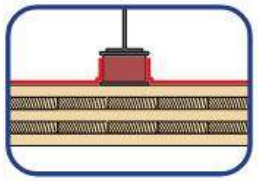
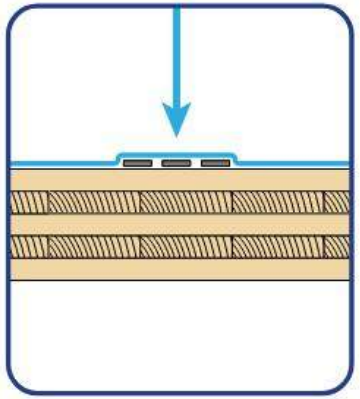
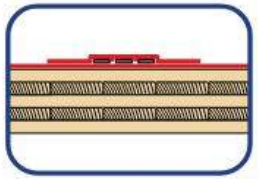
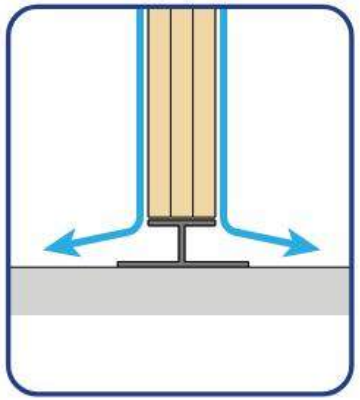
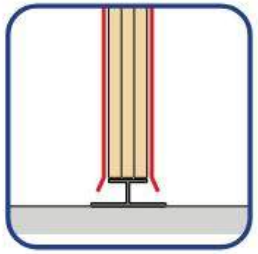


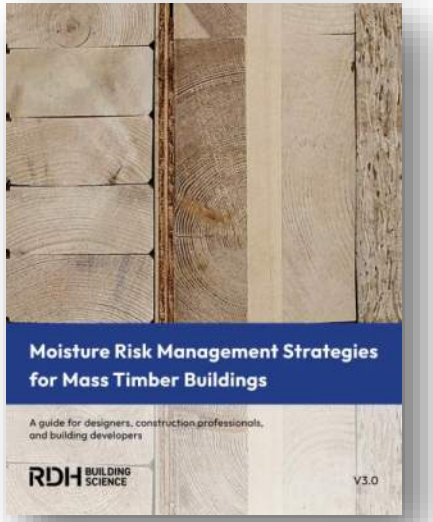
The Details



DESCRIPTION	DETAIL	EXAMPLE PHOTO
 Vertical-to-horizontal interface	 Tape or flashing	
	 Extend horizontal membrane up wall	
 Column penetration	 Seal around penetrations	
	 Tent at column	
 Penetrations through mass timber	 Plywood and membrane over penetration	

DESCRIPTION	DETAIL	EXAMPLE PHOTO
 Penetrations through mass timber	 Detailed penetration with temporary cover	
 Mass timber edge	 Overhanging house wrap or floor/roof membrane	
	 Wax coat and counterflash with floor/roof membrane	
 Mass timber parapet	 Membrane lapped up and over parapet	

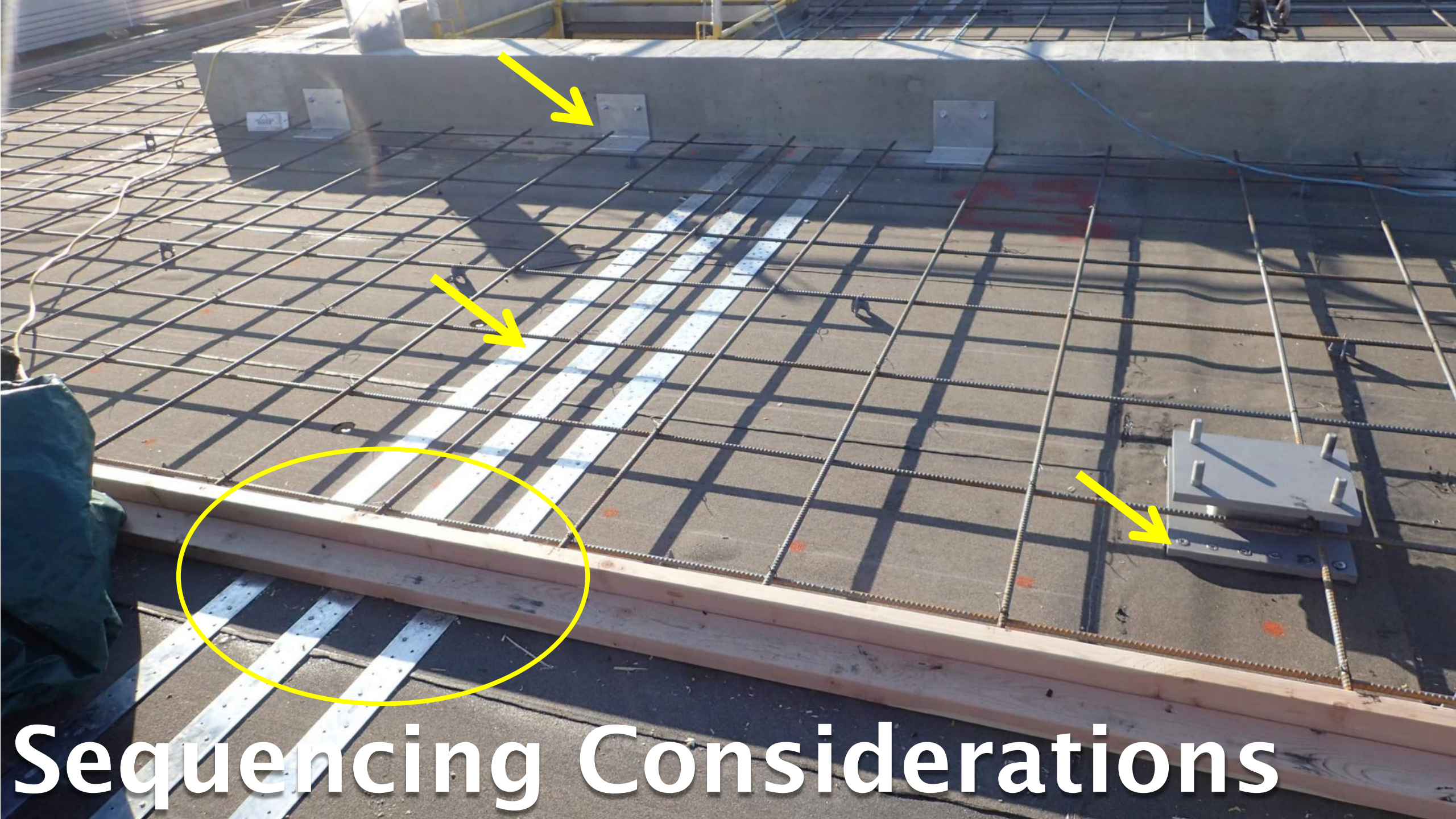
DESCRIPTION	DETAIL	EXAMPLE PHOTO
 Structural connection	 Membrane around connection	
 Structural strapping	 Membrane over structural components	
 Column at concrete	 Factory wrap opened at bottom for drainage	



From our guide

Active Removal & Drainage Always Required

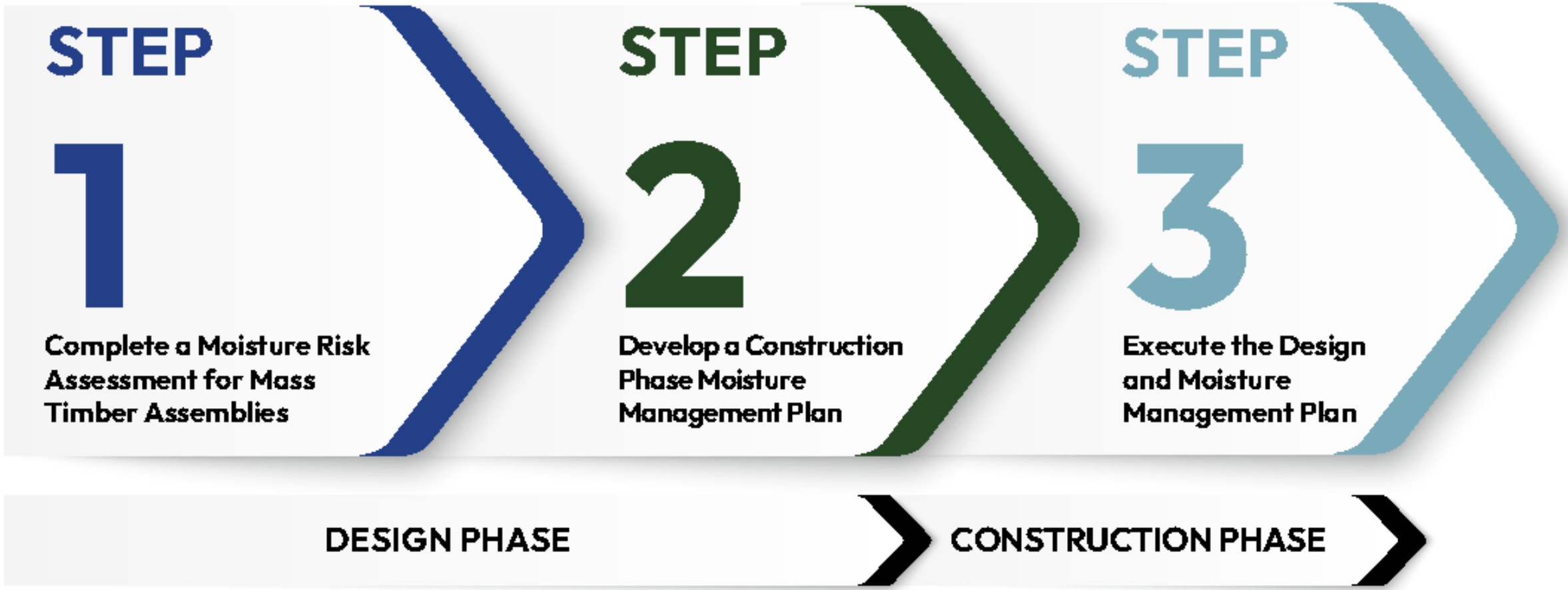
Where Does the Water Go?
Drainage Planning



Sequencing Considerations

Sequencing Considerations

Construction Moisture Management Planning Process

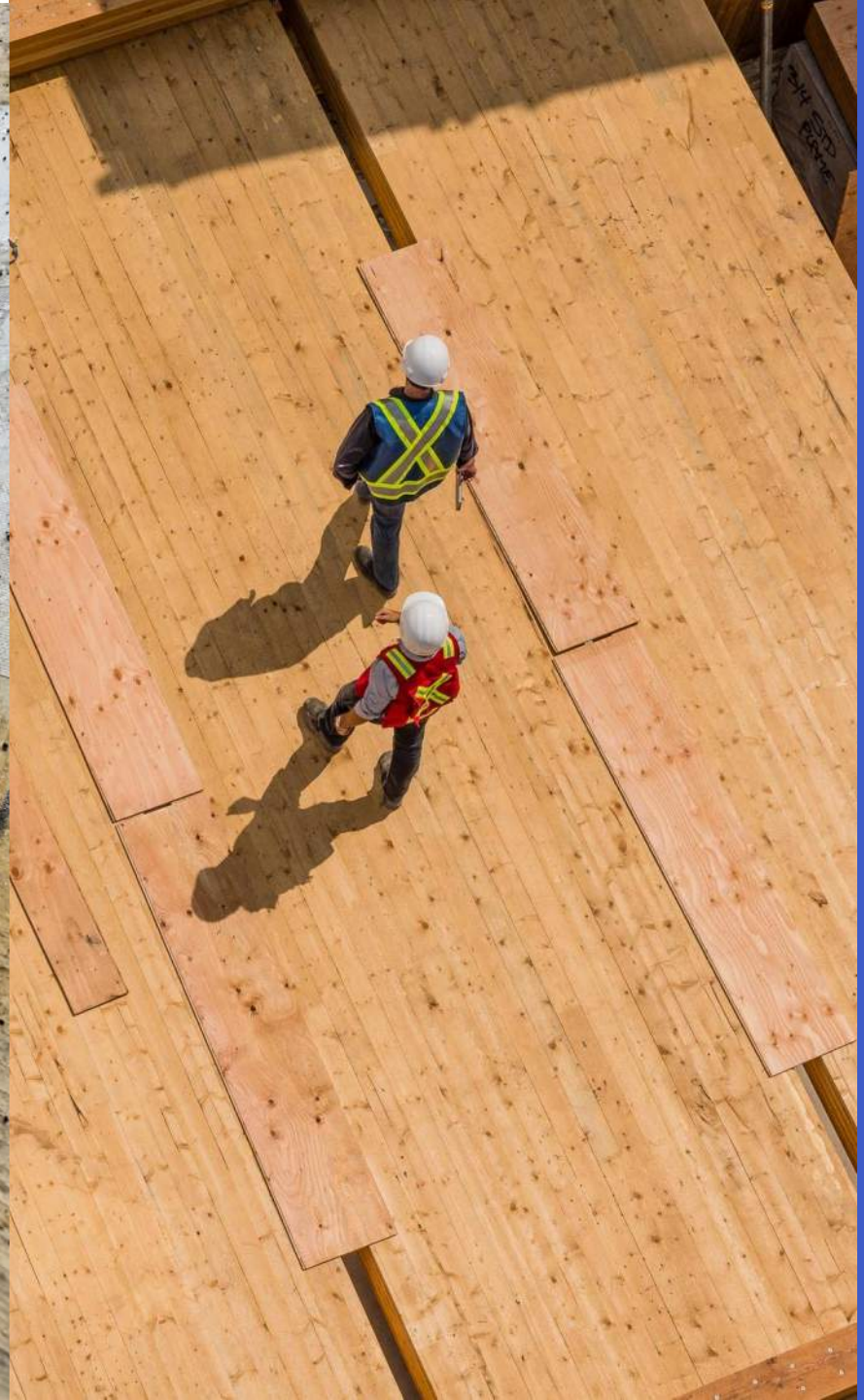


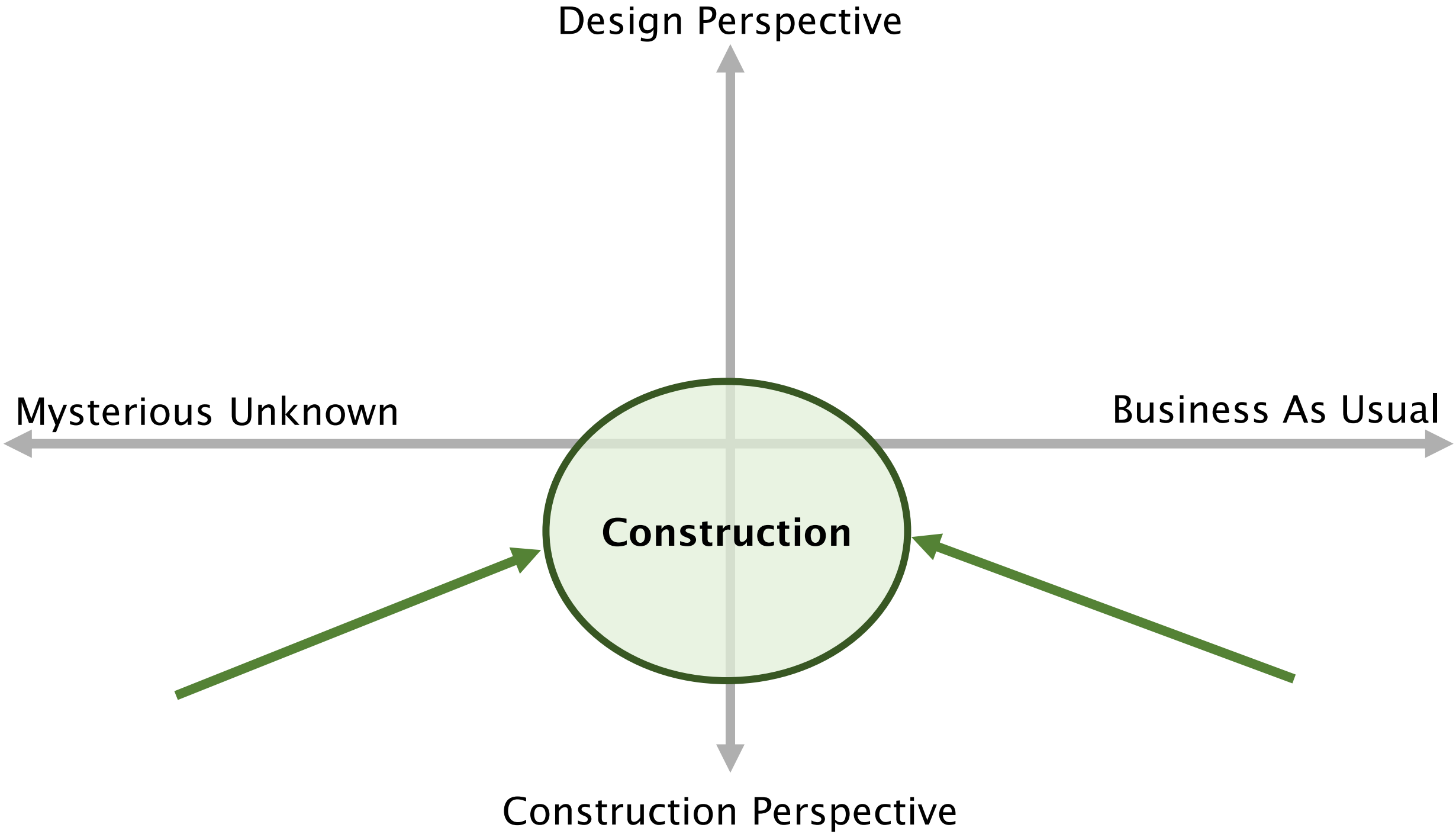
Execute

→Monitor

→Maintain

→Adapt & Revise

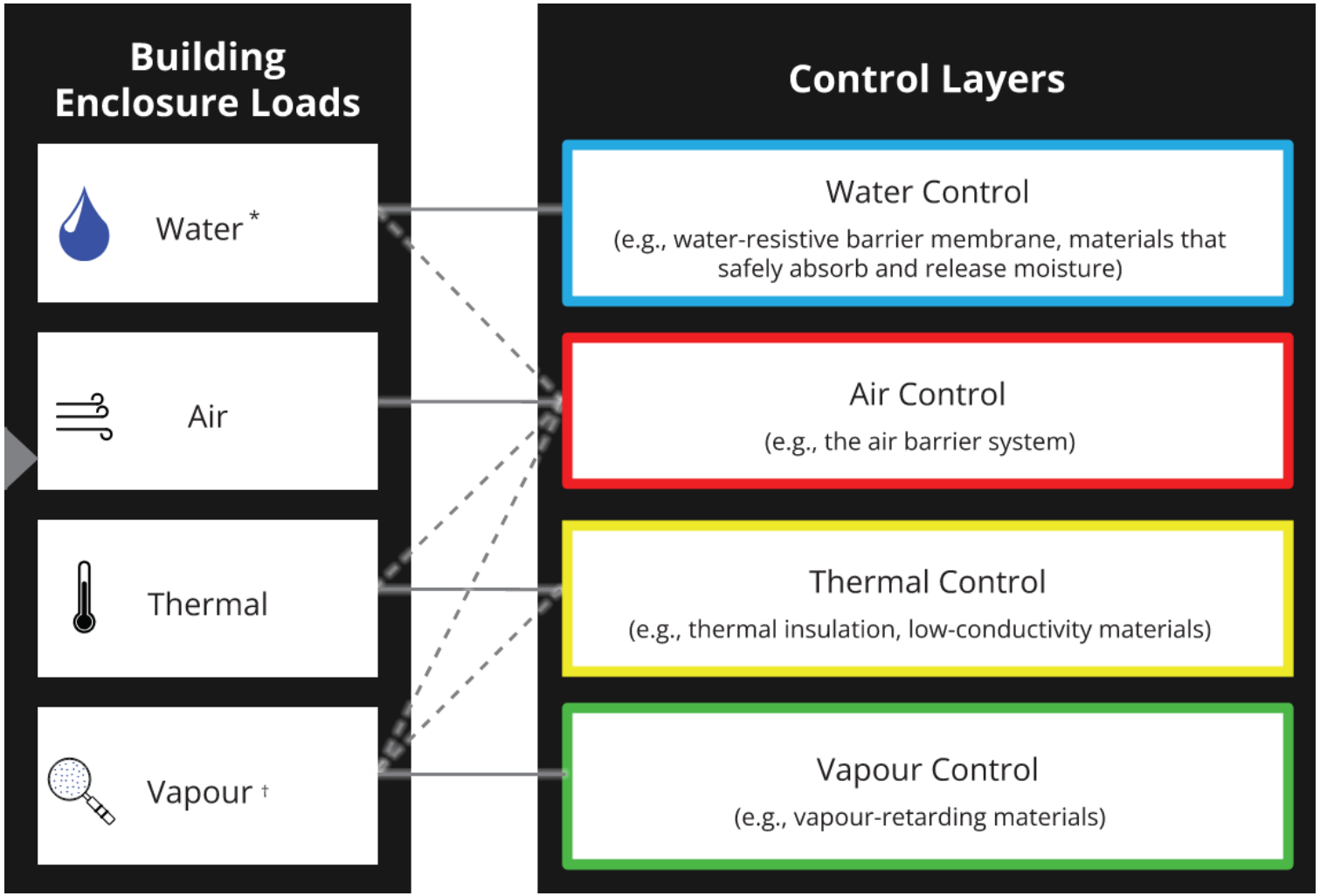



Design Perspective
Mysterious Unknown
Business As Usual
Construction
Construction Perspective

Designing:
How does the assembly design change in mass timber ?

Building Enclosure Design

The fundamentals are the same!



+ Mass Timber

+ Keep the mass timber on the warm side of insulation
+ Mass timber is a vapor barrier
+ Bonus: Increase construction & occupancy moisture durability

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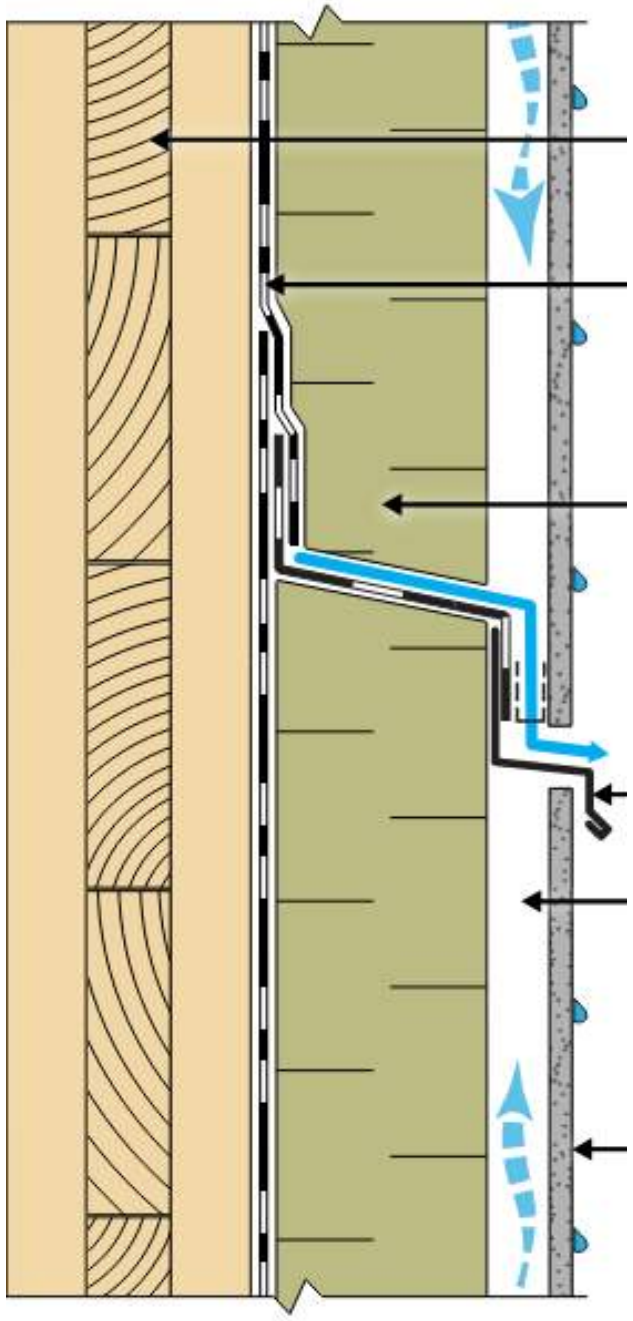
Moisture Design for Wall Assemblies

Moisture Control in Walls

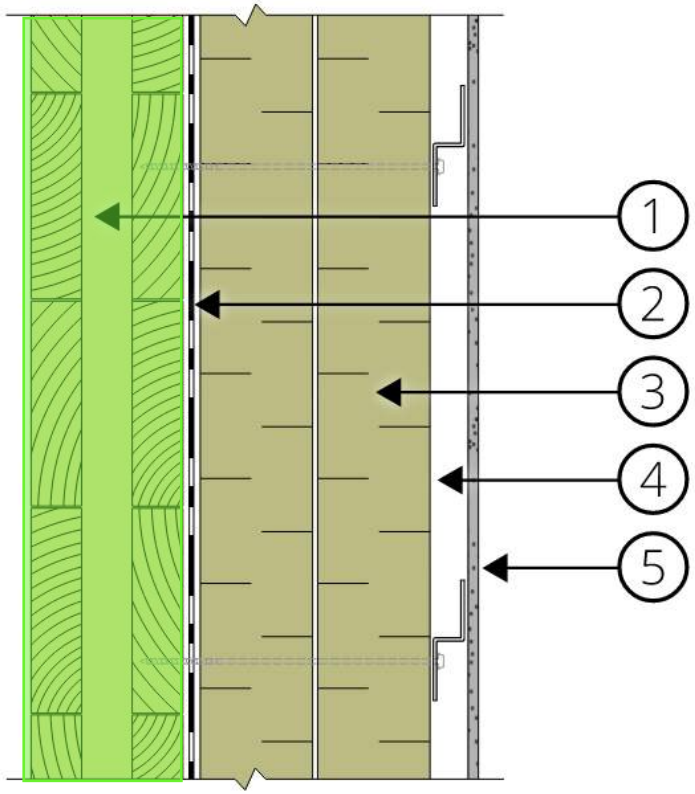
Rainscreen assembly for durability and drying.

4 D’s of Water Control:

- Deflection,
- Drainage,
- Drying,
- Durability

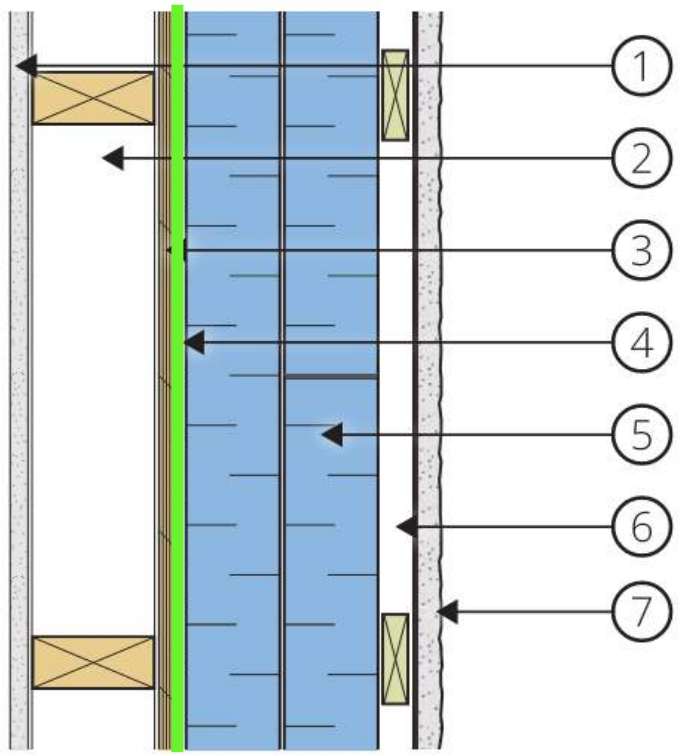


Exterior Insulated Wall



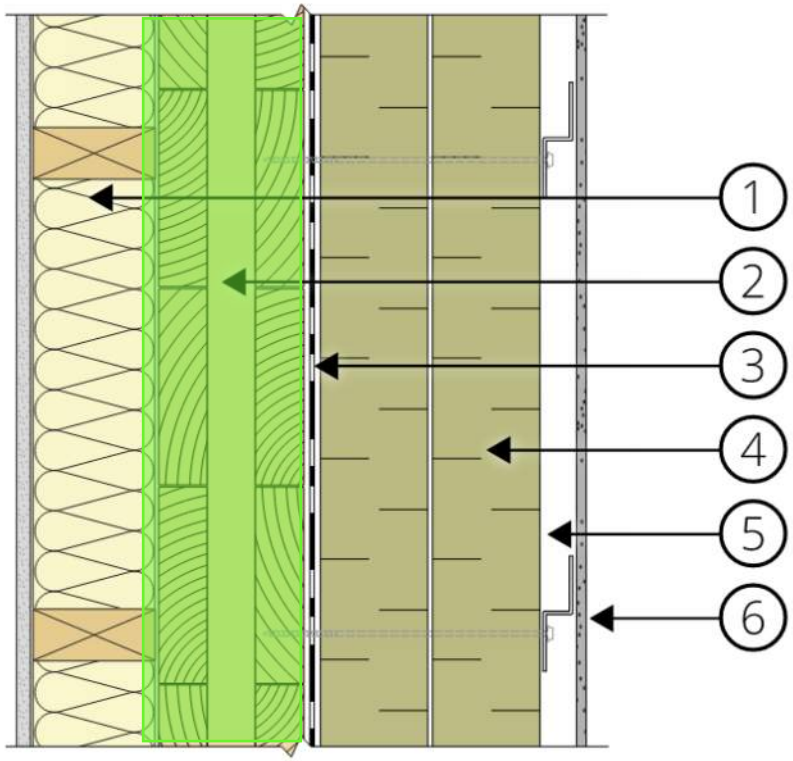
1. Mass Timber VB
2. Vapour-permeable WRB membrane Wat AB
3. Mineral wool insulation Thm
4. Drainage cavity
5. Cladding

Temp Construction Protection



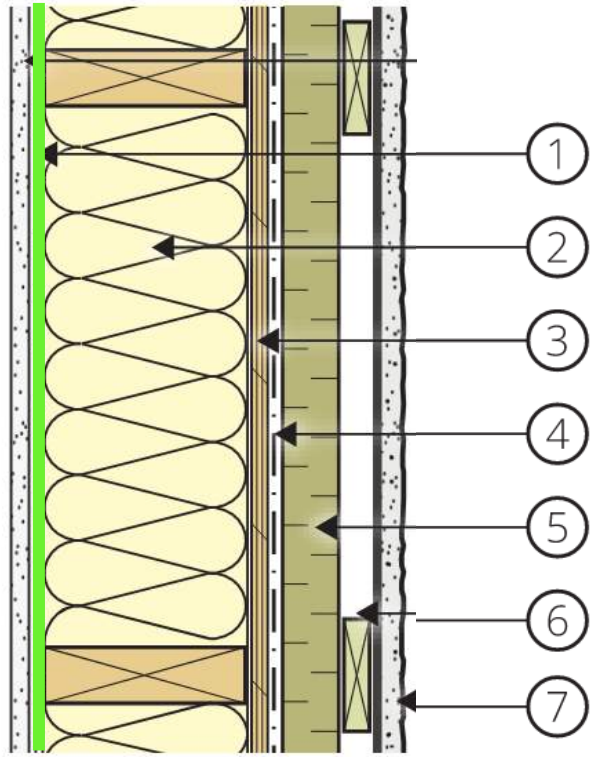
1. Gypsum board
2. Uninsulated wood framing
3. Exterior sheathing
4. Vapour-impermeable WRB VB Wat AB
5. Rigid insulation Thm
6. Drainage cavity
7. Cladding

Split Insulated Wall



1. Interior insulation Thm
2. Mass Timber VB
3. Vapour-permeable WRB membrane Wat AB
4. Mineral wool insulation Thm
5. Drainage cavity
6. Cladding

Temp Construction Protection

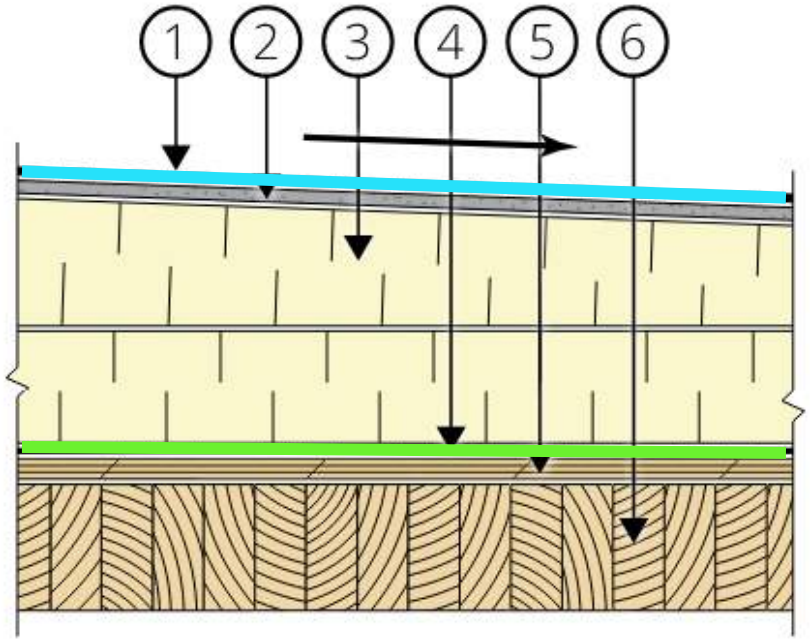


1. Polyethylene sheet VB
2. Interior insulation Thm
3. Exterior sheathing
4. Vapour-permeable WRB Wat AB
5. Mineral wool Thm
6. Drainage
7. Cladding

Moisture Design for Roof Assemblies

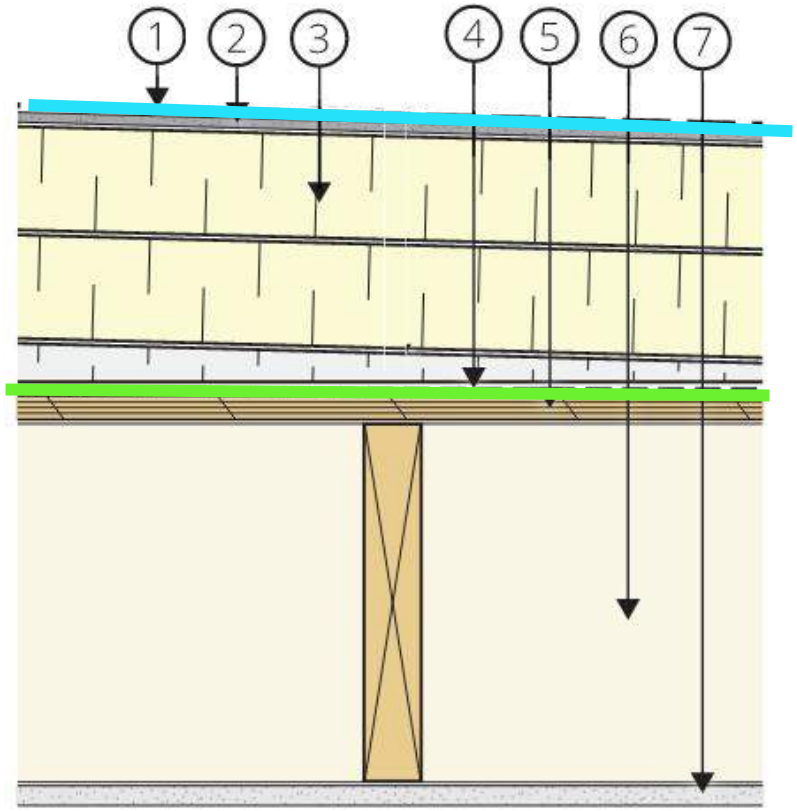
Moisture Control in Roofs

- Assembly layers are typically the same
- Roof leaks in mass timber assemblies have increased consequence & can often go undetected therefore need:
  - Durable materials
  - Redundancy in design



1. Roof membrane Wat
2. Coverboard
3. Rigid insulation Thm
4. Air and vapor barrier membrane VB AB
5. Sheathing
6. Mass Timber

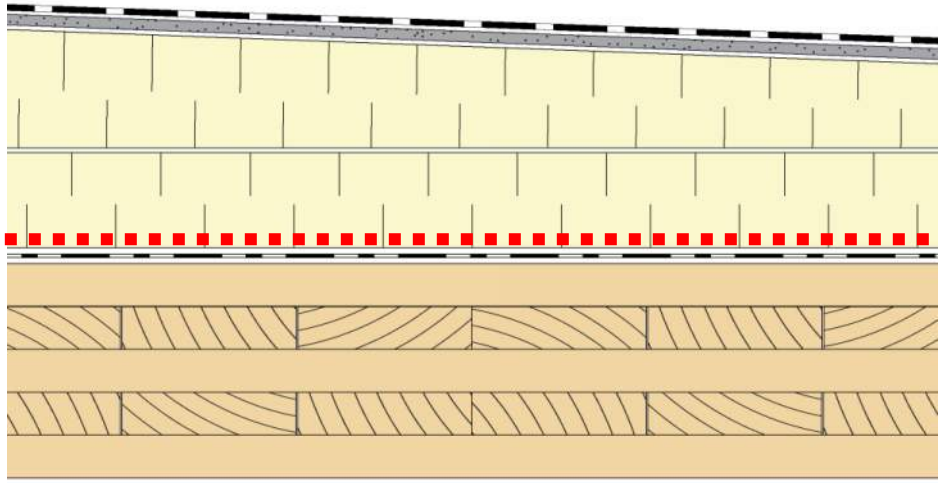
Temp Construction Protection



1. Roof membrane Wat
2. Coverboard
3. Rigid insulation Thm
4. Air and vapor barrier membrane VB AB
5. Sheathing
6. Uninsulated roof joists
7. Gypsum board

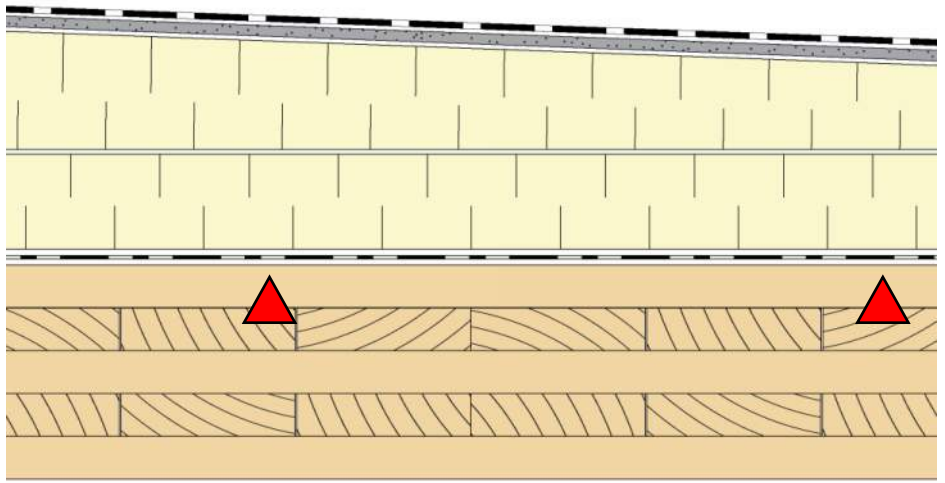
Design with Durable Materials

Design with Redundancy: Leak Detection or Monitoring



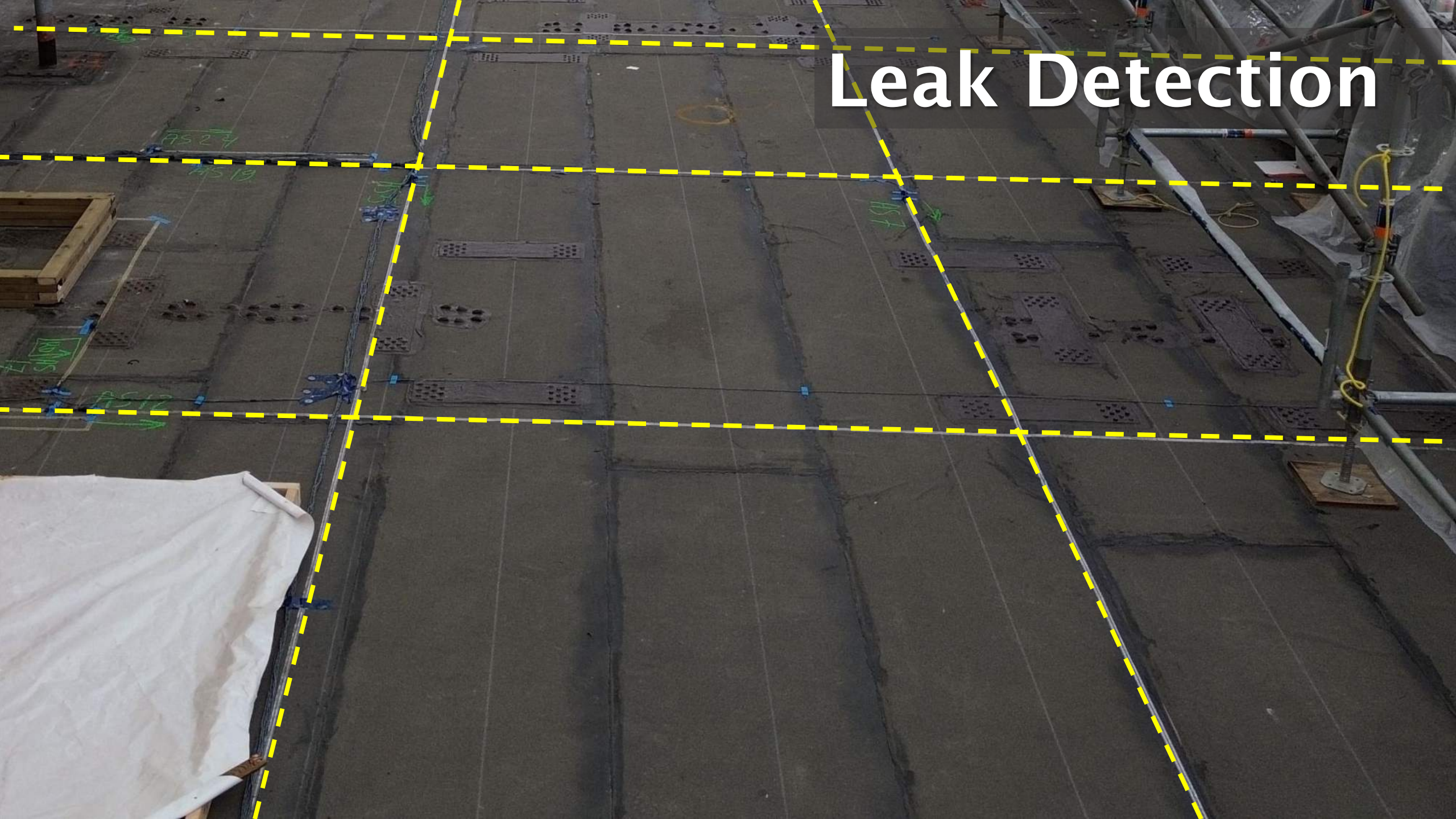
Electronic leak detection for mass timber

- Installed on top of the air and vapor membrane
- Grid layout
- Does not measure wood moisture levels.

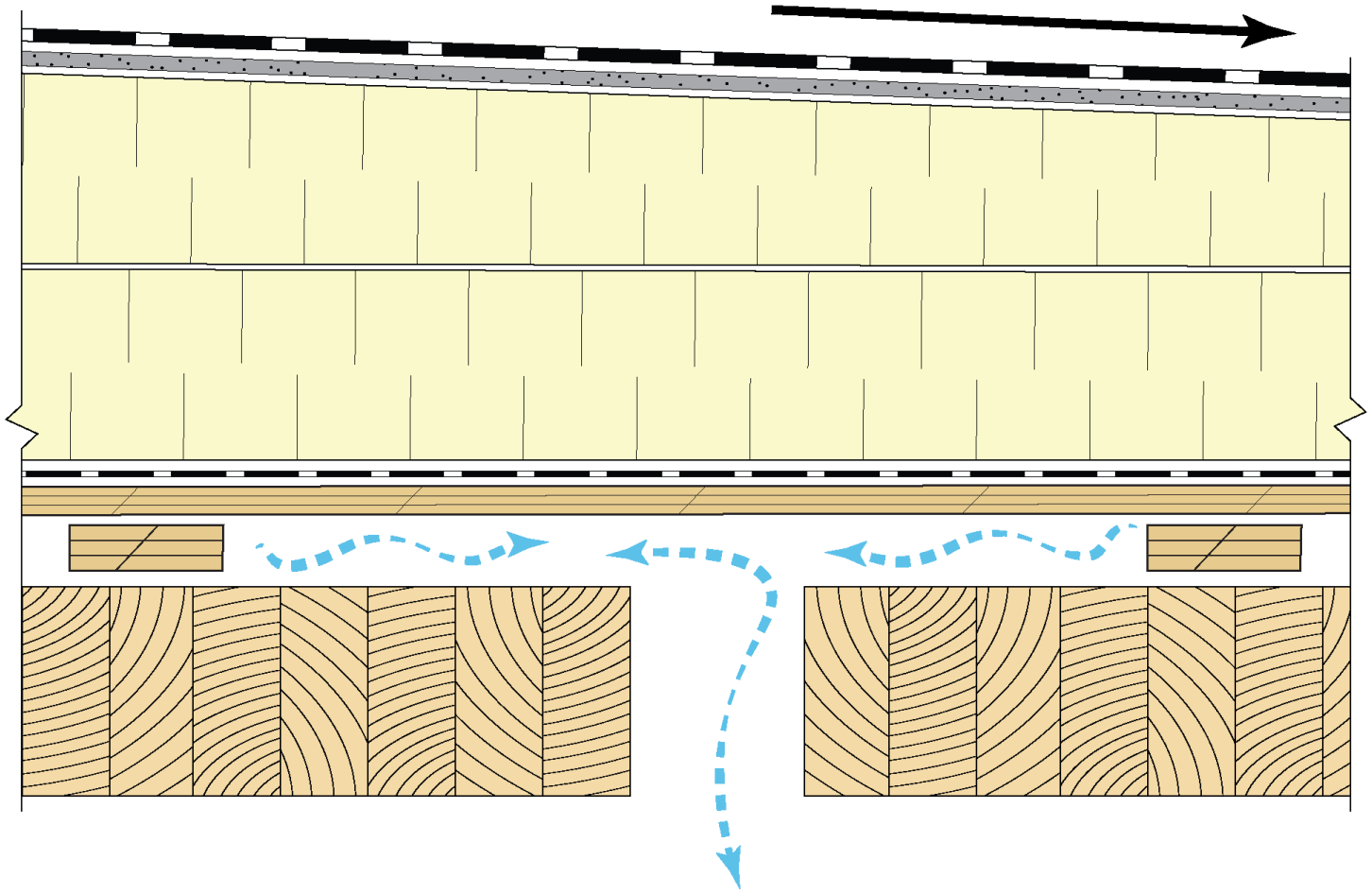


Wood moisture content sensors

- Installed to directly into the panel below the air and vapor membrane
- At discrete locations
- Limited coverage so must install in strategically locations


Leak Detection

Design for Redundancy: Increased Drying with Interior Vented Mass Timber Structure

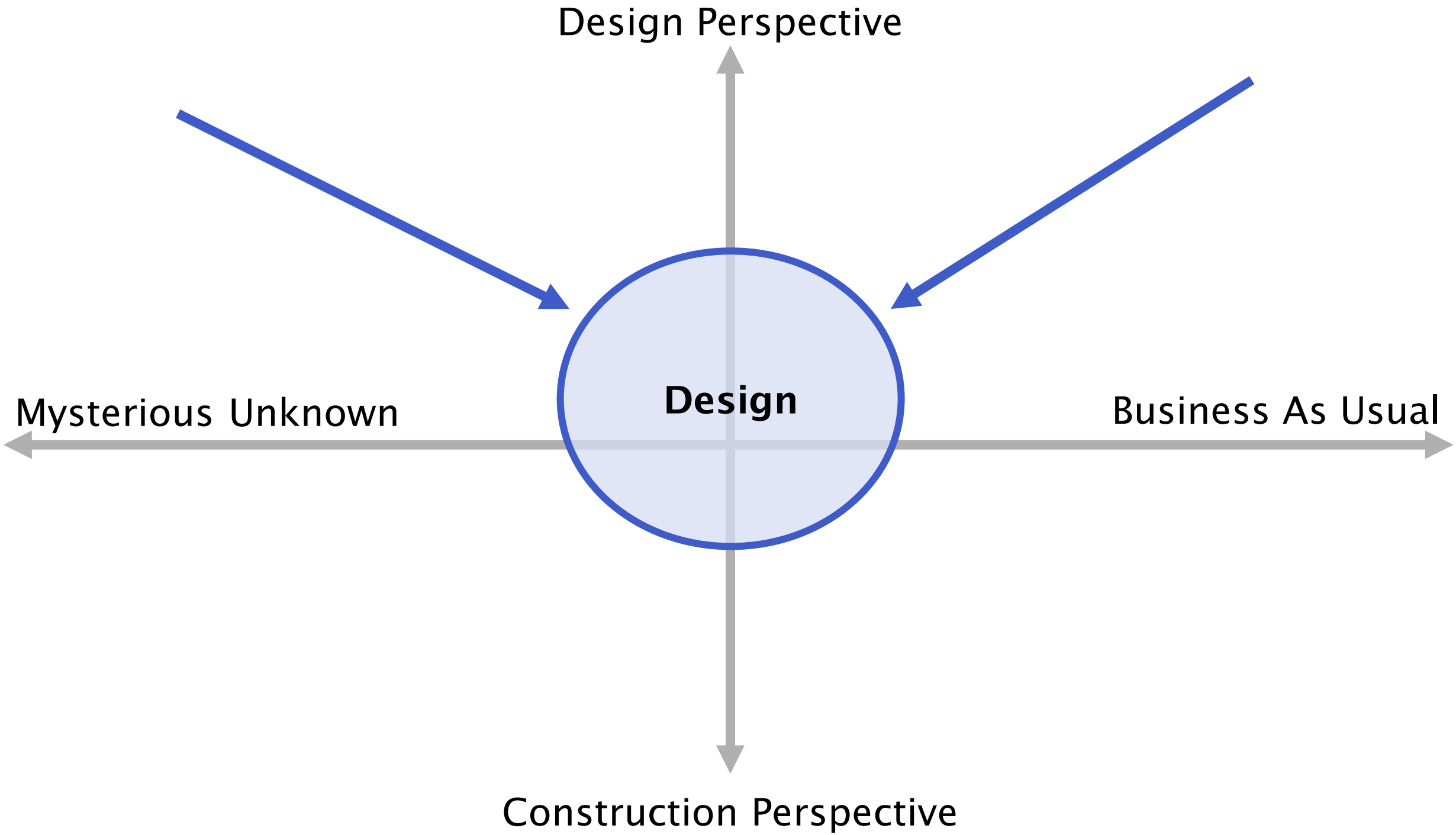


Interior Vented Mass Timber Structure

Moisture Design for Floor Assemblies

Moisture Control in Floors

- Consider leaks during occupancy
  - Mechanical rooms
  - Shower drains
  - Dishwashers
- Moisture sensors at plumbing
- Protective membrane at target locations
- Temp construction protection adds occupancy protection


Design Perspective
Mysterious Unknown
Design
Business As Usual
Construction Perspective

Design to Improve Construction Moisture Management

How to Collaborate

Include moisture management intentions in specifications

Early coordination & communication

Understand how design decision impact moisture risk

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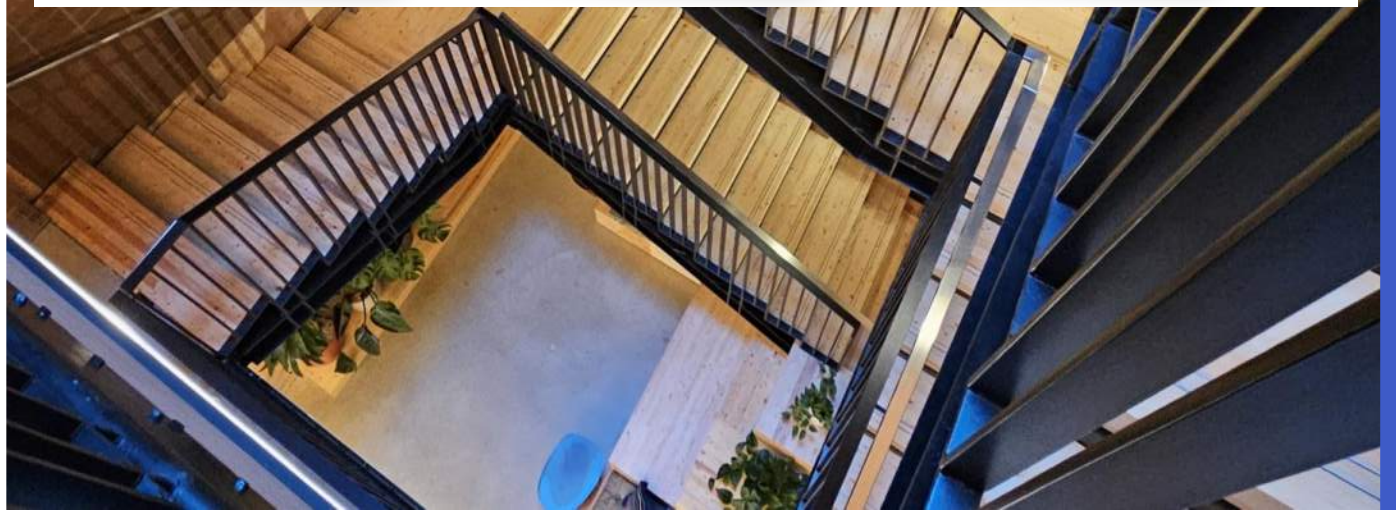
Thinking Through Moisture Risk

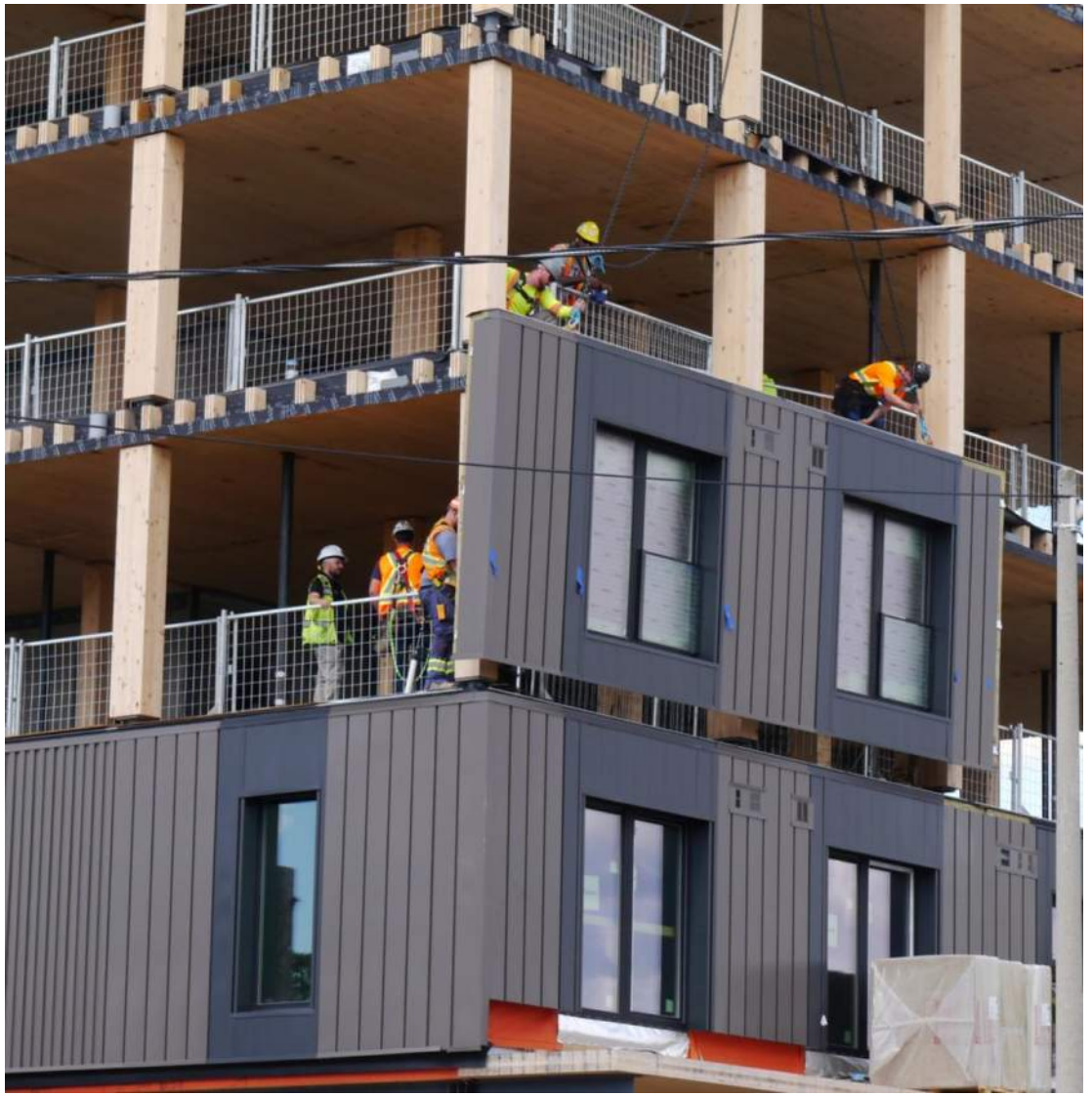
- How ~~will~~ does the design progress through construction
  - Exposure
  - Drainage
  - Ability to be protected
  - Increased risk factors
- What assembly material ~~could~~ will be used as mid-construction temporary protection
  - Temporary roofs
  - Temporary details

RECALL:



Moisture Exposure Reduction with Prefabricated Façade

vs.



Moisture Exposure Reduction with Sloped Panels

HIGH

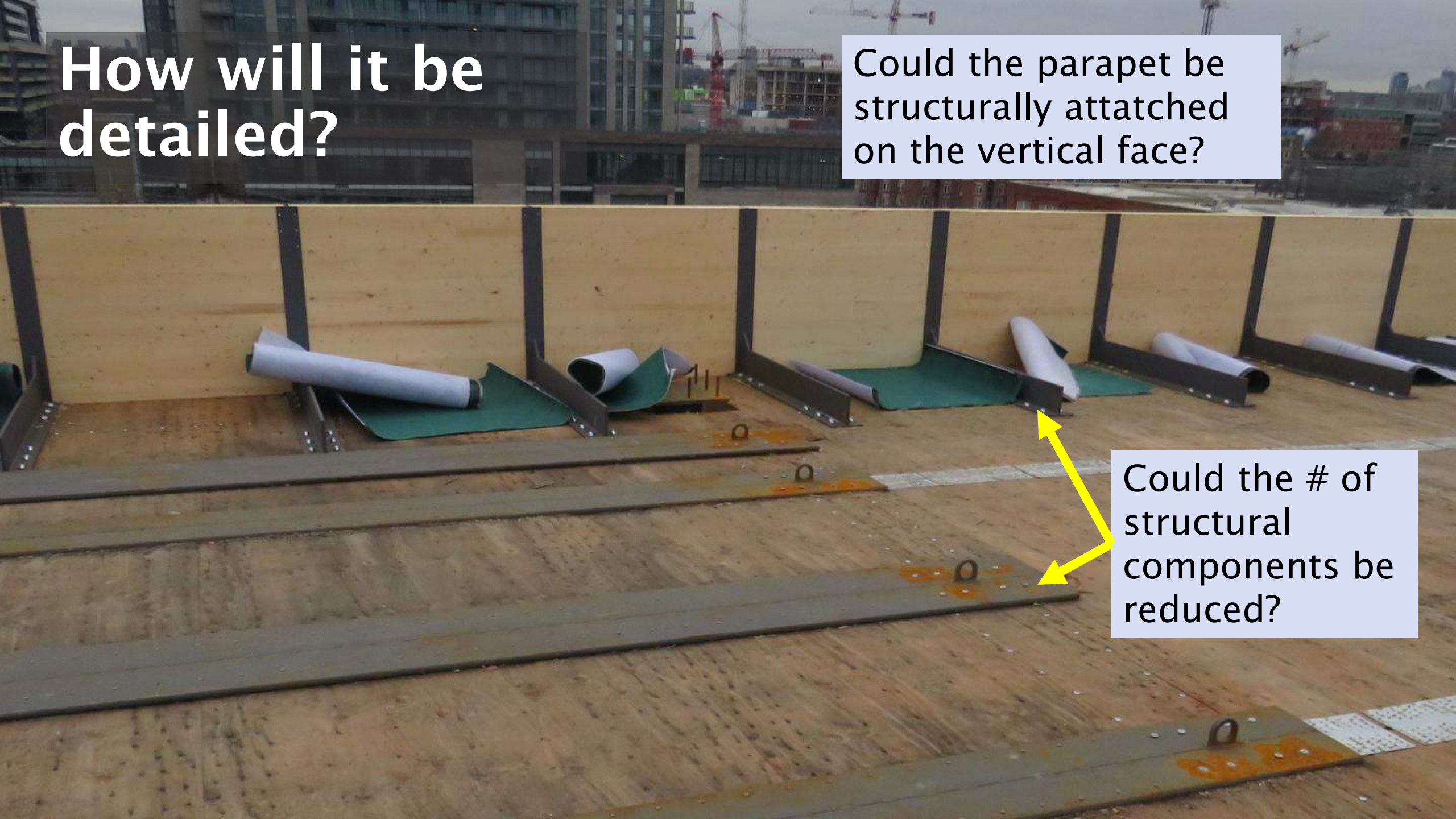
MODERATE

How will it be detailed?

- Difficulty with structural attachment
- Complicated geometry to transition to increases risk of water leaks during construction.

How will it be detailed?

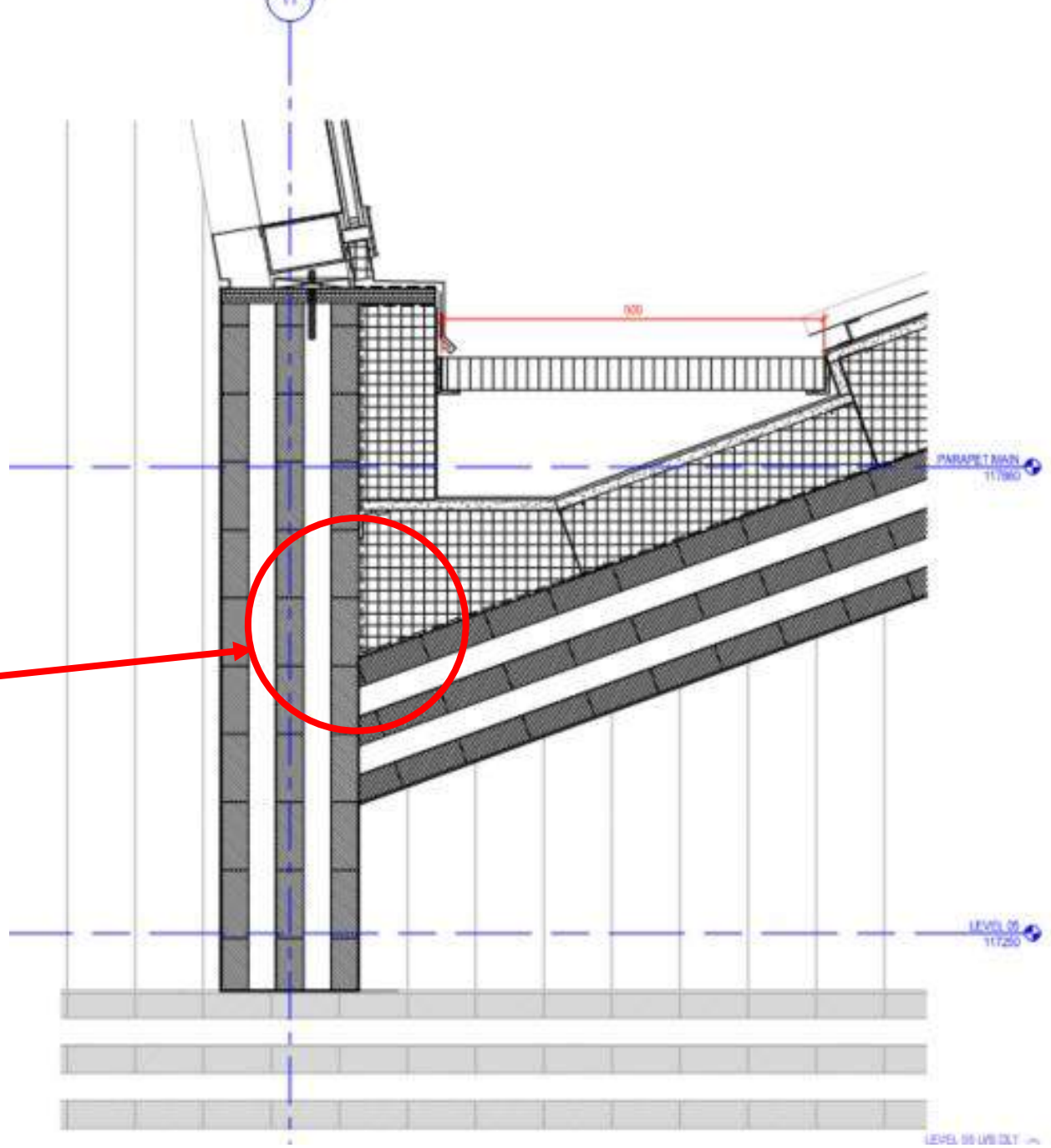
Could the parapet be structurally attatched on the vertical face?



Could the # of structural components be reduced?

Where will the water go?

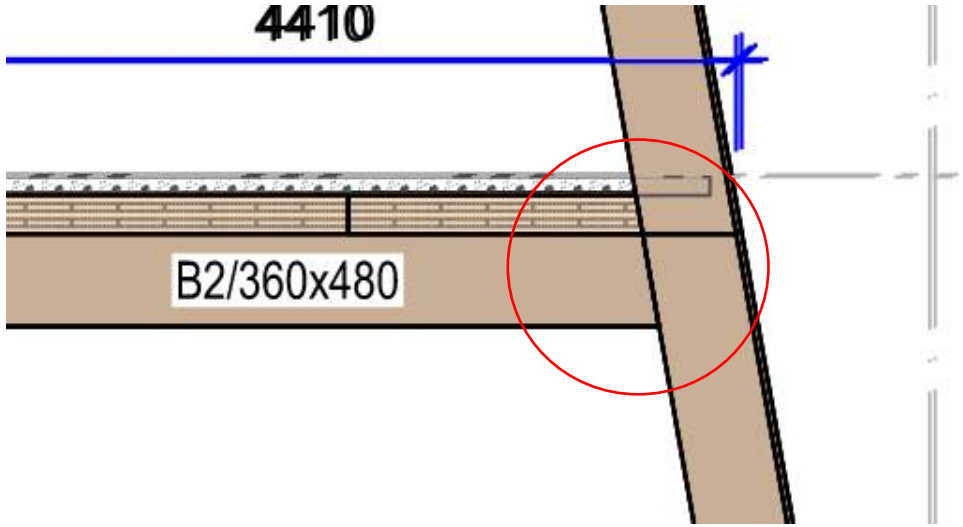
How will this be drained mid construction?

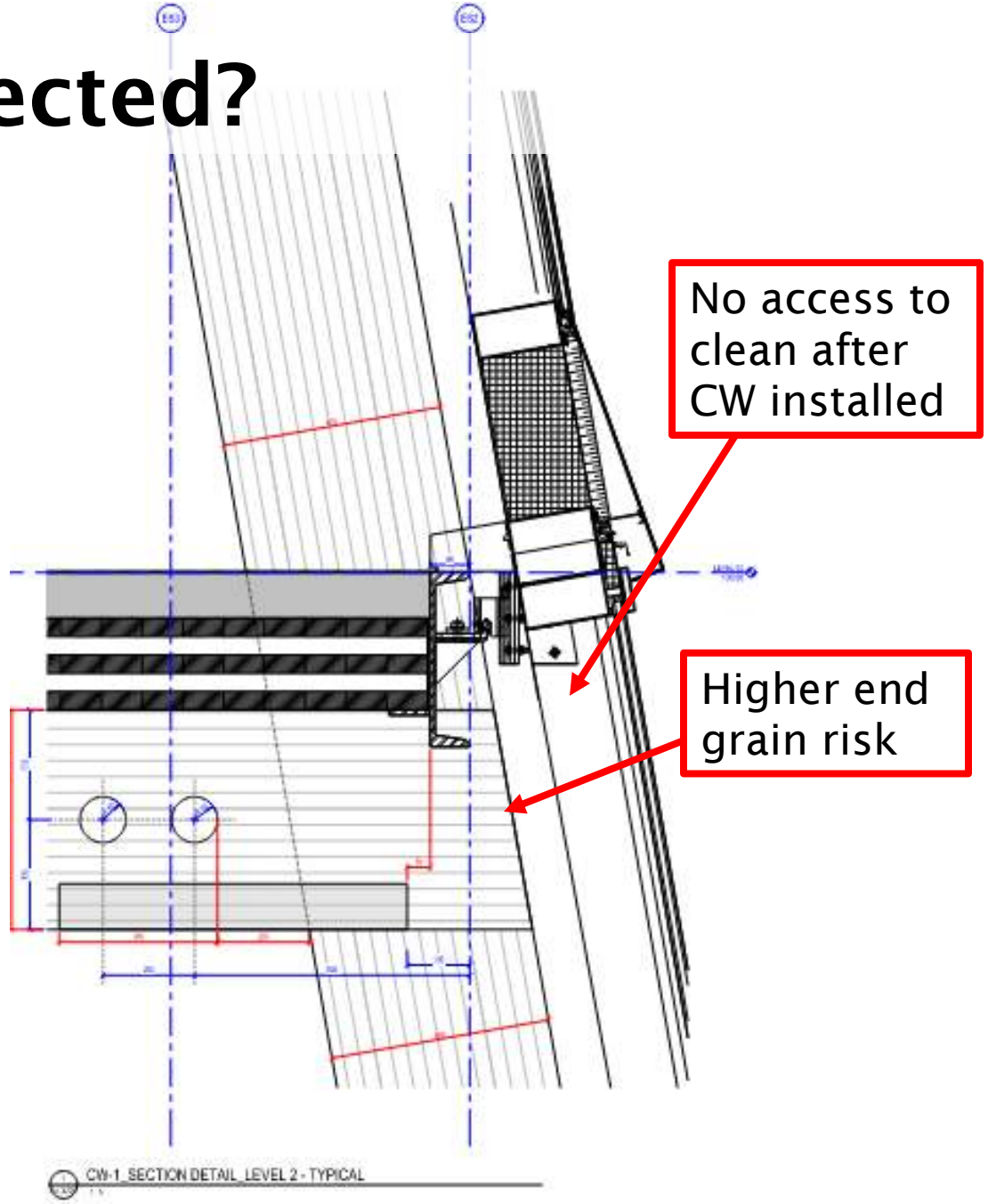


Where is the edge grain exposed?

How is the perimeter protected?

- Perimeter columns & perimeter of beam are sloped (not vertical) so will have increased exposure at skyward facing side.
- No overhead protection from floor above.

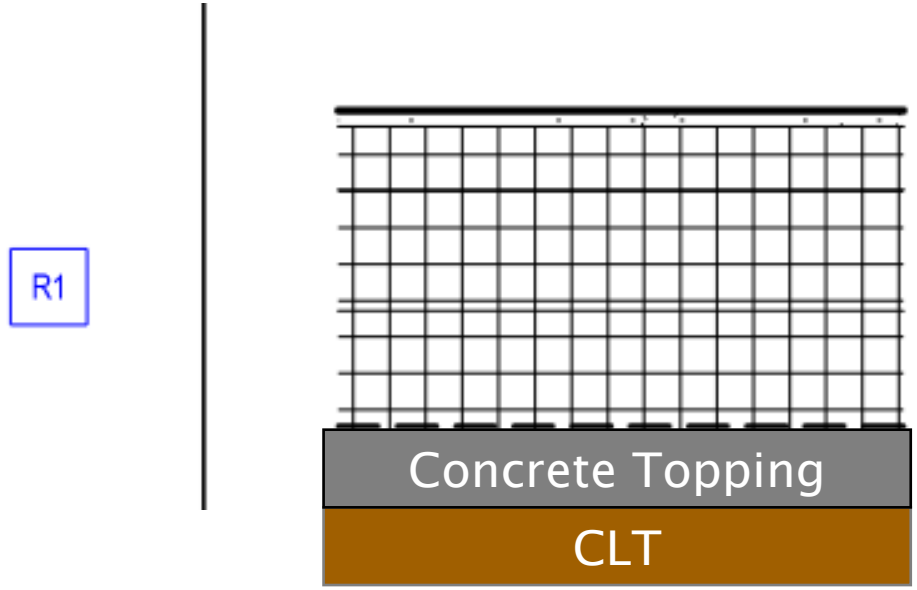




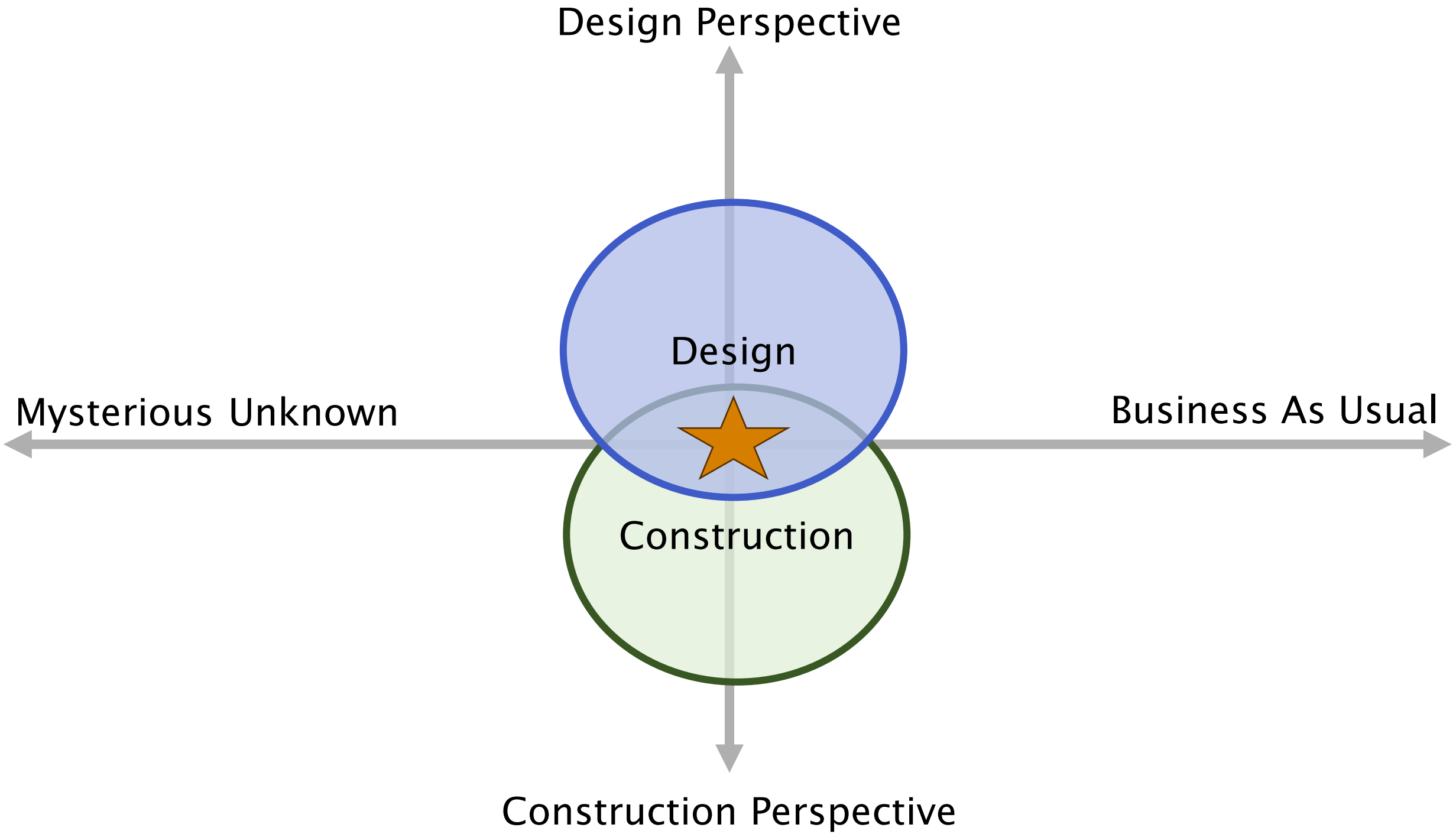
Thoughtful Design of Details & Assemblies

vs.

Early Communication of Risk - Example



- Low durability membrane (increased risk of leaks)
- No redundancy (no leak detection)
- Concrete topping on a roof (increased risk of trapping construction moisture)
- Installed during winter months.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Thank you

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This concludes The American Institute of Architects Continuing Education Systems Course.

Questions?

For More Information

RDH Mass Timber Design Guide and Moisture Management Guide available at RDH.com in the RDH Technical-Library

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RDH BUILDING SCIENCE

QUESTIONS?

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Savannah Gillette

RDH Building Science

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