Design Detailing & Installation for Durability per CSA A440

LEEP
LOCAL ENERGY EFFICIENCY PARTNERSHIPS

Natural Resources Canada
Ressources naturelles Canada
Canada

Goal Today

Understand energy efficient moisture management *"best practices"* and code requirements to produce durable wood-frame assemblies with and without exterior insulation

Discussion Points

- Best practices for installation
- *1st and 2nd Planes of Protection*
- Code and CSA 440.4 integration
- CSA A440.4 standard
- *Integration into wall assemblies with and without exterior insulation*
- *Detailing*
- *Testing using ASTM E1105*

Discussion Points

It is strongly recommended that a robust knowledge exterior insulations and of vapour permeability in assemblies as provided in the **LEEP exterior wall insulation presentation** also be incorporated

Reference Materials & Handouts

TBD

CSA A440.4

- **First window installation standard**, CSA A440, in 1972.
- **Originally for residential buildings**, the standard expanded to include non-residential and high-rise residential buildings
- **Shimming and Anchoring Diagrams**: Revised to reflect fenestration product construction improvements and updated requirements.
- **Sub-sill Flashing**: Installation requirements updated based on improved techniques and knowledge.
- **Air and Water Leakage Testing**: Methods updated to ensure fenestration product performance and installation integrity.
- **Installation Requirements**: Addresses issues that could compromise fenestration product performance, with consultation of a design professional advised for methods not specified.

CSA A440.00

- CSA A440.1 User selection guide to windows
- CSA A440.2 Fenestration Energy Performance
- CSA A440.3 User guide to energy performance
- **CSA A440.4 Residential and low-rise installation**
- CSA A440.5 User guide to Residential and low-rise installation

Development stage

- CSA A440.6 High exposure Fenestration Installation

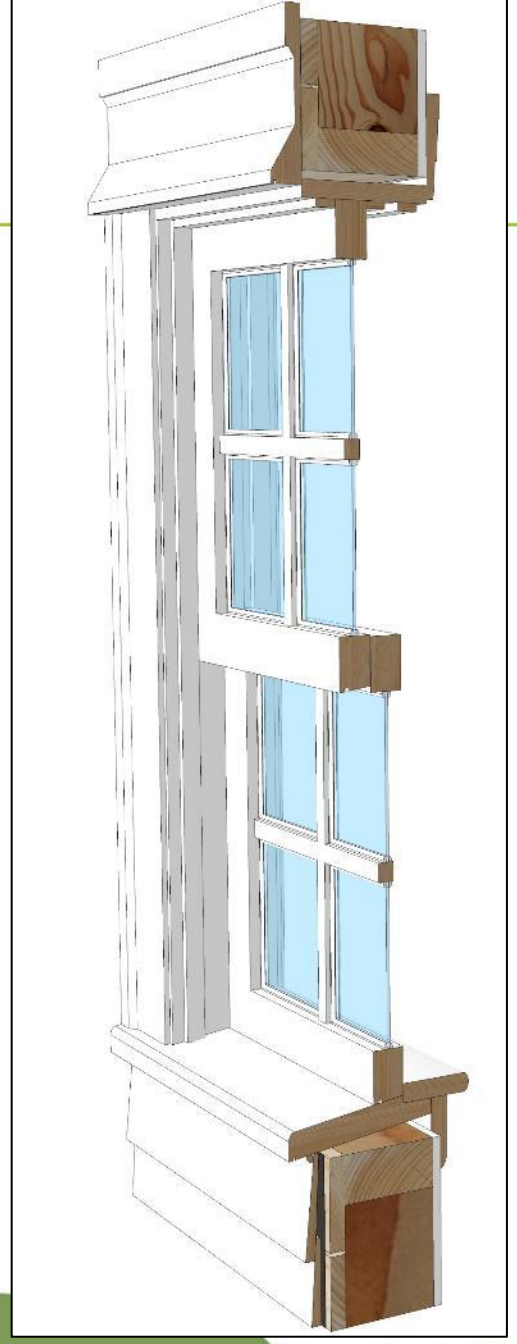
CSA A440.4

2007	2019	2024
Sill projection for moderate and higher exposures	Sill protection for all doors Mulled Windows	Mandatory sill protection for all doors and windows
Back dams or slope sills not mandatory	Back dams or slope sills are mandatory on fenestrations requiring sill protection	Back dams or slope sills are mandatory on fenestrations requiring sill protection
Shimming and blocking schedules	Shimming and blocking schedules	Reduced discussions on outdated methodology

- 2015 NBC uses CAN/CSA A440.4 (2007)
- 2020 NBC uses CAN/CSA 440.4 (2019)
- Proposed NBC 2025 use Proposed CAN/CSA 440.4 (2024)

Historical

- Moisture resistive materials (old growth fir)
- Air drying (High natural air leakage)
- Slopes (drainage)
- Deflection (headers, build outs)
- Surface tension breaks (kerfs)



Poor quality installation techniques

Prevailing thinking:

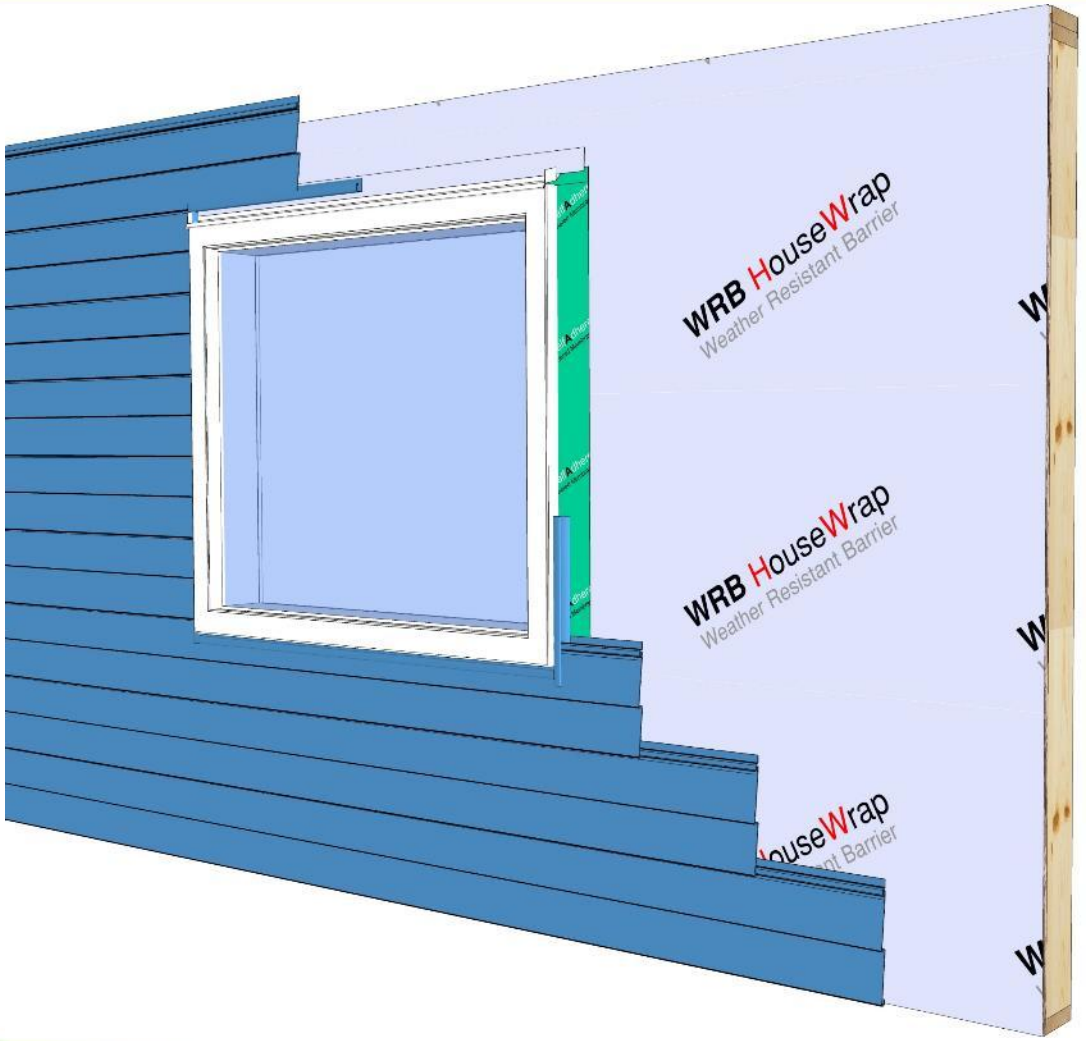
- “seal exterior better”
- “Water won’t enter rough opening”
- “we've always done it this way”
- “that seems too much work”
- “not my job”

Planes of Protection

FIRST

- Cladding
- Sealants

- Deflection
- Overhangs
- Decks



SECOND

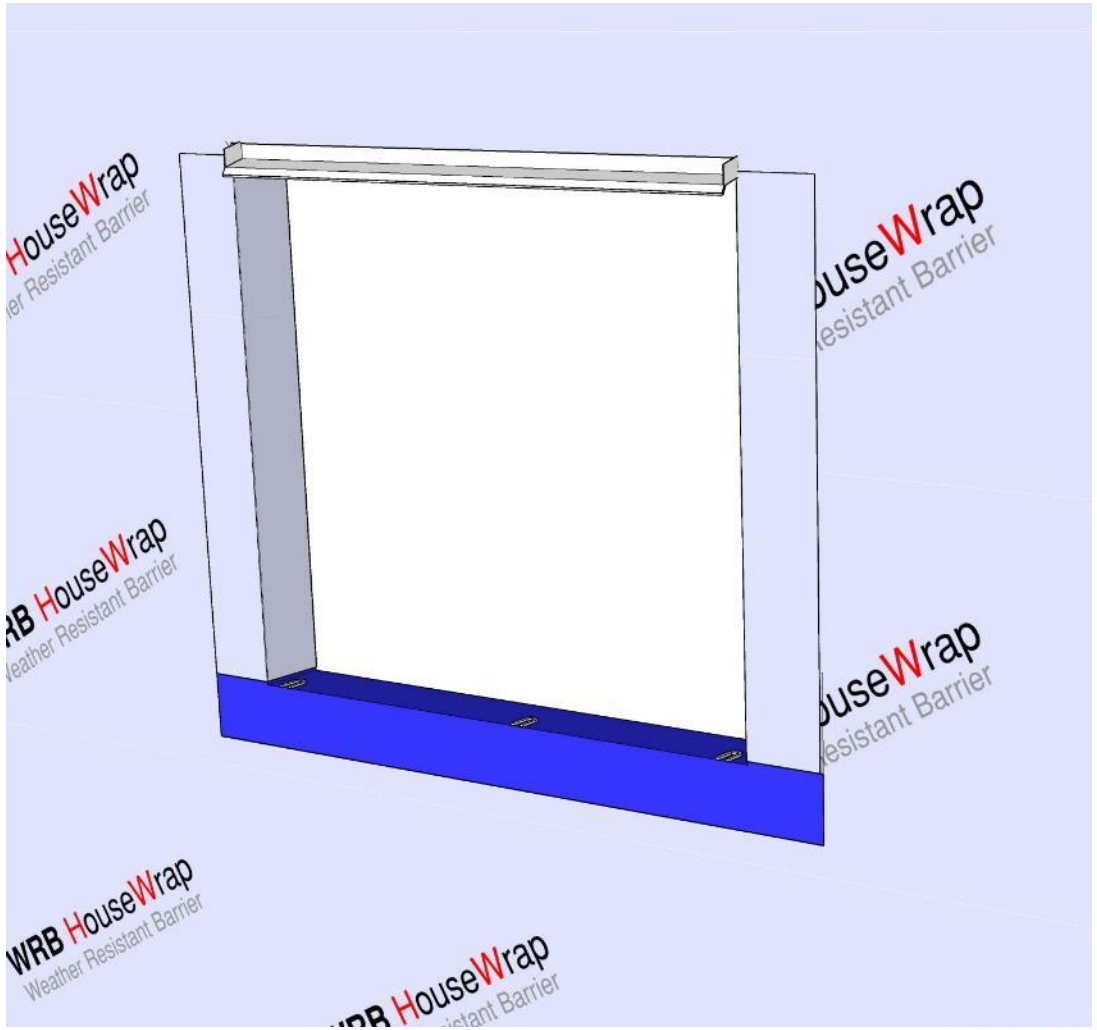
- Weather barrier
- Flashing

- Drainage
- Includes R.O.
- Soffits

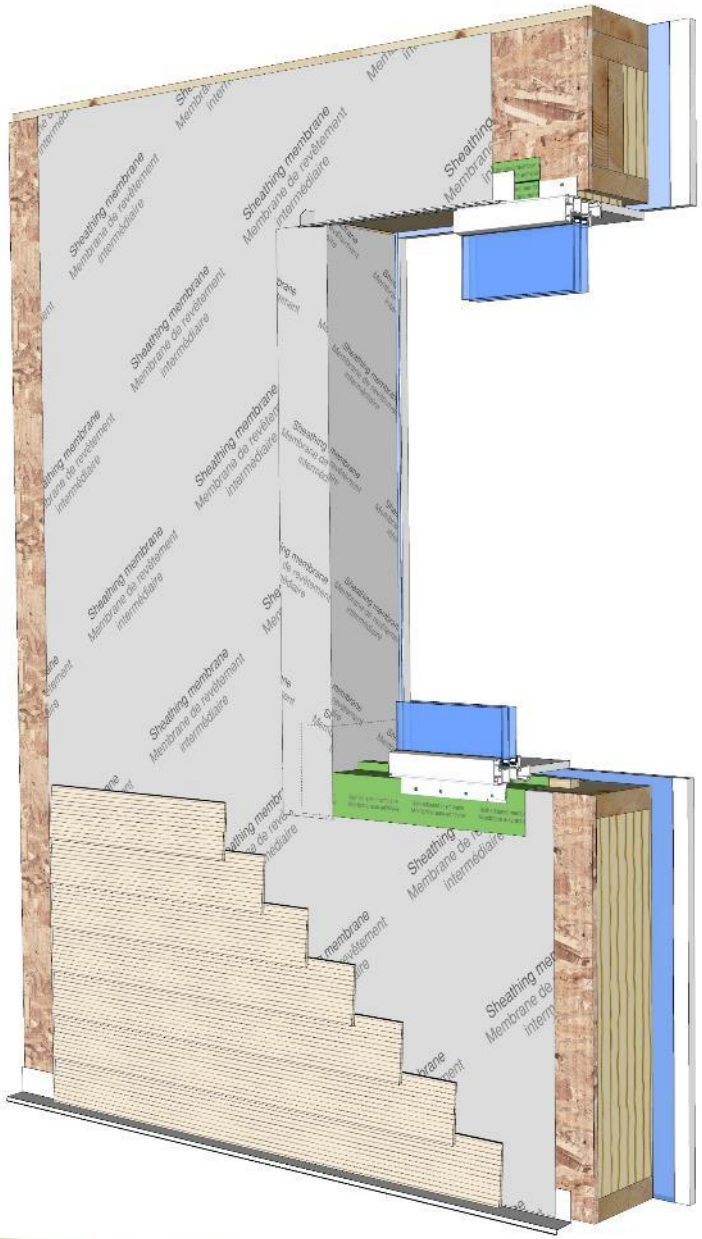
Second Plane of Protection

- Treat rough opening as second plane
- WRB sides
- Waterproof sill
- Drainage back to exterior

PCF 1950, 1951



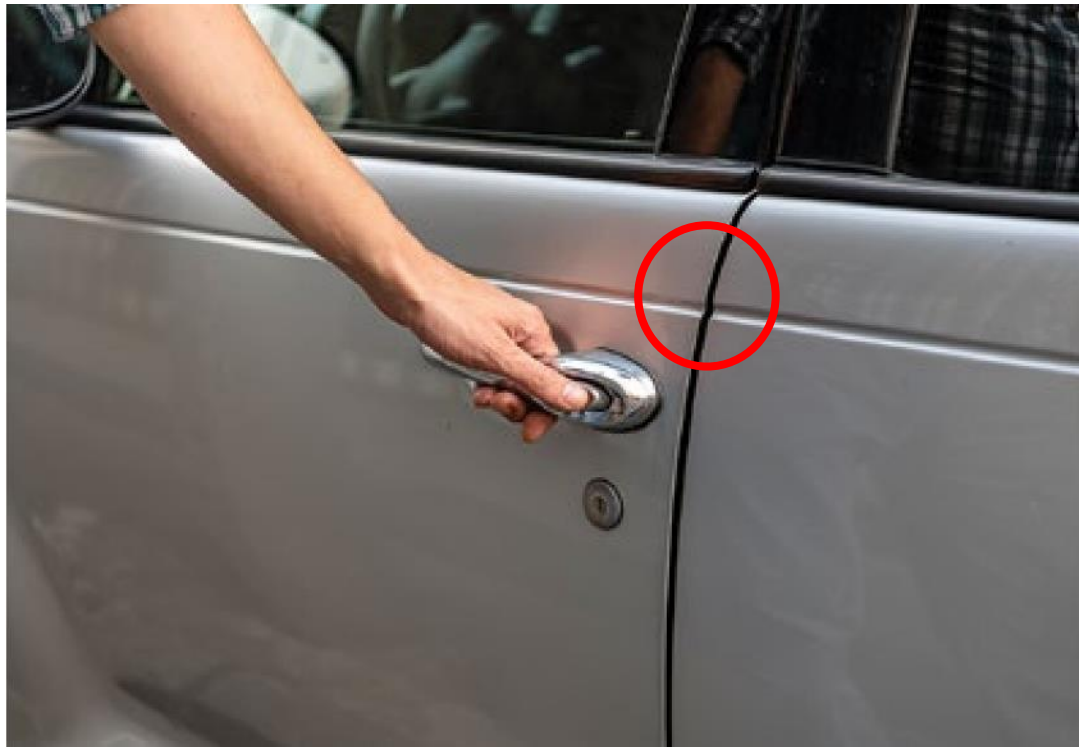
Moisture Principles



- Control moisture entry
- Control moisture accumulation
- Provide removal (drainage and drying)

- Treat fenestrations as porous
- Integrate drainage and treat cavity to receive and remove moisture using a clear and defined path

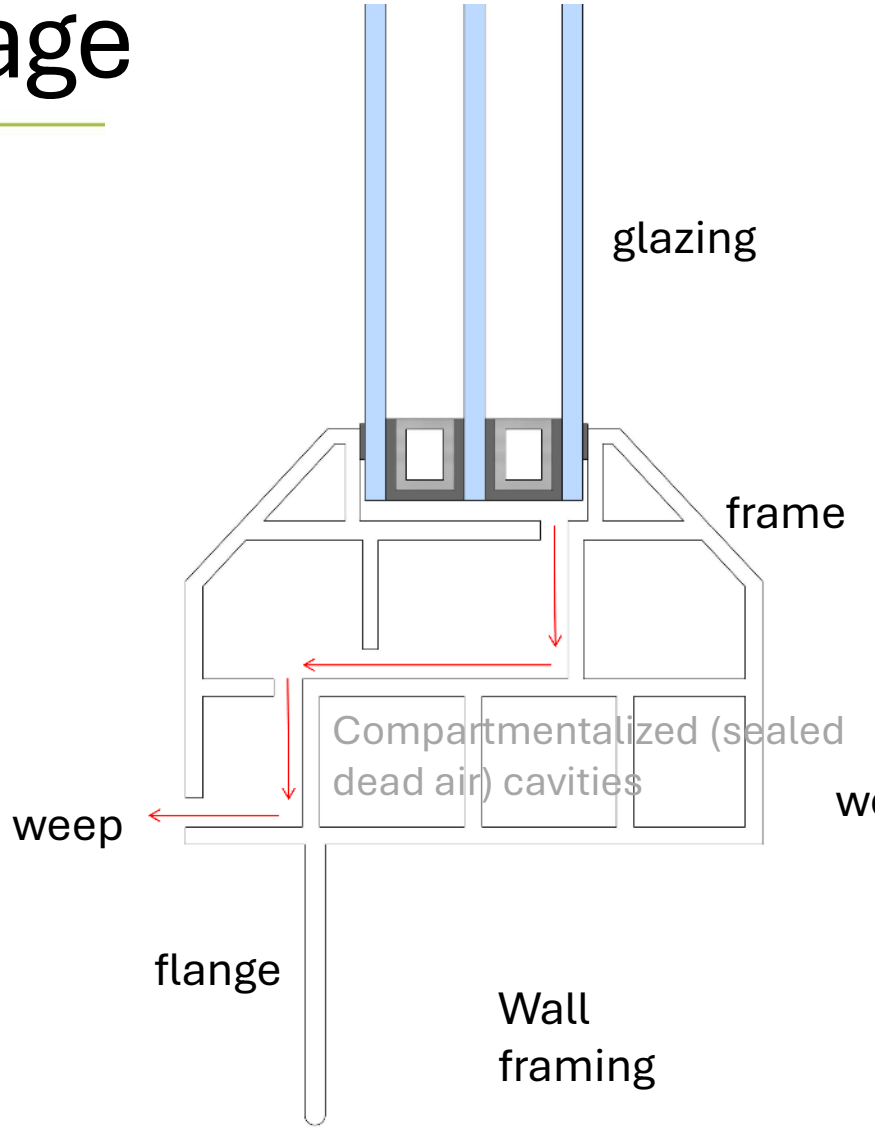
Sealing (keep water off the air pressure plane)

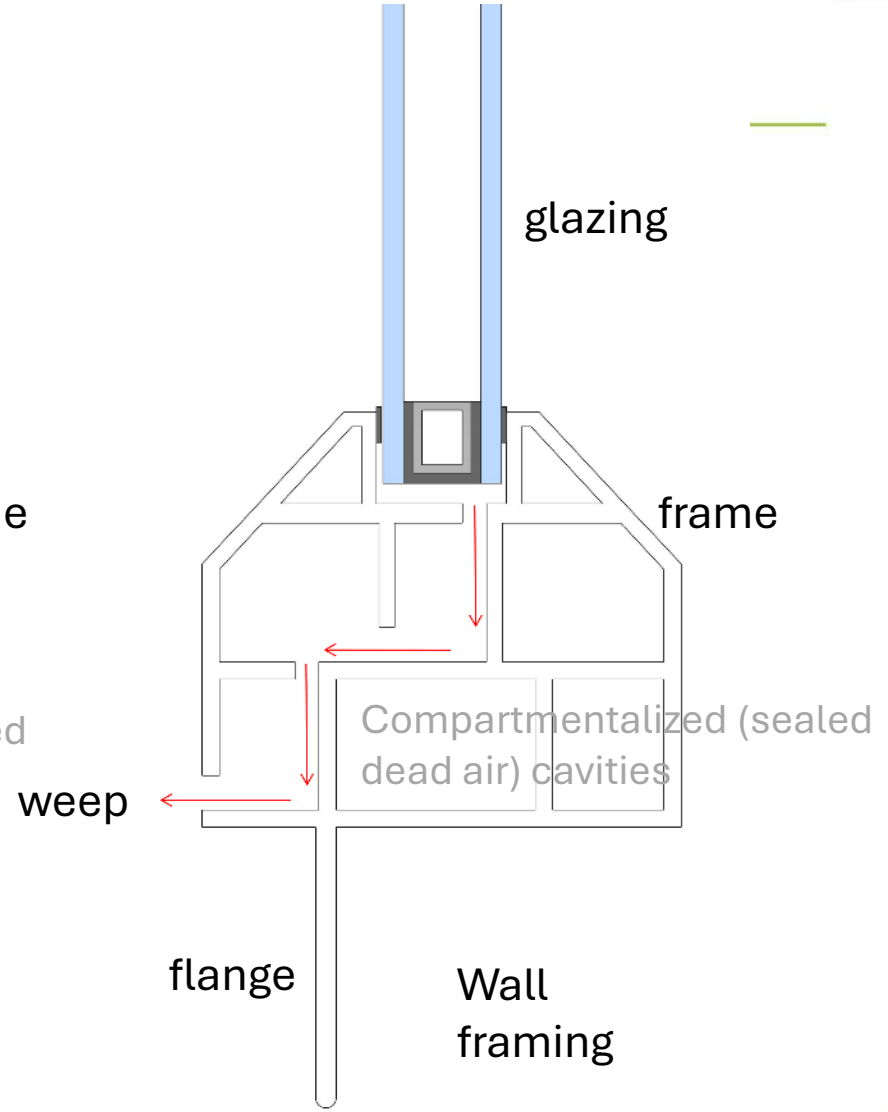


Example: vehicles have weatherstripping on the interior versus exterior

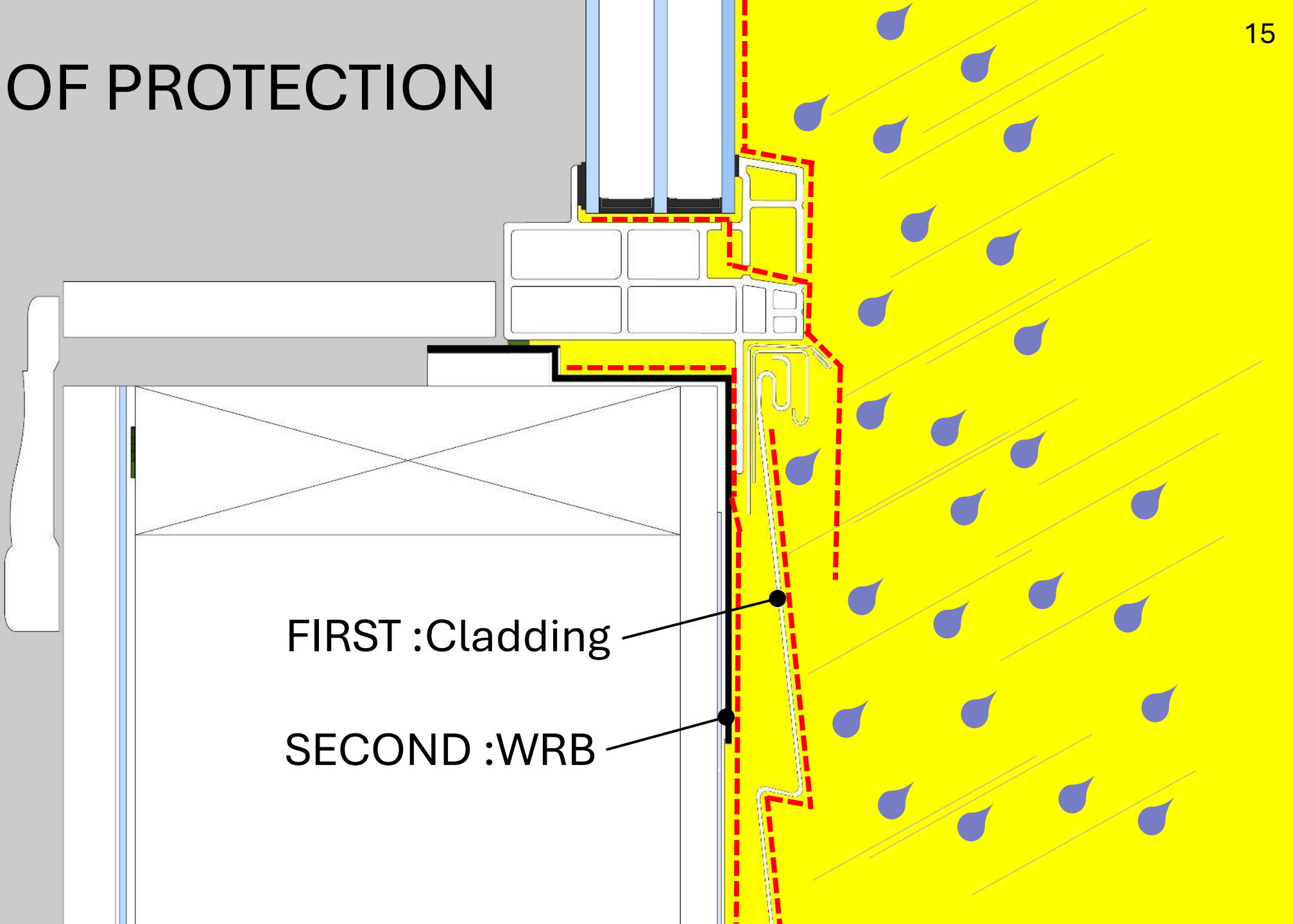
Internal drainage

- Designed to allow water ingress
- Provides internal drainage back to exterior

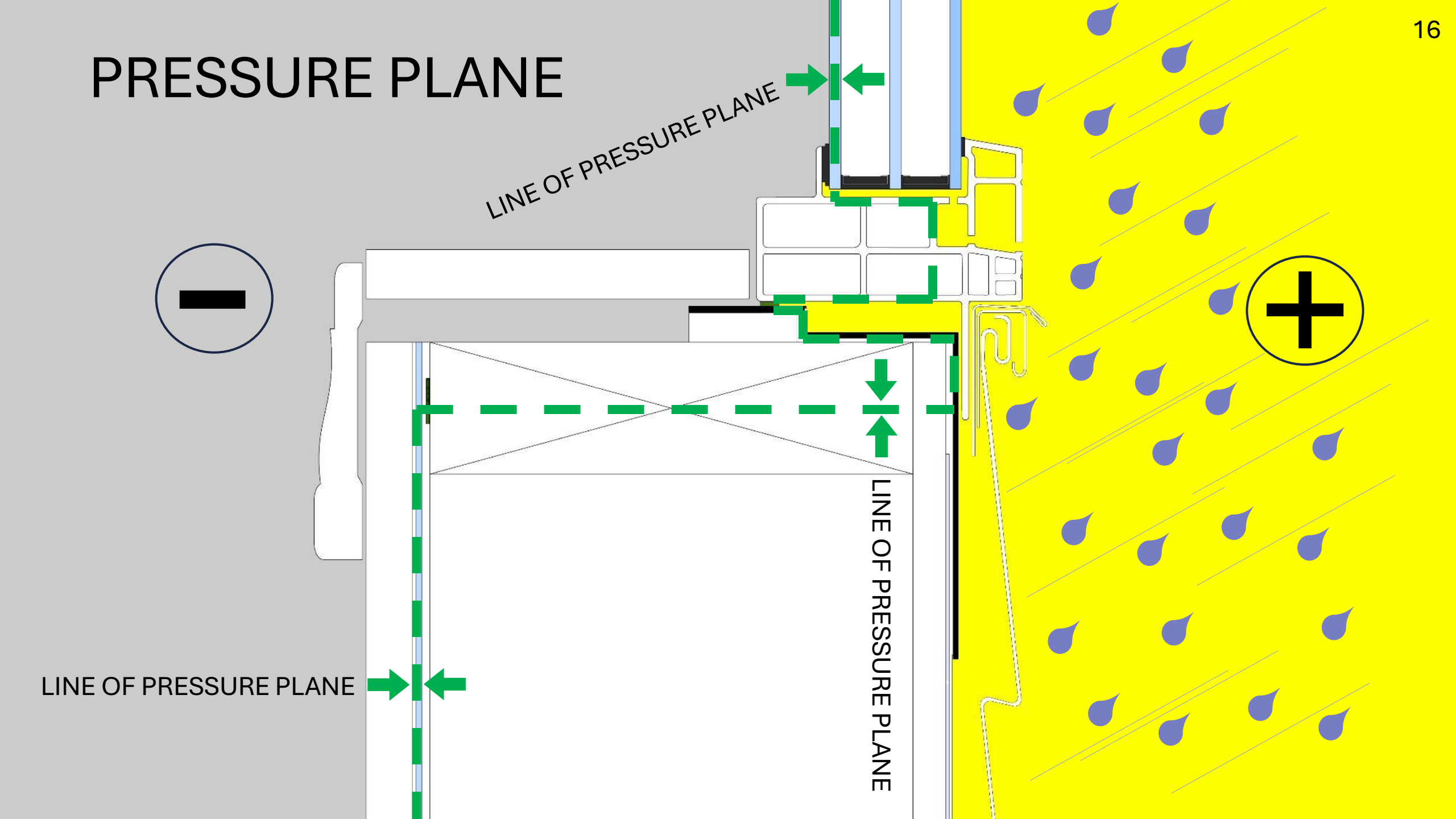




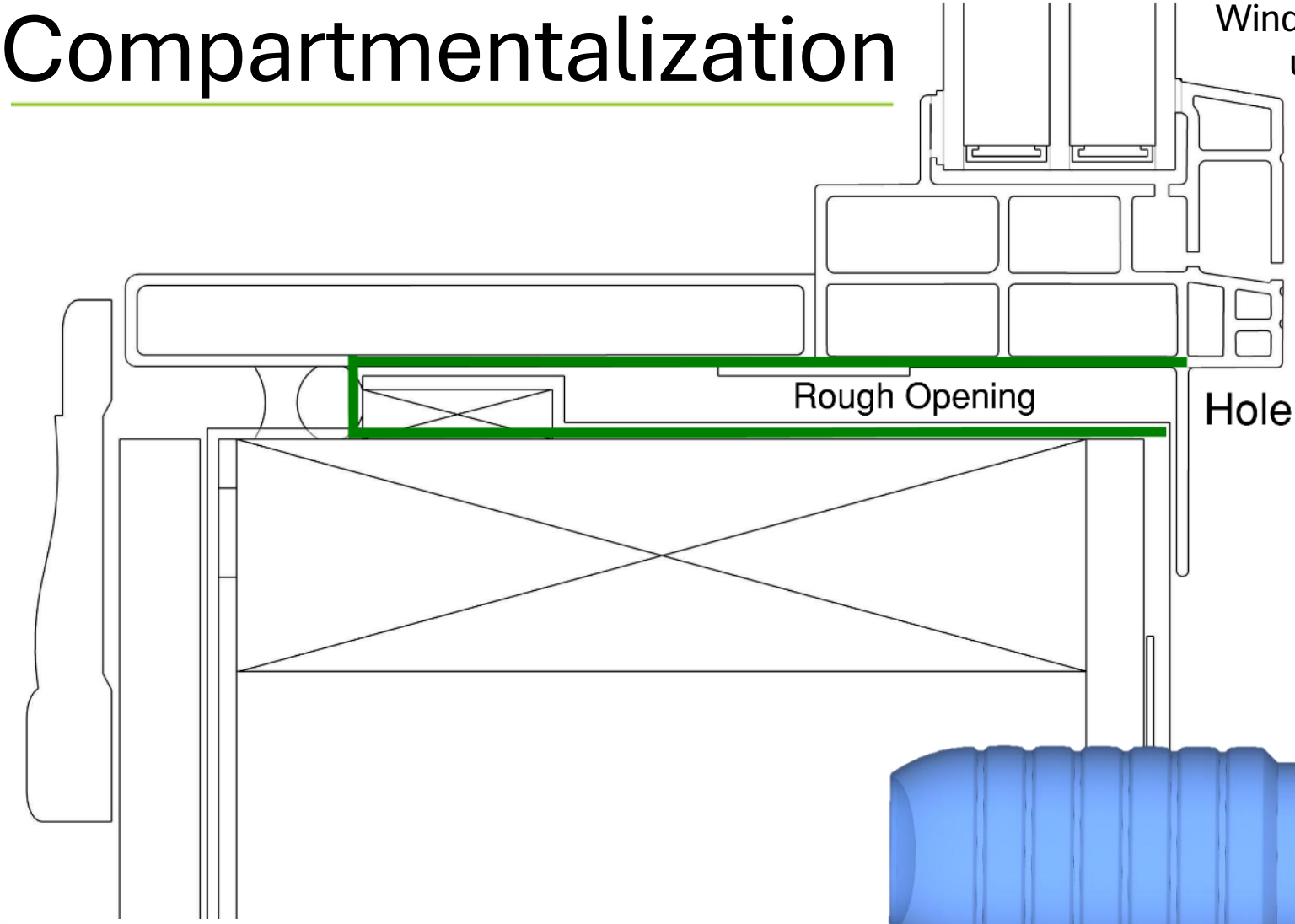
PLANES OF PROTECTION



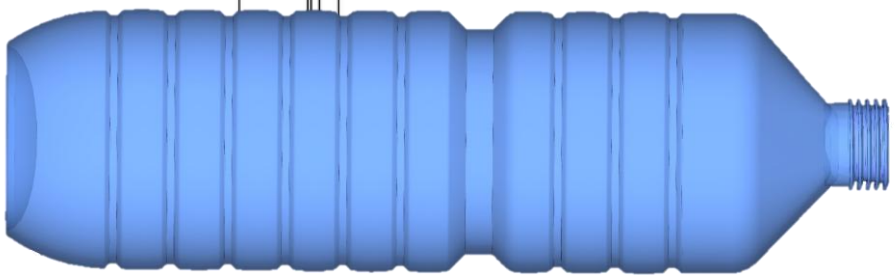
PRESSURE PLANE

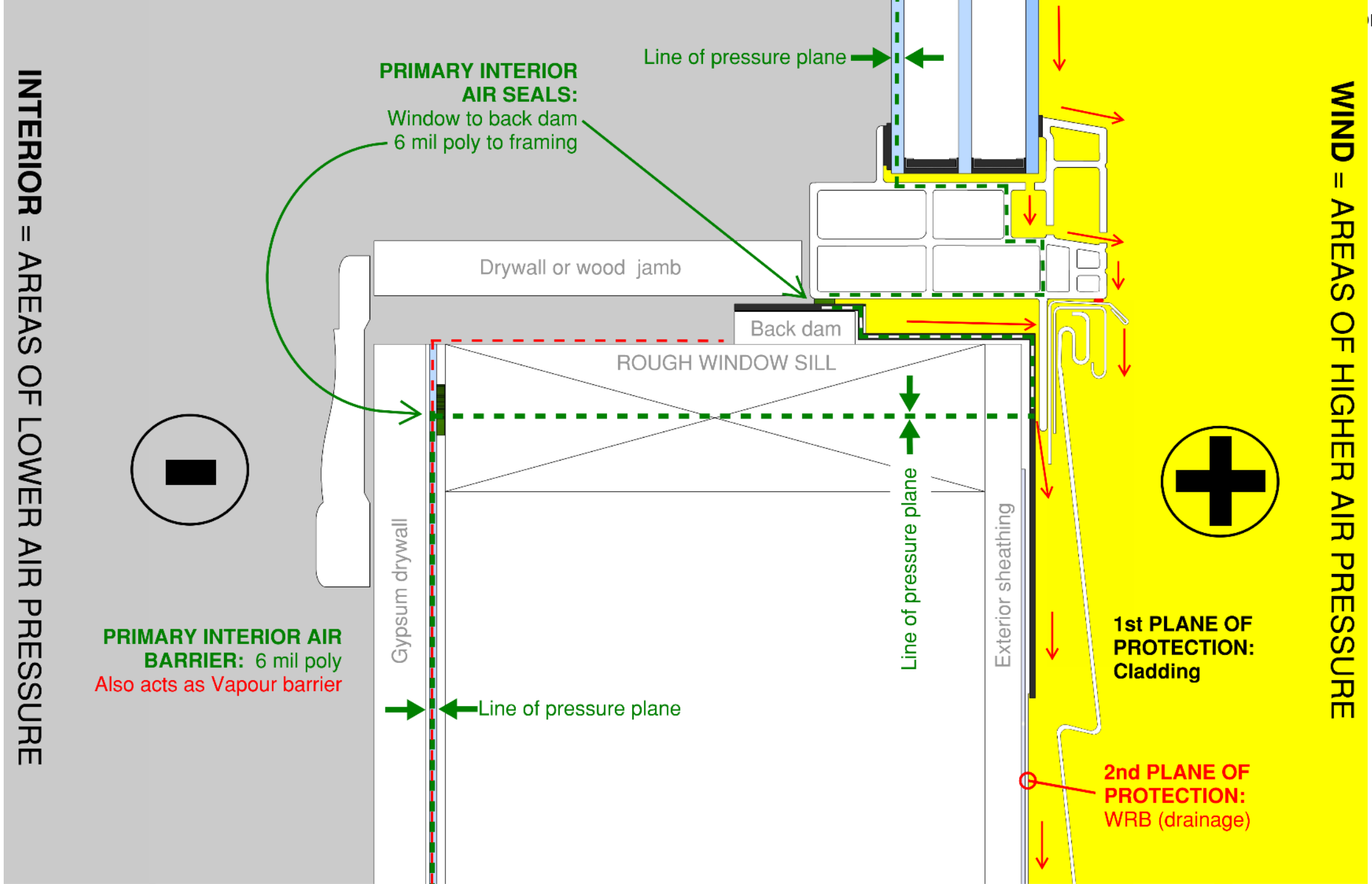


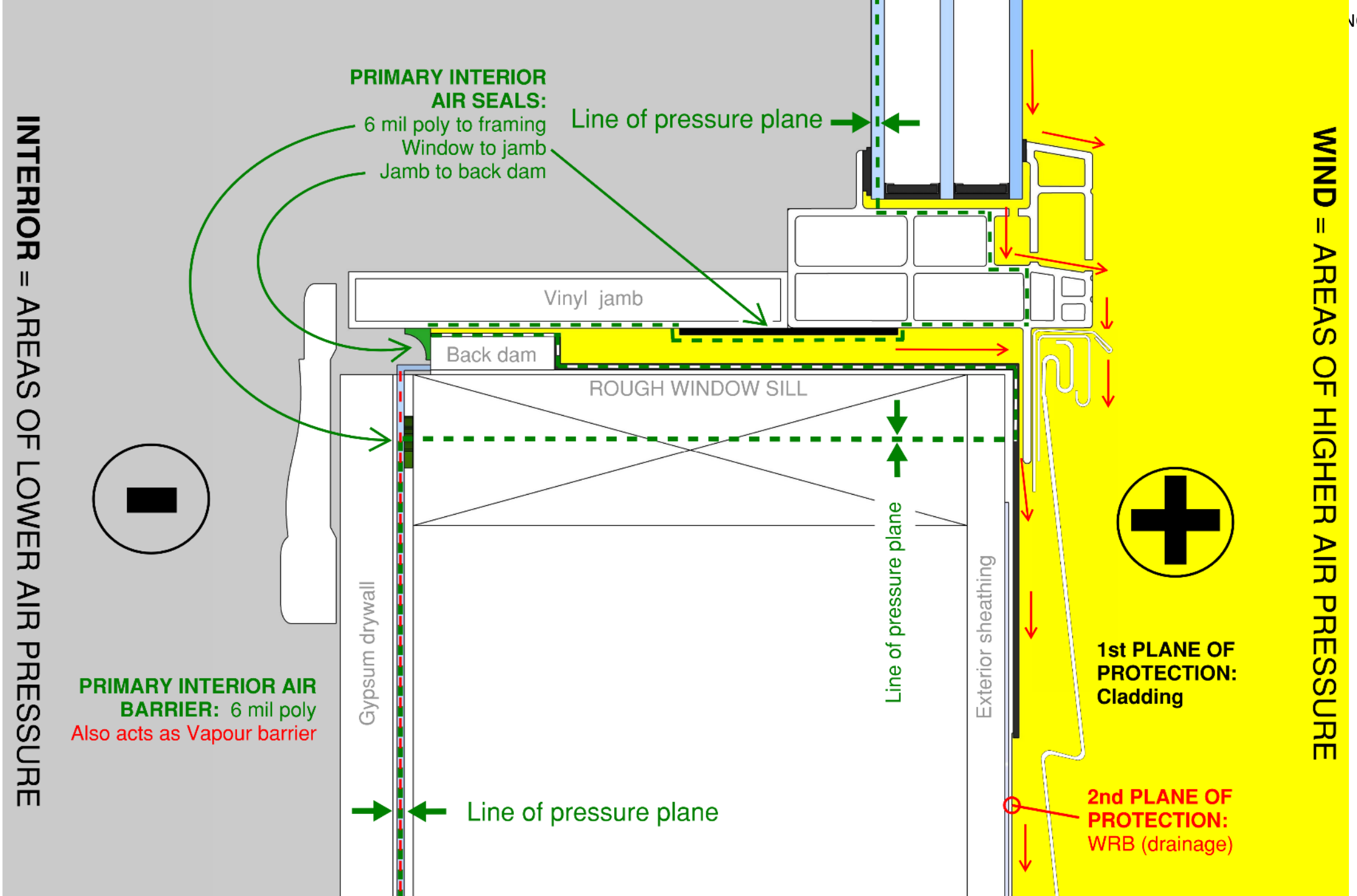
Compartmentalization



Create an airtight rough opening cavity that is open on the end for drainage of incidental moisture




INTERIOR = AREAS OF LOWER AIR PRESSURE
WIND = AREAS OF HIGHER AIR PRESSURE
PRIMARY INTERIOR AIR SEALS:
Window to back dam
6 mil poly to framing
Line of pressure plane
Drywall or wood jamb
Back dam
ROUGH WINDOW SILL
Gypsum drywall
Line of pressure plane
Exterior sheathing
PRIMARY INTERIOR AIR BARRIER: 6 mil poly
Also acts as Vapour barrier
Line of pressure plane
1st PLANE OF PROTECTION:
Cladding
2nd PLANE OF PROTECTION:
WRB (drainage)


INTERIOR = AREAS OF LOWER AIR PRESSURE
WIND = AREAS OF HIGHER AIR PRESSURE
PRIMARY INTERIOR AIR SEALS:
6 mil poly to framing
Window to jamb
Jamb to back dam
Line of pressure plane
Vinyl jamb
Back dam
ROUGH WINDOW SILL
Gypsum drywall
Line of pressure plane
Exterior sheathing
PRIMARY INTERIOR AIR BARRIER: 6 mil poly
Also acts as Vapour barrier
Line of pressure plane
1st PLANE OF PROTECTION: Cladding
2nd PLANE OF PROTECTION: WRB (drainage)

Overhangs

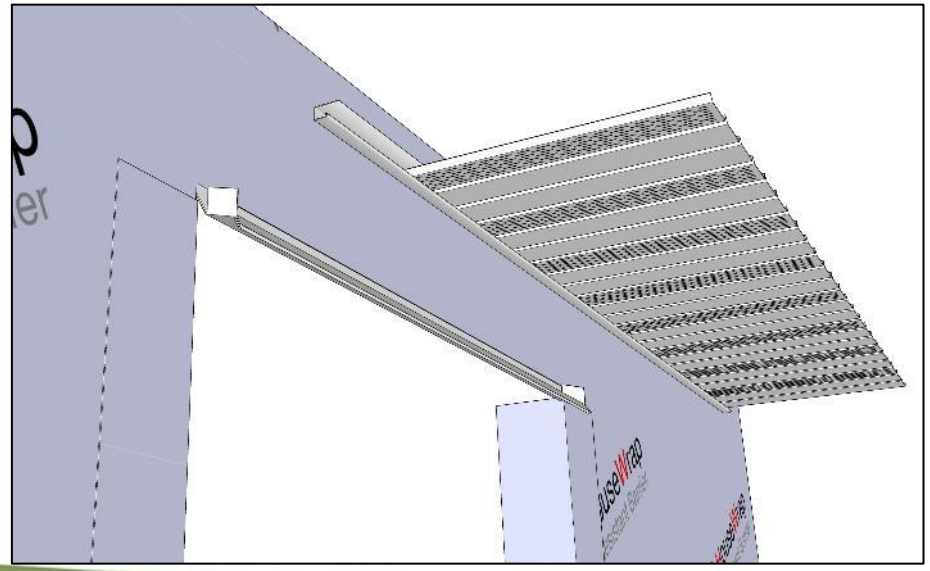
- Studies show overhang size and style can reduce window issues by up to 25%
- Where limited overhang protection is used, more robust detailing is required to mitigate moisture ingress in the window installation details

Overhangs

- Larger overhangs
- Zero overhangs
- Reverse overhangs (butterfly roofs)
- Anticipate higher moisture loads from incidental and wind driven rain

Tie-In’s

- Water from above or behind which reach's the sheathing can enter



Section 9.27. Cladding

9.27.1. Application

9.27.1.1. General

1) Where lumber, wood shingles, shakes, fibre-cement shingles, planks and sheets, plywood, OSB, waferboard, hardboard, vinyl, aluminum or steel, including trim and soffits, are installed as cladding on wood-frame walls exposed to precipitation, the cladding assembly shall comply with

a) Subsections 9.27.2. to 9.27.12., or

b) Part 5.

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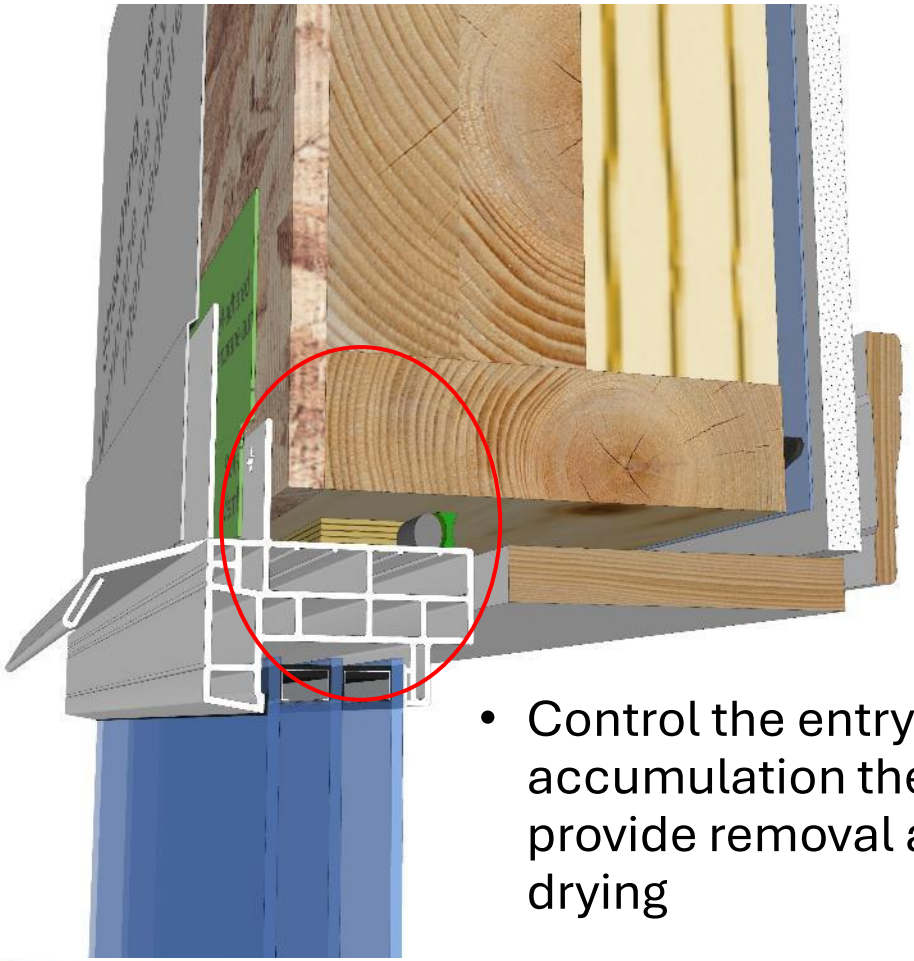
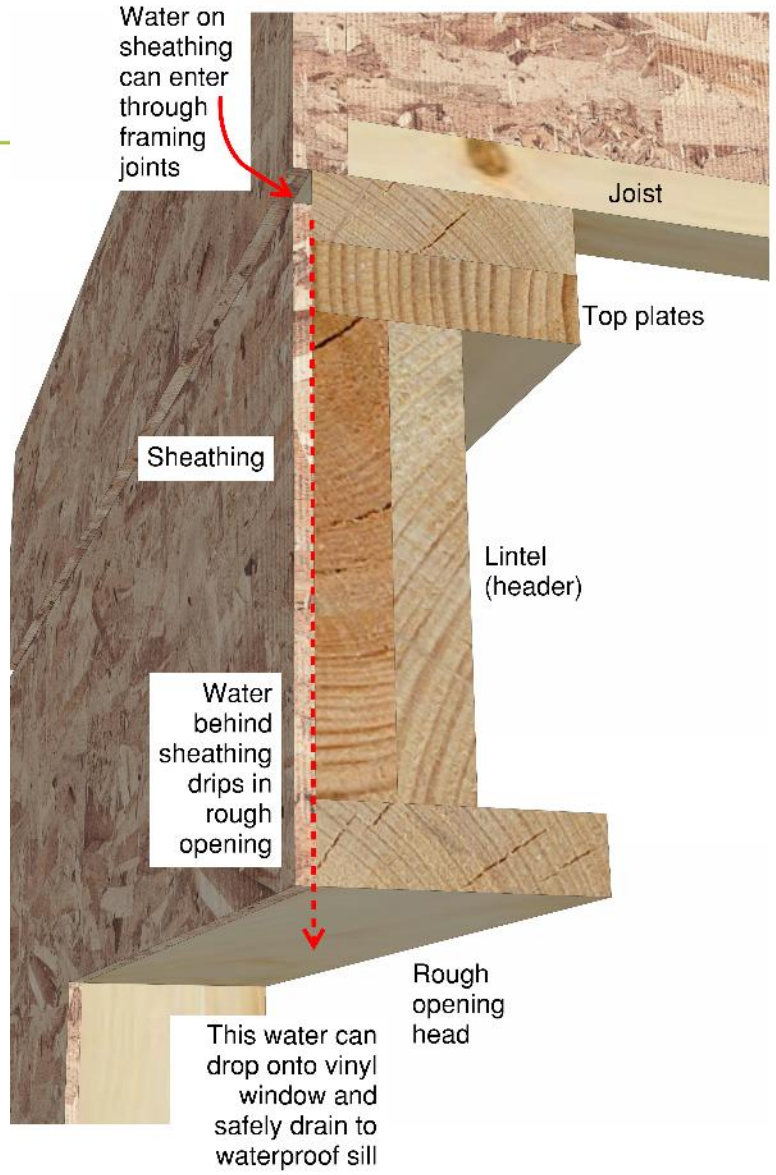
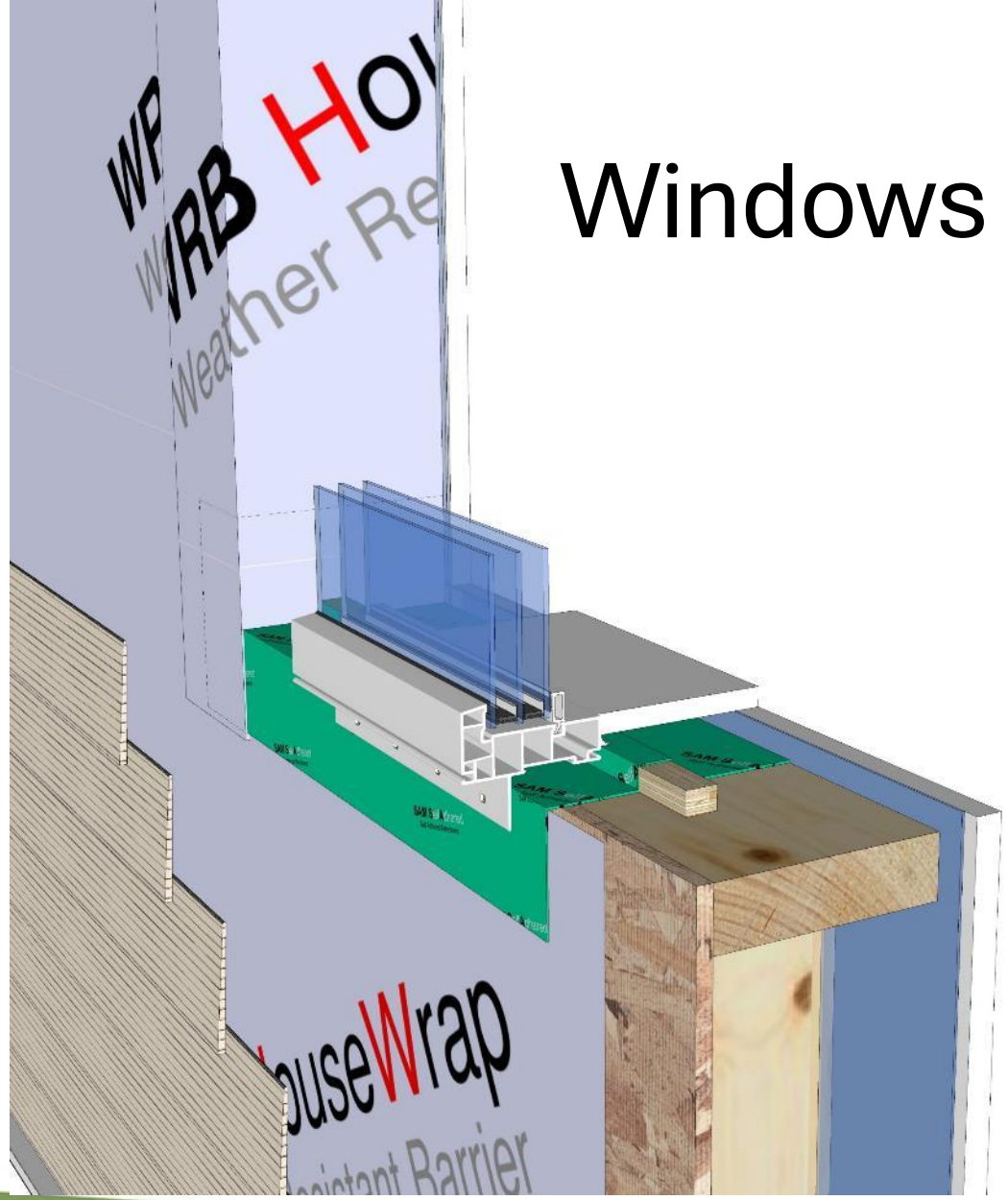
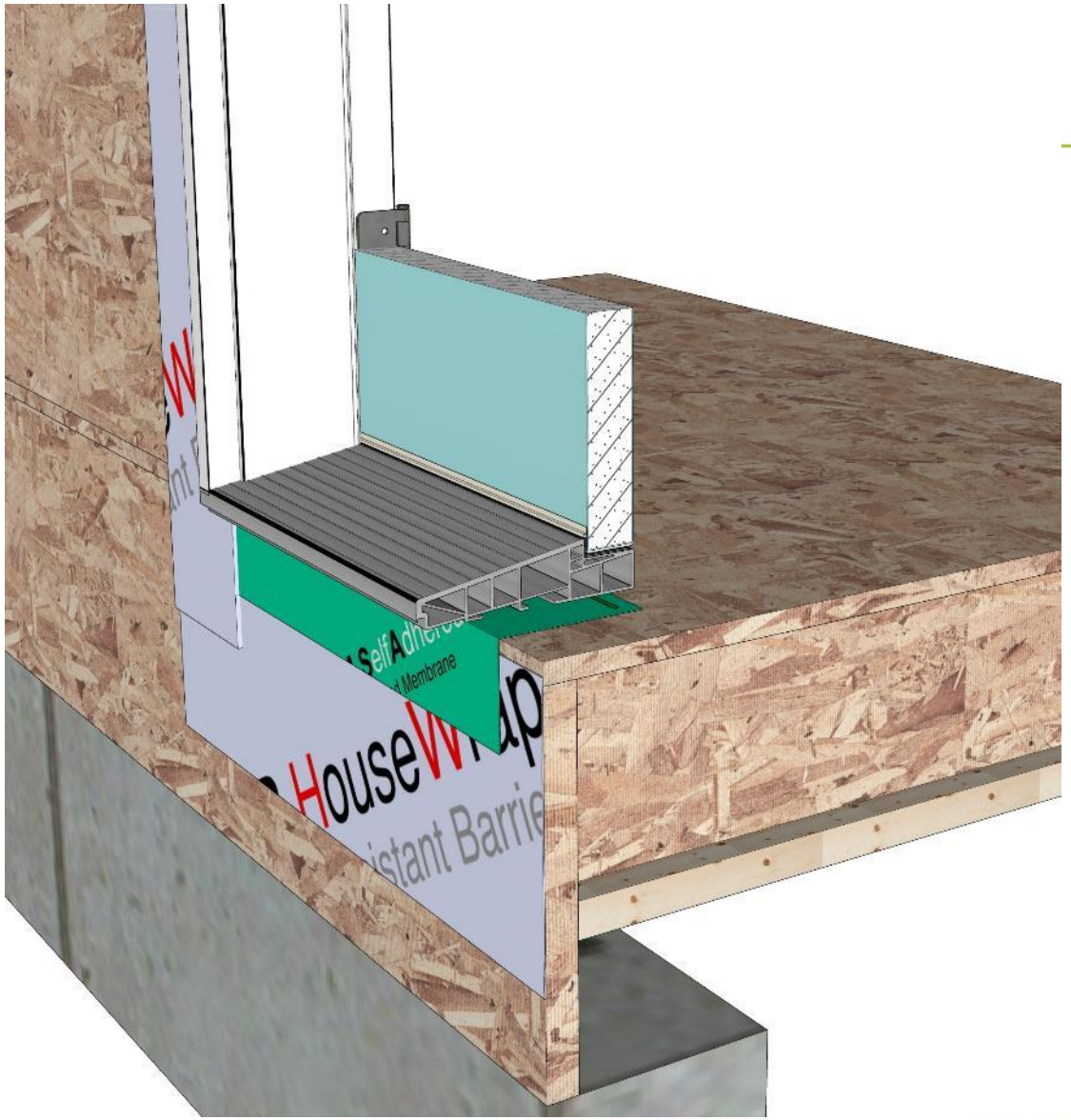


- Control the entry and accumulation then provide removal and drying



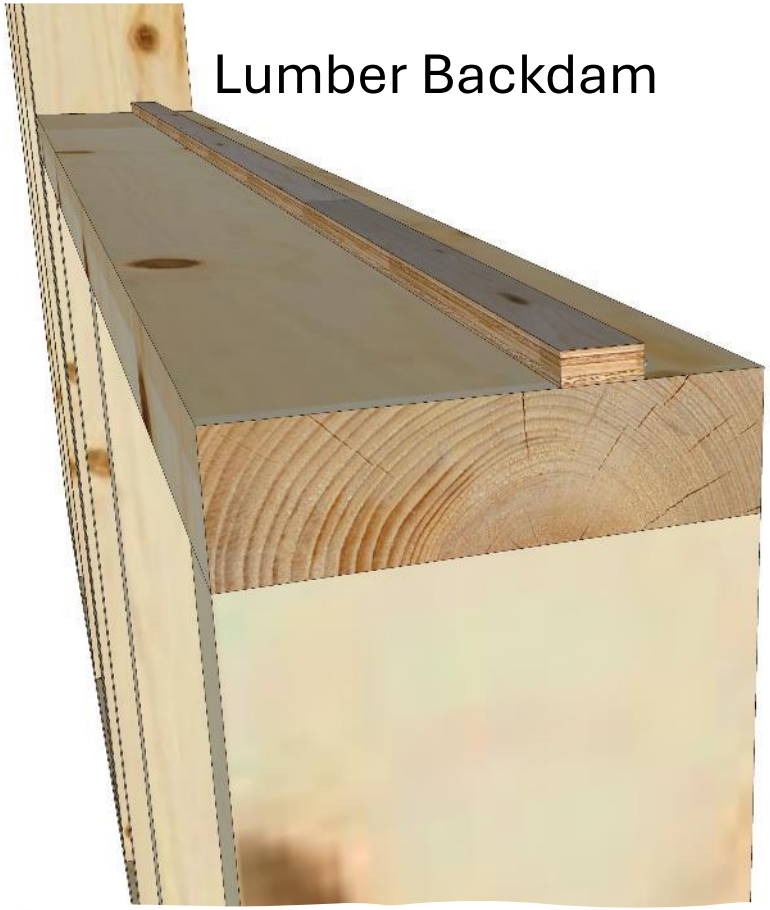
Windows


WRB
Weather Re
ouseWrap
istant Barrier


Membrane
HouseWrap
istant Barrie

Sills – Sloped or Backdams

Apply prior to self adhered membranes



Lumber Backdam

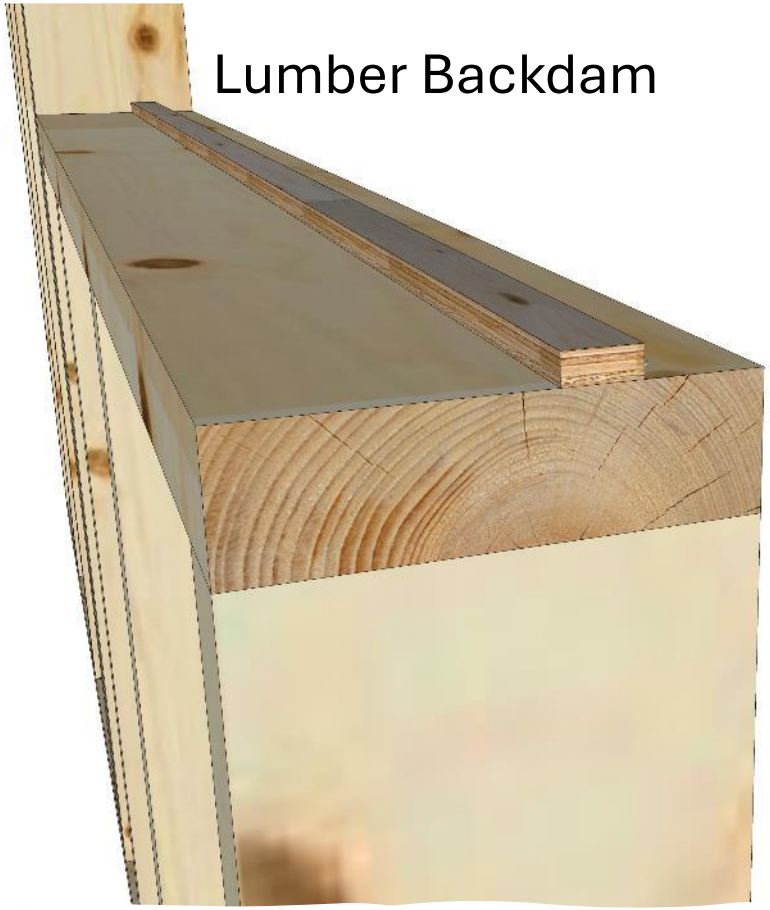
Metal Backdam

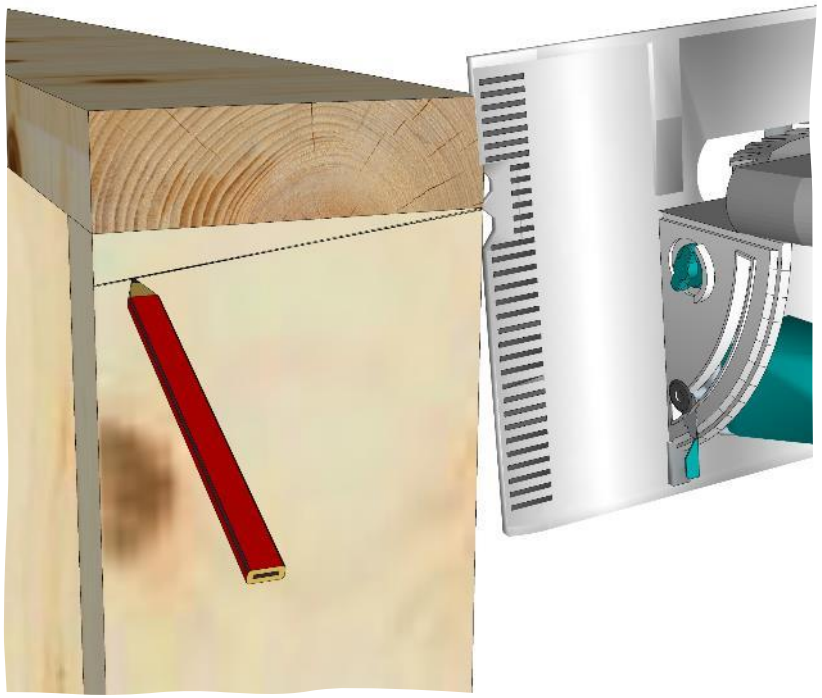
Sloped by cutting studs, or applying clapboard or pre-manufactured sloped sill

Sills – Sloped or Backdams

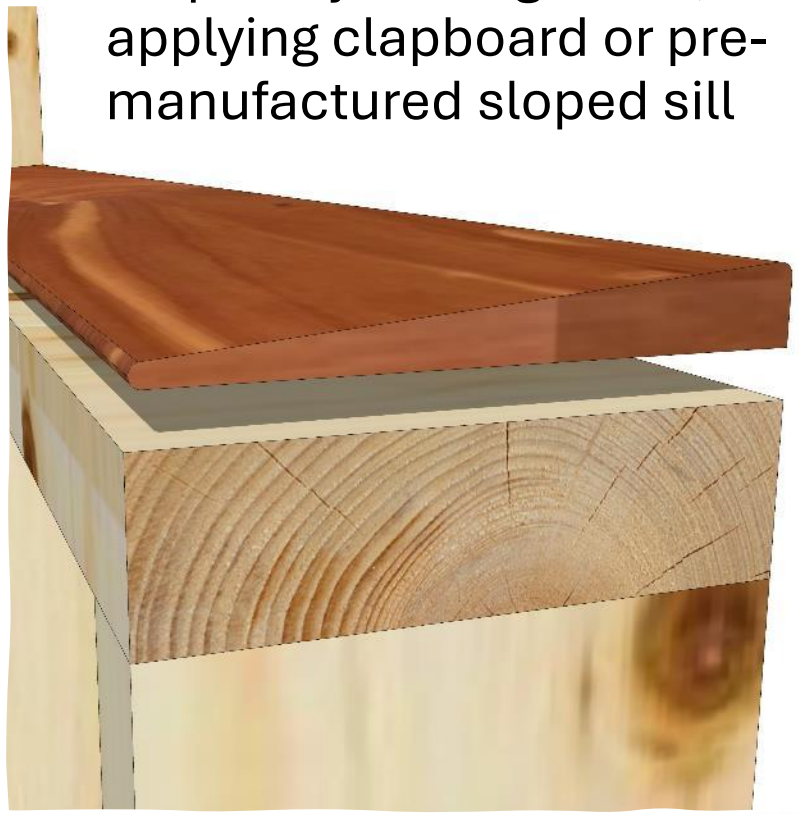
Apply prior to self adhered membranes

Lumber Backdam





Sloped by cutting studs, or applying clapboard or pre-manufactured sloped sill



Sills – Sloped or Backdams

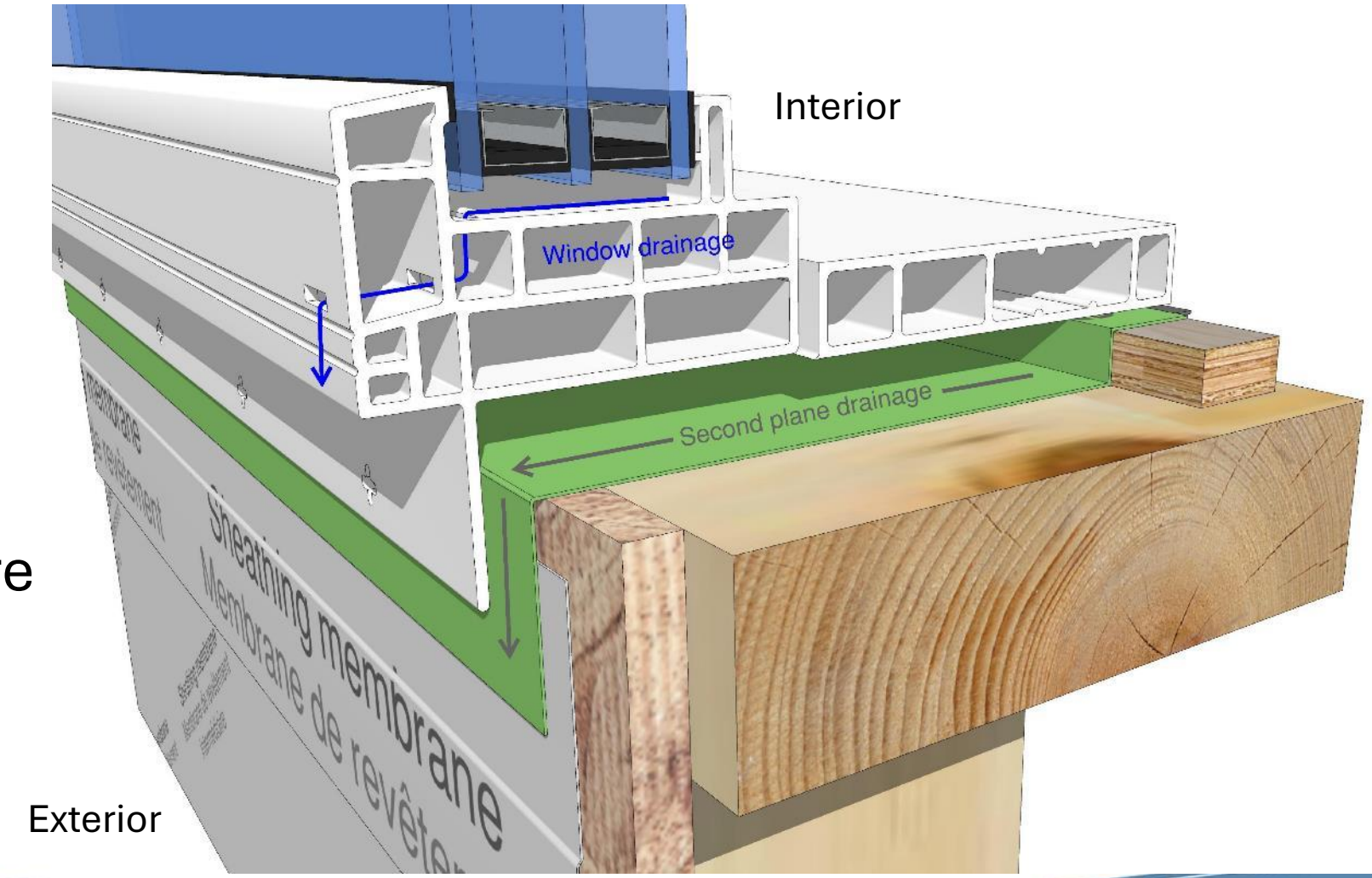
Back dam

Sloped

Back Dam

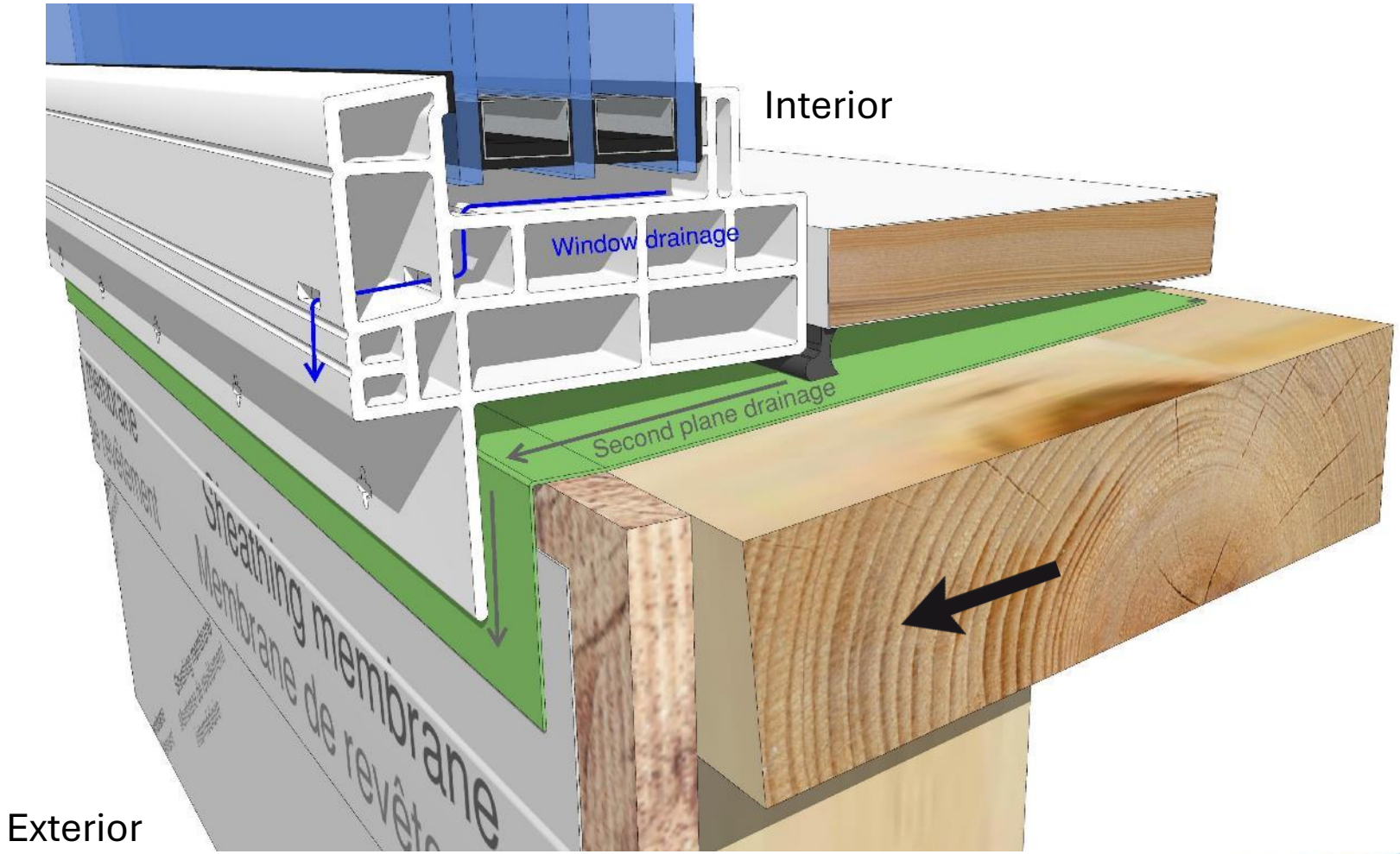
Rough opening with water impervious subsill protection drains to 2nd plane

Define 2nd plane where water is to be managed



Sloped Sill

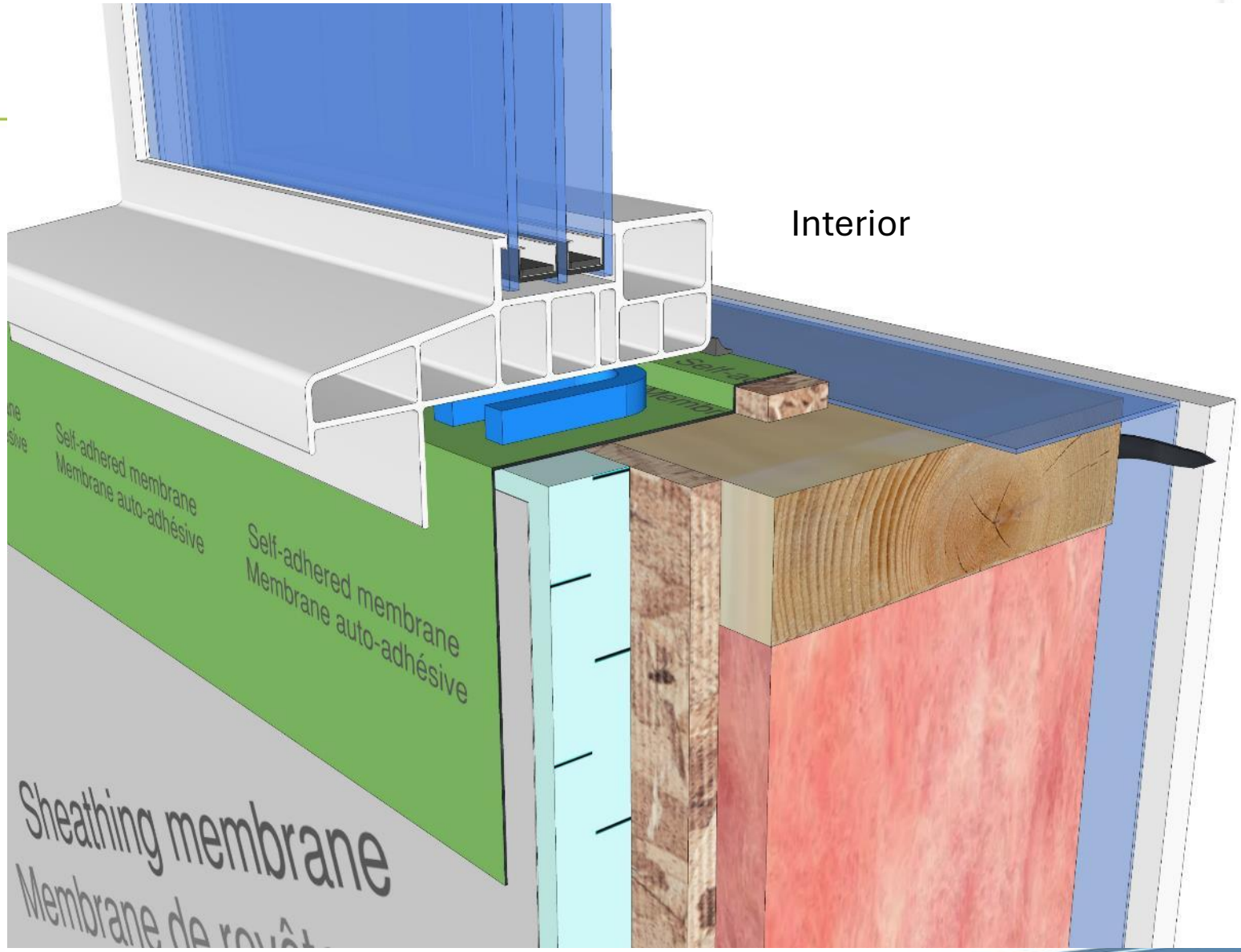
Sloped sill with water impervious subsill protection



Back Dam

c/w 1” rigid and WRB

Backdam with water impervious subsill protection to 2nd plane

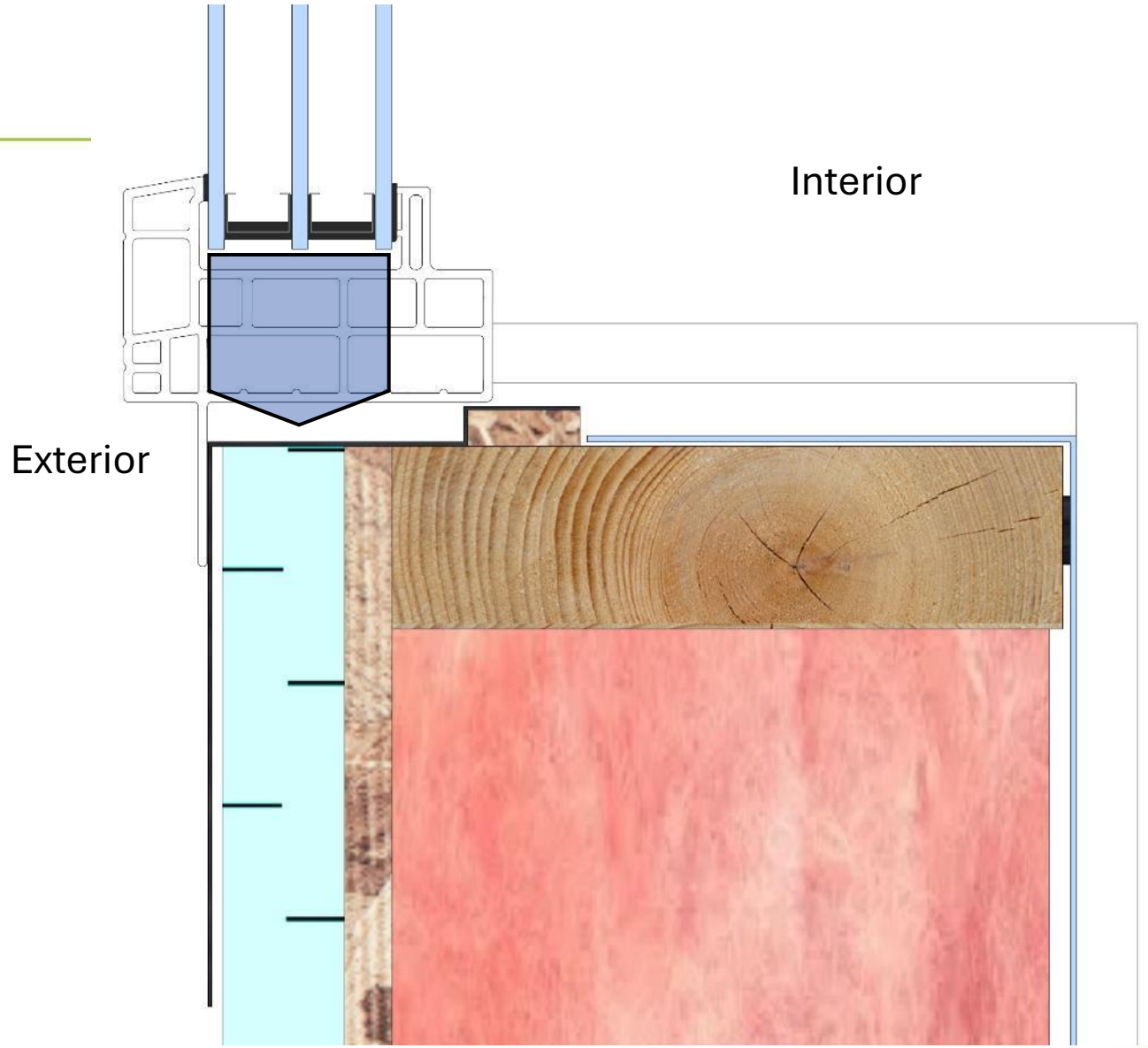


Structural

Glazing weight transfer

Move window inward to be supported by the wall

Add a structural support at the insulation layer



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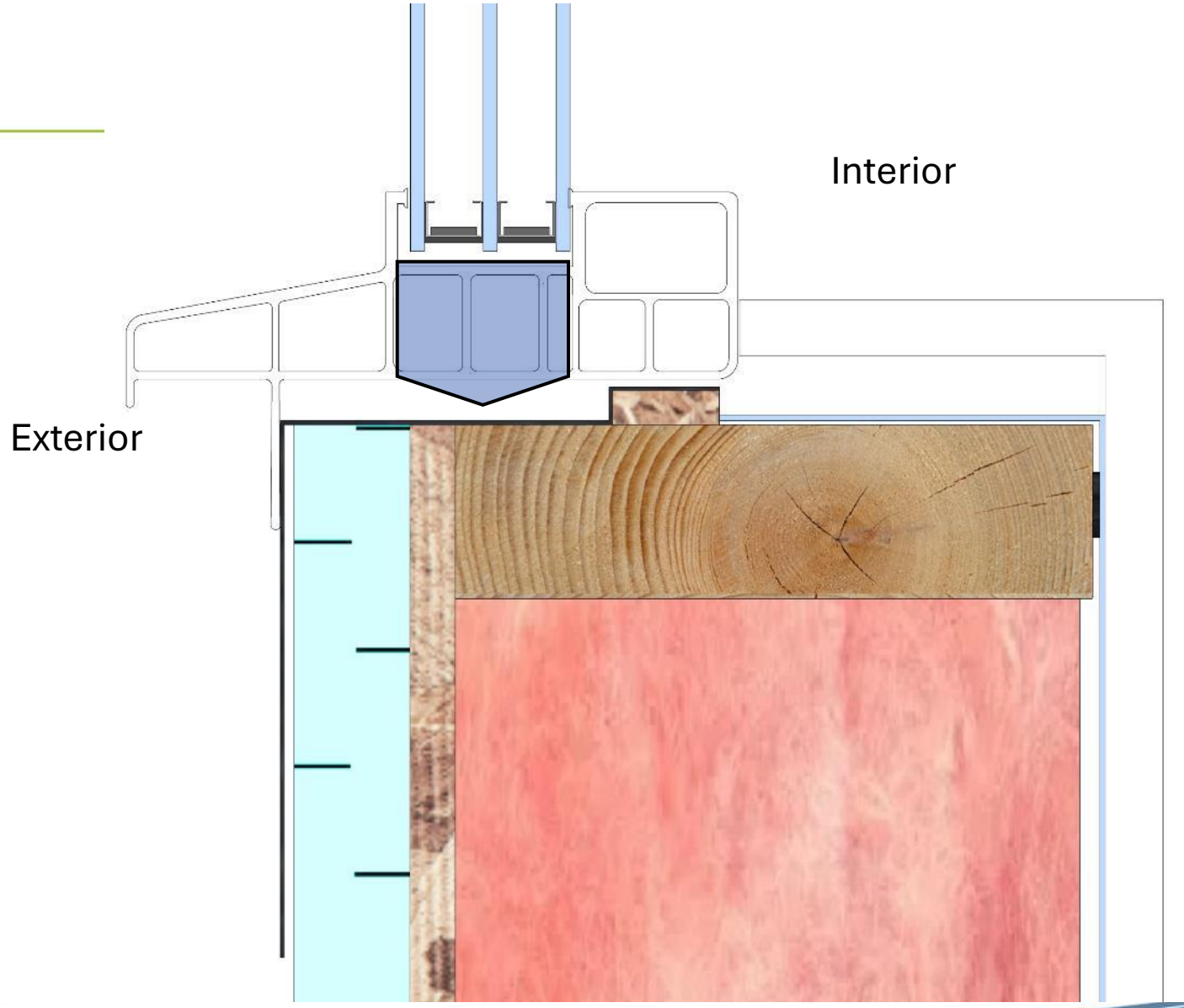


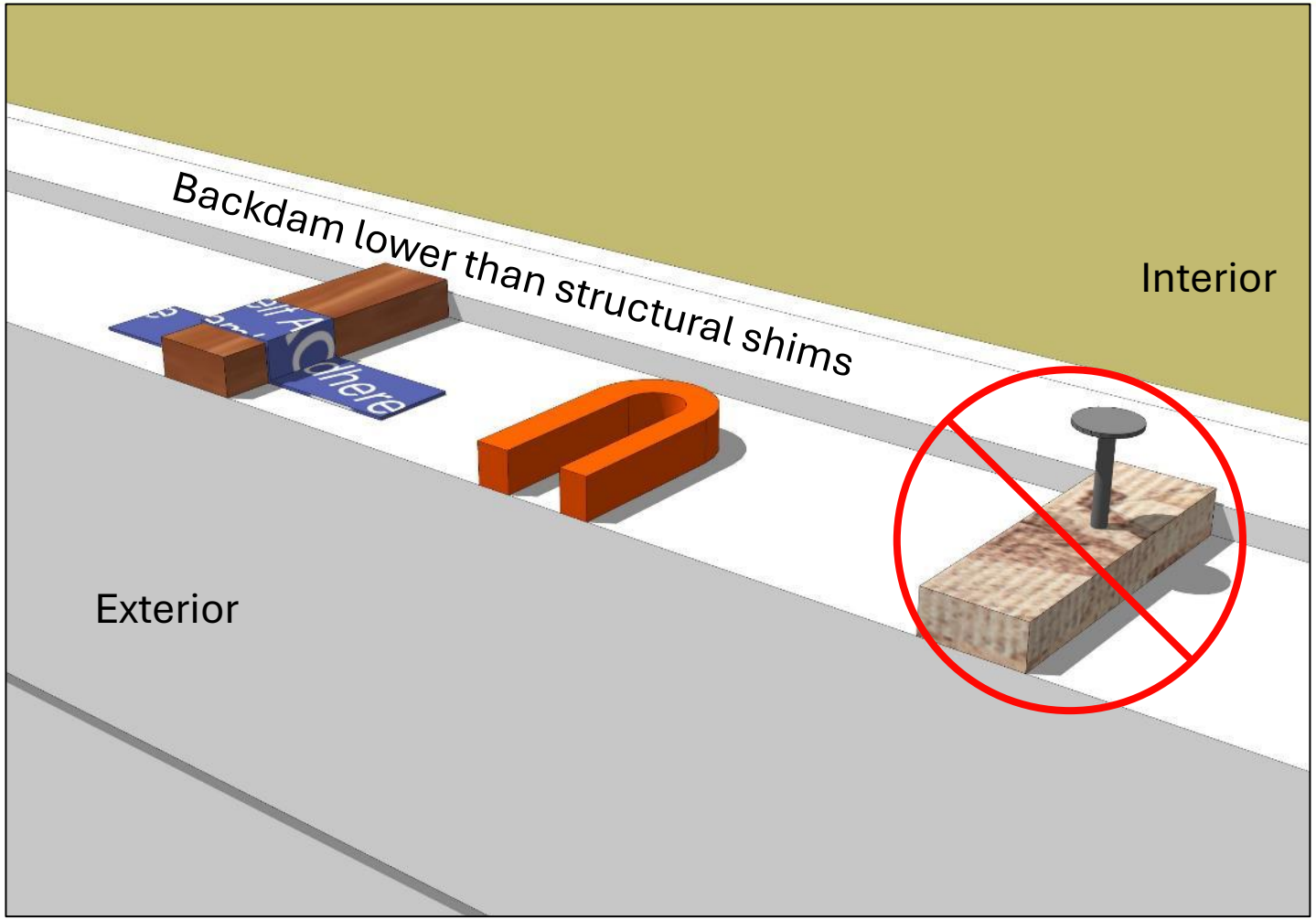
Structural

Glazing weight transfer

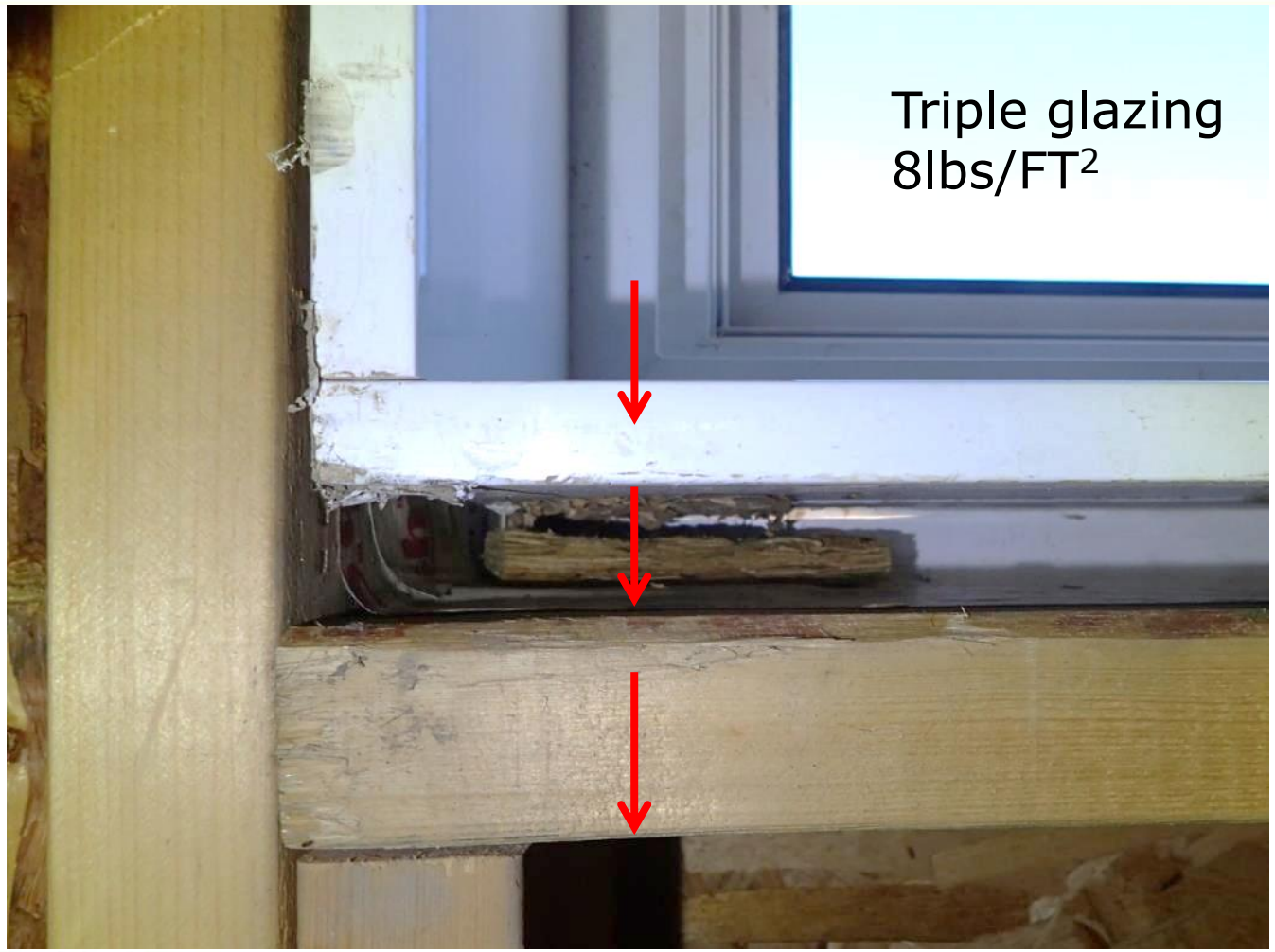
Back not used for window support

No OSB

Do not nail through horizontal plane



Supports (Structural)



Glazing

Setting blocks

Frame

Shim

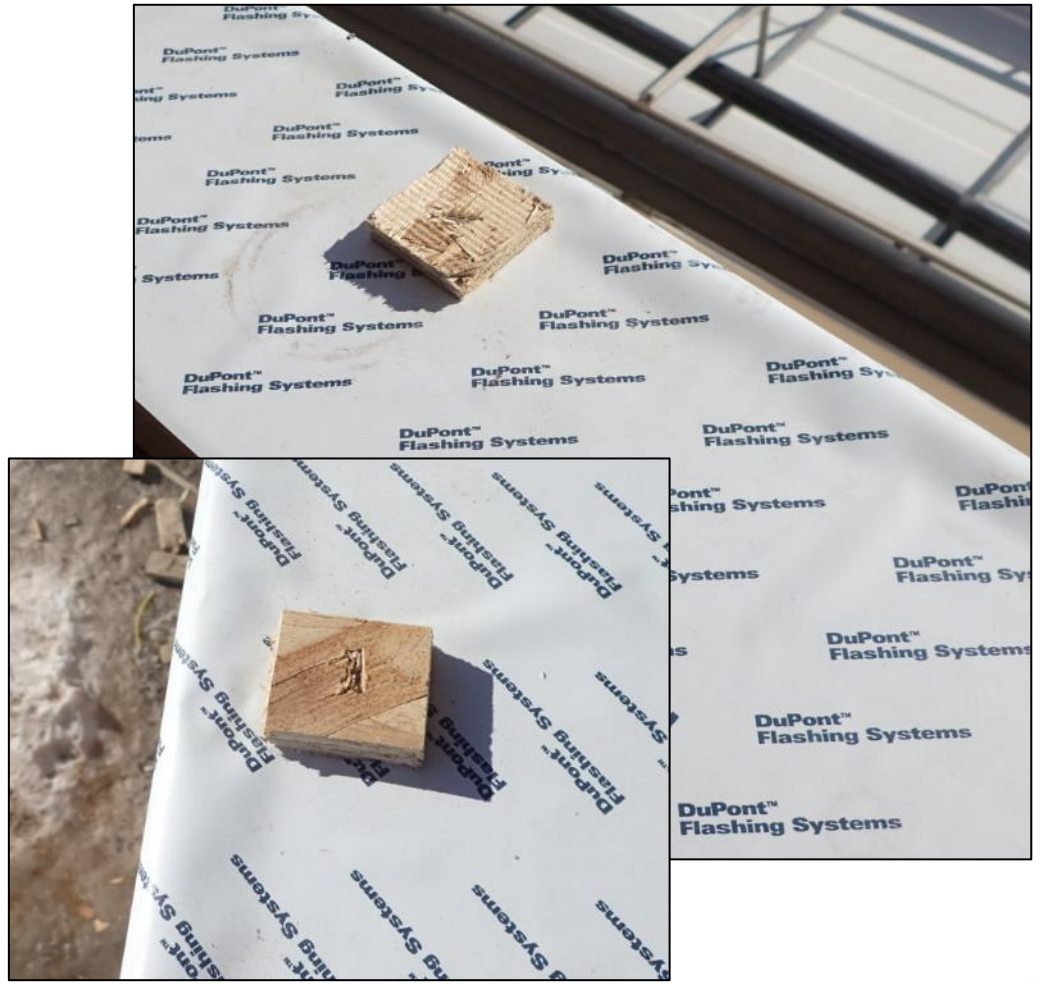
Framing

Must not be moisture sensitive

OSB NOT permitted as shims

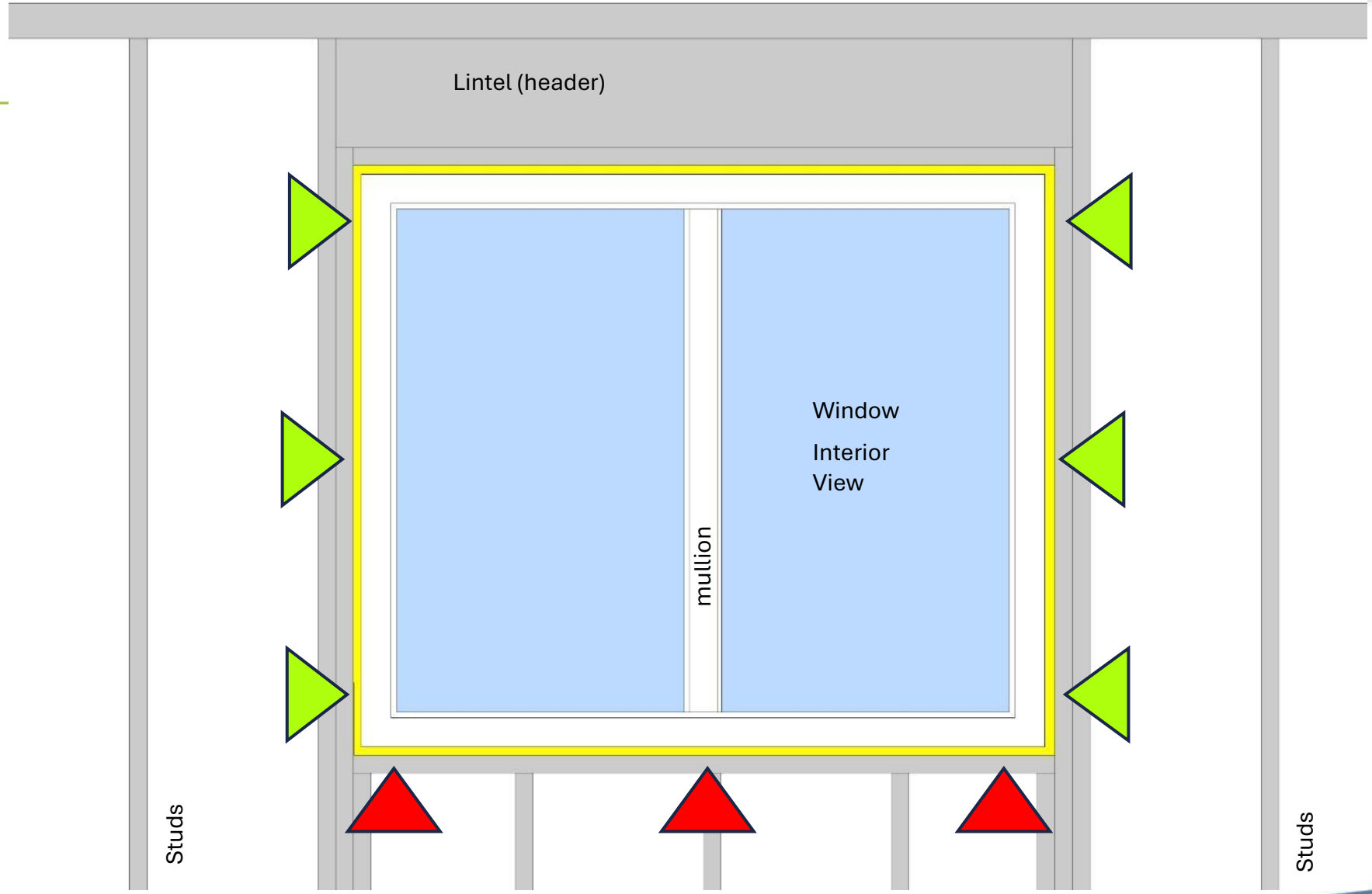
Supports (Structural)

- Moisture sensitive materials such as OSB should not be used
- Avoid nailing through shims – adhered only



Window Structural Support

Blocking required 3 sides for non-flanged windows



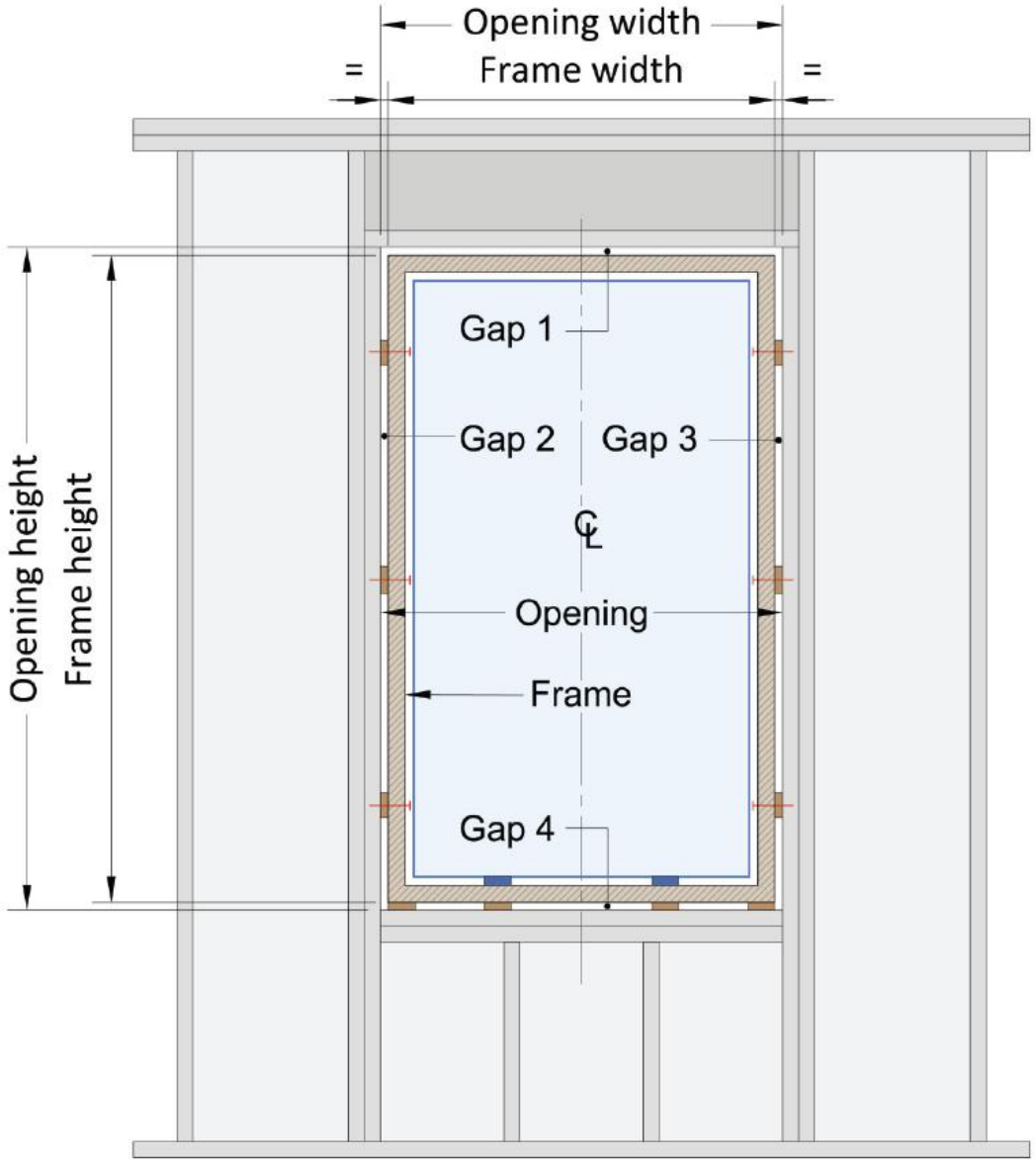
Window Structural Support

Non-flanged

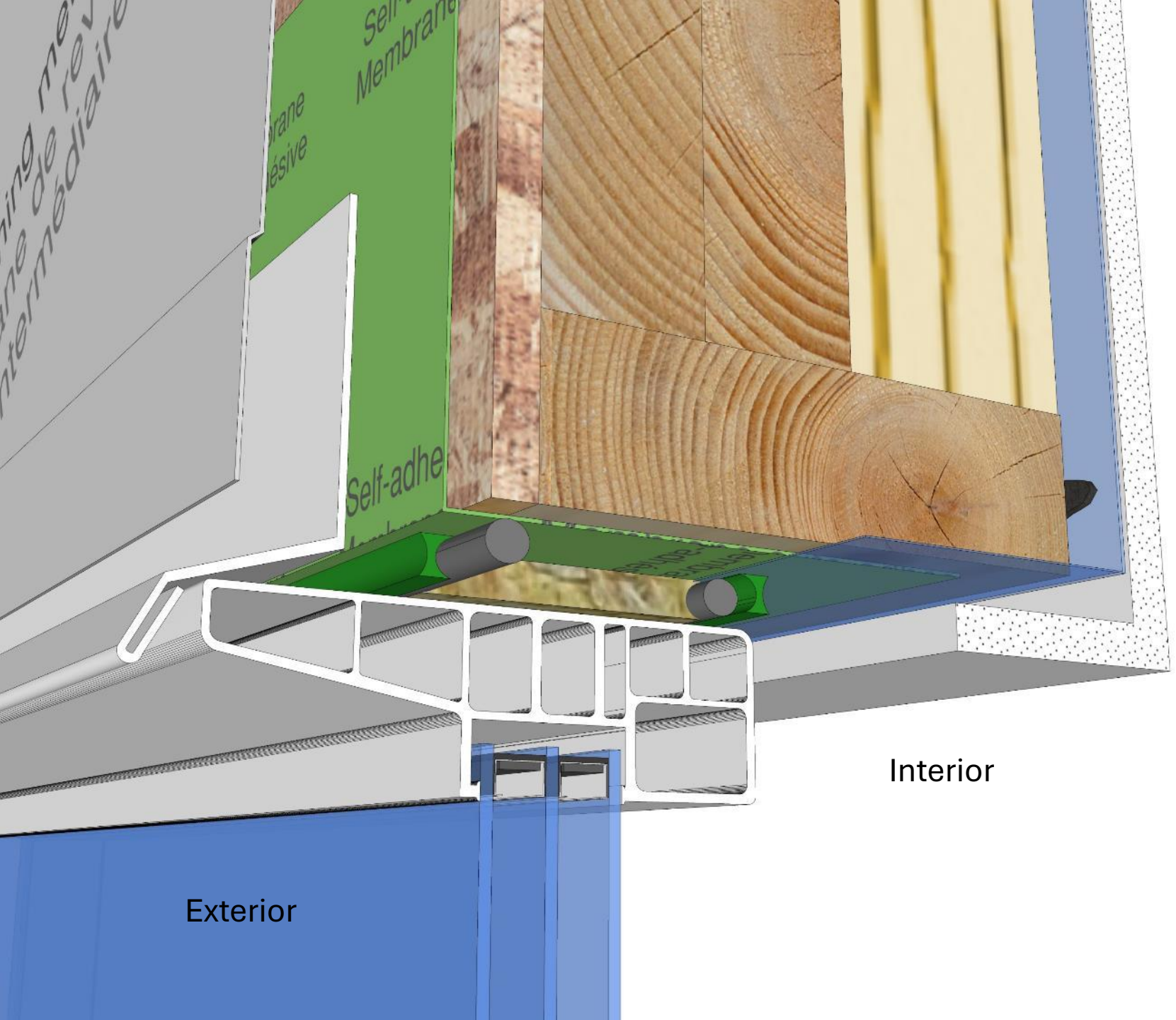
Casement

Tilt and turn

Triple glazed



Non-Flanged Window



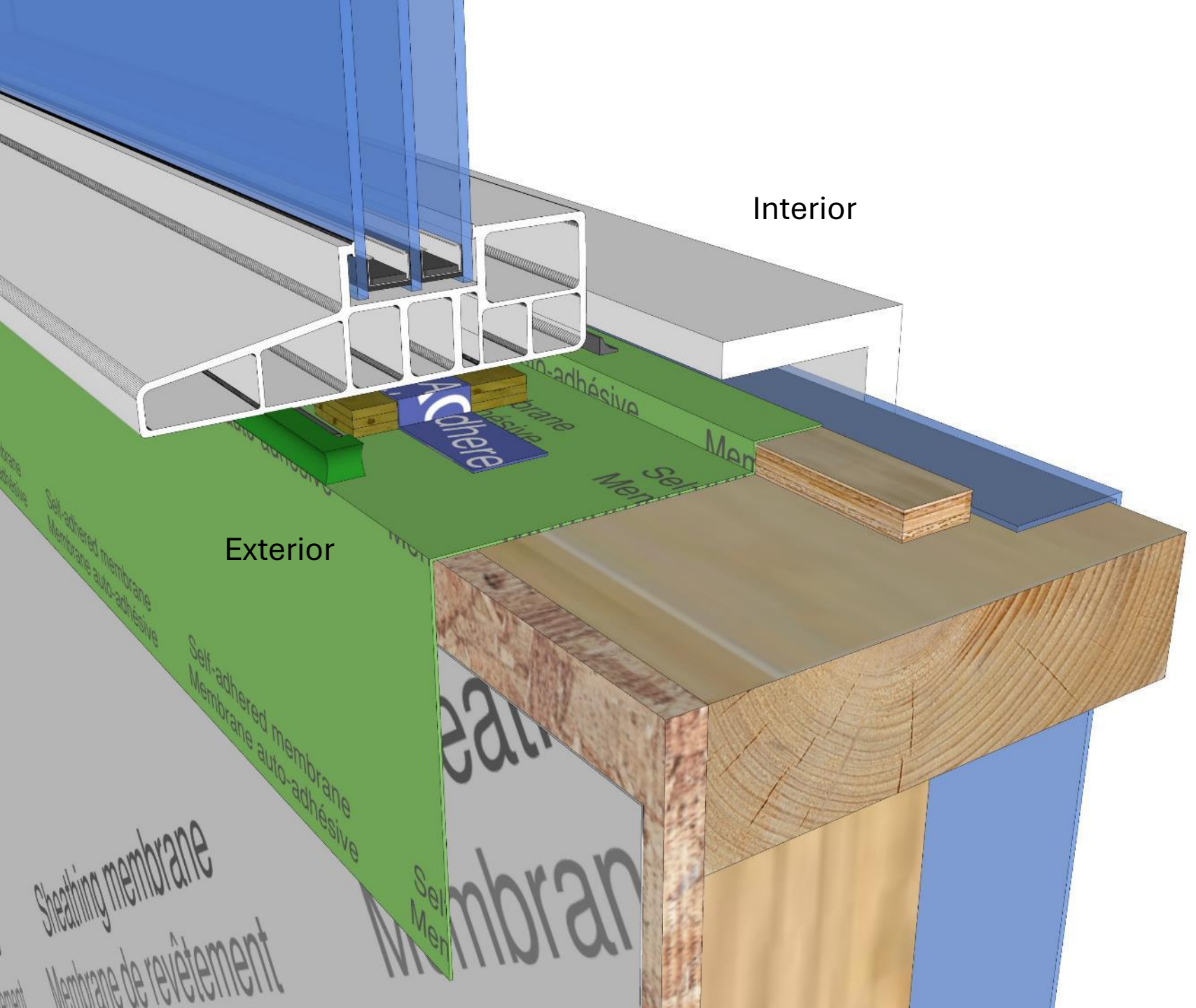
Backer Rod and sealant for exterior and interior

Interior is the primary air barrier

Exterior is primary water barrier

Canada

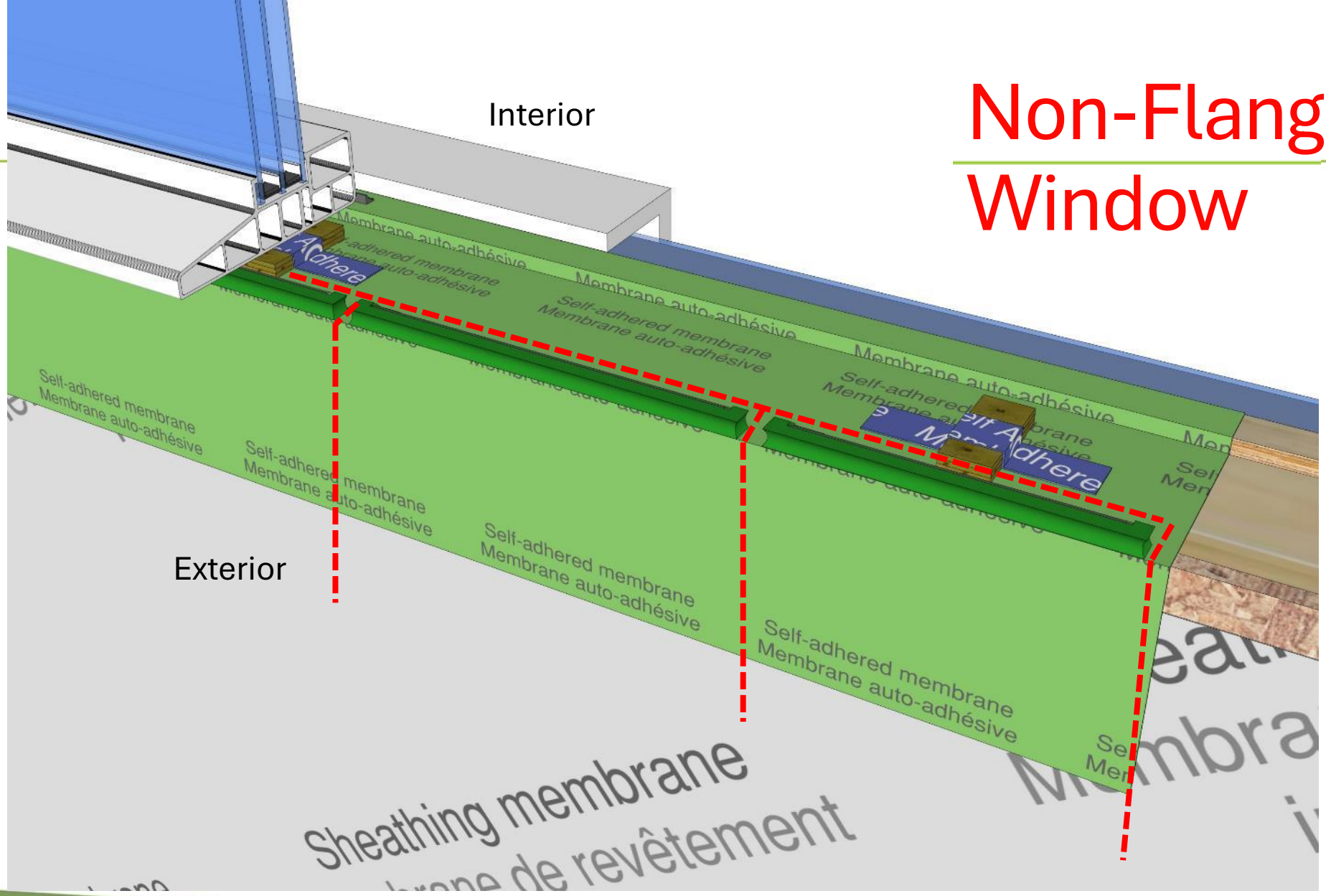
Non-Flanged Window



Back dam provide primary air seal and water seal

Exterior backer and sealant require weeps

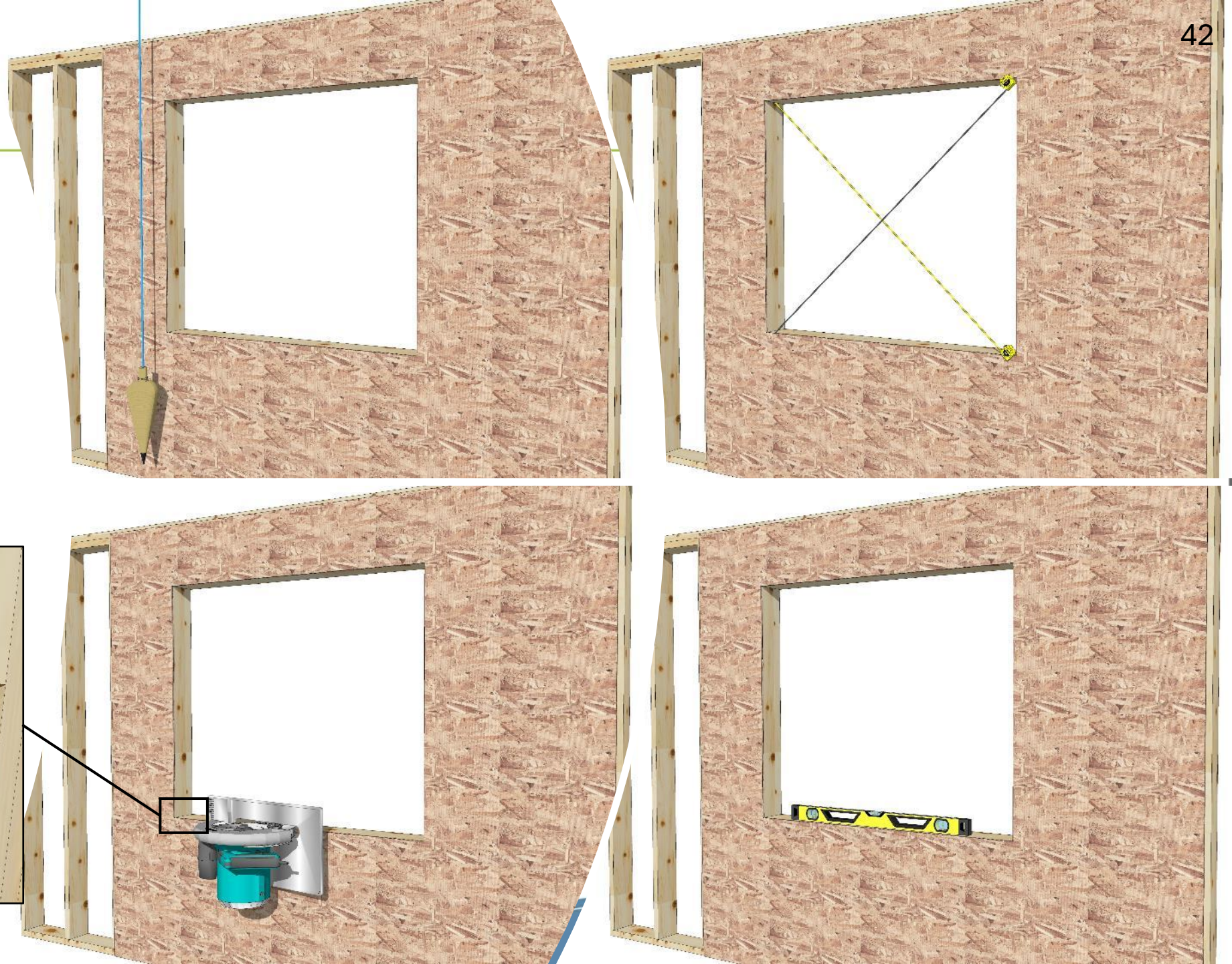
Non-Flanged Window



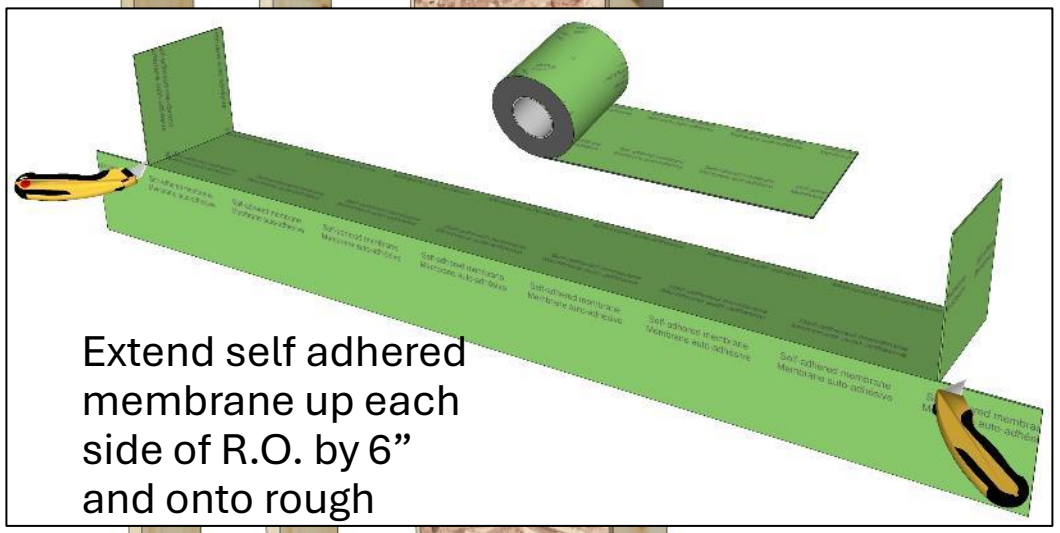
Provide weeps for sill pan 2nd plane should allow for full drainage of cavity

Installation basics

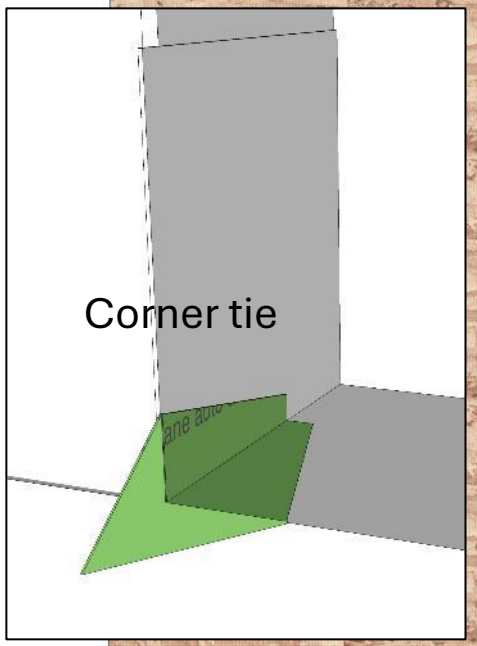
- Plumb
- Level
- Square
- Sheathing flush



- Where WRB installed AFTER windows, apply a strip of WRB below window or door R.O.
- Apply primer as per manufacturer recommendations

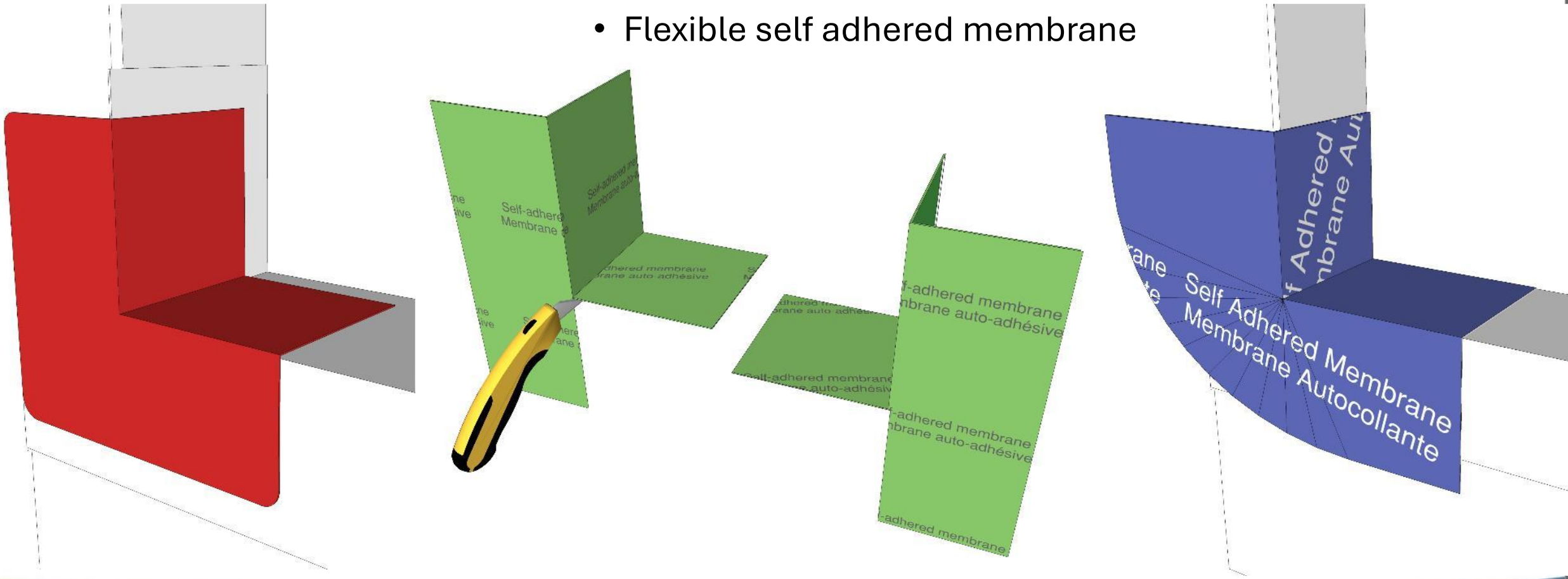


Extend self adhered membrane up each side of R.O. by 6” and onto rough

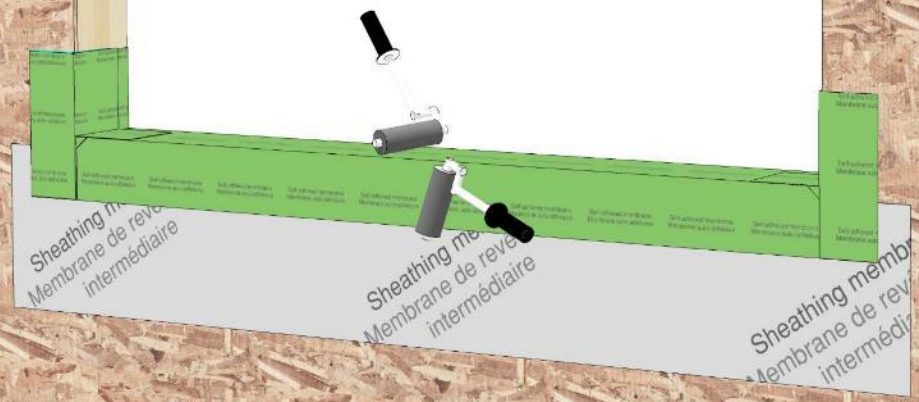


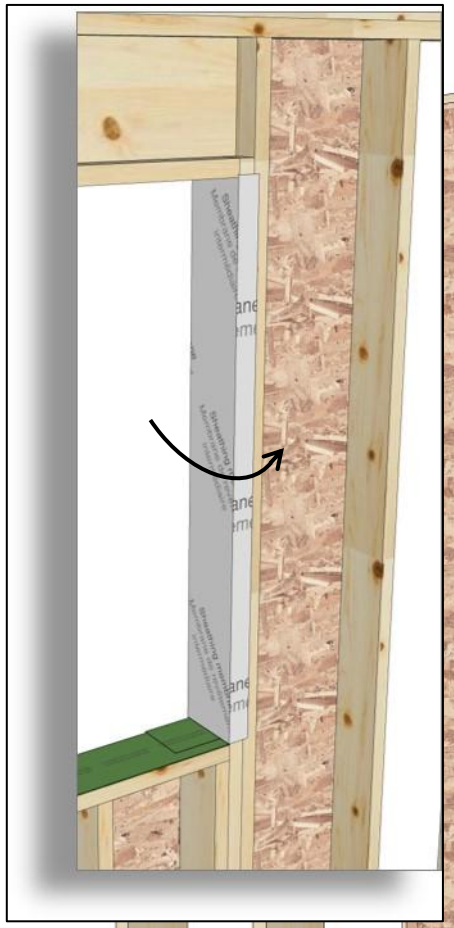
Corners:

- Hand made from Self adhered membrane as shown
- Pre-manufactured corners
- Flexible self adhered membrane



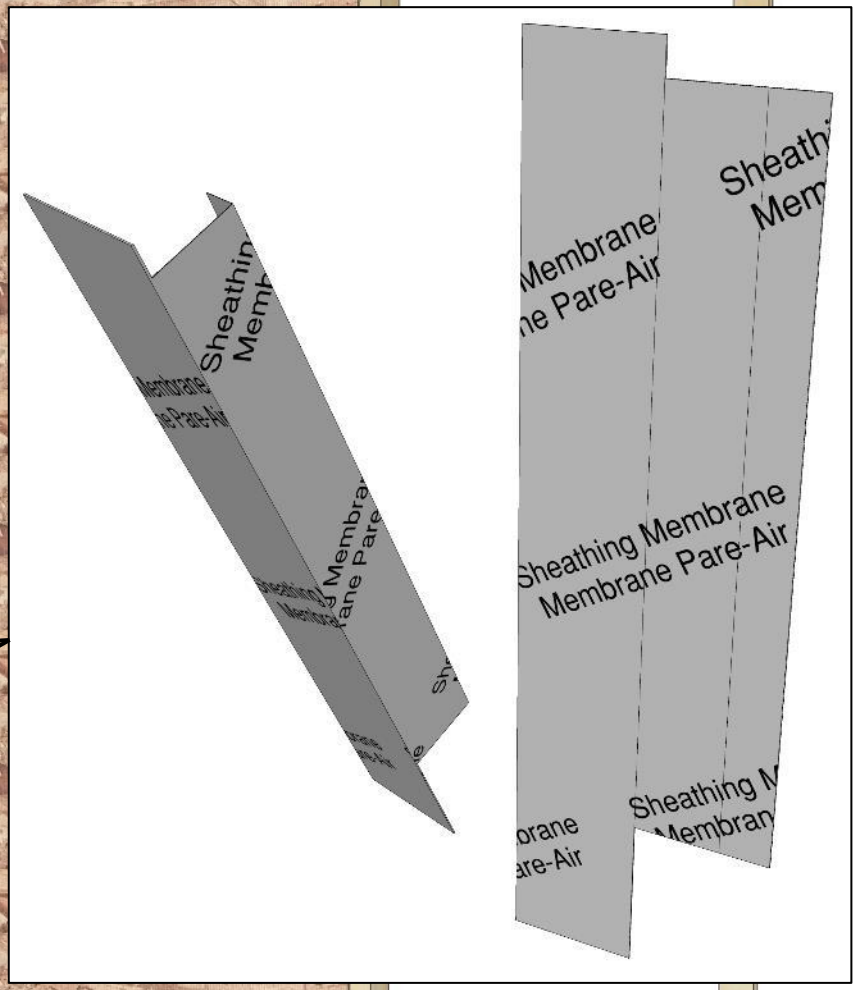
During or shortly after application of self adhered membranes use a small hard roller to ensure adherence as many membranes use pressure sensitive adhesives.





Rough opening is part of 2nd plane of protection, therefore should be protected on sides to encourage water drainage from upper to lower and onto waterproof sill protection.

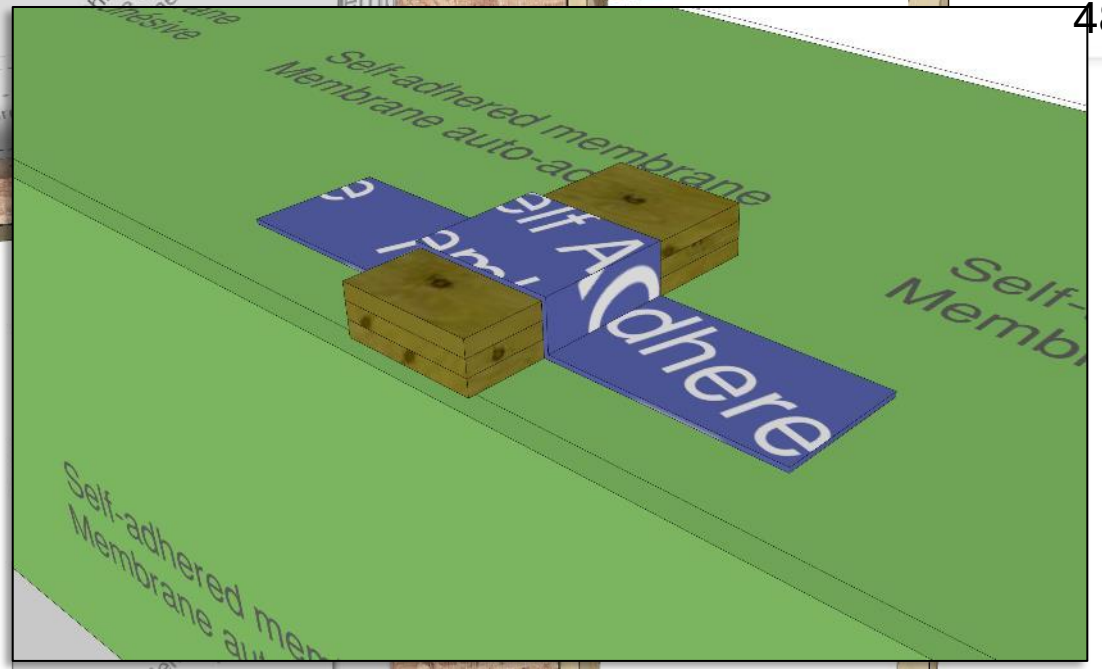
Folding into interior ensures tie into interior primary air barrier

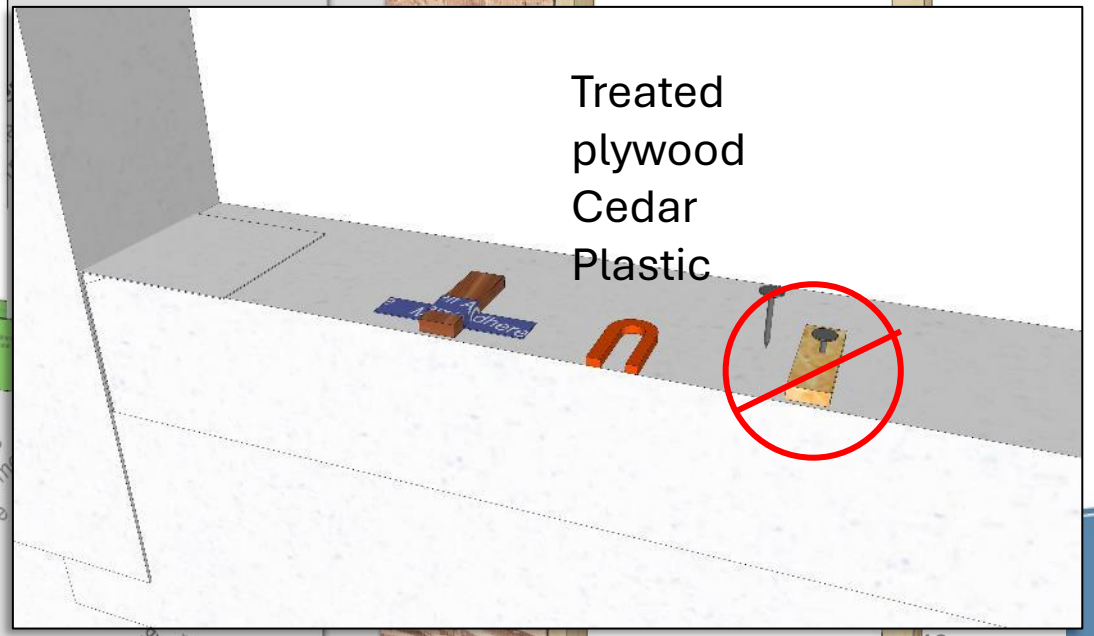


Shims

Shims are to transfer the weight of the window glazing through the frame and onto the shims, which then carry that load to the framing.

Do not fasten through the horizontal membrane

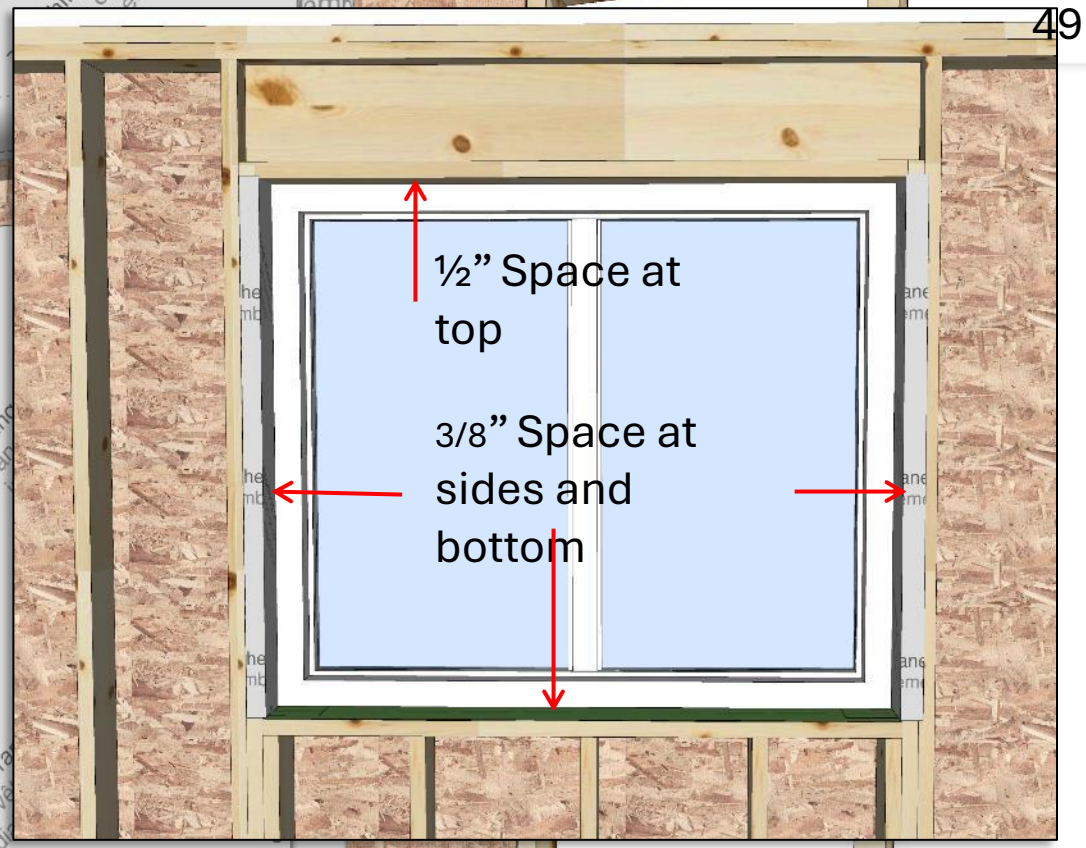




INSTALL

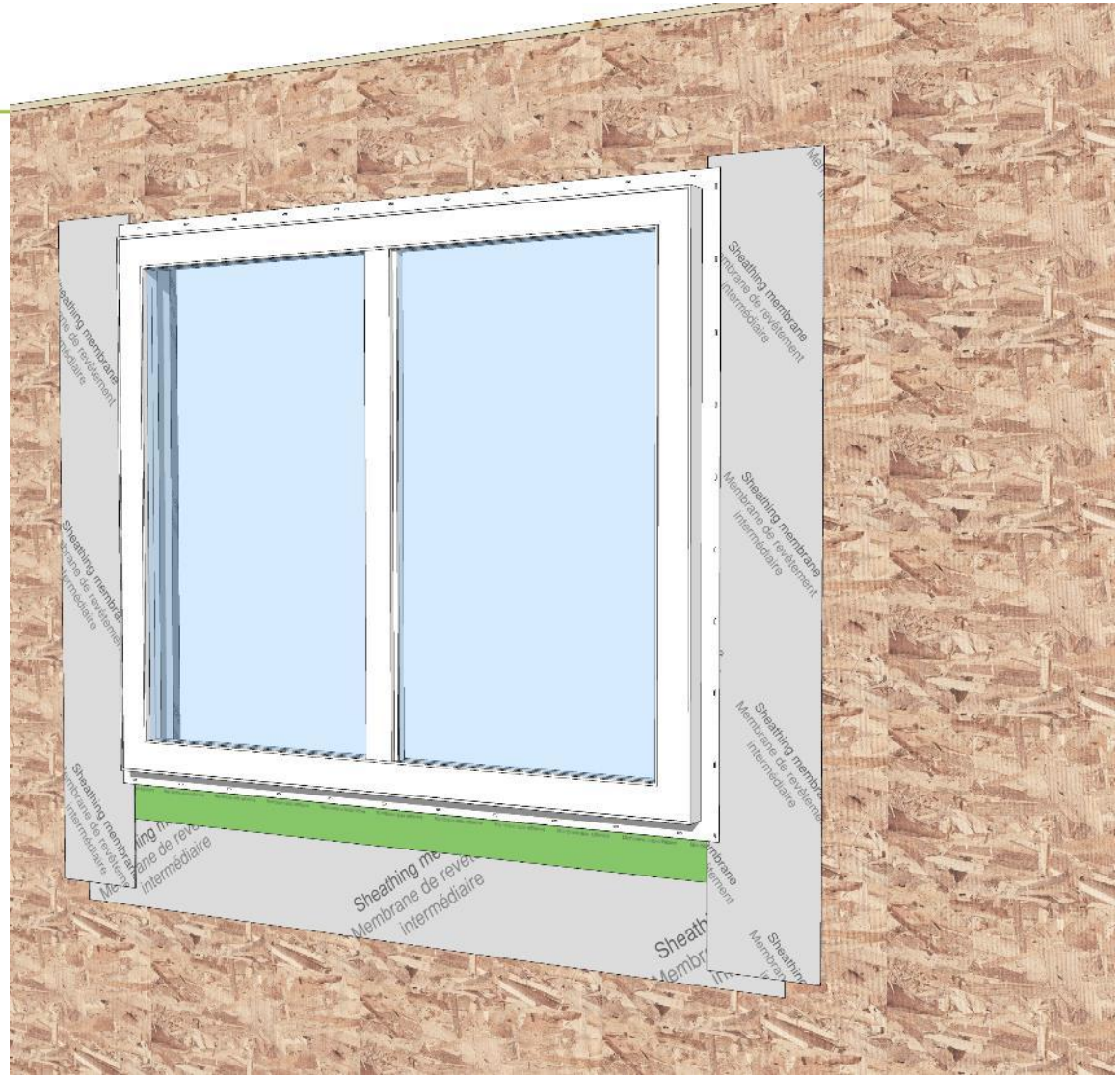
The window can now be installed.

- Center in opening
- Set window directly onto shims
- Nail or screw through slots in flange
- Fasten every second cutout
- Do not nail within 6” of each corner

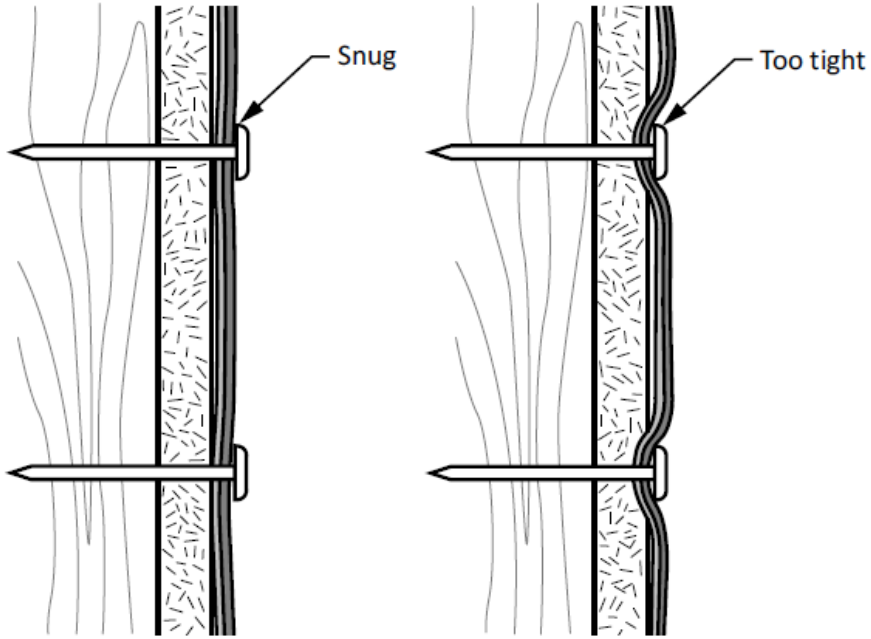


Fastening

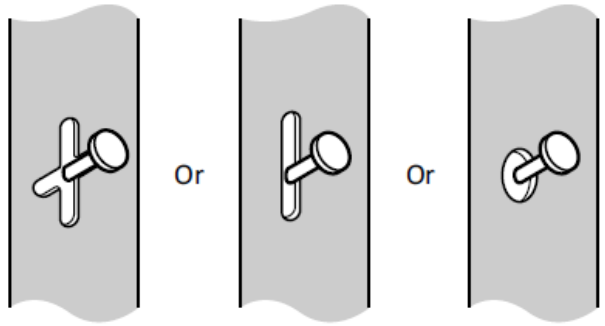
Install fasteners into slotted spaces and do not overtighten. uPVC vinyl windows must be able to expand and contract similar to vinyl siding



Fastening



Detail A



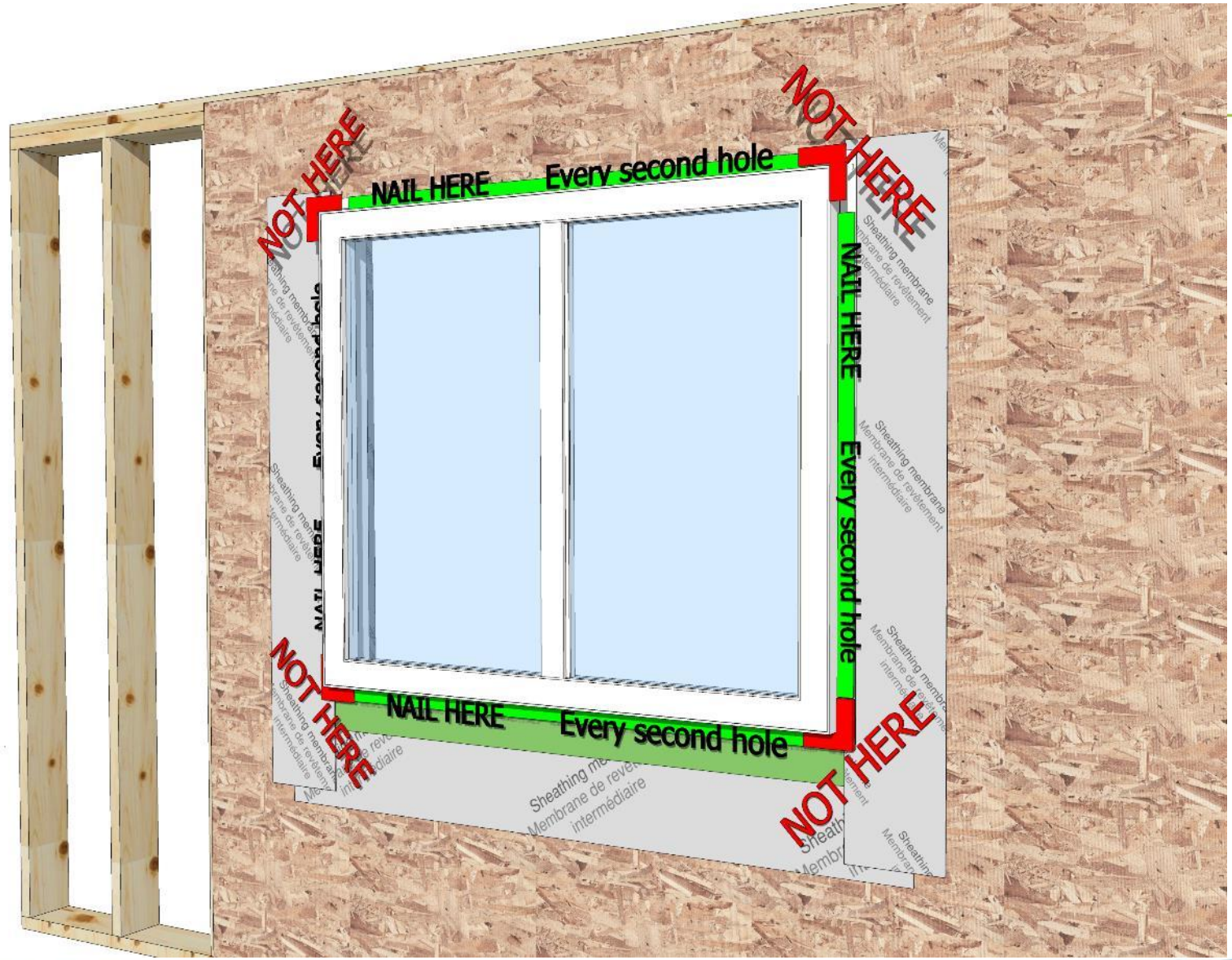
Nail placement options

Detail B

Fastening

Install fasteners as per manufacturers instructions.

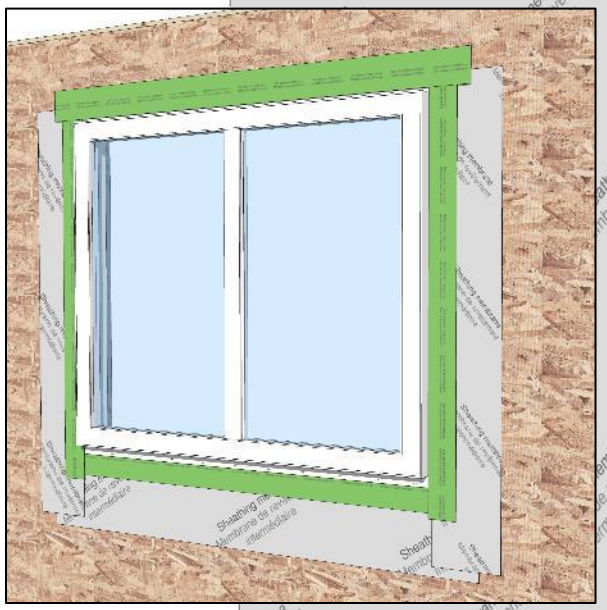
Windows have been tested based on how the manufacturer installed

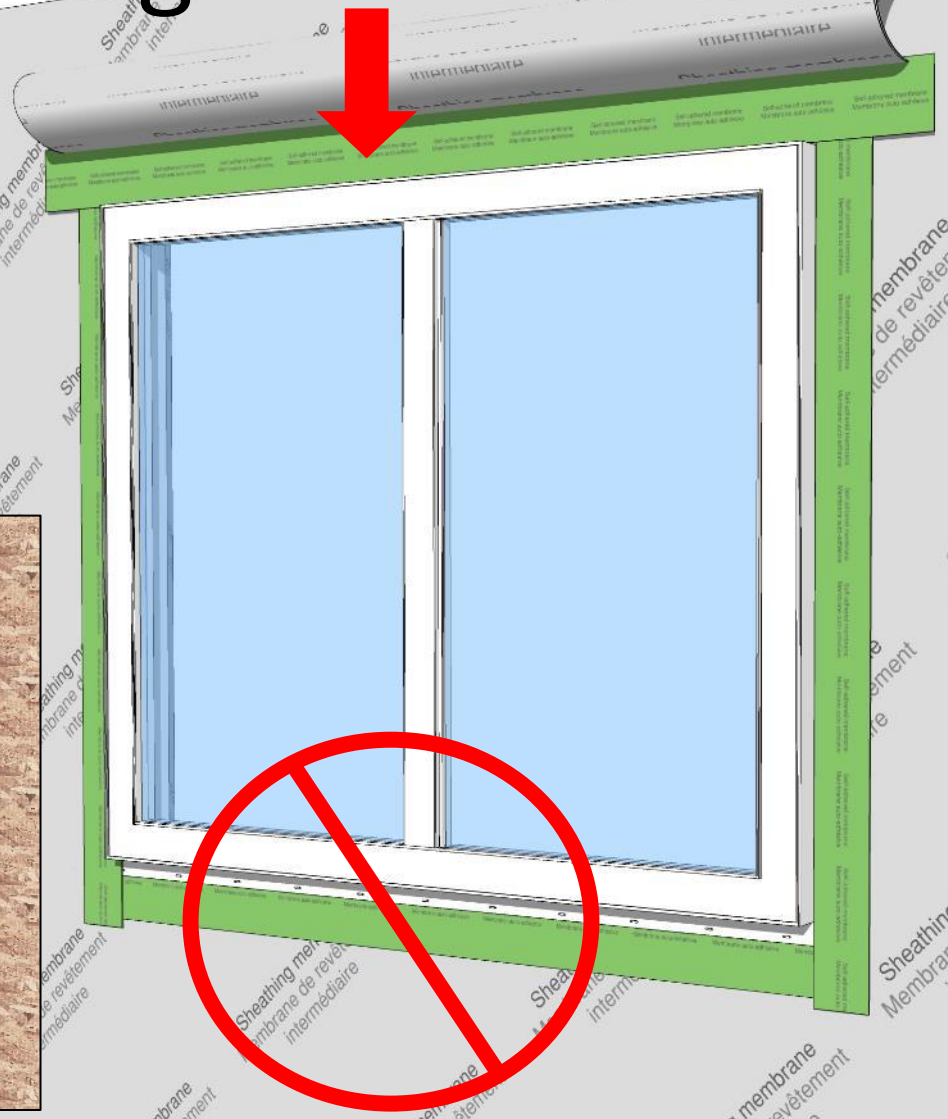


Seal head flange

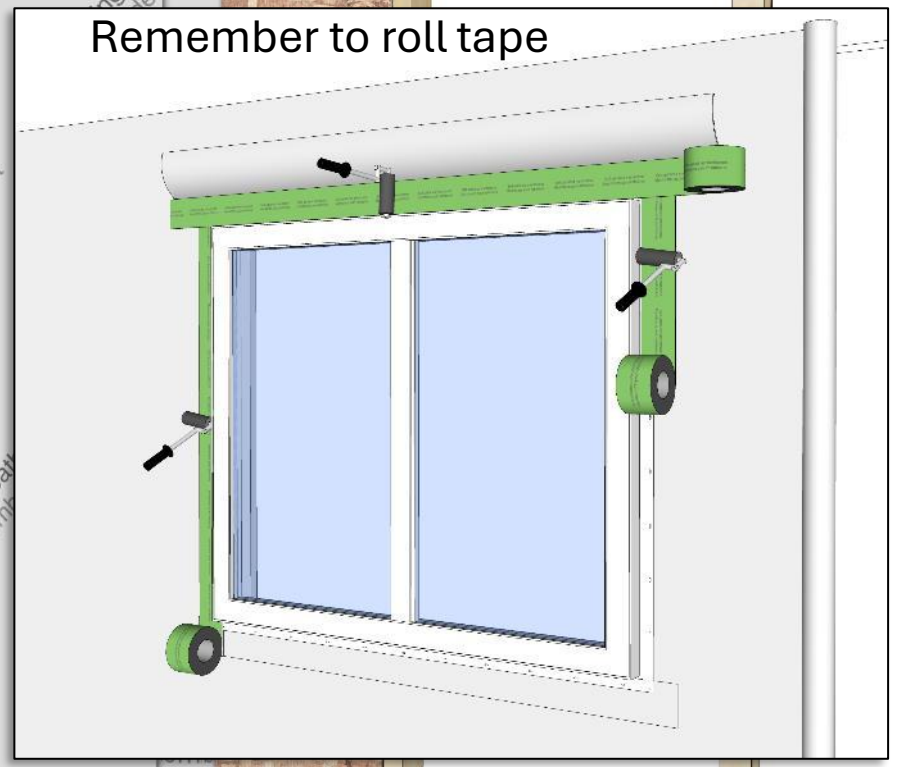
Seal the head flange with self adhered membrane

Do not seal the sill

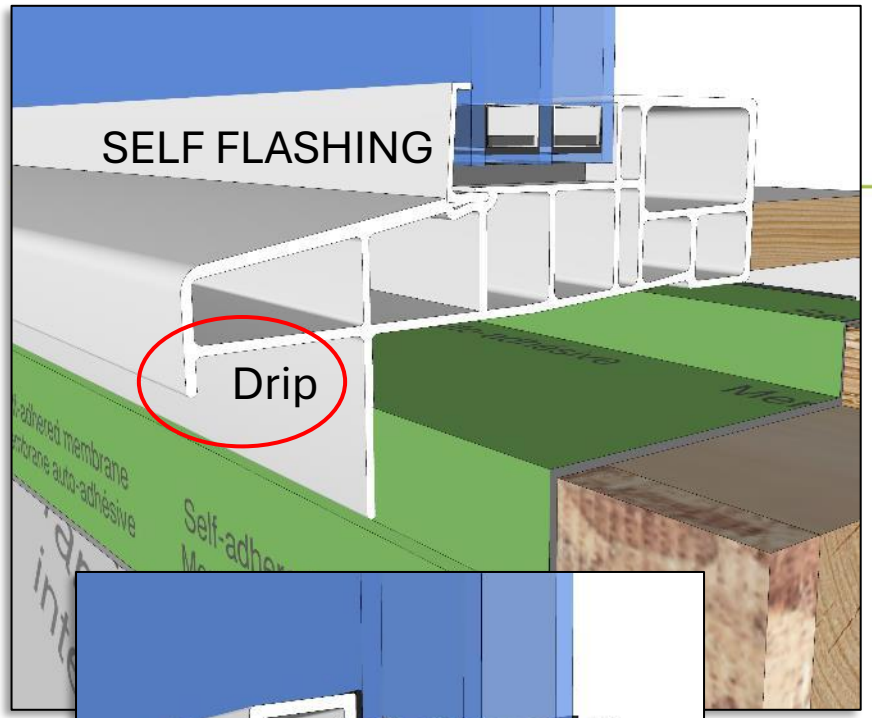




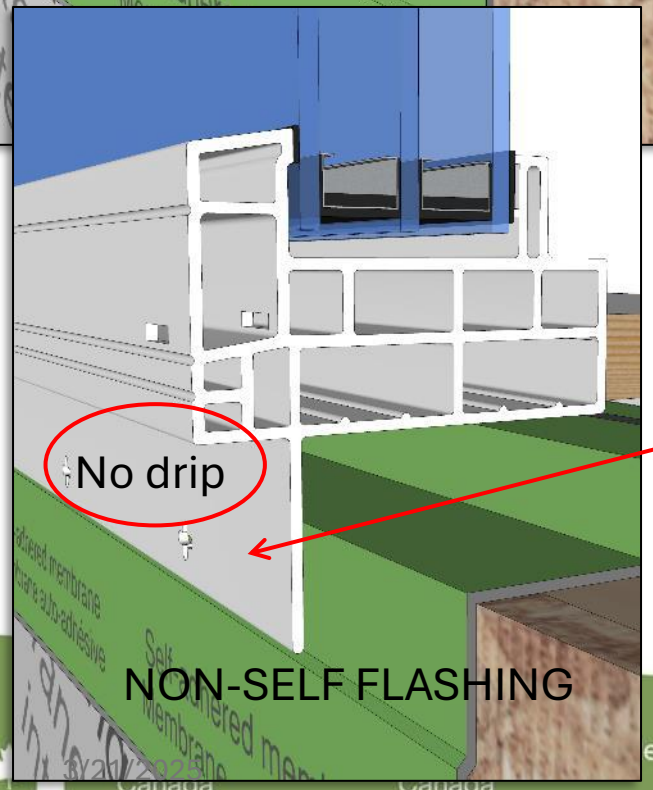
Remember to roll tape



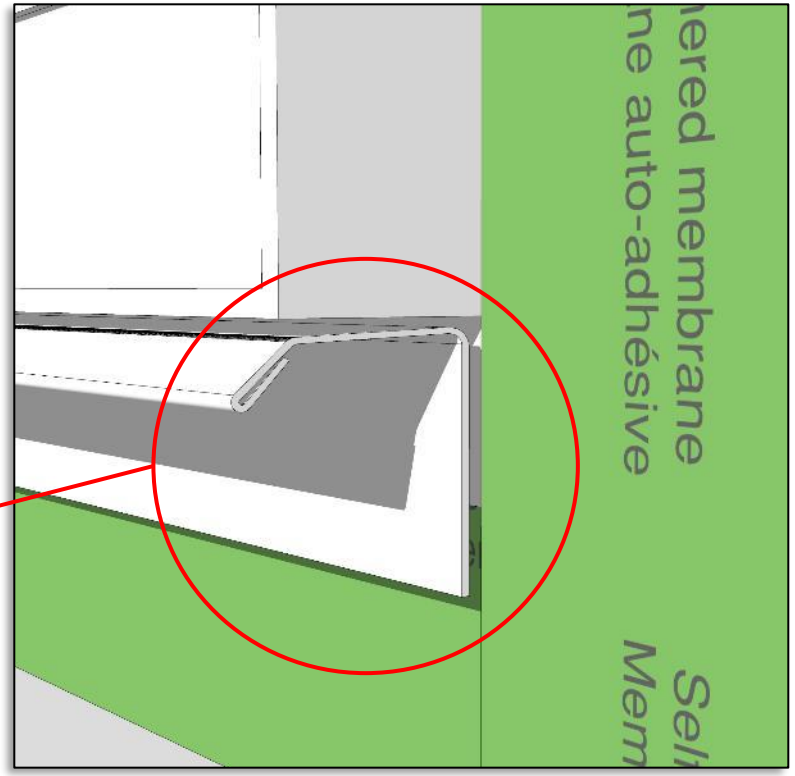
SELF FLASHING



Self flashing windows do not require an additional flashing

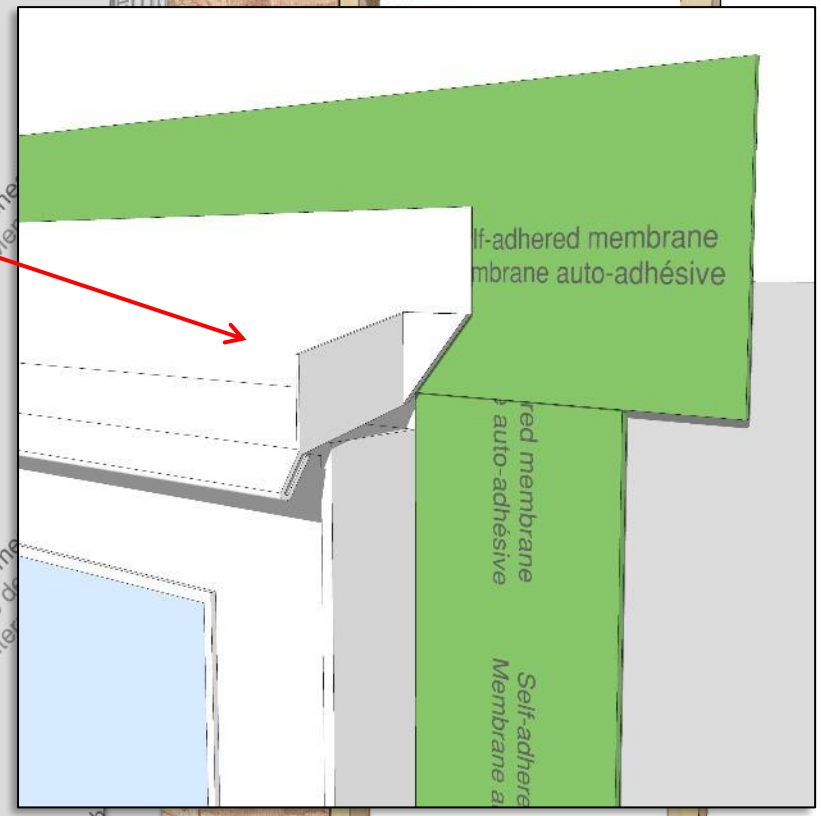


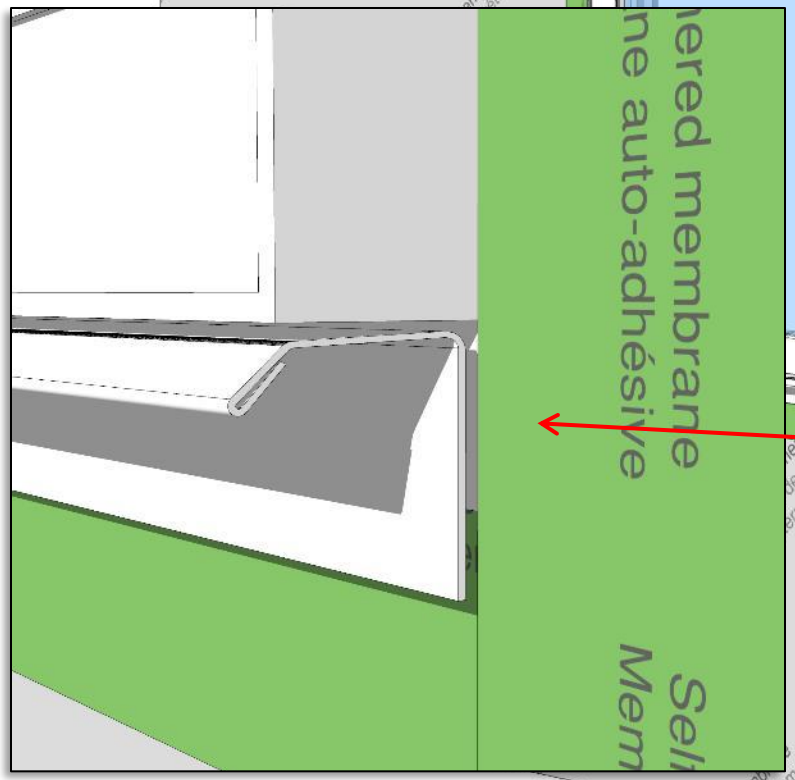
NON-Self flashing window requires an additional flashing – as image on right



Install the head flashing with

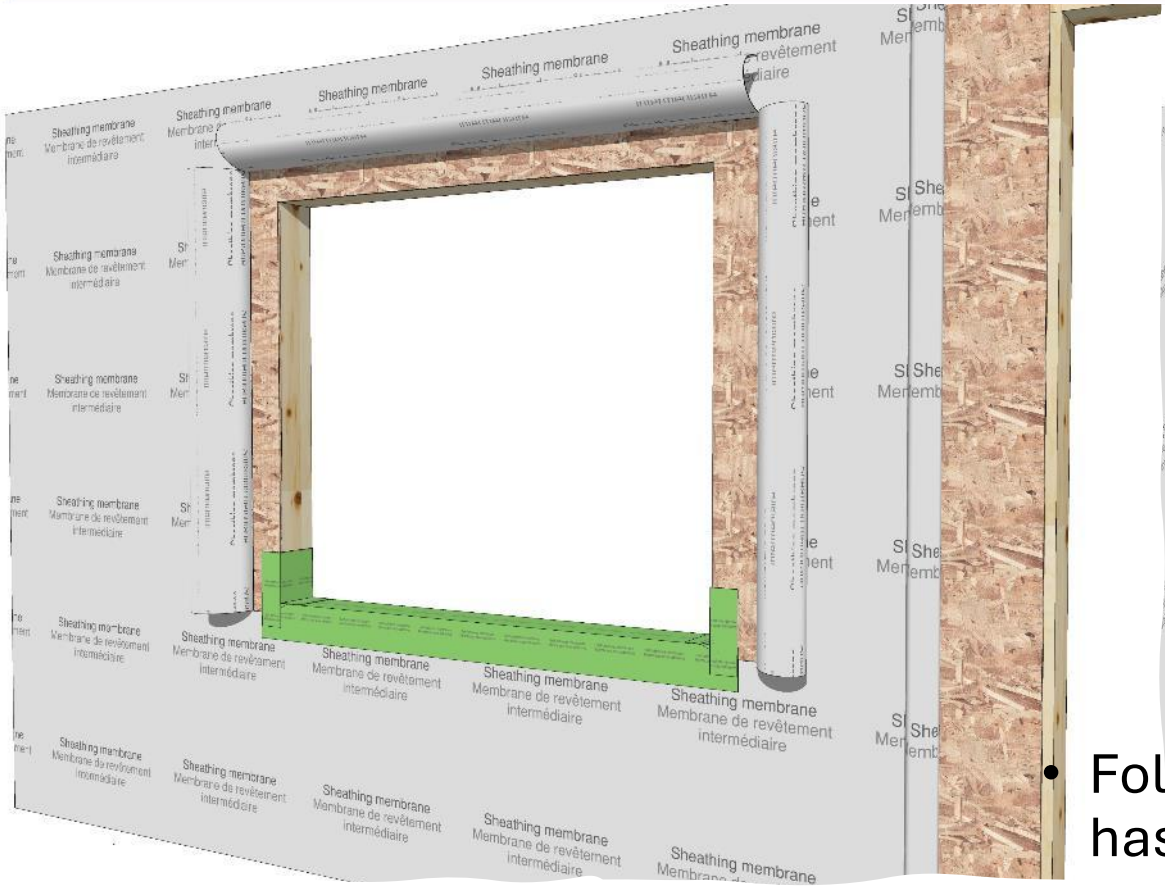
- 6% slope
- 2” flashing rise on back
- End dams
- Extend over ¼”
- Extend down 3/8”

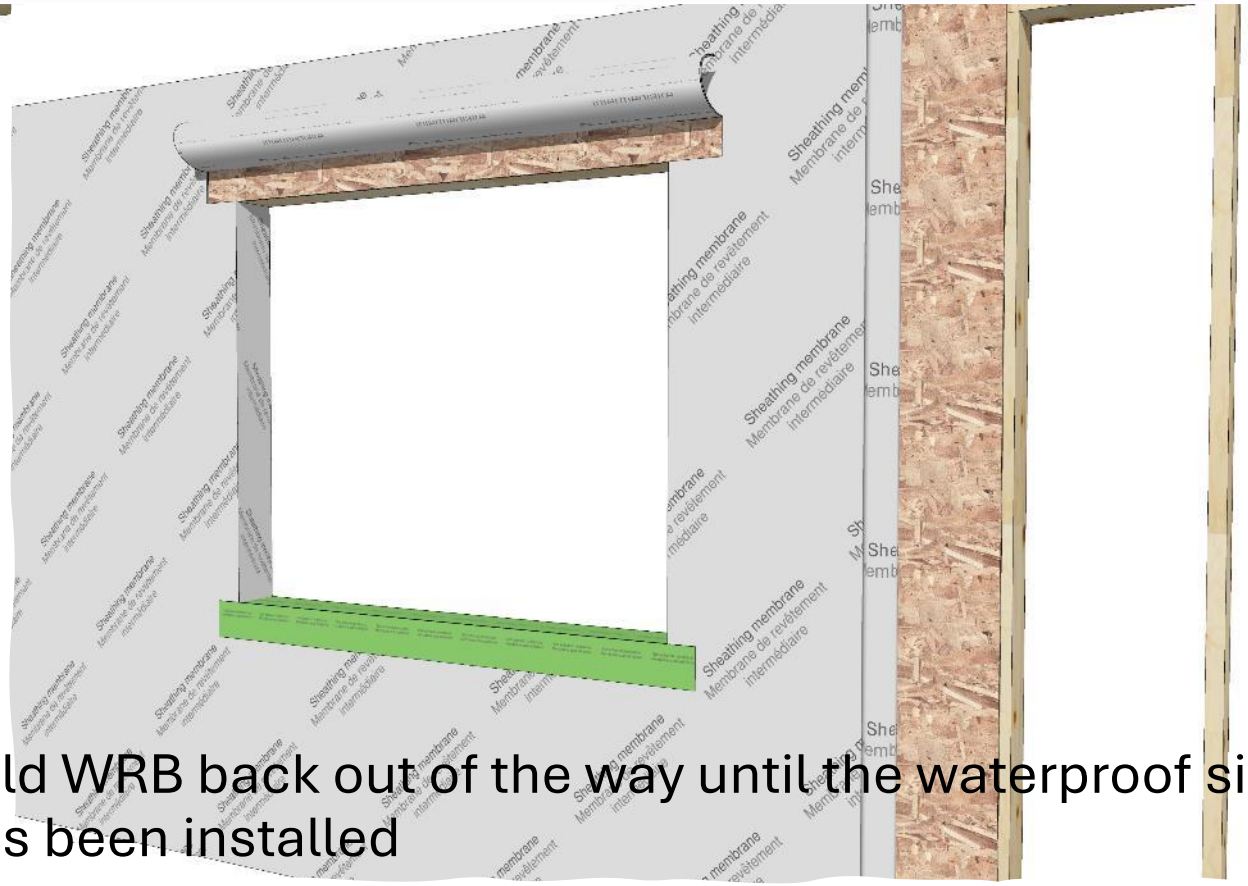




Install sill (reverse) flashing if windows are not self flashed

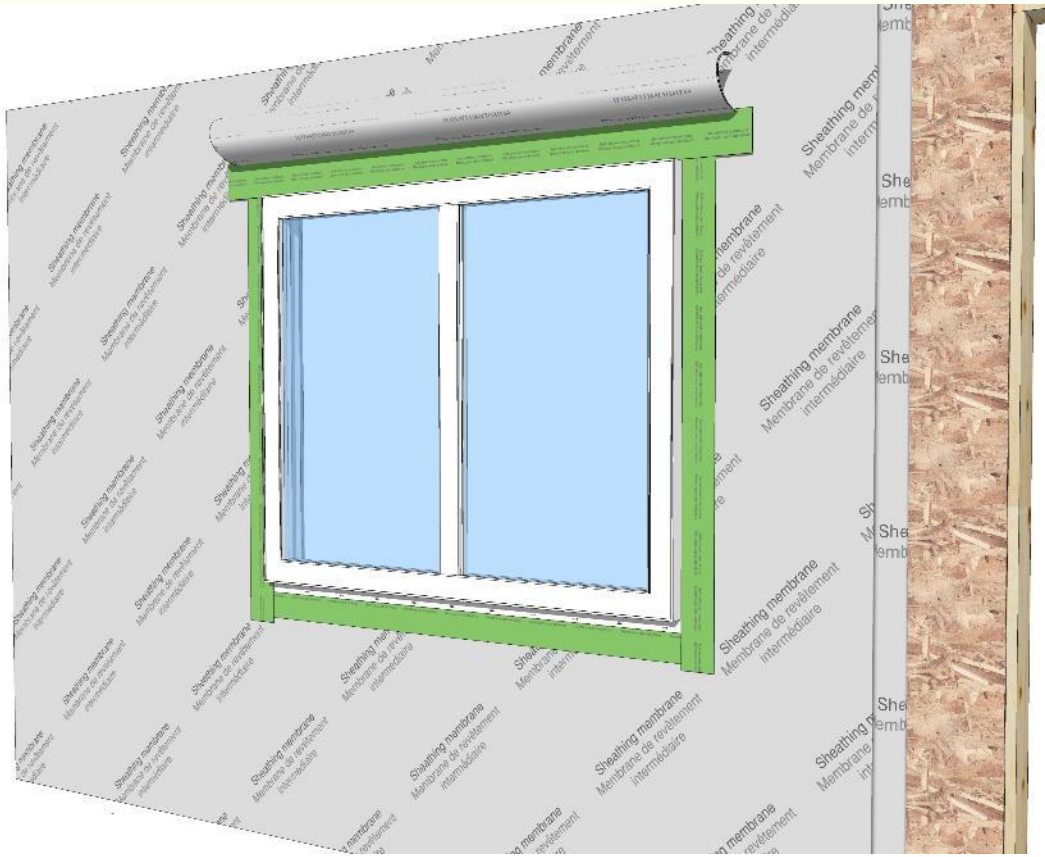
WRB installed prior to windows





- Fold WRB back out of the way until the waterproof sill has been installed
- After sill installation, fold sides into R.O extending into and around to the interior by 2”

WRB installed prior to windows

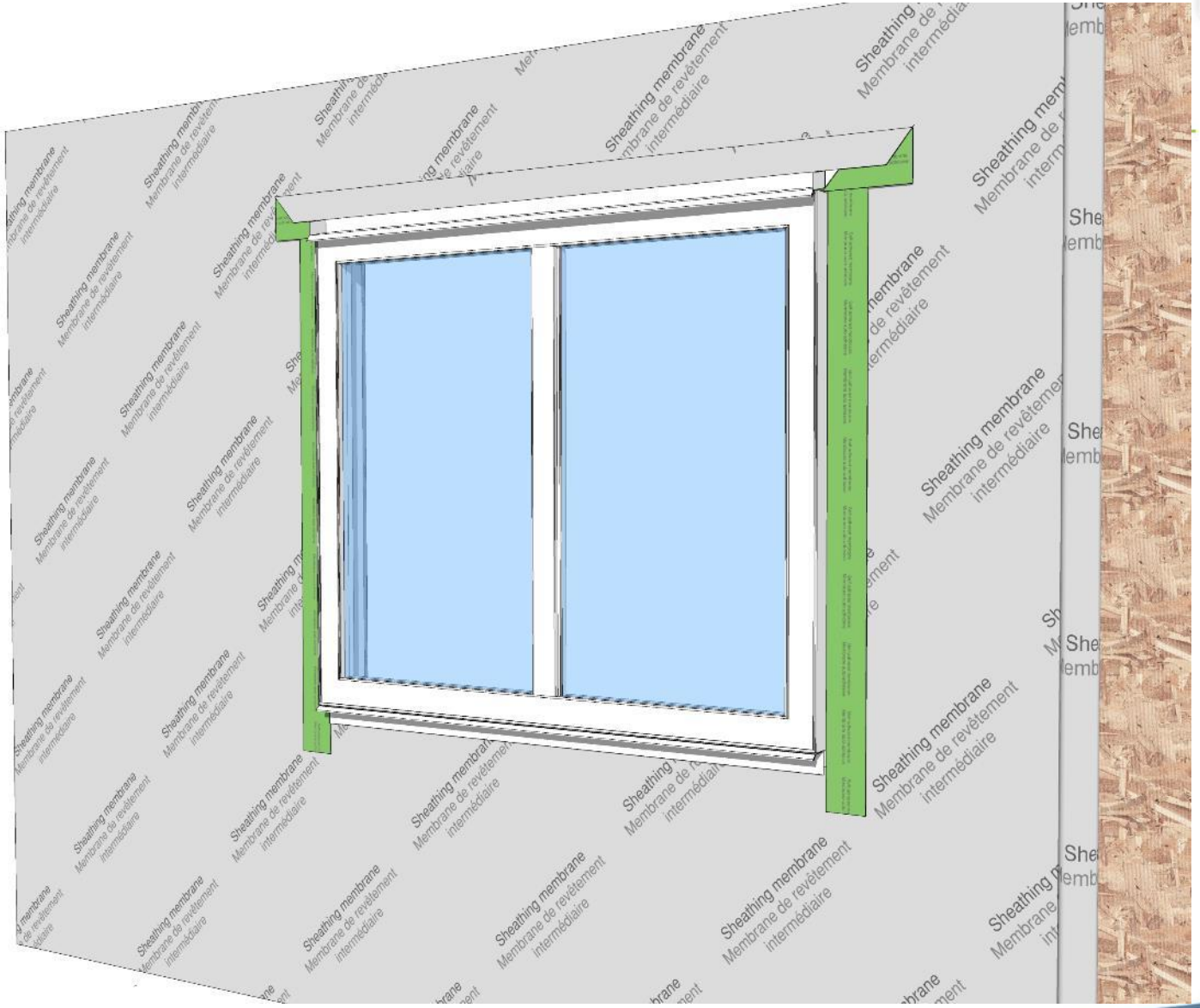


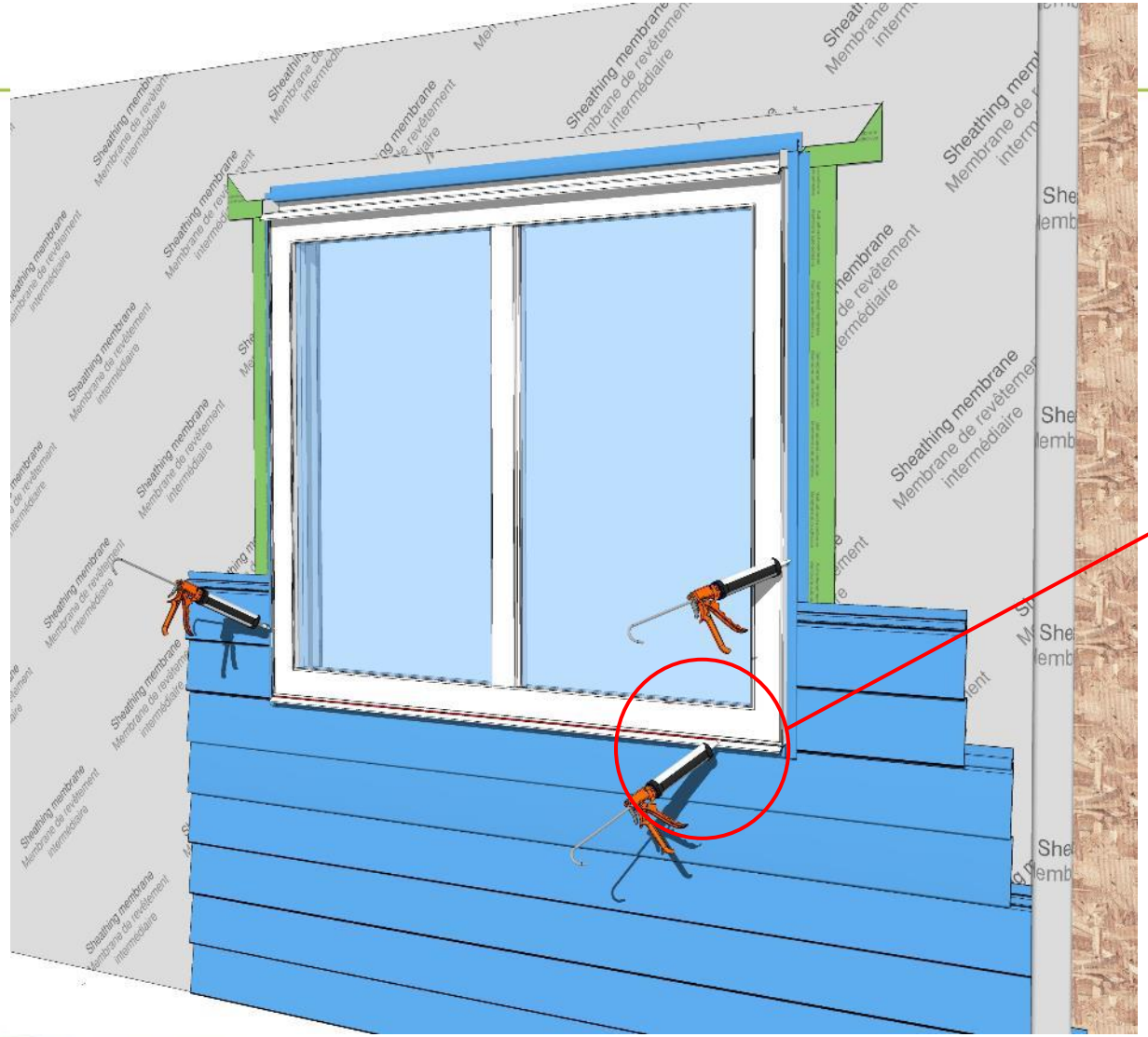
Apply either sealant or compatible self adhered membrane to flanges

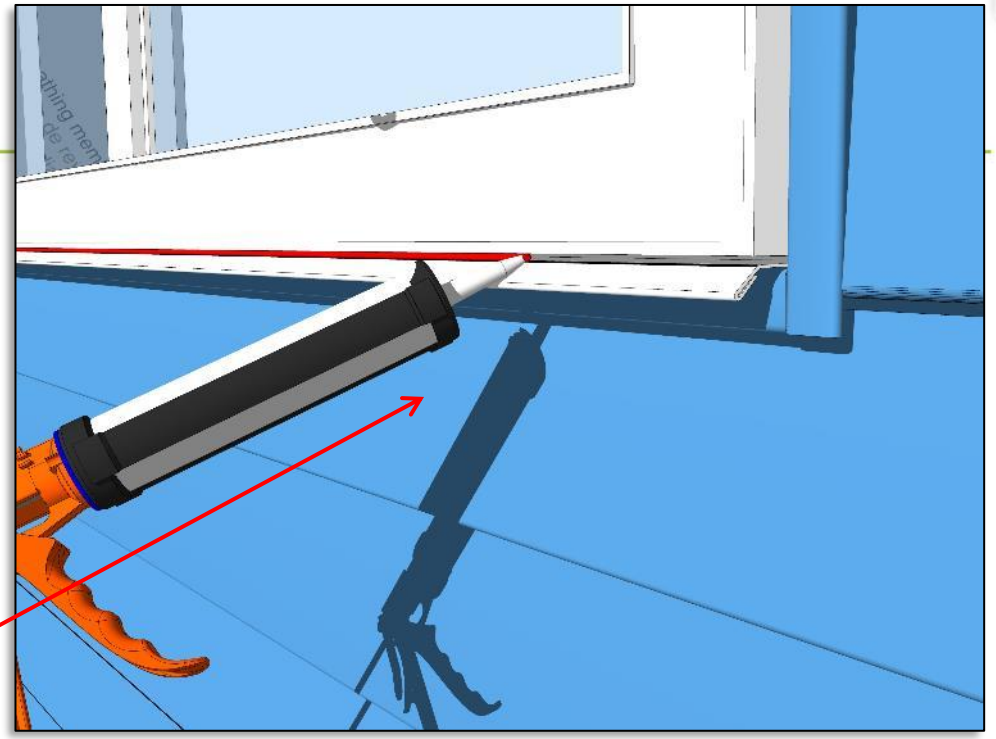
Seal the head to the sheathing and the sides to the jambs

Head Flashing

Install head flashing and fold WRB down over head flashing





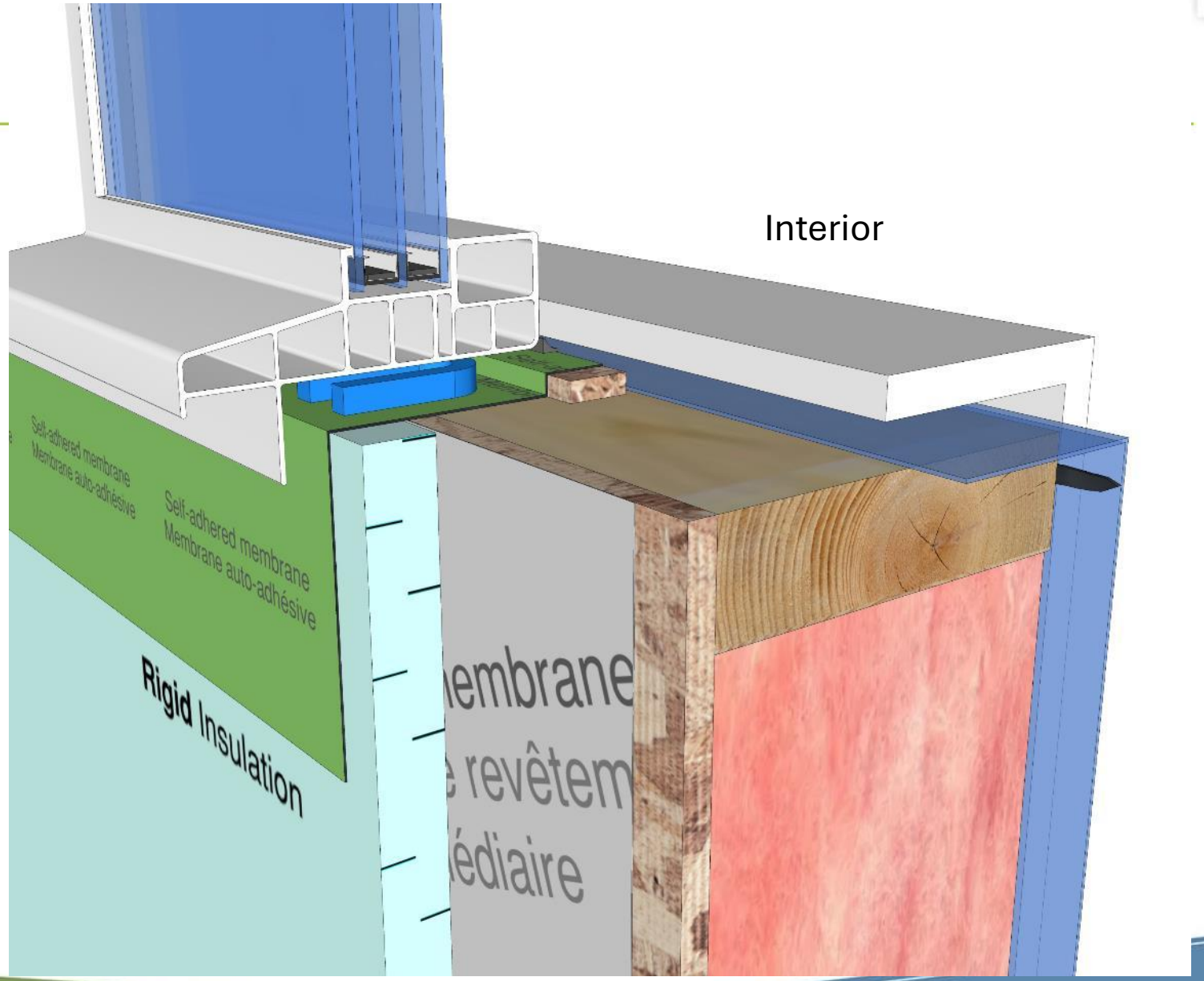


Apply sealant to the window to jambs and sill

2nd Plane

c/w 1” rigid and WRB

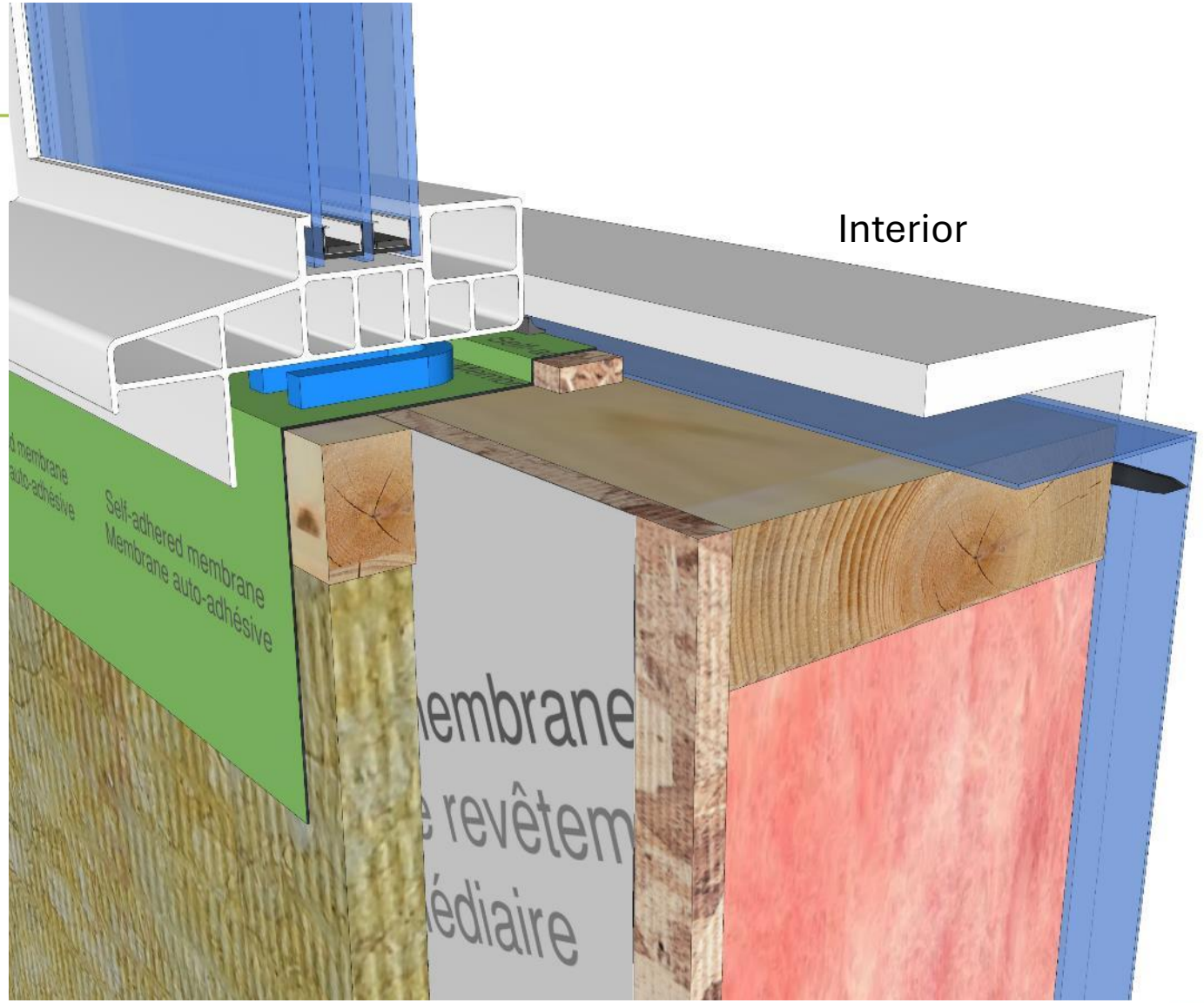
Where WRB is placed between rigid and is should only be used as air barrier – extend sill pan over to create 2nd plane on face of rigid



2nd Plane

c/w 1” insulation board and WRB

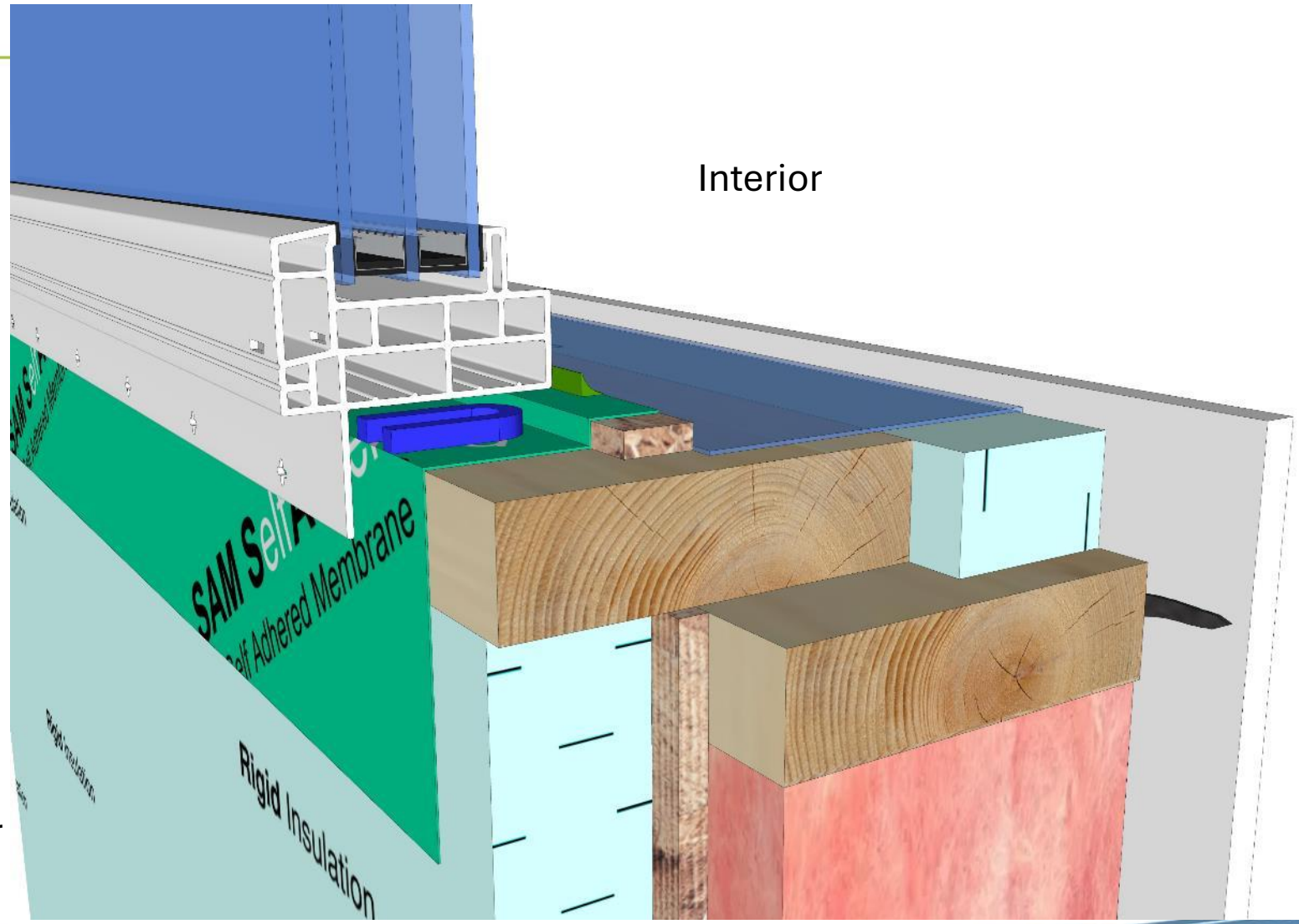
Where WRB is placed between insulation board sill pan 2nd plane should allow for full drainage of cavity



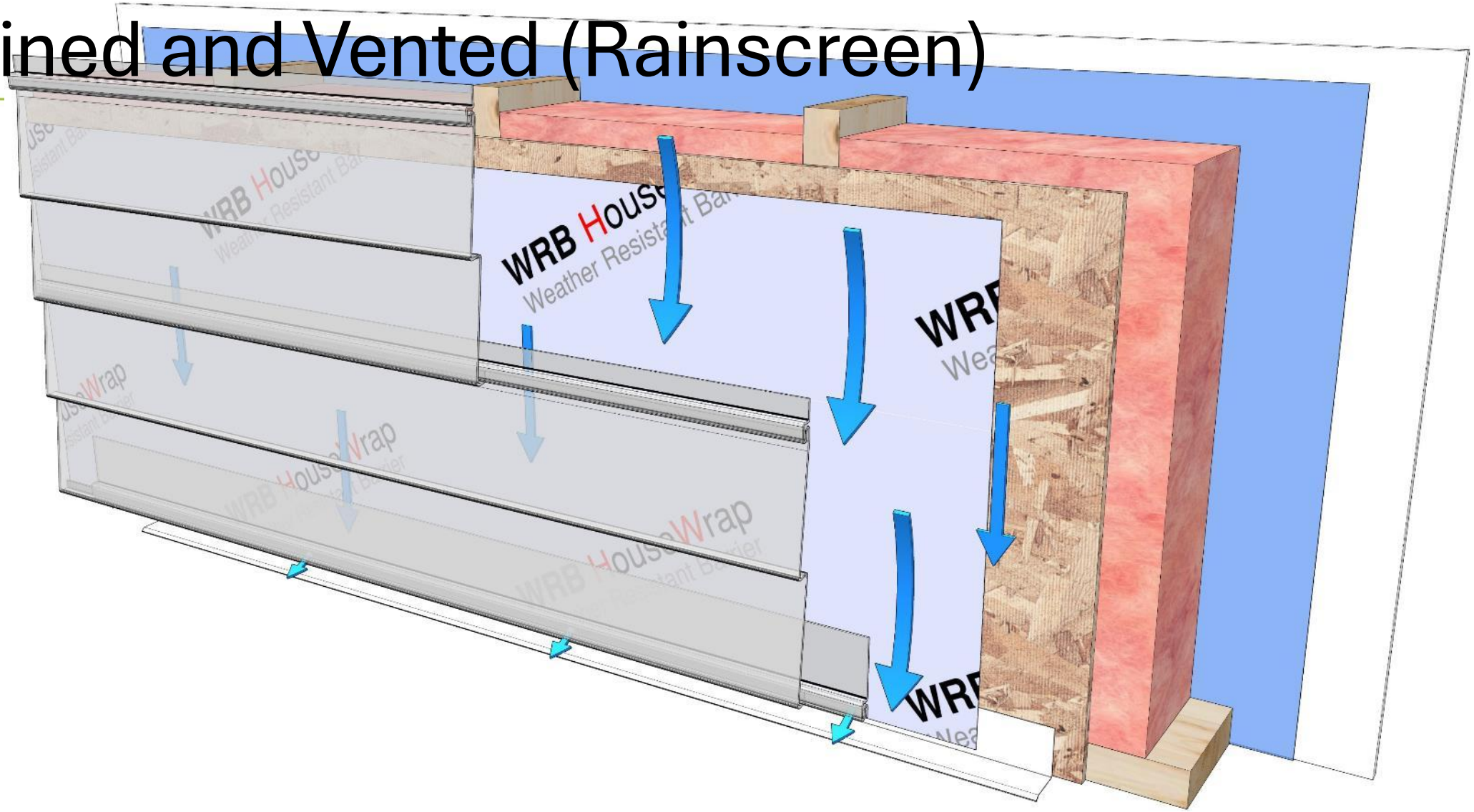
Back Dam

c/w 2” rigid used as the WRB

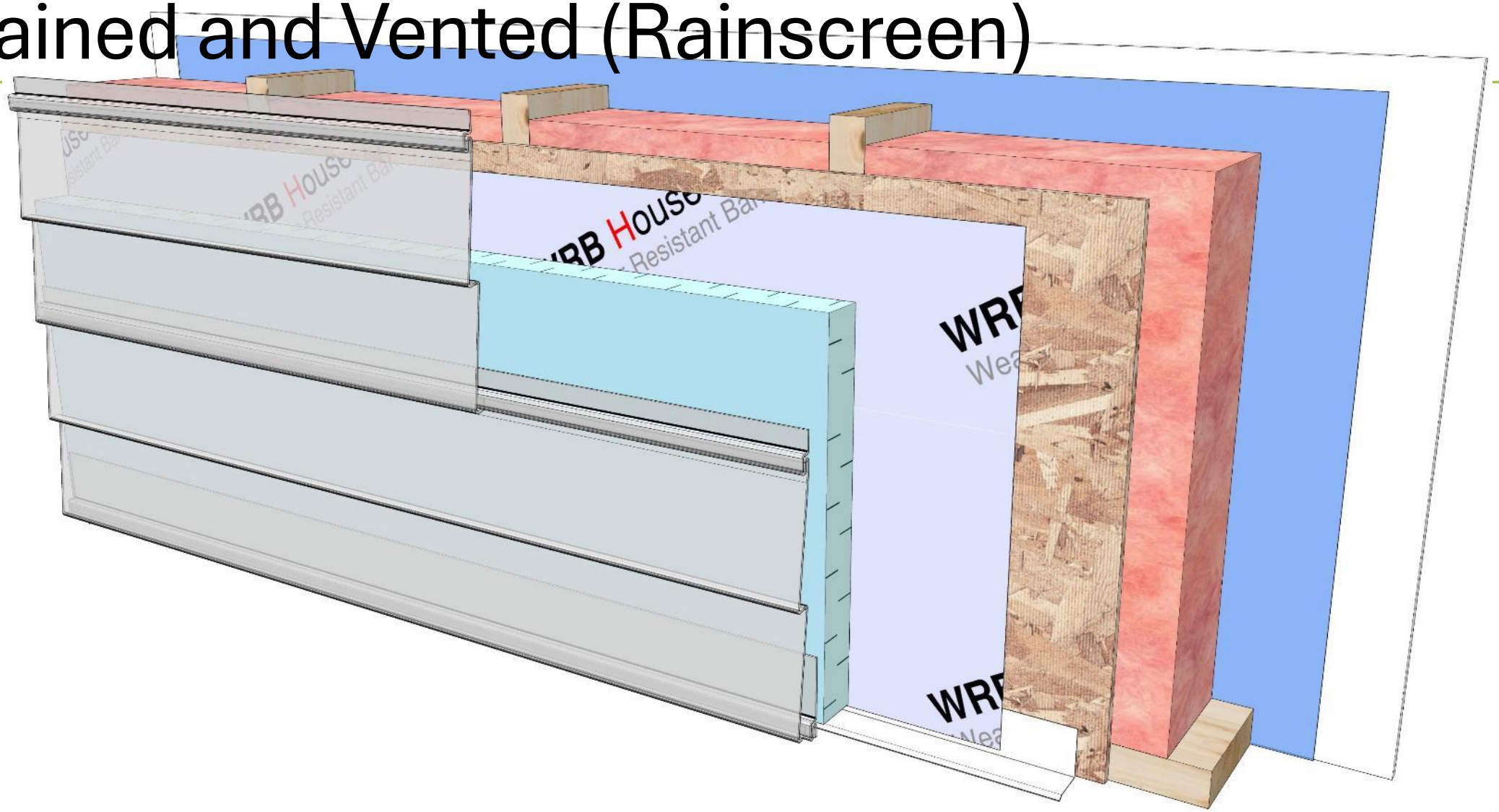
Backdam with water impervious subsill protection to 2nd plane



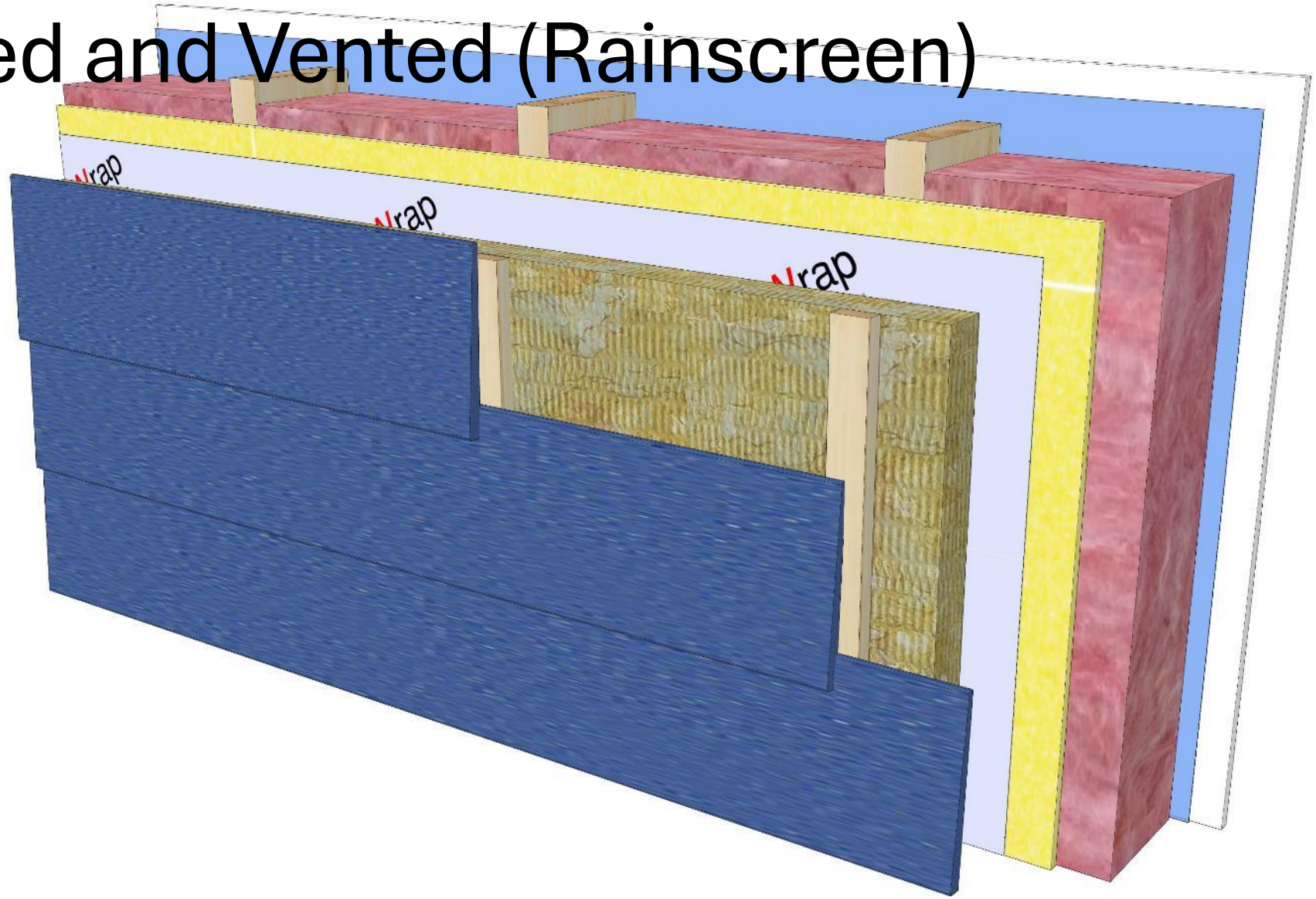
Drained and Vented (Rainscreen)



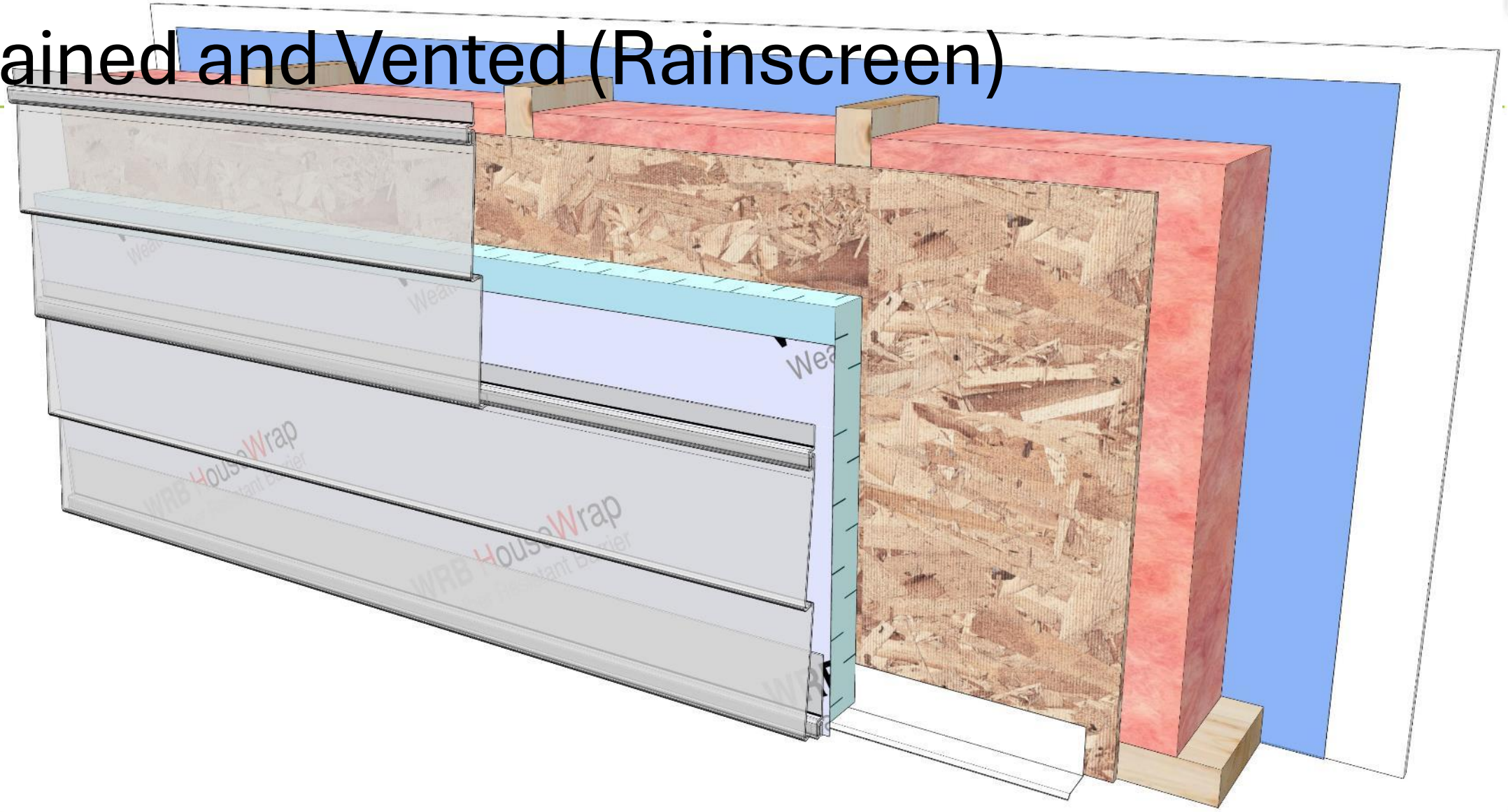
Drained and Vented (Rainscreen)



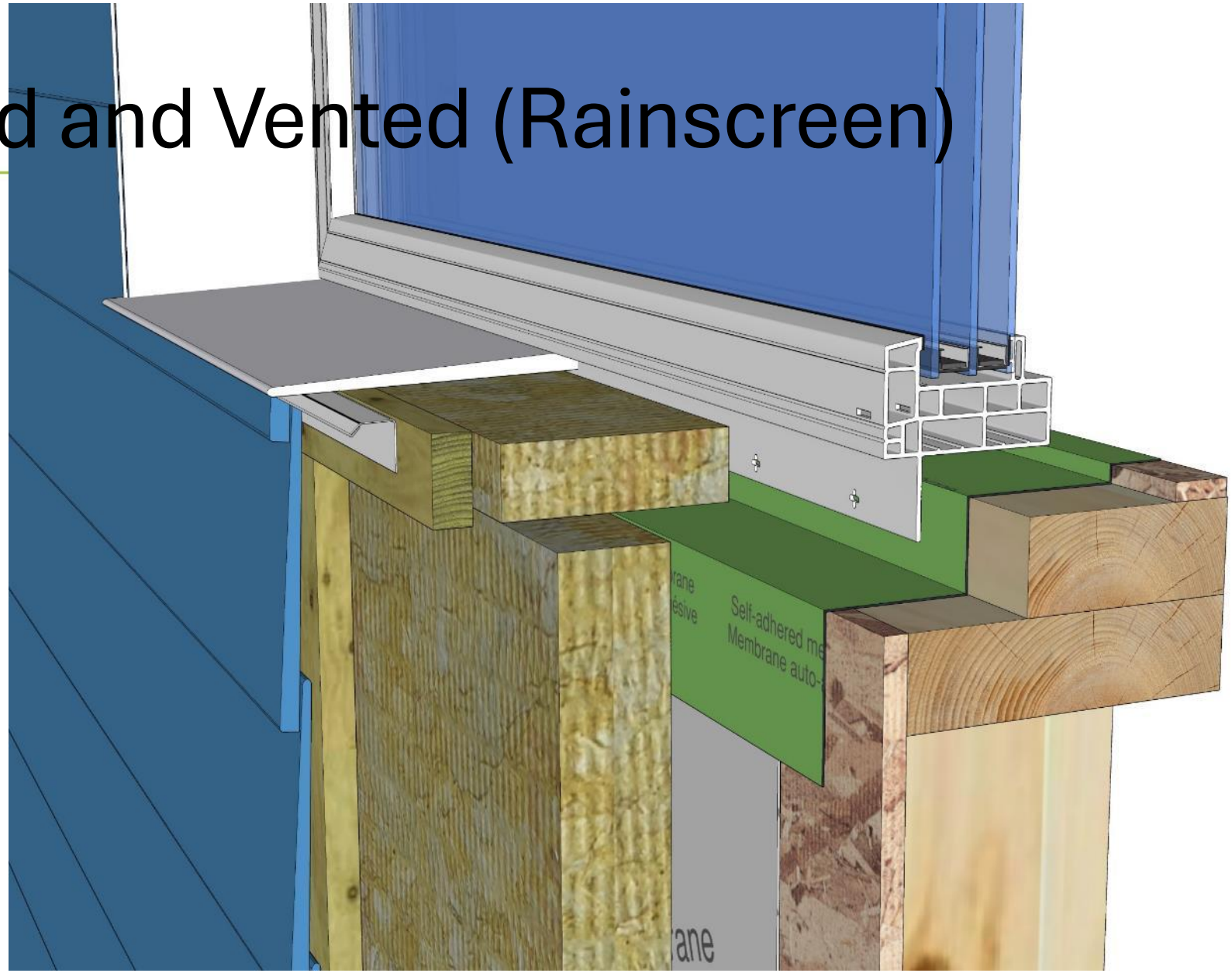
Drained and Vented (Rainscreen)



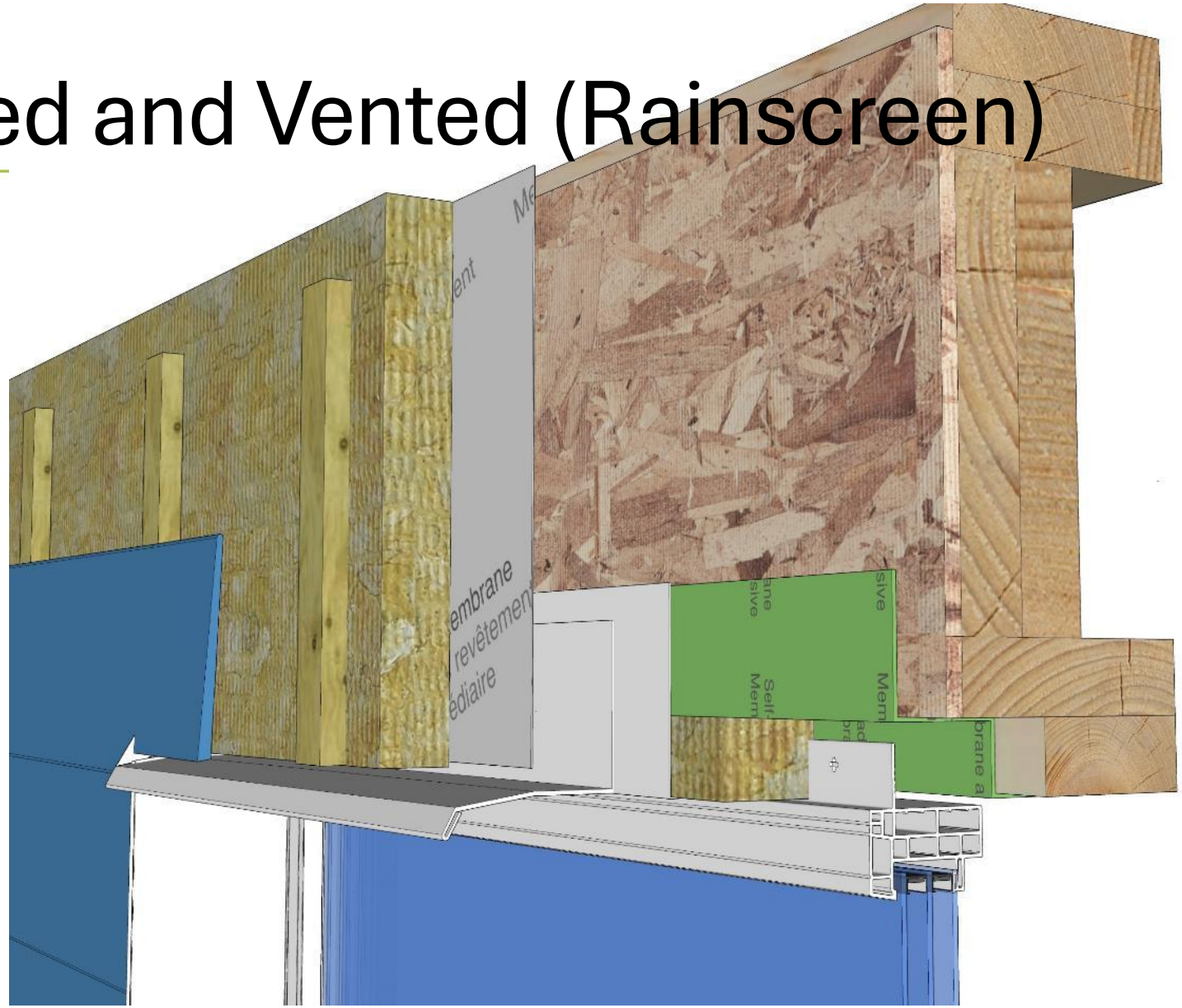
Drained and Vented (Rainscreen)



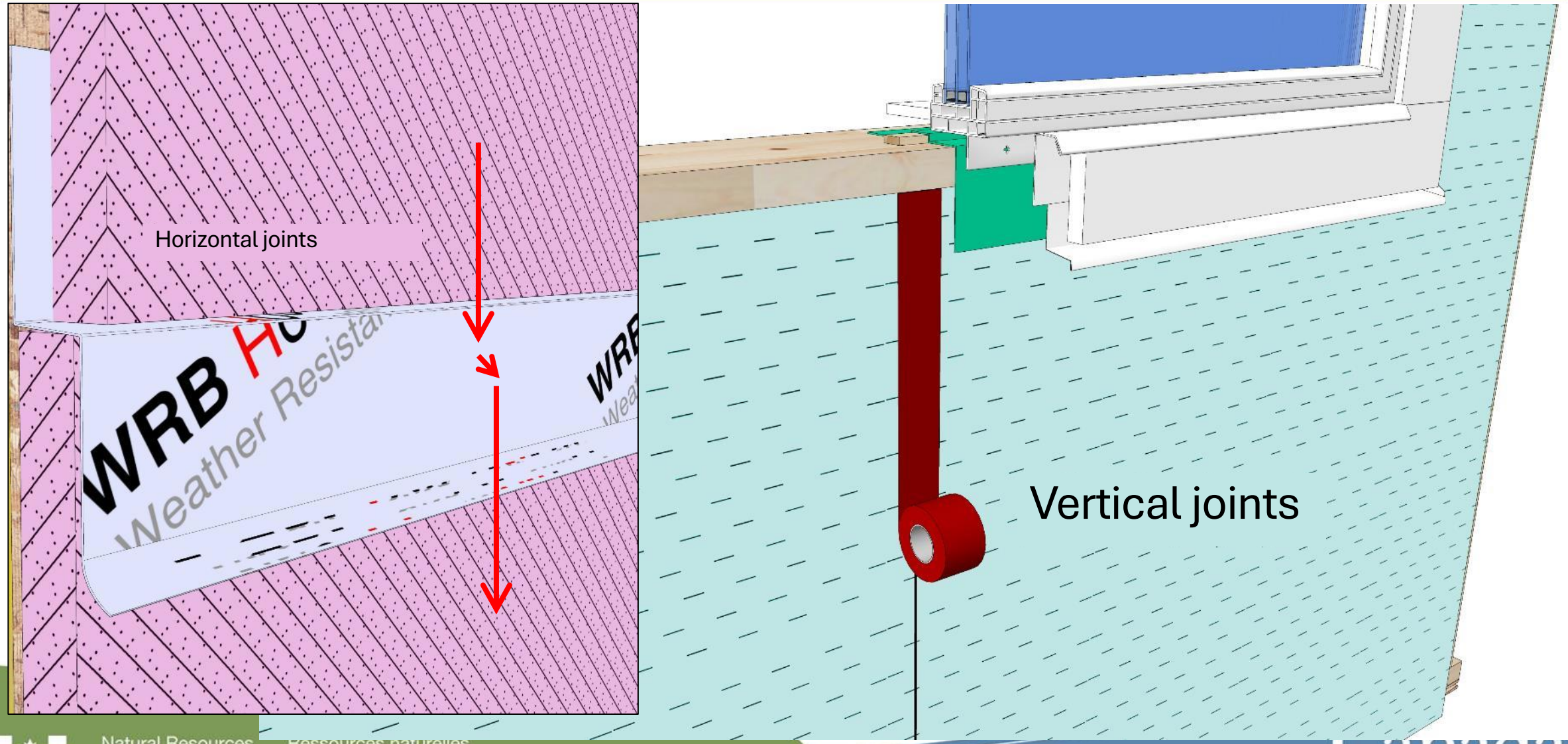
Drained and Vented (Rainscreen)

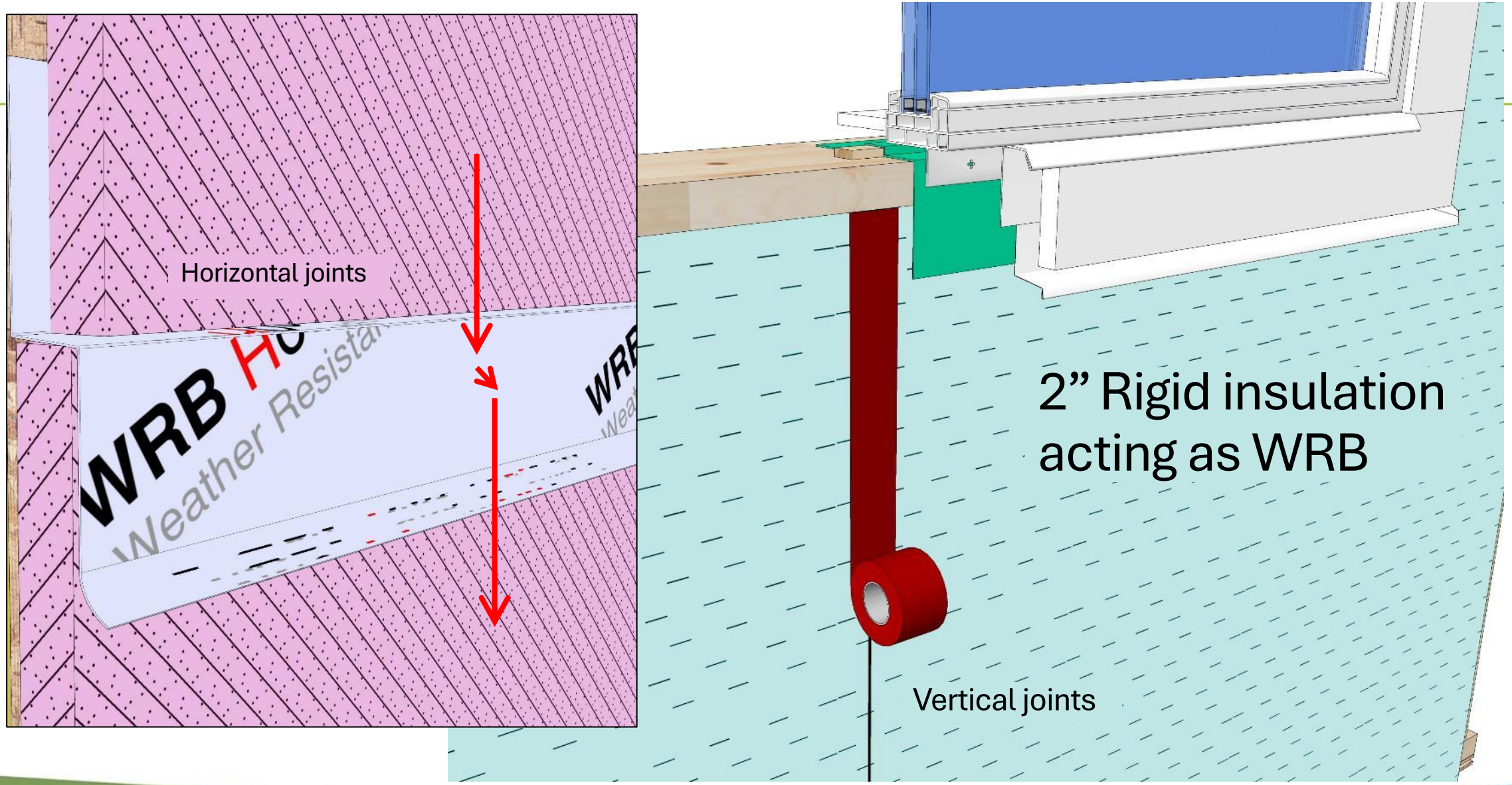


Drained and Vented (Rainscreen)

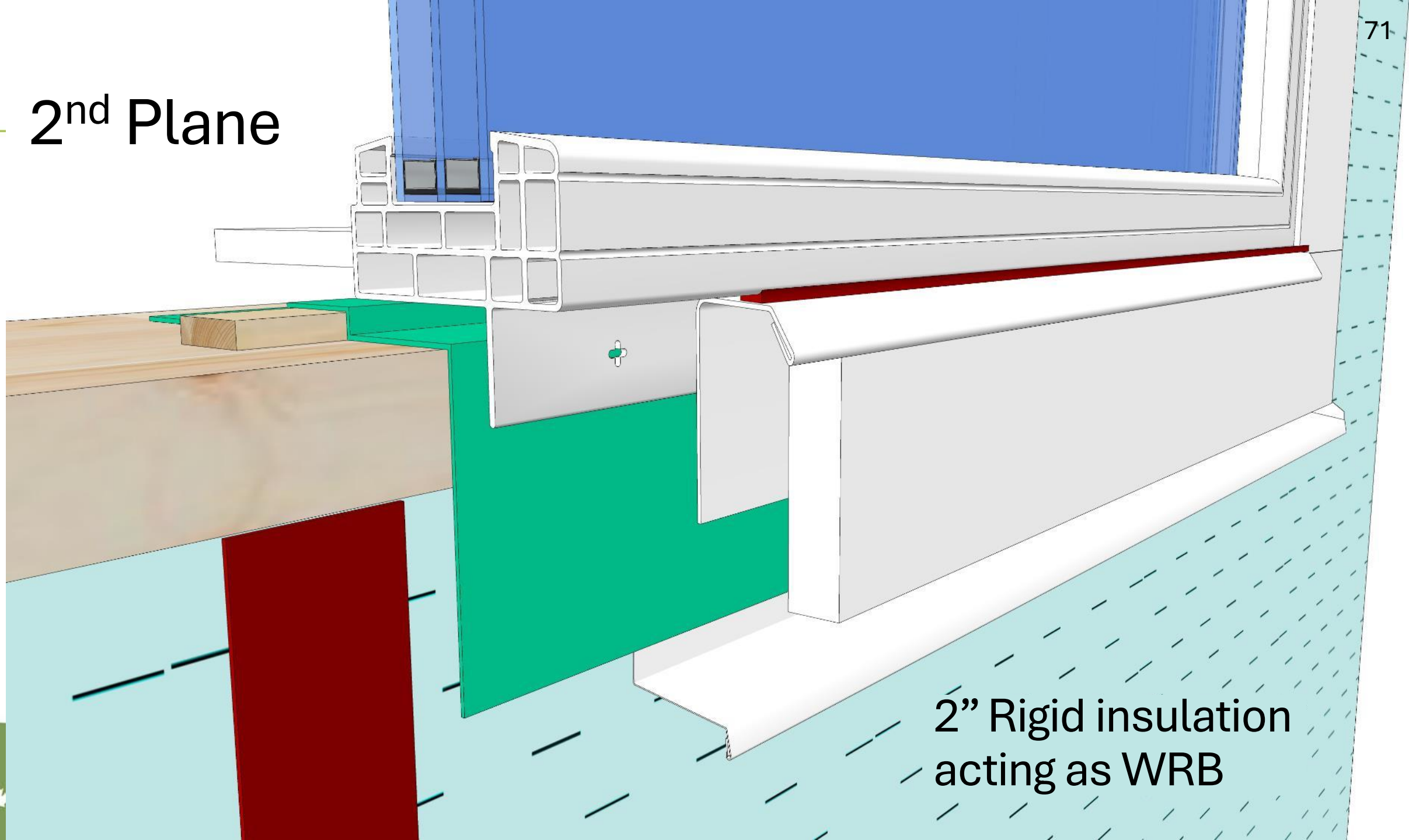


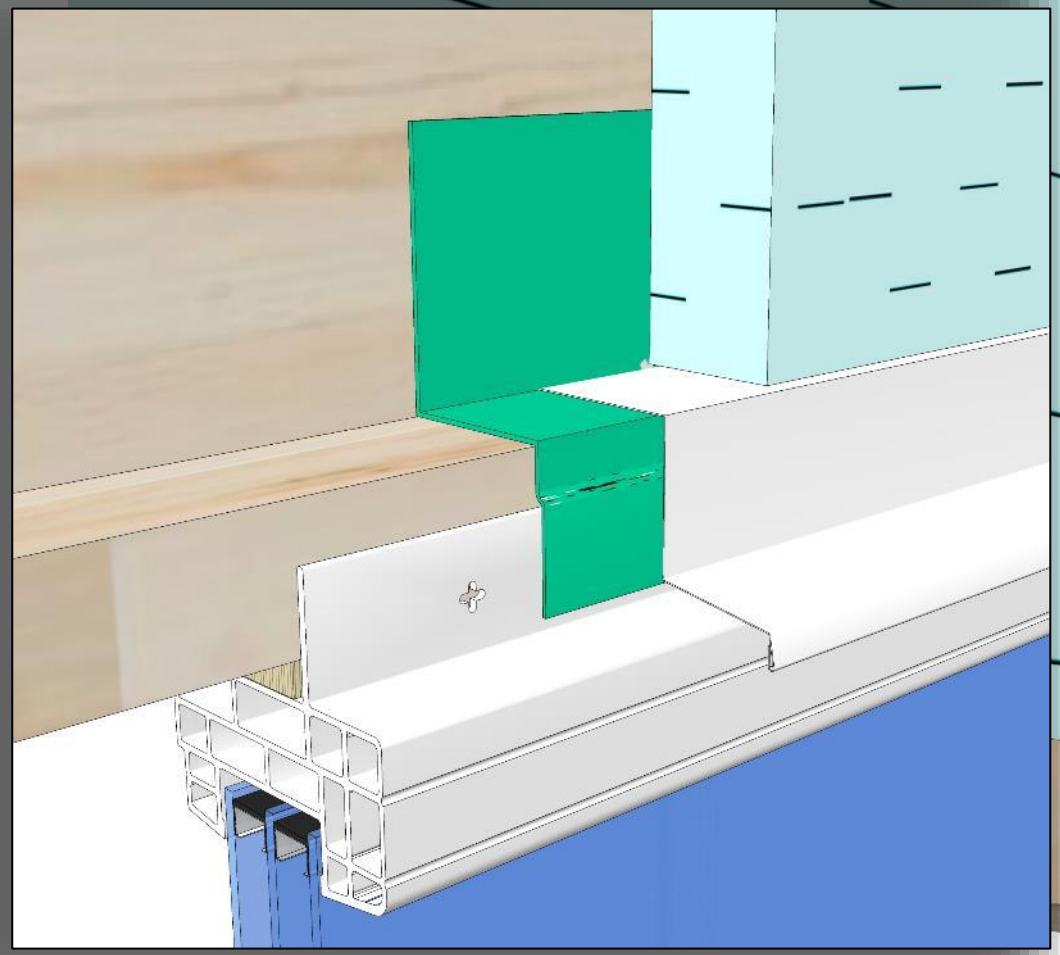
WRB Location & Drainage




Horizontal joints
2” Rigid insulation acting as WRB
Vertical joints

2nd Plane

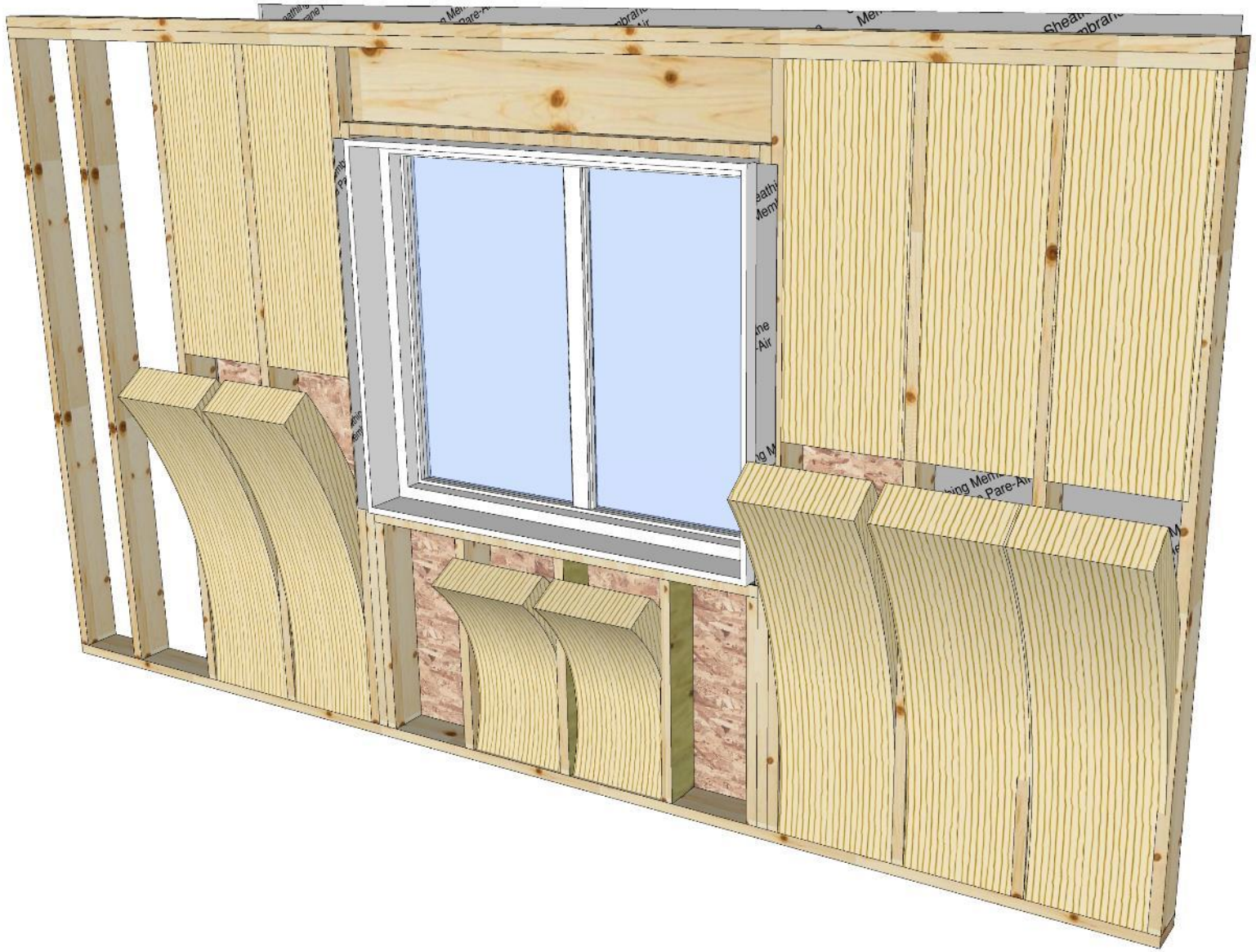




2” Rigid insulation acting as WRB

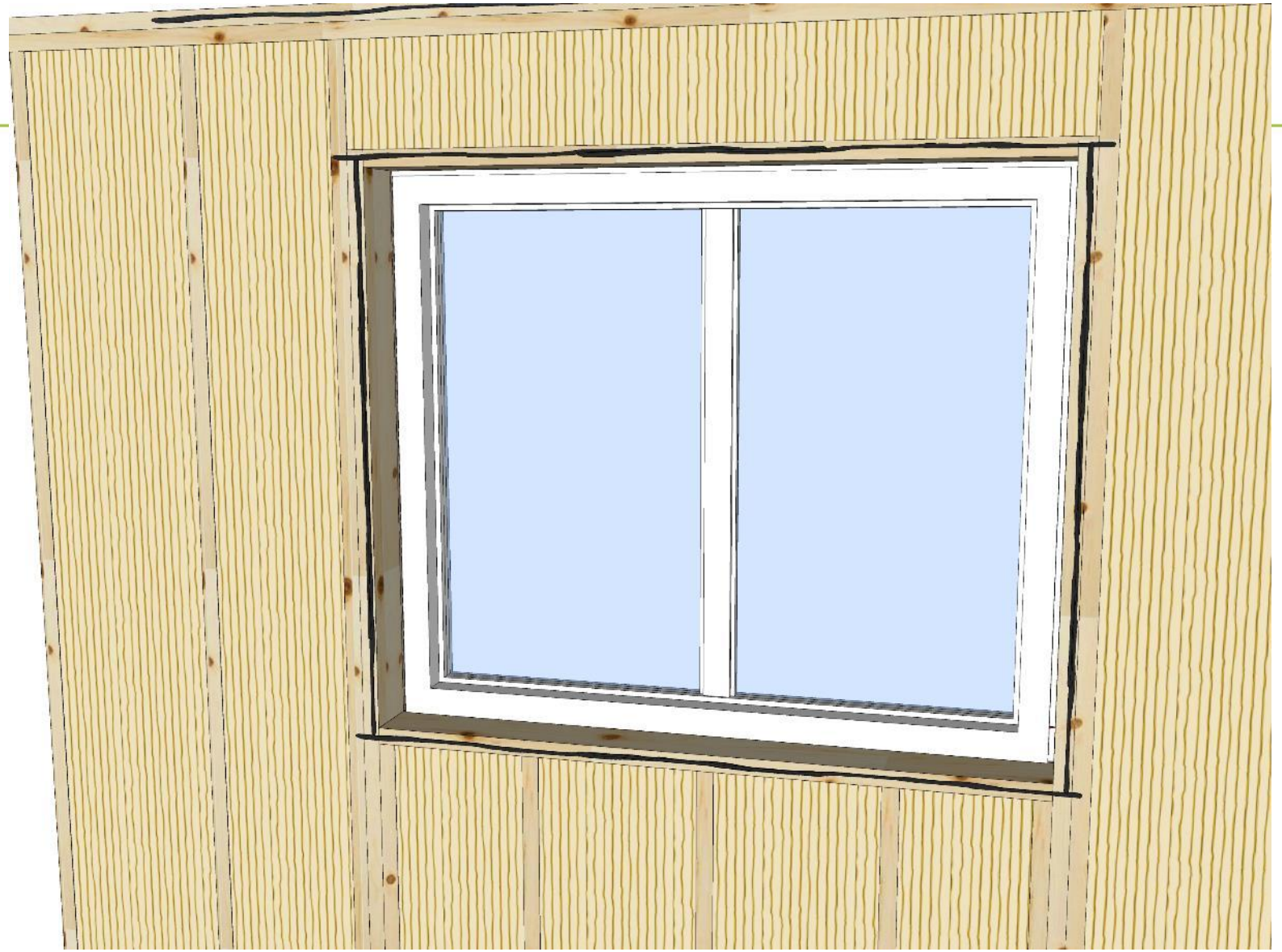
Insulation

Interior
primary
air barrier
6-mil poly



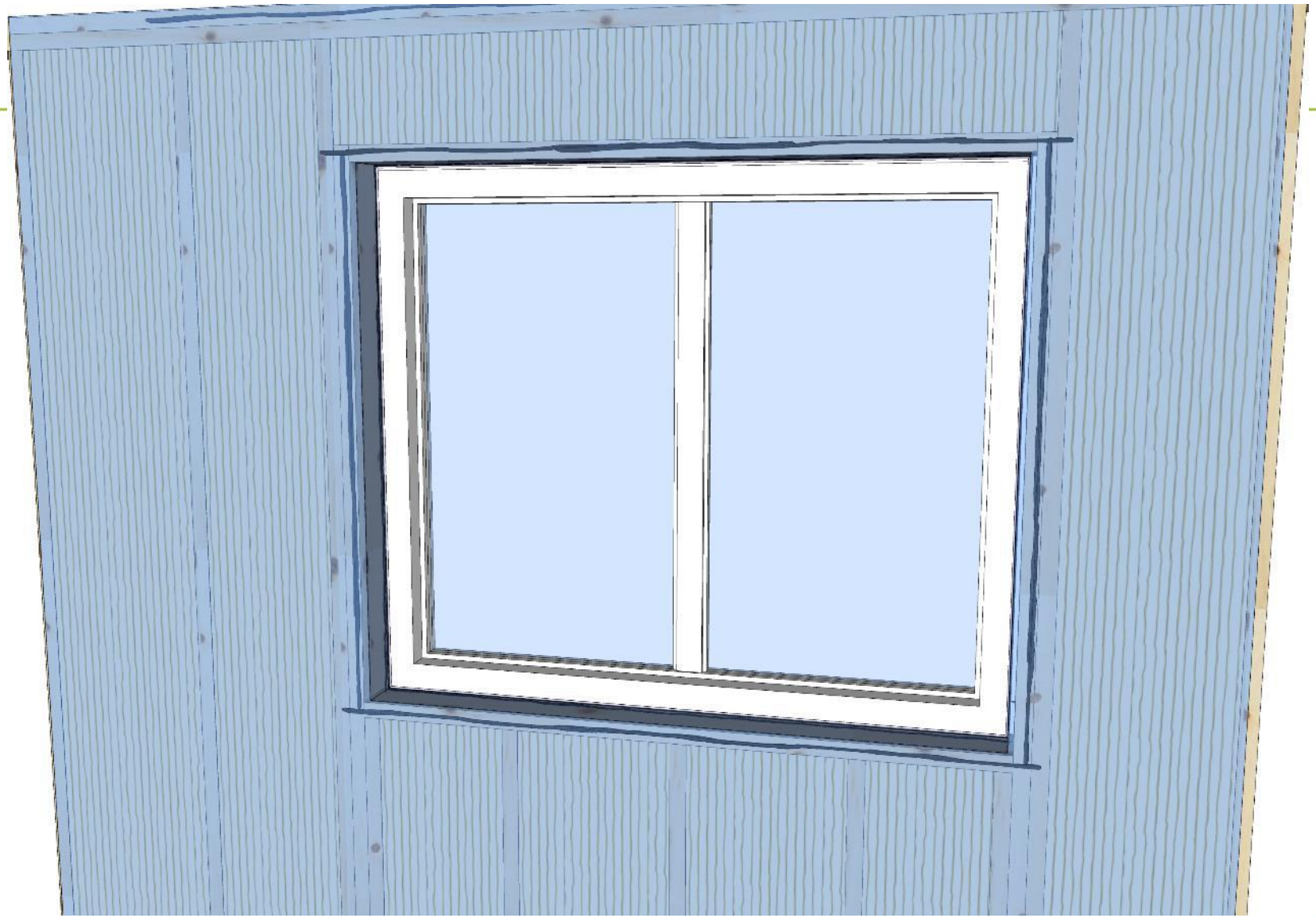
Sealant

Interior
primary
air barrier
6-mil poly



Poly

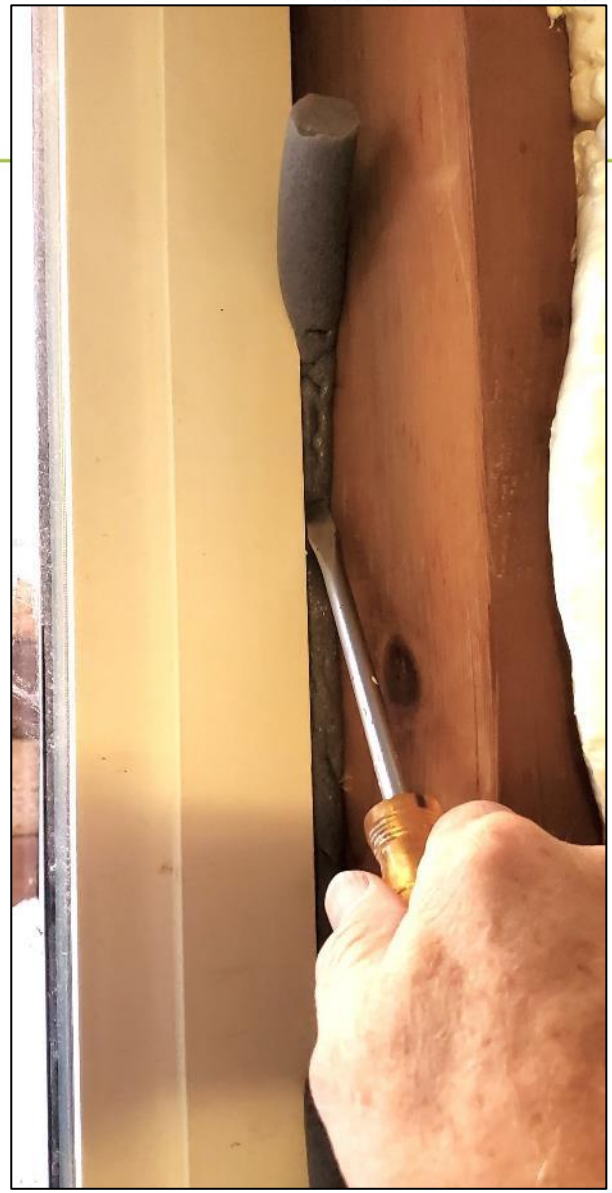
Interior
primary
air barrier
6-mil poly



Rough opening air sealing

LOW Expansion

Spray foam and Sealant



Backer rod and Sealant

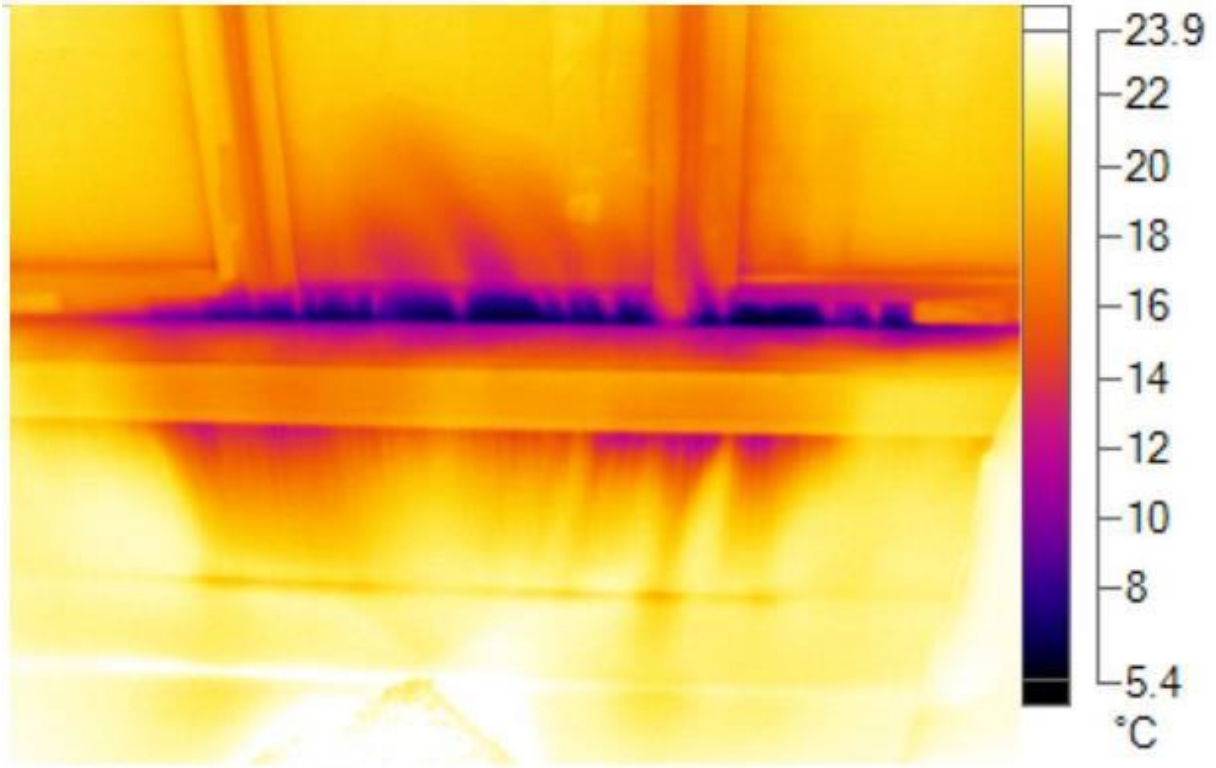
Rough opening Insulation

Mineral Wool
Hydrophobic
Not airtight

Fiberglass
Absorbent
Not airtight

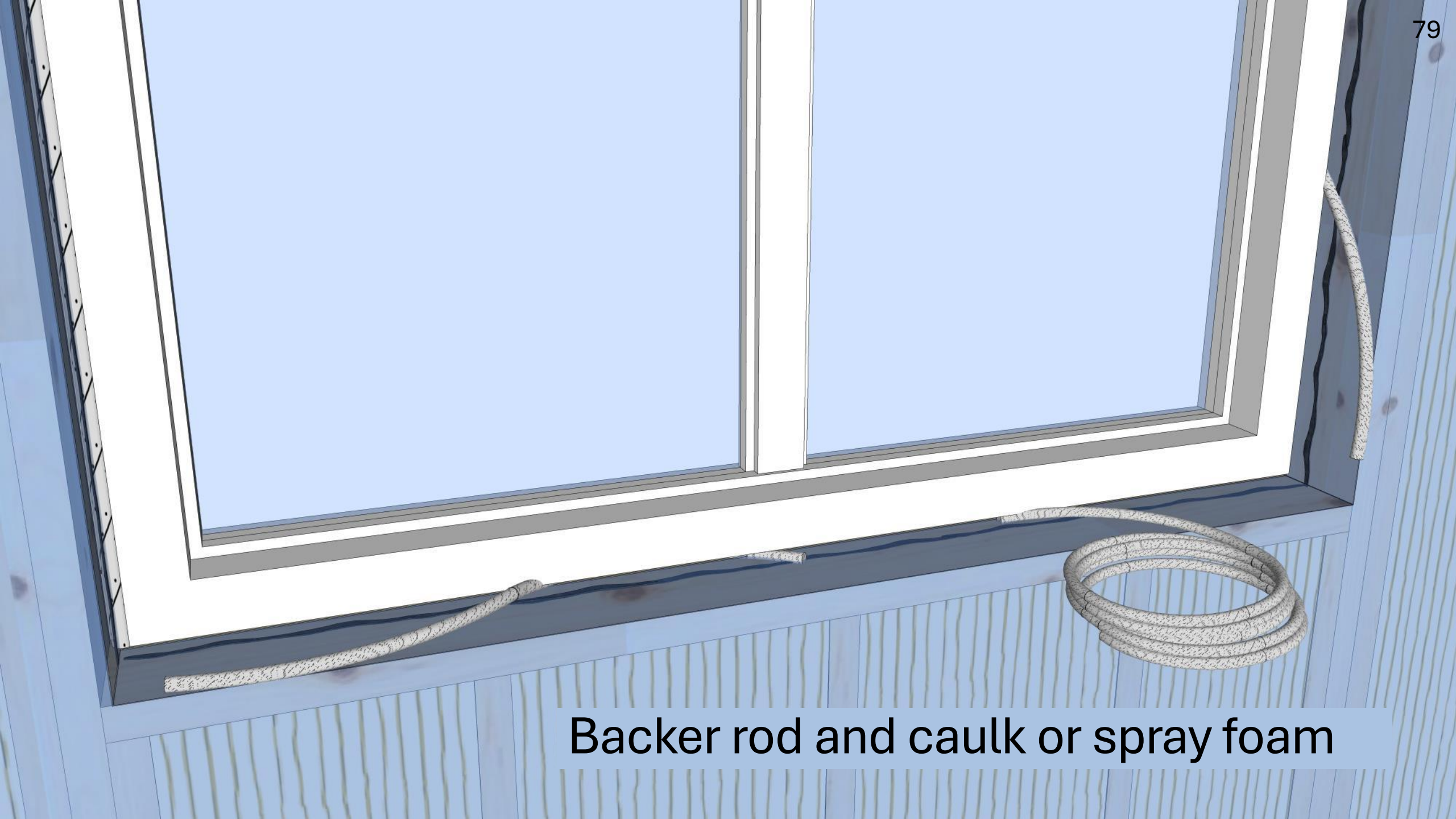
Spray foam
Semi absorbent
airtight

Rough opening air sealing risks



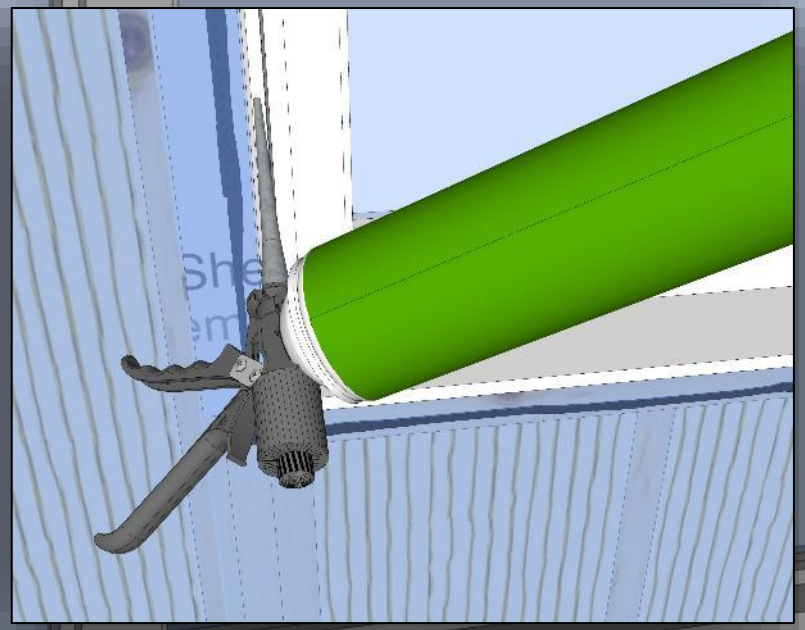
IR007699.IS2

Visible Light Image



Backer rod and caulk or spray foam

ROBUST AIR BARRIER

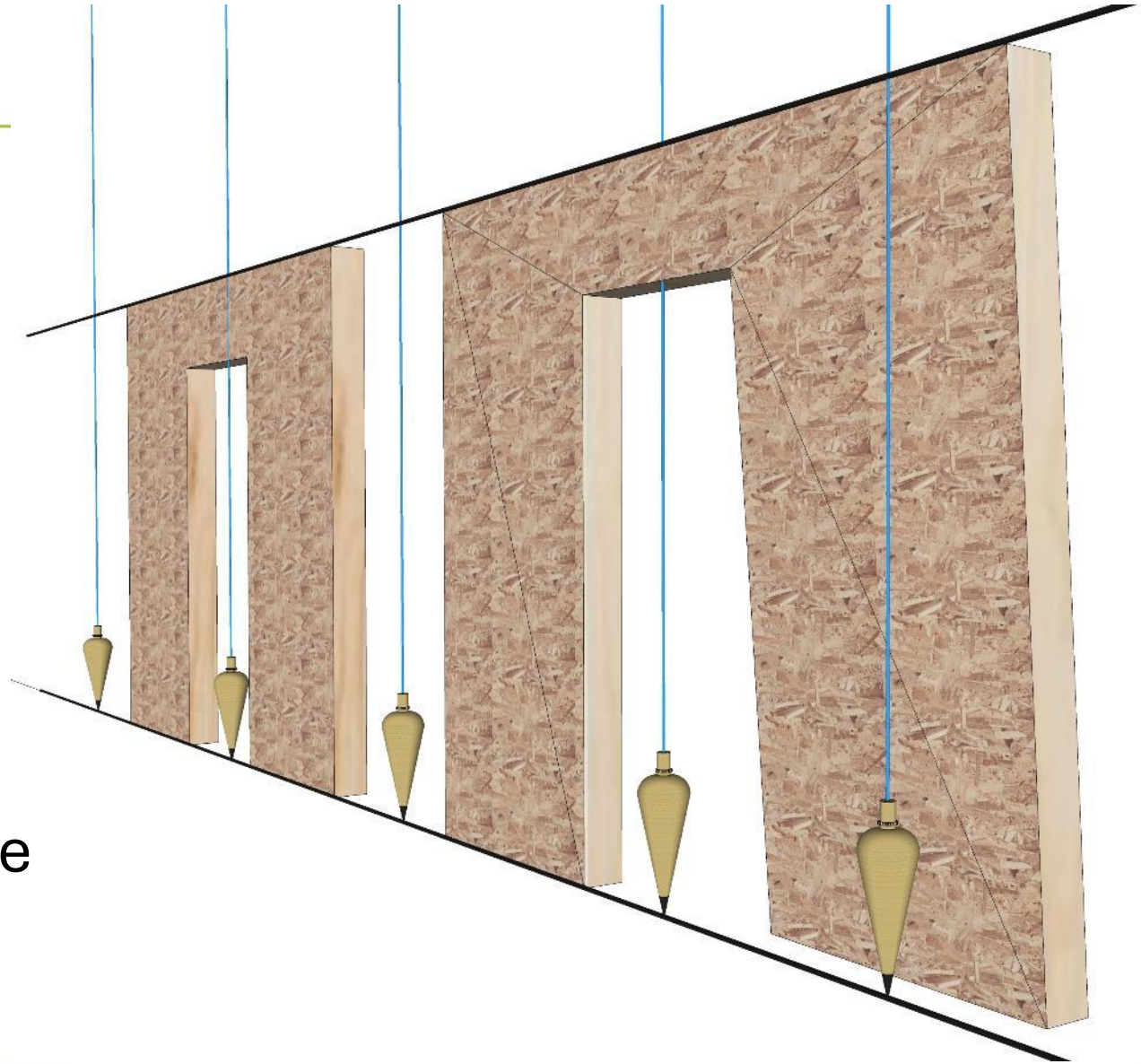


Backer rod and caulk or spray foam

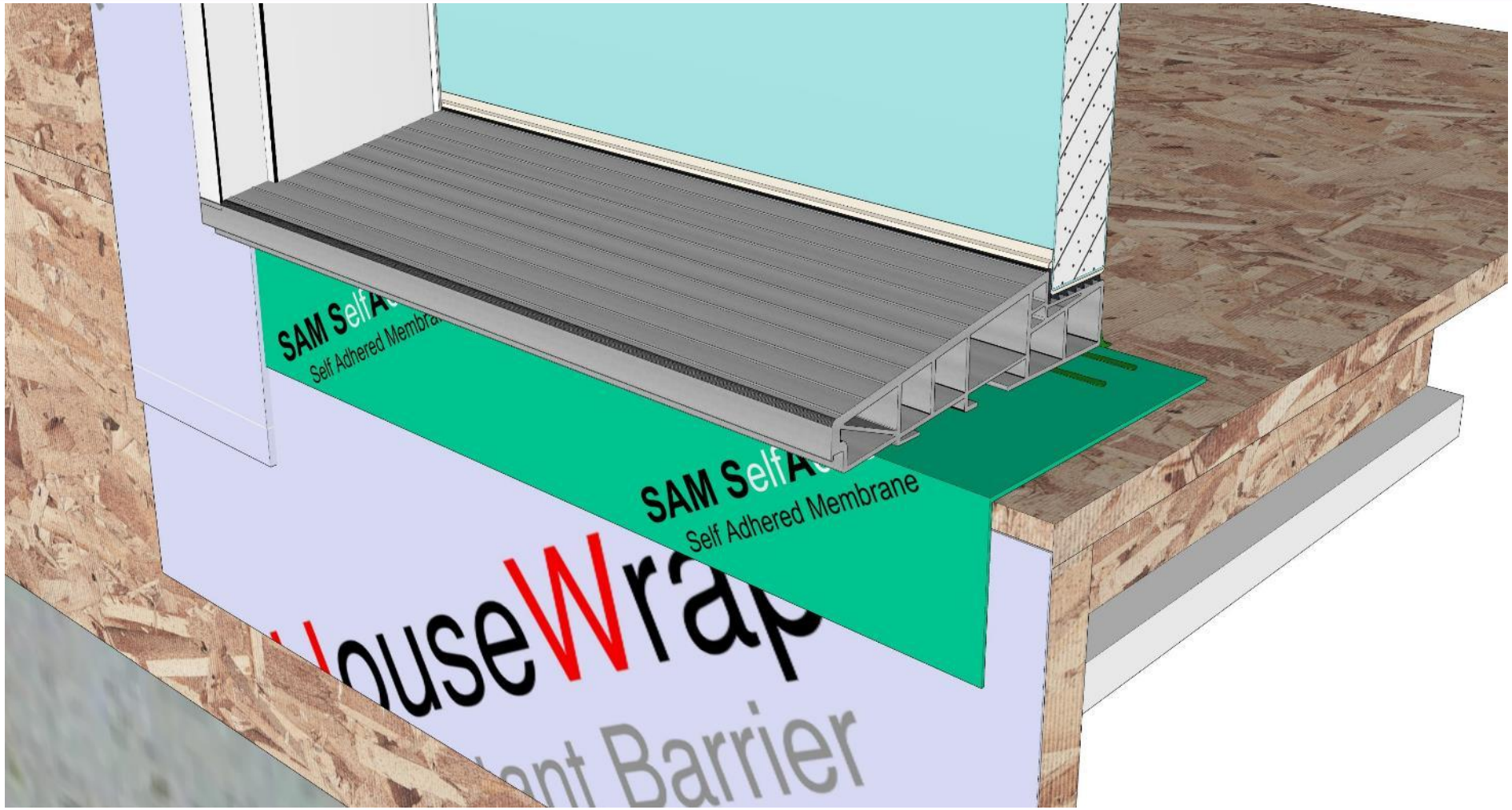
Doors

- Flatness
- Not skewed
- Plumb
- Level sill

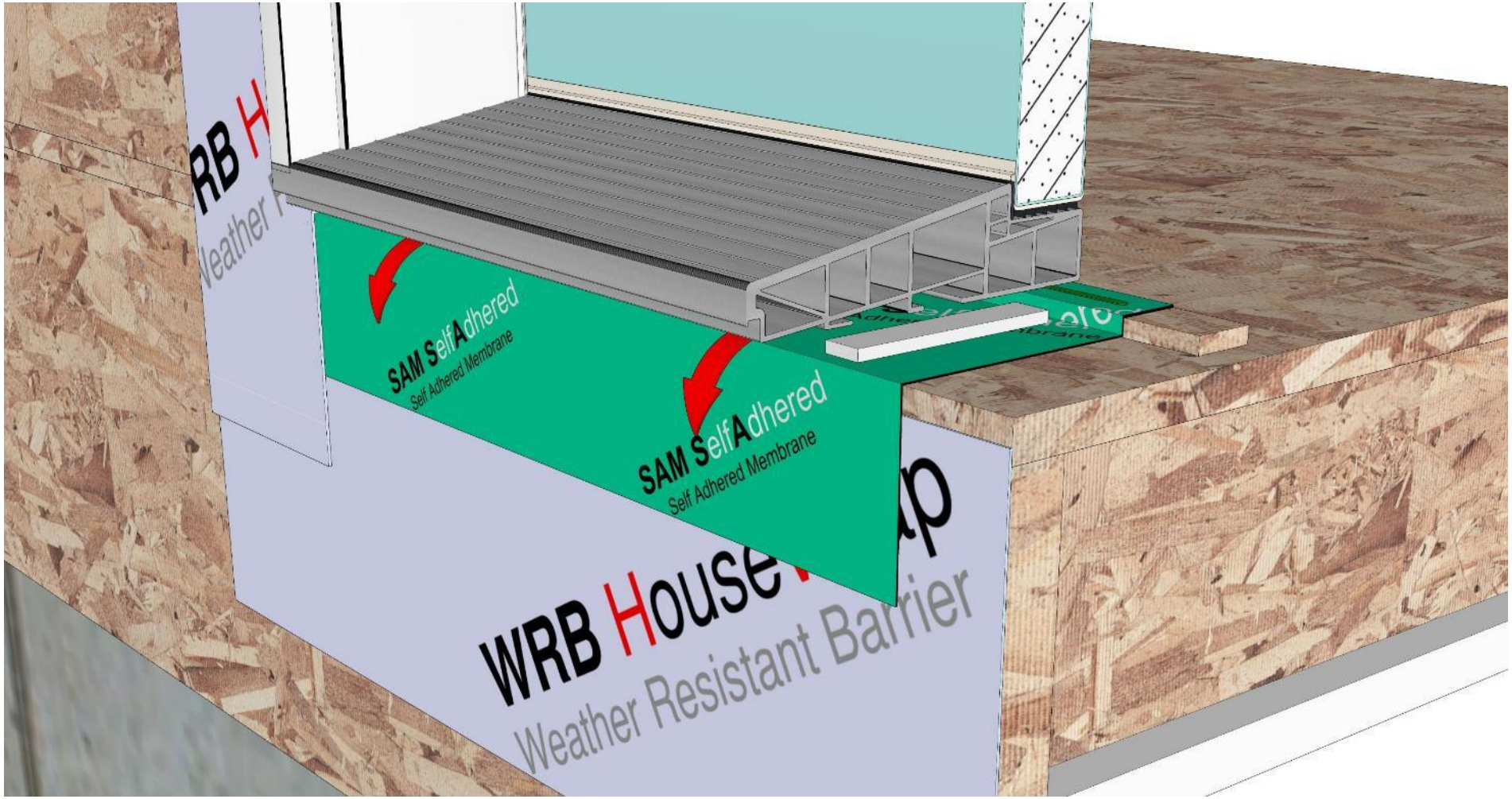
Building envelope detailing remains the same as windows

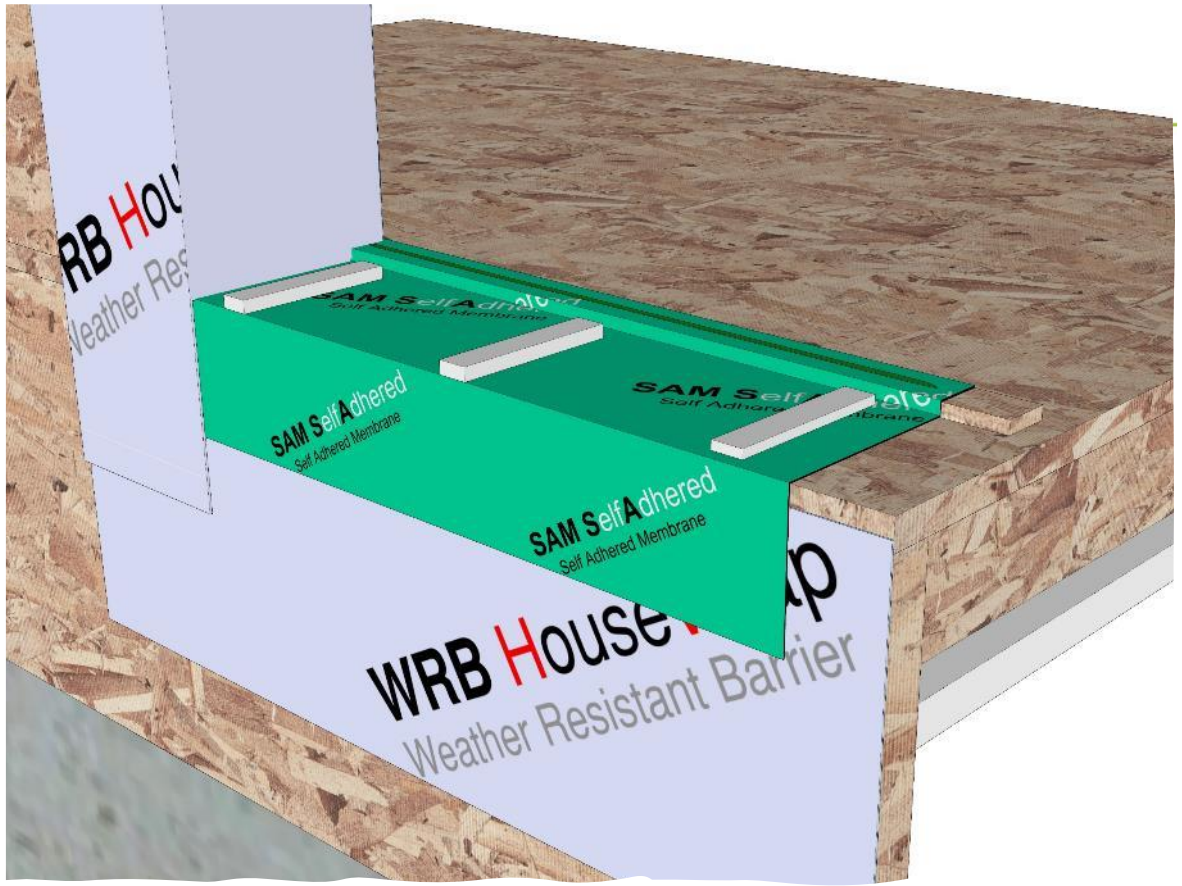


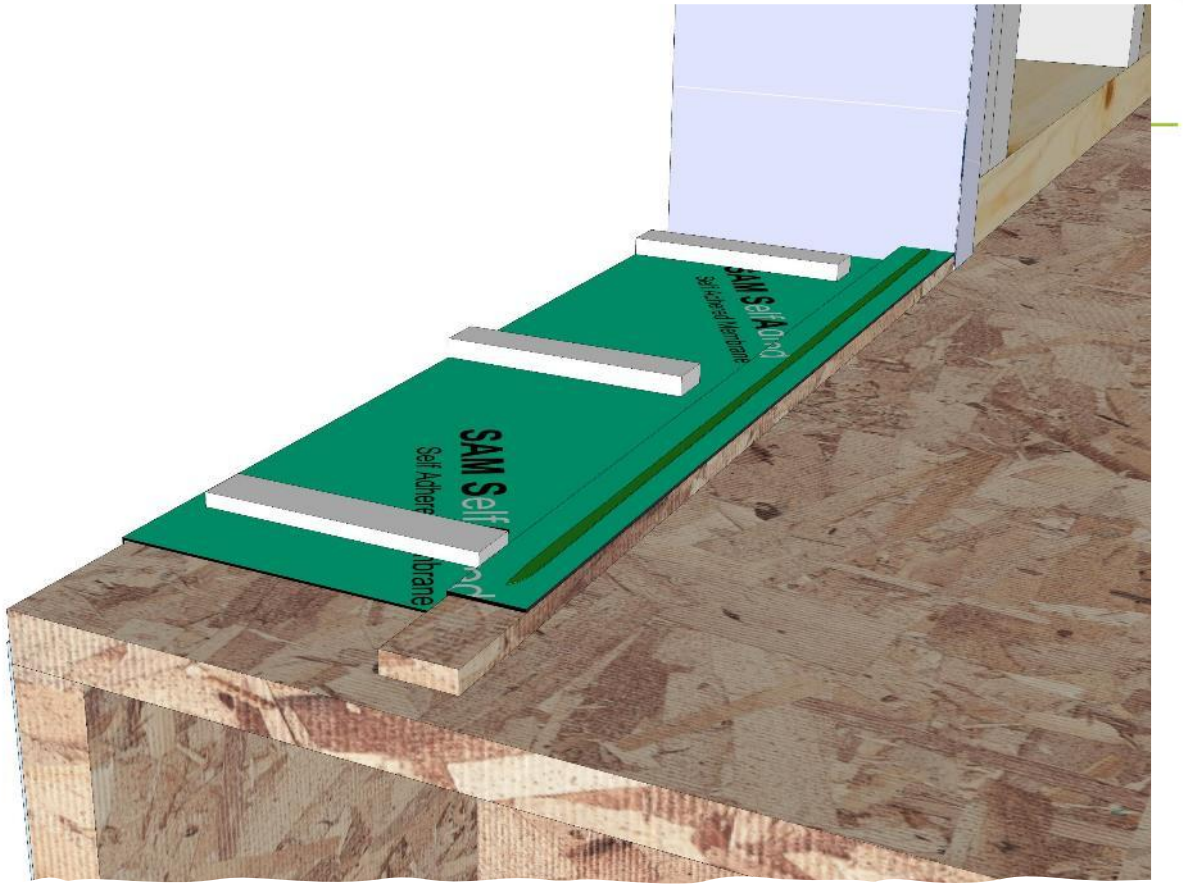
Current= Sill protection



2020 NBC and 2019 CSA A440.4 = Sill protection



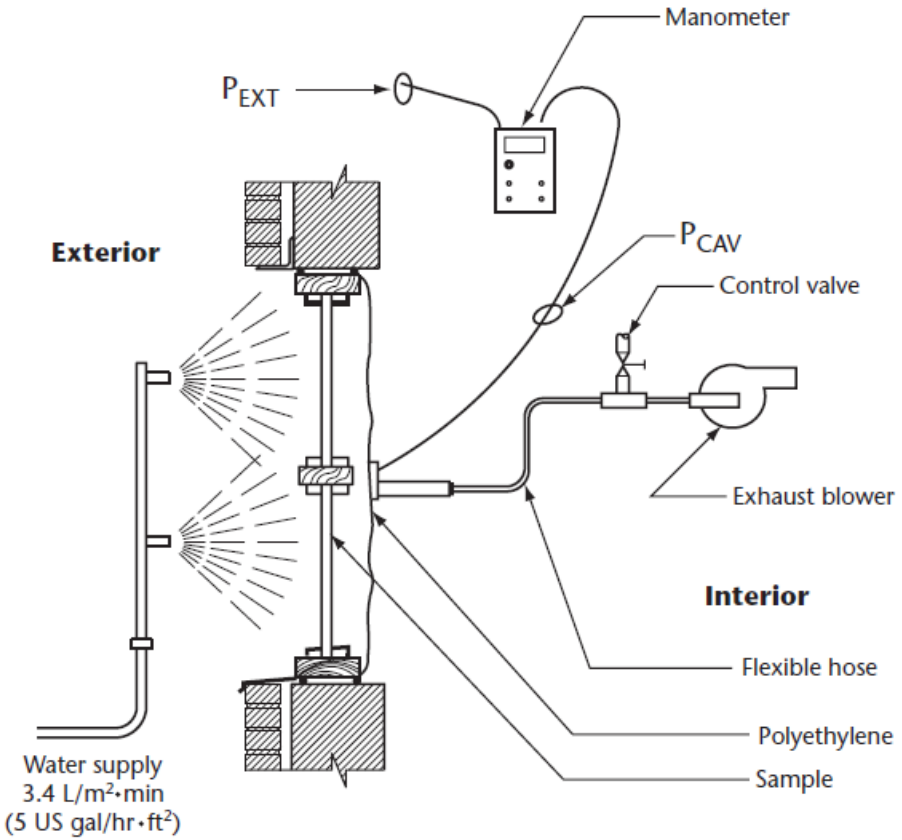




New Requirements

Addition of back dams or sloped sills for door installations

Testing Methods



Legend:
P_{EXT} = *external pressure*
P_{CAV} = *cavity pressure (chamber)*

Note: *This figure has been adapted, with permission, from AAMA 502.*

Figure D.1
Test method A
(See Clause D.3.2.)

- AAMA 502 Water leakage and window testing
- Air pressure difference between interior and exterior
- Water applied to exterior fenestration and wall

ASTM 1105 E

- ASTM 1105 E Water leakage and window testing
- Air pressure difference between interior and exterior
- Water applied to exterior fenestration and wall

ASTM 1105 E

- ASTM 1105 E Water leakage and window testing is designed to verify installation of new windows rather than for existing leakage

- Allows testing of planned installation methods on larger complex buildings

- Reduces risk particularly in taller buildings and in environments with wind driven rain

Take Aways

- Structural support glazing: shims and blocks
- *Identify 2nd Planes of Protection*
- Drain R.O. to second plane
- Sheathing membrane between rigid insulation is for air barrier only
- *Primary air barrier* on interior R.O.
- Primer and roller for self-adhered membranes

Thank You!

QUESTIONS?

LEEP
LOCAL ENERGY EFFICIENCY PARTNERSHIPS

Building Science Considerations for Window & Door Integration within Exterior Walls