

## **NOTICE: THIS SESSION WILL BE RECORDED FOR EDUCATIONAL USE.**

### ***The Privacy Act***

It is NRCan's responsibility to inform you about the collection and management of personal information as per the [Privacy Act](#). It applies to meetings organised and recorded using the Microsoft Teams platform. The data collected remain within NRCan's tenant.

### **What personal data is collected**

The content of the meeting, which includes audio, video and images as well as the name and email you used to register for this event.

### **Why this meeting is being recorded**

A meeting will be recorded for educational purposes so the content can be used for future reference. The NRCan LEEP Team may share this recording with selected industry partners.

### **Consent**

By participating in this online meeting, you are giving your consent to the conditions indicated above. At any time, you can withdraw your consent and leave the meeting. All recordings are subject to the [Access to Information](#) and [Privacy Act](#).

### **Contact**

If you have any concerns or questions, please contact Clarice Kramer, NRCan LEEP Team: [clarice.kramer@nrcan-rncan.gc.ca](mailto:clarice.kramer@nrcan-rncan.gc.ca)



*March 13, 2025  
CACEA webinar*

# LEEP Technical Training: Net Zero Energy Wall Assemblies

LEEP Contact: [clarice.kramer@nrcan-rncan.gc.ca](mailto:clarice.kramer@nrcan-rncan.gc.ca)



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

## Acknowledgements:

**Graham Finch**, P.Eng.

Principal, Senior Building Science Specialist

**James Higgins**, AScT

Associate, Senior Building Science Consultant

**RDH** BUILDING  
SCIENCE

**LEEP** LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

CanmetENERGY  
**Canada**



# LEEP wall guide objectives

For buildings to achieve higher performance levels, we need a fundamental change in wall design and construction.

- Build-on familiar wall-types and skills;  
but - Upgrade - for better over-all performance
- Increase effective R-values & reduce thermal bridging
- Airtight enclosures reduce loss & heating/cooling loads, less energy is required to keep occupants safe and comfortable
- Reliable water-protection systems & water-shedding details that work for thicker walls
- Effective vapour barriers to avoid trapping moisture inside wall assemblies



# LEEP NZE Wall Guides (7 Documents)

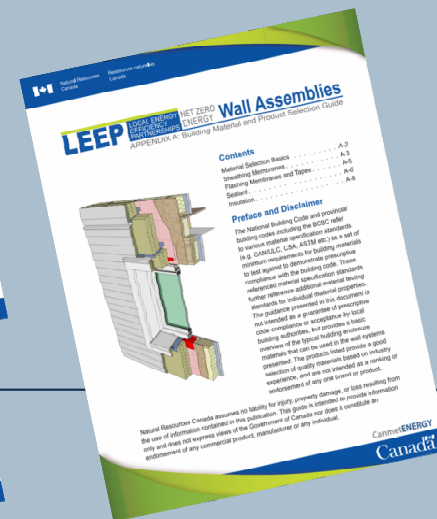
Free Download. Search: "LEEP Technology Guides and Tools"



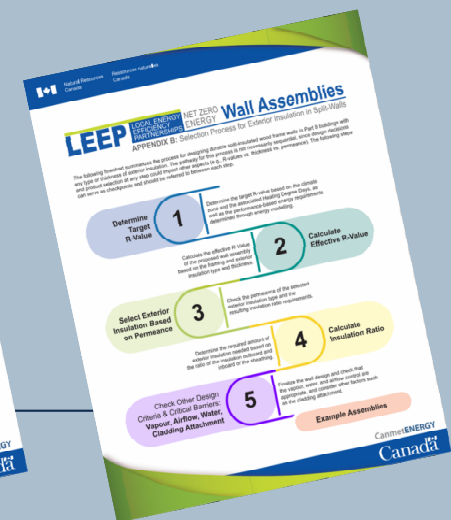
Intro and Wall Selection Guide



4 NZE Wall Assembly Guides



Appendix A Material Selection



Appendix B Exterior Insulation Selection

# Agenda

- Why Enclosure First?
- Wall Selection Overview
- Overview of Wall #1 thru #4
- Exterior Insulation Selection
- Material Selection
- NZE Renovations/Retrofits



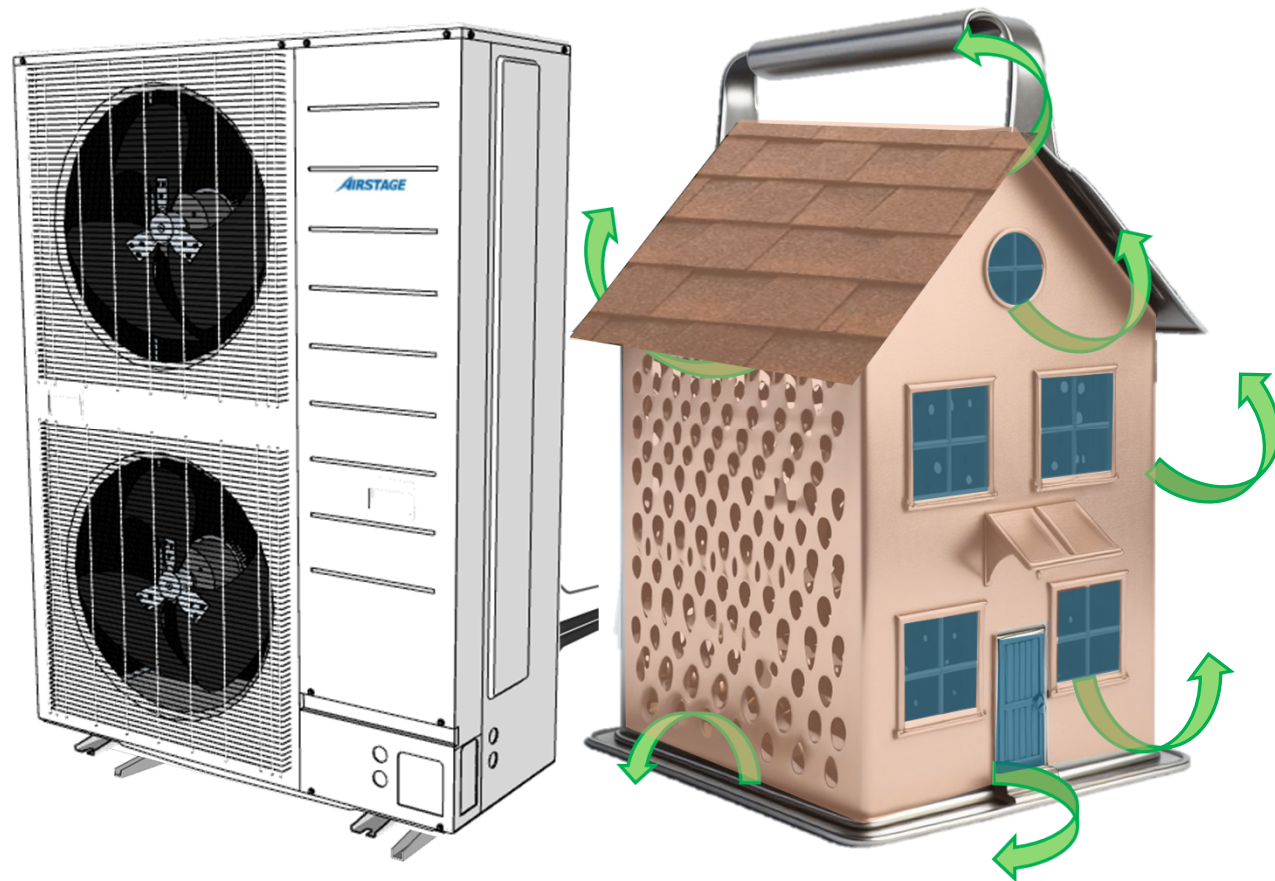
# Why “Enclosure First” for Net Zero Energy?

“Just use a heat pump”...

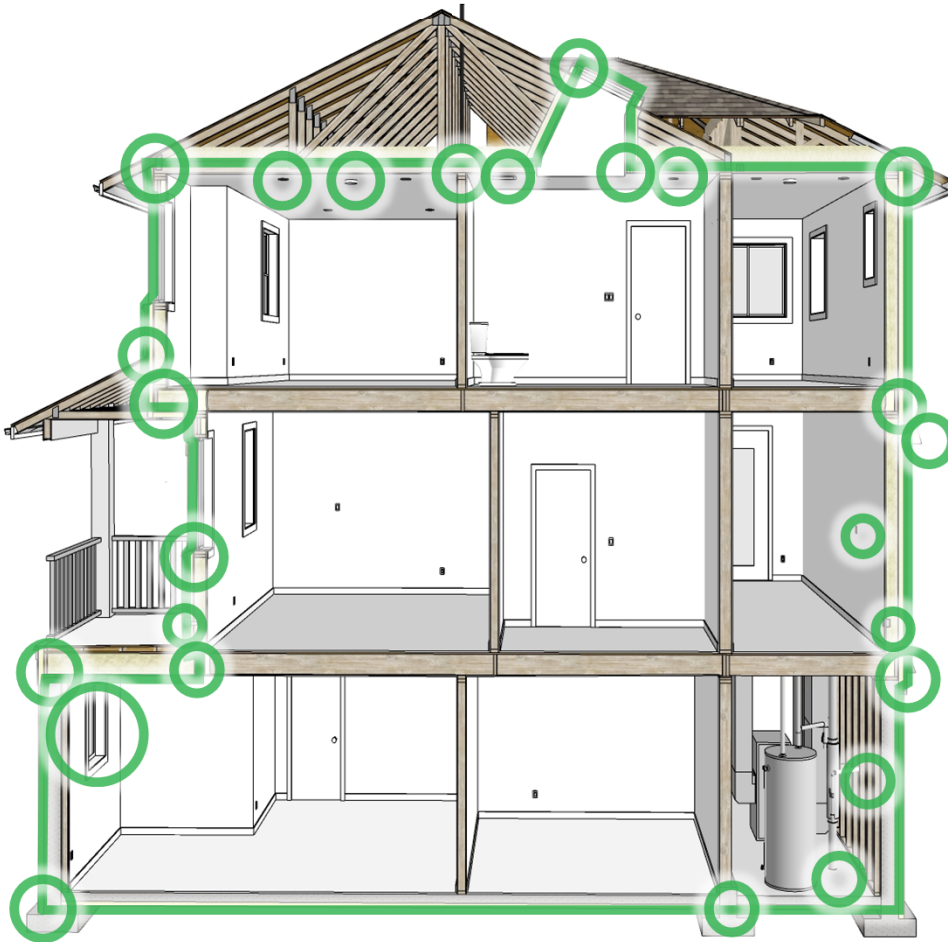
Can your heat pump keep up?

Airtightness and R-value is key

Mechanical follows enclosure



# Airtightness is Fundamental to NZE

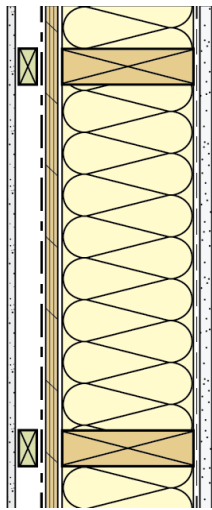


**$\leq 1.0$  ACH  
Recommended**



# “How We’ve Always Done It”...

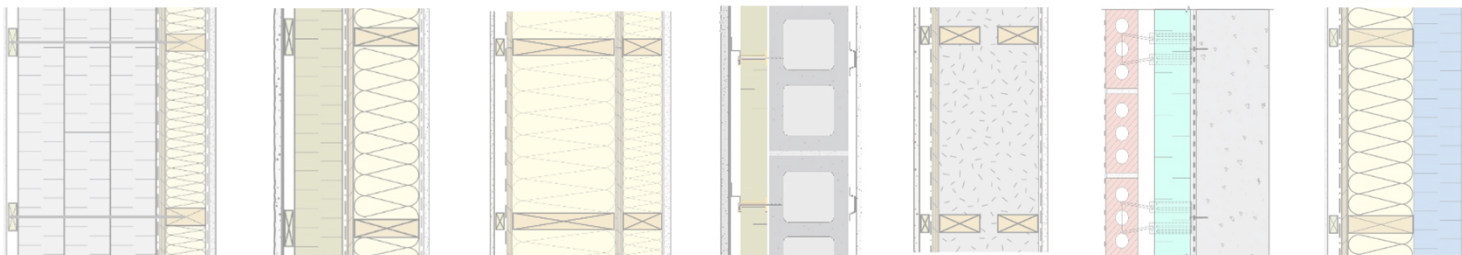
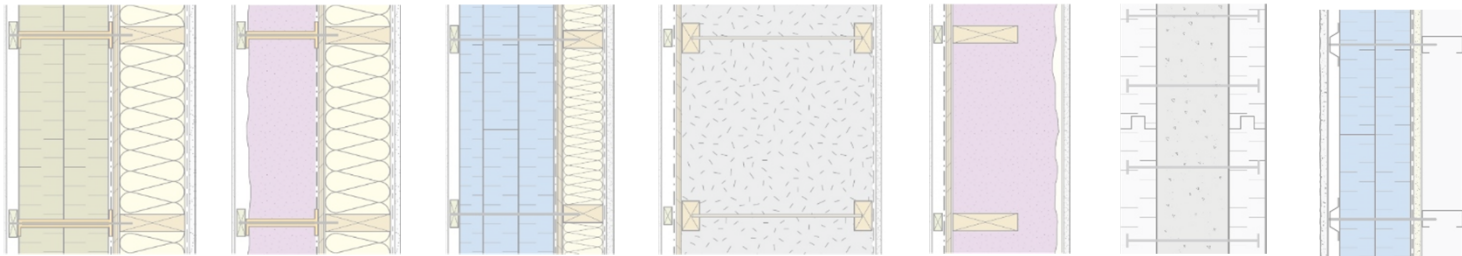
**Net Zero Energy** construction will usually require higher wall effective R-values, when compared to traditional wall assemblies.\*



**Interior-Insulated 2x6  
(~R-18 eff.)**

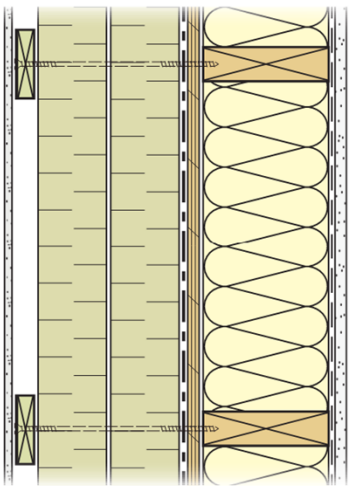


# How Do You Achieve Higher R-values?



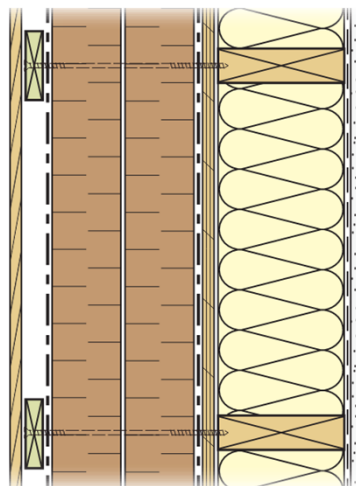
# Four Wood-Frame Above-Grade Walls

The four **LEEP NZE Wall Assembly Guides** offer guidance on straightforward approaches to higher R-value and more airtight wall assemblies



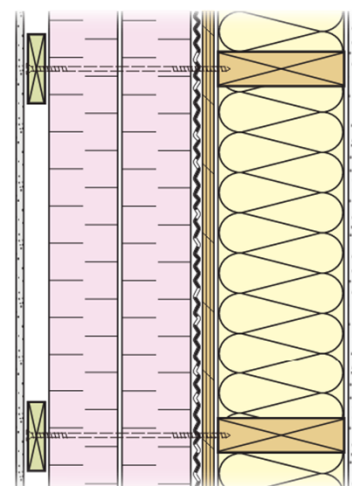
**Wall #1**

Split-Wall: Vapour Permeable  
Exterior Insulation



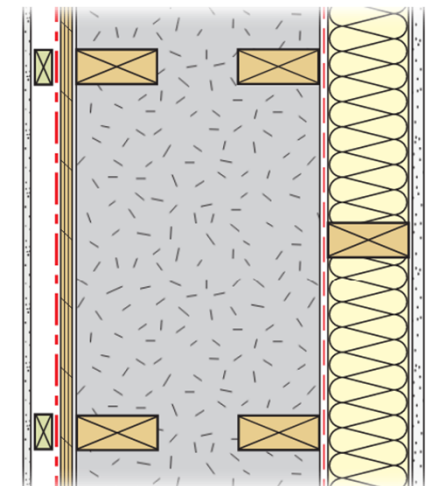
**Wall #2**

Split-Wall: Wood Fibre  
Exterior Insulation



**Wall #3**

Split-Wall: Low-Permeance  
Exterior Insulation



**Wall #4**

Double Stud Wall with  
Interior Service Wall

## **Disclaimer:**

# **Code Compliance and Performance Verification**

- Wall assemblies must comply with all local applicable codes / AHJs.
- Responsibility for code compliance always lies with the building owner.
- The Building Official is only there to oversee and apply the local code.
- New technology may come to market faster than AHJ's can prepare for.
- Collaboration is key.
- Use IDP and 'up-front planning' before the permit application.
- Alternative solutions /engineering may be required initially.

# Code Compliance Categories



**Acceptable  
Solution**

“letter of the law”

1.2.1.1.(1)(a)

**Alternative  
Solution**

“at least as well as”

1.2.1.1.(1)(b)



**Engineered**

Sealed  
and/or

Letter of Assurance

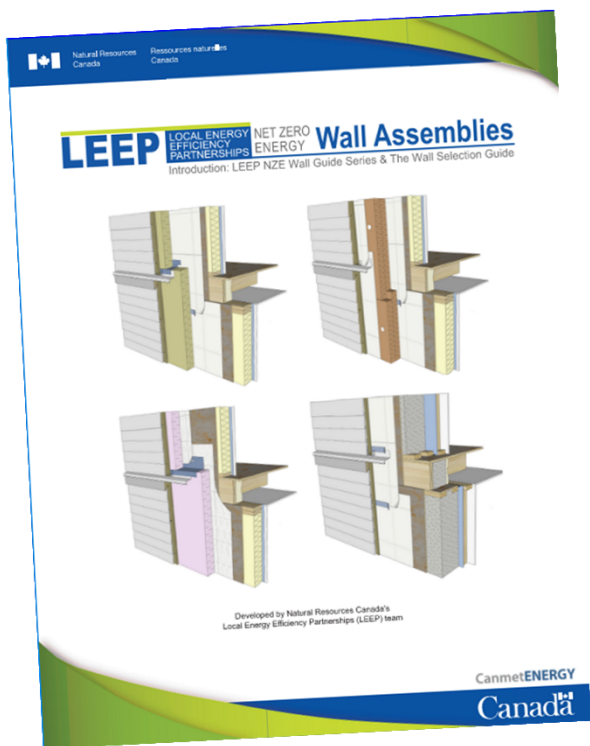
**LEEP**

LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

NET ZERO  
ENERGY

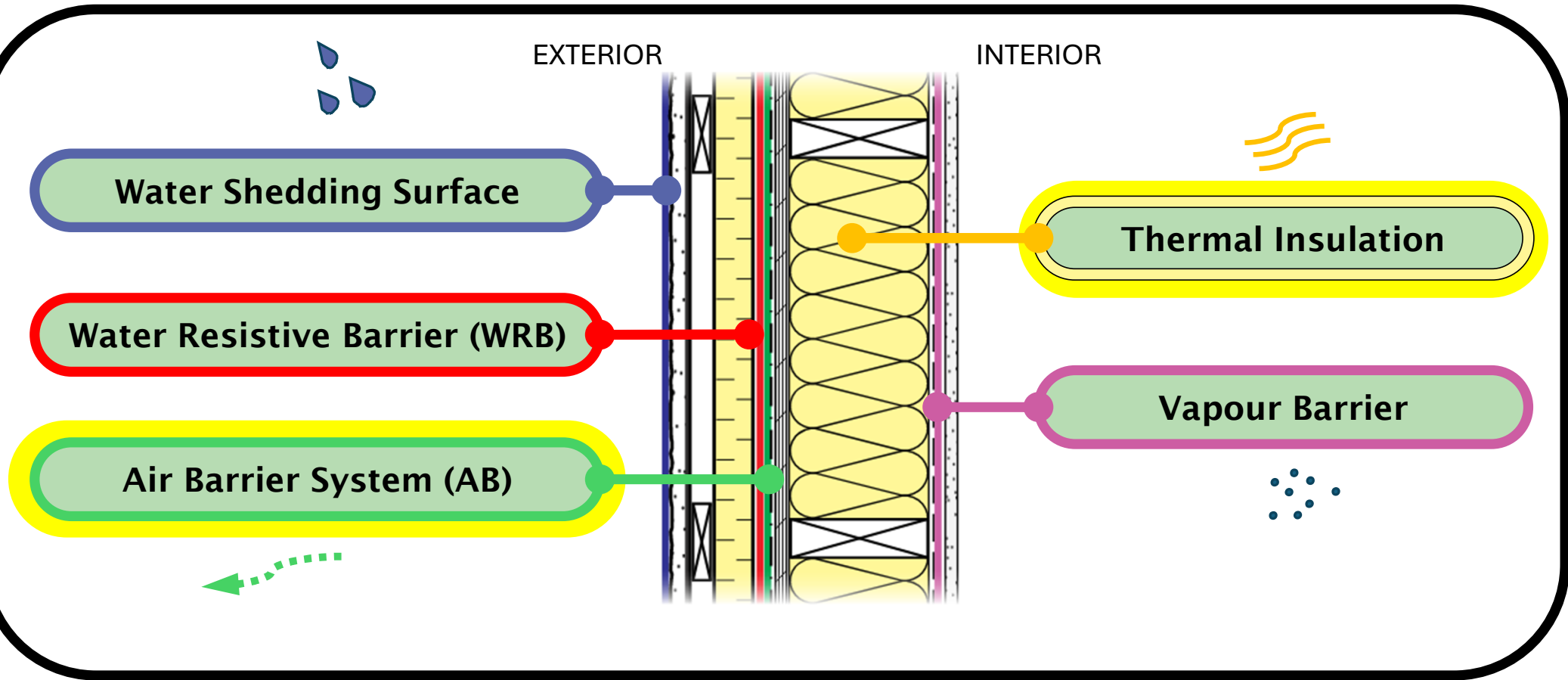
**Wall Assemblies**

Introduction: LEEP NZE Wall Guide Series & The Wall Selection Guide

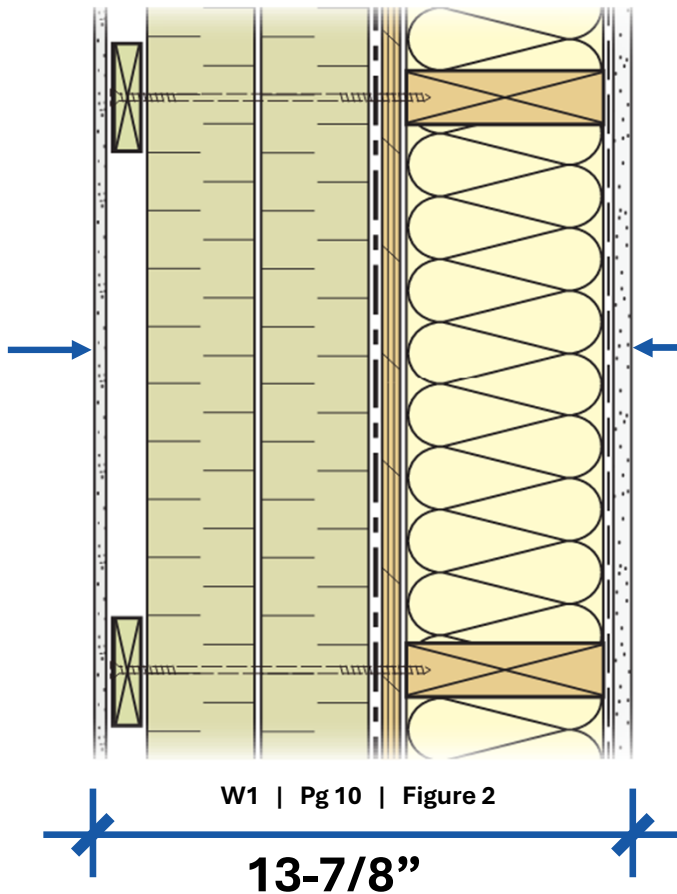


# Introduction: LEEP NZE Wall Guide Series & The Wall Selection Guide

# Wall Assembly Critical Barriers



# Wall #1 Assembly Overview



## *Interior*

Finished gypsum board (1/2")

Vapour Control Layer

## **Batt insulation**

Stud framing (5-1/2" 2x6)

Exterior sheathing (3/4")

## **Sheathing membrane (AB/WRB)**

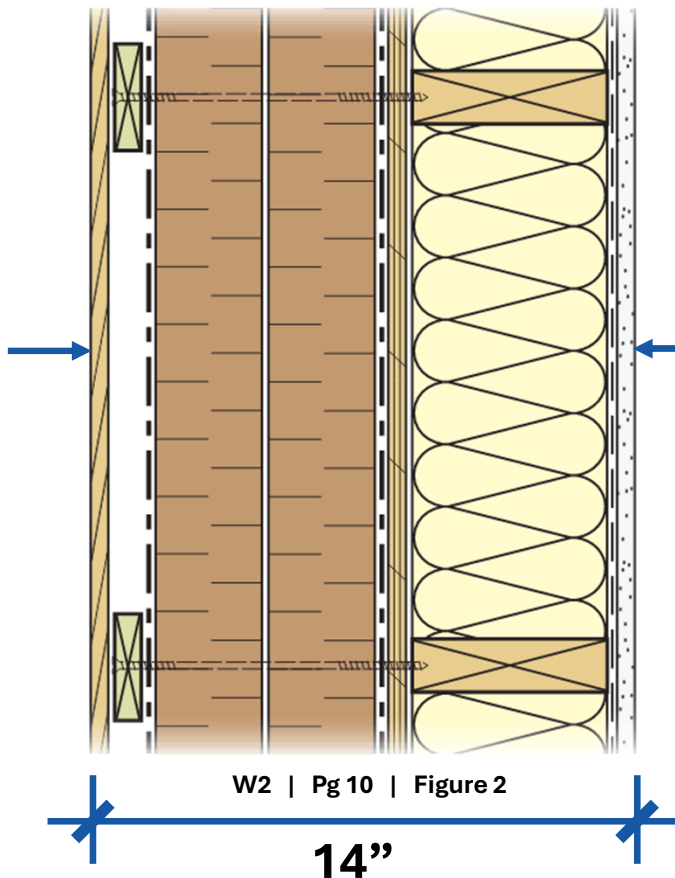
**Exterior vapour permeable rigid insulation (6")**

Strapping + rainscreen cavity (3/4")

Cladding (3/8")

## *Exterior*

# Wall #2 Assembly Overview



## *Interior*

Finished gypsum board (1/2")

Vapour Control Layer

## **Batt insulation**

Stud framing (5-1/2" 2x6)

Exterior sheathing (3/4")

## **Sheathing membrane (AB)**

## **Wood fibre rigid insulation (6")**

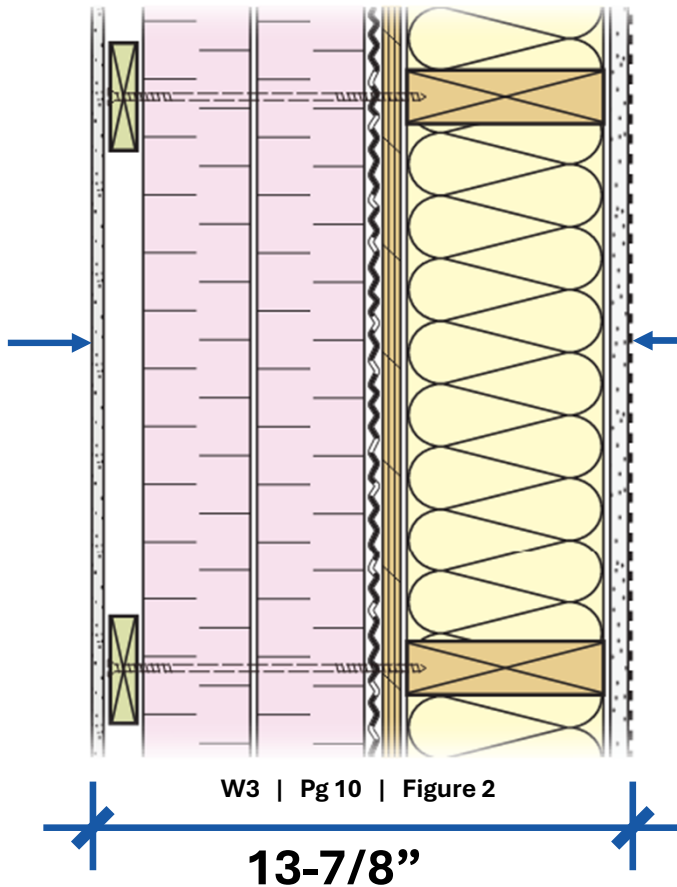
Sheet membrane (WRB)

Strapping + rainscreen cavity (3/4")

Cladding (1/2")

## *Exterior*

# Wall #3 Assembly Overview



## *Interior*

Vapour retarder paint

Finished gypsum board (1/2")

## **Batt insulation**

Stud framing (5-1/2" 2x6)

Exterior sheathing (3/4")

**Dimpled/drainable sheathing membrane (AB/WRB)**

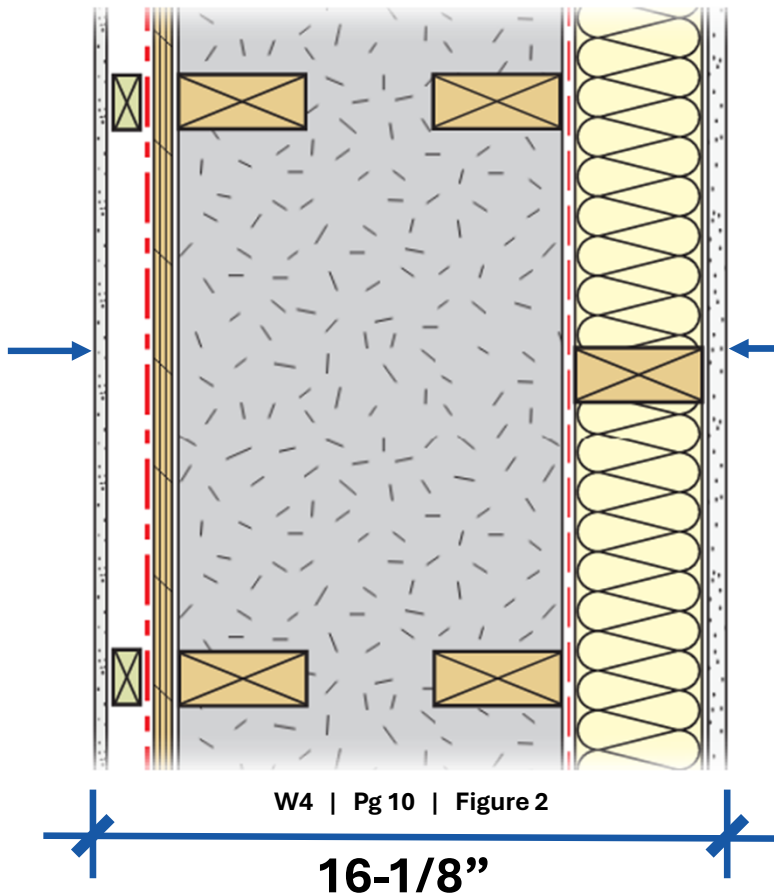
**Rigid low-permeance foam insulation (6")**

Strapping + rainscreen cavity (3/4")

Cladding (3/8")

## *Exterior*

# Wall #4 Assembly Overview



## *Interior*

Finished gypsum board (1/2")

2x4 framed **insulated** service cavity (3-1/2")

## **Polyethylene (AB)**

Double stud framing (10-1/2")

## **Blown-in dense-pack insulation**

Exterior sheathing (1/2")

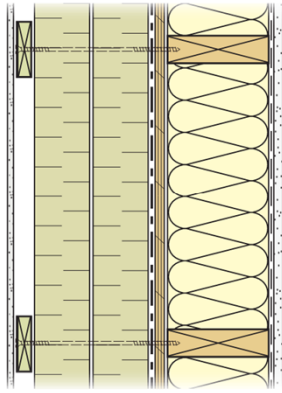
## **Sheathing membrane (AB/WRB)**

Furring/rainscreen cavity (3/4")

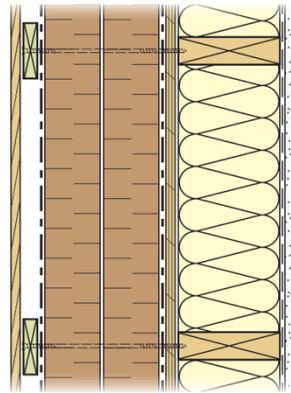
Cladding (3/8")

## *Exterior*

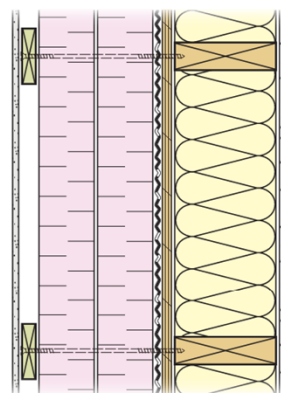
# Wall Selection and Comparison



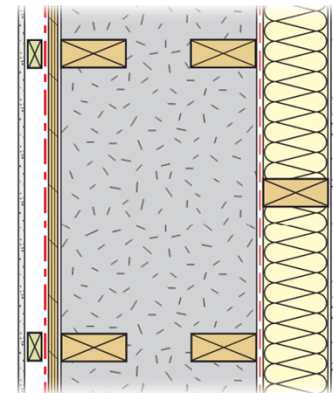
Wall #1



Wall #2



Wall #3



Wall #4



# Wall Selection and Comparison Legend



Acceptable performance but not optimized for given category; requires careful attention during application

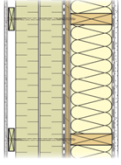
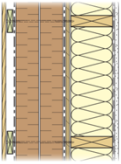
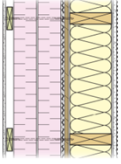
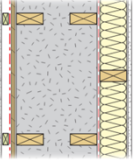


Typically good performance but not necessarily optimized for given category



Good performance and potentially optimized for given category

# Wall Selection and Comparison

	R-value vs Thickness	Constructability	Cost Premium	Condensation Risk	Moisture Management	Airtightness	Adaptability
	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓

**LEEP**

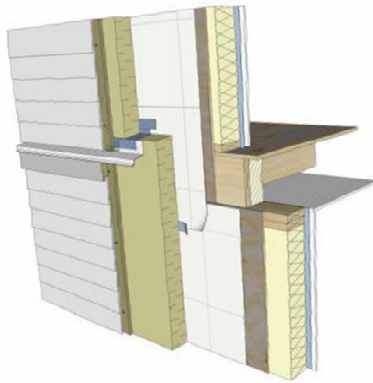
LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

NET ZERO  
ENERGY

# Wall Assembly #1



**LEEP** LOCAL ENERGY EFFICIENCY PARTNERSHIPS NET ZERO ENERGY **Wall Assembly #1**  
Split-Wall: Vapour Permeable Exterior Insulation

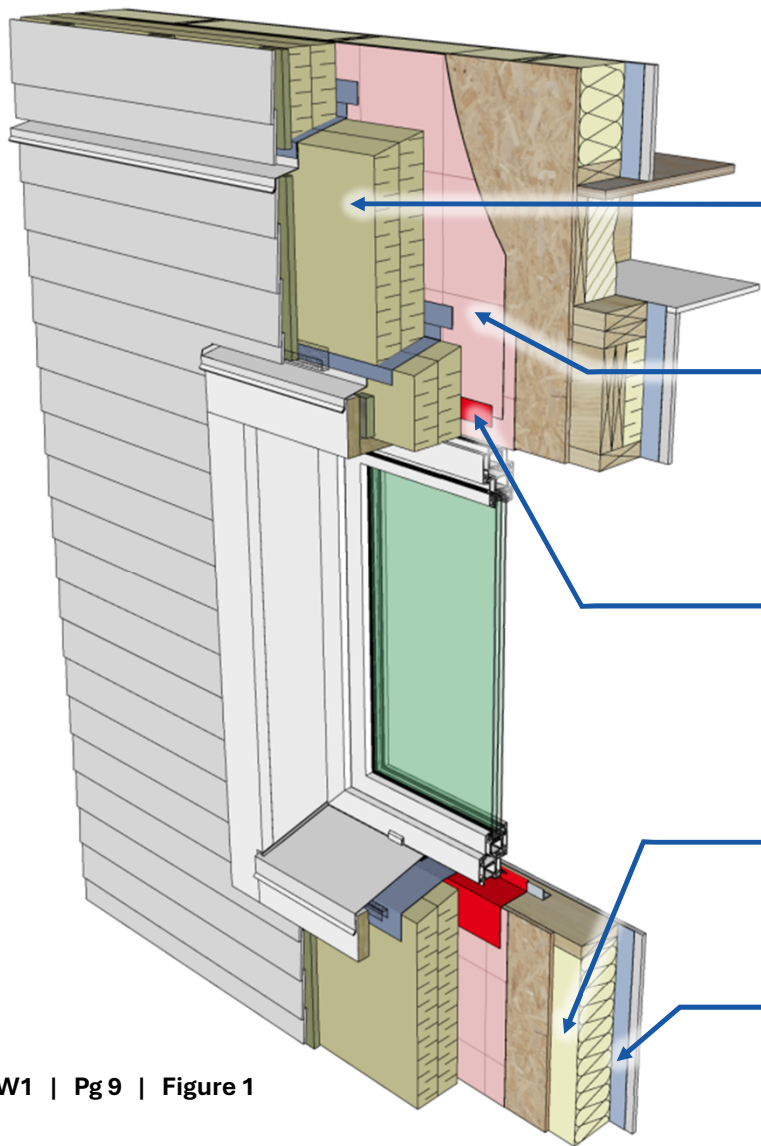


Developed by Natural Resources Canada's  
Local Energy Efficiency Partnerships (LEEP) team



## Split-Wall: Vapour Permeable Exterior Insulation

# Wall #1 Overview

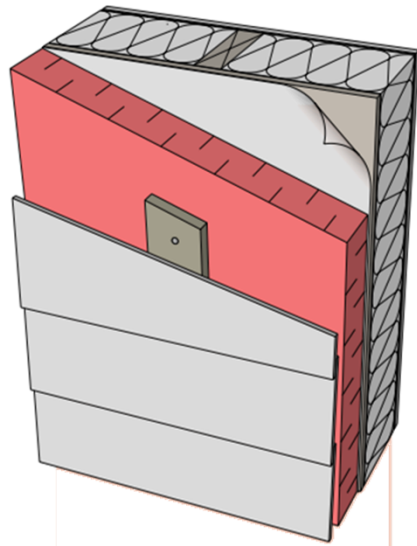


- **Vapour-Permeable Exterior Insulation:** Semi-rigid or rigid stone wool or fibreglass
- **Water-Resistive Barrier:** Vapour permeable sheathing membrane on exterior face of wall sheathing
- **Air Barrier:** Sealed sheathing membrane is most straightforward, other options available
- **Interior Insulation:** Conventional cavity insulation products
- **Vapour Control:** Conventional interior polyethylene

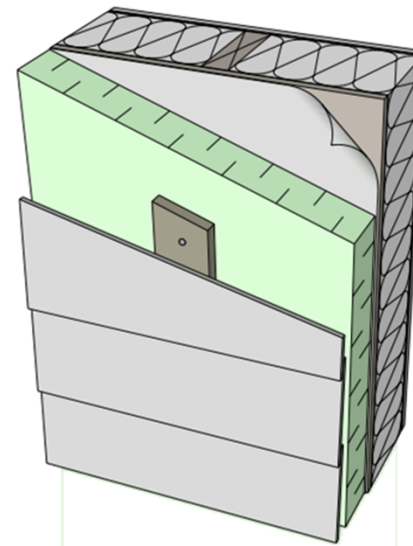
# Exterior Insulation Permeance... coming later

Low Permeance Insulation

Permeable Insulation



VS.



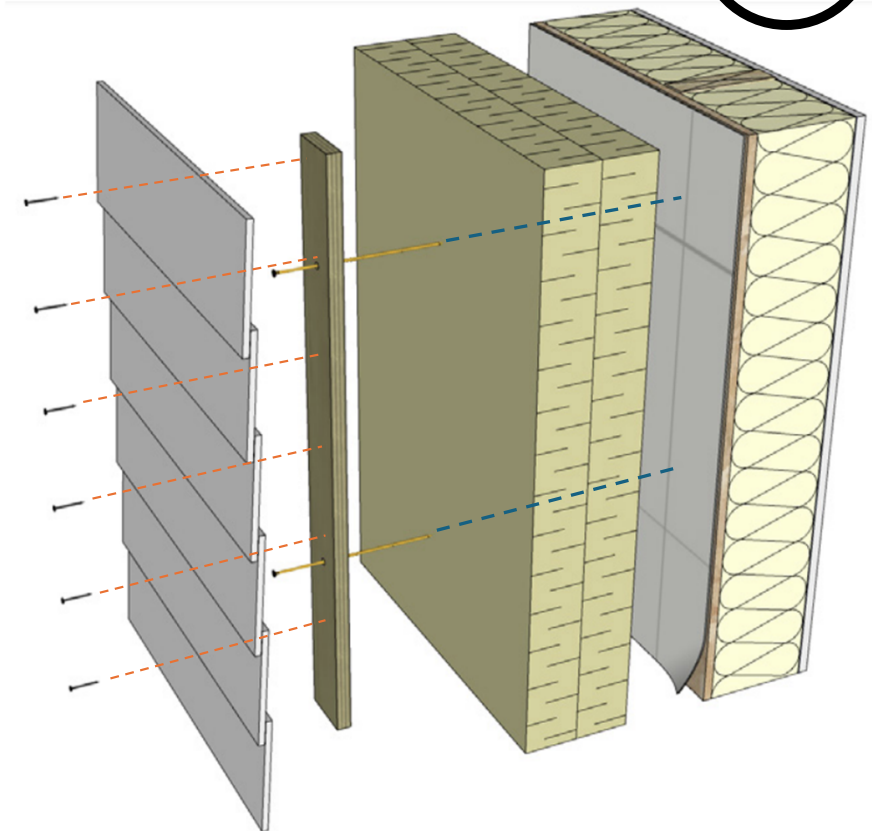
App-B | Pg B-4

## First: Construction and Process

# Fasteners Through Exterior Insulation

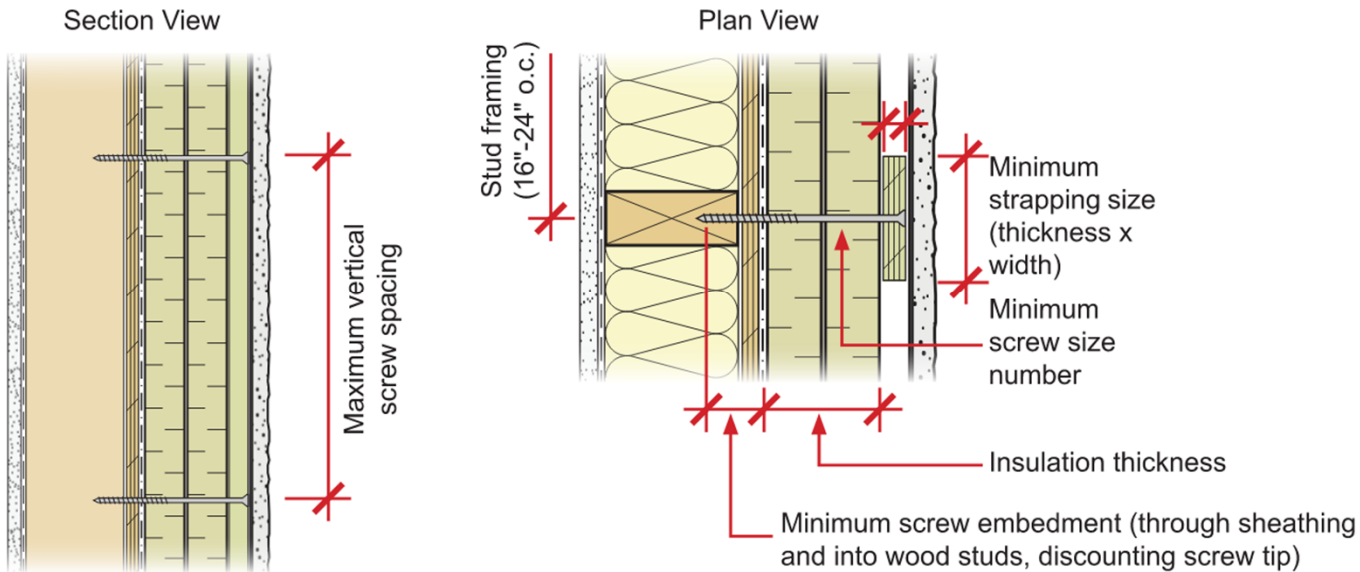


- Any typical cladding can be used
- Use long fasteners to attach strapping, and fasten the cladding to the strapping
- Heavier cladding like brick may require alternative methods
- 3/4" plywood sheathing can serve as sole fastening substrate. No need to align strapping with studs.



W1 | Pg 12 | Figure 4

# Fastener Tables



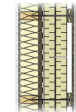
W1 | Pg 26 | Figure 24

Structural Requirements & Fastener Tables

Fastener Tables*	
Assumed Structural Properties	
Rigid mineral wool minimum compressive strength	Stainless/galvanized steel screw allowable tensile strength
439 psf (21 kPa) @ 10% compression, ASTM C165 testing	60,000 psi (414 MPa)

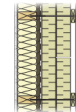
Example Screw Fastener Products	
Trufast HD Roofing Fasteners	GRK Fasteners RA, RSS, RT
My-Ti-Con ASSY Eco	Heco-Topix
Simpson StrongDrive SDWS Timber Screw	SFS Intec Dekfast

Light Weight Cladding



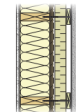
Fastener/Strapping Installation Requirements - Light Weight Cladding				
Thickness of Exterior Insulation	Maximum Vertical Screw Spacing	Minimum Screw Size	Minimum Screw Embedment	Minimum Strapping Size
Light Weight Cladding Below 5 lbs/ft <sup>2</sup> - 16" o.c. Stud Framing				
1" to 2"	24"			
>4 to 8"	16"	#10	1-1/2"	3/4" x 2-1/2"
Light Weight Cladding Below 5 lbs/ft <sup>2</sup> - 24" o.c. Stud Framing				
1" to 2"	16"	#10	1-1/2"	3/4" x 3"
>2" to 8"	12"			

Medium Weight Cladding



Fastener/Strapping Installation Requirements - Medium Weight Cladding				
Thickness of Exterior Insulation	Maximum Vertical Screw Spacing	Minimum Screw Size	Minimum Screw Embedment	Minimum Strapping Size
Medium Weight Cladding Between 5 lbs/ft <sup>2</sup> and 10 lbs/ft <sup>2</sup> - 16" o.c. Stud Framing				
1" to 4"	16"	#12	1-1/2"	3/4" x 3"
>4" to 8"	12"			
Medium Weight Cladding Between 5 lbs/ft <sup>2</sup> and 10 lbs/ft <sup>2</sup> - 24" o.c. Stud Framing				
1" to 4"	12"	#12	1-1/2"	3/4" x 3"
>4" to 8"	8"			

Heavy Weight Cladding



Fastener/Strapping Installation Requirements - Heavy Weight Cladding				
Thickness of Exterior Insulation	Maximum Vertical Screw Spacing	Minimum Screw Size	Minimum Screw Embedment	Minimum Strapping Size
Heavy Weight Cladding Between 10 lbs/ft <sup>2</sup> and 15 lbs/ft <sup>2</sup> - 16" o.c. Stud Framing				
1" to 2"	16"	#14	1-1/2"	3/4" x 3"
>2" to 8"	12"			
Heavy Weight Cladding Between 10 lbs/ft <sup>2</sup> and 15 lbs/ft <sup>2</sup> - 24" o.c. Stud Framing				
1" to 2"	16"	#14	1-1/2"	3/4" x 3"
>2" to 4"	12"			
>4" to 8"	8"			

\*The values provided in the above tables pertain only to wood-frame wall assemblies on low-rise buildings less than three storeys.

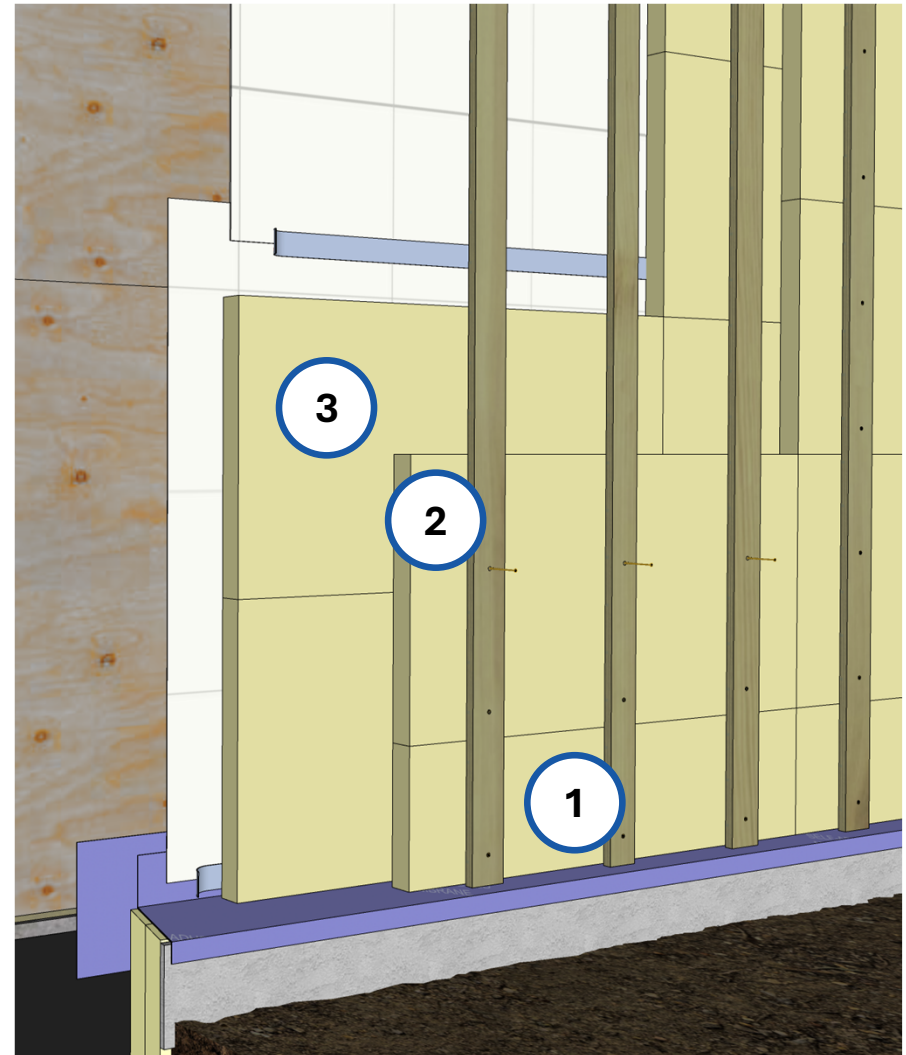
NRCan LEEP NZE Wall Guides

Assembly #1 | Split-Wall, Vapour Permeable Exterior Insulation

W1 | Pg 27

# Installation Techniques

1. Starter course and straps
2. Insulation stacked and fastened
3. Offset courses as needed



W1 | Pg 15 | Figure 6

# Field-of-Wall Exterior Insulation is the Easy Part

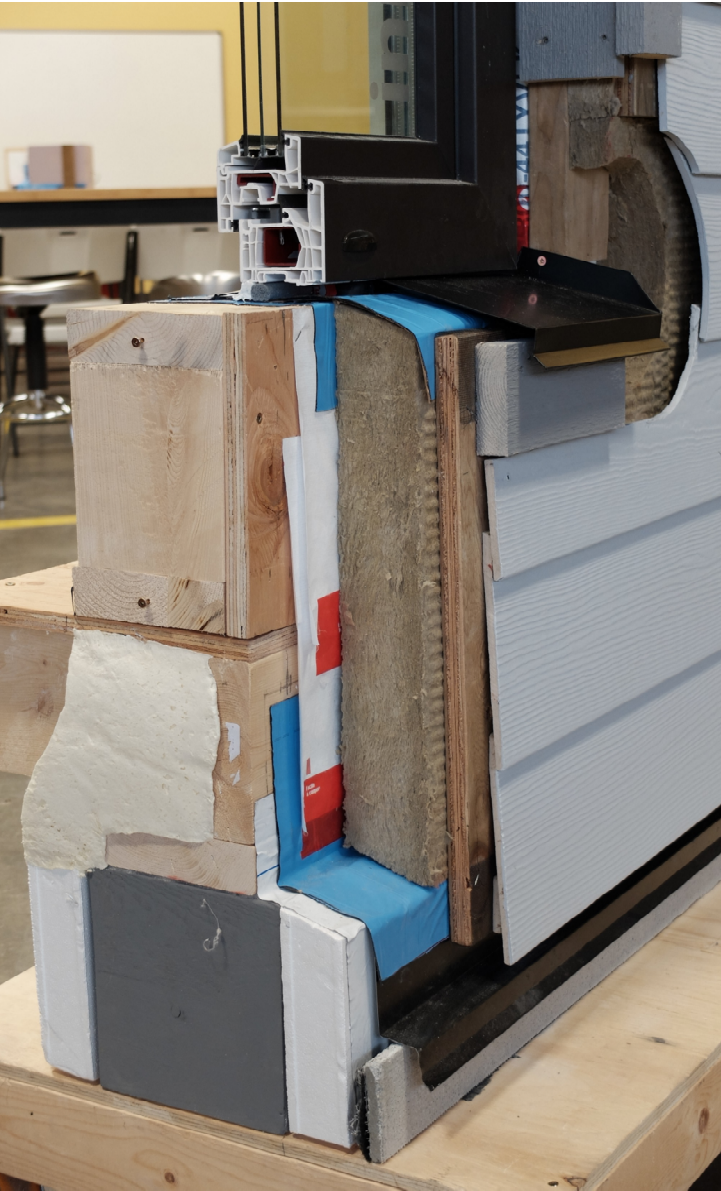


# Details and Process are Key to Success



# Example Exterior Insulation Mockups





# Optimizing Strapping Layout

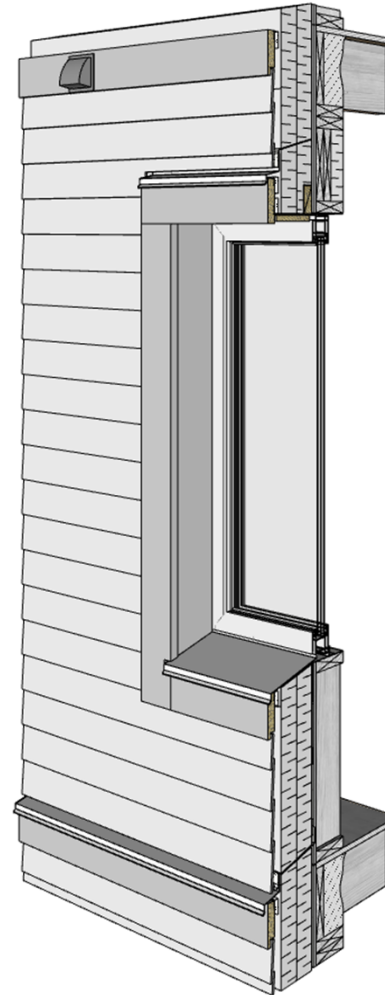
The most appropriate preservative treated plywood.

Avoid extra strapping and use the largest possible pieces of insulation.

Use of clear field strapping around penetrations where possible .....

Full size insulation boards .....

Jamb strap positioned to receive both trim and cladding .....



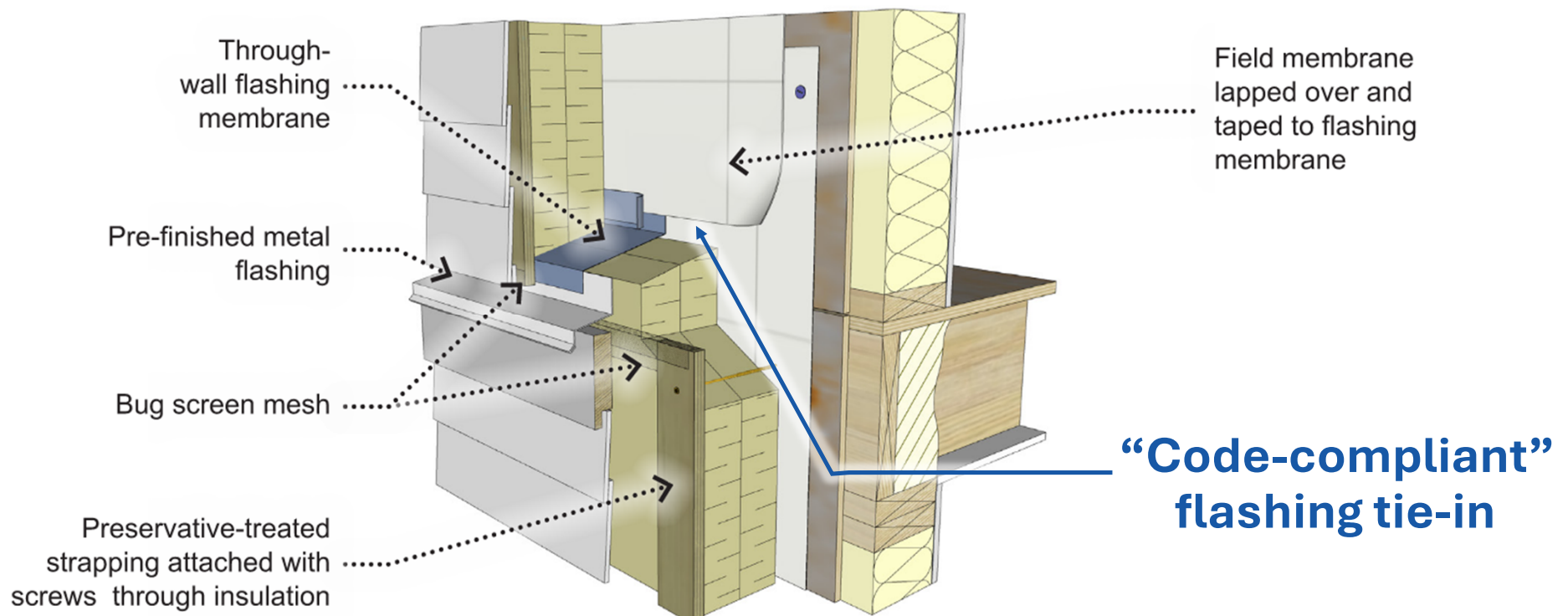
..... Intermittent blocking to receive closure trim

..... Extra strapping only for trim/insect screen terminations

W1 | Pg 17 | Figure 7

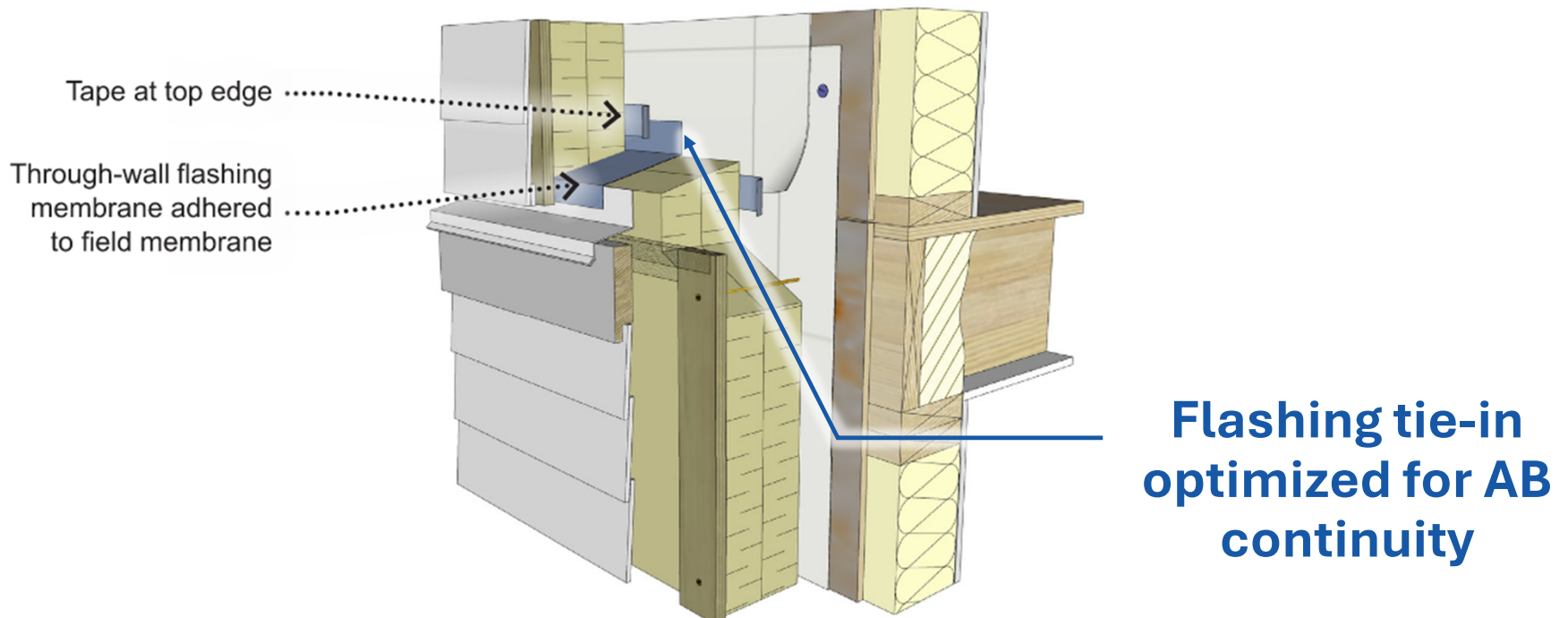
# Exterior Insulation and Flashing

Code language for water management and air barrier doesn't account for exterior insulation and modern materials. Flashing tie-in is tricky.



# Exterior Insulation and Flashing

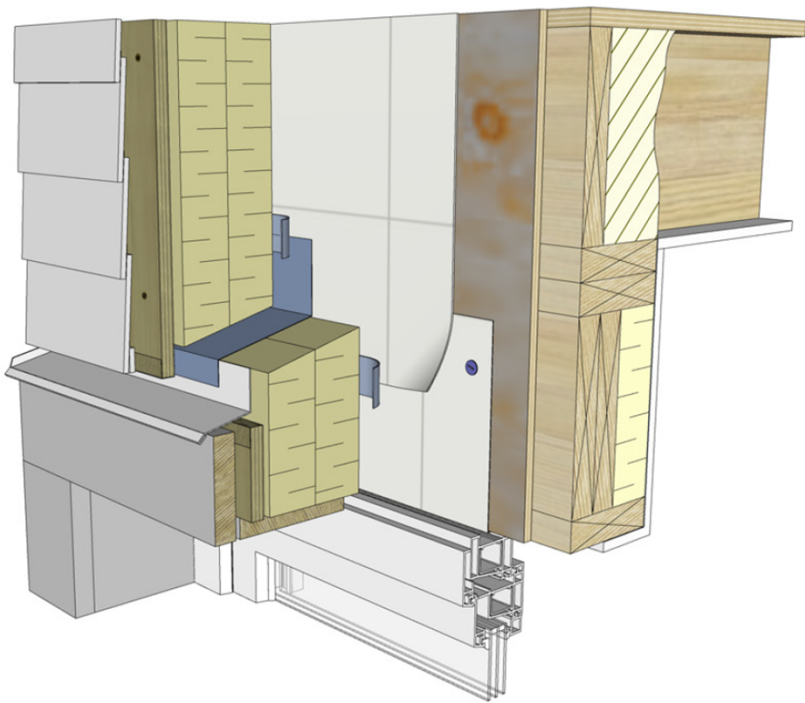
Guides show details optimized for sequencing and air barrier continuity



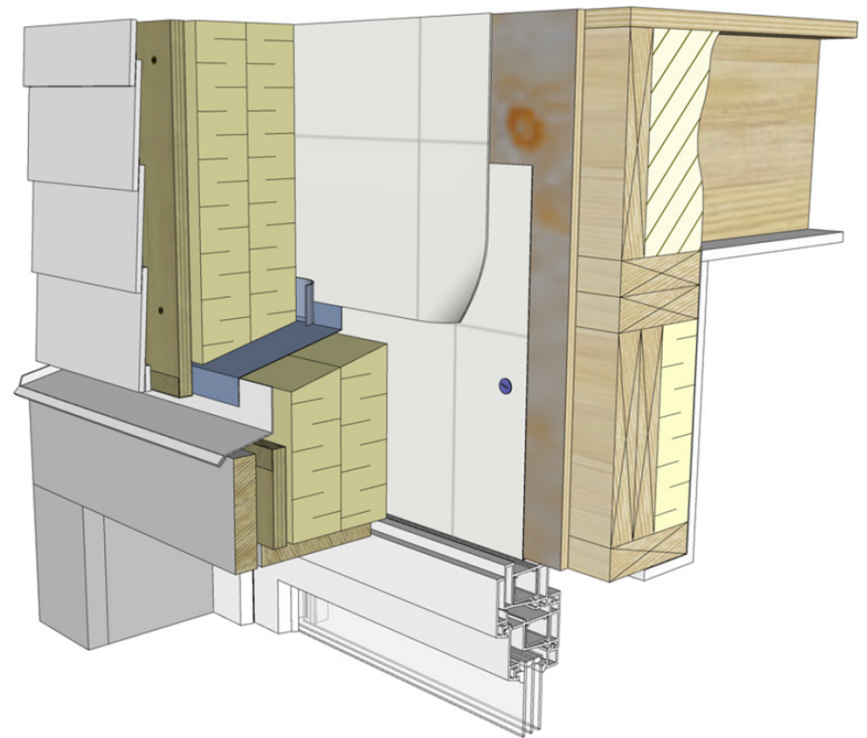
W1 | Pg 18 | Figure 9

# Exterior Insulation Around Windows

Flashings over openings?



W1 | Pg 25 | Figure 20



W1 | Pg 25 | Figure 21

# Exterior Insulation R-Value

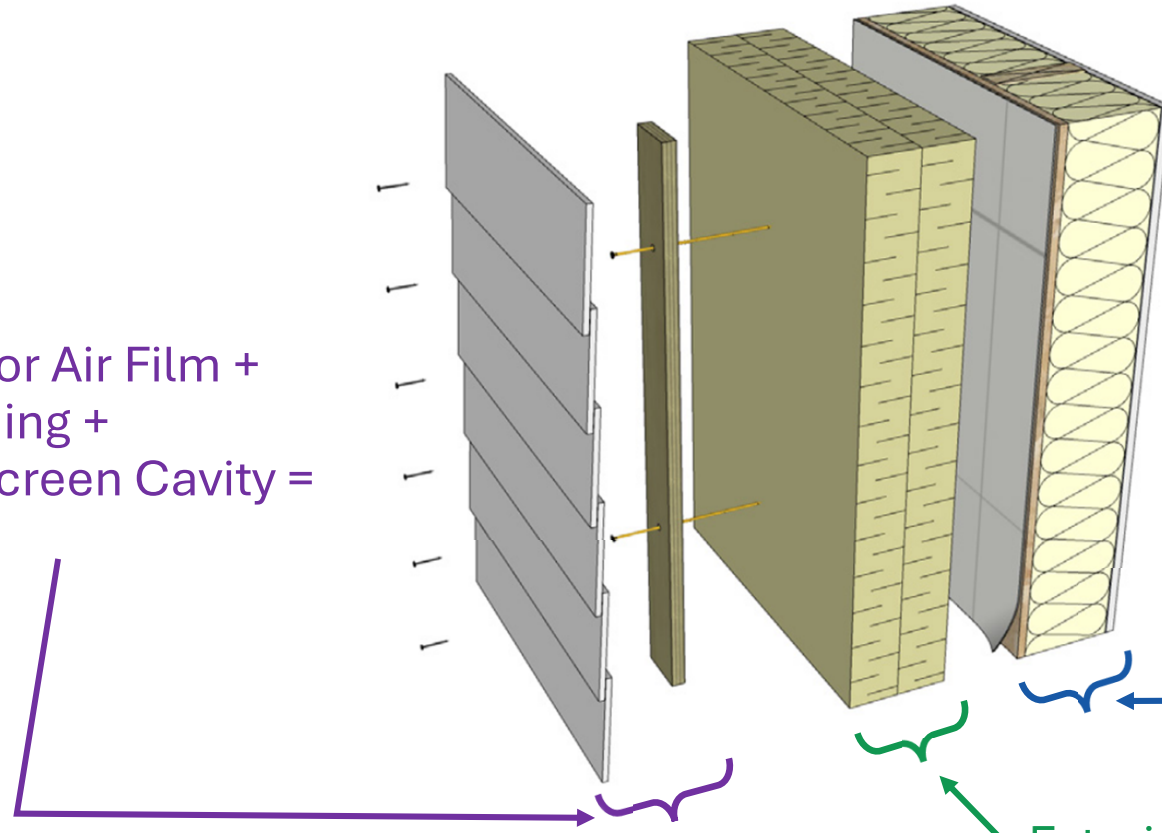
Thickness of Exterior Insulation (inches)	2x4 Framed Wall (R-12 Batts): R-11.3*		2x6 Framed Wall (R-19 Batts): R-16.2*		Thickness of Exterior Insulation (inches)
	90% Effective (i.e., galvanized screws)	95% Effective (i.e., stainless steel screws)	90% Effective (i.e., galvanized screws)	95% Effective (i.e., stainless steel screws)	
1.5	16.7	17	21.6	21.9	1.5
2.0	18.5	18.9	23.4	23.8	2.0
2.5	20.3	20.8	25.2	25.7	2.5
3.0	22.1	22.7	27	27.6	3.0
4.0	25.7	26.5	30.6	31.4	4.0
5.0	29.3	30.3	34.2	35.2	5.0
6.0	32.9	34.1	37.8	39	6.0
7.0	36.5	37.9	41.4	42.8	7.0
8.0	40.1	41.7	45	46.6	8.0
9.0	43.7	45.5	48.6	50.4	9.0
10	47.3	49.3	52.2	54.2	10
12	54.5	56.9	59.4	61.8	12

W1 | Pg 11 | Figure 3

Exterior Air Film +  
Cladding +  
Rainscreen Cavity =  
~R-1

Interior Air Film +  
Insulated Cavity +  
Sheathing =  
~R-11 (2x4) to R-14 (2x6)

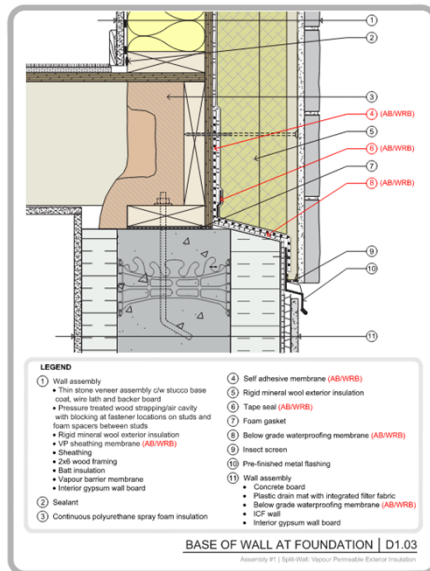
Exterior Insulation = ~R-4 per inch\*



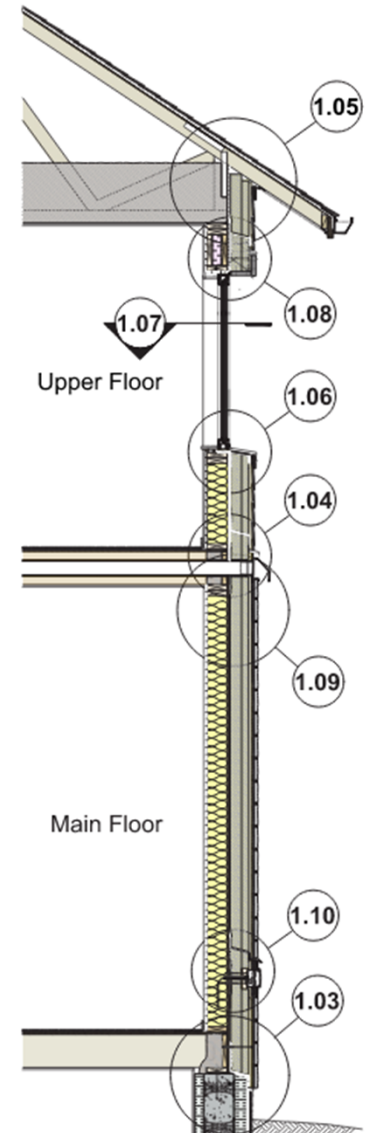
W1 | Pg 12 | Figure 4

# Typical Construction Details

Eight typical details with focus on **air** and **thermal** continuity

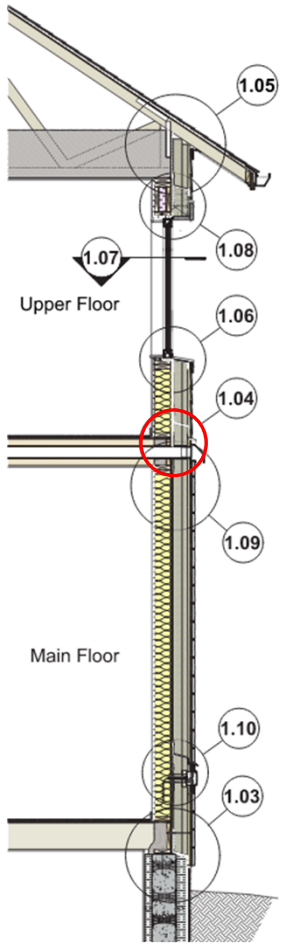


W1 | Pg 36

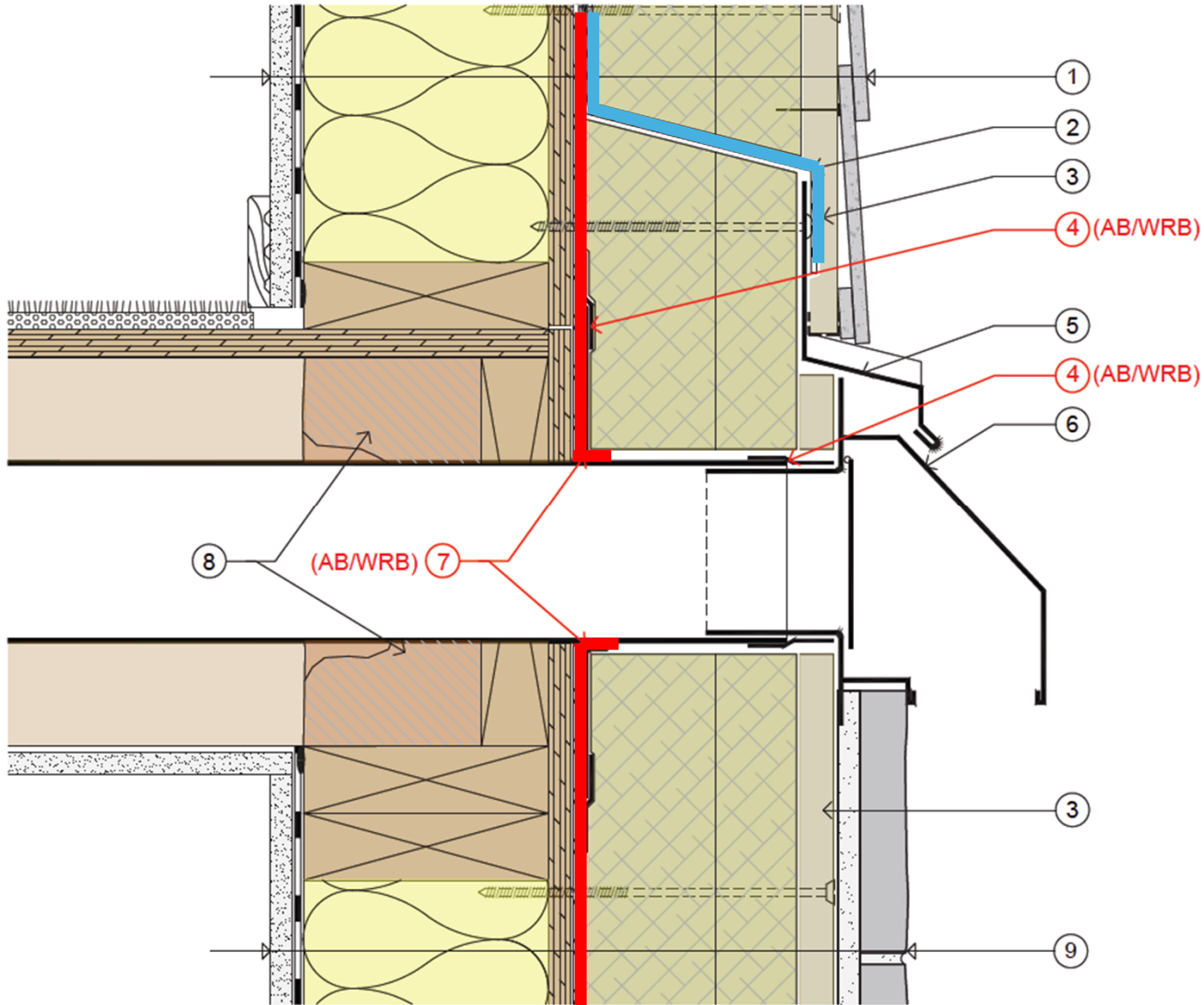


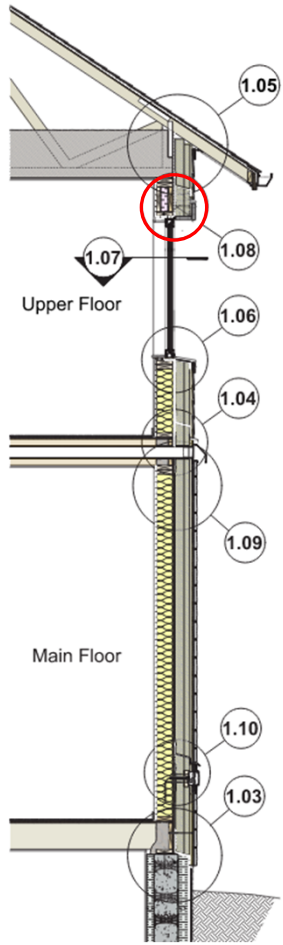
W1 | Pg 35



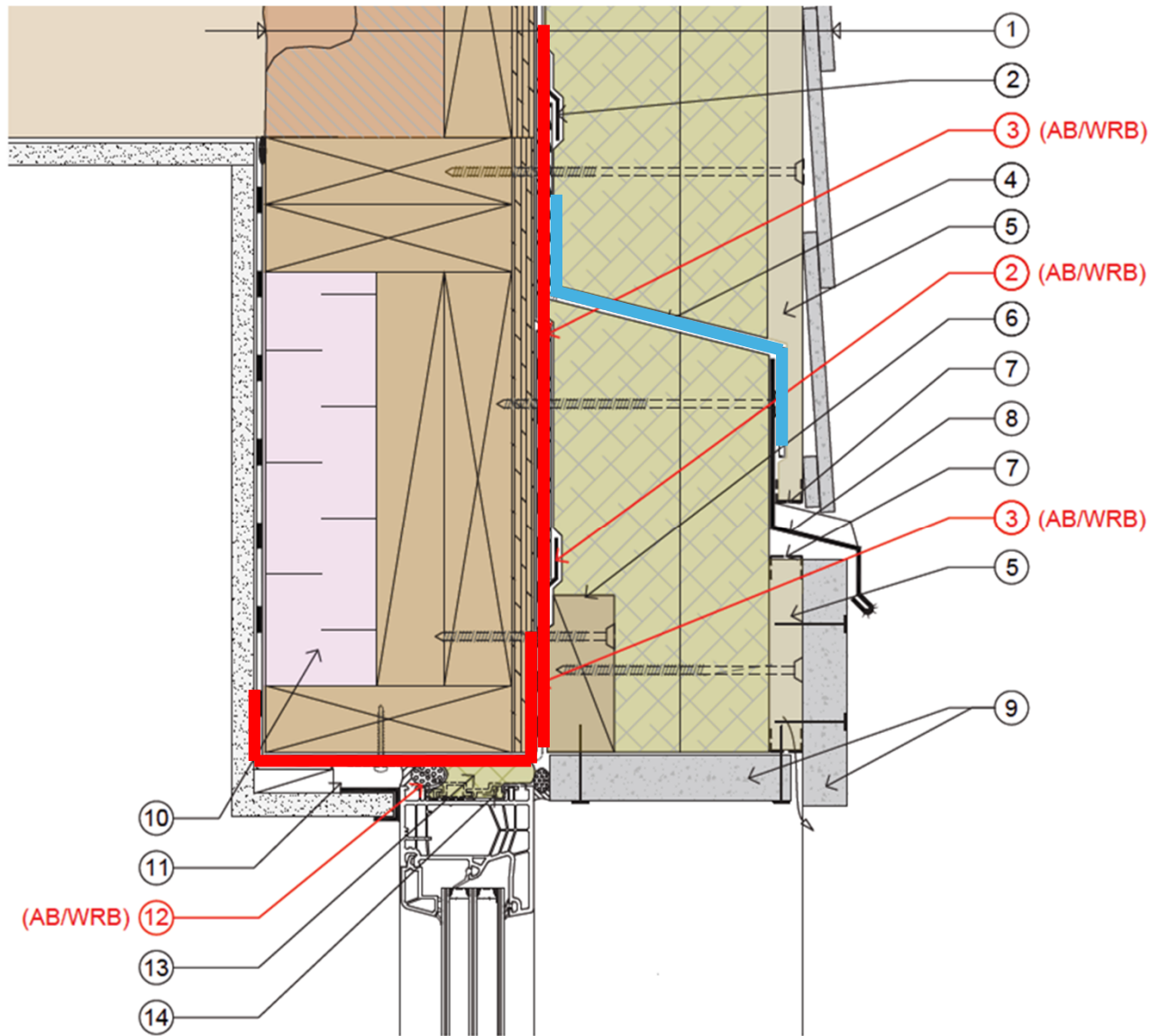


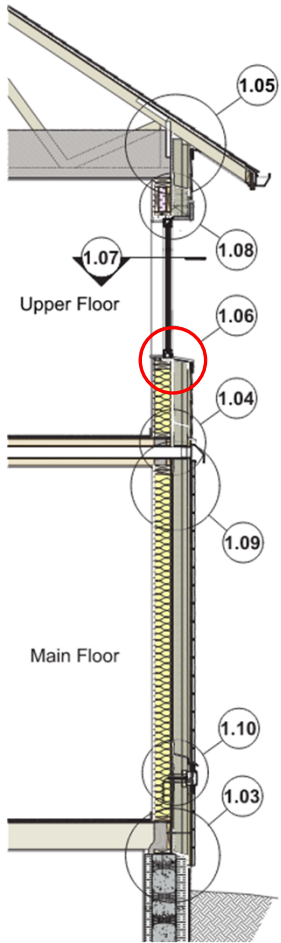
Vent Penetration



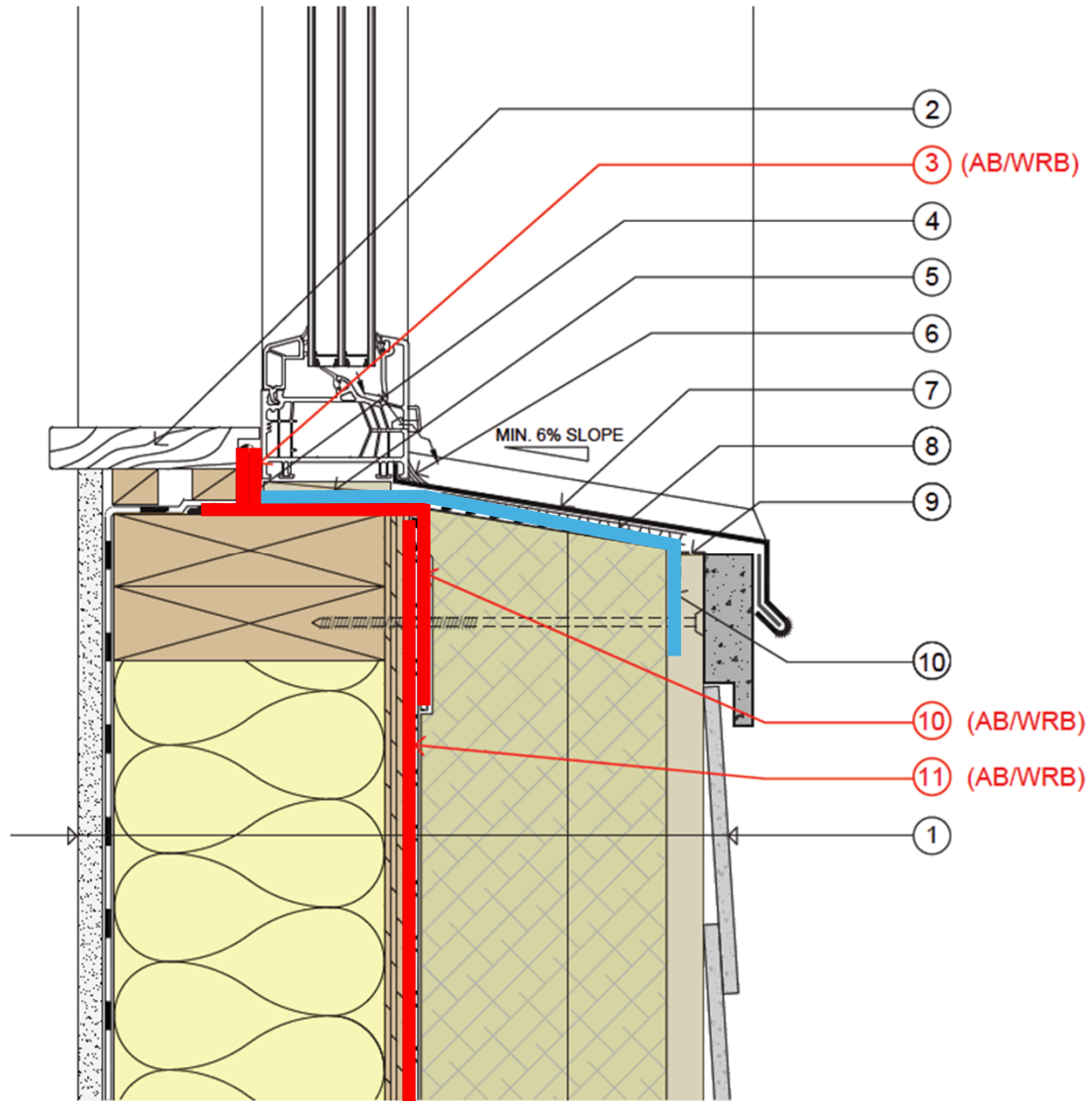


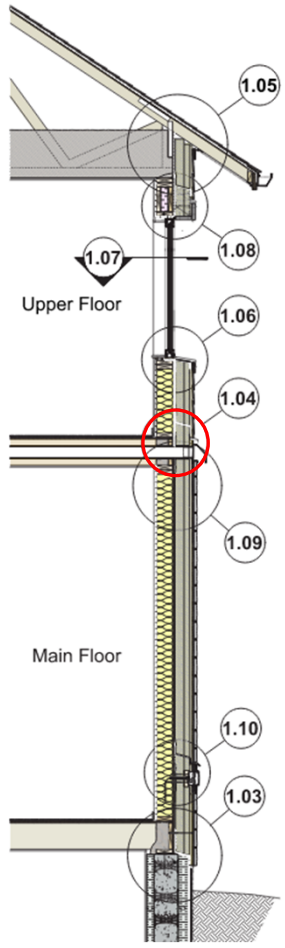
Window Head



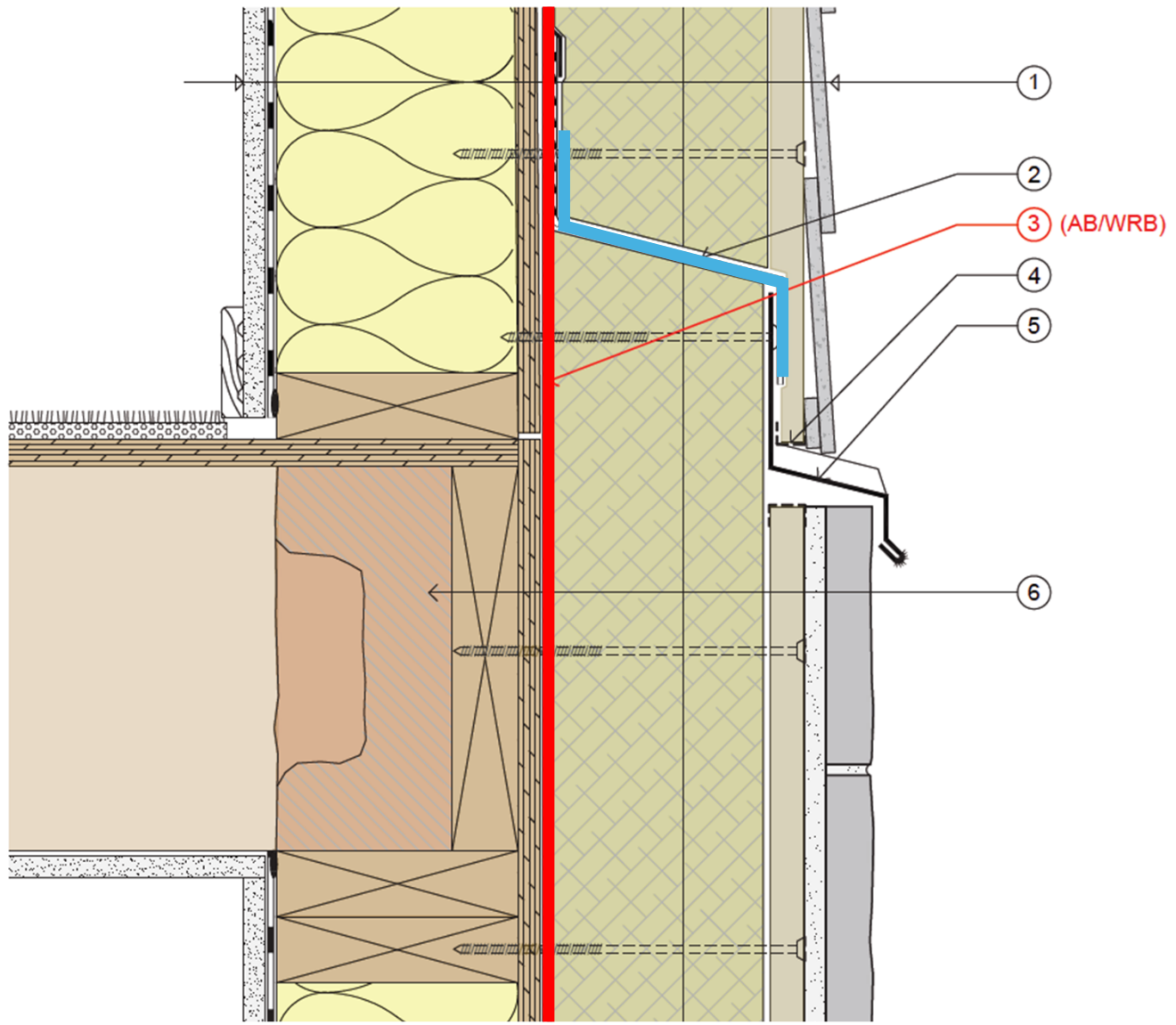


Window Sill

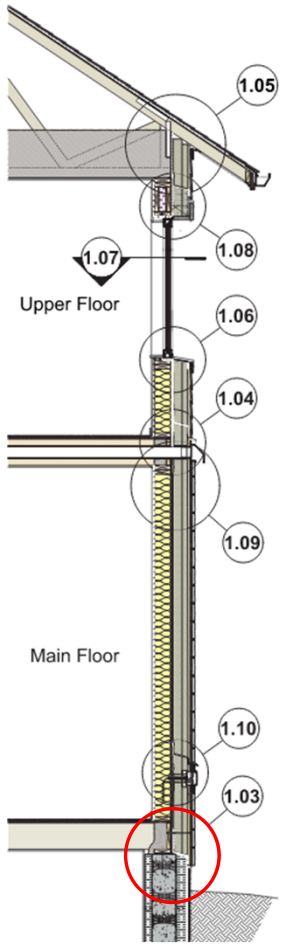




Floor Line



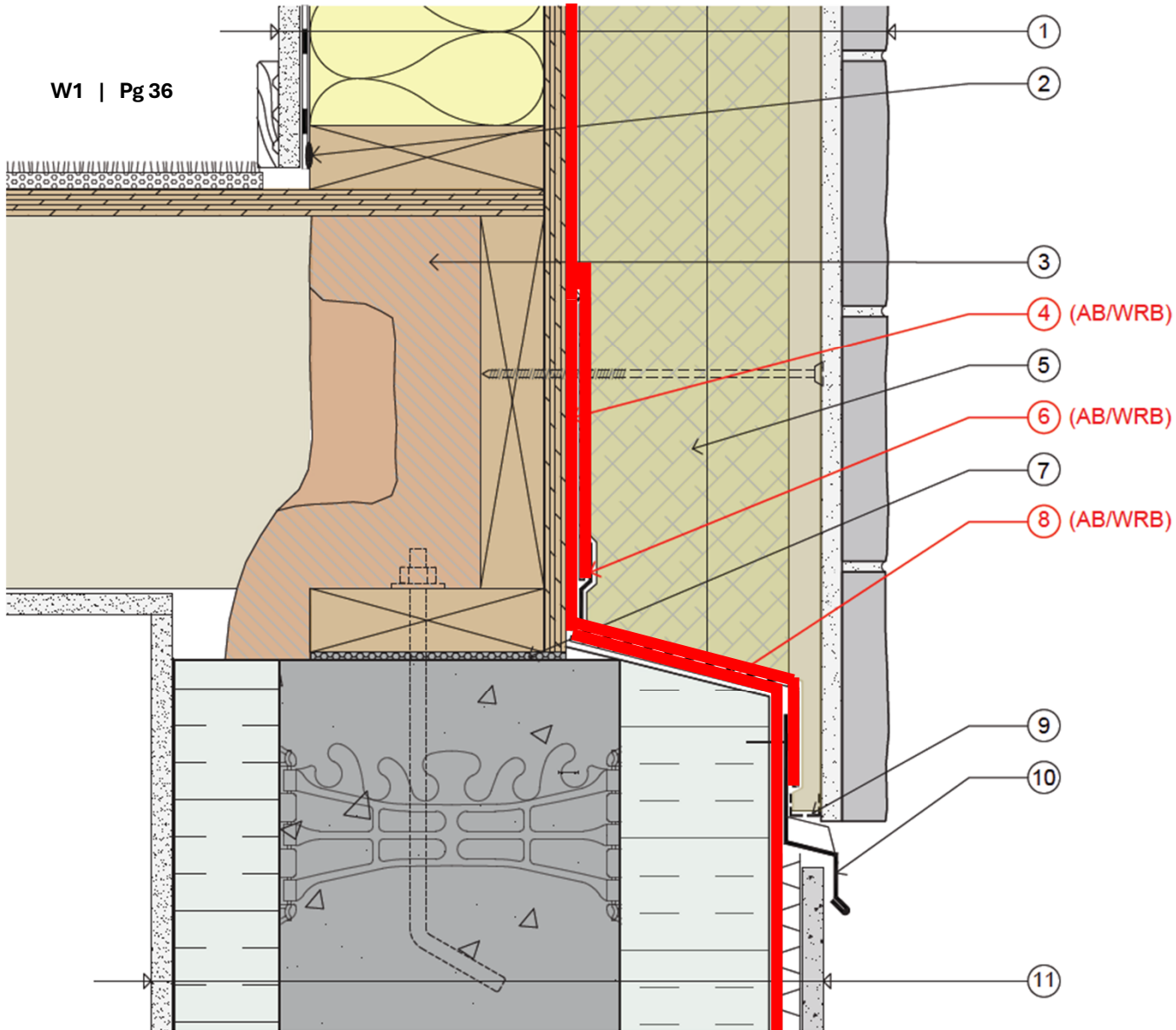
W1 | Pg 36



Upper Floor

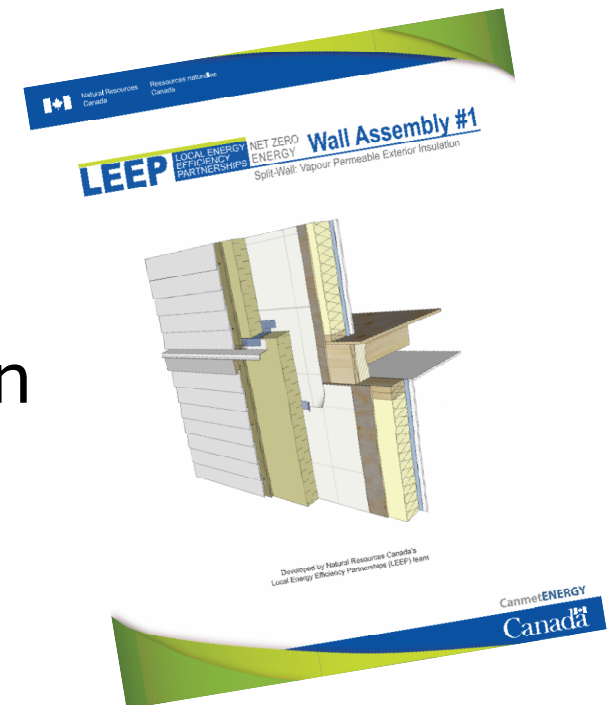
Main Floor

Bottom of Wall



## More Information Included in Each Guide:

- Alternative strapping approaches
- Flashing attachment
- Rainscreen free area
- Vapour barrier and exterior insulation
- Window Installation
- Air barrier approaches
- Builder Checklist



# Questions?

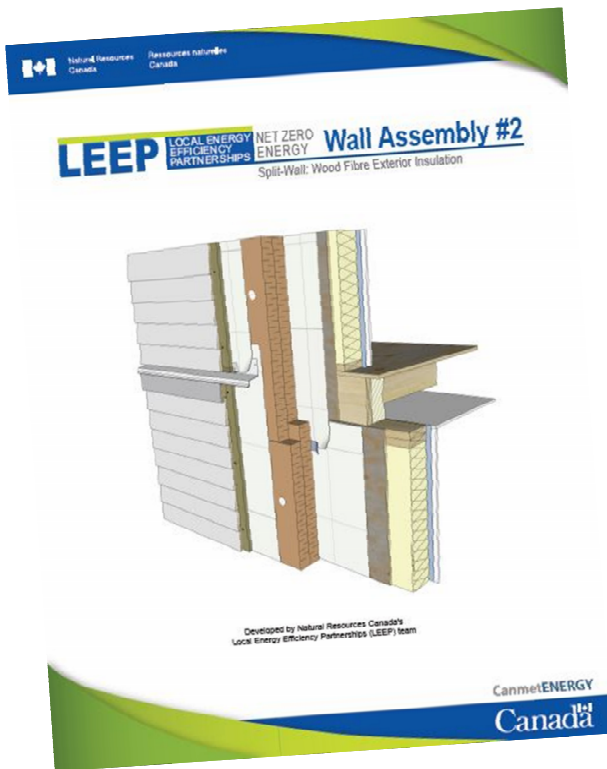


**LEEP**

LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

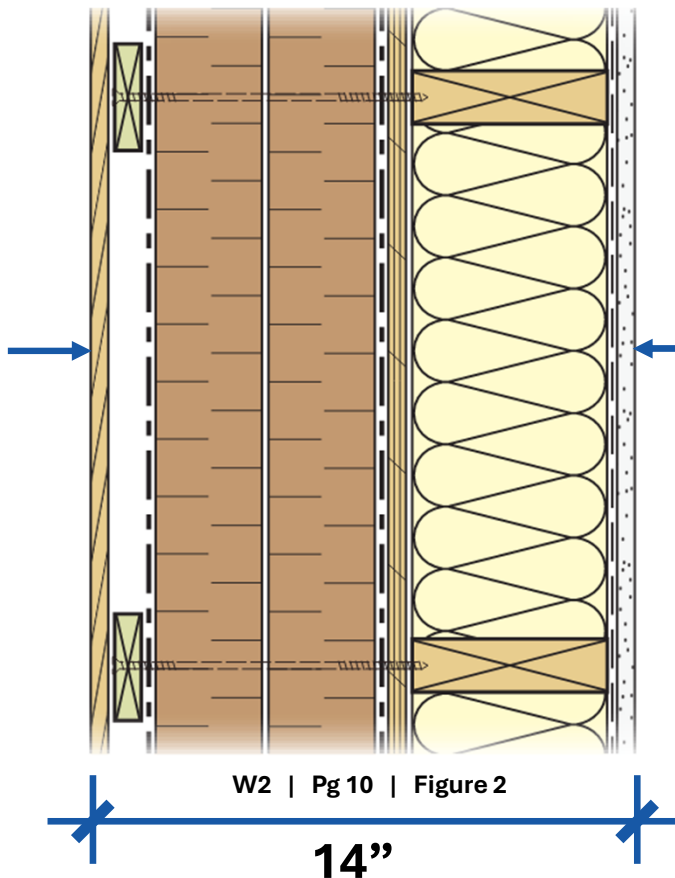
NET ZERO  
ENERGY

# Wall Assembly #2



## Split-Wall: Wood Fibre Exterior Insulation

# Wall #2 Assembly Overview



## *Interior*

Finished gypsum board (1/2")

Vapour Control Layer

## **Batt insulation**

Stud framing (5-1/2" 2x6)

Exterior sheathing (3/4")

## **Sheathing membrane (AB)**

**Wood fibre rigid insulation (6")**

**Sheet membrane (WRB)**

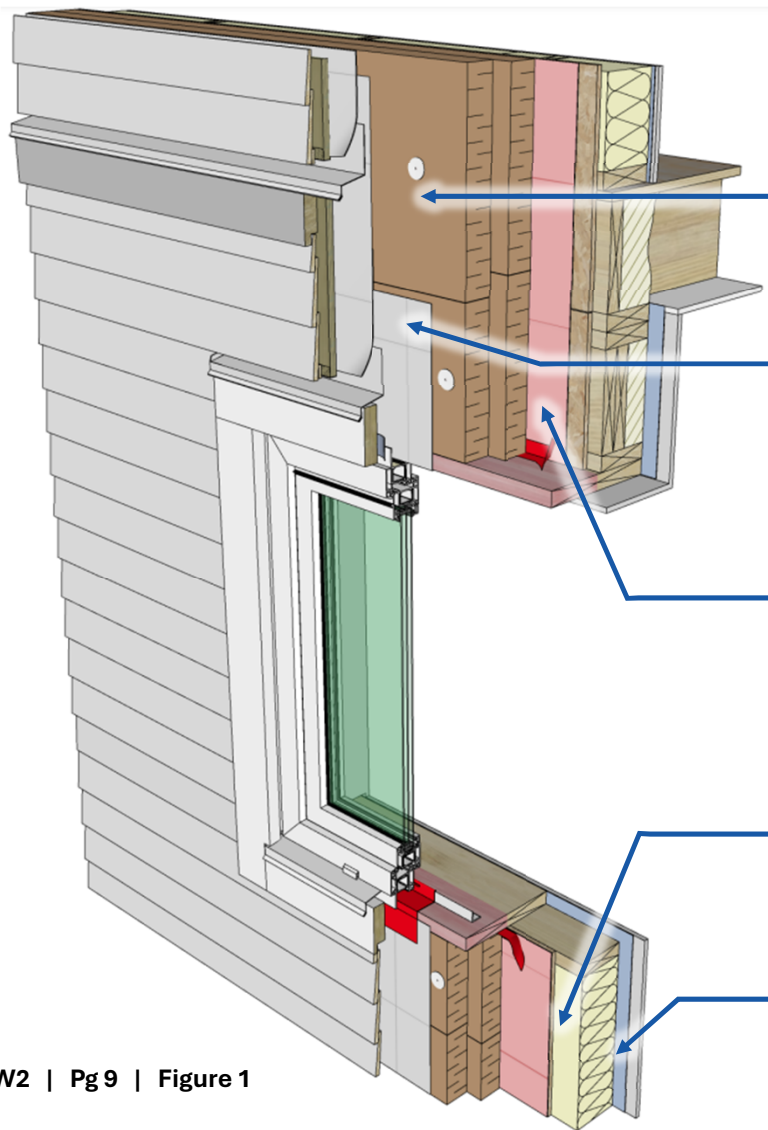
WRB

Strapping + rainscreen cavity (3/4")

Cladding (1/2")

## *Exterior*

## Wall #2 Overview



• **Vapour-Permeable Exterior Insulation:** Wood fibre rigid insulation

• **Water-Resistive Barrier:** Vapour permeable sheathing membrane on **exterior face of exterior insulation**

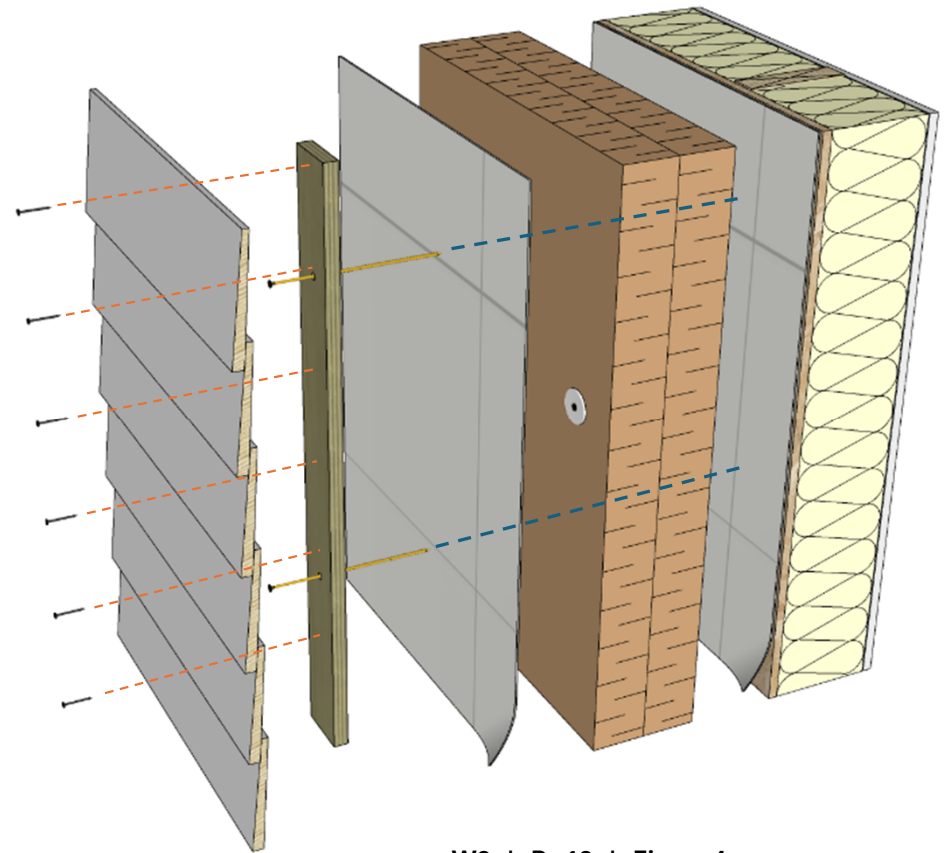
• **Air Barrier:** Sealed sheathing membrane is most straightforward, other options available

• **Interior Insulation:** Conventional cavity insulation products

• **Vapour Control:** Conventional interior polyethylene

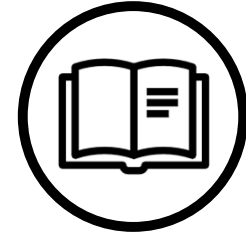
## Similar to Wall #1

- Vapour permeable rigid insulation
- Any typical cladding can be used
- Use long fasteners to attach strapping, and fasten the cladding to the strapping
- Additional sheet membrane for water protection of WFI
- Some unique air barrier considerations



W2 | Pg 12 | Figure 4

# Wood Fibre Insulation (WFI)



New product for most jurisdictions



Limited long-term moisture durability data in Canada



Some WFI products don't meet *CAN/ULC S706 Wood Fibre Insulating Boards* per NBC etc.



Collaborate with your Building Official



Use with exterior sheathing membrane for moisture protection

Confirm manufacturer warranties



If needed, use as an Alternative Solution to *CAN/ULC S706*

# Example WFI Products

SONOclimat\*



[eco-building.ca](http://eco-building.ca)

Steico



[steico.com](http://steico.com)

Gutex



[ca.475.supply](http://ca.475.supply)

Pavatex



[wood100.ca](http://wood100.ca)

# WFI Code Compliance Case Study



## 9.25.2.2.

### Insulation Materials

**1)** Except as required in Sentence (2), thermal insulation shall conform to the requirements of

CAN/ULC-S703-09	Standard for Cellulose Fibre Insulation (CFI) for Buildings
CAN/ULC-S704.1:2017	Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
CAN/ULC-S706.1:2016	Standard for Wood Fibre Insulating Boards for Buildings

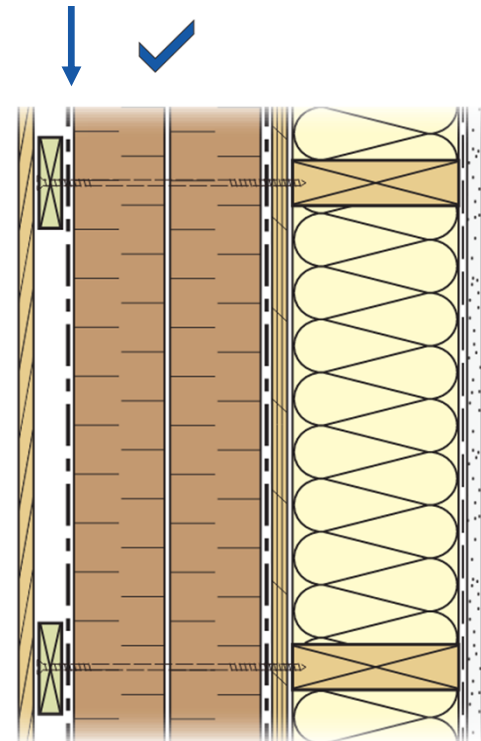
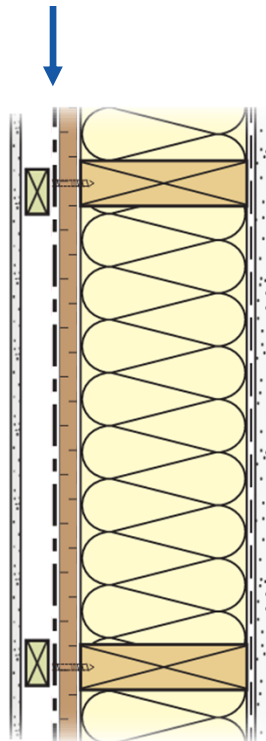
# WFI Code Compliance Case Study



Simplest approach: meet  
**CAN/ULC S706.1 Wood Fibre Insulating Boards**



bpcan.com

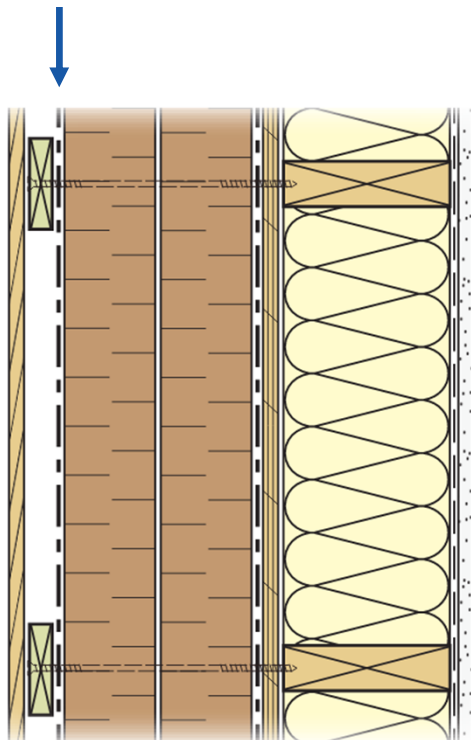


W2 | Pg 10 | Figure 2

# WFI Code Compliance Case Study



## Alternative Solution: show equivalence to CAN/ULC S706.1 Wood Fibre Insulating Boards



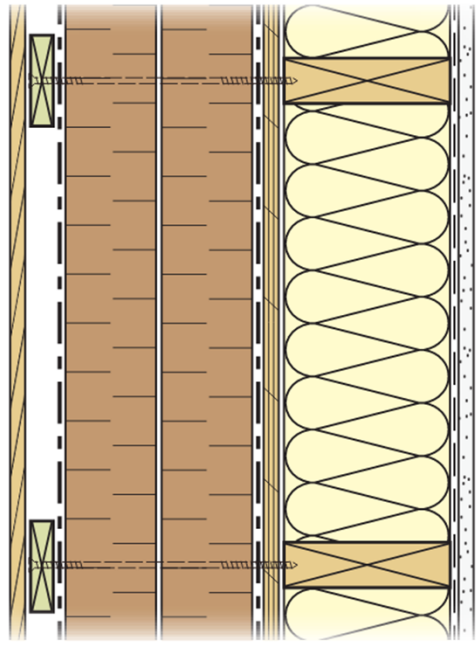
W2 | Pg 10 | Figure 2

Density	ASTM D-1037	≥ 16,5 lb / ft <sup>3</sup> ≥ 265 kg / m <sup>3</sup>
Transverse load at rupture	ASTM C-209	≥ 179 N ≥ 40 psi
tensile strength perpendicular to surface	ASTM C-165	≥ 24 KPa ≥ 3,5 psi
Tensile strength parallel to surface	ASTM C-209	≥ 350 KPa ≥ 51 psi
Water absorption	ASTM C-209	≤ 5 %
Lineare expansion	ASTM D-1037	≤ 0,5 %
Compressive strength (10 % def.)	ASTM C-209	≥ 344.75 KPa ≥ 50 psi
Thermal resistance / inch (1")	ASTM C-518	RSI = 0,47 / in. R = 2.7 / in.
Thermal resistance total		RSI = 0,7 R = 4.05
Water vapour permeability	ASTM E96 / E96M-13	26 perms 1490 ng / Pa · s · m <sup>2</sup>

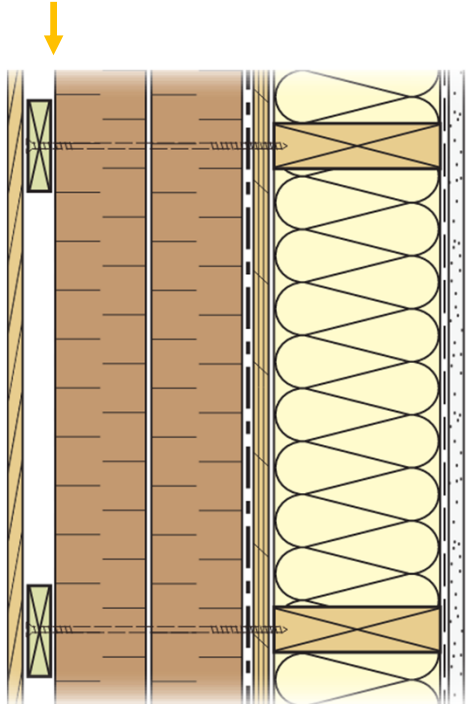
# WFI Code Compliance Case Study



'Engineered' Approach

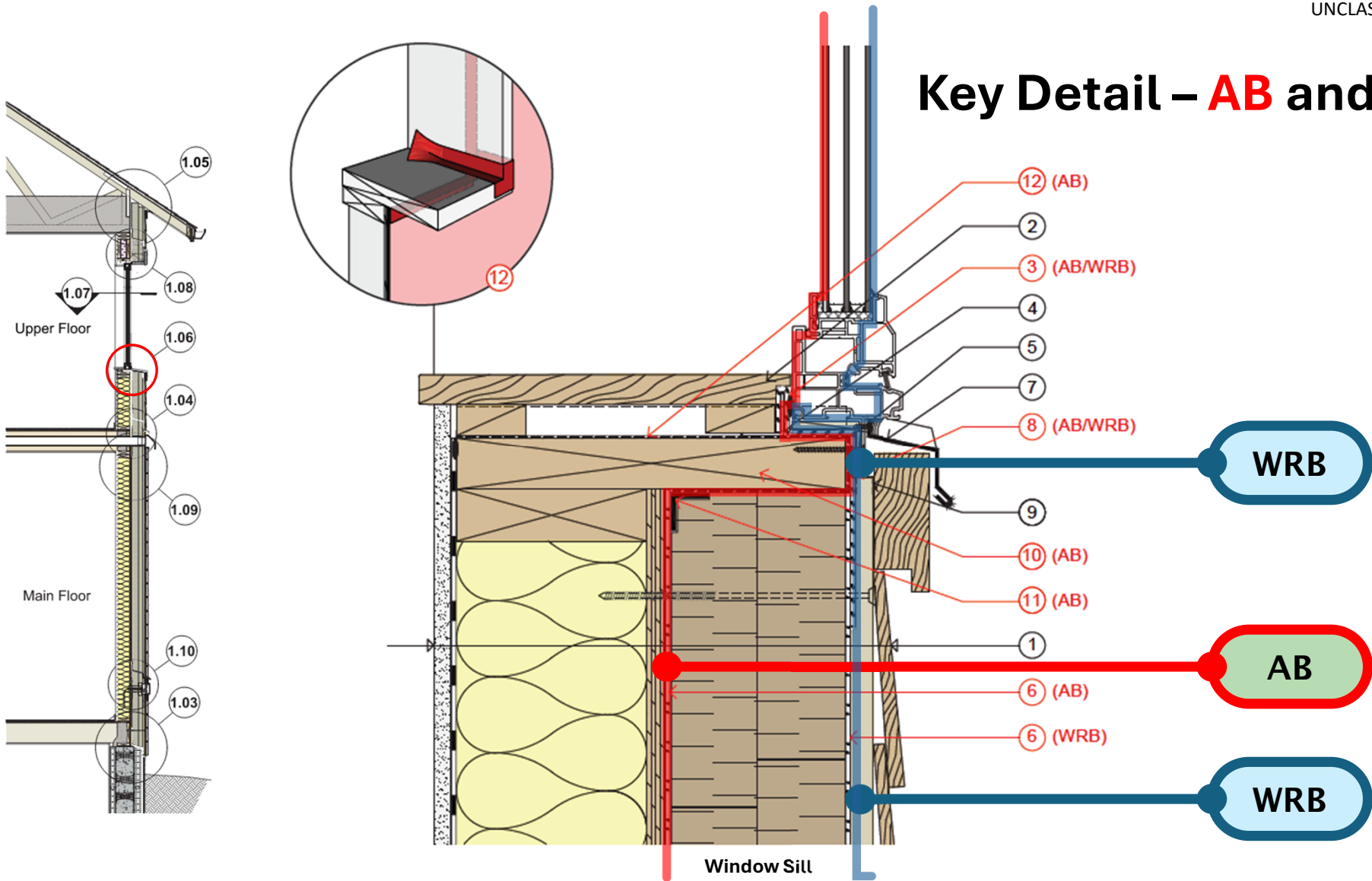


'European' Approach



W2 | Pg 10 | Figure 2

# Key Detail – AB and WRB



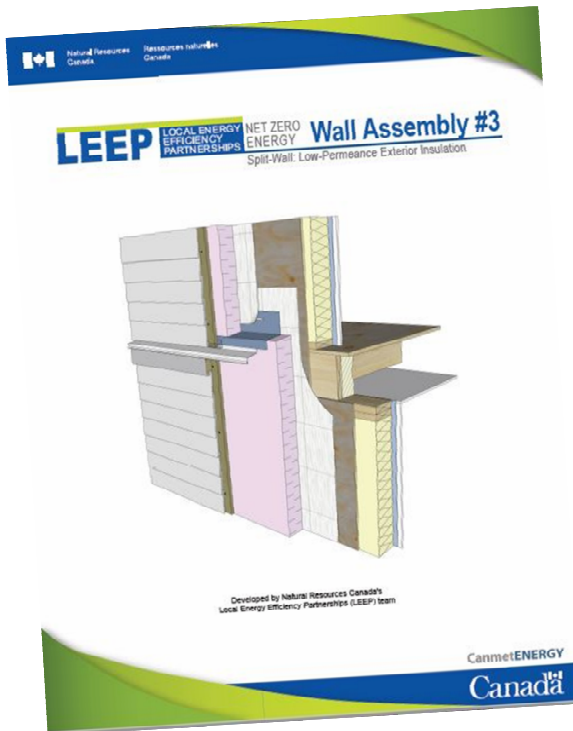


**LEEP**

LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

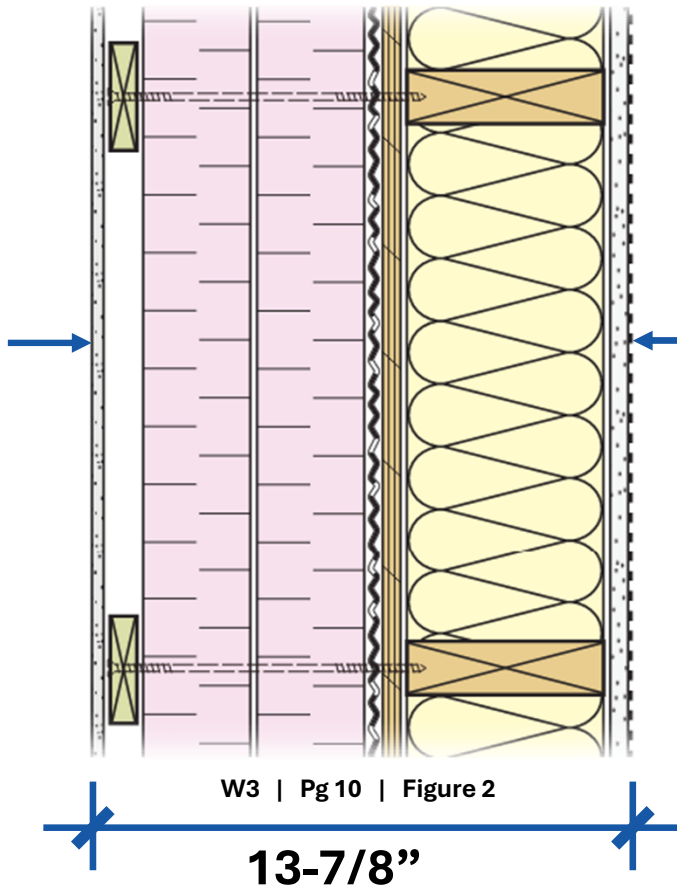
NET ZERO  
ENERGY

# Wall Assembly #3



## Split-Wall: Low-Permeance Exterior Insulation

# Wall #3 Assembly Overview



## *Interior*

Vapour retarder paint

Finished gypsum board (1/2")

## **Batt insulation**

Stud framing (5-1/2" 2x6)

Exterior sheathing (3/4")

**Dimpled/drainable sheathing membrane (AB/WRB)**

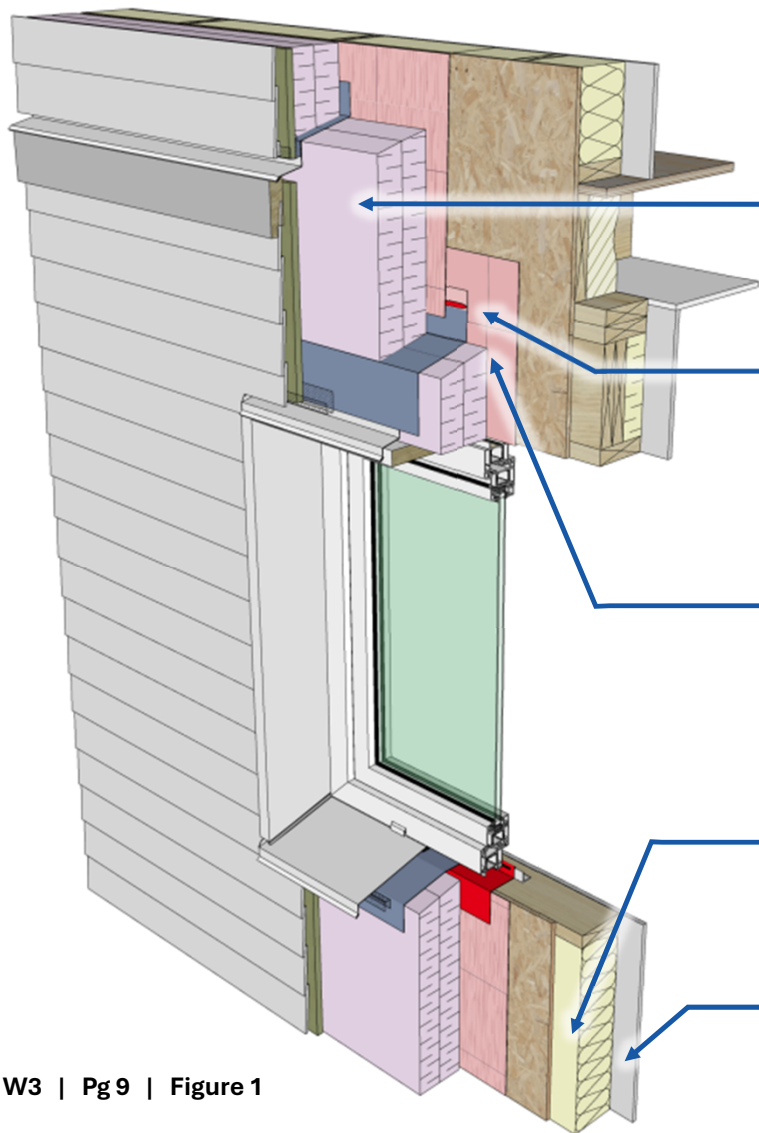
**Rigid low-permeance foam insulation (6")**

Strapping + rainscreen cavity (3/4")

Cladding (3/8")

## *Exterior*

## Wall #3 Overview



- **Low-Permeance Foam Exterior Insulation**

- **Water-Resistive Barrier:** Vapour permeable dimpled/drained membrane on exterior face of sheathing

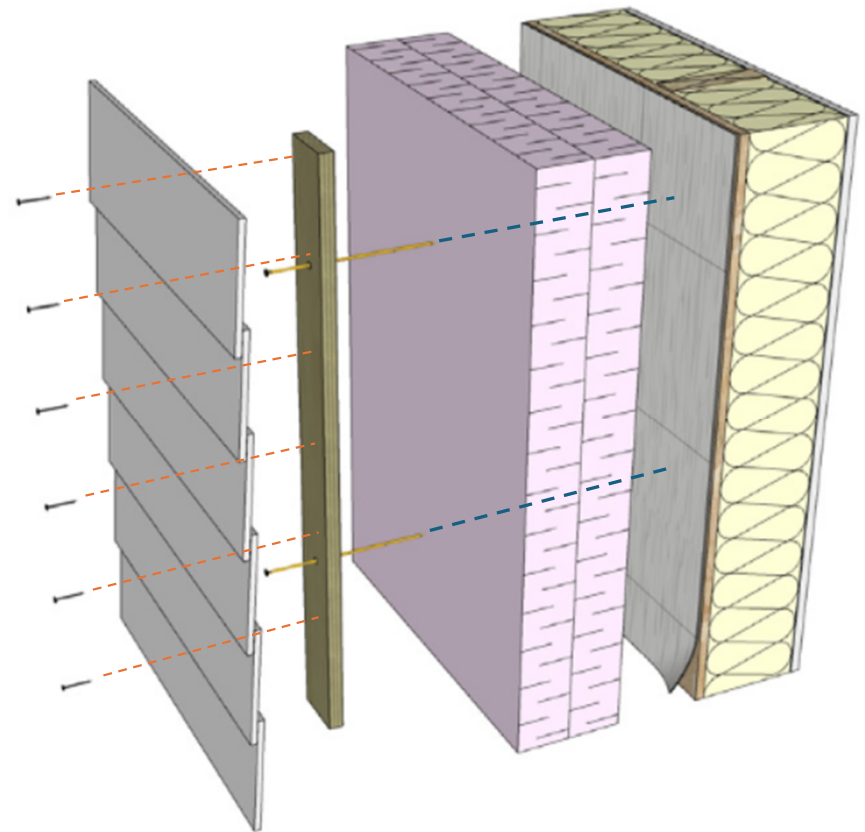
- **Air Barrier:** Sealed sheathing membrane is most straightforward, other options available

- **Interior Insulation:** Conventional cavity insulation products

- **Vapour Control:** Smart vapour retarder or vapour barrier paint

## Similar to Wall #1

- Any typical cladding can be used
- Use long fasteners to attach strapping, and fasten the cladding to the strapping
- Low-permeance exterior layer requires careful design consideration
- Good exterior water management is key



W3 | Pg 12 | Figure 4

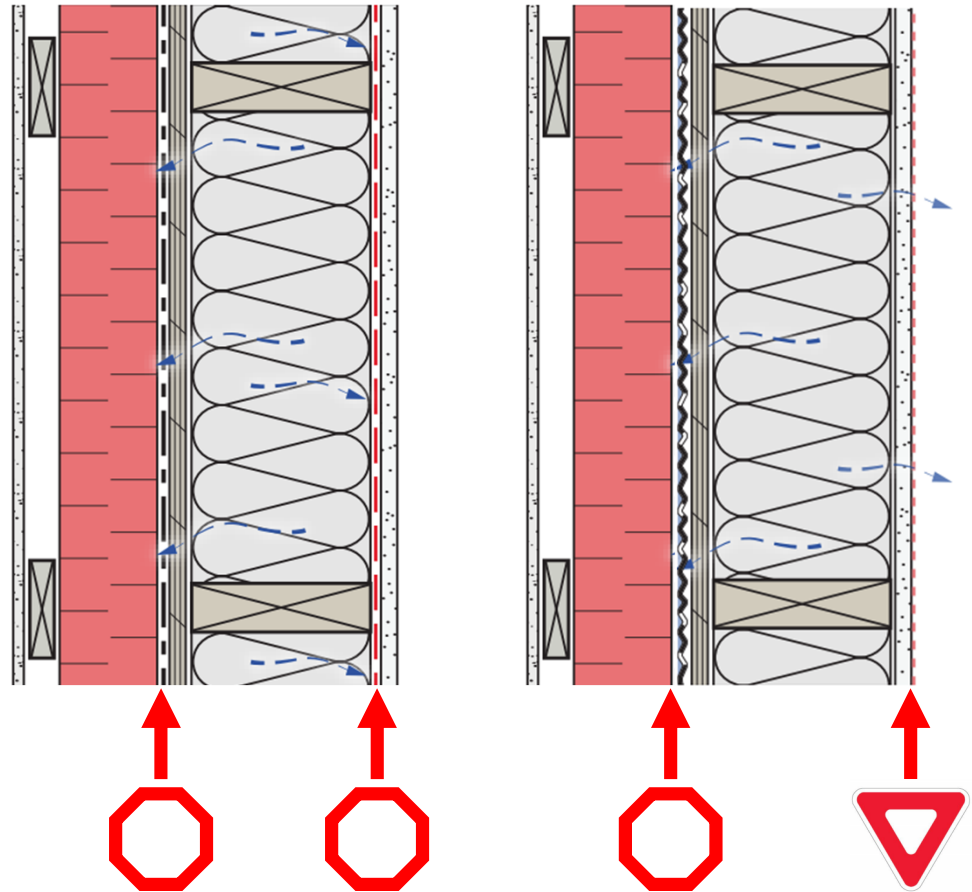
# Vapour & Liquid Water

Vapour retarder paint or smart vapour barrier helps avoid the risk of trapping moisture

More on this later

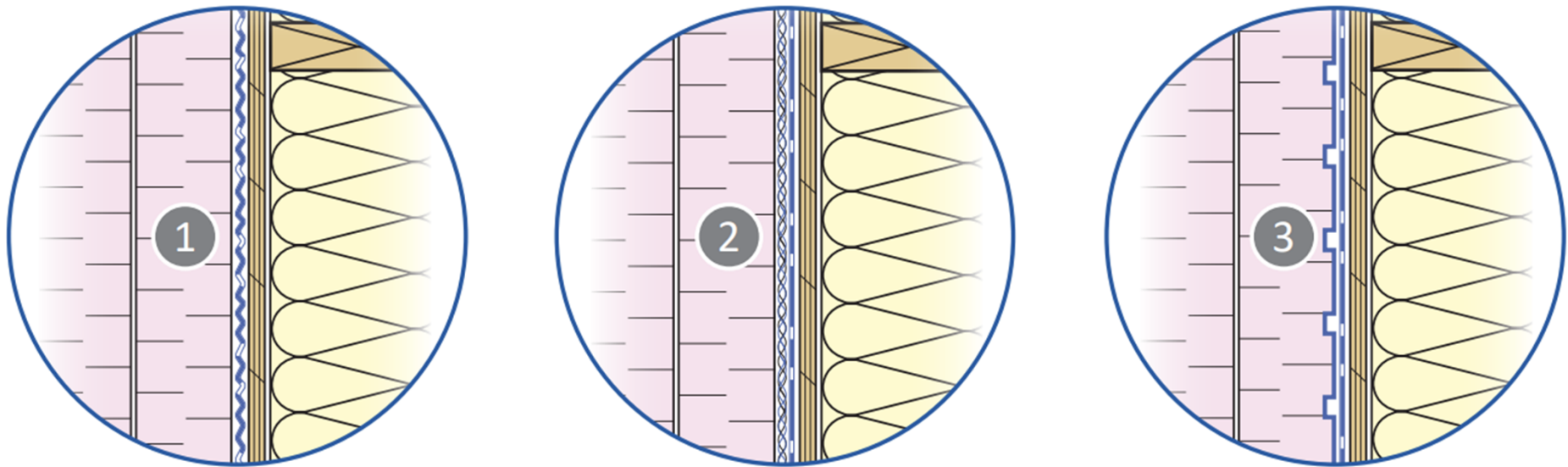


W3 | Pg 12 | Figure 5



# Drainage Options

- 1) Grooved/dimpled sheathing membrane
- 2) 1/4" to 3/8" woven drainage geotextile against sheathing membrane
- 3) Exterior insulation with drainage grooves against sheathing membrane



# Exterior Insulation and Flashing

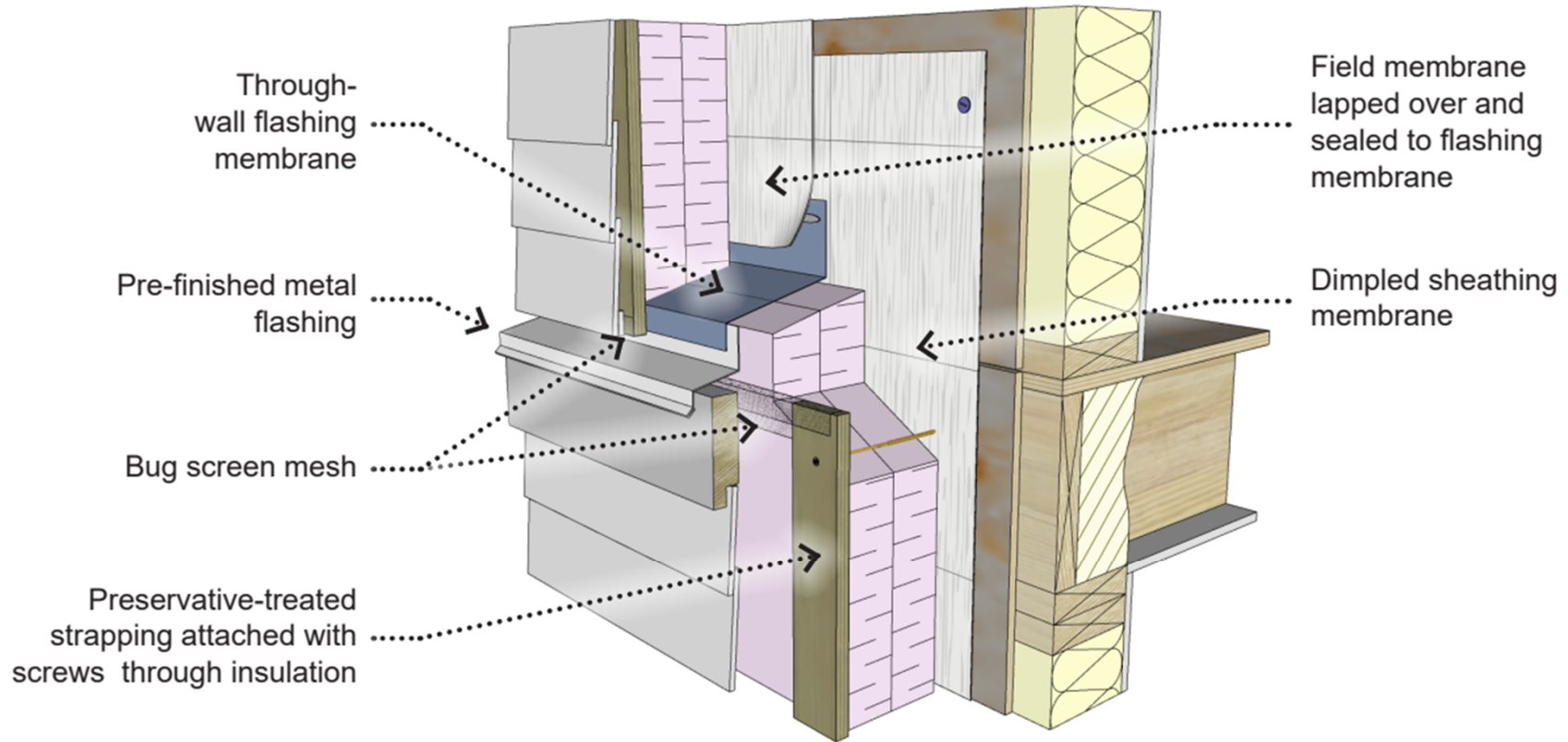


Figure 10 Conventional through-wall flashing detail and strapping installation



**LEEP**

LOCAL ENERGY  
EFFICIENCY  
PARTNERSHIPS

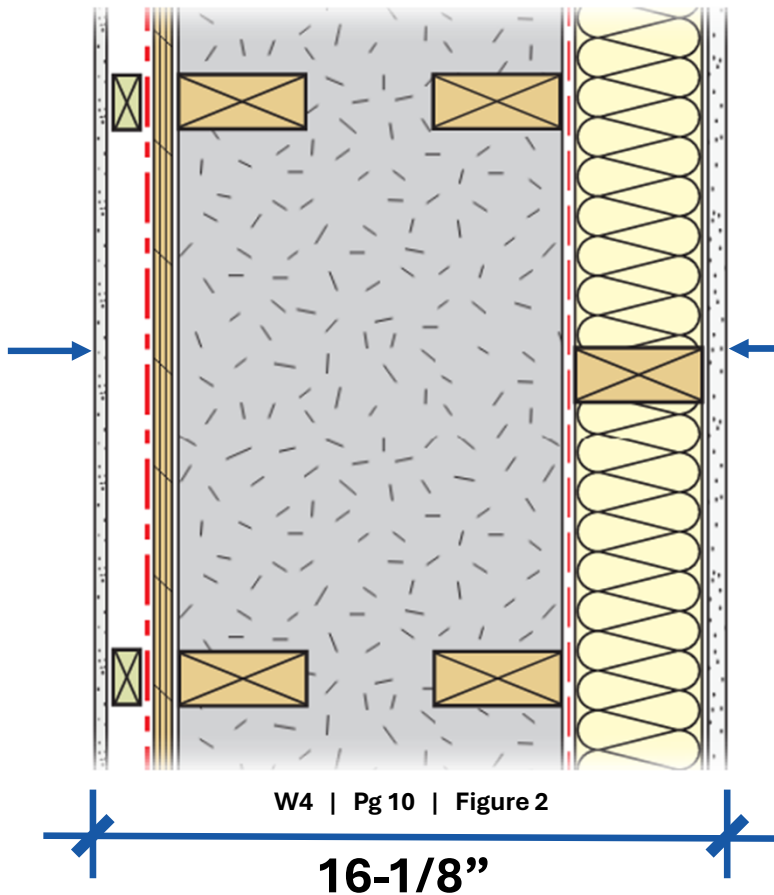
NET ZERO  
ENERGY

# Wall Assembly #4



## Double Stud Wall with Interior Service Wall

# Wall #4 Assembly Overview



## *Interior*

Finished gypsum board (1/2")

2x4 framed **insulated** service cavity (3-1/2")

## **Polyethylene (AB)**

Double stud framing (10-1/2")

## **Blown-in dense-pack insulation**

Exterior sheathing (1/2")

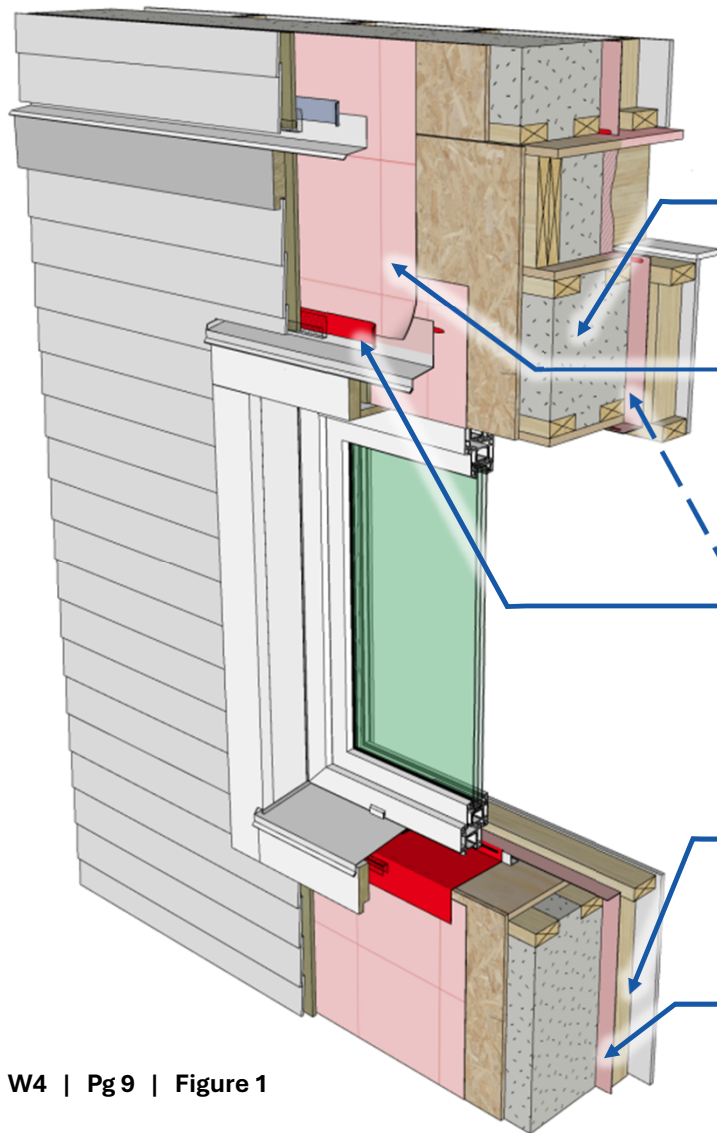
## **Sheathing membrane (AB/WRB)**

Furring/rainscreen cavity (3/4")

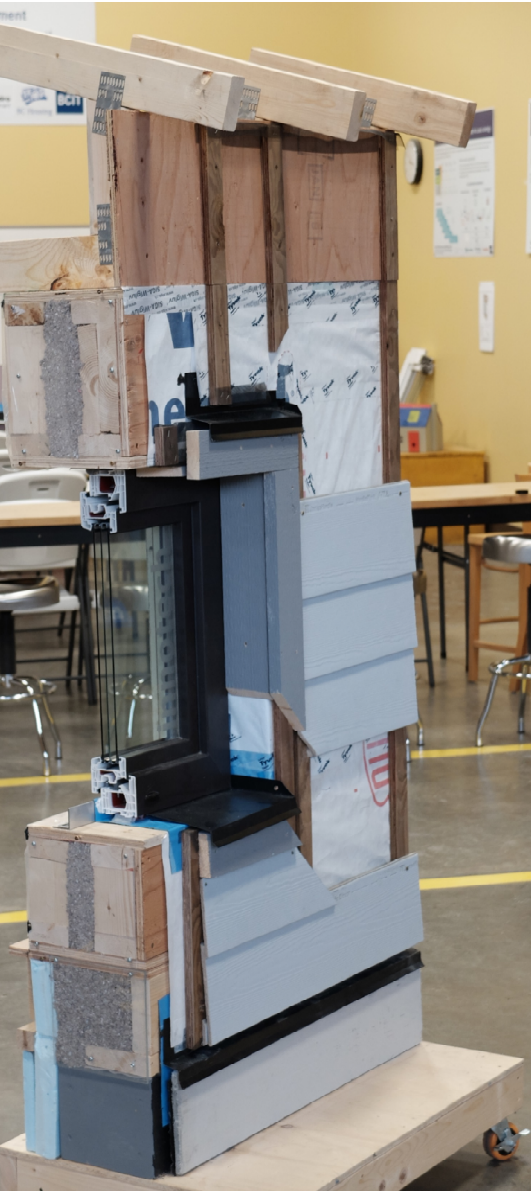
Cladding (3/8")

## *Exterior*

## Wall #4 Overview

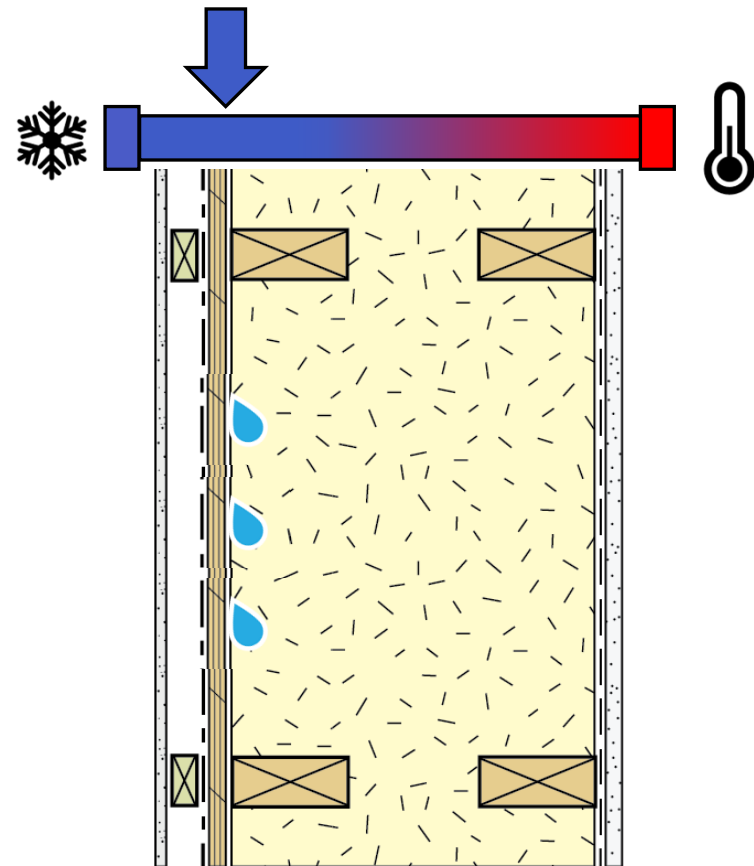


- **Blown-in dense pack insulation:** In 2x4 framed double-stud cavity
- **Water-Resistive Barrier:** Vapour permeable sheathing membrane on exterior face of wall sheathing
- **Air Barrier:** Exterior membrane as primary, interior as secondary air barrier
- **Service Wall Insulation:** Conventional cavity insulation products
- **Vapour Control:** Conventional interior polyethylene

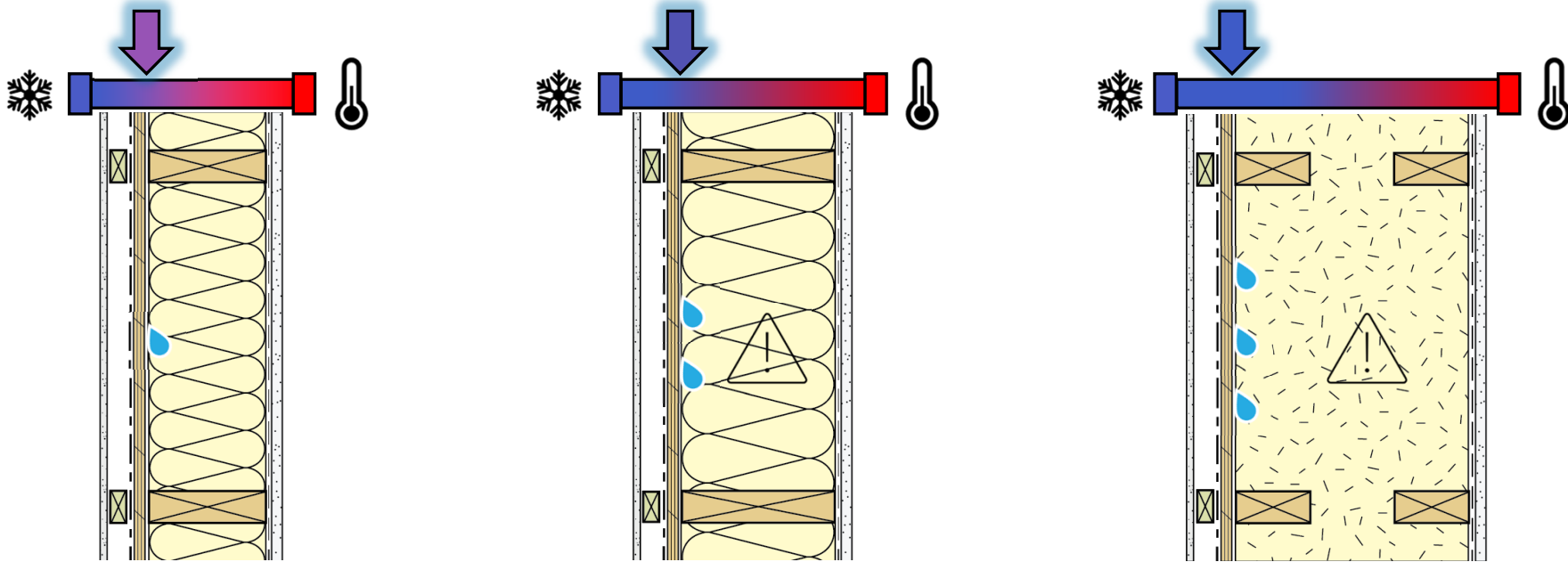


# Deep Wall Durability Risk

- ⚠ Deeper wall means less interior heat reaches the exterior sheathing during cold periods
- ⚠ Exterior sheathing stays colder for longer
- ⚠ Cold sheathing means condensation risk



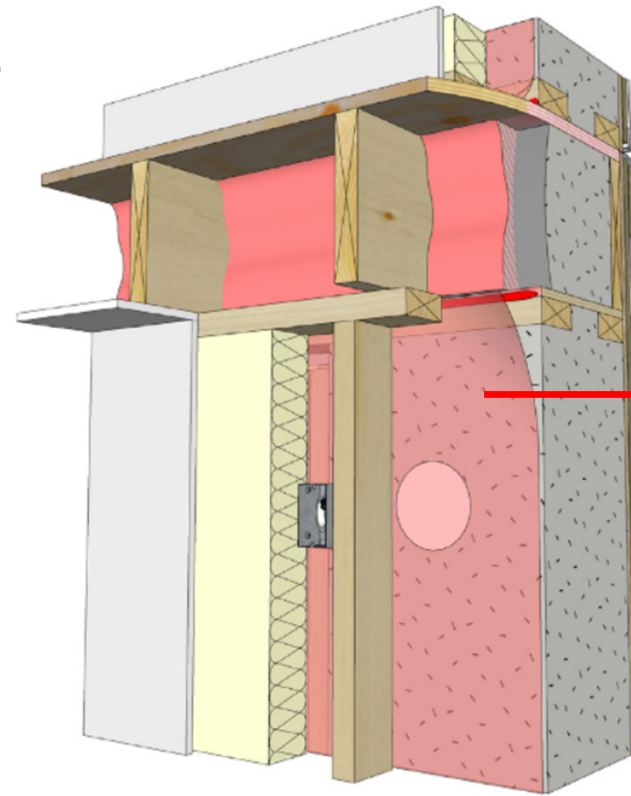
## More Interior Insulation Means Colder Sheathing



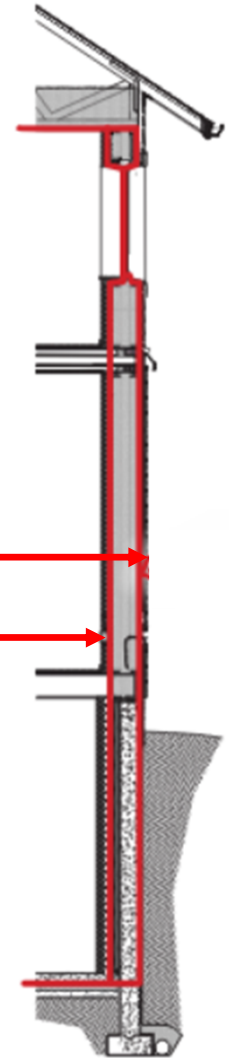
Colder Sheathing Means Higher Condensation Risk

# Deep Wall Risk Management

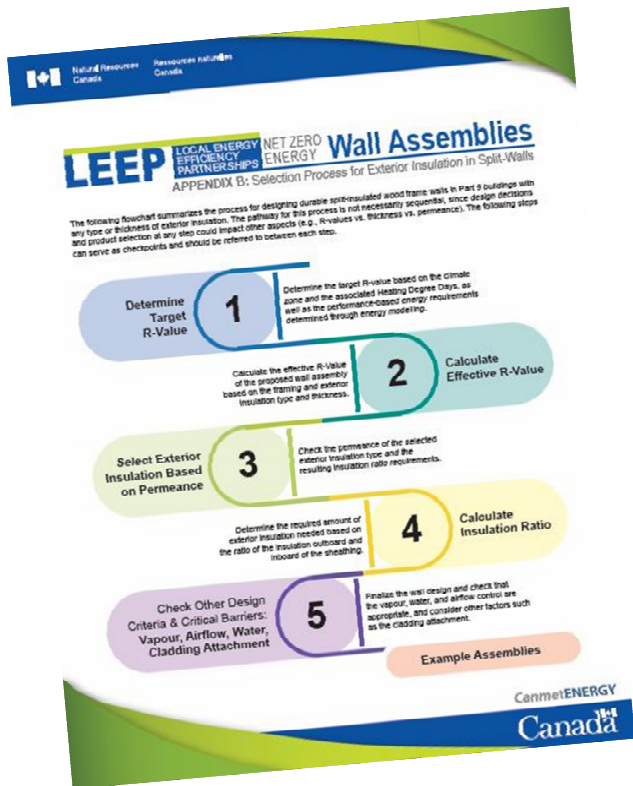
- ✓ Use interior secondary air barrier/vapour barrier behind **service wall**
- ✓ Properly pack the dense-pack insulation
- ✓ Keep indoor humidity levels below 40% RH



W4 | Pg 20 | Figure 15



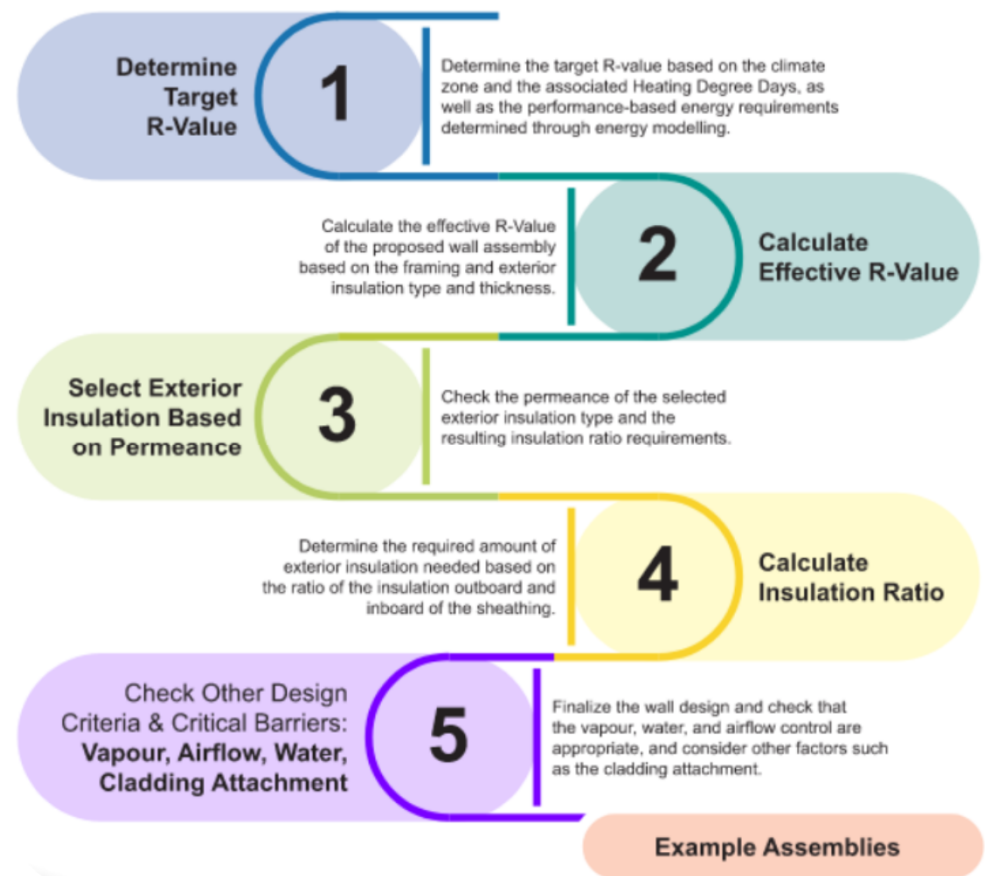
W4 | Pg 21 | Figure 16



# LEEP Wall Guides Appendix B: Selection Process for Exterior Insulation in Split-Walls

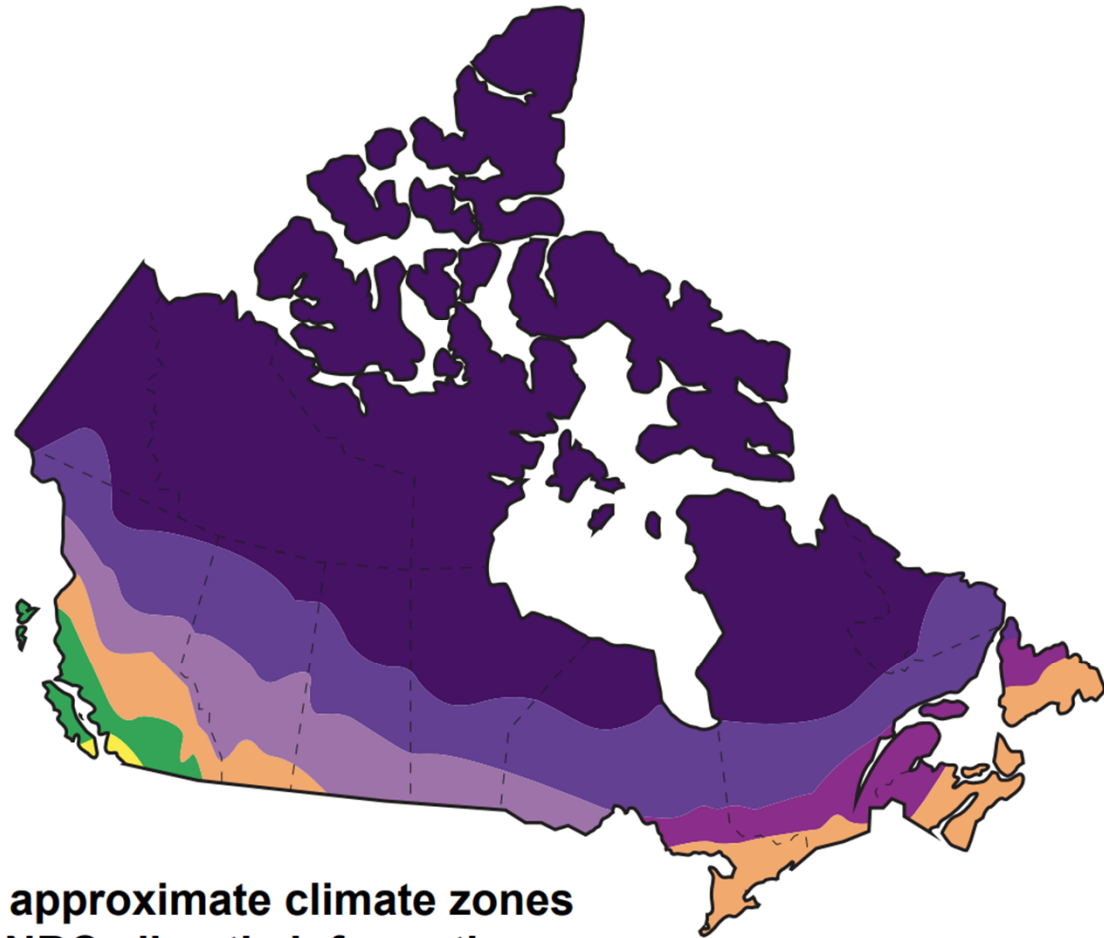
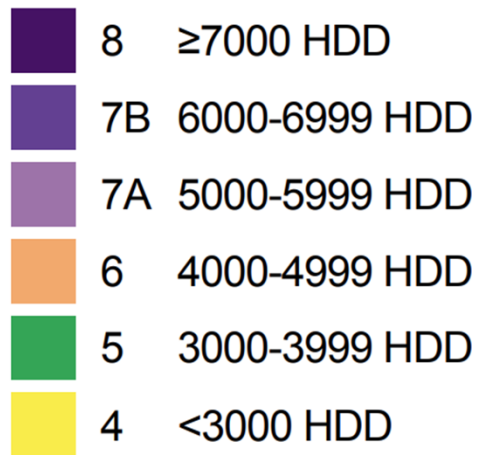
## Procedure

1. Determine Target R-Value
2. Calculate Effective R-Value
3. Select Exterior Insulation Based on Permeance
4. Calculate Insulation Ratio
5. Check Other Design Criteria & Critical Barriers



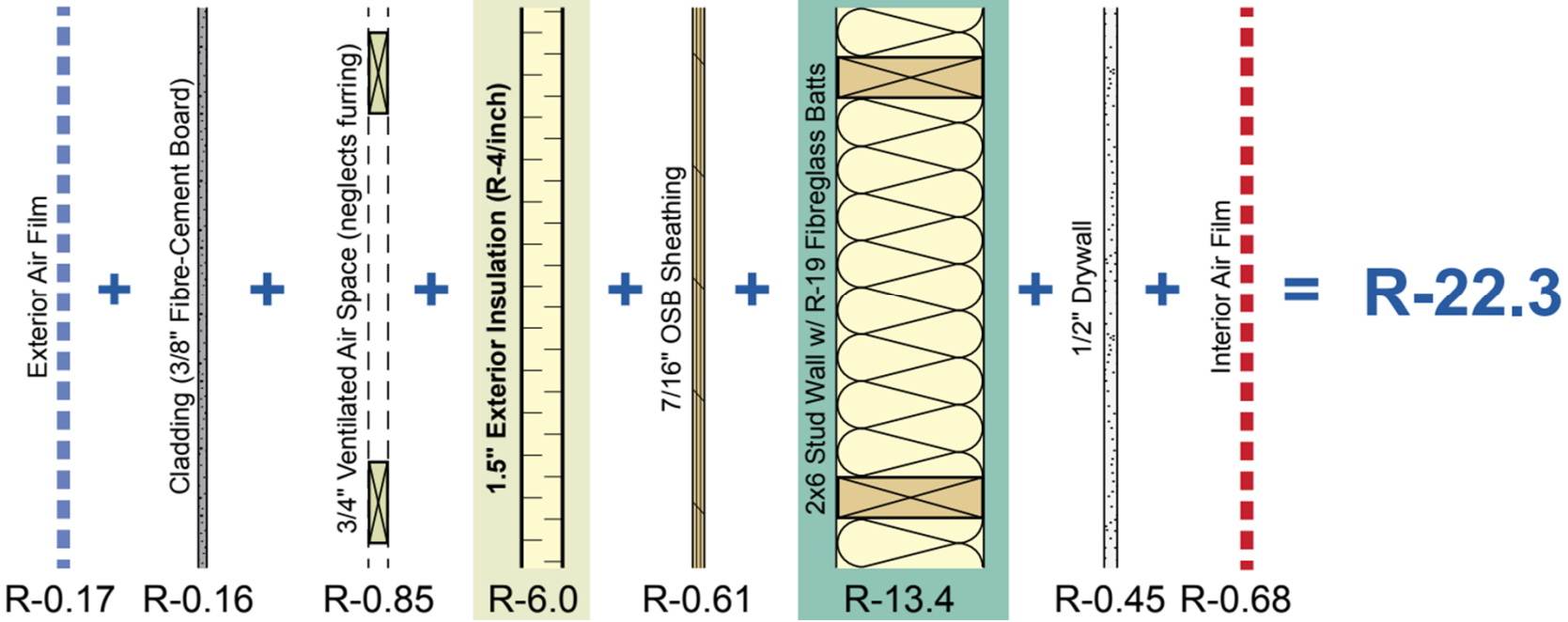
# 1

Determine  
Target  
R-Value



**Canadian approximate climate zones  
based on NBC climatic information.**

# 2 Calculate Effective R-value

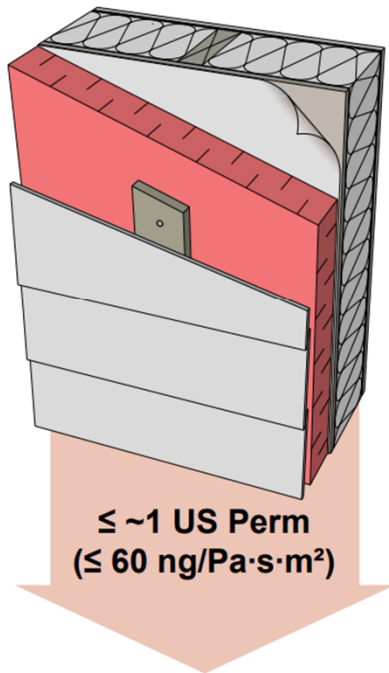


# 3

Select Exterior Insulation Based on Permeance

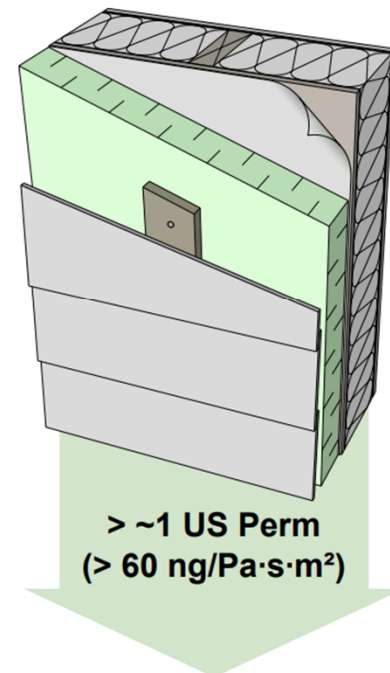
Low permeance exterior insulation triggers code requirements for **minimum ratio**

## Low Permeance Insulation



Insulation with permeance close to 1 US perm must be carefully considered

## Permeable Insulation



**Table B-2 Approximate Dry Cup Permeance of Typical Exterior Insulation Types (US perms)**

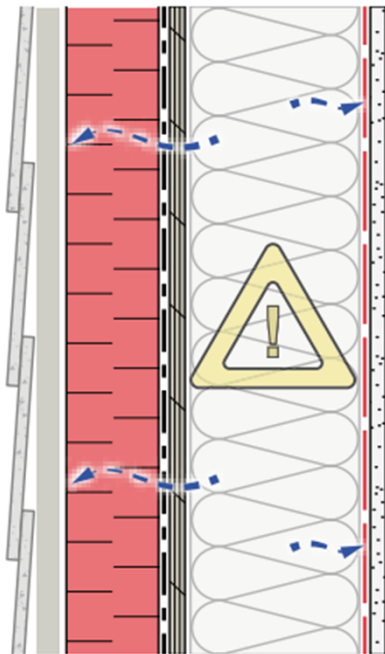
	1"	2"	3"	4"	5"	6"	7"	8"
XPS	0.9	0.4	0.3	0.2	0.2	0.1	0.1	0.1
Closed Cell Spray Foam	1.7	0.9	0.6	0.4	0.3	0.3	0.2	0.2
Polyiso with Fiberglass Facer	2.0	1.0	0.7	0.6	0.4	0.4	0.3	0.3
Polyiso with Foil Facer	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EPS/GPS with Poly Facer	0.5	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Unfaced EPS/GPS Type 2	3.5	1.8	1.2	0.9	0.7	0.6	0.5	0.4
Unfaced EPS/GPS Type 1	5.2	2.6	1.7	1.3	1.0	0.9	0.7	0.7
Wood Fiber Board	9.1	4.6	3.0	2.3	1.8	1.5	1.3	1.1
Hybrid Open Cell Spray Foam	20.5	10.3	6.8	5.1	4.1	3.4	2.9	2.6
Open Cell Spray Foam	60.2	30.1	20.1	15.1	12	10	8.6	7.5
Rigid Mineral Wool	88.8	49.5	29.6	22.2	17.8	14.8	12.7	11.1
Cellulose	92.3	46.1	30.8	23.1	18.5	15.4	13.2	11.5
Rigid Fiberglass	145	72.5	48.4	36.3	29	24.2	20.7	18.1

**≤ ~1 US perm triggers ratio requirements\***

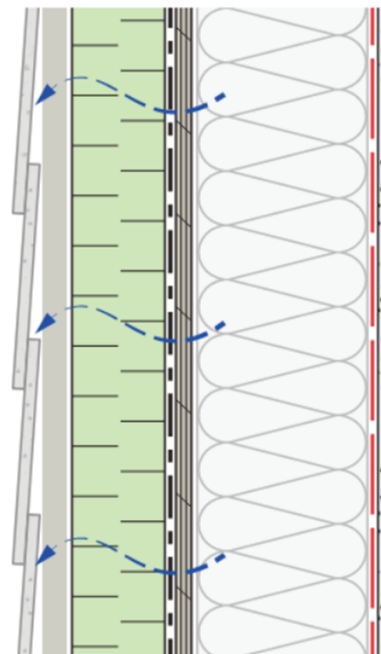
# 3

## Select Exterior Insulation Based on Permeance

Low permeance exterior insulation with interior poly can trap moisture while permeable exterior insulation does not.



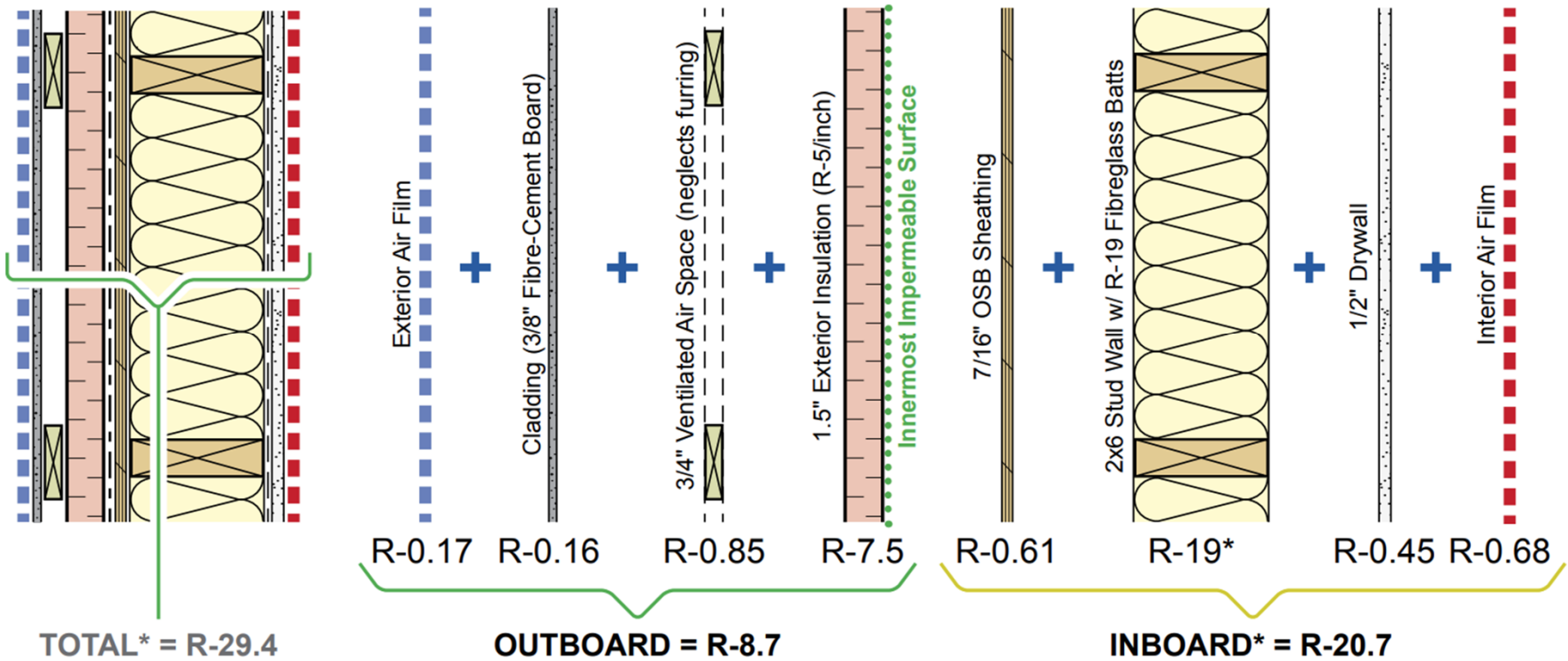
Appendix B | Page B-8



Appendix B | Page B-9

# 4

## Calculate Insulation Ratio



## 4

Calculate  
Insulation  
Ratio

## LEEP Insulation Ratio Guidance

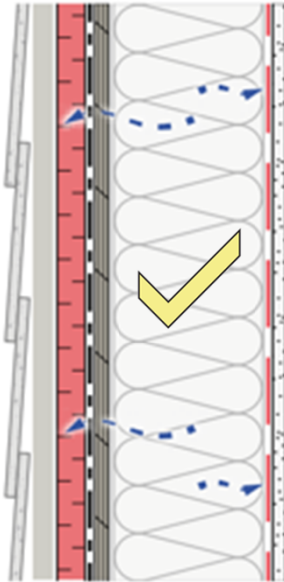
- Use Higher Ratios than “code minimum”
- Accounts for potential higher interior humidity than typical code assumptions
- Reduces risk of exterior sheathing reaching above 80% RH (i.e., not just liquid condensation)



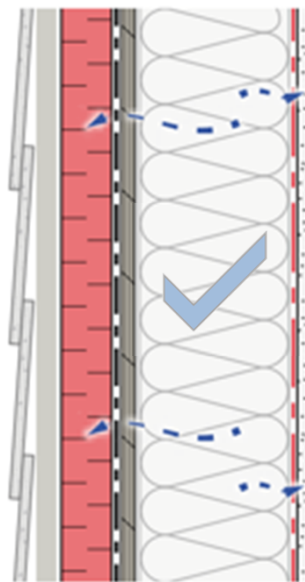
# 4

## Calculate Insulation Ratio

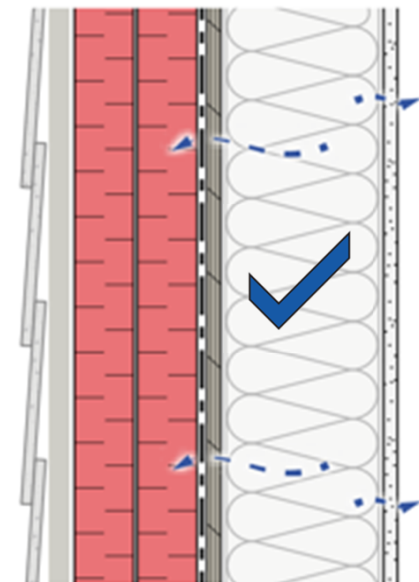
Going above code minimum ratios reduces risk of condensation and trapped moisture



**Code-Minimum Insulation Ratio**



**Low Insulation Ratio**



**High Insulation Ratio**

## 4

Calculate  
Insulation  
Ratio

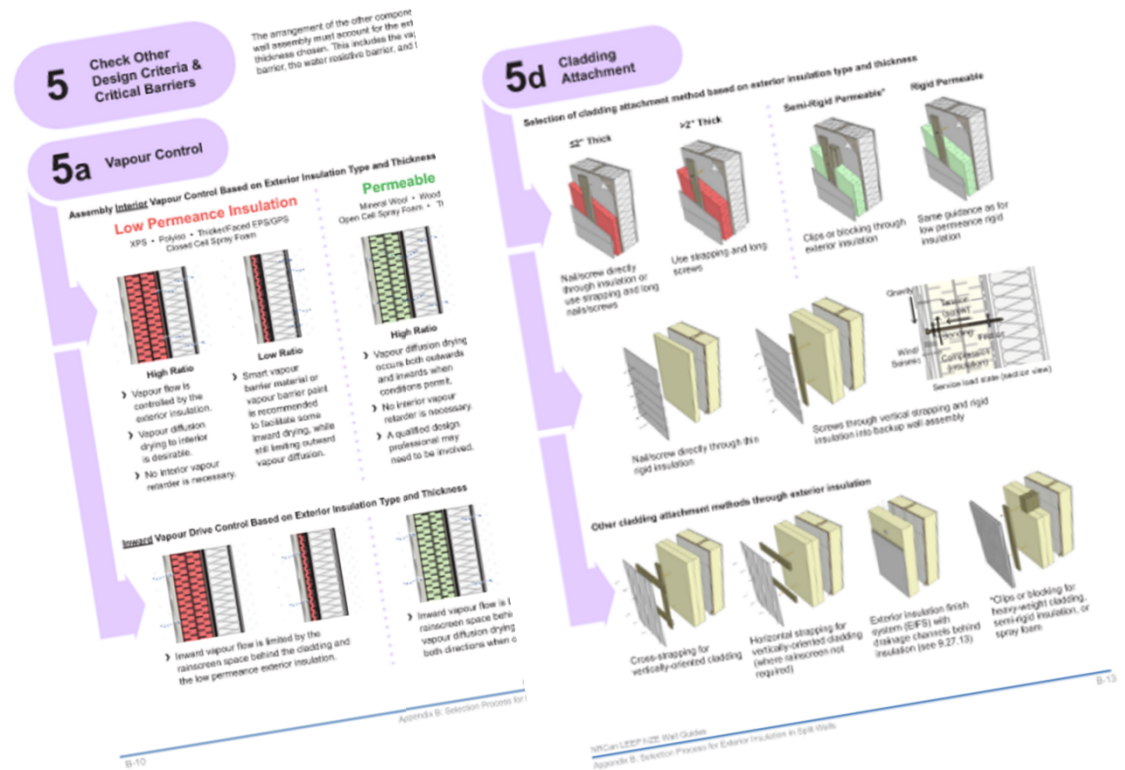
**Table B-4 Recommended Ratios of Outboard to Total R-value to Keep the Sheathing Reliably Below 80% RH for Assemblies with Low Permeance Exterior Insulation  $\leq$  ~1 US perm<sup>1</sup>**

Climate Zone	Heating Degree Days (HDD)	Low Ratio Higher Indoor Relative Humidity Interior Vapour Retarder Required <sup>2</sup>	High Ratio Interior Vapour Retarder not Required <sup>3</sup>	
			Standard Indoor Relative Humidity	Higher Indoor Relative Humidity
4	<3000	0.21	0.29	0.50
5	3 000–3 999	0.25	0.33	0.55
6	4 000–4 999	0.29	0.47	0.57
7A	5 000–5 999	0.33	0.57	0.63
7B	6 000–6 999	0.37	0.63	0.70
8 <sup>1</sup>	7 000–7 999	0.41	0.75	0.80
	8 000–8 999	0.45		
	9 000–9 999	0.49		
	10 000–10 999	0.53		
	11 000–11 999	0.57		
	$\geq$ 12 000	0.61		

# 5

## Check Other Design Criteria & Critical Barriers

- Vapour Control
- Airflow Control
- Water Management
- Cladding Attachment

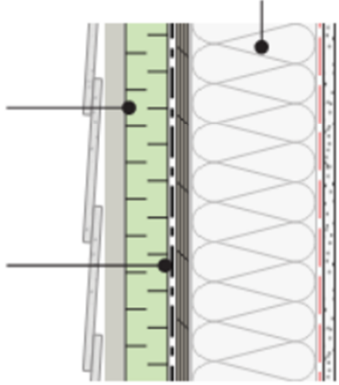


# Example Assemblies

1

R-19 BATT IN 2X6 WALL,  
6 MIL POLY

R-8 2" RIGID  
MINERAL  
WOOL  
SEALED  
SHEATHING  
MEMBRANE  
(AB/WRB)

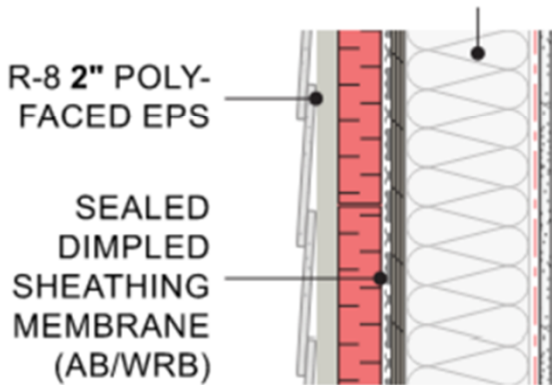


Are there ratio requirements?	No (permeable exterior insulation)
Outboard to total R-value ratio?	<b>0.31</b>
Appropriate climate zone(s)?	Any
Approx. effective R-Value?	R-24.3
Additional notes	Permeable insulation allows for standard practices and efficiently boosts R-value

# Example Assemblies

3

R-24 BATT IN 2X6 WALL,  
SMART VAPOUR BARRIER

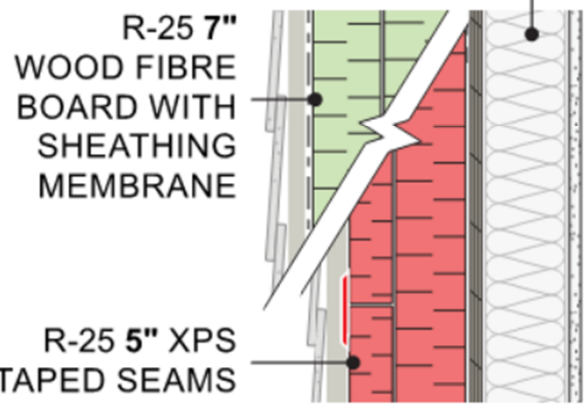


Are there ratio requirements?	Yes (low permeance exterior insulation)
Outboard to total R-value ratio?	<b>0.26</b>
Appropriate climate zone(s)?	Thru CZ 5
Approx. effective R-Value?	R-26
Additional notes	Interior vapour retarder is key when using a low ratio wall

# Example Assemblies

4

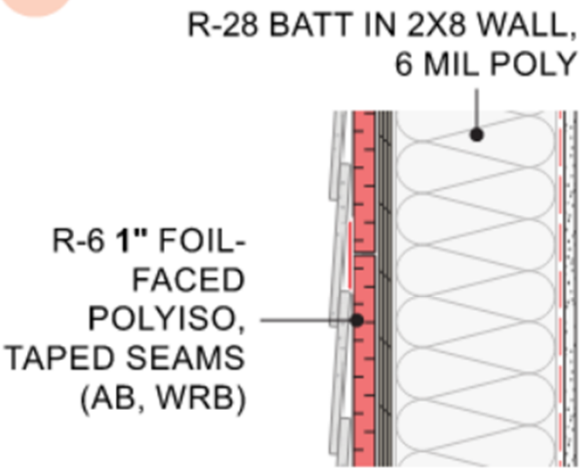
R-12 BATT IN 2X4 WALL,  
NO INTERIOR VAPOUR RETARDER



Are there ratio requirements?	Yes (no interior vapour retarder)
Outboard to total R-value ratio?	0.66
Appropriate climate zone(s)?	Thru CZ 7B, Standard Indoor RH
Approx. effective R-Value?	R-36.4
Additional notes	High ratio is needed to be able to omit the interior vapour retarder regardless of exterior insulation permeance

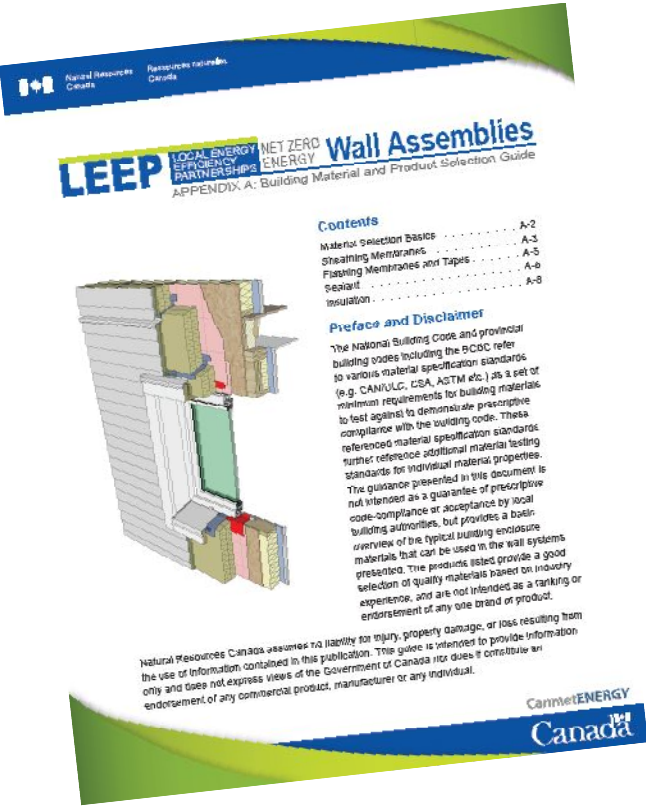
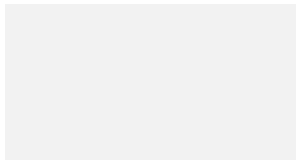
# Example Assemblies

6



Are there ratio requirements?	Yes (low permeance exterior insulation)
Outboard to total R-value ratio?	<b>0.18</b>
Appropriate climate zone(s)?	<b>Not recommended for any</b>
Approx. effective R-Value?	R-27.2
Additional notes	Thin low permeance exterior insulation on a deeper wall is not appropriate for most scenarios

**LEEP** LOCAL ENERGY EFFICIENCY PARTNERSHIPS NET ZERO ENERGY Wall Assemblies  
 APPENDIX A: Building Material and Product Selection Guide



**LEEP Wall Guides  
 Appendix A:  
 Building Material and  
 Product Selection Guide**

**Contents**

- Material selection Basics . . . . . A-2
- Sheathing Membranes . . . . . A-3
- Flashing Membranes and Tapes . . . . . A-5
- Sealant . . . . . A-6
- Insulation . . . . . A-8

**Preface and Disclaimer**

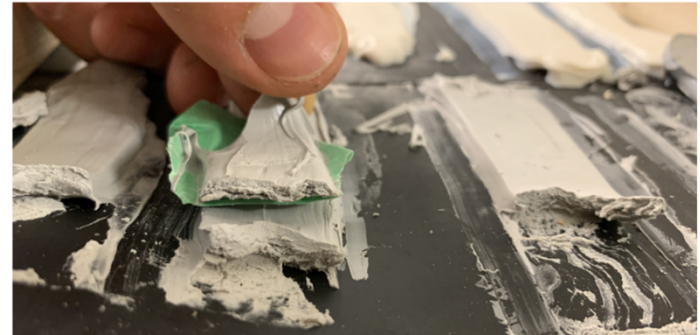
The National Building Code and provincial building codes including the NBC refer to various material specification standards (e.g. CAN/ULC, CSA, ASTM etc.) as a set of minimum requirements for building materials to test against to demonstrate prescriptive compliance with the building code. These referenced material specification standards further reference additional material testing standards for individual material properties. The guidance presented in this document is not intended as a guarantee of prescriptive code-compliance or acceptance by local building authorities, but provides a brief overview of the typical building enclosure materials that can be used in the wall systems presented. The products listed provide a good selection of quality materials based on industry experience, and are not intended as a ranking or endorsement of any one brand or product.

Natural Resources Canada assumes no liability for injury, property damage, or loss resulting from the use of information contained in this publication. This guide is intended to provide information only and does not express views of the Government of Canada nor does it constitute an endorsement of any commercial product, manufacturer or any individual.

CanmetENERGY  
 Canada

# Material Selection Basics

- “Code Compliant”
- Durable
- Compatible
- Adhesive
- Constructable
- Construction Grade



Appendix A | Page A-7 | Figure 4



Appendix A | Page A-7 | Figure 3

# Sheathing Membrane

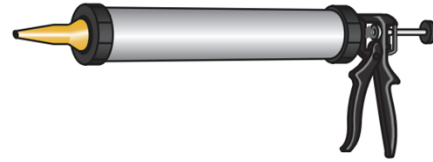




# Insulation

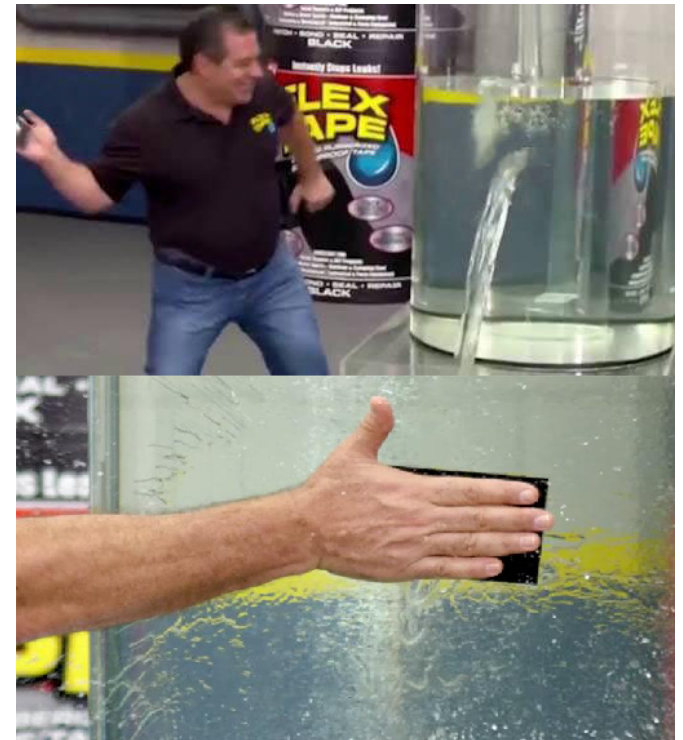


# Sealant



## Consumer-Grade Products Have Marketing Directly on Them:

- “100% Waterproof”
- “Crack Proof”
- “Superior Flexibility”
- “Silicone Tough”
- “Easy Clean”

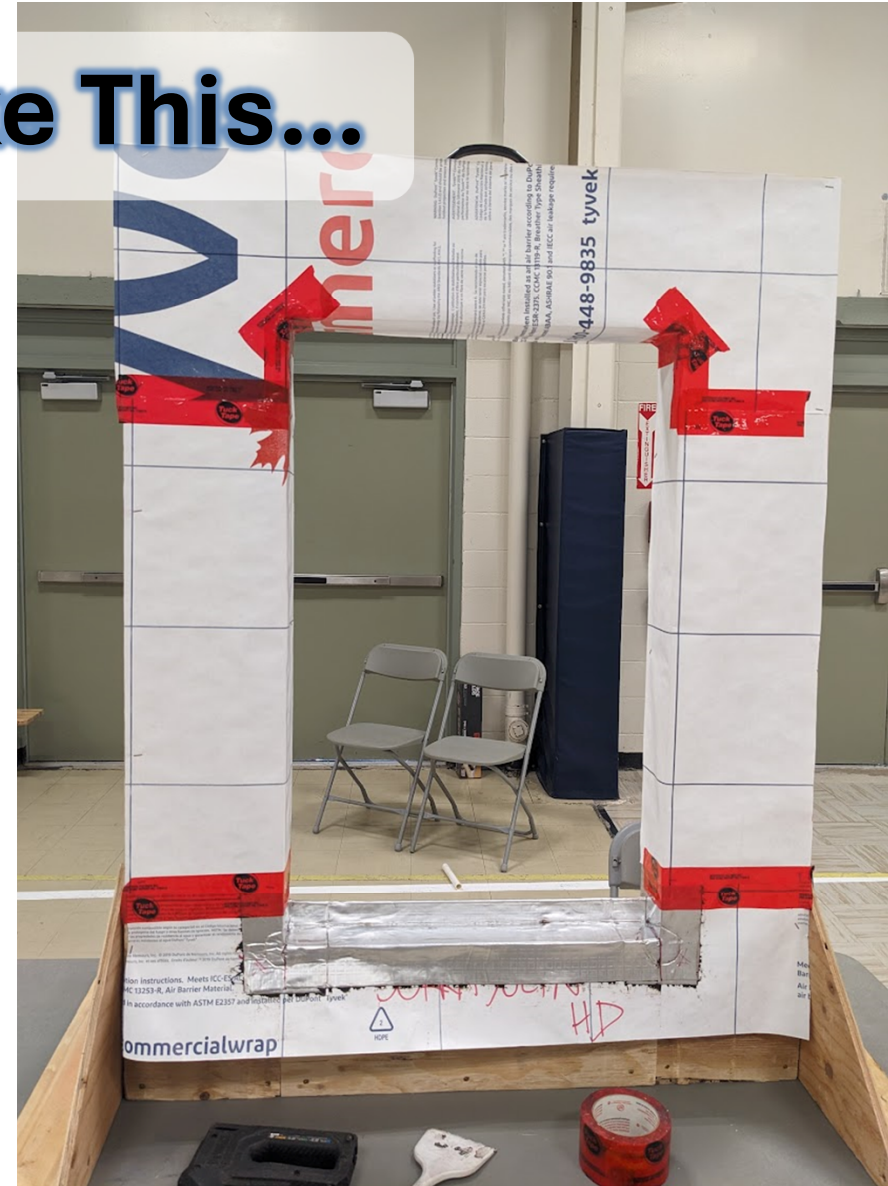


Source: Flex Seal

# Reminder: Good Design and Materials Can't Make up for Bad Install...



**Install it Like This...**



Not Like This...



**LEEP NZE Walls  
for  
Renovation  
& Retrofit**



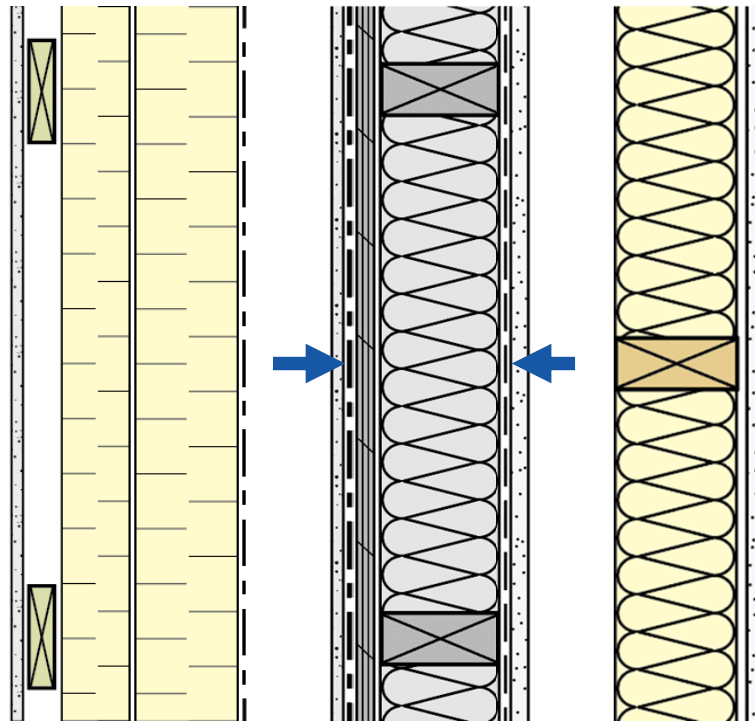
# Goals of Wall NZE Retrofit: Better Airtightness and R-Value




# New Insulation for Old Walls

**New exterior  
insulation**

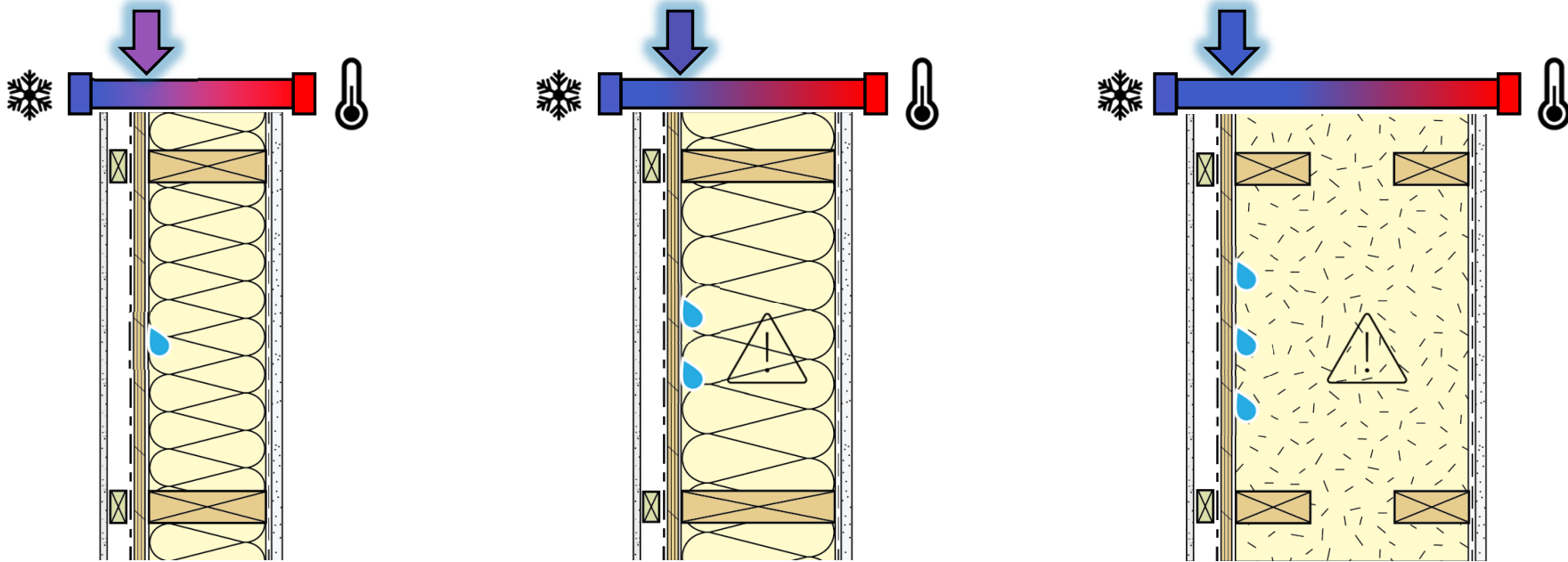
Lower  
hygrothermal  
risk.



**New interior  
insulation**

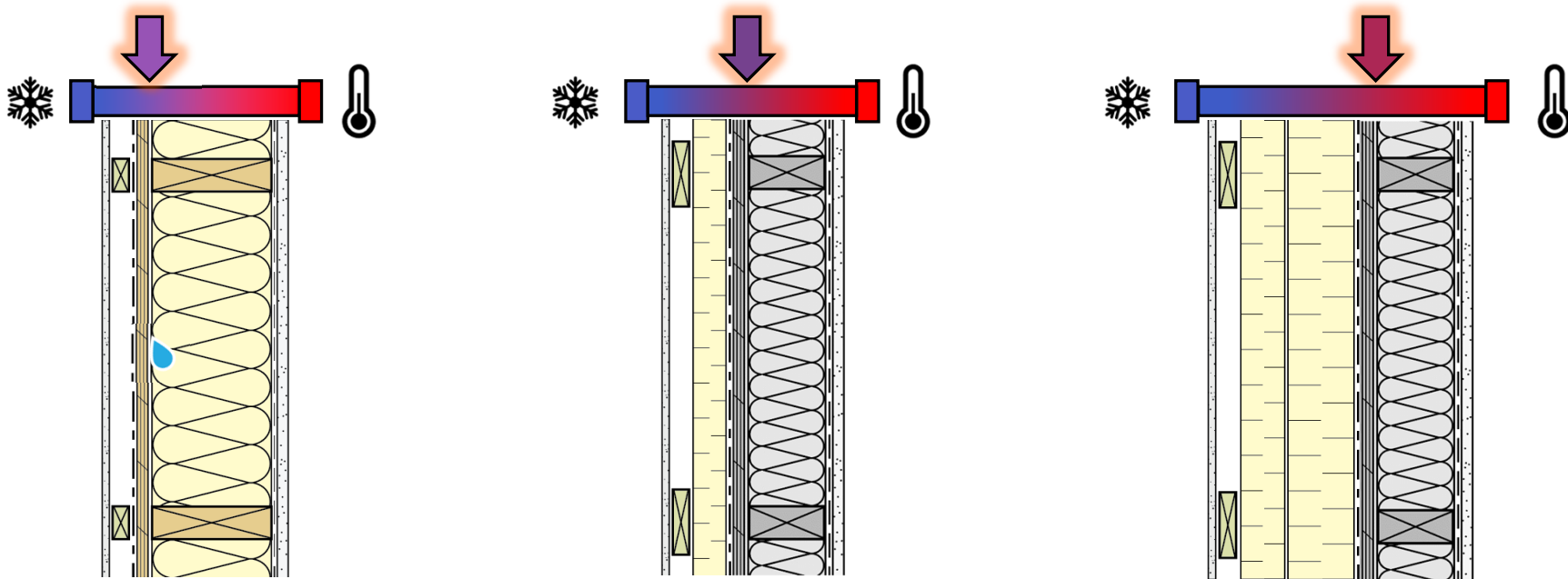
Beware of  
hygrothermal  
risk. 

## More Interior Insulation Means Colder Sheathing



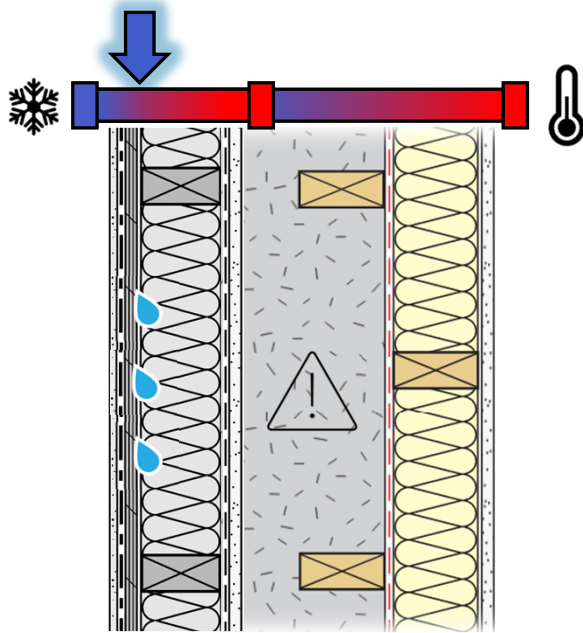
Colder Sheathing Means Higher Condensation Risk

## More Exterior Insulation Means Warmer Sheathing



Warmer Sheathing Means Lower Condensation Risk

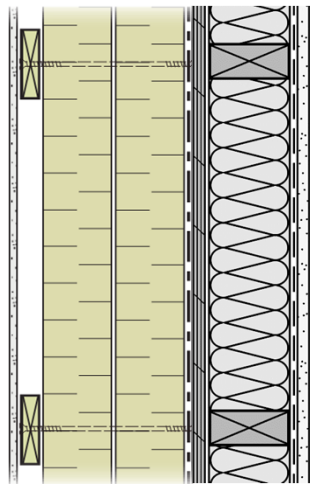
## Ways to Manage Interior Insulation Condensation Risk



- **Excellent interior air barrier behind service cavity**
- **Active balanced home ventilation system**
- **Permeable exterior layers + rainscreen**
- **Biocide treatment for exterior sheathing?**

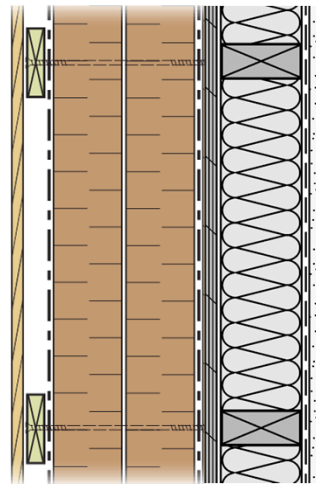
# Retrofit Wall Selection – Similar to new NZE Walls

## Exterior Insulation Retrofit Concepts



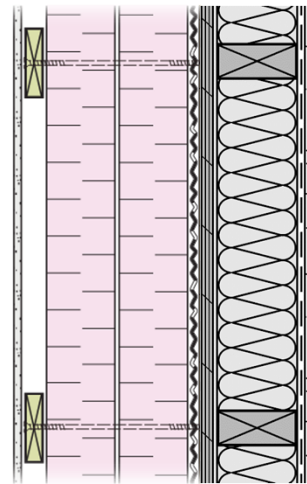
**Wall #1**

Split-Wall: Vapour Permeable  
Exterior Insulation



**Wall #2**

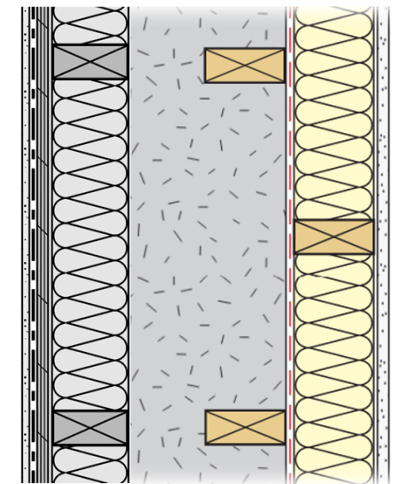
Split-Wall: Wood Fibre  
Exterior Insulation



**Wall #3**

Split-Wall: Low-Permeance  
Exterior Insulation

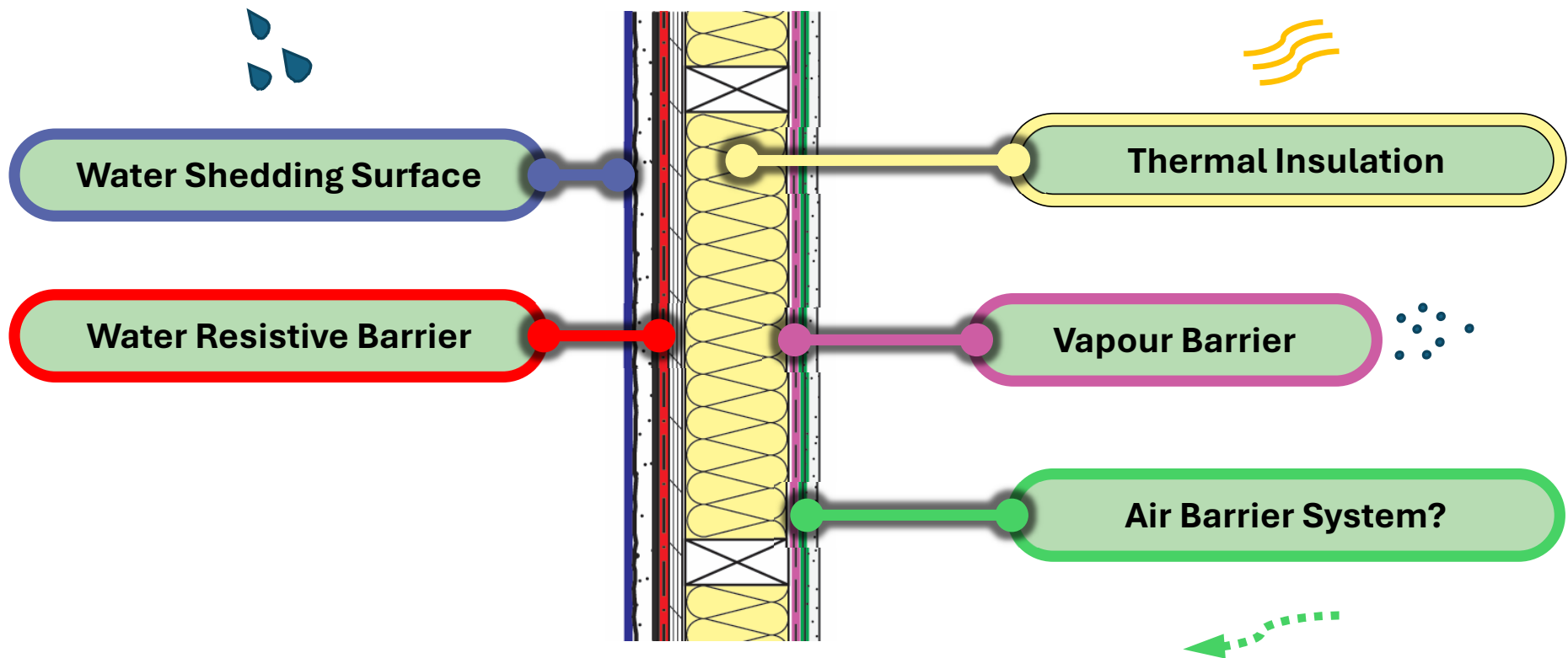
## Interior Insulation Retrofit Concept



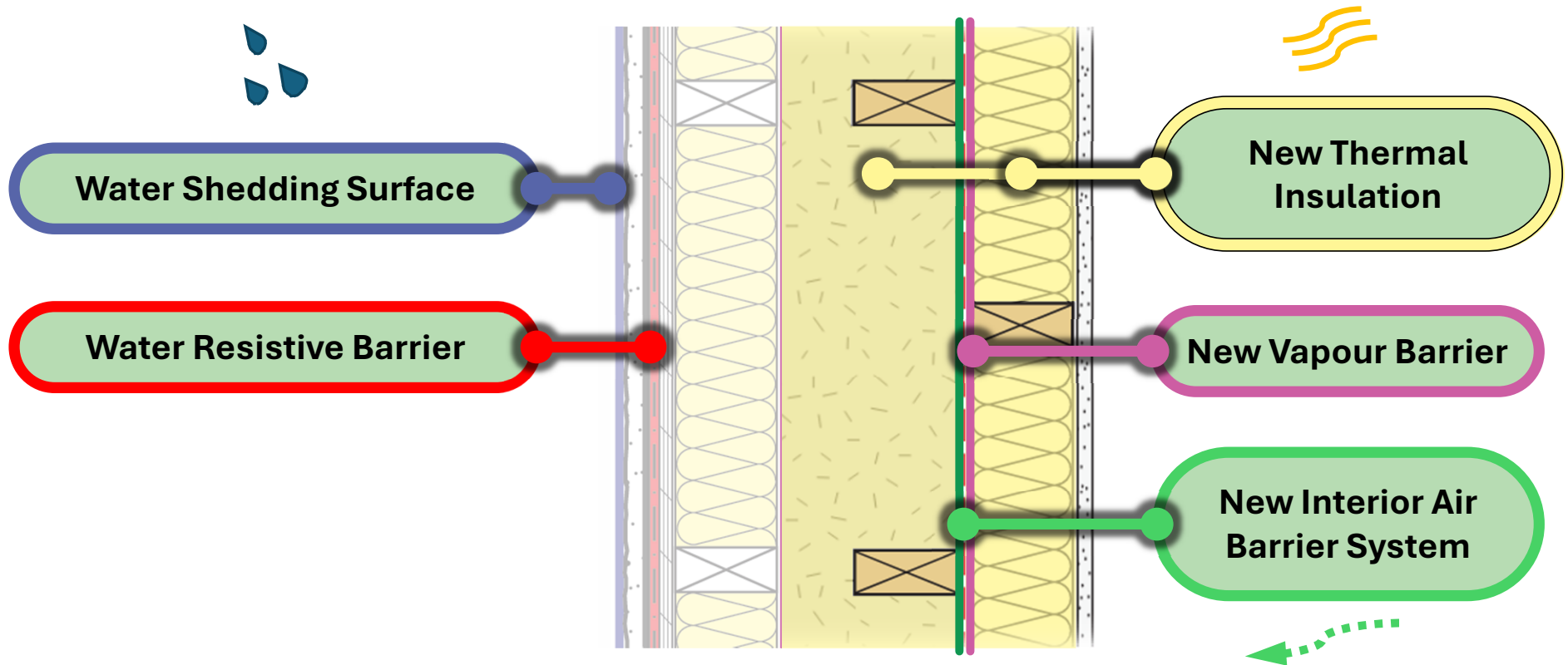
**Wall #4**

Double Stud Wall with  
Interior Service Wall

# Environmental Loads and The Five Control Layers



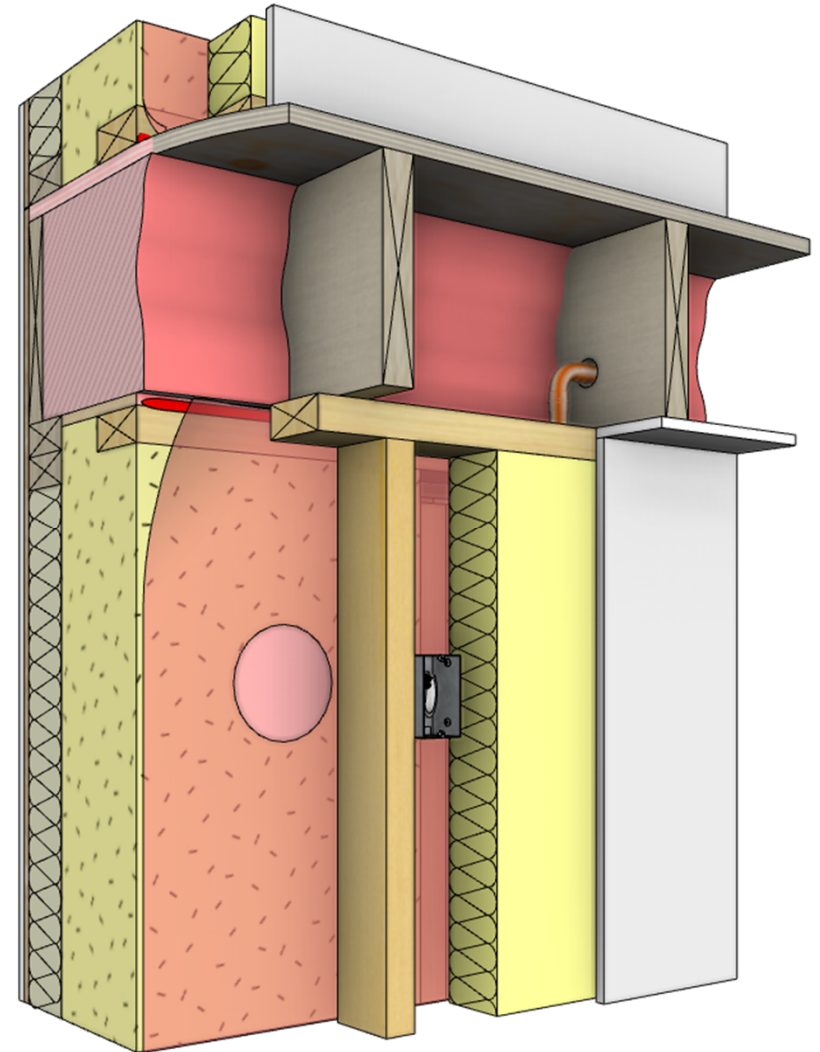
# Control Layers for New Interior Insulation



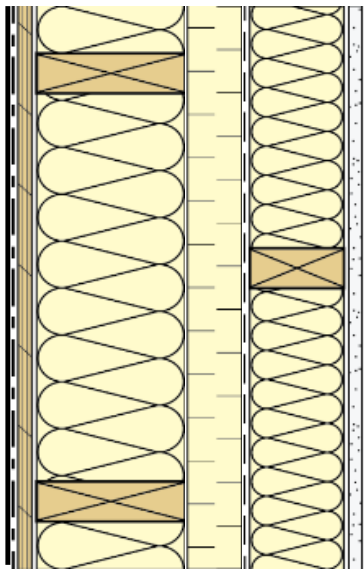
# New Interior Insulation and Air Barrier Considerations



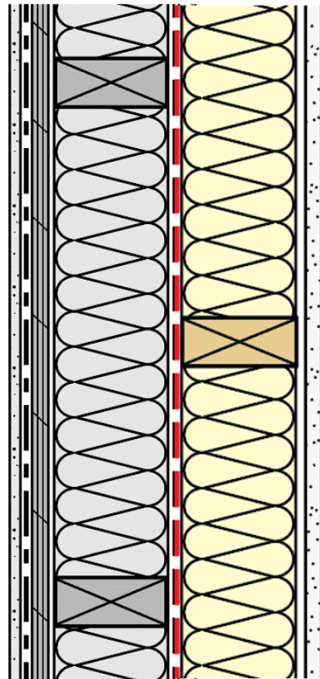
- Plan for the floor joist areas?
- Re-route services into new service cavity?
- Continuity around existing components – difficult?
  - Stairs
  - Tubs
  - Cabinets
  - Etc.
- Lots of re-framing likely required



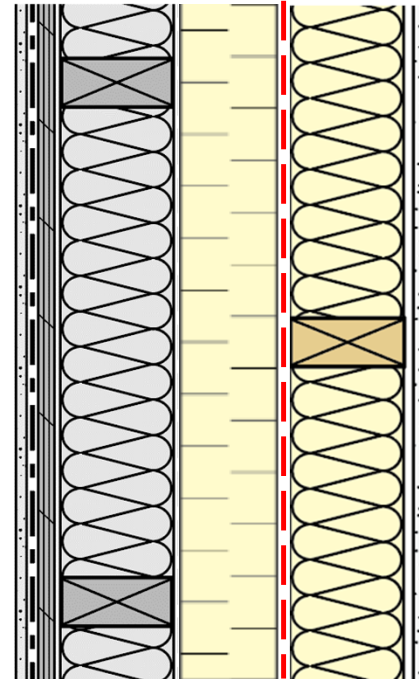
# Case Study: Deep Wall with Decayed Sheathing



## Other Interior Insulation Retrofit Concepts

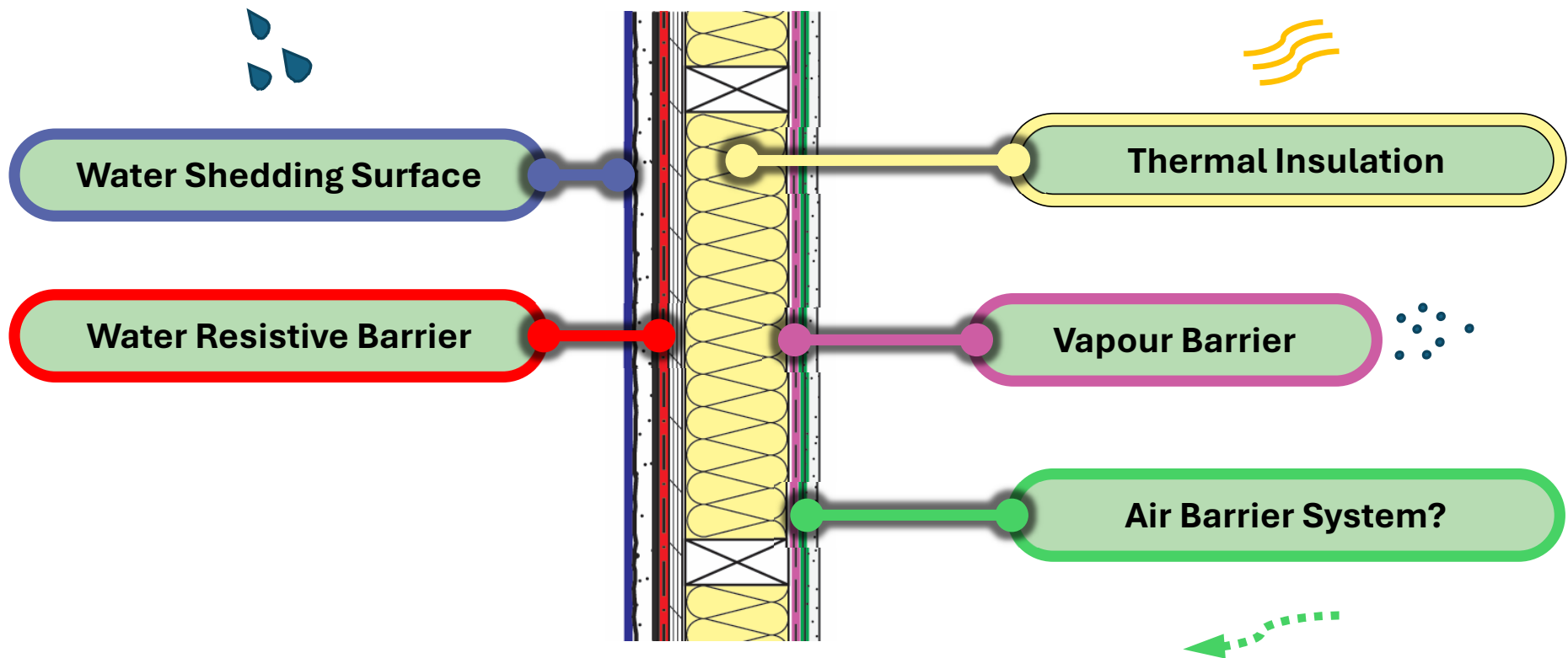


Insulated Service  
Cavity Only

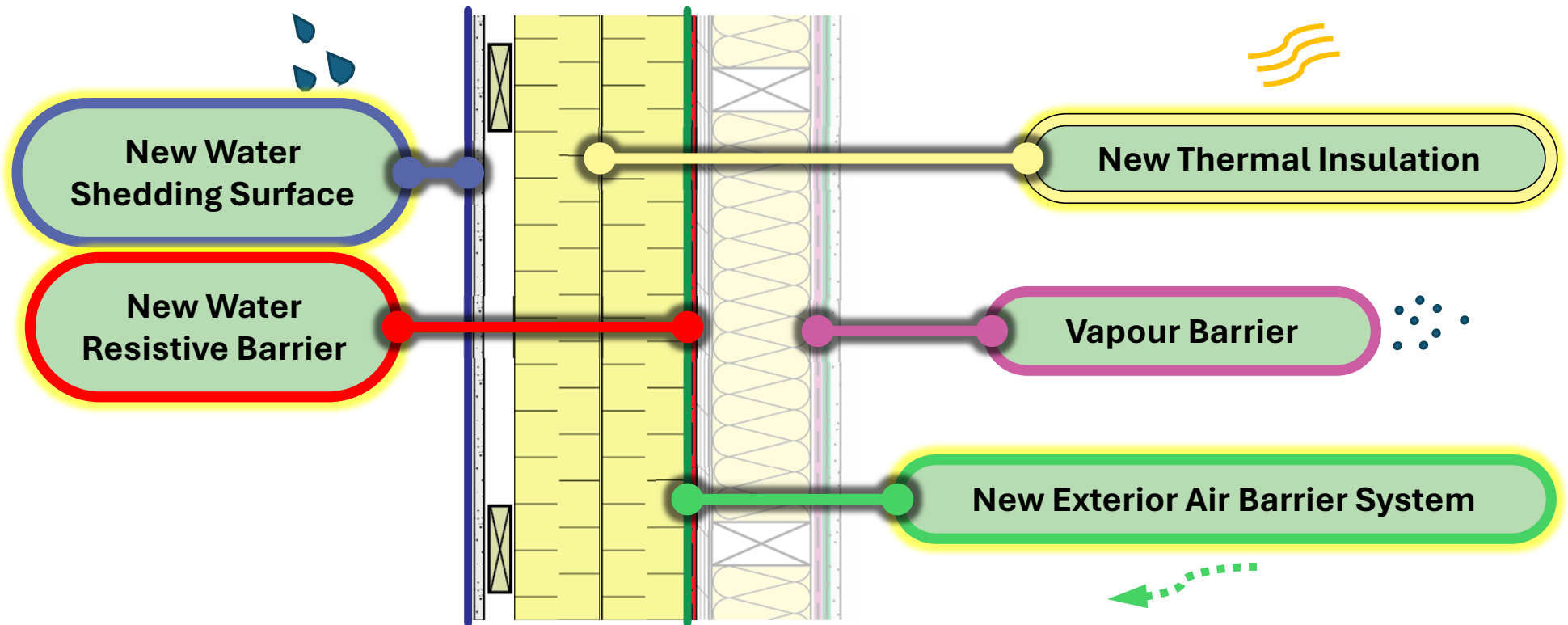


Foam Board with  
Service Cavity

# Environmental Loads and The Five Control Layers

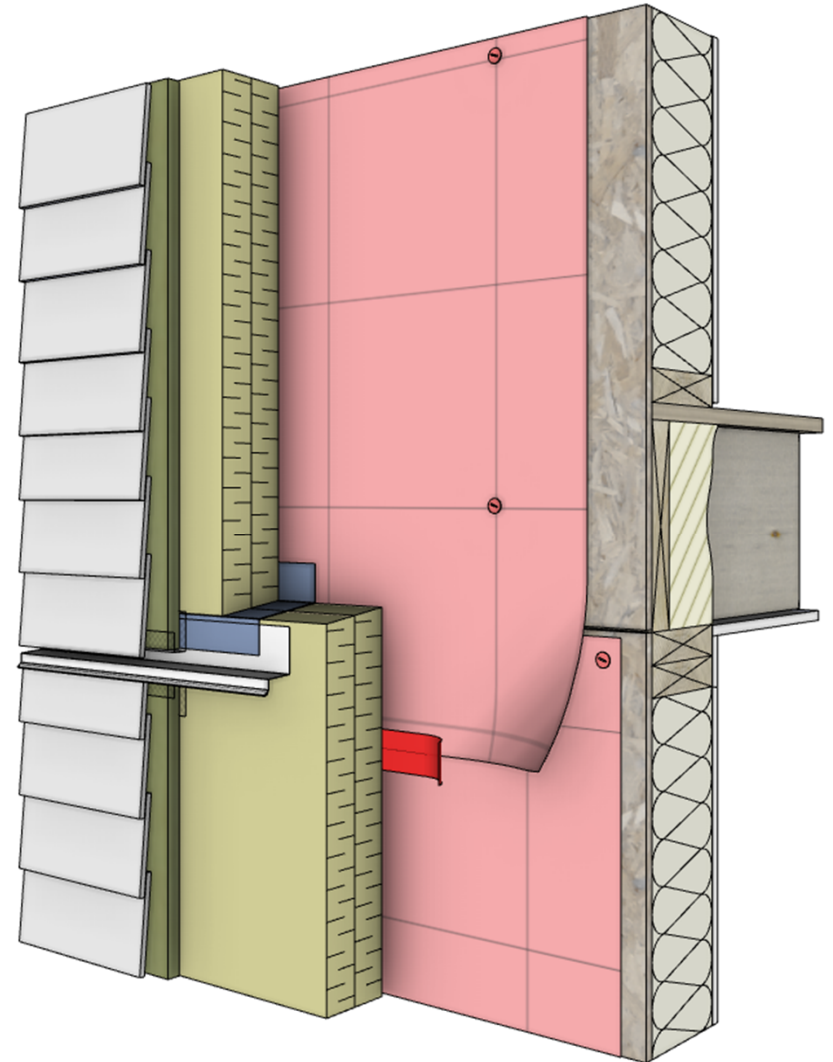


# Control Layers for New Exterior Insulation

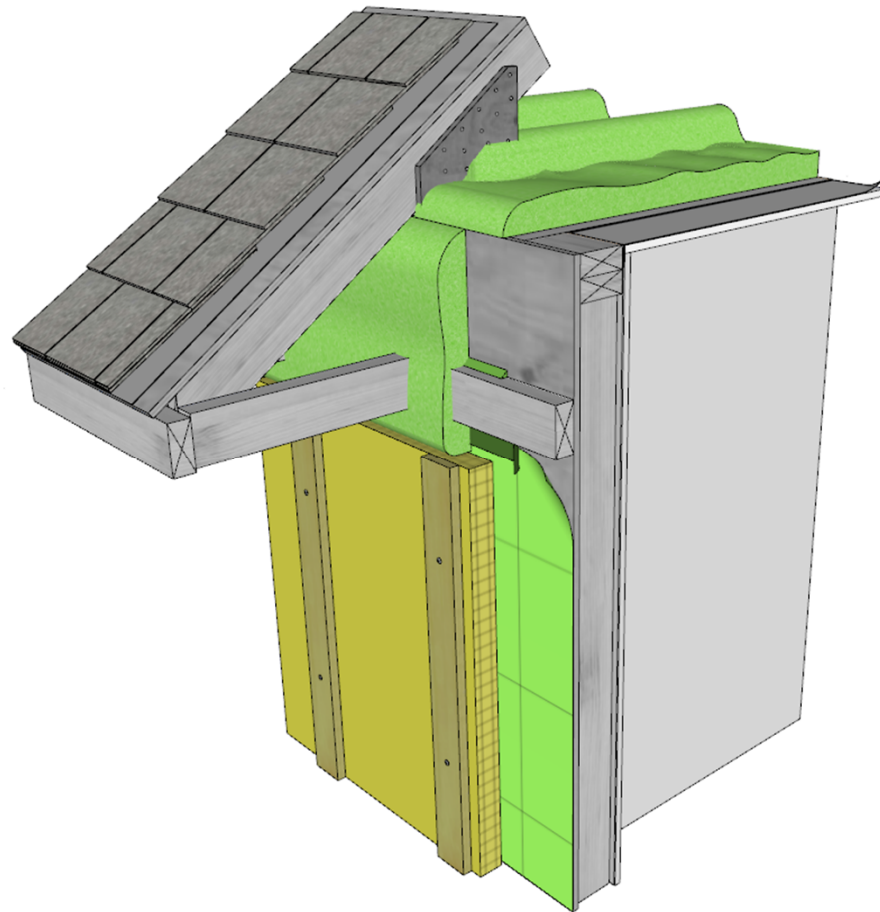


## New Exterior Insulation and Air Barrier Considerations

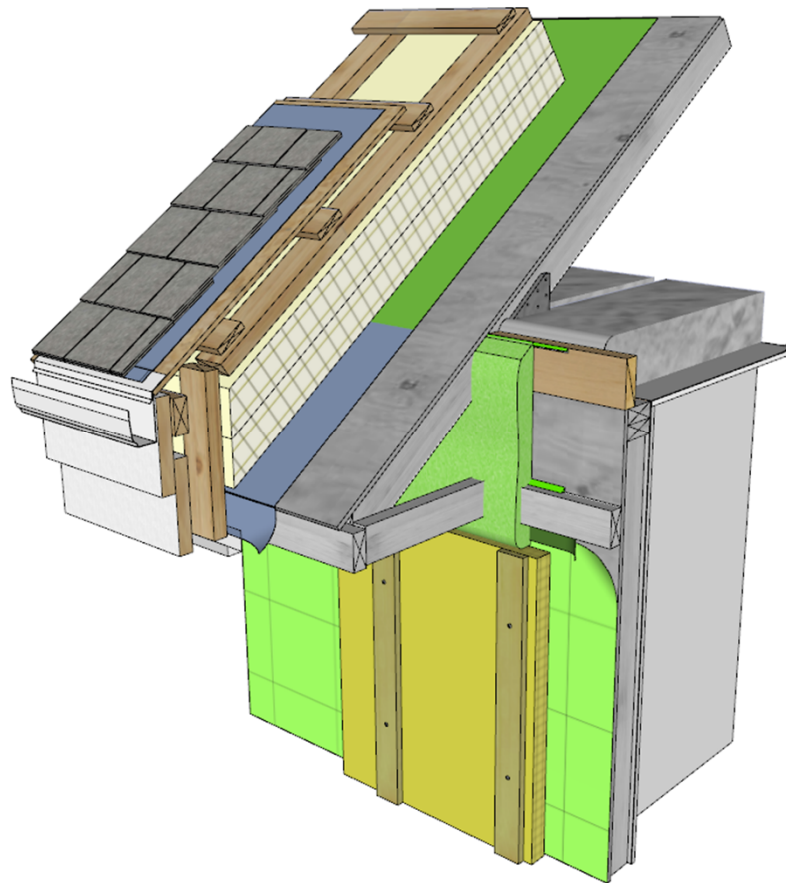
- Continuity around existing components?
  - Balconies
  - Canopy roofs
  - Garage wall interface
- Extend exterior service penetrations out to new cladding.
- Reposition windows?
- Tie-ins at other assemblies?



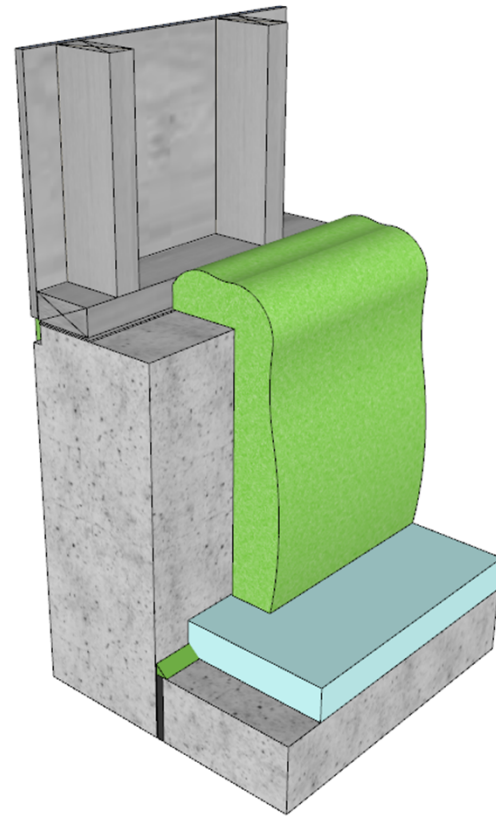
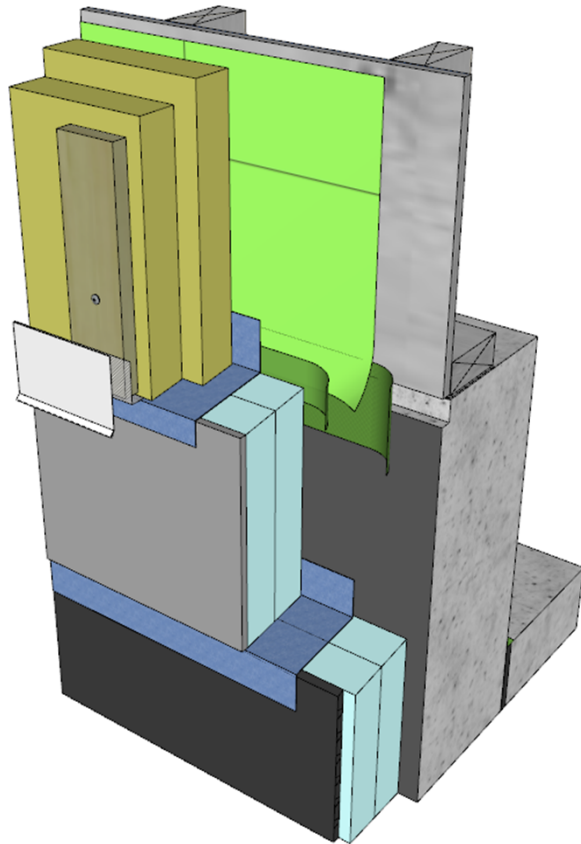
## Retrofit: Roof to Wall - Attic Flash/Fill



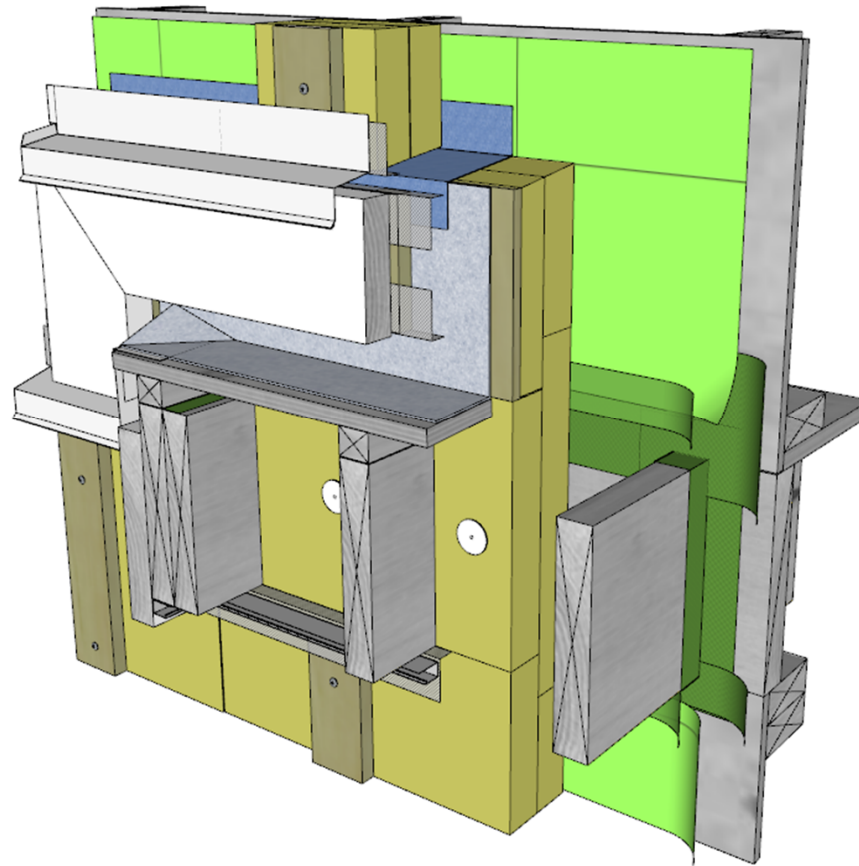
## Retrofit: Roof to Wall – Exterior Insulation



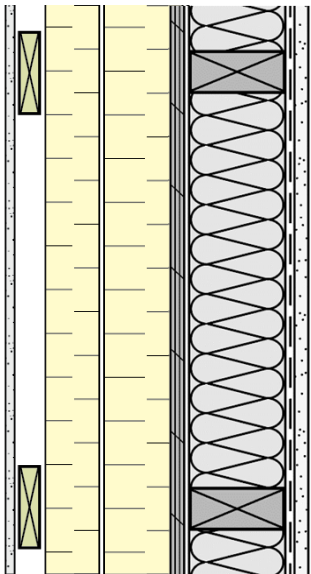
# Retrofit: Base of Wall



## Retrofit: Cantilevered Balcony



# Case Study: New Stone Wool Exterior Insulation



**Before - 1956 Bungalow**



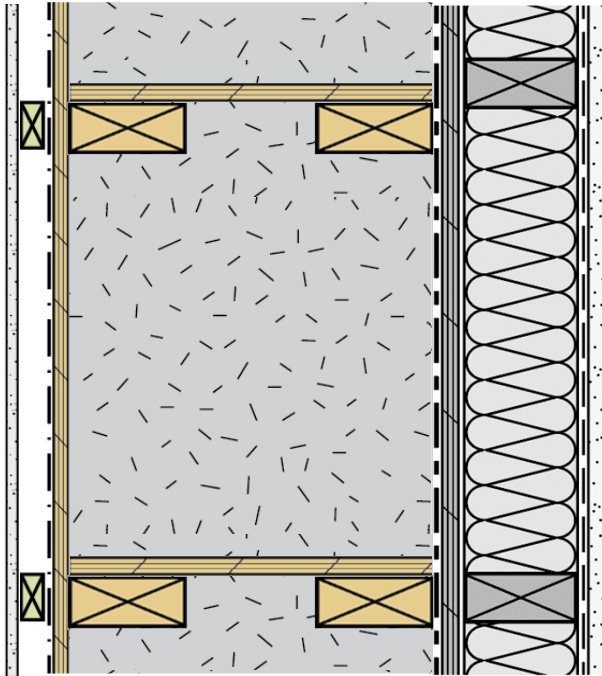
During



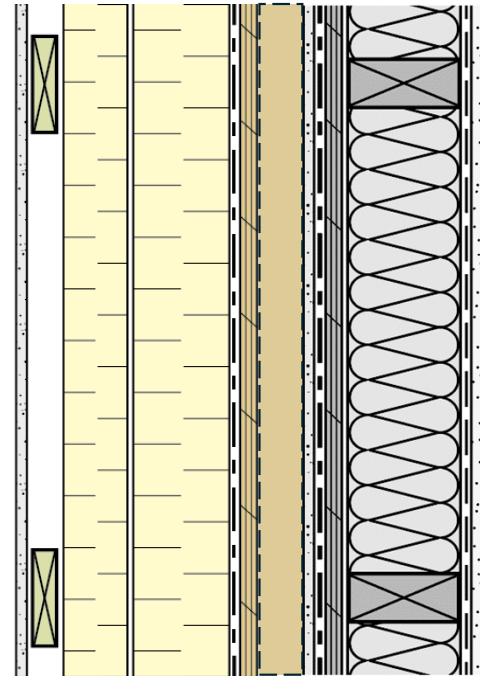
**After – High Performance 1956 Bungalow**



## Other Exterior Insulation Retrofit Concepts

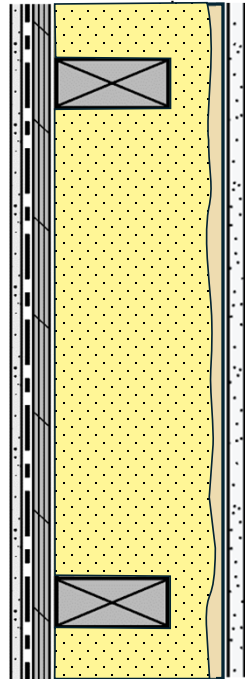


Larson Truss

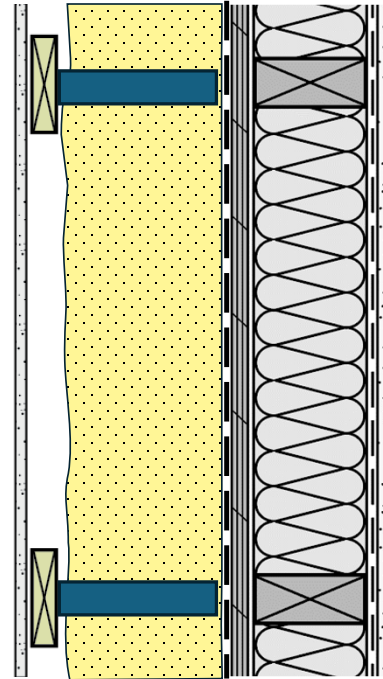


Insulated Panel  
(Prefab)

# Spray Foam Insulation Retrofit Concepts



Interior Furring  
and Spray Foam



Exterior Spray  
Foam



UNCLASSIFIED - NON CLASSIFIÉ



**Reality of Spray Foam...**





LKIN2699.MOV



# INTERIOR Retrofit Go/No-Go

- ✓ Air sealing top priority
- ✓ Airtightness QA/QC during construction
- ✓ Improved exterior water management if needed
- ✓ Good interior ventilation
- x New insulation without excellent air sealing
- x Poor exterior water management evident and left as-is
- x No plan for ventilation

## EXTERIOR Retrofit Go/No-Go

- ✓ Air sealing top priority
- ✓ Airtightness QA/QC during construction
- ✓ Improved exterior water management
- ✓ Solid existing structure
- x New insulation without excellent air sealing
- x Poor exterior water management
- x Inappropriate structure to support exterior components



# LEEP NZE Wall Guides (7 Documents)

Free Download. Search: "LEEP Technology Guides and Tools"



Intro and Wall Selection Guide

4 NZE Wall Assembly Guides

Appendix A Material Selection

Appendix B Exterior Insulation Selection

# Questions?



Canada 