

Over or Under? The Best Options for Installing Both a WRB and Exterior Continuous Insulation

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VIRTUAL HIGH PERFORMANCE
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EXTENDED

The WHY:

- **Code Driven**
- **Energy Savings**
- **Comfort**
- **Sustainability**

Code Process



Development

- Model code language and requirements are written.



Adoption

- Codes become law by being adopted by state or local agencies

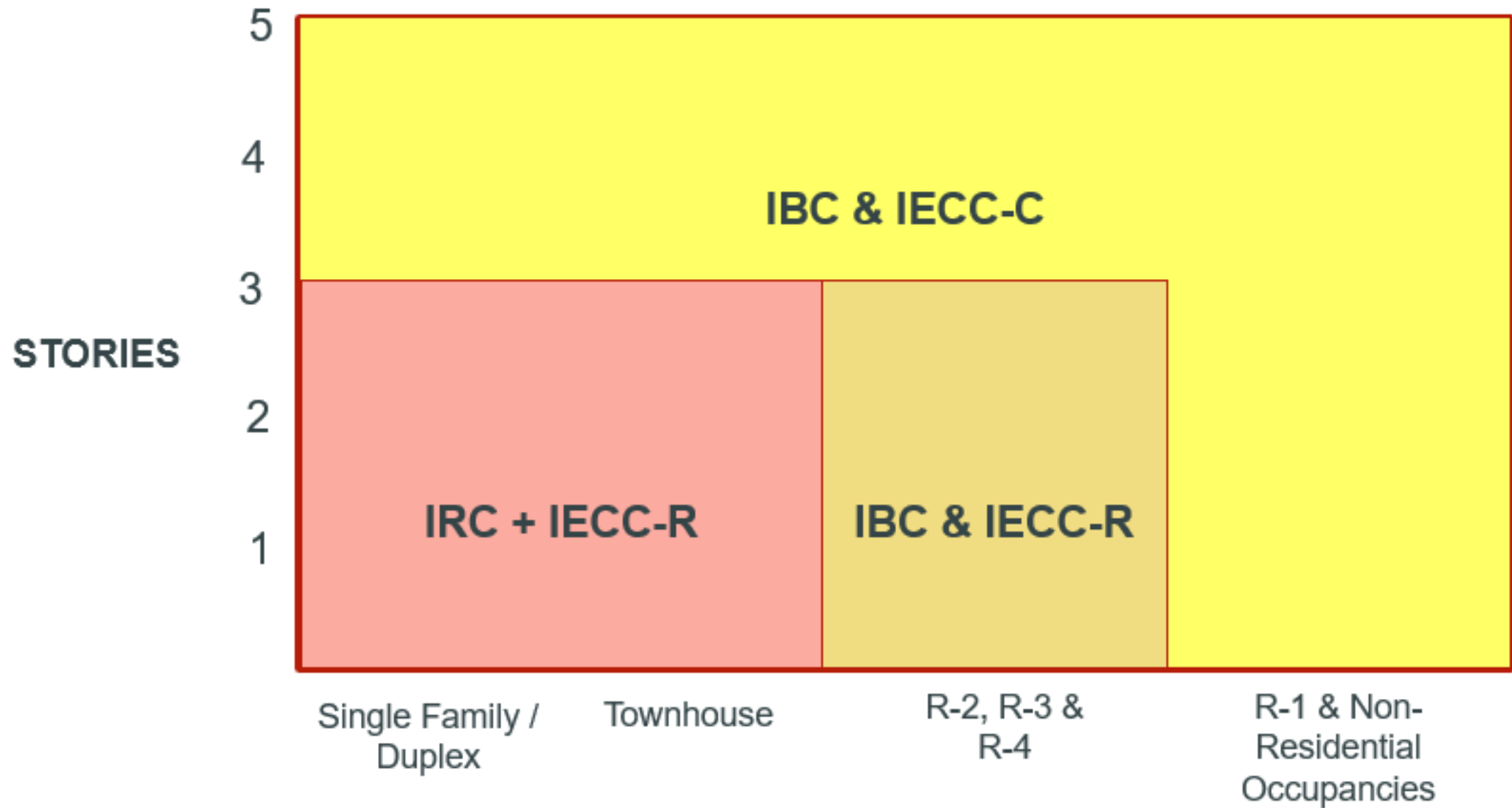


Enforcement

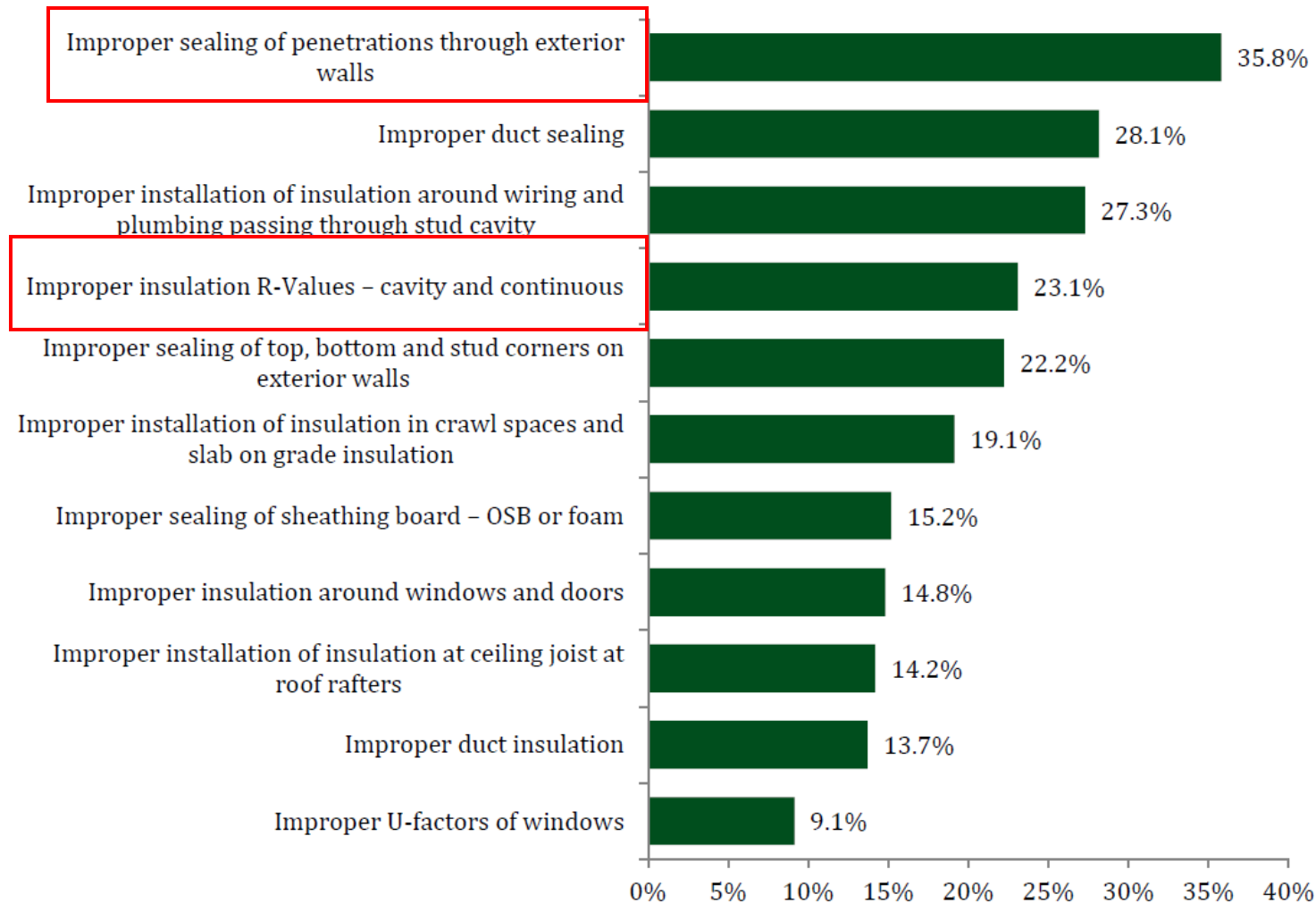
- Codes are enforced by local code officials
- Code Interpretation
- Product Compliance
- Training

New editions of codes published on 3-year cycle





Most Common Energy Code Violations



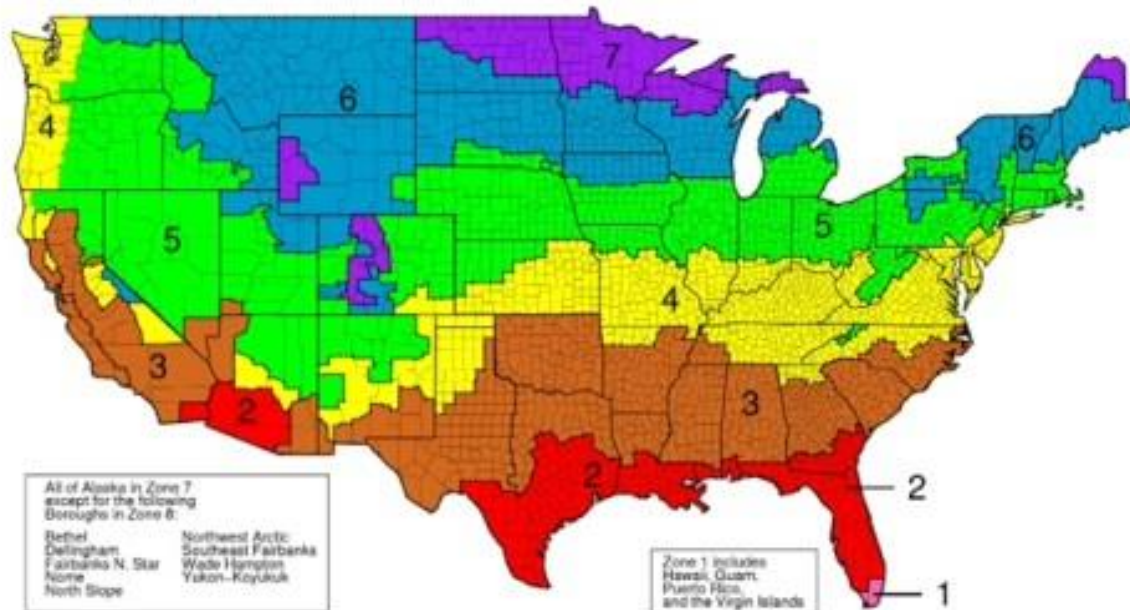
"Please indicate the three (3) most common energy code violations you see"; N=810

Advancement of IECC – Residential Energy Efficiency

	IECC 2006	IECC 2009	IECC 2012	IECC 2015
DOE Goal Improvement	Baseline	17%	30%	50%
DOE Actual Determination	Baseline	14%	32%	34%

IECC Residential Code: Residential Wood-Frame Wall R-value Requirements

RESIDENTIAL BUILDING. For this code, includes R-3 buildings, as well as R-2 and R-4 buildings three stories or less in height above grade

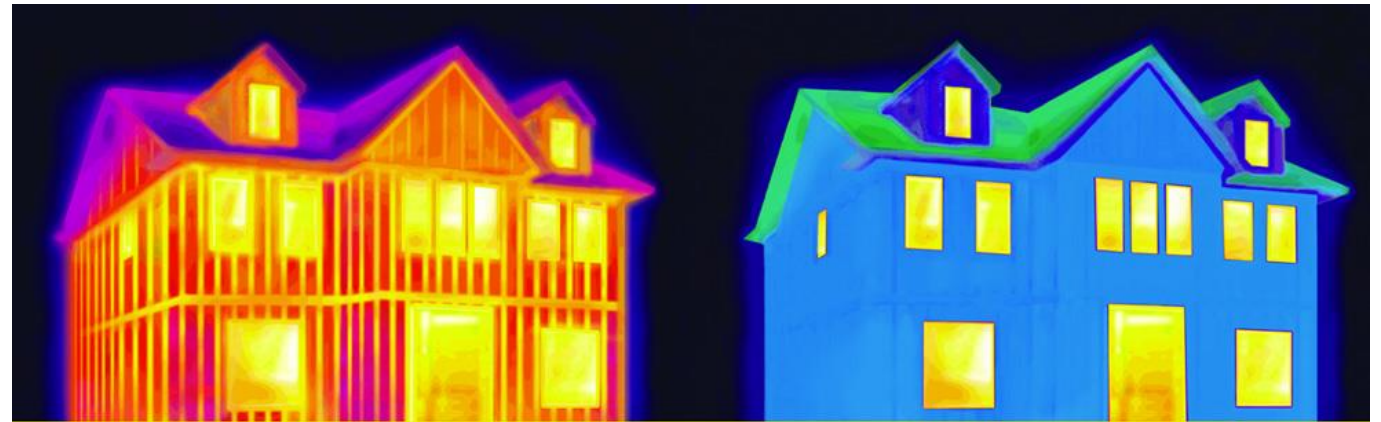


CLIMATE ZONE	2006 IECC	2009 IECC	2012, 2015, 2018 IECC
1	13	13	13
2	13	13	13
3	13	13	20 or 13+5
4 X-MARINE	13	13	20 or 13+5
4 MARINE	19 or 13+5	20 or 13+5	20 or 13+5
5	19 or 13+5	20 or 13+5	20 or 13+5
6	19 or 13+5	20 or 13+5	20+5 or 13+10
7	21	21	20+5 or 13+10
8	21	21	20+5 or 13+10

Building Science for Thermal Management

Benefits of Exterior Continuous Insulation (CI)

- Framing members reduce the total wall R-value by 25-30% (Thermal Bridging)
- Exterior wall insulation can add 30% or more to the home's energy efficiency for the lowest cost



Use of an air barrier and continuous insulation are the most effective ways to eliminate thermal bridging and air leakage issues associated with traditional stud framing and cavity insulation.

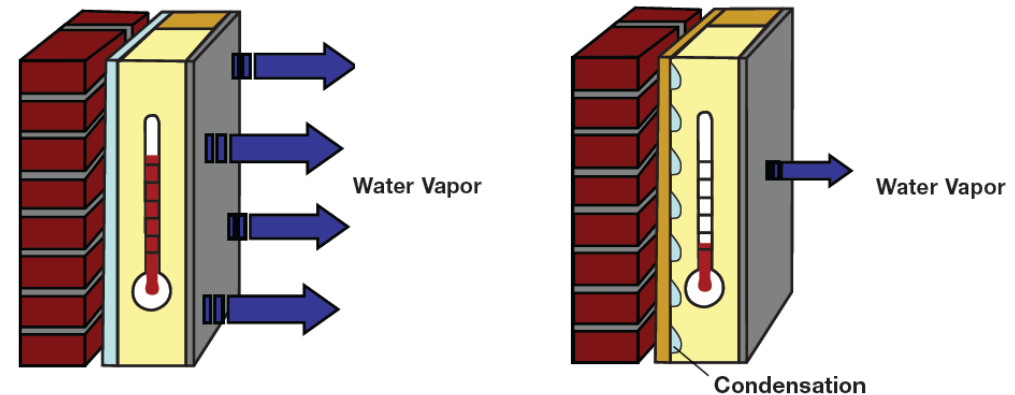
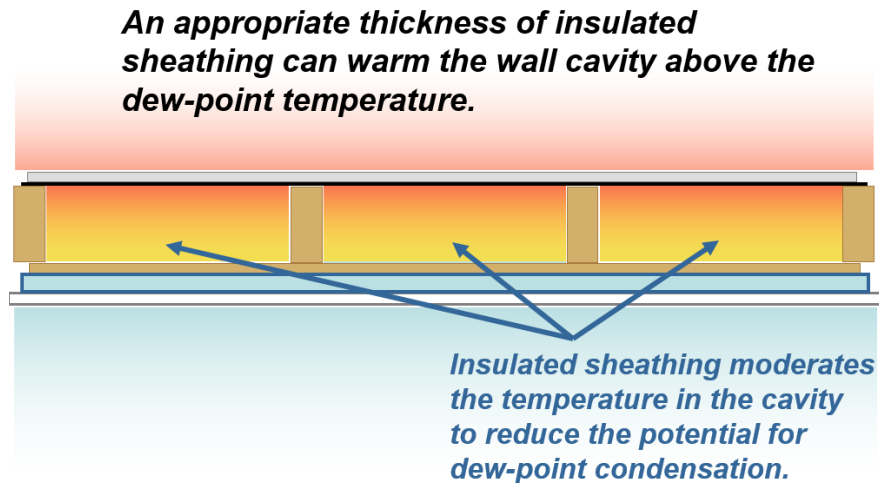
CI Reduces Thermal Bridging



Building Science for Thermal Management

Benefits of Continuous Exterior Insulation

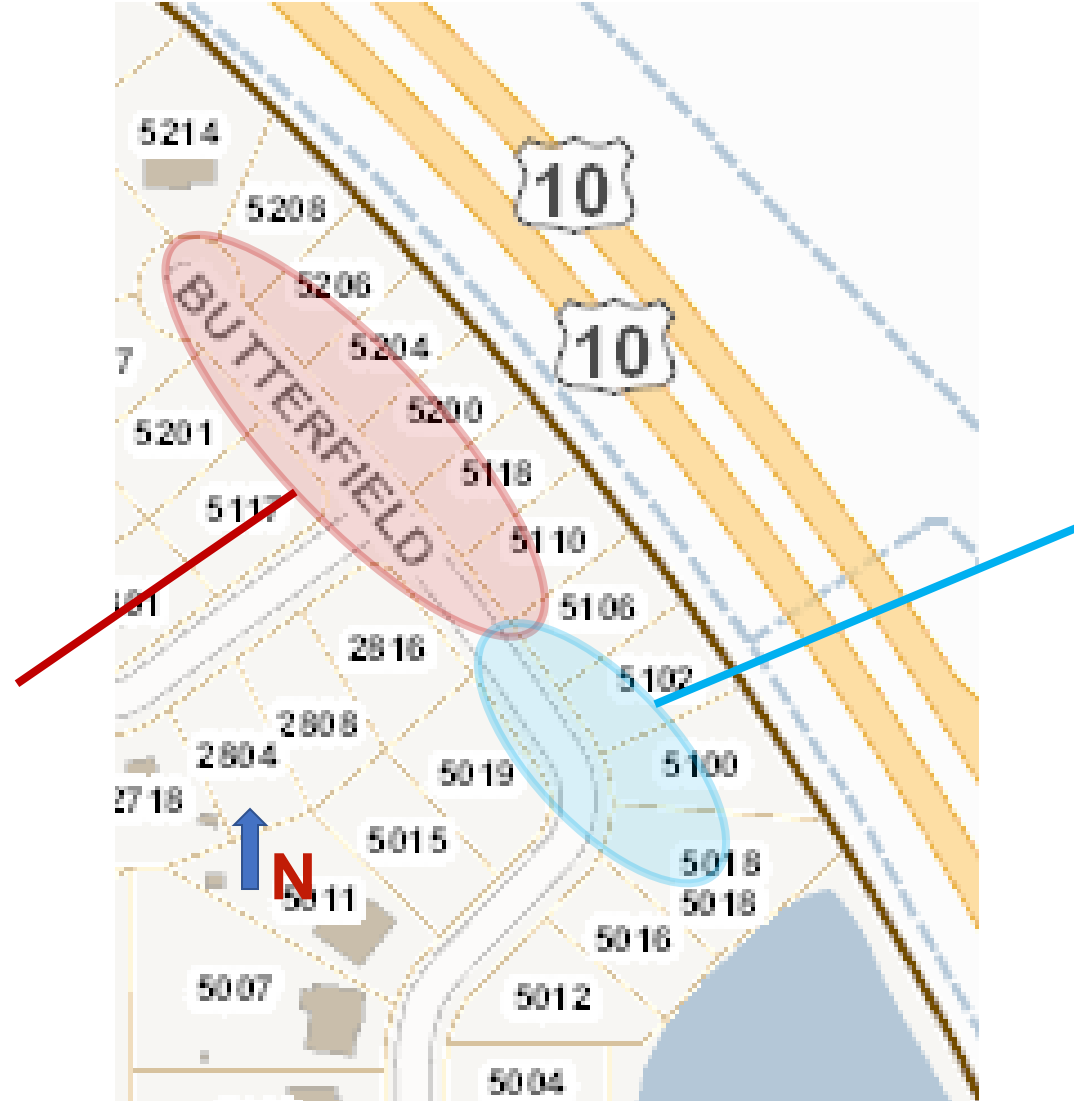
- Changes the temperature profile of the wall
- Reduces potential for condensation in the wall system



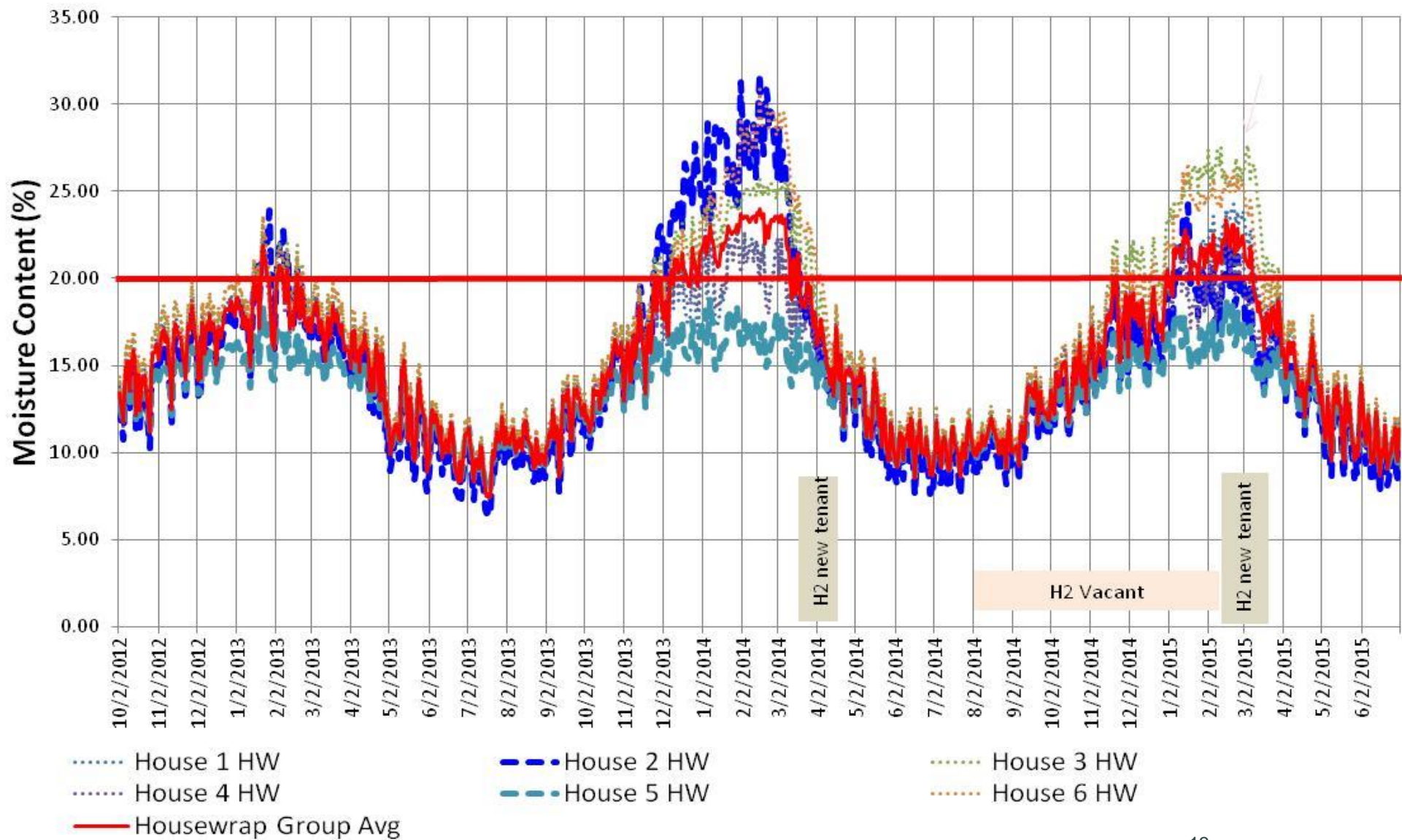
2X6 OSB/HW

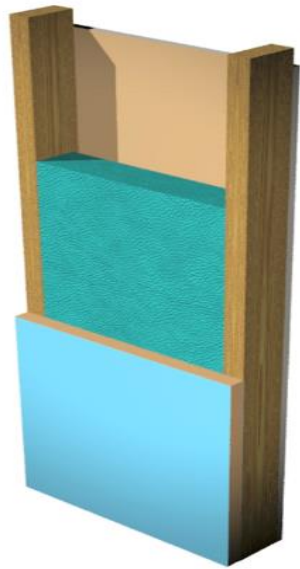


2X4 R5 CI & SPF

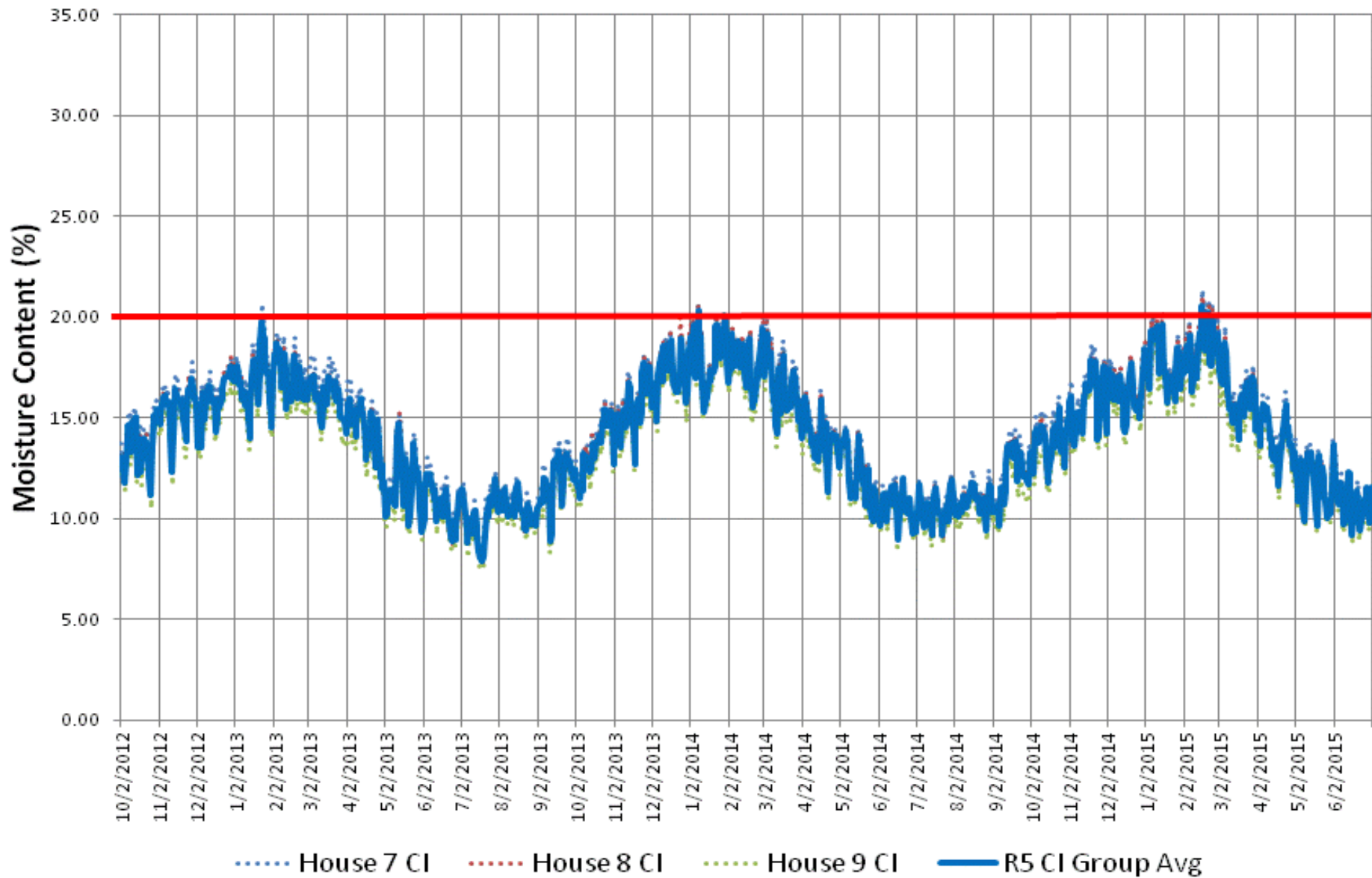


Moisture Content - Housewrap Houses Interior Sheathing Surface - Above Grade Cavity



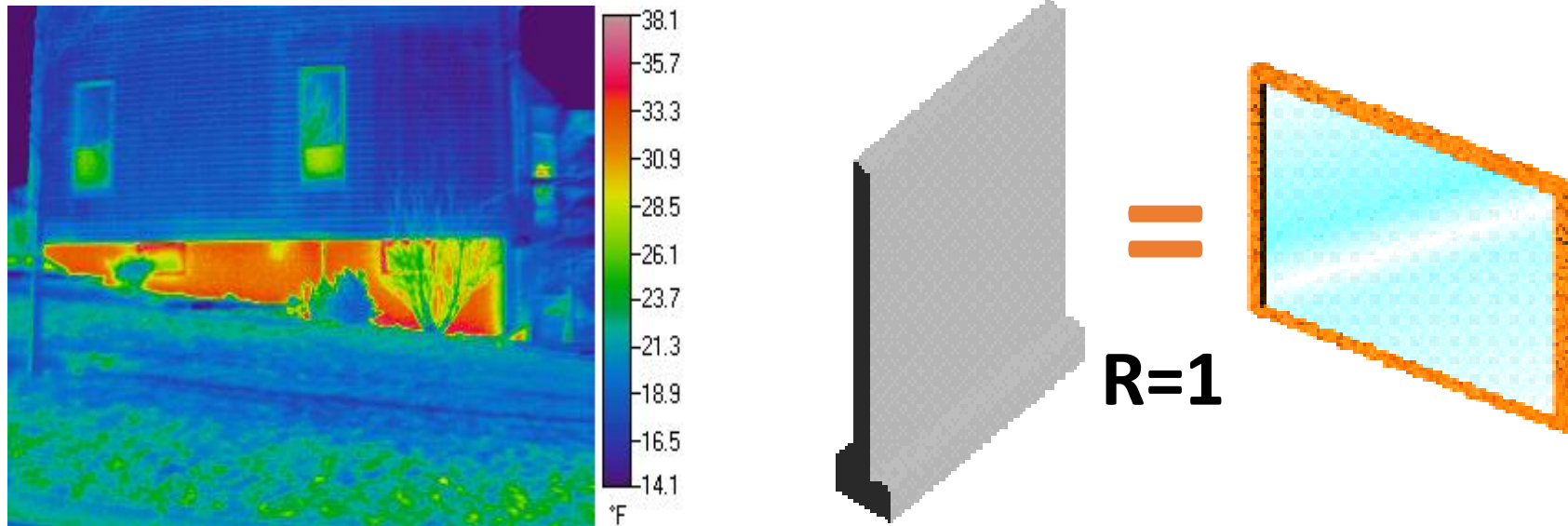


Moisture Content- R5 CI Houses Interior Sheathing Surface - Above Grade Cavity



Building Science for Thermal Management

Benefits of Basement Insulation



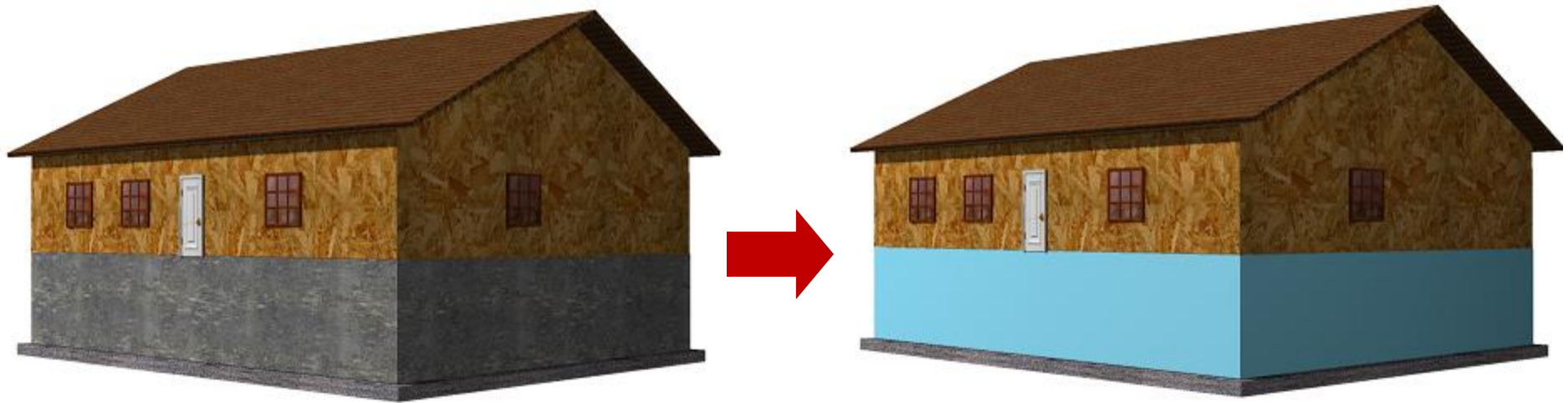
Most basements are made with concrete or concrete block with no insulation. Concrete is a poor insulator (similar to a single pane of glass!) and allows a great deal of energy to escape.

Building Science for Thermal Management

Benefits of Basement Insulation

What difference does basement insulation make?

- Basement insulation has a significant effect on reducing energy usage. This is reflected in the change in HERS rating when insulation is added to a basement wall.



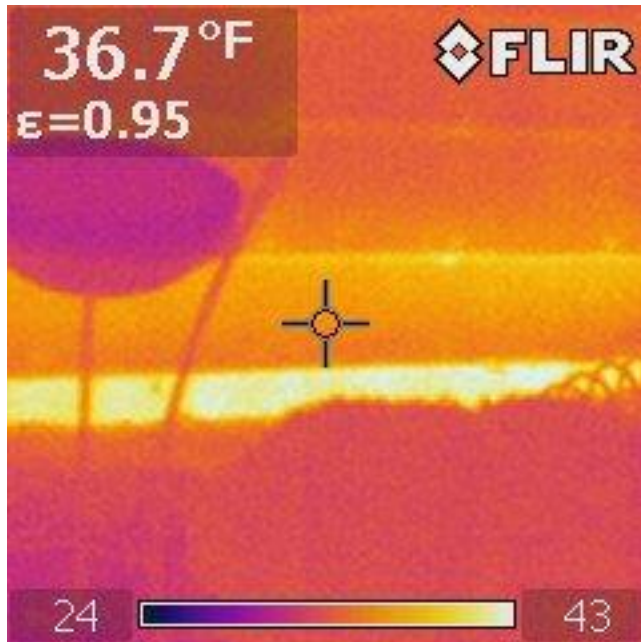
Results

Rating: 96 ➔ 88

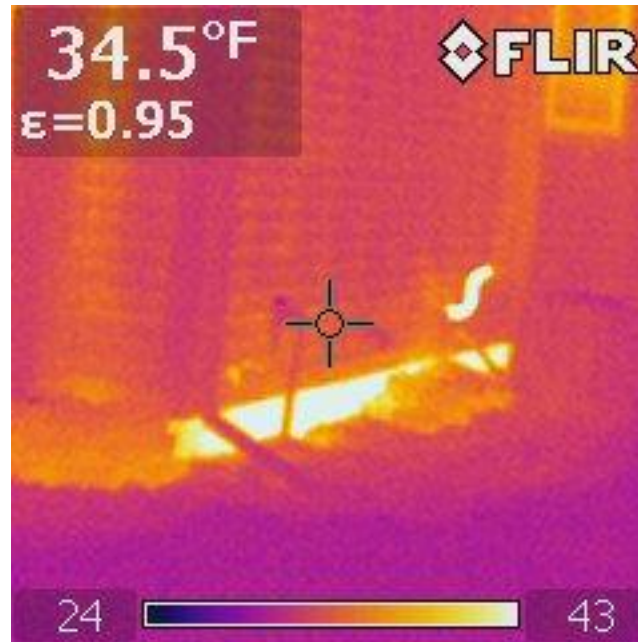
(+R-5 Foundation Insulation)

CI in Foundations: Why?

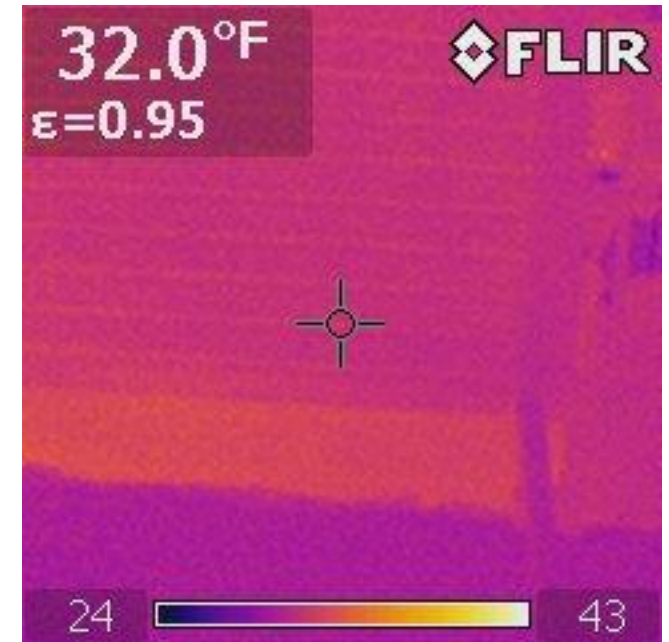
Foundations can be a significant source of heat loss



No Exterior

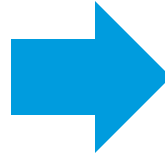
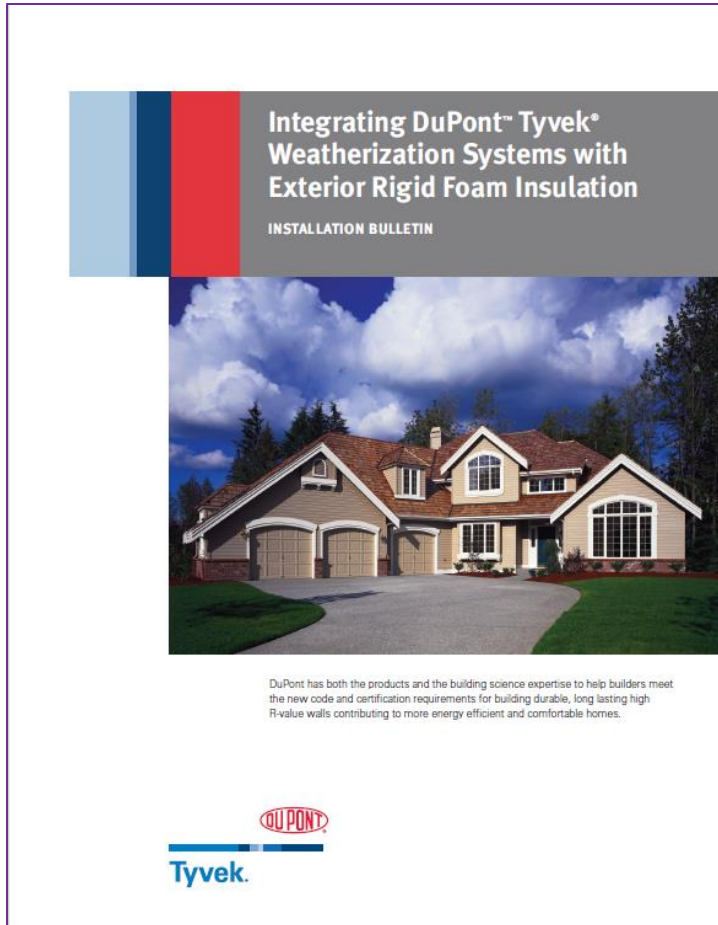


Batt Interior



XPS Exterior

The HOW:



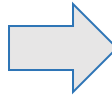
Integrating DuPont™ Tyvek® Weatherization Systems with DuPont Exterior Continuous Insulation

For Single-Family Homes and Wood-Framed Residential Multi-Family Buildings Less Than 6 Stories

DuPont has both the products and the building science expertise to help builders meet the new code and certification requirements for building durable, long lasting, high R-value walls contributing to more energy efficient and comfortable homes and multi-family buildings.

The purpose of this presentation is to provide guidance and information for integrating Water-Resistive and Air Barriers (WRB) and Self-Adhered Flashing Systems products with Exterior Continuous Insulation (CI) on Single Family Homes and Wood-Framed Residential Multi-Family Buildings Less than 6 Stories. This presentation contains information on the following:

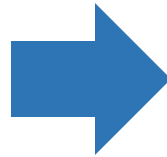
- **General Considerations**
- **Fastening Considerations**
- Interfaces/dissimilar materials
- Fire Warnings
- Material Compatibility
- Facade Considerations
- **Sealing Penetrations**
- **Installation Sequences and Window Flashing Considerations**



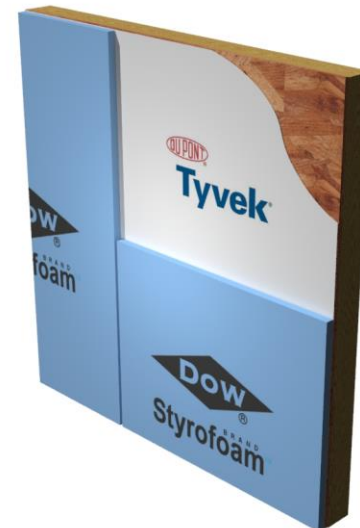
- **General Considerations**
- **Fastening Considerations**
- **Sealing Penetrations**
- **Installation Sequences and Window Flashing Considerations**

General Considerations

To ensure the best water management, the **WRB should be installed on the same plane as the window flanges for easier integration with the flashing**, which helps provide the most effective performance. **WRBs can be installed under or over Exterior Continuous Insulation. The WRB installation relative to the ci is based on whether the windows will be aligned with the exterior finished wall or recessed from it.** For remodeling projects where the existing windows will be retained, the alignment of the windows is already determined by the current placement. Depending on the window's position relative to the Exterior Continuous Insulation, **jamb extensions may be needed during window finishing**. If extensions are located on the exterior, an exterior grade material should be used. Extensions in the exterior sill should be sloped to the outside.



- **WRB should be installed on same plane as window**
- **WRB can be installed OVER or UNDER CI**
 - **Determined based on whether window aligned with exterior wall or recessed from it**
 - **Jamb extensions may be needed**



General Considerations Continued

Windows Aligned with Exterior Finished Wall

In this case the WRB can be installed either under or over the Exterior Continuous Insulation.

- UNDER-wood buck bump out needs to be installed-Flashing details for the bump out are required
- OVER- prepare the window and door openings before the Exterior Continuous Insulation and WRB



WRB over CI

Windows Recessed from Exterior Finished Wall

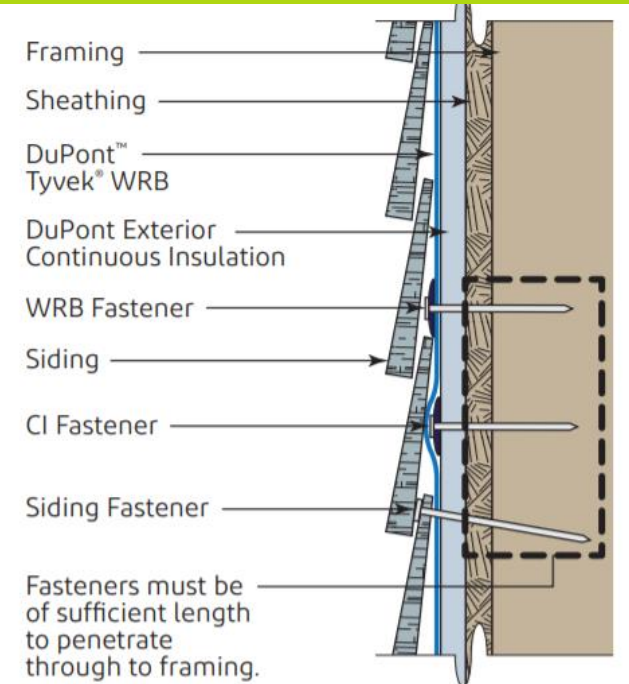
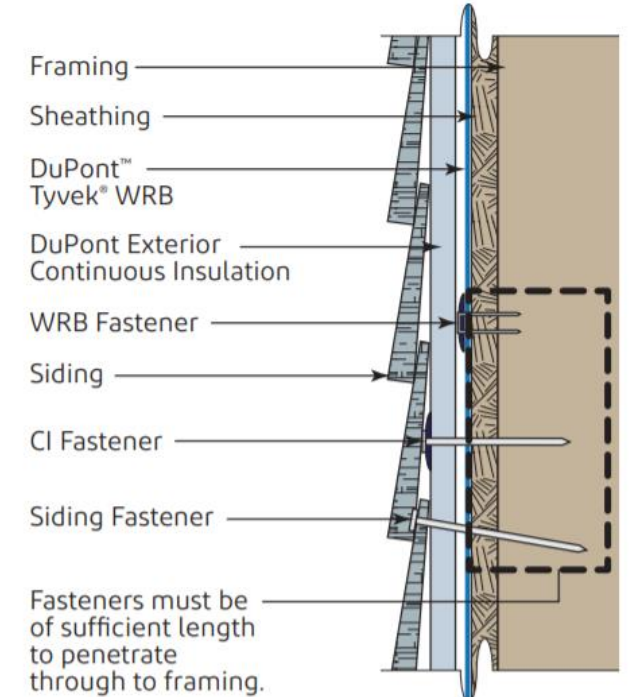
In this case the WRB should be installed UNDER the Exterior Continuous Insulation. A WRB with enhanced drainage is recommended for.

Windows should be flashed and integrated with the WRB. The window will be recessed from the finished wall and the surrounding Exterior Continuous Insulation must be protected.

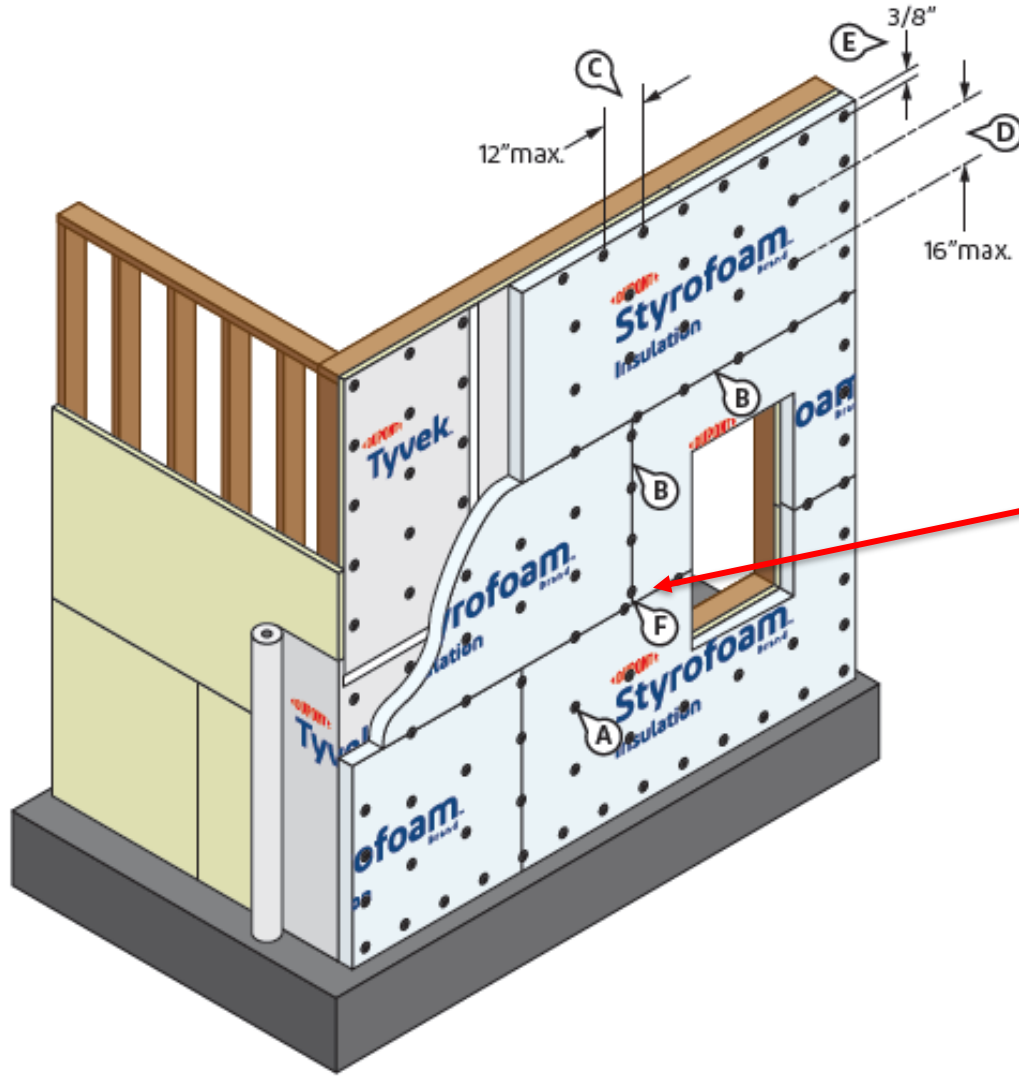
WRB Fastening Requirements

When installing WRBs UNDER Exterior Continuous Insulation, you can follow the WRB's guidelines of temporary fastening, if applicable. *Temporary Fastening* as specified in the Installation Guidelines can be utilized when the Exterior Continuous Insulation is installed over the WRB as soon as practically possible in order to maintain the integrity and performance of the WRB.

Rigid foam sheathing has little or no nail-holding power and should not be used as a nailing base for the WRB or cladding. **When the WRB is applied over the Exterior Continuous Insulation, the WRB should be fastened through the Exterior Continuous Insulation into the studs or underlying nail-base sheathing.** Nail lengths must account for the thickness of the applicable wall assembly components at the time of attachment to secure to the stud as shown in Figures 1 and 2 below. Fastener spacing should be followed per the applicable guidelines of the WRB of choice. Avoid over-driving nails, which can result in dimpling of the siding due to the compressible nature of the Exterior Continuous Insulation. Extra caution is necessary if power-driven nails are used for attachment.



Continuous Insulation Fastening Requirements:



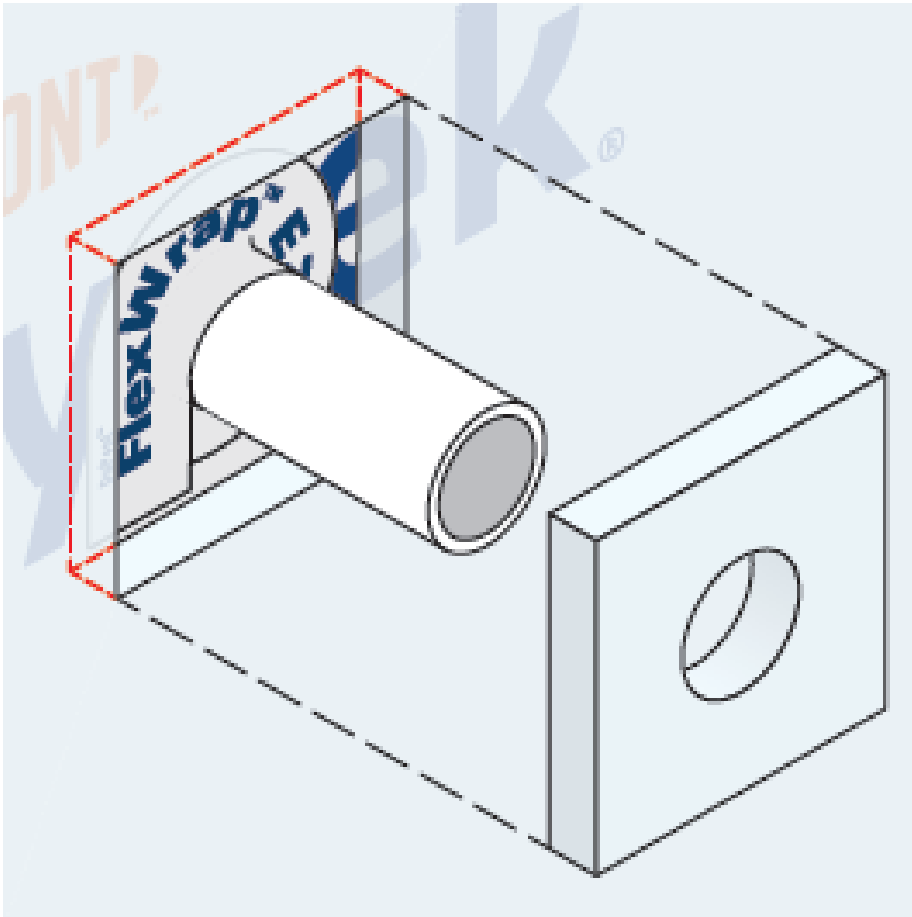
Insulation boards can be installed using **3/8" head galvanized nails, 1 inch crown galvanized staples, or 1 inch head plastic cap nails or equivalent fasteners long enough to penetrate framing a minimum of 3/4 inch.**

For fasteners with cap/washers greater than 1", one fastener can be used at the intersection of 2 boards, but use at least 2 fasteners at the intersection of 3 or more boards.

Fasten insulation boards maximum 12" on center at wall perimeters, and fasten insulation boards maximum 16" on center into framing around openings and along stud lines in field of the wall. Set back perimeter fasteners 3/8" from board edges and ends.

NOTE: The number of fasteners is based on building performance specifications, type of fastener used, wall installation sequencing, and local weather conditions expected during the wall construction process. The Exterior Continuous Insulation need only be fastened with the minimum number of fasteners to hold it in place until the permanent cladding fasteners are installed.

Sealing Penetrations



WRB UNDER CI

Mechanical, electrical, plumbing, and HVAC wall penetrations must be sealed to the WRB drainage plane. Follow the guidance of the WRB manufacturer for how they recommend adhering flashing to seal the penetrations to the WRB. The penetration details apply to installations where the WRB is installed either UNDER or OVER the CI.

Penetrations can often be made late in the construction process after the WRB and/or Exterior Continuous Insulation has been installed. There are different considerations depending whether the WRB is installed UNDER or OVER the Exterior Continuous Insulation.

- When the WRB is installed OVER the Exterior Continuous Insulation, the penetration can be sealed directly to the WRB since it is the outermost layer.

Advantages and Challenges when Choosing Installation Sequence of WRB and CI

	WRB UNDER CI	WRB OVER CI
Advantages	<ul style="list-style-type: none">• Fasteners for Tyvek® will follow standard installation• Depending on time foam is installed, Tyvek® may be installed according to temporary fastening.• Foam provides additional protection for the WRB.	<ul style="list-style-type: none">• Window WRB and flashing details follow standard installation practices (I-cut and standard integral flanged window flashing).• Much easier to address penetrations (late in process)• Drainage plane directly behind cladding.• Easier to observe installation details for the WRB.• Number of continuous insulation fasteners may be reduced when initially installed. Total number of penetrations through WRB will be less.
Challenges	<ul style="list-style-type: none">• All penetrations should be addressed prior to foam installation• Some installations require bump out flashing details (added complexity).	<ul style="list-style-type: none">• Longer WRB fasteners are required (must be hand/pneumatically nailed).

Installation Sequences and Window Flashing Considerations for Wall Systems with a DuPont™ Tyvek® WRB and DuPont Exterior Continuous Insulation (CI)

Windows Installed BEFORE DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 1
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 2

Windows Installed AFTER DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 3
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 4
Windows Aligned with the exterior wall	WRB UNDER CI	YES	SEE Section 5

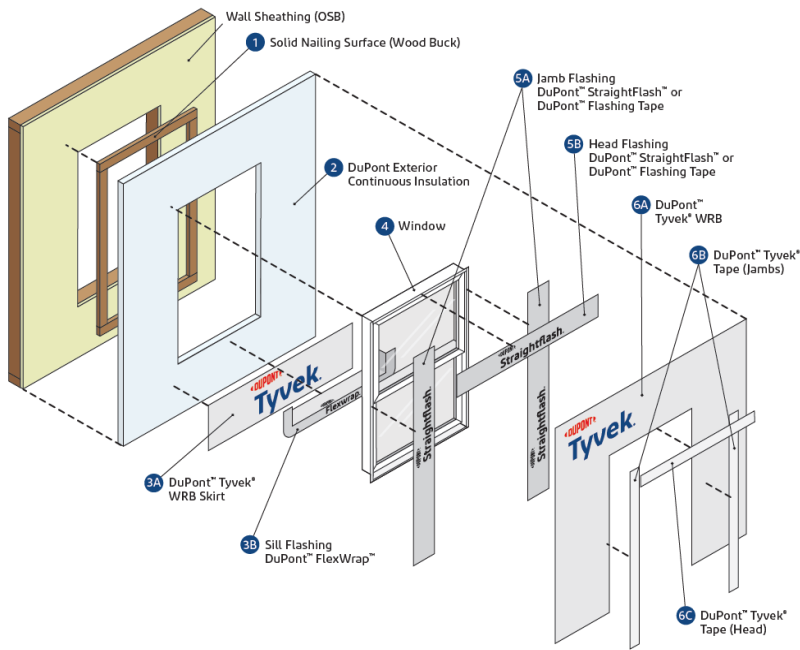
***NOTE:** When the WRB is installed OVER CI, and ci thickness does not exceed 1 ½”, wood buck bump out frames may not be required around the window rough opening depending on window manufacturer’s requirements. If the window manufacturer does not require a wood buck bump out frame, DuPont recommends cutting the DuPont Exterior Continuous Insulation flush with the window rough opening. When installing the window, ensure that fasteners account for the thickness of the ci and are sufficient length to penetrate the stud per window manufacturer’s requirements.



Section 1

Windows Installed BEFORE the WRB & Windows Aligned with Exterior Wall: WRB OVER CI

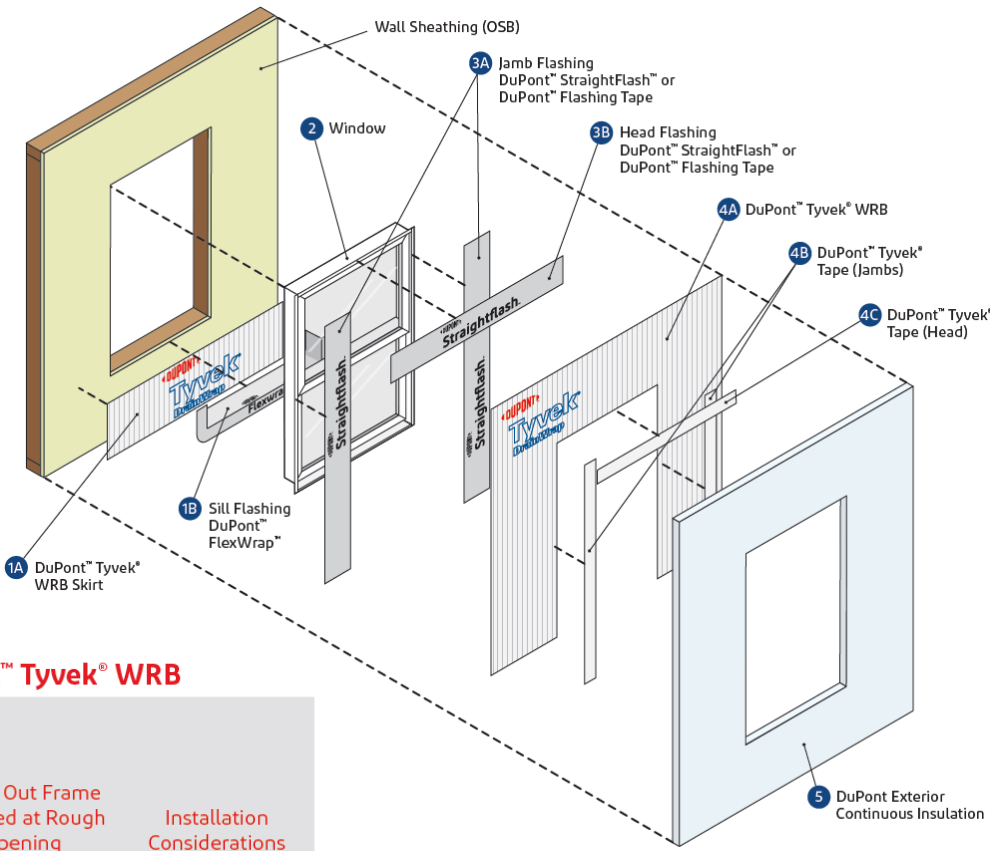
If the windows will be installed BEFORE the DuPont™ Tyvek® WRB and will be aligned with the exterior wall, then the WRB must be installed OVER the DuPont Exterior Continuous Insulation. Follow these steps:



Section 2

Windows Installed BEFORE the WRB & Windows Recessed from Exterior Wall: WRB UNDER CI

If the windows will be installed BEFORE the DuPont™ Tyvek® WRB and will be recessed from the exterior wall, then the WRB must be installed UNDER the DuPont Exterior Continuous Insulation. Follow these steps:



Windows Installed BEFORE DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 1
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 2

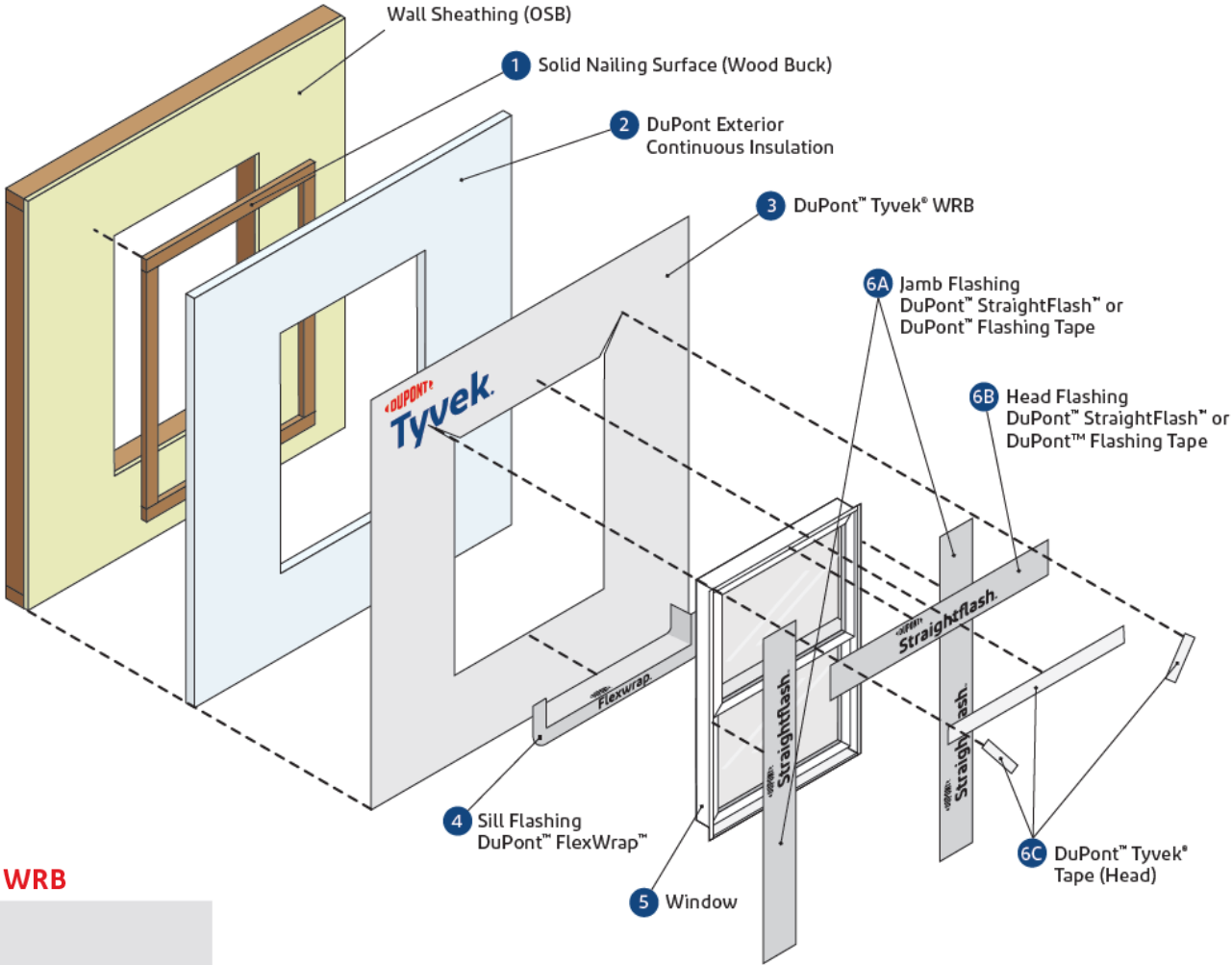


Section 3

Windows Installed AFTER the WRB & Windows Aligned with Exterior Wall: WRB OVER CI

If the windows will be installed AFTER the DuPont™ Tyvek® WRB and they will be aligned with the exterior wall, then the WRB must be installed OVER the DuPont Exterior Continuous Insulation. Follow these steps:

- 1. Prepare window opening - install solid nailing surface (wood buck).¹
- 2. Install DuPont Exterior Continuous Insulation.
- 3. Install DuPont™ Tyvek® WRB per current *DuPont™ Tyvek® Water-Resistive and Air Barriers Installation Guidelines*.
- 4. Protect window sill per current *DuPont Self-Adhered Flashing Installation Guidelines*.²
- 5. Install window per manufacturer’s guidelines.
- 6. Flash window per current *DuPont Self-Adhered Flashing Installation Guidelines*.³



Windows Installed AFTER DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 3
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 4
Windows Aligned with the exterior wall	WRB UNDER CI	YES	SEE Section 5

*NOTE: When the WRB is installed OVER CI, and ci thickness does not exceed 1½”, wood buck bump out frames may not be required around the window rough opening depending on window manufacturer’s requirements. If the window manufacturer does not require a wood buck bump out frame, DuPont recommends cutting the DuPont Exterior Continuous Insulation flush with the window rough opening. When installing the window, ensure that fasteners account for the thickness of the ci and are sufficient length to penetrate the stud per window manufacturer’s requirements.

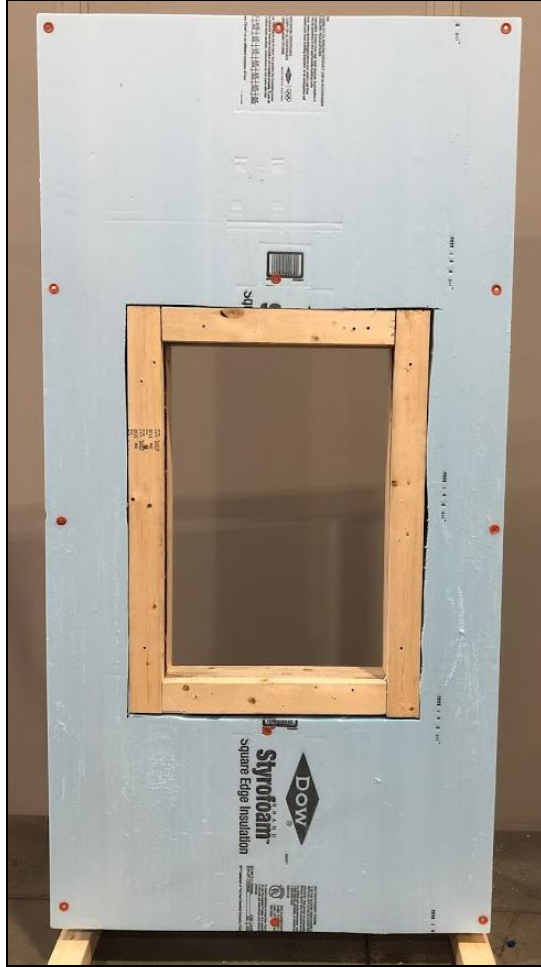


Section 3

Windows Installed AFTER the WRB & Windows Aligned with Exterior Wall: WRB OVER CI



1. Prepare window opening - install solid nailing surface (wood buck).



2. Install DuPont Exterior Continuous Insulation.



3. Install DuPont™ Tyvek® WRB.

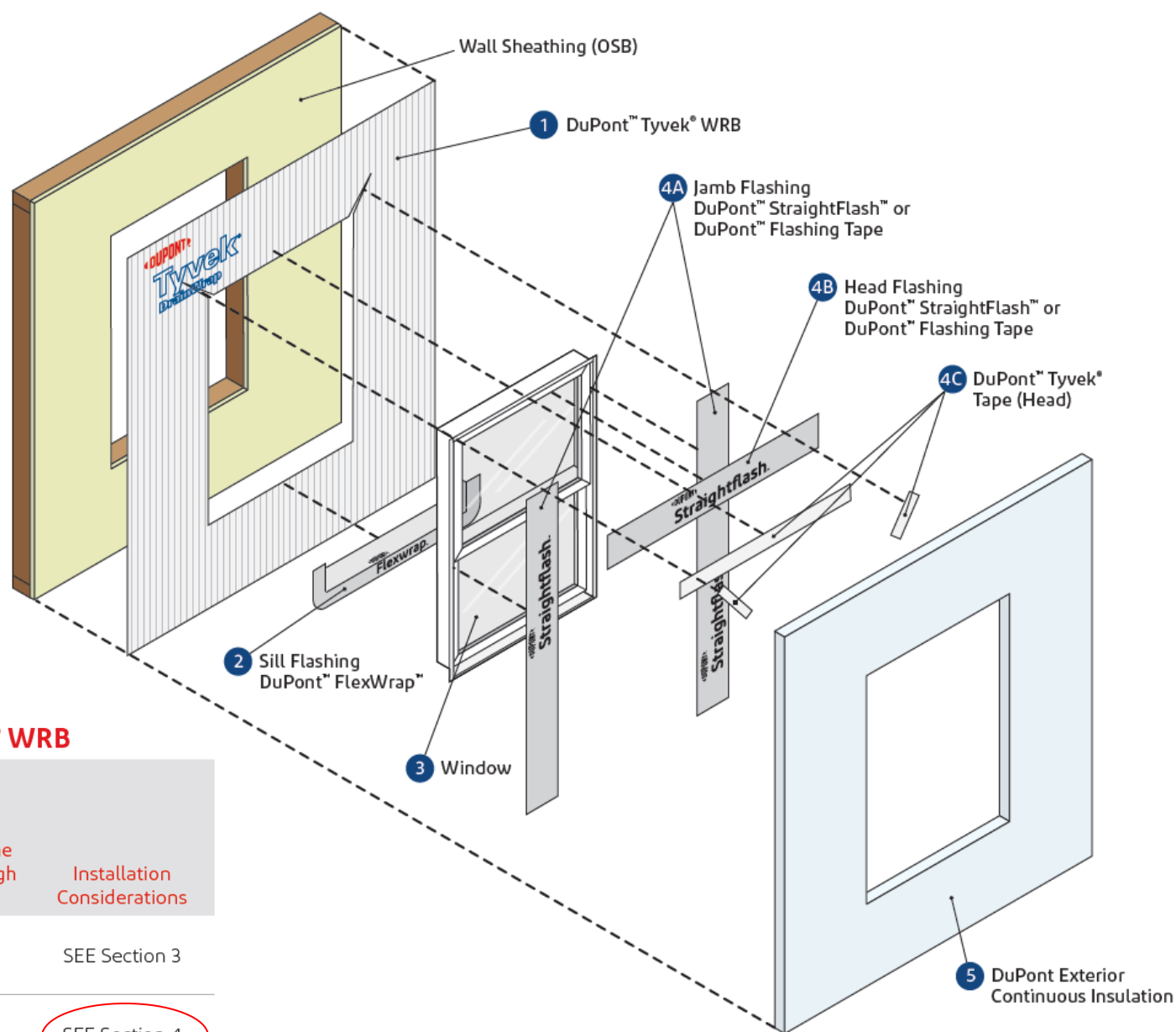


4. Install DuPont™ FlexWrap™.
5. Install window.
6. Flash window using DuPont Self-Adhered Flashing Products.



Windows Installed AFTER the WRB & Windows Recessed from Exterior Wall: WRB UNDER CI

1. Install DuPont™ Tyvek® WRB per current *DuPont™ Tyvek® Water-Resistive and Air Barriers Installation Guidelines*. DuPont™ Tyvek® DrainWrap™, DuPont™ Tyvek® StuccoWrap®, or DuPont™ Tyvek® CommercialWrap® D is recommended for enhanced drainage.
2. Protect window sill per current *DuPont Self-Adhered Flashing Installation Guidelines*.
3. Install window per manufacturer's guidelines.
4. Flash window per current *DuPont Self-Adhered Flashing Installation Guidelines*.¹
5. Install DuPont Exterior Continuous Insulation.



Windows Installed AFTER DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 3
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 4
Windows Aligned with the exterior wall	WRB UNDER CI	YES	SEE Section 5

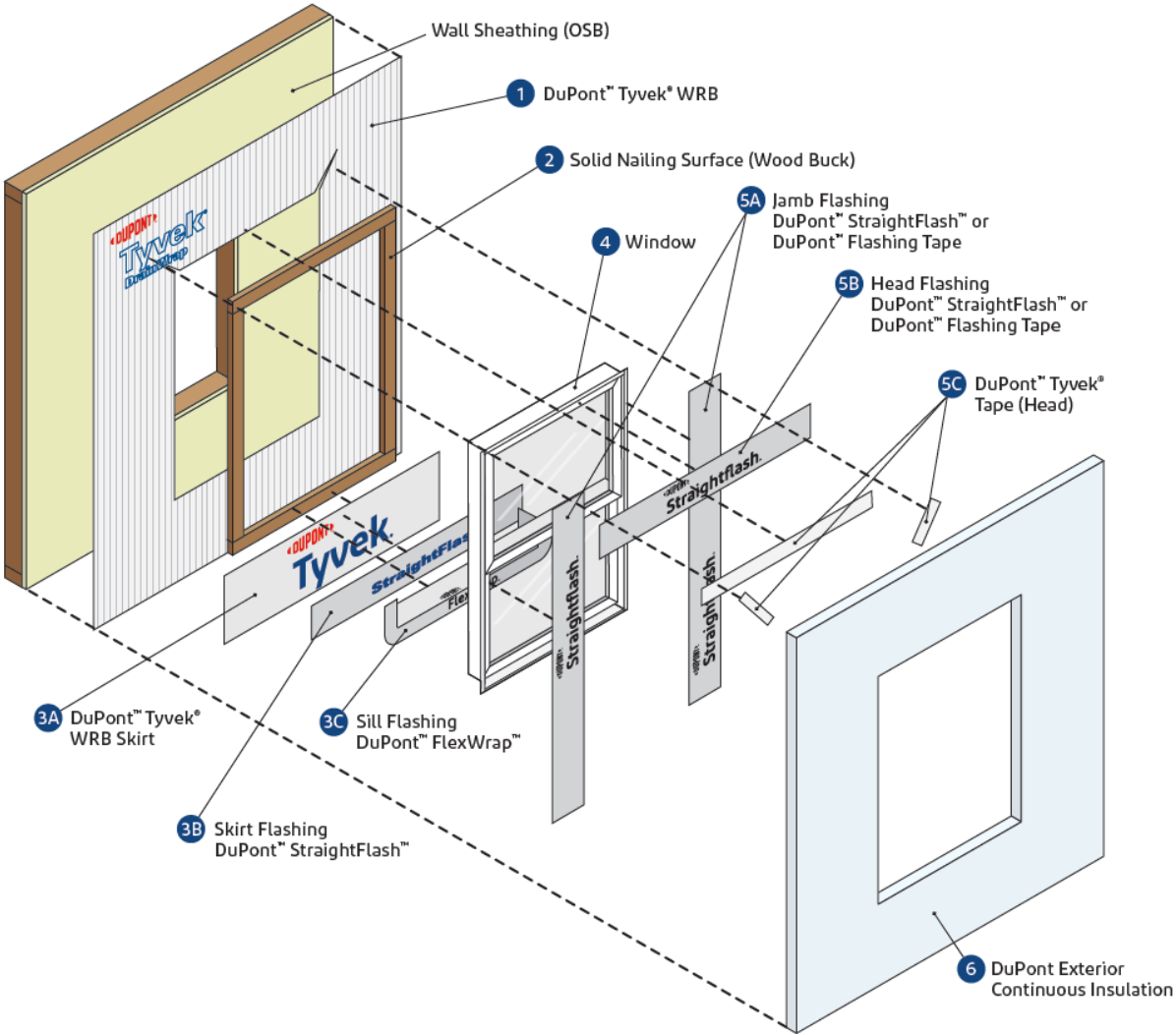
Windows Installed AFTER the WRB & Windows Aligned with Exterior Wall: WRB UNDER CI

If the windows will be installed AFTER the DuPont™ Tyvek® WRB and they will be aligned with the exterior wall, a wood buck bump out must be installed and the WRB is installed UNDER the DuPont Exterior Continuous Insulation. Follow these steps:

- 1. Install DuPont™ Tyvek® WRB per current *DuPont™ Tyvek® Water-Resistive and Air Barriers Installation Guidelines*. DuPont™ Tyvek® DrainWrap™, DuPont™ Tyvek® StuccoWrap®, or DuPont™ Tyvek® CommercialWrap® D is recommended for enhanced drainage.
- 2. Install wood buck bump out frame around window rough opening.
- 3. Protect bottom of wood bump out frame and window sill per current *DuPont Self-Adhered Flashing Installation Guidelines*.¹ NOTE: There are several methods for flashing a wood buck bump out. Refer to the applicable Installation Guidelines for more information.
- 4. Install window per manufacturer’s guidelines.
- 5. Flash window per current *DuPont Self-Adhered Flashing Installation Guidelines with a Wood Buck Bump Out*.
- 6. Install DuPont Exterior Continuous Insulation.

Windows Installed AFTER DuPont™ Tyvek® WRB

Placement of Window Relative to Finished Wall	Placement of Tyvek® WRB (WRB) vs. DuPont Exterior Continuous Insulation (CI)	Bump Out Frame Installed at Rough Opening	Installation Considerations
Windows Aligned with the exterior wall	WRB OVER CI	YES*	SEE Section 3
Windows Recessed from the exterior wall	WRB UNDER CI	NO	SEE Section 4
Windows Aligned with the exterior wall	WRB UNDER CI	YES	SEE Section 5



Section 5

Windows Installed AFTER the WRB & Windows Aligned with Exterior Wall: WRB UNDER CI



1. Install DuPont™ Tyvek® WRB.
2. Install bump out frame.



3. Protect bump out sill and window sill per current installation methods.



4. Install window.
5. Flash window using DuPont Self-Adhered Flashing Products.



6. Install DuPont Exterior Continuous Insulation.



Questions?



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