BUILDING SCIENCE
Building Code Compliance – Building Science

• Building Science
  – Water-Resistive Barriers (WRB)
  – Air Barriers (AB)
  – Vapor Retarders (VR)
  – Moisture Control
Water Resistive Barrier (WRB)

• Only applies to approved products
• Installation requires use of approved flashing tapes
• Quality installations are durable
  – Rigorous code acceptance testing
  – Field studies confirm (after 15 years of service)
  – More wind resistant than membrane/wrap
WRB Installation
(NIST Net-Zero Energy House / BSC / ARES)
Water Resistive Barrier

- Rain water is the main concern with moisture for all types of walls (with or without CI)
- WRB equivalence of taped FPIS
  - Confirmed by code compliance research report as defined by the IBC Sections 104.11.1 Research reports and 1703.4.2 Research reports.
  - ABTG RR XXXX (not yet online)
  - TER No. 1410-05 (not yet online)
- Foam sheathing products + flashing tapes = WRB
Water Resistive Barrier

• Meets energy code and WRB requirements (  
  – Designer/Builder must consider cost of WRB and insulation strategy

  \[ \text{R703.2 Water-resistive barrier. One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls.} \]

  – IRC R703.2

• WRB required on essentially all exterior walls (regardless of cladding type)

• Code requires #15 asphalt felt or equal
Water Resistive Barrier

- WRB equivalence is usually confirmed by a code evaluation service such as ICC-ES, IAPMO, ATI, or DrJ Engineering
- Several foam sheathing products + flashing tapes = WRB
- Meets energy code and WRB requirements in one package
  - Designer/Builder must consider combined cost of WRB and insulation strategy when comparing options
WRB Performance Testing Comparison

<table>
<thead>
<tr>
<th></th>
<th>15# Felt</th>
<th>Housewraps</th>
<th>FPIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathering</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>AATCC 127</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Taped Joints</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Full Assembly Water Penetration</td>
<td></td>
<td>X</td>
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</tbody>
</table>

Foam sheathing is tested to a full assembly water penetration test. Other common products such as wraps and 15# felt are not. Taped joints and foam sheathing are also subjected to accelerated weathering and then water resistance.
Foam sheathing was not the cause of EIFS moisture problems!

- “Doesn’t foam sheathing trap water or cause condensation in walls with vapor retarder on the outside of a wall?”
  - There remain many attempts to make a comparison with non-drainable (barrier) EIFS purely on the basis that EIFS contains foam sheathing.
Past EIFS problems are misapplied to Continuous Insulation

- Problems with EIFS were associated with:
  - No drainage of cladding (barrier cladding system)
  - No water resistive barrier layer (relied solely on face sealing or caulking of EIFS finish to windows, doors, etc.)
  - Face sealing (caulking) was typically not done or done incorrectly
  - Leaky window units were used
  - Roof/wall flashing was not installed or improperly installed
  - Sometimes used inappropriately with interior vapor barrier (poly) in mix/warm/humid climates

THESE PAST PROBLEMS WITH EIFS HAVE ALL BEEN ADDRESSED IN MODERN BUILDING CODES
WRB Addresses the “H₂O Fear”

• Fearing water is a good thing – if it leads us to follow the code and WRB manufacturer’s installation instructions carefully.

• A properly installed WRB system using an approved material is critical to building durability.

• FPIS is a solution:
  – Many FPIS brands are part of approved WRB systems (TER No. 1410-05)
  – If the FPIS is not approved as a WRB and installed accordingly, then a separate WRB material layer is needed.
Foam sheathing creates a warm, breathable envelope assembly

- In cold climates, CI prevents condensation inside walls by keeping the wall warmer than dew point temperature
- Non-insulated sheathings result in colder walls with greater condensation potential (particularly for low-perm non-insulated sheathings)
- Foam sheathing walls can be designed to breathe (dry) to the interior with proper interior vapor retarder selection to provide a safety factor against uncertain or incidental sources of water intrusion.
Proper Use of VR with Foam Suppresses Condensation & Promotes Drying

• 2015 IRC/IBC have vapor retarder options for use with CI depending on climate and R-value
  – In hot/humid regions (Zones 1 and 2) it is better to have low perm on exterior side of wall with drying to the interior

**R601.3.1 Class III vapor retarders.** Class III vapor retarders shall be permitted where any one of the conditions in Table R601.3.1 is met.
**“Warm Wall” Class III VR Requirements and Foam Sheathing R-value**

<table>
<thead>
<tr>
<th>CLIMATE-ZONE</th>
<th>CLASS III VAPOR RETARDERS PERMITTED FOR: <em>a</em></th>
</tr>
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<tbody>
<tr>
<td>Marine 4</td>
<td>Vented cladding over wood structural panels.</td>
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<tr>
<td></td>
<td>Vented cladding over fiberboard.</td>
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<tr>
<td></td>
<td>Vented cladding over gypsum.</td>
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<td></td>
<td>Insulated sheathing with $R$-value $\geq 2.5$ over $2 \times 4$ wall.</td>
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<tr>
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<td>Insulated sheathing with $R$-value $\geq 3.75$ over $2 \times 6$ wall.</td>
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<tr>
<td>5</td>
<td>Vented cladding over wood structural panels.</td>
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<tr>
<td></td>
<td>Vented cladding over fiberboard.</td>
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<tr>
<td></td>
<td>Vented cladding over gypsum.</td>
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<tr>
<td></td>
<td>Insulated sheathing with $R$-value $\geq 5$ over $2 \times 4$ wall.</td>
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<tr>
<td></td>
<td>Insulated sheathing with $R$-value $\geq 7.5$ over $2 \times 6$ wall.</td>
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<tr>
<td>6</td>
<td>Vented cladding over fiberboard.</td>
</tr>
<tr>
<td></td>
<td>Vented cladding over gypsum.</td>
</tr>
<tr>
<td></td>
<td>Insulated sheathing with $R$-value $\geq 7.5$ over $2 \times 4$ wall.</td>
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<tr>
<td></td>
<td>Insulated sheathing with $R$-value $\geq 11.25$ over $2 \times 6$ wall.</td>
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<tr>
<td>7 and 8</td>
<td>Insulated sheathing with $R$-value $\geq 10$ over $2 \times 4$ wall.</td>
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<tr>
<td></td>
<td>Insulated sheathing with $R$-value $\geq 15$ over $2 \times 6$ wall.</td>
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</table>

For SI: 1 pound per cubic foot = 16 kg/m³.

*a.* Spray foam with a minimum density of 2 lb/ft³ applied to the interior cavity side of wood structural panels, fiberboard, insulating sheathing or gypsum is deemed to meet the insulating sheathing requirement where the spray foam $R$-value meets or exceeds the specified insulating sheathing $R$-value.

[Link to code](#)
Air Barriers

- **Air Barrier (AB)**
  - Requirements for air barriers are addressed in the energy code, not the building code (see Module 8).
  - Most foam sheathing products with properly sealed joints meet air-barrier requirements (air permeability test)
    - Check with manufacturer
  - Air barriers are also important to the building code’s interest in durability and moisture control because they help prevent moist air from leaking into and condensing in assemblies.