Insulating with Exterior Rigid Foam

Presented by: Chris Hine

PHRC Webinar Series
Tuesday, October 14, 2014 1:00 pm

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This webinar will focus on the benefits and obstacles of an exterior wall assembly constructed with rigid foam. Rigid foam can currently be used as an option in the prescriptive insulation design path for the 2009 IECC and 2009 IRC Chapter 11. The installation of rigid foam to the exterior of the wall has added benefits such as the increase of overall wall assembly R-values, the reduction of thermal bridging and can be an added barrier for air infiltration. Along with the benefits come added obstacles. Some of these obstacles include the overall thickness of the wall assembly when used in conjunction with wood structural panels. This added thickness can deviate from industry standard extension jambs for doors and windows. The added insulation also directly affects the dew point within the wall assembly. We will take a brief look into what happens to the dew point in standard wall assemblies when rigid foam is added. With the information included in this webinar, the decision to add rigid foam to the exterior of a residential home will be both educated and informed.
Learning Objectives
At the end of the this course, participants will be able to:

1. Understand the energy efficiency requirements for meeting the optional prescriptive path to the 2009 IECC and 2009 IRC Chapter 11 for insulating with exterior rigid foam.

2. Understand code regulations and different application methods for installing rigid foam. This will include adding foam over wood structural panels (WSP), adding foam under WSP and adding standalone foam sheathing with the introduction of proprietary and nonproprietary tie-in-bracing to achieve wall bracing requirements.

3. Identify the areas of concerns for increasing the overall thickness of the wall assembly and looking at solutions to those concerns. An example of this would include taking a look at the building design and reviewing the methods and details of exterior wall assemblies used to effectively install doors and windows with standard 4 9/16” and 6 9/16” extension jambs.

4. Understand how the added insulation changes the dynamic of the “building science” within the wall assembly. This includes the movement of the dew point based on R-values and cavity insulation and associated potential risks of having the dew point located within the wall cavity.

Poll #1 – Who’s who?

Agenda
• Rigid Foam Sheathing
• Exterior Foam and Energy Efficiency
• Wall Bracing with Foam
• Foam and Water-Resistive Barriers
• Critical Framing Details
• Mitigating Moisture Risks
• Wrap-up & Questions
Rigid Foam Sheathing

Three types of foam

• Expanded Polystyrene (EPS)
  – Insulfoam
  – R-Tech
  – Benchmark Foam
• Extruded Polystyrene (XPS)
  – STYROFOAM
  – FOAMULAR
  – GreenGuard
• Polyisocyanurate (ISO)
  – Thermax
  – Tuff-R
  – RMax

Expanded Polystyrene (EPS)

• Common uses
  – Insulated concrete forms
  – SIPs
• Typical thermal resistance: R-4 per inch
• Vapor permeability: 5 perms (Class III vapor retarder)
• Durability
  – Avoid prolonged exposure to UV
  – Requires care when cutting and handling (fragile edges)
Extruded Polystyrene (XPS)

- **Common uses**
  - Sheathing
  - Under-slab insulation
- **Typical thermal resistance**: R-5 per inch
- **Vapor permeability**: 1.1 perms (Class III vapor retarder)
- **Durability**
  - Avoid prolonged exposure to UV
  - Matrix is stronger than EPS beads. More forgiving on the jobsite.

Polyisocyanurate (ISO)

- **Common uses**
  - Sheathing
- **Typical thermal resistance**: R-6.5 per inch
- **Vapor permeability**:
  - < 1.0 perms with fiberglass facing (Class II vapor retarder)
  - 0.03 perms with foil facing (Class I vapor retarder)
- **Durability**
  - Facing can be more resistant to UV
  - Matrix is stronger than EPS beads. More forgiving on the jobsite.

Exterior Foam and Energy Efficiency
The Energy Code

- **2009 International Energy Conservation Code**
  - Chapter 4

- **2009 International Residential Code**
  - Chapter 11

The Energy Code

- Three prescriptive options for wall insulation based on the 2009 ICC Codes (Climate zone 5 & 6)
  - Cavity insulation only (R-20)
  - Cavity plus continuous (R-13 + R-5)
  - h. R-13 cavity insulation plus R-5 insulated sheathing
  - Equivalent U-factor (U-.060)

### R-value of total wall assembly

<table>
<thead>
<tr>
<th>Component</th>
<th>Cavity R-value</th>
<th>Frame R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air film</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>Lap siding</td>
<td>0.62</td>
<td>0.62</td>
</tr>
<tr>
<td>7/16” OSB</td>
<td>0.62</td>
<td>0.62</td>
</tr>
<tr>
<td>Batt insulation</td>
<td>2.1</td>
<td>-</td>
</tr>
<tr>
<td>Stud</td>
<td>-</td>
<td>0.08</td>
</tr>
<tr>
<td>Interior air film</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Gypsum board</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Total R-values</td>
<td>21.14</td>
<td>9.62</td>
</tr>
<tr>
<td>Total U-factor (U-R-value)</td>
<td>0.0425</td>
<td>0.1062</td>
</tr>
</tbody>
</table>

R-value of total wall assembly

<table>
<thead>
<tr>
<th>Component</th>
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<th>Frame R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air film</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>Lap siding</td>
<td>0.67</td>
<td>0.67</td>
</tr>
<tr>
<td>7/16&quot; OSB</td>
<td>0.62</td>
<td>0.62</td>
</tr>
<tr>
<td>Batt Insulation</td>
<td>1.15</td>
<td>--</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Stud</td>
<td>4.38</td>
<td>4.38</td>
</tr>
<tr>
<td>Inside air film</td>
<td>0.68</td>
<td>0.68</td>
</tr>
<tr>
<td>Total R-value</td>
<td>20.54</td>
<td>11.92</td>
</tr>
<tr>
<td>Total U-factor</td>
<td>0.0487</td>
<td>0.0839</td>
</tr>
</tbody>
</table>

U overall = (0.0487 x 0.75) + (0.0839 x 0.25) + 0.0575 = 0.0575

Roverall = 1/0.0575 = 17.4


Why?

• Total R-value for a 2x6 wall = R-17.1
• Total R-value for a 2x4 wall with exterior foam = R-17.4

Principle of Thermal Bridging

• Thermal Conductivity @ ~ 70° F
  – Wood (pine) = 0.14 (W/mK)
  – Fiberglass insulation = 0.04 (W/mK)
  – Air = 0.023 (W/mK)

• Therefore, wood has more than three times the thermal conductivity of fiberglass insulation
Thermal Bridging

On average, up to 25% of a typical wall is wood (studs, plates & headers)
Poll #2 – Head Count

Certificate Password:
Foam1014
(Note – password is case sensitive)

Wall Bracing with Foam

Options for Bracing with Foam

• Let in Bracing – LIB
• Hybrid – Wood Structural Panel and Foam
• Wood Structural Panels
• Proprietary Systems
Let in Bracing

- Let in bracing - 2006 IRC
  - R602.10.3 Braced wall panel construction methods.
    - Method
      1. Nominal 1-inch-by-4-inch continuous diagonal braces let in to the top and bottom plates and the intervening studs or approved metal strap devices installed in accordance with the manufacturer’s specifications. The let-in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.

Where can LIB be used?

- Method #1 – Let in bracing (LIB)

<table>
<thead>
<tr>
<th>SACRIFICIAL CATEGORIES OR WOOD TYPES</th>
<th>CONDITION</th>
<th>TYPE OF BRACING</th>
<th>AMOUNT OF BRACING **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A and B1, B2, B3, B4, and C1, C2, C3, or D1 or D2 in No.</td>
<td>One story</td>
<td>Top of structure</td>
<td>Method 1.2, 3, 4, 5, 6, 7a, 7b. Laid in accordance with Section R602.10 and at a minimum of 23 feet on center on bottom 6 inches shall be laid in accordance with Method 1.2, 3, 4, 5, 6, 7a, 7b.</td>
</tr>
<tr>
<td>Multi-story wood frame buildings with elevators only</td>
<td>Ground story</td>
<td>Other story</td>
<td>Method 1.2, 3, 4, 5, 6, 7a. Laid in accordance with Section R602.10 and at a minimum of 23 feet on center on bottom of story.</td>
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</tr>
</tbody>
</table>

What qualifies as LIB?

- Let in bracing - 2006 IRC
  - R602.10.3 Braced wall panel construction methods.
    - Method
      1. Nominal 1-inch-by-4-inch continuous diagonal braces let in to the top and bottom plates and the intervening studs or approved metal strap devices installed in accordance with the manufacturer’s specifications. The let-in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.
1x4 LIB

• 1x4 Let in bracing - 2006 IRC

What else qualifies?

• Approved metal strap - 2006 IRC
  – R602.10.3 Braced wall panel construction methods.
    1. Nominal 1-inch-by-4-inch continuous diagonal braces let in to the top and bottom plates and the intervening studs or approved metal strap devices installed in accordance with the manufacturer’s specifications. The let-in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.

Metal strap Bracing (Simpson)
Metal strap Bracing (Simpson)

- Simpson WB & WBC installation application
  - Must be installed in either a “V” or “X” pattern

Metal strap Bracing (Simpson)

- Metal strap Bracing (Simpson)
  - RCWB installation application
    - Maximum 1 1/8” deep saw kerf in stud

Images courtesy of www.strongtie.com
Metal strap Bracing (Simpson)

Metal strap Bracing (USP)

Foam with structural sheathing

• 2009 IRC

Images courtesy of www.strongtie.com

Images courtesy of www.uspconnectors.com
Foam with structural sheathing

- IECC Table 402.1.1 – Footnote h
  - R-13+5 means R-13 cavity insulation plus R-5 insulated sheathing
  - If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used
  - If structural sheathing covers more than 25% of the exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2

Proprietary systems

Huber Zip R-Sheathing
- R-3.6 @ 1”
- R-6.6 @ 1.5”

BOTH:
- Structural sheathing
- Water resistive barrier
Installation:
- Use compatible tape
- Follow MII for nailing

Foam and Water-Resistive Barriers
**Water-Resistive Barrier Strategy 1**
- **WSP + WRB + Foam**
  - Improved durability
    - WRB is supported by WSP
    - WRB is protected by foam
  - Recommended for areas with:
    - High exposure
    - High rainfall
  - Best for “innie” windows

**Water-Resistive Barrier Strategy 2**
- **WSP + Foam + WRB**
  - Best for “outie” windows
  - More exposure to the elements
  - Longer fasteners required for housewrap

**Water-Resistive Barrier Strategy 3**
- **WRB under foam**
  - No structural sheathing
  - Housewrap stretched across stud
  - WRB is protected by foam
  - Care must be taken when installing WRB
  - Best for “innie” windows
Water-Resistive Barrier Strategy 4

- WRB over foam
  - No structural sheathing
  - More exposure to the elements
  - Best for “outie” windows

Water-Resistive Barrier Strategy 5

- Foam as WRB
  - Check ES Report
  - All seams must be taped
  - Flashing details at openings are critical

Critical Framing Details
**Inset Window Exterior Jamb Details**

**Window installation (innie)**

- Example of an “innie” window installation. The window is set to the inside standard location.
“Innie” window sill detail

“Innie” window head detail

Outset Window Exterior/Interior Jamb Details

Images courtesy of Greenbuildingadvisor.com
Window installation (outie)

- Example of an “outie” window installation. The window is set to the outside standard location.

“Outie” window sill detail

“Outie” window head detail
How to install siding over foam?

- Foam is not a substrate for nail holding and therefore does not have nail withdrawal capacity.
  - Extend the fastener length by the thickness of the continuous insulation being used.

Mitigating Moisture Risks

What happens to the temperature inside a wall assembly? (OSB sheathing)

Note that with insulation the temperature in the stud bay falls below freezing.

We should be concerned with condensation and in some cases freezing.
What happens to the temperature inside a wall assembly? (foam sheathing)

Inside Condition 70°F

Outside Condition 10°F

Wrap-up

- Identify the type of foam to be used
- Attach foam to framing per manufacturer's instructions
- Consider wall bracing options at the design phase
- Proper flashing at openings

Questions & Evaluations

Link for certificate:
http://www.cvent.com/d/q4qtpb/4W

Next webinar:
Tuesday, November 11 at 1:00pm
The Appraisal Process