High Performance Enclosure Strategies: Part I, Existing Home

Deep Energy Retrofits

Anastasia Herk
IBACOS
Project Partners

Manufacturers, Contractors, NYSERDA, Engineers

Bayer MaterialScience

SIMPSON Strong-Tie

Dow

Carrier

JM

IBACOS
Goals of Research Project:

• Evaluate cost and performance trade offs between:
  – Spray-foam exterior walls
  – Rigid foam exterior walls
  – Home Performance with Energy Star Home (HPwES) on steroids

• 50% peak load and annual heating load reduction

• R-30 Target for Center of Wall

• .25 CFM50 per SSF (Shell Square Foot)

• $10/SSF insulation strategies

• 20% minimum cost contribution from homeowners
Assumptions about the Homeowner:

- Homeowner has an older house so they were already going to re-side and possibly install new windows
- This could lead to other energy upgrade opportunities:
  - HVAC
  - Air sealing
  - Upgraded Windows
  - Insulation
  - Water heating
Why do this?

- Why cover existing siding?
  - Minimize need for disturbing existing construction that includes lead paint (Spray foam encapsulates it)
  - Allows for re-skinning building without having to remove existing siding

- Why use spray foam?
  - Spray foam is an integral insulation, air sealing and draining plane material in one application
  - No taping and flashing like you would with rigid
Brainstorming Ideas: Bottom of Wall
First House Construction Detail: Bottom of Wall

- **Existing Wall Structure**
- **2x4 Stud Framing**
- **2 1/2 SPF Insulation Directly to Existing Structure**
- **2x6 Ledger Board**
- **Thermoply Sheathing**
- **Vinyl Siding Installed over T-Ply**
- **J-Chanel Terminates Vinyl Siding**

**Process of Installation**
1. Place Ledger Boards
2. Install Vertical 2x4 Member
3. Spray Foam
4. Install Thermoply to Close Wall Cavity
5. Install Vinyl Siding

**Gray tone indicates existing structure**
Initial concept
Initial concept
Sketchup Ideas

FOAM SPRAYED BETWEEN STUDS

NEW WINDOW INSTALLED

EXISTING SIDING

2X4 STUDS ON EDGE

SPRAY FOAM IN CAVITY BETWEEN STUDS

NEW SIDING INSTALLED OVER SYSTEM

2X6 LEDGER BOARD

XPS INSTALLED ON INTERIOR OF FOUNDATION
Mockups: Door/ Electrical/ 1st-2nd Floor

- 2-Story
- Rim/band Joist Detail
- Rim/band Joist Attachment
- Door Frame Detail
- Electrical Detail
Mockups: Window Details/ Top of Wall

- New Wall to Roof Detail
- Window Installation Detail
- Top of New Wall Detail
- Exterior Corner Detail
- Electrical Detail
Mockups: Window Details/ Top of Wall
Test House: Existing Condition
New wall framing
Installation of Spray Foam
New Wall Intersection at Roof
New Wall with Full Insulation
Installation of Thin Profile Structural Sheathing and New Siding
## Air Sealing Improvements

<table>
<thead>
<tr>
<th>Improvement Stage</th>
<th>CFM50</th>
<th>CFM50 Reduction from Start</th>
<th>% Reduction from Start</th>
<th>ACH50</th>
<th>CFM50/SSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>2675</td>
<td>0</td>
<td>0%</td>
<td>8.8</td>
<td>0.40</td>
</tr>
<tr>
<td>Air Seal Attic</td>
<td>1925</td>
<td>750</td>
<td>28%</td>
<td>6.3</td>
<td>0.29</td>
</tr>
<tr>
<td>Wall Build-Out (Including Windows and Foam)</td>
<td>1800</td>
<td>875</td>
<td>33%</td>
<td>5.9</td>
<td>0.27</td>
</tr>
<tr>
<td>Spray Foam Band Joist/ERV Installed</td>
<td>1625</td>
<td>1050</td>
<td>39%</td>
<td>5.4</td>
<td>0.25</td>
</tr>
<tr>
<td>Air Sealing Between Basement and First Floor</td>
<td>1590</td>
<td>1085</td>
<td>41%</td>
<td>5.2</td>
<td>0.24</td>
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</tbody>
</table>
## Peak Load Reductions:

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre Retrofit BTUH</th>
<th>Post Retrofit BTUH</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Heat</td>
<td>Cool</td>
</tr>
<tr>
<td>Basement</td>
<td>15141</td>
<td>2988</td>
</tr>
<tr>
<td>Living Room</td>
<td>12714</td>
<td>6858</td>
</tr>
<tr>
<td>Dining Room</td>
<td>3834</td>
<td>1899</td>
</tr>
<tr>
<td>Kitchen</td>
<td>6034</td>
<td>3691</td>
</tr>
<tr>
<td>Study/Office</td>
<td>4322</td>
<td>1801</td>
</tr>
<tr>
<td>Master Bedroom</td>
<td>7009</td>
<td>4097</td>
</tr>
<tr>
<td>Bedroom 1</td>
<td>5931</td>
<td>2546</td>
</tr>
<tr>
<td>Bath</td>
<td>1187</td>
<td>520</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>56,172</strong></td>
<td><strong>24,400</strong></td>
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</table>
## Test House: Costing

### House 1

<table>
<thead>
<tr>
<th>Wall Work</th>
<th>Contract Amount</th>
<th>Actual Cost/sf</th>
<th>Actual Costs/sf</th>
<th>Actual Costs/sf</th>
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<tbody>
<tr>
<td>Remove Siding</td>
<td>$6,822</td>
<td>$0.70</td>
<td>$0.70</td>
<td></td>
</tr>
<tr>
<td>New Framing</td>
<td></td>
<td>$2.57</td>
<td>$2.57</td>
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<tr>
<td>Remove windows</td>
<td></td>
<td>$0.31</td>
<td>$0.31</td>
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<tr>
<td>Window Trim</td>
<td>$4,096</td>
<td>$2.17</td>
<td>$2.17</td>
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<tr>
<td>Spray foam</td>
<td>$8,177</td>
<td>$3.81</td>
<td>$3.81</td>
<td></td>
</tr>
<tr>
<td>Install T-ply</td>
<td>$3,222</td>
<td>$1.70</td>
<td>$1.70</td>
<td></td>
</tr>
<tr>
<td>Box bottom</td>
<td>$2,122</td>
<td>$0.53</td>
<td>$0.53</td>
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</tr>
<tr>
<td>Install siding</td>
<td>$14,722</td>
<td>$7.21</td>
<td>$7.21</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>$39,317</strong></td>
<td><strong>$19.01</strong></td>
<td><strong>$19.01</strong></td>
<td></td>
</tr>
</tbody>
</table>

### House 1 vs Actuals

<table>
<thead>
<tr>
<th>Item</th>
<th>Actual Costs/sf</th>
<th>Actual Costs/sf</th>
<th>Actual Costs/sf</th>
<th>Actual Costs/sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$41,552</td>
<td>105.6%</td>
<td>$19.01</td>
<td></td>
</tr>
<tr>
<td>Total Actual w/ Donated Material</td>
<td>$41,552</td>
<td></td>
<td></td>
<td>$19.01</td>
</tr>
<tr>
<td>Actual % vs Projected</td>
<td>105.6%</td>
<td></td>
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</tbody>
</table>
Test House: Lessons Learned

- Installation of Ledger Boards
- Brackets and Spray Foam
- Extending timing with construction
- Permitting process
- Order of installation
- The challenge of staging construction for testing
- Integrating utility logistics
Step-by-step Installation Process

Step 1

Step 2

Step 3
Step-by-step Installation Process

Step 4

Step 5

Step 6
Step-by-step Installation Process

Step 7

Step 8

Step 9
Step-by-step Installation Process

Step 10

Step 11

Step 12
Step-by-step Installation Process

Note: Some siding profiles may require thin profile structural sheathing
Anastasia Herk
Project Manager
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