Cold Climate Case Study – Foulds Residence

Concord, MA

Residential Building Energy Efficiency Meeting 2010
20 July 2010
Foulds Residence

- Project Location

Concord, MA
Climate Zone 5A (Cold)
Foulds Residence
Concord, MA

- **Project Overview**
  - **Builder:** Synergy Companies Construction, LLC
  - **Type:** Single Family
  - **Stories:** 2
  - **Bedrooms:** 5
  - **Baths:** 4 Full
  - **Floor Area:** 2,794 sq. ft.
  - **Basement Area:** 1,528 sq. ft.
Project Overview

- Estimated Energy Reduction: 87%
- Estimated Energy Savings: $4,700 / year
- HERS Index: 18
- Estimated Cost: $600,000
- Construction Start: August 2009
- Construction Finish: June 2010
- Construction Schedule: 10 Months
Source Energy Savings – Parametric Annual Loads Study
### Source Energy Savings

Estimated Whole House Energy Use Comparison

<table>
<thead>
<tr>
<th>Source (10^6 BTU/yr)</th>
<th>Site (10^6 BTU/yr)</th>
<th>Area + Bsmt (sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>1795</td>
<td></td>
</tr>
<tr>
<td>39%</td>
<td>No. of Bedrooms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Mileage Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (10^6 BTU/yr)</td>
</tr>
<tr>
<td>74</td>
</tr>
<tr>
<td>38%</td>
</tr>
</tbody>
</table>

With 7.0 kW PV System

<table>
<thead>
<tr>
<th>ESTIMATED NET ENERGY USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (10^6 BTU/yr)</td>
</tr>
<tr>
<td>44</td>
</tr>
<tr>
<td>-4%</td>
</tr>
</tbody>
</table>
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- Enclosure & Mechanical Design
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Enclosure Design - Roof

- R-63 Roof Insulation – Vented and Unvented Roofs
  - R-63 Vented
    2” rigid insulation + high density closed cell spray foam (2.0 pcf) in rafter bays + 2” rigid insulation below roof rafters
  - R-63 Vented
    18” cellulose in attic floor
  - R-63 Unvented
    10 ½” high density closed cell spray foam (2.0 pcf)
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- Enclosure Design – Walls and Windows
  - R-45 Wall Insulation
    - 5 ½” cellulose in stud bays + 2 layers 2” foil-faced polyisocyanurate
  - R-4 Windows
    - Low-E triple pane argon filled, U = 0.24 & SHGC = 0.23, VT = 0.36
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- **Enclosure Design – Foundation**
  - R-25 Basement Walls
    - 2” XPS rigid insulation with 2x4 stud wall filled with fiberglass batt insulation
  - R-13 Rim Joist Area
    - 2” high density closed cell spray foam (2.0 pcf)
  - R-10 Basement Slab
    - 2” XPS below slab
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- **Mechanical Design**
  - Dual fuel heat system: 95% AFUE gas furnace + air source heat pump
  - Cooling: 15.5 SEER / 8.2 HSPF split system
  - Fantech HRV
  - (2) zone duct system
  - CFL light fixtures
  - Drainwater heat recovery
  - 0.94 EF gas condensing tankless water heater
Foulds Residence

- 7.0 kW PV System
Foulds Residence
Concord, MA

- Systems Testing
  - Rough-In Blower Door
    - 1203 CFM 50 target
    - 1019 CFM 50
    - 1.44 ACH 50
    - 0.13 CFM 50 per sq. ft. enclosure area
  - Final Blower Door
    - 505 CFM 50
    - 0.72 ACH 50
    - 0.07 CFM 50 per sq. ft. enclosure area
  - Duct Leakage to Outside
    - 18 CFM 25 (1.5%)
  - Total Duct Leakage
    - 120 CFM 25 target (10%)
    - 220 CFM 25 (18%)
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- Gaps, Barriers & Future Steps
  - Modeling
    - How do we model and measure the benefit of drainwater heat recovery?
    - How do we model dual fuel heating systems?
    - Are some dual fuel heating systems better than others?
    - How do we model lighting controls?
  - Design
    - Can we get R-5 historic looking windows?
    - Can we get R-5 windows with a high Visible Transmittance (VT)?
    - How do we get reliable information on dual fuel heat from manufacturers?
  - Construction
    - How do we get less leaky sheet metal ductwork systems?
    - Are mechanical contractors ready to make the switch to dual fuel heat?
    - Who is in charge of basic mechanical system commissioning?
- Testing & Monitoring
  - How do we measure the efficiency of the dual fuel heating system?
  - How do we administer a whole house energy monitoring system?
Gaps, Barriers & Future Steps

Modeling

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### Gaps, Barriers & Future Steps

#### Design
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### Foulds Residence Window Comparison Table

<table>
<thead>
<tr>
<th>Description of Windows</th>
<th>U-value</th>
<th>SHGC</th>
<th>Window Cost</th>
<th>Added Cost</th>
<th>Annual Energy Cost</th>
<th>Cost Change</th>
<th>Simple Payback</th>
<th>Cost Target (30 year)</th>
<th>Cost Target (60 year)</th>
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</thead>
<tbody>
<tr>
<td>Baseline: Andersen 400 Series</td>
<td>0.34</td>
<td>0.29</td>
<td>$24,293</td>
<td>$0</td>
<td>$2,207</td>
<td>$10</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Andersen 200 Series</td>
<td>0.34</td>
<td>0.30</td>
<td>$14,761</td>
<td>($9,532)</td>
<td>$2,198</td>
<td>($16)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Marvin Integrity Wood Ultimate Series</td>
<td>0.34</td>
<td>0.32</td>
<td>$34,000</td>
<td>($293)</td>
<td>$2,129</td>
<td>($51)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Marvin Clad Ultimate Series</td>
<td>0.34</td>
<td>0.30</td>
<td>$35,191</td>
<td>($6,898)</td>
<td>$2,196</td>
<td>($19)</td>
<td>959</td>
<td>$24,563</td>
<td>$34,553</td>
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<tr>
<td>Marvin Clad Ultimate Low E Series</td>
<td>0.35</td>
<td>0.38</td>
<td>$48,911</td>
<td>($24,618)</td>
<td>$1,939</td>
<td>($213)</td>
<td>118</td>
<td>$30,533</td>
<td>$36,773</td>
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<tr>
<td>Harvey Tributes Series</td>
<td>0.33</td>
<td>0.32</td>
<td>$28,265</td>
<td>($16,025)</td>
<td>$2,183</td>
<td>($38)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Harvey Triple Glazed Tribute Series</td>
<td>0.20</td>
<td>0.19</td>
<td>$11,106</td>
<td>($13,187)</td>
<td>$2,046</td>
<td>($161)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Pella ProLine Series</td>
<td>0.33</td>
<td>0.30</td>
<td>$14,600</td>
<td>($9,793)</td>
<td>$2,193</td>
<td>($14)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Pella Designer Series (DG-high storm)</td>
<td>0.28</td>
<td>0.29</td>
<td>$30,500</td>
<td>($6,207)</td>
<td>$2,111</td>
<td>($96)</td>
<td>65</td>
<td>$27,173</td>
<td>$30,053</td>
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<tr>
<td>Pella Architect Series</td>
<td>0.34</td>
<td>0.32</td>
<td>$32,500</td>
<td>($7,257)</td>
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<td>257</td>
<td>$25,133</td>
<td>$25,873</td>
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<tr>
<td>ThermaProC 725 Series Low SHGC</td>
<td>0.20</td>
<td>0.22</td>
<td>$34,000</td>
<td>($9,707)</td>
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<td>($110)</td>
<td>54</td>
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<tr>
<td>ThermaProC 725 Series High SHGC</td>
<td>0.20</td>
<td>0.44</td>
<td>$34,000</td>
<td>($9,727)</td>
<td>$1,884</td>
<td>($323)</td>
<td>30</td>
<td>$33,983</td>
<td>$43,873</td>
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Gaps, Barriers & Future Steps

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