

bsc

Building America for Cold Climates:

5 • 10 • 20 • 40 • 60 @ 2

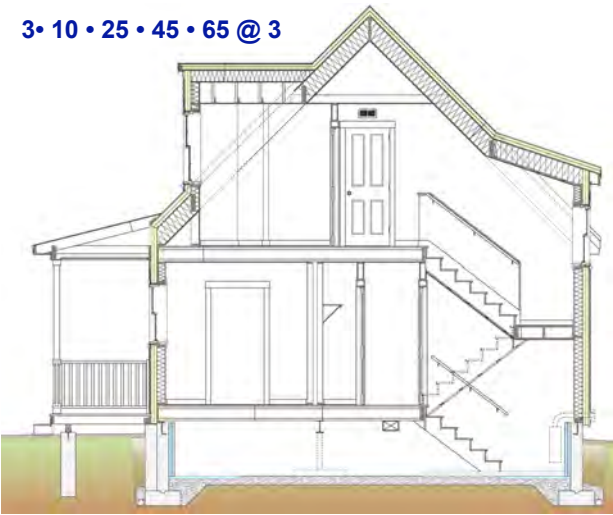
Betsy Pettit, FAIA
 Building Science Corporation
www.buildingscience.com

NESEA Building Energy Conference
 Boston, MA March 12, 2009



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bsc 3 • 10 • 25 • 45 • 65 @ 3



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Westford House



Westford House Dedication Ceremony October 5th, 2008



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Habitat for Humanity of Greater Lowell

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Project Overview

- Builder: Habitat for Humanity of Greater Lowell
- Location: Westford, MA
- Climate: Cold (5A)
- Type: Single Family, Affordable
- Stories: 1 ½
- Bedrooms: 3
- Baths: 2 Full
- Floor Area: 1340 sq. ft.
- Basement Area: 816 sq. ft.



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Habitat for Humanity of Greater Lowell

Project Overview

- Estimated Energy Reduction: 50 %
- Estimated Energy Savings: \$1,259 / year
- Cost: \$200,000
- Construction Start: March 2008
- Construction Finish: October 2008
- Construction Schedule: 8 Months

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Habitat for Humanity of Greater Lowell

Prescriptive-based Code Approval

- Meets 7th Edition Massachusetts One-and Two-Family Dwelling Code (based on 2003 ICC International Residential Code)
 - Vapor Diffusion Retarders
 - Single Headers
- Exceeds IECC Section 404 Compliance by over 50%

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bsc How the Costs Breakdown


| | |
|---|------------------|
| • Foundations installed including concrete | \$ 3,500 |
| • Slab installed including concrete | \$ 1,000 |
| • Lumberyard pricing of entire package including foam sheathing | \$70,000 |
| • Framers cost to enclose building including windows and foam | \$12,500 |
| • Electrical, Plumbing, Mechanical equipment and installation | \$30,000 |
| • Interior finishes, cabinets, appliances, GWB and installation | \$30,000 |
| • Septic systems and site work | \$13,000 |
| • General labor and overhead | \$40,000 |
| TOTAL PRE SITE GENERATED ENERGY | \$200,000 |
| Lowell HFH donated labor | -\$40,000 |
| Lowell HFH donated materials | -\$25,000 |
| Total Cost to HFH | \$125,000 |
| | |
| •3.5 kW PV system after tax credits | \$24,000 |
| | |
| TOTAL WITH SITE GENERATE ENERGY | \$224,000 |
| | |
| Energy Balance left: +/- 400 therms of gas at \$1.50/therm | \$600 per year |

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bsc Lowell Habitat for Humanity Westford, MA
2,156 sq. ft. @ \$92/sq. ft. **HERS 49**

Gas (400 therms) = \$50/month @ \$1.50 /therm
Electric (4200 kWh) = \$50/month @ \$.15/kWh
= **\$3.30 per day**

With 3.5 kWp PV (350+- kWh/month)
Electric = \$0



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U.S. Department of Energy
EnergySmart Home Scale™

Estimated annual energy usage:
Electric (kWh) 6124
Natural Gas (therms) 422
Conditioned floor area (sq. ft.): 1408

Meets The Builders Challenge

Your Home! **50**

18 Williams Avenue, Westford, MA
Rated by Building Science Corporation
Rating conducted November, 2008

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bsc PV & SHW Installation

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- Source Energy Savings

Source Energy Parametric Annual Loads Study

| Component | Category |
|---------------|----------|
| Biomass | Other |
| Axial flow | Other |
| US average | Other |
| Air Seal | Other |
| Ducts | Other |
| R-19 DYE | Other |
| 4x12 wall | Other |
| 4x8 wall | Other |
| R-40 roof | Other |
| 4x12 roof | Other |
| 4x8 roof | Other |
| Crack R-20 | Other |
| LowE | Other |
| 96% RH/E | Other |
| Env | Other |
| 0.82 E/F | Other |
| DL | Other |
| ES Appliances | Other |

Heating, Hot Water, Lighting, Other

40% Reduction

44.1%

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Habitat for Humanity of Greater Lowell

- Enclosure Design

- R-66 Roof Insulation (unfaced fiberglass batt insulation with (2) 2" layers foil-faced polyisocyanurate insulating sheathing on roof sheathing)
- R-45 Walls (2x6 framing at 24" o.c. with unfaced fiberglass batt insulation and (2) 2" layers foil-faced polyisocyanurate insulating sheathing)
- Windows (Low-E double pane argon filled, U = 0.33 & SHGC = 0.28)

Wall Section

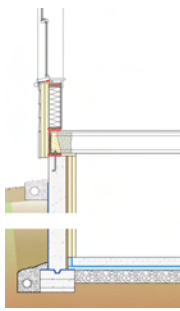
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- Enclosure Design
 - R-26 Basement Walls (2) 2" layers foil-faced polyisocyanurate insulating sheathing)
 - R-13 Rim Joist Area (2" high density spray foam at first floor rim joist area)
 - R-10 Basement Slab (2" XPS below slab)



Wall Section


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Habitat for Humanity of Greater Lowell

- Mechanical Design
 - 96% AFUE Gas Furnace
 - 0.82 EF Instantaneous Water Heater
 - Fantech Energy Recovery Ventilator (ERV)



Fantech ERV



Furnace and Return Ductwork

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Window Installation Demonstration



Window Flashing Demonstration







Installing Siding on Wall Mock-Up

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- Construction Support Photos

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Foundation Wall Insulation 17

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ERV Intake and Exhaust

Side Door

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- Neutral Cost Analysis

Assumed Financing Rate: 7%

Assumed Financing Term (years): 30

| Run ID | Parametric Run | Cumulative Cost | Savings | Annual Finance Cost | Simple cash flow |
|--------|-------------------------------------|-----------------|---------|---------------------|------------------|
| 16 | 15 + ES Appliances | \$9,825 | \$1,121 | \$792 | \$329 |
| | Add third party inspections @ \$700 | \$10,525 | \$1,121 | \$848 | \$273 |

Assumptions: 30 year mortgage, 7% interest rate, \$1.40/therm, \$0.18/kWh

- \$329 annual net positive cash flow (\$1121 annual savings - \$792 added mortgage cost)
- \$273 annual net positive cash flow assuming testing/inspections ~\$700 (\$1121 annual savings - \$848 added mortgage cost)

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Community Gathered before Westford House Dedication Ceremony

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