



## Building America Case Study Whole-House Solutions for New Homes

### Nelson Construction

Hamilton Way | Farmington, CT

#### PROJECT INFORMATION

**Construction:** New home

**Type:** Single-family

**Builder:** Nelson Construction  
Farmington, CT

[www.nelsonconstructionct.com](http://www.nelsonconstructionct.com)

**Size:** 2,960 to 3,540 ft<sup>2</sup>

**Price Range:** \$650,000+

**Date Completed:** 2009

**Climate Zone:** Cold

**Team:** Building Science Corporation

#### PERFORMANCE DATA

**HERS Index:** 53-54

**Projected annual energy  
cost savings:** \$3,447

**Incremental cost of energy-  
efficiency measures:** \$18,000

**Annual mortgage  
payment increase:** \$2,055

**Annual net cash flow  
to homeowner:** \$1,392

**Billing data:** Not available

Nelson Construction partnered with Building America research team Building Science Corporation to design and test 10 high-performance homes in Farmington, Connecticut. Completed after the housing downturn in April 2009, all homes sold within 2 months of being listed at selling prices starting at \$649,000.

The team designed a building enclosure with superior thermal and air boundaries that exceed 2012 IECC requirements. This included R-13 foam-sheathed walls filled with R-19 cellulose, R-50 attic insulation, insulated concrete form basement walls, and a fully insulated slab. The team used closed-cell spray foam to seal air leakage trouble spots such as the rim joists, holes through sill and top plates for wires and plumbing, holes in the ceilings and walls, and rough openings around doors and windows. The improved thermal boundary (insulation and air barrier) allowed for considerable equipment savings. The team downsized the 14 SEER air conditioner from 4.5 or 5.0 tons to 3.0 or 3.5 tons, depending on the house model. The HVAC system was reduced from two air handlers (one in the attic and one in the basement) to one in the basement with zone control dampers for each floor.

To aid air distribution and ensure balanced house pressures within such tightly sealed homes (3 to 3.3 ACH 50), one ducted return is located on each floor, and jump ducts are installed in each bedroom. Fresh outside air comes into the home through an electronically dampered duct to the return side of the air handler. A flow regulator provides fixed outside air-supply quantities independent of air-handler blower speed, and the HVAC system provides circulation and temperature tempering. Stale air is exhausted through a fan in an upstairs bathroom. This 1-sone-rated fan is connected to the main space with a 6-inch jump duct.

*(Photo top left)* Building America helped Nelson Construction achieve calculated HERS scores of 53-54 on homes thanks to exceptional air sealing and insulation levels that exceed the 2012 IECC, with insulated concrete form foundation walls, cellulose-filled, polyiso-sheathed walls, and R-50 of blown fiberglass in the attic. Billing data confirmed the energy savings, which enabled the builder to downsize the HVAC 1.5 tons and from two air handlers to one.

## KEY ENERGY-EFFICIENCY MEASURES

### HVAC:

- 94% AFUE sealed-combustion gas furnace, 14 SEER air conditioner; air handler in conditioned basement
- Ducts in conditioned space with less than 5% leakage (R-6 flex runouts in dropped ceiling or in floor joists)
- Temp- and timer-controlled fresh air intake; exhaust fan ducted to draw from main living space; transfer grilles

### Envelope:

- 24-inch-on-center advanced framing of 2x6 studs
- Wall insulation: 2-inch foil-faced polyisocyanurate sheathing (R-13) and stud cavities filled with R-19 cellulose
- Attic insulation: R-50 blown fiberglass
- Foundation insulation: R-10 2-inch extruded polystyrene foam (XPS) below slab; R-10 2-inch XPS cast in walls (Thermomass)
- Windows: Double-glazed, low-emissivity, argon-filled, vinyl-framed;  $U = 0.32$ ,  $SHGC = 0.27$
- Air sealing tightness: infiltration of 3.0 to 3.3 air changes per hour (ACH) at 50 pascals

### Lighting, Appliances, and Water Heating:

- 100% CFL
- ENERGY STAR® appliances optional
- 0.82 EF (energy factor) instantaneous gas hot water heater

For more information, please visit:

[www.buildingamerica.gov](http://www.buildingamerica.gov)



Building America research showed minimal insulation R value difference between spray foaming the entire opaque surface of a wall and spray foaming only areas known for leaks. The team used this “critical seal” approach for air sealing and cost savings at basement and second floor rim joists.

## Lessons Learned

- Design-stage computer analysis estimated that 18.5% of the energy-efficiency savings could be achieved by reducing air infiltration.
- Building America research showed minimal difference in air sealing effectiveness between spray foaming the entire opaque surface of a wall and spray foaming only areas known for leaks. The team used this “critical seal” to save money and still provide a good air seal by spraying urethane closed-cell foam to air seal basement rim joists and the rim joists between the first and second floors. Full spray coverage was used in the ceiling of the garage to ensure no potential air leakage to the living space above.
- Basement walls are insulated concrete, consisting of 2 inches of extruded polystyrene foam (XPS) sandwiched between two 4-inch layers of concrete. Two inches of R-10 XPS extends under the entire foundation slab.
- Nelson filled the 2x6 24-inch on-center wood stud wall cavities with R-19 damp-spray cellulose cavity insulation and sheathed the walls with two inches (R-13) of foil-faced polyisocyanurate insulating sheathing, Tyvek wrap, and vinyl siding.

“We have been an ENERGY STAR builder as long as it has been around, and we wanted to push the limits for energy efficiency. Teaming up with Building Science Corporation through Building America gave us the confidence to push way beyond what we might have tried on our own.”

*Chris Nelson, president of Nelson Construction*

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For more information, visit:  
[www.buildingamerica.gov](http://www.buildingamerica.gov)

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