FINAL CONSTRUCTION REPORT

NYSERDA
RESIDENTIAL PERFORMANCE CHALLENGE

HOUSE #1
113 WOODLAND AVE - HOME HEADQUARTERS

Revised January 2011

Submitted to:

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Submitted by:

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House Description

This house was completed in Spring 2010 by Home Headquarters (www.homehq.org). This 2326 square foot two-story includes an ICF foundation and 2 inches of exterior foam. Closed cell foam is used in the shed roofs.

The design for this energy efficient house – known as the "Energy Efficient Sherwood" – was originally developed for a location on Newell Street in 2008. The design was ultimately built at 113 Woodland Ave.

Figure 1. Completed Home

The various key construction details are summarized in the following Figures. Table 1 compares the originally proposed improvements to the actual implemented features. Table 2 summarizes the costs of the implemented improvements. During construction we worked with the contractor and recommended additional measures that could be implemented to better adjust to constructability. In many respects the final design is better than we originally proposed.

Figure 2. Insulation Shown Inside the Garage (rigid foam applied before drywall)

Foam cut back around the window

Tool used to cut out foam around the windows

Dow Wallmate with firring strips

Firring strips with tape applied

Figure 3. Details for Installing Exterior Foam

Blown Fiberglass in Attic

Foam Board Scraps used in Rim Joist

BIBS System in Exterior Wall

Figure 4. Construction Details

HHQ staff decided to use an ICF foundation instead of the cinder block wall with exterior insulation that we had originally suggested. They found that cost premium for ICF was smaller because they had moderately-skilled workers available to assemble and place the concrete forms. Contractor bids for the block wall were only a few thousand dollars lower than the costs HHQ incurred to build the ICF wall (see Table 2). This drove their decision to upgrade to an ICF foundation.

Similarly, they used their lower-cost labor to cut scrap foam pieces left over from the exterior foam installation (see Figure 3) in order to fill in between the rim and band joints (see Figure 4). Then they used cans of spray foam to seal in the pieces. This resulted in a cost-effective means of achieving 4 inches of foam in the rim and band joints while also using up the scrap material and providing good utilization of their lower-skilled staff.

The overall feedback we received from the HHQ staff lead us to conclude that many of the details we had suggested with intention of lowering costs may have been too complicated. It may be better to use a little more materials if it provides for more consistent and easier

implement design. The HHQ staff was very pleased with the installation process for the exterior foam.

The budget for the HVAC contractor was originally set based on a standard condensing furnace. We worked with the HVAC to minimize the supply and return ductwork so that the furnace could be upgraded to a 95% efficient, two-stage 60 Btu/h unit while retaining the same budget. We worked to move many supply grills towards the middle of the house, and minimized the return ductwork by having central return grills in the center of the house (upstairs and down). The reduced sheet metal and ductwork took advantage of the reduced thermal losses and stratification that result from the highly efficient building envelope.

Figure 5. Two-Stage Gas Furnace

Ventilation for the house is provided by a fresh air intake on the return side of the furnace and an Energy Star exhaust fan runs continuously in the bathroom at 65 cfm. A gravity damper shuts off the intake when the furnace fan is off. Initially the fresh air vent was installed near the exhaust vent for the hot water heater. However, the vent was ultimately moved towards the front of the house.

Water heating is provided by a conventional 40-gallon gas-fired water heater.

The blower door test found the air tightness to be 2.12 ACH50. A major fraction of the leakage was through the door connecting the house to the garage.

Table 1. Actual Design Details: Woodland Ave

	Base Design	Proposed Design (2008)	Actual Design (2010)
Walls	2x6 walls w/ Fiberglass Batts 16 in oc R19	2x4 wall cellulose, w/ 2 in exterior XPS foam board (DOW Wallmate)	2x6 wall 24 in OC Spacing w/ BIBS, w/ 2 in exterior XPS foam board (DOW Wallmate) R32
Attic	Fiberglass batts R38	R41 blown cellulose (11.5 in) Foam top plates, spray to proper vent	**Blown Fiberglass (18 in) R45**
Basement Walls	Masonry wall with 5½ inch Fiberglass Blanket (6 ft down wall)	2 in exterior XPS foam board (DOW Perimate)	**Nudura Insulated Concrete Form (ICF) R22**
Windows	U=0.35, SHGC=0.52 (double hung) U=0.33, SHGC=0.50 (inoperable)	U=0.35, SHGC=0.52 (double hung) U=0.33, SHGC=0.50 (inoperable)	**U=0.29, SHGC=0.26 (double hung)**
Rim/Band Joists	5½ inches of Fiberglass R21	6 in Closed Cell Spray Foam	**4 in XPS foam board/froth pack sealed w/ 2 in exterior XPS Foam Board R30**
Garage Ceiling	Fiberglass batts R30	Fiberglass batts R30	**Open cell foam w/ 1 in Polystyrene R35**
Shed Area Roofs	Fiberglass batts R38	3 in Closed Cell Spray Foam R21	3 in Closed Cell Spray Foam R21
Garage Walls	None	2 in exterior XPS foam board (DOW Wallmate) R10	2 in exterior XPS foam board (DOW Wallmate) R10
Garage-to-house Wall	2x6 walls w/ Fiberglass Batts 16 in oc R19	2x4 wall cellulose, w/ 1 in DOW Thermax taped	**2x6 wall w/ Blown Fiberglass w/ 2 in exterior XPS foam board (DOW Wallmate) R29**
Air Tightness	5 ACH50 (with basement)	1-2 ACH50 (with basement)	2.12 ACH50 (with basement)
Ventilation	Bathroom & kitchen exhaust fans 100 cfm, 15 hours/day, 20 Watts	Air Cycler 65 cfm continuous distributed to each bedroom	**Fresh air scuttle** **65 cfm continuous**
Heating	92% efficiency Gas Furnace	94% efficiency boiler	95% efficiency 2-stage Gas Furnace
Water Heating	0.65 EF, 40 gallon, Gas Water Heater	Indirect Tank on Boiler	**0.65 EF, 40 gallon, Gas Water Heater**

Table 2. Summary of Capital Cost Differences

113 Woodland Ave Additional Costs						
	Units	Quanity	Unit Cost	Base Costs	Final Costs	Cost Difference
Above Grade Walls						
2 inch foam on ALL exterior walls	ft^2	2580	1.5		$ 3,870	
1x3 furing	ft^2	2580	0.085		$ 219	
BIBS in Walls (excluding garage-to-ext)	ft^2	2172	1.00		$ 2,172	
Deduct for 5.5" FG batt (exclud garage-to-ext)	ft^2	2172	0.55	$ 1,195		
				$ 1,195	**$ 6,261**	**$ 5,067**
Basement Walls						
ICF Wall	ft^2	976	20.5		$ 20,008	
Drainage	ft^2	976	0.69		$ 673	
Deduct for Masonry Wall with 2" foam	ft^2	976	17.42	$ 17,002		
				$ 17,002	**$ 20,681**	**$ 3,680**
Rim/Band Joists						
4" rigid foam in rim/band joist	ft^2	226	3.52		$ 796	
Deduct for 5.5" FG batt in rim/band joist	ft^2	226	0.55	$ 124		
				$ 124	**$ 796**	**$ 671**
Shed Roofs						
Shed roof - Closed cell Spray foam	ft^2	150	3.5		$ 525	
Deduct for R38 Fiberglass batts in Shed roof	ft^2	150	1.150	$ 173		
				$ 173	**$ 525**	**$ 353**
2nd Floor Ceiling						
18" Blown Fiberglass in Attic	ft^2	850	1.80		$ 1,530	
Deduct for R38 Fiberglass batts	ft^2	850	1.15	$ 978		
				$ 978	**$ 1,530**	**$ 553**
Garage Ceiling						
Open Cell Foam in Garage Ceiling	ft^2	323	2.76		$ 891	
Deduct for R30 FG batts	ft^2	323	1	323		
				$ 323	**$ 891**	**$ 568**
Heating and Ventilation						
95% Efficient Gas Furnace		1	5400		$ 5,400	
Deduct for 92% Efficient Gas Furnace		1	4850	$ 4,850		
				$ 4,850	**$ 5,400**	**$ 550**
Total						**$ 11,440**
Notes: ALL exterior walls includes garage-to-inside & garage-to-exterior						

Energy Performance

The energy use predicted by RemRate for the final house is shown in Table 3. The design heating load for the house decreased by about one third compared to the base house.

Table 3. Summary of Energy Use and Savings

	Annual Load (MMBtu)	Design Load (MBtu/h)	Total Fuel (MMBtu)	Relative Heating Load	Annual Cost	Cost Savings
Base House (5 ACH50)	60.7	34.6	117.3	100%	$ 1,760	$ -
Actual (2.12 ACH50)	39.4	24.4	92.9	65%	$ 1,394	$ 366

The house was rated according to the EnergyStar requirements. Savings are primarily due to air tightness and added insulation. The HERS Index for the house was 57 and the HERS Score was 88.8.

We also completed a Co-Heating test at the house. Electric heaters were controlled to maintain the temperature in house. A datalogger controlled the resistance heaters in three separate zones to maintain the space temperature. The results of this test are presented in a separate report.

Setup for co-Heat Test

Blower Door Setup

In addition to reviewing 12 months of utility bills, we plan to install data loggers to monitor heating system and total house performance. We will install battery powered data loggers to measure the parameters listed in Table 4. Data will be recorded at hourly intervals by battery-powered dataloggers. We will periodically retrieve data from the loggers.

Table 4. Monitored Points to be Measured at the

1	Hot Water Use (gallons)	Omega FT flowmeter
2	Total House Power (kWh)	Wattnode Power Mtr
3	Furnace Electric Power (kWh)	SHW Power Mtr
4	Furnace Stage 1 Runtime (hrs)	Veris Current Switch
5	Furnace Stage 2 Runtime (hrs)	Veris Current Switch