Case Study #2 Bellingham Court

SUMMARY: This profile features a house which a local contractor built for himself (Figure 1). A key feature of the house was the double stud exterior wall system that incorporated a 51 mm (2 in.) layer of type IV expanded polystyrene (EPS) foam, between a 38x140 mm (2x6 in.) structural wall and a 38x89 mm (2x4 in.) inner wall. He also utilized a high-efficiency propane "combo" system to provide space heating and domestic hot water.

Figure 1: SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments: This contractor-homebuilder has built more than 10 high efficiency single-family houses in the past 10 years. All of these homes have similar wall style and R-values. His clients usually find him, though he has built spec homes in the past.

The featured house in this profile is his own. He wanted to build SuperGreen for himself because of the energy efficiency, the livability of the home and the lower cost to operate and heat it. At the time this case study was prepared, he had lived in this SuperGreen home for a month. He had moved from an older home in Whitehorse.

He had a local draftsperson draw up the design. They didn't need to do a lot of research, because energy-efficient construction is "pretty much common knowledge these days". They focused on insulation, the heating system, and products like energy efficient light emitting diode (LED) lights that also have a higher life expectancy.

His philosophy is that you can spend money on heating fuel or on high R-value insulation levels and he thinks people are generally aware of the tradeoffs between building envelope vs. heating costs. However they may not want to spend the money to super-insulate a house up front.

Location: This SuperGreen house is located in the Whistlebend subdivision, Whitehorse, Yukon.

Designer-Builder Team: The trades on this house worked as a team, they are efficient and they know how to work together. Generally they discuss details with the clients and mark their decisions on the walls. This seems to work out.

Type of House: This is a large 427 m^2 (4,600 ft^2), two-storey detached home with a finished basement and a heated attached garage.

[1] SuperGreen is a Yukon Housing Corporation standard of energy efficient house construction.

Technical Details

Building Envelope:

- Walls (Figure 2): 38x140 mm (2x6 in.) fibreglass batt filled wall, 51 mm (2 in.) of type IV EPS foam board in between, and a 38x89 mm (2x4 in.) fibreglass filled wall inside. Total effective RSI 7 (R40).
- Ceiling: High heel trusses, vented attic, blown cellulose. Total effective RSI 12 (R70).

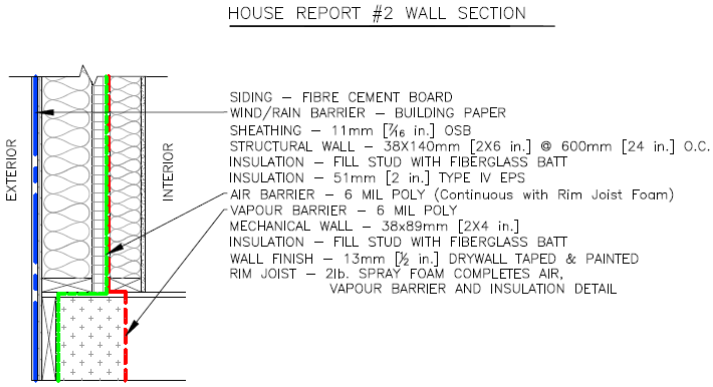


Figure 2: Wall section

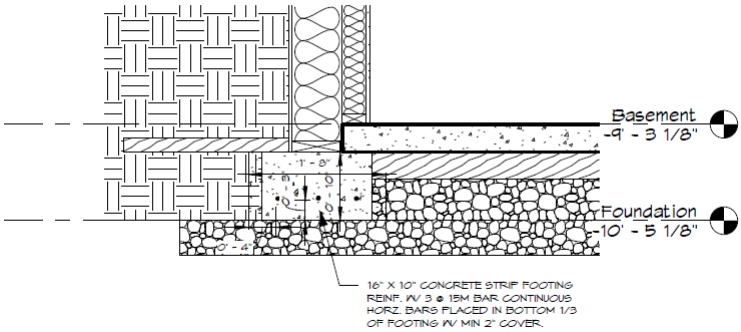


Figure 3: Foundation section

- Foundation (Figure 3): Preserved wood, 38x184 mm (2x8 in.) wall, poly vapor barrier, with 38x89 mm (2x4 in.) wall on the inside. Fibreglass batt insulation. Total effective RSI 6.7 (R38).
- Foundation floor (Figure 3): 100 mm (4 in.) EPS type IV foam below the concrete slab. Total: RSI 3.5 (R20).
- Windows: Vinyl, fixed and casement style, triple glazed, argon-filled, low-e coated.
- Doors: 3 steel polyurethane foam filled insulated doors, 1 fibreglass insulated main door.

Mechanical Systems:

- Space heating: Primary: Navien America 91% efficient propane boiler (CSA P.9-11 compliant), in-floor hydronic radiant system.
- Ventilation: Fully ducted Vanee 1001 heat-recovery ventilator (HRV), 67% SRE at -25°C (13°F), balanced at 66 L/s (140 cfm) high speed and 41 L/s (87 cfm) low speed.
- Hot water: Instantaneous hot water supplied by propane-fired boiler.

Lessons Learned:

If he was building again, he would design a smaller house. This house is too big for his personal needs.

He didn't use the EnerGuide Rating System (ERS) as he didn't learn about it until too late. Next time he would involve people who know how to run the plans through the ERS earlier in the process in order to better understand optimal pathways to achieving his energy efficiency goals.

Finding the sources of air-leakage were the greatest challenges. He described how he just wandered around the house, locating and repairing them. "It's just a time-consuming process." He also has experience with a double-wall system, which is his least-favourite. In his opinion, the wall system used on this house is the best available as it eliminates thermal bridging.

He likes the strength of the 38x184 mm (2x8 in.) foundation wall below grade, but would have chosen insulated concrete forms (ICF) over the preserved wood foundation had his budget permitted.

For the ceiling, the builder feels blown cellulose is a good, cost-effective product and you achieve a high RSI-value.

He had always wanted to try a boiler and is pretty happy with it. Also, propane is a cleaner product than oil with less environmental risks related to storage and use. He would never choose electric heat due to cost of operation.

Figure 4: Windows

Neither the window products (Figure 4) he purchased (chosen because they offer coloured frames) nor the customer service of the company he purchased them from met his expectations. For future projects, he would choose locally manufactured windows, which are now available with painted frames.

Although he believes that the long-term savings of a SuperGreen house will offset the initial incremental cost of construction, he also believes that higher up-front cost can be a mortgage limitation for people who might be considering SuperGreen. He knows that lots of contractors know how to achieve higher R-values but clients tend to want to keep the initial cost as low as possible.

Other Energy Efficiency and Sustainability Features:

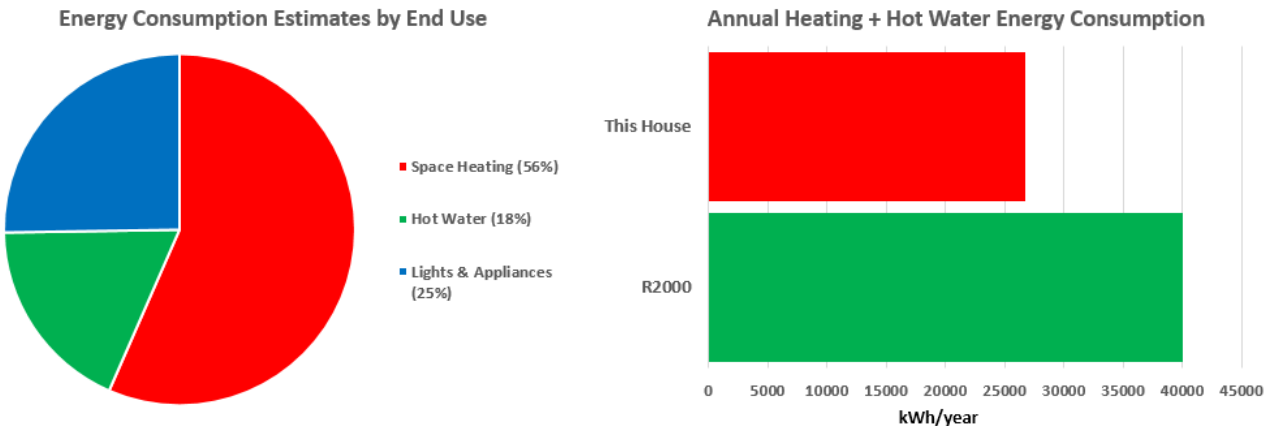
- Lighting: About 60% of the fixtures use light-emitting diode (LED) lamps, the rest incandescent.
- All appliances are Energy Star® rated (stove top is propane, oven is electric).

House Energy Consumption Performance:

An EnerGuide rating is a measure of a home's energy performance. EnerGuide has been in place since the mid 1990's. It makes use of actual house parameters like insulation values, mechanical equipment efficiencies and air tightness in a computer energy simulation (Hot 2000) using standardised occupant conditions for plug in loads, hot water use and thermostat settings. The figure below shows the energy breakdown of this house.

The R2000 program has been in place since the 1980's and has been the benchmark for energy efficient new housing in Canada. That benchmark has been upgraded recently, but for reference this house has been compared to the old familiar standard where a house deemed to be efficient gets an 80 or better on the EnerGuide scale.

EnerGuide Rating: 86



Project latitude	60.5°N
Annual heating degree day zone	>6000HDD°C
Mean January temperature	-16.2°C (2.8°F)
January heating design temperature	-41°C (-43°F)
Heating system design heat load	17 kW (58,006 BTU/h)
Main floor(s) heated area	269 m^2 (2,872 ft^2)
Finished basement heated area	135 m^2 (1,452 ft^2)
Total Liveable Area	404 m^2 (4,324 ft^2)
Building footprint	198 m^2 (2,134 ft^2)
Window area	38 m^2 (412 ft^2)
% of windows facing south	31%
Air leakage rate @ -50 Pa (*as operated*)	0.4 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	131 cm^2 (20 $in.^2$)
Annual energy usage per m^2	78 kWh/m^2
Projected total annual energy usage	31,314 ekWh/yr* (10,028 kWh/yr + 2,998 L propane/yr)
Actual performance as it compares to occupant utility bills	Data not available - House occupied less than 1 year at time of publication

**ekWh is equivalent kWh determined by showing the energy content of the fuel plus electrical energy. Propane has an energy content of 7.1 kWh/L*

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