Case Study #1 Wann Road

SUMMARY: This profile features a house built by a local mechanical contractor for himself. He chose a factory-built house (Figure 1) with higher performance wall system due to a compressed building timeline. He added an additional 38x89 mm (2x4 in.) inner framing to the exterior walls for plumbing and electrical. He also installed a dual-stage cold-climate heat pump.

Figure 1: Factory Built SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments: This homeowner had built his previous house about three years before this new house. He didn't want to pay for increasing energy costs and looked at the long-term payoff of going SuperGreen. His focus was on higher insulation levels and also on the mechanical systems, because he wanted to use an air-source heat pump and needed the house heating requirements to be low enough to match his heat pump's heating capacity to make it work.

Location: This SuperGreen house is located on a rural lot in the Porter Creek area of Whitehorse, Yukon.

Designer-Builder Team: The homeowner acted as his own general contractor and designer. He bought a prefabricated Pacific Homes house with a 'SmartWall®' package. He added interior framing and insulation and applied his knowledge to develop the mechanical systems design and ducting layout. His tradespeople had not worked together as a team before this, but they recommended each other. Nobody other than himself provided drawings. He didn't do any special up-front work with the trades, but they had lots of ongoing discussions to address next steps as they went.

Type of House: This is a detached, moderate-sized, two-story house with a finished basement. It has a total living area of 357 m^2 (3,846 ft^2.). There is a heated attached garage.

Technical Details

Building Envelope:

- Walls (Figure 2): 38x184 mm (2x8 in.) insulated with expanded polystyrene (EPS), interior 38x89 mm (2x4 in.) framing insulated with mineral wool. Effective RSI 6.3 (R36).
- Ceilings: High heel trusses, vented attic with effective RSI 11.4 (R65), blown fibreglass.

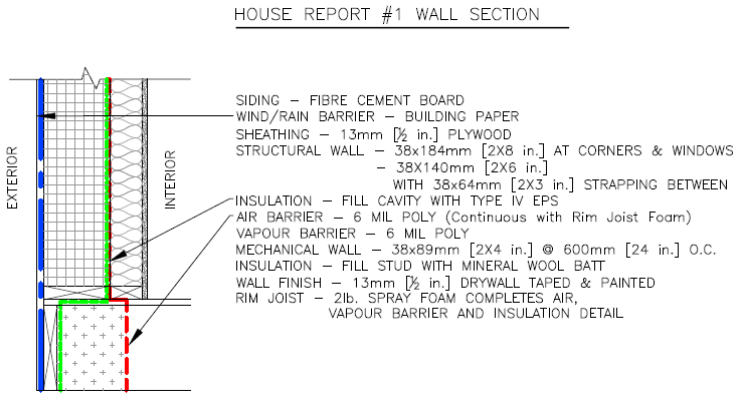


Figure 2: Wall section

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

- Foundation: 38x184 (2x8 in.) preserved wood foundation (PWF) with fibreglass insulation effective RSI 3.4 (R21).
- Foundation floor: 5 cm (2 in.) of type IV EPS.
- Windows: Fixed and casement triple glazed, argon-filled, low-e coating.
- Doors: Fibreglass, polyurethane foam-filled.

Figure 3: Heat pump

Mechanical Systems:

- Space heating: Dual stage cold-climate air-source heat pump (HSPF 9.4) (Figure 3) with an electric coil in the furnace fan unit as back-up. The air distribution is zoned so each floor has its own thermostat. A propane fireplace was also installed.
- Ventilation: Fully ducted Lennox HRV3-195 dual core heat-recovery ventilator (HRV) 78% SRE at -25°C (13°F) balanced at 59 L/s (125 cfm) high speed and 42 L/s (90 cfm) low speed.
- Hot water: Electric conserver tank.

Figure 4: Framing

Lessons Learned:

If he was doing it again, he might design the house a bit smaller and use different windows, but he likes the wall system. It makes for a tight strong house. He estimates that the extra interior wall framing (Figure 4) added about 25% extra to the construction timeline. The only other SuperGreen wall system he's had experience with was a spray foam wall.

He would build the foundation walls and floor about the same, but put more insulation into them. He was very happy with the ceiling insulation as he felt it was a good thermal value for the cost.

Next time, he would go with quadruple pane windows from a local manufacturer. He found the ones he installed don't seal very well.

He chose an air source heat pump because he felt it is a more efficient and cost-effective way to heat with electricity and offers the option of air-conditioning in the summer months as well. The zoned air distribution system allowed him to set the heat on each floor independently. He reports that the heat pump system is "super cheap to operate".

He considered solar hot water and photovoltaic (PV) systems but deemed it too expensive for his budget.

In the owner's perspective, the house took much longer to build and cost much more than a conventional house. He has done the math and concluded that there will not be a payback from energy savings on his extra insulation investment over the 25 year duration of his mortgage. On the other hand, according to his math, the cold climate air source heat pump does pay off.

He thinks that in general, most people don't want to put extra money up front. They want the most house they can get for the least cost. "The houses in some of the new subdivisions are all alike, built for people who don't care much about energy efficiency and feel that they can't afford to go green."

Since he built his house, his cousin has decided to build a SuperGreen home as well.

Other Energy Efficiency and Sustainability Features:

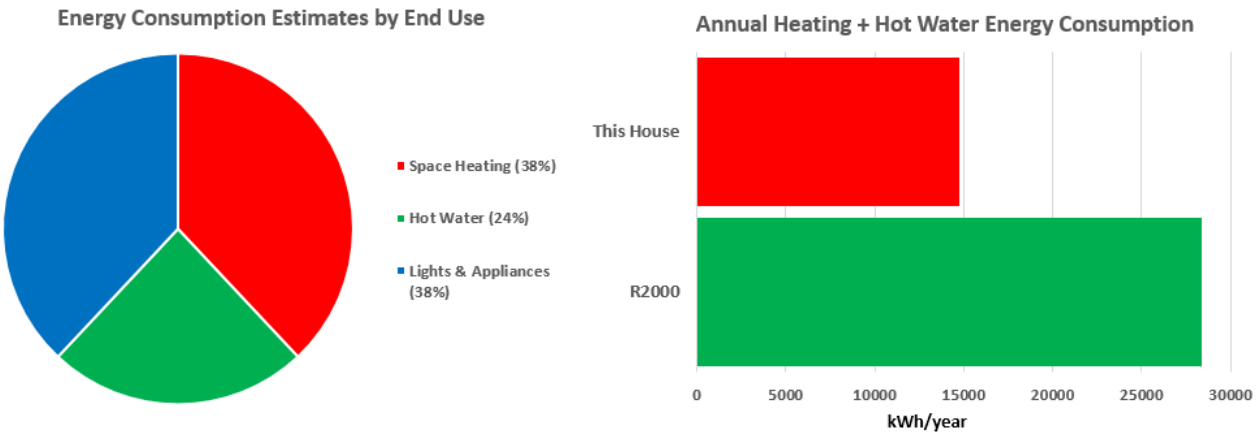
- Control systems: No setback thermostat; the owner likes to keep the indoor temperature constant.
- Lighting: Light-emitting diodes (LED) lamps, compact florescent lamps (CFL), motion and light sensors outside and a timer for the light in the garage.
- Appliances: All appliances are Energy Star® rated.

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: 87



Project latitude	60.5°N
Annual heating degree day zone	>6000HDD^{o}C
Mean January temperature	-16.2^{o}C (2.8^{o}F)
January heating design temperature	-41^{o}C (-43^{o}F)
Heating system design heat load	14 kW (47,768 BTU/h)
Main floor(s) heated area	211 m^2 (2,271 ft^2)
Finished basement heated area	114 m^2 (1,225 ft^2)
Total liveable area	325 m^2 (3,496 ft^2)
Building footprint	131 m^2 (1,411 ft^2)
Window area	41 m^2 (443 ft^2)
% of windows facing south(SE,SW)	64 %
Air leakage rate @ -50 Pa (*as operated*)	1.3 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	405 cm^2 (62.7 in^2)
Annual energy use per m^2	73 kWh/m^2
Projected total annual energy usage	23,636 kWh/yr
Actual performance as it compares to occupant bills	Projected load is similar to actual over 2-year period of occupancy

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