Case Study #6 Aksala Drive

SUMMARY: This profile features a house (Figure 1) designed by a homeowner-architect and built by her brother, a local builder. The walls are framed with 38x89 mm (2x4 in.) with an exterior insulation system comprised of 150 mm (6 in.) of rigid type IV expanded polystyrene (EPS) foam. The house is heated with electric baseboards.

Figure 1: SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments: The designer and her partner, both architects, had previously owned a SuperGreen condo. They wanted to experiment with their own house to see what they could achieve in terms of long-term cost savings and trying to reduce their reliance on fossil fuels. Her brother, a local builder, was willing to try something new and seized the opportunity to build SuperGreen.

In designing the house, they used their own knowledge as architects as well as information from the Cold Climate Housing Research Center (CCHRC) in Fairbanks, Alaska. The design focuses on increased levels of wall Insulation and high quality windows. A local energy expert assisted with mechanical system design.

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

Designer-Builder Team: They did most of the drawings themselves, except the ventilation plans which changed during the course of construction. The builder did a lot of extra research to make sure all the systems would work.

This was the first time their trades had worked together on a SuperGreen house, but they recommended each other. The homeowner-designer team were on-site most of the time every day during construction and between themselves and the builder, they didn't give anybody much room to stray from the plan. Their coordination approach was very "hands-on" and the tradespeople had to stick to what they provided.

They had a lot of family members working on this house which helped keep costs down.

Type of House: This detached house is a modest size at a total of 204 m^2 (2195 ft^2), including finished and unfinished space. It has an additional 80.4 m^2 (865 ft^2) rental income suite, included to help offset the mortgage. It has no attached garage. The suite has a main floor and finished basement, while the main living area is two-storey with an unfinished basement.

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

Technical Details

Building Envelope:

- Walls (Figure 2): 38x89 mm (2x4 in.) wall with fibreglass batt insulation, exterior plywood sheathing with the air-vapor barrier on outside, then 6 inches of expanded polystyrene (EPS) insulation, weather barrier, wood strapping and siding. Effective RSI 7.6. (R43).
- Ceilings: High heel trusses, vented attic with RSI 12.3 (R70), blown-in cellulose.

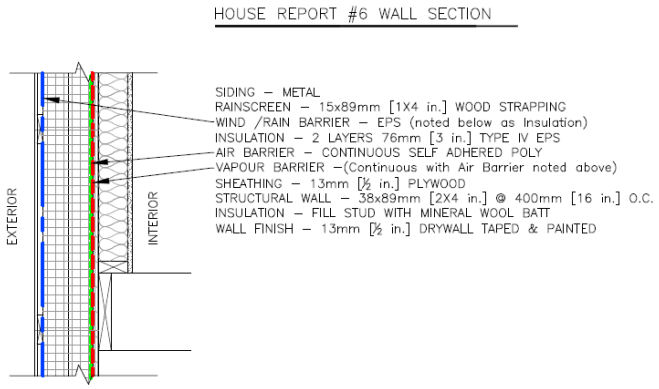


Figure 2: Wall section

- Foundation: Full basement, 38x184 mm (2x8 in.) preserved wood foundation (PWF), with 10 mm (4 in.) of type IV EPS, blue skin stick-on foundation protection.
- Foundation floor: 10 mm (4 in.) type IV EPS HS40 foam insulation, poly air vapour barrier, 38x140 mm (2x6 in.) PWF wood sleepers, 1.3 mm (0.5 in) plywood floor sheathing.
- Windows: Fixed and casement style vinyl, triple-glazed, argon-filled low-e throughout (locally manufactured).
- Doors: Metal polyurethane foam-filled with a double pane window.

Mechanical Systems:

- Space heating: Electric baseboard, planning to add a propane fireplace for ambiance and back-up.
- Ventilation: Separate fully ducted Venmar EKO 1.5 ECM heat-recovery ventilator (HRV) 64% SRE at -25°C (13°F) balanced at 61 L/s (130 cfm) high speed with 31 L/s (65 cfm) low speed for the main house and 42L/s (90 cfm) high speed with 21 L/s (45 cfm) low speed for the suite.
- Hot water: Separate electric conserver hot water tanks for each space.
- Renewable energy system: It won't be difficult to add solar photovoltaic (PV) to the house which is something they would like to do in the next 5 years.

Lessons Learned:

For the walls, the builder wanted to experiment with a wall system from CCHRC and to try something different than what other local builders were doing. The construction took a bit longer than expected due to the unforeseen lengthy installation time of the 150 mm (6 in.) of rigid insulation. This resulted in multiple passes around the building assembly that weren't anticipated to complete the layers of the wall.

There were a couple of difficulties working with the foam, both cutting through the thickness of it which added time and also, it was difficult to find the studs through the insulation so the builder missed them every once in a while.

Figure 3: Exterior view from the living room

There were no problems with the trades and the polyethylene air-vapour barrier, though they were not used to seeing the poly on the exterior of the sheathing. The structural engineer recommended against putting too many holes in the 38x89 mm (2x4 in.) walls, which in some cases was not respected by the trades.

If they were doing another house, they would stick with their final wall assembly. They would also design deeper roof trusses to accommodate more insulation, to bring it up to RSI 17.6 (R100). The builder would like to try a "hot roof" design.

The foundation walls worked out well and were really easy to build. The builder found it easier to work with the foam in a below grade situation. For the floor, they wish they had added more insulation, either spray foam or fibreglass batts.

They worked with a local EnerGuide Rating system (ERS) specialist who ran the final design through the EnerGuide program, but they would have preferred to work with the program before they started planning, to run different wall options through the program to see if another system would have been better (lower cost).

Initially, the inspector didn't understand the location of the air and vapour barrier, but once the wall system was explained everything was fine.

Figure 4: Kitchen

They chose electric heat because it was cheap to install and because there is so much insulation, they anticipate the house shouldn't need much electricity to heat. In retrospect, they would have liked to consider other heating systems such as heat pumps which are more efficient, but they didn't want a furnace.

Since they built their house, her mother, who was building a new home, has also decided to build SuperGreen. She decided that having lower utility bills and a more efficient home was worth it.

The builder feels that generally, people are worried about getting in trouble if they build something wrong, so they stick with what they know. He agrees that the up-front cost of SuperGreen is a bit higher but most of the effort goes into insulation and taking care of vapour-barrier continuity.

He would like to see more contractor breakfasts so builders know they aren't the only ones out there, and more incentives for renewable and energy-efficiency.

Other Energy Efficiency and Sustainability Features:

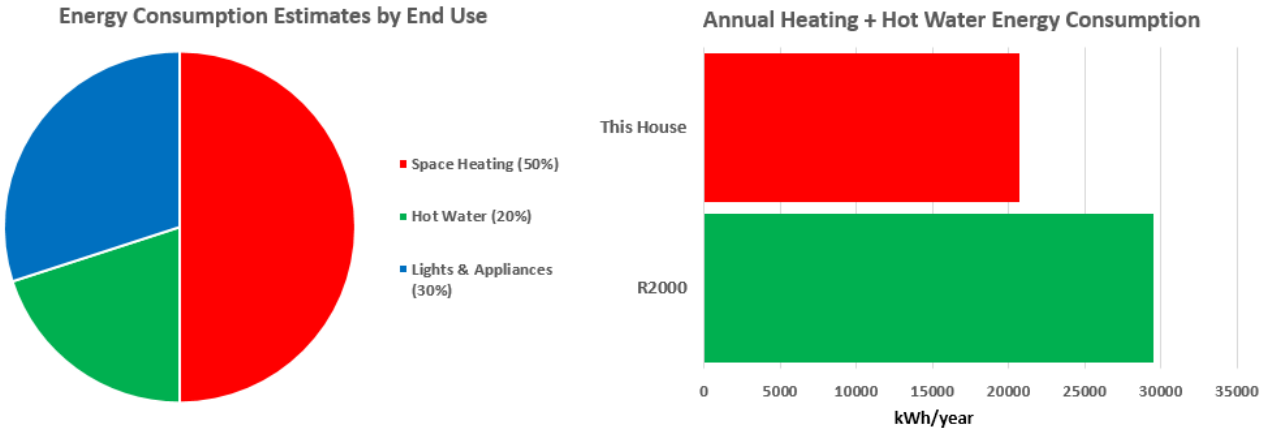
- Control systems: Motion and light sensors outside. Wireless thermostats on their baseboards which they hope to figure out how to control with their smartphones.
- Lighting: 50% light-emitting diode (LED) lamps (over time they will change the rest over to LED) and some halogen lamps.
- Appliances: All appliances are Energy Star® rated. They have a gas range with electric oven.
- Other features include: Most windows are located on the south and west sides for solar gain.

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: 85



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	15.5 kW (52,888) BTU/h)

Main floor(s) heated area	171 m^2 (1,840 ft^2)
Finished basement heated area	103 m^2 (1,104 ft^2)
Total liveable area	274 m^2 (1,944 ft^2)
Building footprint	124 m^2 (1,337 ft^2)
Window area	46 m^2 (496 ft^2)
% of windows facing south	41 %
Air leakage area @ -50 Pa (*as operated*)	0.7 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	216 cm^2 (33.5 in^2)
Annual energy use per m^2	107 kWh/m^2
Projected total annual energy usage	29,423 kWh/yr
Actual performance as it compares to occupant utility bills	Data not available - House occupied less than 1 year at time of publication

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