Case Study #3 War Eagle Way

SUMMARY: This profile features a house which a local contractor built for himself (Figure 1). He framed up a 38x140 mm (2x6 in.) structural wall with minimal framing and filled it with high density spray foam. He then installed 25 mm (1 in.) of rigid polyisocyanurate foam board insulation with a foil facer on both sides and an inner 38x89 mm (2x4 in.) wall with mineral wool insulation. This house has conventional electric space heating with wood back-up.

Figure 1: SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments: For this small house design, this owner-builder used mainly Yukon Housing information, articles from 'Fine Homebuilding' magazine on northern homes and his own thought process to narrow down his design to a system with the most insulation for the least amount of space. Because he is also a contractor, he is constantly surrounded by energy-efficient construction so it didn't require much extra research. For this house, he focused on orientation, wall structure, windows and insulation.

As a wood-burner, he knew how little cordwood would be needed to heat a SuperGreen house. He is conscious about not wanting to depend on sources of heat other than wood, which he can get by himself. It's not all about cost, it's about burning a fuel that you're familiar with, so you can be in tune with the heat source.

He and one building partner have worked together for about 25 years. They have lots of experience building houses in the north. He wanted to build a home for himself that would last for 100 years, by trying to get away from materials that can break down. For example, in the case of sheet polyethylene air and vapour barriers, you have rely on how well they are installed for them to work properly. But for spray-applied foam insulation systems, you can get an air and vapour barrier in one application.

In the 1980's, vapour barriers were a big issue, but there wasn't enough attention to how it was sealed. It's a process of evolution. Over the years, we began putting more insulation in houses. Many builders didn't want to seal the vapour barrier for fear of making the house too tight. Some of these homes are showing mold now, so the importance of sealing and good ventilation is becoming clear. The problem with batt insulation is that it isn't effective if air is moving through it because the air and vapour barrier hasn't been sealed perfectly. With solid foam walls there is far less of an issue. Now we can apply different layers of foam to get a solid air and vapour barrier.

Location: This SuperGreen house is located in a country residential area of Whitehorse, Yukon.

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

Designer-Builder Team: The building team included the builder, his long-time work partner and the same trades team that they work with on all their houses. They discuss the project as needed, but the trades don't need too much explanation, as their practices have evolved as a team over the years.

The insulation subcontractor is a spray foam company. In the past, there were a few issues with sprayers who previously didn't need to be as precise, but now they have to spray the foam with accuracy and perfection.

Type of House: The house is a small 112 m^2 (1200 ft^2) two-storey detached timber frame hybrid on a heated crawlspace. It has no attached heated garage and no secondary suite.

Technical Details

Building Envelope:

- Walls (Figure 2): Combination of high density wall system, 38x140 mm (2x6 in.) structural wall with intermediate 38x89 mm (2x4 in.) studs. High-density spray foam insulation filled the outer cavity followed by another 25 mm (1 in.) layer of rigid polyisocyanurate foam board insulation with a foil facer on both sides, then mineral wool insulation was installed in the inner 38x89 mm (2x4) wall. The builder feels this is the highest RSI (R) value in the least amount of space. Effective RSI 7.7 (R44).

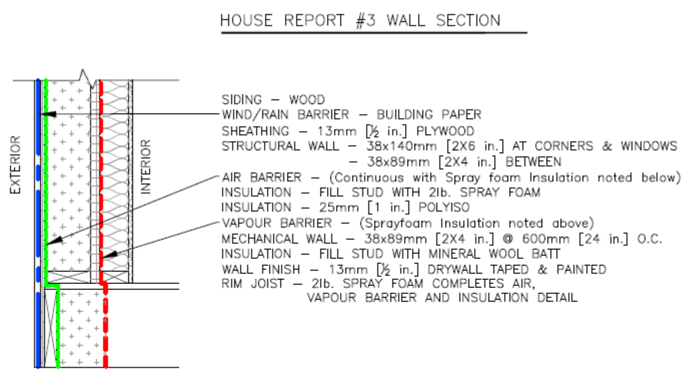


Figure 2: Wall section

- Ceilings: "Hot roof" design - 250 mm (10 in.) of high-density foam insulation. Effective RSI 9.5 (R54).
- Foundation: Crawlspace on ICF (insulated concrete form) blocks, filled with concrete and added more foam on the outside - 200 mm (8 in.) of high-density foam Effective RSI 7 (R40), so minimal heat loss.
- Foundation floor: Insulated with 75 mm (3 in.) high-density EPS topped with 75 mm (3 in.) 2lb spray foam Effective RSI 5.3 (R30).
- Windows: Vinyl, fixed and casement style, quad-glazed with insulated vinyl frames throughout (locally manufactured)
- Doors: Owner-built wood doors - foam filled, double system for air barrier.

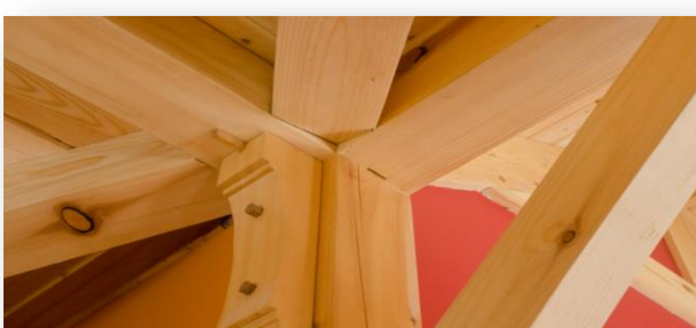


Figure 3: Interior detail

Mechanical Systems:

- Space heating: Electric baseboard, wood cook-stove back-up because that is what the owner is familiar with. Electric baseboards were chosen for low-cost and simplicity.

- Ventilation: Fully ducted Eneready 2000 Diamond E heat-recovery ventilator (HRV) 70% SRE at -25°C (13°F) balanced at 47 L/s (100 cfm) High speed and 24 L/s (50 cfm) low speed.
- Hot water: Electric conserver tank.
- Rain water is collected for the garden.

Lessons Learned:

This builder has been perfecting his design over the years and would use a similar design in future homes (Figure 4), though he admits he's always looking for little ways to sneak in another layer of insulation.

For the foundation walls, the ICF was a little pricier than framing but he would do it again if the customer could afford it.

If the house wasn't so well insulated he would still heat with wood, but would have to install more electric baseboards. They have to control the wood stove so that they are not getting too hot, which is a nice problem! They may need to get a brick oven to store the heat overnight.

Figure 4: Kitchen

He did not use the EnerGuide rating system. In his opinion the recommendations can be misleading. He knows he's a bit stubborn that way. He feels that systems are designed by people who only work on the computer rather than experiencing it by themselves on a ladder at the actual work place, which can just make things more confusing.

Figure 5: Wood cook stove

Other Energy Efficiency and Sustainability Features:

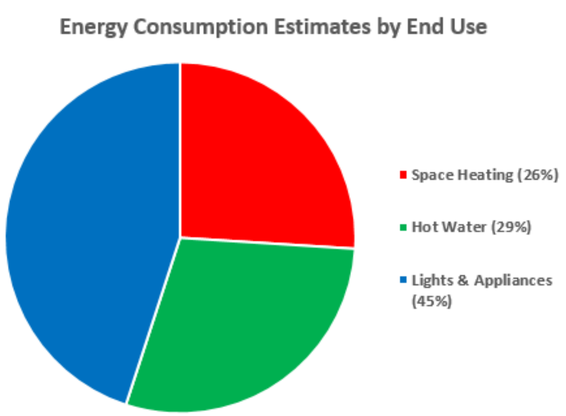
- Lighting: Mixed of halogen lamps, light-emitting diode (LED) lamps and some compact fluorescent lamps (CFL). Since the house is very well insulated, the heat produced by the lights contributes to the heating too, so the builder did not necessarily use the most energy efficient technologies.
- Appliances: All appliances are Energy Star® rated. He also has a secondary wood cook stove (Figure 5).
- Other features include: Orientation - how the house is positioned to capture passive solar heat gains, location of the wood stove is very important together with trying to keep house more open to get even heat everywhere.

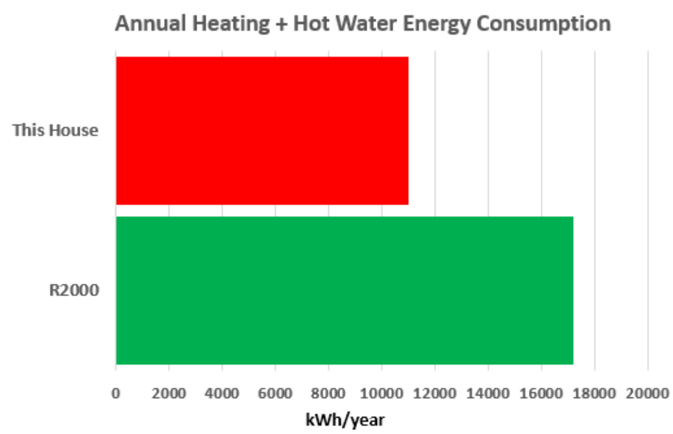
Energy Consumption Performance:

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	6 kW (20,472 BTU/h)
Main floor(s) heated area	95 m^2 (1,022 ft^2)
Crawlspace heated area	58.5 m^2 (630 ft^2)
Total liveable area	95 m^2 (1,022 ft^2)
Building footprint	77 m^2 (830 ft^2)
Window area	19.8 m^2 (152 ft^2)
% of windows facing south	37%
Air leakage rate @ -50 Pa (*as operated*)	0.9 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	128 cm^2 (19.76 in^2)
Annual energy use per m^2	208 kWh/m^2
Projected total annual energy usage	19,714 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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