Case Study #7 Takhini Hot Springs Road

SUMMARY: This profile features a house built by a homeowner using high efficiency structural insulated panels (SIPs). This house (Figure 1) is a simple design built 15 km outside of Whitehorse City limits off the Takhini Hot Springs Road. The homeowner chose to build a high-efficiency home, despite the fact that he was not bound by the City's thermal performance bylaws. This house is heated with wood with conventional electric heat as a back-up.

Figure 1: SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments:

The homeowner took the Yukon Housing Corporation (YHC) Homeowner/ Builder Self-Help Course which included one lecture on super energy-efficient construction techniques. He was in the process of designing a "retirement home", so his key criteria were minimizing operating and maintenance costs and minimizing the complexity of running it. SIPs (Figure 2) were more economical for overall cost of installation and have less materials waste. He wanted to build green, but affordable green.

He and his wife would have liked to incorporate renewable energy technologies into the house, but they weren't ready to install any until they were more proven cost effective. Instead they focussed on insulation and air-tightness and a compact design. He used SIPs, and added more insulation to this wall system, quad windows and a double exterior door system and maximized his glazing for solar gain.

For resources, he used information from the YHC course, local energy specialists and consultants, the local window manufacturers, the company who fabricated the SIPs, a building inspector, a civil engineer, a building designer and a carpenter.

Location: This SuperGreen house is located in an agricultural area off the Takhini Hot Springs Road near Whitehorse, Yukon.

Figure 2: SIPs assembly

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

Figure 3: SIPs assembled

Designer-Builder Team:

He and his wife came up with the design and drew up the plans which they gave to the SIPs company who prepared the engineered drawings. They started by contracting a friend who is a carpenter. Together they learned how to assemble the prefabricated SIPs walls and roof based on details from the manufacturer. An example of this is using heavy duty tie down straps to pull sections together for an airtight seal.

They were open to experimenting, problem solving and thinking through the details together. The owner and his carpenter completed the majority of the trades work calling upon specific expertise as necessary.

They designed and built the house so they could manage it themselves and so they could control the cost. He was building it primarily for them to live in. They did not run the design through the EnerGuide rating program. They found the building inspector very supportive and helpful with any issues that came up.

He suggests that contactors, tradespeople and individual homeowners would benefit from education on SuperGreen (SIPs in particular) education and incentive programs are good promotional tools.

He notes that because heating is very expensive, it's worthwhile to spend extra money up front especially in relatively low cost items like insulation and air tightness.

Type of House: This is a modest-sized detached two-storey house with a 2 m (6.6 ft.) crawlspace and a living area of approximately 214 m^2 (2300 ft^2). It has no attached garage but does have an attached woodshed and has no rental suite. The crawlspace includes 88 m^2 (952 ft^2) for storage and utilities (hot water tank, HRV).

Technical Details

Building Envelope:

- Walls (Figure 4): 21 mm (8 1/4 in.) SIPs RSI 6.4 (R36) with a 38x89 mm (2x4 in.) interior wall against the SIPs insulated with fibreglass batts. Effective RSI 9 (R51.5).
- Ceilings: Hot roof cathedral ceiling 300 mm (12 in.) SIPs, Effective RSI 9.2 (R52) insulation.
- Foundation: Crawlspace preserved

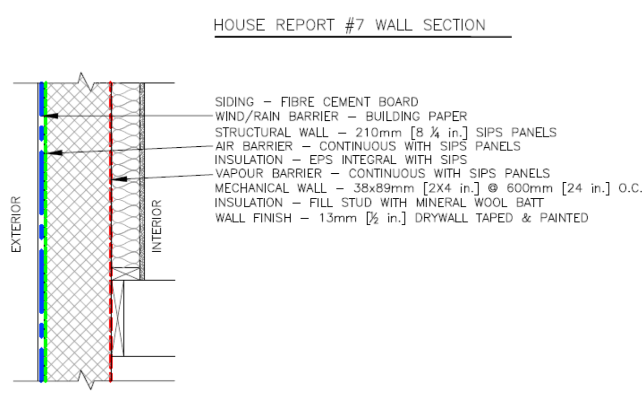


Figure 4: Wall section

wood foundation (PWF) with staggered double studs on a concrete strip-footing. The sections of the main floor walls that are below ground are built the same as the crawlspace.

- Foundation floor: Type IV expanded polystyrene (EPS) and 6 mil poly covered with washed pea gravel.
- Windows: Fixed and casement style, quadruple-glazed, argon-filled low-e throughout (locally manufactured).
- Doors: Polyurethane foam filled metal doors with glass and locally manufactured double exterior door system.

Mechanical Systems:

- Space heating: Primary: EPA wood stoves (large one for main heating, smaller one in living area when required). Secondary: Electric baseboards.
- 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 35 L/s (75 cfm) low speed.
- Hot water: Electric conserver hot water tank.


Figure 5: Quad windows

Lessons Learned:

He chose the wall system for energy efficiency and ease of construction. Though he has no experience with other energy efficient wall systems, he was happy with the house design and with the SIPs. They found that builders/ contractors don't want to build with SIPs because they're not experienced with them and it's not profitable for them because the fabrication and materials purchase occurs elsewhere. For himself as the homeowner, he found SIPs were fast to put up.

Similarly with the site built foundation walls he would use this system again. It was relatively inexpensive and easy to build.

They used fibreglass batt insulation for the foundation walls because of cost, but the alternative would have been spray foam insulation.

He chose quad windows (Figure 5) because they are the most energy efficient. They increased R value by more than 45% compared to triple glazed with coatings for only a 25% increase in cost. He would use quad windows again, but he admits they were very heavy to install. The added bonus is the better sound barrier to outside noise.

For his main entry door he chose a solid single door in combination with an arctic entry. He chose to keep the doors solid and place quad windows adjacent to the doors to let in the light, rather than putting glass in the door.

Figure 6: Woodstove

The other entries use a double door system which is working well, though he thought there might be a frosting issue between two doors but there is no evidence of this so far. The esthetic and convenience trade off was creating the air lock. They found that the thickness of the wall at 330 mm (13 in.) was perfect for this double door system. When you put the two doors together and close them it squeezes the air out. This keeps the inner door warmer.

Figure 6: Vaulted ceiling

In a future vaulted ceiling (Figure 6), he would insulate the same way. It was effective and inexpensive and relieved lot of ventilation problems that can occur in an attic. With SIPs he didn't have to apply a vapour barrier because the SIPs are both an air and vapour barrier, but installed one anyhow just to be sure.

For the heating system, he made decisions based primarily on the low capital cost of electric baseboards and wood stoves (Figure 7). Wood is also plentiful and low cost in his area. Baseboards are the least expensive to install, and wood stoves are inexpensive to operate. He keeps the baseboards at a minimum 10 degrees Celsius, he notes they seldom come on.

Figure 7: Wood stove

He wanted to allow natural convection of hot air, so he left the chimney chase open to allow heat to go up to the first floor. He brings the wood through a 'wood bin' like in the old days when they delivered coal. The bin is connected to the wood shed and filled from the outside. He put considerable thought into wood storage and accessibility so he could eliminate the need to carry the wood through the house. He expects to use between 3 and 3 ½ cords of wood per year.

Building a SuperGreen home influenced his choice of heating systems because he believes that using primary wood heat maximizes heating cost efficiency. In the future he plans to explore some different heating system options such as an air source air heat pump as a way of using electric heat more efficiently.

Other Energy Efficiency and Sustainability Features:

- Lighting: Mostly light-emitting diode (LED) lamps and some compact fluorescent lamps.
- Appliances: All appliances are Energy Star® rated.

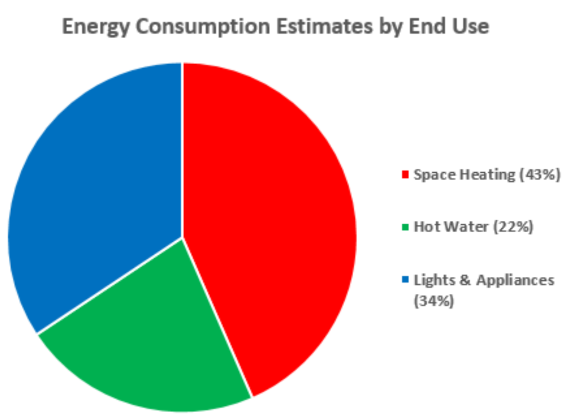
- Other features include: Four rainwater collection barrels for gardens, induction cook stove, a simple high efficiency bath fan air circulation system to move heated air from the wood stove to other rooms; and a stairway ceiling fan to move heat around. They collected their untreated waste construction wood and use it for kindling.

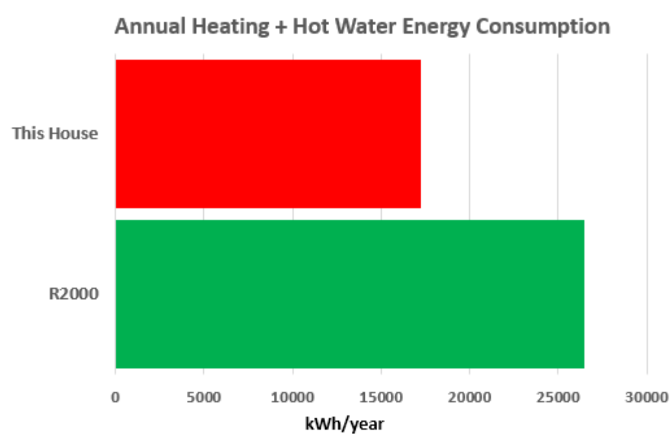
Energy Consumption Performance:

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	10.5 kW (35,827 BTU/h)
Main floor(s) heated area	185 m^2 (1,988 ft^2)
Crawlspace heated area	88 m^2 (952 ft^2)
Total liveable area	185 m^2 (1,988 ft^2)
Building footprint	100 m^2 (1,080 ft^2)
Window area	31.8 m^2 (342 ft^2)
% of windows facing south	61 %
Air leakage area @ -50 Pa (*as operated*)	1 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	277 cm^2 (43 in^2)
Annual energy use per m^2	140 kWh/m^2
Projected total annual energy usage	25,936 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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