Case Study #8 Nijmegan Road

SUMMARY: This profile features a duplex (Figure 1) built by a contractor-designer who incorporated old, simple, high-quality ideas with SuperGreen energy-efficiency. This is the first Leadership in Energy and Environmental Design (LEED) Canada for Homes certified project in Yukon. The wall design is a 38x89 mm (2x4 in.) double stud wall filled with low-density spray foam insulation. The house has electric heat, but also incorporates thermal storage in the basement floor to reduce electrical peaks on the grid.

Figure 1: SuperGreen House, Whitehorse, Yukon

Why SuperGreen[1]? Builder, Occupant Comments:

The designer-builder attended a talk on a SuperGreen house which Yukon Housing Corporation (YHC) built in Watson Lake. He was taken by the comment that "there is nothing simpler to do". Building for sustainability and reducing the risk to fluctuating energy costs inspired his decision to build high-efficiency.

This is a two-storey duplex with a basement, no heated attached garage and no secondary suite. It was built as an investment and to showcase the energy efficiency.

Location: This SuperGreen house is located in the infill neighbourhood of Takhini North, Whitehorse, Yukon.

Designer-Builder Team:

The design approach was based on YHC's design and included lots of insulation. A small-construction contractor agreed to take on the project. The contractor had no previous experience in building SuperGreen, but was willing to be innovative and try new things.

The tradespeople who worked on this house had worked on other houses as a team. They worked well together under the jobsite supervision and coordination of the owner-builder. None of the trades prepared drawings in advance, but there was an initial team meeting to kick off the project and identify potential problems. Since the design was based on YHC's SuperGreen, they did not use the EnerGuide Rating program to evaluate building options.

While the EnerGuide program results were not used to model different "what-if" scenarios, the design was used in the EnerGuide modelling to achieve a LEED certification for the house.

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

Type of House: This house is 2-storey side by side duplex constructed on a full unfinished basement. Each side is 89 m^2 (960 ft^2). The project was built as a spec home and it has been awarded LEED Canada for Homes Gold certification.

Technical Details

Building Envelope:

- Walls (Figure 2): Double 38x89 mm (2x4 in.) stud truss type wall. The cavity was filled with low-density foam insulation, with the poly air-vapour barrier on the inside of this double wall. They added an additional interior 38x89 mm (2x4 in.) wall insulated with mineral wool for mechanical/electrical services.

  Effective RSI 9.2 (R52).

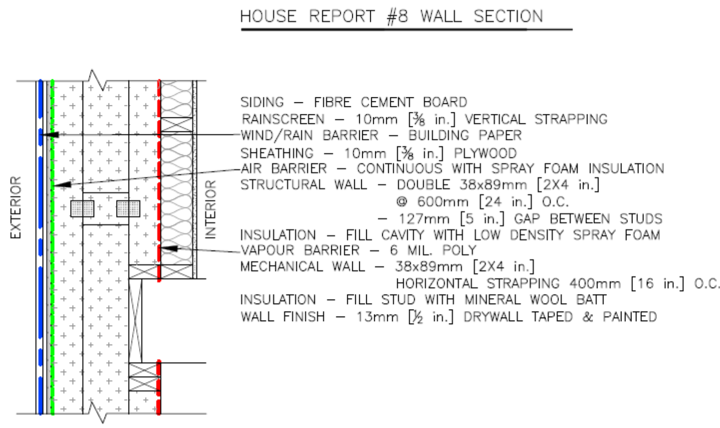


Figure 2: Wall section

- Ceilings: Vented attic, high heel trusses, RSI 17.6 (R100), cellulose.
- Foundation: Insulated concrete form (ICF) foundation RSI 6.9 (R39).
- Foundation floor: 6 inches of type IV expanded polystyrene foam (HS40) RSI 5.3 (R30) under concrete slab.
- Windows: Vinyl, fixed and casement style, triple-glazed, argon-filled, low-e on all windows (locally manufactured).
- Doors: Metal polyurethane foam-filled double door arctic-combo system.


Figure 3: Hot water

Mechanical Systems:

- Space heating: Electric baseboard, in-slab radiant heat in basement for thermal storage. Electric baseboards were chosen for low-cost and simplicity. A high-performance house doesn't consume much energy, so no need for an expensive heating system. As well, it's considered to be "green" energy when hydro-electricity is available.
- Ventilation: Fully ducted Venmar EKO 1.5 ECM heat- recovery ventilator (HRV) 64% SRE at -25°C (13°F) balanced at 57 L/s (120 cfm) high speed and 28 L/s (60 cfm) low speed.
- Hot water: Electric conserver tank with drain water heat recovery on main drain line (Figure 3).
- Renewable energy system: Provisions were made for solar photovoltaic (PV) and solar hot water, but systems are not installed at this time. This included installing chases from the attic to the basement for solar hot water lines plus pre-wiring from the attic to the electrical panel area for future solar PV. The long-axis of the house is East-West with the roof slope oriented south to facilitate the installation of solar PV or thermal

panels.

Lessons Learned:

If he was doing it again, the owner-builder would fine-tune the wall system to speed up construction and "constructability". He would use taller floor joists and better plan where the ductwork was going in advance to reduce bulkheads from dropped ductwork in the ceiling.

The builder prefers the approach of insulating *from the inside* to allow a better plan for the connections between walls and ceilings.

Another challenge was convincing the plumber not to make an attic access hole in the air-vapour barrier. In the end, it is the general contractor who has to fix the leaks.

Next time, this builder would use the same design (ICF) for the foundation walls - resilient, strong, fast, easy to work on (Figure 4). They would also use the same method for the floor. As well, they were very happy with using blown cellulose for ceiling insulation. It is inexpensive to install and effective.

Locally manufactured windows were chosen for availability, performance and price, but they have un-insulated vinyl frames at this time unless they are insulated as a special request.

Figure 4: ICF detail

Other Energy Efficiency and Sustainability Features:

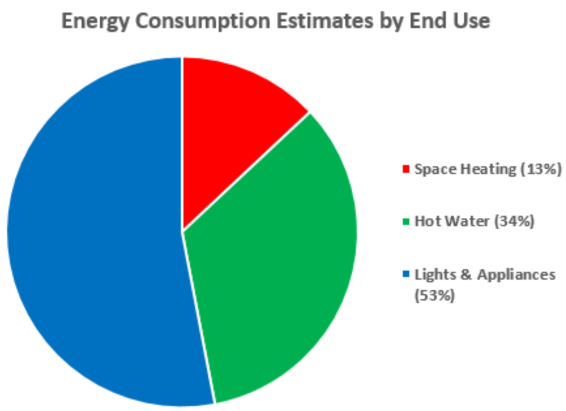
- Control systems: Programmable setback thermostats in each room.
- Lighting: Combination of compact fluorescent lamps (CFL), light-emitting diode (LED), incandescent and halogen lamps. Some motion-sensors in closets.
- Appliances: All appliances are Energy Star® rated.
- Indoor environment features include hard surface floors (easily cleaned so better air quality due to less dirt & dust) and good climate control (walls are very well-insulated, so the house maintains a more constant temperature and is therefore very comfortable).
- Purposeful low-waste building practices - careful sorting and re-use facilitated by using only 38x89 mm (2x4 in.) dimensional lumber for the walls rather than several sizes.

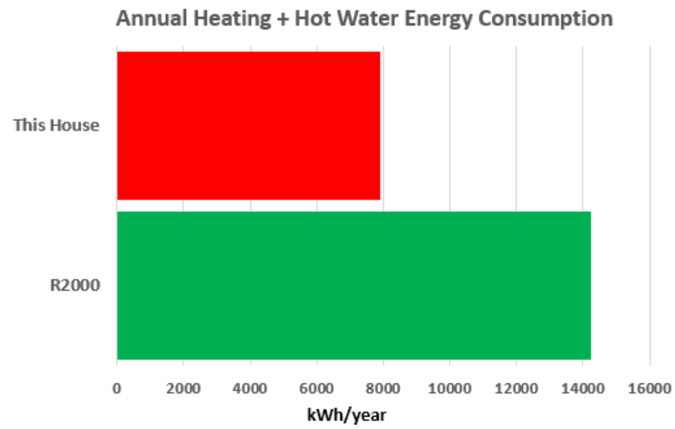
Energy Consumption Performance:

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°C
Mean January temperature	-16.2°C (2.8°F)
January heating design temperature	-41°C (-43°F)
Heating system design heat load	4.5 kW (15,354 BTU/h)
Main floor(s) heated area	74 m^2 (792 ft^2)
Basement heated area	37 m^2 (396 ft^2)
Total liveable area	111 m^2 (1,188 ft^2)
Building footprint	45 m^2 (480 ft^2)
Window area	12.4 m^2 (134 ft^2)
% of windows facing south	29%
Air leakage area @ -50 Pa (*as operated*)	0.62 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	59 cm^2 (9.2 in^2)
Annual energy use per m^2	150 kWh/m^2
Projected total annual energy usage	16,644 kWh/yr
Actual performance as it compares to occupant utility bills	20 % less annual energy was used over 2-year period than predicted due to occupant lifestyle (both sides show same trend)

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