Case Study #9 Phoenix Rising

SUMMARY: This profile features the first of Habitat for Humanity's (HFH) SuperGreen houses built in the Yukon. They began constructing this triplex after Yukon Housing Corporation (YHC) built their first SuperGreen houses. HFH is a non-profit organization that builds houses for families in need, who are not eligible for a conventional mortgage. The family must have lived in the Yukon for one year.

On the site of an ex-drug house, the process of building this home - aptly named *"Phoenix Rising"* - was meant to put some positive energy back into the property.

Figure 1: SuperGreen House, Whitehorse, Yukon

In addition to employing local tradespeople, Phoenix Rising incorporated labour that benefitted many aspects of the community. Yukon College carpentry, plumbing and electrical classes also gained hands-on experience with SuperGreen construction techniques. Whitehorse Corrections Centre contributed work crews. As well as the regular volunteers, the would-be owners invested sweat equity into their future home.

This house has a truss wall where the exterior is a non-bearing 38x70 mm (2x3 in.) the interior framing of the truss is a structural 38x89 mm (2x4 in.).

The cavity is filled with dense packed cellulose insulation. This house is heated with conventional electric baseboard to simplify maintenance costs.

Why SuperGreen[1]? Builder, Occupant Comments:

The primary builder-designer, who also runs the carpentry program at Yukon College, has always been interested in energy efficiency. Phoenix Rising was a champion project for the carpentry program, providing students with a chance to work alongside and learn about YHC and HFH.

The design focused on the building envelope, insulation and windows. Using publications from the Canadian Wood Council, the wall system was developed under the guidance of YHC who was extensively involved in the project.

The builder-designer thinks that increased costs and the need for more training of trades is a limiting factor to broader adoption of SuperGreen. Phoenix Rising did a lot of advertising about the project, presenting the public with straightforward easily understood cost-benefit analysis.

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

Location: This SuperGreen house is in an urban residential area on Wheeler Street in downtown Whitehorse, Yukon.

Designer-Builder Team: While several people with plenty of experience in designing and building houses were part of the project team, this project did not have a designer per se. They had a technical committee - consisting of a team of skilled people both paid and unpaid including YHC, Whitehorse Bylaw, contractors and the Energy Solutions Centre to provide feedback and recommendations on the house components. Final decisions rested with HFH's Board of Directors.

Yukon College carpentry program instructor fulfilled the role of site supervisor while the building was being clad to weather. This included coordinating all of the trades, specialists, carpentry students and volunteers, who were coming in to help throughout the project as needed. Most of the people who worked on this house had not worked together before. However, in keeping with the practice of Yukon College carpentry program, they all met regularly to discuss any issues and next steps.

Paid tradespeople were provided with drawings of the house and expected to show plans of where wiring and plumbing would go for Yukon College students to install.

Type of House: This is a modest two-storey triplex on a 1.2 m (4 ft.) crawlspace with each unit having 130 m^2 (1400 ft^2) of living area. There are no additional suites.

Technical Details

Building Envelope:

- Walls (Figure 2): Hybrid custom Larsen truss, 360 mm (14 in.) stand-off on the outside of a 38x89 mm (2x4 in.) inner frame wall. Effective RSI 9.9 (R56).
- Ceilings: High heel trusses, vented attic with blown cellulose RSI 14 (R80).
- Foundation: Foundation walls similar to main floor but used preserved wood below grade.

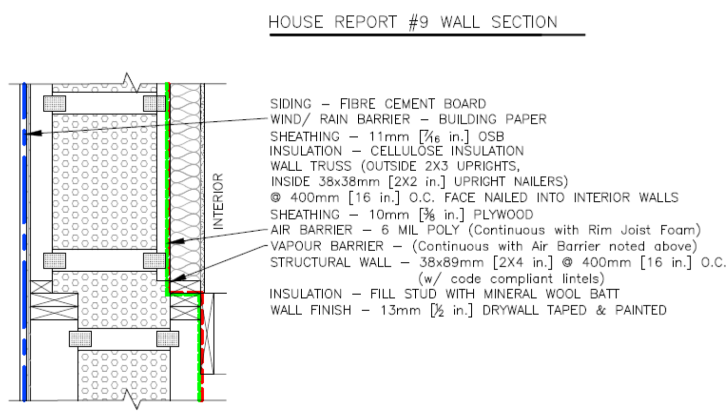


Figure 2: Wall section

- Foundation floor: 2 inch layer of type IV expanded polystyrene (EPS) RSI 1.8 (R10) on the ground.
- Windows: Fixed and casement style, quadruple-glazed, argon-filled, low-e throughout (locally manufactured).
- Doors: Double-door system - two exterior polyurethane insulated doors - one interior to the wall, one exterior to the wall.

Mechanical Systems:

- Space heating: Electric baseboard, chosen for economy.
- Ventilation (Unit A): Fully ducted Eneready 2000 Diamond E heat-recovery ventilator (HRV) 70% SRE at -25°C (13°F) balanced at 57 L/s (120 cfm) high speed and 24 L/s (50 cfm) low speed.
- Hot water: Electric conserver tank.
- Renewable energy system: Passive solar gain only.

Lessons Learned:

The design took a few false starts to get on track. After some initial floundering the project was reassigned to Yukon College carpentry program and YHC who embraced the opportunity to work together to build a SuperGreen home for HFH. Still, the main hurdle for this project was that there wasn't a proper designer on the team. This created many problems, particularly with integrating mechanical systems, electrical and plumbing (Figure 3).

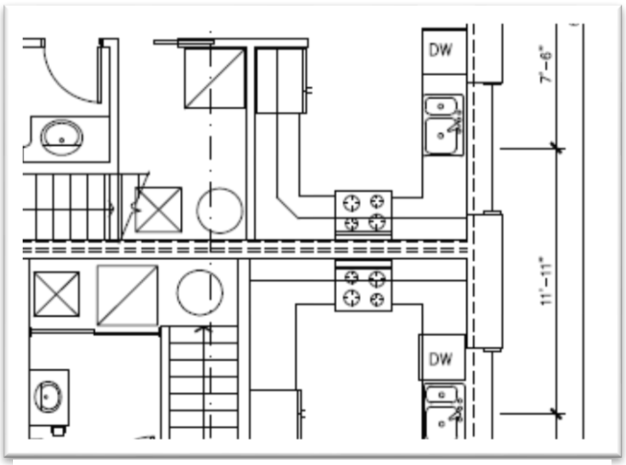


Figure 3: Mechanical systems, electrical and plumbing

The electrical, plumbing and HRV were all installed by the college trades classes so knowing exactly what to do at the outset was paramount.

Finishing of the house was taken on by another group and not all the details were known by all the groups involved. The project survived numerous challenges along the way, partially due to the nature and timing of the project, coordinating professional tradespeople and institutional involvement in the process. They obtained variances from local authorities to allow the building to encroach on the property boundaries.

Throughout construction, YHC ran EnerGuide models and the team incorporated changes based on the results for economics and other considerations.

They chose a Larsen wall-truss system (Figure 4) in order to completely wrap the building in a solid layer of cellulose insulation with no thermal bridging. However, while the builder liked the idea of it on a very simple box shaped building, if they were doing it again, he thinks the stand-off wall was perhaps a bit too deep and overall success depends upon the cellulose applicator's experience.


Figure 4: Larsen wall-truss system

The cellulose settled in the wall leaving a gap at the top, so the walls had to be topped up during construction. Due to uncertainty with future cellulose settling, and the way HFH builds their houses - particularly using volunteer labour - this wall system is no longer used. Construction took somewhat more time than standard, partly due to the number and variety of experience of the people working on it.

For the foundation walls, the preserved wood truss walls were difficult to design to support lateral soil pressure. They wouldn't choose this foundation wall system again and would use insulated concrete forms (ICF) if the project could afford it. They were satisfied with the ceiling system and would do it the same way again. They chose electric heat because it is inexpensive to install, and cost efficient in a super insulated house.

The main builder (college carpentry instructor) has experience with different wall systems, but he has no favourite - it depends on the context. His own home has just 38x140 mm (2x6 in.) walls, but he regrets not building a thicker wall. He has a friend who attempted to build a SuperGreen house, influenced by Phoenix Rising, but it went very badly due to lack of builder understanding of the wall system.

The double door combination of two exterior doors (one interior one exterior) needed to be refined to allow a vented lite in one door for pressure relief. The extra thick wall assembly is also believed to put the doors too far apart and have too much space between causing moisture issues (freezing locks).

Other Energy Efficiency and Sustainability Features:

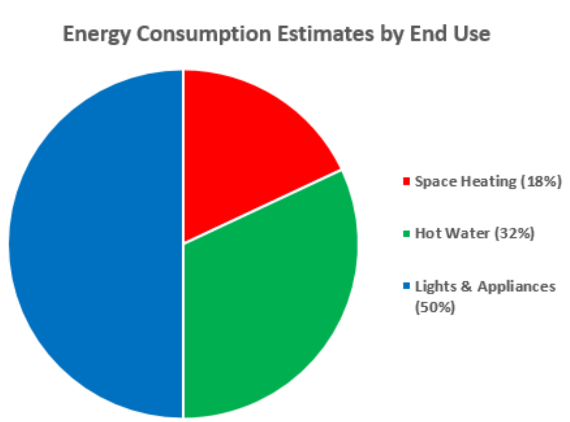
- Appliances: All appliances are Energy Star® rated.
- Other features include: Drain water heat recovery on drain line. This triplex received the first production quadruple-pane windows from the local manufacturer.

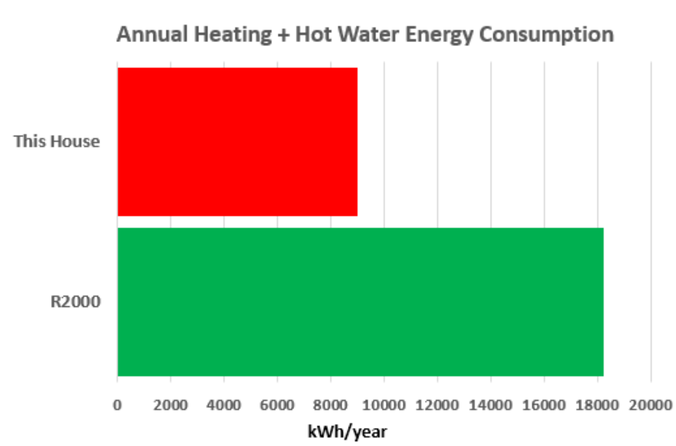
Energy Consumption Performance (Unit A):

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	5.5 kW (18,766 BTU/h)
Main floor(s) heated area	130 m^2 (1,404 ft^2)
Crawlspace heated area	65 m^2 (702 ft^2)
Total liveable area	130 m^2 (1,404 ft^2)
Building footprint (whole triplex)	217.7 m^2 (2,344 ft^2)
Window area	21.2 m^2 (228 ft^2)
% of windows facing south	38 %
Air leakage rate @ -50 Pa (*as operated*)	1.1 ach
Equivalent leakage area (hole size) @ -10 Pa (*as operated*)	136.1 cm^2 (21.1 in^2)
Annual energy use per m^2	136 kWh/m^2
Projected total annual energy usage	17,726 kWh/yr
Actual performance as it compares to occupant bills	2% below projected averaged over a 4-year period

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