

What's Behind The Walls & More

The house was designed to show that with thoughtful, simple design volunteers can build a very good house that outperforms the building code and still meets Habitat Canada's guidelines for a three bedroom family home. The Partner family will live in a house that is very energy efficient, offers good indoor air quality and comfort, has durability both for natural events such as wild fire and winter storms and a long, low maintenance, service life.



The home is two storeys with about 1250 sq. ft. of floor area. The cube form is very energy efficient and has a small surface to volume ratio. The two storey design reduces the area and cost of the foundation and the roof by about half. The house can be expanded to the east and west in the future. The house meets Natural Resources Canada's Net Zero Ready criteria. By adding solar panels, the annual electrical operating cost of the home can be Net Zero.

Through a competitive process, the home has been recognized by CMHC for a National Housing Strategy Co-Investment Fund capital grant. This is a first for Pointe au Baril and the Habitat affiliate Ontario Gateway North which serves north eastern Ontario.



As there is no community fire service in Pointe au Baril and the house is sited in a forested area, MNRF's building approval required the exterior of the home to be fire hardened. The roof and siding are steel, wood posts, fascia and soffits are metal clad and entry pads are concrete and gravel. For a 10m. (35') radius around the home there are no trees or ground cover - just grass to cut. From 10 to 35m. (100') the understorey and dead wood has been cleared and touching trees thinned. Building on a bedrock crown simplified this requirement.

www.edcoproducts.com/products/steelsiding

www.stanleysteel.ca/roofing-siding



The house has been tested for air leakage during three important stages of construction. The final test result was a rating of .68 Air Changes per Hour (ACH) at a pressure of 50 Pascals. The standard for an Energy Star home is 2.5 ACH/50. Builders production homes are most often beyond 3.0 ACH/50. The toughest and higher construction cost standard is Passive House at .60 ACH/50. Being under 1.0 ACH/50 is real achievement for the designers and the volunteer builders.

Build right, ventilate right is the goal with a very tight building envelope. Low air changes mean less random air to heat and cool but also requires controlled ventilation for a healthy living environment. Fresh air is provided by a fully ducted, balanced ventilation system that delivers fresh air to the bedrooms and living room and extracts an equal amount of air from the moister areas of the house such as the kitchen, utility room and bathroom.

85% of the heat from the exhaust air is transferred to the incoming cold air. The home has a vanEE Gold series, Energy Recovery Ventilator (ERV) in the utility room with the 6" main and 4" branch ducts hidden in the second floor, open web, floor assembly. Humidity is also managed by the ERV.



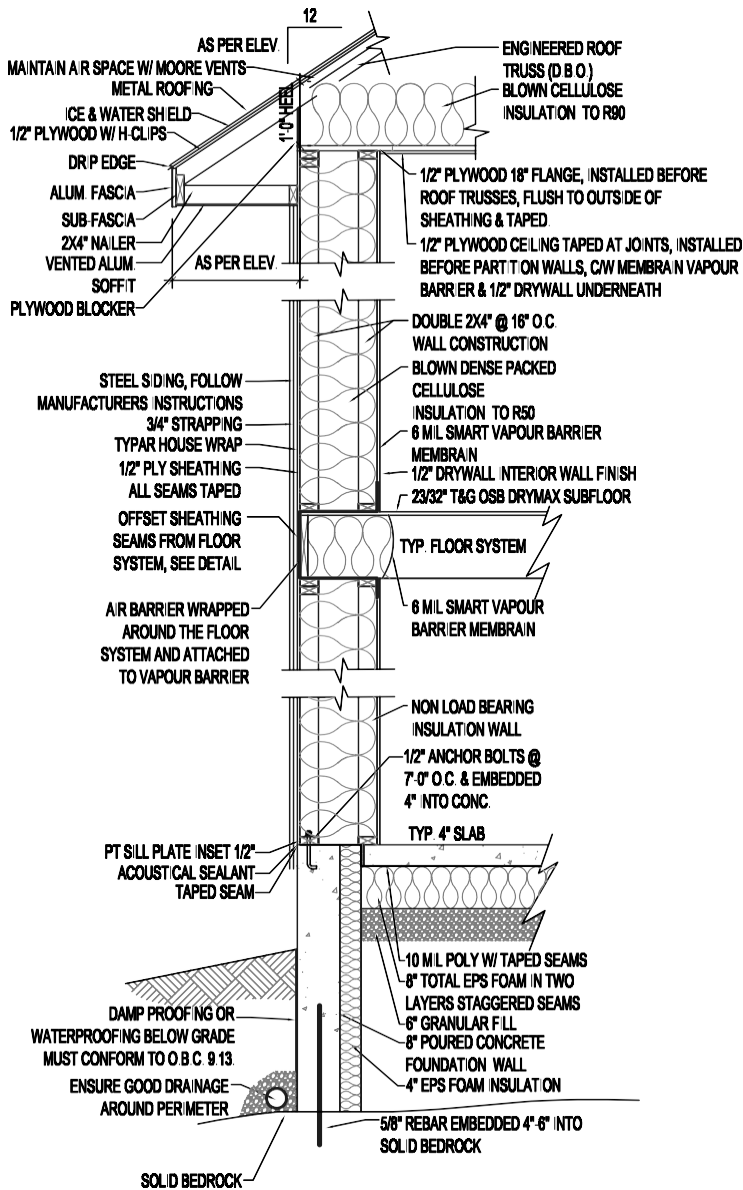
www.vanee.ca/en/products/residential-air-exchangers

Main Floor Assembly: The main floor is a concrete slab with vinyl T&G plank flooring. Uninsulated concrete floors can be a significant source of heat loss. But in the Habitat house, concrete floor temperatures are the same as the exterior and interior walls. How come? The eight inch cement filled block walls, on the inner surface have four inches of EPS foam in 4x8 sheets from the sill to the bedrock. Under the concrete slab are two layers of four inch EPS foam sheets for R34 insulation and a 10 mil vapour barrier that comes up the wall and is sealed to the outside of the foundation. The concrete floor has both thermal and vapour breaks from the cold bedrock and block wall. The large south facing windows in the living and dining areas are glazed to let in the winter sun to warm the concrete floor.

That’s bare foot comfort on concrete without the cost of mechanical in floor heat lines!



www.isolofoam.com/en
www.wrmeadows.com/en.ca/perminator-underslab-vapor-barrier



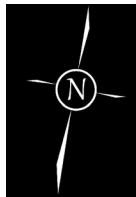
TYP. DETAILED WALL SECTION

SCALE N.T.S.

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Exterior wall assembly: The exterior walls are 15 inches (381mm) deep and have a whole wall assembly insulation value of +R 50, are air tight but not vapour tight and have a seven inch thermal break between the inner non load bearing wall and the outer wall. Both walls are 2x4" wood stud construction. The outer walls are sheathed in half inch plywood, with all seams taped and offset at the floor assembly. Plywood is known as the original smart vapour barrier and responds much better to moisture than OSB. Tyvek and like house wraps are a water resistant barrier although many builders use it as an air barrier. The Habitat walls are designed to vent to the interior and the exterior. Volunteers could build and erect a wall in a couple of hours, while still having fun.

A standard code built home of 2x6" stud walls, OSB sheathing and two inch foam sheets has an insulation value of A R30 and the materials cost more because foam + OSB + 2x6 are a higher cost per square foot than double wall with cellulose. 2x4's are quite cheap. The heating bill for the life of the house is thousands of dollars less per year and the wall is designed to allow any errant moisture to passively escape.



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The seven inch wall gap makes wiring easy. Thermal imaging on the exterior sheathing shows a very even temperature across the wall surface. Back vented EDCO steel siding assists the dispersal of any vapours and water.



Insulation: The exterior wall cavity is insulated with dense pack cellulose blown in under pressure and temporarily held in position by a mesh fabric. Cellulose is recycled paper products with a fire and insect treatment. It is cheaper than foams and fiberglass and has very low manufacturing carbon impact. The wall cavity is completely filled, insulation is tight to the wood studs and blowing pressure fills irregular cavities. The insulation value of the wall assembly is R50+.

Cellulose, along with triple glazed windows, and the wall assembly design contribute to superior sound dampening. The blast of the nearby freight train horn is barely audible inside the house.

A smart vapour barrier is attached to the plates and studs with acoustic sealant and taped at all seams. The smart vapour barrier is Membrain, a nylon product that adapts to varying humidity. In the winter the interior wall cavity is moisture tight; in the summer, the permeability increases to let any errant moisture out.



www.soundsealsinsulation.com/products-services/blown-in-insulation

Insulation video – <https://f.io/YFDBfjic>

www.certainteed.com/membrain

Second Floor Ceiling: An air-tight attic floor is important in building a high performance home. On the second floor, a half inch plywood ceiling was attached to the underside of the raised heel roof trusses after the trusses were secured to the outer exterior wall with hurricane ties. The plywood ceiling seams are taped. Volunteers then installed the interior walls, attic soffit baffles and the attic hatch. The attic ceiling has only three edge sealed penetrations; the plumbing vent stack, the solar ready electrical pipe and, the attic hatch. The attic was air leakage tested, tuned up and then insulated with blown cellulose to R90, about +30" deep. The plywood ceiling provides good support for the deep insulation and easy attachment for the half inch drywall ceiling. The attic hatch has three levels; an R34 foam insulated lift up top, a mid level R16 tilt panel and, a finished ceiling level plywood panel with weather stripping.



Heating: The conservative, permit application, heat load for the Habitat house is 16000 BTUs (100,000 BTUs is a therm.). The smallest conventional forced air furnace is 40,000 BTUs. There is no natural gas service in the area, so the most common and cheapest urban source of home heat was out. The affordable capital, best operating performance and cost choice was Fujitsu, Low Temp, electric Air Source Heat Pump (ASHP) at A\$2.10 /therm. averaging the Ontario medium density cost of electricity over 7 days. The off peak therm. cost is A\$1.70. Because of solar heat gain through the south facing windows, the actual cost will be less as solar heat gain displaces higher cost week day on peak and mid peak electricity. In case of power outages and temperatures below -25C, the backup heat is a best in class Rinnai direct vent propane wall furnace at A \$2.90/therm. Both modulate, have quiet fans, digital thermostats, and are safe for a child's touch. Electric base board has a low capital cost, provides a further level of heat backup, room by room control, but the highest operating cost at A\$6.15 per therm. The electric baseboards should be used sparingly or not at all. If used at nights and on weekends, the electric baseboard operating cost comes down to A\$4.70 a therm.

The two ASHP can deliver up to 28,000 BTUs. The primary unit is on the main floor, the secondary unit is in the upper hall stair wall. The propane wall furnace is on the main floor. With high insulation values and low air infiltration the home is uniformly comfortable. During construction, the propane wall furnace was used for heat and after the building was insulated, maintained an even temperature on both floors.

From a very cold early November to the end of March during completion of construction to occupancy, with walls uninsulated until early December, the propane wall furnace used 567 litres of propane. Parry Sound Fuels reports that most homes in the winter would use 2500 litres of propane. Air sealing for new build or energy retrofitting does work. The modelled annual heat cost for the ASHP is under \$500.



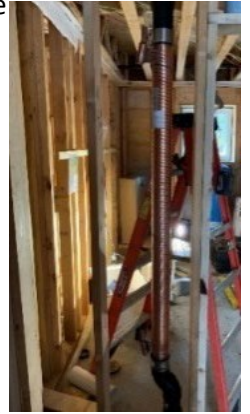
www.fujitsugeneral.com/us/residential/technology/xlth-low-temp-heating

www.rinnai.us/gas-home-heating/direct-vent-furnaces

Water Heating: There are several energy conservation strategies for water heating, which is often 20% to 25% of household energy cost, particularly with teenagers drowning in the shower. The lowest operating cost options are on demand propane or heat pump electric; however, they are also significantly the highest capital cost. Hard water from a well means regular servicing of the on demand heater will be required and in an air tight house, combustion venting can be an issue. With open web floor trusses the cold air exhaust from the heat pump water heater can be disbursed with nominal effect on the living space. The



compromise solution was an up sized (60 gal. not 40 gal.), well insulated, resistance electric water heater with the addition of a 24/7 timer to only heat water during the 64 % of the week when off peak electrical rates are in effect. Tank temperature is increased to around 55C. (130F.) which when mixed with cold water at the tap increases the volume of usable hot water. The cost of electrically heated water is reduced by some 25% and the electric resistance cost premium over propane is reduced to 25%. The cost of heating hot water is further reduced by the



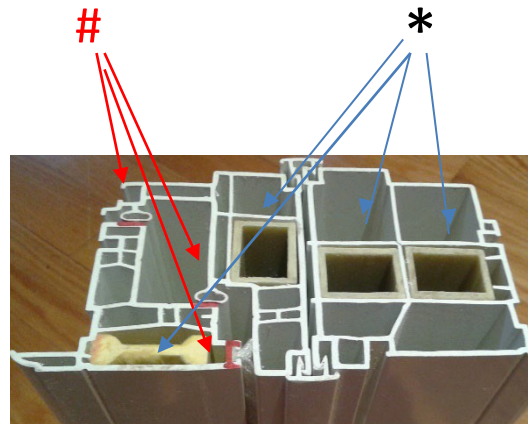
Renewability Energy, Power Pipe, drain water heat recovery unit hidden in the entry wall to the utility room. The copper, pipe on pipe, heat exchanger transfers heat from the shower drain warm water to the cold water supply line to the hot water tank. A tight building plumbing layout further increases the performance of the Power Pipe. With the combination of water heating with off peak power and the Power Pipe the cost of electric resistance water heating is now about the same as propane or \$3.75 per therm. With the combination of heating only with off peak power and the Power Pipe the cost of electric resistance water heating is now about the same as propane or \$3.77 per therm.

<http://renewability.com/>

Windows: The window glazing is all triple paned. A triple glazed window has a warmer interior surface temperature than double glazed. The benefits of triple glazing are thermal comfort, greatly reduced convection cold air draft and noise reduction. The sound of the nearby freight trains almost disappears.

The large windows are focussed on the south side and glazed to let low angle winter sun into the rooms to contribute to heating.

The wide eaves and fixed south side awning block the higher angle summer sun from entering the house. The window glazing on the other three sides of the house is coated to retain heat and reject low angle morning and afternoon summer sun. Decola/Hometech multi-chambered vinyl window frames have fiberglass inserts (* - blue lines) to improve the energy efficiency of the window frame (the red # lines indicate the three compression seals in the Hometech operating windows). Energy efficient construction reduces the need for operating windows, which are more expensive than fixed windows.



The flanged windows were installed with Tyvar flex and flashing tapes using a fully adhered system.

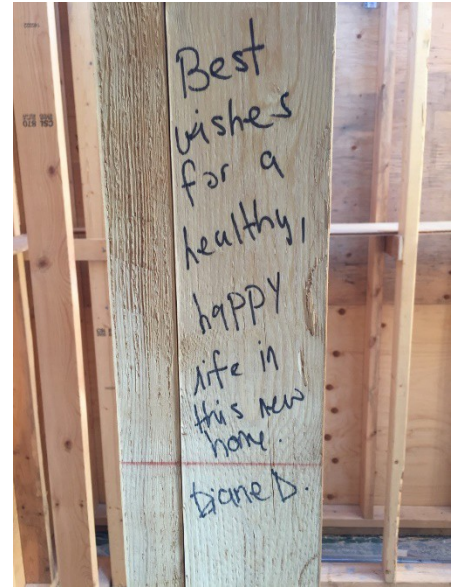
Volunteers watched a You tube video “ Waterproof Window Installation with Rick Arnold’ before putting the windows in. Here’s the link <https://www.youtube.com/watch?v=ycdgjUZf0HO> Window sealing is important in achieving a low ACH rating.

<https://www.decola.ca/>

<https://hometechwindow.com/hometech-advantage/>



Signed with love: Behind the drywall and buried in insulation, you will find handwritten messages and signatures of the more than 100 great volunteers and trades from the islands, the village, the Parry Sound district, and beyond that helped build the house. A written time capsule in a great lifetime house!



For more information, questions and comments about the Pointe au Baril Green Build, the products, and testing please contact the Build Co-ordinator, Bob Fisher, by e-mail at bfisher@osborne-group.com

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