Kenogami House

The Kenogami House in Saguenay, Quebec is the first home built under Ecohome's Net Zero Heat program. It holds the highest LEED point score achieved in Canada [106], a Net Zero Heat rating of 14.6 kWh and a Home of the Year Award from Green Builder© Media in the U.S. for Best Resilient Design.

Mike Reynolds

NET ZERO HEAT

Net Zero Heat is an Ecohome design service and rating system that uses regional climate data to determine the design parameters that would be necessary to build a home that can be heated exclusively by the sun.

Along with its unprecedented achievements, the Kenogami House continues to act as a laboratory for resilient, cold climate building practices. Through software energy modelling, it was determined that the Kenogami House would likely require 14.6 kWh of heat per square metre per year, but its actual performance seems to be even better. Only after a year of operation will we know exactly how much supplementary heat it requires.

What we have learned this first winter is that four hours of heat captured from the sun can provide approximately two days of comfort with no additional heat added beyond normal interior gains, such as those that come from appliances, electronics and people. Heat also seems to be required only between November and mid-February when the days are the shortest.

Regardless of outdoor [Celcius] temperatures in the minus twenties, with full sun the Kenogami House has achieved interior temperatures as high as 26.9 °C, a temperature where many people will have already turned on their air conditioners.

During average winter conditions of temperature and cloud coverage for the Saguenay region, the Kenogami House went 10 days in February with no supplementary heat, yet maintained temperatures in the mid 20s and dropped only to 20.4 °C after consecutive overcast days.

THE BUILDING ENVELOPE

- 91% of glazing is south facing
- Windows are triple glazed, fiberglass framed and argon filled > R4.8
- Ceiling insulation: 3" Polyisocyanurate and 36 inches of cellulose > R151
- Wall insulation: 14" of EPS foam and 7.5 " of mineral wool > R80
- Slab on grade insulation: EPS foam and polyurethane > R64
- 0.57 ACH @ 50 Pa [Air Changes per Hour at 50 Pascals of pressure]

ENERGY SYSTEMS

- 5,400 W photovoltaic solar panels with battery backup
- Radiant floor heat powered by a high-efficiency gas boiler
- 84% efficient **Zehnder** Novus 300 ERV [Energy Recovery Ventilator]

MATERIALS

- Slab on grade, wood frame, and exterior EPS insulation.
- Sidings a mix of steel, stone and locally harvested red spruce.
- Windows by Inline Fiberglass.
- **Isolofoam** Isofix [EPS] below slab on grade.
- Air to water heat pump provides cooling capacity and dehumidification.

ARCHITECT Lucie Langlois
OWNER/GENERAL CONTRACTOR Alain Hamel
DESIGN TEAM Emmanuel Cosgrove, Denis Boyer, Benjamin Zizi
PHOTOS Alain Hamel

THE SOUTHERN FACADE WITH NUMEROUS WINDOWS FOR PASSIVE HEATING WITH THE PROTECTION OF ROOF OVERHANGS AGAINST THE SUMMER SUN [1], AND A PV GROUND INSTALLATION [2].

ISOLOFOAM ISOFIX [EPS] SOLID INSULATION IS USED BELOW THE SLAB ON GRADE [3]. THE HOUSE IS ORIENTED FOR MAXIMUM SOLAR HEAT GAIN [4]. THE BUILDING ENVELOPE IS HIGHLY SEALED AND INSULATED [5]. THE AIR/VAPOUR BARRIER IS SANDWICHED BETWEEN THE WOOD FRAME AND EPS EXTERIOR INSULATION, WHICH HAS HORIZONTAL STRAPPING TO RECEIVE THE SIDING [6]. THICK R-80 WALLS CONSIST OF 14 IN. OF EPS FOAM AND 7.5 IN. OF MINERAL WOOL. WINDOWS ARE TRIPLE GLAZED AND FIBERGLASS FRAMED, WHICH PROVIDE LONG LIFE AND GOOD THERMAL RESISTANCE [7].


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CHART OF TEMPERATURE DIFFERENCES WITH NO AUXILIARY HEAT

DATE	TIME	EXT. TEMP. ºC	INT. TEMP. ºC	SLAB ºC
Feb, 17 [full sun]	8:00 am	-20.9	22.2	19.5
	12:00 pm	-16.9	26.1	19.5
	5:00 pm	-14.7	26.9	19.5
Feb. 18 [mixed sun and cloud]	7:00 am	-24	22.6	20
	10:00 am	-14.1	24.3	19.5
	6:00 pm	-5.7	24.3	20
Feb. 19 [overcast]	6:30 am	-3.1	20.8	19
	1:00 pm	-0.5	22.8	18.5
	6:30 pm	-1.2	22.5	18.5


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To balance heat through the home, unheated water is pumped through the slab floor transferring the warmth of the sun from the southern exposure to the north end of the house, also helping prevent rooms exposed to the sun from overheating.

HEATING WITH A HAIR DRYER

While the Net Zero Heat Program designs from the benchmark of complete passive solar heating, in terms of resiliency we would always recommend at least some alternative heat source to ensure comfort during prolonged overcast periods. At this level of thermal performance, one centrally located single heater of approximately 2,100 w [a powerful hairdryer] would likely be more than sufficient during the most extended cold and overcast conditions, but for the most part would not be used at all.

While similar in concept, a Zehnder ERV [Energy Recovery Ventilator] was chosen over an HRV [Heat Recovery Ventilator], as they are particularly well-suited to extreme northern climates. Air is able to support less and less water vapour the colder it gets, and an ERV extracts that energy-rich moisture from interior exhaust air before it is ejected. This helps keep indoor humidity at more comfortable levels, along with retaining the added heat energy [known as 'latent heat'] that is contained in vapour compared to dry air.


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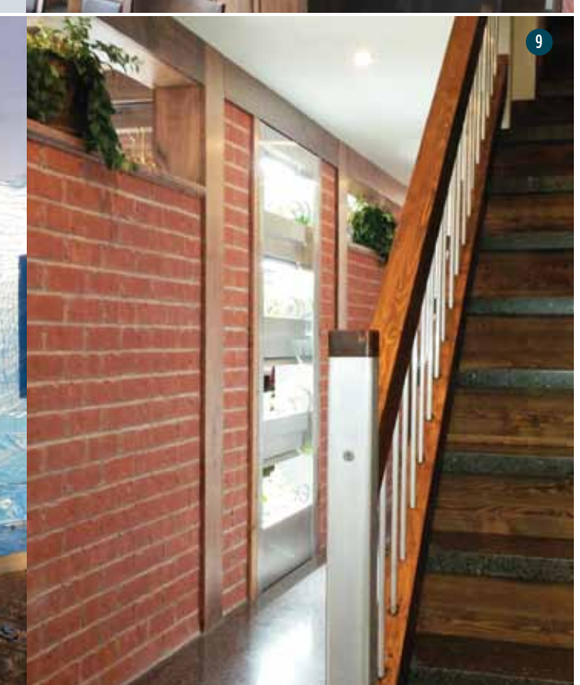
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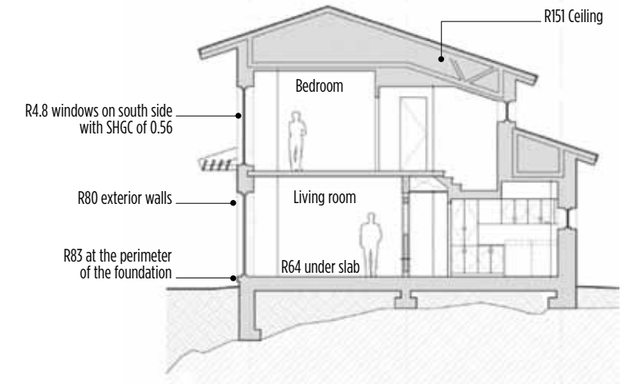

Kenogami thermal envelope

THE SUPER-INSULATED KENOGAMI HOUSE RECEIVES A CONTINUOUS SUPPLY OF FRESH FILTERED AIR THROUGHOUT THE HOUSE WITHOUT THE NEED TO OPEN WINDOWS. THROUGH THE HIGH-EFFICIENCY ZEHNDER ENERGY RECOVERY VENTILATOR THE AIR IS BROUGHT INTO THE HOME CLOSE TO ROOM TEMPERATURE, MINIMIZING THE HIGH COSTS OF CONSTANT HEATING OR AIR CONDITIONING [8]. THE THERMAL MASS OF CONCRETE FLOORS AND BRICK ABSORB HEAT AND BALANCE TEMPERATURES [9].

The Zehnder ERV system will continue to offer energy savings in summer months, as removing moisture from exterior air before it is injected into the home makes high temperatures more bearable, and also reduces the load on air conditioning systems. In this case, the ERV in conjunction with the high R value building envelope and passive cooling design will likely make air conditioning unnecessary except in extended heat waves with high nighttime humidity levels.

As the homeowner and part of the Ecohome design team, Alain Hamel will continue to experiment with the latest energy systems to further enhance the performance and thermal comfort of his home. Currently being explored is the option of a thermal battery and an air-to-water heat pump. This would serve as an air conditioner; in effect, to cool the home on sunny winter days while producing hot water essentially for free.

Heat extracted from indoor air would be transferred to a phase change thermal battery, which can store about 10 times the heat by volume as water. This allows excess daytime heat to be used for domestic hot water use, or released into the slab floor to balance temperatures through the night.

As this home was designed for resiliency, among other notable features it includes an underground 2,000 gallon rainwater harvesting system which feeds showers and toilets during all seasons, being recharged in winter by melt runoff on warm days.

DURABLE, LOW MAINTENANCE DESIGN

The true cost of a home can only be determined when factoring in its expected lifespan and the maintenance that will be required along the way. To that end, both interior and exterior surfaces have been designed to endure.

The goal during the design of this home was to make it as durable, efficient and autonomous as possible. Many of the design features are original, and these technologies are new to the market. It is for these reasons that we consider the Kenogami House a living laboratory of resilient building technologies that will continue to be fine tuned, while offering insight and inspiration to others. ❖

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