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***REPORTS* ON ENVIRONMENTALLY INTEGRATED HOMES**

BLACK BANK HILL:
THE BENEFITS OF A HIGH-PERFORMANCE ENVELOPE

December 2012

The house at Black Bank Hill is situated in Ontario's Niagara Escarpment region on a high plateau overlooking the surrounding landscape. Designed to the Passive House standard, this project has a highly efficient and well-sealed building envelope combined with innovative heating solutions. We are pleased to share our strategies for creating thishighly comfortable, sustainable house design.

There are a number of green home design highlights in this project, most notably our use of Durisol Insulated Concrete Forms (ICFs) in the exterior walls. The decision to work with the Durisol product was made very early on in the design process and

everything else was designed around that: the shape and size of the walls were designed to make use of full blocks with no need for cutting or re-shaping.

Durisol ICFs, made of 100% recycled cement-bonded wood fibre, come in varying thicknesses with a rigid mineral wool insulation insert. We designed the Black Bank Hill wall section using the thickest 14" blocks with the highest base R-value of 28. However, we designed a unique Durisol wall system to achieve a final R-value of 38.

Typically, a Durisol ICF wall is plastered on the inside and outside for what is referred to as a "breathable" mass wall. However, we were anxious that this detail wouldn't enable a high enough insulation value and that as the plaster cracks in time the house would become leaky as Tom always says, "Seal it tight and ventilate it right!"

Instead, we developed a detail that incorporates a 1 ½" layer of closed cell polyurethane to the outside of the blocks, providing a full seal and an additional R-10 insulation value. We first attached 2x4" wood stand-offs with bolts cast into the wall, the foam insulation was spray around these stands off. 1x4" straps were then attached to the wood stand-offs and the exterior siding was installed to the strapping, creating an air space behind. On the inside, the drywall is screwed directly into the Durisol blocks.

With the small exception of the ½" diameter metal bolts used to attach the wood stand-offs, the insulation in this wall section is consistent throughout the whole wall. With more traditional stick frame construction, the wood studs act as a conductor rather than an insulator seriously reducing the effective R-value of the wall. Moreover, Durisol block can run from the footings to the roof trusses eliminating the need for traditional foundation wall insulation. The rest of the house is insulated with R-30 under the slab and R-60 in the roof.

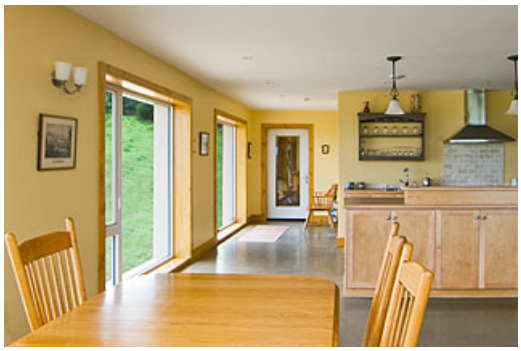
The home has no basement, so we developed a unique solution to accommodate plumbing, electrical and other services in the ceiling. We combined a raised roof-truss with a drop celing to create a plenum space to run services in.

Typically, roof insulation and the vapour barrier are installed over the ceiling which is problematic when punching holes through for lights, plumbing stacks and smoke detectors. In Black Bank Hill, however, the insulation is above the plenum space so it is continuous and has virtually no penetrations.

In complement to the highly efficient building envelope, the Energy Recovery

Ventilator (ERV) provides ventilation. Made by Ultimate Air, the "Recouperator" is the most efficient ERV in North America. At 96% efficiency, it captures the heat and moisture of the exhaust air and maintains the freshness of the incoming air, providing warm and moist fresh air to the house with very little heating input required.

The superior insulation and air tightness, along with the ERV, create very little need for mechanical heating and no need for cooling. What little heating is needed is provided in three ways:



Passive solar design: Three large, south-facing windows in the home's Great Room allow passive solar heat gain directly from the winter sun. The roof overhang lets the low winter sun shine in, and inversely blocks the heat from the high angles of the hot, summer sun.

Wood stove: With the house situated on a wood lot, the owners were very keen to have a wood stove provide much of their heat. The stove's heat is distributed through ducts in the ceiling plenum by a manually switched fan that draws hot air from the ceiling space above the wood stove and pushes it to the bedroom in the cooler end of the house.

Electric in-floor heating: With such low heating needs, the payback on the capital cost of the mechanical equipment became the driving force of our decision-making process. A typical boiler with hydronic in-floor heating would have cost around $15,000 to install. Instead, our clients opted for an electrical in-floor heating system that uses electric cables embedded into the floor slab with individual thermostat controls in each room. The total cost for this system, installed, was around $3,000. Although the operating costs associated with electric heat tend to be high, the system in this home is used so rarely, that, with the super low up-front cost, it proved to be the most cost-effective choice overall.

The home was completed in March 2011. Since then, the home's electricity use averaged 40 kWh per day, amounting to about $125 per month (plus applicable taxes, delivery and debt retirement charges). While a typical Canadian home consumes a lower daily average (about 30 kWh), that figure does not include natural gas for heating or hot water. The owners of Black Bank Hill have no gas bills, so overall their home uses 60% less energy than a typical Canadian home!

Black Bank Hill has an EnerGuide rating of 86. This score can go even higher if the

owners decide to install renewable energy equipment in the future. We designed the roof structure to accommodate a 10 kW solar PV system and a domestic solar hot water system. All they'll need to do is plug it in!

Recently the Black Bank Hill house was featured in Niagara Escarpment Views Magazine. Copies of the magazine can be picked up from our office or any of the locations listed on their website. http://www.escarpmentviews.ca/