Energy Efficiency Retrofits

by Martin Mattes

Where do you start with an energy efficient retrofit of an existing home? The most cost effective way to decide new insulation levels and areas to upgrade is to model the home or renovation project with a computer program. Much the same way R2000 builders have been modelling new homes with the HOT2000 software to learn where and how much insulation they are going to install, CANMET of Natural Resources Canada has developed a new software program called AUDIT2000. Essentially it is the same as HOT2000 but it makes the modelling of existing homes much easier.

The program models existing building parameters such as heating equipment and variable base loads, and has a complete information section that does not affect the energy output but is useful for statistical purposes when printing out a report for the homeowner.

With nearly eight years worth of HOT2000 experience modelling many new R2000 and conventional homes with respect to energy efficiency, I was recently given the opportunity to teach a six-week Building Analyst Course in Sydney, Nova Scotia. In first-time modelling existing houses with energy efficient upgrades, some enlightening realities glared not only at me but also at my students.

In total, the class as a whole modelled about 85 houses in the Sydney area and we had to ask some fundamental questions, starting with: Why do homeowners replace windows? For all the houses we modelled, the best case had a 28-year payback and the worst more than 40 years. The obvious reason homeowners replace windows are: the windows have failed; they add value to the home; to "keep up with the Jones"; or for aesthetics reasons. However, strictly from an energy standpoint, it is probably one of the worst investments that can be made. Naturally, the window manufacturers don't want you to hear this! The reason for the long term payback is simple: old windows have an R-value of about 1.05, while a new vinyl, low-E, argon gas, insulated spacer, casement window will have an effective R-value of about 2.93.

While the air leakage is reduced, both the old and new windows cover the same area and the R-value has only increased by two. There is still considerable heat loss. Another concern is that sometimes improving the window can lower the net solar gains. Yet homeowners have the misconception that replacing windows is a great energy efficient retrofit. The computer models do not lie. Window replacement is not money well spent with respect to energy savings in energy retrofits!

This is not to put down high performance windows. In new construction or where new windows must by used, they should always be considered. However, if the replacement is simply driven by energy retrofit considerations, a more careful analysis is needed.

In all the homes we modelled, not one of our reports to the homeowner recommended replacing windows! Air leakage control is one of the greatest areas with a significant payback, but introducing mechanical ventilation to ensure good indoor air quality may offset the payback to the point where financially it becomes a hard sell. While you cannot easily put a price on indoor air quality, some consumers have a limited budget and will not accept a 14-year payback to air seal their home and then introduce ventilation to offset the tightness. You have to educate the homeowner and explain the added occupant comfort due the reduced drafts, increased indoor air quality and control. In addition, the reduced infiltration of moist air into the building assembly will prolong the structure's life.

Another big misconception with most consumers is thinking that the ceiling is an area of high heat loss. Although adding insulation to the attic is usually inexpensive, normally the ceiling accounts for only 3-9% of the heat loss of the entire building envelope. The basement floor routinely has a higher heat loss, mainly because the basement floor has the same surface area but usually

RETROFIT ACTION	SAVINGS/YEAR	COST OF RETROFIT	PAYBACK (YEARS)
Air seal to 1.5 ACH @ 50 Pa., install HRV	$215.77	$3,600.00	16.7
Replace all windows with low-e, argon gas, vinyl casement	$446.34	$14,500.00	32.5
Insulate basement walls to R20	$110.04	$1,400.00	12.7
TOTAL	$772.15	$19,500.00	25.25

has an effective R-value of 1.14 (i.e., no insulation) while the ceiling will normally have R20-40.

Let's look at a typical 1,200 sq. ft. raised bungalow I modelled recently in Kitchener, Ontario. First, I addressed the home itself and tried to model the following upgrades. (The main walls accounted for most of the total heat loss. However, the home is brick and there were no cost effective measures to insulate the exterior walls so I chose not to suggest any changes to the walls.)

Clearly I was not going to sell the home owner on any kind of retrofit job at these paybacks, so I started over and addressed the heating system. The original home had an oil furnace and electric domestic hot water heater. However, it happens they have natural gas in the area.

While replacing the furnace did not actually increase the efficiency of the home, the payback is an amazing 2.1 years and the truth is, after year two the homeowner will be saving $1,300.00 per year. This home owner is happy that he is under budget, did not spend money on retrofits that provided unrealistic paybacks and he was ecstatic that he hired me for $250.00 to give him a report that saved him thousands in unnecessary renovation work.

RETROFIT ACTION	SAVINGS/YEAR	COST OF RETROFIT	PAYBACK (YEARS)
Install draft induced gas furnace, lease hot water tank	$1,311.83	$2,800.00	2.10

The crucial point is, if you are not a design evaluator, either buy the software and get the training or hire a Building Analyst/ Design Evaluator. Your local CHBA office should have a list of names. The couple of hundred dollars you spend on the report could save you and your customer thousands of dollars on unnecessary retrofit work, and will make you look more professional in the end.

What I am suggesting here is that there may be several ways to serve the customer. Not always are those that seem obvious at first glance the best or most cost effective. Tools have been developed, and they should be taken advantage of. They may surprise you, and put you in good light with your customer. ☼

Martin Mattes has been actively involved with the renovation and new construction sector in Nova Scotia - as a college instructor, builder, realtor, R-2000 Design Evaluator and New Home Warranty Director. He is presently building a new home in Cambridge, ON, where is taking up residence.

Beware of Manufacturers' Claims

Every so often a product is promoted as able to perform in an application for which it has not been tested. One such case that has come to our attention recently is Thermo-Foil.

Thermo-Foil is a polyethylene bubble pack material finished with an aluminized reflective coating. It has been evaluated by CCMC for use in a wall cavity system, where it is used for the air and vapour barrier and as a reflective thermal barrier.

However, for the last year or so Thermo-Foil has been claiming an R-10.5 value when used as under slab insulation (an application for which it has not been evaluated.) The claim that the membrane has an insulating value of R-10.5 leaves something to the imagination. In a wall or ceiling application, with a furred air space, the material adds the equivalent of about R-4 to the assembly. It stretches the imagination that by itself, under a concrete slab, with no airspace other than the bubble pack itself, it will have an R value of 10.5!

The claim is based on a thermography test. Unfortunately, thermography is a tool used to observe where heat flows through a building assembly, but it is not a recognized test procedure for measuring thermal insulation values.

Because of the aggressive marketing, many builders, especially in New Brunswick, have become interested in using the material for its insulating properties. However, they will not receive credit for this for their R-2000 homes. If something looks too good, ask questions, but don't rely on the manufacturer for all the answers. Get an independent opinion.

When used below grade, under the slab, the sales literature is correct to suggest it will eliminate basement dampness. As this material is a multiple-layered laminated material, it will be a tougher, more effective moisture barrier, better able to resist damage during construction than regular poly.

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