Energy Answers

Rob Dumont

What is it like to live in what may be the world's best-insulated house?

Let's break that question down into a few parts.

First, how well insulated is your house?

There is lots of insulation: the attic is R80 (RSI 14), the walls are R60, the basement walls are R60, and the basement floor is R35. It is possibly the best-insulated house in the world. We used cellulose insulation throughout, because of its carbon-fixing nature (wood pulls carbon dioxide out of the atmosphere) and because of its recycled content.

What are the other energy-efficient factors that cause the house to perform so well?

Besides the high insulation, we have excellent windows. They are triple-glazed with two low-E coatings, argon gas, and low-conductivity spacer bars. The house is very well sealed. It has a tightness level of 0.47 air changes per hour at 50 pascals. To my knowledge this is the third tightest house in Saskatchewan. In addition, we have 170 square feet of solar panels on the south wall of the house.

So, it is not just the insulation that makes the house an efficient performer. The airtight envelope, excellent windows, high-efficiency double-core air-to-air heat exchanger, passive and active solar systems, low-energy appliances, compact fluorescent and T8 lighting have contributed as well to the good performance.

What are some observations about the comfort in the house?

One thing we have noticed is that putting the heating source underneath the windows in the house is not necessary, although temperatures here in Saskatoon will drop to -40°C, and our average temperature in January is about -18°C. The windows arequite good insulators, and consequently, the cold window effect is not noticed in the house. Thus one of the first observations is that even in a very cold climate, it is not necessary to put space heating under every window in every room. This has many implications about where forced air outlets can be located. One could save a modest amount of money on a house by having the warm air outlets along the interior partitions, rather than along the outside walls.

A second observation is that although there is a very good insulation factor through the house, we need a space heating source in every room with a door. We have noticed that if the heat is turned off in a room and the door is closed, less convection of heat occurs. In colder weather, the room temperature will drop a couple of degrees Celsius, and the room will be outside the comfort zone. However, if you do have a very open floor plan, and there are no doors, it is not necessary to have a heat source in each room in a very well insulated and sealed house. Again, this has implications for reducing the cost of heating systems.

In your low-energy house, do you notice the cold outdoors as much as in a conventional house?

I once lived in a house that was extremely leaky. It had been partially rebuilt, and the house had an air change rate of 33 air changes per hour at 50 pascals. Needless to say, it was breezy, and one thing that I noticed was that the house temperature had to be raised in the colder weather because it was so uncomfortable, particularly when sitting near the windows, because of the radiant effect of the cool window surfaces. The draftiness and uneven temperatures of the house were also noticeable.

So, definitely, when you have a very well-insulated house and sealed house with good windows, even in a very cold climate, the house interior conditions become much less dependent on exterior conditions.

How do you handle humidity in a cold climate house?

In colder weather, the moisture content in the air outside drops considerably, and the fresh air being brought in through the air-to-air heat exchanger is very dry. We ventilate the house at approximately 50 litres per second (100 cfm). The house has a floor area of 3,300 square feet, and my wife, daughter and I live in the house. This venti-

lation rate is about 0.23 air changes an hour, and is sufficient to control odours, building material offgassing, etc. What we find is that if we do not humidify, the humidity level in the house will drop below 20% relative humidity in colder weather, and the Canadian residential guideline is 30%. Thus we use a humidifier at night, on the second floor where the bedrooms are located, and can maintain relative humidity levels at about 30% through the winter. The humidifier is a Duracraft model which is quiet and has a wick type of humidification pad, with air blown through the pad. This humidifier has the advantage that none of the salts in the water are released into the air, and therefore, the air quality is not compromised. Because of concerns about bacterial growth, every morning we run the humidifier dry and in the evening fill it with fresh water. It is a real challenge in larger homes in cold climates that are properly ventilated to get sufficient humidity without adding pathogens to the air from poorly designed humidification apparatus. Although there is a little labour associated with the humidifier, it is satisfactory for us.

What implications do you think the use of so much insulation has in a house?

One implication is that you can save quite a bit on the mechanical systems in a house by going to much better insulated walls, attics and floors. This house has 3,300 square feet including the basement, and the peak heat loss is only 4.5 kW, or 15,400 Btu per hour. With this small heat loss, it is possible to use smaller heating equipment with a resulting saving in cost.

A recurring theme of mine is that houses are not just grab-bags of unrelated components, but should be a "system" where items are carefully sized and integrated. I would ask people to look carefully when they are designing houses and reap the benefits of properly sizing such things as heating equipment.

One of the things that I have noticed is that the price of insulation has stayed relatively constant over the last 15 years. Most of the batt and cellulose insulation has stayed around 2¢ per square foot per R value over this period, whereas many other components in houses like furnaces and wood, and so on, have increased in price. This is important, because some old rules of thumb about what is an appropriate amount of insulation in a house have not taken into account the fact that the price of insulation has stayed relatively constant while other items have inflated.

What is the energy performance of your house?

Conventional houses in Saskatoon generally run somewhere between 250 and 300 kWh per square metre of floor area per year. The R-2000 houses on the prairies measured some years ago came in at 143 kWh per square metre, and for this last year which, admittedly, has been very warm by our standards, we have only used 38 kWh per square metre. The previous winter it used 47 kWh per square metre. Thus, the house uses about one third the energy of the R-2000 houses, and about one-sixth the energy of a conventional house of the same size.

What other things do you want to do to your house — do you plan to improve other aspects of the house?

Well, to start with, I don't plan to retrofit the walls in the near future. However, there are several appliances that we would like to upgrade. Our washing machine is a conventional top-loading unit and we hope to replace that with a horizontal axis washing machine which will reduce hot water consumption. We have the plumbing in the house set up so that a grey water heat exchanger can be added, and we would like to do that. We would also like to replace the old freezer in the house which is an R12 Freon-based unit with a newer R134A unit. A similar-sized new freezer uses about one-half the energy of our existing freezer. So these should help to bring our energy consumption down further.

Any final comments you would like to make about the house?

Yes. As concern about the deterioration of the atmosphere caused by fossil fuel burning increases, I think more people will have to start building houses to the same level of efficiency as our house. I also hope that in a few years our house will be regarded as thermally obsolete as better, more-efficient technologies come along.

Meanwhile, if all Canadian buildings were constructed or retrofitted to the standards used in our house, Canada would be a long way toward meeting the Kyoto targets.