#3677

Northern Housing retrofits

Fort Severn Housing Retrofit

Retrofitting can prolong the life of a house, making it easier and less expensive to heat, and a more comfortable place to live. If the retrofit isn't carried out properly, all the money invested may simply 'go up the chimney'. The Fort Severn Housing Retrofit Project showed there are a number of considerations to keep in mind when retrofitting northern housing.

Before retrofit

Fort Severn

Fort Severn is a small Ontario community located on the south-west shore of Hudson's Bay. Winters can be long and harsh with more than 8,000 degree-days (°C), yet the majority of the existing housing stock does little to reflect this climate. Fifty-two of the sixty houses in the community were built prior to 1983. Typical construction involved 2x4" stick-framing, with little more than R12 in the walls, attic, and floor.

Discontinuous permafrost soils and improper foundation construction have resulted in differential settlement, creating cracks in the building shells. These factors in conjunction with poorly installed windows and doors, create drafty and uncomfortable living conditions.

The houses are heated primarily with wood. The use of non-approved woodstoves is widespread, a situation that is both inefficient in terms of fuel consumption, and unsafe for the users.

These conditions have resulted in high operation and maintenance costs, high wood-fuel consumption, and houses with a life span as low as ten years.

The Project

Beginning in 1985 with monies from Canada Mortgage and Housing Corporation (CMHC), Indian and Northern Affairs Canada and Remote Community Demonstration Program, the Fort Severn Band carried out a series of twenty-four retrofits over a three year period. Beyond the obvious benefit of making the houses more comfortable and energy-efficient, the retrofits were part of a larger effort to reduce fuel consumption and conserve local wood resources. The following measures were implemented in the retrofits:

** Original crawlspace structures were removed, replaced with preserved wood crawlspaces.*
** Glass fibre insulation was added to the floor to bring it up to R24.*
** One inch of semi-rigid insulation was added to the exterior to raise the insulation of the walls to R16.*
** New exterior siding was installed*
** R28 insulation was added to the attic for a total of R40.*
** Doors and windows were replaced with more efficient units, and in some cases, exterior storm windows were installed.*
** New woodstoves with insulated chimneys were installed.*

The amount spent on individual units ranged from $11,000 to $16,000.

Six houses (built prior to-1983) were monitored for a period of one year. Of these three had been retrofitted, the non-retrofits serving to create a data base for evaluation and comparison. The houses were monitored for indoor temperature and humidity, fuel wood consumption, foundation movement, air infiltration and air quality. In addition, interviews and visual inspections were carried out.

What was found?

While residents of the retrofitted units reported the houses to be more comfortable and easier to heat, the monitoring results show only a slight positive difference between the retrofit and non-retrofit houses.

* Indoor temperature and humidity data were tabulated for each home and correlated to wood stove performance. The data suggested only a slight improvement in energy-efficiency for the retrofitted houses.

* The differential movement of each foundation was monitored over the course of four site visits. While a small amount of foundation movement was recorded around the exterior, there was evidence of significant movement at the interior floor/wall area of two of the retrofits and two of the non-retrofits.

Heat loss through the floor is believed to have thawed soil around the centre beam, while exterior areas remained frozen, resulting in differential movement.

* To test for air leakage the houses were depressurized to 50 Pa using a blower door. The test results did not indicate a significant difference between the retrofit and non-retrofit

houses. An average conventional home, properly retrofitted should have an air change per hour (ACH) of about 3.5. In Fort Severn the retrofitted houses averaged almost

After retrofit

double this figure, registering a low of 6.6 ACH and a high of 9.8 ACH. The non-retrofitted houses averaged 9.0 ACH.

To pinpoint areas of air leakage, thermal bridging, and low insulation values, thermography tests were conducted before and during the air infiltration tests. Thermographic analysis of both the retrofitted and non-retrofitted homes showed large leakage areas around ceiling fixtures, through wall electric outlets and switches, and through attic hatches. Signs of moisture retention in the attic were also evident. On the positive side, the analysis did reveal significant thermal improvements associated with the new insulated cladding on the retrofitted units.

Conclusions

Although residents reported that the retrofitted houses were more comfortable, the monitoring results revealed that the retrofits did not accomplish all that they were intended to. Conversations with those involved in the project have identified four key areas that anyone undertaking a retrofit should do well to keep in mind.

1. The foundation

Unless the foundation is, or can be made structurally sound and stable, any differential movement will destroy the fruits of your labour. Discontinuous permafrost, such as that encountered in Fort Severn, poses a significant problem for foundations. The slightest deviation from recommended foundation design can result in differential movement.

2. Air sealing

Concentrate on fundamental energy conservation techniques. Any retrofit, minor or major, should begin with an intensive program of caulking, weatherstripping and, if possible, the provision of an air-vapour barrier. It is doubly important to seal all the leaks and seams in the building envelope. Not only does this help to keep the heat in, but it protects the building structure and the insulation from the damaging effects of moisture.

Too much emphasis has been placed on improving the thermal resistance of these structures, and not enough on the little measures that pay large dividends - sealing the leaks in the building shell.

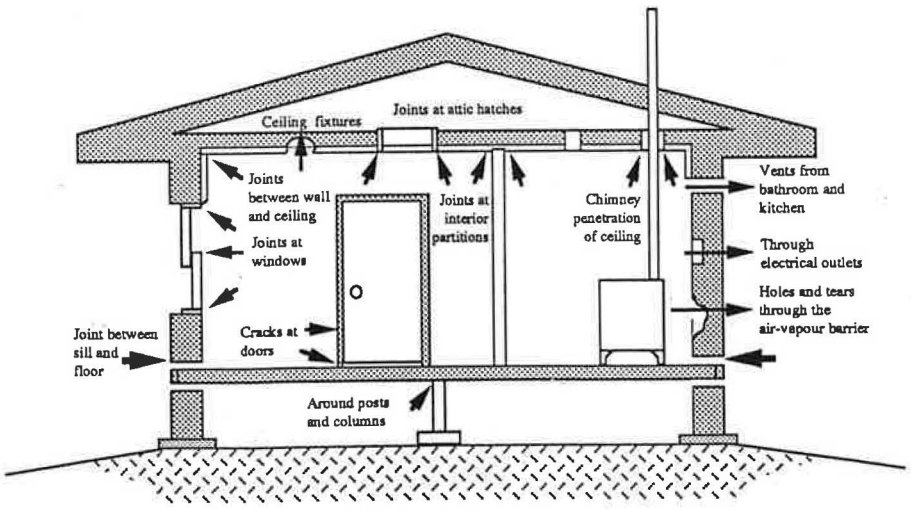
3. Check the house operation

While not directly tied to a retrofit, the operation of the house, especially the heating system, can often spell the difference between success and failure.

The wood stoves used in Fort Severn are a simple updraft design. On average this style of stove is 15% less efficient than other types. In addition, the occupants of the retrofitted units continued to burn wood at the rate which they were accustomed to before the retrofit. More efficient stoves, capable of high temperature burning should be selected for use especially in remote areas.

4. Don't retrofit unless it is worth it

Not all houses are 'retrofit candidates'. This is especially important when considering major measures such as those undertaken in this project. If the investment is going to outlive the structure, don't invest!



Potential Air Leakage Sites

The following list details energy-efficient modifications and measures that can form part of a northern retrofit. Ideally, all of the measures should be carried out. Where this isn't possible, those with the shortest payback should be carried out first. The list has been prioritized accordingly. After making sure that the foundation is structurally sound, consider the following improvements:

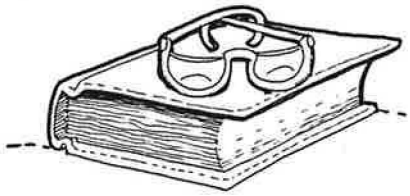
* *The house should be thoroughly air sealed (caulking, weatherstripping) and where possible, an air-vapour barrier should be installed.*
* *Once the house has been made tighter, make sure there is adequate ventilation for the occupants.*
* *Add insulation to the floor (minimum R28).*
* *Add insulation to the above-grade walls (minimum R25).*
* *Add insulation to the attic (min R40)*
* *Improve doors and windows (min. double-glazed with a ½" air space).*
* *Make sure that the heating equipment has been sized properly and is functioning as it should.*

Keewatin-Aski Ltd (consulting engineers) estimate a cost of approximately $18,000 per unit to carry out these measures in Fort Severn, including transportation and labour. While this price tag might appear high, it is less than one-third the cost of building a new house. With the possibility of doubling the life span of an existing house, taking the time and effort to perform the retrofit properly can more than pay back the investment.

The work described was done as a project in the Remote Community Demonstration Program funded by Energy Mines and Resources Canada.

Building Environmentally Clean Homes

Richard Kadulski



We all enjoy the new gadgets that make our work and leisure more enjoyable. Many are thanks to the new compounds our technological society has created in the last few years.

In construction, we are using products that didn't exist 20 or even 10 years ago. But this development has a price that we are only now discovering.

The pollution of the environment, be it the emissions of the factories making these products or the garbage generated is a cost we have to come to terms with. There is another and that is what is known as ecological illness (or environmental hypersensitivity). There are no official statistics yet to tell us how serious the situation is but we know that it is becoming more widespread.

This is an illness not easy to pin down as symptoms vary from person to person. They may be acute or chronic, and vary from a minor nuisance to severe disability. An environmentally sensitive person reacts to very small exposures to pollutants, toxic chemicals, or seemingly harmless substances, depending on the material, the severity of the exposure, and the patient's susceptibility.

The sources are all around us. A study done for the U.S. Environmental Protection Agency found levels of toxic pollutants in indoor air up to five times higher inside houses than outdoors. This pattern was noted in heavily industrialized areas as well as in remote rural areas. The conclusion is that most Americans are living in toxic environments. In fact, the EPA studies *"show that there has been no fresh air in the U.S. for 20 years. Today, the best air available is found at certain sea shores, mountain tops, and in unpopulated areas"*.

Because of the similar conditions and construction practices, the situation would not be any different in Canada.

How serious is the problem?

Some estimates suggest that as much as 20% of the population may have some symptoms of ecological illness. What you consider a hay fever allergy, a lingering cold or chronic headaches just could be the result of environmental sensitivity. Symptoms may include unexplained weakness, swelling of eyes, hands, or feet, spots on the skin, impaired judgement or vision, memory loss, pains, headaches, depression, hyperactivity and nervousness. Generally, children and women are more sensitive that men.

The impact on families can be serious if the source of the stress is not recognized. Yet, it is difficult to diagnose because reactions are often unique to the individual. Before diagnosis, the individuals often are considered to be metally ill or hypochondriac.

Doctors don't start with an ecological illness perspective because they don't know enough about the subject. Many of the symptoms are similar to other identifiable ailments. It's when all other possibilities have been eliminated that ecological illness might be considered.

If a customer does not feel comfortable about a product or house, but can't quite pin it down, there just may be a valid reason (even if it can't be pinpointed accurately). It could be a reaction to some product in the environment.

Evidence seems to indicate that the illness can be reversed as long as the person suffering can escape to a clean environment. Generally, it means providing a clean room for the person to get away from the toxic sources.

In **Solplan Review** No. 16 we reviewed some of the key issues in environmentally clean environments.

The most important feature of the clean home environment is an absence of pollutants - in other words you try to remove the source of pollution rather than trying to clean it up after it's in the house. It sounds easy, but how do you go about it?

If you go to your local building supply dealer and start to ask