• Widening the scope of the regulations to cover repair and refurbishment of existing buildings.

• The introduction of a regular, mandatory "health check" for buildings, similar to that used to ensure the safety of cars in the UK. This would be done every 5 years or so, or at certain trigger points such as at change of ownership or tenancy, and would set out recommended energy efficiency improvements.

• The introduction of performance indices based on whole-building carbon dioxide emissions, so that dwellings can be compared by their emissions characteristics, and a minimum standard can be set.

• The introduction of new efficiency requirements for building services including heating systems, air conditioning systems (which are growing in popularity in UK housing), mechanical ventilation systems and lighting systems (to encourage the use of compact fluorescent lighting).

• Requirements for the commissioning of building services, and possibly also the introduction of a dwelling "log book" which would be a record of the building's design specification and subsequent maintenance and renovation. (In the UK, cars have log books.)

Currently no air infiltration standard has been suggested. However, UK construction is poor, with typical air change rates for new construction of about 8 air changes per hour at 50 Pascals. (This compares with the average Canadian house at 3.3 ACH, except for BC where it is a bit over 4 ACH.)It is expected that any new requirement may initially be fairly lenient to allow the industry to go through the learning process of how to build airtight construction. After a few years it is likely that the standards will be made tougher.

Since the majority of UK housing is built to the minimum requirements of the codes, the changes, if implemented, will represent a significant improvement to housing standards. There is now a growing desire in the UK to improve quality in housing and a feeling that this is essential.

The industry is waiting for the first draft of the proposed new regulations, which should be published later in 1999. This will be followed by a further consultation process. It is expected that the regulations will come into force in early 2001. It is also possible that there may be a staged adoption of progressively tougher standards. ☼

Do Our Residential Mechanical Ventilation Standards Make Sense?

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One of the great things about Solplan Review is that it provides an excellent forum for the exchange of opinions on building science issues. So permit me to do just that - offer a few opinions about residential mechanical ventilation standards. My concern is that the current standards may have some serious, perhaps even fatal, flaws which will seriously inhibit their effectiveness and value. Let me explain.

Canada has three different standards governing the design and installation of ventilation systems (with some provinces using their own variations). The oldest is CSA F326 "Residential Mechanical Ventilation Systems" which is referenced by the R-2000 Program and, more recently, by the 1995 National Building Code (NBC). It is generally regarded as complex, difficult to understand but capable, in theory, of providing a good quality ventilation system. The second standard in common use is the prescriptive component of Section 9.32 of the 1995 NBC, which was developed at the request of the Canadian Home Builders Association in an attempt to achieve the general intent of CSA F326, but without its complications and difficulty. Both CSA F326 and Section 9.32 have their limitations and have received a lot of criticism. To be fair, much of this criticism has dealt with relatively minor details or has resulted from lack of training or workmanship problems (all of which are solvable).

However, there are some fundamental weaknesses with both these standards that cannot be solved with minor tweaking or better training. Let us consider them before exploring the third option for ventilation standards.

The Depressurization Dilemma

Perhaps the biggest problem with both CSA F326 and Section 9.32 is their treatment of excessive depressurization in houses containing spillage-susceptible appliances. The problem is that most of these devices will spill at very low indoorto-outdoor pressure differentials (for example, at about 5 Pascals for a naturally aspirated appliance). Both CSA F326 and Section 9.32 require make-up air to be introduced in houses with spillage-susceptible appliances. CSA F326 permits either a passive make-up air vent (a hole in the wall) or a powered make-up air (one that uses a blower to introduce the outdoor air) while Section 9.32 requires a powered make-up air. In theory, either will work - at least in calm wind conditions.

From my perspective the biggest problem with these systems is this: will the homeowner defeat them by plugging the duct or disconnecting the make-up air fan? How many people will leave a 6", 8" or 10" hole open in the side of their house once winter sets in and they can feel the wind howling through the basement? Sure, warning labels can be put on the ducts or fans and people can be advised not to obstruct them - but is this realistic? Once the make-up air system is defeated, the house is vulnerable to combustion spillage and all the health and safety risks which that creates.

To complicate matters further, there is debate and confusion about what conditions should be used to determine the depressurization limit. CSA F326 and Section 9.32 use somewhat different approaches, neither of which is consistent with the Gas Code (CGA B149), which calls up a more rigorous test condition (i.e. with all exhaust appliances operating). In addition, there is the issue of high-capacity exhaust devices which are not part of the ventilation system. Recent experience is showing that many new houses built to the 1995 NBC will fail the depressurization requirements of the Gas Code simply due to the presence of a clothes dryer. Elaborate make-up air solutions can be implemented (such as interlocking exhaust devices and using preheaters to temper the outdoor air), but these are complicated and expensive. They may also require the use of elaborate and failure-prone control systems. Often eliminating the spillage-susceptible appliances may actually be less expensive than to add a make-up air system.

The Utilization Issue

The purpose of any ventilation system is to exhaust pollutants and supply outdoor air. This dictates that the system must be used on a reasonably consistent basis. What happens if the homeowners do not use the system because they believe it wastes energy, creates cold drafts or induces other problems? Obviously, the air quality will be compromised.

Ten years ago, as part of the Flair Homes Energy Demo Project, we monitored the use of ventilation systems over a three-year period. In houses with Heat Recovery Ventilators (HRVs), ventilation systems were operated by the homeowners an average of 19 hours/day (80% of the time). However, in houses with central exhaust systems (with the same flow capacity as the HRVs and with relatively quiet blowers), the systems were used an average of 37 minutes/day (less than 3% of the time). Guess which houses had the better air quality?

I think the main reason for these use patterns was that the people with HRVs figured out they could ventilate without a huge impact on their energy bills or comfort. In contrast, those people with central exhaust systems realized that every time the blower went on, their utility bills would skyrocket. Other researchers have reported similar results. Although the technology has improved in the last decade, neither CSA F326 nor Section 9.32 require heat recovery. Thus, there is a strong possibility they may suffer the same utilization problems experienced by the central exhaust systems in the Flair Project. (I would love to see some utilization monitoring of current ventilation systems).

Again, we can take the attitude that building codes cannot legislate how people live in houses. However, this is unfair and a bit of a cop-out. The behaviour of people is relatively predictable and we have to design solutions that have a reasonable chance of being used. I am not sure we have achieved that with either CSA F326 or Section 9.32.

Furnace Mixed Air Temperatures

Both CSA F326 and Section 9.32 require supply air (i.e., outdoor air) to be introduced into the house and distributed to the bedrooms and some of the other rooms. For houses with forced air heating systems, the furnace ductwork is the logical means for distributing the outdoor air. However, if the air is not tempered, it can create thermal shock, condensation and corrosion problems with the furnace heat exchanger. A controlled amount of outdoor air can be mixed with the furnace return air to provide an acceptable mixed air temperature. However, this is easier said than done and achieving, and maintaining this delicate balance can be tricky. Further, chilling the return air with outdoor air can create comfort problems that may further impede the homeowner's use of the system.

So, What is the Answer?

While CSA F326 and Section 9.32 are acknowledged as ventilation system options, there is actually a third alternative in widespread use, although it is not normally recognized as such. This is the "R-2000 ventilation system." Ventilation systems used in R-2000 houses must comply with CSA F326, but they must also have a couple of other features that set them apart from both CSA F326 and Section 9.32 systems. First, all R-2000 houses have HRVs - not because they are formally required but so the house can meet the R-2000 Energy Target. Second, the R-2000 Program does not permit spillage-susceptible combustion appliances to be used for the space or water heating systems and places restrictions on the type of wood-burning appliances that can be used. Based on extensive monitoring, we know for the most part that "R-2000 ventilation systems" *do work*. People use them; they are reliable; air quality is good; and health and safety problems are kept to a minimum.

So, what can we learn from this?

Lesson #1: Eliminate Spillage-Susceptible Appliances

If the R-2000 experience with more than 8000 houses is any indication, the only workable solution to the depressurization problem is the elimination of spillage-susceptible appliances. Conventional make-up air systems just invite homeowner intervention. Nobody has invented a magic make-up air box that works reliably and safely - and costs less than replacing spillage-susceptible appliances with non-spillage susceptible types. Also, since non-spillage susceptible appliances are usually higher efficiency devices, there use will also provide energy savings and reduced greenhouse gas emissions.

Lesson #2: Heat Recovery Must Be Included As Part of The Ventilation System

If we expect homeowners to operate their ventilation systems on a consistent basis, heat recovery must be included. Otherwise, the energy penalty and comfort problems will ultimately deter people from using the systems. Heat recovery also provides a reliable solution to the furnace mixed air temperature problem.

The Future

Here is my prediction for the future of Canadian housing.

Ten years from now, only non-spillage susceptible combustion appliances will be used in new houses. Remember what happened with naturally aspirated furnaces? Expect the same to occur with hot water heaters and other appliances. Second, all new houses will be built with some type of heat recovery on their ventilation systems thereby making it practical for them to be used on a continuous basis, no matter the time of year. ☼

Attention Earthship, Earthpod builders and promoters
Wanted: Details of Working Earth Integrated Homes

There is a lot of interest in earth-integrated homes. How well they really work is speculative. Proponents often make outlandish claims, while engineering principles suggest they cannot possibly work that way. Is there something that engineering knowledge is missing, or is it a question of lifestyles?

Bion Howard, an environmental building consultant based in Maryland USA, would like to investigate projects built using these technologies. He is proposing to do an energy evaluation, and review the projects with their builders and owners. This professional analysis will be done at no cost, but builders and owners must agree to allow the results to be published, although privacy and proprietary information will be respected. Plans, material specs, and climate/location information is needed for built examples. Construction videos, utility billing data, owner statements, and contact information will also be helpful.

If you have been involved in such a project, or have an associate who has, contact

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Deadline for submissions: August 25, 1999.