#4180

sites. Since Sept. 1, 1989 all bin loads containing more than 20% by volume of recyclable corrugated cardboard have been banned from all sites.

Wood wastes will be banned as soon as a local recycling facility, capable of handling the quantities generated in Metro Toronto, has been opened.

Wood waste processing has been slow to develop, and markets have been uncertain. There has been some discussion of the possibilities of chipping wood wastes and using the chips as on-site ground cover. Unfortunately decomposing wood requires large amounts of nitrogen; something found with abundance in grass. If chipped wood was used as ground cover, there is a strong possibility that it would kill the sod laid down over it because of the high levels of tannic acids in SPF lumber. Using these chips for surface treatment such as on hiking paths or bike trails is a feasible option.

In the Vancouver area, clean wood is chipped and used by industrial users as a supplement to hog fuel in incinerator/cogeneration units.

In Ontario there is a strong market for wood chips and shavings among horse breeders and racetrack operators.

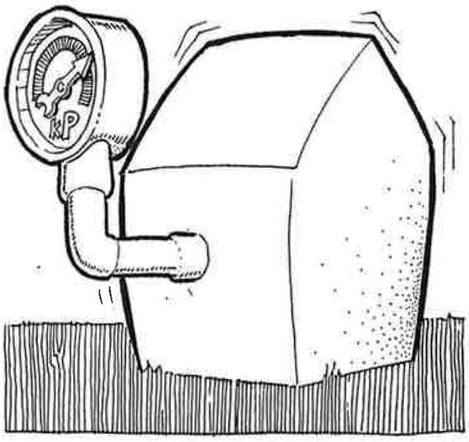
Recommendations currently being considered by Metro Toronto, if implemented, will require builders involved in new developments larger than 25 units to table a detailed plan for managing solid wastes, including reuse and recycling objectives. These plans will have to be approved before the project can proceed.

In Greater Vancouver, waste is being sorted, with recyclable or reusable materials being diverted. Current tipping fees for general waste are $52/ton. Clean pre-sorted waste tipping fees are less.

In smaller more isolated areas all these options may not exist, but a well thought out waste management strategy still is needed.

"Making a Molehill out of Mountain" report prepared for the Toronto Home Builders Association; THBA, 20 Upjohn Rd. North York, Ont. M3B 2V9

Airtightness of new detached Houses



Richard Kadulski

Improved airtightness in houses provides higher comfort levels and reduces:

- energy consumption;
- the potential for moisture damage to the building envelope;
- soil gas entry;
- noise transmission through the building shell.

In 1989 CMHC and EMR sponsored a study of the airtightness of new, merchant builder houses in Canada. The airtightness of 200 new houses was tested using fan doors, depressurizing the houses under three conditions:

1) all intentional openings were sealed (in accordance with the CGSB Standard for Airtightness Testing as used by the R-2000 program)

2) as for (1) but with combustion air supply ducts sealed to measure how much of make-up air was available elsewhere. This simulated the airtightness of the house under a condition where only a make-up air inlet is open.

3) with most openings left unsealed as under normal operating conditions. This represents the normal operating conditions of the house and was done without sealing any openings that normally allow air into the house.

The Airtightness is expressed in air changes per hour (ACH) at a pressure of 50 Pascals (0.4" water gauge). It can also be expressed in terms of Normalized Leakage area (NLA), which is a measure of the total openings in the building envelope.

The R-2000 program places a maximum limit of 0.7 cm^2/m^2 which is the same as saying that the maximum allowable leakage area is about 1 sq. inch for every 100 sq. ft. of surface area of the house.

NLA measurements are a better term for comparison as they are independent of the size of the house, but the study results were quoted in ACH.

The study found that there is a wide variation in the air leakage rates of new houses (Table 1). Airtightness varies from a low of 0.98 to a high of 11.13 ACH. Vancouver houses showed the widest variation (The highest was 11.13 and the lowest 2.86) Saskatoon and Quebec City showed the least variation, the highest air change rate being only 2.1 times the lowest.

Overall, there is no doubt that houses are being built tighter today. Compared to data from a similar study done in 1982/83, new homes built today are about 30% tighter than those built less than a decade ago.

New B.C. houses still tend to be the leakiest. In other areas where houses were already built tightly, the change has not been nearly as dramatic. The greatest improvement appeared to be in B.C., where it would seem that the

TABLE 1
Average Air Change Rates for New Houses

Location	Air Change Rate (@ 50 Pa) Average	Minimum	Maximum
St. John's	3.63	2.70	5.34
Halifax	3.22	1.71	5.96
Fredericton	2.93	1.51	5.34
Quebec City	2.86	1.86	3.83
Montreal	3.30	1.71	5.51
Ottawa	4.06	2.50	5.99
Toronto	3.60	2.47	5.35
Winnipeg	2.08	0.98	3.46
Regina	2.44	1.22	3.88
Saskatoon	2.58	1.79	3.77
Edmonton	3.00	1.35	5.04
Vancouver	6.19	2.86	11.13

average air change rates decreased by almost 40% (from 9.33 to 5.95). However, a direct comparison may not be proper as we understand that the B.C. houses tested in the early 80's may have been smaller than new houses (a good portion were townhouses).

Peter Moffat of Sheltair Scientific in Vancouver, who does much air leakage testing in B.C., estimates that based on his experience, B.C. houses today are only 8% tighter than earlier houses. However, the trend is definitely there - houses are getting tighter.

The airtightness level appears to be generally related to the severity of the climate. Houses in the colder regions of the country tend to be more airtight than those located in the more temperate areas. (The banana belt syndrome is at work here - people in B.C. forget they still heat houses, even though we don't do that much shovelling).

Why is it important to know how airtight houses are?

Houses contain equipment for ventilation and to exhaust combustion by-products. Improper construction techniques or selection of equipment will have a severe impact on indoor air quality and more importantly, the health and saftey of residents.

Concern about the quality of the air inside houses is growing as the understanding of the health and productivity effects of indoor air quality increases. The concentration of air pollutants inside is directly related to the source strengths of the pollutants and the rate at which they are exhausted from the space. Most older buildings rely on wind and temperature driven air leakage to provide ventilation. This approach has poor control and usually creates drafts that occupants try to seal.

Tighter structures also encourage the build up of high moisture levels. Higher humidity levels promote the growth of moulds, some of which are harmful to health. High moisture levels inside the house mean that the water vapour inside will condense on a cold surface. This can be windows and doors or in the structure if there are leakage paths to the outside. Water vapour getting into the walls and roof spaces can lead to premature deterioration of finishes and structural members.

Control of indoor air quality and humidity levels is achieved by exhausting stale air. The cooler exterior air (with less absolute quantities of moisture) brought inside lowers the indoor humidity.

Approximately 10% of new houses built in Canada are equipped with whole-house ventilation systems. The remainder have exhaust fans in bathrooms and kitchens. These exhaust air from pollutant generating areas and rely on air leakage through the building envelope to provide replacement (make-up) air. If the house envelope is airtight (as it should be) the living space will be depressurized unless there is adequate make up air supply.

Depressurization of the house can cause combustion spillage from most naturally aspirating (i.e. units without draft induced or sealed venting of combustion products) fuel fired furnaces, boilers, and hot water heaters. Combustion by-products such as carbon dioxide, oxides of nitrogen, and possibly carbon monoxide are released into the house. Depressurization also increases the chances that soil gases will be drawn into the house.

The amount of the depressurization is proportional to the difference between the rate at which air is exhausted and the rate at which it leaks into the building through cracks and holes in the envelope.

Because of the potential problem, proposed standards are suggesting that in houses with naturally aspirating fuel burning appliances, depressurization should not exceed 5 Pascals.

TABLE 2
Air Flow Needed to Depressurize New Houses to 5 Pa
Air Flow - cfm *(l/s)*

Location	Average	Minimum	Maximum
St. John's	253 *(120.6)*	147 *(70.1)*	415 *(197.6)*
Halifax	229 *(109.2)*	82 *(39.2)*	538 *(256.5)*
Fredericton	218 *(104.0)*	126 *(60.4)*	341 *(162.6)*
Quebec City	130 *(62.3)*	82 *(39.1)*	338 *(161.1)*
Montreal	155 *(74.2)*	66 *(31.7)*	269 *(128.1)*
Ottawa	354 *(168.9)*	187 *(89.4)*	500 *(238.4)*
Toronto	375 *(178.7)*	172 *(81.9)*	663 *(315.8)*
Winnipeg	145 *(69.0)*	64 *(30.5)*	328 *(156.4)*
Regina	186 *(89.0)*	86 *(41.2)*	277 *(131.9)*
Saskatoon	215 *(102.7)*	135 *(64.7)*	297 *(141.6)*
Edmonton	250 *(119.0)*	129 *(61.3)*	447 *(212.9)*
Vancouver	464 *(221.3)*	205 *(97.5)*	711 *(338.5)*

What can generate 5 Pascals of depressurization?

Most new houses contain at least a clothes dryer and a bathroom or kitchen fan. These devices, operating at the same time can provide an air flow of at least 230 cfm (113 L/s).

A clothes dryer, a bathroom fan, and a kitchen rangehood drawing 230 cfm, can generate a depressurization of at least 5 Pa in the average new house in seven out of 12 cities (Quebec City, Winnipeg, Montreal, Regina, Saskatoon, Halifax, and Fredericton).

Much of the low cost ventilation equipment used in most houses does not perform as its supposed to (it is not suitable for continuous use because it is too noisy and is not durable). In spite of the poor performance of cheap fans, 18% of new houses will depressurize to more than the 5 Pascal limit recommended for naturally aspirated combustion appliances. 20% of new houses will be depressurized by more than 10 Pa by the average dryer, bathroom plus kitchen fan.

Table 2 shows the average, minimum and maximum airflows required to create a pressure difference of 5 Pascals in typical new houses.

With today's busy lifestyles, it is not out of line to suggest that most fans will run at the same time, as people come home from work, one takes a shower, supper is cooked, and a load of laundry is done (or it may be in the morning as everyone is rushing to get out of the house).

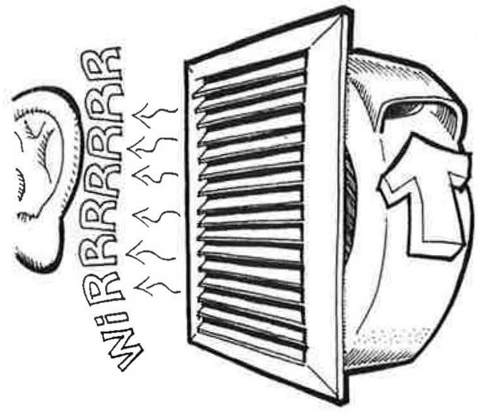
The moral of the story? New houses are being built tighter. When designing and equipping the house, it must be remembered that the house works as a whole system. When selecting exhaust equipment it is important to consider how it relates to all the other equipment in the house.

This item is based on work by Tom Hamlin, Michael Lubun and John Forman reported on in an as yet unpublished draft report.

Ventilation Case Study: the importance of noise levels

Richard Kadulski

Regular readers will know I have written much about energy efficiency and ventilation issues. Many probably believe I live in a state-of-the-art energy efficient home. It may dismay some that home is really a modest 1 bedroom 650 sq.ft. mid 70's vintage spec built condo apartment (that's taken a lot of effort to repair construction faults!).



At long last, I have installed a central ventilation system: an AERECO humidity controlled ventilation system (Solplan Review No. 11 Oct-Nov 1986). It has a central fan with exhaust ports in the kitchen area and bathroom. Humidity controlled fresh air inlets are located in the bedroom and living area.

The unit continuously draws about 44 cfm (18 cfm from the bathroom, 26 from kitchen) to maintain a 50% relative humidity. The system places the apartment under a small negative pressure (approx 0.006" WG or 1½ Pascals). Until we weather-stripped the door, this was enough to draw in smells from the unpressurized hallway.

The apartment is a corner unit so that in theory "cross ventilation" is available. Was there any point in going to this great length? I can verify that "cross ventilation" doesn't work all the time, especially when you need it most! During the winter it's too cold to open the windows, in the spring and fall leaving windows open all day has no effect (assuming security was not a consideration).

The smell of fried onions or other cooking odours or the aroma of smelly socks left on the floor would linger even if a window or two was left open. In other words, despite the best intentions the apartment could generally have been described as being stuffy. The continuously operating ventilation system has resolved the problem of lingering odours; the apartment is no longer stuffy.

However, the installation underlined the importance of paying attention to the noise levels generated by continuously operating mechanical equipment. Today's younger generation, by the time they reach their late teens has often suffered hearing loss after time spent in rock concerts, in loud night clubs or under Walkman earphones and may not appreciate quiet.

But for someone who appreciates quiet, or at least being able to control their auditory environment, and has good hearing, the control of noise and the elimination of irritating back-

TABLE A
Measured noise levels

background level	30 dB
Refrigerator[1]	39 dB
Microwave[1]	58 dB
Plumbing noises[2]	41 dB
Central ventilation system when first installed[3]	33 dB
soft whisper at 6 feet	35 dB
background level (in a quiet office)	35 - 40 dB

[1]from 3 feet away

[2]building plumbing noises from a common wall

[3]about 12 feet away from the exhaust