How to Get the Ventilation You Need in Your House

Canadians are coming to value the importance of airtight homes with proper ventilation. The old farmhouses built generations ago tended to be drafty, uncomfortable and very dry in winter due to high air leakage. In contrast, due to improvements in building codes and construction practices, new houses incorporate good air barriers and meet requirements for minimum ventilation. However, most existing houses fall somewhere between these two scenarios.

WHAT DOES THIS MEAN TO YOU?

If your house is stuffy, has lingering odours or has high humidity levels in fall and winter, it is likely your house does not receive adequate ventilation. If you or your children have respiratory conditions, such as asthma, bronchitis or chronic colds, getting the proper amount of fresh air is even more important. Windows can provide fresh air if there is a wind or driving force, but open windows can cause comfort problems, increase heating and cooling costs and may be a security risk. Using a mechanical ventilation system, such as an exhaust fan or a heat or energy recovery ventilator (HRV/ERV), can be more effective. Bottom line, proper ventilation is important for your health and for your home.

VENTILATION

Ventilation is often defined as a means of providing fresh air while removing or diluting stale air. However, the word “ventilation” can describe several different types of air movement.

Natural infiltration

Houses get some fresh air from natural infiltration. This is the amount of fresh air that comes into your house through leaks and intentional openings (see Figure 1), and is commonly measured in air changes per hour (ACH). An air-change rate of 0.5 ACH means half of the house air is changed every hour, or the amount of fresh air that enters the house every two hours equals the volume of the house. Exfiltration, or the amount of air that exits the house, is always offset by infiltration as the house attempts to reach equilibrium – if it didn’t, the house would become depressurized (or very rarely, pressurized). It should be noted that infiltration is uncontrolled ventilation influenced by such things as wind, outdoor temperature and height of building. These factors make it impossible to know exactly how much and from where air enters or exits the house. As such, it can lead to comfort problems.

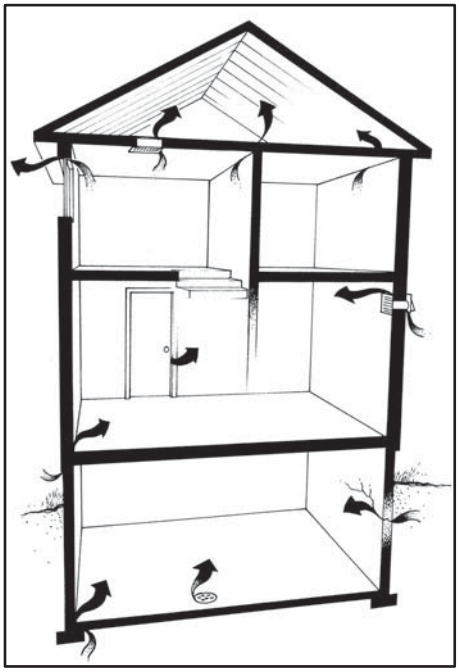

Figure 1: Infiltration and exfiltration of air in a house

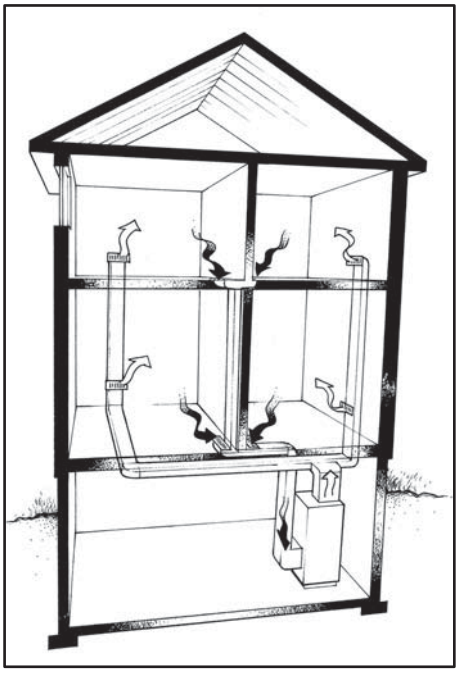

Figure 2: Distribution of air throughout a house

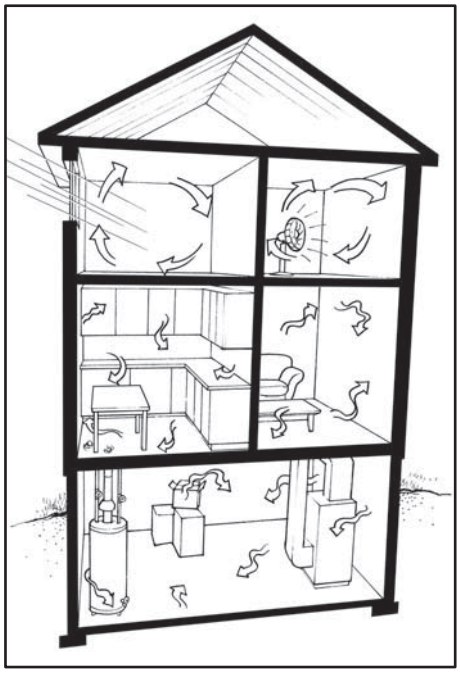

Figure 3: Circulation of air in a house

Distribution and circulation

Fresh air needs to be moved around the house, particularly to rooms with closed doors, such as bedrooms (see Figure 2). Without distribution, fresh air might not reach all the rooms in a house, and could cause pockets of stale or moist air. Distribution of air throughout a house usually requires fans and ducting systems.

Circulation of fresh air within a room is necessary to reduce under-ventilation such as in large spaces or rooms with lots of furniture or stored items (see Figure 3). Fans, or better yet, an upgraded distribution system can help here too.

IS VENTILATION NECESSARY?

Ventilation and good air quality are sometimes under-appreciated. If your furnace breaks down in the winter and the house starts getting cold, you will notice that problem within a couple of hours. Insufficient ventilation however will generally not be noticed as quickly as it takes time for symptoms, such as stuffy air, moisture accumulation or mould to develop.

A good time to get a sense of your indoor air quality is when you enter your house, before you get accustomed to the indoor air. Do you notice residual cooking odours, smelly garbage or even a musty smell from mould? It should smell fresh and neutral.

People need fresh air all the time, but the need for additional ventilation will vary depending on the season. In the middle of winter, when it is very cold or windy outside, the natural air-change rate of the house will be high and you may not require additional

mechanical ventilation. This high winter air-change rate is a result of stack effect caused by the force of rising warm air: the greater the difference between the interior and exterior temperatures, the stronger the force of the stack effect. The stronger force results in more warm air leaking out the upper portions of the house while cold air is sucked in to replace it in the lower areas of the house; hence a greater rate.

However, there are many times in fall, winter and spring when mechanical ventilation may make sense. Mechanical ventilation is even beneficial for mid-summer if you are using air conditioning and you do not open windows for extended periods of time. In fact, summer is when houses have the lowest natural air change rate as the stack effect is much less since the interior and exterior temperature differentials are much smaller.

PROVIDING GOOD VENTILATION

All houses can be provided with good additional ventilation, usually at a reasonable cost. Here is advice for a variety of houses, starting with the most difficult to ventilate.

Older houses with no ducts or fans

Most owners of older homes rely on opening windows in bathrooms and kitchens to get a cross breeze to meet their ventilation needs. However, bedrooms are often under ventilated so some type of mechanical ventilation system should be considered. This is especially important if these houses are to be or have been tightened as a result of renovations and energy retrofits.

Bathroom and kitchen exhaust fans vented to the outside are recommended as a minimum to remove odours and moisture produced at the source. However, they are less effective at providing adequate ventilation than a whole house ventilation system.

A word of caution: Exhaust only ventilation also can promote high levels of depressurization especially if powerful exhaust fans are used. High levels of depressurization can cause the exhaust gases from many types of fuel-burning appliances such as wood stoves and gas-fired water heaters to reverse their flow in the chimney and spill back into the home. This is a dangerous situation and must be avoided. More information can be found on this topic in the section on combustion gases in your home.

For homeowners who want the benefits of an air distribution system offered by an HRV or ERV, dedicated ventilation ducting in smaller dimensional sizing is available for regular low velocity systems. Furthermore, high velocity systems offer even smaller ductwork ideal for renovations but the system must be designed and installed properly to prevent noise from the air flows. Ductwork can be installed between existing floors, wall cavities, corner spaces, closets, in or on basement ceilings and in drop ceilings. However, do not install ducting systems in the attic, as the temperatures in Canadian attics are inappropriate for ducting in both the summer and winter.

Houses with bathroom fans and forced-air furnaces

Homeowners that rely on bathroom exhaust fans as their ventilation strategy should know that this system depends on outdoor air to leak in through various gaps in the house to replace the air being exhausted. The furnace fan and ducting system then mix this infiltrating fresh air with house air and distribute it around the house.

In some houses in various parts of the country, a “ventilation” fan switch is located by the thermostat so the furnace fan starts at the same time as the ventilation fan to ensure ventilation air is distributed and circulated throughout the house. In some cases a small duct is run from the exterior to the return trunk duct of the furnace to introduce fresh air directly into the furnace. This duct to the furnace return reduces the drawing of air through wall leaks and promotes tempering of the outdoor air before it reaches the rooms. Though this is not the best way to run a ventilation system, it can be made to work.

The steps involved are:

1. Install a good bathroom type fan vented to the outside in a central location. Make sure it is designed for continuous operation, highly energy efficient (less than 50 watts) and quiet (1.0 sone or less) so you won’t get annoyed by the sound. A smaller size fan (25 litres/second or 50 cubic feet/minute) is adequate. A fan with a higher air flow should include a speed controller.
2. If steps have been taken to air seal the house, it may be necessary to install a duct from outside to the furnace as noted previously.
3. Leave it running all the time, or at least when the house is occupied. If your furnace or central air conditioner is running frequently, then the fresh air is being distributed. You can leave your furnace fan on to ensure distribution, but that will usually cause high electrical consumption. New furnaces can be purchased with DC fan motors or older furnaces upgraded with conversion DC fan motors that can be controlled to run at under 100 W at low speed (non DC fan motors have power consumption of 400–600 W). If you have an inefficient furnace fan and need to use the furnace fan for distribution, consider installing a fan-cycling controller or a programmable thermostat that includes a fan-cycling feature (sometimes referred to as a fan circulator). This will give you additional control to limit the furnace fan operation to reduce the fan motor electrical consumption. Even 20 minutes an hour should ensure adequate circulation in most situations. Having the ventilation fan electrically linked to the furnace fan will ensure that when you start your ventilation system, the furnace fan comes on also and the fresh air gets distributed.

HRV or ERV connected to the furnace ducting system

Heat and energy recovery ventilators are mechanical devices that provide good ventilation without a big energy cost for heating the incoming outside air. These

ventilators both use the air being exhausted to preheat incoming air. They are able to recover 60–90% of the heat from the outgoing air which means, in winter, the incoming air will be much warmer than outside air (but still cooler than house air). The balanced ventilation provided by these devices does not usually create house depressurization that could affect the proper and safe functioning of fuel fired appliances in the home.

In addition, an ERV also transfers a portion of the moisture from the more humid air flow (indoor air in winter and the outdoor air in summer) to the more dry air flow, helps to regulate humidity level in the house. During the heating season, this can reduce drying out the interior of some air tight homes, which might occur with HRVs, especially in cold dry climates. Also, an ERV can improve indoor humidity control and substantially reduce air conditioning energy consumption on warm humid days.

Since the HRV or ERV in this case uses the furnace ductwork, the furnace fan has to be on, or at least cycling on and off, for the fresh air to get distributed around the house. This is easily achieved using the HRV or ERV control to turn the furnace fan on (this is called interlocking). The same considerations apply about installing or retrofitting a furnace with a DC fan motor or installing a fan-cycling controller or a programmable thermostat that includes a fan-cycling feature. HRVs and ERVs, just like furnaces, need maintenance and cleaning.

See Natural Resources Canada's publication *Heat Recovery Ventilators* for additional information and advice.

Separately ducted HRVs and ERVs

This system can be the most efficient way to ventilate your house especially if no ductwork exists. The HRV or ERV preheats the incoming air and its internal fan distributes the now tempered fresh air and draws the stale air through its own dedicated ducting. This system does not require a furnace fan to run as part of the ventilation distribution system which can result in significant energy savings. Though duct sealing is always recommended to ensure that conditioned or fresh air gets to its intended location, this is particularly important with dedicated duct systems. Sealed ducts help ensure that the small blower fans in HRV and ERVs can deliver the volume of air required.

The HRV or ERV should be used anytime the house is normally closed up. Run it continuously at low or medium speed, and switch to "high" for times when you want more ventilation. If you are buying an HRV or ERV, pick one that has been independently certified (e.g. choose one with a Home Ventilating Institute (HVI) certification sticker), or an ENERGY STAR® certified model. For ERVs, ensure that it is tested at low temperature in the HVI directory; ENERGY STAR certified models are all tested at low temperature. Choosing one with a high "sensible recovery efficiency" and a fan motor with low energy consumption will ensure lowest operating costs. There is a

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listing of rated HRV/ERVs on Natural Resources Canada's website and on the HVI website at **www.hvi.org**. Also ensure the contractor installing and balancing the HRV/ERV has been trained to do so through an organization such as the Heating, Refrigeration and Air Conditioning Institute of Canada or through La Corporation des maîtres mécaniciens en tuyauterie du Québec in Quebec.

As mentioned in the previous section, make sure the HRV/ERV is regularly maintained.

RUNNING THE VENTILATION SYSTEM

Ventilation is not as critical when the house is unoccupied, although some houses require ongoing mechanical ventilation to control moisture and its potential to damage the home (e.g. reduce condensation forming on windows in winter which can cause damage to window frames, trim and walls). To help control the amount of ventilation required and to prevent over ventilation which wastes energy and tends to dry out a home, simple to sophisticated controls from timers to electronic programmable controllers are available. However, there are times when high ventilation rates are needed such as:

- The first fall and winter for a new or substantially renovated house, to get rid of construction related moisture.
- Houses with high numbers of occupants, either temporary or permanent.
- Houses in which renovation activities (drywalling, painting, floor re-finishing, etc.) or new furniture are creating high concentrations of pollutants.
- Houses in which bedroom doors are generally closed during sleeping hours and no return air grille exists. Open doors help ensure the bedroom air has the same quality as the air in the rest of the house. Closed-door bedrooms require higher ventilation rates or good distribution systems.
- Houses whose residents have respiratory problems (people allergic to outdoor pollutants require filtered outdoor air).

SUMMARY

Most Canadian houses will benefit from the fresh air supplied by mechanical ventilation. In new houses, fresh air is most efficiently delivered by an HRV or ERV. In existing houses, quiet and efficient bathroom and kitchen fans, or HRVs when practical, linked to proper controls can improve air quality. Using efficient furnace fan motors and furnace fan cycling controls will help to distribute fresh air to all rooms of the house at a reasonable cost. Duct sealing is a good idea to reduce air flow loss.

Mechanical ventilation puts control of household indoor air quality at the homeowner's fingertips rather than having the weather dictate the air change rate within different parts of the house. It also allows for the house to be built or renovated to high air tightness levels to reduce heating bills and improve comfort while ensuring good indoor air quality throughout.