Code Ventilation Requirements

The 1995 edition of the National Building Code of Canada has extensively changed the ventilation requirements for housing. The code includes detailed prescriptive requirements, because in the past ventilation system design and compliance has varied.

In this piece we are focusing on the new requirements in the National Building Code. These requirements apply in all areas except for Ontario and B.C. where provincial requirements were modified several years ago, and will be continued with only minor modifications.

Ongoing cross Canada surveys of conventional, merchant builder houses have shown that houses are increasingly being built tighter. The trend to more airtight construction has been with us for the past 50 years or so through the introduction of new products and construction techniques. If today's houses relied only on leakage through the building envelope for fresh outdoor air, then 70% of them would have less than 0.3 air changes per hour (ACH) over the heating season, and 90% would have at least one month when the air change rate would be less than 0.3 ACH.

Houses normally do not need this much ventilation all the time, although it has been recognized that about 0.3 ACH for the average sized house is a suitable minimum level for health and comfort. If this rate cannot be achieved, most households will experience poor indoor air quality and high humidity levels at some times.

Traditionally, a significant portion of the air change in houses was due to air flow up the flue. However, with modern heating equipment the dynamics have changed. Electric heating eliminates the need for flues. High efficiency combustion furnaces reduce the air flow up a flue by more efficient combustion, by restricting flue air leakage between firing periods, and eliminating the need for open flues.

The increased use of such heating systems combined with increased emphasis on sealing the building envelope has led to a concern that the natural air change may be inadequate at times to provide a healthy environment. Condensation problems resulting from higher humidity levels within the dwelling are also a concern. That is why the Building Code has included requirements for mechanical ventilation for many years.

The purpose of ventilation is to maintain healthy indoor conditions for occupants. Ventilation for occupants must not be confused with ventilation requirements for the structure or combustion air requirements for combustion equipment, which is part of the heating system.

Changes to the ventilation requirements of the 1995 NBC were made because of concerns that the 1990 code ventilation requirements were inadequate, especially regarding distribution of outdoor air brought into the house and the prevention of the depressurization of the house, which can interfere with the venting of combustion appliances.

Essentially, every house must be provided with a mechanical system that complies with CSA Standard F326 "Residential Mechanical Ventilation Requirements." This is a comprehensive performance standard that offers flexibility for those experienced in ventilation system design. However, because it is a performance standard, it requires professional design to prove compliance. That is why home builders requested that prescriptive alternatives that meet the performance requirements be written into the code. As a result, Section 9.32 has been greatly expanded to offer prescriptive alternatives. The latest code changes provide a choice of "prescriptive" and "good practice" options for compliance with ventilation requirements.

System Capacity

The ventilation system capacity is essentially related to the number of people in the house rather than to the volume of the house. Total system capacity is based on the number and types of rooms as noted in the table. For example, a three-bedroom house, with family room, recreation room, two bathrooms and basement requires a total ventilation capacity of 70 cfm.

Ventilation can be supplied by a single fan or a combination of fans, but clearly labelled controls must allow the airflow to be reduced to 50%. If the principal fan is controlled by a dehumidistat or other automatic control, a manual switch must be able to override the automatic control.

Exhaust fans must be coupled to an air intake such as a pipe from the exterior into the return air system of a forced air furnace to limit pressure unbalance in the house. The size of the exhaust is limited to prevent over-ventilating and to avoid excessive depressurization of the house. The principal exhaust fan must provide at least at 50% of the

Total ventilation capacity		
(example calculation for a 3 bedroom house)		
Room	Capacity	
	(l/s)	*(cfm)*
master bedroom	10	*21.18*
2 other bedroms	10	*21.18*
living room	5	*10.59*
dining room	5	*10.59*
kitchen	5	*10.59*
family room	5	*10.59*
3 bathrooms	15	*31.77*
basement	10	*21.18*
Total ventilation capacity required	65 l/s	*137.67*

total capacity required. If it is a large fan, reducing its air flow must be possible. The concern is that a system run at full capacity could make the house very dry and the heating bills very high, so the occupants might simply turn the ventilation off and forget it.

Ducts must be sized correctly. Measurements of actual installations have found that kitchen and bathroom fans often deliver about half the rated exhaust flows, mainly because of incorrect installation. That is why code tables lay out minimum duct sizes required for each fan. These are to be used if specific recommendations are not provided by the fan manufacturer.

Supplemental Exhaust

Kitchen and bathroom exhaust fans are required to remove contaminants near their point of origin before they can mix with air from other rooms.

Each kitchen must have an exhaust fan with a minimum capacity of 50 L/s (105 cfm) and each bathroom at least 25 L/s (53 cfm). The total of the supplemental fans must add up to at least the difference between the total ventilation capacity and the capacity of the principal exhaust fan.

Common practice in some parts of the country is to use recirculating range hoods, so this may be a new requirement. Note that recirculating hoods are only partially effective if the charcoal contained in the filter is recharged regularly. Most units have so little charcoal, they can become ineffective at odour removal in a matter of weeks. Not many people are aware of this, and few replenish the filter. The net effect is that most recirculating hoods do little more than make noise!

Downdraft cook tops have fans that vent to the exterior. These have to overcome natural forces, so they are very powerful, and can depressurize houses to unsafe levels. That is why most will require dedicated make-up air.

Distribution

Fresh outdoor air brought into the house must be distributed to the living areas, especially the bedrooms. This requirement has been introduced into the code because of the mounting evidence of poor air quality in the bedrooms of houses that do not have air ducted circulation.

The outdoor air must be provided to each bedroom and to each floor (including the basement). In houses where there is no storey without a bedroom (e.g., a basement-less bungalow), ventilation air must be supplied to the main living area. This is simple in houses with forced air heating systems because the heating ducts do double duty as ventilating ducts. Houses without forced air heating, such as baseboard or radiant heat, need a system of small ducts to distribute the outdoor air to each bedroom and to each storey without a bedroom.

Outdoor air must be tempered before being circulated through the house. This can be accomplished by using a heat recovery ventilator, a heating element in the incoming air duct or by mixing it with indoor air. However, the latter approach is more complicated as it requires careful design and balance of the airflows between the outdoor air and indoor air ducts. It is too complex to deal prescriptively so where tempering by mixing with indoor air is chosen the system must be designed to meet CSA-F326.

Ventilation in homes with Forced Air Heating

For the ventilation system tied to a forced air heating system, the heating ducts circulate the outdoor air. The furnace must be wired so that, whenever the principal exhaust fan is running, the furnace runs and fresh outdoor air is brought into the heating system's return air plenum upstream of the connection to the furnace. Minimum duct sizes are specified depending on whether the supply air enters passively or through an auxiliary supply fan.

1995 NBC Summary of Ventilation Requirements

Principal exhaust and supply
- capacity based on room count
- must be able to ventilate continuously at half the required ventilation capacity
- supply and exhaust must be balanced
- control by centrally located switch
- ventilation air must be distributed to living areas
- supply air must be tempered

Supplementary exhaust
- 25 l/s for bathrooms not served by principal exhaust
- 50 l/s in kitchen if not served by principal exhaust
- supplemental exhaust plus principal exhaust fan must equal or exceed total ventilation capacity
- fans must meet sound ratings
- manual controls

Make-up air
- must protect against soil gas entry and combustion gas spillage
- must be installed for devices that exhaust more than 75 L/s
- must reduce pressure imbalance to 75 L/s or less
- operate automatically
- incoming air must be tempered

Outdoor air can be tempered before it reaches living areas of the house by mixing it with the return air in the furnace's return air plenum. A 3 m minimum distance between the furnace and the outdoor air supply duct connection is specified to enable a thorough mixing of air before the cold air reaches the furnace heat exchanger. This will avoid condensation of combustion products that could occur resulting in reduced heat exchanger life.

Ventilation in homes without Air Heating Systems

If there is no forced air heating system or, if it is decided not to use the heating system to distribute the outdoor air, then a dedicated distribution system must be installed. Because the system only handles ventilation air, smaller ducts can be used and the supply fan can be smaller than a normal furnace circulation fan. The supply fan must operate at the same time and rate as the principal exhaust fan to avoid either pressurizing or depressurizing the house.

Fresh air supply grills must be put in the ceiling or high up in the wall, (within 300 mm of the ceiling).

Protection Against Depressurization

Exhaust fans can cause spillage of combustion products from combustion appliances if the house is depressurized. Appliances vulnerable to pressure-induced spillage are those that draw combustion air from the house, vented through a natural draft chimney. Examples include older gas furnaces and water heaters with a draft hood, oil furnaces with a barometric damper, open fireplaces and wood stoves. Appliances such as gas furnaces and water heaters with induced draft venting systems and the "sealed combustion" oil furnaces are resistant to spillage and do not require make-up air openings.

Most fireplaces are vulnerable to spillage, even those with so-called "airtight" glass doors and outside combustion air intakes, because "airtight" doors are not really airtight. Gas stoves are not required to be vented, but for occupant health and moisture control they should always be vented to the outside. Their operation will not be affected significantly by depressurization of the house so make-up air openings are not required.

A carbon monoxide detector must be installed on or near the ceiling of any room that has a wood burning fireplace or stove, unless the unit has tight fitting doors that close off the firebox from the living area.

If the house includes combustion appliances vented through a chimney, then any exhaust device with a capacity greater than 75 L/s (158 cfm) must be provided with make-up air. The supply fan must be connected to the exhaust fan, so that it works simultaneously. The make-up air has to be tempered to at least 12 °C before being introduced into the living areas. The size of the make-up air fan must be big enough so the net exhaust is reduced to 75 L/s. So for example, a 150 L/s downdraft cook top fan would have to be wired to a 75 L/s supply fan.

Fan Sound Ratings

Ventilation system fans must be quiet so that building occupants do not turn them off. Fan noise level is expressed in "sones" tested by the Home Ventilating Institute (HVI). The higher the rating, the noisier the fan. The principal exhaust fan must have a maximum rating of 2 sones.

Many kitchen exhaust fans have sone ratings greater than 3.5 so they cannot be used to meet the "for ventilation" capacity requirements. In this case the kitchen exhaust may be met by the principal exhaust fan, if the principal exhaust fan is installed so that it withdraws all of its air from the kitchen.

Experience in B.C., is that 2.5 sones (the code minimum for the past 5 years) is far too noisy. The B.C. code will be requiring a maximum sound rating of 1.0 sones for continuously operating fans and 1.5 sones for intermittent fans.

Ducts

Except for exhaust ducts in kitchens, dedicated ventilation system ducts can be made of combustible materials. (i.e. adequately sized plastic pipe can be used) Exhaust ducts must vent to the outdoors and not into an attic or roof space because venting into such spaces will lead to water condensation within the roof space that will eventually cause serious structural damage.

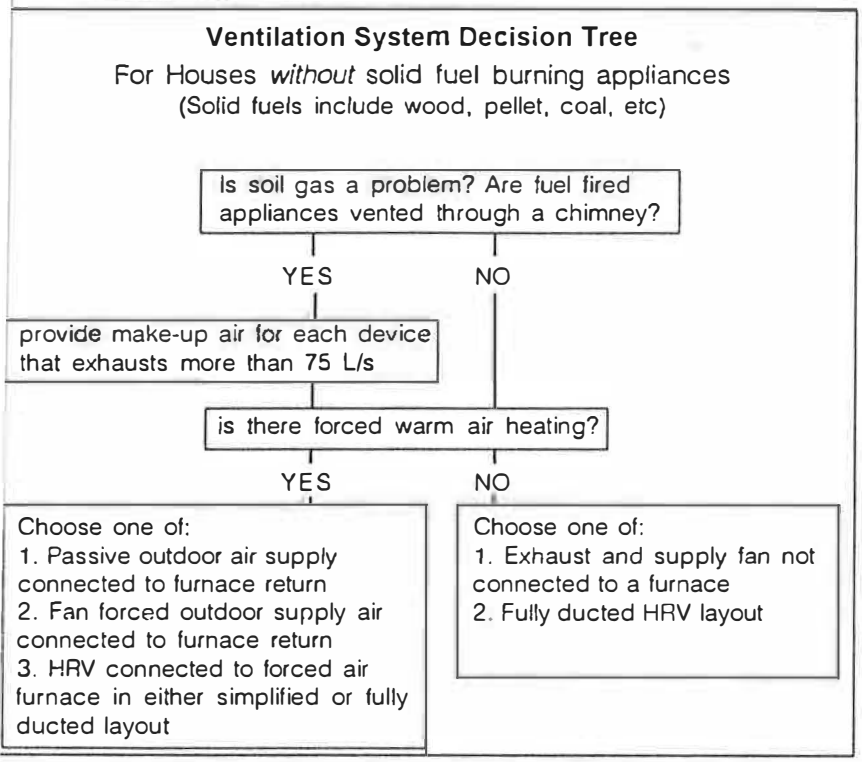
When exhaust ducts pass through unheated spaces, moisture can condense in them, so the ducts must be insulated with waterproof insulation able to withstand occasional wetting, and be airtight to prevent the transfer of moisture into concealed spaces through which they pass. Joints and seams must be sealed.

Supply ducts bringing outdoor air through a heated area (such as fresh air into the return air side of the furnace plenum), must also be insulated.

Kitchen exhaust ducts are subject to build up of grease deposits in them unless they are equipped with grease filters near the intake. The entire duct must be accessible for cleaning if it has no filter.

Heat Recovery Ventilators

The building code does not require the use of a heat recovery ventilator. However, if an HRV is



installed, manufacturers' installation requirements, including balancing and sizing of air flows must be followed. When operating at the required rate, the two air streams must be balanced within 10% of each other.

The ventilators must be provided with a condensate drain, installed where it will not affect the operation of the system.

Outdoor Intake and Exhaust Openings

Intake and exhaust duct hoods are subject to rain and snow entry, and also to insects and rodents, so they must be shielded from the weather and be fitted with corrosion-resistant screens.

Air intakes must be clearly labelled, and must be at least 18" above finished grade so in a location where the incoming air will not be contaminated by soil gases, automobile exhaust, oil or gas vents.

Fans designed to operate intermittently must be equipped with back draft dampers. ☼

Resources

Complying with Residential Ventilation Requirements in the 1995 National Building Code
CMHC $12.95 Tel: 1-800-668-2642

Residential Mechanical Ventilation Manual, HRAI, includes a code guide for specific provinces. This comprehensive manual is aimed at those with a sound understanding of mechanical systems. They also offer code related courses.
HRAI Tel.: 1-800-267-2231
Fax: 905-602-1197

SHBA Design Sheets: Ventilation Requirements, 1995 National Building Code. These were prepared for builders to supplement the CMHC code compliance publication. They are free to Saskatchewan Home Builders's Association members. Manitoba HBA is considering using this material. Non-members may purchase copies.
For information:
SHBA, tel.: 306-569-2424, fax: 306-569-9144

1998 BC Code Ventilation Requirements

The 1998 BC building code is adopting, with minor modifications, the 1995 NBC except for section 9.32 - the ventilation requirements, which will be unique to BC. This change was made based on the desire to keep incremental costs low, and yet provide minimum standards that are enforceable and yet provide a satisfactory air exchange. They also reflect the fact that most of the construction activity in BC is on the coast, the area with the mildest climate in the country and traditionally the leakiest house construction.

The key elements of the BC code requirements are:

The ventilation capacity is based on number of bedrooms, 0 cfm for a master bedroom, 15 cfm for each additional bedroom to a maximum of 75 cfm. However, there is no requirement for full distribution through the dwelling.

Each bathroom and kitchen must have an exhaust fan with minimum flow rate (80 cfm for kitchen, 50 cfm for bathroom if intermittent, 20 cfm if continuous).

The principal exhaust fan must either be designed to run continuously, or by adjustable timer to provide a minimum of two 4 hour operating periods per day. In addition, the principal exhaust fan rating is based on air flow at 50 Pa (0.2" WG) external static pressure, and a maximum sound rating of 1.0 sone for continuously operating fans and 1.5 sones for intermittent fans.

Make up air from the exterior must be provided. Passive and active make up air strategies are allowed.

If large exhaust appliances are present, active make up air is required especially in houses with open combustion appliances.

1998 Ontario Code Ventilation Requirements

The Ontario building code revised the ventilation standards in the last code revisions, so while the 1998 Ontario building code will be closer to matching the 1995 NBC, section 9.32 - the ventilation requirements, will substantially remain as they have been in the past.

The Ontario code specifies that the ventilation capacity is based on number of bedrooms, 15 L/s (31.8 cfm) for a master bedroom, 7.5 L/s (15 cfm) for each additional bedroom, but if there are more than 4 bedrooms, the ventilation system must be designed.