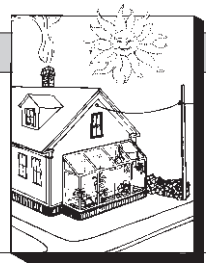


Whole-House Ventilation That Works

by Terry Brennan

Over the past few years, I've been surprised at the number of fairly airtight new houses I've seen. I'm not talking about houses built only by energy specialists either. Many of the builders are just trying to produce the best house they can, and have learned enough to close off the big leaks in the ceilings. They know about recessed lights, plumbing chases, and kitchen soffits, and they use sheet-metal firestops around chimneys where they pass through ceilings.

The houses I've pressure-tested that were built since 1984 typically range from 3 to 5 air changes per hour (ach) at 50 Pascals (compared to 1 to 3 ach for very energy-efficient houses, and 9 to 18 for typical houses built before the early 1980s). A house that measures 1 to 3 ach at 50 Pacscals will have 0.2 to 0.3 air changes per hour of *natural* infiltration.

That level of tightness is good for reducing heating and cooling costs and for keeping moisture out of the building shell. It's bad, however, if running the range hood causes the fireplace flue to backdraft. Unfortunately, you don't know how tight a house is unless you measure it.

You may be making your houses tight enough that you need to better plan your ventilation system.

Prevent Backdrafting

The most important step in planning a ventilation system is to make sure that the combustion equipment gets enough air that it doesn't backdraft. I think you should do this no matter what kind of ventilation system you use or how tight you build your houses.

There are two ways I like to protect against backdrafting. One is to use combustion equipment (furnaces, boilers, etc.) with outside air ducts that supply air directly into the unit. With this approach, any fireplaces must also have outside air ducts and airtight doors. This strategy isolates the entire combustion process from the rest of the house.

The second approach is to power-vent the combustion appliances. Some equipment comes power-vented, and there are kits that let you add power venting to others. Be sure you follow manufacturers' directions and the applicable codes when installing any combustion equipment.

Add Ventilation

Once you've protected against combustion backdrafting, the next step is to make sure that the living space has adequate ventilation. There are three important aspects to this: First, keep sources of contaminants out of the house if you can. Second, control unavoidable sources with local exhaust ventilation. Third, provide enough ventilation to meet the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) guidelines for ventilation, ASHRAE 62-89.

The areas in a house that need exhaust ventilation are the kitchen range, dryer, bathrooms, laundry, and any room planned for activities that produce odors, moisture, or other airborne contaminants. A hobby room where paints and varnishes are used might be an example. The kitchen range and dryer should always have their own separate exhausts. Grease-soaked lint is bad news in the event of a fire.

ASHRAE 62-89 says that intermittent local exhaust should be 100 cfm for the kitchen and 50 cfm for bathrooms. These are the *delivered* airflow rates. When you take a 50-cfm fan and run 15 feet of flex duct, the airflow is knocked down to more like 40 cfm and won't meet the guideline. And if you start out with a 25-cfm fan you definitely won't meet it.

For providing fresh air to the living space, ASHRAE's new recommendations say that a residence should have at least .35 ach and not less that 15 cfm per person. While ASHRAE says that this ventilation rate can be met with natural ventilation (open the windows) and infiltration (leave the building leaky), I don't think this is a reasonable approach in the Northeast.

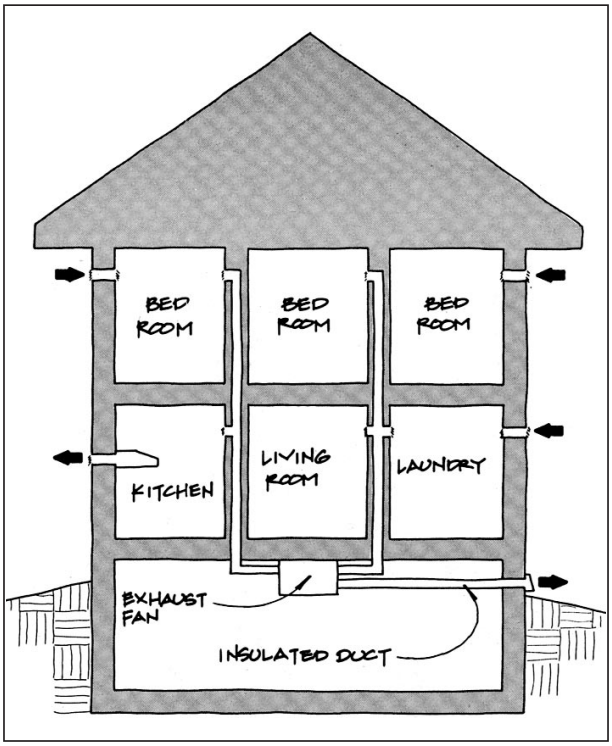
First, nobody but my grandmother opens his window in January to get ventilation air. Second, if you leave the building leaky enough to get .35 air changes minimum, then the average infiltration rate will be much higher, resulting in wasted energy. Last, if the building shell is tightened to 2 or 3 ach at 50 Pascals, it takes only a small fan to control the pressure differences between the inside and the outside of the house.

This means that a simple ventilation system, using a minimum amount of energy, can protect the walls and attic from condensation, prevent radon entry, and supply the recommended amount of outside air. I've found that using one central exhaust fan—rather than several separate fans—has a number of advantages.

One Central Fan

A central exhaust ventilation system consists of a central fan, collection ductwork, and a way to control the fan (see illustration). I generally locate the fan in the basement, where it is easy to install and inspect, and will not freeze. Then I run exhaust ductwork from the fan to the bathrooms, laundry, and living area. A control switch is located in each of those rooms. Last, insulated duct is run from the fan to the outdoors. What I like about these systems is that they are very quiet, they move enough air, and the control strategy is simplified because you are only operating one fan.

The fan is the heart of the system. You buy one good fan, not several small and possibly inadequate ones. I've had good luck with an in-line duct fan made by R.B. Kanalflakt that moves about 200 cfm in free air. These fans can be easily connected to round pipe, use only about 70 watts of electricity, are very quiet, and have long-lived bearings and motors.



A high-quality central exhaust fan can maintain good air quality in tightly built houses. This system makes the most sense with hydronic or electric heat.

In the past few years several manufacturers have introduced central exhaust *systems* (see listing at end of article). They provide all the pieces needed: fans, ductwork, grills, fittings, and switches. I've used the American Aldes and Kanalflakt systems and like them pretty well. Getting all the components in one place is very convenient.

Ducts in a Row

If the fan is the heart of the system, ductwork is the veins. With the fan located in the basement it is fairly easy to get the ductwork up through the walls. I place the exhaust grilles in the walls about a foot down from the ceiling. With the outlets in the walls, rather than the ceilings, no moist bathroom exhaust air leaks into the attic and there is no risk of water condensing in the duct and running back into the bathroom.

When using a single fan to exhaust from several locations, it's important to provide a way to balance the airflow. You can use in-line dampers or operable dampers at the grille. One manufacturer of over-the-counter systems, American Aldes, markets unique self-balancing, in-line dampers which work well.

I like using 3-inch-diameter PVC pipe for ductwork because it seals airtight, is easy to work with, and has very low resistance to airflow. Check out using plastic ducts with your fire marshal. Make it clear that you are not distributing conditioned air, but are just exhausting contaminants. Also, if the pipe passes through a fire-rated wall (like between the garage and house) you must use a fused-link damper or other fire control product at the penetration.

The Brains of the Operation

The brains of the system are the controls. Control can happen in a number of ways. At first I used four-way switches and limited control to three locations, usually the living room and two bathrooms. This system works well if you only need three switch locations. The fan ventilates the entire house whenever someone flips one of the switches.

More often now I use relays to turn on the system. This way any number of switches can be used to turn the system on. However, the switch that turned it on must also be the switch that turns it off. This method allows the use of a humidity sensor to turn the system on when a preset humidity level is reached. In this way an upper limit is put on wintertime indoor humidity.

A third strategy, used by the Aldes system, is to use a high-speed/low-speed control. In this way the house is ventilated continuously at a low flowrate and at a higher flowrate whenever a manual switch or humidity sensor is activated. This strategy means that whether the occupants are paying attention or not, they are getting some ventilation. This method is part of the Canadian ventilation guidelines.

One last important point on ventilation control: Because these things are so quiet, people don't notice they are running and forget to turn them off. Timer switches and operating lights can help with this. I prefer the electronic timer switches to the spring-loaded type because of durability. Also, always install a main on and off switch so that the whole system can be shut down by the occupant. There is no need to ventilate the house when you've gone to visit mom for a week. If this switch is within eyesight of the fan, it can also serve as the code-required disconnect.

Fresh Air Inlets

The last option to consider is whether or not to add passive air inlets. These are simply little ducts that are placed throughout the wall to allow outside air in. Remember that if you are exhausting 200 cfm of air from the house there must be 200 cfm entering the house somewhere. You can gain some control over where it comes in by making the shell airtight and installing these manufactured holes.

The inlets come in several models from at least a few manufacturers (see listing below). Some have adjustable or humidity-operated dampers. Such passive supply vents work best in very airtight buildings, but even in moderately tight buildings you can use them in places where you definitely want outside air to leak in—in closets or bathrooms, for example.

In general, the inlets are best placed near the ceiling where the cold air can mix well with room air before contacting people. Try to place the vents at least 3 feet away from occupants.

I use central exhaust systems in houses with hot-water baseboard or electric-resistance heat. If the clients want a warm air heating system I prefer to use one of the new systems that combine space heating, water heating, and heat-recovery ventilation. ■

Terry Brennan consults on energy design and Chuck Silver designs custom homes. They currently run training seminars on energy-efficient construction for the New York State Energy Office, and take turns writing this column.

Manufacturers of Central-Exhaust Systems & Components

American Aldes Corp.
4539 Northgate Court
Sarasota, FL 34234
813/351-3441
(Complete systems, fans, ducts, self-balancing dampers, passive inlets)

Can-Aeroco Ventilation
104 Runnymede Rd.
Toronto, Ontario M6S 2Y3
416/767-8906
(Complete Systems, fans, ducts, dampers, passive inlets)

DEC International
Thema-Stor Products Group, Inc.
P.O. Box 8050
Madison, WI 53708
608/222-3484
(Complete systems, fans, passive inlets)

FanTech
2225 Industrial Blvd.
Sarasota, FL 34234
813/351-2947
(Systems, fans, diffusers, accessories)

R,B. Kanalflakt
1121 Lewis Ave.
Sarasota, FL 34237
813/366-7505
(Complete systems, fans, fittings)

Titon, Inc.
P.O. Box 6164
S. Bend, IN 46660
219/271-9699
(passive inlets)