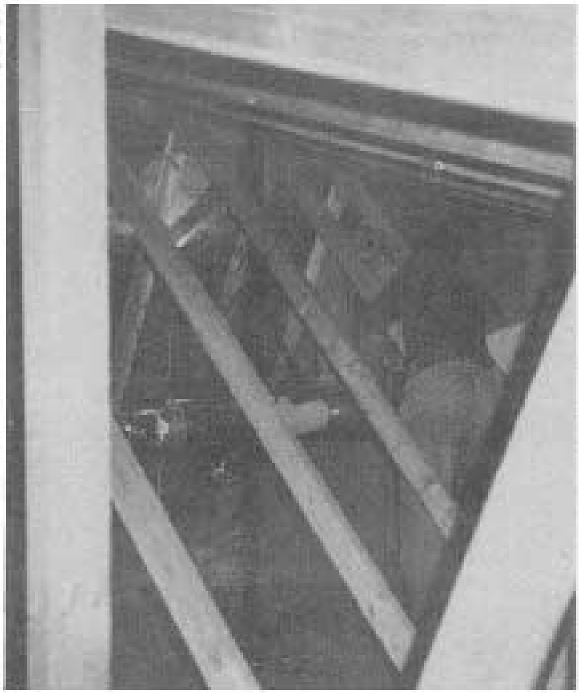
No-Frills Fresh Air



A contractor puts the finishing touches on a prototype French-made ventilation system. The advanced exhaust-only system, from Aereco, should be available soon in Canada and the U.S.

by Charles Eberdt

Simple upgrades to your current approach can ventilate the whole house

Since the early 1980s, the utilities in the Northwest have sponsored two major programs promoting energy-efticient construction techniques in new homes. Although these programs initially required air-to-air heat exchangers, a little over a year ago the rules were relaxed to include less expensive non-heat-recovery systems.

These simpler systems will not satisfy everyone in every house. But they do most of what a ventilation system should. The systems consider supply air as well as exhaust. Good distribution is stressed, and controls are meant to be "user friendly." While time is the true test, to date the systems seem to be satisfying both homeowners and builders.

Control at the Source

No ventilation system can solve all indoor-pollution problems. In some cases, whole-house ventilation can actually aggravate a problem. For example, an exhaust-only system can actually encourage radon to enter a house by depressurizing it. Moisture and odors, on the other hand, are generated inside the house from day-to-day activities and should be handled by a ventilation system.

The best way to deal with any pollutant is at its source. Taking the following four steps in the order shown will produce the best results:

1. Don't bring the pollutant into the house in the first place.
2. Seal it up at the source if it is brought in.
3. Ventilate the pollutant locally at its source.
4. Ventilate the space, generally.

Four Strategies

1. Upgraded bath fan. The most popular ventilation strategy we use is the integrated-spot-and-whole-house system (Figure 1). In this case, typical bath fans (50 cfm minimum capacity) and kitchen fans (100 cfm minimum capacity) are installed. One of these "spot" fans, however, is upgraded to a more powerful and quieter model. This is usually a centrally located bath fan. The upgraded fan must be able to continuously deliver airflow equivalent to 10 cfm per bedroom plus an additional 10 cfm. Its noise should be rated at no more than 2.5 sones. For a four-bedroom house, this is only a 50 cfm fan. We recommend sizing fans larger than the minimum and using split-capacitor fans, which permit the use of a variable speed control.

The spot ventilators are controlled by simple manual switches, or, preferably, a spring-loaded timer. The unit that serves the whole house must have a manual switch in the main living space as well as an automatic control. This can be either a dehumidistat, which turns on the fan when the indoor humidity reaches a certain level, or an automatic timer, which turns the fan on at adjustable intervals.

The supply side of the ventilation is provided by vents cut through the exterior walls in bedrooms, plus at least one for the main living space. Both the circular Fresh 80s from DEC International and the rectangular inlets from American Aldes Corp. are used. These units are designed to let in only a small amount of air, on the order of 10 cfm (Figure 2).

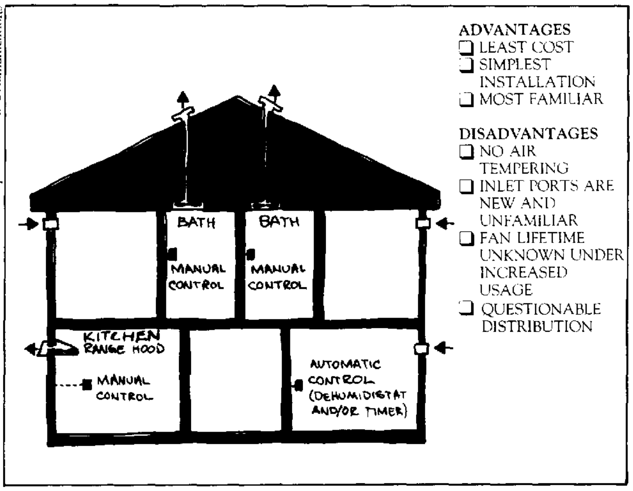


Figure 1. Upgraded bath fan. *This is the least expensive system. It requires a centrally located bathroom and a strong, quiet bath fan.*

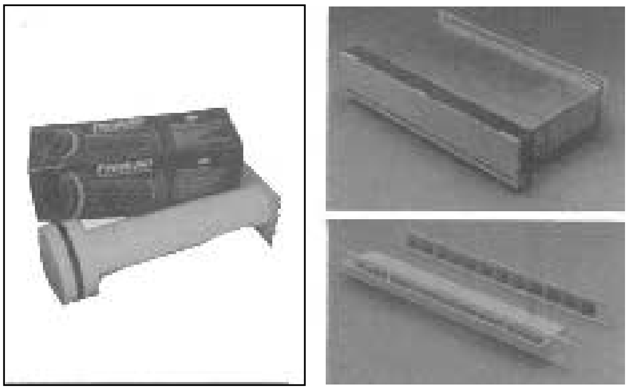


Figure 2. *Fresh-air inlets go in bedrooms and the main living space. The Fresh 80 (left) is opened and closed with a pull cord. The Aldes inlet ports (right) are engineered to provide constant airflow or regulate it by humidity.*

Where the inlet vents are located is important. We want them in the rooms where we spend a lot of time, such as bedrooms (research shows that moisture problems are common in bedrooms). But, in general, we don't need inlets in rooms with exhaust fans, such as kitchens and baths. Comfort is another consideration. The vents are usually installed high in the wall so the air incoming cold air mixes with the warmest air in the room before coming in contact with people.

2. Whole-house fan. A second variation is called discrete-spot-and-whole-house system (Figure 3). In this case, the whole-house fan is a separate unit installed in the main living space. It is controlled as described above—with both a manual and an automatic control. Fresh air is supplied as in the first strategy. This system is preferred for houses where there is no centrally located bath. It will cost more because of the additional fan installation, but may be simpler and more durable in the long run.

3. Central exhaust. The third variation is the ducted-central-exhaust system (Figure 4). Again the only difference is on the exhaust side. Here, one powerful fan is installed and the rooms that need exhaust are ducted to it. One advantage can be quietness, since the fan is located away from the pickups. Another advantage is fan quality.

Probably the classic system in this style is the American Aldes VMP-K series. This is a carefully engineered unit that comes with quite a variety of optional accessories (Figure 5). VanEE also makes a solid unit, the EX 200, but does not have as complete a line of accessories. Some builders prefer to put together their own components, often using high quality Kanalflakt fans.

4. Furnace tie-in. The last variation is a change to the supply side (Figure 6). Instead of the wall inlets to bring in fresh air, an outside duct is run to the return side of the forced-air heating system. A motorized damper in the duct opens only when the exhaust equipment comes on. Any of the three exhaust strategies above can be used.

What Do Homeowners Think?

Since these systems can succeed only if users accept them, we sought feedback from homeowners living with non-heat-recovery ventilation. In general, the owners we spoke with were pleased with the comfort in the homes, but their experiences offer some guidance for future installations.

Perhaps the biggest surprise is that almost no one complained about the wall inlets being drafty or causing discomfort (except for a few negative comments about windy days). This included homes with babies as well as one with a 96-year-old. In one case, dust was brought in while topsoil was being moved around. In another case, wood smoke sometimes got introduced. One man mentioned that one vent developed a whistle under strong winds. These instances reinforce the importance of careful vent placement and of using closable inlets. Condensation near inlets was minimal to nonexistent.

One homeowner didn't like the looks of the vents. She had them installed low in the wall where they would be hidden by furniture. Closets are another popular hiding place.

Bv comparison. ducting fresh air to the furnace return seems more problematic. The problem is not one of comfort, but of how to control the air coming in, and how to assemble the components. The ideal system would open the damper and turn on the furnace fan whenever the exhaust fan comes on. This would ensure good distribution of the fresh air via the furnace supply system.

Making the first switching relay is not a problem, but connecting to the fan circuit on the furnace can be. Some equipment's UL listing may be voided, a step-down transformer may be required externally, it can be difficult to isolate the fan circuit, and the HVAC contractor may not understand what is wanted or how to do it.

One owner/builder I interviewed figured it cost him nearly $500 to work out

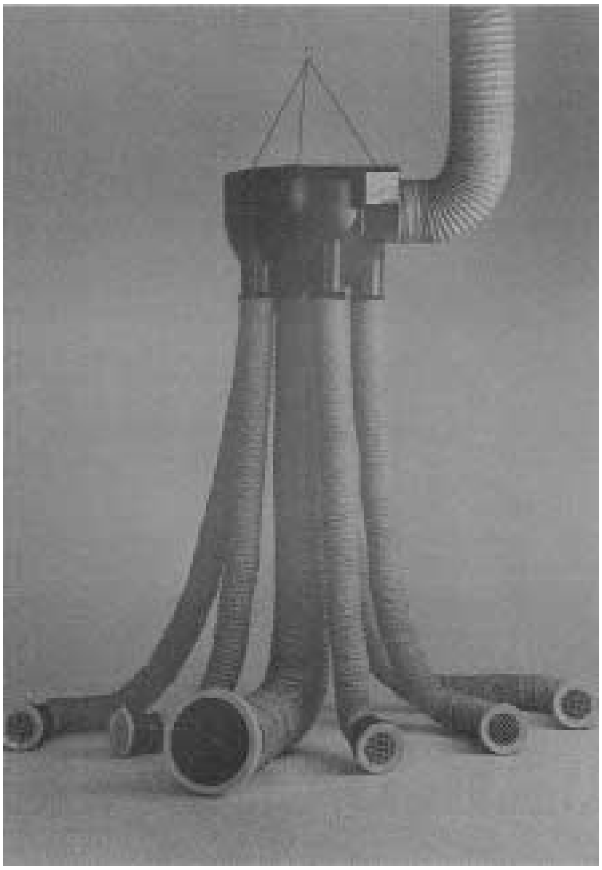


Figure 5. The octopus-like VMPK system from American Aldes uses a single powerful fan to continuously exhaust from kitchen, baths, and living spaces.

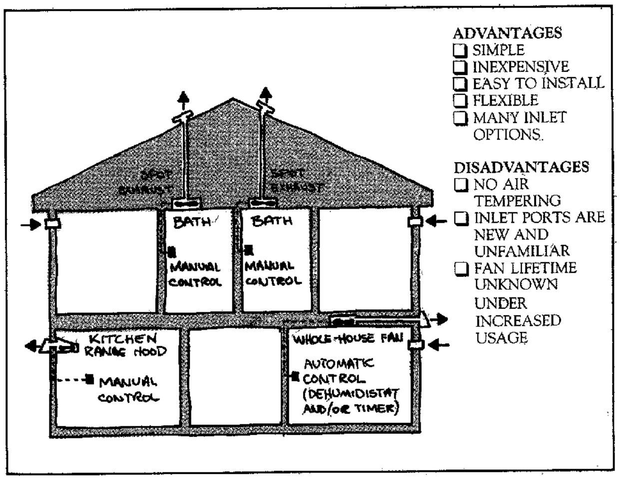
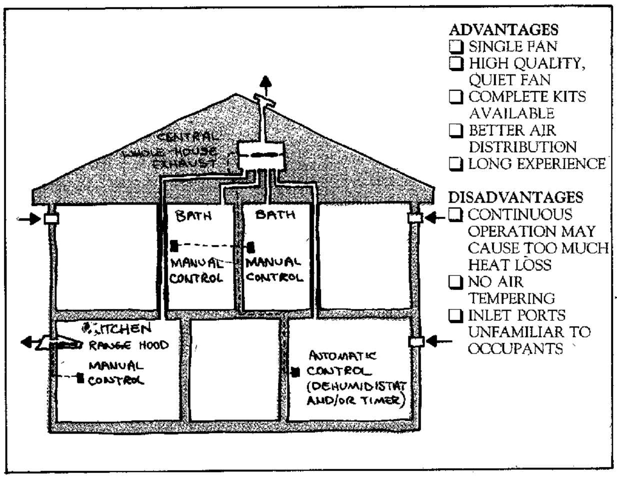


Figure 3. Whole-house fan. *This is similar to the first strategy, but requires an extra fan. It offers flexibility and may be simpler and more durable in the long run.*



Adapted from Iris Communications

Figure 4. ***Central exhaust fan.*** *The central exhaust fan can replace several fans with a single powerful unit. Complete pre-engineered kits are available that promise better air distribution.*

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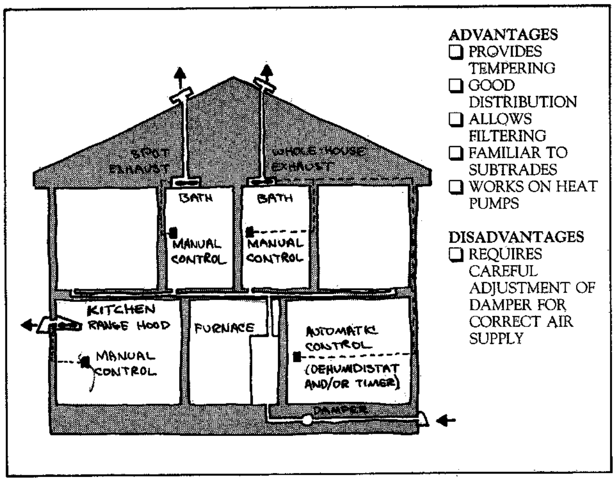

Figure 6. Furnace tie-in. *For homes with warm-air heating, you can get good distribution of fresh air by bringing it in through the furnace. But mechanical tinkering may be necessary.*

the connection. This included burning out one solenoid valve he was using for the damper because the instructions were incorrect. On the other hand, homeowners with heat pumps in the dry climate of Ashland, Ore., are simply tying open the damper and running the distribution fan constantly at a low speed. This slightly pressurizes the house, but since the climate is dry there is little concern about this forcing moisture into the walls. This may also be a good option for houses with radon problems since the positive pressure may reduce the rate of radon entry.

Fan Noise and Power

It is no surprise that a number of homeowners said they would prefer a larger and quieter fan. It is possible to buy a 50 cfm fan with a low noise rating for just $10, but you get what you pay for. Many inexpensive fans are not designed to run continuously. Larger fans running at a slower speed will be quieter and last longer. Also a variable-speed control provides the occupant with much wider airflow choices.

Installation is also important. In most bath fans, the airflow rate falls off quickly when friction is increased due to ductwork. Too much ductwork or too many turns can reduce the airflow to almost nothing. Poor installation can also increase the noise—due to increased vibration. Both Kanalflakt and Penn Zephyr bring their cabinet-mounted fans down to about 1.5 sones by installing them in insulated boxes.

Controls

Keep the system controls as simple as possible. With simple controls, less can go wrong. Also, if the homeowner understands how the system works, he or she is less likely to undermine it accidentally or intentionally.

The dehumidistat control (Figure 7) seems to confuse people. Since most of us are used to turning a dial up for comfort, turning the dehumidistat down seems backwards. Also, while the manufacturers claim accuracy to around 4 percent, installers often say 20 percent is more like it. Some homeowners complain that the fan doesn't come on until the dial reads 35 percent. Is the house really dry, or is the dial inaccurate?

One solution is to instruct the homeowner to look at the windows and to adjust the dial to a level that eliminates window condensation. (Condensation, however, was not a problem in these houses.)

One homeowner in Vancouver, Wash., reported an unforeseen problem related to his dehumidistat control. His family heats with wood as well as electricity. Once they left the heat turned off while away for a weekend. After they left, the house began to cool. This raised the humidity enough so that the whole-house fan came on. As the house continued to cool, the fan continued to run. When they returned, the house was as cold inside as it was outside. A minimum thermostat setting of 55°F most likely would have avoided the problem.

Since a dehumidistat does not respond to odors, a timer may be a more responsive control. It also allows the occupant to set the ventilation rate at a level he perceives to be appropriate. From the builder's point of view, the timer is not expensive and provides the ability to properly control the system.

As with the inlet ports, the homeowners generally set the timer units once and then left them alone. Some of the homes I visited had them set as low as an hour a day in fifteen- or thirty-minute intervals. It is hard to say whether their reported lack of problems was due to the dry winter, frequent use of spot ventilation, or the natural leakiness of the houses.

People also appreciate the ability to determine when the fan comes on. A number reported they use the timed cycle when they are sleeping. Others set it to coincide with activities like cooking or showering. Still others choose to run the fan when they are at work. This last seems contrary to the commonsense notion of supplying fresh air for people, not for the house. Yet, only one complaint of stuffiness was related to poor airflow. In general, these occupants did not perceive condensation or odors to be problems.

Regardless of the type of automatic control, make sure you provide a manual override so that people can turn the system on or off at will. The perfect system, perhaps, is one that will work "with the occupant, or in spite of him."

Why Build Tight?

We are often asked, "Why should I build a tight house, just to turn around and punch holes in it? This is a good question. If we are not building tight, perhaps it doesn't help much to put in the supply side of the system.

The problem with building a loose house is that we lose control. We can't know how loose it is until it is too late to correct it. Also, we can't ensure the leakage will provide a good distribution of fresh air. Since the house will only "ventilate" when there is a driving force like the stack effect or wind, we can't be sure when we will get ventilation mostly when it's cold and windy). Or how much. Or how it will affect any combustion equipment.

We know that wintertime natural ventilation (what we call "infiltration" when we don't like it) can be as much as ten times greater than the air leakage in spring and fall. All the extra air change in the winter is at the occupant's expense—in dollars and comfort. Research done at Lawrence Berkeley Labs already indicates that a tight house with mechanical ventilation will provide more consistent air quality at less cost. The inexpensive systems described here may not meet all the goals of the ideal ventilation system, but they do take us several steps along the way.

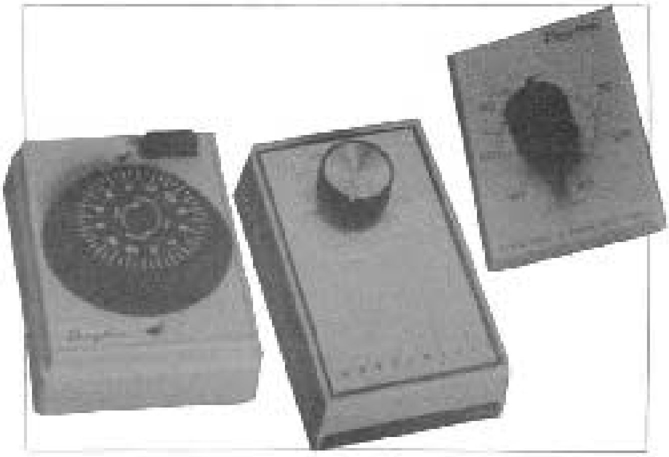

Figure 7. The control options include (from left to right) a 24-hour adjustable timer, a dehumidistat, and a simple spring-loaded crank timer.

Characteristics of an Ideal Ventilation System

Listed below are ten characteristics of an ideal ventilation system. Homeowners will find some more desirable than others.

1. **tight house**
2. **spot and whole house ventilation**
3. **properly sized**
4. **quiet**
5. **durable**
6. **supply air as well as exhaust**
7. **good mixing/distribution**
8. **manual and automatic controls**
9. **back-draft prevention**
10. **heat recovery**

At What Cost Heat Recovery?

The requirement for heat-recovery ventilators (HRVs) was dropped from the Northwest energy programs when researchers found them less cost-effective than originally thought. They found the following: The units cost more to install than first estimated, the rouses were not as much tighter than conventional houses as expected, and he "hassle factor" caused builders to resist using them.

The main factors affecting the cost-effectiveness of heat recovery are the climate, cost of fuel, and the installed cost of the unit.

Take, for example, a homeowner planning a new 1,500-square-foot home in Seattle, Wash. The climate is mild 4,800 degree days) and the average wintertime temperature is 45°F. If he plans to ventilate at a rate of .35 air changes per hour, he would need 70 cfm of continuous ventilation. If he runs hat ventilation for seven months, twenty-four hours a day, 9.5 million Btus of heat will have to be replaced. At $.05/kWh, this amounts to $140 a year. Giving heat recovery the benefit of the doubt, its installed efficiency is not likely to be greater than 70 percent, yielding about $98 of savings. If the unit costs $1,500 installed, that's a pretty long payback.

If he moves to a climate that averages 30°F in the winter and has $.08/kWh electricity, he is looking at 17.1 million Btus and an annual cost of $402 to reheat the ventilation air. Heat recovery looks much better (though he probably wants to consider a different heating fuel). If he heats with an 85-percent AFUE gas furnace and can buy gas for $.50 per therm, his annual ventilation cost is back to $101.

This does not account for the power consumption of the ventilation equipment either. If the HRV consumes 100 watts, that's $25 per season at $.05/kWh or $40 per season at $.08. If the HRV requires 240 watts, our $.08 cost goes up to $97 per year.

How about the cost of the ventilation equipment? In a small house the installed cost of a simple exhaust-only system could be as low as $300. As the house becomes more complex, however, the systems cost more. At some point, the cost of the "simpler" system rivals that of a heat-recovery system, making that the more attractive alternative.

Although the average installed cost of heat-recovery-ventilators in our region runs $1,500, innovations may help bring that down. Currently on the market is a heat exchanger made by Star Mfg., which can be fitted with a microprocessor unit that self-balances the fans. If one side of the unit is under pressure, say by wind loading on one side of the house, the unit self-adjusts to balance the flow at the designed rate. Star claims that the unit will respond the same way to pressure from the furnace distribution fan. This simplifies the installation considerably. The equipment costs around $900. The installation involves just the unit and four short ducts.

Currently on the market is a heat exchanger that can be fitted with a microprocessor unit that self-balances the fans.

A similar self-balancing device is reportedly under development by Vent-Aire (Engineering Development Inc.), which manufactures an integrated heating, cooling, and ventilation system.

So if non-heat-recovery continues to get more complicated and expensive, and heat-recovery systems continue to get simpler and cheaper-we may yet see a time when HRVs fulfill their initial promise of convenient, cost-effective ventilation. ■

Charles Eberdt trains builders and code officials in energy-efficient construction techniques, as part of the Super Good Cents Program and the Northwest Energy Code.

For More Information on the ventilation systems and components mentioned in this article, contact:

American Aldes Corp., 4539 Northgate Court, Sarasota, FL; 813/351-3441.

DEC International, Inc., P.O. Box 8050, Madison, WI; 608/222-3484.

Engineering Development Inc., 4850 N. Park Drive, Colorado Springs, CO 80918; 303/599-9080.

Penn Ventilator Co., Inc., Red Lion & Gantry Roads, Philadelphia, PA 19115; 215/464-8900.

B. Kanalflakt, Inc., 1121 Lewis Ave., Sarasota, FL 34237; 813/366-7505.

Star Heat Exchanger Corp., B109-1772 Broadway St., Port Coquitlam, British Columbia V3C 2M8; 604/942-0525.

VanEE (Conservation Energy Systems, Box 10416, Minneapolis, MN 55440; 800/667-3717.