The Swedish Solution

by Richard Karg

When it comes to energy innovations, the Swedes have a reputation for taking the lead and showing us the way. Now they are at it again—this time with the exhaust-air heat pump.

This new system is making an important contribution to ventilation technology in Sweden, particularly in areas of more moderate climate. (In colder regions, similar to New England, the air-to-air heat exchanger still reigns supreme.)

Although the exhaust pump has yet to hit the stands in the U.S., one model is now available in Canada and is expected to reach the U.S. market in the near future.

How it Works

Despite its more complex technology, the exhaust pump has distinct advantages over the heat exchanger. Here's how it works:

The exhaust pump, installed next to an integral domestic hot-water heater, pulls exhaust from the bathroom, kitchen and laundry areas through the exhaust-air ductwork.

A fan directs the exhaust air over a cooling coil, which extracts much of its thermal energy.

The heat pump then transfers this thermal energy to the hot-water tank. If the thermal energy is not sufficient to heat the water, an electric coil assists; if more energy is produced than needed, the excess heat is automatically transferred to the hydronic space-heating system. (Some systems use an additional water tank to store any excess energy.)

Fresh, outside air enters through special vents, which usually are installed over windows, to replace the air that is exhausted. (The "Fresh 80" vent manufactured in Sweden is specifically designed for this system. It diffuses incoming air, reducing its speed and eliminating uncomfortable drafts.)

Swedish technicians recommend that 80 percent of the fresh air enter through these vents, with the remaining 20 percent entering through various openings in the building envelope. Maintaining this ratio requires a tight house—less than 0.15 air changes per hour, according to Professor Arne Elmroth of Stockholm's Royal Institute of Technology.

If there is an unintended leak in the envelope near any of the exhaust grills, the proper ventilation patterns are short-circuited.

Cost and Performance

Over the past several years, the exhaust pump has become the most widely used ventilation system in Sweden's single- and multi-family homes.

Multi-family housing designers count on one pump to provide the hot water for three flats. A 1981 study of one such system found that it supplied 97 percent of the hot tap water for a 112-unit building in Stockholm—at an average coefficient of performance of 3.1. This was a retrofit project with a calculated payback of four to six years at a cost of about $600 per flat.

The cost of installing an exhaust pump in a single-family home is substantially higher—about $2,400, according to Thomas Jacobsson of Nibe-Verken AB, a pump manufacturer. This price includes the pump itself as well as a blower to provide whole-house ventilation, the hot-water heating system and part of the space heating system.

Pros and Cons

In Sweden, exhaust pumps enjoy a competitive edge over heat exchangers for a number of reasons.

Although they require more electricity to operate, they reclaim more thermal energy in the exhaust air than heat exchangers and are slightly less expensive to install—partly because no supply ductwork or frost protection is necessary. They also provide most of the tap-water heat in a given building.

The blower runs throughout the year, providing the necessary ventilation required by building codes and ensuring that the internal air is under negative pressure. (Negative pressure prevents moisture-laden air from entering through openings in the building envelope; positive pressure promotes it.)

Unlike heat exchangers, there is no possibility of cross-contamination of supply and exhaust air. The two air flows are never in close proximity.

Exhaust pumps also have some drawbacks, however. Because they allow greater negative air pressure than heat exchangers, there is a greater potential of creating problems with combustion appliances—and in extreme cases, increasing the concentration of radon gas within a building.

Another disadvantage is the untempered, incoming air that enters through the vents. If the outside temperature is 10 F, the incoming air also will be 10 F. A heat exchanger with an efficiency of 80 percent, on the other hand, would warm the air to approximately 58 F. This is the main reason that exhaust pumps are used in more moderate climate zones and heat exchangers are used in colder areas.

Finally, exhaust pumps are more complex than heat exchangers and thus cost more to maintain.

Despite its more complex technology, the exhaust-air heat pump has distinct advantages over the heat exchanger.

The Exhaust-Air Heat Pump

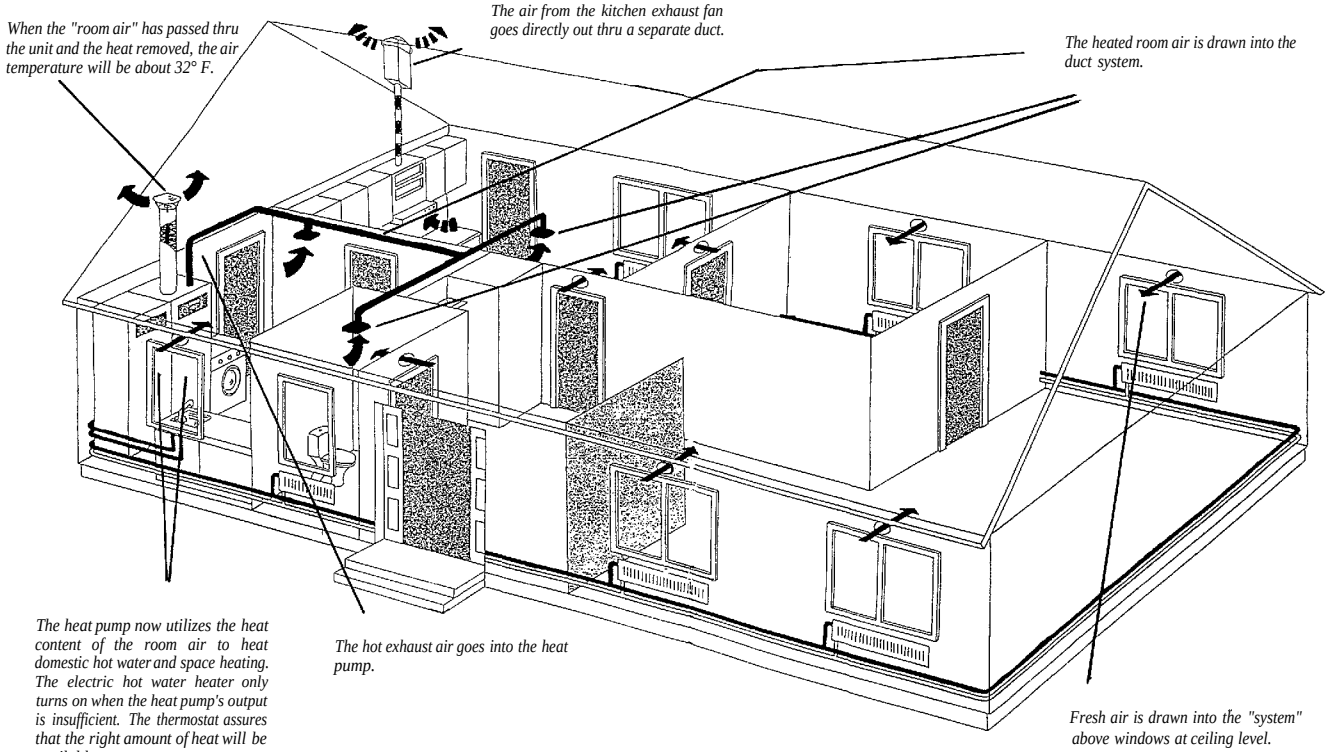

Illustration courtesy Nibe-Verken AB.

The Version Sold in Canada

The exhaust pump now available in Canada is manufactured by Electro Standard AB of Sweden and sold by Fiberglas Canada Inc. (FCI) for about $3,000. This system provides ventilation, most of the tap hot water and *some* of the space heat and air conditioning.

The heating and cooling capacities of this system are limited, however— 7,500 Btu per hour and 6,000 Btu per hour, respectively—so back-up systems are required.

The major drawback of the Electro Standard is the FCI-suggested method of venting fresh air into the house. Rather than specifying special vents like the "Fresh 80" above the windows, the company recommends that the building be constructed in a "breathable" manner so that fresh air can enter through the envelope.

There are a number of problems with this "solution."

First of all, ventilation patterns are no more predictable than the "breathing" characteristics of any given house. The chances of intake air entering the envelope in an evenly dispersed pattern are virtually nil. Most likely, the bulk of the air would enter through just a few places in the envelope—or, alternatively, the building might be too tight to allow enough air to enter at all, thereby causing the pump to malfunction.

Another problem with this random-air-intake suggestion is that it increases the possibility of high radon concentrations. If this "breathable" house doesn't breathe *enough*, internal negative pressure will increase. This in turn could boost the emission of soil gas from the basement and thereby increase the concentration of radon.

Another potential result of high negative pressure is back-drafting of combustion appliances (wood stoves, water heaters, furnaces and the like). Keep in mind that the exhaust fan draws fresh air into the house through the path of least resistance. If that path happens to be the chimney, the results can be serious.

Finally, if the right conditions exist, a "loose" house can promote water condensation in the walls, causing rot and a reduction in R values.

By using the Electro Standard to cool a house during the summer, moisture in warm, outside air might be pulled through a "breathing" hole and condense as it nears the cooler, interior wall. In cold weather, condensation can occur if exfiltration caused by the stack effect exceeds the infiltration created by the exhaust fan.

These problems could be significantly reduced—if not eliminated—if FCI would simply recommend that homes installed with Electro Standard exhaust pumps be built as tightly as possible and equipped with intake air vents. •

For more information about the Electro Standard exhaust-air heat pump, contact Larry Miller, R-2000 Program Development, Fiberglas Canada Inc., 3080 Yonge St., Toronto, Ontario M4N3N1; (416)482-2836.

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