Green Tech Notes

Presented by USGBC-Missouri Gateway Technical Committee

Audience: **√ Residential**
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Volume 1, Issue 1 ~ April 2012

Energy Recovery Ventilators (ERV): A Wise Decision

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Outside air is needed inside a building to allow its occupants to be healthy and productive. Energy efficient building design requires that building envelope air infiltration be minimized to reduce energy usage associated with conditioning interior air to the temperature and humidity desired for occupancy. A building that is properly designed and built for energy efficiency will have less passive air infiltration than is required to meet the current recommendations for fresh air levels. In a way, air sealing a building is a green building Catch-22: a building must be tightly sealed to be energy efficient, but must also be well ventilated for both occupant and structural health. If you allow air to move into and out of a building in an uncontrolled manner, in the summer it will bring in unwanted heat and humidity and lose cool dry conditioned air. In the winter, the incoming air will be cold and dry, and the outgoing air will be warm and comfortably humid. Unconditioned humid air in the summer could lead to condensation problems (mold, rot, and water damage), while dry winter air can cause problems with shrunken woodwork, dry skin, and bleeding nasal passages.

Fortunately, there are high-tech solutions to this problem: Heat recovery Ventilators (HRVs) and Energy Recovery Ventilators (ERVs)
An HRV is essentially a heat exchanger combined with ventilation ducting which brings in fresh outside air and exhausts stale indoor air. Different models do this different ways, but basically as the air streams flow past each other, heat moves from one stream to the other. In the winter, warm stale exhaust air heats the cold incoming air. By the time the stale air exits the building, it is essentially at outdoor temperature and the fresh air that started out cold is now effectively at room temperature. The opposite happens in summer.

An ERV is similar to an HRV, but with an additional function. An ERV acts as a heat exchange ventilator, but is also able to transfer humidity between air streams. In climates like St Louis, this feature is very valuable. In the winter, you have spent money and energy adding humidity to the building so that it is more comfortable and does not damage wood floors, furniture, or your skin and nasal passages. You do not want to throw that humidity away. The ERV traps the outgoing humidity and adds it back to the dry fresh air coming in. And in the summer, you

spent a lot of money and energy removing humidity from the indoor air, so you would like not to drag a lot of humidity into the building with the fresh air. The ERV can help with this, though not as efficiently as in the winter. Note: there are circumstances where an ERV is not appropriate. These include hospital sick areas, where air borne pathogens should not be returned to the space, and situations like kitchen or bathroom areas, where you do not want the aromas to be brought back into the space.

Another thing – ERVs actually save money and load on the HVAC system. It is not intuitive, but the longer you run the ERV above that needed for air quality the faster it saves money and energy. Remember that the ERV recycles heat and humidity. Since this is heat and humidity that has already been paid for, the more of it you can recycle the better.

The calculations are complex, with many variables. Included in these are: volume of building; tightness of building; HVAC choice; microclimate, specifically the total heating and cooling degree days and their spread across the calendar; target indoor humidity and actual outdoor humidity; and total U-value of the entire building enclosure. Many dependent variables exist, including: air density and temperature; relative humidity and temperature; air density and humidity; wind speed; envelope temperature and building envelope leakage. Many other factors exist as well. We will quickly look at three situations. All three have been chosen to be residences to reduce building usage, hours of operation, occupation density, and other confounding issues.

Situation one: a moderate size (2000-2500 sq ft) home, built to 1995 code with expected mistakes in design and construction. In this situation, a single ERV would be overwhelmed by leakage, but it would be able to recycle ~ 50% of the expected air flow at maximum speed. In this situation, the ERV would pay for itself in 4-5 years. Note, however, that the total cost of heating and cooling will be high, although not as high as without the ERV.

Situation two: Same building size, built to IECC 2009 code, with highly efficient furnace and air conditioner. In this case, the ERV has an estimated simple payback of about ten years, with low utility bills.

Situation three: Same building size, built to Passive House standards, with an air tightness better than 0.60 ACH50. No central HVAC, but a minisplit air-air heat pump. In this case, the ERV runs only enough to ventilate the building. In this case, mechanical ventilation is absolutely mandatory, but an ERV will take a long time to pay for itself in direct energy savings. However, if you look at the common alternative of a simple forced ventilation system, the ERV is clearly superior because it allows for a significantly smaller HVAC.

So, in summary, as we continue down the logical path of tightening buildings to make them more energy efficient, ERVs will become standard equipment. They already are standard in the most energy efficient buildings we have and are designing today.

Tech Notes is a project of the USGBC-Missouri Gateway Chapter Technical Committee, produced on a quarterly basis and archived on the Chapter's website in the Technical Resource Network. Want to author a Tech Note? Or suggest a topic? Contact the Chapter at usgbc-mogateway@mobot.org.