Building America Case Study

Ventilation System Effectiveness and Tested Indoor Air Quality Impacts

Tyler, Texas

PROJECT INFORMATION

Project Name: Ventilation Effectiveness

Location: Tyler, TX

Partners:

University of Texas, TxAIRE, *uttyler.edu/txaire/houses/*

Building Science Corporation, *buildingscience.com*

Building Component: Heating, ventilating, and air conditioning (HVAC), whole-building dilution ventilation

Application: New and retrofit; single-family and multifamily

Year Tested: 2012

Climate Zones: All

PERFORMANCE DATA

Cost of energy-efficiency measure (including labor): $250–$2,000 depending on CFIS or ERV system used, respectively

Projected energy savings: 8%–10% of HVAC energy

Projected energy cost savings: $50–$75/year

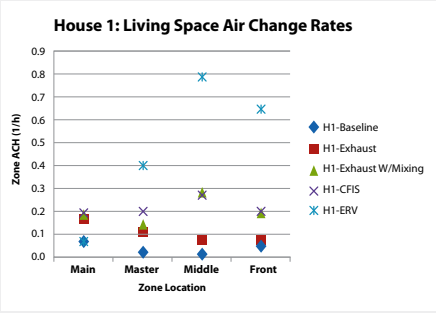
Building America SM U.S. Department of Energy

ASHRAE Standard 62.2-2010 may be considered the "standard of care" for ventilation system design and operation in residential buildings, but it has technology gaps. For example, ASHRAE Standard 62.2 uses a catchall approach that assumes that the entire house is a single, well-mixed zone and that there is no difference in the way whole-building ventilation systems provide effective ventilation. To facilitate that assumption, the ventilation rate has to be high enough to accommodate the worst-performing system, which is single-point exhaust. The ventilation rate can be optimized (and avoid overventilation) by using high-performing systems that draw in outside air and filter and fully distribute that air to occupant areas (including bedrooms where occupants spend the most continuous time). Higher performing ventilation systems may be able to eliminate unnecessary overventilation and provide indoor air quality that meets or exceeds Standard 62.2 and comfort at a lower cost.

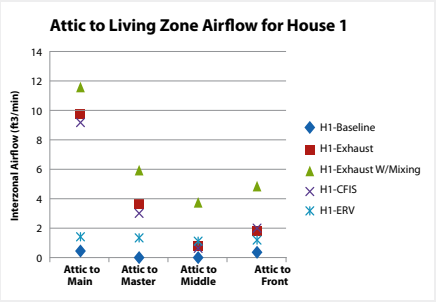
In this study, the U.S. Department of Energy Building America team Building Science Corporation tested the effectiveness of various ventilation systems at two unoccupied, single-family lab homes at the University of Texas at Tyler. These homes offered a unique opportunity to directly compare nearly identical homes. The only difference was that House 1 had a vented attic and House 2 had an unvented attic assembly. The team measured building and zone

Exterior photos from the rear of the test homes at the University of Texas at Tyler. House 1 is shown on the left, and House 2 is shown on the right.

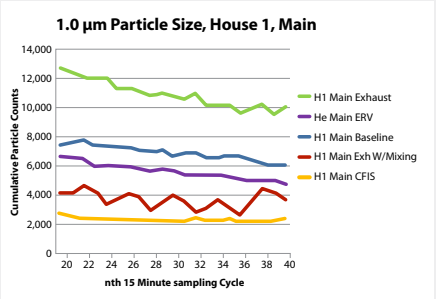
TESTING RESULTS



The CFIS and exhaust with central system mixing showed the best uniformity of zone air change rates.



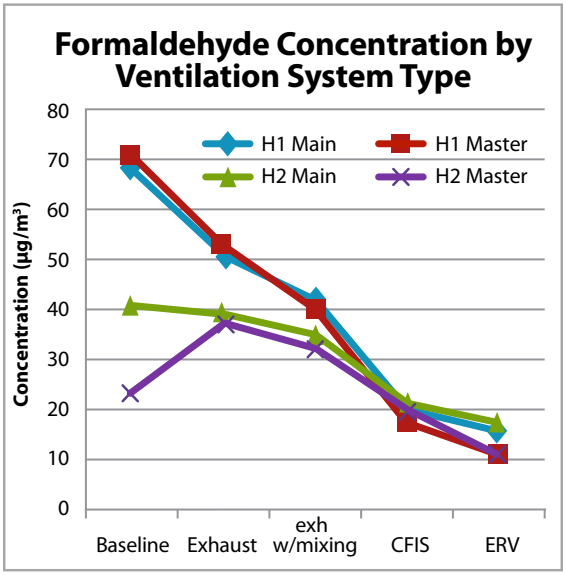
One-third of the outside air for the exhaust ventilation system in House 1 came from the attic.



Exhaust ventilation showed the highest particle counts; CFIS showed the lowest particle counts because of improved air filtration.

For more information see the Building America report *Ventilation System Effectiveness and Tested Indoor Air Quality Impacts* at *buildingamerica.gov*.

Image credit: All images were created by BSC.



In House 1, all ventilation systems reduced the formaldehyde concentration compared to the indoor baseline concentration, which was roughly 20 times higher than what would be expected outdoors. Exhaust-only ventilation reduced the indoor formaldehyde concentration the least, followed by exhaust with mixing, central fan-integrated supply (CFIS), and energy recovery ventilator (ERV). The CFIS and ERV systems in both houses generally showed a 60%–70% reduction in formaldehyde concentration compared to the exhaust system.

enclosure leakage, air change rates, interzonal airflow, and particle counts for formaldehyde and other volatile organic compound (VOC) concentrations.

The testing showed that single-point exhaust ventilation was inferior as a whole-house ventilation strategy because much of the outside air source came from the attic, the ventilation air was not distributed, and air could not be filtered. Central system air recirculation and mixing can help improve the distribution and filtration of the exhaust system. In contrast, the supply and balanced ventilation systems showed a significant benefit to drawing outside air from a known outside location and filtering and distributing that air.

Lessons Learned

- Compared to the exhaust systems, the CFIS and ERV systems showed better ventilation air distribution and lower concentrations of particulates, formaldehyde, and other VOCs.
- System improvement percentages were estimated based on four system factor categories of balance, distribution, outside air source, and recirculation filtration.
- Recommended system factors can be applied to reduce ventilation fan airflow rates relative to ASHRAE Standard 62.2-2010 to save energy and reduce moisture control risk in humid climates.
- HVAC energy savings is predicted to be 8%–10%, or $50–$75 per year.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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