Building America Case Study

Technology Solutions for New and Existing Homes

Impact of Infiltration and Ventilation on Measured Space Conditioning Energy and Moisture Levels in the Hot-Humid Climate

Cocoa, Florida

PROJECT INFORMATION

Project Name: Flexible Residential Test Facility

Location: Cocoa, FL

Partners:

Florida Energy Systems Consortium
www.floridaenergy.ufl.edu/

Building America Partnership for Improved Residential Construction,
www.ba-pirc.org

Building Components: Infiltration and ventilation

Application: Single-family

Year Tested: 2012–2013

Applicable Climate Zone(s): Hot-humid

PERFORMANCE DATA

Costs for reducing infiltration and incorporating mechanical ventilation in buildings will vary greatly depending on the condition and configuration of each building.

Data for experiments conducted in the FRTF is available through
www.infomonitors.com/rtf/

The topics of air infiltration and mechanical ventilation are controversial among building scientists for several reasons. In humid climates, decreasing air exchange can reduce summer moisture loads. Envelope tightening is often recommended as an efficiency strategy for existing homes, and air sealing techniques may be implemented without adding mechanical ventilation. During cooler weather when the air conditioner is not running, lower air exchange levels can contribute to elevated interior moisture levels. The prevalence of single-pane windows and elevated interior moisture in the South can result in condensation on colder days. Mechanical ventilation requirements are becoming a part of high performance home programs and new residential energy codes, yet, few data are available on the relationship of infiltration and ventilation to interior moisture levels and energy use for homes in a hot and humid climate.

To address this need, the U.S. Department of Energy team, Building America Partnership for Improved Residential Construction, conducted research in two identical, full-scale laboratory homes in central Florida to assess the moisture and space conditioning impacts of infiltration and mechanical ventilation. In the flexible residential test facility (FRTF), the team conducts research on advanced building energy efficiency technologies under controlled conditions.

The homes are designed to model average existing Florida building stock, but are highly configurable. Air leakage rates can be controlled in both the horizontal and vertical planes. One home was configured to operate at approximately 8 ACH50; while the other was configured to operate at approximately 2 ACH50 and was operated with and without 63 cfm of supply ventilation.

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INFILTRATION SITES

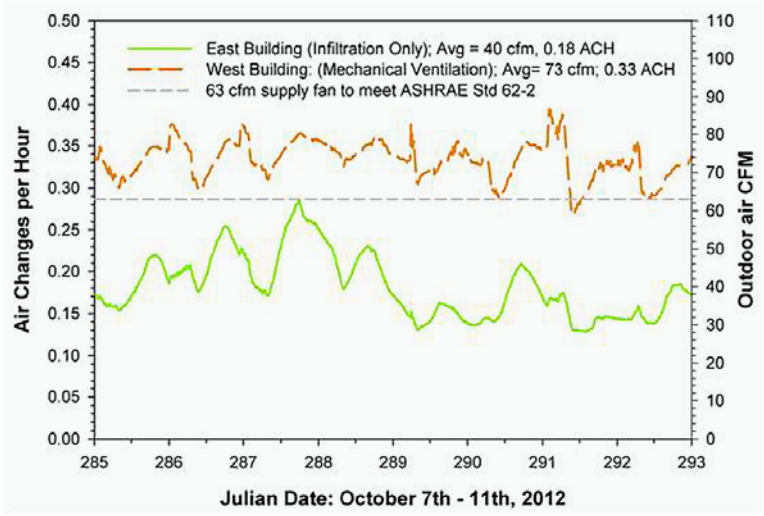
Each lab was configured with four controllable ceiling leakage sites providing ~70% of leakage area.

The remaining 30% of leakage area was vertical plane and was achieved using metal shims at all windows.

An energy recovery ventilator was modified to provide mechanical ventilation in a supply-only mode, with no heat or enthalpy recovery.

For more information, see the Building America report, *Flexible Residential Test Facility: Impact of Infiltration and Ventilation on Measured Cooling Season Energy and Moisture Levels,* at *www.buildingamerica.gov*

Image credit: All images were created by the BA-PIRC team.



CO_2 is used as a tracer gas to measure infiltration in near real time.

Lessons Learned

- Comparative winter testing of the side-by-side homes revealed the tighter building used approximately 15% less heating energy than the leaky building when not mechanically ventilated and 15% more energy when mechanically ventilated.
- During the winter, the inside temperature of the single-pane windows in the tight home fell below the interior dew point temperature. Condensation was observed when windows were not opened for ventilation. Condensation was not observed in the leaky home.
- Comparative summer testing revealed that without ventilation, the tighter building saved little cooling energy over the leaky home and showed only modest differences in moisture levels. This was largely due to the lack of infiltration-driving forces in Florida's climate.
- When mechanical supply ventilation was added to the airtight home during the summer of 2012, cooling energy use increased by about 28% or 6 kWh per day. Building moisture increased on average by 6%, approaching and sometimes exceeding an interior relative humidity of 60%.
- During cold winter periods (where outside air was drier than inside), condensation did not occur in the tighter building with mechanical ventilation.
- Balanced against the added energy use and moisture levels, tracer gas testing revealed that without mechanical ventilation, even the leakier "infiltration only" building was almost always under the recommended ASHRAE 62-2 ventilation level and experienced greater variation in ventilation rates.

Looking Ahead

Further experimentation will examine the potential of enthalpy recovery ventilation systems to address moisture issues and improve energy performance. Testing suggested that "smart" ventilation control systems may be able to provide needed ventilation under drier summer and winter conditions and reduce the air introduced during periods of peak space conditioning.

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For more information, visit:
www.buildingamerica.gov

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