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, Florida

Partners: Florida Energy Systems Consortium

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.infomoinitors.com/rtf/

Perhaps no residential topic has been discussed as much among building scientists as air infiltration and mechanical ventilation. In humid climates, reducing air exhange can reduce summer moisture loads. Envelope tightening is usually recommended as an efficiency strategy for retrofitting an existing home. However, during cooler weather where the air conditioner is not running, lower air exchange can contribute to elevated interior moisture levels. Even though severe cold weather is rare in the Deep South, the prevalence of single-pane windows and elevated interior moisture can result in condensation. Mechanical ventilation requirements are becoming a part of high performance programs and new energy codes. In existing homes, air sealing techniques may take place without adding ventilation.

To assess the moisture and space conditioning impacts of infiltration and mechanical ventilation in homes in hot-humid climates, the Florida Solar Energy Center conducted experiments in two geometrically-identical, full-scale, side-by-side residential research facilities. Known as the flexible residential test facility (FRTF), these research homes are used to conduct 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 8.5 ACH50, while the other was configured to operate at approximately 2.5 ACH50 and was operated with and without 63 cfm of supply ventilation.

> "Although there is no national regulation of airtightness, many jurisdictions, regulatory bodies, codes and standards associations are beginning to include requirements for limiting envelope leakage… There is currently a range of allowable leakage levels that are not the same depending on which code or standard is being referenced."
> *Philosophy and approaches for airtightness requirements in the USA, Proceedings of International Airtightness Workshop, Brussels, Belgium*

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INFILTRATION SITES

The labs were each configured with 4 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.

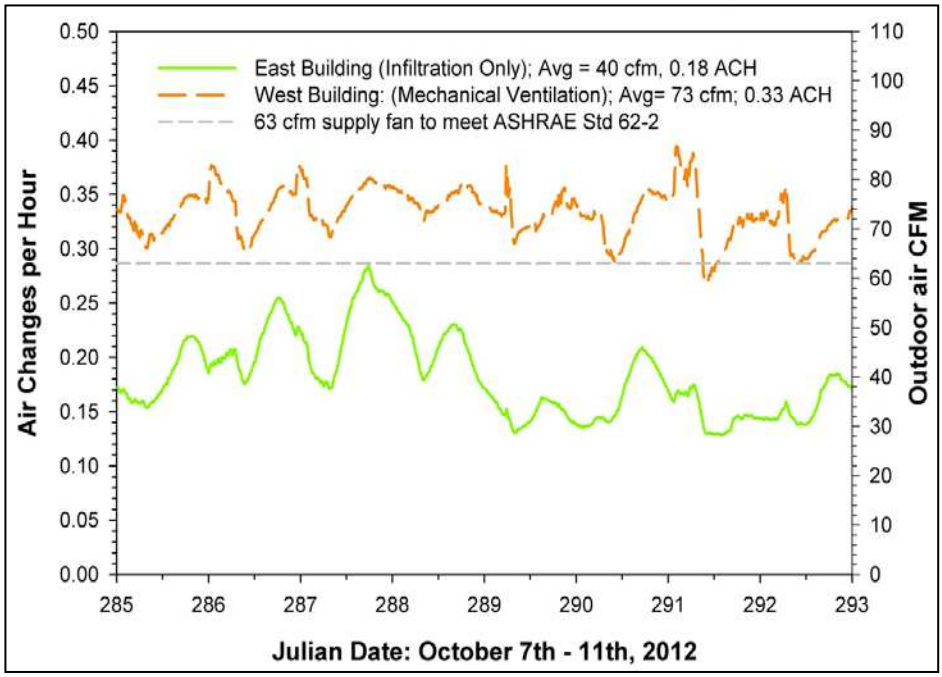

Figure 1. CO_2 is used as a tracer to measure infiltration in near real time.

Lessons Learned

- Comparative winter testing of the side-by-side homes revealed that the tighter building used approximately 15% less heating energy than the leaky building when it was not ventilated, and 15% more heating energy when it was ventilated.
- During the winter, the inside temperature of the single pane windows in the tight home were below the interior dew point temperature. However, condensation was observed only when the home was not ventilated.
- Comparative summer testing of the side-by-side homes revealed that without ventilation, the tighter building had little if any cooling energy savings over the leaky home, and only modest differences in moisture content.
- When mechanical ventilation was added to the airtight home during the summer of 2012, cooling energy use increased by 38%, or about 4 kWh per day. Building moisture increased significantly, approaching and often exceeding an interior relative humidity of 60%.

Looking Ahead

Further experimentation will examine interactions with duct system leakage as well as the potential of enthalpy recovery ventilation systems to address moisture issues and improve energy performance. Results of this research should inform both new construction and retrofit activity.

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