Evaluating Comfort and Air Exchange in New Florida Homes

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August 6, 2015

Research Purpose and Goal: This research proposes to evaluate the impact of mechanical ventilation on interior comfort conditions in new Florida homes. Indoor temperature, relative humidity (RH), and short and long term air exchange rate will be measured in thirty homes built and occupied since 2013. A range of mechanical ventilation sytems and building air tightness will be targeted. Results will indicate:

1) What is the RH in newly constructed, mechanically ventilated homes and how does that compare to literature data from non-mechanically ventilated homes?
2) What is the air exchange rate in newly constructed, mechanically ventilated homes, and how does that compare to the design values, and consensus standards targets?

Definition of the Problem: Whole building air exchange is a required element for maintaining healthy indoor air quality (IAQ) in residential buildings. Air exchange dilutes indoor air pollutants with fresh, outdoor air. Other components that make up a comprehensive strategy for IAQ include limiting materials and activities that provide the source of pollutants, and employing local exhaust in dedicated areas where high concentrations of contaminants are likely to occur (e.g., kitchens).

The 2014 Florida Building Code, Energy Conservation was modeled after the 2012 International Energy Conservation Code to limit natural air infiltration through leaks in the building envelope and require air change be supplemented through whole house mechanical ventilation. Air infiltration by natural mechanisms is variable according to weather and building based driving forces. Newer mechanical ventilation standards deem the uncertainty and variability of natural air exchange insufficient, and recommend a more consistent and reliable delivery of outdoor air through mechanical means. However, there is concern among Florida builders and contractors about the implications associated with introducing large volumes of humid outside air on such a consistent basis. These implications include the potential impact on comfort, and both first and operating costs of the home.

Background: Data on RH in new homes in the hot humid climate is scarce, but humidity control is a growing concern. Improved energy codes result in more energy efficient buildings that reduce the demand and duration of air conditioning, which is the primary mechanism by which moisture is removed from the indoor environment. Prolonged periods of elevated RH can affect comfort, health, and durability. ASHRAE Standard 55 is a commonly referenced standard for comfort which, for given metabolic rates and clothing insulation, provides a range of temperatures and RH's that would be deemed acceptable by 80% of the population. In practice, maintaining indoor RH below 60% in homes with cooling set points of 74-78 F is a general

target for comfort, health, and durability. Conditions resulting in prolonged periods of RH > 65% are generally avoided.

The 2014 Florida Building code, Energy Conservation requires that building envelope leakage be characterized by a blower door test to ensure a maximum of 5 air changes per hour at 50 pascals pressure difference between the inside and outside (ACH50). Homes with resulting leakage less than 5 ACH50 are required to be mechanically ventilated. ASHRAE Standard 62.2-2010, on which the 2014 Florida Building Code requirement is based, as well as the newer ASHRAE Standard 62.2-2013 are commonly referenced standards for whole house mechanical ventilation. The standards use blower door measurement to estimate natural air exchange, and recommend an additional amount of air exchange be delivered mechanically. Data on actual long-term air change rates in homes is scarce, making it difficult to determine levels of air exchange actually achieved. Many factors cause the level of air exchange to vary, including weather and occupant interaction with windows and mechanical ventilation systems.

Approach to the research: The scope of this project is to conduct a mix of short- and long-term data collection in thirty homes built and newly occupied since 2013. The homes will have differing levels of mechanical ventilation and building air tightness. The homes will be spread across north, central, and south Florida.

Short term measurements (HAC = heating and air conditioning system, HVAC = heating, ventilation, and air conditioning system):

- Audit of pertinent house characteristics
- Building air tightness (CFM50, ACH50)
- Mechanical ventilation air flow rates (CFM)
- Tracer gas for short term air change rate (HAC on, mechanical ventilation on, natural infiltration all HVAC off)
- Differential pressure: indoor main body with reference to outdoor
    - (HAC on/off, mechanical ventilation on/off, exhaust fans on/off)
- Differential pressure: bedrooms with reference to main body (closed doors, HAC on)

Long term measurements (2 months or more):

- Hourly temperature and relative humidity (and corresponding HVAC status: on/off)
- Tracer gas for long term 6 month average air change rate (all 30 homes)
- Tracer gas for interim term air change rate (10 central Florida homes, every 2 months)

Expected Outcome and Impact on The Code: Results may serve as the basis for a Florida specific modification to the base IECC, permitting higher natural infiltration rates and lower mechanical rates to better manage relative humidity and comfort. A final report that includes suggested recommendations for changes to the Florida Building Code will be provided.

Budget: $118,924