The Case for Mechanical Ventilation and Air Tightness Requirements in Florida

By Mike Moore, P.E.

Overview

To safeguard public health and promote energy savings and affordability, Florida should maintain the model building code requirements of 5 air changes per hour at 50 pascals (5 ACH50) for building air tightness verification and mandatory requirements for whole-house mechanical ventilation for the following reasons:

1. New, energy efficient and durable construction is by nature tight construction. Studies have shown that in Florida, new homes typically have an air tightness between 3 and 6 air changes per hour at 50 pascals ("ACH50").[3]
2. For construction with an air tightness below 10 ACH50, controlled mechanical ventilation is needed to deliver the minimum air change rate recommended by national consensus-based codes and standards.
3. Reducing the stringency of the code requirement for mechanical ventilation is in direct opposition to national codes and standards which require mechanical ventilation in the interest of public health. Proposals to strip the code of this public safeguard are based solely on expediency and first costs with no consideration for the research and data that point to significant health costs linked to poor indoor air quality and inadequate ventilation.
4. The building tightness and mechanical ventilation requirements in model code language have been developed through a multi-step process that involves expert testimony, public hearings, builder input (builders hold more committee seats than any other group on the model code committees), and the final oversight of government public safety officials. Prior to model codes being adopted in Florida, this process is repeated again through the leadership of the Florida Building Commission. HB 535 and SB 704 seek to override this entire process by proposing politically expedient rollbacks in provisions of the code that are intended to safeguard public health. Flint, Michigan provides an excellent example of the dire consequences that can result from pursuing politically expedient measures that run counter to considerations for public health.

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Florida Homes Are Built Tight and Need Mechanical Ventilation to Meet National Standards for Minimum Acceptable Indoor Air Quality

Code requirements and modern building practices are resulting in homes being built tighter today than ever before. Building a tight home is good practice from both an energy efficiency and a durability perspective. Since 2010, the Florida Building Code has included prescriptive air sealing requirements.[1] The 2010 code included an air leakage testing option stating, "Building envelope tightness and insulation installation shall be considered acceptable when tested air leakage is less than seven air changes per hour when tested with a blower door at a pressure of 50 pascals."[2] As previously indicated, the current Florida code requires air leakage to be 5 ACH50 or below. Simply following Florida's code language that has been in place since adopting the 2010 code will result in homes regularly testing around 5 ACH50.

Florida's Homes Are Too Tight not to Specify Mechanical Ventilation!

- Homes are and will continue to be built tightly due to good building practices and updated codes and standards.
- Without mechanical ventilation, a Florida home would have to have air leakage exceeding 10 ACH50 to provide the minimum annual rate for acceptable indoor air quality.
- Air tightness studies of Florida homes built since 1987 have returned an average of 3.2-6.1 ACH50.[3]
- If the Florida legislature elects to roll back the mechanical ventilation requirement to 3 ACH50 and below, they will reduce the fresh air rate by up to 65% of that promulgated by codes and standards to maintain a minimum level of acceptable indoor air quality.

National codes and standards set a target of 0.35 natural ACH for the *minimum* combined infiltration and ventilation rate (i.e., "fresh air" rate). To achieve this rate without using mechanical ventilation, a home would have to have an air leakage exceeding 10 ACH50, which would represent poor construction compromising the safety, durability, and performance of the building, in addition to not meeting Florida's code requirements since 2010. Based on studies sampling over 15,000 dwelling units built since 1987, Florida's current building practices and codes have resulted in homes regularly achieving an air tightness between 3 and 6 ACH50.[3] Table 1 provides a summary of the seasonal and average fresh air rates experienced by a typical single family home in Florida that can be expected at various air tightness levels without including mechanical ventilation. Absent mechanical ventilation, typical homes in Florida would have 40% to 65% less fresh air than the minimum targeted fresh air rate in model codes and standards. If the Florida legislature elects

[1] Table R402.4.2 of the 2010 Florida Building Code: Energy Conservation and Table R402.4.1.1 of the 2014 Florida Building Code: Energy Conservation.
[2] http://publicecodes.cyberregs.com/st/fl/st/b1500v10/st_fl_st_b1500v10_4_par033.htm?bu=FL-P-2010-000011
[3] Vieira R, Sonne J, McIlvane J, & Sutherland K. 2015. Evaluating the Economic Impacts of the Legislatively Delayed Provisions of the 5th Edition (2014) Florida Building Code, Interim Progress Report. Presentation to the Florida Building Commission Mechanical Technical Advisory Committee.

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	Average Fresh Air Changes Per Hour [Annual Target in Codes and Standards = 0.35 Fresh Air Changes Per Hour]					
Building Air Tightness (ACH50)	Winter	Spring	Summer	Fall	Annual	% Less than Code and Standard Minimum
3	0.15	0.11	0.09	0.13	0.12	65%
5	0.23	0.17	0.13	0.19	0.18	49%
6	0.27	0.19	0.16	0.22	0.21	40%
7	0.31	0.22	0.18	0.25	0.24	31%
10	0.42	0.31	0.25	0.35	0.33	5%

Table 1. Deficiency of natural ventilation to achieve the code- and standard-targeted minimum rate for fresh air (i.e., 0.35 air changes per hour). Values were calculated using the U.S. Department of Energy's EnergyPlus software to model a typical 2,600 ft^2, three-bedroom, single-family home in Orlando, FL.

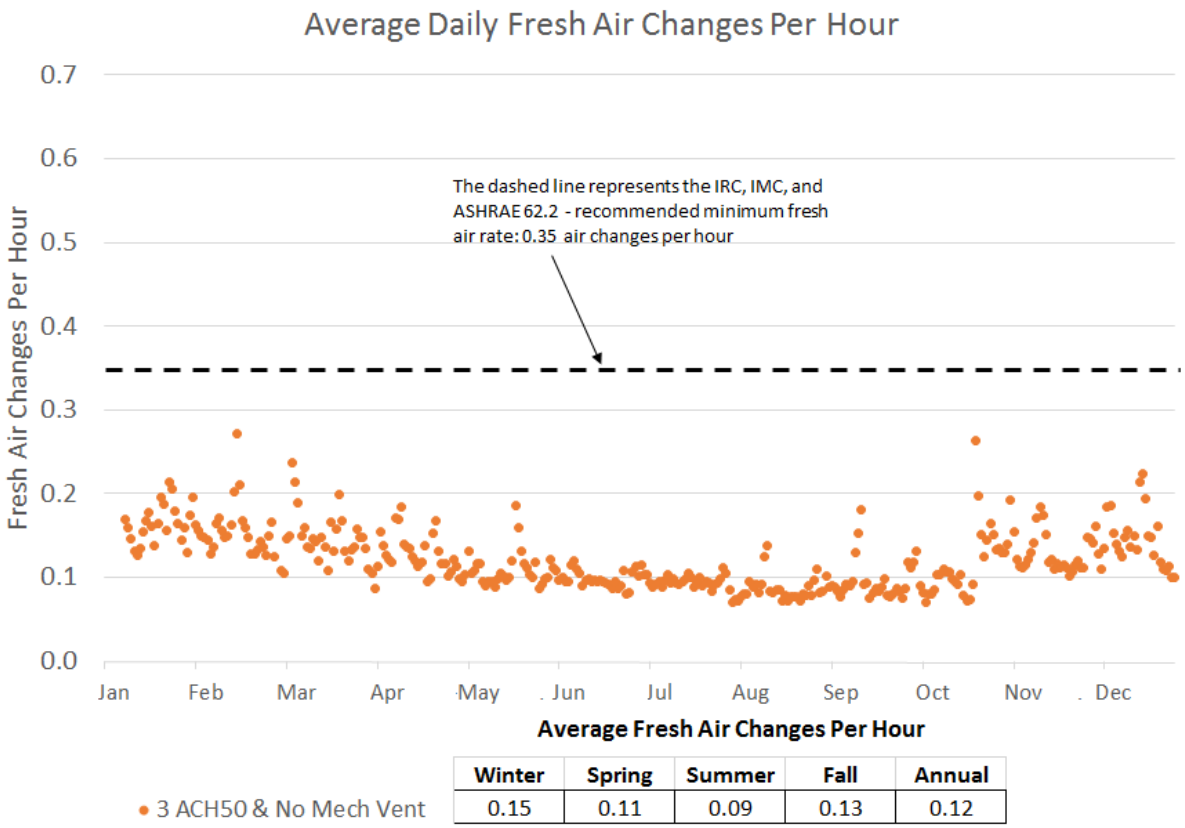

Figure 1. At 3 ACH50, the average annual fresh air changes per hour is 0.12, which is 65% less than promulgated by codes and standards to provide minimum acceptable indoor air quality. In the summer, when indoor formaldehyde levels are generally their highest, the average fresh air rate of a 3 ACH50 home with no mechanical ventilation dips to 0.09, which is 74% lower than the minimum target in model codes and standards.

Poor Indoor Air Quality Means Big Public Health Costs

The biggest health benefit of mechanical ventilation relates to improvements in indoor air quality. Indoor air can be many times more polluted than outdoor air, and the average American spends 90 percent of the day inside. Ventilation systems can significantly improve a home's air quality by removing allergens, pollutants, and moisture that can cause mold problems.

When homes rely solely on air leakage through walls, roofs, and windows to provide fresh air, there is no control over the source or volume of air that comes into the house. In fact, air leaking into the house may come from undesirable areas such as the garage, attic, or crawl space. Common indoor air pollutants in new homes include biological pollutants (mold spores, dust mites, bacteria, viruses, pollen, animal dander); combustion pollutants (including carbon monoxide, nitrous oxides, and particulate matter); volatile organic compounds (VOCs) emitted from many paints, glues, and other building materials (this is called "off-gassing"); and, in some areas of Florida, radon.[4] Another contributor to poor indoor air quality in Florida is moisture. When done well, proper ventilation will assist in pollutant and moisture removal and control.

If Florida's legislature elects to roll back the mechanical ventilation requirement to only apply to homes tighter than 3 ACH50, studies indicate that the net effect will increase occupant formaldehyde exposure by 40% or more, with higher spikes expected in hot humid summer conditions when formaldehyde emissions are highest.[5]

Mechanical Ventilation is Necessary for Healthy Indoor Air

- Helps remove harmful allergens, pollutants, and moisture from homes.
- Provides fresh air in accordance with model codes and standards minimum requirements.
- Provides more balanced fresh air rates across all seasons.
- Helps mitigate risk of formaldehyde emissions and concentrations.
- Helps improve occupant health issues such as asthma and other respiratory issues.

[4] Source:http://www.myfloridahomeenergy.com/help/library/hvac/ventilation/#sthash.Bvb08KuX.dpbs

[5] Hult EL, Willem H, Price PN, Hotchi T, Russell ML, and Singer BC. 2015. Formaldehyde and acetaldehyde exposure mitigation in US residences: in-home measurements of ventilation control and source control. Indoor Air 25:523-535. The 40% increase is the effect of moving from 0.35 air changes per hour to 0.12 air changes per hour based on Figure 4 of the report.

Various studies have identified major costs associated with the negative health effects of poor indoor air quality. In fact, research suggests that poor IAQ is responsible for around $500 annually in health related costs per person in the U.S., which translates to $10 billion annually in Florida.[6,7,8,9,10] According to a U.S. Department of Energy study, the first costs associated with a mechanical ventilation system can be as low as $350[11], which works out to less than $19 per year when amortized over a 30-year loan at 3.5%. Assuming an average household size of 2.54 people, the cost to maintain minimum acceptable indoor air quality is less than $8 per year per person. This investment in public health pales in comparison to the $500 per year estimate of health related costs associated with poor IAQ.

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The Code Development Process is Sound and Should not be Overwritten by the Legislature

Model building code language is a result of a process that considers expert testimony and diverse opinions from all stakeholders. Model code requirements are what industry experts identify as the minimum requirements for new homes to ensure they are built to today's construction standards.

The International Code Council (ICC) develops the model codes and uses a process where input from both their voting members and all stakeholders are taken into account before making any changes. Anyone who wishes to submit a code proposal, or change to an existing code requirement may do so. Proposals are first heard by a code development committee focusing on a specific topic area. In this particular case, proposals to amend blower door testing requirements would be heard by the energy committee, while changes to the mechanical ventilation requirements would be heard by the residential code committee. Both of these committees have membership of code officials and industry professionals, with builders being a primary stakeholder on each. After the committee votes on a proposal, anyone can submit a public comment to alter the committee's decision. Uncontested decisions are passed via a consensus vote at the second hearing by ICC membership. Contested decisions are reviewed and must be considered individually by ICC membership and passed at the second hearing. ICC

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[6] Logue JM, Price PN, Sherman MH, & Singer BC. 2012. A Method to Estimate the Chronic Health Impact of Air Pollutants in U.S. Residences. Environmental Health Perspectives 120(2):216-222.
[7] Turner WJN, Logue JM, and Wray CP. 2012. Commissioning Residential Ventilation Systems: A Combined Assessment of Energy and Air Quality Potential Values. LBNL-5969E.
[8] Brown DW. 2008. Economic value of disability-adjusted life years lost to violence: estimates for WHO Member States. Rev. Panam Salud Publica, 24, 203-209.
[9] Lvovsky K, Huges G, Maddison D, Ostro B, and Pearce D. 2000. Environmental costs of fossil fuels: a rapid assessment method with application to six cities. Washington, D.C.: The World Bank Environment Department.
[10] Highfill T and Bernstein E. 2014. Using Disability Adjusted Life Years to Value the Treatment of Thirty Chronic Conditions in the U.S. from 1987-2010. U.S. Department of Commerce Bureau of Economic Analysis WP 2014-9.
[11] http://www.floridabuilding.org/fbc/commission/FBC_1215/Fire_TAC/EconomicImpactDealyedCodeInterimReport_Nov2015.pdf

membership, composed of governmental officials whose primary interest are public health and life safety, have the final determination of what changes are made to the code. These changes are vetted on a national level.

The ICC is a Trusted Industry Source

Codes and standards adopted by the International Code Council (ICC) undergo a lengthy review and comment period. ICC codes are:

- Innovative and coordinated
- Are efficient and effective.
- Are developed through the efforts of public safety officials.
- Are up to date and state of the art.
- Are revised every 18 months, and new editions are published every three years.
- Are economically viable and practical.

Source: *http://www.iccsafe.org/codes-tech-support/codes/code-development/code-*

The requirements for mechanical ventilation were introduced during the 2012 ICC code cycle process. The IRC Development Committee (which included several builder representatives) reviewed these changes in 2009, and the final version of the change was passed in May of 2012. The requirement for blower door testing and air tightness of 5 ACH50 was introduced during the same cycle, and the final version was passed in October of 2012. Changes for both mechanical ventilation and mandatory air tightness testing were introduced at the same time in recognition that both building codes and modern building practices had established a need to use mechanical ventilation to provide fresh air in homes. *The code requirement for whole house mechanical ventilation was specifically set at 5 ACH50 or tighter because all homes adopting this code would also need to be tested and achieve a 5 ACH50 or tighter envelope air tightness.* These two requirements need to be coordinated because all newly constructed homes (even homes leakier than 5 or 7 ACH50) need ventilation in order to provide acceptable indoor air quality. Since 2012, the code requirements for air tightness and mechanical ventilation have been challenged and upheld through the ICC code hearing process two additional times, carrying through to the 2015 and 2018 versions of the codes.

Prior to the adoption of model codes at the state level, the Florida Building Commission conducts a rulemaking process that considers the merits of state specific amendments. This process includes public comment periods, Commission meetings, and recommendations developed by appointed representative stakeholder groups. In late 2015, the FBC initiated a rulemaking process for the most recent model codes, and several parties have submitted proposals to change the mechanical ventilation requirement and blower door requirement. Most of these proposals have been submitted by a consultant who has been retained by the Florida Home Builders Association. In other words, builders are currently exercising their opportunity to have their position on mechanical ventilation and air tightness heard through an established and official process within the State of Florida. The Florida Building Commissions' rulemaking process, not the legislature, is the venue where building code proposals should be and are being heard.

Legislators are encouraged to support the model code process and not override it as there is a technical and consensual basis for requiring tight homes and mechanical ventilation. There have been numerous studies exemplifying the positive attributes of tight home construction which embrace the use of mechanical ventilation to maintain proper indoor air quality, resulting in the industry mantra, "Build tight, ventilate right."

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The Code Represents Compromise

As they pertain to Florida, the model code requirements for both building air tightness and mechanical ventilation already represent a compromise. Understanding that infiltration and ventilation is climate dependent, the code requirements vary based on climate zone. For hot, humid climates like Florida (Climate Zones 1 & 2) the air tightness target was set to 5 ACH50. In Climate Zones 3-8, which represents the vast majority of the country, the code requires 3 ACH50.

Additionally, the national consensus standard on indoor air quality, ASHRAE 62.2, requires mechanical ventilation for ***all*** conditioned dwelling units, regardless of building tightness. However, the International Residential Code only requires mechanical ventilation for units at 5 ACH50 or less. When approving this requirement, the International Residential Code committee stated, "The proposed threshold is appropriate for determining where mechanical ventilation is required." This comment considered the nation as a whole, where dwelling units achieving an air tightness target of 5 ACH50 ***and*** providing mechanical ventilation can be expected to provide acceptable indoor air quality on average.

To date, over a dozen states have adopted code language requiring air tightness testing at or below 5 ACH50 and mechanical ventilation for residential dwelling units, including Alabama and Texas, which like Florida have large populations in Climate Zone 2.

Summary

The model code requirements for mechanical ventilation and building air tightness have been developed through an open and consensus-based process that gives ample opportunity for amendments with a sound technical basis. The mechanical ventilation requirement was introduced to safeguard public health. A legislative action to roll back this provision without sound technical basis is imprudent at best and could be considered negligent or even injurious at worst. Any proposed amendments to the code provisions should continue to be heard through the state's established process and not within the legislature.

About the Home Ventilating Institute

The Home Ventilating Institute (HVI), founded in 1955, is an international nonprofit association of the manufacturers of home ventilating products. HVI's core purpose is "To Make Indoor Air Healthier." Through its Certified Ratings Programs, HVI provides a voluntary means for residential ventilation manufacturers to report comparable and creditable product performance information based upon uniformly applied testing standards and procedures performed by independent laboratories. Certified performance ratings include airflow, sound and energy.

Today, HVI represents manufacturers from the United States, Canada, Asia and Europe, producing the majority of the residential ventilation products sold in North America. HVI certification is a prerequisite for obtaining the ENERGY STAR® rating for mechanical ventilation equipment.

HVI's Mission Statement

"We are champions of healthy indoor air working together to advance and promote dependable ventilation practices through product certification, consumer education, and codes and standards participation."

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