HOME VENTILATING INSTITUTE

13 February 2024

Georgia Department of Community Affairs
2024 International Residential Code Task Force
60 Executive Park South, N.E.
Atlanta, Georgia 30329-2231

Re: Proposed Code Amendments Submitted to Georgia's 2024 IRC Task Force

Dear DCA Staff and 2024 IRC Task Force:

HVI is an ISO 17065 compliant certification body and a trade association representing over 100 manufacturers located in North America, South America, Asia, and Europe. Our manufacturer members provide the residential and light commercial ventilating products that deliver essential indoor air quality (IAQ) to homes and businesses. The HVI-Certified Products Directory (CPD) contains listings for heat and energy recovery ventilators (HERVs), bath/utility room exhaust fans, kitchen exhaust fans, dryer exhaust duct power ventilators, in-line supply and exhaust fans, whole-house fans, duct termination fittings, and soffit vents, among other products.

HVI appreciates the opportunity to present comments on the Proposed Code Amendments that have been submitted to the 2024 IRC Task Force. HVI supports the development of codes and standards that encourage the specification and use of energy efficient ventilation systems in support IAQ. This comment advocates for the disapproval of IRC-2024-17, which modifies Section R303.4 of the IRC and nullifies the model code requirement for mechanical ventilation for most new dwelling units in Georgia.

Thank you for the opportunity to present these comments. Please direct any questions to Josh Lynch, HVI's Engineering Director (compliance@hvi.org).

Kind regards,

Jacki Donner

Jacki Donner, CEO/Secretary

Recommendation: Adopt the Model-Code Requirements for Mechanical Ventilation of New Dwelling Units

Discontinue Georgia's Modification of IRC Section R303.4

HVI requests that the DCA discontinue Georgia's state-specific modification of Section R303.4 of the International Residential Code (proposed code amendment IRC-2024-17) that only requires mechanical ventilation of dwelling units where the building has a leakage of 3 ACH50 or less, for the following reasons:

1. New, energy efficient and durable construction is by nature tight construction. A U.S. DOE study of new Georgia homes found that the average air leakage rate of new homes to be 4.7 ACH50.
2. For construction with an air leakage less than 9 ACH50, infiltration is not sufficient to deliver the minimum air change rate recommended by national consensus-based codes and standards. Even above 9 ACH50, ventilation would still be needed much of the year to meet the minimum recommended air change rate on a seasonal basis.
3. The IRC no longer has a requirement for mechanical ventilation as a function of air leakage testing. Instead, it requires mechanical ventilation for any dwelling unit that is subject to the air sealing requirements of the IRC/IECC.
4. Incremental first costs associated with a 2024 IRC/IECC code-compliant mechanical ventilation system in Georgia can be as low as $15 per dwelling unit.
5. Reducing the stringency of the code requirement for mechanical ventilation is in opposition to national codes and standards which require mechanical ventilation in the interest of public health. Proposals to remove this safeguard from the code may slightly reduce construction costs, but research points to significant health costs that can be incurred from poor indoor air quality (IAQ) resulting from inadequate ventilation.
6. Both Alabama and Louisiana, states with similar climates zones to Georgia, have adopted the IRC/IECC and retained the requirement for mechanical ventilation of all dwelling units.

Georgia Homes Are Built Tight and Need Mechanical Ventilation to Meet Standards and Model Codes to Support Minimum Acceptable IAQ

Energy 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 at least 2012, Georgia's State Minimum Standard Energy Code has mandated air sealing of dwelling units in Section 402.4, and a recent DOE energy code compliance study found that the average air leakage rate was 4.7 ACH50.[1]

Georgia's 2023 IECC Supplements and Amendments emphasize the importance of air sealing and supporting health considerations as follows, "Air infiltration accounts for substantial heat loss, heat gain and moisture migration in a building. Proper sealing around all doors, windows and other envelope penetrations through the walls, ceiling and foundation is as important to code compliance as are proper

[1]Pacific Northwest National Laboratory. 2022. Georgia Residential Energy Code Field Study: Final Report. Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830. https://www.energycodes.gov/sites/default/files/2022-09/Georgia_Field_Study_State_Report_PhaseIII_final_pub.pdf.

insulation R-values and component U-factors. It is not the intention of this code to abridge safety or health." Yet, the Georgia State Minimum Standard One and Two Family Dwelling Code goes on to remove the model code requirement for mechanical ventilation of these tight homes for all but the tightest level of construction.

Model codes and standards set a target of 0.35 natural ACH for the *minimum* combined infiltration and ventilation rate (i.e., "fresh air" rate; see Section 303 of the 1995 CABO and Section R303 of the IRC from 2003-2009, replaced by the requirement for a whole-house mechanical ventilation system beginning in 2012). To achieve this rate on an annual average basis via infiltration (e.g., without using mechanical ventilation), a home in Macon, GA would have to have an air leakage of 9 ACH50 (see Table 1), which is not permitted by Georgia's State Minimum Standard Energy Code and would represent poor construction compromising the durability and performance of the building.

Table 1 provides a summary of the seasonal and average fresh air rates for a typical single-family home in Georgia that can be expected at various air sealing levels via infiltration.[2] Relying solely on infiltration, and absent mechanical ventilation, typical new homes in Georgia would have 30% to 60% less fresh air over the course of a year than the minimum targeted fresh air rate in model codes and standards to maintain minimum acceptable IAQ. Additionally, Table 1 and Figure 1 demonstrate that the daily average air change rate for a leaky, 9 ACH50 home falls far below the recommended code minimum air change rate most of days between May and October and is especially low in the summer – when indoor formaldehyde levels peak.

	Average Fresh Air Changes Per Hour [Annual Target in Model Codes and Standards = 0.35 Fresh Air Changes Per Hour]					
Building Air Tightness (ACH50)	Winter	Spring	Summer	Fall	Annual	% Less than Model Code and Standard Minimum
3	0.17	0.12	0.1	0.16	0.14	60%
5	0.26	0.17	0.14	0.25	0.21	40%
7	0.36	0.23	0.19	0.33	0.28	20%
9	0.45	0.29	0.23	0.41	0.35	0%

Table 1. Deficiency of infiltration to achieve the model code- and standard-targeted minimum rate for fresh air (i.e., 0.35 air changes per hour).[2]

While natural ventilation can help to boost air change rates, studies have shown that window operation is limited in many homes. Reasons occupants give for not operating windows include security/safety; comfort; energy savings; privacy from neighbors; and efforts to keep out precipitation, dust, noise, outdoor odors, pollen/allergens, and wood smoke.[3] Other limitations to natural ventilation with windows include inability to control the ventilation rate (resulting in over-ventilation and under-ventilation depending on outdoor conditions), inability to filter the incoming air, and inability to control

[2] Building energy simulations to estimate combined infiltration and ventilation rates were generated using the U.S. Department of Energy's EnergyPlus software to model a typical 2,600 ft^2, three-bedroom, single-family home in Macon, GA.

[3] Offermann, F. J. 2009. Ventilation and Indoor Air Quality in New Homes. California Air Resources Board and California Energy Commission, PIER Energy-Related Environmental Research Program. Collaborative Report. CEC-500-2009-085.https://www.arb.ca.gov/research/apr/past/04-310.pdf.

the direction of the airflow (which is less effective than mechanical ventilation that can exhaust indoor air contaminants at their source). With respect to comfort, despite Georgia having a relatively temperate climate, window operation for natural ventilation may not be likely for much of the year based on unacceptable temperature differences between outdoor and indoor air. For example, over 50% of the time, the difference between indoor and outdoor temperature in Macon, GA exceeds 10°F and could result in uncomfortable drafts (see Figure 2). For these reasons, natural ventilation should be used as a complement, and not as an alternative, to mechanical ventilation of dwelling units.

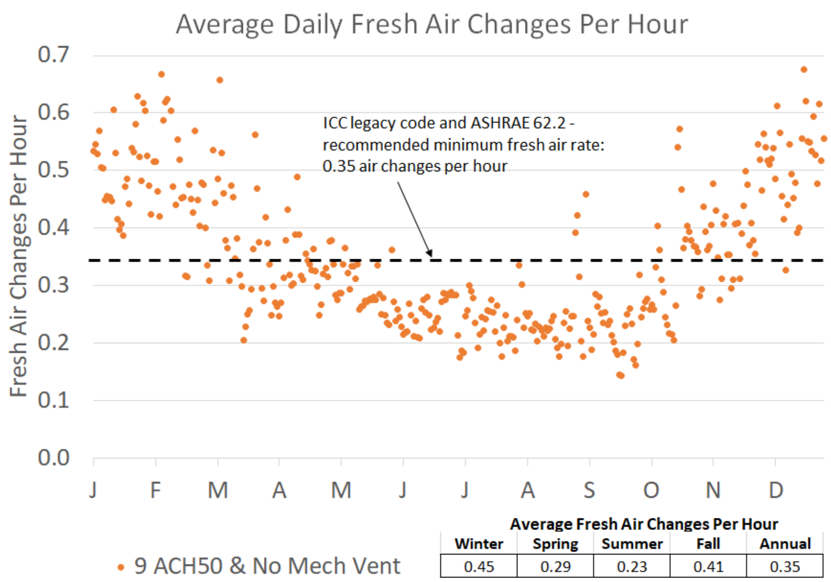

Figure 1. At 9 ACH50 without mechanical ventilation, the average annual fresh air changes per hour from infiltration is 0.35, which is equal to that promulgated by model codes and standards for minimum acceptable IAQ. In the summer, however, when indoor formaldehyde levels are generally their highest, the average fresh air rate of a 9 ACH50 home with no mechanical ventilation dips to 0.23, which is 35% lower than the minimum target in model codes and standards. In fact, even at 9 ACH50, there are 212 days per year where the average fresh air changes per hour from infiltration is less than 0.35.

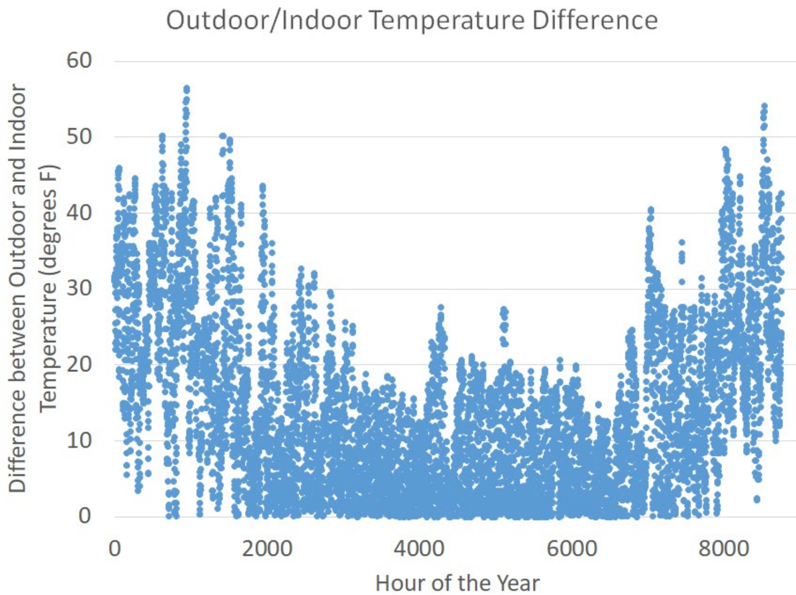

Figure 2. Opening windows for natural ventilation is limited by comfort concerns. This graph shows the temperature difference between indoors and outdoors for each hour in Macon, GA. Over half the year, the temperature difference between outdoors and indoors exceeds 10°F. Many of the hours with a ΔT less than 10°F occur in the summer, when humid conditions outdoors make window operation for ventilation less likely.

Poor IAQ Can Mean Big Public Health Costs

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

When homes only rely 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. Air leaking into the house may come from undesirable areas such as the garage, attic, or crawl space. Common indoor air contaminants in new homes include biological contaminants (mold spores, dust mites, bacteria, viruses, pollen, animal dander); combustion contaminants (including carbon monoxide, nitrous oxides, and particulate matter); formaldehyde emitted from finishes, furniture, and building materials; and, in some areas of Georgia, radon.

Mechanical Ventilation is Needed

to Support Acceptable Indoor Air Quality

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

Various studies have identified significant costs associated with the negative health effects of poor IAQ. By leveraging

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recent research[4,5,6] we can conservatively estimate that poor IAQ is responsible for around $278 annually in health-related costs per person in the U.S., which translates to over $3 billion annually in Georgia.[7] The incremental first cost associated with a code-compliant whole-house mechanical ventilation system can be as low as $15,[8] which works out to about $1.20 per year/dwelling unit when amortized over a 30-year loan at 7%. This investment to support public health pales in comparison to the $278 annual per person estimate of health-related costs associated with poor IAQ.

Why do the I-codes Require Whole-house Mechanical Ventilation Regardless of the Building Air Tightness Level?

As shown previously in this document, dwelling units as leaky as 9 ACH50 will still need mechanical ventilation for much of the year to meet the minimum 0.35 air changes that have long been recommended or required by model codes and standards. So, how did the 5 ACH50 come about as the trigger for requiring whole-house mechanical ventilation in the IRC? The I-code requirements for mechanical ventilation were introduced during the 2012 ICC code cycle process. *The code requirement for whole-house mechanical ventilation was set at 5 ACH50 not because 5 ACH50 represents a sweet spot beyond which mechanical ventilation is no longer needed. Rather, 5 ACH50 was selected because there was broad consensus that dwelling units built that tightly should definitely be provided with mechanical ventilation.* Following the IRC adoption of language requiring whole-house mechanical ventilation at 5 ACH50, the IECC was amended to require air sealing and verification at 5 ACH50 or less across all climate zones, based on an energy and construction cost-benefit analysis. Since that time, the model code has migrated away from the 5 ACH50 trigger for mechanical ventilation to simply require all air-sealed dwelling units to be provided with mechanical ventilation (see 2024 IRC Section R303.4).

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[4] Morantes et al. Environmental Science & Technology 2024 58 (1), 242-257. DOI: 10.1021/acs.est.3c07374

[5] Daroudi et al. Cost per DALY averted in low, middle and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Eff Resour Alloc. 2021 Feb 4;19(1):7. DOI: 10.1186/s12962-021-00260-0.

[6] Highfill T, Bernstein E. Using disability adjusted life years to value the treatment of thirty chronic conditions in the U.S. from 1987 to 2010: a proof of concept. Int J Health Econ Manag. 2019 Dec;19(3-4):449-466. DOI: 10.1007/s10754-019-09266-x.

[7] From the Daroudi study, assumes an averted cost per Disability Adjusted Life Years (DALY) of $69,499. This is conservative value, as other sources place the valuation at $100-$200k (see Highfill & Bernstein). From the Morantes study, assumes health benefit of 400 DALYs saved/10^5 person/year/dwelling unit [found as the difference between the DALYs associated with the less than half of the median concentration of unventilated homes (2200 was found for a sample of typical homes from the U.S., U.K., Canada, and China; for this estimate, 1000 was assumed as a conservative value for U.S. housing stock without mechanical ventilation) and ventilated homes (600)].

[8] Assumes an exhaust-only system is used to provide whole-house mechanical ventilation in compliance with the 2024 IRC/IECC and that provision of bathroom exhaust and kitchen exhaust is standard practice. $15 is the estimated incremental cost for a builder to upgrade from an entry-level Broan A80 exhaust fan ($65.32) meeting the 2021-2024 IRC M1505.4 minimum airflow of 50 cfm at a static pressure of 0.25 in. w.g. to a Broan LP80 exhaust fan ($80.00) that additionally meets the 2024 IECC Table R403.6.2 fan efficacy requirement for whole house mechanical ventilation exhaust fans. Pricing is retail on-line pricing from HomeDepot.com as of 2/5/2024.

Summary

To achieve the minimum air changes recommended or required by legacy codes and standards, whole-house mechanical ventilation is needed for homes in Georgia, even when the leakage is as high as 9 ACH50. The I-code mechanical ventilation requirement was introduced to safeguard public health, and incremental costs associated with a minimally-compliant whole-house mechanical ventilation system can be very low (~$15), especially when compared with health costs associated with poor IAQ.