C-4: Excess ventilation limitation (C403.2.6)

Summary: Limit allowed ventilation air to 135% of IMC required ventilation. Currently there is a minimum ventilation requirement in the IMC, but no maximum ventilation restriction in energy codes. The proposal would retain compatibility with green building programs that call for higher than minimum (130%) ventilation air to maintain indoor air quality. For applications where higher ventilation rates are desired, an exception is provided for systems that include heat recovery. This proposal avoids excess ventilation and saves excess heating and cooling of outside air. Significant energy savings are expected in both warm and cold climates.

DOE proposal C-4 was revised on December 18, 2015.

Stakeholder Feedback: There were two public comments received for proposal C-4. Comments are summarized below, followed by a DOE review:

- It would be helpful to have language describing the energy and economic impact of proposal C-3 being published in the 2018 IECC on this proposal.

  Review: Generally, for individual proposals DOE analyzes measures individually against the current code, as it is unknown what other proposals may be included. When an entire new edition is completed, DOE completes an analysis of the interactive effects of proposals in the new code edition in its entirety.
- It was noted that minimum ventilation varies around the world, upsized ventilation systems may be more efficient at lower levels, lower ventilation may reduce productivity, economizers are not accommodated, and reduction to a minimum is already required.

  Review: The proposal does not change the minimum required ventilation, it just sets an upper limit relative to it. It does not preclude upsizing the system as long as ventilation is set within limits. Productivity issues should be addressed where the minimum ventilation level is set, and with heat recovery higher ventilation is allowed under this proposal. Economizer operation is not precluded, and the current code capability allowing reduction to a minimum does not result in setting at that minimum.

In response to these comments and internal review, DOE will submit its proposal with the same intent as originally posted and will include minor revisions to better align wording with the *International Mechanical Code*.

= = = IECC PROPOSAL:

Modify Section C403.2.6 as follows:

C403.2.6 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code* or applicable codes or accreditation standards. Where mechanical ventilation is provided, the system shall ~~provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the *International Mechanical Code*.~~comply with one of the following:

1. Design system outdoor air intake flow rate shall not exceed 135% of the required minimum outdoor air intake flow rate.
2. The system includes exhaust air energy recovery complying with Section C403.2.7.

Reason: Currently Chapter 4 of the *International Mechanical Code* establishes the minimum outside air required for ventilation; however, there is no upper limit for ventilation in IECC prescriptive requirements; although there is a requirement that systems have the capability of being reduced to the minimum. This addendum offers the designer two options:

- Green building standards have established 130% of required minimum ventilation for indoor air quality credits. This option limits ventilation to 135%, providing a reasonable allowance for accuracy of balancing.
- Should more ventilation be desired in a particular building, that additional ventilation can be provided, as long as heat recovery is used to offset the energy cost of higher ventilation rates.

Field studies have shown that ventilation rates exceed minimums. A PIER study[1] of 40 buildings prepared for California Energy Commission found a median ventilation rate of 76 cfm per person, when minimum standards are in the 10 to 20 cfm per person range. A study[2] of ventilation rates in 100 U.S. commercial buildings did find that half were below minimum ventilation rates; however, this indicates that half were at or above minimum ventilation rates. The spread of ventilation rates based on peak CO^2 was quite wide with the upper quartile having ventilation rates more than 38% above the mean. So it is possible that a quarter of the buildings exceeded the limits in this proposal. These studies indicate there is potential for savings by placing reasonable limits on ventilation rates.

Energy Savings: An analysis of the DOE small office prototype shows that supplying 135% of the ventilation instead of 170% results in 0.6% total building energy cost savings in hot climates, 1.4% in moderate climates, and 3.1% in cold climates.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

Cost impact: There is no anticipated cost increase, as this represents a control/design requirement rather than a requirement for additional equipment. The current balancing requirements in code require that air systems be balanced, so this proposal simply adjusts the level to which outside air should be balanced. If ventilation is limited, there is a reduction in required heating or cooling peak capacity, thereby reducing costs. As an option, a building may still exceed the ventilation threshold and choose to incur the cost of the heat recovery system.

Cost-effectiveness: This change is cost-effective in that it provides significant savings with no anticipated cost increase.

[1] Deborah Bennett, Xiangmei (May) Wu, and Amber Trout. "Indoor Environmental Quality and Heating, Ventilating, and Air Conditioning Survey of Small and Medium Size Commercial Buildings: Field Study." University of California Davis for California Energy Commission, 2011. http://www.energy.ca.gov/2011publications/CEC-500-2011-043/CEC-500-2011-043.pdf.

[2] Persily, Andrew K., J Gorfain, and G Brunner. "Analysis of US Commercial Building Envelope Air Leakage Database to Support Sustainable Building Design." In Indoor Air, 2005. http://fire.nist.gov/bfrlpubs/build05/PDF/b05053.pdf.