Building America Case Study

Evaluation of Ventilation Strategies in New Construction Multifamily Buildings

New York, New York

PROJECT INFORMATION

Project Name: Evaluation of Ventilation Strategies in New Construction Multifamily Buildings

Location: New York, NY

Consortium for Advanced Residential Buildings (CARB): *http://carb-swa.com*

Application: New construction; multifamily

Building Component: Mechanical Ventilation

Date completed: 2013

Climate Zone: Mixed-humid

To test the airflow through the PTAC fresh air kit, the team used a custom device that combines a powered capture hood and an orifice plate. The pressure on the PTAC fresh air fan is affected by the conditions in the apartment—exhaust fans, PTAC fresh air fan, and blower fan. As the pressure changes, so does the flow the fresh air fan delivers.

In multifamily buildings, particularly in the Northeast, exhaust ventilation strategies are the norm as a means of meeting both local exhaust and whole-unit mechanical ventilation rates. The issue of where fresh air is coming from is gaining significance as airtightness standards for enclosures become more stringent. Researchers from the U.S. Department of Energy Building America team Consortium for Advanced Residential Buildings (CARB) have found that most high performance, new construction, multifamily housing in the Northeast use one of four general strategies for ventilation:

- Continuous exhaust only with no designated supply or make-up air source
- Continuous exhaust with ducted make-up air to apartments
- Continuous exhaust with supply through a make-up air device integral to the unit HVAC, such as a packaged terminal air conditioner (PTAC)
- Continuous exhaust with supply through a passive inlet device, such as a trickle vent.

Insufficient information is available to equipment designers on how these various systems are best applied. Product performance data are based on laboratory tests; products are assumed to perform similarly in the field. Proper application involves matching expected performance with estimated building pressures, but those conditions may not be consistent in the finished building.

To address this challenge, CARB researchers monitored building pressure across apartment doors and across make-up air devices for several weeks to validate system performance of the four substantially different strategies for providing make-up air to apartments.

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Comparison of Ventilation Strategies of Tested Buildings

EXHAUST ONLY

- Material cost = $150–$200/fan
- Fan energy per studio apartment (assumed 24/7 operation) = 28 kWh/yr (apartment exhaust fan)
- Efficacy (make-up air delivered/ exhaust) = 20% (from door gap)

DUCTED MAKE-UP AIR SUPPLY

- Material cost = $800–$1,200 per apartment
- Fan energy per studio apartment (assumed 24/7 operation) = 214 kWh/yr (supply and exhaust fans)
- Efficacy (make-up air delivered/ exhaust) = 40%–105%

PTAC FRESH AIR FAN

- Material cost = $90 more than standard PTAC
- Fan energy per studio apartment (assumed 24/7 operation) = 239 kWh/yr (outdoor air fan and exhaust fan)
- Efficacy (make-up air delivered/ exhaust) = 10%–25%

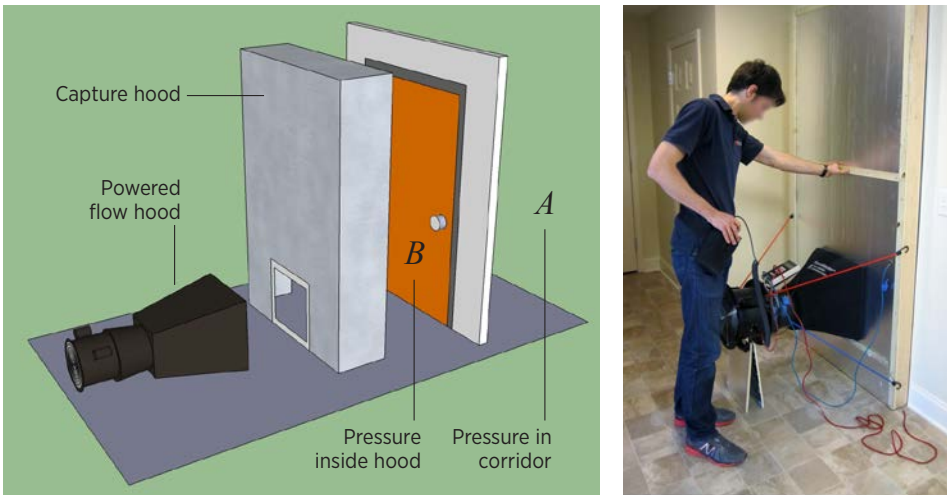
TRICKLE VENTS

- Material cost = $40/vent
- Fan energy per studio apartment (assumed 24/7 operation) = 80 kWh/yr (apartment exhaust fan)
- Efficacy (make-up air delivered/ Exhaust) = 15%–40%

Values are based on measurements and assumptions of four test buildings and may not be representative of other buildings.

For more Information, see the Building America report, *Evaluation of Ventilation Strategies in New Construction Multifamily Buildings,* at: *buildingamerica.gov*

Image credit: All images were created by the CARB team.



Concept for testing airflow through a door frame (left) and actual test in progress (right).

Lessons Learned

- For exhaust-only systems, such as those with no ducted supply or with passive inlet vents, testing found that the controlled make-up air fraction, or the supply rate of make-up air of known origin to the exhaust rate, ranges from less than 50% to more than 150%, even in the same building.
- Because the operation of passive devices such as trickle vents is based on a pressure difference, any factors that affect the pressure across the device will directly affect the flow. The role of wind is clearly visible by the short-term fluctuation of the pressure monitoring results.
- Operating the PTAC blower created more variability of flow than did wind speed. Thus, this system approach provides make-up air more reliably than passive inlets.
- Active make-up air strategies, such as ducted supply air from a central rooftop unit, can effectively deliver specified quantities of make-up air to apartments; however, a thorough testing and balancing process is required. In the units tested under this study, the performance varied from 12% to 132% of the design. This wide range indicates the need for clear, well-defined specifications and careful construction oversight with commissioning and verification of system performance.

Next Steps

CARB will evaluate the installed performance of make-up air systems in two additional multifamily buildings to substantiate earlier findings and support the recommendations for improving the design. Data-driven best practice recommendations from this study have the potential to influence building standards in the near term and make a substantial long-term impact on the market by establishing reliable performance criteria for the make-up air strategy.

U.S. DEPARTMENT OF ENERGY
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