Building America Case Study

Design Guidance for Passive Vents in New Construction, Multifamily Buildings

New York, New York

PROJECT INFORMATION

Construction: New dwelling units

Type: Multifamily

Topic: Passive ventilation performance

Date completed: 2014

Climate Zones: Mixed, humid, cold

PERFORMANCE CRITERIA

- Continuous exhaust: >3 × required ASHRAE 62.2 outdoor air CFM
- Apartment airtightness: ≤0.20 CFM50/ft^2 of enclosure
- Entry door leakage area: ≤5 in.^{2}
- Fan efficiency: ≥3 CFM/W
- Central exhaust leakage: ≤5 CFM/ register at 50 Pa

In an effort to improve indoor air quality in high-performance, new construction, multifamily buildings, dedicated sources of outdoor air are being implemented. Passive vents are being selected by some design teams over other strategies because of their lower first costs and operating costs. The U.S. Department of Energy's Building America research team Consortium for Advanced Residential Buildings constructed the following steps, which outline the design and commissioning required for these passive vents to perform as intended.

Design Steps

1. **Determine the local exhaust ventilation strategy.** Passive vents require continuous exhaust ventilation to perform consistently and reliably. This can be achieved with either a central or an in-unit exhaust system. For either system, select the most efficient fan, with a minimum efficiency of 3 CFM/W, with multiple speed settings to increase exhaust, if needed. For in-unit exhaust, select fans certified by ENERGY STAR®. For central exhaust, select fans with ECM and direct drive, seal the ductwork (≤5 CFM per register at 50 Pa), and specify constant airflow regulators to balance the system. If continuous exhaust will not be provided for each apartment, passive vents should not be used.

2. **Assess the air-sealing performance targets.** Passive vents require a high level of compartmentalization. The minimum airtightness target for each residential unit should be 0.20 CFM/ft^2 of enclosure. If this level cannot be achieved, passive vents should not be used.

3. **Design air barriers.** A continuous air barrier should be established to compartmentalize each apartment. Periodic blower door testing should be conducted at critical stages of the construction process to ensure that the air barrier is implemented correctly. In addition, the apartment entry door should be well sealed with weather stripping and a door sweep.

4. **Determine the passive vent flow rate required for each apartment.** ASHRAE Standard 62.2, or similar, can be used to determine the whole-house ventilation rate. This rate is the flow of outdoor air to be provided through the passive vents.

Building America SM U.S. Department of Energy

Passive Vent Design Process

PASSIVE VENT FLOW RATE

ASHRAE 62.2-2010 whole-house rate:

$Q_{tot} = 0.01*A_{floor} + .5*(N_{br} + 1)$

ASHRAE 62.2-2013 whole-house rate:

$Q_{tot} = 0.03*A_{floor} + 7.5*(N_{br} + 1)$

Where:

Q_{tot} = whole-building ventilation flow rate (CFM)

A_{floor} = floor area of apartment (ft^2)

N_{br} = number of bedrooms (at least one)

FREE AREAS OF TYPICAL PASSIVE VENTS

Trickle vent ≈ 4 $in.^2$

Airlet ≈ 2.6 $in.^2$

For more information see the Building America Measure Guideline *Passive Vents* at *buildingamerica.gov*.

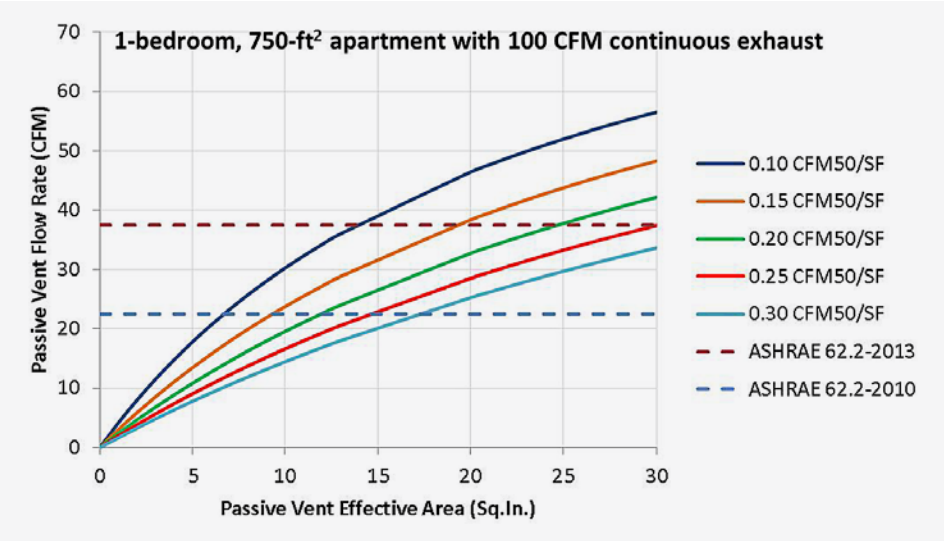
Image credit: All images were created by the Consortium for Advanced Residential Buildings.

5. **Calculate the required passive vent area and exhaust flow rate.** The calculator (link below) can then be used to calculate the passive vent area needed to meet that outdoor air rate. The value for the continuous exhaust flow rate should be adjusted iteratively to identify a passive vent area and an exhaust flow rate that are acceptable for each residential unit layout. The number of windows or number of acceptable penetrations in the exterior wall generally limits the number of passive vents chosen.

6. **Design and locate passive vents.** The required vent area should be translated to a specific number of trickle vents or airlets using the effective free opening of each, typically 4 $in.^2$ and 2.6 $in.^2$, respectively. The vents should be located as specified by the manufacturer, typically near the ceiling.

7. **Commission the passive vent design, construction, and installation.** A mockup unit should be inspected before building-wide installation. For trickle vents, the opening through the window frame should conform to the manufacturer's specifications, be free of obstructions, and provide the area and shape required. Airlets should be installed near the ceiling and all filters properly installed. Exhaust system criteria from Step 1 should be confirmed, including flow rate.

8. **Verify the performance of the enclosure.** A final blower door test should be conducted to confirm the apartment airtightness and door leakage. If targets are not achieved, update the values in the calculator and increase the exhaust rates as needed.



An example of passive vent flows and areas at various airtightness levels for a one bedroom, 750-ft^2 apartment with 100 CFM of continuous exhaust. At 0.20 CFM50/ft^2, three trickle vents would be needed to meet ASHRAE 62.2-2010. To access an interactive version of this tool visit *here*.

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