HT 6: ENSURE VENTILATION AIRFLOW IN RESIDENCES

New York City Mechanical Code

Summary

Issue: The new requirements for ventilation in the Building Code save a great deal of energy. However, if the systems are not adjusted properly, the energy savings will come at the expense of indoor air quality.

Recommendation: In new construction, require improved design parameters, testing, and balancing for exhaust ventilation systems.

Proposed Legislation, Rule or Study

Amendments to the New York City Mechanical Code:

1. Add a new Section 516 as follows:

SECTION MC 516: KITCHEN AND BATHROOM EXHAUST SYSTEMS

516.1 General. Mechanical exhaust systems, in Occupancy Groups R1 and R2, shall meet the following criteria:

1. Maintain a minimum negative static pressure of 0.2” w.g. at the furthest register or grille in the system.
2. Be provided with adjustable speed controls: systems 2,000 CFM or less shall be provided with direct drive fans with speed controls; systems greater than 2,000 CFM shall be direct drive with speed controls or belt drive with variable frequency drives.
3. Dampers installed in intermittent systems shall be UL Class 1, low leakage type with local switch control.
4. Exhaust fans serving intermittent systems shall shutdown on no demand.
5. Each exhaust grille assembly must be equipped with a self-balancing damper that responds to changes in duct pressure to allow a constant airflow (+/- 20%) over a range of operating pressures from 0.2 in WC to the greater of: 0.5 in WC or the maximum system operating pressure at the particular exhaust register/grille. Adjustable register assemblies that allow for the free area to be manually adjusted in the field shall not be permitted to meet this requirement. Self-balancing dampers shall be designed and installed so that they may be easily removed for cleaning or replacement.
6. In central exhaust systems, the minimum requirements for continuous exhaust ventilation at kitchen and bath outlets in Table 403 shall not be exceeded by more than 100%. Timers shall not be installed on systems designed based on continuous ventilation rates in Table 403.
7. All transverse joints in exhaust duct systems shall be sealed including but not limited to connections between ductwork and registers/grilles, branch connections and duct connections to roof membrane/deck, etc. In existing buildings, all connections between ductwork and registers/grilles and duct connections to roof membrane/deck shall be sealed at the time of substantial repair/upgrade work including roof fan replacement.
8. Except where noted, all of the requirements in this section apply to existing systems at the time of substantial repair/upgrade work including roof fan replacement.
9. 

2. Amend Section 403 to add a note under Table 403.3 as follows:

i. The ventilation rate shall be the minimum rate required at the air outlet. Total fan airflow rate shall include a duct leakage component equal to 15% of outlet design flow.

3. Amend Section 202 to include the following definition:

Joint, Transverse Duct: Transverse joints are connections of two duct sections oriented perpendicular to airflow, including but not limited to connections between ductwork and registers/grilles, spin-ins, taps, and other branch connections, access door frames and jambs, duct connections to equipment and duct connections to roof membrane/deck, etc.
Supporting Information

Issue - Expanded
The lower kitchen, bath and corridor ventilation requirements in the new 2008 New York City construction code compared to the 1968 code will result in 10% - 30% reductions in heating energy use in residential buildings and 50% reductions in exhaust fan electricity use for all buildings with kitchen or bath central exhaust ventilation systems. However, these energy benefits will come at the expense of indoor air quality if the code does not address the reality of the balancing issues associated with systems that attempt to exhaust a relatively small amount of air from multiple locations in a building. The lower kitchen and bath exhaust ventilation rate requirements in the new 2008 code are acceptable for indoor air quality only if these exhaust rates are actually realized. As the exterior envelopes of buildings are tightened to reduce energy waste, effective ventilation system performance is becoming that much more critical. In addition to new construction, this code will apply when ventilation systems in existing buildings are being renovated. Existing ventilation ductwork originally designed for 100+ CFM per kitchen and 50 CFM per bath per the 1968 code is ideally suited to be rehabbed to exhaust lower airflow rates from these spaces per the 2008 code. In this case, existing ductwork is effectively oversized, which reduces the pressure drop between the exhaust fan and individual exhaust registers/grilles. Such a reduction in pressure drop has two primary benefits: (1) improved balancing performance and (2) reduced fan electricity use.

Environmental & Health Benefits
As the exterior envelopes of buildings are tightened to reduce energy waste, effective ventilation system performance is becoming that much more critical. The proposed changes will preserve the energy benefits of the 2008 code while assuring adequate indoor air quality.

This proposal was found to have no significant positive environmental impact.
This proposal was found to have a high positive health impact per building and to impact a small number of buildings. It was thus given a health score of 2.

Cost / Savings
This proposal is not expected to have any significant impact on capital costs.

Precedents
Other Jurisdictions:
1. Note that multi-story central kitchen and bath ventilation systems with severe balancing problems are much more represented in NYC than in other locations. As such, NYC should be a leader on these issues.
2. California's Title 24 requires pressure testing of HVAC ducts.

LEED:
LEED requires building designs to comply with ASHRAE Standard 62.1 as a prerequisite and buildings are commissioned to ensure that they perform as designed. The proposed code change is consistent with these LEED prerequisites.

Implementation and Market Availability
1. Passive, self-balancing dampers that regulate airflow by responding to changes in duct pressure without the requirement of electric power are an off-the-shelf technology.
2. Improved duct sealing strategies are well known to the industry.
3. In practice, proposed language change to 513.10.5 means that belt driven fans are acceptable and all direct drive fans should have speed controllers, which are very low cost and readily available add-ons.

Notes:
1. The following supporting findings are from a recent New York State Energy Research and Development (NYSERDA) research project undertaken by Steven Winter Associates to assess the performance of conventional bath and kitchen central exhaust ventilation systems and to evaluate performance upgrades:
   - One-time balancing of conventional systems with manually adjustable registers (even if done properly) is subject to particular environmental conditions at the time of balancing (wind and stack effect). In a tall building, a system balanced in the winter will not be balanced in the summer.
   - Conventional adjustable registers have relatively large free areas that result in relatively small pressure differences across the registers. Such small pressure differences result in significant fluctuations of exhaust airflow in response to changing outdoor ambient conditions (wind and stack effect).
   - Measurements of the leakage of 30 exhaust shafts in new NYC multifamily buildings indicate that the leakage levels required by the new code are not realistically achievable without code language that calls out in greater detail the particular leakage locations that must be addressed in these systems.
   - In order to function properly, an exhaust ventilation system must operate at a high enough pressure to minimize the impact of fluctuations due to wind and stack effect. Leaky duct systems make operation of systems at...
sufficiently high pressures difficult.

2. Relevant parts of the New York City Mechanical Code:

All of the following sections below impact the performance of central exhaust ventilation systems:

403.1 Ventilation system. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.

403.3.4 Balancing. Ventilation systems shall be balanced by an approved method. Such balancing shall verify that the ventilation system is capable of supplying the airflow rates required by Section 403.

513.10.5 Fans. Calculations and manufacturer's fan curves shall be part of the documentation procedures.

603.2. Duct sizing. Ducts installed within a single dwelling unit shall be sized in accordance with ACCA Manual D or other approved methods. Ducts installed within all buildings shall be sized in accordance with the ASHRAE Handbook of Fundamentals or other equivalent computation procedure.

603.9. Joints, seams and connections. All longitudinal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA HVAC Duct Construction Standards.

603.17. Registers, grilles and diffusers. Duct registers, grilles and diffusers shall be installed in accordance with the manufacturer's installation instructions. Balancing dampers or other means of supply air adjustment shall be provided in the branch ducts or at each individual duct register, grille or diffuser.