Multifamily Ventilation – Best Practice?

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Presentation Outline

• Basic Objectives
• Exhaust Systems
• Make-up Air Systems
Two Primary Ventilation Objectives

1) Providing Fresh Air - *Whole-House*
2) Removing Pollutants - *Local Exhaust*

Our goal is to find the simplest solution that satisfies both objectives while minimizing cost and energy impacts.

Common Solution: Align local exhaust with fresh air requirements (Ex: 25 Bath + 25 Kitchen)
Exhaust-Driven Fresh Air Design

- Exhaust slightly depressurizes the units
- Outside air enters through leaks, cracks, or planned inlets
- Widely used in the North
Multifamily Ventilation Best Practice

- Step 1: Understand ventilation requirements
- Step 2: Select the simplest design that can achieve both air quality and energy objectives
- Step 3: Build a tight building
- Step 4: Pay attention to installation quality
- Step 5: Check to make sure ventilation works
- Step 6: Educate users
Exhaust: Central and Unitized

Central Exhaust

Unitized Exhaust
Standard Central Exhaust Practice

- Roof or mushroom fans
- Vertical shaft with horizontal take-offs
- Sidewall or ceiling grilles at each floor
- Continuous operation
Mechanical Designers’ Intent

• Balancing damper → transferring responsibility to balancing contractor
• Many grilles, many floors, relatively low flow targets, plus wind and weather on balancing day = balancing is difficult
Automatic Balancing Dampers

Balance in two ways:

• Provide restriction in size of opening (increase static pressure)
• Dynamically self-adjust to changes in the system (automatic balancing)
Duct Leakage

- Roof curb?
- Takeoffs?
- Transverse (sectional) joints?
- Longitudinal (lengthwise) joints?

Register connections can be the largest set of leaks.
Best Practice

• Include performance specifications for duct tightness in construction documents
• Call out specific details to be sealed: all joints, takeoffs, connections, registers, etc., etc.

Then test for leakage:
• Good = 10 CFM50/register
• Better = 5 CFM50/register
Duct Sealing Methods

Aeroseal® aerosol duct sealant sticks to holes in ductwork and seals them
Working elevators and power on the roof are helpful.

- Prepare a plan.
- Check weather report!
Mastic Spray

Rotating spray head applies mastic directly to leaks identified by camera - Simple concept
- Very effective on straight shafts
In-Unit Exhaust Systems

Small fans, relatively low flow (50-100 CFM), low power consumption, easier to balance floor to floor
In-Unit Ventilation Quality Control

- Duct sealing
- Avoid kinks, long duct runs; use rigid duct
# Exhaust System Design Parameters

<table>
<thead>
<tr>
<th>Central Systems</th>
<th>Unitized Systems</th>
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<tbody>
<tr>
<td>• Constant Air Regulating (CAR) dampers to balance flows</td>
<td>• ENERGY STAR fans with variable speed where appropriate</td>
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<tr>
<td>• <strong>Airtight ductwork</strong>, including fan and grille connections</td>
<td>• Short straight duct runs</td>
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<tr>
<td>• <strong>Tightly compartmentalized units</strong></td>
<td>• <strong>Tightly sealed ducts</strong></td>
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Exhaust-Driven Make-up Air Strategies

Current Research Focus
Where is the make-up air coming from?

• Leaks
• Trickle vents
• Make-up air supplied to corridor
• Vent or fan within PTAC
Trickle Vents - Designed Inlets

• Intentional openings in building envelope that allow a trickle of air into buildings in response to pressure differential
• Trickle Vents often built into window frames
Trickle Vents – Installed Performance

• Flow from trickle vents measured with hot wire anemometer in a building under actual operating conditions.

• Also measured inside/outside pressure difference across exterior window.
Trickle Vent Airflow vs. Pressure Difference

Air flow at typical building operating pressures is expected to be about 5-10 CFM per trickle vent – a “trickle”

AAMA = American Architectural Manufacturers Association
Comparison of trickle vents in two buildings

Trickle Vent Airflow vs. Pressure Difference, Two Buildings

1st bldg.

2nd bldg.
Airflow patterns in a tight unit with trickle vents

With Door to Corridor Un-taped

Total Exhaust = 78 CFM

Exhaust Total
78 CFM

78 CFM exhaust
Airflow patterns with trickle vents

With Door to Corridor Un-taped

Supply Total
66 CFM

Exhaust Total
78 CFM

% From Trickle Vents
24%

% From Corridor
61%

% From Other Sources?
15%

Total Exhaust = 78 CFM
Total Measured Supply Through Trickle Vents and Door Frame = 66 CFM
This Year’s Research Plan

1. Evaluate performance of more systems in more buildings
   – Corridor supply systems
   – Trickle vents
   – PTAC outside air vents

2. Measure pressure variation within buildings and apartments over time
   – 2 weeks in winter and 2 weeks in summer
Earlier Testing

- Airflow through gaps in apartment door

Door "Shroud" Measurement Technique

- Plastic shroud over door frame
- Adjustable sharp-edged orifice
- A) Pressure inside shroud
- B) Pressure in apartment
- C) Pressure in corridor
Latest Test Rig

Powered Flow Hood
Energy Conservatory’s FlowBlaster™
Other Make-up Air Inlets
Variability in Driving Forces

Typical for Winter – But what about summer, windy days, …
Pressure Monitoring

Locations of pressure sensors
Pressure Monitoring
Best Practice Summary

• Step 1: Understand ventilation requirements

• Step 2: Select the simplest design that can achieve both air quality and energy objectives

• Step 2: Build a tight building

• Step 3: Pay attention to installation quality

• Step 4: Check to make sure ventilation works

• Step 5: Educate users
Thank You