Energy Impacts of Ventilation Strategies in Multifamily Projects

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Generic Multifamily Ventilation

- Air leakage IN/OUT through elevator and stairwell shafts
- Ventilation Air IN (Mechanical + Pressure)
- Air flow IN/OUT through open windows
- Air intermittently exhausted OUT using bathroom/kitchen fans
- Natural Air-Leakage IN/OUT through enclosure
- Interior Air-Leakage between suites/common areas/floors
- Air flow IN/OUT
Multifamily Energy Use

Electric Baseline, New Construction in PDX

- Lighting: 6.6
- Equipment: 7.8
- Heating: 5.1
- Fans: 7.0
- DHW: 9.4
Energy Impact of Ventilation Tempering

0.06 CFM/SF vent in PDX

- Load = 10.8 kBtu/sf (graph)
- Min. case, usually higher

0.10 CFM/SF...

- Load = 18.0 kBtu/sf

Graph info
- No heat recovery
- ~30% WWR
- U-0.35 windows
- Code walls, roof
- 50-60% of load offset by internal gains
Smallest baseline end use, why do we care?

• More design team control over HVAC

• Huge variation in loads
  – Continuous vs intermittent exhaust?
  – IAQ (staleness, odors, humidity/mold)
  – Pressurization issues

• ~70% of consumption is at night (7pm-7am)
  – Fuel mix implications
Determining Minimum Unit Ventilation

- Ventilation min. for occupants/staleness
  - ASHRAE 62.2 req’s ~0.06 CFM/sf
  - OR Mech Code req’s 0.35 ACH (~0.06 CFM/sf)

- Bathroom exhaust
  - 20 CFM continuous
  - 80 CFM intermittent (4 hour equiv.)

- Kitchen hood
  - 25 CFM continuous
  - 150 CFM intermittent (4 hour equiv.)
  - Often see 300-500 CFM for intermittent hoods

- **Intermittent** may result in fewer CF of exhaust, but also oversizing of make-up systems
Reduction first!

• Why do we design >0.06-0.1 CFM/SF?
  – Balancing intermittent + decentralized exhaust streams (bathroom, kitchen)
  – Odor mitigation

• Solutions
  – Localized designs
  – Centralized exhaust risers
“Classic” 1: 100% OA Corridor RTU

- Intended to prevent negative pressure, odor transfer
- No return shaft to save $$
- $0.2-0.5$ CFM/SF in corridors (0.06-0.075 req’d)
- 35-75 kBtu/SF w/ 80% gas furnace

An overventilated corridor is a scary corridor!
“Classic” 1: 100% OA Corridor RTU

Corridor Pressurization System Performance in Multi-Unit Residential Buildings, Ricketts & Straube, 2014
“Classic” 2: Trickle Vents

- Pressurization issues
  - Trickle vent ≠ path of least resistance
- Whistling
- Often drives ME to include “Classic” 1
“Classic” 3: PTAC ventilation

- Fans run 24/7 or inadequate ventilation
- Large OA damper penetration increases infiltration
- Handling intermittent kitchen exhaust:
  - Vent. rate usually oversized…
  - Or ME includes “Classic” 1
Solution 1: Localized Vent. + Exhaust Makeup

- Continuous bathroom and kitchen exhaust
- In-unit makeup
- Balanced, opportunity for HRV
- Minimal ductwork compared to centralized
- **NC and retrofit**
Solution 2: Localized HRVs

- Centralized HR difficult due to myriad exhaust sources
- One solution:
  - Local HRVs for apartment bathroom exhaust, ventilation
  - Central HR for cooking exhaust, or no HR on cooking exhaust
  - Communal laundry with HR option
- $1.5-3/sf adder vs PTHP
Solution 2: Localized HRVs

Caution! Do not oversize the HRV!

- 50 CFM cont. ventilation: $7,900 \text{ kBtu load}$
- 130 CFM cont. w/ 65% HRV: $7,200 \text{ kBtu load}$
Case Studies: Apartment Project #1

Passive House Envelope, HRVs, electric heat

- Heating load ↓ 70%,
- Energy/cost ↓ 50%

Bathroom exhaust passes through HRV to preheat ventilation air
Solution 3: DOAS ducted to units

- Floor-by-floor or whole building
- Continuous exhaust to minimize sizing, controls
- Balanced, opportunity for HRV and economizing
Case Studies: Apartment Project #2

- Ducted ventilation from central unit – fan energy ↓ 40%
- Split systems
  - Heat pumps should operate below 35 F!

![Energy Cost Intensity Graph]

- **ASHRAE 2007 Baseline**
- **100% CD Design**
2019 Energy Code Updates

- Will the classics be nixed by 2019 Energy Code?
  - NOPE
  - Heat Recovery req. has specific exception for Classic 1
- Process exhaust historically unregulated, will continue
- Push to require local HR or centralized exhaust?
THANK YOU!

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