Energy



Multifamily Ventilation and IAQ

A Market-level Assessment of Standard and Best Practices

Marian D. Goebes, PhD

TRC – Research and Technology Commercialization Group

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Overview

Multifamily ventilation and IAQ needs

1. Dwelling unit ventilation
2. Compartmentalization
3. Filtration

For each, discuss:

- What is it and why is it needed?
- Standard practices
  - International Energy Conservation Code (IECC), adopted in most states
  - Am. Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62.2, adopted by many programs and CA
- Best practices

Spotlight: San Francisco ordinance as best practice

For time constraints: Focus on new construction

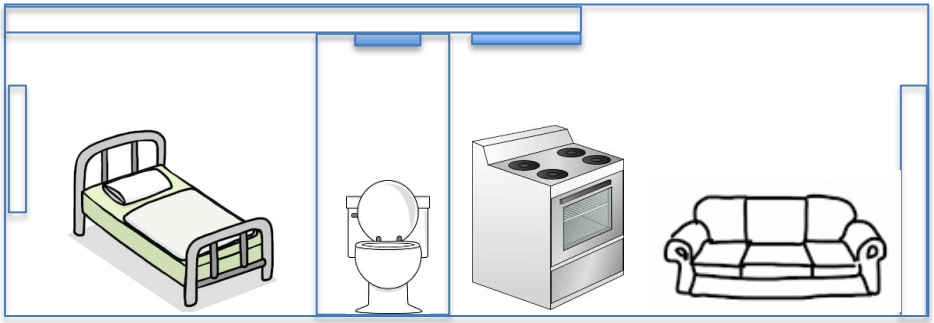
Dwelling Unit Ventilation: Why?

- Dwelling unit ventilation = providing fresh (outdoor) air to each unit to dilute indoor pollutants
- Historically, MF units ventilated with infiltration and operable windows
- In past decade, codes moved to requiring mechanical ventilation
  - Buildings being constructed more tightly, so less infiltration
  - Offerman (2010) study of 108 homes found occupants don't open windows regularly

Dwelling Unit Ventilation: How?

Most codes, including IECC and ASHRAE 62.2, allow 3 strategies

- Exhaust-only
  - Local exhaust fan(s) runs continuously
  - Make-up (supply air) theoretically comes from infiltration or passive vents



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  - Fan provides supply air into unit
- Balanced:
  - Fan provides supply air into unit, and exhaust fan removes air from unit at same rate

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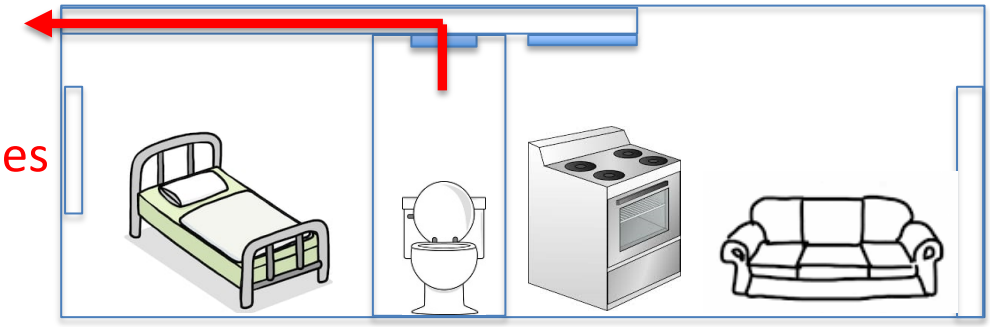

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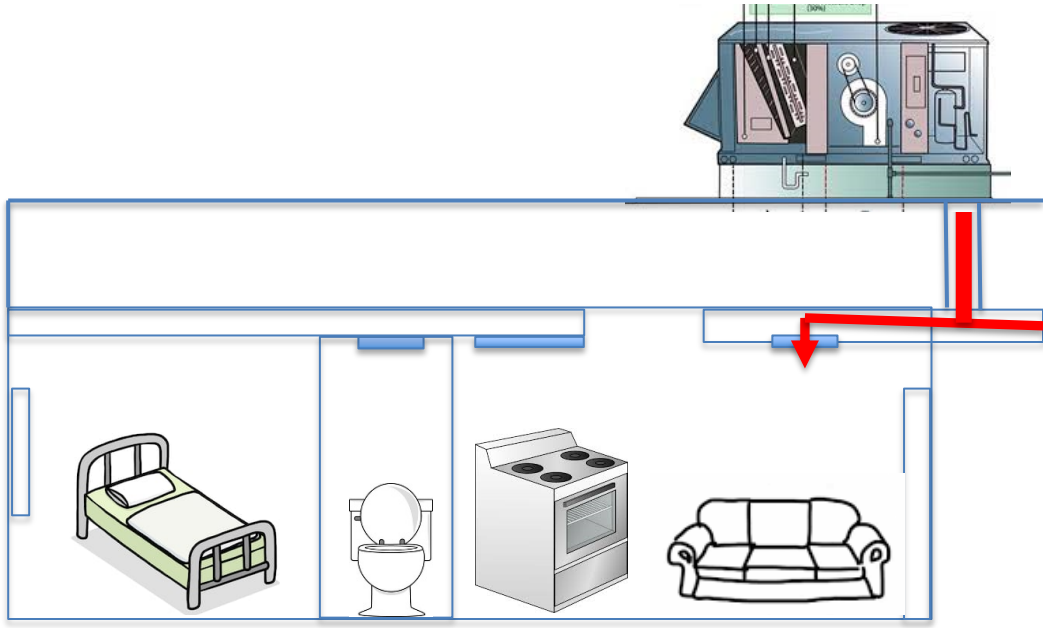

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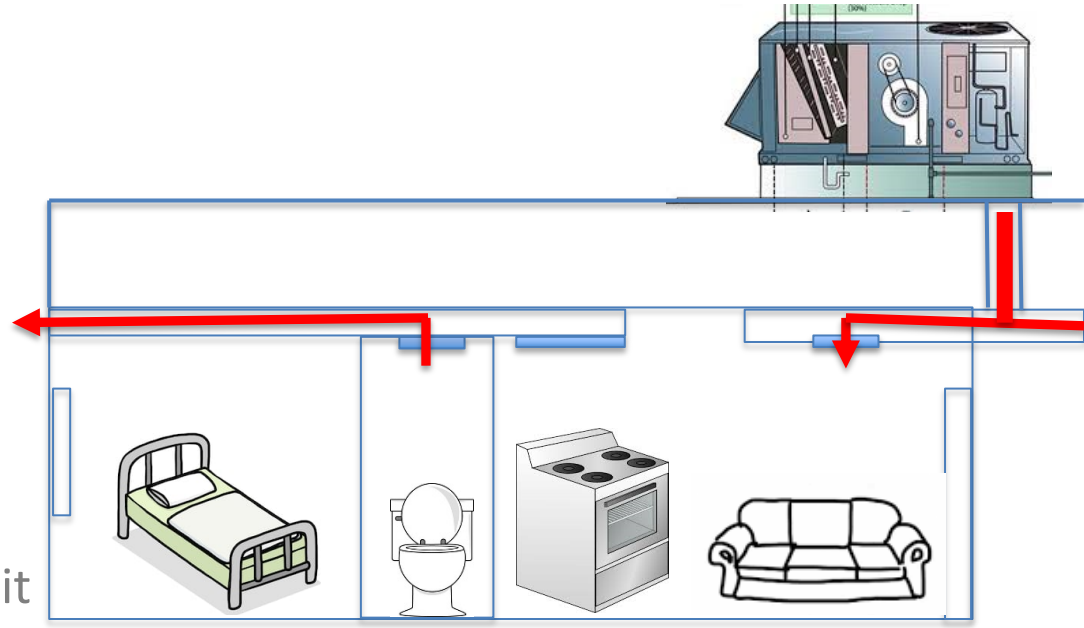
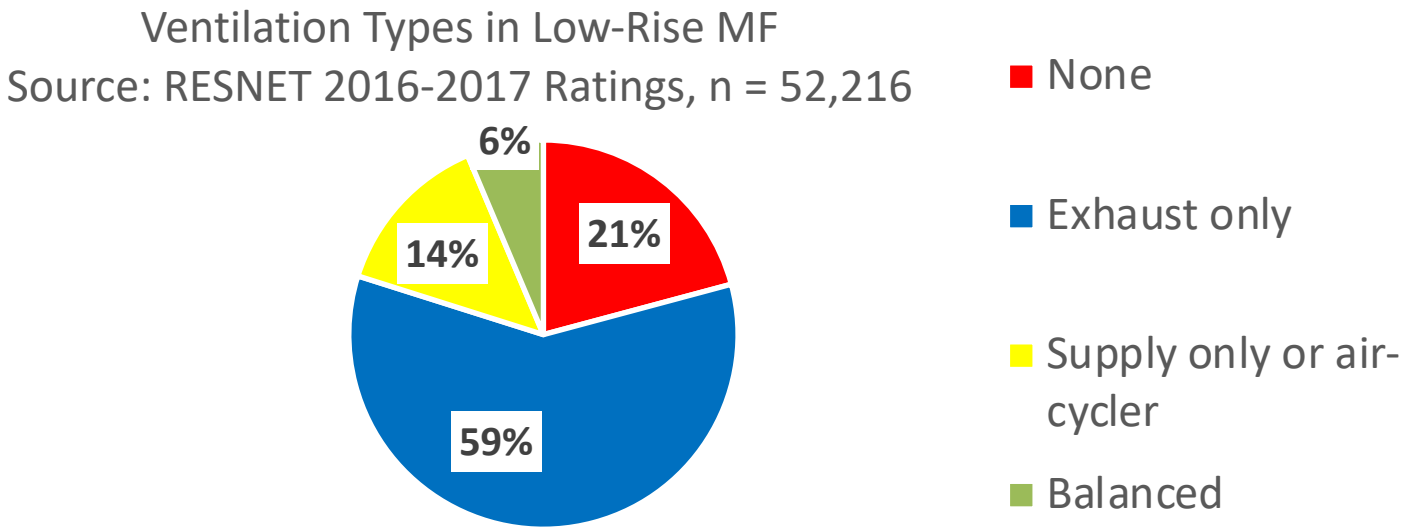


Dwelling Unit Ventilation: Standard Practice

- Exhaust-only most common in MF

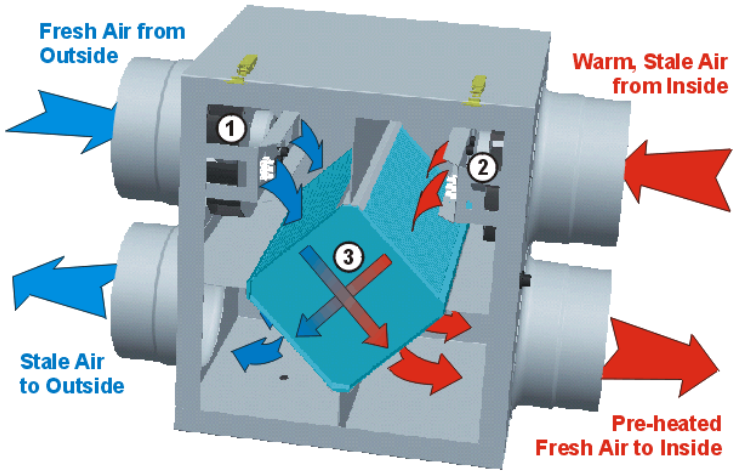


- Concerns with exhaust-only
  - Insufficient supply air (CARB 2015: 13-36% through passive vents)
  - Some “fresh air” likely transfer air from neighboring units
  - Occupants often cover up passive vents

Dwelling Unit Ventilation: Best Practice

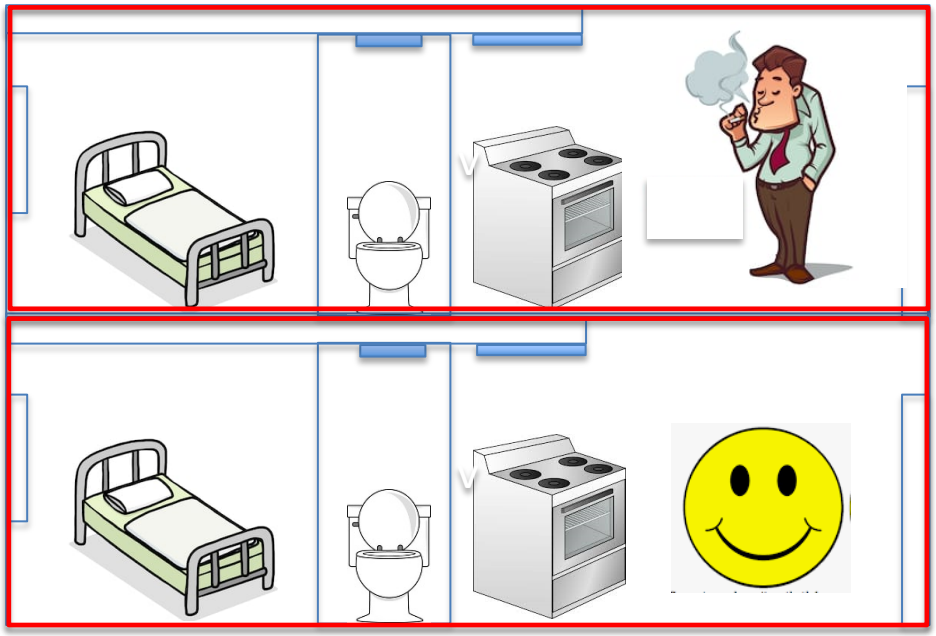
- Require balanced or supply-only
- Example code: Minnesota requires balanced ventilation for all new MF
- Designs include:
  - Central ventilation, ducted to each unit
  - Heat or Energy Recovery Ventilator (HRV or ERV)
- Additional cost: ~$1000/unit (based on individual ERV)

HRV



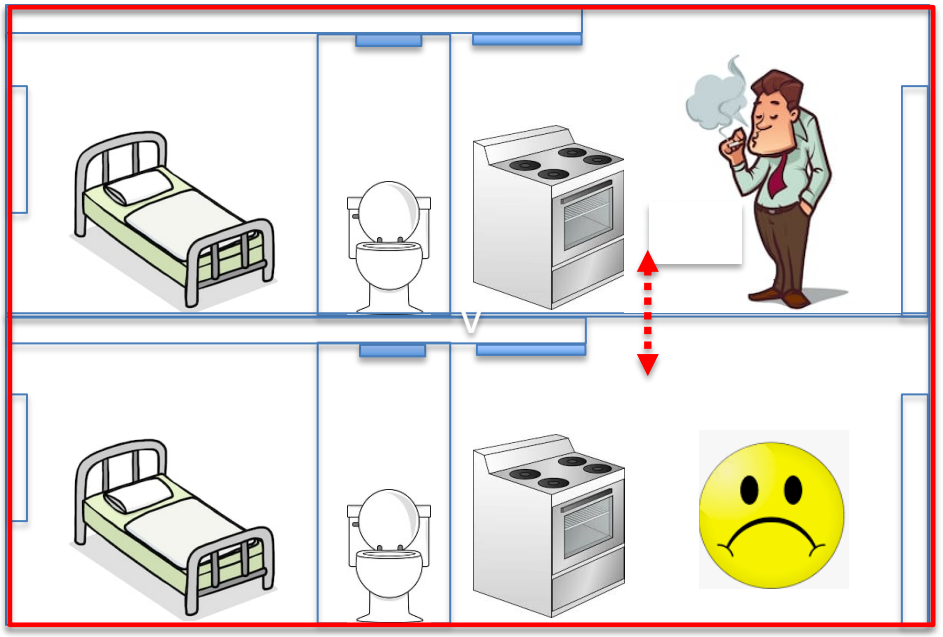
Compartmentalization: Why?

- Compartmentalization = sealing each dwelling unit from exterior, neighboring units, and all other interior spaces
- Reduce pollutant transfer between units



Compartmentalization: Standard Practices

- IECC-2018 has tightness requirement, but can be met at whole building or individual unit level
  - Exterior envelope could be tight, with little sealing between units -> air transfer



- Better practice:
  - ASHRAE 62.2-2019 will require ≤**0.3** cfm50/sf at individual unit level
  - About $290 per unit for sealing and testing

Compartmentalization: Best Practice

- LEED for Homes Midrise Multifamily requires ≤**0.23** cfm50/sf
- Best practice implementation:
  - Careful job with traditional caulking and sealing
  - Aerosolization:
    - Pressurize unit
    - Release small particles of sealant
    - Sealant particles build up, sealing cracks
  - ~$500/unit for sealing to 0.23 cfm50/sf and testing

Sealed Air Leaks using Aerosolization (Source: Western Cooling Efficiency Council

Filtration: Why, and Standard Practice

- Filter supply air through HVAC system
- Why?
  - Remove particulate matter (PM), especially smaller particles (PM2.5)
  - PM2.5 causes asthma, respiratory problems, and cardiovascular disease
- Filters with higher Minimum Effectiveness Reporting Value (MERV) remove larger fraction of PM2.5
- Standard practice
  - MERV 6-8, required in IECC and ASHRAE 62.2
  - Removes very little PM2.5

Filtration: Best Practice

- Best practice: MERV 13 or higher
  - Removes ~70-85% of PM2.5
  - Incremental cost ~$80, although it can limit equipment choices
- Best practice implementation
  - Thicker filters (≥ 2”) to reduce static pressure for energy
  - Educate maintenance staff or tenants on replacing filters often

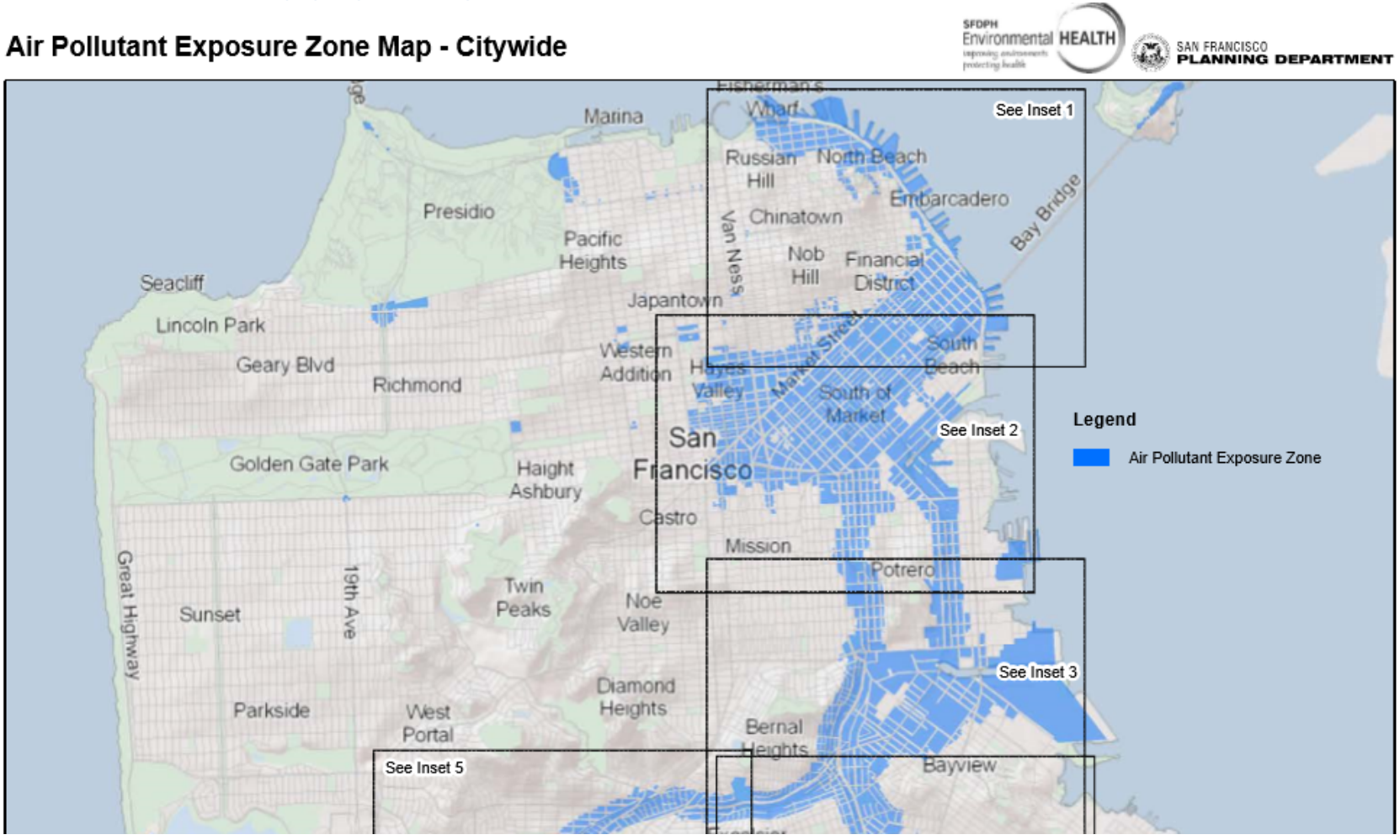
Best Practice: San Francisco Article 38

- Problem: Heavy development of MF buildings along freeway corridors
- People living within 500 feet of a freeway suffer higher rates of asthma, heart attacks, and pre-term births (Barboza, 2017)

Image from Barboza 2017, LA Times

Best Practice: San Francisco Article 38

- Residential new construction in high PM2.5 zones must use balanced or supply-only ventilation and MERV 13 filtration



Best Practice: San Francisco Article 38

"I knew the engineering community in the Bay Area was creative, but I didn't realize how creative."

Jonathan Piakis, SF Dept of Public Health

- Implementation strategies have included:
  - Central supply air ducted to each unit
  - Individual ERVs or HRVs
  - Designers continue to devise various other methods

Summary

MF IAQ Need	Why?	Std Practice	Best Practice	Best Practice Implementation	Approx. Incremental Cost /unit
Dwelling unit ventilation	Buildings getting tighter	Exhaust-only	Balanced or supply-only	Central supply ducted to units, or individual ERVs/HRVs	~$1,000
Compart-mentalization	Reduce pollutant transfer	None or little	0.23 cfm50/sf, individual unit level	Careful job with traditional sealants, or aerosolization	~$500
Filtration	Reduce indoor PM2.5	MERV 6 - 8	MERV 13	Deeper filters, encourage maintenance	~$80
Total					**~$1,580**

Everyone – particularly policy makers – must push for these requirements. Otherwise, standard practices will continue.