Ventilation in Spray Foamed (tight) Buildings

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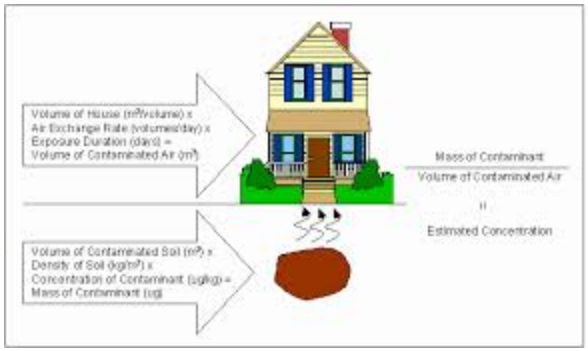
You are Finicky

- It has been a looooooong winter, yes?
- We can't wait for Spring. Can't. Wait.
- In 3 weeks it will be 85 and humid and we'll all be complaining that it's too hot.

- We have a *narrow* comfort range
- New England has a *wide* temperature (and humidity) range

…So, we live indoors

- We used to open windows to get fresh air, now we Air-condition
- Allergies also discourage use of windows
- Commercial Buildings often have in-operable windows

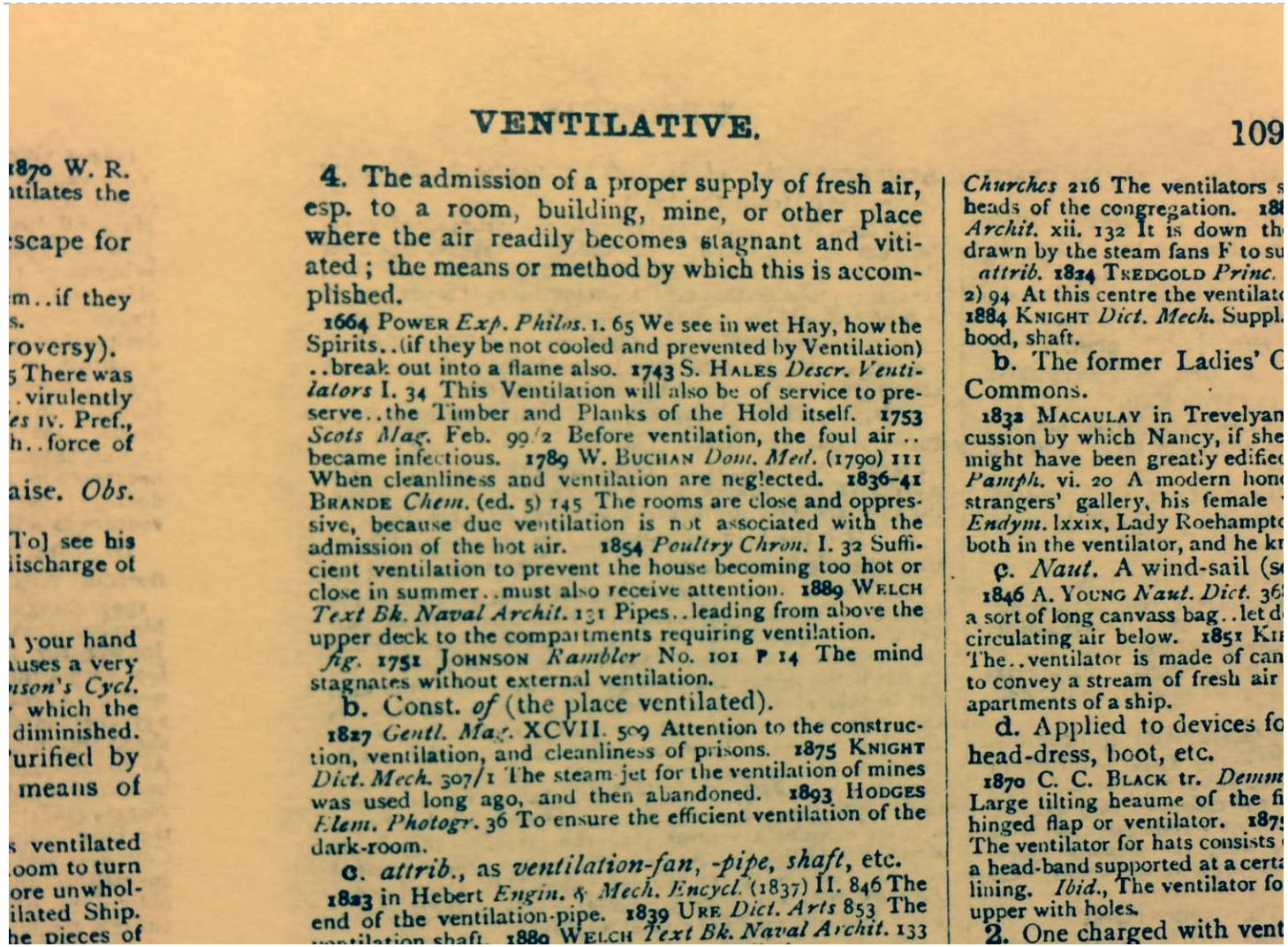


- EPA estimates that indoor air has 5-times more contaminants than outdoor air*
- **when is this not true?*

Energy used to be cheap

- Throw another log on the fire (or more coal, etc.)
- As energy costs rise, focus on conservation and efficiency also rise
- The most cost-effective way to save energy is to make buildings tighter*
- * *say what?*
  - *Normalized for other conditions*
  - *Based on a set of assumptions*
- Buildings have gotten increasingly tighter
- What other effect has this had?

Ventilation (Oxford Compact Dictionary)



VENTILATIVE. 109

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4. The admission of a proper supply of fresh air, esp. to a room, building, mine, or other place where the air readily becomes stagnant and vitiated; the means or method by which this is accomplished.

1664 POWER *Exp. Philos.* I. 65 We see in wet Hay, how the Spirits..(if they be not cooled and prevented by Ventilation) ..break out into a flame also. 1743 S. HALES *Descr. Ventilators* I. 34 This Ventilation will also be of service to preserve..the Timber and Planks of the Hold itself. 1753 *Scots Mag.* Feb. 90/2 Before ventilation, the foul air .. became infectious. 1789 W. BUCHAN *Dom. Med.* (1790) 111 When cleanliness and ventilation are neglected. 1836–41 BRANDE *Chem.* (ed. 5) 145 The rooms are close and oppressive, because due ventilation is not associated with the admission of the hot air. 1854 *Poultry Chron.* I. 32 Sufficient ventilation to prevent the house becoming too hot or close in summer..must also receive attention. 1889 WELCH *Text Bk. Naval Archit.* 131 Pipes..leading from above the upper deck to the compartments requiring ventilation.

fig. 1751 JOHNSON *Rambler* No. 101 P 14 The mind stagnates without external ventilation.

b. Const. *of* (the place ventilated).

1827 *Gentl. Mag.* XCVII. 509 Attention to the construction, ventilation, and cleanliness of prisons. 1875 KNIGHT *Dict. Mech.* 307/1 The steam-jet for the ventilation of mines was used long ago, and then abandoned. 1893 HODGES *Elem. Photogr.* 36 To ensure the efficient ventilation of the dark-room.

c. *attrib.*, as *ventilation-fan, -pipe, shaft*, etc.

1823 in Hebert *Engin. & Mech. Encycl.* (1837) II. 846 The end of the ventilation-pipe. 1839 URE *Dict. Arts* 853 The ventilation shaft. 1880 WELCH *Text Bk. Naval Archit.* 133

Churches 216 The ventilators s
heads of the congregation. 18
Archit. xii. 132 It is down th
drawn by the steam fans F to su
attrib. 1824 TREDGOLD *Princ.*
2) 94 At this centre the ventilat
1884 KNIGHT *Dict. Mech.* Suppl.
hood, shaft.

b. The former Ladies' C
Commons.

1832 MACAULAY in Trevelyan
cussion by which Nancy, if she
might have been greatly edifie
Pamph. vi. 20 A modern hon
strangers' gallery, his female
Endym. lxxix, Lady Roehampt
both in the ventilator, and he k

c. *Naut.* A wind-sail (s

1846 A. YOUNG *Naut. Dict.* 36
a sort of long canvass bag..let d
circulating air below. 1851 KI
The..ventilator is made of can
to convey a stream of fresh air
apartments of a ship.

d. Applied to devices fo
head-dress, boot, etc.

1870 C. C. BLACK tr. *Demm*
Large tilting heaume of the f
hinged flap or ventilator. 187
The ventilator for hats consists
a head-band supported at a cert
lining. *Ibid.*, The ventilator fo
upper with holes.

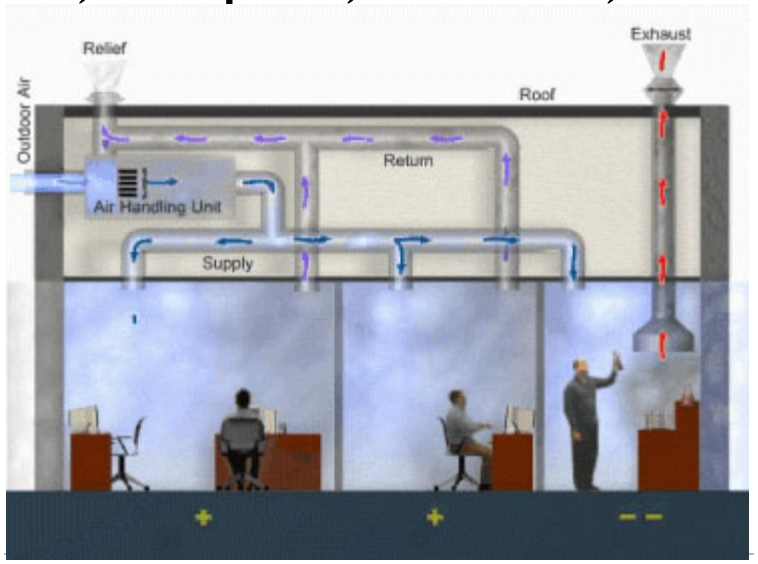
2. One charged with vent

Ventilation: Natural vs. Mechanical

- Natural: Windows, doors, other holes in buildings, cracks in building materials, etc.
  - Stack effect: How a chimney drafts
  - "negative stack effect"
  - Consistency?

The Liberty flying house balloon

- Mechanical: Fans, ducts, registers, dampers, controls, etc.
  - Controlled
  - Measurable (easily)
  - Predictable
  - Designed (Intentional)
  - Spot ventilation



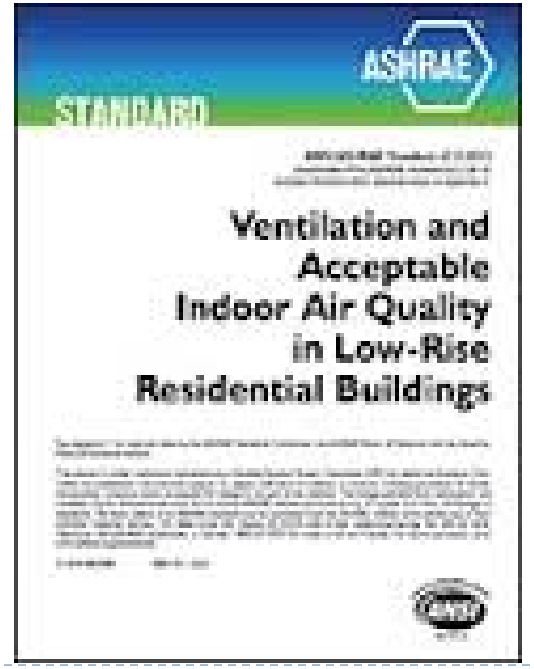
Does Mechanical Ventilation save energy?

- When ventilation is added to a building, energy costs:
  - Rise.
  - Fall.
  - Stay the same.
  - None of the above.

- Health & Safety trump Energy Efficiency, Green Building
- More isn't necessarily better

OK, so we need it, but how much?

- Over & Under
  - Expense & efficiency
- ASHRAE (standards)
  - American Society of Heating, Refrigeration, and Air-Conditioning Engineers
  - 62.1 – Commercial buildings
  - 62.2 – Residential buildings

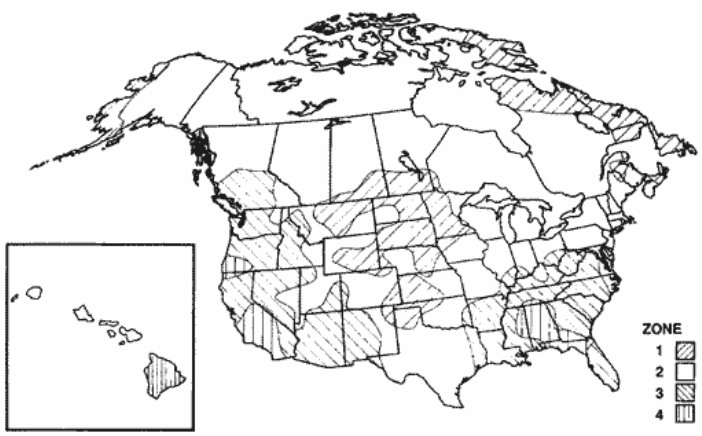


ASHRAE 62.2 2010 includes:

- Spot ventilation requirements
- Attached garages must be adequately sealed from living space to prevent migration of contaminants
- Clothes driers must be vented to exterior
- All duct joints outside conditioned space must be sealed
- Sone rating requirements must be met
- Branch duct systems must have backdraft
- dampers
- Whole-home fan flow must be verified (tested)
- Continuous vs. intermittent fan specifications

ASHRAE 62.2: Mech. & Natural

- N-factor (natural) variables:
- • Geographic location
- • Building height
- • Building exposure
  - The n-factor for the house illustrated would be different if it was one story taller, or less shielded. The map shown below is a Climate Zone Map used to determine the geographic variable.



Calculating ventilation

CFMfan = 0.01Afloor + 7.5(Numberbedroom + 1) + (alternative compliance supplement) - (Infiltration credit)

- A = conditioned floor area; "the part of the building that is capable of being thermally conditioned for the comfort of occupants." (ASHRAE 62.2, p.3)

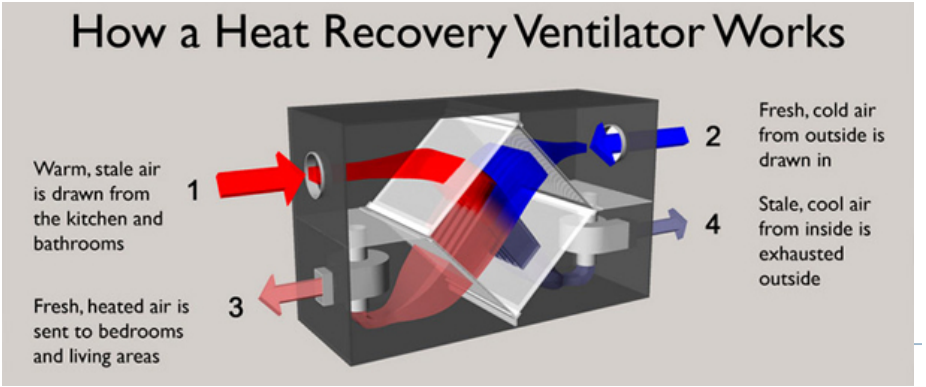
Table 4.1 from ASHRAE 62.2

Floor Area (ft^2)	0-1 Bedrooms	2-3	4-5	6-7	>7
< 1500 ft^2	30	45	60	75	90
1501 – 3000	45	60	75	90	105
3001 – 4500	60	75	90	105	120
4501 - 6000	75	90	105	120	135
6001 -7500	90	105	120	135	150
> 7500 ft^2	105	120	135	150	165

Types of Mechanical Ventilation

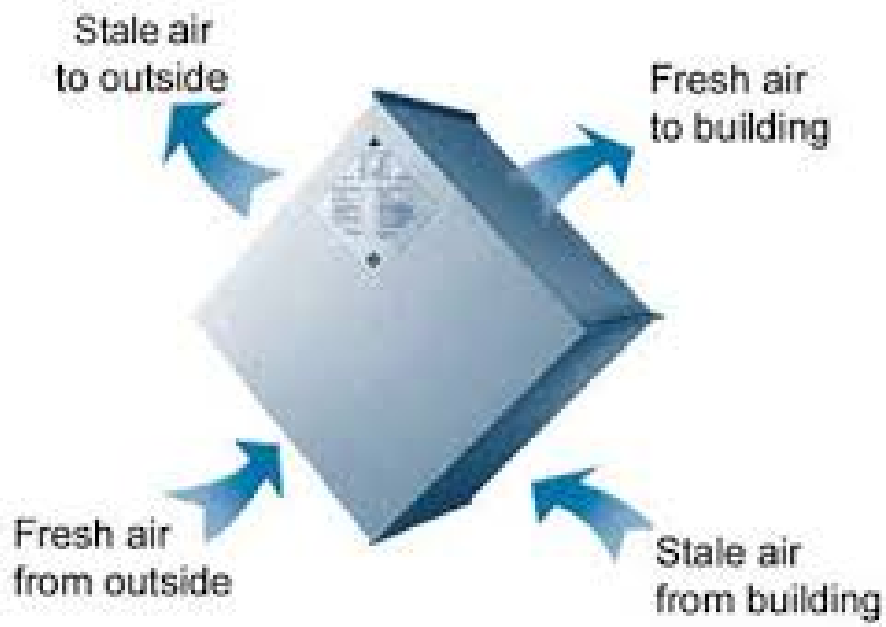
- Exhaust-only
  - Pushing air out and relying on induced infiltration
  - Bathroom fan typically used

- Supply-only
  - Adding air and relying on dilution
- Balanced
  - HRV
  - ERV



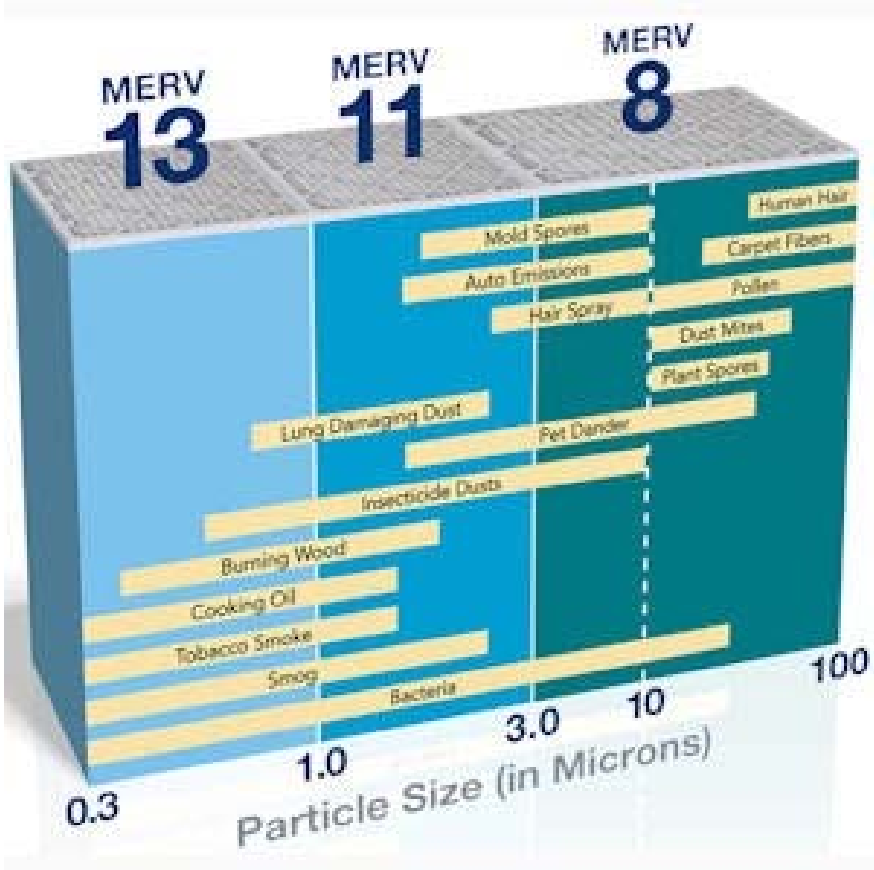
ERV and HRV

- Heat Recovery Ventilator
  - Does not exchange moisture, only conditioned/unconditioned air
- Energy Recovery Ventilator
  - Permeable core
  - Moisture transfer
  - Freeze up?



Filtration

- MERV: Minimum Efficiency Reporting Value
  - Higher is better
  - Quality matters
  - Energy impact?
  - Cost impact?
  - LEED



Questions?

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