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Building Science

Adventures In Building Science

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Build Tight - Ventilate Right

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How Tight?
What's Right?

Air Barrier Metrics

Material	0.02 l/(s-m ²) @ 75 Pa
Assembly	0.20 l/(s-m ²) @ 75 Pa
Enclosure	2.00 l/(s-m ²) @ 75 Pa 0.25 cfm/ft ² @ 50 Pa

Getting rid of big holes	3 ach@50
Getting rid of smaller holes	1.5 ach@50
Getting German	0.6 ach@50

Best

As Tight as Possible - with -

Balanced Ventilation

Energy Recovery

Distribution and Mixing

Source Control - Spot exhaust ventilation

Filtration

Material selection

Worst

Leaky - with – Nothing

Spot Ventilation in Bathroom/Kitchen

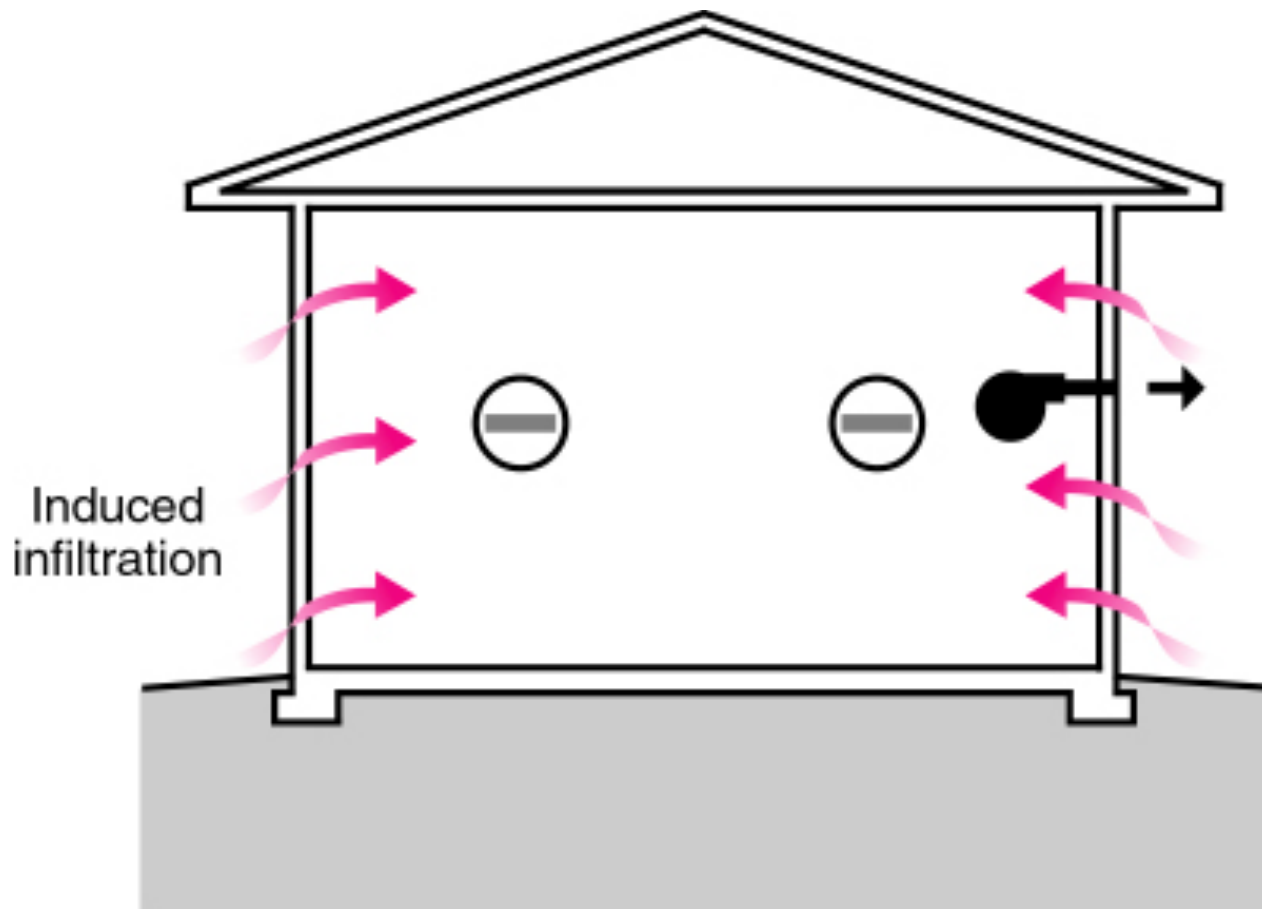
Exhaust Ventilation – with – No Distribution
and No Mixing

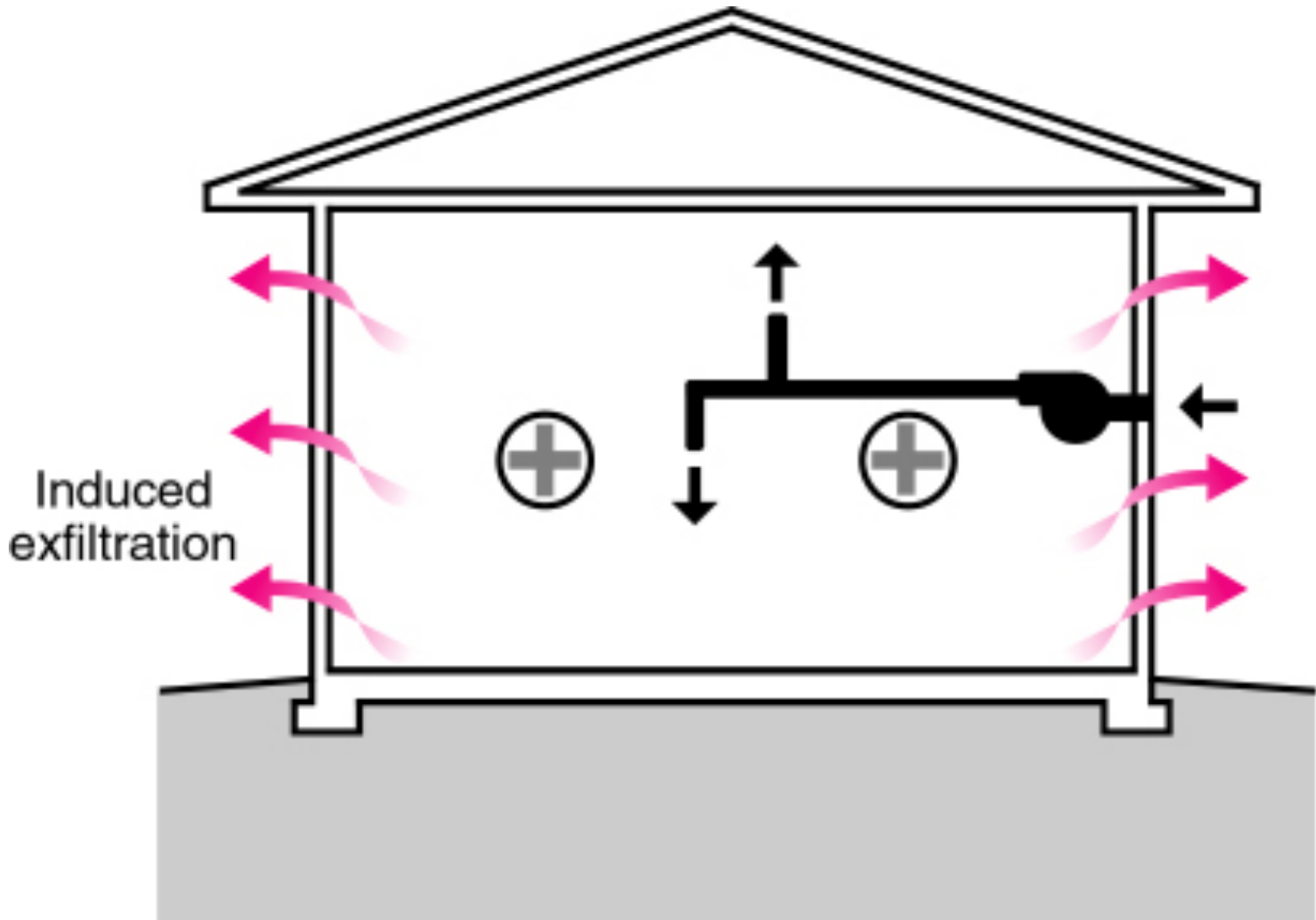
Three Types of Controlled Ventilation Systems

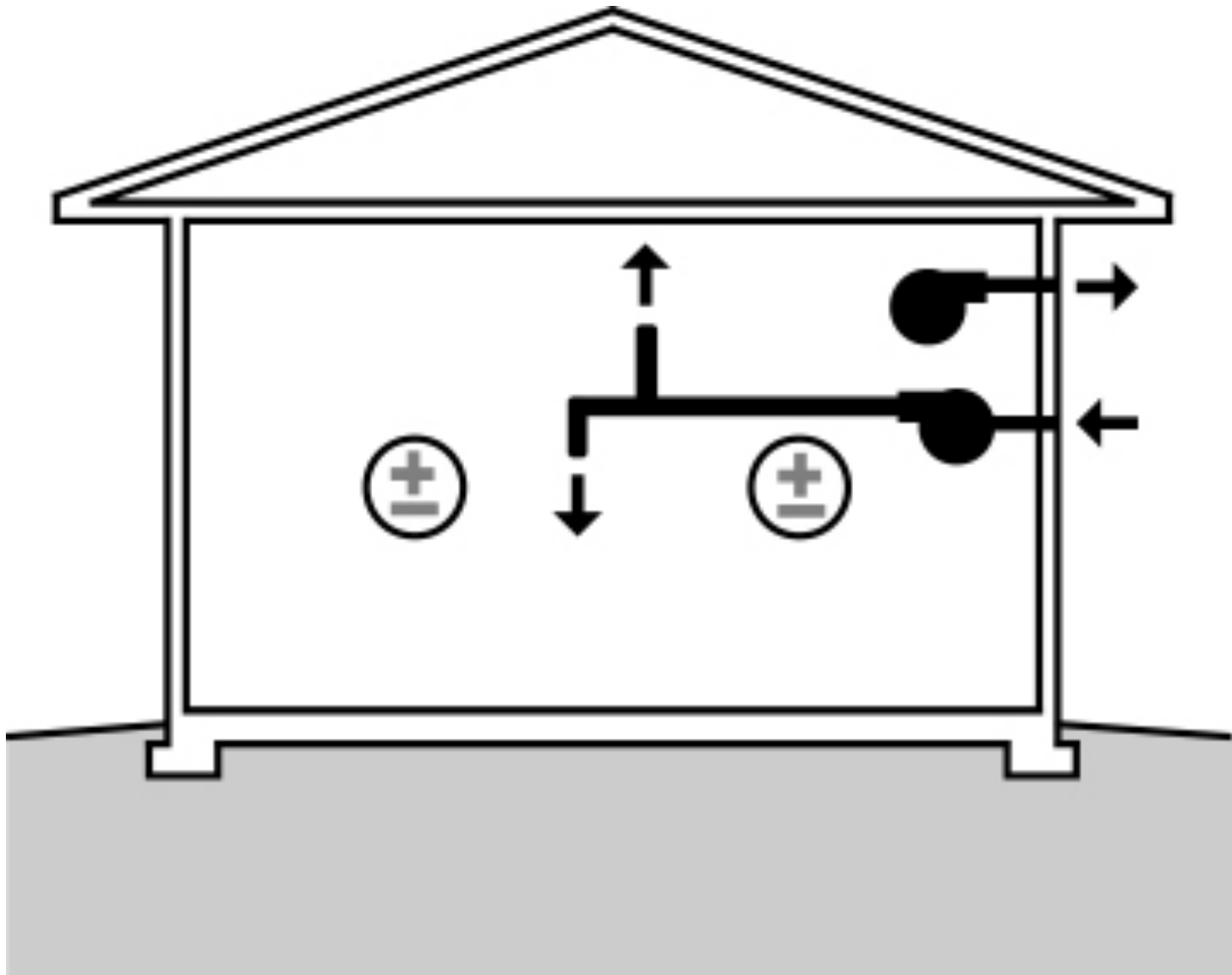
Exhaust Ventilation

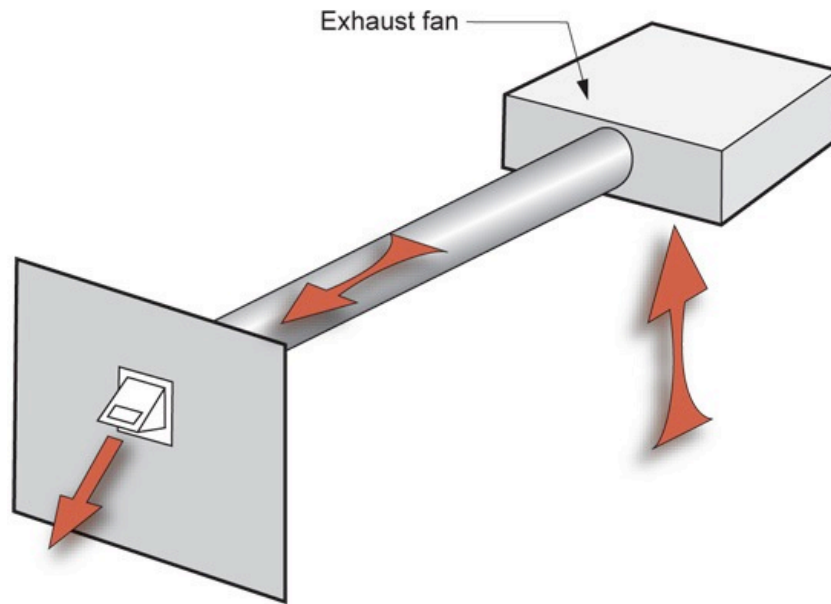
Supply Ventilation

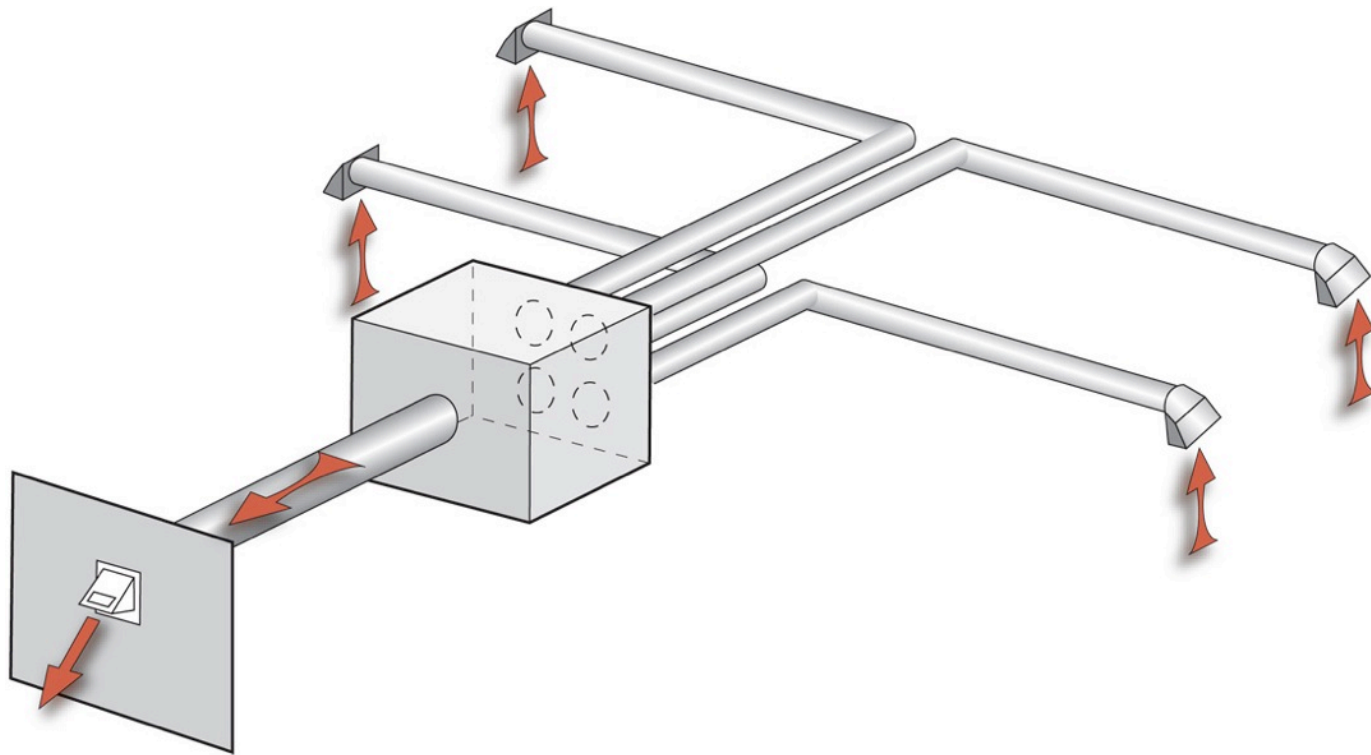
Balanced Ventilation

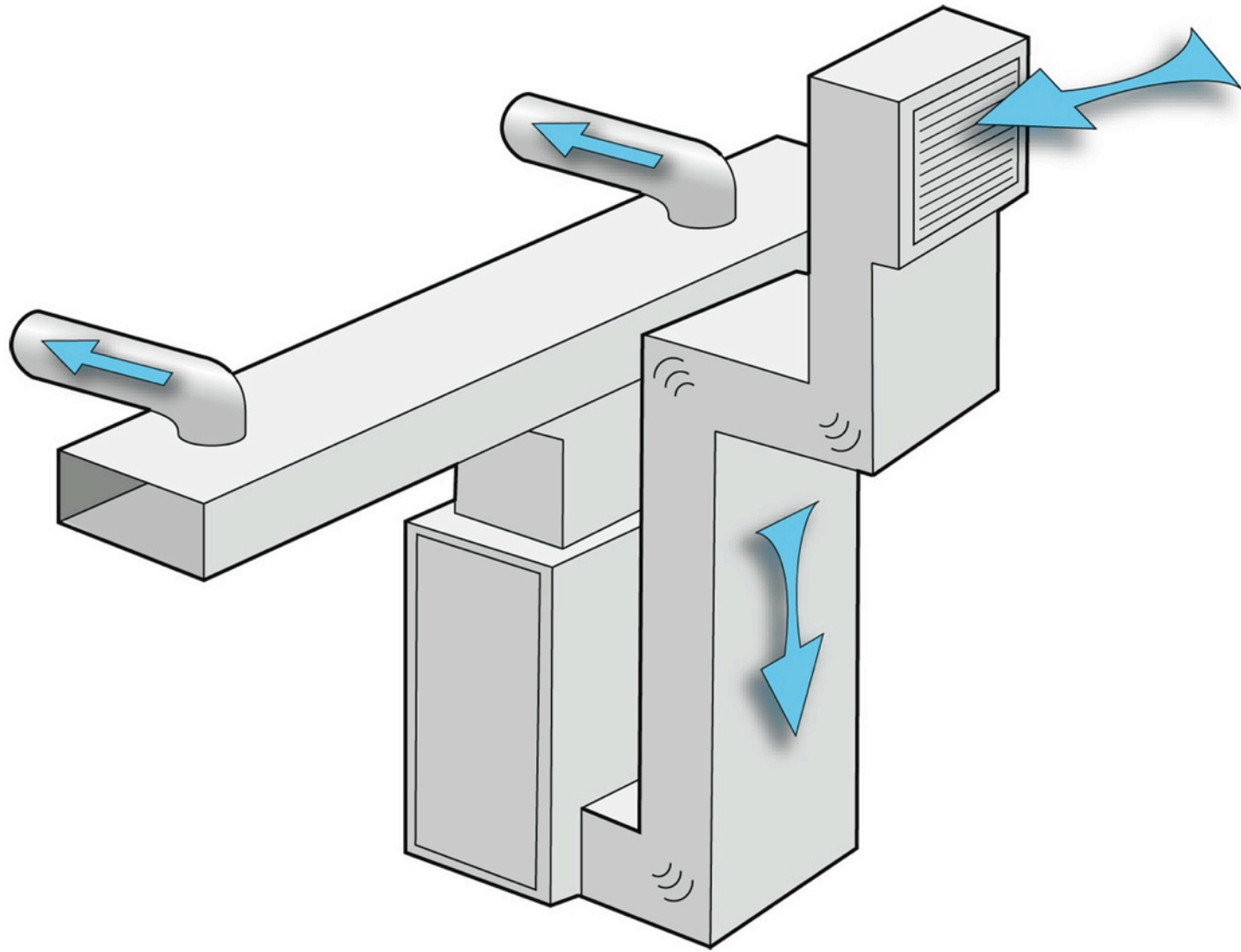


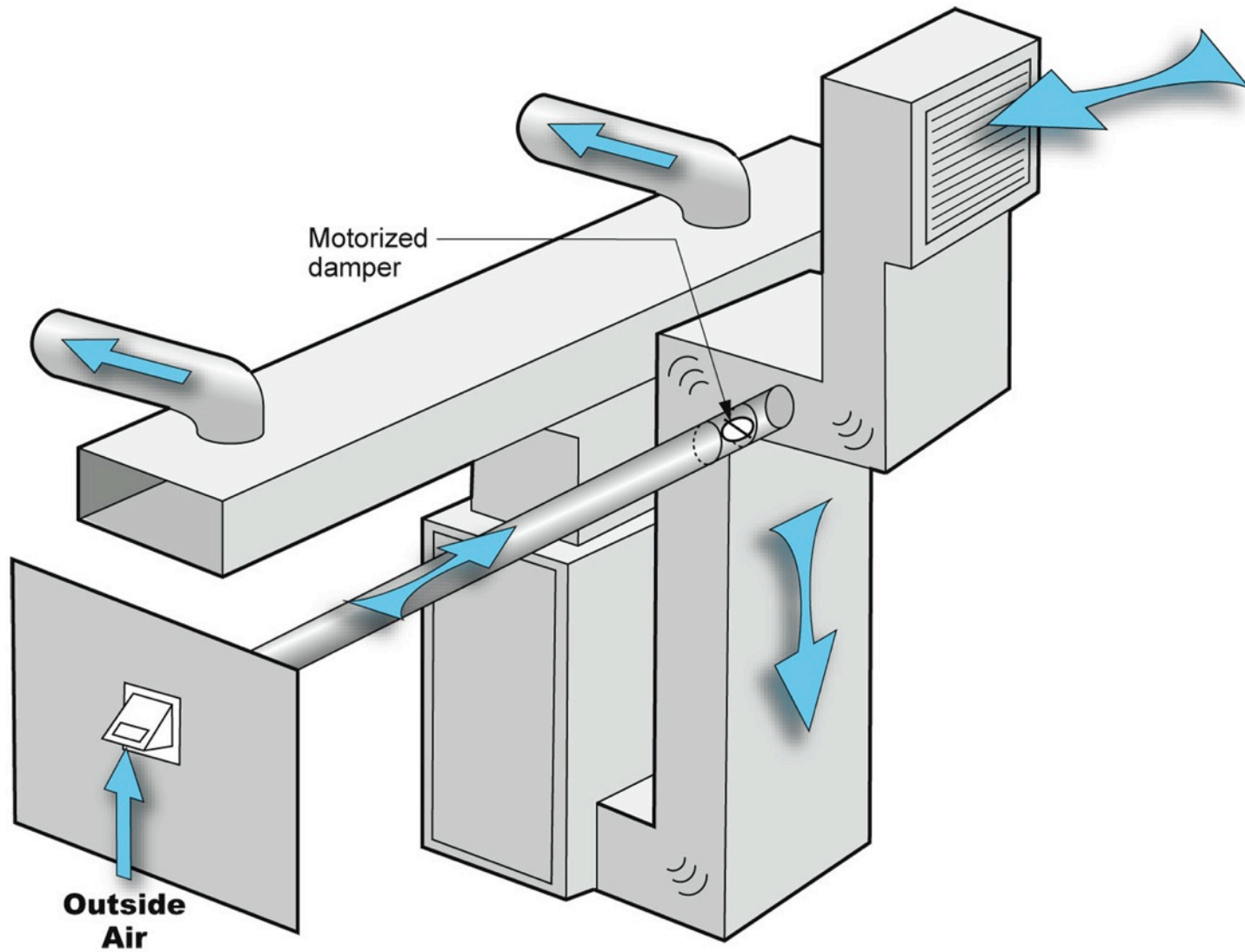


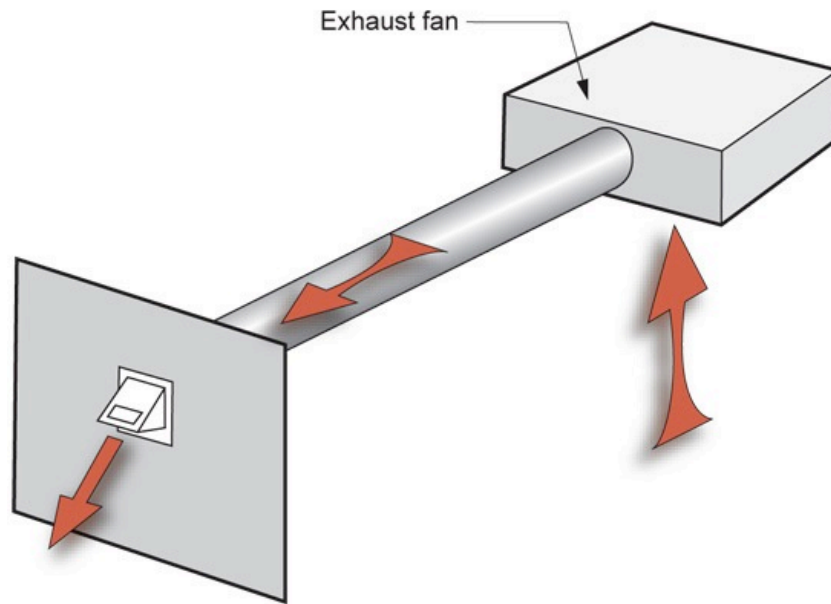


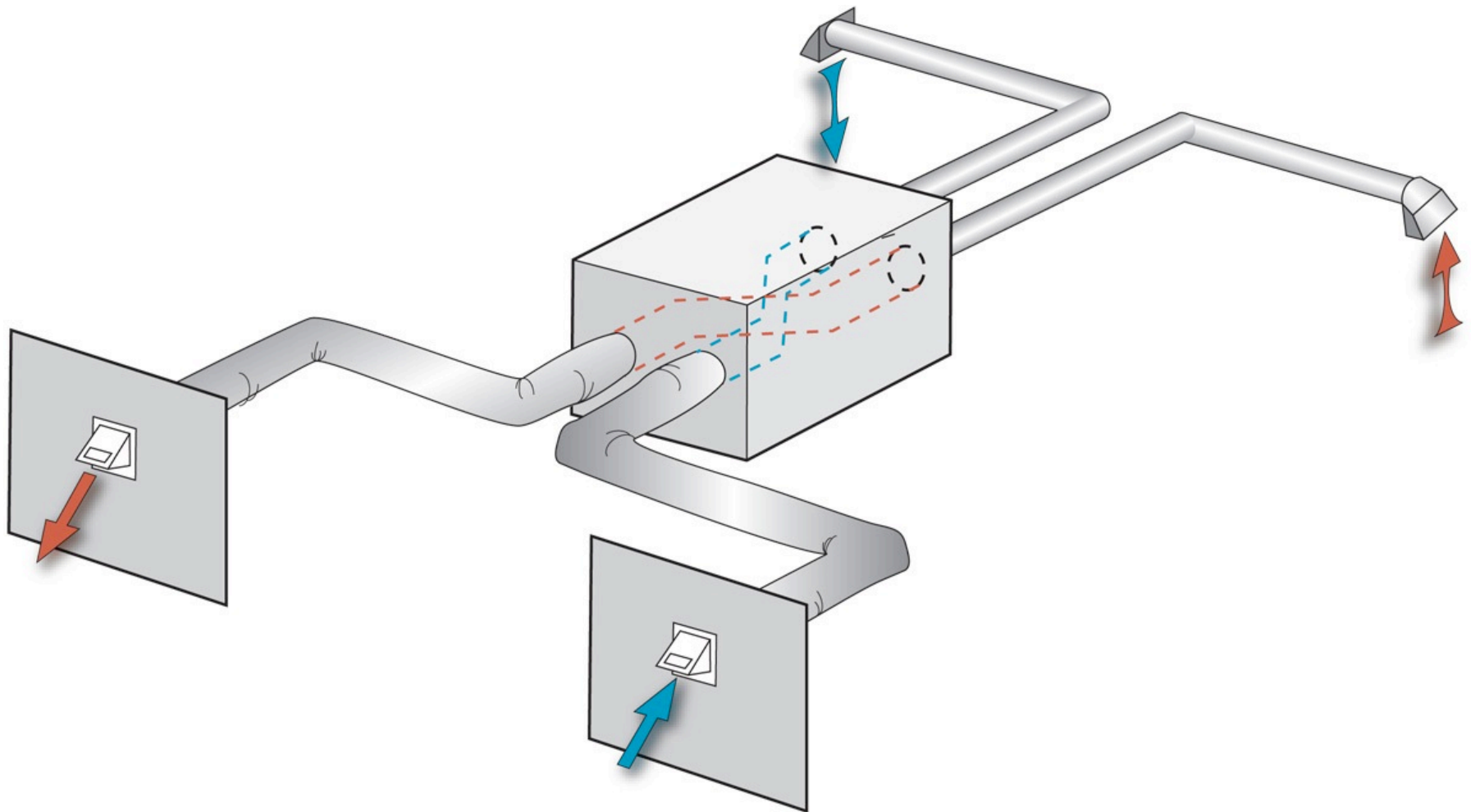












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The Applicable Studies Focus on Dampness

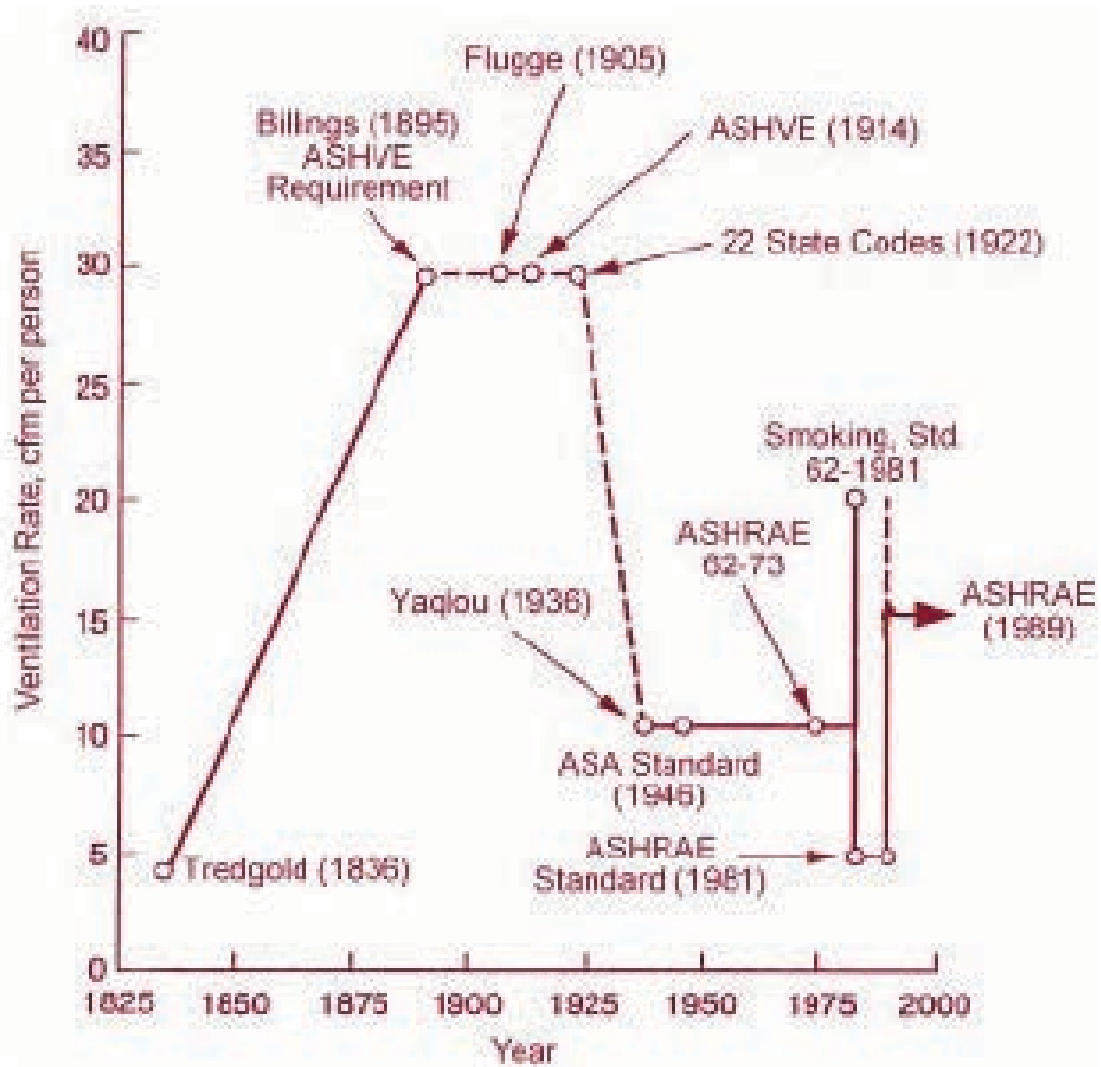


Figure 1: Minimum ventilating rate history.

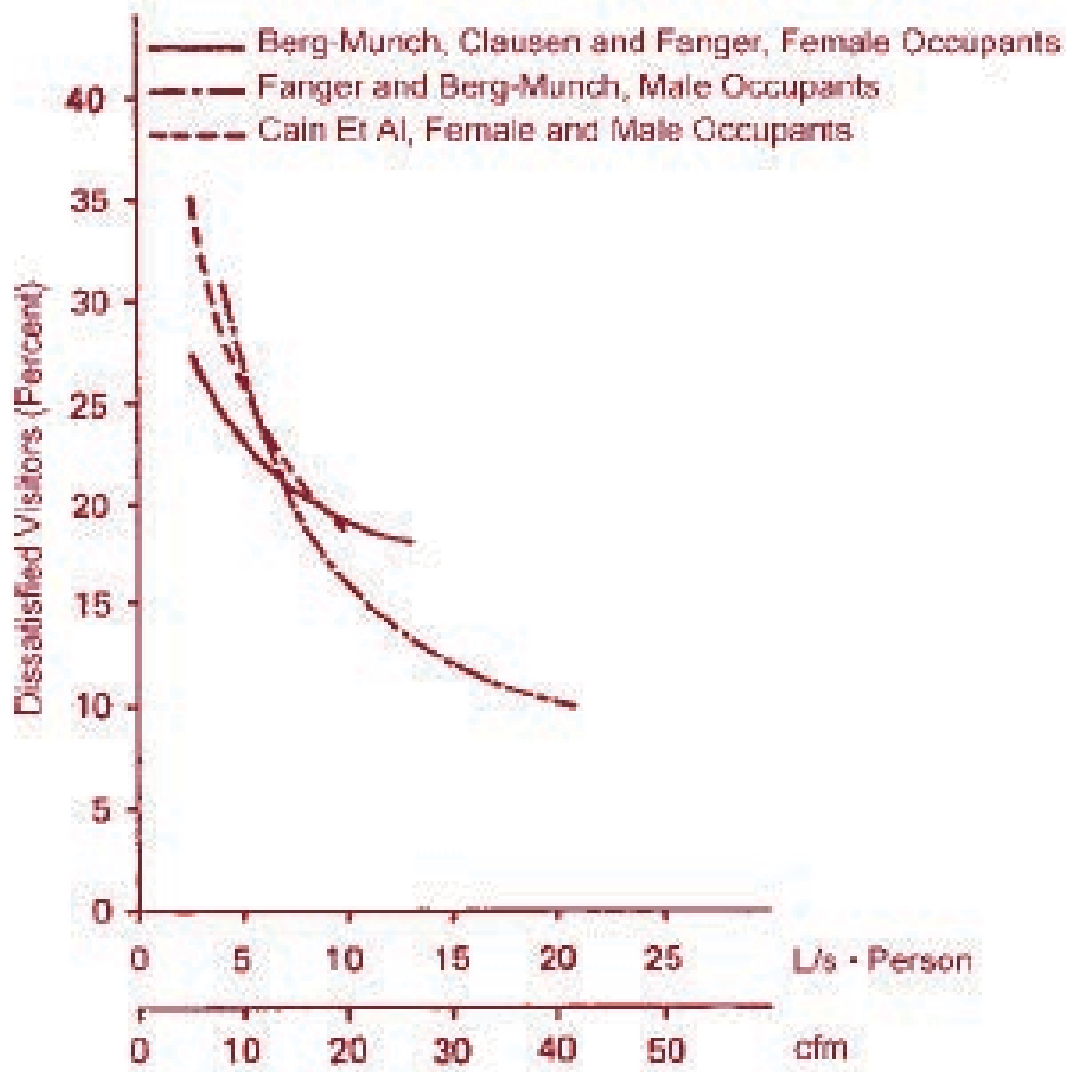


Figure 2: Odor acceptance.

House

2,000 ft²

3 bedrooms

8 ft. ceiling

Volume: 16,000 ft³

.35 ach 93 cfm

.30 ach 80 cfm

.25 ach 67 cfm

.20 ach 53 cfm

.15 ach 40 cfm

House

2,000 ft²

3 bedrooms

8 ft. ceiling

Volume: 16,000 ft³

Ventilation Rates

.35 ach	93 cfm	62 - 73	5 cfm/person	20 cfm
.30 ach	80 cfm		10 cfm/person	40 cfm
.25 ach	67 cfm	62 - 89	15 cfm/person	60 cfm
.20 ach	53 cfm		.35 ach	90 cfm
.15 ach	40 cfm	62.2 - 2010	7.5 cfm/person + 0.01	50 cfm
		62.2 - 2013	7.5 cfm/person + 0.03	90 cfm

Office

Occupant Density

15/1000 ft² (67 ft²/person)
15 cfm/person

62 - 89

5/1000 ft² (200 ft²/person)
17 cfm/person

62.1 - 2007

Correctional Facility Cell

Occupant Density

20/1000 ft² (48 ft²/person)
10 cfm/person

62.1 – 2007

C.P. Yaglou

Harvard School of Public Health

1936

1955

150 ft³ → 20 cfm/person

300 ft³ → 12 cfm/person

C.P. Yaglou

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1936

1955

150 ft³ → 20 cfm/person 18.75 ft² 106 occupants

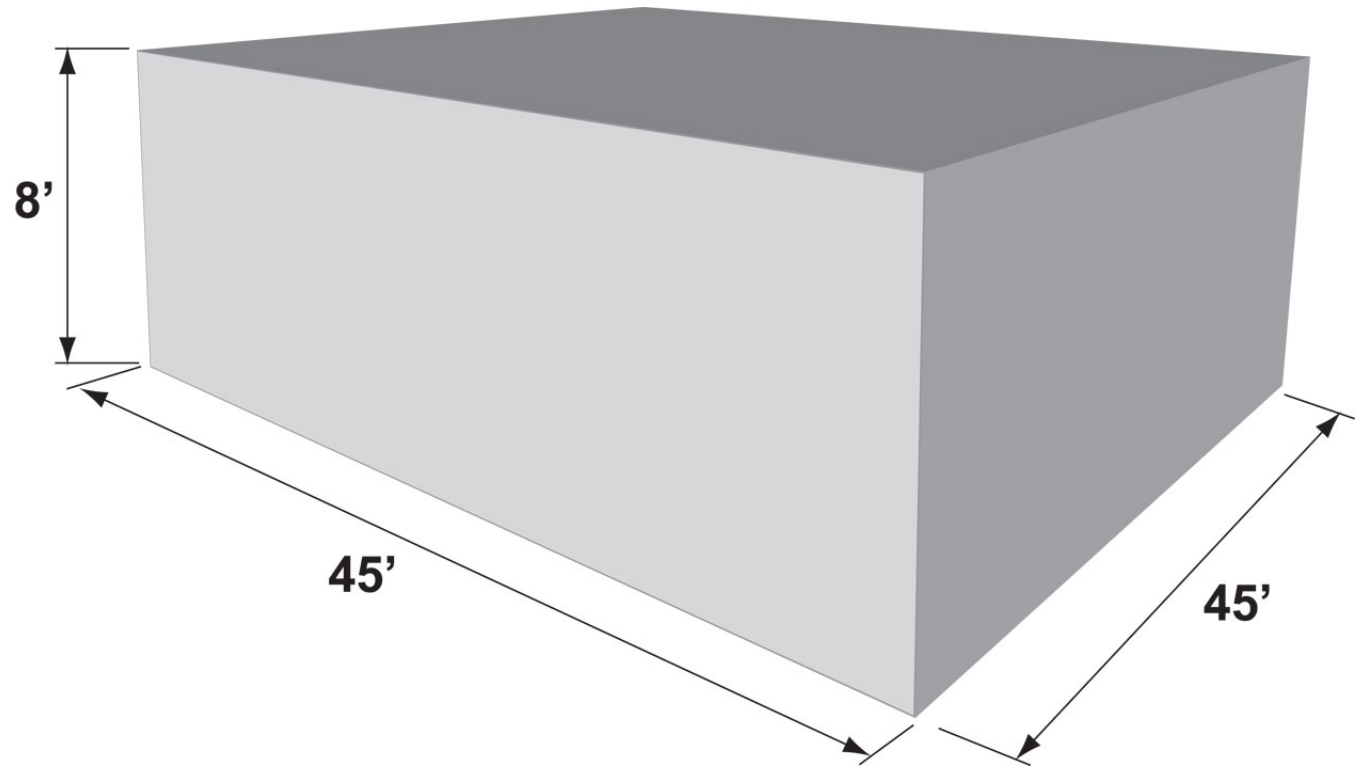
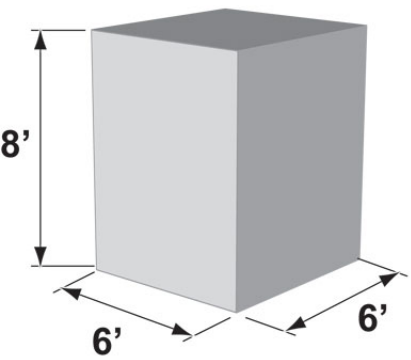
300 ft³ → 12 cfm/person 37.5 ft² 53 occupants

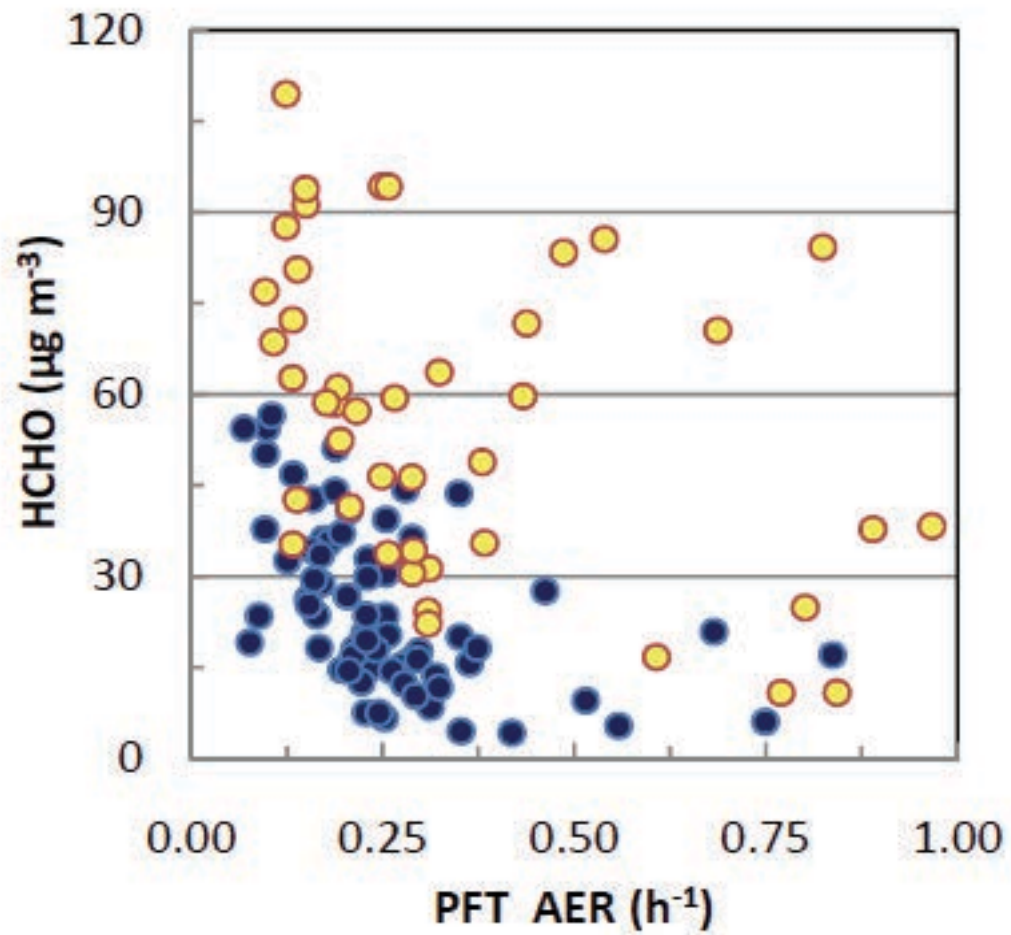
Experiment

470 ft³ → 59 ft²

200 ft³ → 25 ft²

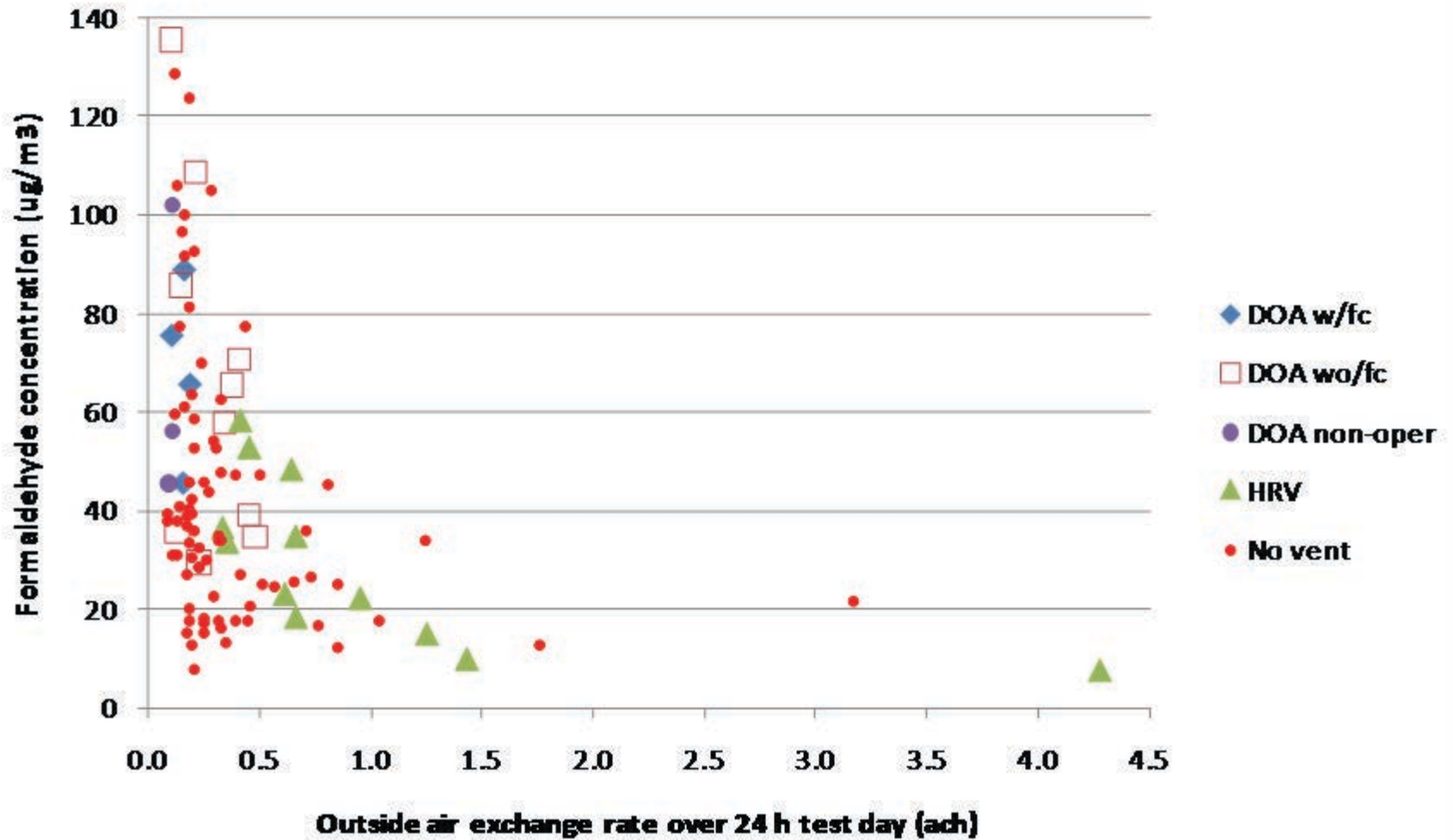
100 ft³ → 12 ft²





Aubin, D., Won, D.Y., Schleichinger, H., 2010

Formaldehyde sample concentration versus PFT measured outside air exchange rate over the test day



ASHRAE Standard 62.2 calls for 7.5 cfm per person plus 0.03 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one

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Occupancy is deemed to be the number of bedrooms plus one

Outcome is often bad – part load humidity problems, dryness problems, energy problems

IRC 2015 and 2018 calls for 7.5 cfm per person plus 0.01 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one

3 Bedroom House – 2,500 ft²

30 cfm plus 75 cfm

105 cfm

3 Bedroom House – 2,500 ft²

30 cfm plus 25 cfm

55 cfm

The Cult of The Blower Door



Blower Door Can't Get You The True ACH On A Short Term Basis – Hour, Day, Week

Don't Know Where The Holes Are

Don't Know The Type of Holes

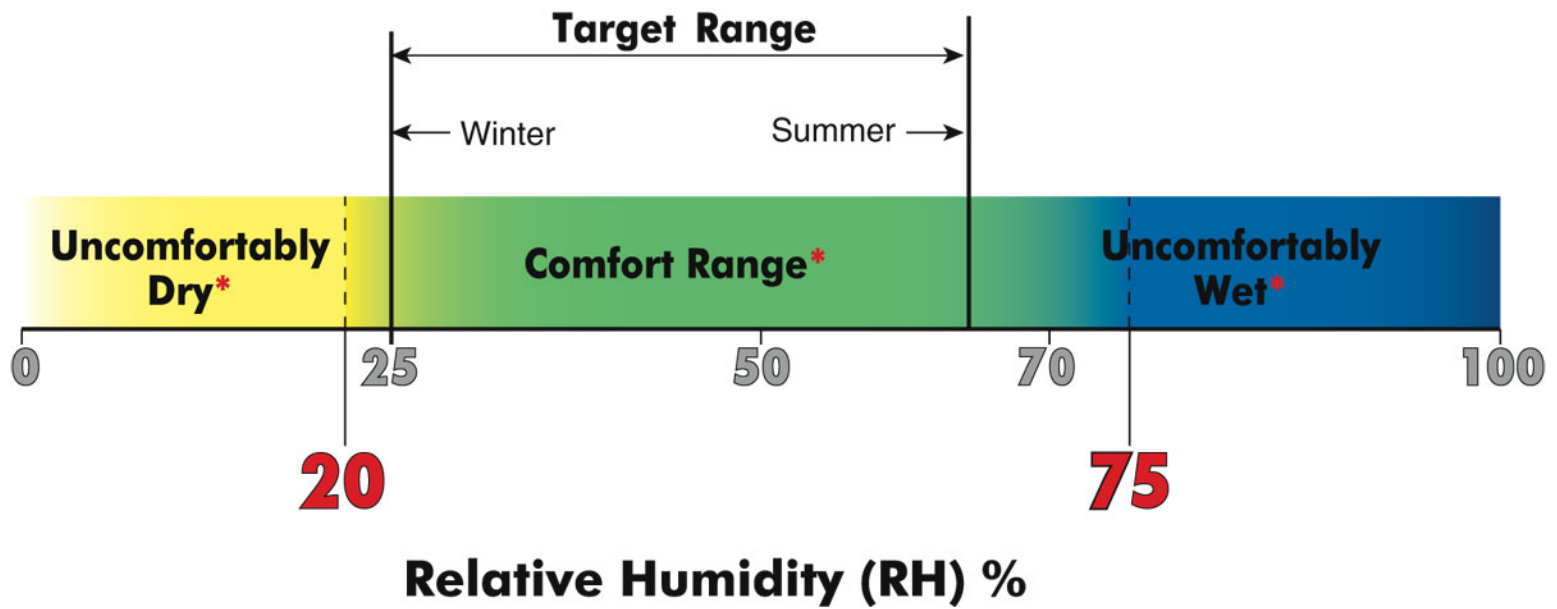
Don't Know The Pressure Across The Holes

Dilution Is Not The Solution To Indoor Pollution

Source Control

Dilution For People

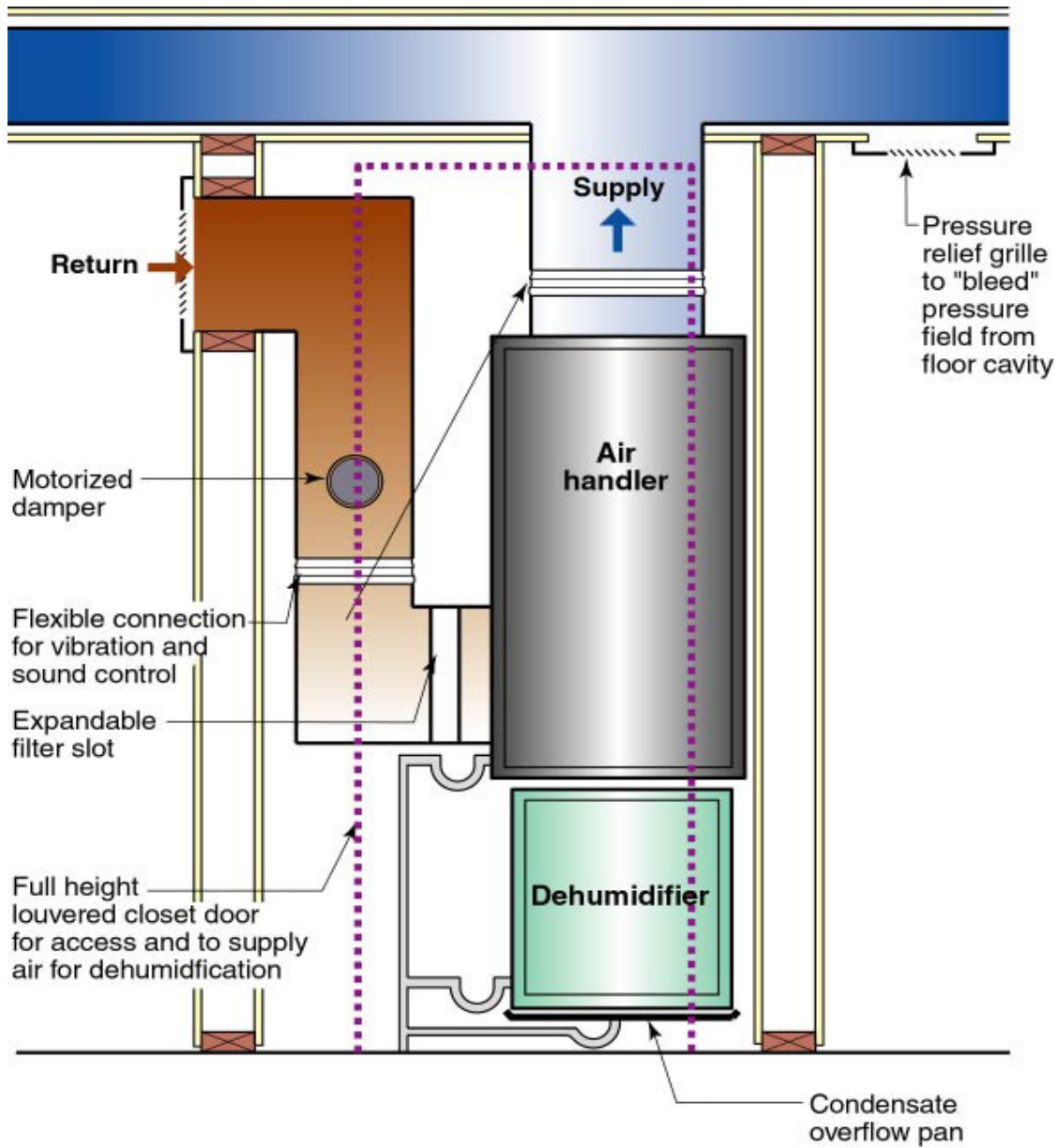
Source Control For The Building



Recommended Range of Relative Humidity

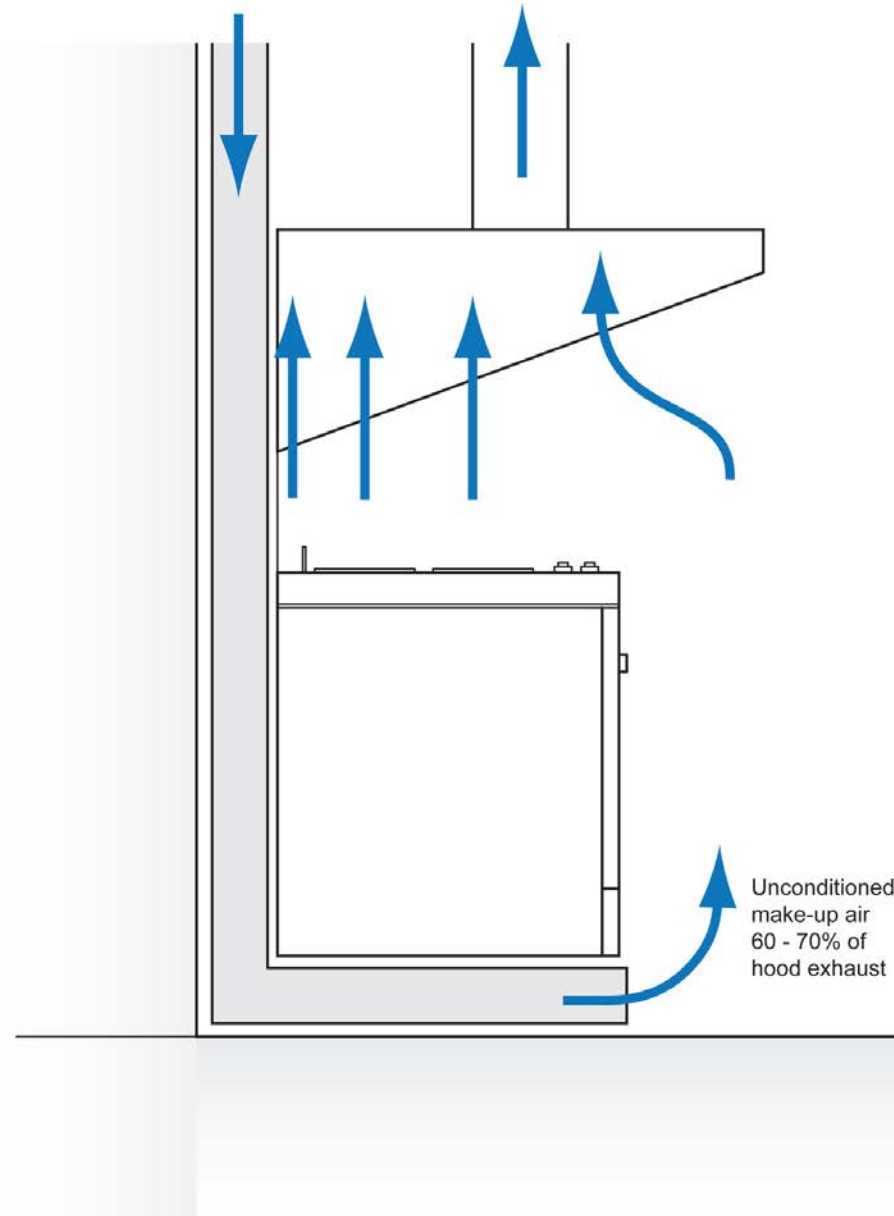
Above 25 percent during winter

Below 70 percent during summer

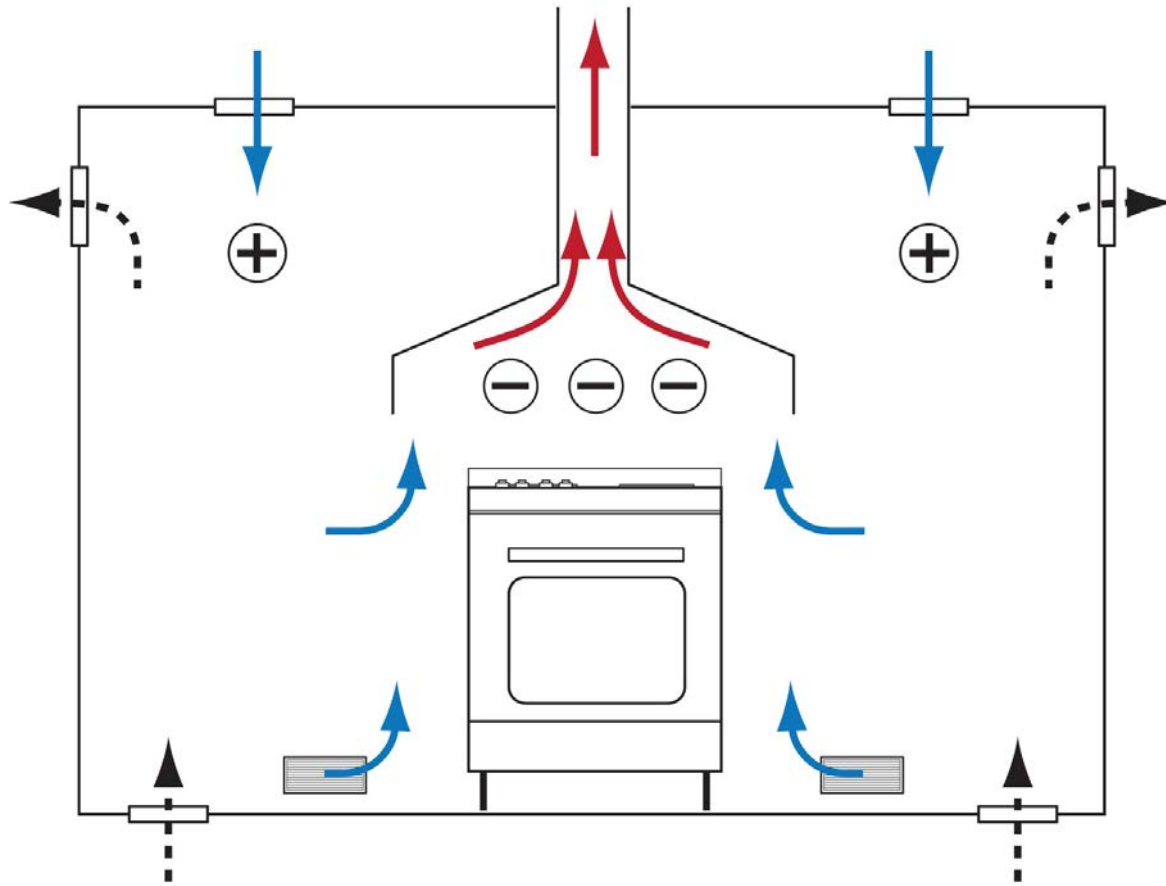


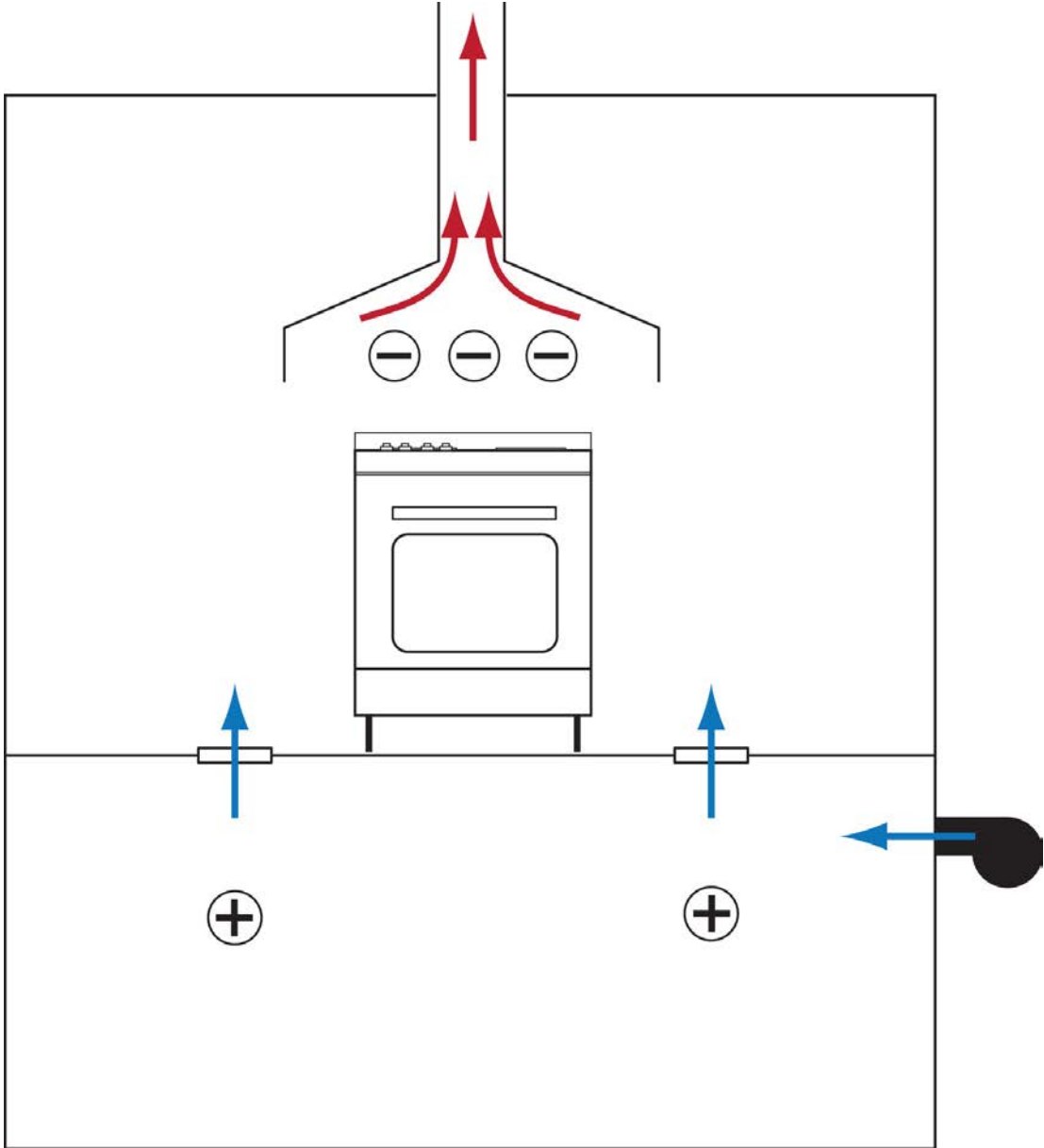


Kitchen Exhaust Hoods





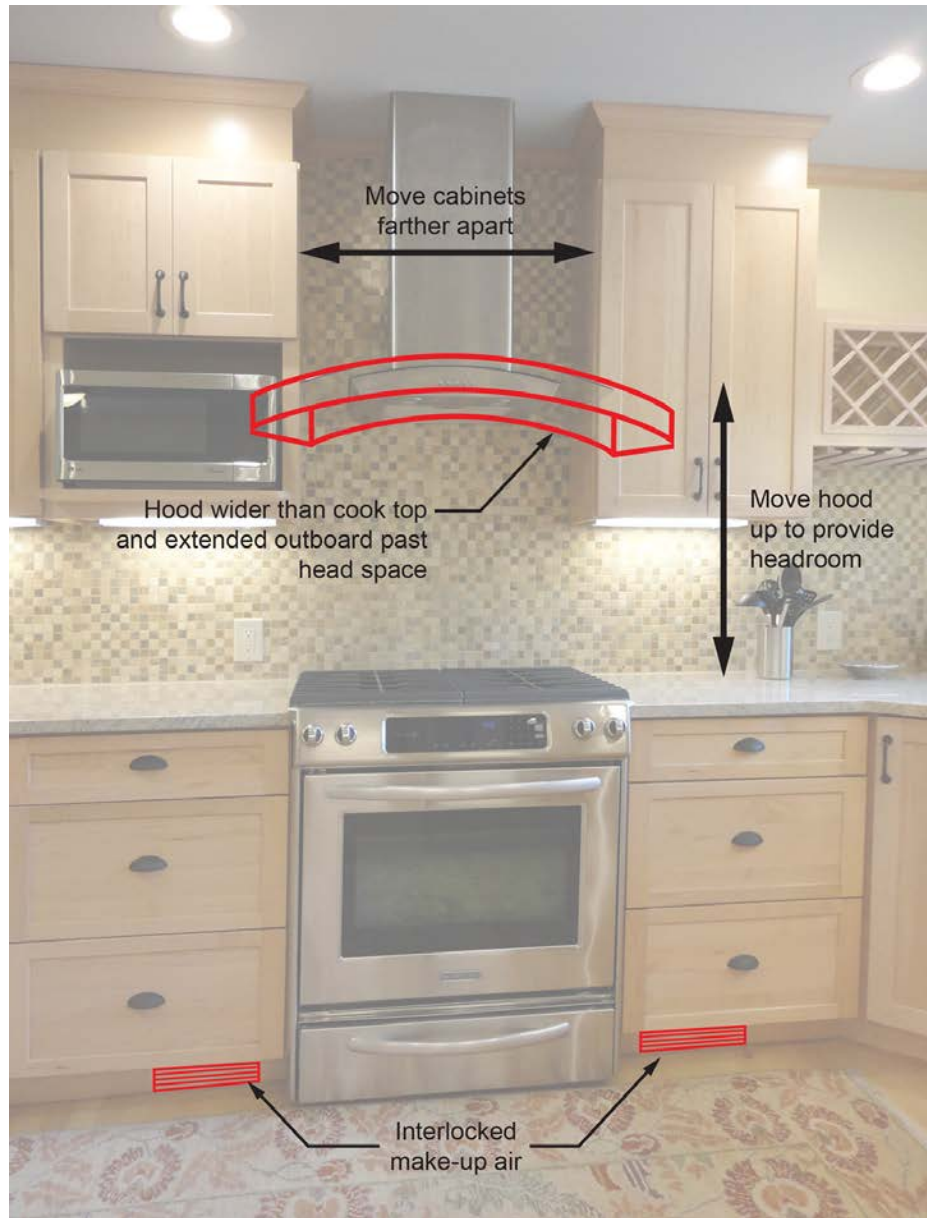














Clothes Dryers





Fireplaces







Approaches

