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Building Science

Adventures In Building Science

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Build Tight - Ventilate Right

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Build Tight - Ventilate Right

How Tight?

What's Right?

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Air Barrier Metrics

Material	0.02 I/(s-m ²)@75 Pa
Assembly	0.20 I/(s-m ²)@75 Pa
Enclosure	2.00 I/(s-m ²)@75 Pa

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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

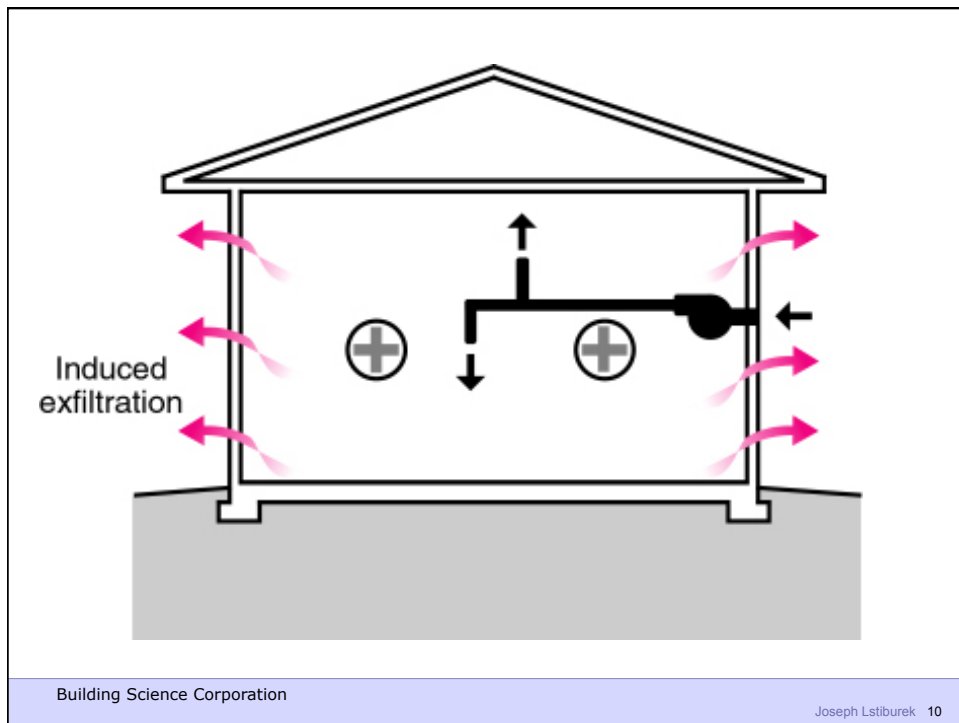
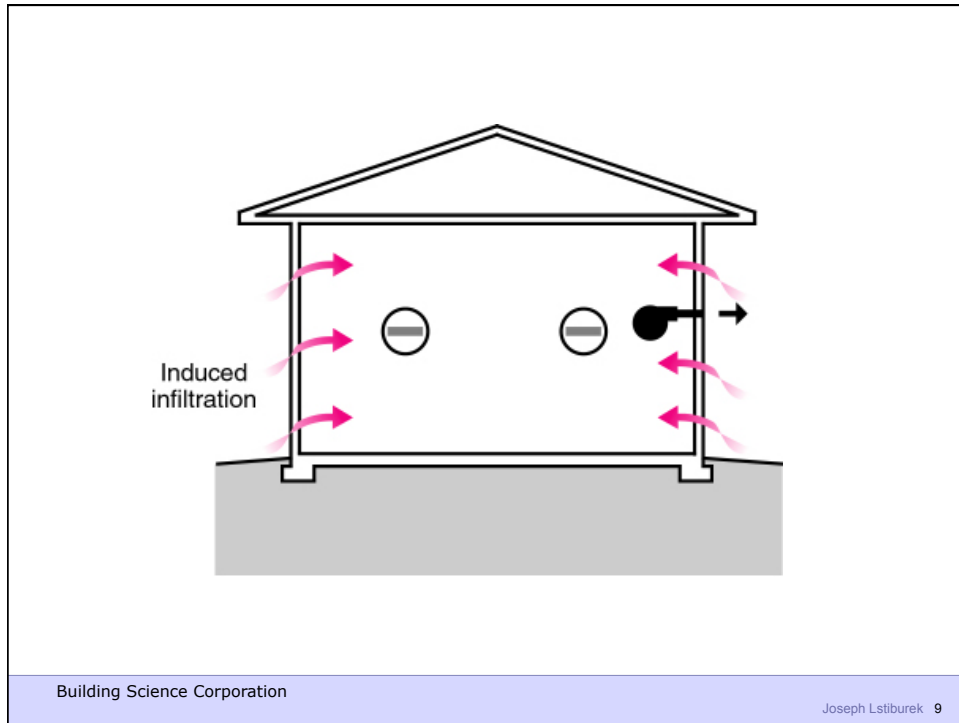
Exhaust Ventilation – with – No Distribution
and No Mixing

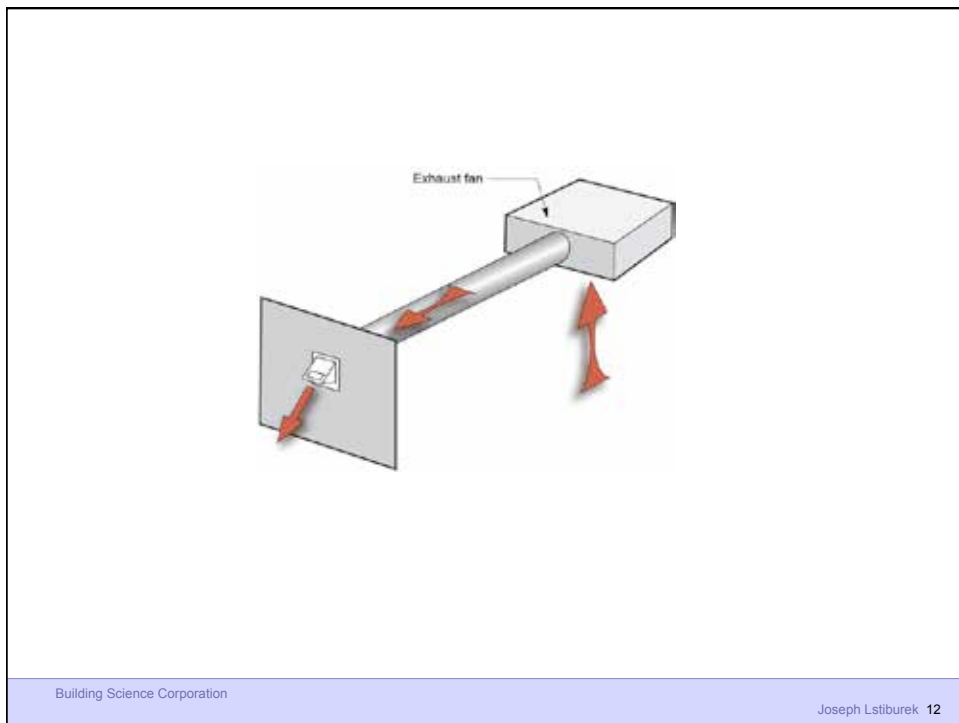
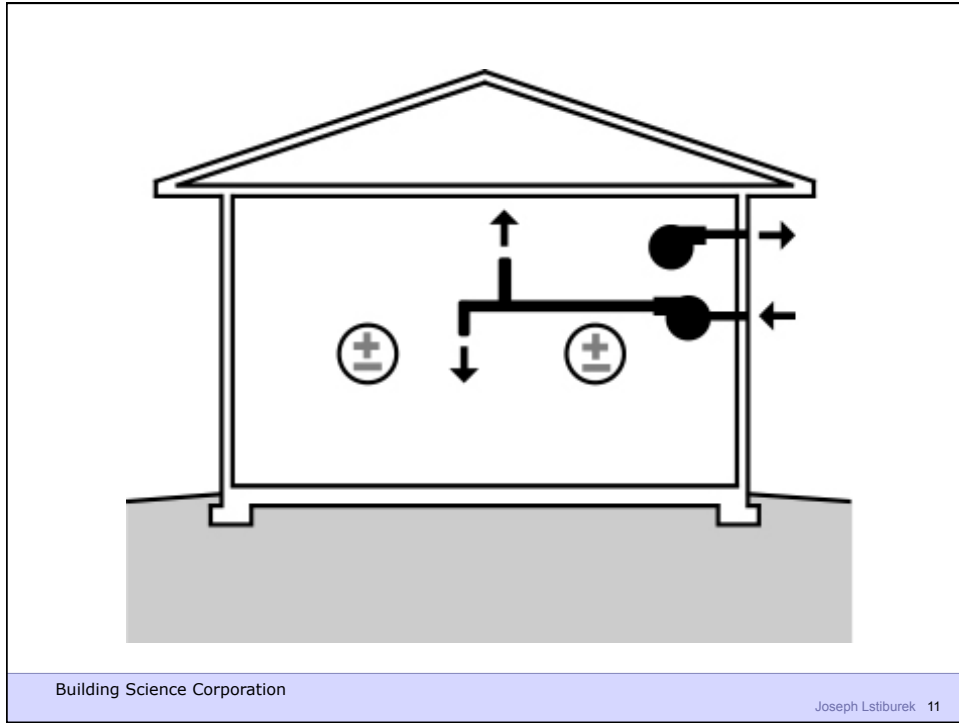
Three Types of Controlled Ventilation Systems

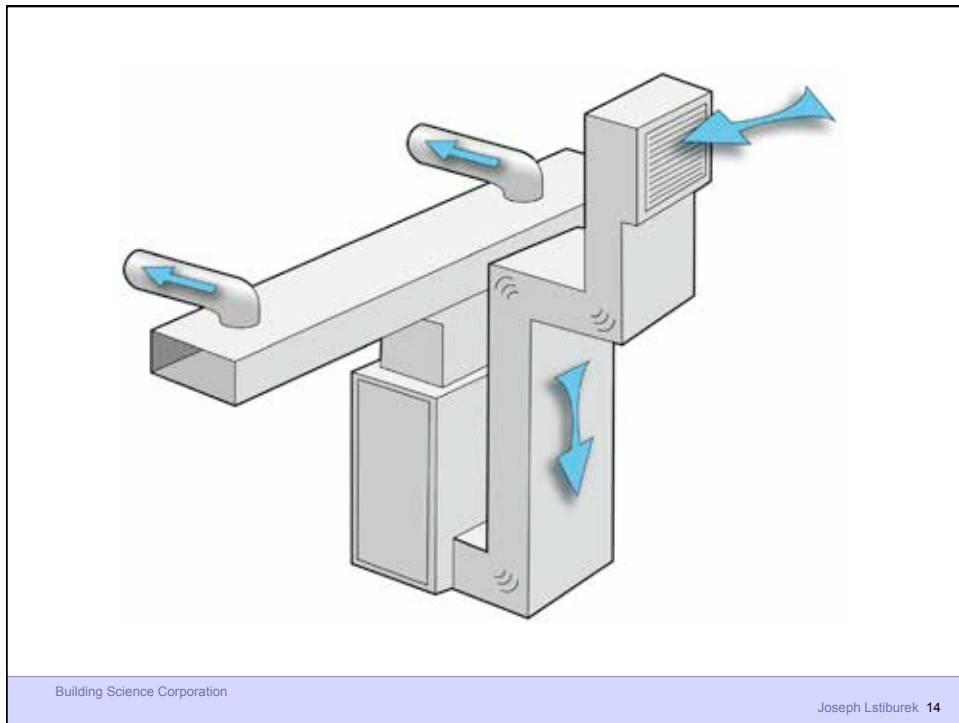
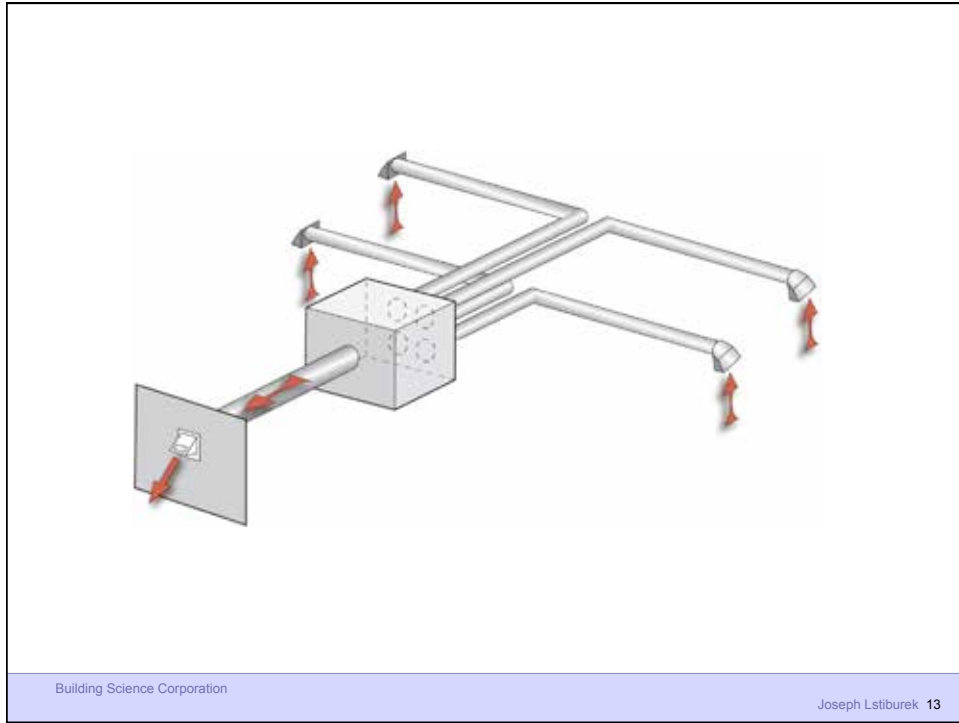
Exhaust Ventilation

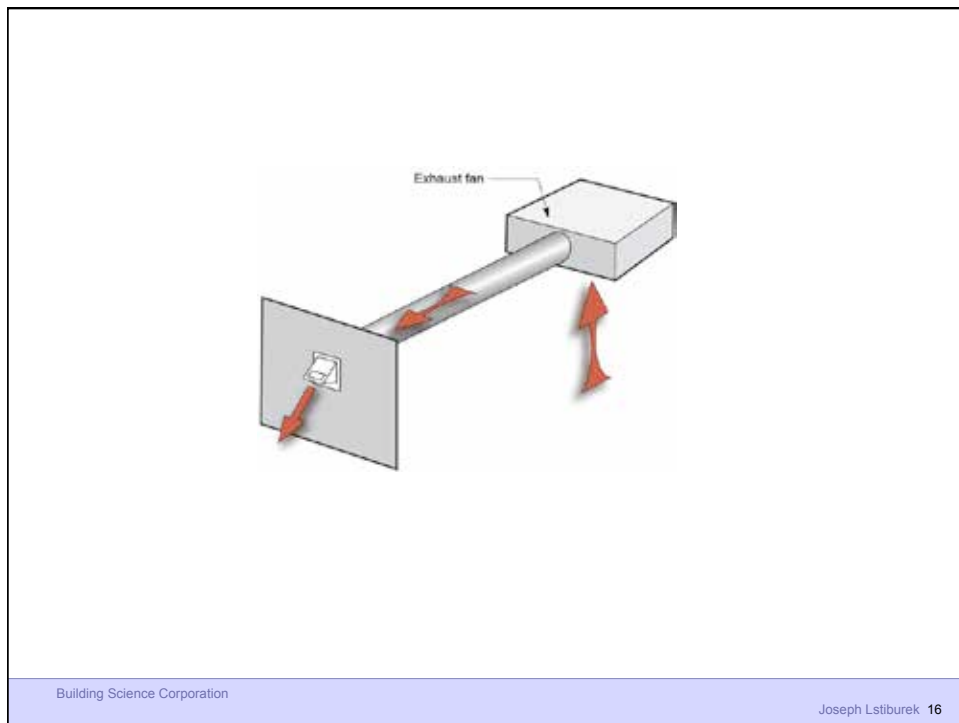
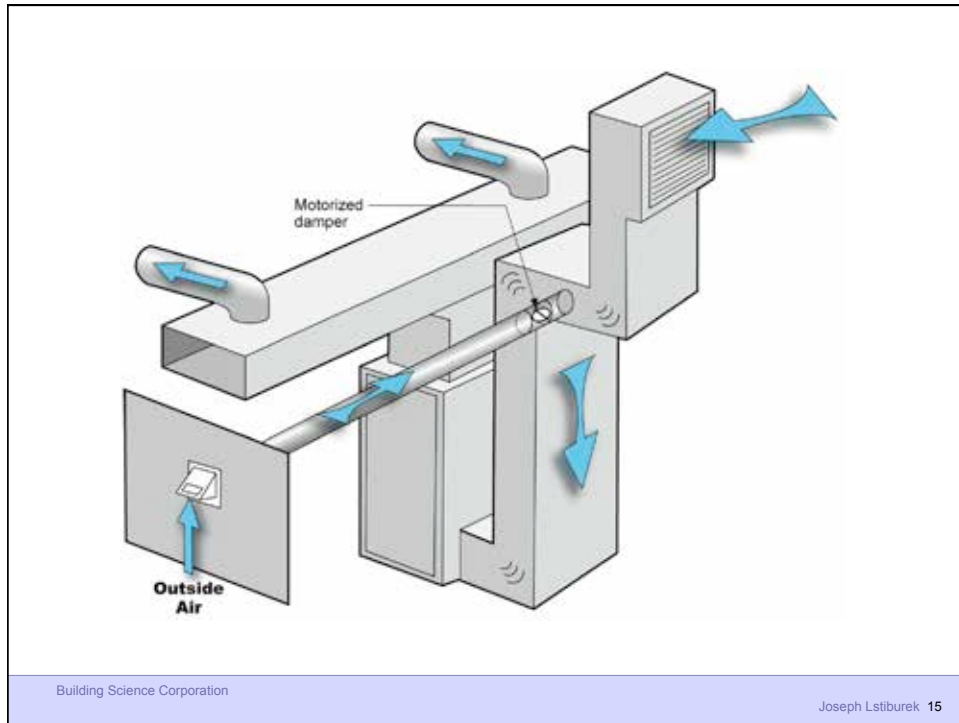
Supply Ventilation

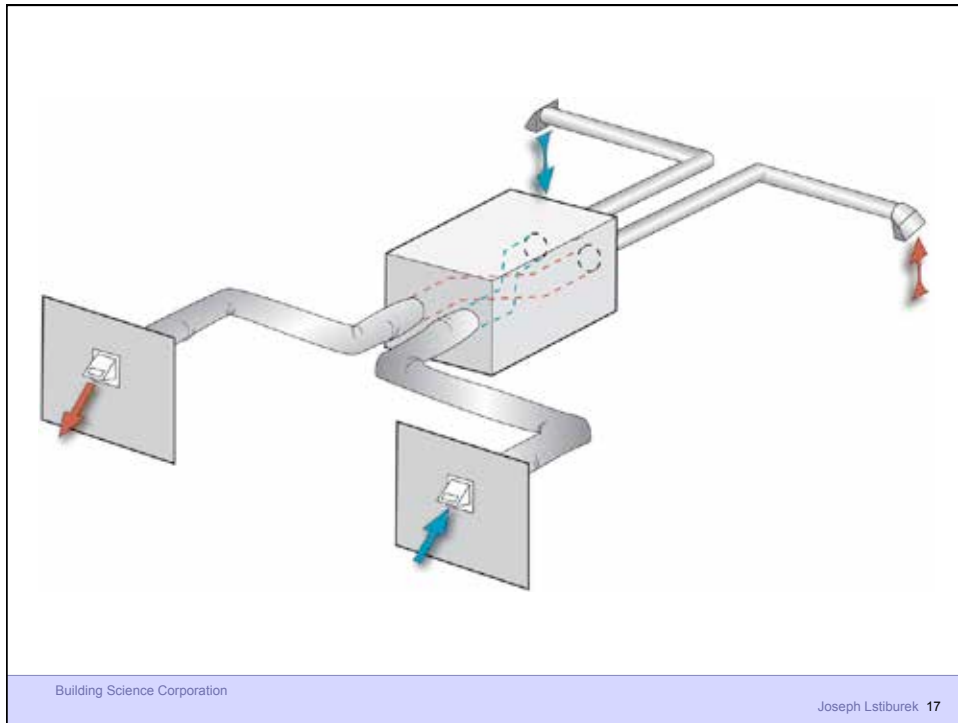
Balanced Ventilation











Ventilation Rates Are Based on Odor Control

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Ventilation Rates Are Based on Odor Control
Health Science Basis for Ventilation Rates is
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 Almost Nothing Cited Applies to Housing
 The Applicable Studies Focus on Dampness

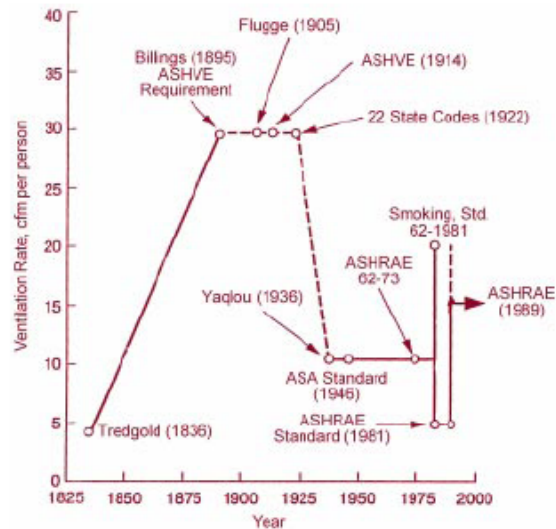
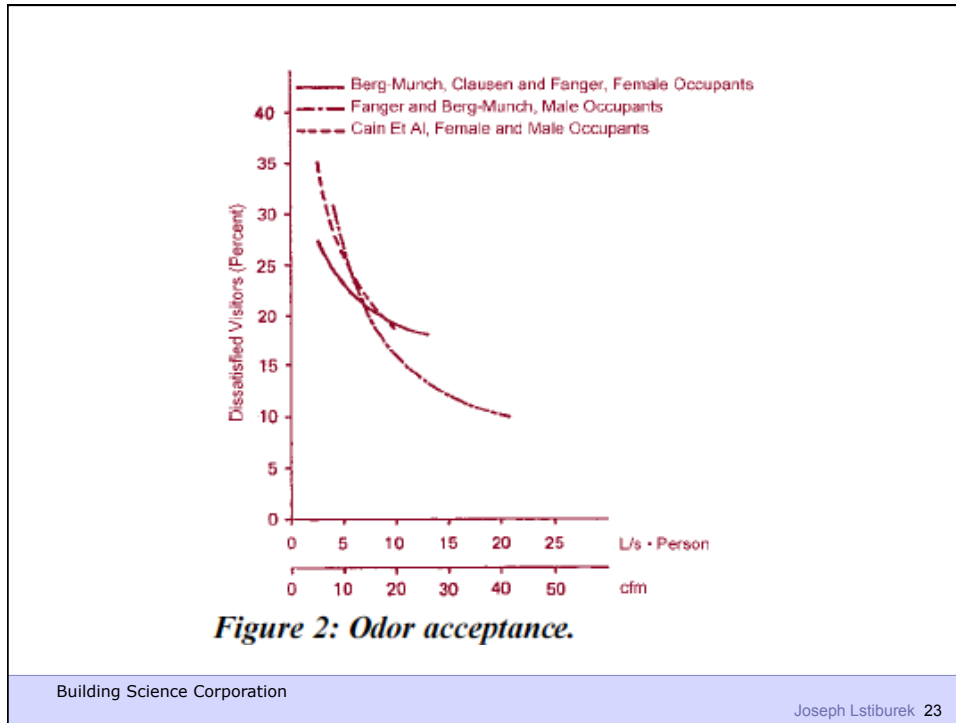


Figure 1: Minimum ventilating rate history.



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

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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	50 cfm
			+ 0.01	
		62.2 - 2013	7.5 cfm/person	90 cfm
			+ 0.03	

Office

Occupant Density

15/1000 ft² (67 ft²/person) 62 - 89
 15 cfm/person

5/1000 ft² (200 ft²/person) 62.1 - 2007
 17 cfm/person

Correctional Facility Cell

Occupant Density

20/1000 ft² (48 ft²/person) 62.1 – 2007
 10 cfm/person

C.P. Yaglou

Harvard School of Public Health

1936

1955

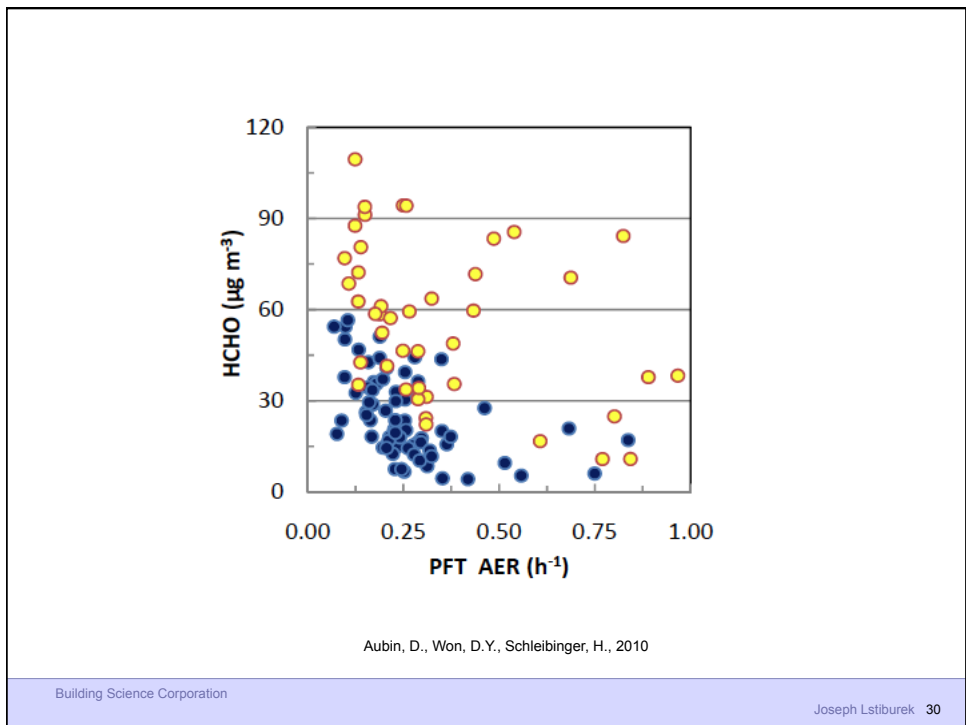
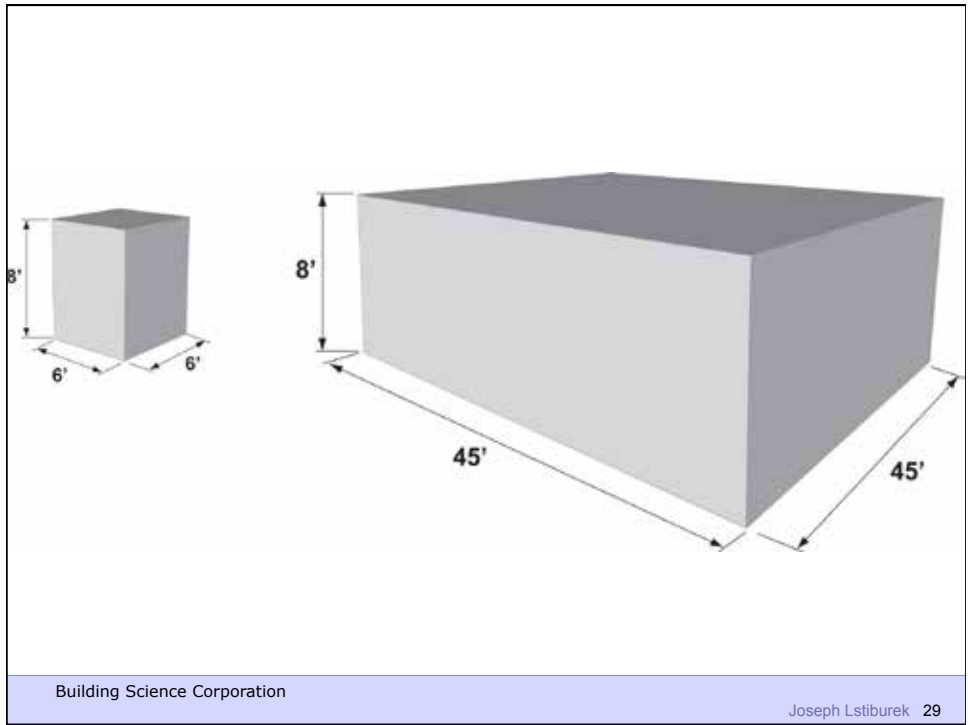
150 ft³ → 20 cfm/person300 ft³ → 12 cfm/person**C.P. Yaglou**

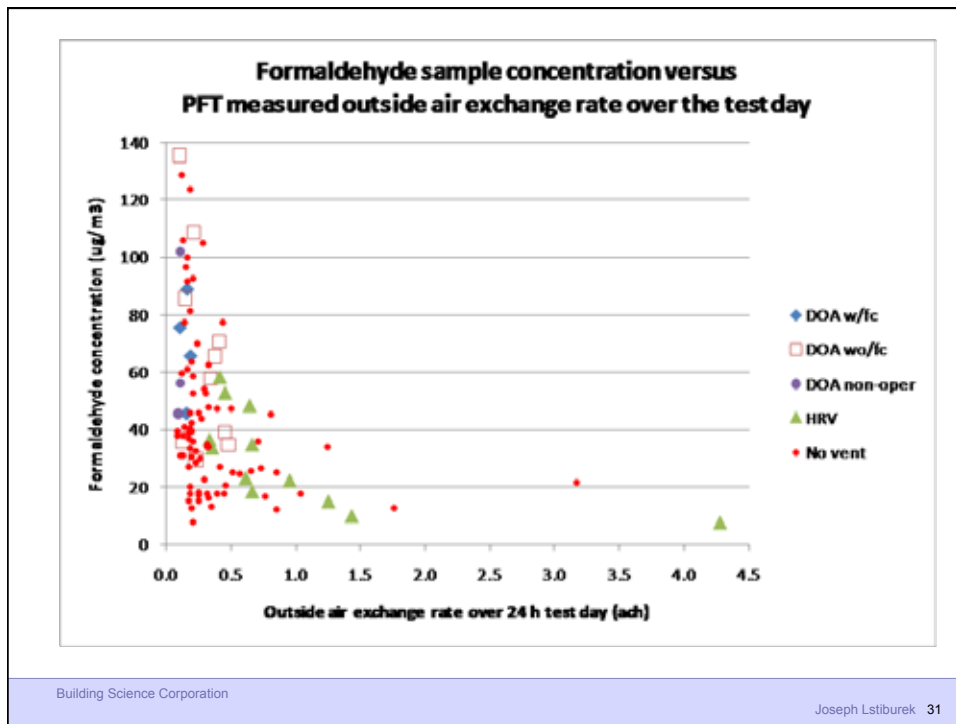
Harvard School of Public Health

1936

1955

150 ft³ → 20 cfm/person 18.75 ft² 106 occupants300 ft³ → 12 cfm/person 37.5 ft² 53 occupants**Experiment**470 ft³ → 59 ft²200 ft³ → 25 ft²100 ft³ → 12 ft²





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

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

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Don't Know Where The Holes Are
Don't Know The Type of Holes
Don't Know The Pressure Across The Holes

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Dilution Is Not The Solution To Indoor
Pollution
Source Control

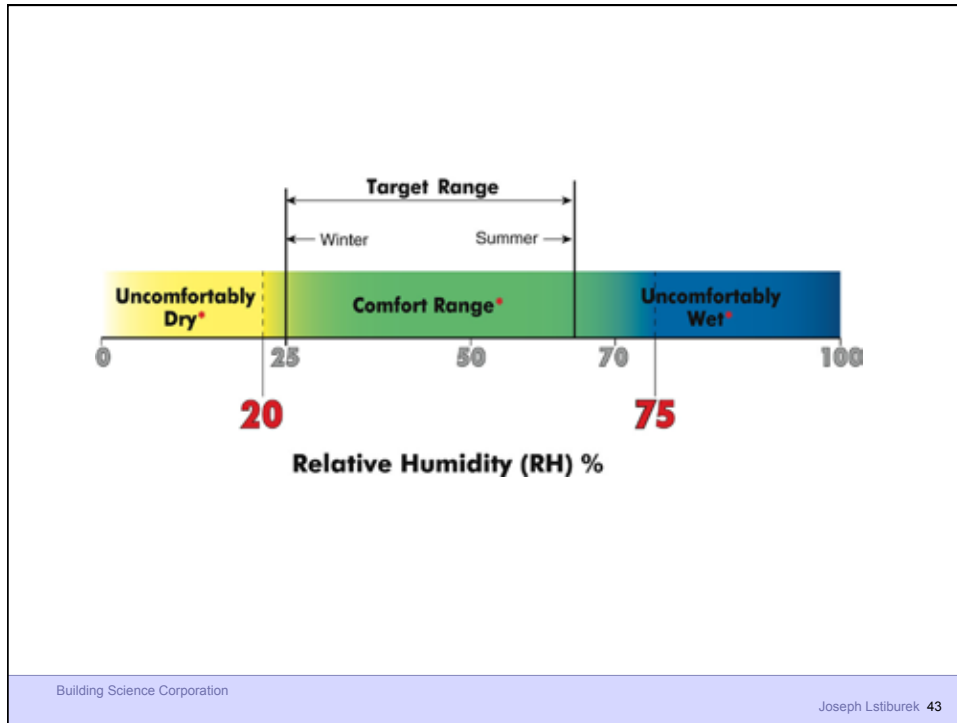
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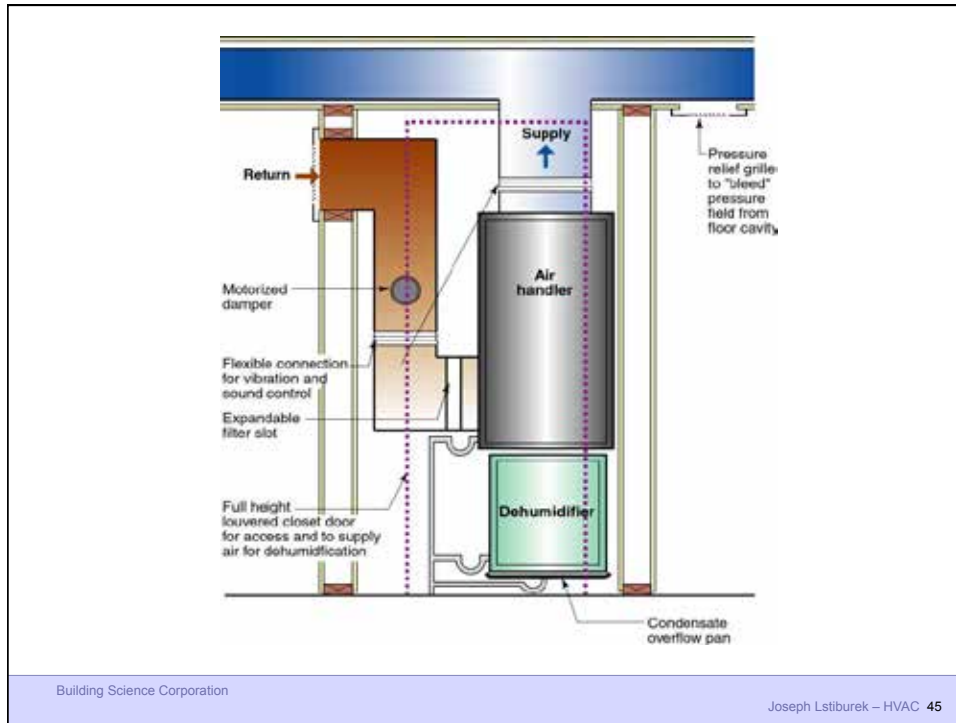
Dilution For People
Source Control For The Building

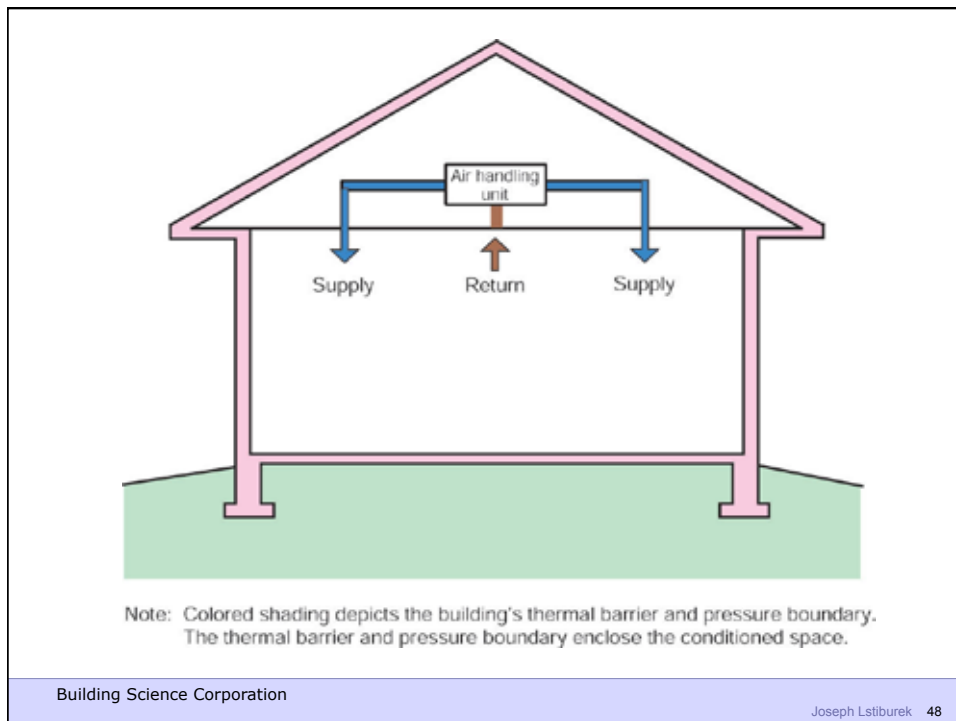
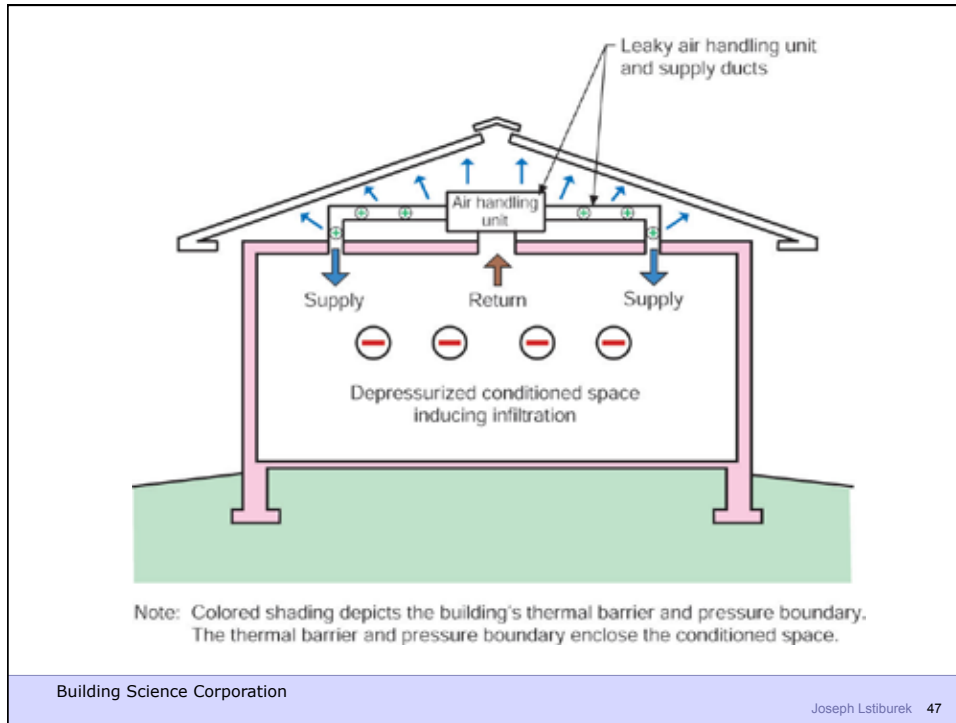
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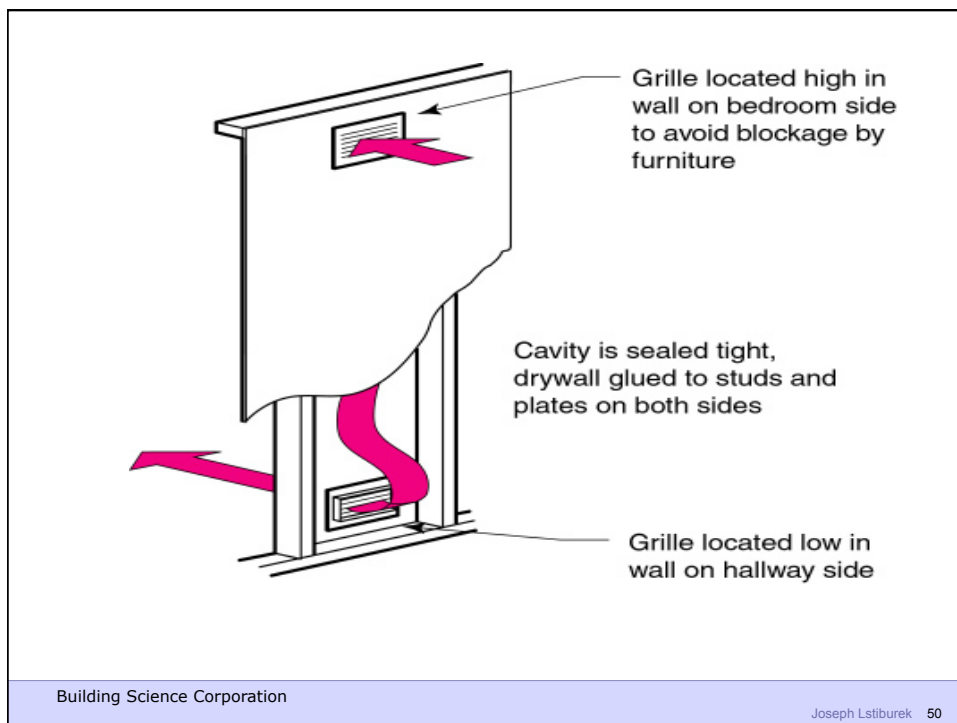
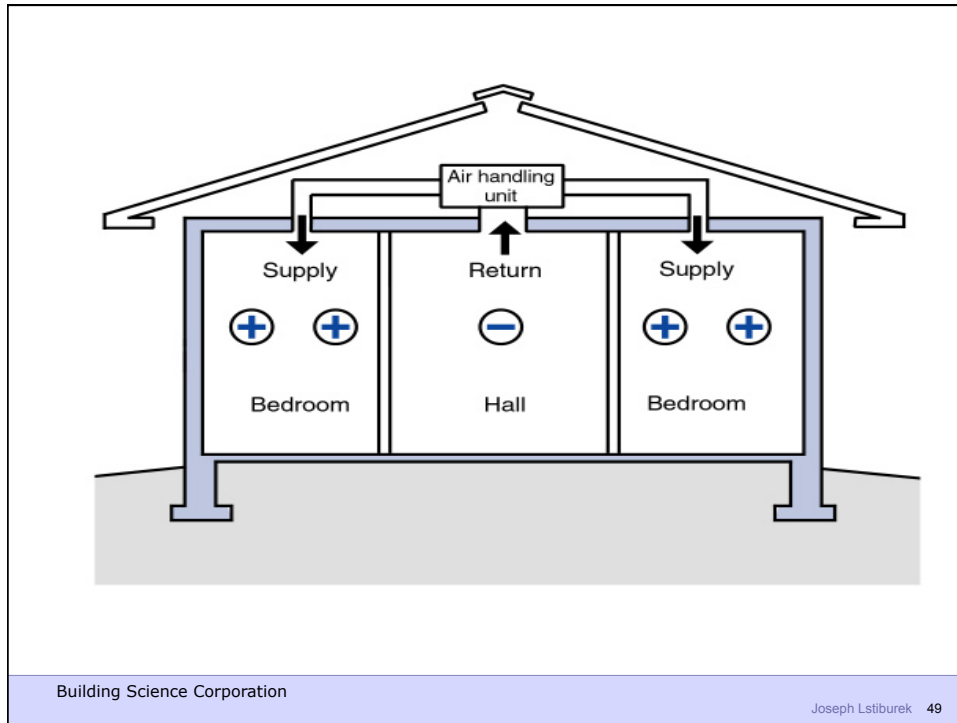
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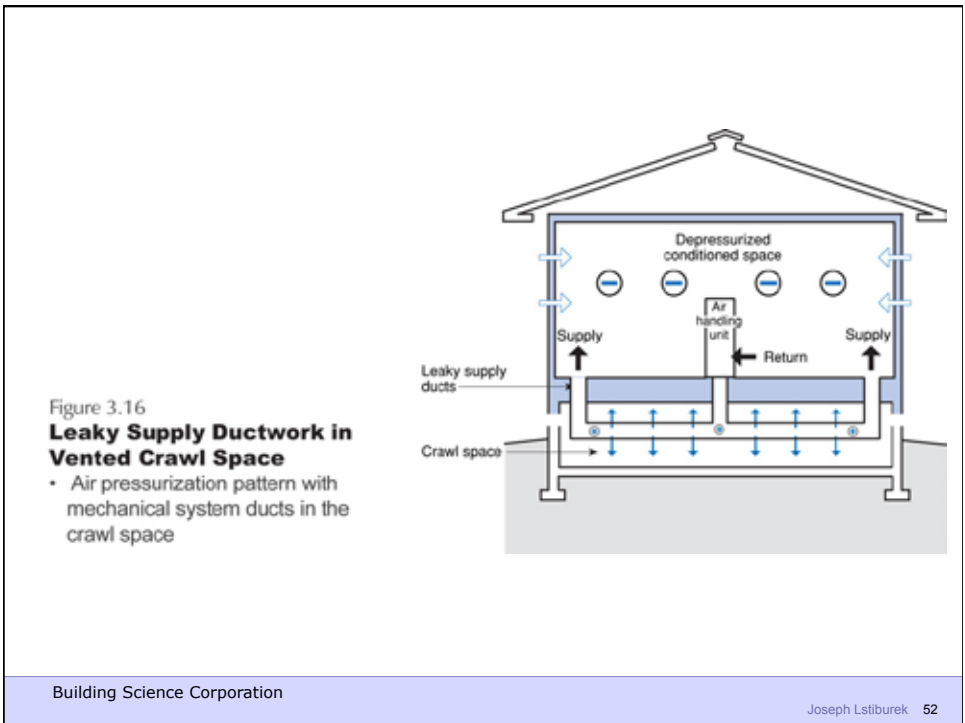
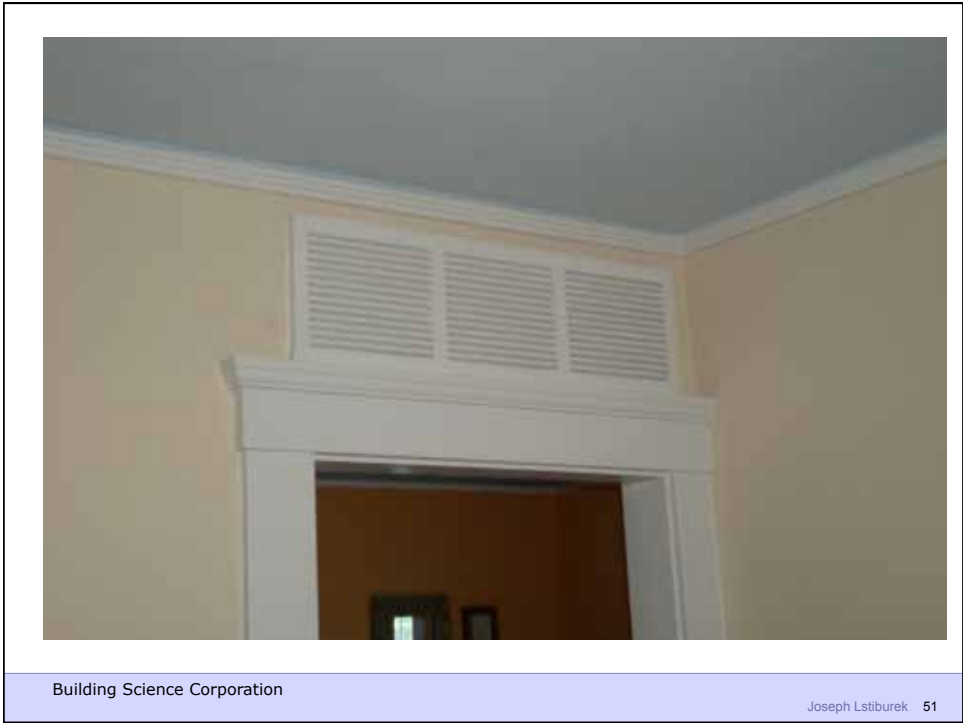


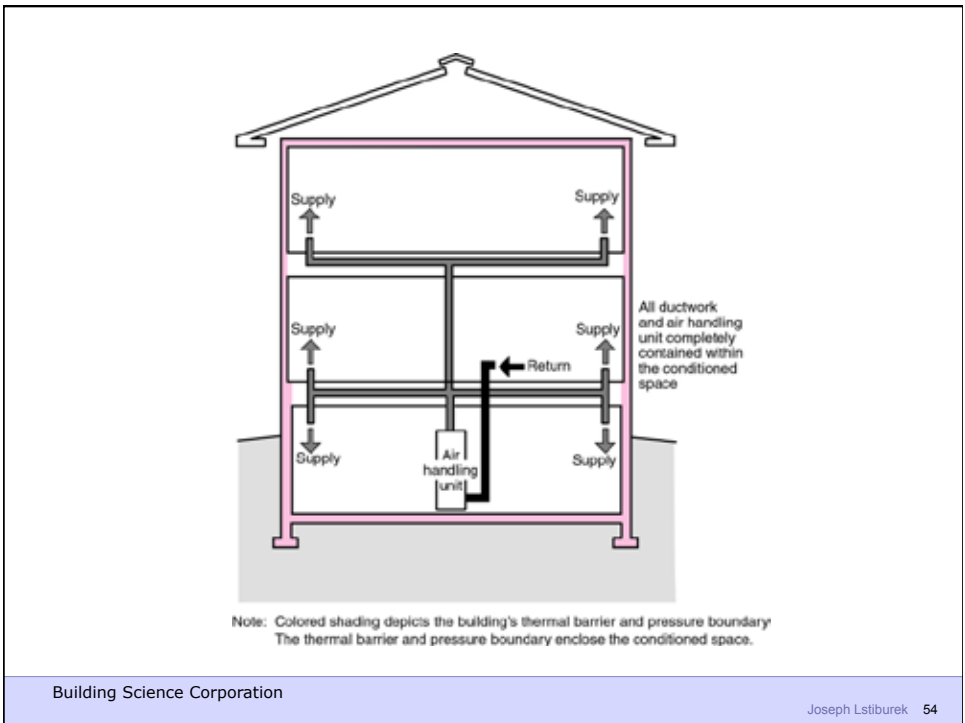
Recommended Range of Relative Humidity
Above 25 percent during winter
Below 70 percent during summer

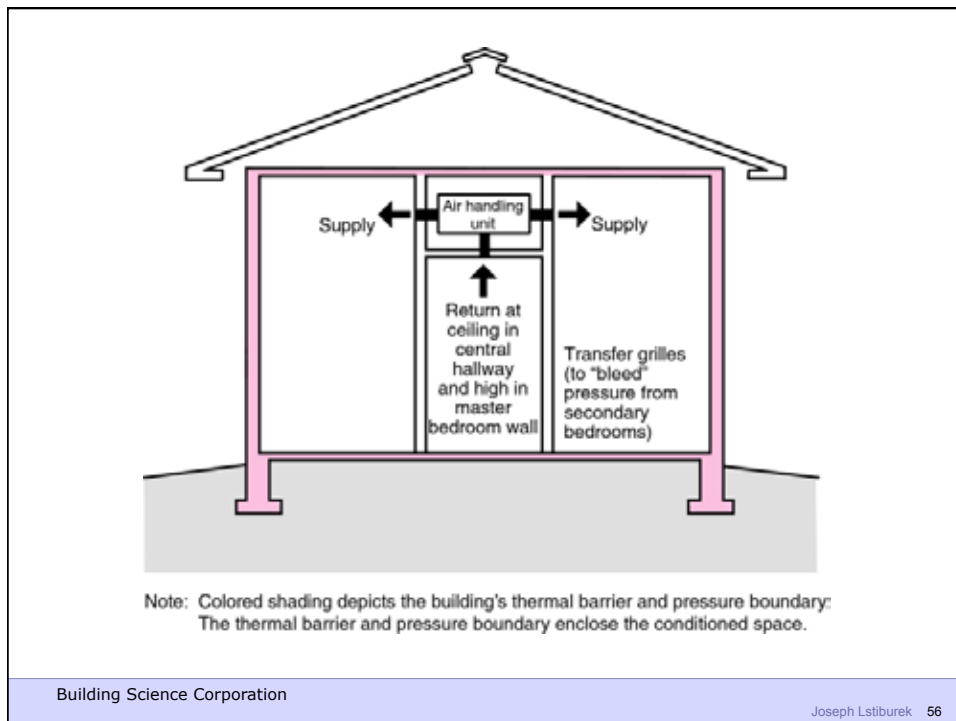
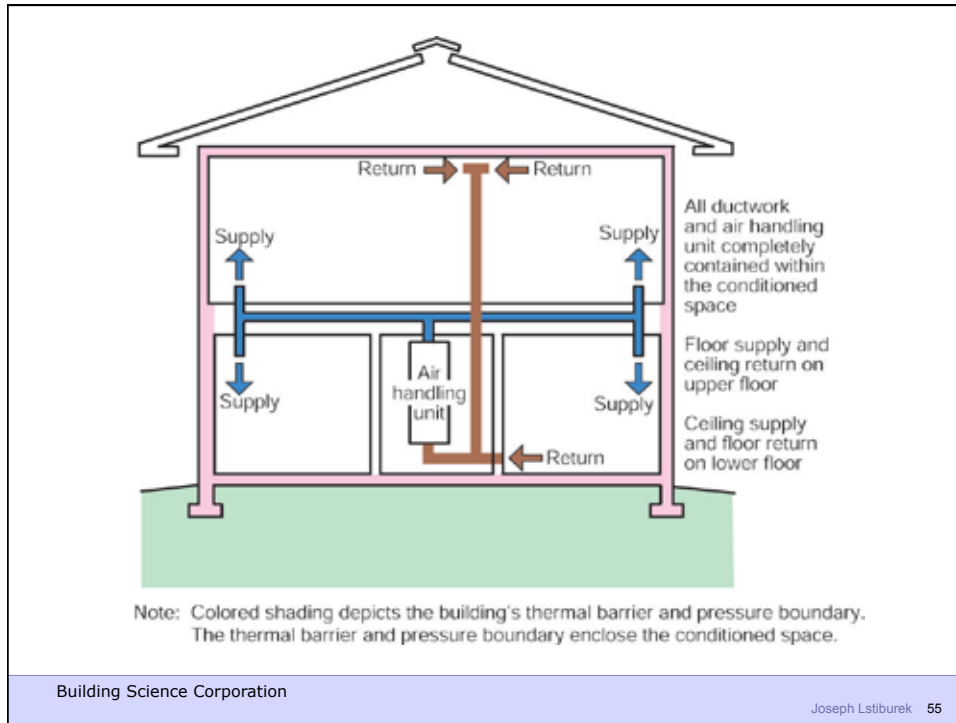


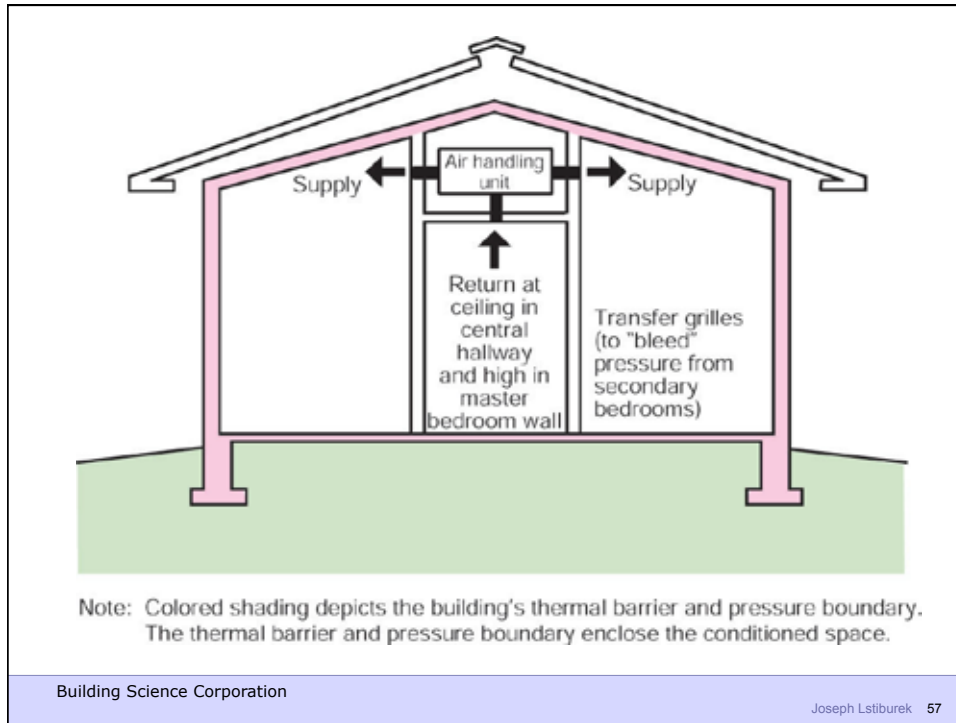


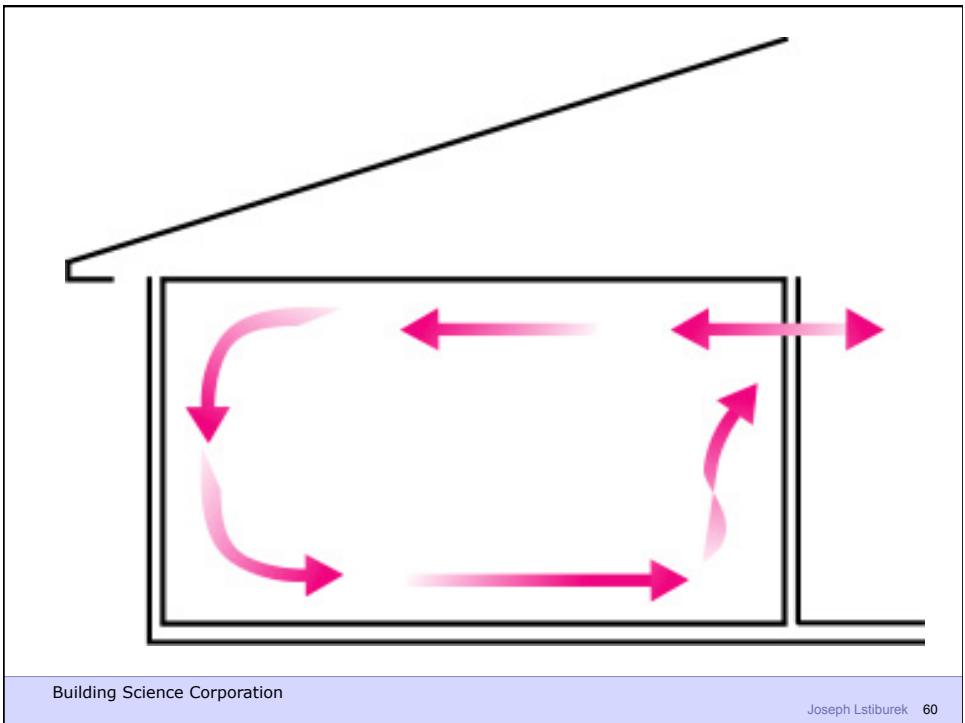
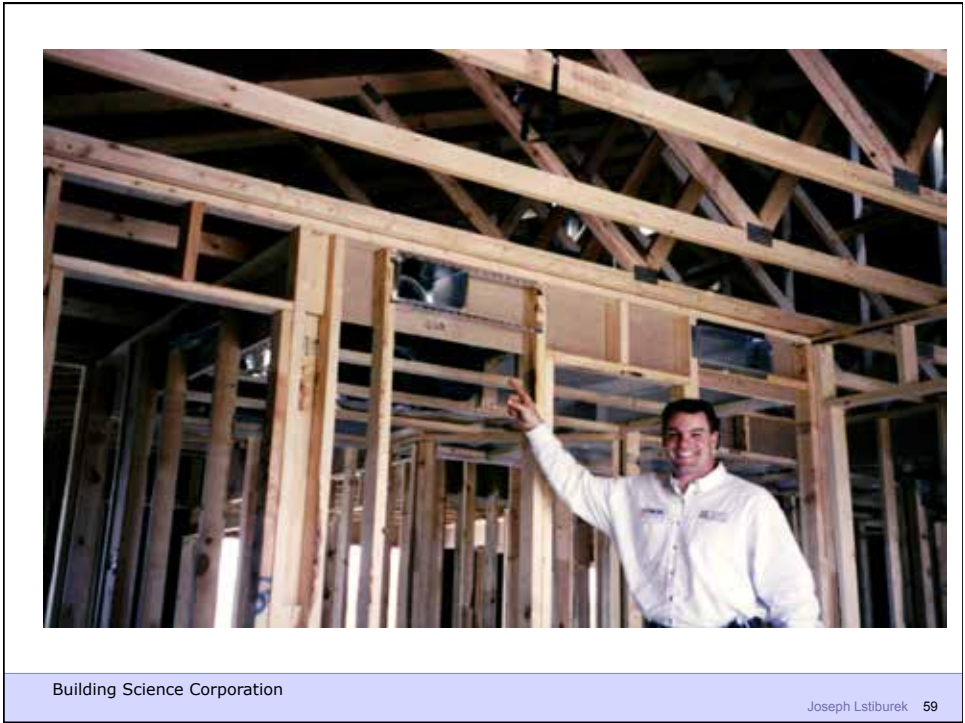














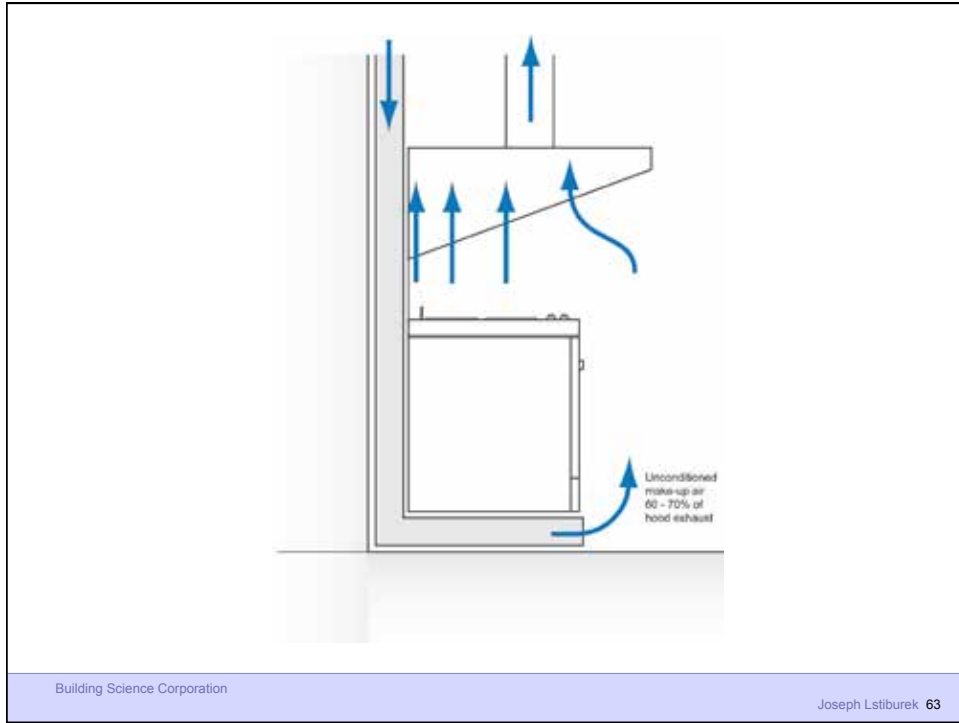
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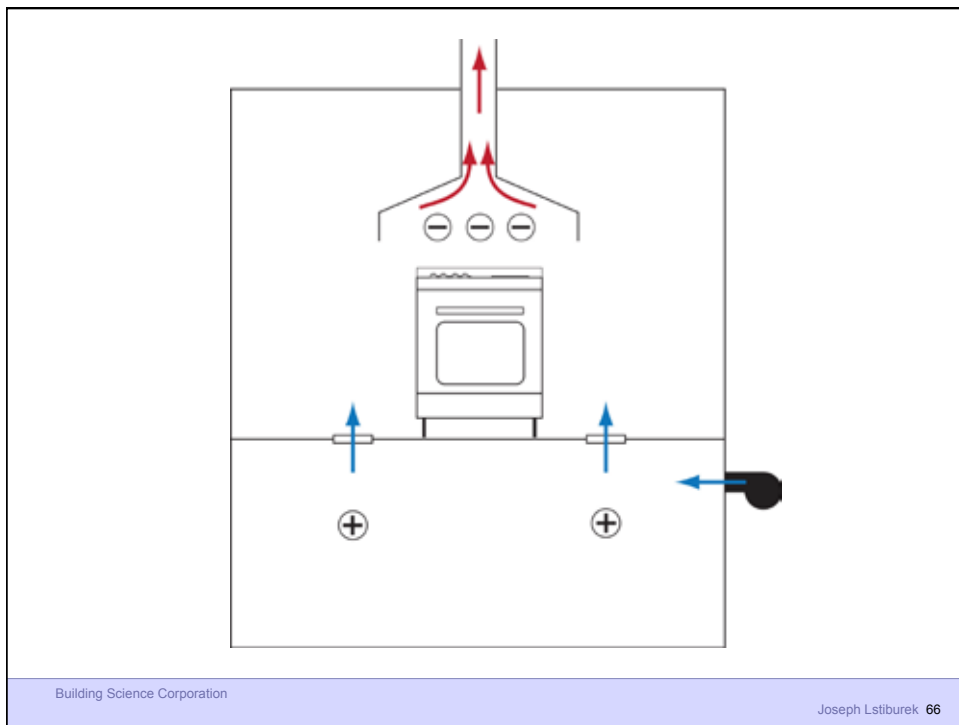
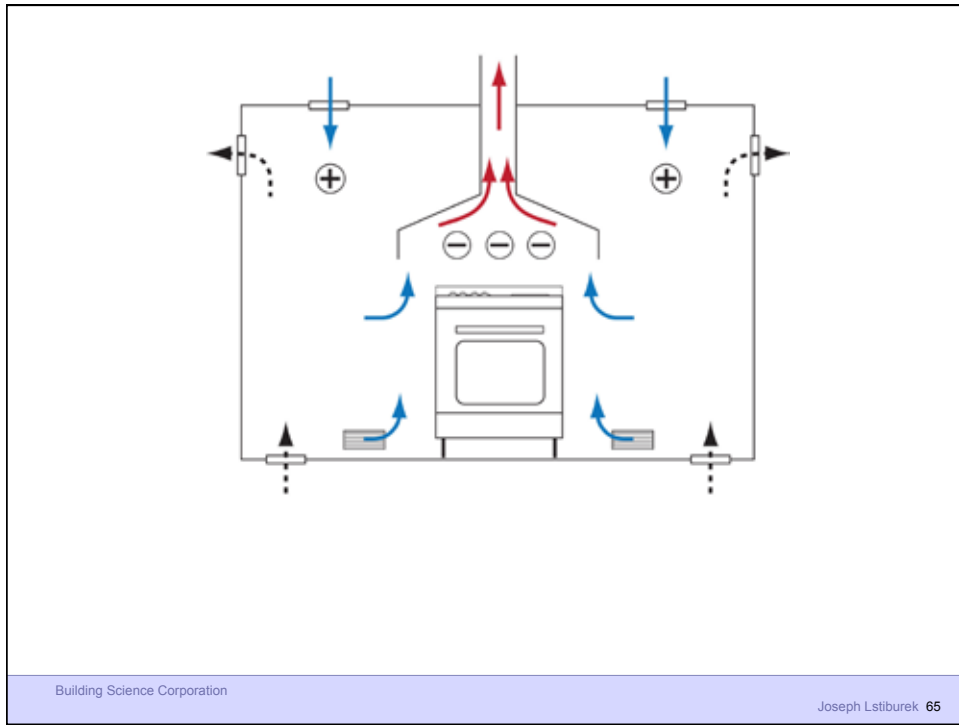
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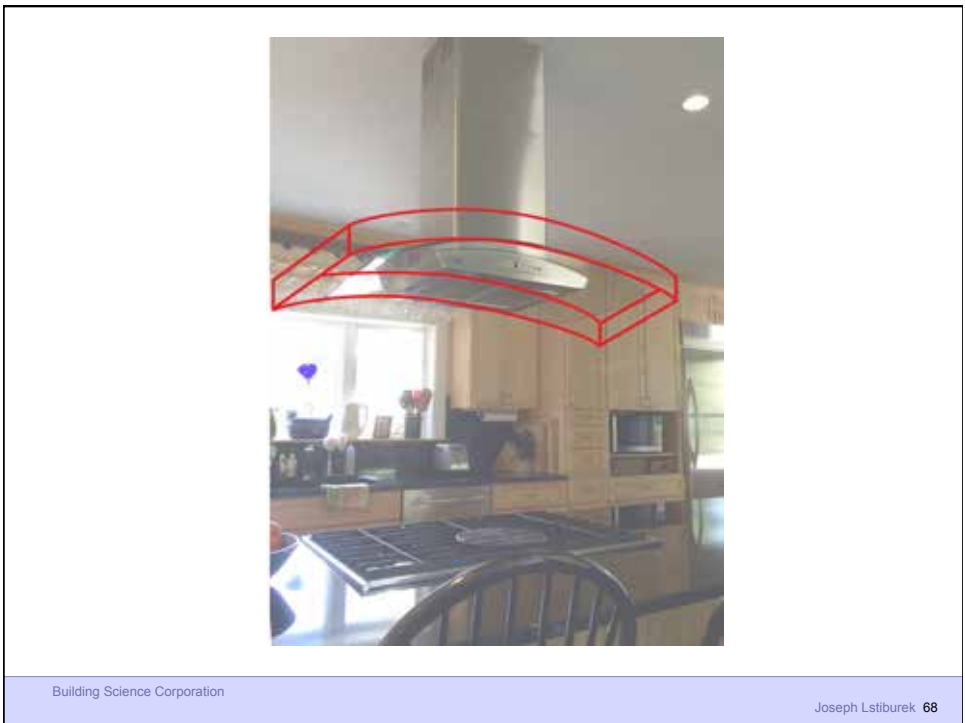
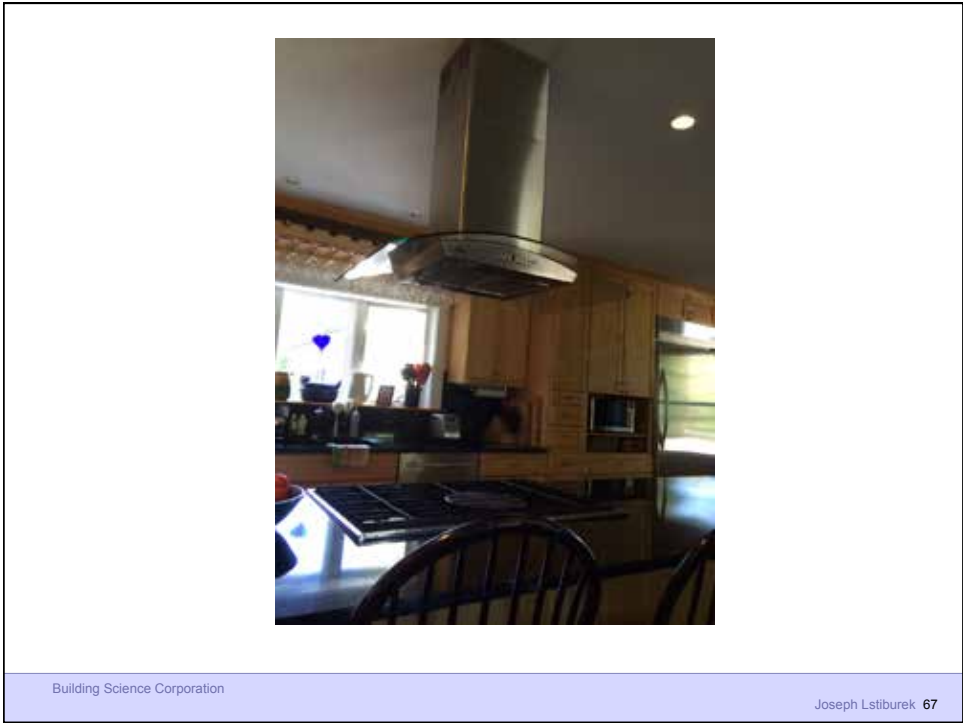
Kitchen Exhaust Hoods

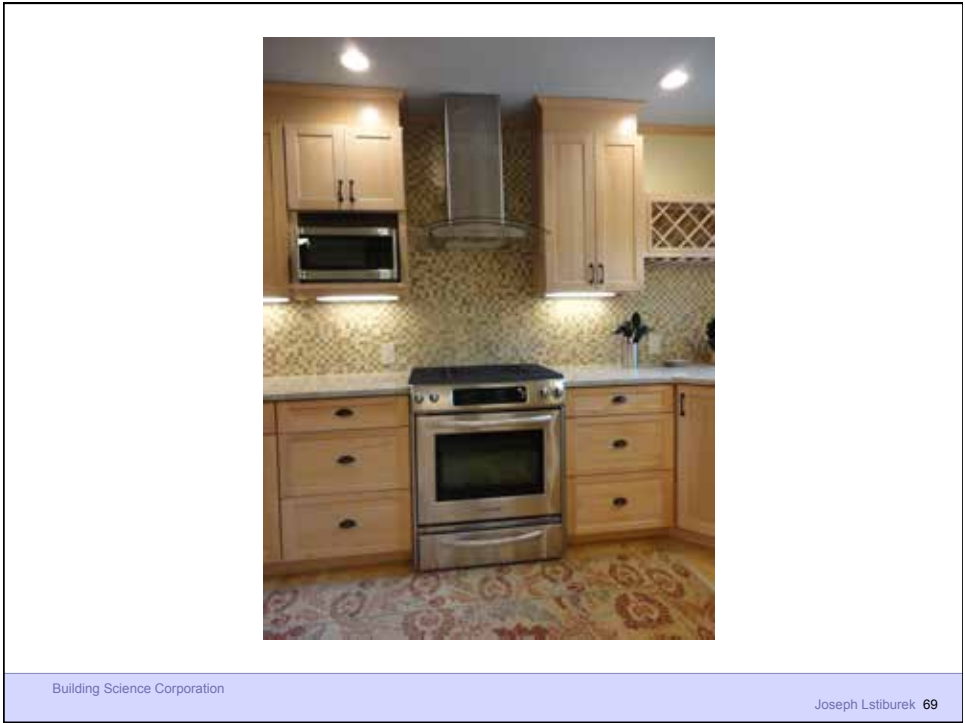
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Clothes Dryers

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Fireplaces

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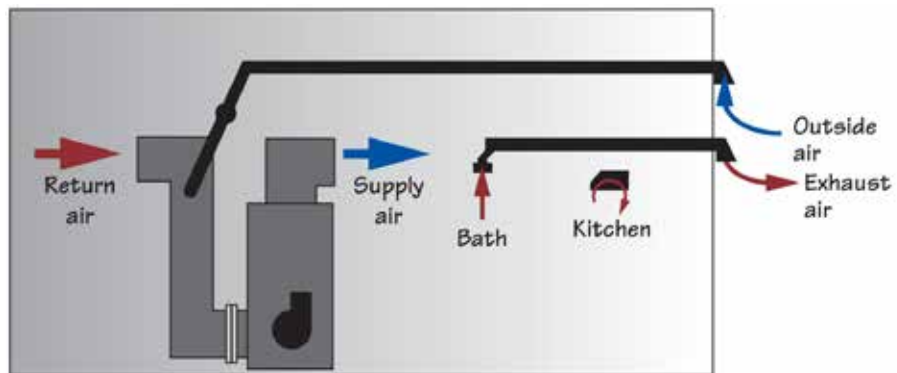
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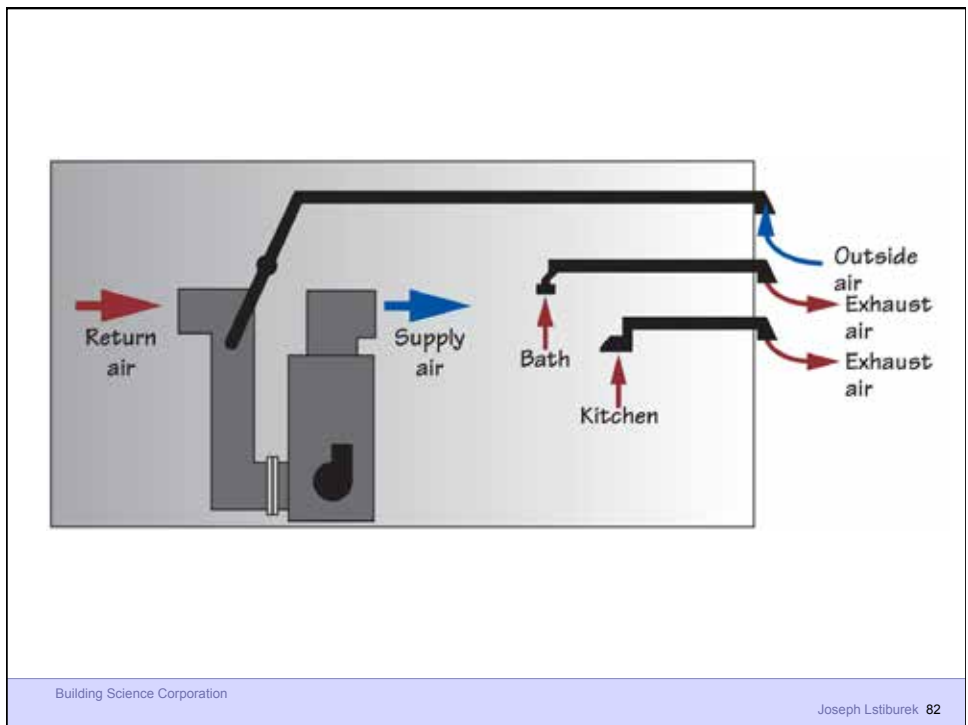
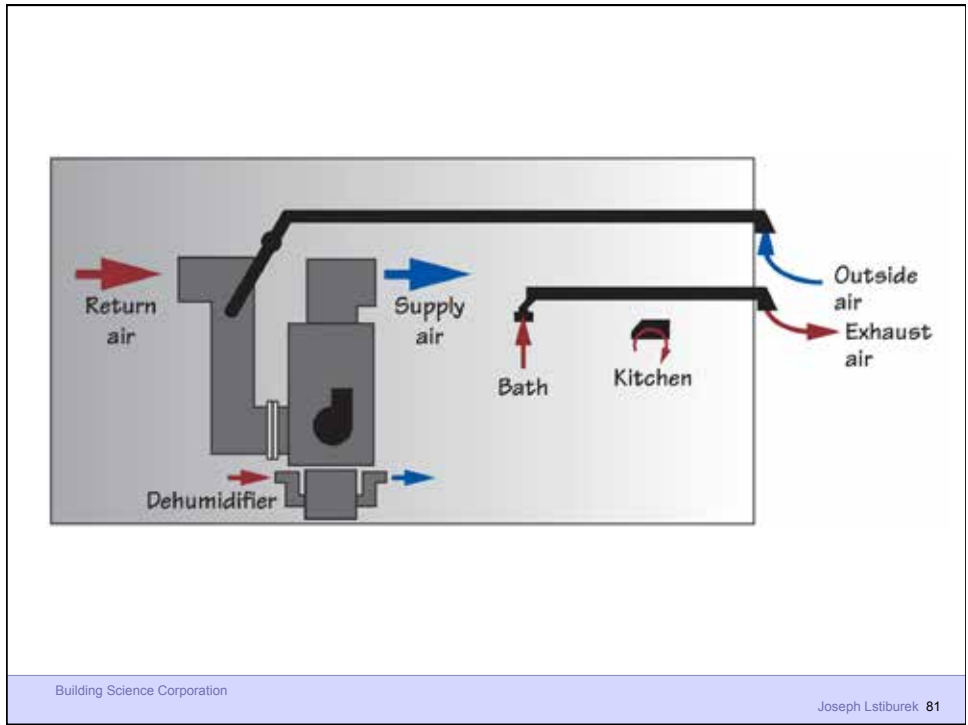


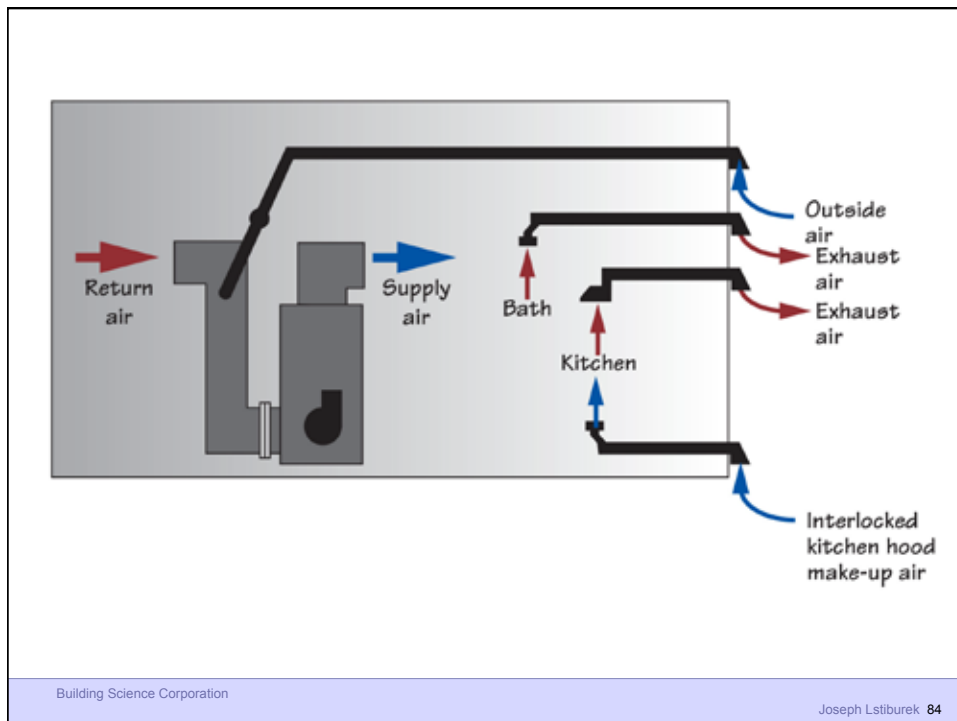
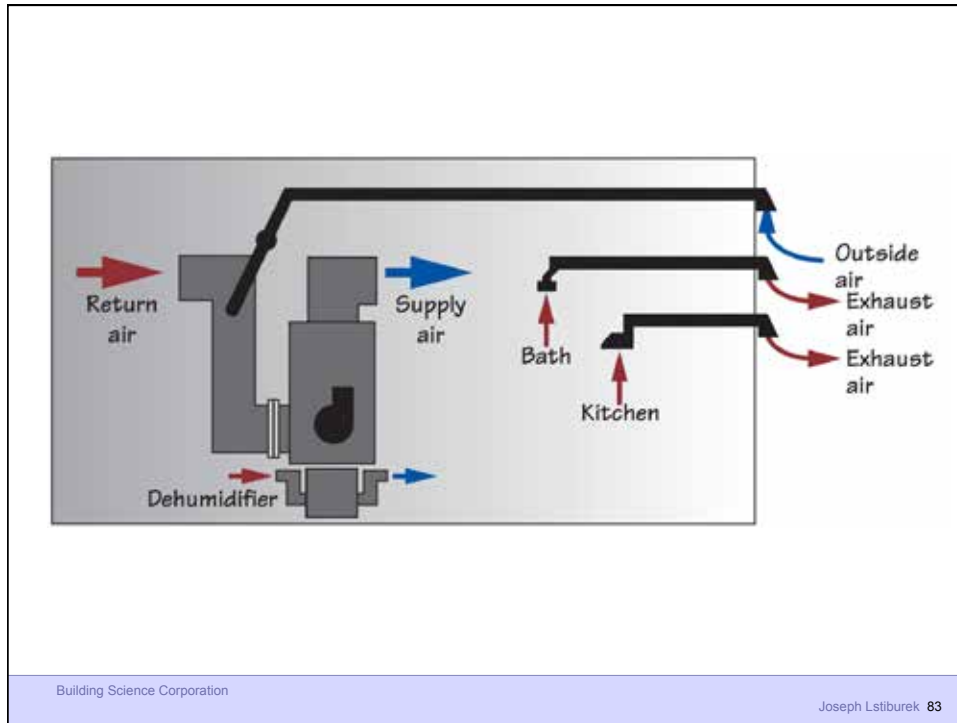
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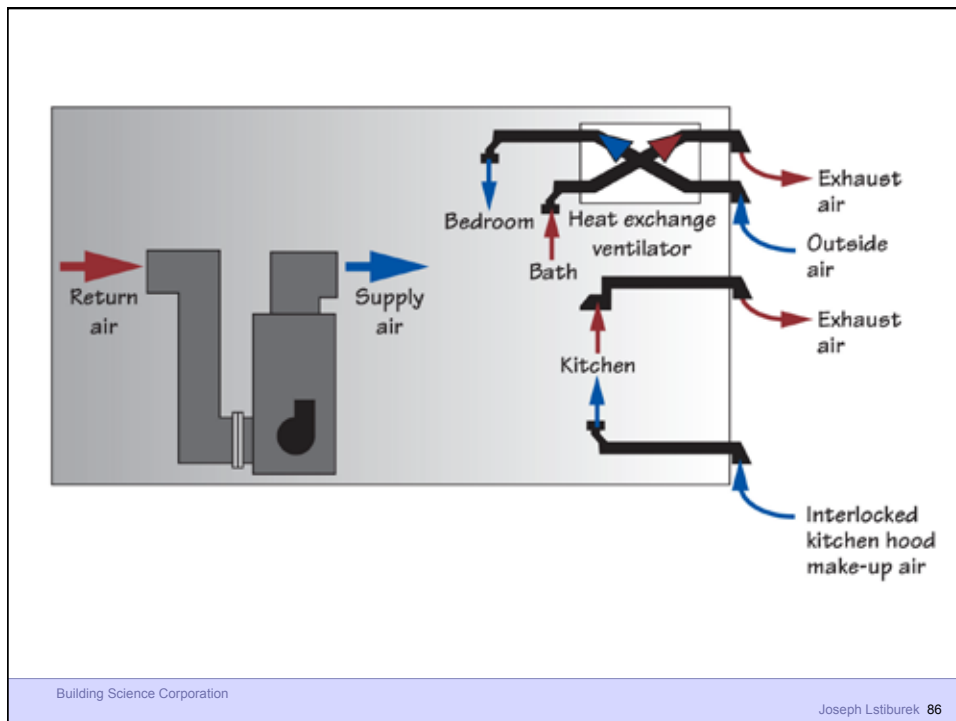
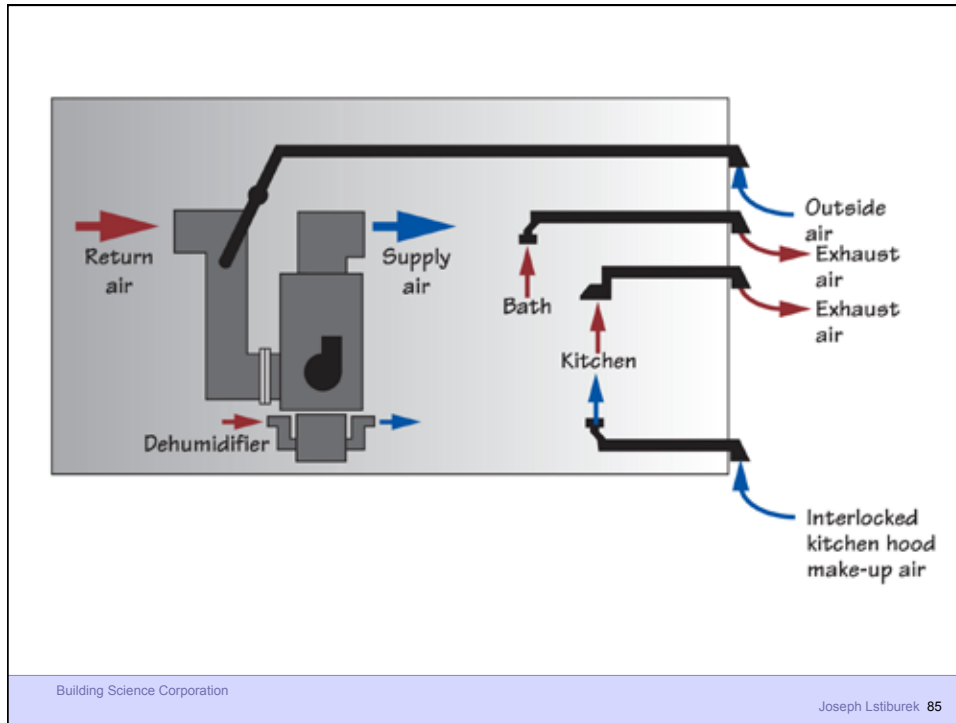
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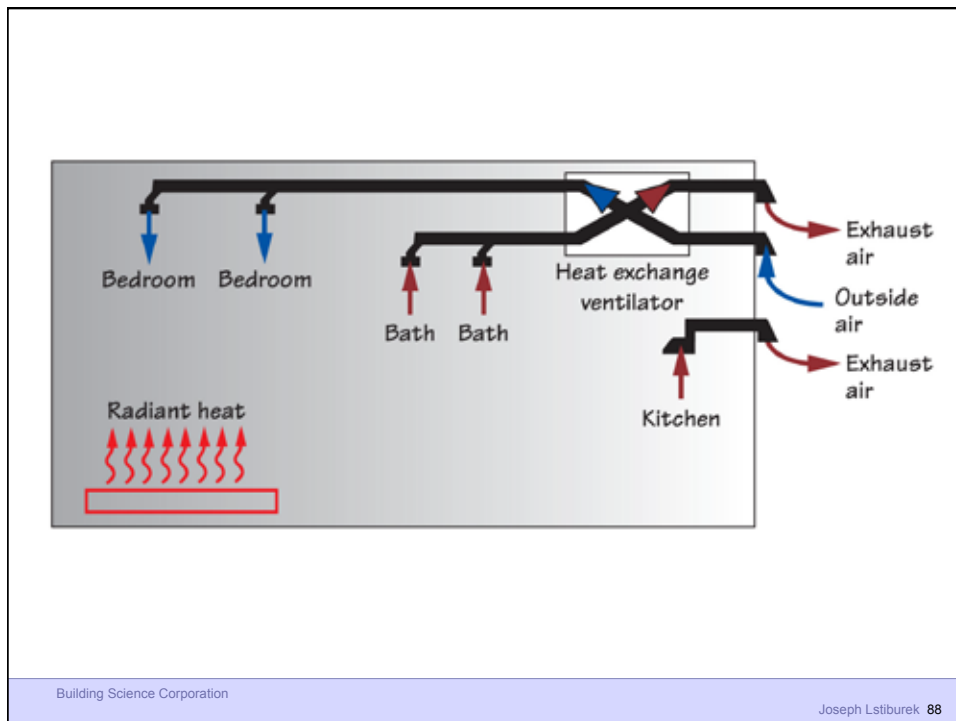
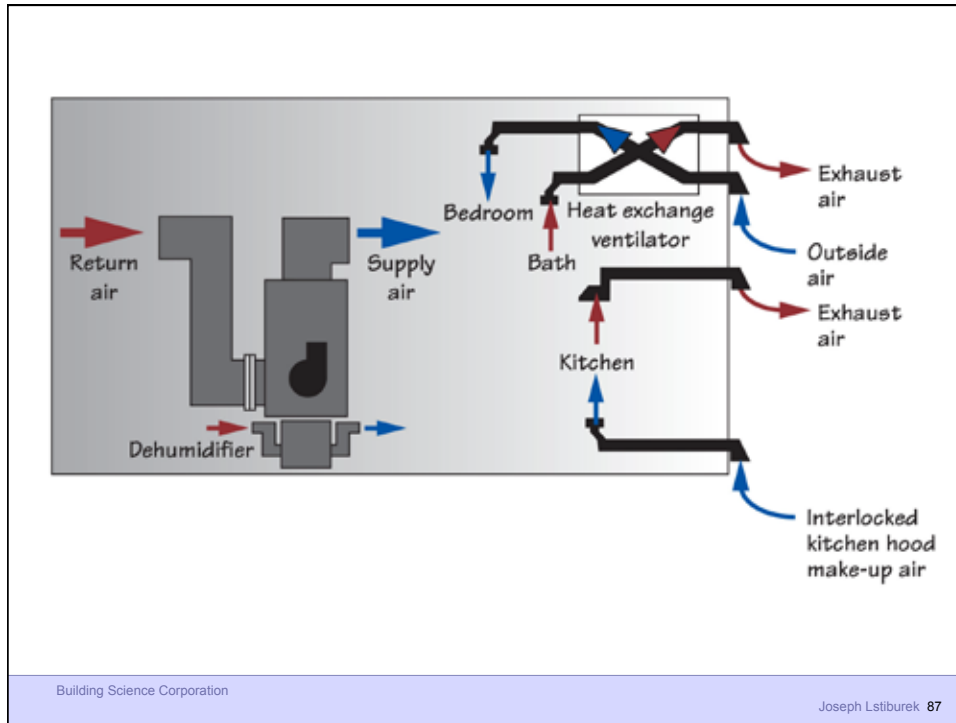
Approaches

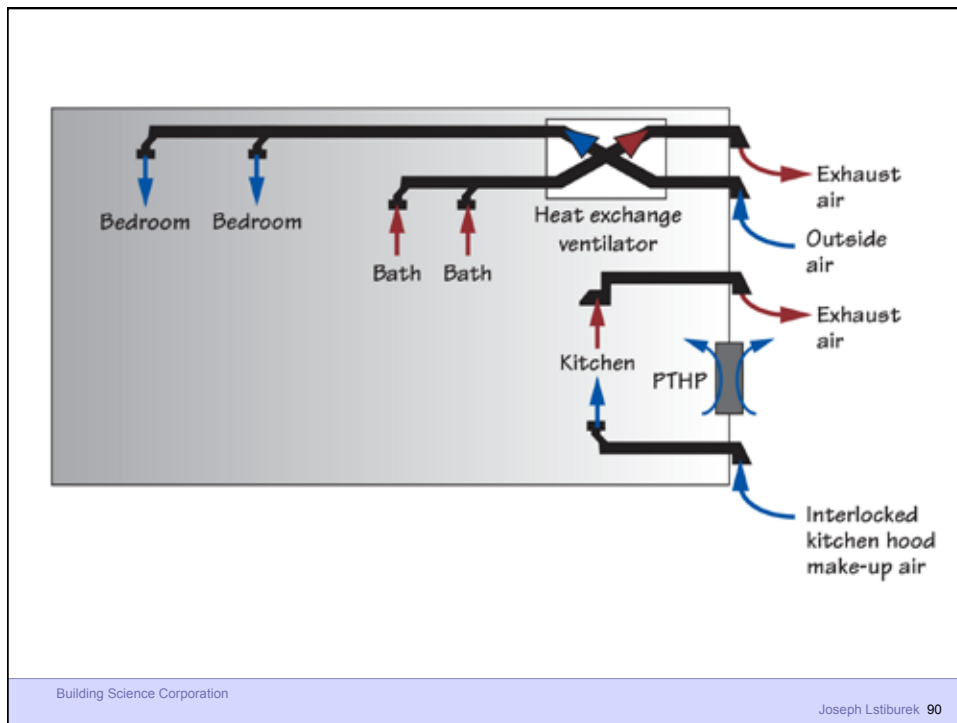
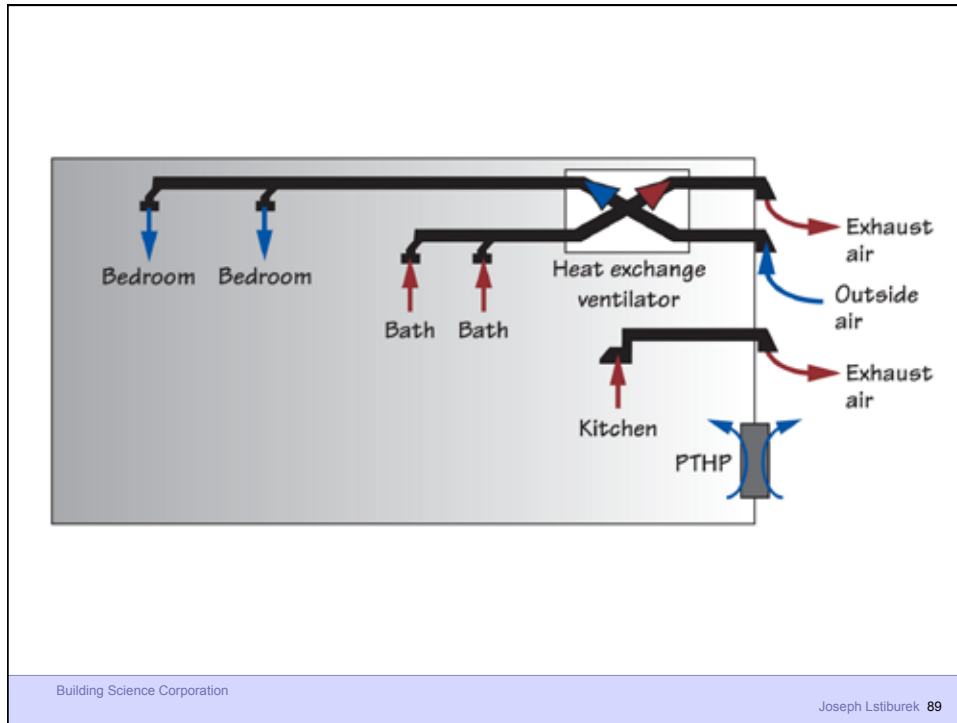


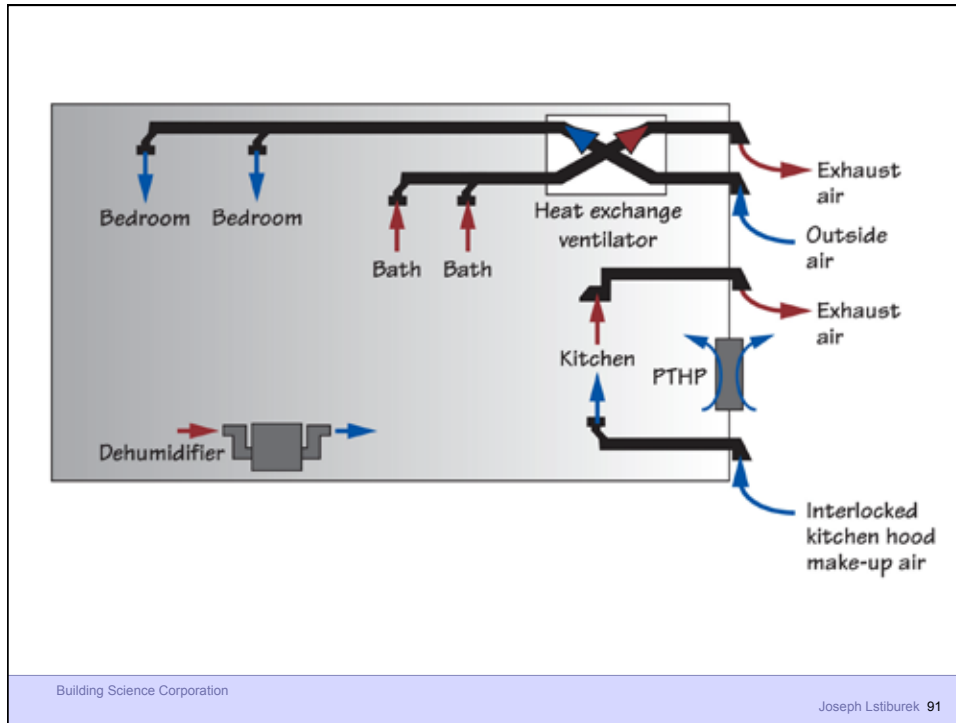


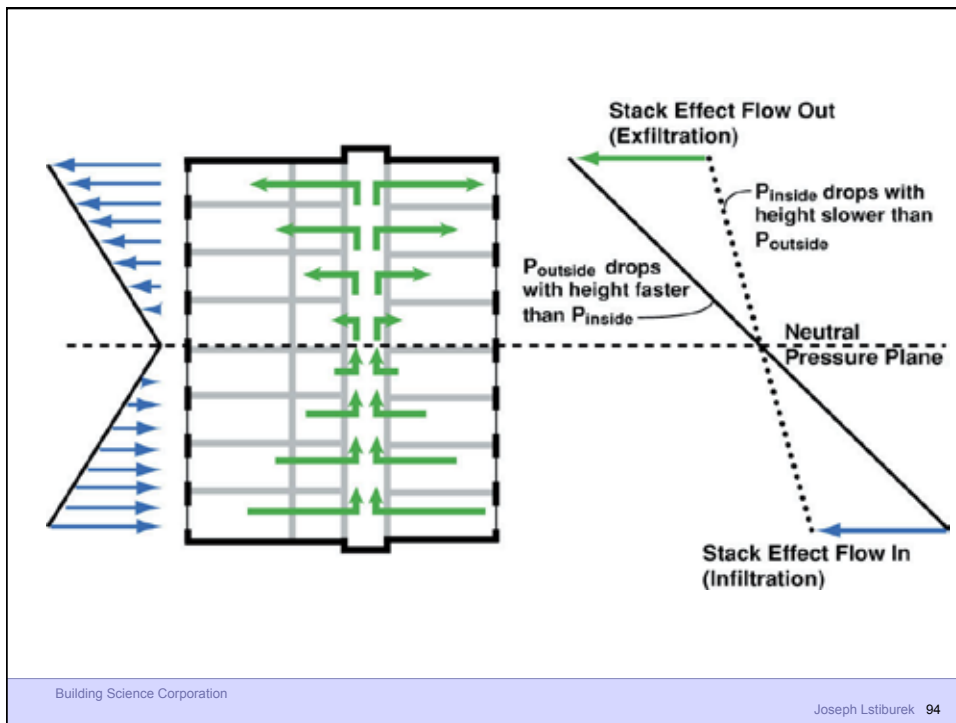
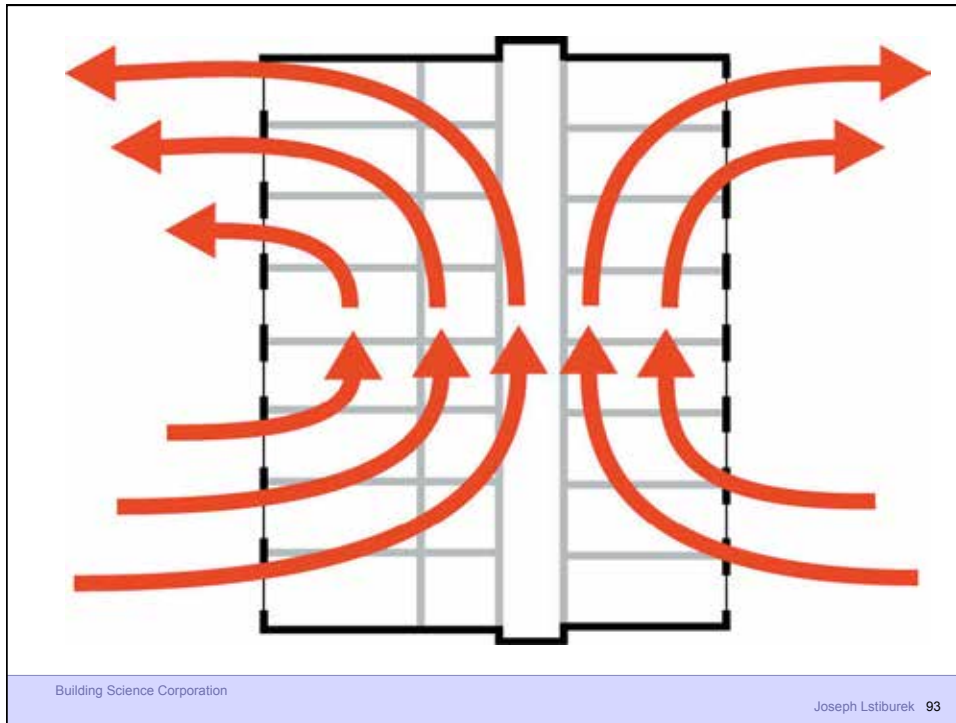


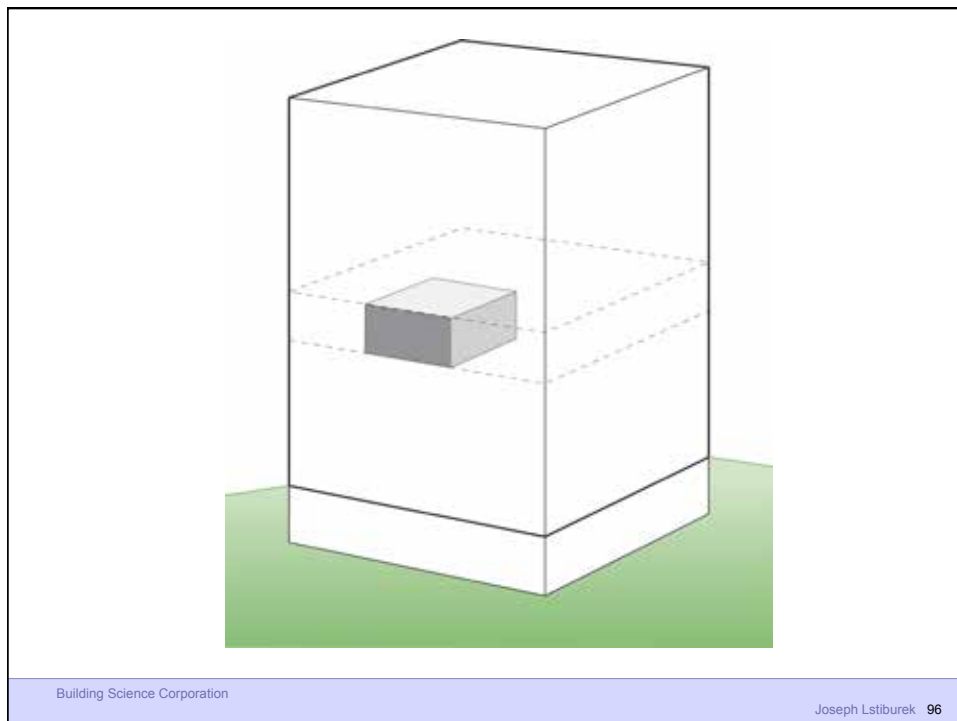
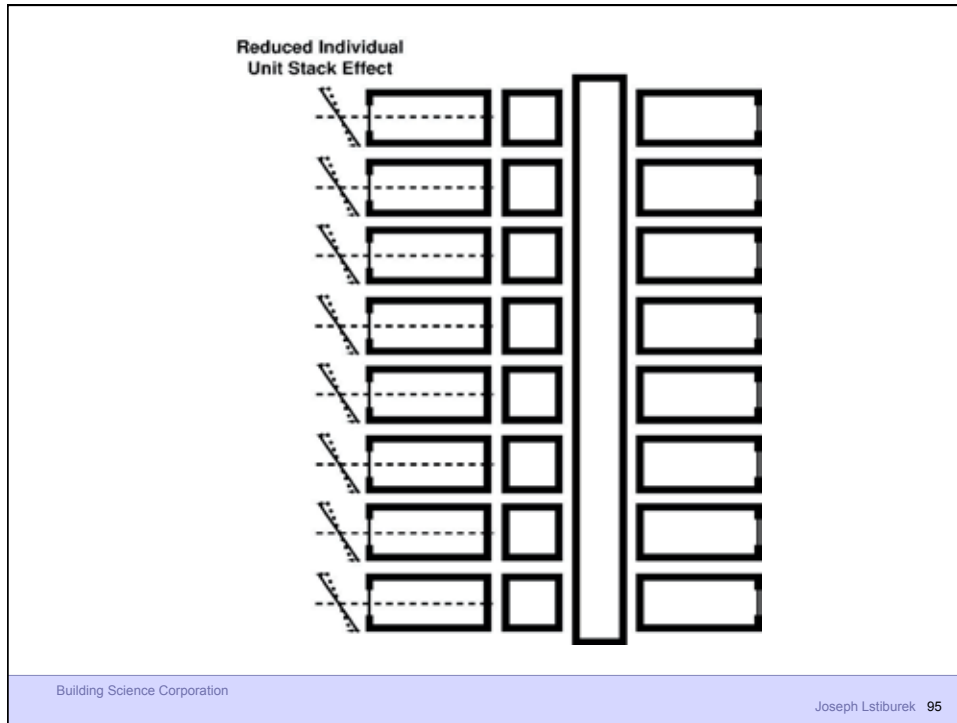


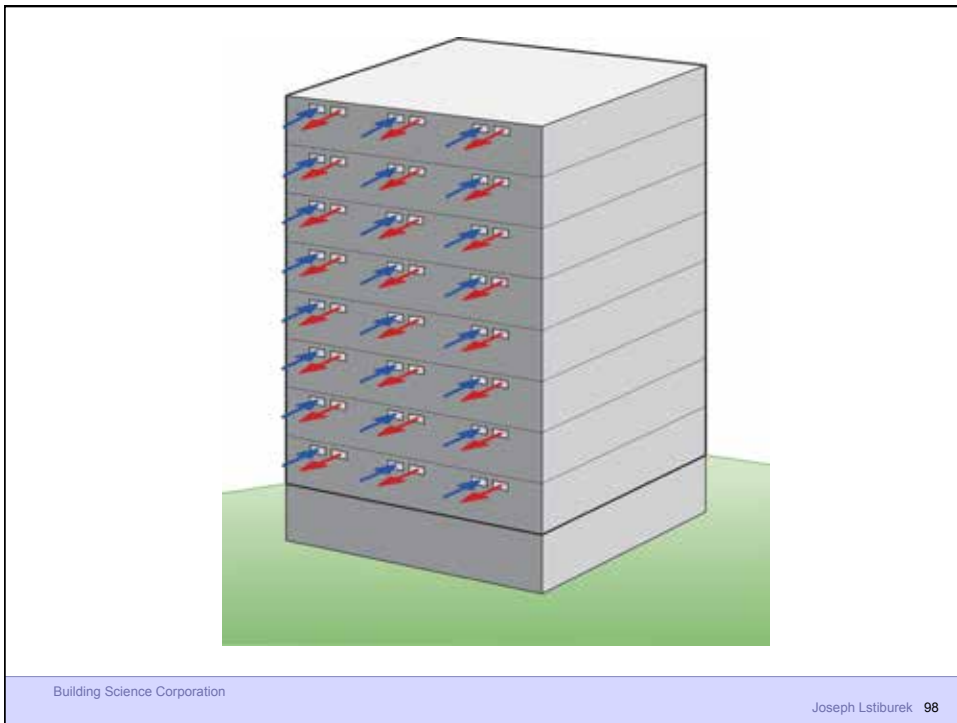
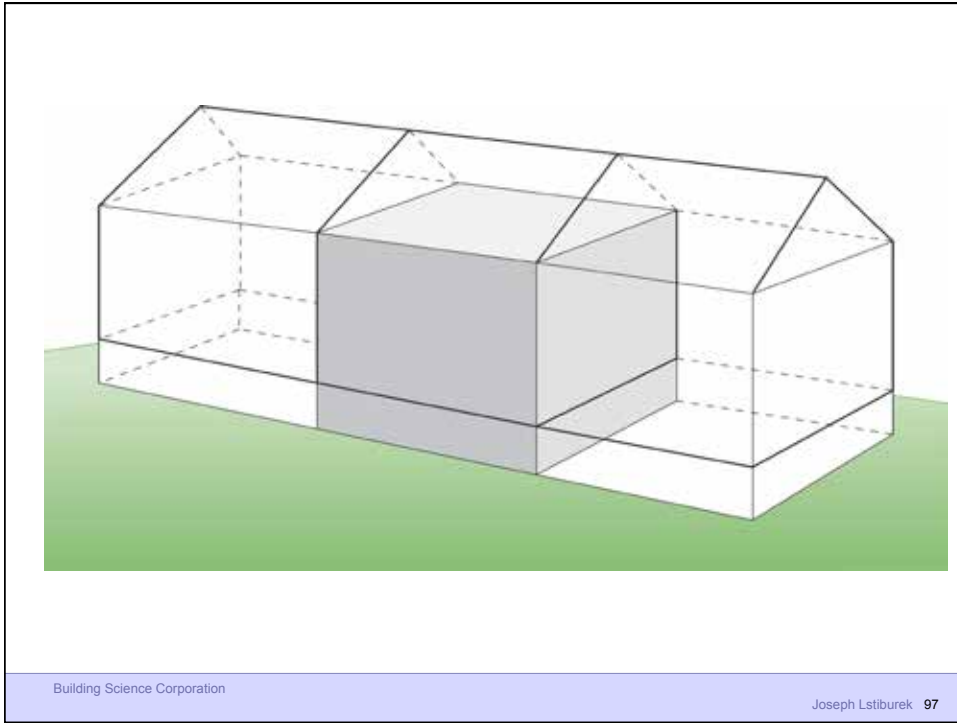


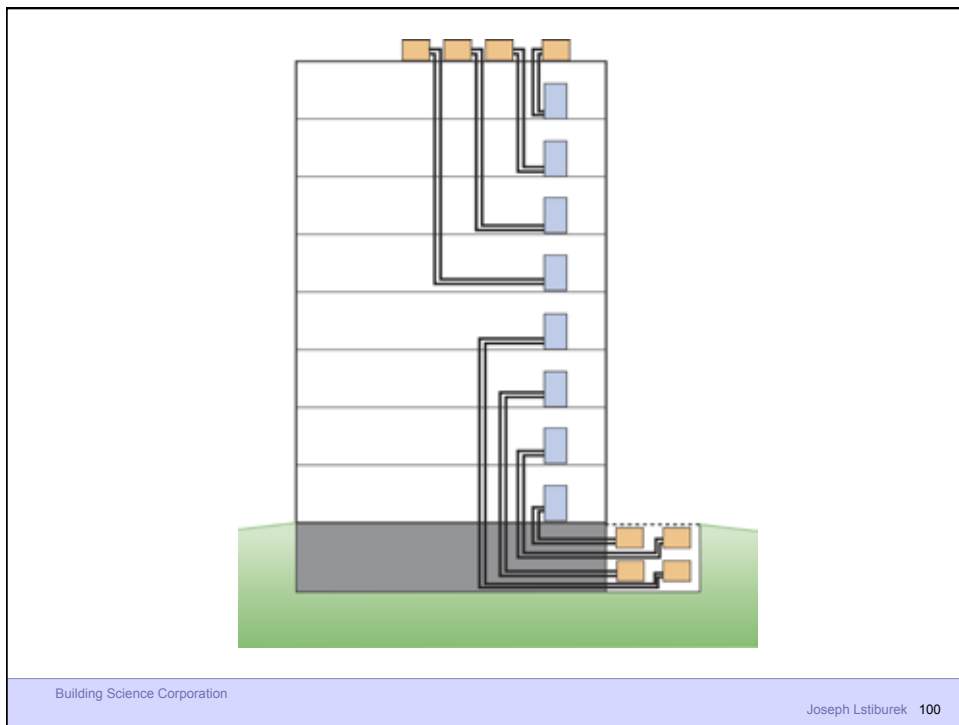
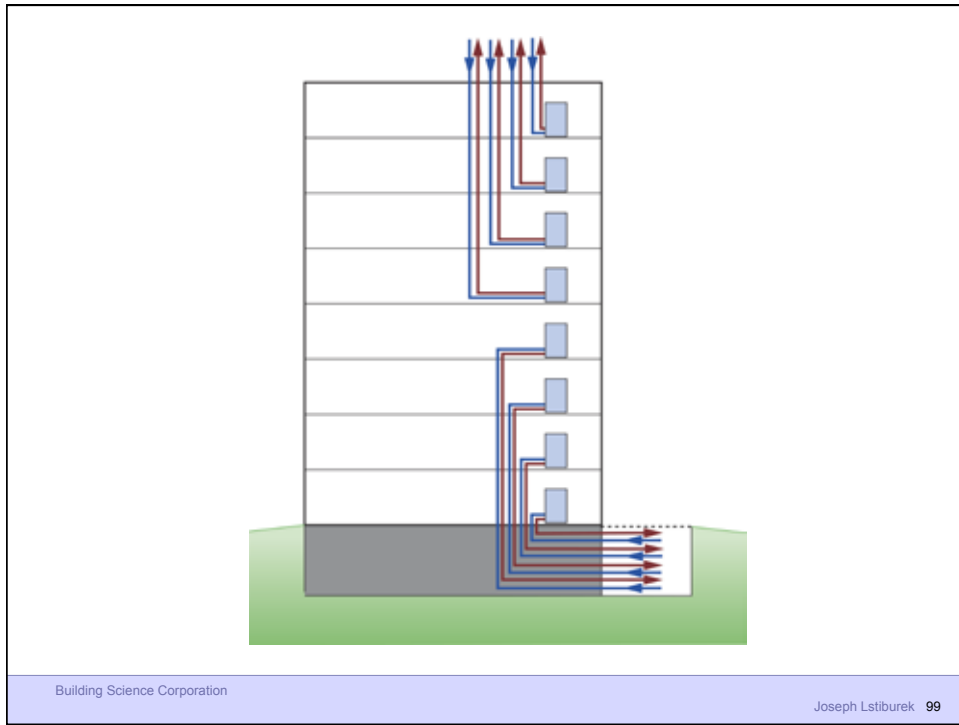


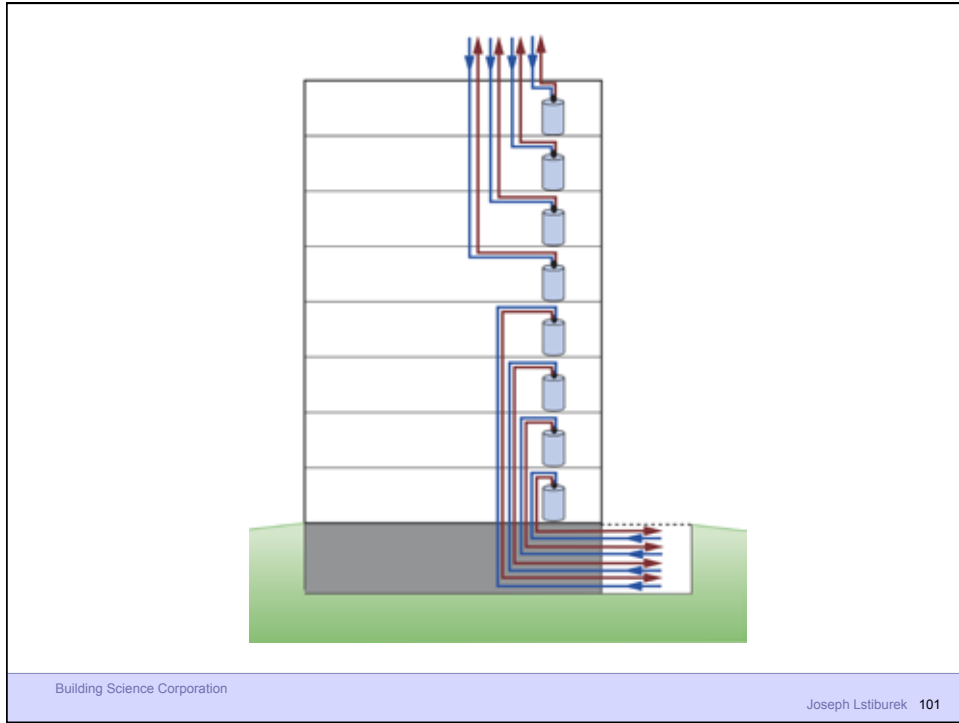














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