Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

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Ventilation

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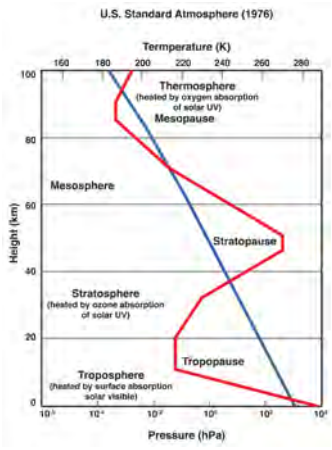
Lapse Rate



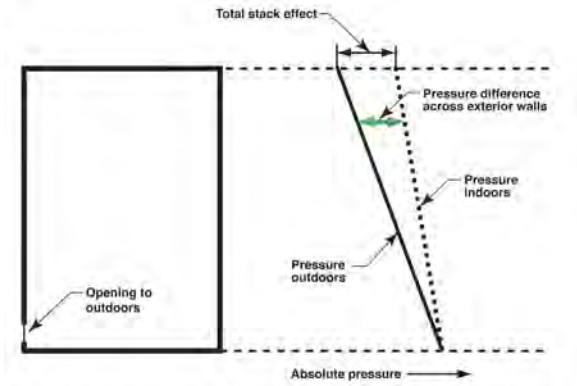


Figure 11.1: Building with no internal separations with opening at the bottom (Adapted from G.O. Handegord, 1998)

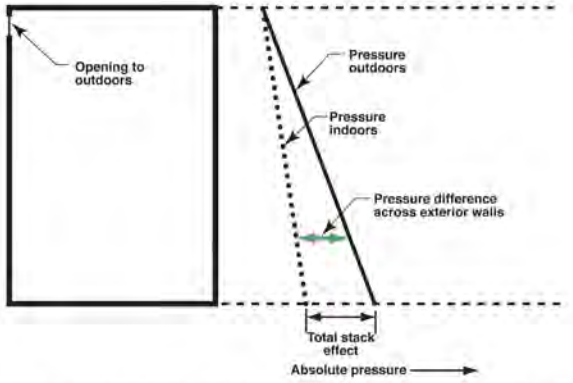


Figure 11.2: Building with no internal separations with opening at the top
(Adapted from G.O. Handegord, 1998)

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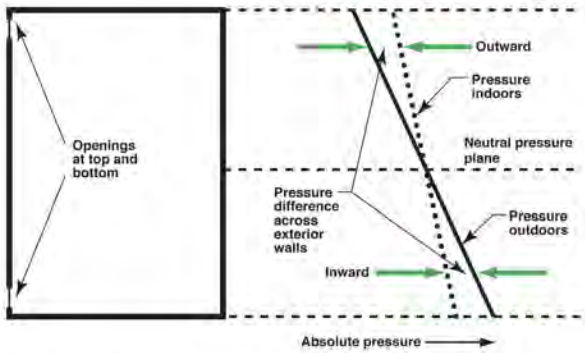

Figure 11.3: Building with no internal separations with openings at top and bottom
(Adapted from G.O. Handegord, 1998)

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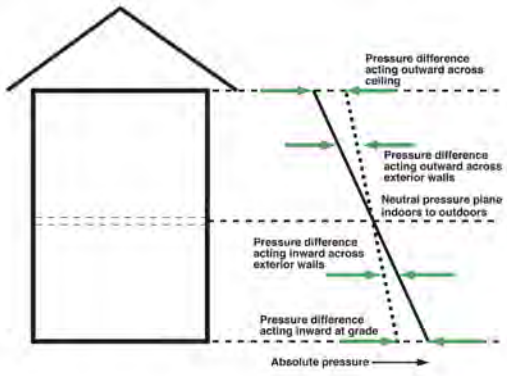

Figure 11.4: Basic two storey house with vented attic
(Adapted from G.O. Handegord, 1998)

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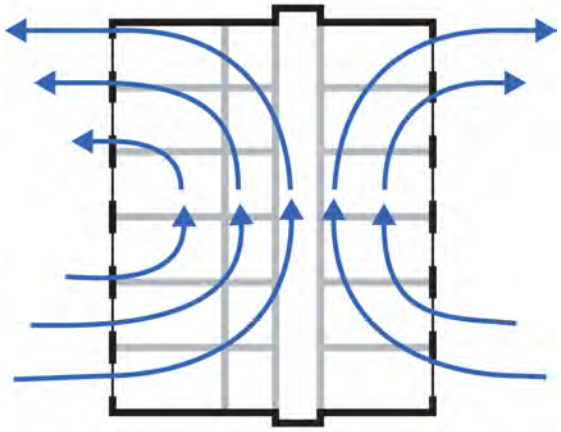

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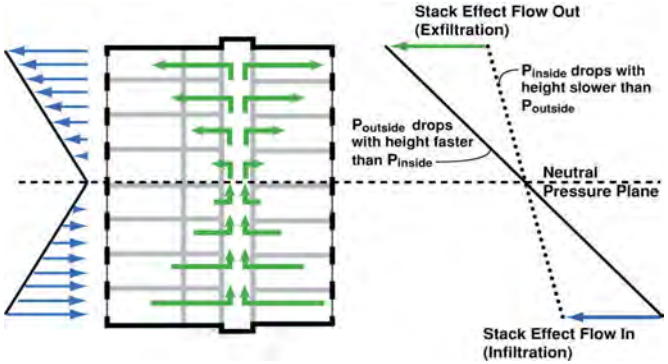

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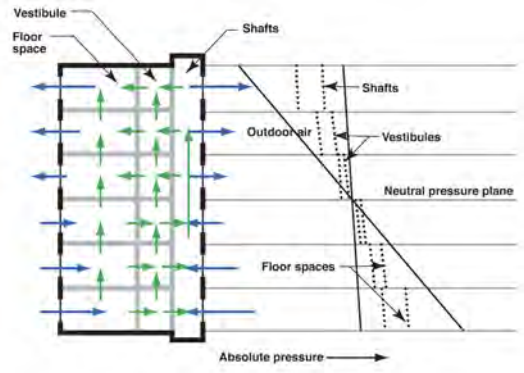

Figure 11.8: Stack effect pressures in high rise office building
(Adapted from G.O. Handegord, 1998)

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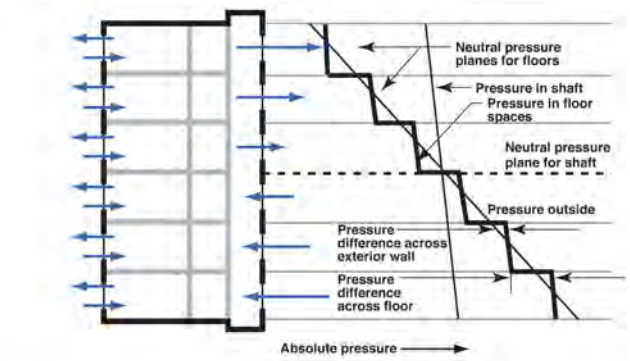

Figure 11.9: Multi-storey building with floor spaces isolated from vertical shafts (Adapted from G.O. Handegord, 1998)

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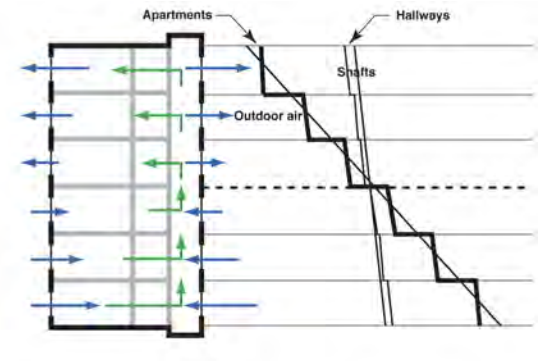

Figure 11.12: Apartment building with tighter apartment entry doors (Adapted from G.O. Handegord, 1998)

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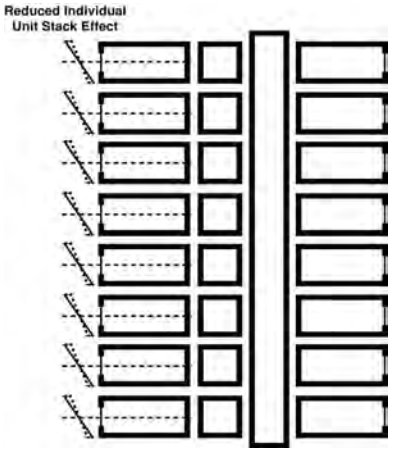

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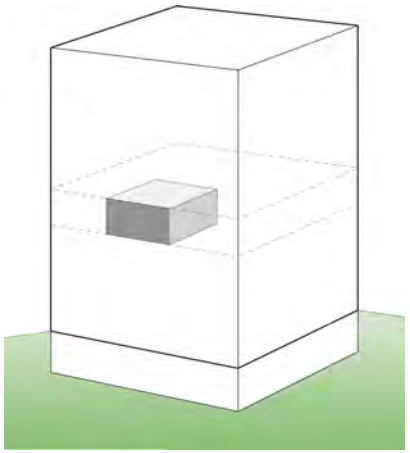

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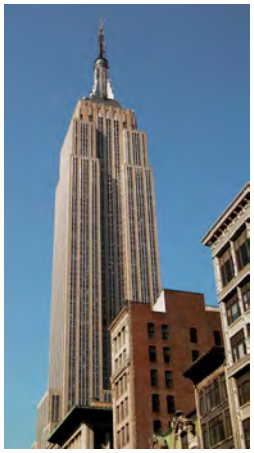

Build Tight - Ventilate Right

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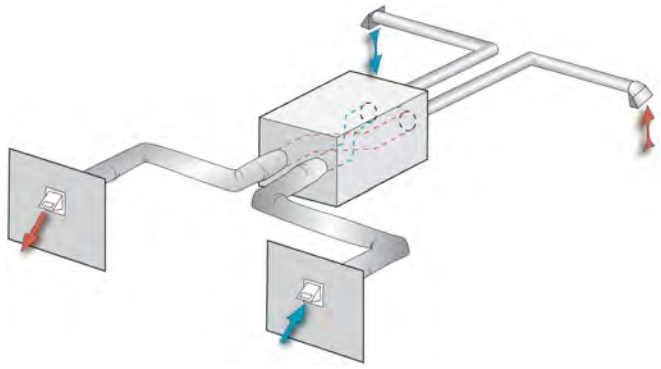
How Tight?
What's Right?

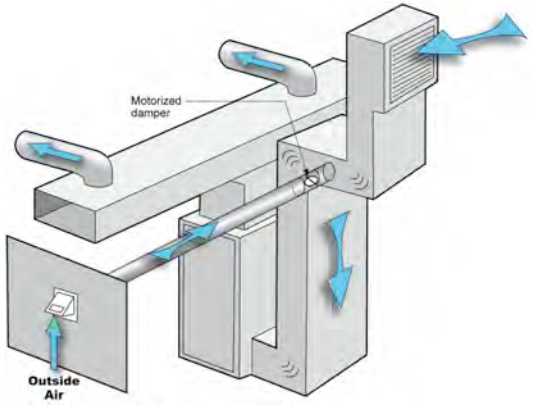
Air Barrier Metrics

Material	0.02 l/(s-m2) @ 75 Pa
Assembly	0.20 l/(s-m2) @ 75 Pa
Enclosure	2.00 l/(s-m2) @ 75 Pa
	0.35 cfm/ft2 @ 50 Pa
	0.25 cfm/ft2 @ 50 Pa
	0.15 cfm/ft2 @ 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

As Tight as Possible - with -
Balanced Ventilation
Distribution
Source Control - Spot exhaust ventilation
Filtration
Material selection
Energy Recovery





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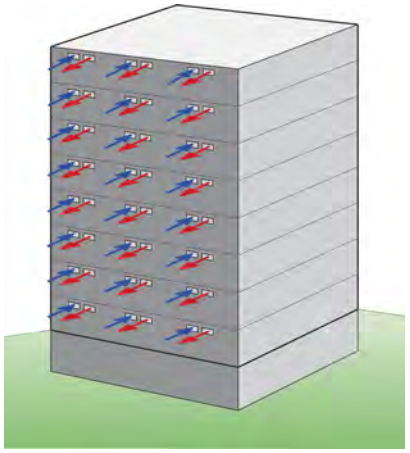

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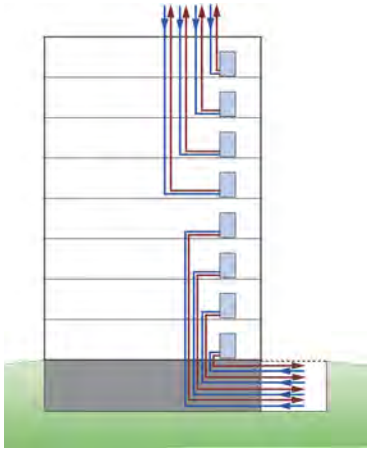

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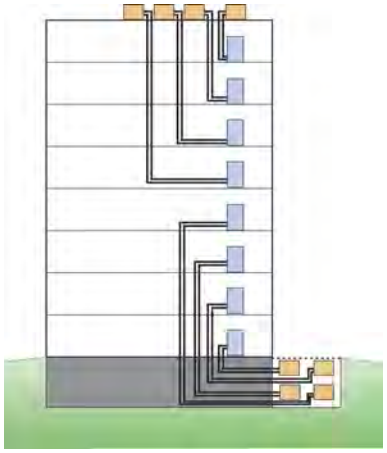

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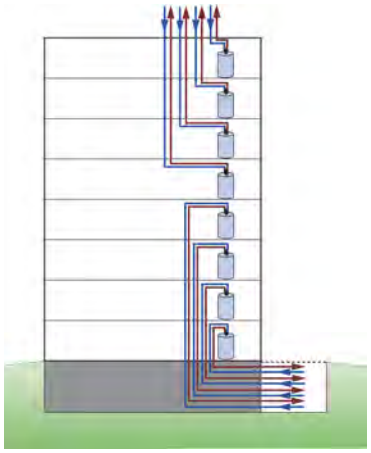

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Joseph Lstiburek – HVAC 41

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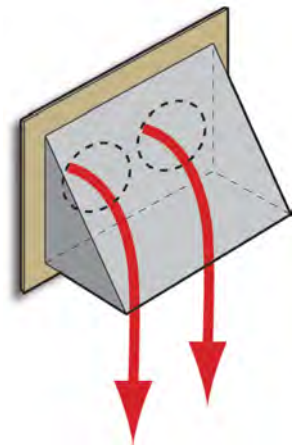

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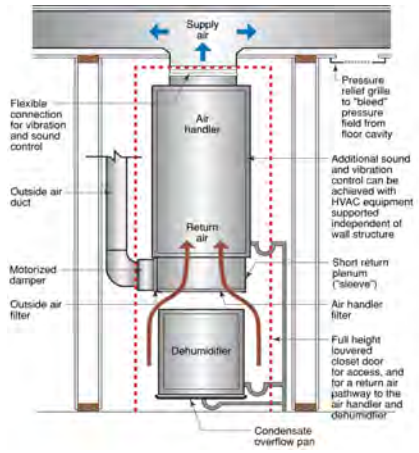

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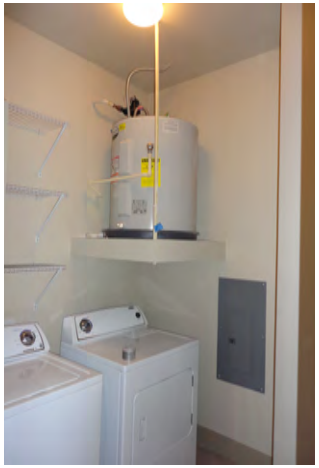

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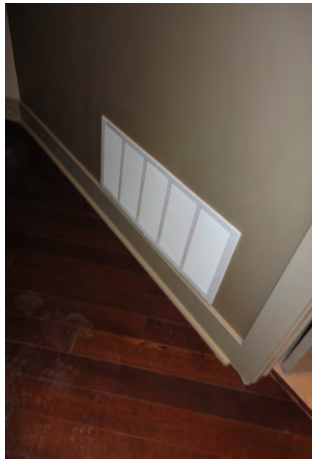

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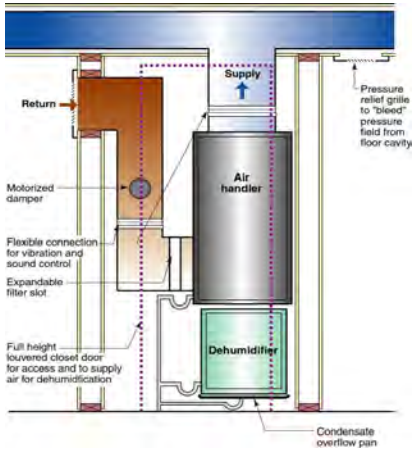

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Joseph Lstiburek – HVAC 49

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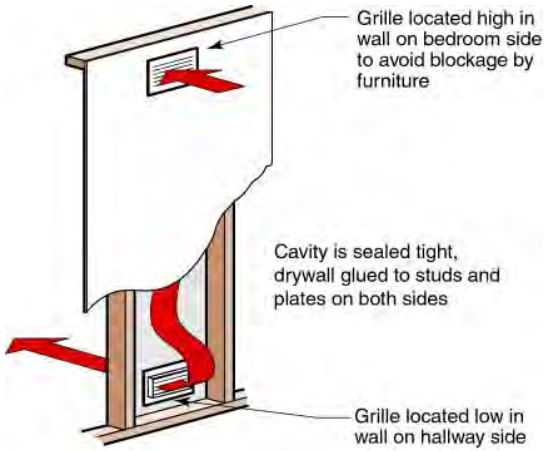
Joseph Lstiburek – HVAC 50



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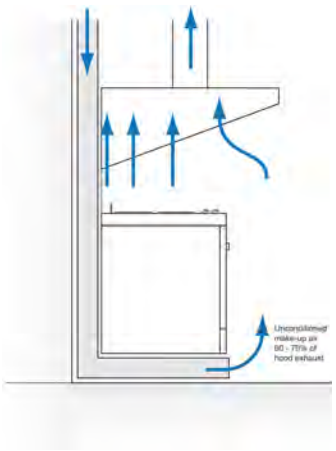

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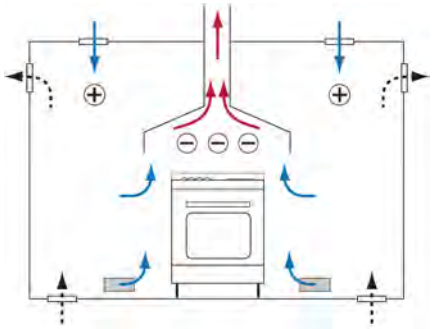

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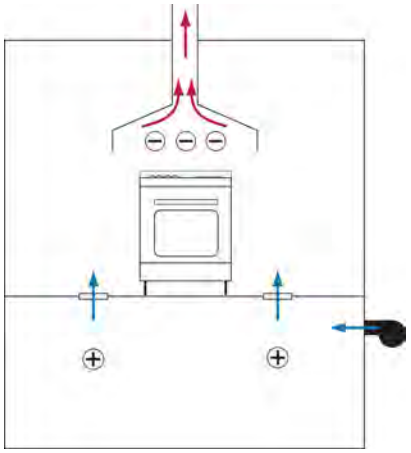

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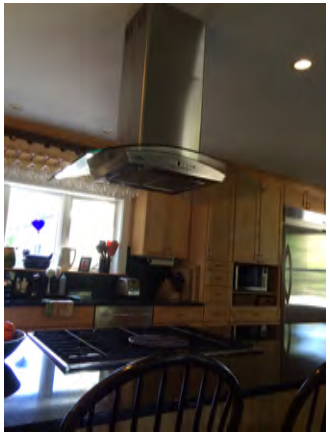

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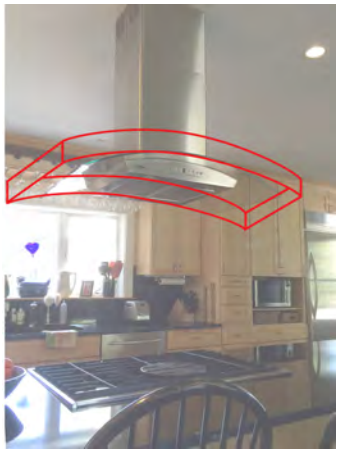

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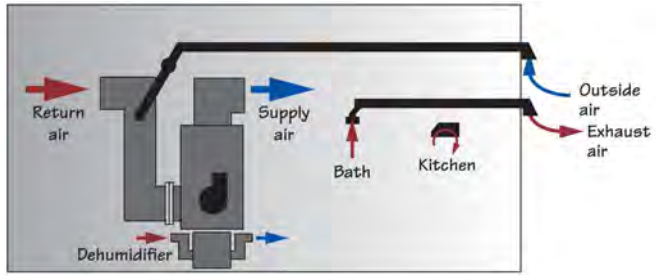

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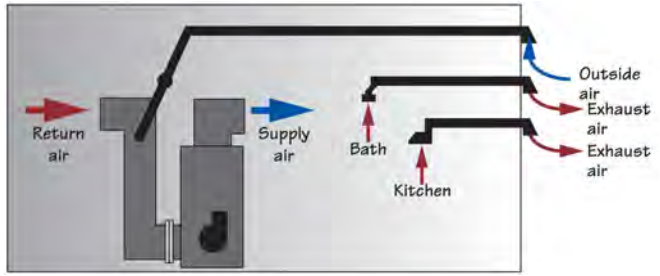

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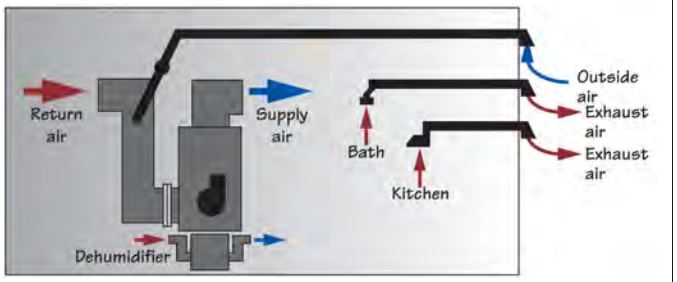

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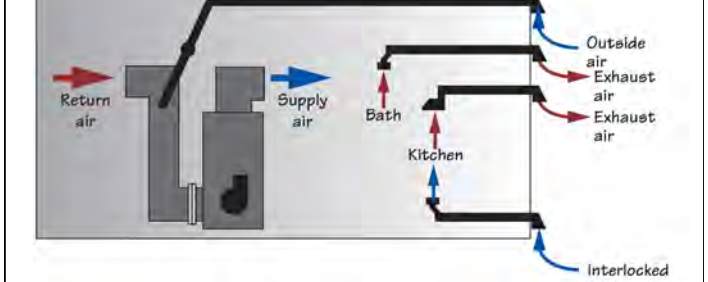

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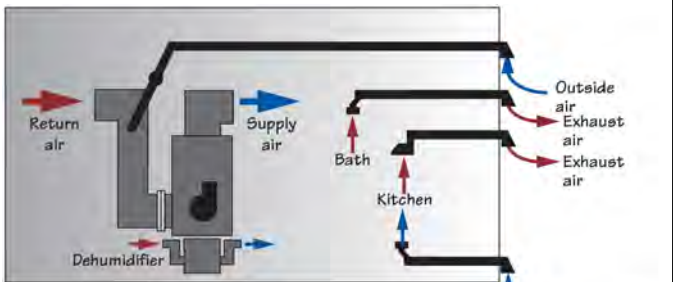

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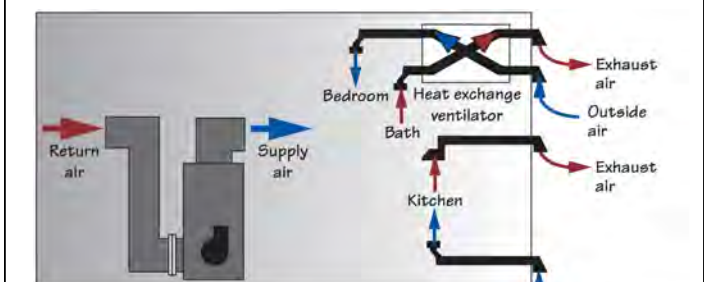

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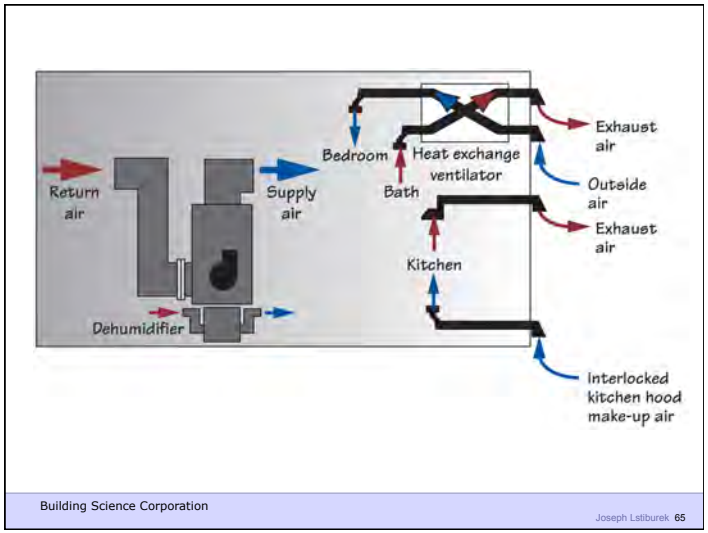
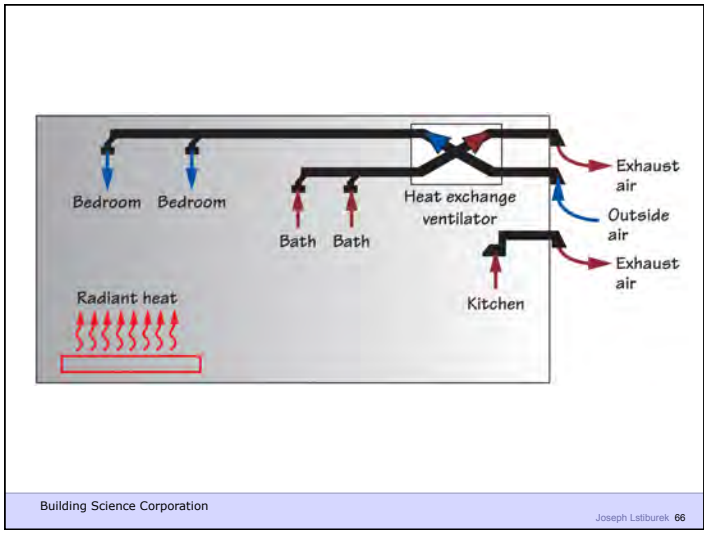
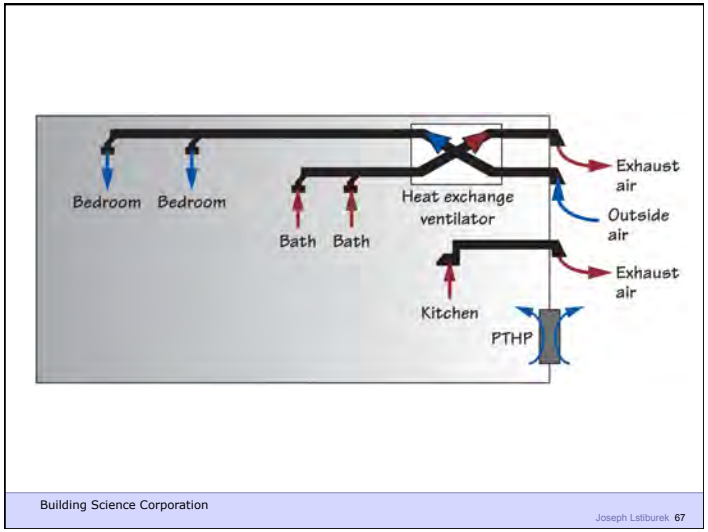
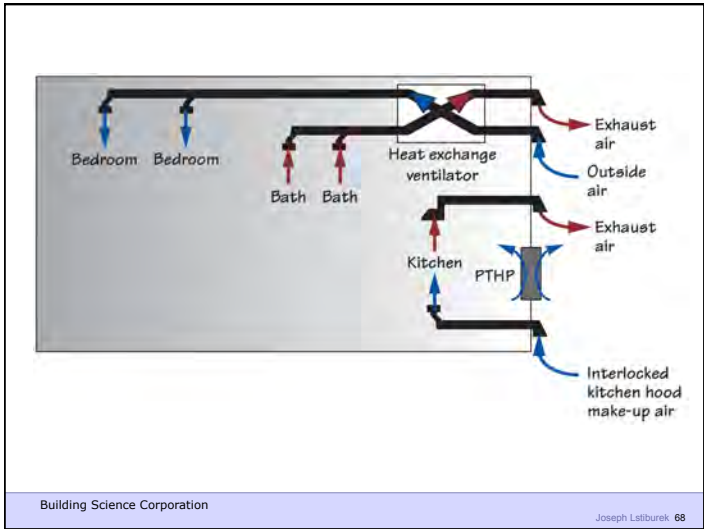
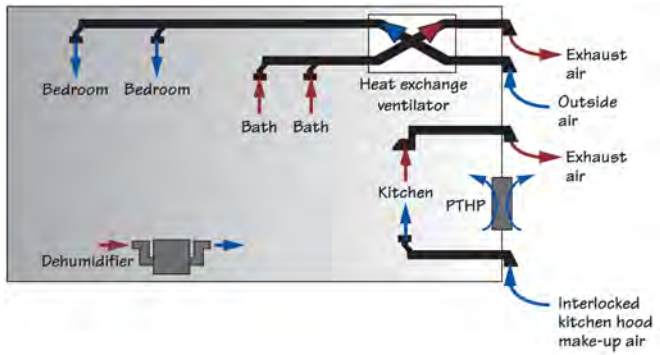

Return air
Supply air
Bedroom
Heat exchange ventilator
Bath
Exhaust air
Outside air
Exhaust air
Kitchen
Dehumidifier
Interlocked kitchen hood make-up air
Building Science Corporation
Joseph Lstiburek 65


Bedroom Bedroom
Heat exchange ventilator
Bath Bath
Exhaust air
Outside air
Exhaust air
Radiant heat
Kitchen
Building Science Corporation
Joseph Lstiburek 66


Bedroom Bedroom
Heat exchange ventilator
Bath Bath
Exhaust air
Outside air
Exhaust air
Kitchen
PTHP
Building Science Corporation
Joseph Lstiburek 67


Bedroom Bedroom
Heat exchange ventilator
Bath Bath
Exhaust air
Outside air
Exhaust air
Kitchen
PTHP
Interlocked kitchen hood make-up air
Building Science Corporation
Joseph Lstiburek 68



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Joseph Lstiburek 70

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Joseph Lstiburek 71

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Joseph Lstiburek 72

Building Science Corporation Joseph Lstiburek 73

Building Science Corporation Joseph Lstiburek 74

Building Science Corporation Joseph Lstiburek 75

Building Science Corporation Joseph Lstiburek 76

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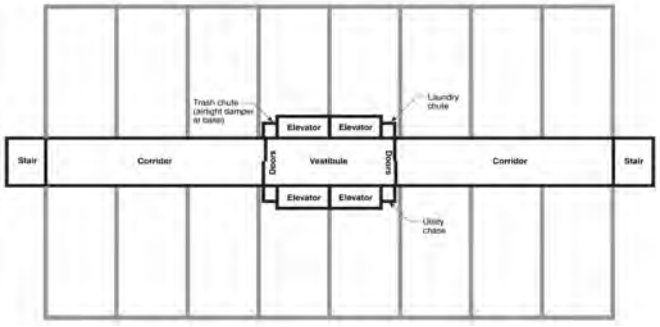

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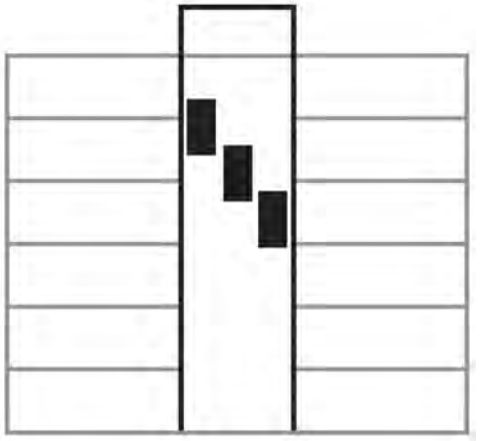
Joseph Lstiburek – HVAC 78

Building Science Corporation
Joseph Lstiburek – HVAC 79



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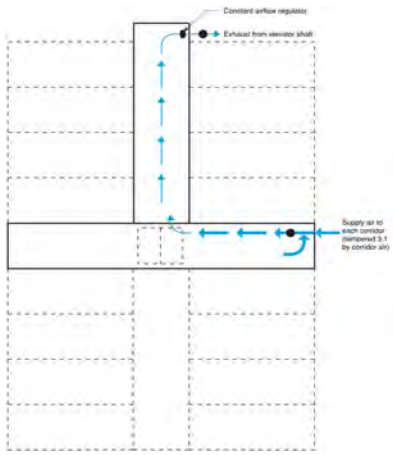
Joseph Lstiburek – HVAC 80



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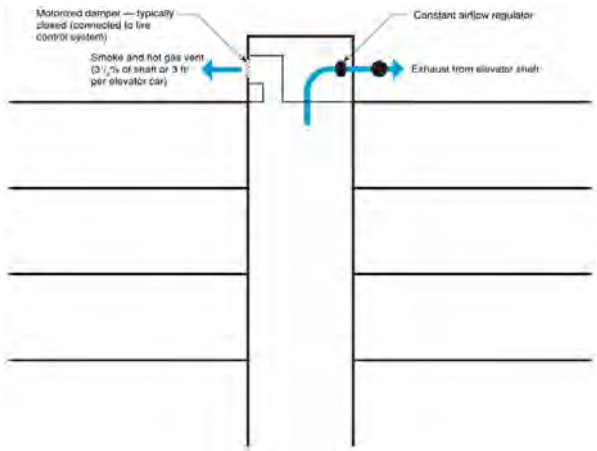

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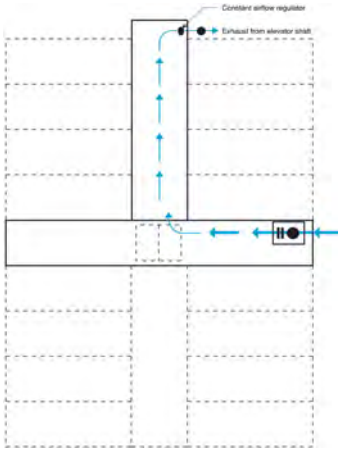
Building Science Corporation



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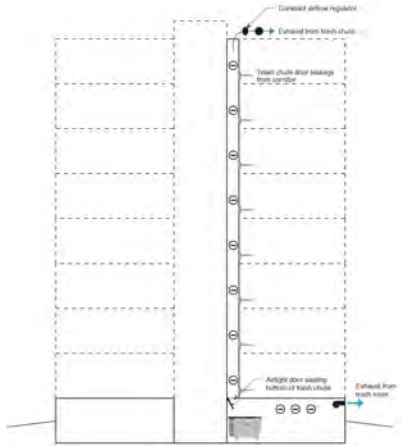

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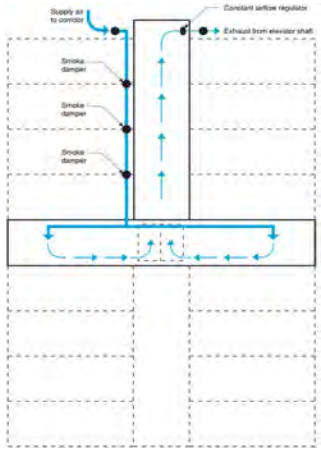
Joseph Lstiburek 86



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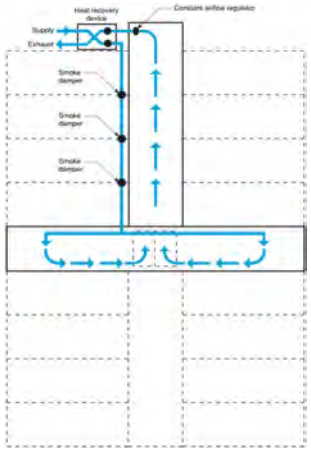

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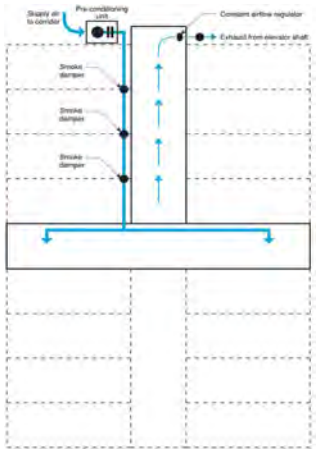

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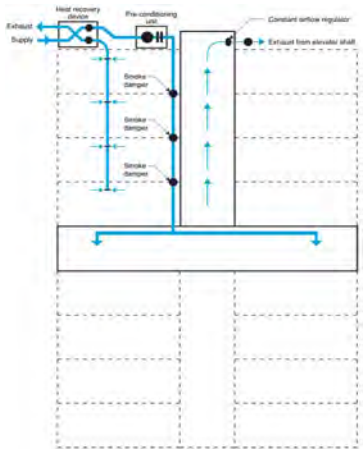
Joseph Lstiburek – HVAC 89



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Joseph Lstiburek – HVAC 91

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Joseph Lstiburek 92