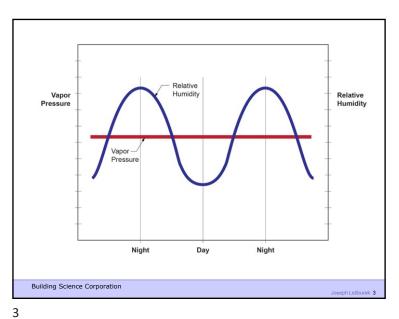
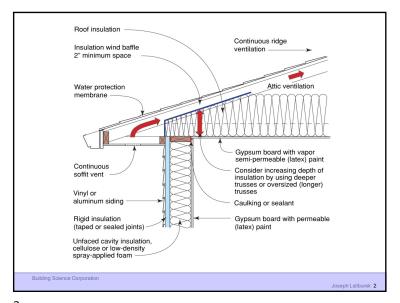
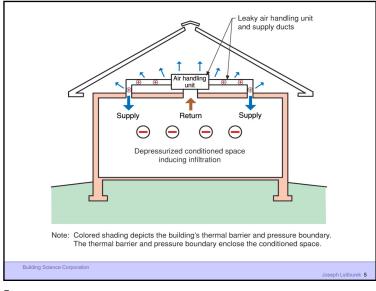
Ventilation In Attics Building Science Corporation Joseph Lstiburek 1

1









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Joseph Lstiburek 6







Building Science Corporation

Joseph Lstiburek 10

10

9





11 12



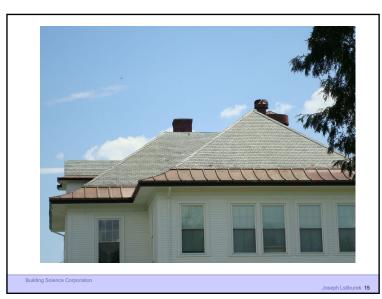
Thin ice slab under snow
Melt water running under thin ice slab
Ice dam
Icicles

Building Science Corporation

Thin ice slab
Under snow
Melt water running down underside of sheathing of s

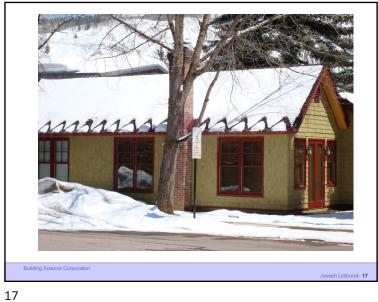
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13



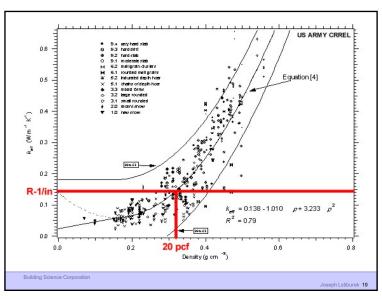


15 16



Building Science Corporation Joseph Lstiburek 18

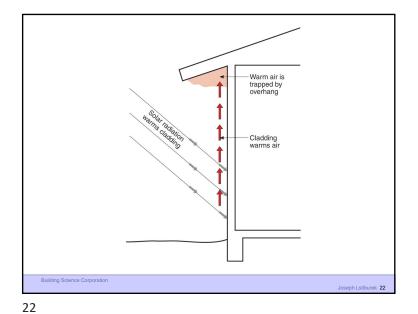
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19 20





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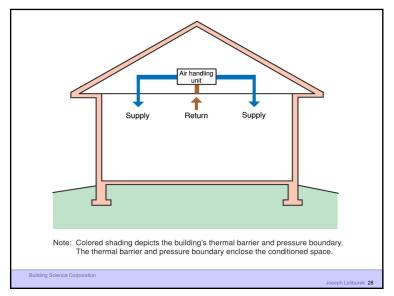
23 24

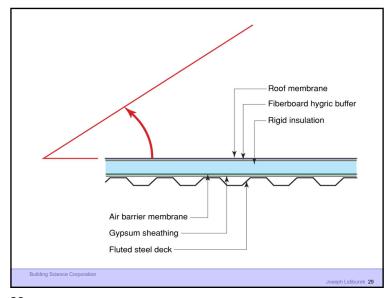


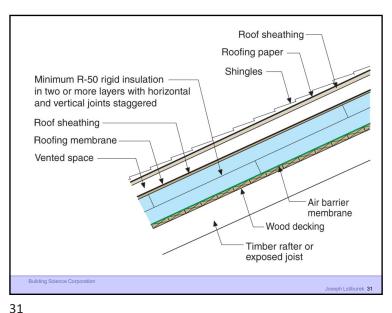
3 FLAT ROOF+ MECH DORMER RIDGE CAP DETAIL Building Science Corporation Joseph Lstiburek 26

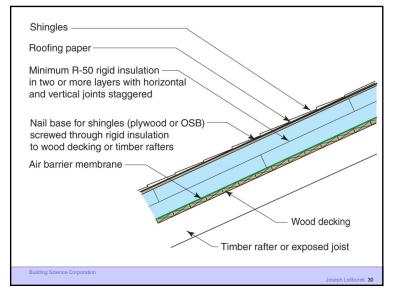
26

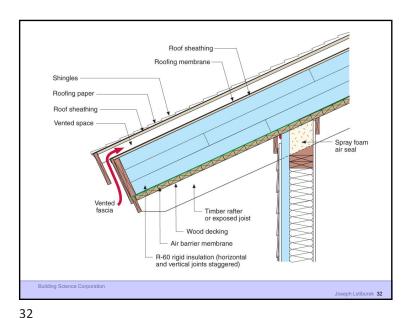


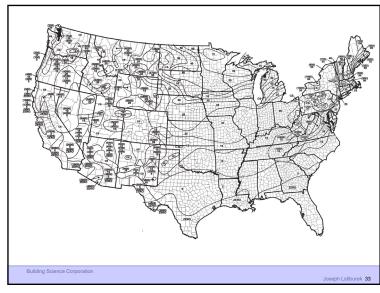




















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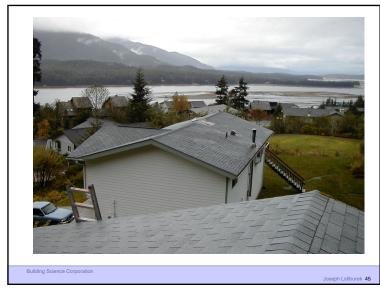


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Joseph Lstiburek 42









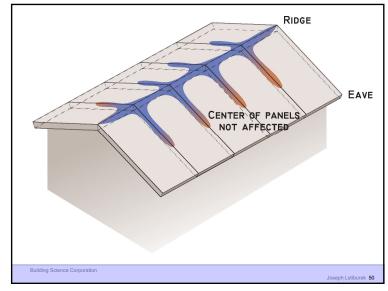
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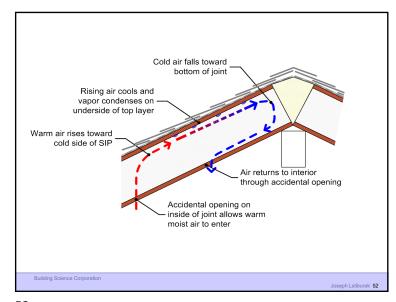
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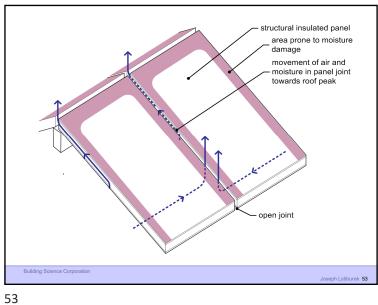


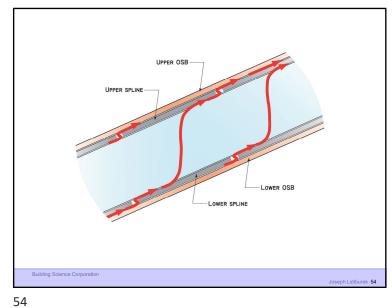
49 50





51 52













57 58





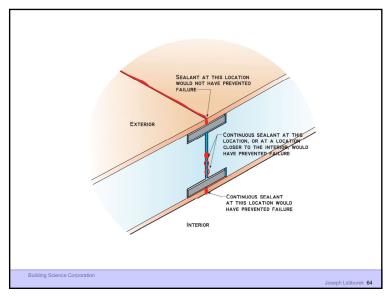
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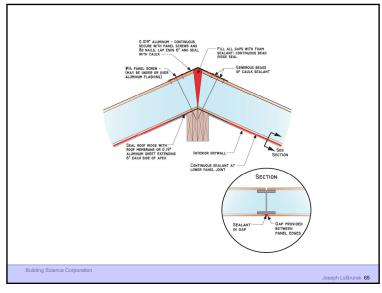
Building Science Corporation Joseph Lstiburek 62

62





63 64







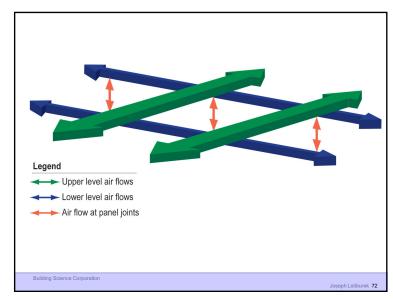




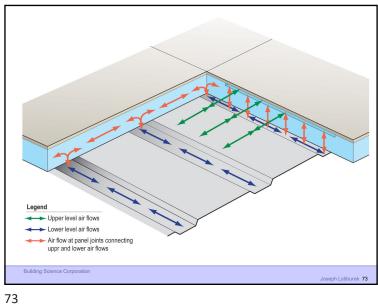


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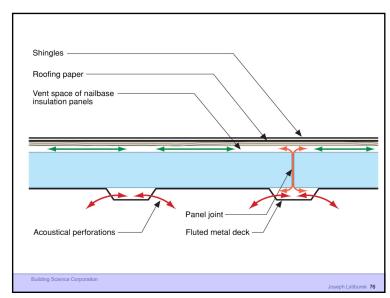
71 72



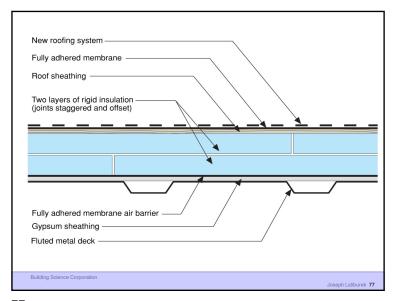
Building Science Corporation Joseph Lstiburek 74

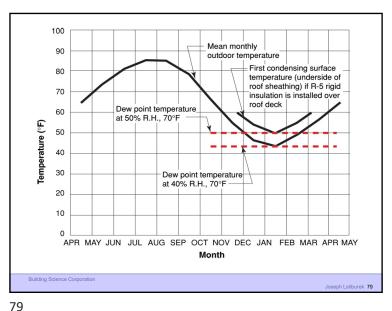
74



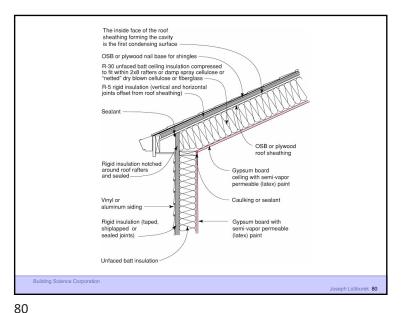


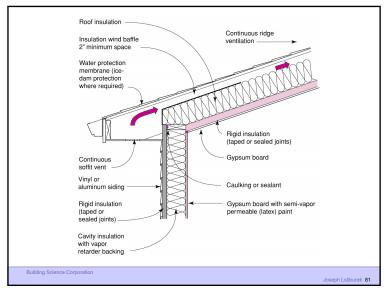
75 76

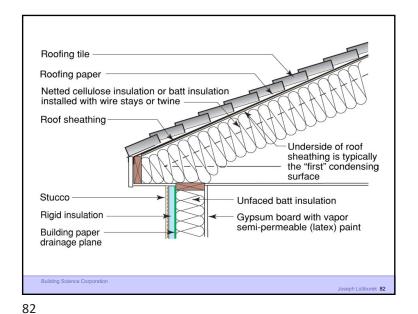




Shingles Roofing paper R-19 batt insulation installed with wire stays or twine or netted cellulose R-5 rigid insulation (vertical and horizontal joints offset from roof sheathing) 3/8" sheathing over rigid insulation Roof sheathing Underside of roof Sealant sheathing is typically the "first" condensing Rigid insulation surface notched around roof trusses and sealed-Unfaced batt insulation Vinyl or aluminum siding Gypsum board with vapor semi-Rigid insulation permeable (latex) paint Building paper drainage plane Building Science Corporation Joseph Lstiburek 78



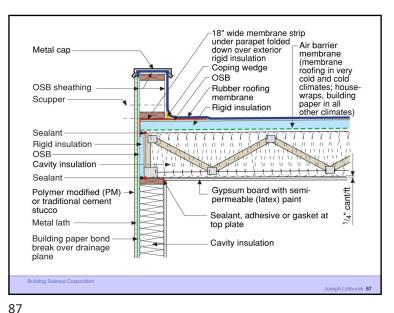


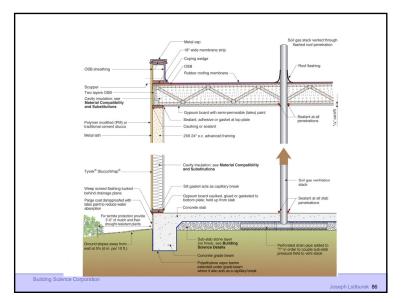


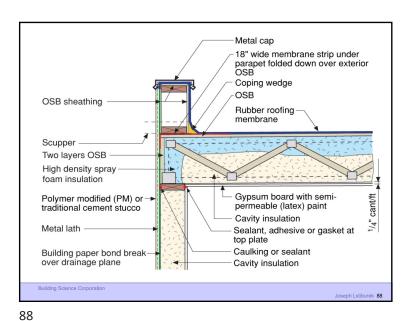


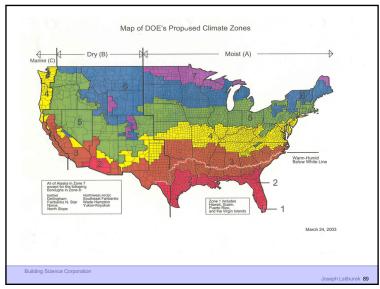












Low density spray foam insulation

Asphalt shingles

Roofing paper

Roof sheathing

Raised heel truss
Rigid foam, or comparable, as backdam

Soffit

Roof underlayment sealed to drip edge

Gypsum board with latex paint (acts as thermal barrier separating occupiable space)

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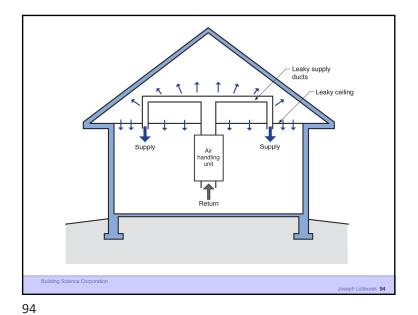
89





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Conditioned Attics Not Unvented Attics Need Supply Air

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Lotibaroit 01

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Hygric Buoyancy

Conditioned Attics Not Unvented Attics Need Supply Air 50 cfm/1000 ft2 of Attic

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Components in Dry Air	Volume Ratio compared to Dry Air	Molecular Mass - M (kg/kmol)	Molecular Mass in Air
Oxygen	0.2095	32.00	6.704
Nitrogen	0.7809	28.02	21.88
Carbon Dioxide	0.0003	44.01	0.013
Hydrogen	0.000005	2.02	0
Argon	0.00933	39.94	0.373
Neon	0.000018	20.18	0
Helium	0.000005	4.00	0
Krypton	0.000001	83.8	0
Xenon	0.09 10 ⁻⁶	131.29	0
Total Molecular Mass of Air			28.97

99

Components in Dry Air	Volume Ratio compared to Dry Air	Molecular Mass - M (kg/kmol)	Molecular Mass in Ai
Oxygen	0.2095	32.00	6.704
Nitrogen	0.7809	28.02	21.88
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Hydrogen	0.000005	2.02	0
Argon	0.00933	39.94	0.373
Neon	0.000018	20.18	0
Helium	0.000005	4.00	0
Krypton	0.000001	83.8	0
Xenon	0.09 10 ⁻⁶	131.29	0
Total Molecular Mass of Air			28.97

Note Water Vapor (H2O) is 18 Dry Air is 29

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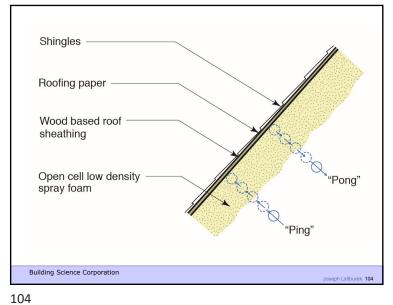
Joseph Lstiburek 101

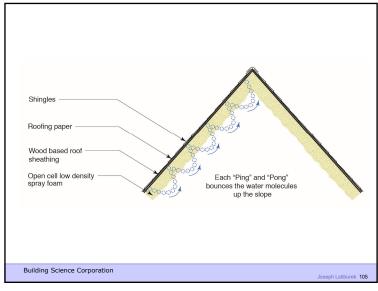
101



Building Science Corporation Joseph Lstiburek 102

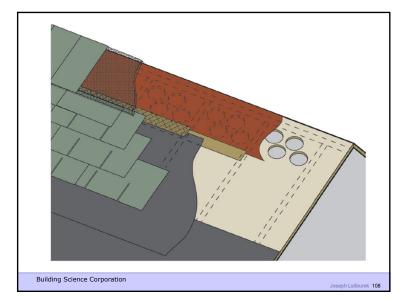
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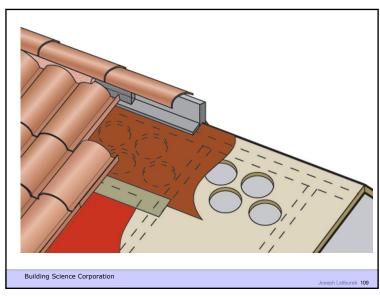


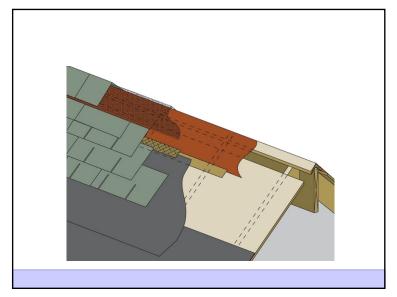




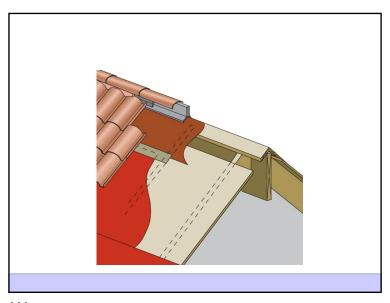








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111 112



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Joseph Lstiburek 114

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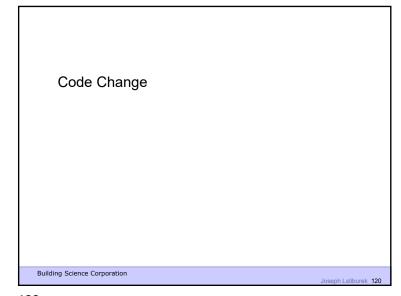
115





117





119 120

R806.5 Unvented attic and unvented attic enclosed rafter assemblies.

- vapor diffusion port
- port area 1:600 of the ceiling area
- vapor permeance greater than 20 perms
- roof slope greater than 3:12
- insulation under the roof deck or at the ceiling
- air supply 50 cfm/1000 ft2 ceiling area when insulation installed directly under the roof deck
- Climate Zones 1, 2 and 3

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oseph Lstiburek 121

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Sweating Ducts

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123

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Vapor Diffusion Port: A passageway for conveying water vapor from an unvented attic to the atmosphere.

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Inconh Letihurak 1

122

Sweating Ducts
Light Colored Roofs

Cool Roofs

Radiant Barriers

ACCA Manual J, S and D

ASHRAE 62.2

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Joseph Lstiburek 124

Ductwork Attic Dehumidification System

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Joseph Lstiburek 125

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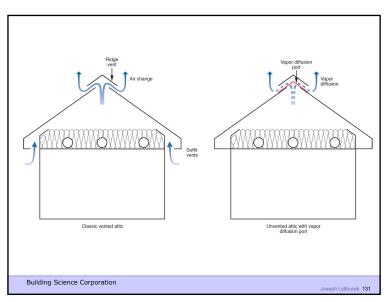




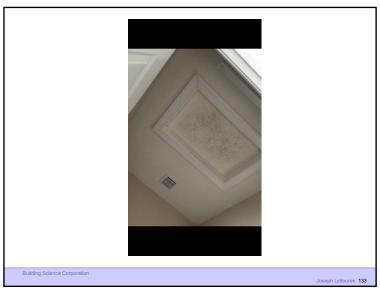
127



















Crawl spaces must be completely connected to either the outside or the inside

Vented crawl spaces work

Unvented conditioned crawl spaces work

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Incanh Letihurak 138

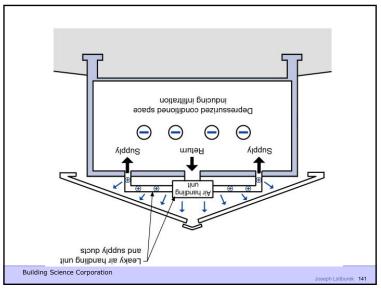
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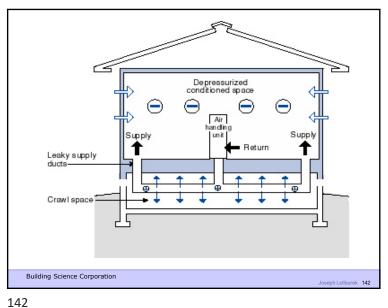
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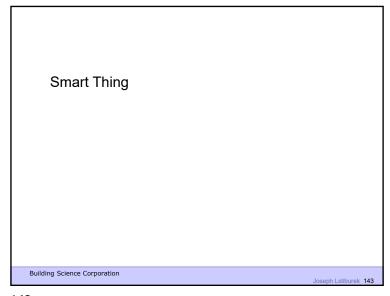
Don't Do Stupid Things

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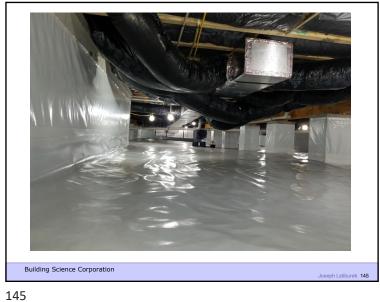
140











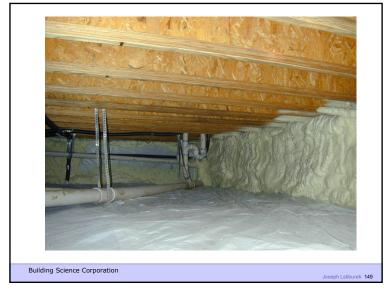
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147 148



Continuous polyethylene vapor diffusion retarder/air flow retarder air flow retarder air space concrete support pad

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Continuous Masonry support pier column or masonry pier waterproofing under steel column or masonry pier steel column or masonry pier space concrete support pad

149

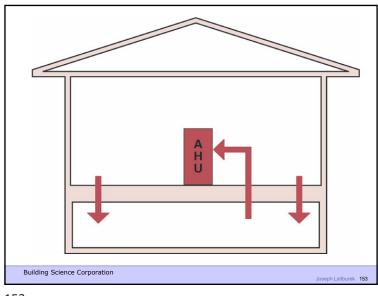
Conditioned Crawlspaces Not Unvented
Crawlspaces
Need Supply Air
50 cfm/1000 ft2 of Crawlspace Area

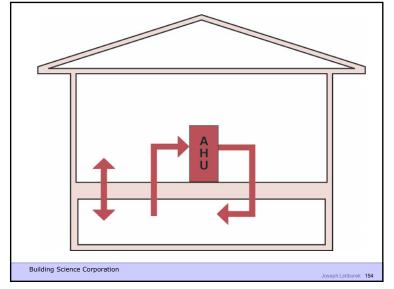
Or
Dehumidification

AHU

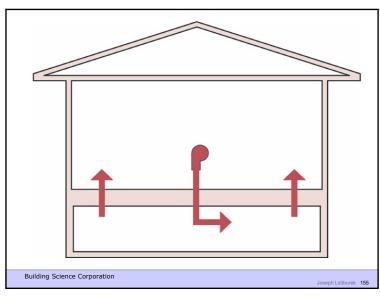
Building Science Corporation

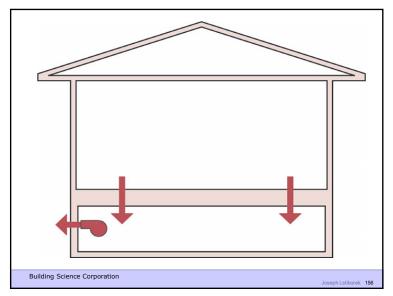
151 152



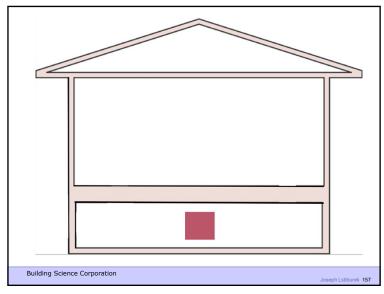


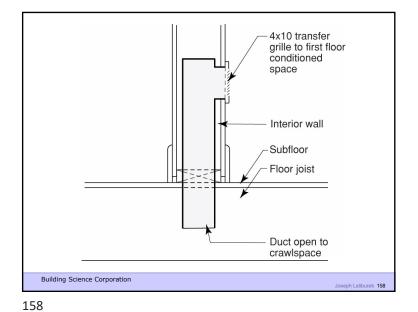
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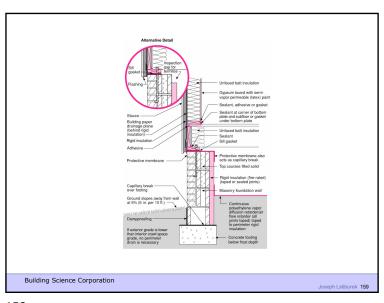


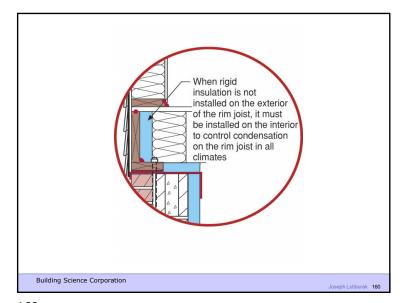


155 156

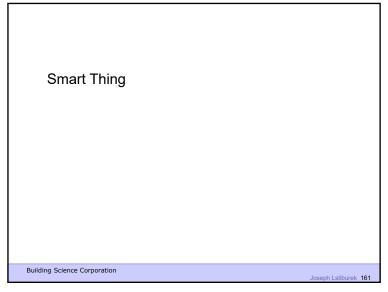






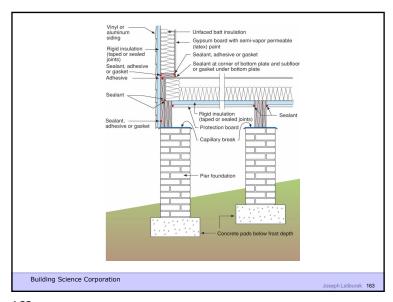


159 160



 Unfaced batt insulation
 Gypsum board with semi-vapor permeable (latex)
 paint 1/2" OSB sheathing - Sealant, adhesive or gasket Furring — Sealant at corner of bottom plate and subfloor or gasket under bottom plate Sealant (typ.)
Rigid insulation
Gasket Sealant, adhesive or gasket Batt insulation Rigid insulation (fire-rated, taped and sealed joints) Capillary break Sealant Masonry foundation wall Treated wood nailer Ground slopes away from wall at 5% (6 in. per 10 ft.) Continuous polyethylene vapor diffusion retarder (all joints overlapped) Capillary break over footing Dampproofing Building Science Corporation Joseph Lstiburek 162 162

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163 164



Building Science Corporation

Joseph Latiturek 166



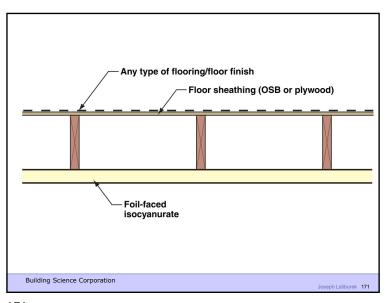


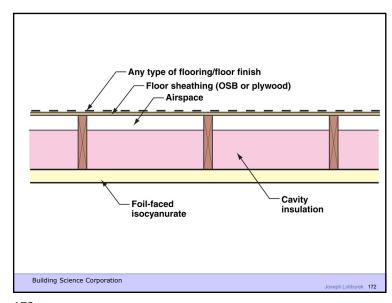


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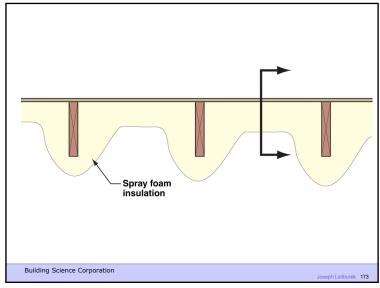
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171 172



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Tile

Grout

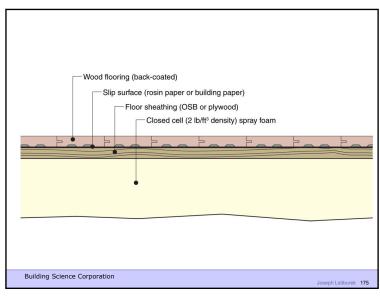
Cement board/fiber cement underlayment

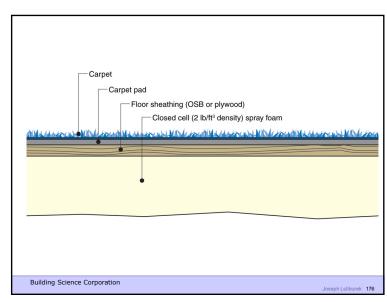
Floor sheathing (OSB or plywood)

Closed cell (2 lb/ft³ density) spray foam

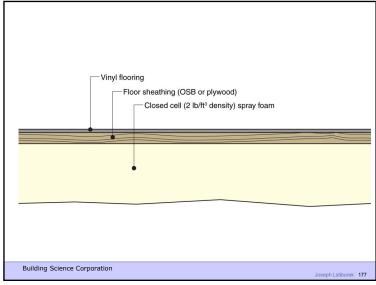
Joseph Lstiburek 174

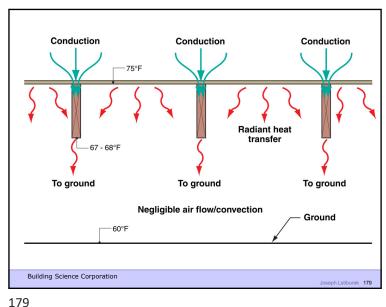
173





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Interior 75 - 78°F Summer 68 - 72°F Winter Heat from enclosure Ventilation air Ventilation Ground temperature (always colder than enclosure interior) Building Science Corporation Joseph Lstiburek 178

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