

NAHB National Green Building Conference
May 12, 2008
Alex Lukachko and Al Cobb



presents

Building Science with Structural Insulated Panels (SIPs)

2008 NAHB National Green Building Conference
May 12, 2008 - New Orleans



This presentation is available at

www.buildingscienceseminars.com/presentations
www.sipschool.org/ (home page)



The Structural Insulated Panel Association (SIPA) is a non-profit trade association representing manufacturers, suppliers, fabricators/distributors, design professionals, and builders committed to providing quality structural insulated panels for all segments of the construction industry.

More information about SIPA can be found at:
www.sips.org

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Introduction



Alex Lukachko, Associate
alex@buildingscience.com
Building Science Corporation
30 Forest Street, Somerville, MA
www.buildingscience.com



Al Cobb, President
al@sipschool.org
SIPschool
808 French Road, Shenandoah Junction, WV
www.sipschool.org

NAHB National Green Building Conference
May 12, 2008
Alex L. Kuttel, PhD
Outline for this session

1. SIPs and Green Building

2. Building Science for SIPs

We will review theory and details for SIPs construction, including:

- drainage planes and claddings
- vapor control
- vented and unvented roofs
- HVAC for airtight, energy-efficient buildings

3. SIPs and green building rating tools

Please ask questions at any time

Building Science with Structural Insulated Panels (SIPs)

ABOUT SIPS CONSTRUCTION



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Building Science with Structural Insulated Panels (SIPs)

SIPS AND GREEN BUILDING

SIPs and Green Building

SIPs material properties:

- low embodied energy
- efficient use of wood
- reduced construction waste
- low VOC emission

SIPs system properties:

- excels in energy efficiency, durability, indoor environmental quality

Building Science with Structural Insulated Panels (SIPs)

BUILDING SCIENCE FOR SIPs

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Theory: Enclosure Design

Historical changes

- More airtight, less energy 'flow,' less moisture tolerance, changing conditions of use

Performance goals

- Comfortable, Healthy, Durable, Resource Efficient

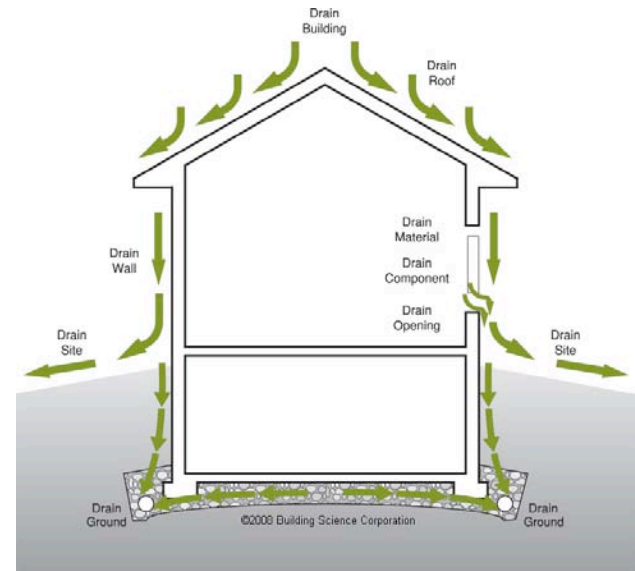
Enclosure requirements

- Control Heat, Air, Moisture (rain, vapor, soil)
 - Heat – continuous layer of insulation
 - Air – continuous air barrier
 - Moisture – drainage plane, capillary breaks

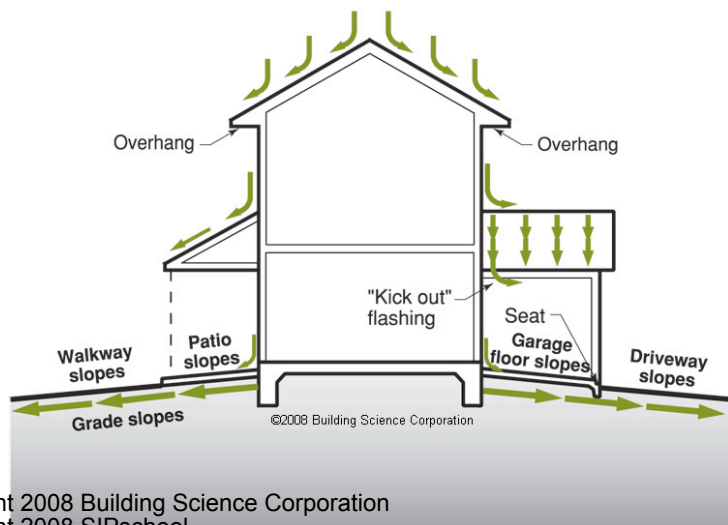
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RAIN CONTROL

Concept: Layering Materials to Shed Water

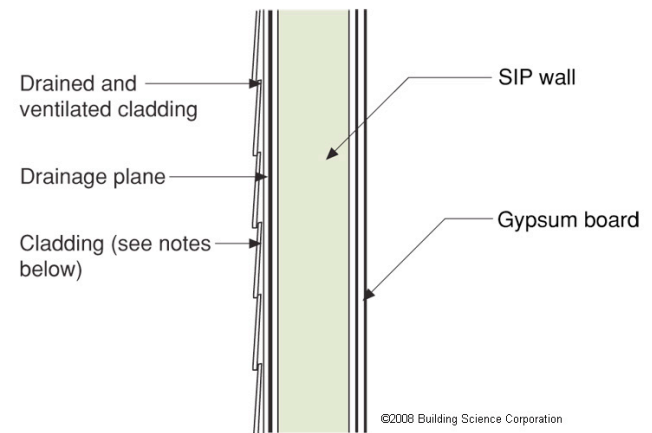


Drain the Building



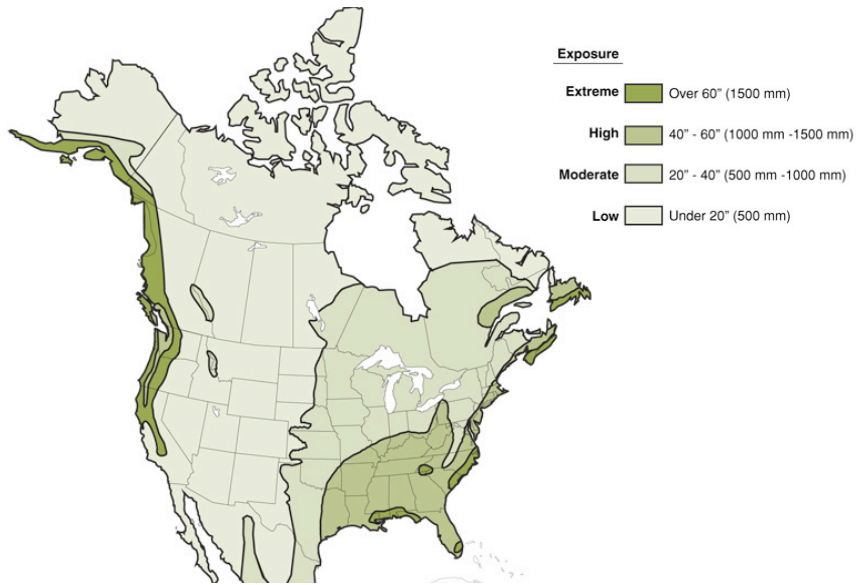
Drained and Ventilated Cladding

Provide Drainage Plane and Drainage Gap



All claddings should be drained and back-ventilated where **annual rainfall exceeds 20 inches**

North America Average Annual Rainfall



Cladding Types and Drainage Gap

Provide Drainage Plane and Drainage Gap

Wood and Fiber Cement Siding

-install over a 1/4-inch (6mm) spacer strip over a water resistive barrier

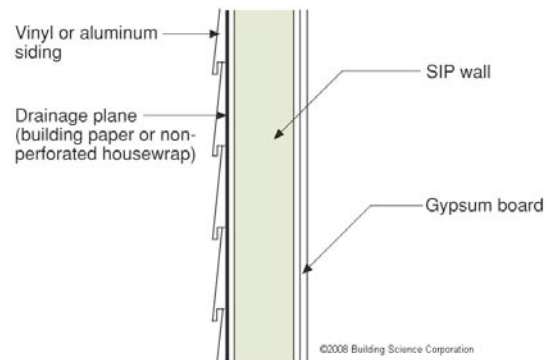
Cedar Shingles, Traditional Stucco, and Manufactured Stone Veneer

-install over 3/8-inch (9mm) drainage mat over a water resistive barrier

Vinyl or Aluminum Siding is inherently back-ventilated

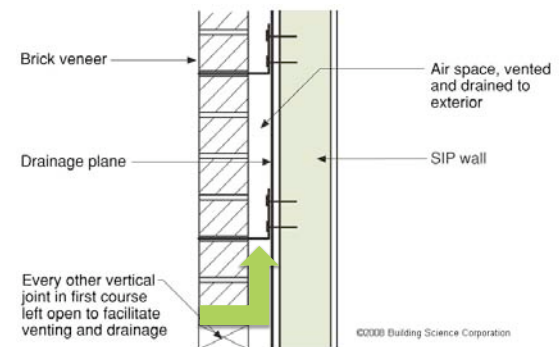
Drained and Ventilated Cladding

Provide Drainage Plane and Drainage Gap



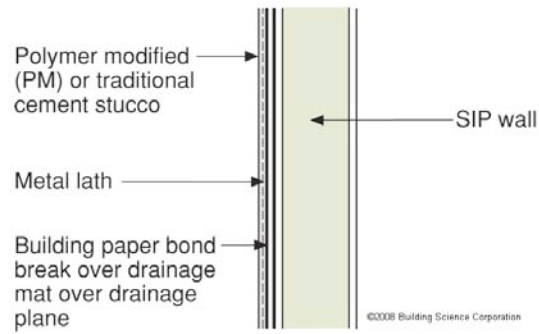
Can be used in all regions

Water Managed Wall – Brick Veneer

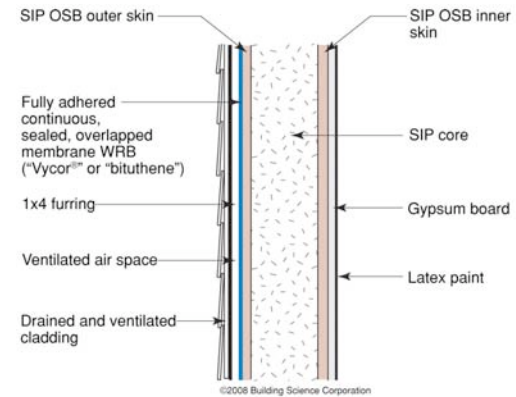


Drained and Ventilated Stucco Cladding

Provide Drainage Plane and Drainage Gap



Gulf Coast Hot-Humid Wall



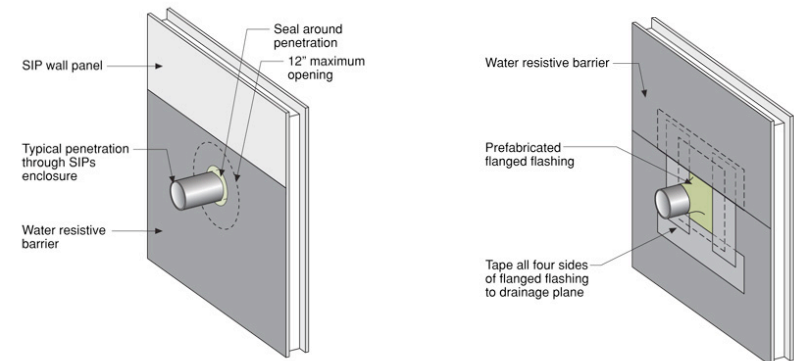
Gulf Coast Hot-Humid Wall

- Ventilated, drained rain screen cladding
- Fully-adhered water resistive barrier (WRB) on exterior of SIP panel is preferred
- Asphalt impregnated felt or building paper as water resistive barrier (WRB) is acceptable

Installing a Window with Housewrap



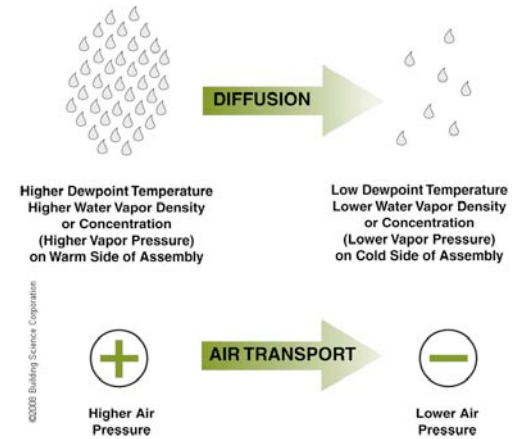
Wall Penetration Max Size and Flashing



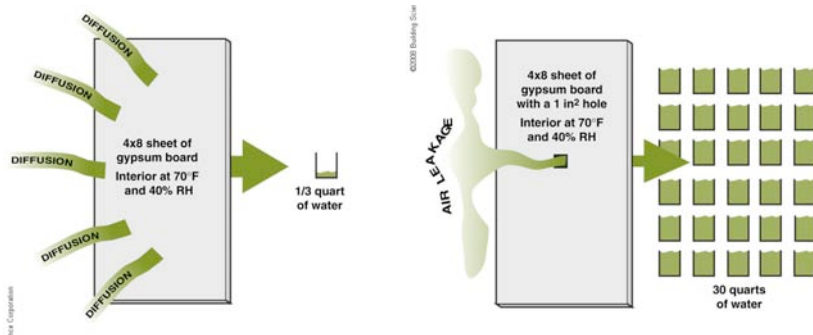
Building Science with Structural Insulated Panels (SIPs)

VAPOR CONTROL

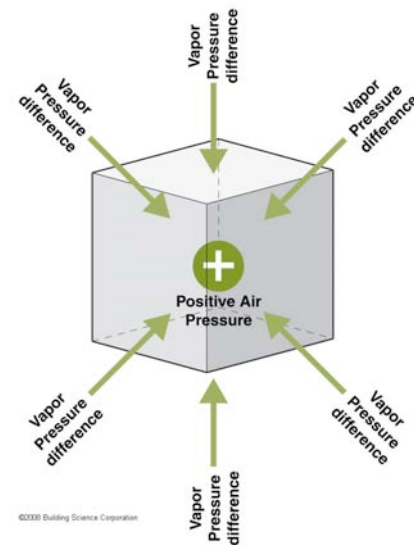
Theory: Diffusion vs. Air Leakage



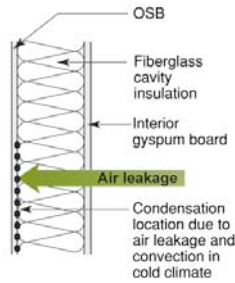
Diffusion vs. Air Leakage



Air Pressure and Vapor Pressure

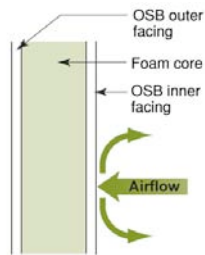


Frame Walls vs. SIP Wall



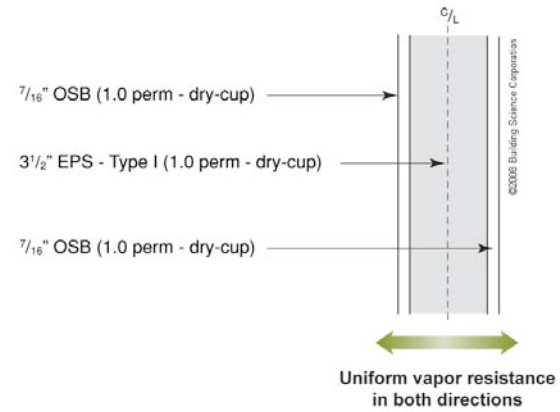
- Typical Stick Frame Wall**
- Cavity within typical frame wall is prone to airflow and convection
 - Condensation can occur at exterior sheathing in cold climates

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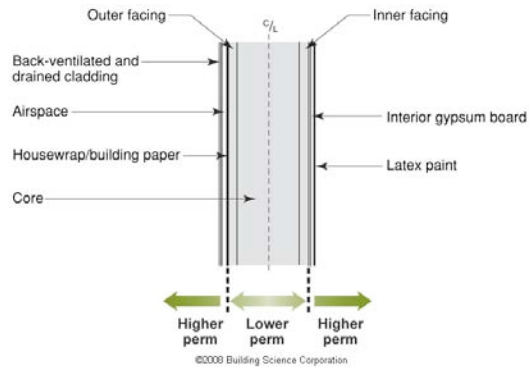


- SIP Wall**
- Core is "solid" and "homogenous" and "air impermeable"
 - Convection and air leakage is not possible within SIP
 - Condensation due to convection and air leakage within SIP is not possible

Bilateral Symmetry



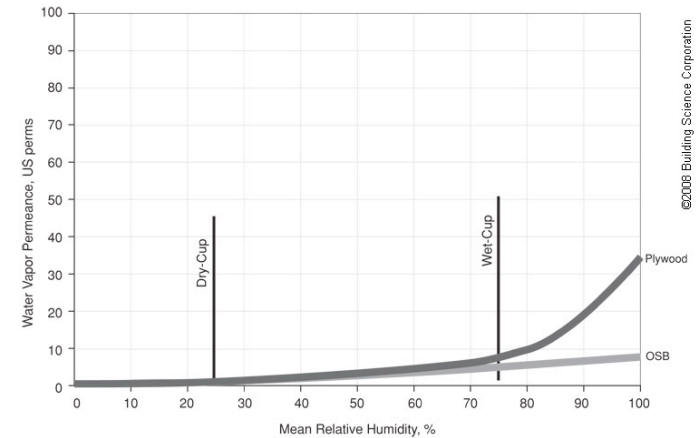
Outward and Inward Drying



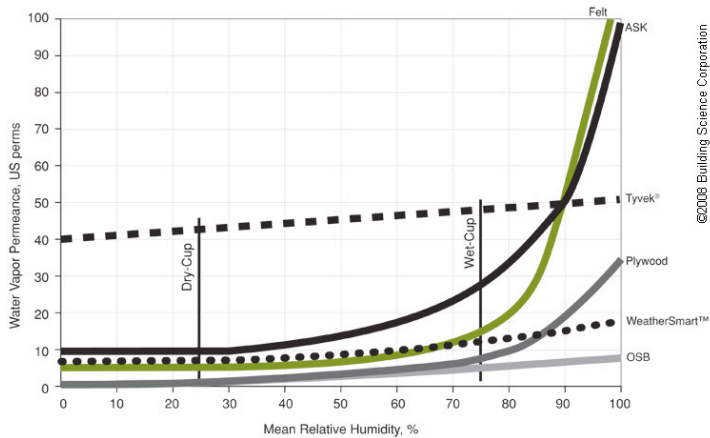
- Outer Layer Towards Cladding**
- Outer layer should be more vapor permeable than core
 - Housewrap/building paper should be more permeable than outer layer
 - Back-ventilating and draining exterior cladding makes exterior cladding more permeable than

- Inner Layer Towards Interior Gypsum Board**
- Inner layer should be more vapor permeable than core
 - Painted interior gypsum board should be more vapor permeable than inner layer

Water Vapor Resistance of OSB and Plywood

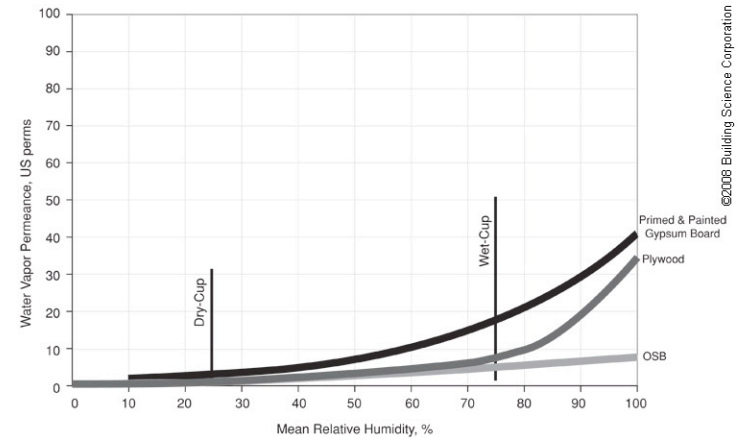


Housewraps and Building Papers



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Painted Gypsum Board



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Vapor Control Code Language

The 2007 Supplement to the IRC currently defines vapor retarders under three classes:

Class I: 0.1 perm or less

(Sheet polyethylene, non-perforated aluminium foil)

Class II: 0.1 perm \leq 1.0 perm

(Kraft faced fiberglass batts) [SIP wall panel]

Class III: 1.0 perm \leq 10 perm

(Latex or enamel paint)

Applicable Code Sections

2006 International Residential Code for One and Two-Family Dwellings

- R202 Vapor Retarder
- N1102.5 Moisture Control

2007 Supplement to the 2006 International Residential Code for One and Two-Family Dwellings

- R202 Vapor retarder Class
- N1102.5 Vapor retarders
- N1102.5.1 Class III vapor retarders
- N1102.5.2 Material vapor retarder class

Building Science with Structural Insulated Panels (SIPs)

VENTED AND UNVENTED ROOFS

Theory: Vented and Unvented Roof Design

Either vented (“cold roof”) or unvented (“hot roof”)

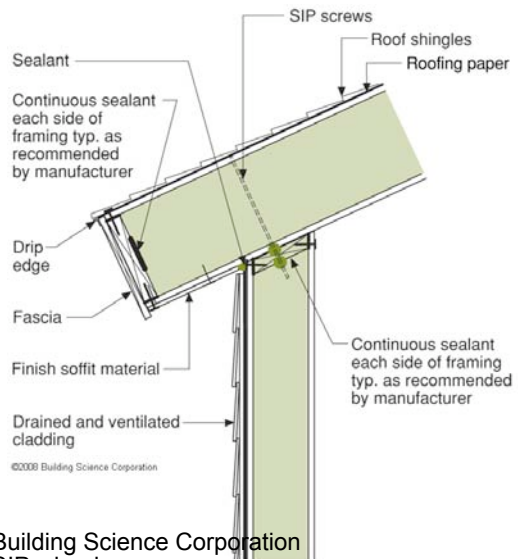
Why vent?

- Cold climates: cold roof surface to control ice dams, vent moisture
- Hot climates: expel solar heated air to reduce cooling

Other issues

- Roof complexity makes venting difficult
- HVAC system components

SIP Roof – Conditioned Attic Space



Applicable Code Sections

2006 International residential Code for One- and Two-Family Dwellings

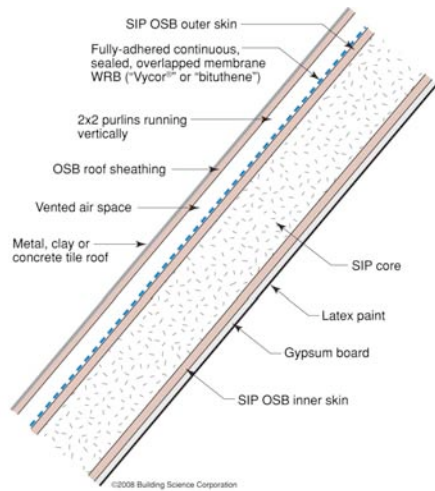
- R806.1 Ventilation required
- R806.2 Minimum area
- R806.3 Vent and insulation clearance
- R806.4 Conditioned attic assemblies

2007 Supplement to the International Residential Code

- R806.4 Unvented attic assemblies
- Table R806.4 Insulation for condensation control

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Alex L. Lusk, Director of Research

Gulf Coast Hot-Humid Hybrid Roof



Gulf Coast Hot-Humid Roof

- Fully-adhered, continuous, sealed, overlapped membrane water resistive barrier (WRB)

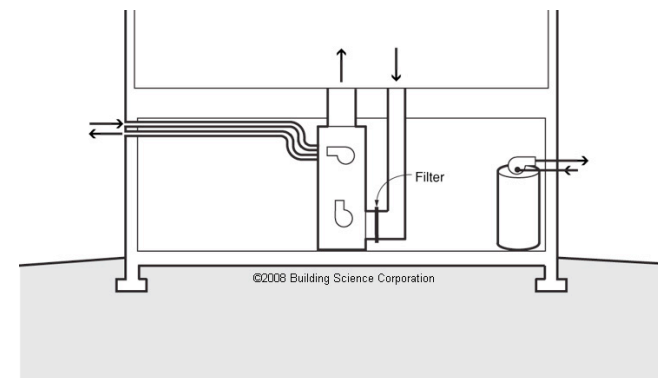
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HVAC FOR AIR TIGHT, ENERGY-EFFICIENT BUILDINGS

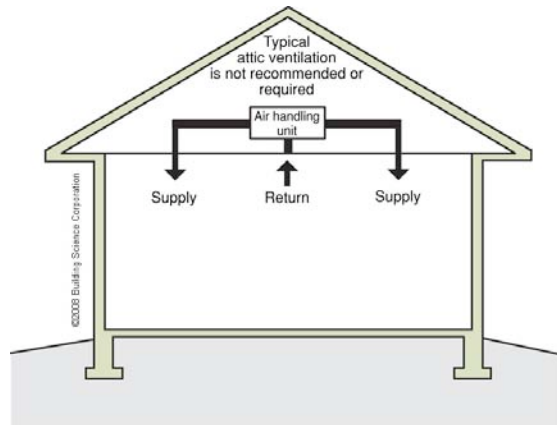
General Principles

- Use sealed combustion, power-vented appliances
- HVAC inside conditioned space
- Provide balanced ventilation system
- Effective ventilation for the whole house
- Properly size HVAC system
- Consider HRV in Cold climates
- Provide supplemental dehumidification in Hot-Humid climates

Use Sealed Combustion and Power-Vented Appliances

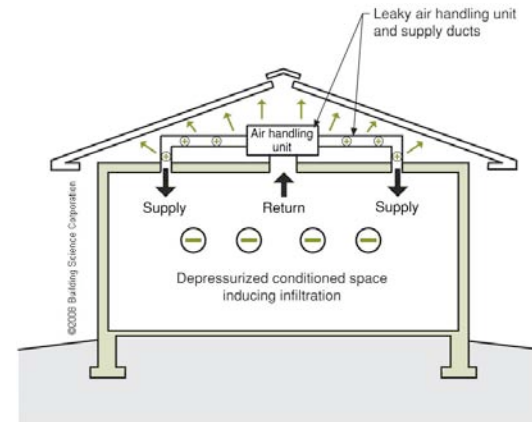


Unvented, Conditioned Attic allows HVAC inside conditioned space



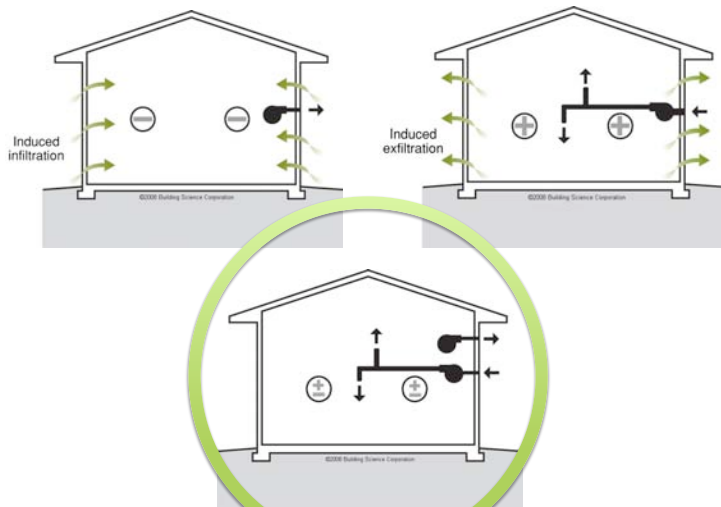
Note: Colored shading depicts the building's thermal enclosure and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.

Not recommended: HVAC outside conditioned space

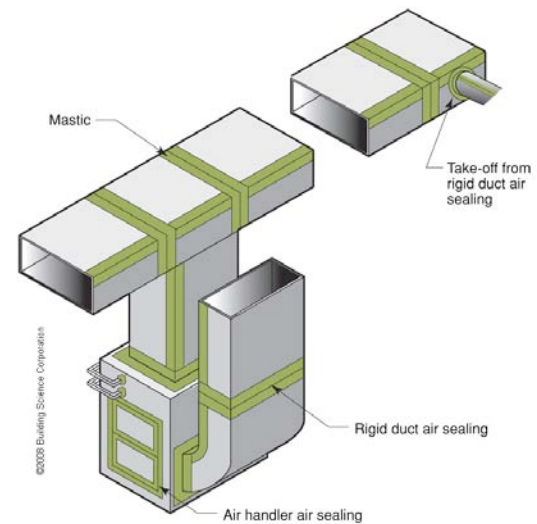


Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.

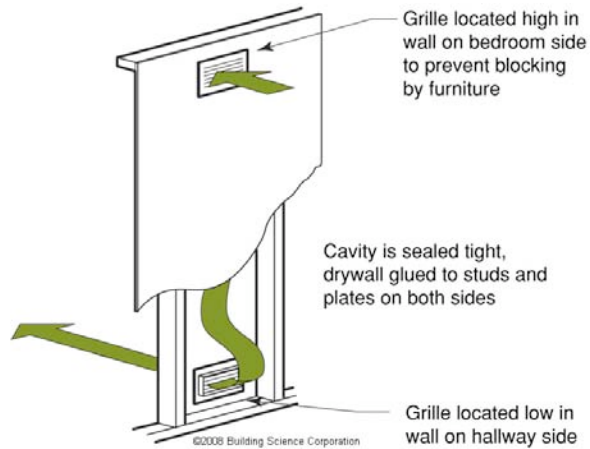
Provided Balanced Ventilation System



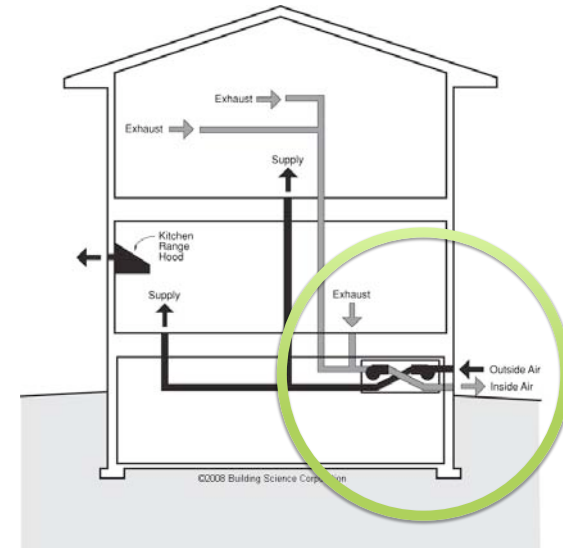
Effective Distribution for the Whole House



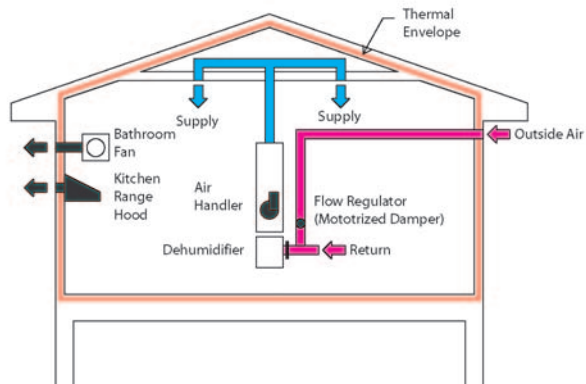
Effective Distribution for the Whole House



Consider Heat Recovery in Cold Climates



Provide Supplemental Dehumidification in Hot-Humid Climates



SIPs and Green Building Rating Programs

NAHB Green Building Standard

- 2.1.6 Use pre-cut or pre-assembled building systems or methods (12 points)
- 3.3.1 Building Envelope – SIPs (8 points)

Also

- Framing plans, layout
- Resource efficiency
- Airtightness and insulation
- HVAC design

Other programs also give credit for SIP construction

Building Science with Structural Insulated Panels (SIPs)

RESOURCES

New Builder's Guide to Structural Insulated Panels (SIPs)



Available at the SIPA Store – www.sips.org

Online Resources

This presentation is available at

www.buildingscienceseminars.com/presentations
www.sipschool.org/ (home page)

General Building Science

www.buildingscience.com

About SIPs and SIPs Construction

www.sips.org

www.sipschool.org

High-performance building in Louisiana

LSU's AgCenter "LaHouse" - www.louisianahouse.org

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Contact Us



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alex@buildingscience.com

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