Building a Livable Home

Making a Building Livable
Find This Presentation

http://www.kenergy.us
What makes a home livable

• Comfort is number one . . . Right?
• You think people want fresh air? Do they associate it with health?
• A satisfying environment in which to live . . . That’s the overall feel of a home.
• How about the durability of the home?
• What else?
Durability may be the Key to Success – Why?
Today’s Agenda

• Trends in construction – materials and methods
• Applications of building science – a bit of what you need to know about building system integration
• The wall system – Drainage Plane, Thermal Barrier, Air Barrier, Vapor Retarder
• House tightness and ventilation
Trends in Construction

Changing materials and methods
Applications of Building Science

Heat Transfer

- Conduction
- Convection
- Radiation
• Conduction
  • The transfer of heat through a solid material, moving from warmer to cooler particles that are in direct physical contact.
Conductive Heat Loss

What is R-value?
Resistance

What is U-factor?
Conductance

Both are a measurement of a material or building assembly’s heat transfer properties

\[ R = \frac{1}{U} \] and \[ U = \frac{1}{R} \]
The transfer of heat through a moving fluid, either gas or liquid. The most common driving force for convective heat transfer is the tendency of a warm fluid to rise due to its lighter density.
Convection Drivers

- Wind
- Fans and Mechanical Systems
- Stack Effect
Airflow affects comfort
Solar Radiation

Building Envelope Principles

• Radiation

The transfer of heat by electromagnetic waves from a warmer to a cooler surface, where the medium is not affected by the transfer. To transfer heat by radiation from one surface to the another, the surface temperatures must be different.
Ultraviolet
2%

Visible Light
47%

Infrared
51%
Solar Heat Gain Coefficient (SHGC)

The ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation

Windows
Solar Heat Gain
SHGC Examples
The Importance of an integrated Building Envelope

Exterior “Filter”

- Separates Exterior from Interior
- Controls the Flow of:
  - Water (weather-resistive barrier)
  - Air (air barrier)
  - Temperature (insulation or thermal barrier)
  - Vapor (vapor retarder)
- The Aim: Maintain Continuity

Opaque Wall Function

Thermal

Weather

Air

Vapor

High Performance Construction

Alan Dunning, AIA – Miller Hull Partnership
Ned S. Kirschbaum, AIA – Fentress Architects

Skins: The Importance of the Thermal Envelope
Building Envelope Principles

The Drainage Plane
Building Envelope Principles

The Thermal Envelope
Vapor Retarders

Basic Requirements
2009 IRC R601.3.2 – 2012 IRC R702.7
Install on “warm-in-winter side” of insulation or inside of frame wall.
Building Envelope Principles

Vapor Pressure

- cooking
- showers
- other

High Vapor Pressure

Low Vapor Pressure
IRC Vapor Retarder Classification – R702.7.2 (2012)

Class I: Sheet Polyethylene, unperforated aluminum foil
IRC VR Classification – R702.7.2 (2012)

Class II: Kraft-faced fiberglass batts
Class III: Vapor Retardant Paints

IRC R601.3.1
Latex or enamel paint are considered a Class III Vapor Retarder
The main reason to retard the transmission of water vapor through building envelopes is to prevent it from condensing to liquid water within the structure.
What is an air barrier?

As Defined by the 2012 IECC

AIR BARRIER
Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or combination of materials.

CONTINUOUS AIR BARRIER
A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.
Why an air barrier
Misalignment

Insulation is not touching the sheetrock air barrier.

Sketch Courtesy of Advanced Energy Corporation
What affects air leakage?

First - Openings (holes) in the Envelope

Drivers – Such as Wind
What affects air leakage?

Fans and Mechanical Systems

Stack Effect
What’s the Impact?

Air-sealing is twice as effective as increasing insulation alone
Air Leakage

Where Does the Air Move?

- Windows: 10%
- Plumbing Penetrations: 13%
- Ducts: 15%
- Electric Outlets: 2%
- Floors, Walls, and Ceiling: 31%
- Fireplace: 14%
- Fans and Vents: 4%
- Doors: 11%
Is this a good air barrier?
Areas for Air Leakage (Infiltration)

Windows and doors
Between sole plates
Floors and exterior wall panels
Plumbing
Electrical
Service access doors or hatches
Recessed light fixtures
Rim joist junction
Air Leakage

Figure 4: Building America—air sealing trouble spots
 Critical Details - Advanced Energy Corp. or NAIMA

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### Critical Details - Air Sealing Installation

<table>
<thead>
<tr>
<th>CRITICAL DETAILS by NORTHWEST ENERGY STAR HOMES</th>
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</thead>
</table>

#### Mistake Proofing

**VERIFICATION**

**AIR SEALING INSTALLATION**

**Critical Details**

Items in bold are a requirement of the Northwest ENERGY STAR Homes Program.

<table>
<thead>
<tr>
<th>PRE-CHECK</th>
<th>SELF-CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All shafts/chases are capped</td>
<td>1. Plumbing/electrical/HVAC penetrations to exterior/unconditioned space are air sealed with foam, caulk, or mastic. NOfibrous insulation is used in fill holes.</td>
</tr>
<tr>
<td>2. All penetrating holes were cleanly cut using a saw and/or drill and are more than 1” larger than the penetrating object to allow for proper air sealing</td>
<td>2. Fire-rated caulking along with flashing or UL-rated collars must be installed continuous around all combustion flues and maintain proper clearance to combustion materials.</td>
</tr>
<tr>
<td>3. Work site is broom cleaned and all safety precautions are taken prior to beginning work.</td>
<td>3. Access doors to knee wall or crawlspace areas, attic hatches, and chimneys are weather stripped and insulated.</td>
</tr>
<tr>
<td></td>
<td>4. Recessed lighting fixtures installed in insulated assemblies are air tight IC-rated and sealed to drywall with caulk, foam, or gasket.</td>
</tr>
<tr>
<td></td>
<td>5. Backer rod or low expansion foam is used to seal around windows and doors.</td>
</tr>
<tr>
<td></td>
<td>6. Work site is broom cleaned after work is complete.</td>
</tr>
</tbody>
</table>

Installer's Name: ____________________________

Builder Name: ____________________________

Builder's Job #: ____________________________

Builder's Date: ____________________________

This Verification form should be signed and filled out by the Installer. Signing this form certifies that all Critical Details are correct and are as designated.

**CRITICAL DETAILS by NORTHWEST ENERGY STAR HOMES**
Resources . . .

Idaho Codes
www.idahoenergycode.com

Vapor Retarders information and Critical Details
www.naima.org

Flashing and Drainage Plane Details
www.Buildingscience.com
Next Session

Whole House Ventilation