Decoding 2016 Envelopes

Let's Talk About Res & Nonres High Performance Walls and Attics

Recording For Future Use

- Decoding Forms™
- Decoding CXR™
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- Decoding Electrical Distribution™
- Decoding Multifamily™
- Decoding 2016 Title 24, Part 6™
- Decoding Attics and Walls™
- Decoding 2016 Nonresidential Lighting™
- Decoding 2016 Resources™
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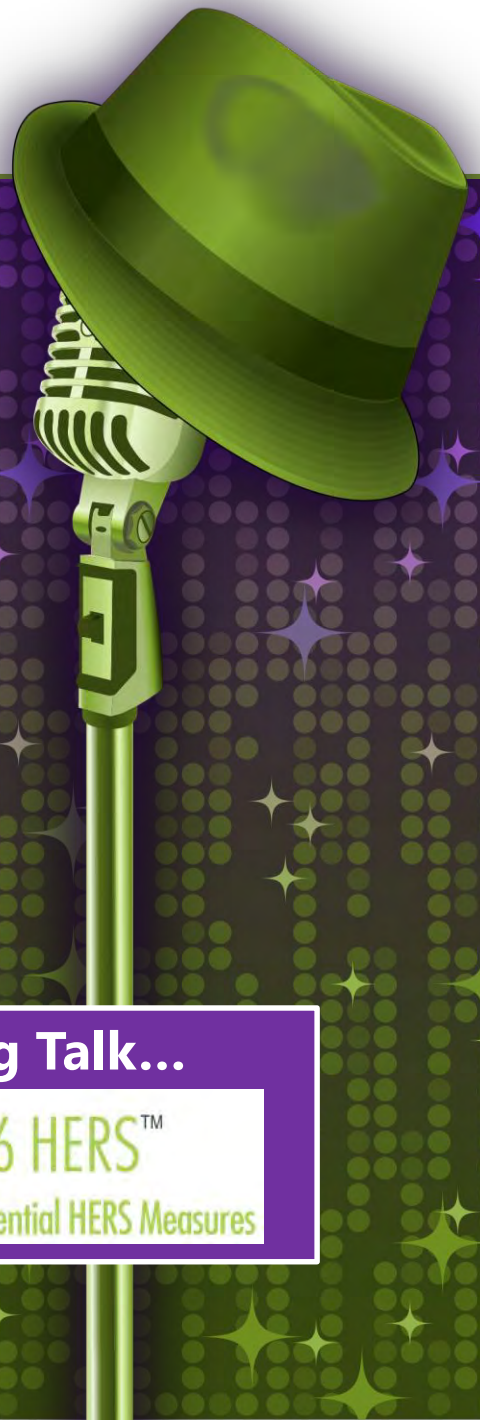
This session is being recorded.



Last Decoding Talk…

Decoding 2016 HERS™

Let's Talk Residential & Nonresidential HERS Measures

Brought to you by…

California Statewide Codes & Standards

SDGE A Sempra Energy utility®

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This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Who Are We?

Gina Rodda
Gabel Energy
gina@gabelenergy.com

GABEL ENERGY
BUILDING ENERGY ANALYSIS + ENERGY CODE COMPLIANCE

Host: Gina Rodda

Gina Rodda, our host for the Decoding Talk series, is a Certified Energy Analyst (CEA), and LEED Accredited Professional (AP).

She is involved in providing residential and non-residential energy calculations for a variety of building types throughout California; an instructor of full day trainings; and host of various webinars specific to Title 24 (Part 6) Building Energy Efficiency Standards.

Gina has been in the energy modeling field since 1991, starting the *ninth* California building energy code cycle of her career.

Who Are We?

Colin Shane
RDH Building Science, Inc.
cshane@rdh.com

RDH
Making Buildings Better

Co-Host: Colin Shane

Colin Shane, M.Eng., P.Eng. P.E. is Principal and Senior Project Manager at RDH Building Science, Inc. in San Francisco, CA and leads both new construction and rehabilitation building enclosure projects.

Colin's experience is varied and covers all components of the building enclosure including walls, glazing systems, balconies, and roofs, and ranges geographically across Canada and the United States.

Colin has a broad knowledge of building construction and applies building science principles to analyze and design durable, energy efficient building enclosures across the United States and Canada.

High Performance Walls and Attics

- Understand the strengths (and weaknesses) of various products are available in the market for high performance envelope features;
- How to address moisture and fire safety issues associates with high performance attics & walls;
- Review some methods on how to detail, specify, and construct these building features for success!

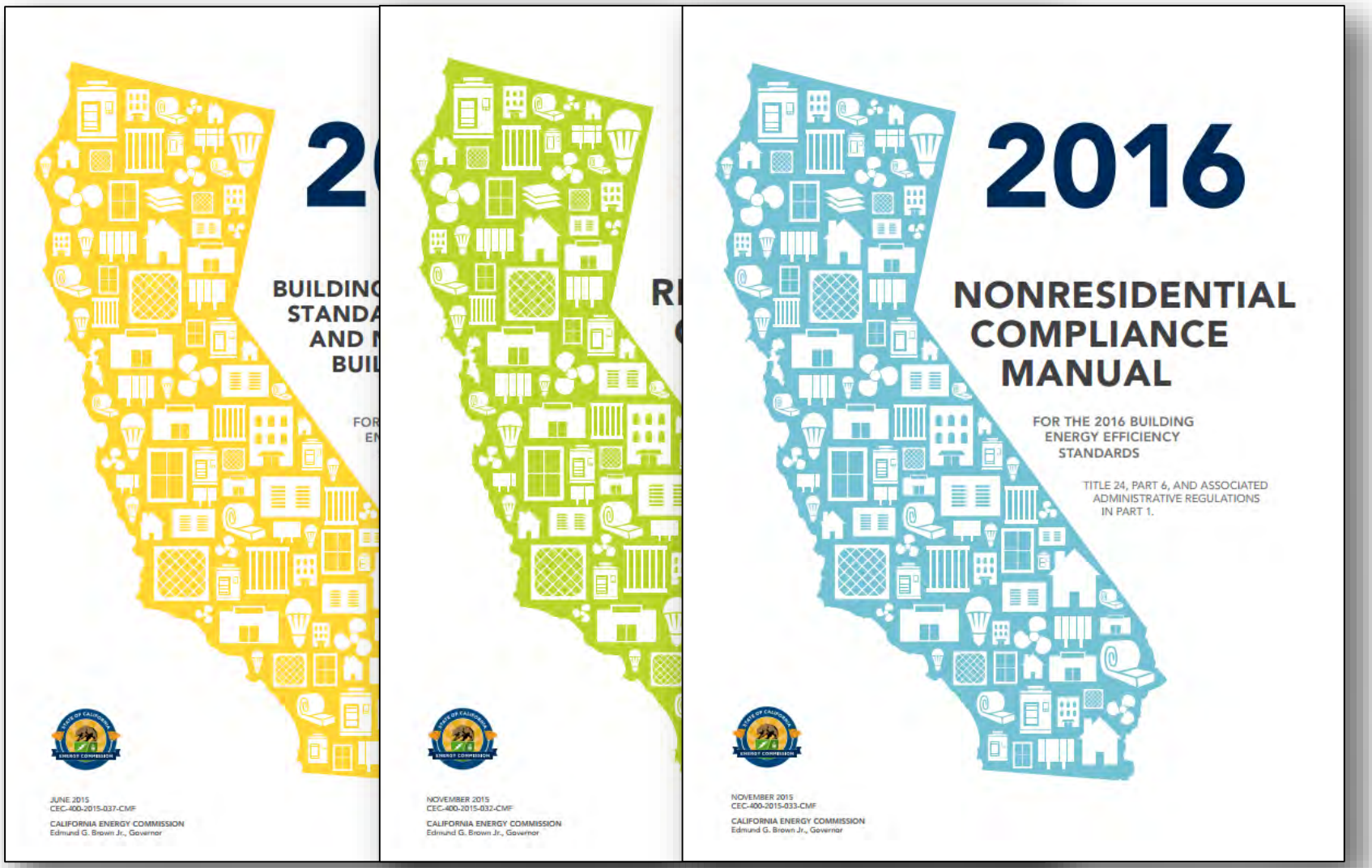
Agenda

Agenda for Today — Approx. Length

- Welcome..... 5 minutes
- Why?!..... 15 minutes
- Let's Talk
  - *Challenge A:* ..... *25 minutes*
  - *Challenge B:* ..... *10 minutes*
  - *Challenge C:* ..... *25 minutes*
  - *Challenge D:* ..... *25 minutes*
- Next Steps..... 10 minutes
- Wrap Up..... 5 minutes

Why?

What? Title 24 Part 6: Energy Code



http://www.energy.ca.gov/title24/2016standards/index.html

Ace Tools™

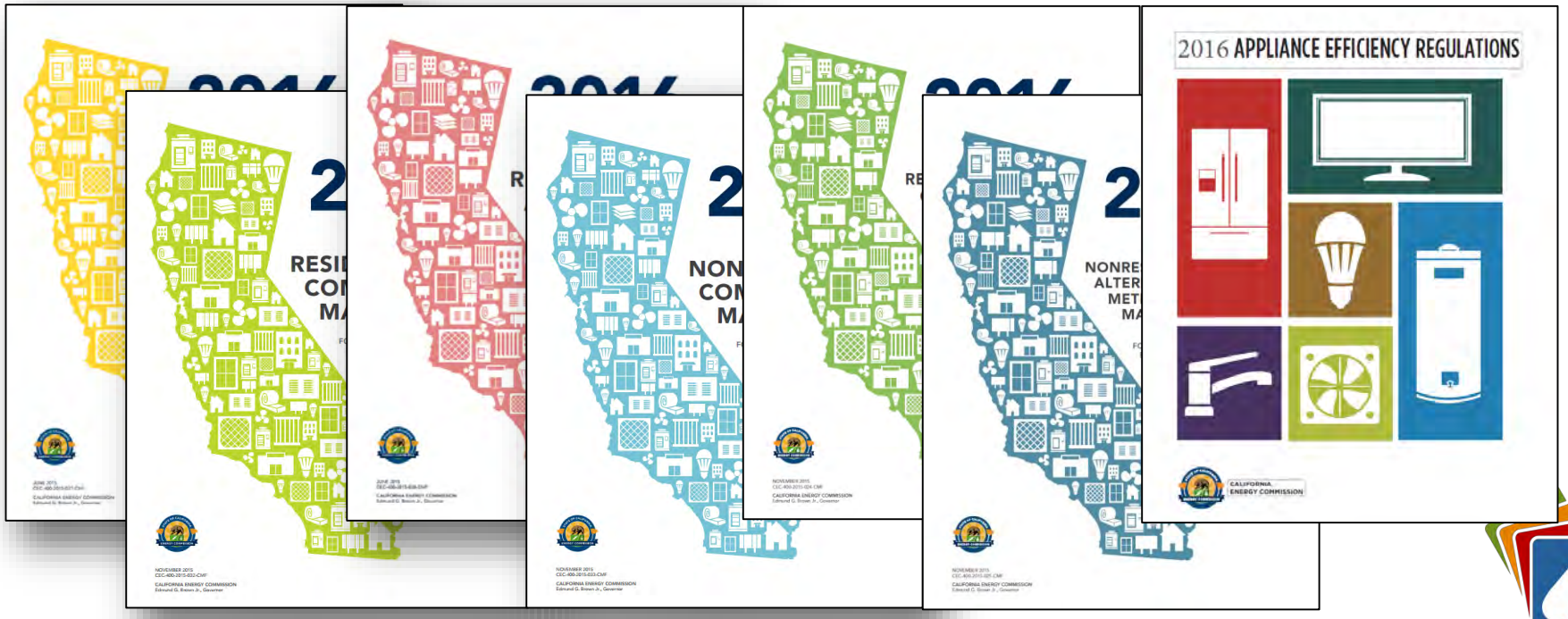
Helps you navigate the Standards using key word search capabilities, hyperlinked tables and related sections

2016 Building and Appliance Efficiency Regulations - Reference Ace v26

Contents | Index | Search

- 2016 BUILDING ENERGY EFFICIENCY STANDARDS
- REFERENCE APPENDICES
- RESIDENTIAL COMPLIANCE MANUAL
- RESIDENTIAL ACM REFERENCE MANUAL
- NONRESIDENTIAL COMPLIANCE MANUAL
- NONRESIDENTIAL ACM REFERENCE MANUAL
- TITLE 20 APPLIANCE EFFICIENCY REGULATIONS
- TITLE 20 APPLIANCE EFFICIENCY REGULATIONS (Appliance-Specific Sections Only

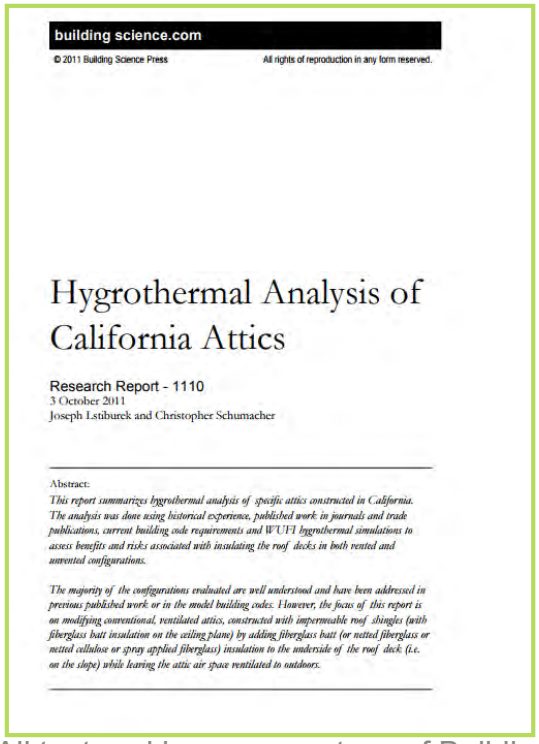
2016 Building Energy Efficiency Standards and Title 20 Appliance Efficiency Regulations Reference Ace Tool

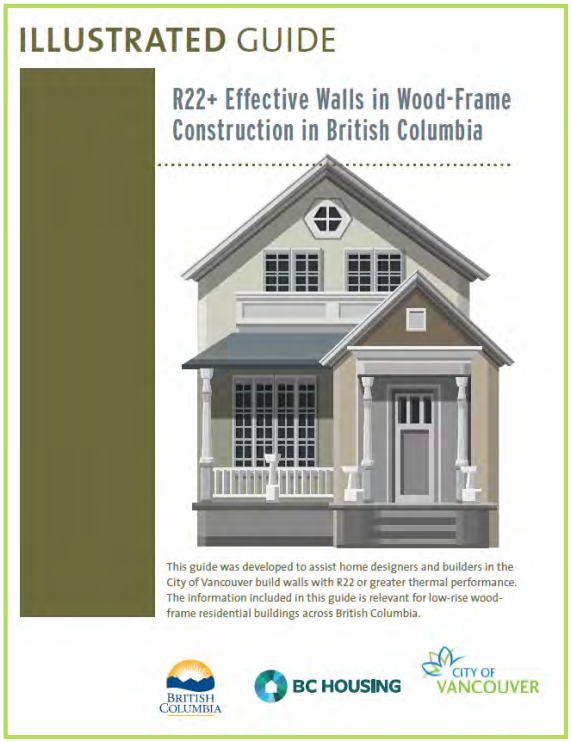


EnergyCodeAce.com/tools

Residential Handouts

- Guide to Insulating Sheathing
- R22+Effective Walls in Wood Frame Construction in British Columbia
- Hygrothermal Analysis of CA Attics





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Nonresidential Handout

ASHRAE Research Project Report RP-1365

Thermal Performance of Buildings Envelope Details for Mid and High-Rise Buildings

Approval: July 6, 2011

Contractor:	Morrison Hershfield 3585 Graveley Street, Suite 610 Vancouver, BC V5K 5J5
Principal Investigator:	Mark Lawton, Morrison Hershfield
Authors:	Patrick Roppel, Morrison Hershfield Wahid Marif, NRC
Sponsoring Committee:	TC 4.4, Building Materials and Building Envelope Performance
Co-Sponsoring Organizations:	Air-Conditioning, Heating, and Refrigeration Institute

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http://www.ashrae.org

RDH Building Engineering Ltd.

FPInnovations

Homeowner Protection Office
Branch of BC Housing

Canadian Wood Council | Conseil canadien du bois

Guide for Designing Energy-Efficient Building Enclosures

for Wood-Frame Multi-Unit Residential Buildings in Marine to Cold Climate Zones in North America

SP-53 FPINNOVATIONS

Code Shift to Effective R-values

Effective R-values

- **Old way:**
  - **Nominal R-values** are the rated R-values of insulation materials which do not include impacts of how they are installed
    - *Example: 5.5" with R-20 batt insulation and 2" R-10 rigid foam insulation*
- **New Way:**
  - **Effective R-values** are the actual R-values of assemblies which include for the impacts thermal bridging through the insulation
    - *Example:*
      - *nominal R-20 batts within 2x6 steel studs 16" o.c. becomes:*
        - *Metal Stud: ~R-9 effective*
        - *Wood studs ~R-15 effective*

All text and images courtesy of Building Science Corp.

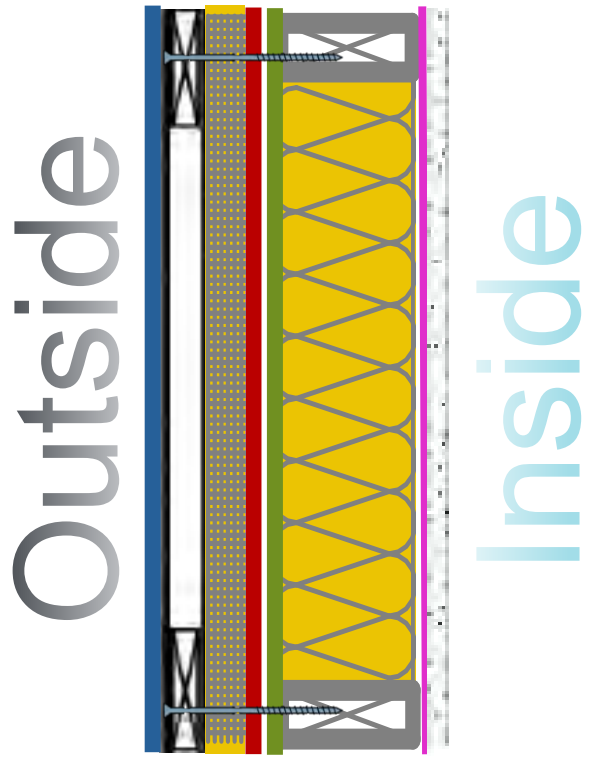
Building Enclosure Design

Fundamentals

- **Support**
  - Structural loads
- **Control** environmental loads between indoors from outdoors
  - Heat flow
  - Air flow
  - Vapor diffusion / condensation
  - Water penetration
  - Light and solar radiation
  - Noise, fire, and smoke
- **Finish**
  - Being durable and maintainable
  - Looking good!

All text and images courtesy of Building Science Corp.

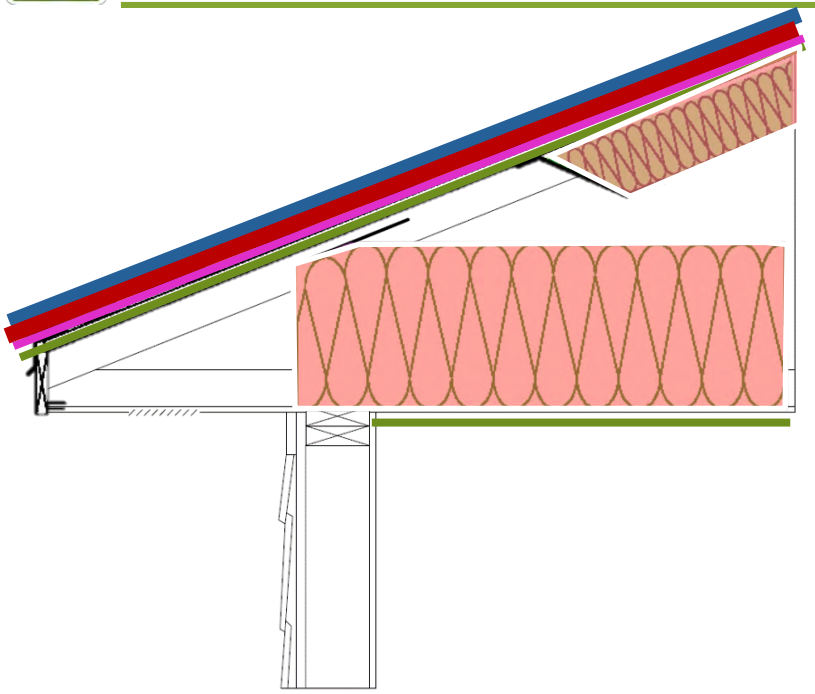
Walls

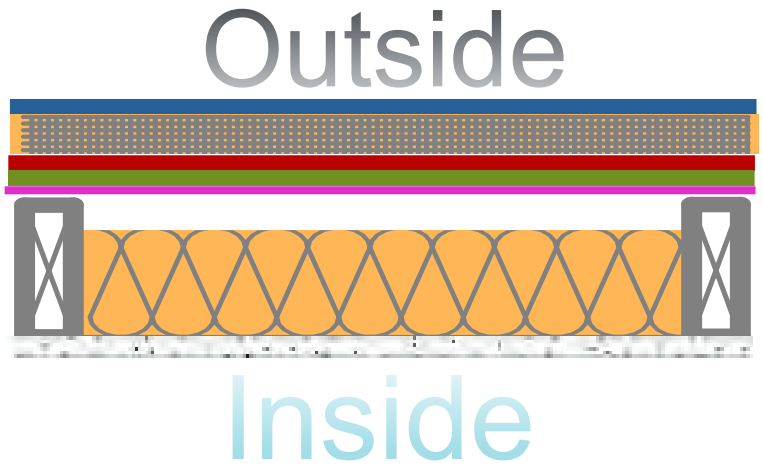


Wall Assembly

- Structure
  - Framing material
    - Wood or metal framing
    - Mass (i.e. concrete)
- Control Layers
  - Continuous (or interrupted) insulation
  - WRB
  - Air barrier
  - Vapor retarder
- Finish (Cladding)
  - Rainscreen assembly
    - Water shedding surface (exterior finish)
    - Secondary barrier (WRB) with ventilation/drainage gap

Roofs





Roof Assembly

- **Structure**
  - Framing material
    - Wood or metal framing
    - Mass (i.e. concrete)
- **Control Layers**
  - Water shedding surface (exterior finish)
  - Water Control Layer
  - Air Control Layer
  - Vapor Control Layer
  - Thermal Control Layers
    - Roof insulation
    - Ceiling insulation

Our Question To You

1. *What is your biggest challenge regarding "high performance" walls and roofs?*
2. *Do you have a tool, practice or tip to share that helps insure a successful design and installation of "high performance" envelopes?*
3. *What are your top 3 concerns regarding "high performance" envelope features?*
4. *If you could wave your magic wand, the CA energy code would include _____ regarding "high performance" envelope requirements?*

Seal it like one would seal a high performance duct system. Use tapes and sealants to make it air tight. It really takes effort and planning. It just does not happen.

Explaining & showing samples of what is required for both. If a builder is not up-to-date on the 2016 changes, they have not added the extra associated costs to their proposals!

Cost, using the products that are compatible with one another, and quality control.

Let's Talk

Challenges

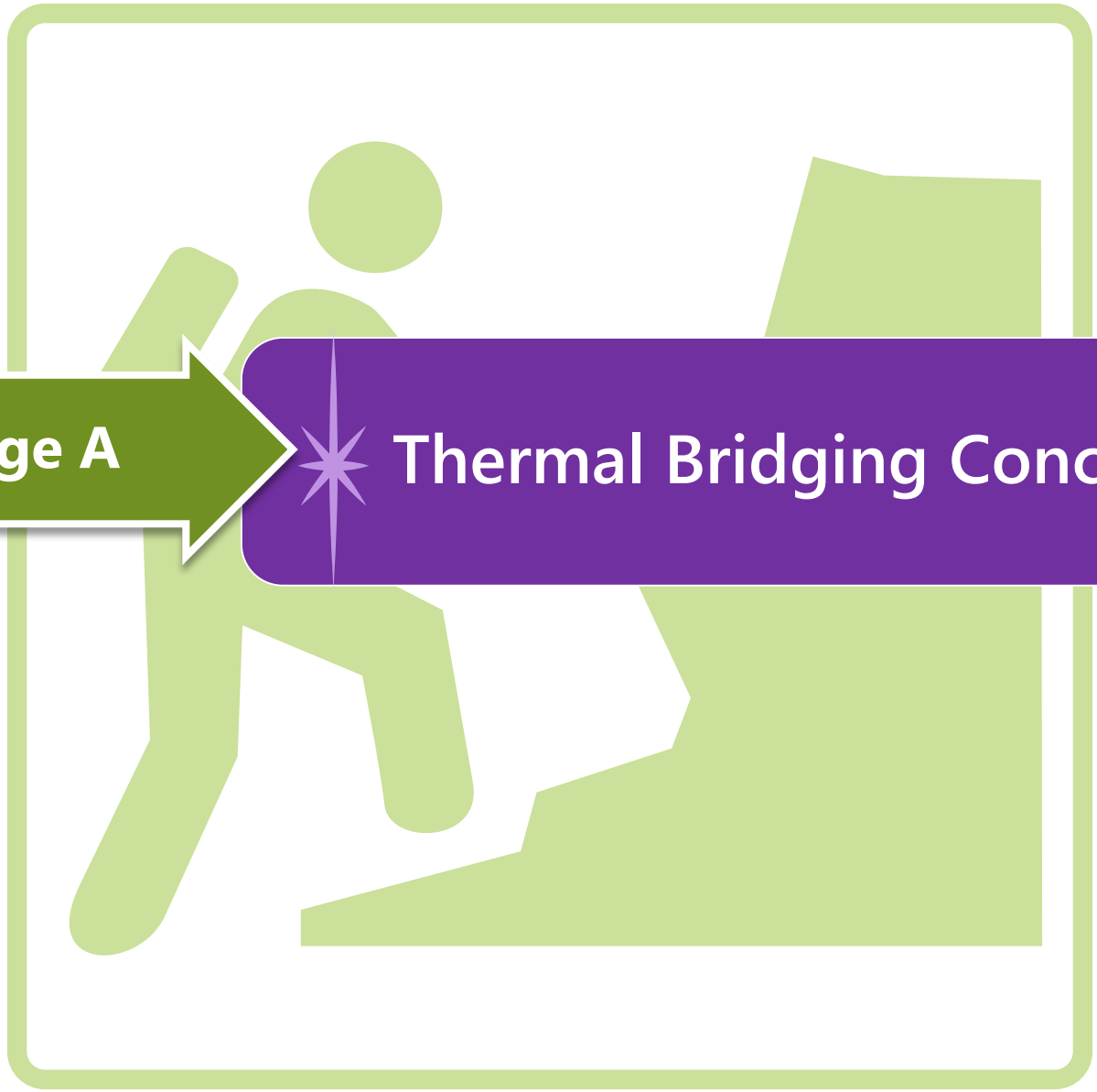
- Challenge A:
  - Thermal Bridging Concerns

- Challenge B:
  - Fire Concerns

- Challenge C:
  - Moisture Concerns

- Challenge D:
  - Solutions to Concerns

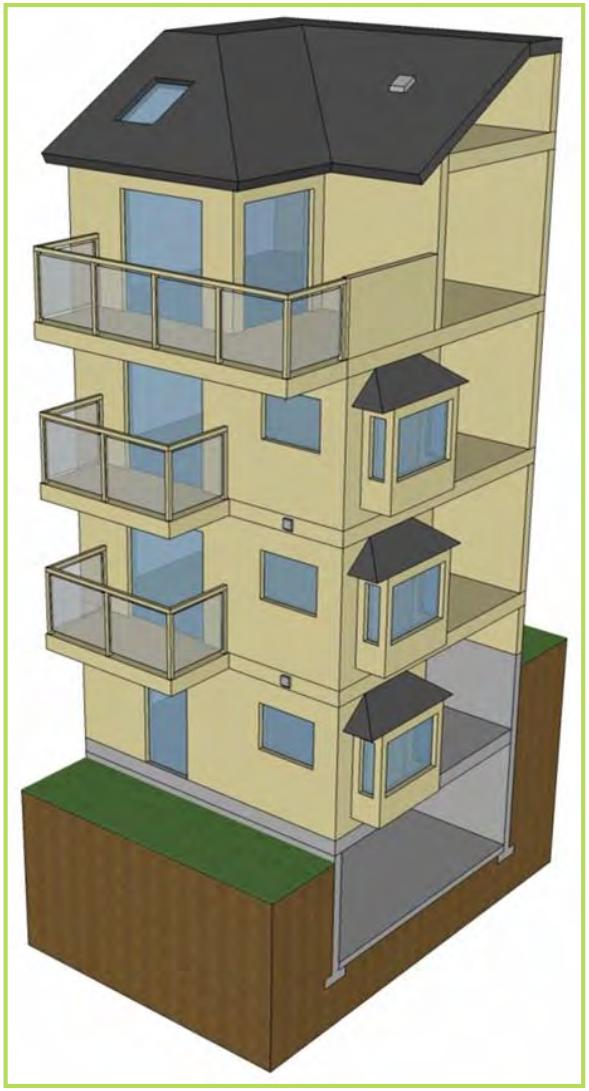
Challenge A



Challenge A

Thermal Bridging Concerns

Building Enclosure Design



Heat Flow/Air Flow

- **Support**
  - Structural loads
- **Control** environmental loads between indoors from outdoors
  - Heat flow
  - Air flow
  - Vapor diffusion / condensation
  - Water penetration
  - Light and solar radiation
  - Noise, fire, and smoke
- **Finish**
  - Being durable and maintainable
  - Looking good!

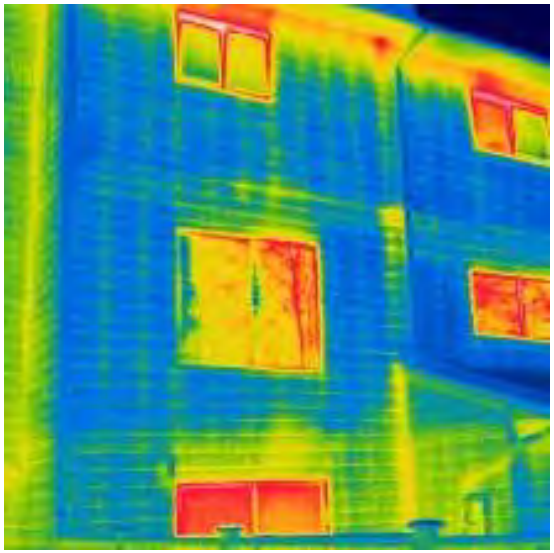
Old Way

New Way: "Light & Tight"

All text and images courtesy of RDH Building Science Inc.

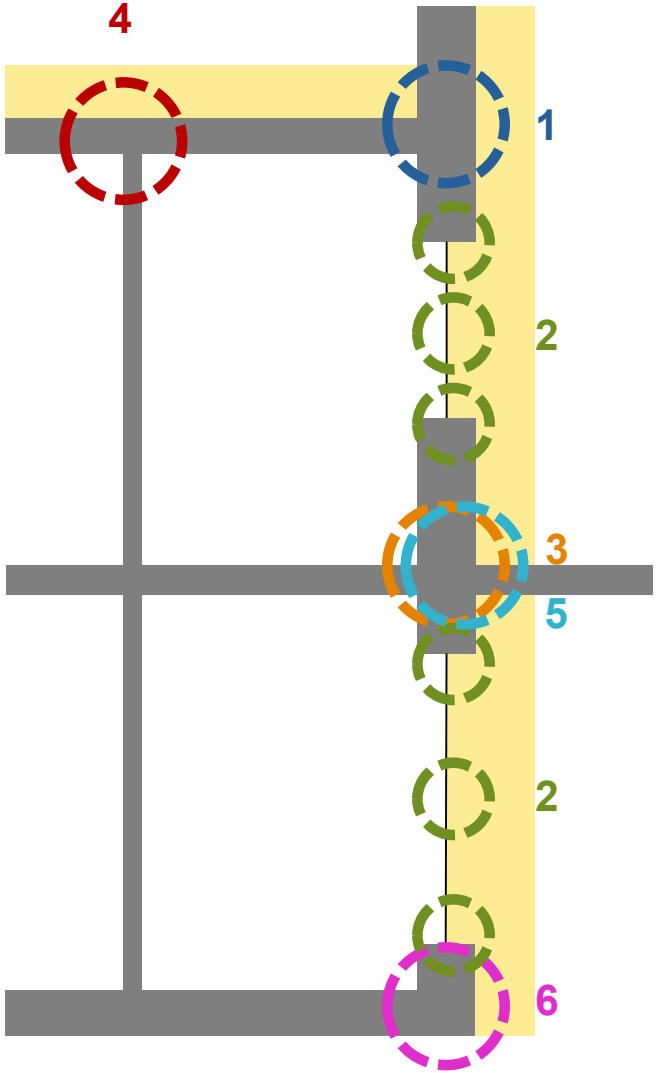
Thermal Bridging Concerns

Walls and Roofs



- Thermal Bridging occurs when a conductive material (e.g. aluminum, steel, concrete, wood etc.) provides a path for heat to bypass installed insulation – reducing the overall effectiveness of the entire wall assembly
  - Heat flow finds the path of least resistance
  - A disproportionate amount of heat flow occurs through thermal bridges even if small in area (even <1% area matters!)
  - Everything matters even the screws/fasteners
  - Adding more insulation doesn't often solve the problem

Thermal Bridging

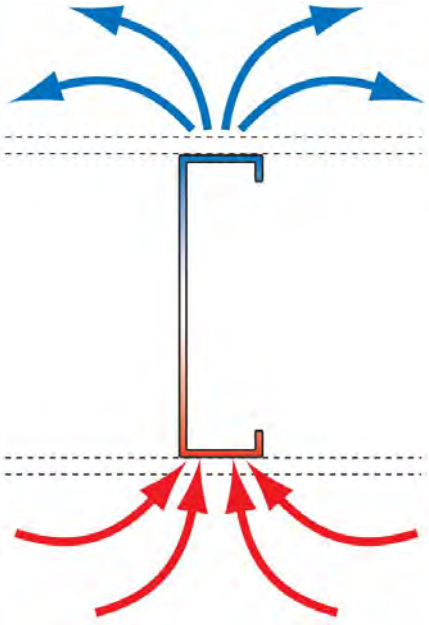


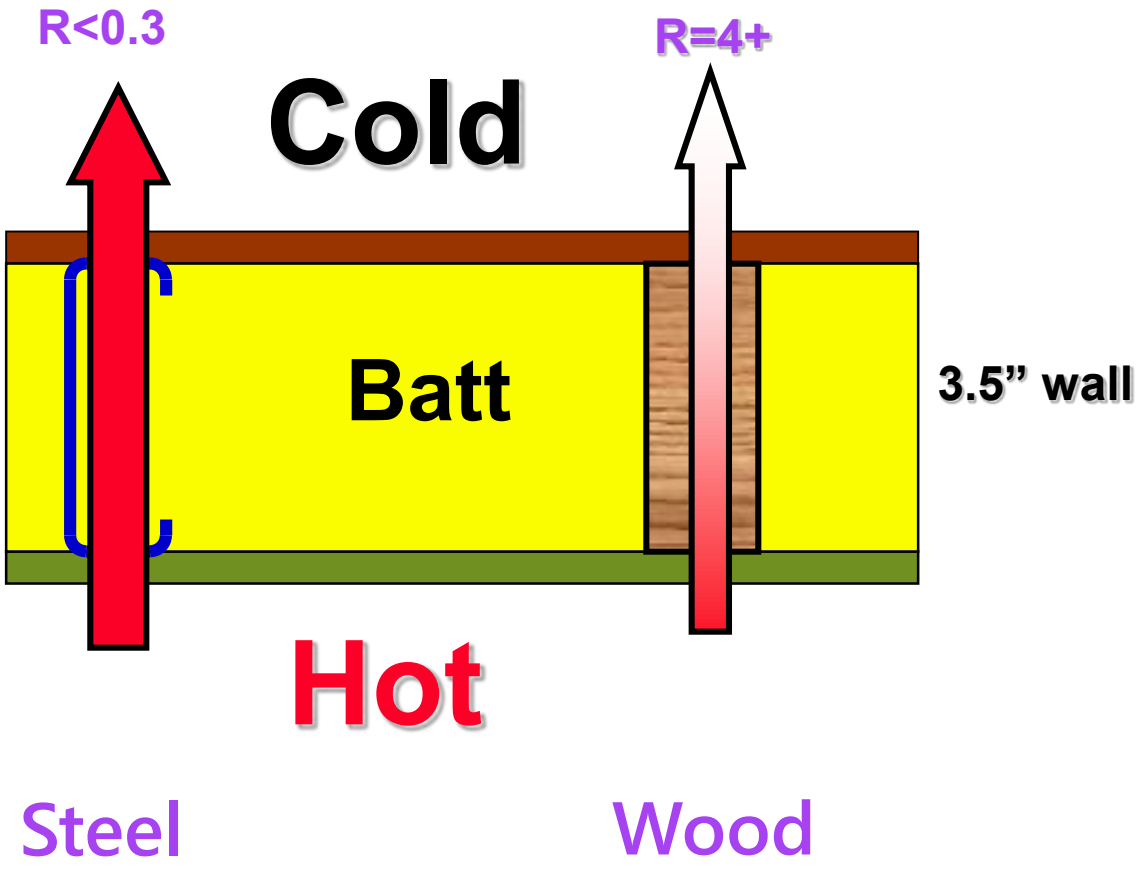
Main Offenders

1. At Eaves/Ridge
2. Window and Door Fitting – Head, Sill Jamb
3. At Projections, Shades Or Intermediate Floors
4. Internal Walls to External Walls
5. Intermediate Floors
6. At Grade

Thermal Bridging

Steel is 400 times more conductive than wood





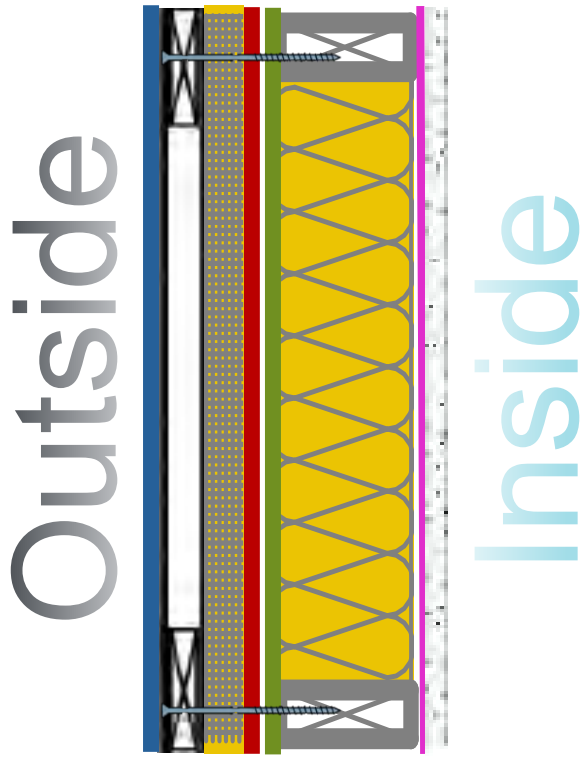
We Know Better Than This…

All text and images courtesy of RDH Building Science Inc.

But Still Try to Get Away with this…

Thermal Bridging Concerns

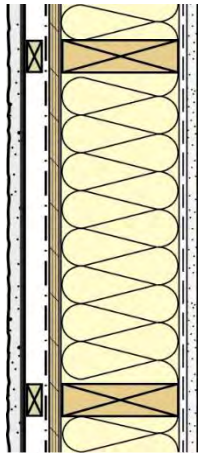
Walls



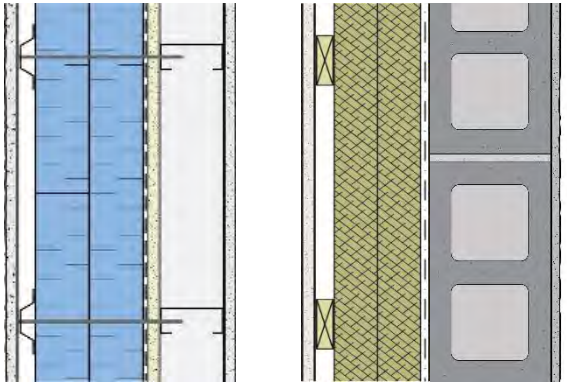
- Structure
  - Framing material
    - Wood or metal framing
    - Mass (i.e. concrete)
- Control Layers
  - Continuous (or interrupted) insulation
    - E.g. insulated sheathing on the exterior
      - Extruded polystyrene
      - Polyisocyanurate
      - Rockwool
      - EPS (esp. for EIFS)
    - Typically 1" or more needed
  - WRB
  - Air barrier
  - Vapor retarder
- Finish (Cladding)

How To Get There?

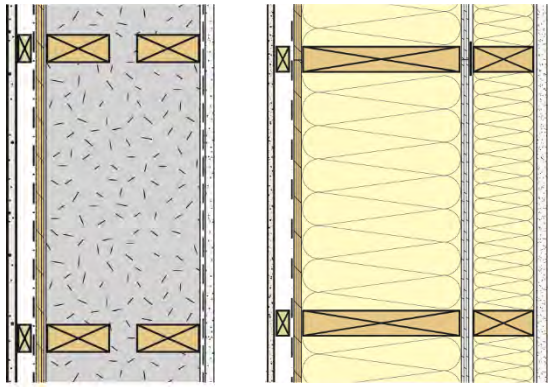
Base 2x6 Framed Wall *<R-16 (wood)*



Exterior Insulation
R-15 to R-60+



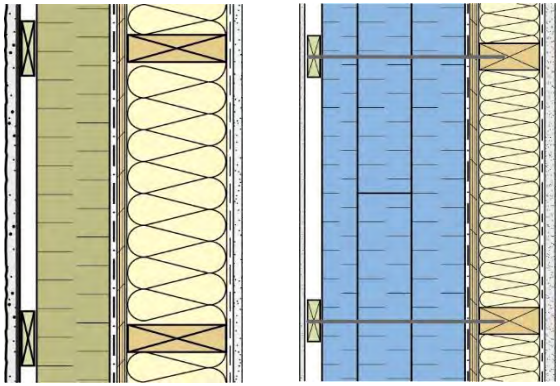
Issues: cladding attachment, thickness



Deep Stud, Double Stud, SIPS
R-20 – R-80+

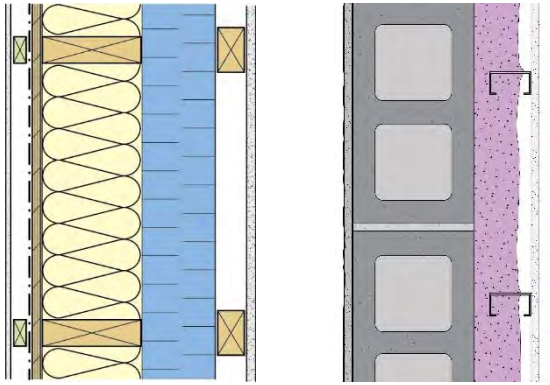
Issues: thermal bridging, thickness, durability

Split Insulation R-20 to R-60+

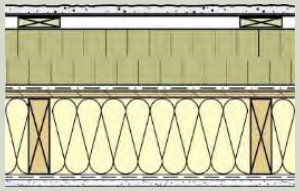
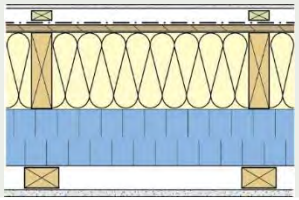
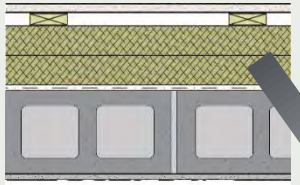
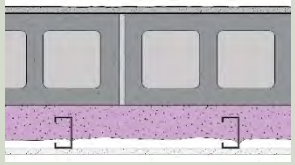


Issues: cladding attachment, material selection

Interior Insulation
R-20 to R-30+

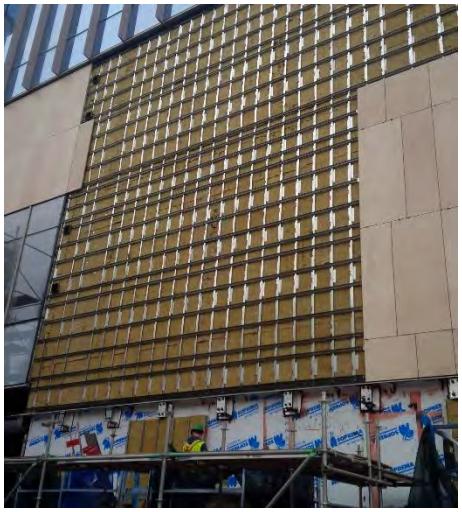


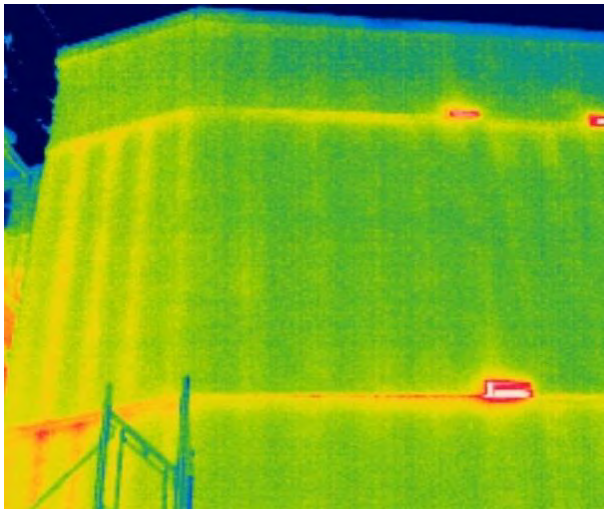
Issues: thickness, durability, interior details

Assembly Type	Key Considerations
Framed: Split Insulated Exterior 	The vapor permeability of the sheathing membrane and the exterior insulation should be carefully considered so as not to create a risk of condensation within the assembly, or to intolerably reduce the ability of the assembly to dry.
Framed: Interior Insulated 	Durability of the exterior sheathing is decreased because temperature and drying ability of exterior sheathing is slightly. Interior insulation is interrupted by floors, so floor edge thermal bridging not improved.
Framed: Double Stud 	Continuity of the air barrier and installation of a vapor barrier are fundamental to the performance of this assembly as the slightly decreased exterior sheathing temperature increases the risk of condensation and related damage.
Mass: Exterior 	Above-grade, this is an extremely durable and efficient assembly. Below grade, since foundation walls can be difficult and expensive to access post-construction it is prudent to design these assemblies conservatively with respect to water penetration and to use durable materials.
Mass: Interior 	Temperature of exterior mass wall is decreased by insulation; need to consider condensation risk in conjunction with air and vapor barriers. Interior insulation is interrupted by floors, so floor edge thermal bridging not improved.

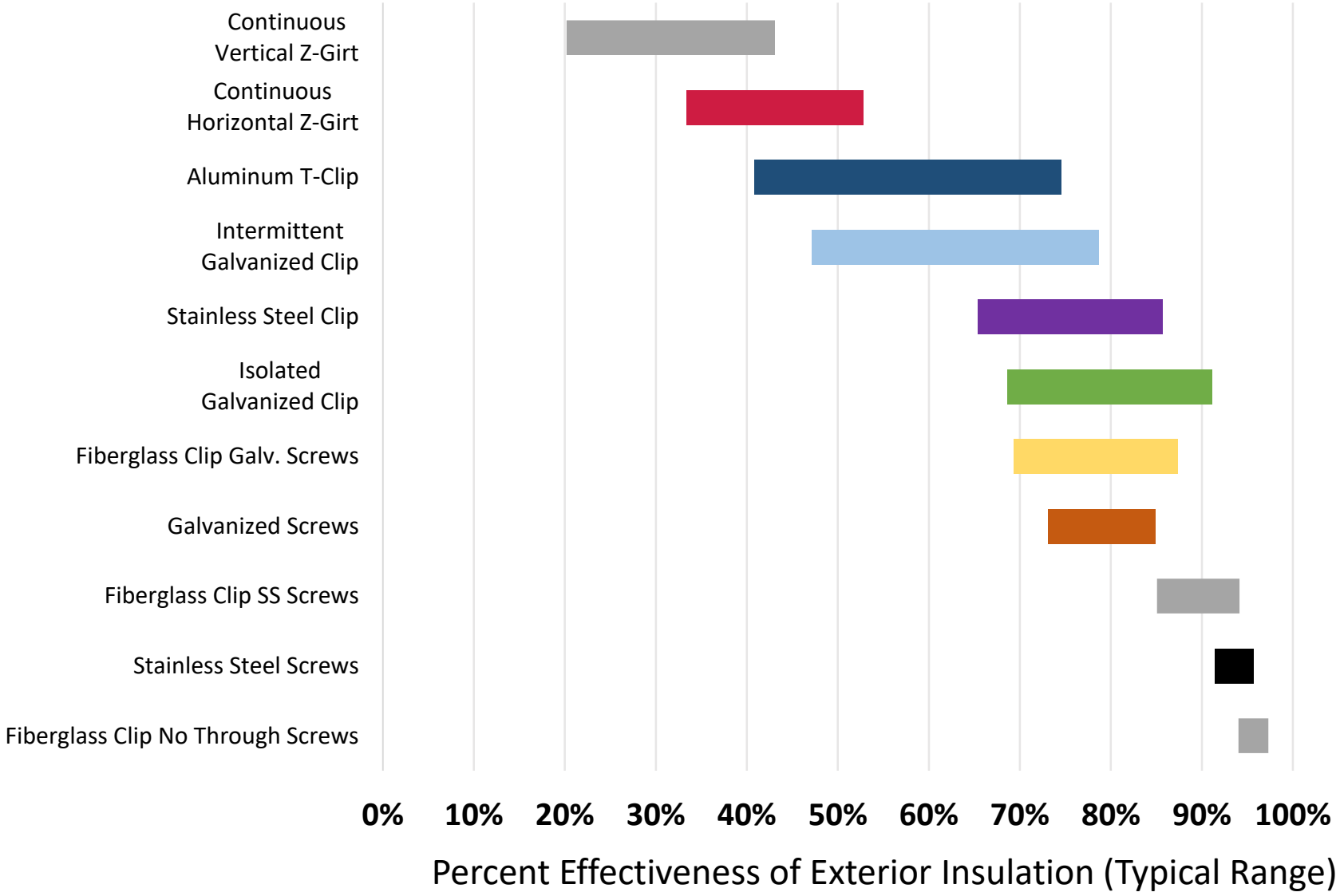
Concerns

- Exterior insulation is only as good as the cladding attachment strategy:
  - What attachment systems work best?
  - What is and how to achieve true continuous insulation (ci) performance?
  - What type of insulation?





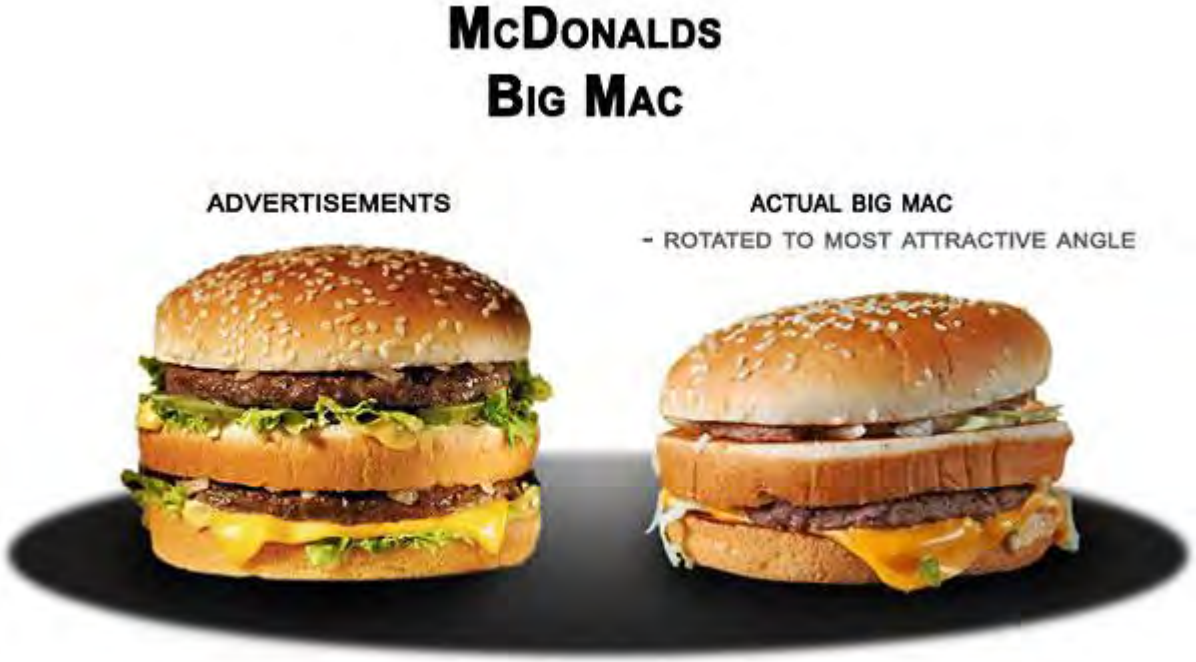
Summary of Cladding Support Performance



Cladding Support	Key Considerations
Fasteners through insulation	Cladding can be attached and supported by vertical strapping which is fastened with long screws through the exterior insulation and into the framed wall. This is in most cases the most thermally efficient mechanically fastened cladding support option, as thermal bridging of the exterior insulation is limited to the fasteners through the insulation. The strapping also creates a drainage space, capillary break, and ventilation cavity (i.e. rainscreen cavity) which is consistent with effective moisture-management techniques. In this arrangement, the rigid exterior insulation and fasteners will act in tandem to carry the cladding load. Extruded polystyrene (XPS), expanded polystyrene (EPS), polyisocyanurate(polyiso), and rigid mineral fibre insulations are suitable for this attachment method. Given the prevalence of this system in low-rise residential construction, further guidance on structural cladding support using screws through insulation is provided in the following pages of this section.
Proprietary Thermally Efficient Spacers and Clips	Proprietary thermally efficient spacer and clip systems can be used to facilitate installation and/or to support heavier claddings or resist larger wind loads. A number of systems exist, and selection should be made based on the thermal efficiency of the spacers in combination with the ability to support the required loads and accommodate the specified insulation thickness. Low conductivity materials such as fiberglass and stainless steel can provide excellent thermal efficiency. These spacer and clips systems provide the additional benefit of facilitating the use of semi-rigid (rather than rigid) insulation.
Continuous Strapping or Wood Spacers:	Cladding can also be supported using continuous wood strapping which penetrates the exterior insulation, or alternatively by standard strapping installed over wood spacers. When continuous wood strapping is used, the reduction of the thermal efficiency of the exterior insulation should be accounted for using a parallel paths approach, consistent with the approach for wood stud walls. Continuous strapping and wood spacers can also provide the additional benefit of facilitating the use of semi-rigid insulation rather than rigid.
Masonry Ties	In cases where masonry cladding is used, masonry ties are used to support the cladding in conjunction with bearing of the masonry on lintels or a shelf angle, consistent with standard practice for this cladding type. These ties can either be installed such that they penetrate the exterior insulation, or can be installed on the exterior face of thermally efficient spacer systems to reduce the thermal impact of the ties.
Structural Adhesive	In some systems, such as Exterior Insulated Finish Systems (EIFS), structural adhesives can be used to attach the exterior insulation and integrated cladding. An advantage of this system is that no structural elements must penetrate the insulation, so consequently there is essentially no reduction in the insulation effectiveness. Historically moisture related issues have been experienced with face-sealed EIFS; however, adequate performance is achievable when installed using rainscreen principles including drainage behind the insulation and good detailing over a robust water resistive barrier.

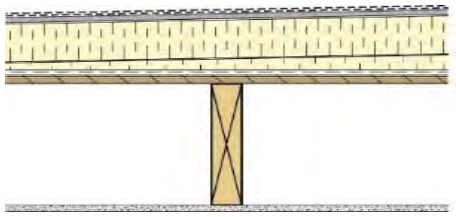
Other Challenges

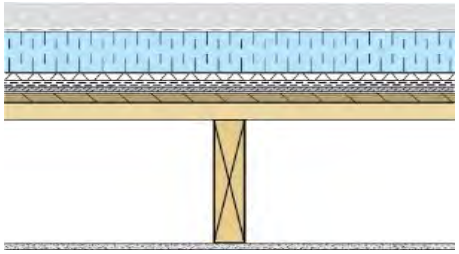
- Cladding and its attachment often a delegated design
  - If so, need to specify performance and design requirements appropriately
  - How do you avoid getting vertical z-girts or the like?

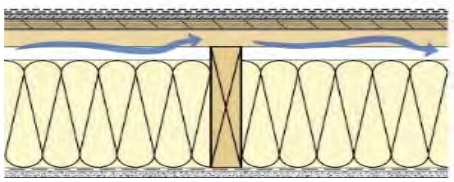


Thermal Bridging Concerns

Roofs

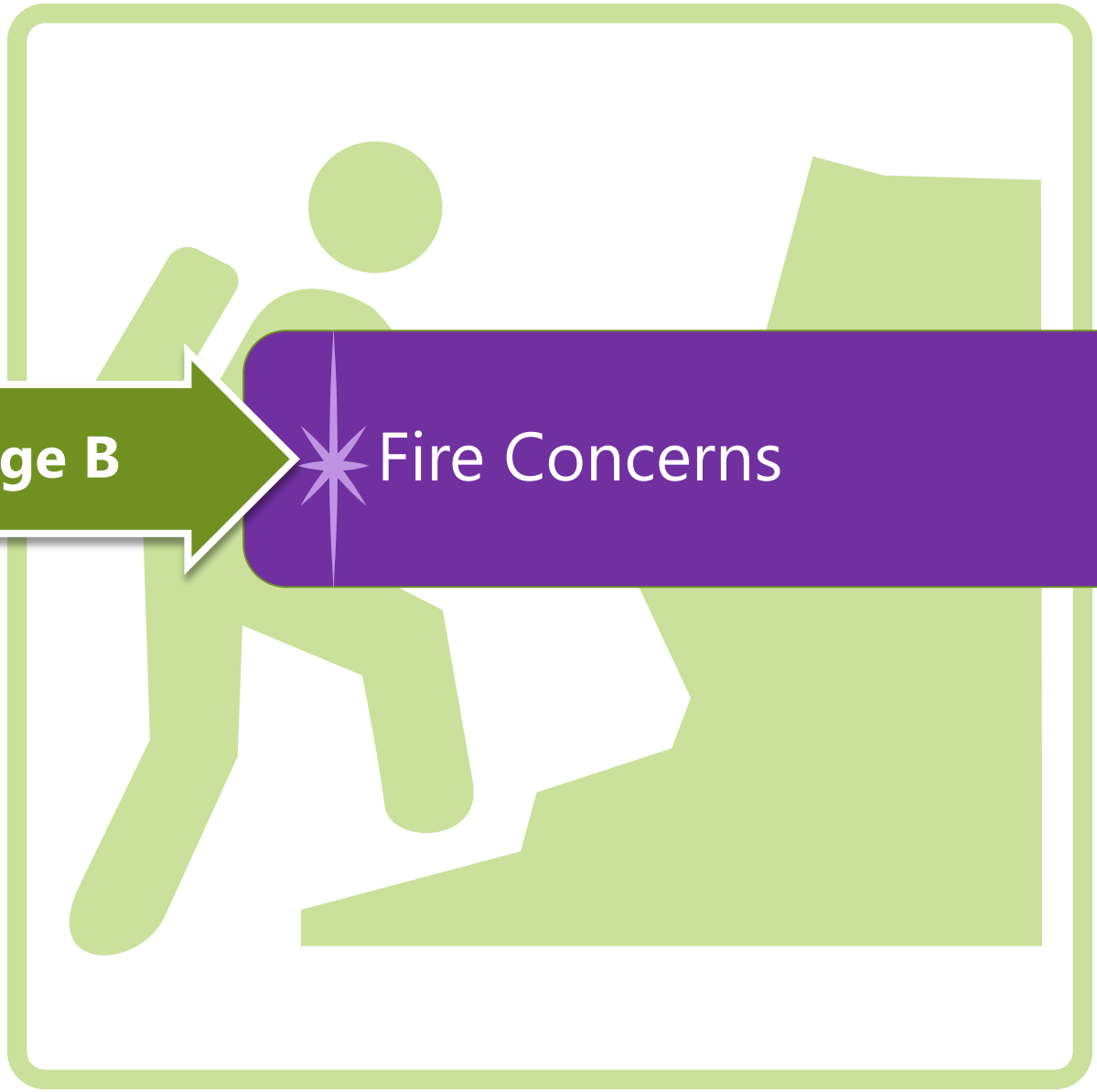






- Thermal bridging typically less of a concern on roof assemblies than walls
- If insulating above deck, mechanically fastening rigid insulation degrades insulation value
- Need to consider bridging if insulating between rafters or joists
- Parapets and other structural penetrations also significant thermal bridges

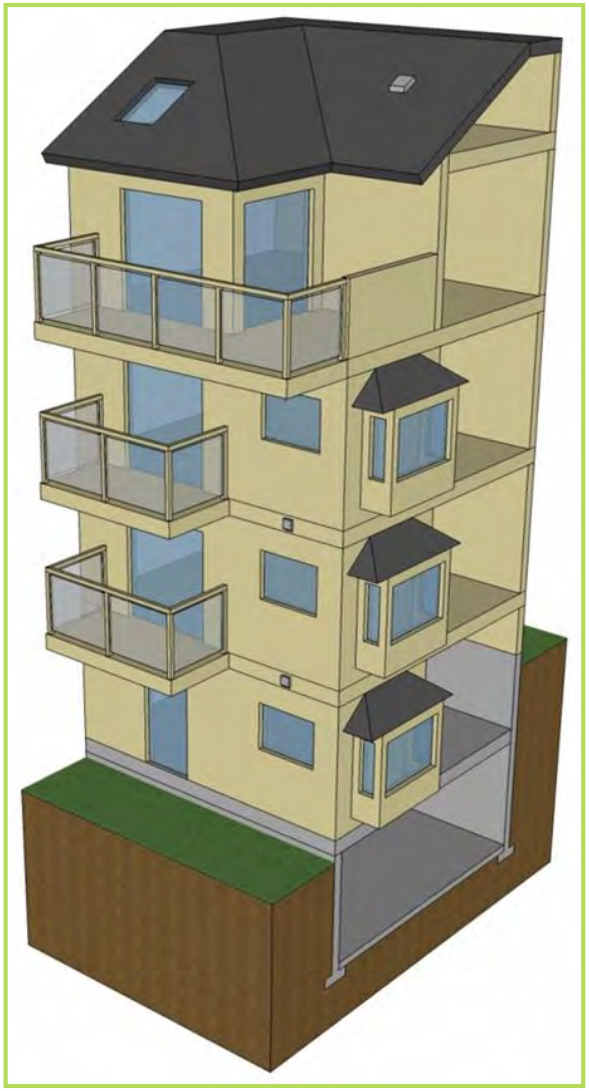
Challenge B



Challenge B

Fire Concerns

Building Enclosure Design



Heat Flow/Air Flow

- **Support**
  - Structural loads
- **Control** environmental loads between
  Separate indoors from outdoors
  - Heat flow
  - Air flow
  - Vapor diffusion / condensation
  - Water penetration
  - Light and solar radiation
  - Noise, fire, and smoke
- **Finish**
  - Being durable and maintainable
  - Looking good!

NFPA Variables to Consider

Insulation Type

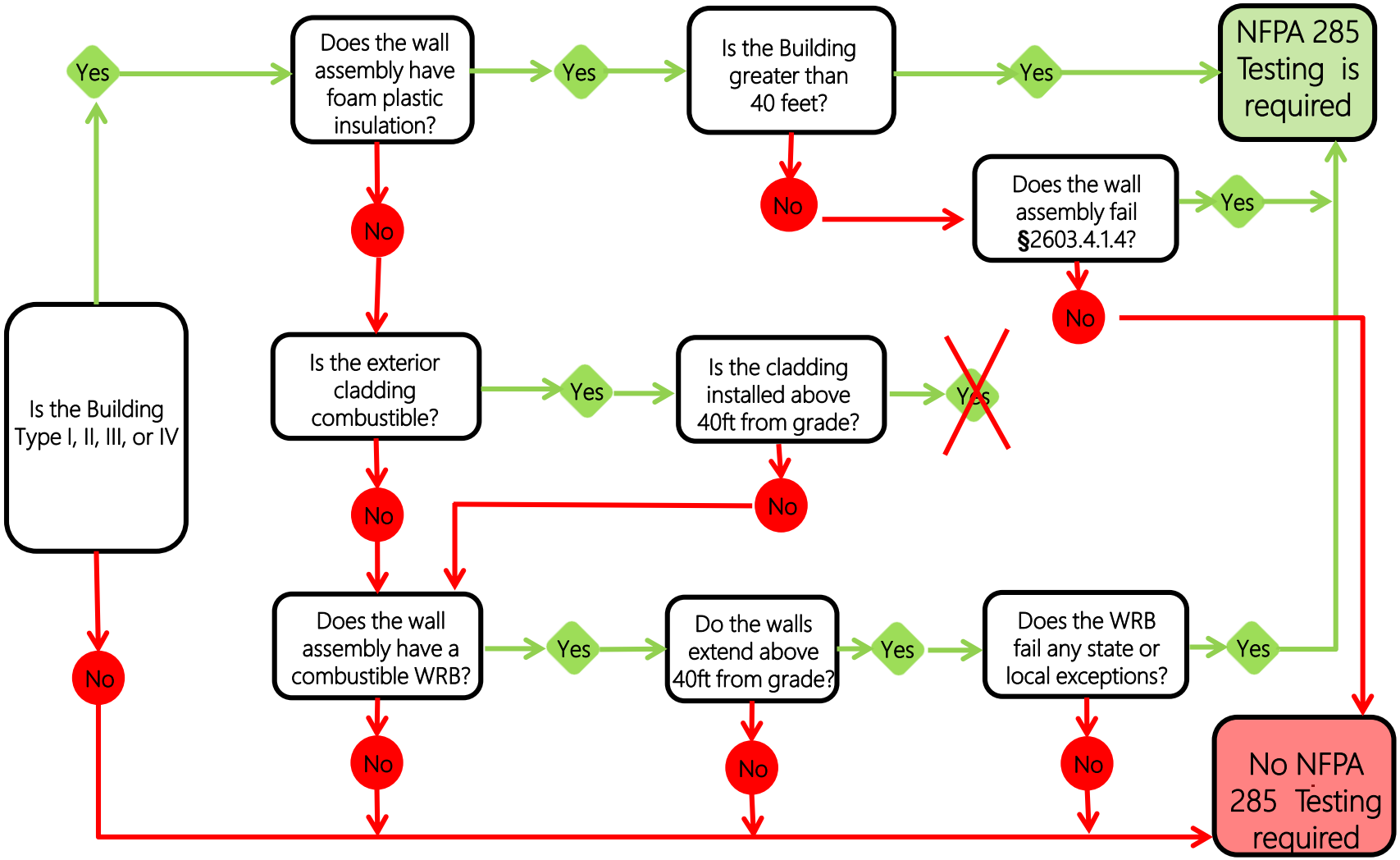
Using WRB?

Height>40'?

Type I – IV?

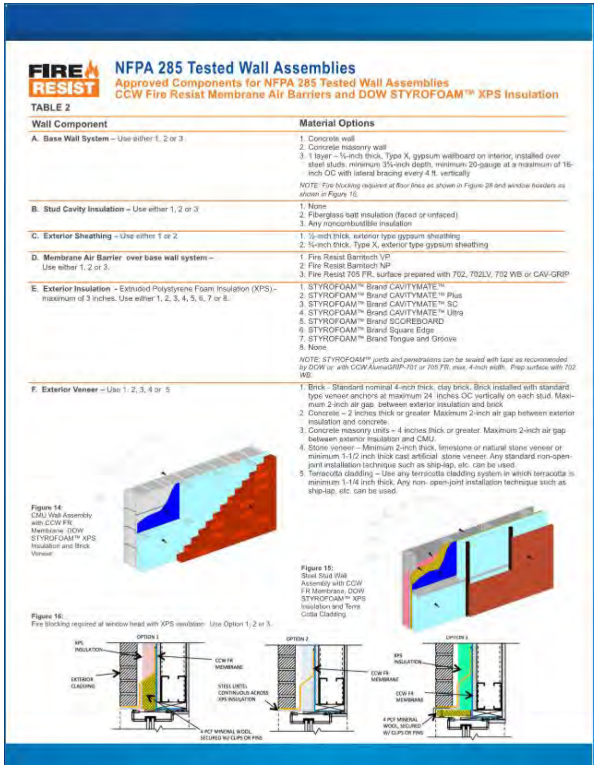
Cladding Type

NFPA 285 – Decision Tree



NFPA 285 – Tested Assemblies

- Manufacturer information is building….



NFPA 285 Tested Wall Assemblies

Approved Components for NFPA 285 Tested Wall Assemblies
CCW Fire Resist Membrane Air Barriers and DOW STYROFOAM™ XPS Insulation

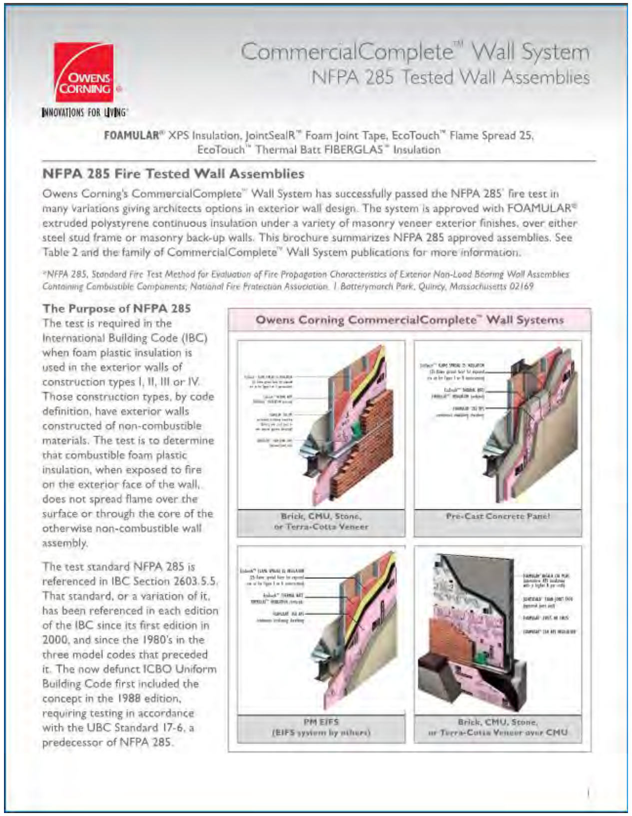
TABLE 2

Wall Component	Material Options
A. Base Wall System – Use either 1, 2 or 3	1. Concrete wall 2. Concrete masonry wall 3. 1 layer – ⅝-inch thick, Type X, gypsum wallboard on interior, installed over steel studs, minimum 3⅝-inch depth, minimum 20-gauge at a maximum of 16-inch OC with lateral bracing every 4 ft. vertically NOTE: Fire blocking required at floor lines as shown in Figure 28 and window headers as shown in Figure 16.
B. Stud Cavity Insulation – Use either 1, 2 or 3	1. None 2. Fiberglass batt insulation (faced or unfaced) 3. Any noncombustible insulation
C. Exterior Sheathing – Use either 1 or 2	1. ½-inch thick, exterior type gypsum sheathing 2. ⅝-inch thick, Type X, exterior type gypsum sheathing
D. Membrane Air Barrier over base wall system – Use either 1, 2 or 3	1. Fire Resist Barritech VP 2. Fire Resist Barritech NP 3. Fire Resist 705 FR, surface prepared with 702, 702LV, 702 WB or CAV-GRIP
E. Exterior Insulation – Extruded Polystyrene Foam Insulation (XPS) – maximum of 3 inches. Use either 1, 2, 3, 4, 5, 6, 7 or 8	1. STYROFOAM™ Brand CAVITYMATE™ 2. STYROFOAM™ Brand CAVITYMATE™ Plus 3. STYROFOAM™ Brand CAVITYMATE™ SC 4. STYROFOAM™ Brand CAVITYMATE™ Ultra 5. STYROFOAM™ Brand SCOREBOARD 6. STYROFOAM™ Brand Square Edge 7. STYROFOAM™ Brand Tongue and Groove 8. None NOTE: STYROFOAM™ joints and penetrations can be sealed with tape as recommended by DOW or with CCW AlumaGRIP-701 or 705FR, max. 4-inch width. Prep surface with 702 WB.
F. Exterior Veneer – Use 1, 2, 3, 4 or 5	1. Brick – Standard nominal 4-inch thick, clay brick. Brick installed with standard type veneer anchors at maximum 24 inches OC vertically on each stud. Maximum 2-inch air gap between exterior insulation and brick 2. Concrete – 2 inches thick or greater. Maximum 2-inch air gap between exterior insulation and concrete. 3. Concrete masonry units – 4 inches thick or greater. Maximum 2-inch air gap between exterior insulation and CMU. 4. Stone veneer – Minimum 2-inch thick, limestone or natural stone veneer or minimum 1-1/2 inch thick cast artificial stone veneer. Any standard non-open-joint installation technique such as ship-lap, etc. can be used. 5. Terracotta cladding – Use any terracotta cladding system in which terracotta is minimum 1-1/4 inch thick. Any non-open-joint installation technique such as ship-lap, etc. can be used.

Figure 14: CMU Wall Assembly with CCW FR Membrane, DOW STYROFOAM™ XPS Insulation and Brick Veneer

Figure 15: Steel Stud Wall Assembly with CCW FR Membrane, DOW STYROFOAM™ XPS Insulation and Terra Cotta Cladding

Figure 16: Fire blocking required at window head with XPS insulation. Use Option 1, 2 or 3.



CommercialComplete™ Wall System
NFPA 285 Tested Wall Assemblies

FOAMULAR® XPS Insulation, JointSealR™ Foam Joint Tape, EcoTouch™ Flame Spread 25, EcoTouch™ Thermal Batt FIBERGLAS™ Insulation

NFPA 285 Fire Tested Wall Assemblies

Owens Corning's CommercialComplete™ Wall System has successfully passed the NFPA 285* fire test in many variations giving architects options in exterior wall design. The system is approved with FOAMULAR® extruded polystyrene continuous insulation under a variety of masonry veneer exterior finishes, over either steel stud frame or masonry back-up walls. This brochure summarizes NFPA 285 approved assemblies. See Table 2 and the family of CommercialComplete™ Wall System publications for more information.

*NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components; National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169

The Purpose of NFPA 285

The test is required in the International Building Code (IBC) when foam plastic insulation is used in the exterior walls of construction types I, II, III or IV. Those construction types, by code definition, have exterior walls constructed of non-combustible materials. The test is to determine that combustible foam plastic insulation, when exposed to fire on the exterior face of the wall, does not spread flame over the surface or through the core of the otherwise non-combustible wall assembly.

The test standard NFPA 285 is referenced in IBC Section 2603.5.5. That standard, or a variation of it, has been referenced in each edition of the IBC since its first edition in 2000, and since the 1980's in the three model codes that preceded it. The now defunct ICBO Uniform Building Code first included the concept in the 1988 edition, requiring testing in accordance with the UBC Standard 17-6, a predecessor of NFPA 285.

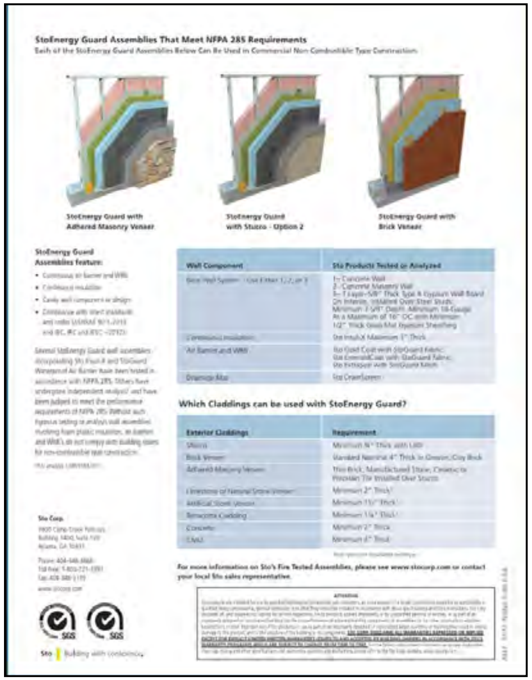
Owens Corning CommercialComplete™ Wall Systems

Brick, CMU, Stone, or Terra-Cotta Veneer

Pre-Cast Concrete Panel

PM EIFS (EIFS system by others)

Brick, CMU, Stone, or Terra-Cotta Veneer over CMU



StoEnergy Guard Assemblies That Meet NFPA 285 Requirements

StoEnergy Guard with Adhered Masonry Veneer

StoEnergy Guard with Stucco - Option 2

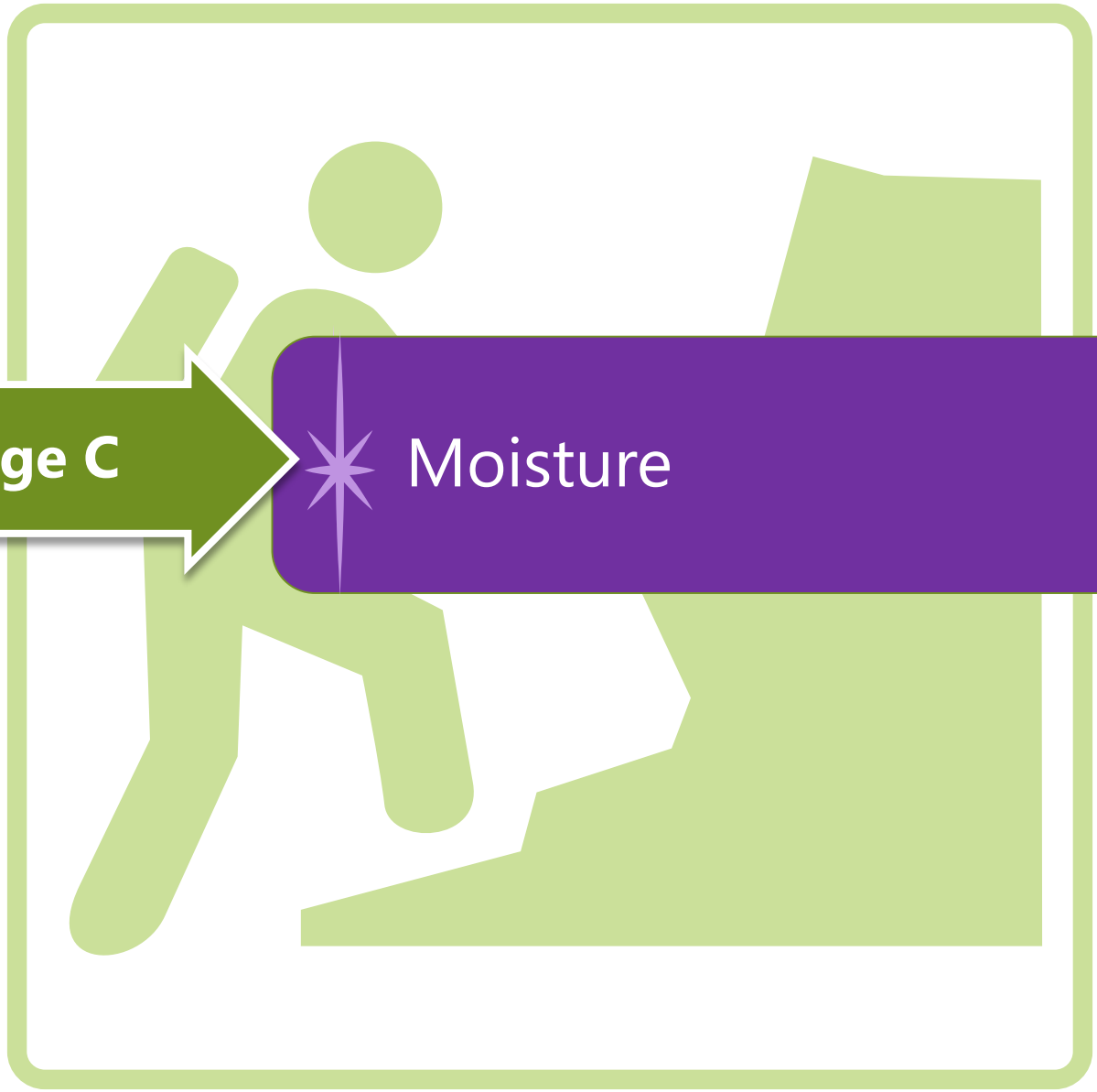
StoEnergy Guard with Brick Veneer

Which Claddings can be used with StoEnergy Guard?

For more information on Sto's Fire Tested Assemblies, please see www.stocorp.com or contact your local Sto sales representative.

All text and images courtesy of RDH Building Science Inc.

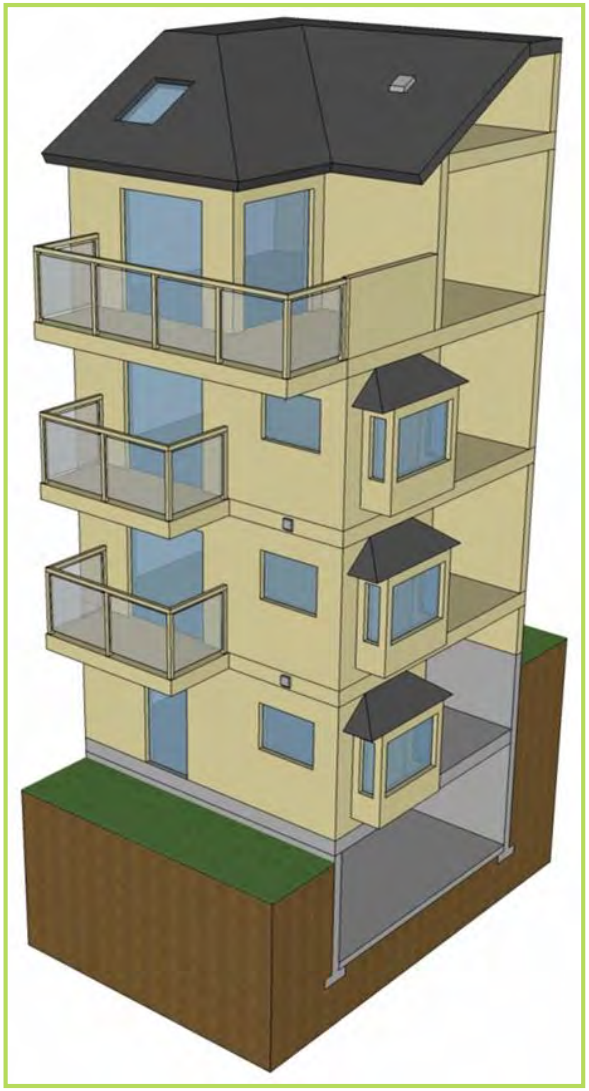
Challenge C



Challenge C

Moisture

Building Enclosure Design



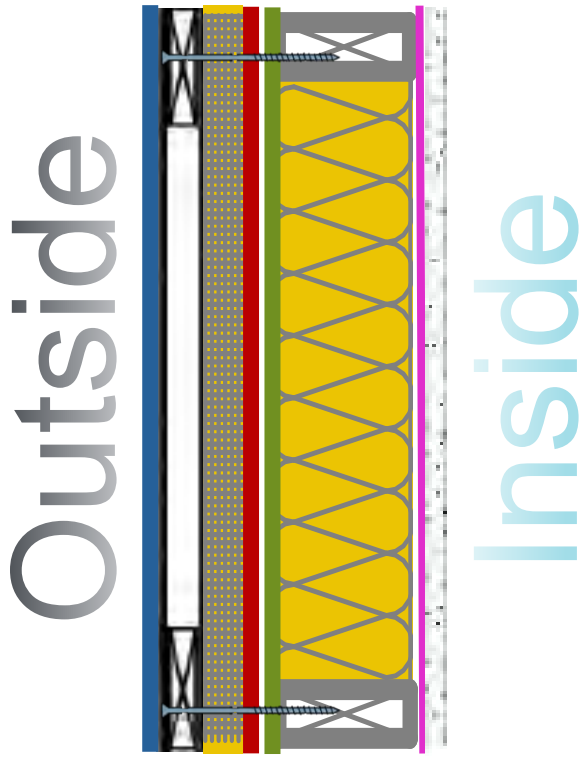
Heat Flow/Air Flow

- **Support**
  - Structural loads
- **Control** environmental loads between
  Separate indoors from outdoors
  - Heat flow
  - Air flow
  - Vapor diffusion / condensation
  - Water penetration
  - Light and solar radiation
  - Noise, fire, and smoke
- **Finish**
  - Being durable and maintainable
  - Looking good!

Old vs. New

Moisture Concerns

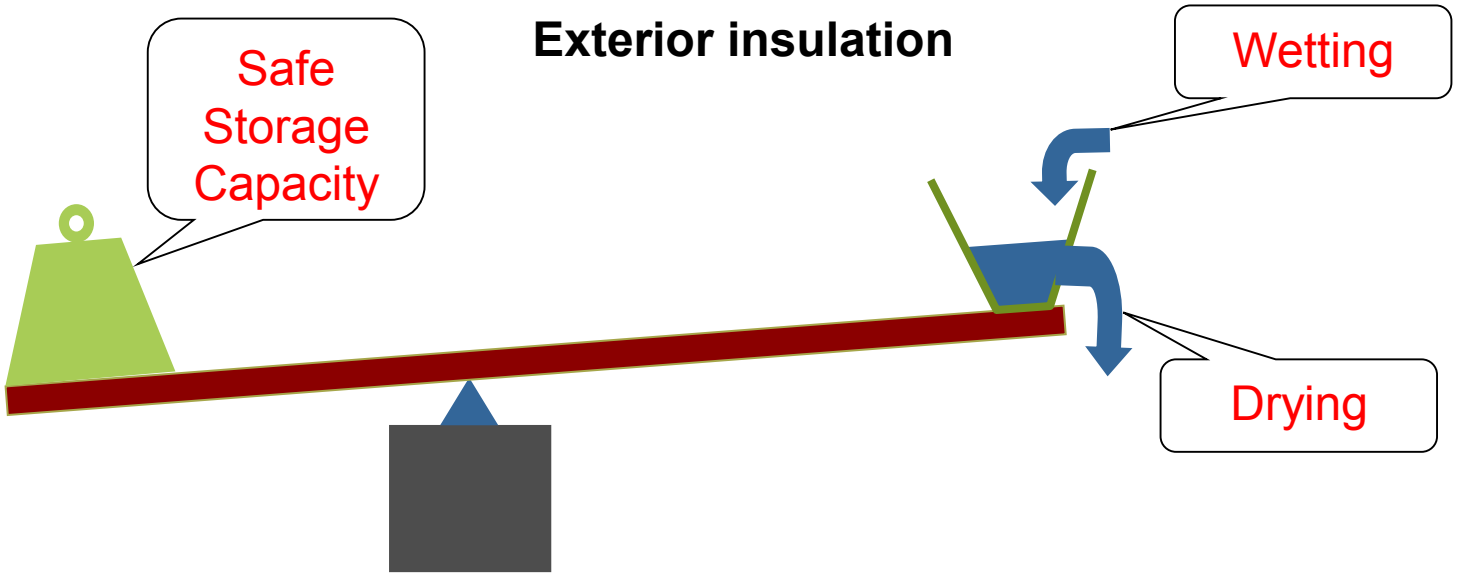
Walls



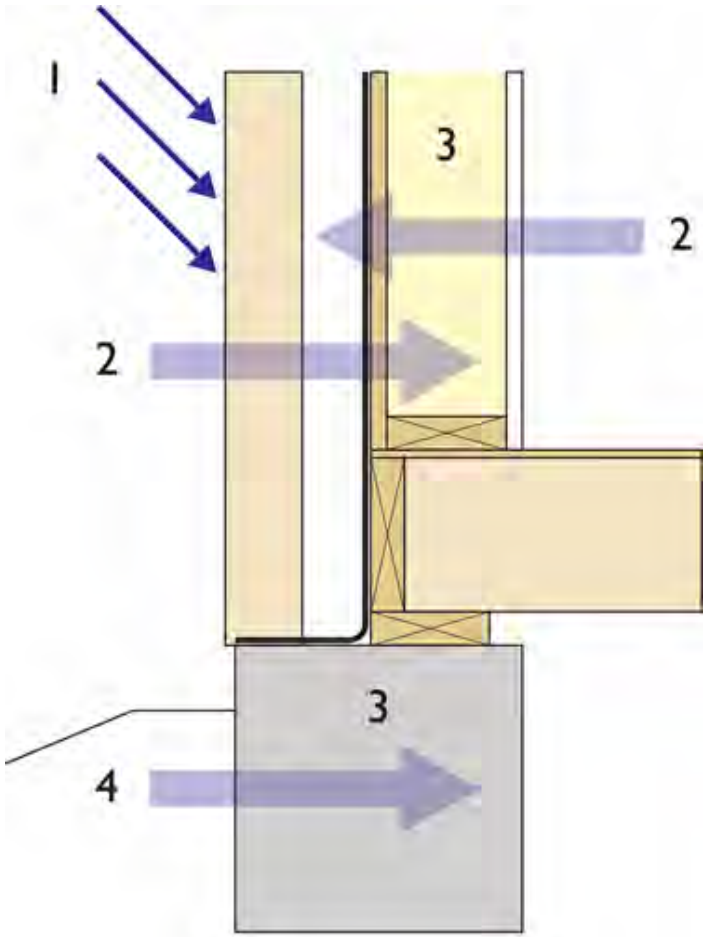
- Structure
- Control Layers
  - Continuous (or interrupted) insulation
    - More insulation = less heat flow to dry out moisture. "Marginal" assemblies that worked in the past may no longer work.
    - Amount, type and placement of insulations matters, for vapor, air and moisture control
  - WRB
  - Air barrier
  - Vapor retarder
    - Rigid exterior foam insulations (XPS, EPS, Polyiso, closed cell SPF) are vapor impermeable (in thicknesses of 2"+)
    - Is the vapor barrier on the wrong side?
      - Fibrous insulation is vapor permeable
      - Allows drying to the exterior
- Finish (Cladding)
  - Rainscreen assembly
    - Water shedding surface (exterior finish)
    - Secondary barrier (WRB) with ventilation/drainage gap

Building Science Basics: Wetting and Drying

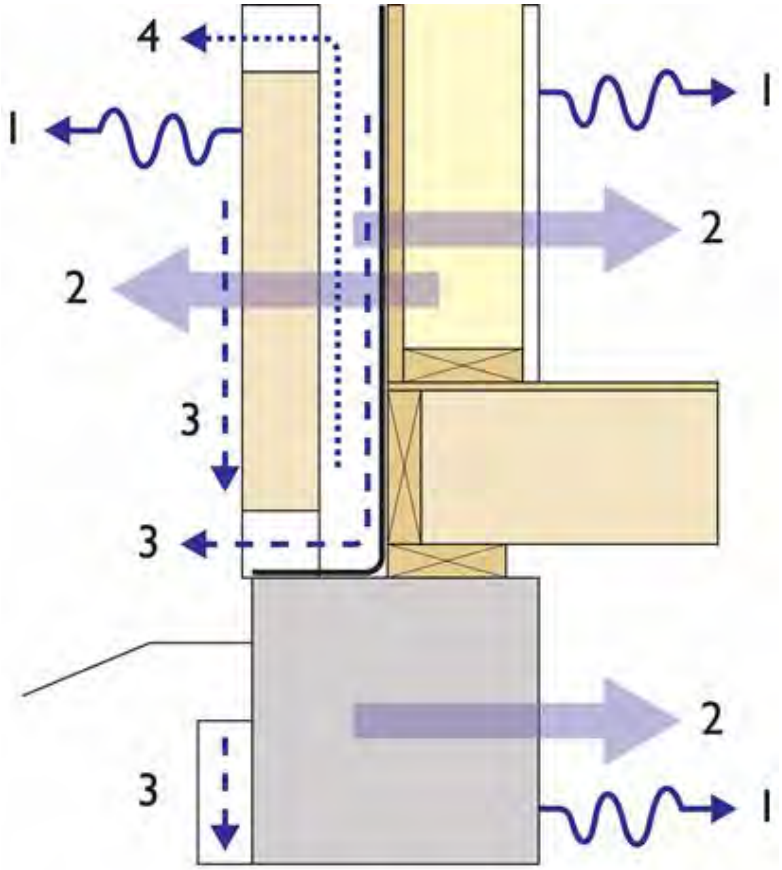
- How can we keep the sheathing and other materials dry under these new conditions?
  - Don't let them get as wet
  - Create space to promote drying
  - Keep sheathing warm!



How do Walls get Wet and Dry?

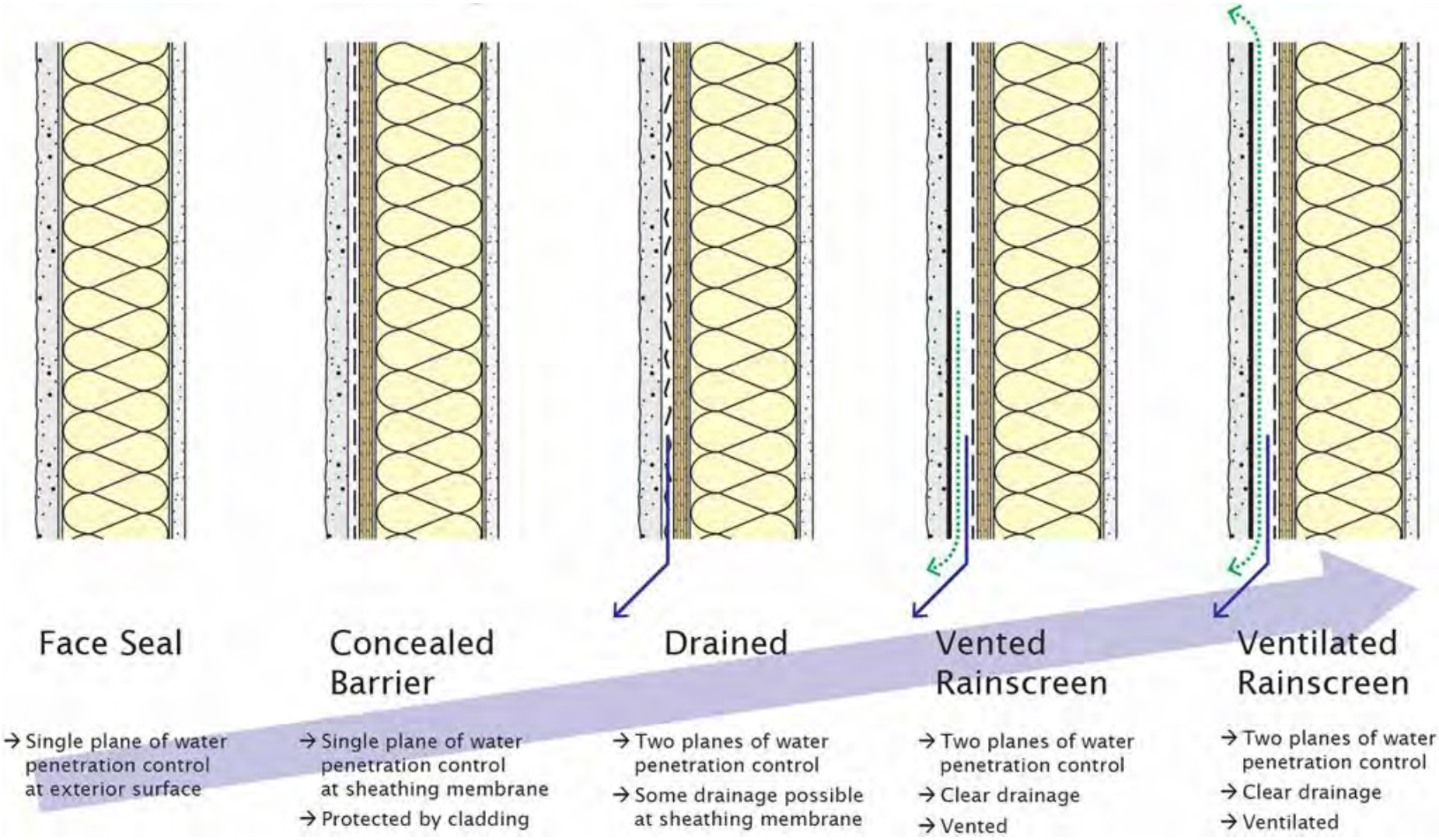


1. Precipitation (rain or snow)
2. Water vapor transported by diffusion and/or air movement (outward or inward)
3. Built-in construction moisture
4. Groundwater

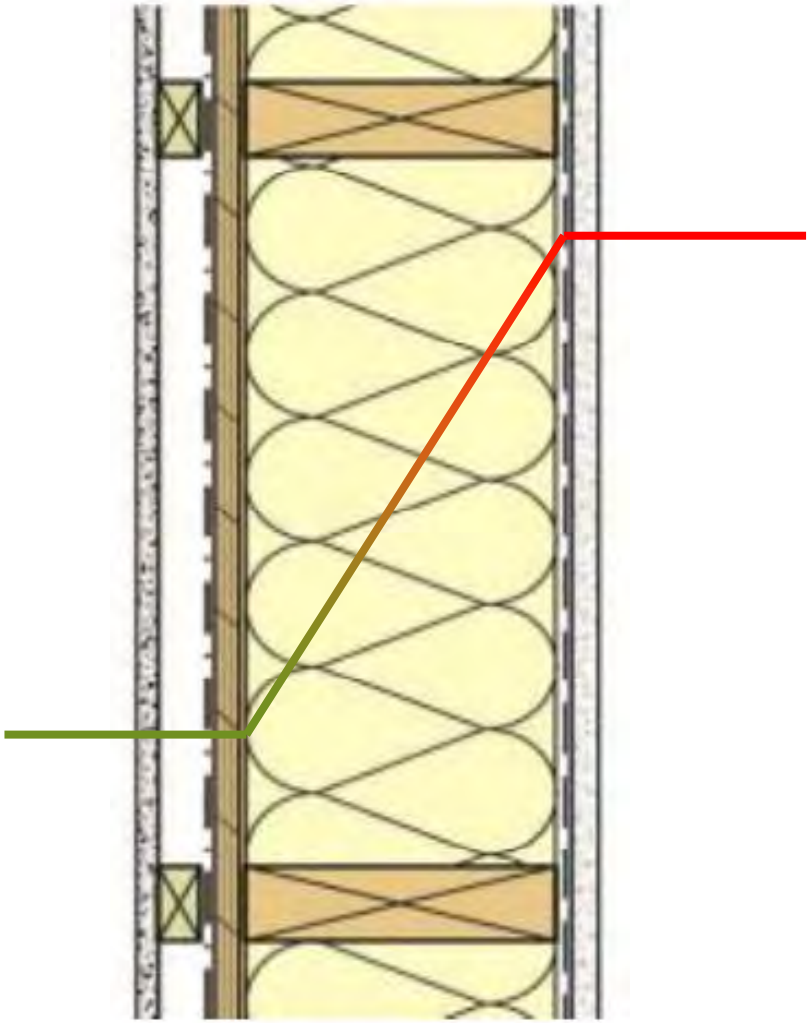


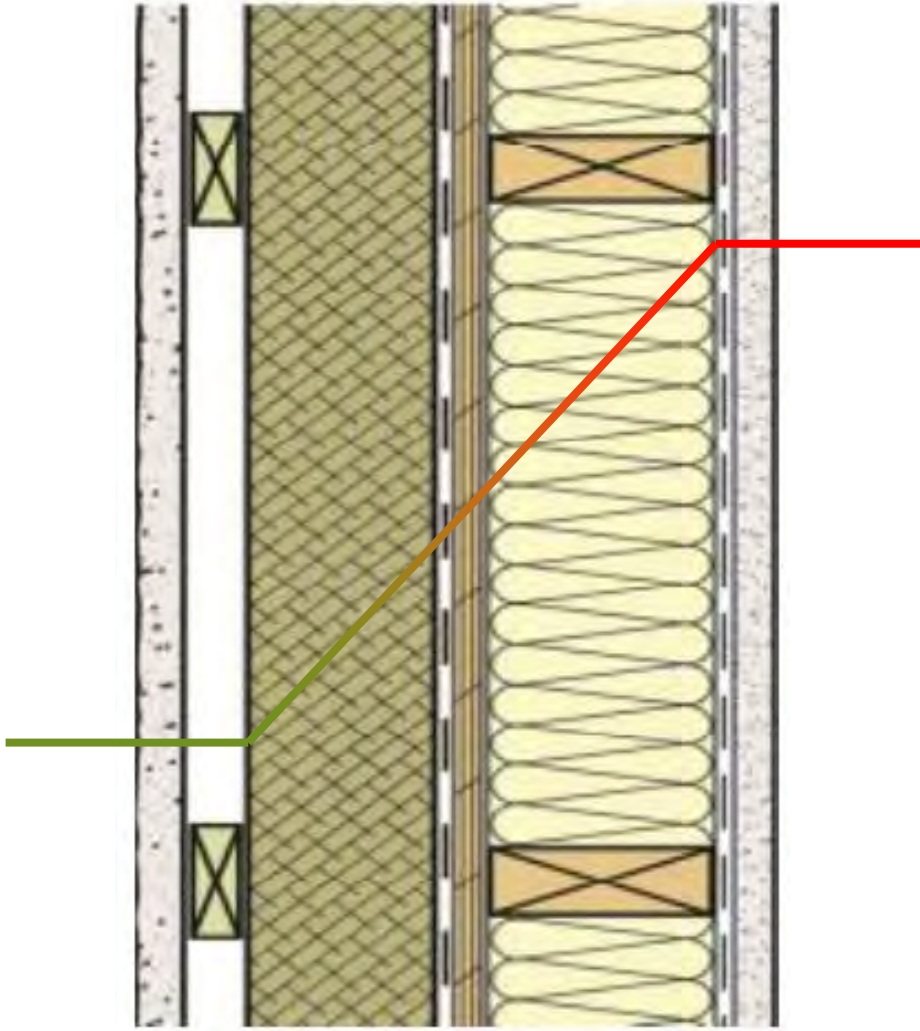
1. Evaporation of water at surfaces
2. Water vapor transport by diffusion and/or air movement (outward or inward)
3. Drainage
4. Ventilation drying by air exchange

Drainage & Ventilation Drying



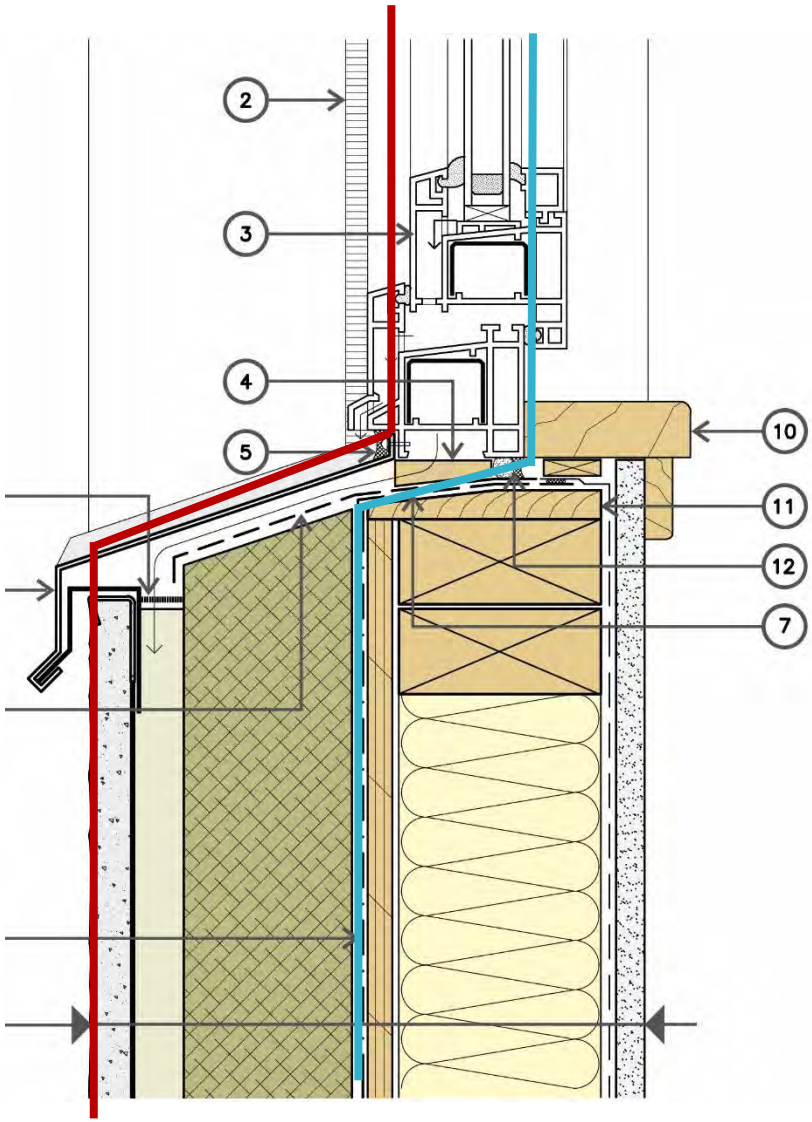
Insulation and Moisture Interaction





Exterior Insulation and Windows

- Need to provide a water shedding seal between exterior cladding and window
  - With exterior insulation exterior cladding is often too far away
- Flashing or trim piece required to create continuity
- Or a window 'buck' to align window with cladding layer

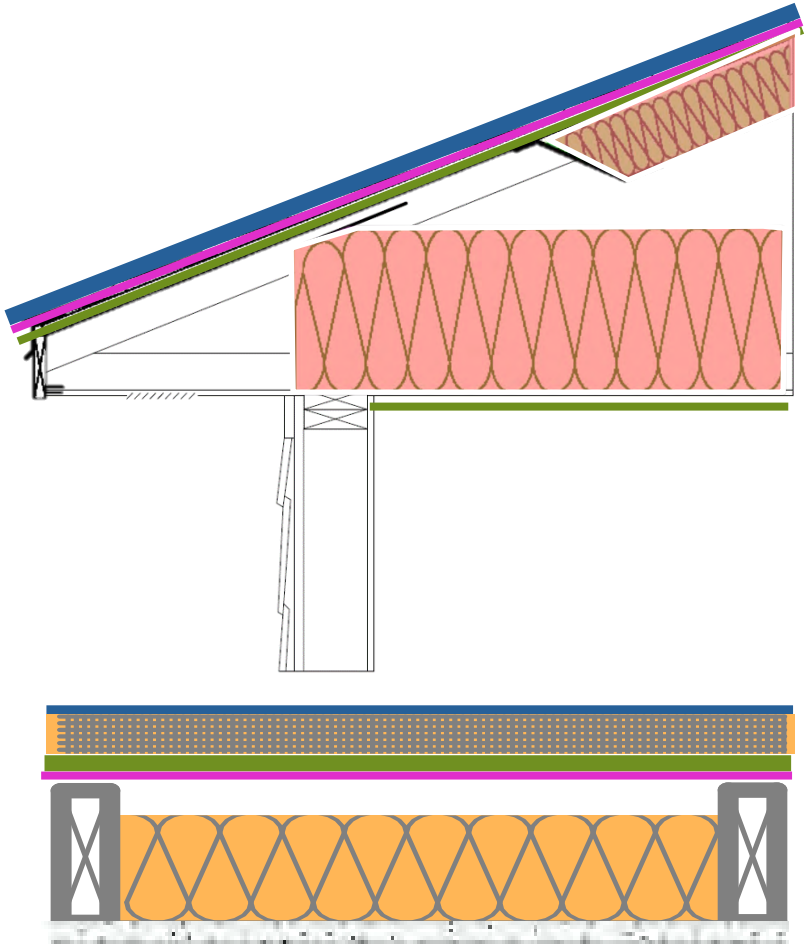


Drained / Ventilated Cladding

Drained/Ventilated Cladding - Stucco

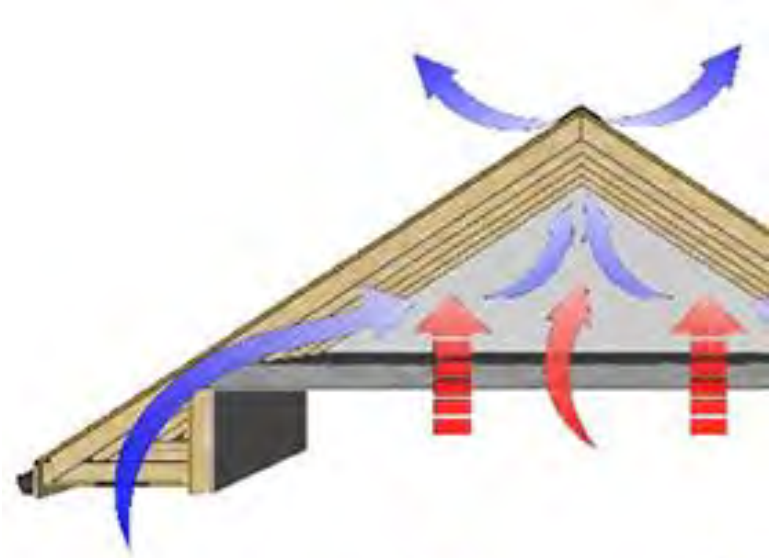
Moisture Concerns

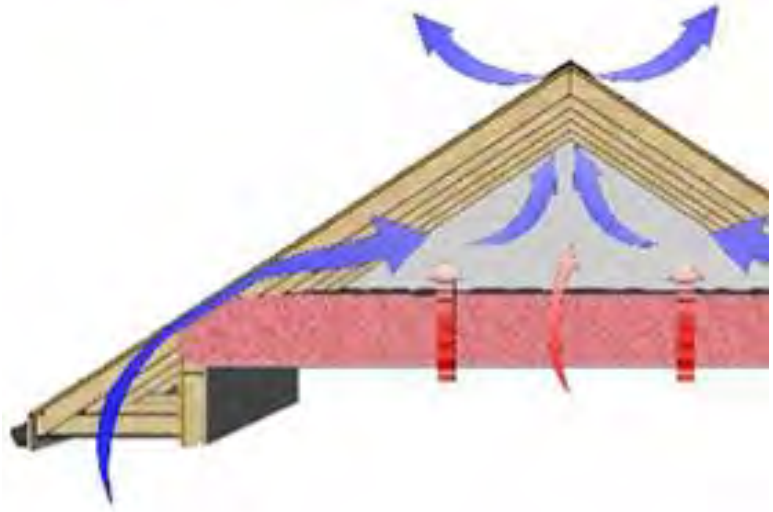
Roof



- Structure
- Control Layers
  - **Water shedding surface (exterior finish)**
    - Roof membrane
  - **Water Control Layer**
  - **Air Control Layer**
  - **Vapor Control Layer**
  - **Thermal Control Layers**

Attics – How they work



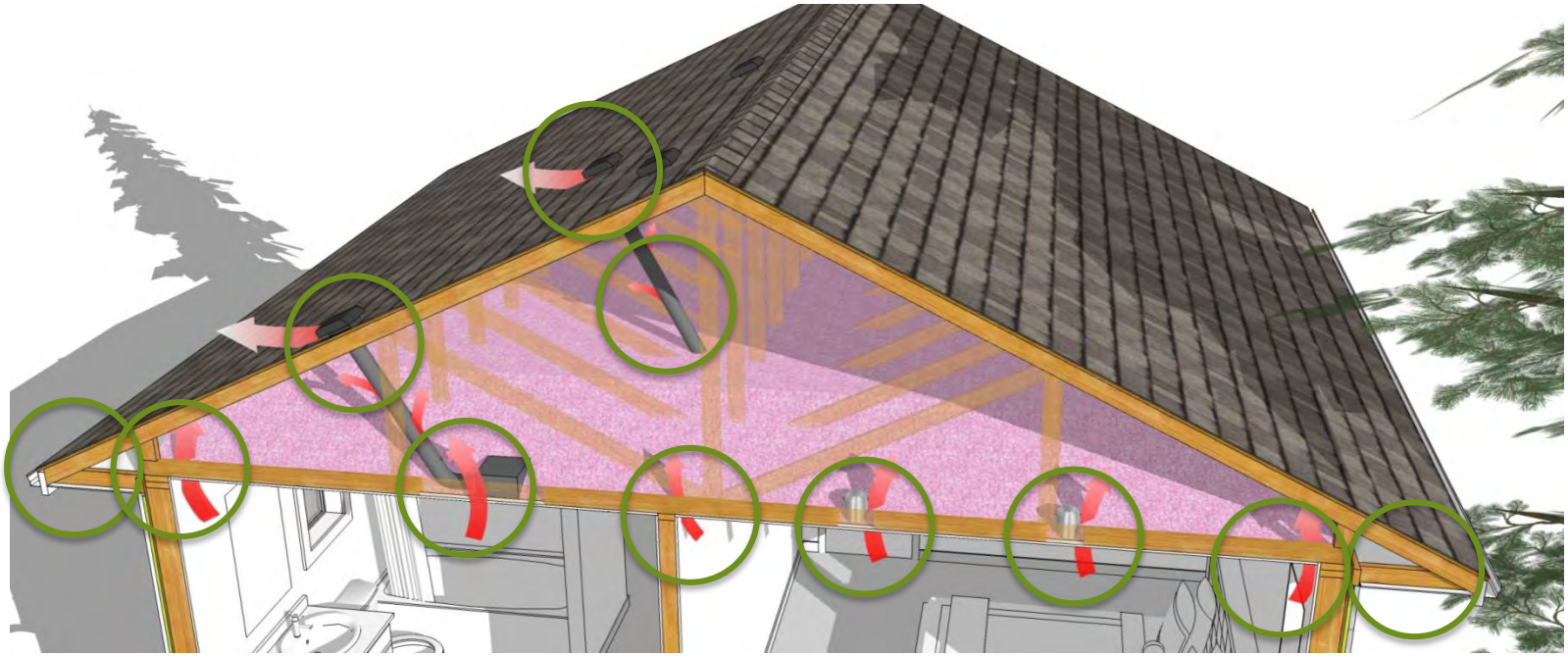


Heat loss from interior warms attic air, decreasing RH.

- Increased insulation levels have generally occurred along side increases in air tightness
  - Less heat, but less moisture too
  - The balance still works
- Buoyancy and wind ventilate the attic space with exterior air
  - Hot air rises, cold air falls

Where Do We See Issues?

- Air leakage (ceiling details)
- Exhaust duct leaks & discharge location (roof, soffit, or wall)
- Inadequate venting provisions (amount, vent location, or materials)

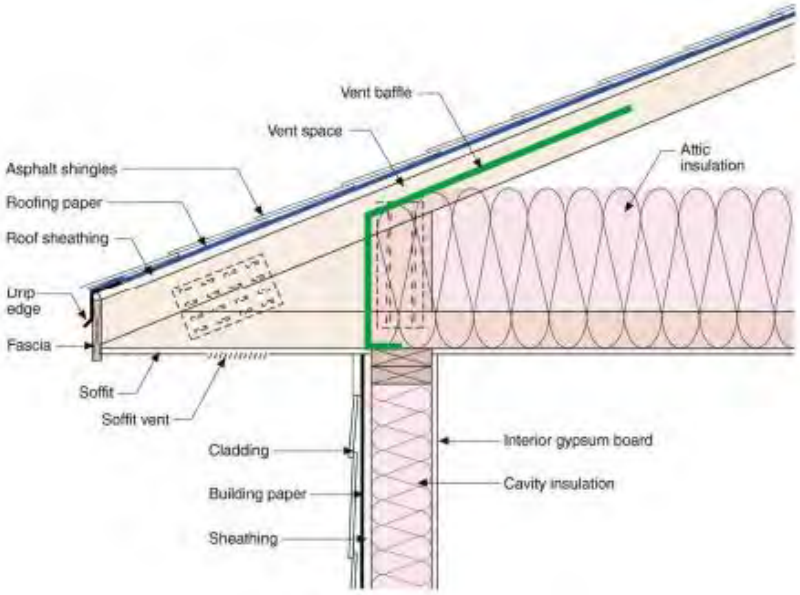


Air Leakage Through Ducts

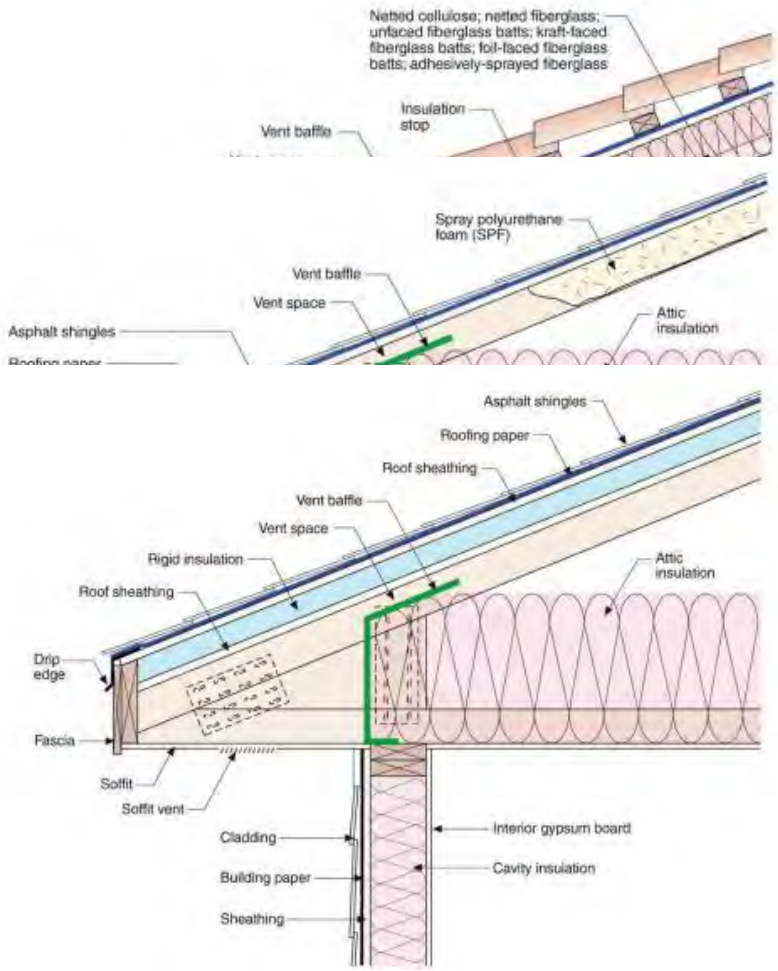
All text and images courtesy of RDH Building Science Inc.

Vented Attic

Old Way

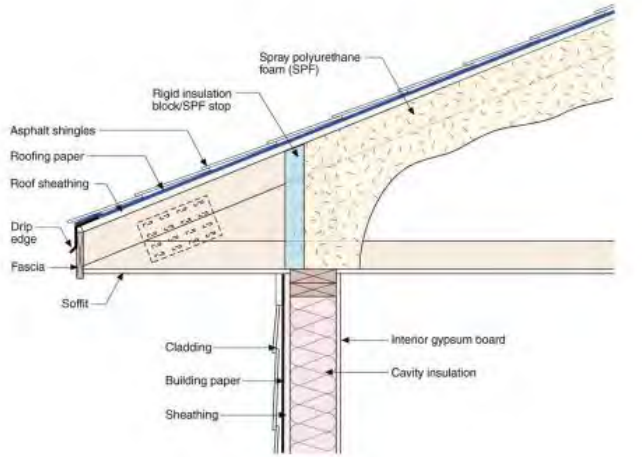


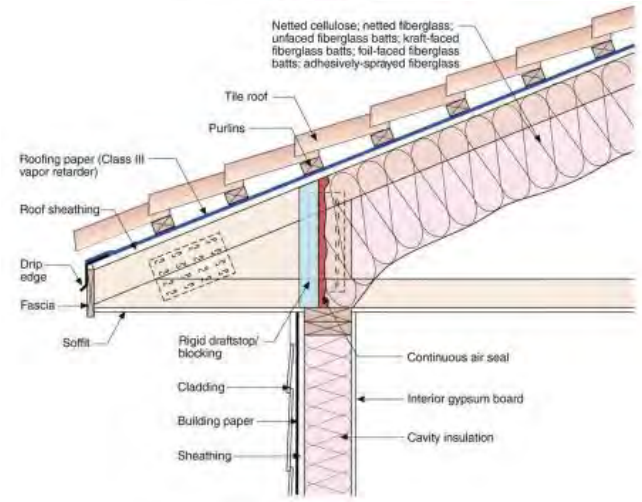
New Way



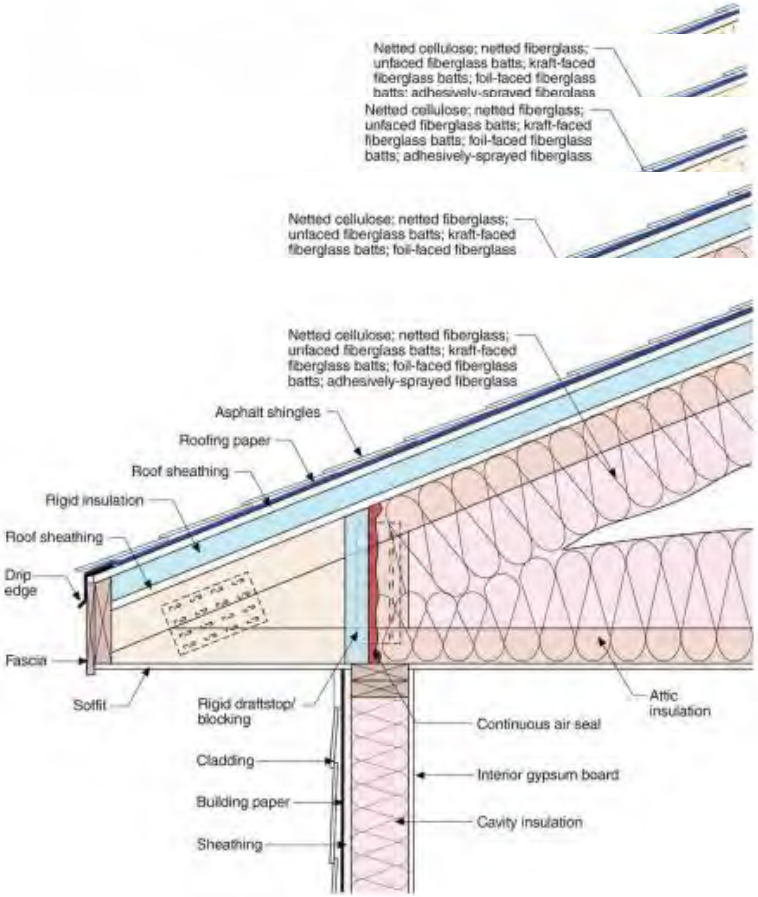
Non-Vented Attic

Old Way





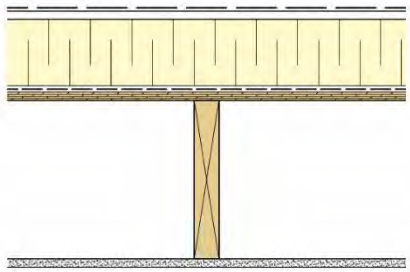
New Way



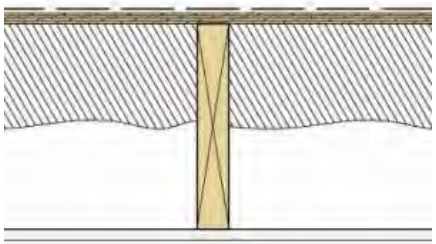
All text and images courtesy of Building Science Corp.

Summary: Low Slope Roof Types

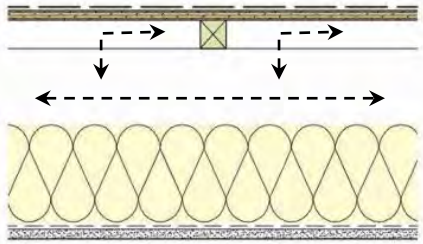
- Conventional



- Unvented (Compact)



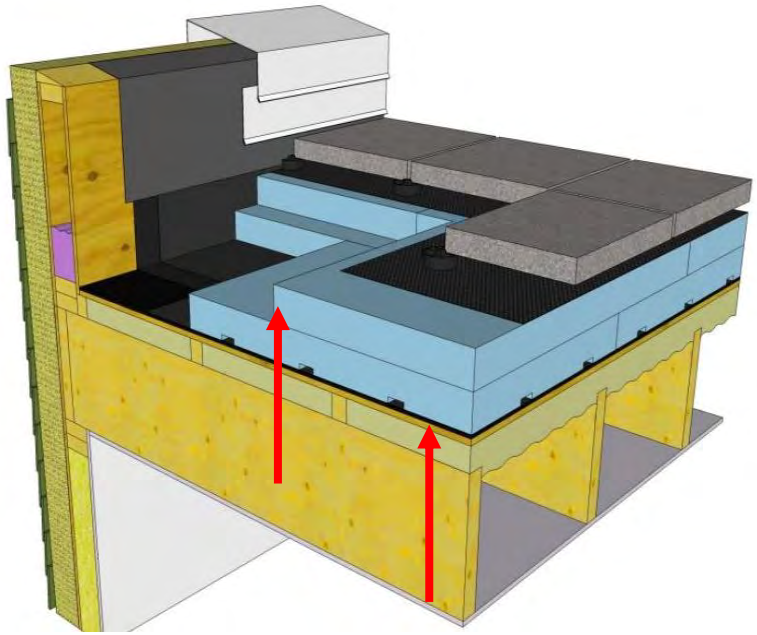
- Vented



Condensation – Interior Insulation

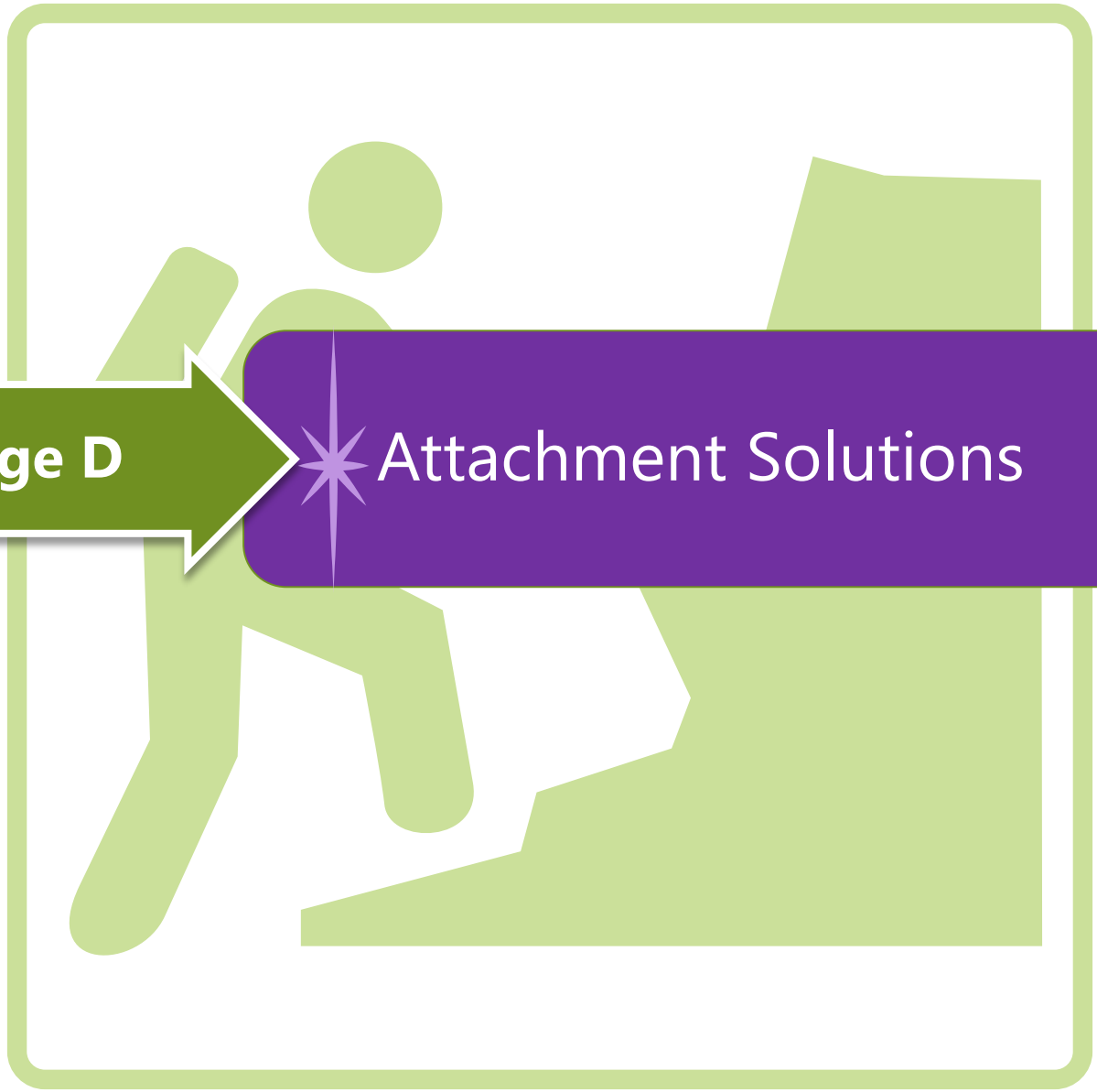
MORE INSULATION
MORE PROBLEMS

Split Insulation Approaches



- Good compromise of performance and cost
- Ratio of exterior insulation to interior insulation dependent on climate and interior humidity levels
- Newest version of California Building Code now includes guidance related to this approach

Challenge D

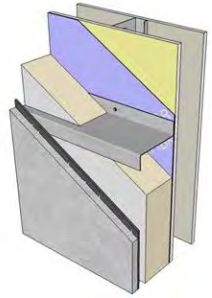


Challenge D

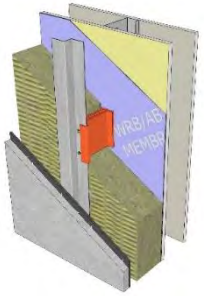
Attachment Solutions

Attachment Solutions

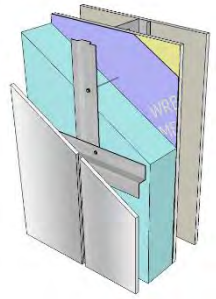
Walls



- **Continuous Girts** – Rigid or Semi-rigid boards or spray-foam (i.e. almost anything works)

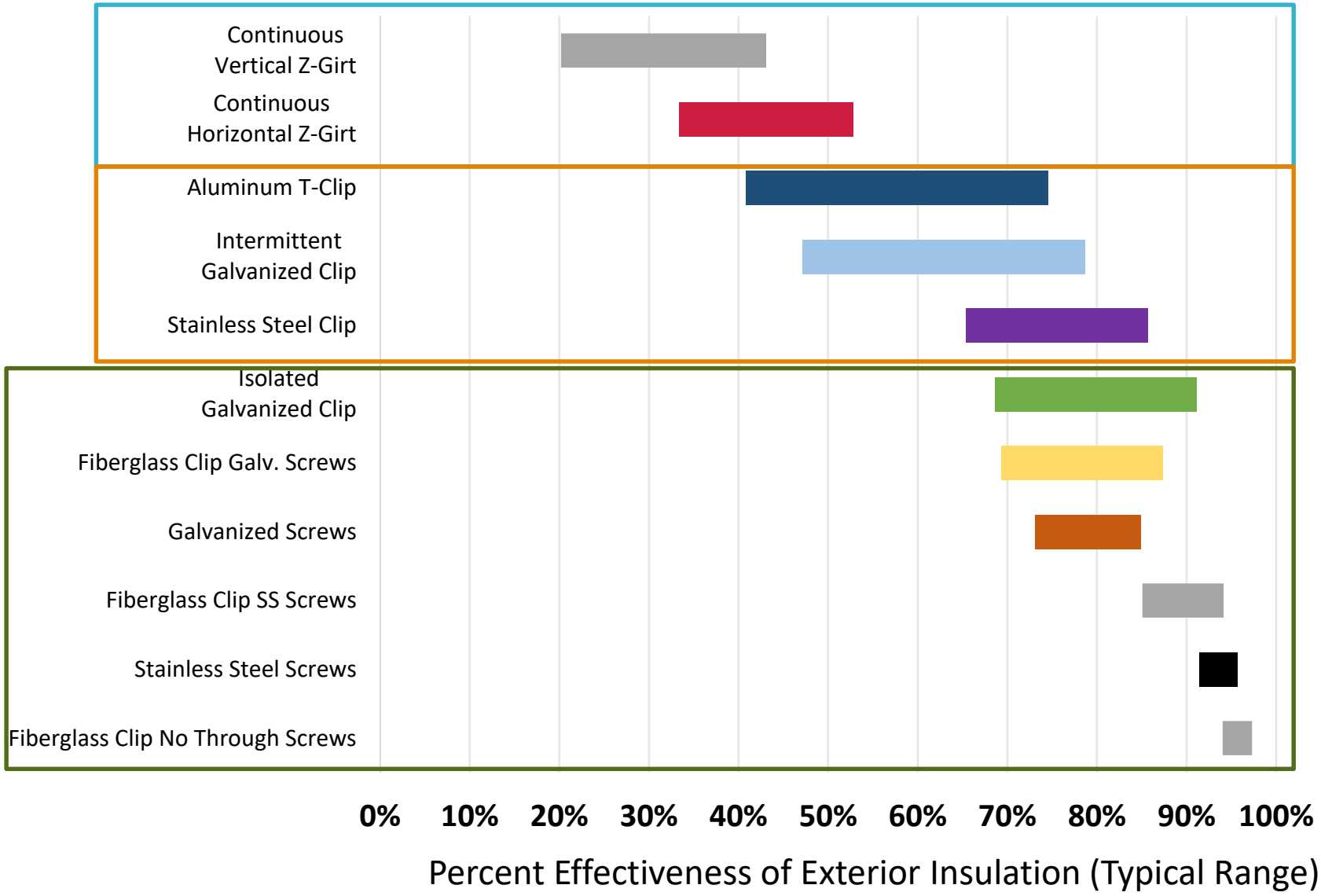


- **Intermittent Clip & Rail Systems** – Semi-rigid boards or spray-foam (i.e. flexibility & ease of installation is key)



- **Screws through Insulation** – rigid insulation boards (i.e. stiff enough to support compression load)

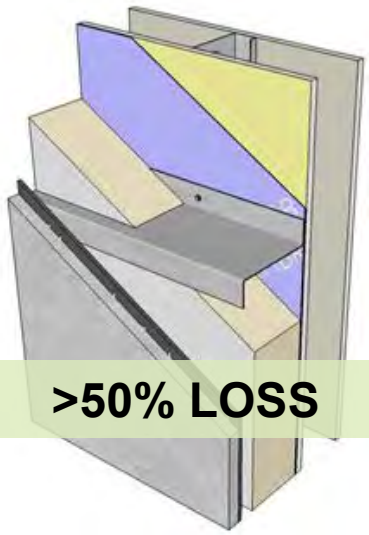
Summary of Cladding Support Performance



Many Cladding Attachment Options & Counting

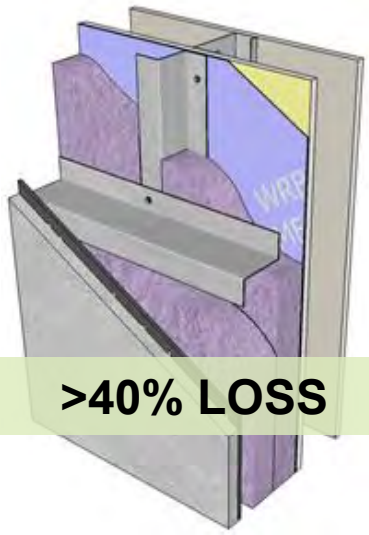
>70% LOSS

Vertical Z-girts



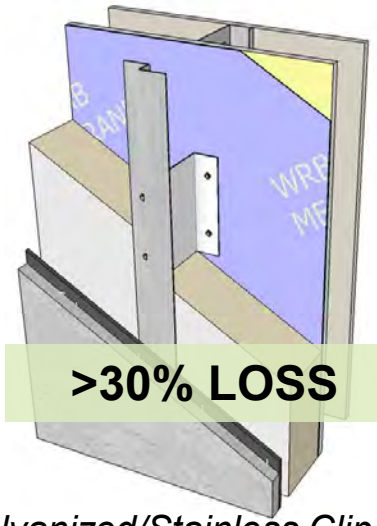
>50% LOSS

Horizontal Z-girts



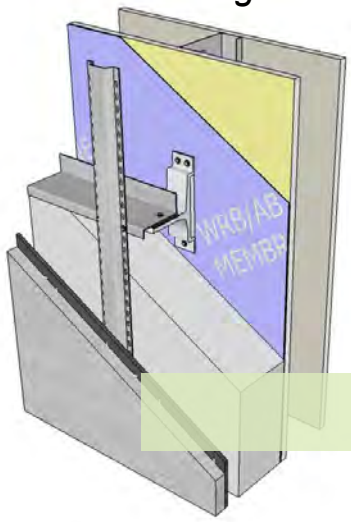
>40% LOSS

Crossing Z-girts

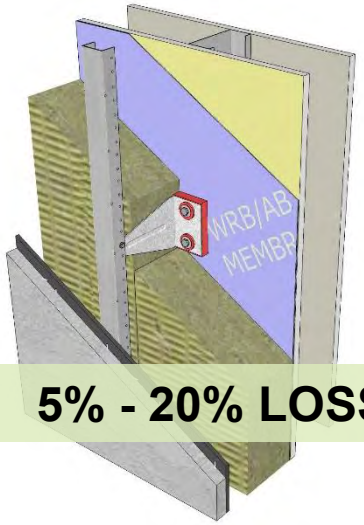


>30% LOSS

Galvanized/Stainless Clip & Rail

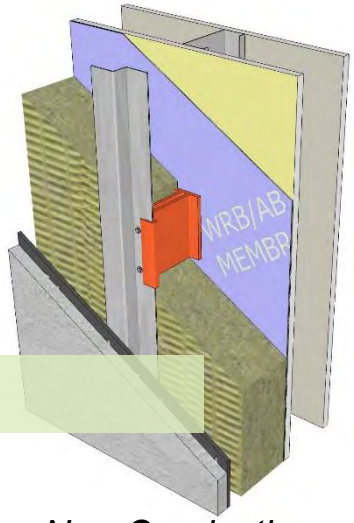


Aluminum Clip & Rail

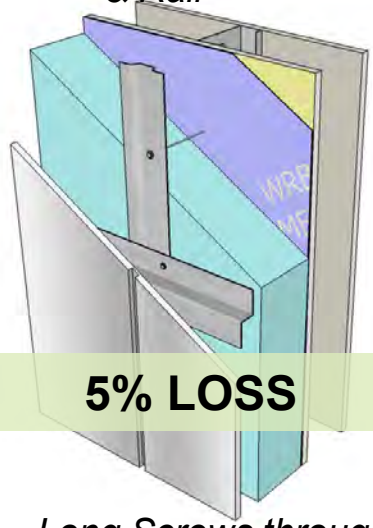


5% - 20% LOSS

Thermally Improved Clip & Rail



Non-Conductive Clip & Rail

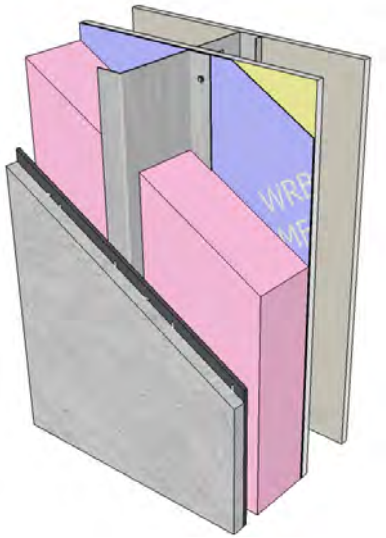


5% LOSS

Long Screws through Insulation

Exterior Insulation Cladding Attachments – A Race to the Top

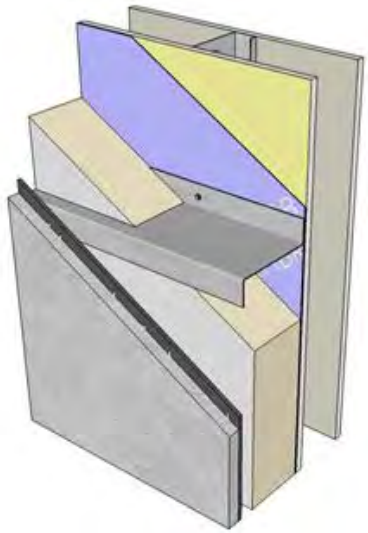
→ Rock Bottom – a 60-80% loss in effective R-value



Vertical Z-girts

Exterior Insulation Cladding Attachments – A Race to the Top

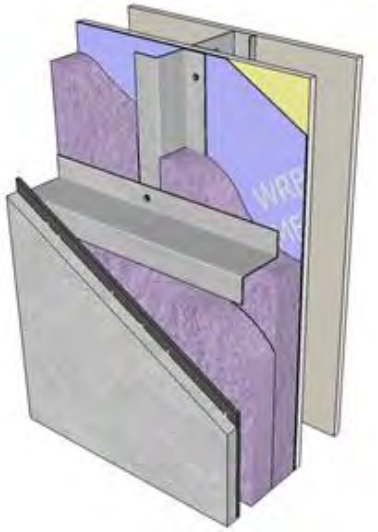
→ Near Bottom – a 50-70% loss in effective R-value



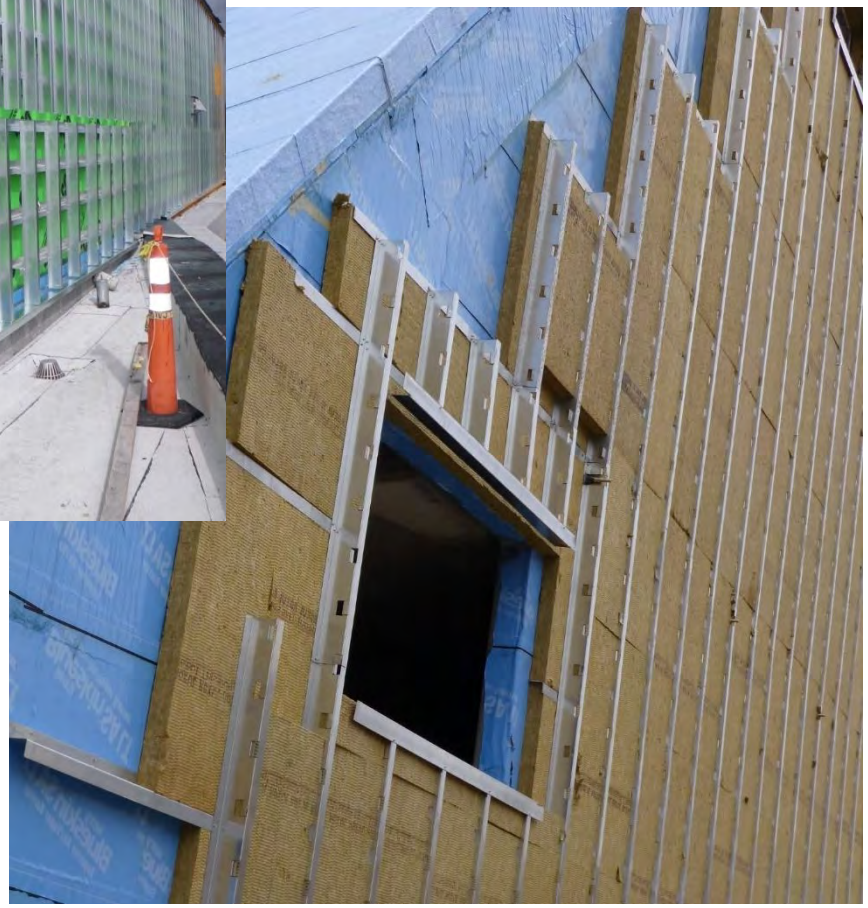
Horizontal Z-girts

Exterior Insulation Cladding Attachments – A Race to the Top

→ Hardly Better – a 40-60% loss in effective R-value

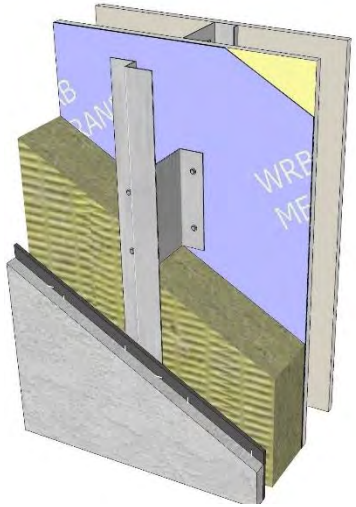


Crossing Z-girts



Exterior Insulation Cladding Attachments – A Race to the Top

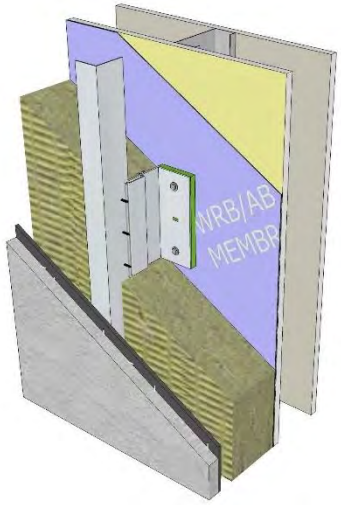
→ Better but Not Great – a 25-50% loss in effective R-value (spacing dependent)

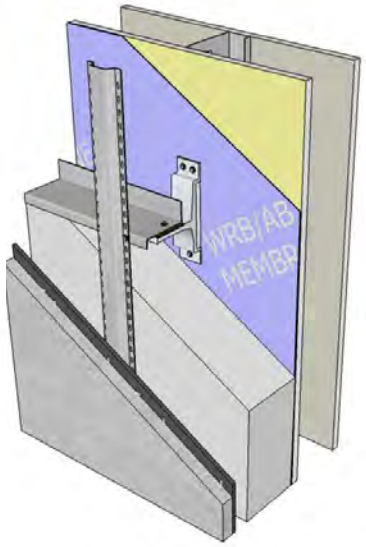


Galvanized Steel Clip & Rail

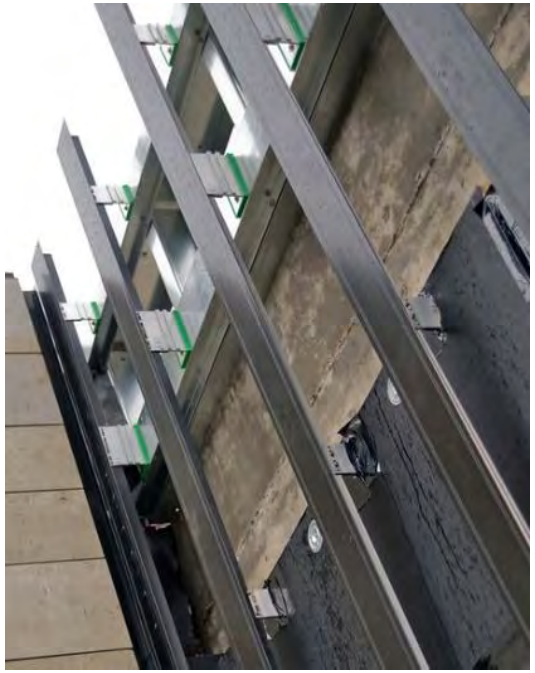
Exterior Insulation Cladding Attachments – A Race to the Top

→ Getting A Bit Better – a 30-50% loss in effective R-value (spacing dependent)





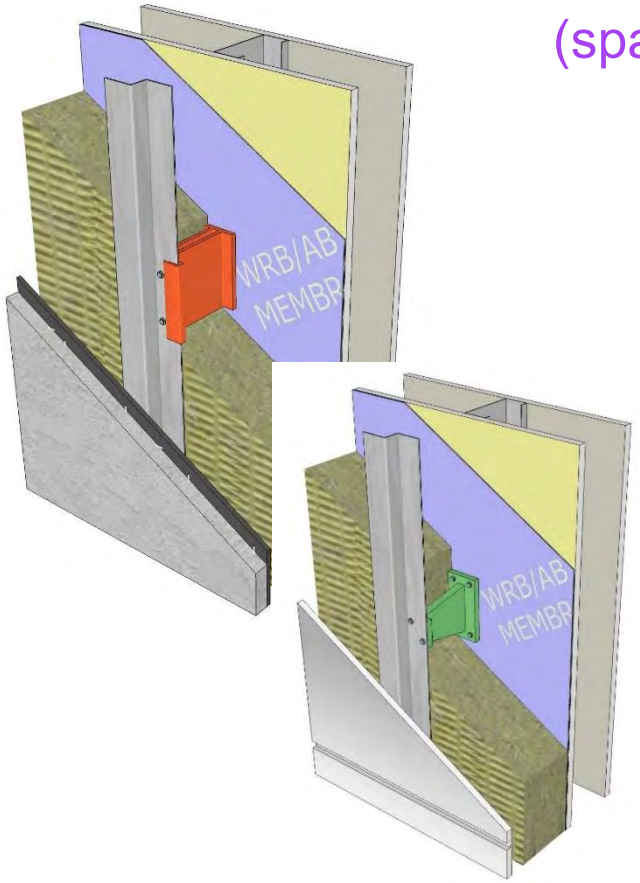
Aluminum (& Thermally Broken Aluminum) Clip & Rail



All text and images courtesy of Building Science Corp.

Exterior Insulation Cladding Attachments – A Race to the Top

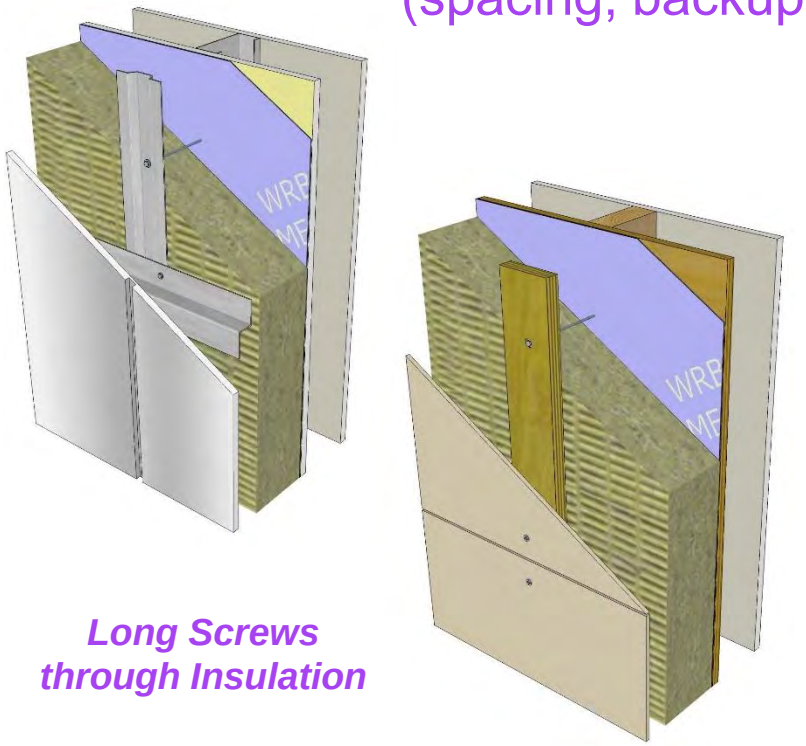
→ High performance – a 5-30% loss in effective R-value
(spacing & screw type dependent)



Fiberglass Clip & Rail w/ Screws

Exterior Insulation Cladding Attachments – A Race to the Top

→ High performance – a 5-25% loss in effective R-value
(spacing, backup-wall & screw type dependent)

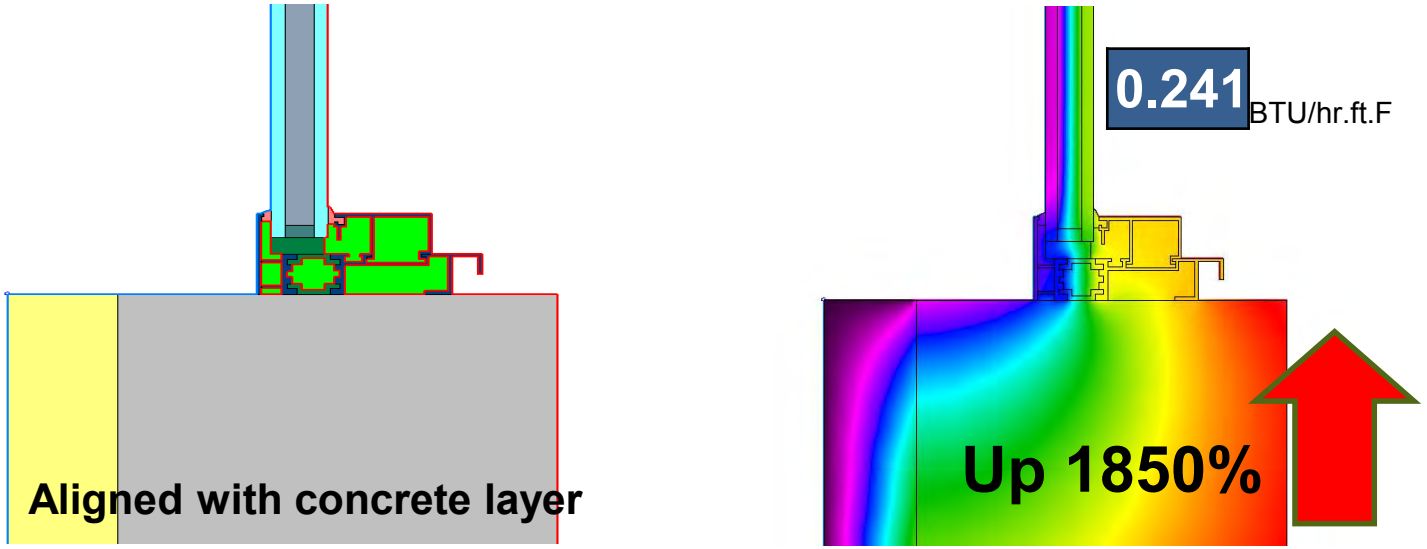


Long Screws through Insulation

Windows

Flanking: When heat flows through gap around two insulated planes

- Common problem at windows



More Complex Details

ASHRAE Research Project Report RP-1365

Thermal Performance of Buildings Envelope Details for Mid and High-Rise Buildings

Approval: July 6, 2011

Contractor: Morrison Hershfield
3585 Graveley Street, Suite 610
Vancouver, BC V5K 5J5

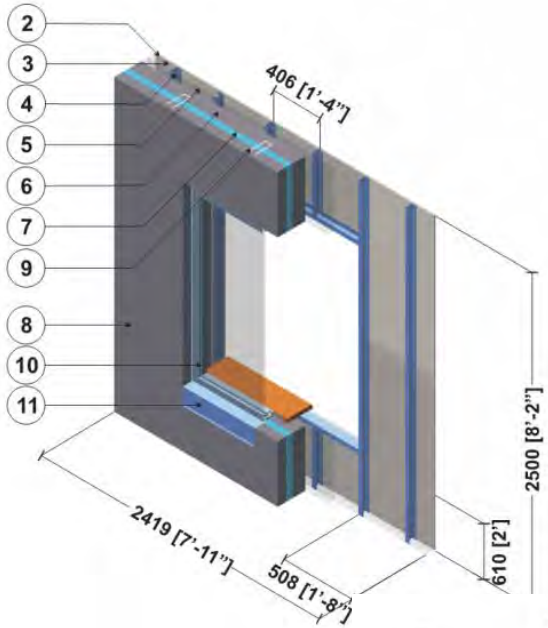
Principal Investigator: Mark Lawton, Morrison Hershfield

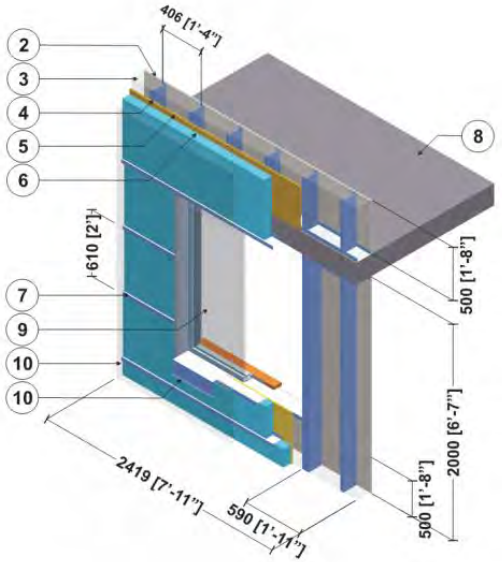
Authors: Patrick Roppel, Morrison Hershfield
Wahid Marif, NRC

Sponsoring Committee: TC 4.4, Building Materials and Building Envelope Performance

Co-Sponsoring Organizations: Air-Conditioning, Heating, and Refrigeration Institute

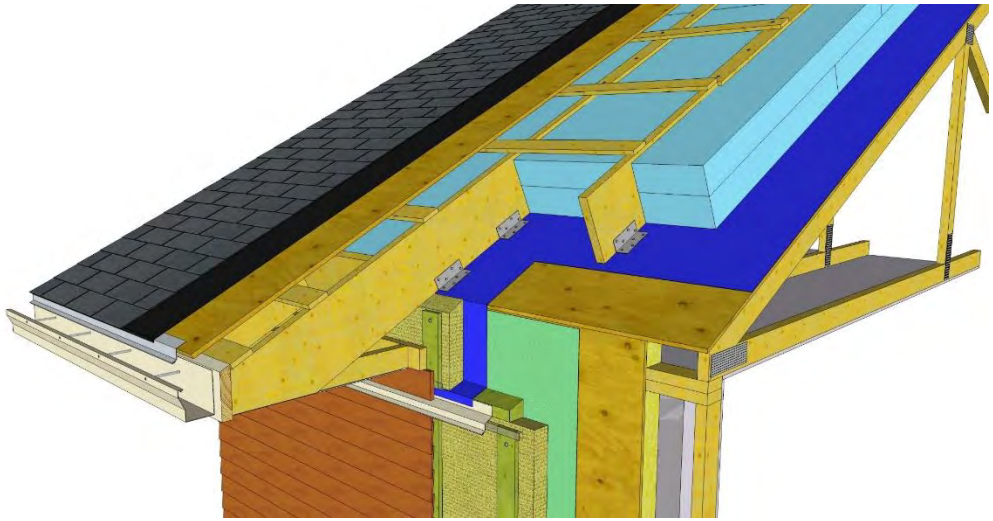
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
http://www.ashrae.org

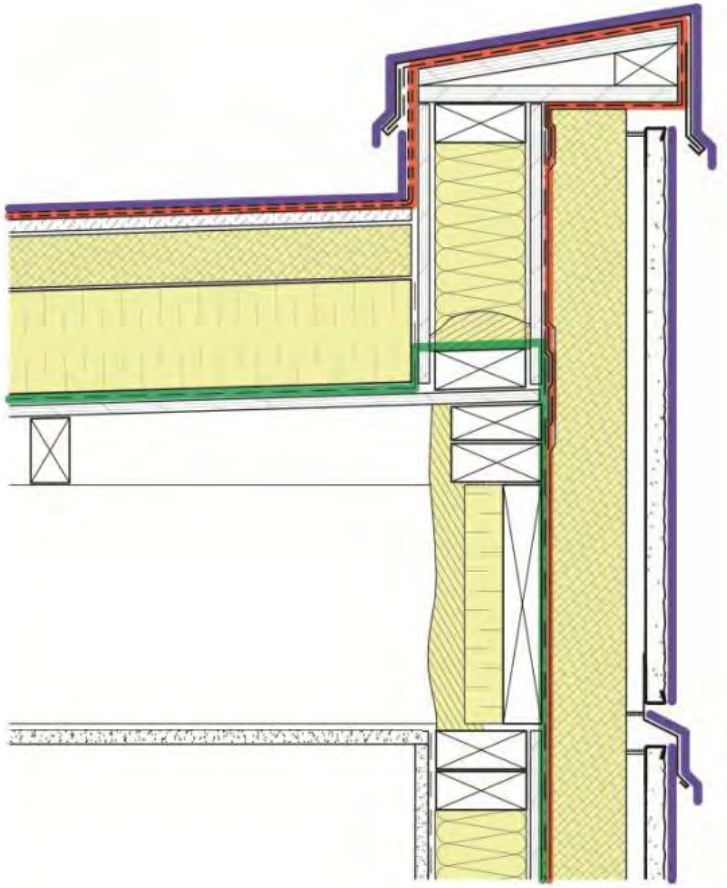




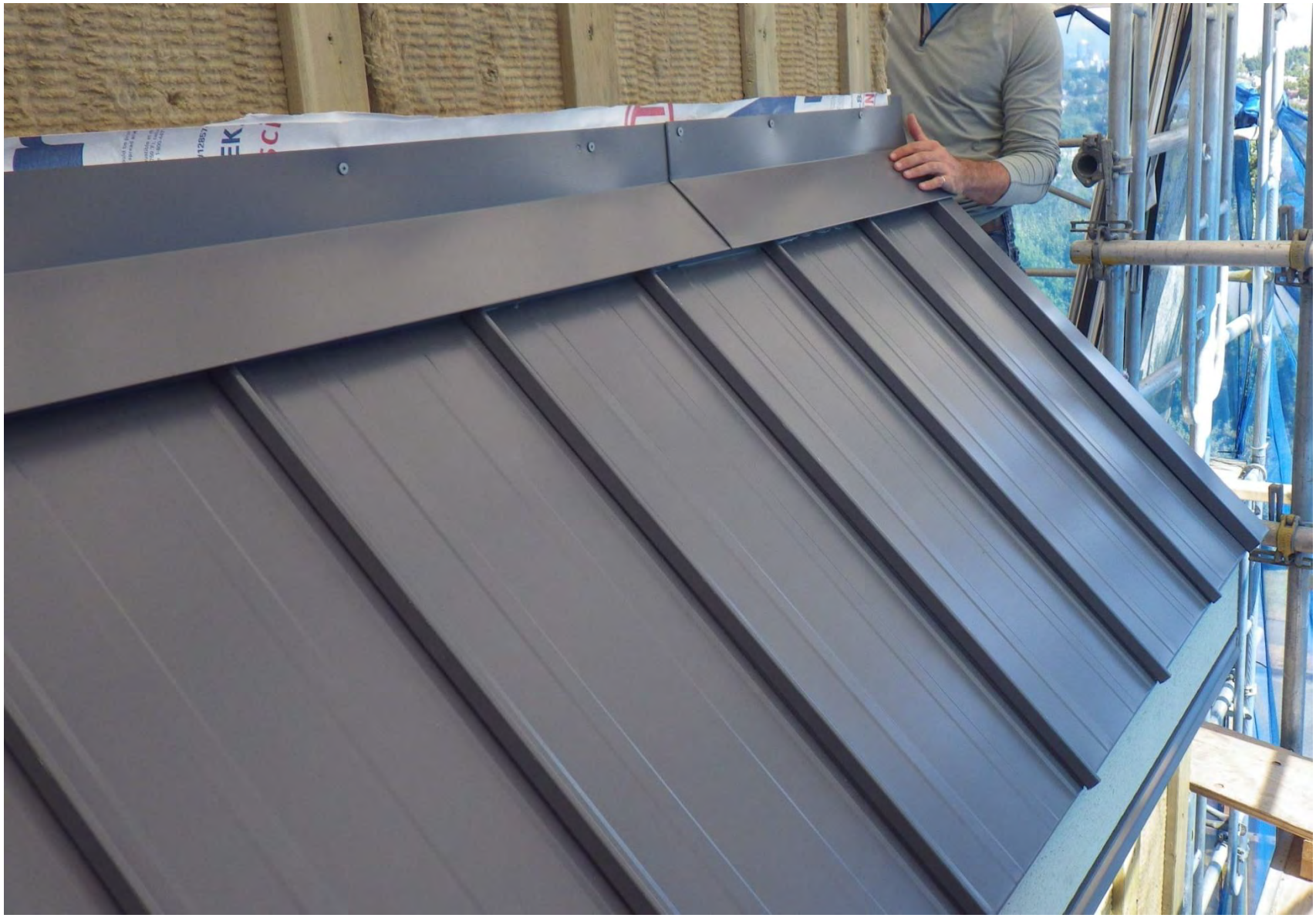
Attachment Solutions

Roof





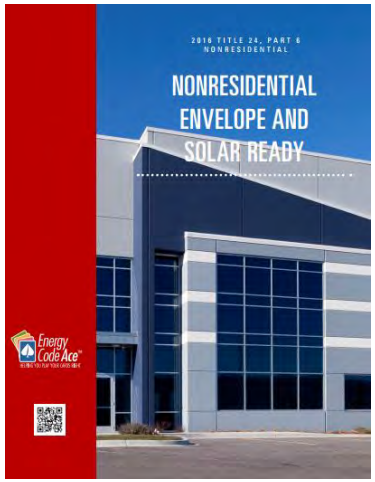
New Sloped Roof / Overhang Assembly

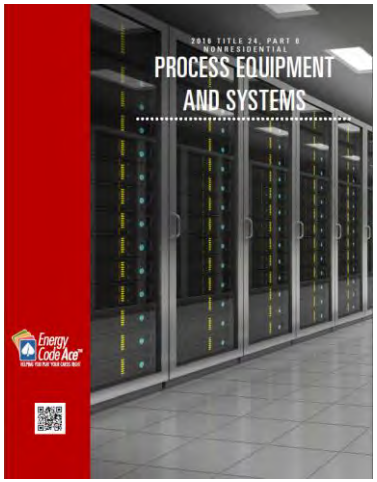


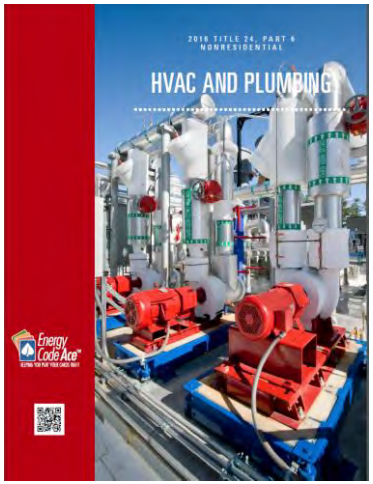
New Low-Slope Roof Assembly

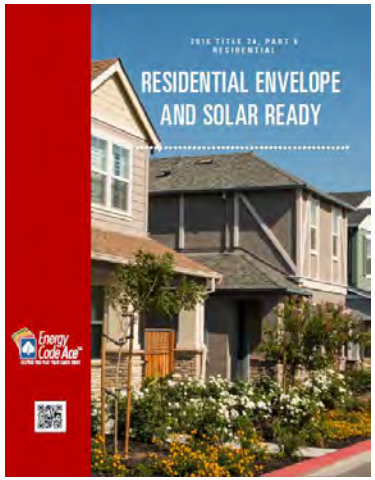
Next Steps

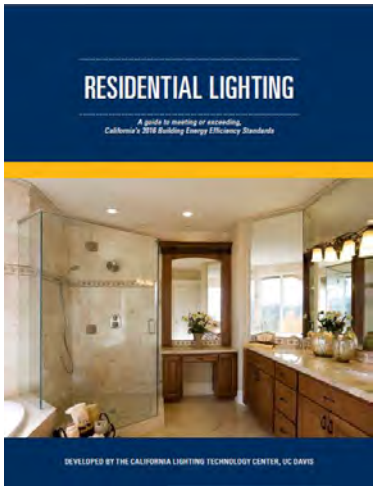
Ace Resources™

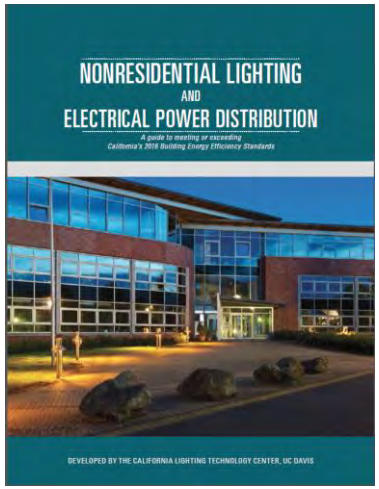








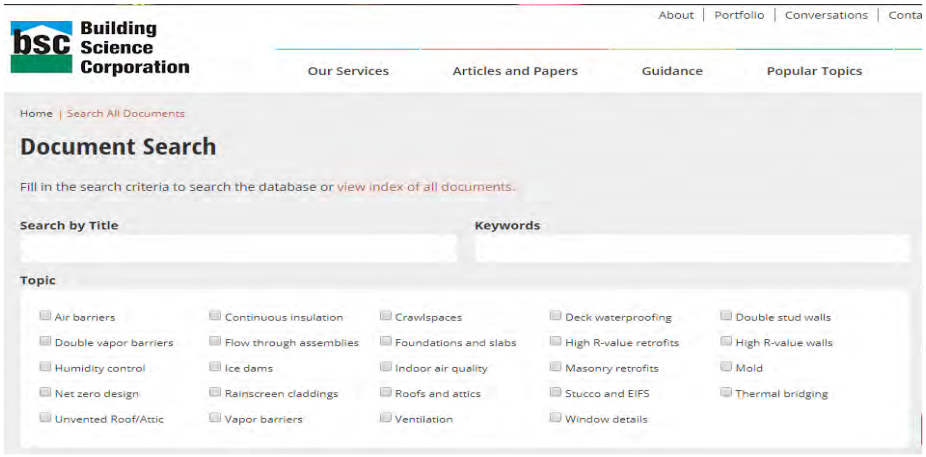




Short manuals including compliance requirements and recommendations for implementing Title 24, Part 6 in new construction, addition and renovation projects.

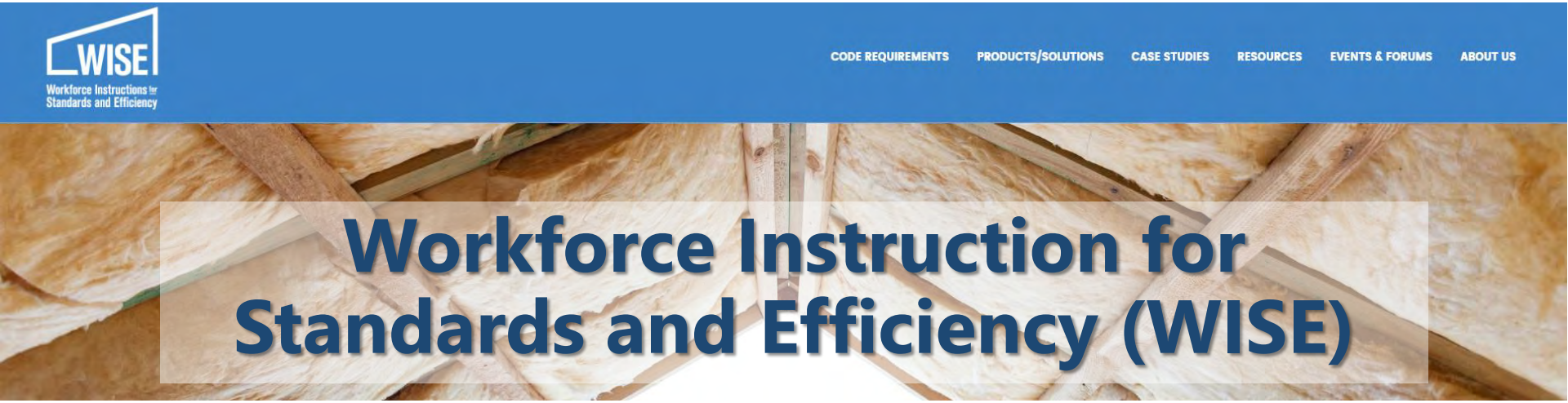
Pretty Much EVERYTHING…

www.buildingscience.com **www.rdh.com**



- In this Decoding Talk came from these amazing resources:
  - Guest speaker ☺
  - Pictures
  - Verbiage
  - Handouts

www.wisewarehouse.org



WISE
Workforce Instructions for Standards and Efficiency

- A training and education program sponsored by the California Energy Commission.
- Curates HPA/HPW technical resources and product information on website
- Provides **FREE in-person, one-on-one trainings** to the CA building industry on overcoming barriers to HPA/HPW implementation.
- Contact Dan Krekelberg, WISE Program Manager
  - dkrekelberg@consol.ws

Ace Training | Decoding Talks™

Coming Soon!

September 2017

NEW NRCC-LTI Form w/ ECA Lighting Wheel

w/Michael Scalzo

November 2017

NonRes Mechanical Acceptance Testing

w/David Wylie

Wrap Up