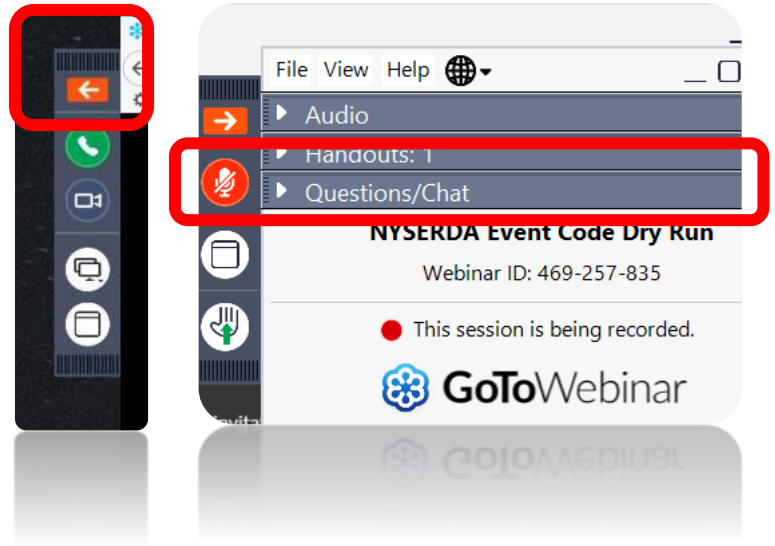
Webinar Overview

All attendees have been placed on mute.

Use the Question Section on the webinar control panel to ask a question at anytime during the presentation.

Q&A will take place at the end of each segment.

Webinar will be recorded and sent.



Submit Responses via PollEverywhere

- Respond at PollEV.com/swa335
- Or text swa335 at 22333 to join, then send your answer

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Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more

PASSIVE HOUSE INCENTIVE STRUCTURE FOR MULTI-FAMILY (5 UNITS OR MORE)				
Incentive Timing	**Activity**	**Incentive Amount**	**Max Incentive (Per Unit)**	**Max Incentive (Per Project)**
Pre-Construction	Feasibility Study[1]	Up to 100% of Feasibility Study Costs	N/A	$5,000.00
	Energy Modeling[2]	75% of Energy Modeling Costs (Before 90% Design Drawings)	$500.00	$30,000.00
		50% of Energy Modeling Costs (90% Design/50% Construction)	$250.00	$15,000.00
Post Construction	Certification[3]	Up to 100% of Certification Costs	$1,500.00	$60,000.00

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

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Workshop 1, Part 1
Continuous Insulation

Steven Winter Associates, Inc.

Since 1972, Steven Winter Associates, Inc. has been providing research, consulting, and advisory services to improve the built environment for private and public sector clients.

Our services include:

- Energy Conservation and Management
- Decarbonization
- Sustainability Consulting
- Green Building Certification
- Accessibility Consulting

Our teams are based across four office locations:
New York, NY | Washington, DC | Norwalk, CT | Boston, MA

For more information, visit
www.swinter.com

Learning Objectives

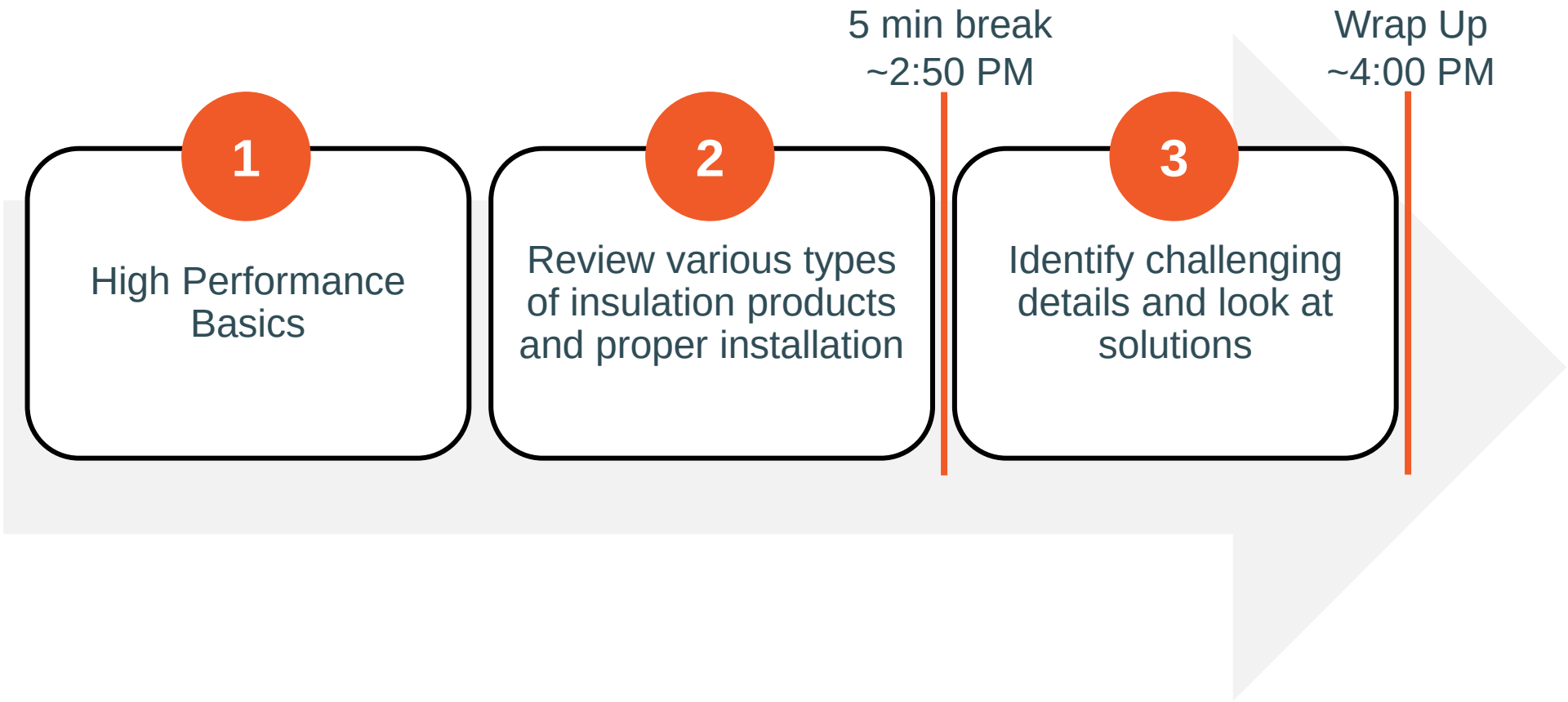
Summarize the importance of continuous insulation

Identify challenging details and propose solutions to overcome

Describe common approaches for continuous insulation of residential projects

Recognize new and innovative insulation components

Overview of Presentation



What is your profession?

A. Architect

B. Engineer

C. Contractor/CM

D. Owner/Developer

F. Consultant

G. Other

What is the one thing that you were hoping to learn about today? (hint: link words with an underscore)

Why are We Here

- Push for Building Electrification (Passive House as a pathway)
- Incentives available
- Benefits
  - Drastically lower energy use and operational cost savings
  - Healthy air quality from ventilation systems
  - Consistent and comfortable room temperatures without air drafts
  - Increased natural lighting and quieter acoustic conditions
  - A more resilient and comfortable building

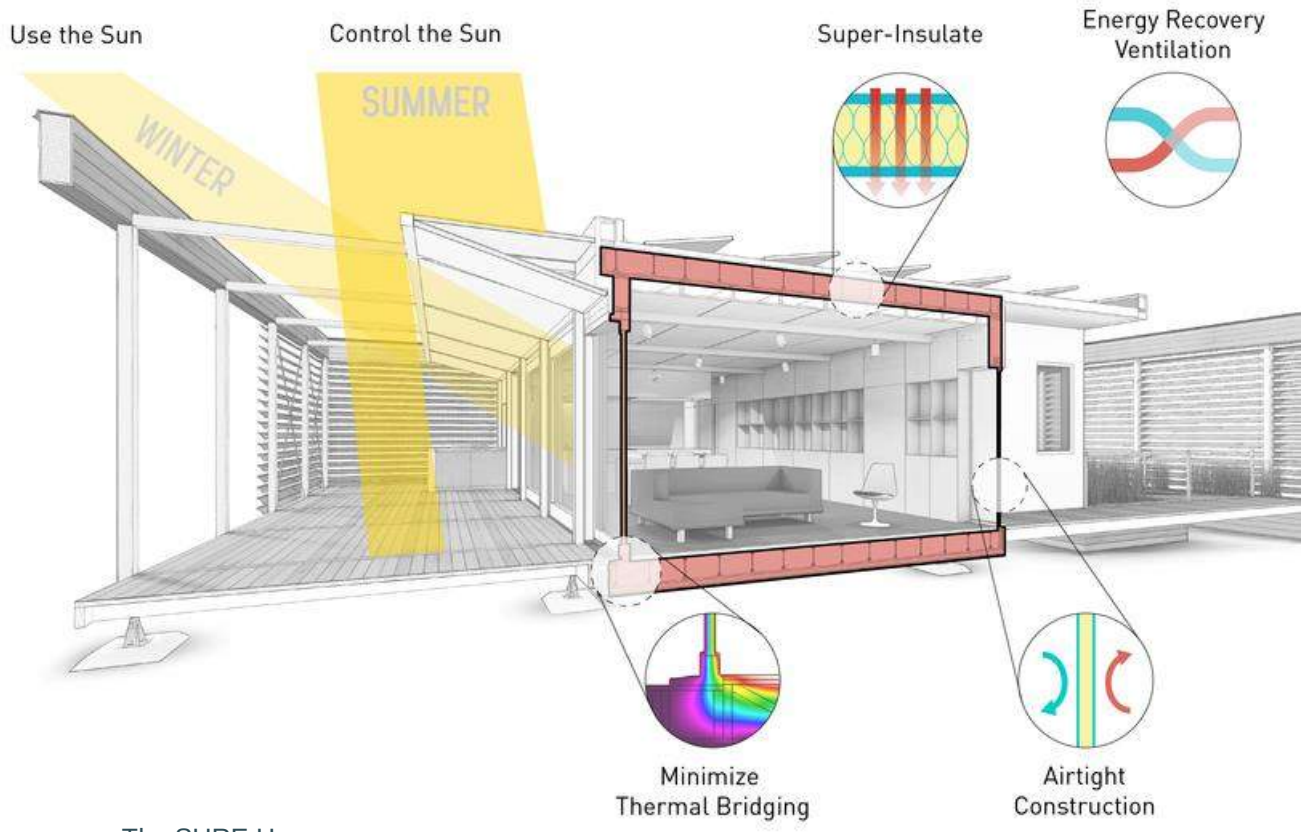
These **Trainings - Each has two parts**

- **Workshop 1: Continuous Insulation**
- **Workshop 2:** Air Sealing and Insulation for Homes
- **Workshop 3:** High Performance Ventilation Systems for Homes

High Performance Basics

Goals of High Performance Buildings

- Building durability
- Energy $ reduction
- Optimal thermal comfort
- Superior indoor air quality
- Carbon emissions reductions



The SURE House

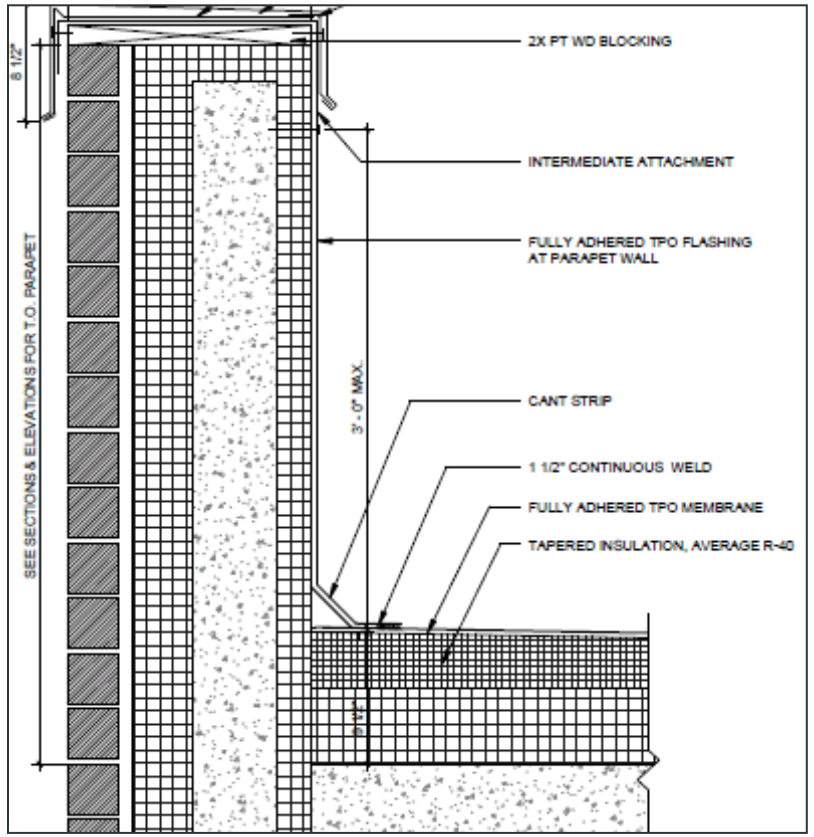
Winner of the 2015 D.O.E. Solar Decathlon

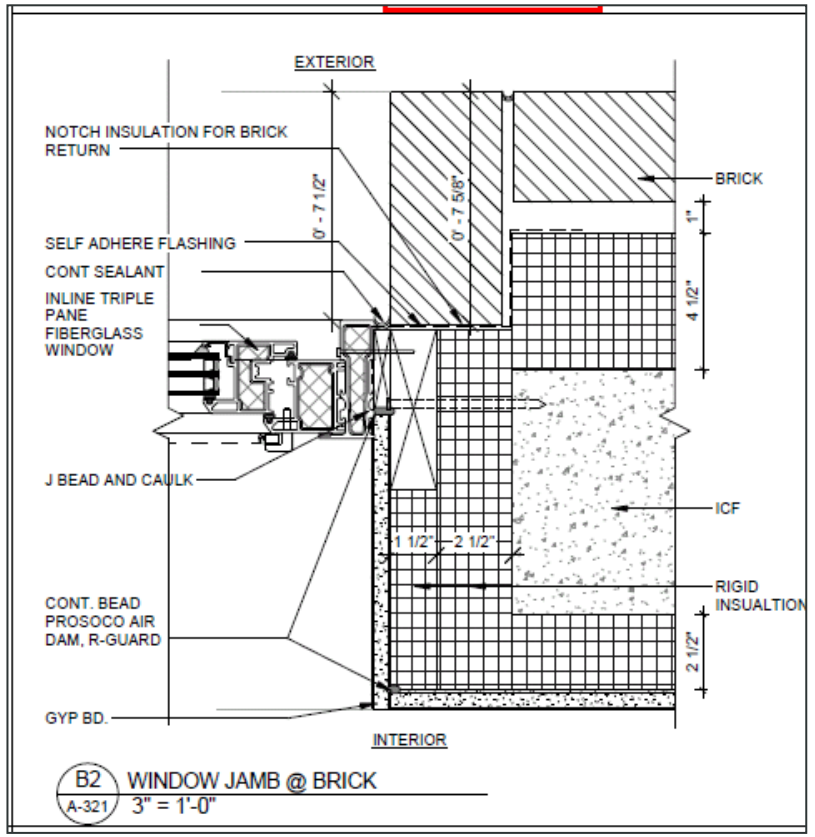
www.surehouse.org

Passive House as a Pathway to High Performance

- Thermal insulation continuity
- Thermal bridge free construction
- Solar control
- Airtightness
- Balanced mechanical ventilation

Continuous Insulation

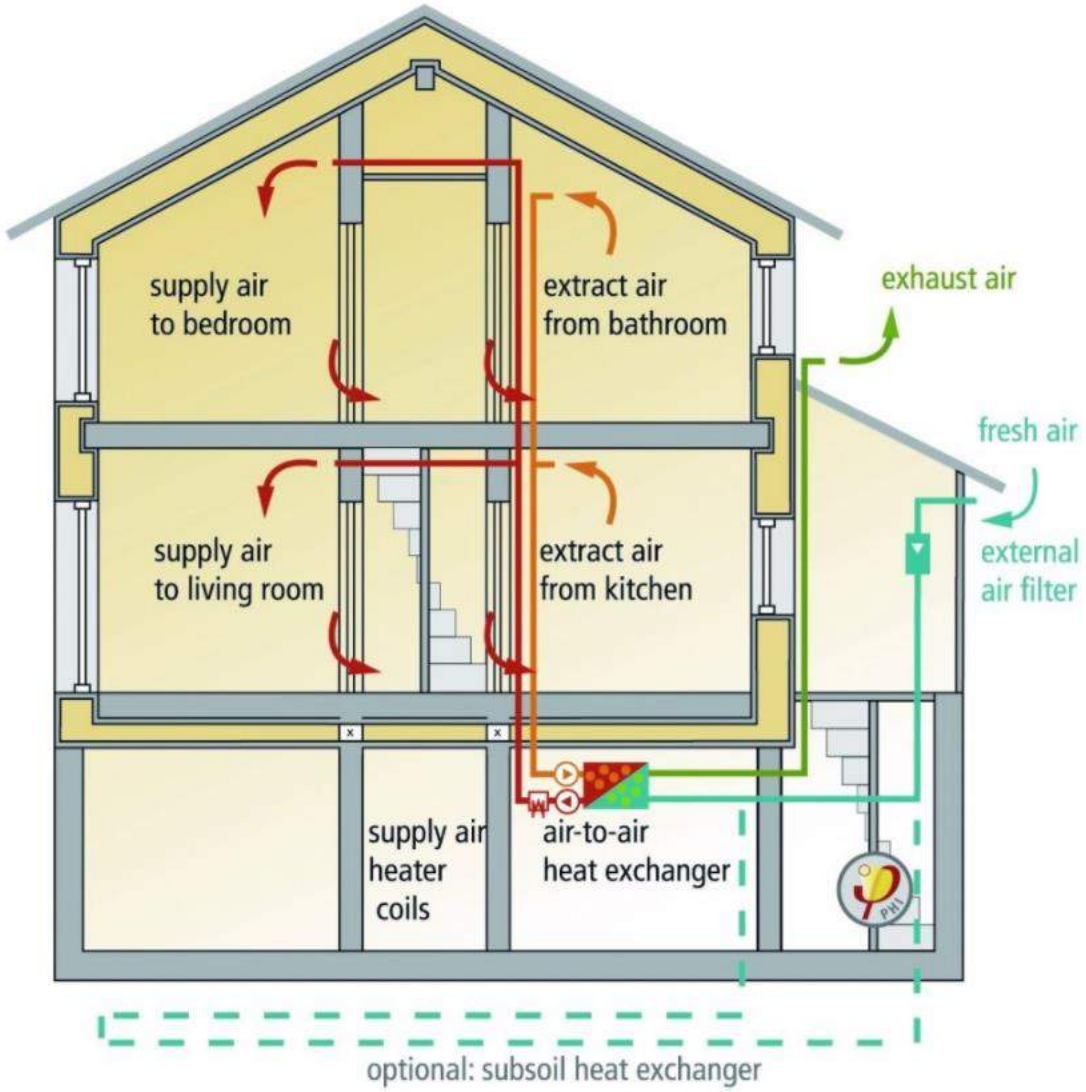




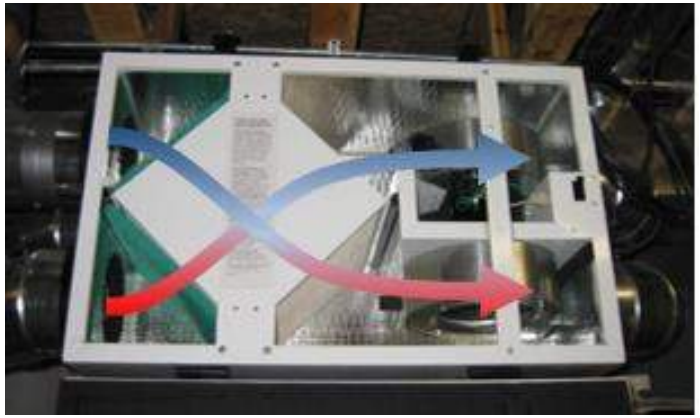
Air-Tightness Blower Door Testing

- Basic Components
  - Gauge (manometer)
  - Shroud
  - Frame
  - Fan

Balanced Ventilation and Heat/Energy Recovery



- Provide fresh, filtered air 24 hours a day
- Heat exchanger +75% Efficient
- Highly insulated and air-sealed ductwork



Questions?

Insulation Options

Building Enclosure Attributes

Thermal Insulation	Air Barrier	Water Resistive Barrier	Drainage Plane	Vapor Retarder
Slows the transfer of thermal energy (heat)	Slows the movement of air through an assembly	Part of the assembly that protects the enclosure from water penetration	Provides a predicable path for shedding water	Slows the rate of vapor diffusion

Thermal Boundary

- Location of insulation in the building shell
- Type of insulation
- Amount of insulation (thickness and area)
- Quality of installation (good, fair, poor)
- Is insulation protected from wind-washing?
- Is insulation protected from moisture?

Thermal Boundary and Air Barrier Integration

- The two boundaries work together to manage Energy, Moisture, and Increase Durability
  - Energy Control = CO2 and $$$ saved
  - Moisture Control = building durability
  - Comfort Control = happy occupants
- To Function Properly Must be:
  - Continuous (no gaps)
  - Aligned with each other

Thermal Boundary

https://www.owenscorning.com/en-us/insulation/residential

Thermal Resistance

R-value
(h · ft²·°F/Btu)

- R-value is a measurement of a material's resistance to conductive heat transfer
- The higher the R-value, the better the insulator

R-values of Common Insulations

Type	R-value/Inch
Fiberglass	2.4 – 4
Cellulose	2.4 – 3.8
Open cell SPF	3.6 – 4.5
Closed cell SPF	5.6 – 7
Mineral wool	3.5 – 4.5
Extruded Polystyrene	5 – 5.5
Polyisocyanurate	6.0 – 6.5

Fiberglass Batts

Fiberglass Batts (R-19 to R23) *CAN* be Effective.

However, more often that not there is difficulty in achieving proper installation.

Blown Cellulose

- Damp-Spray and Dense-Pack Cellulose (R-19 to R-23)
- Dense Pack can contribute to air-tightness

Open-Cell Foam (ocSPF)

- Approximately R-3.5 per inch (varies)
- Easy to rake flush with framing
- Hydrophobic but can hold water
- Respirators and safety measures required

Closed-Cell Foam (ccSPF)

- Approximately R-6.5 per inch
- Air and vapor impermeable
- Installation QA and shrinkage can be concerns
- Respirators and worker safety measures required
- Improved blowing agents but still a GWP concern

Mineral Wool Insulation

- Exterior continuous semi-rigid
- R-4.2/inch
- Air and vapor permeable
- Drainable; used in rain screens

- Interior batts
- R-14 (2 x 4); R-24 (2 x 6)
- Air and vapor permeable

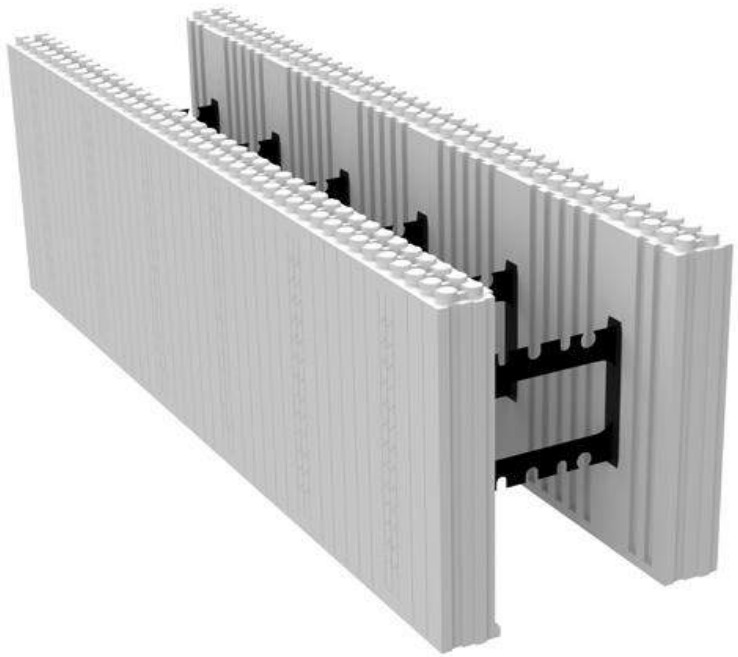
Extruded Polystyrene (XPS)

- Monolithic material with no facer
- Material is very water tolerant (below grade uses)
- R-5 per inch (5.4/inch available)

Polyisocyanurate

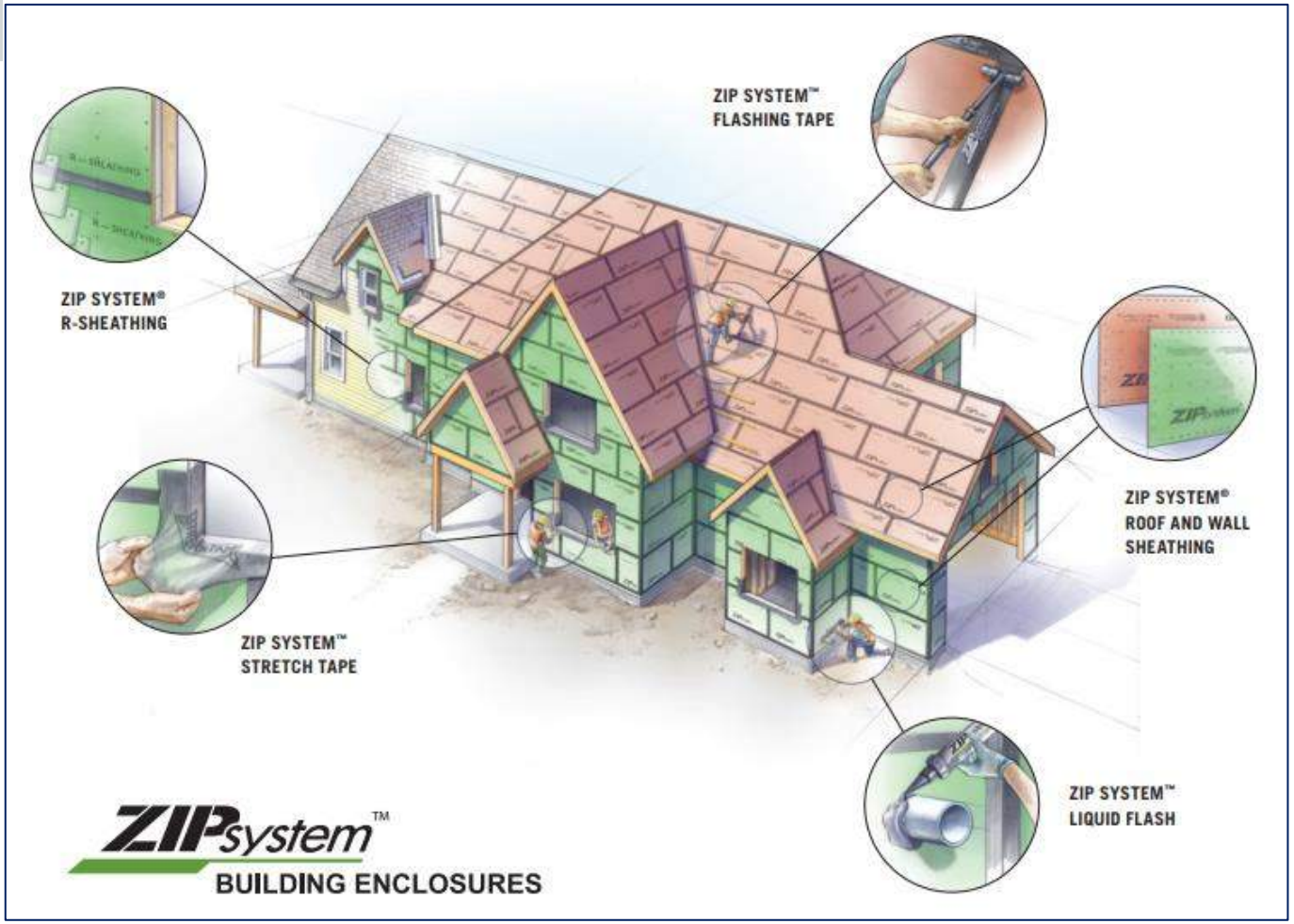
- R-6.5/inch
- Air and vapor impermeable if faced (other facers available)
- Common above-deck roof insulation

Expanded Polystyrene (EPS)



- Monolithic material with no facer
- Material is very water tolerant
- R-4 per inch (R-4.7/inch available)

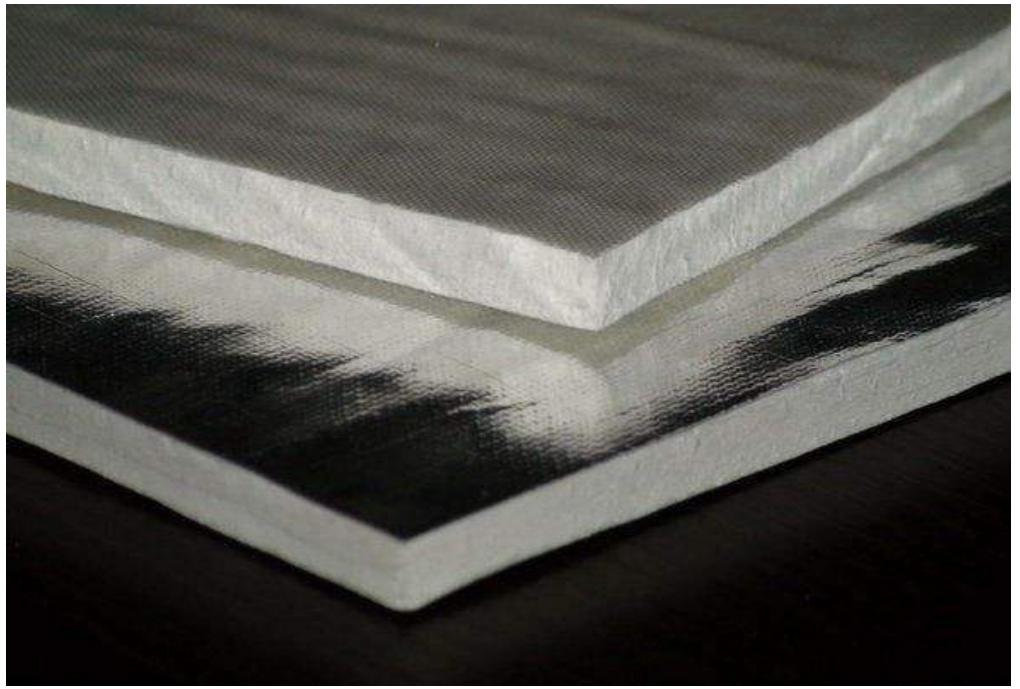
ZIP System & ZIP System R-Sheathing



- Zip R: Structural panel with built-in exterior insulation
- Integrated moisture, air, and thermal protection
- R-values range from R-3 to R-12

1) Built in exterior insulation
2) Integrated water resistive barrier
3) Continuous air barrier
4) Structural durability

Specialty Insulations (Aerogel)



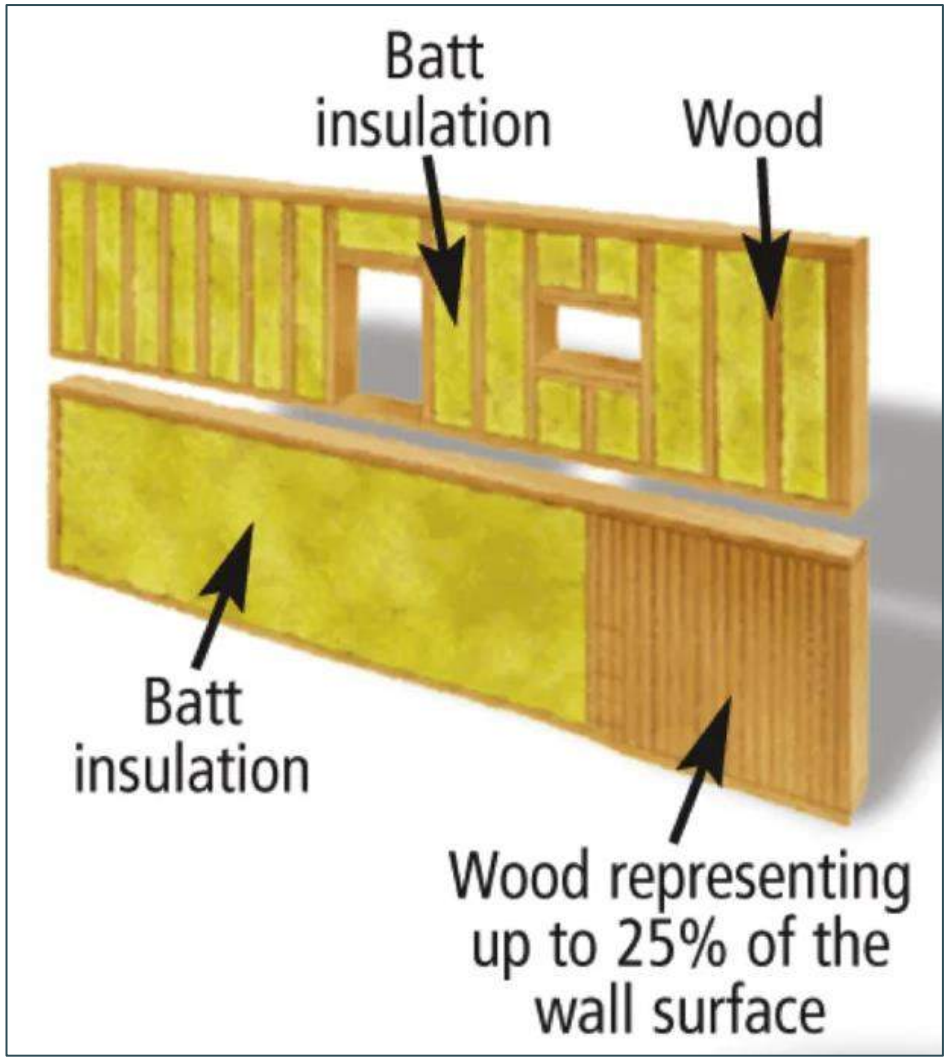
- High R Thermal break and dewpoint control
- Up to R-10 per inch; useful in space-limited applications

Insulation Continuity

- Insulation is like the sweater that keeps you warm, air sealing is the shell that keeps the wind out. We need no gaps in either!

+

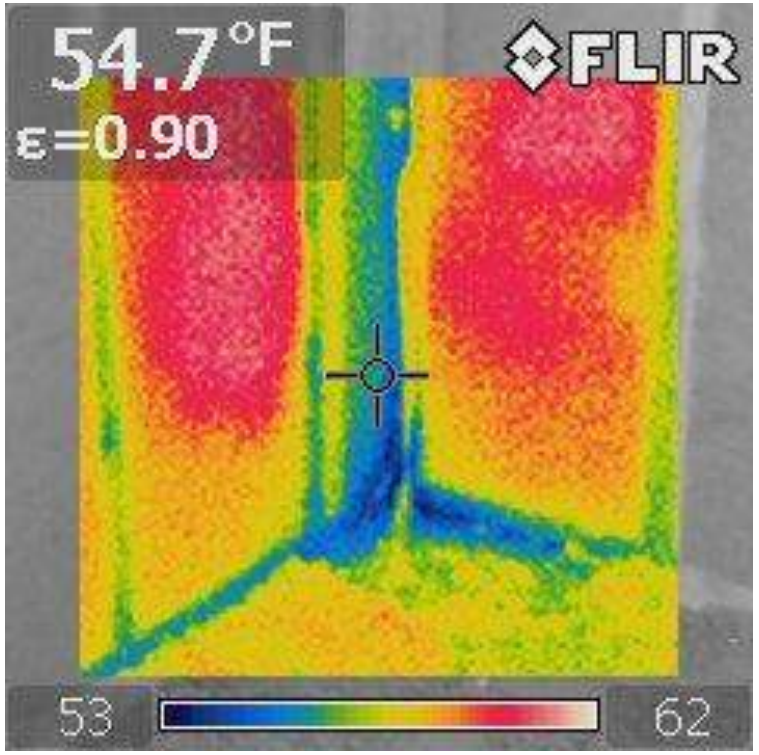
Thermal Bridges in Construction



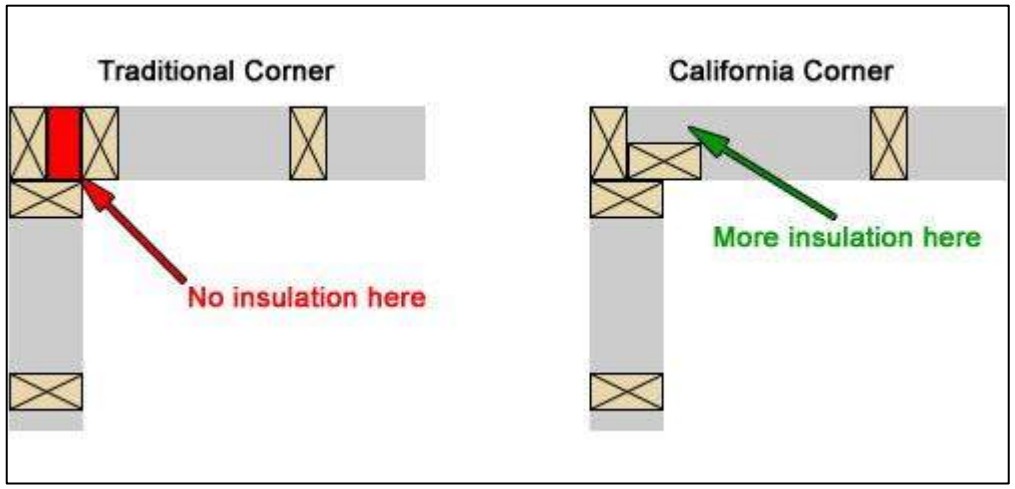
Credit: Sam Hagerman,
Thermal Bridge Free Construction

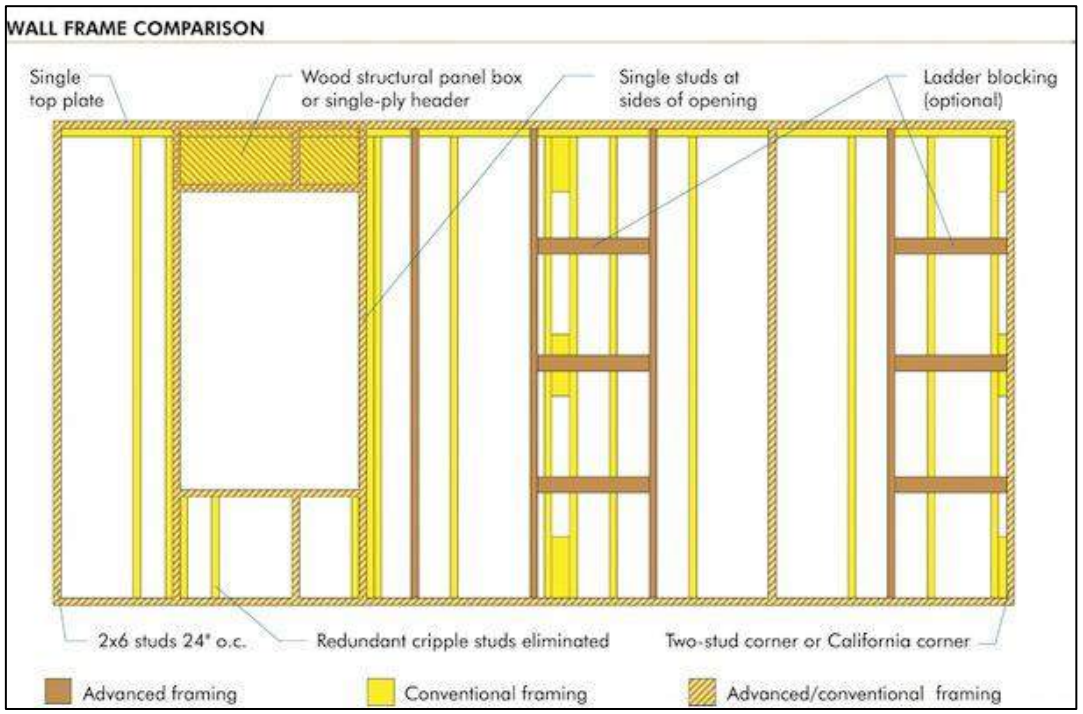
Typical TB Locations

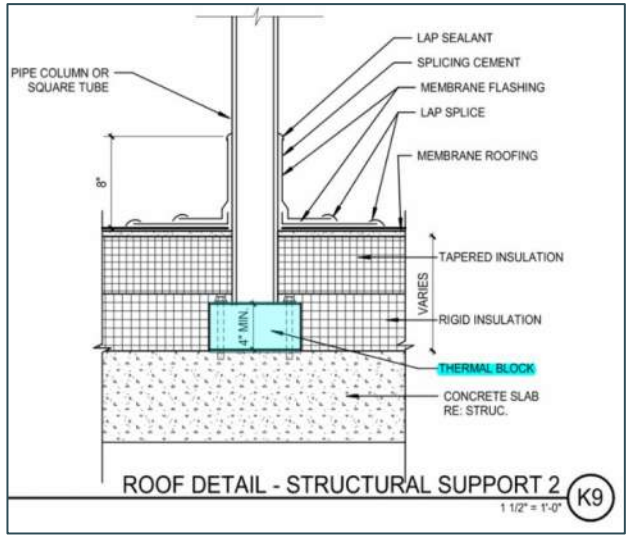
- Framing members
- Top/bottom plates
- Wall corners
- Slab/wall connection
- Roof/wall connection
- Windows/doors
- Multi-story floor framing
- Porches/decks



TB Mitigation



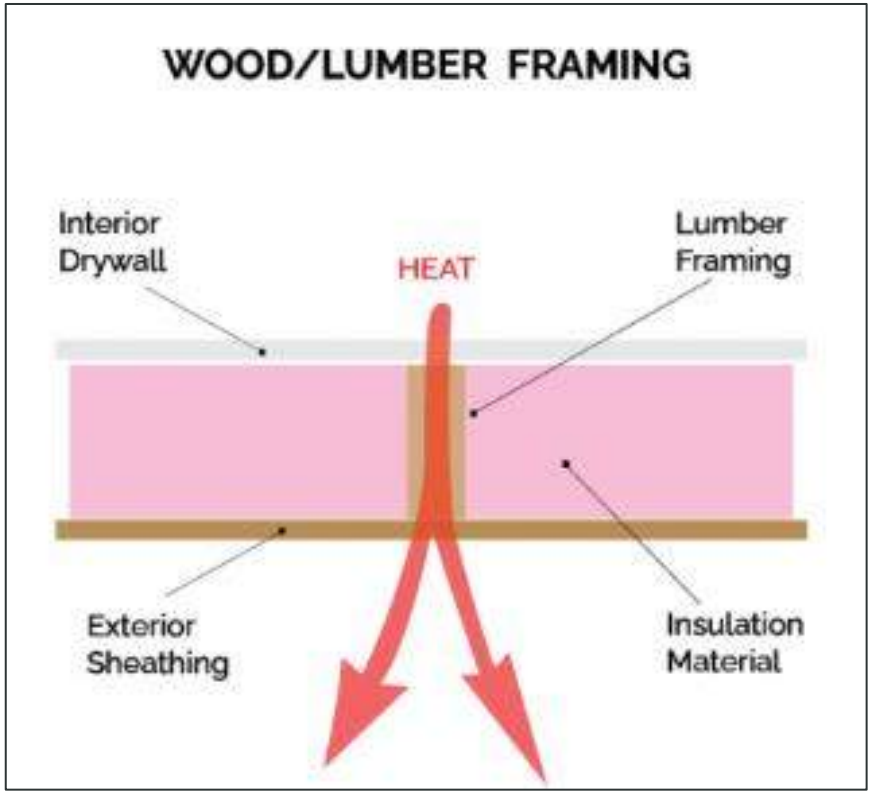




TSTUD™ Manufactured by US ENGINEERED WOOD, INC.

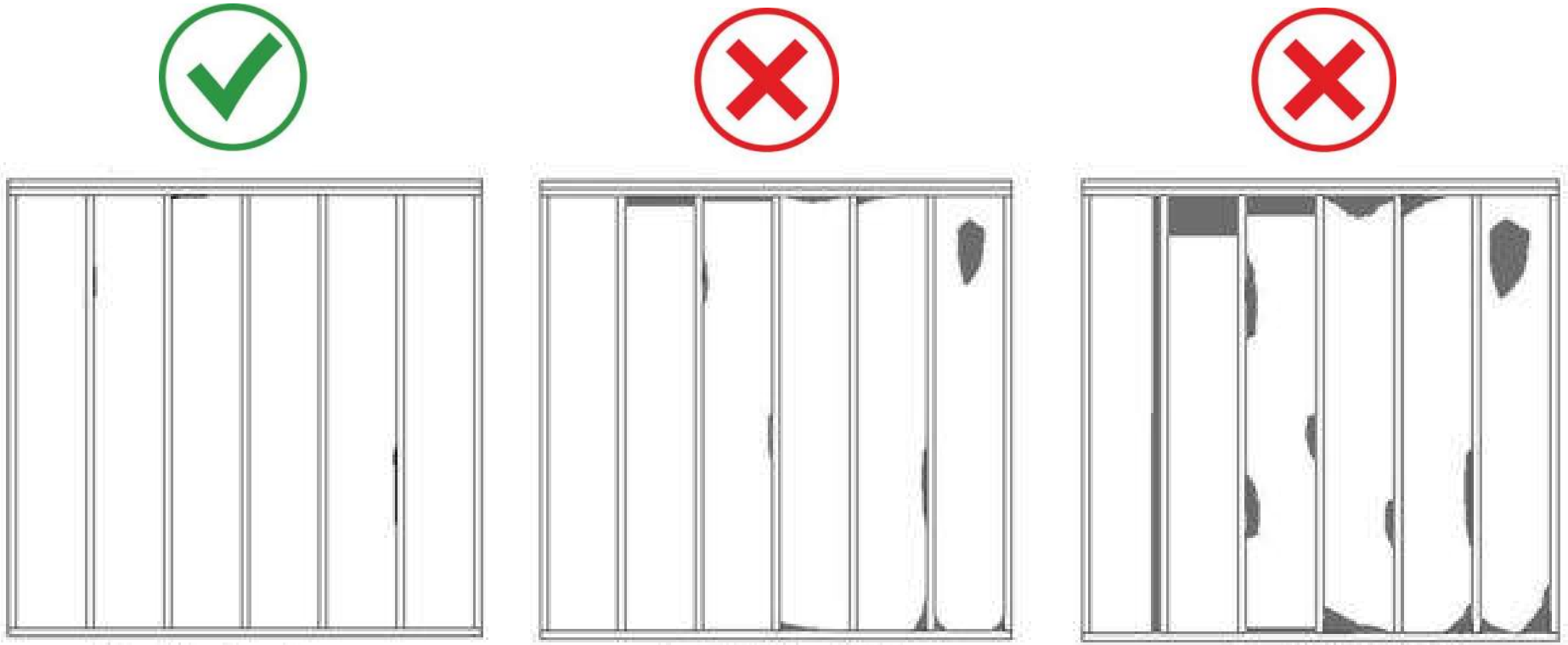
Avoiding Thermal Bridges

- Utilize continuous exterior insulation, or a combination of both exterior and interior insulation
- Plan for and mitigate TBs during design



What diminishes effective R-values in walls? (hint: link words with an underscore)

Installation Grade



Grade I: Almost no gaps

Grade II: Up to 2%

Grade III: 2% - 5%

RESNET protocol for the effect of missing insulation on installation grade

Diagrams from the HERS Standards

Factors Impacting Insulation Performance

- Compression (refer to manufacturer's compression charts)
- "Fluffing", especially blown fiberglass
- Voids and gaps, inconsistent coverage
- Moisture
- Not in contact with the surface it is insulating

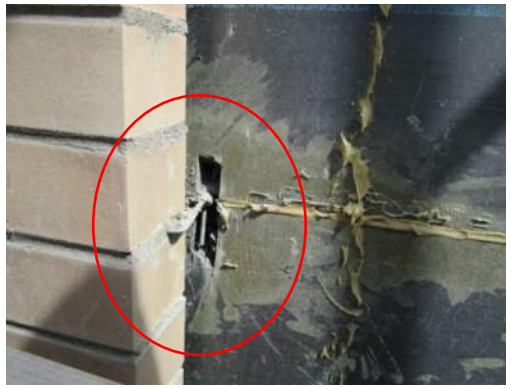
Good Photos – Rigid Insulation

Continuous Tight Insulation: NO GAPS between boards. Well insulated building edge and corners

RIGID INSULATION

Bad Photos – Rigid Insulation

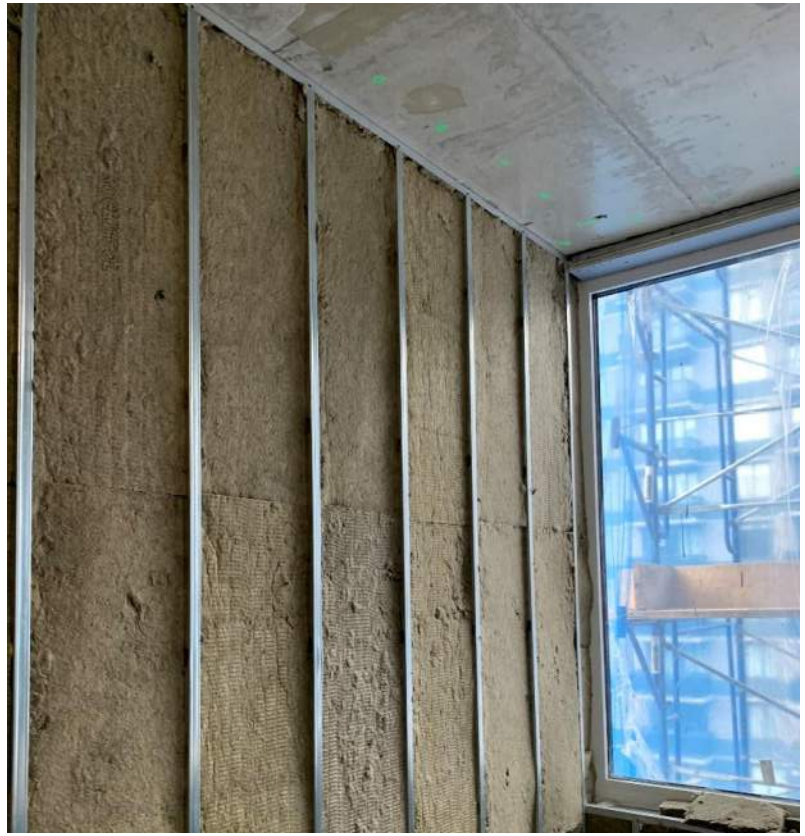
Large Gaps in installation,
Insulation removed by brick ties



Batt Insulation – Bad Photos

Batt Insulation – Good Photos

Properly installed inset-stapled fiberglass insulation, resulting in a Grade I rating.

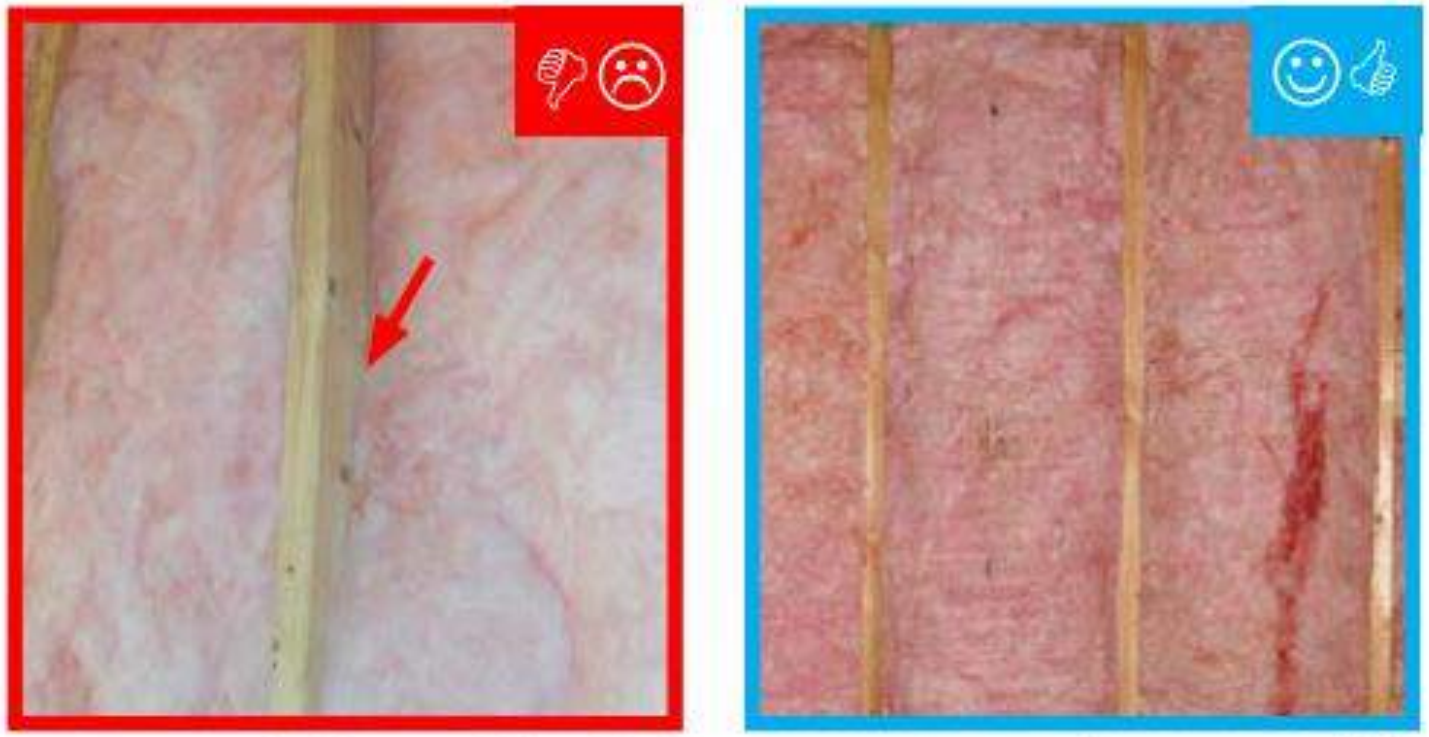


Batt Insulation – Install Details

1. **NO GAPS/VOIDS** — Insulation is installed without gaps/voids. Insulation material is in full contact with all sides of the cavity. Insulation is cut/split around blocking, plumbing, HVAC and electrical components (TERC 2.3, 3.1, 4.3)

Credit: Owens Corning & Advanced Energy

Batt Insulation – Install Details



1. **NO COMPRESSIONS/MISALIGNMENTS** — Insulation is installed without misalignments/compressions. Insulation material is in full contact with all sides of the cavity. Insulation is cut/split around blocking, plumbing, HVAC and electrical components (TERC 2.3, 3.1, 4.3)

Credit: Owens Corning & Advanced Energy

Batt Insulation – Install Details

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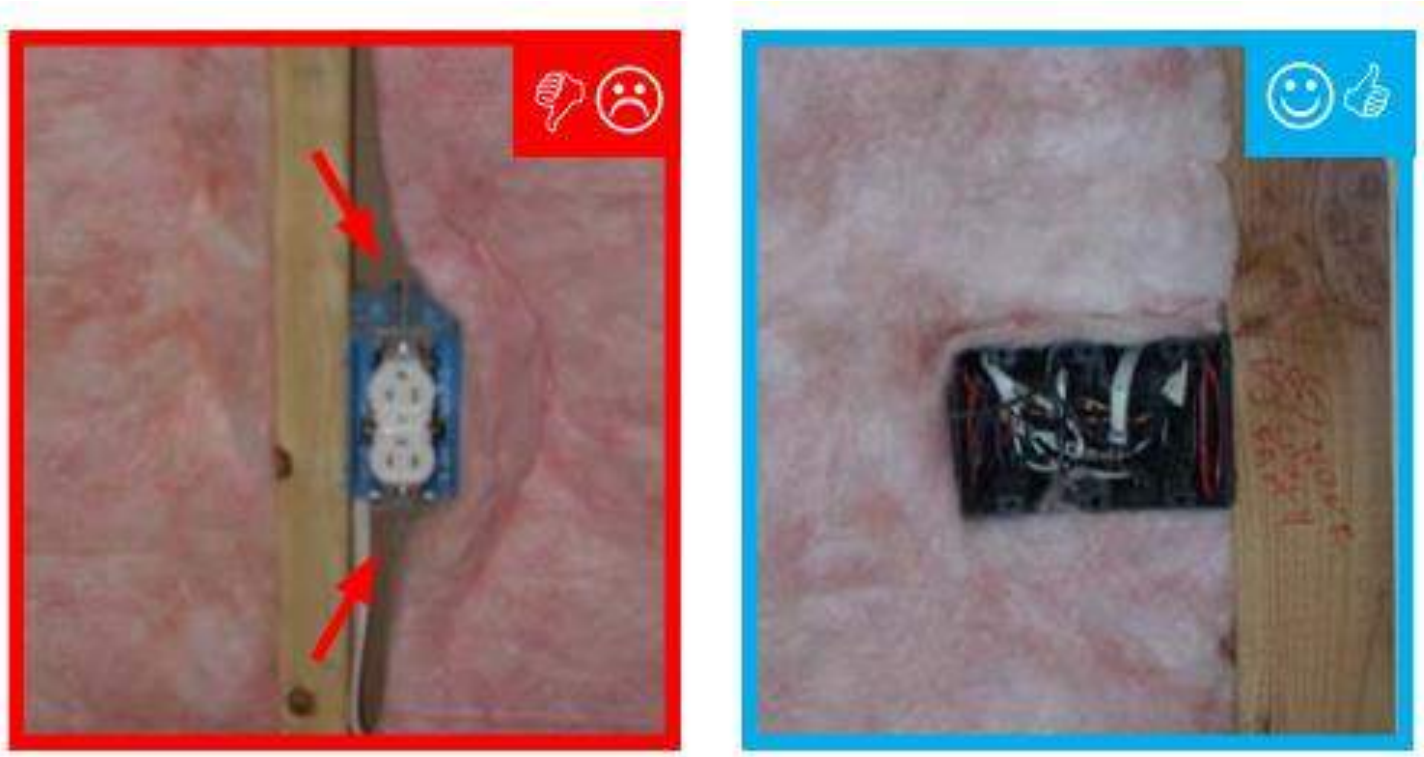
Batt Insulation – Install Details



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Credit: Owens Corning & Advanced Energy

Batt Insulation – Install Details

2. **FLOOR SYSTEMS** — Floor framing shall be completely filled with insulation or insulation is installed to maintain permanent contact with the sub-floor decking (e.g. bonus room floor, crawl space, cantilever) (TERC 3.2)

Credit: Owens Corning & Advanced Energy

Batt Insulation – Install Details

3. **CANTILEVERS** — Insulate any overhanging floor cavities before closing them in with rigid sheathing (TERC 3.2.2)

Credit: Owens Corning & Advanced Energy

Batt Insulation – Install Details

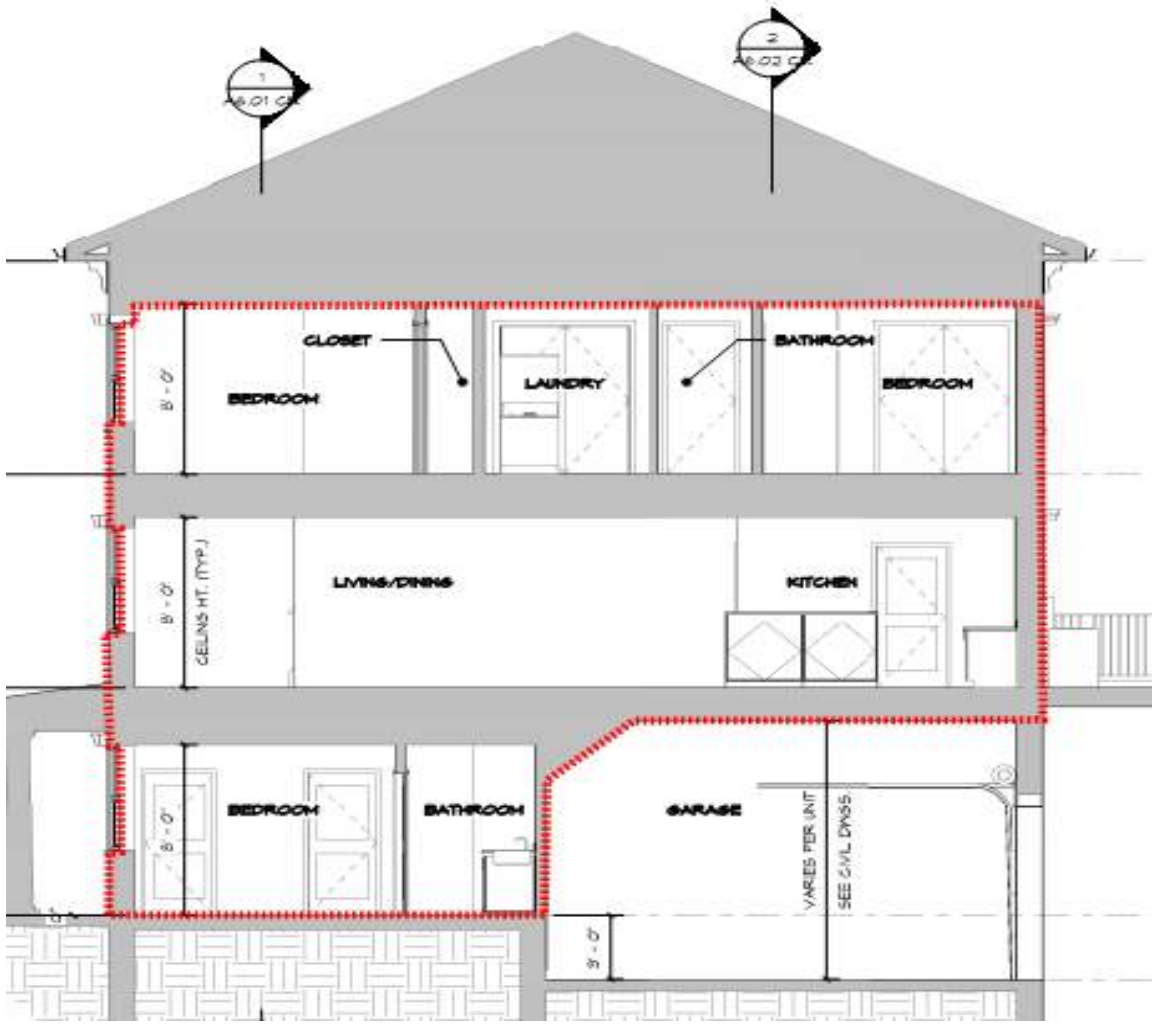
4. **TUBS/SHOWERS/FIREPLACES** — Insulation is installed behind showers, tubs, and fireplaces on exterior, attic, and party walls and rigid sheathing or other supporting material is installed to hold insulation in place (TERC 2.3, 3.1)

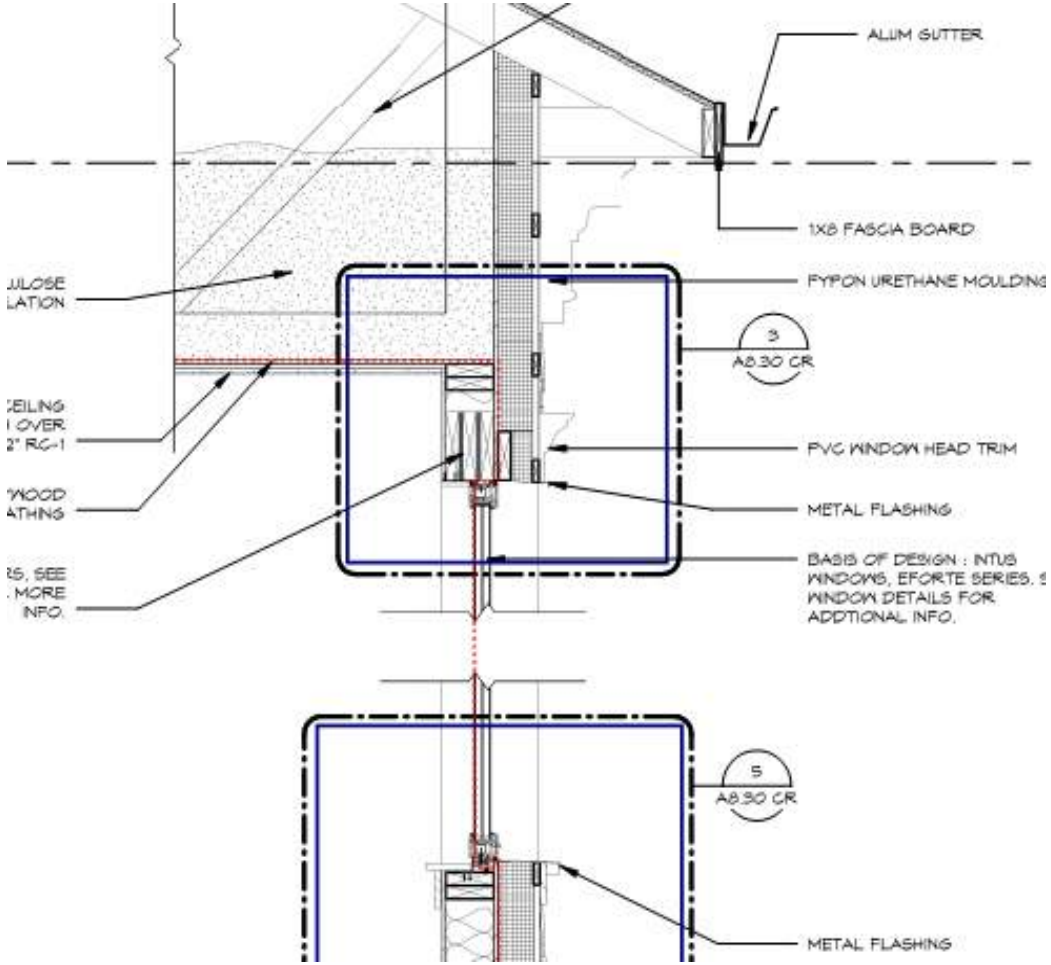
Credit: Owens Corning & Advanced Energy

Questions?

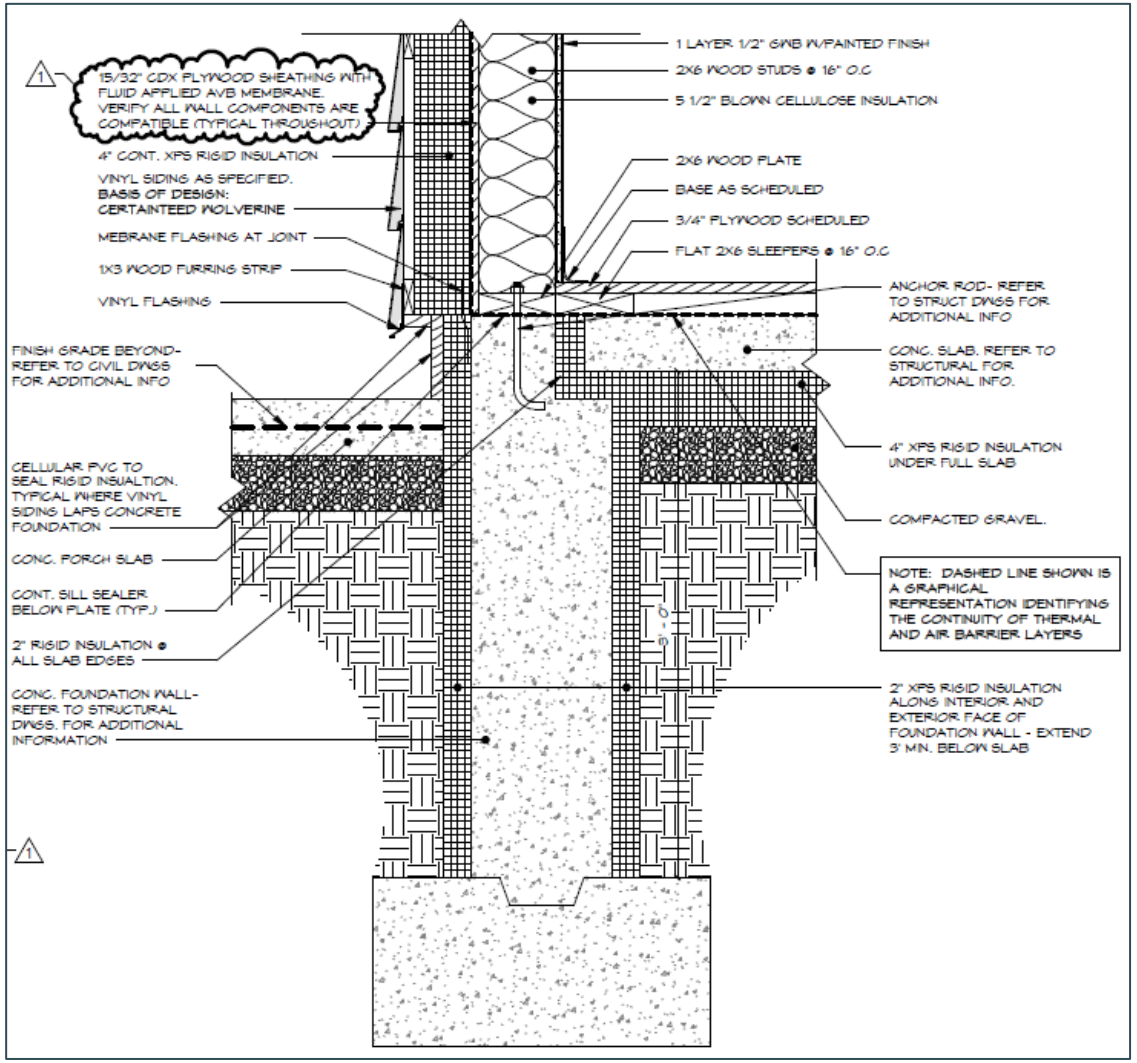
5 Minute Break

Wood Framed – Red Line Test

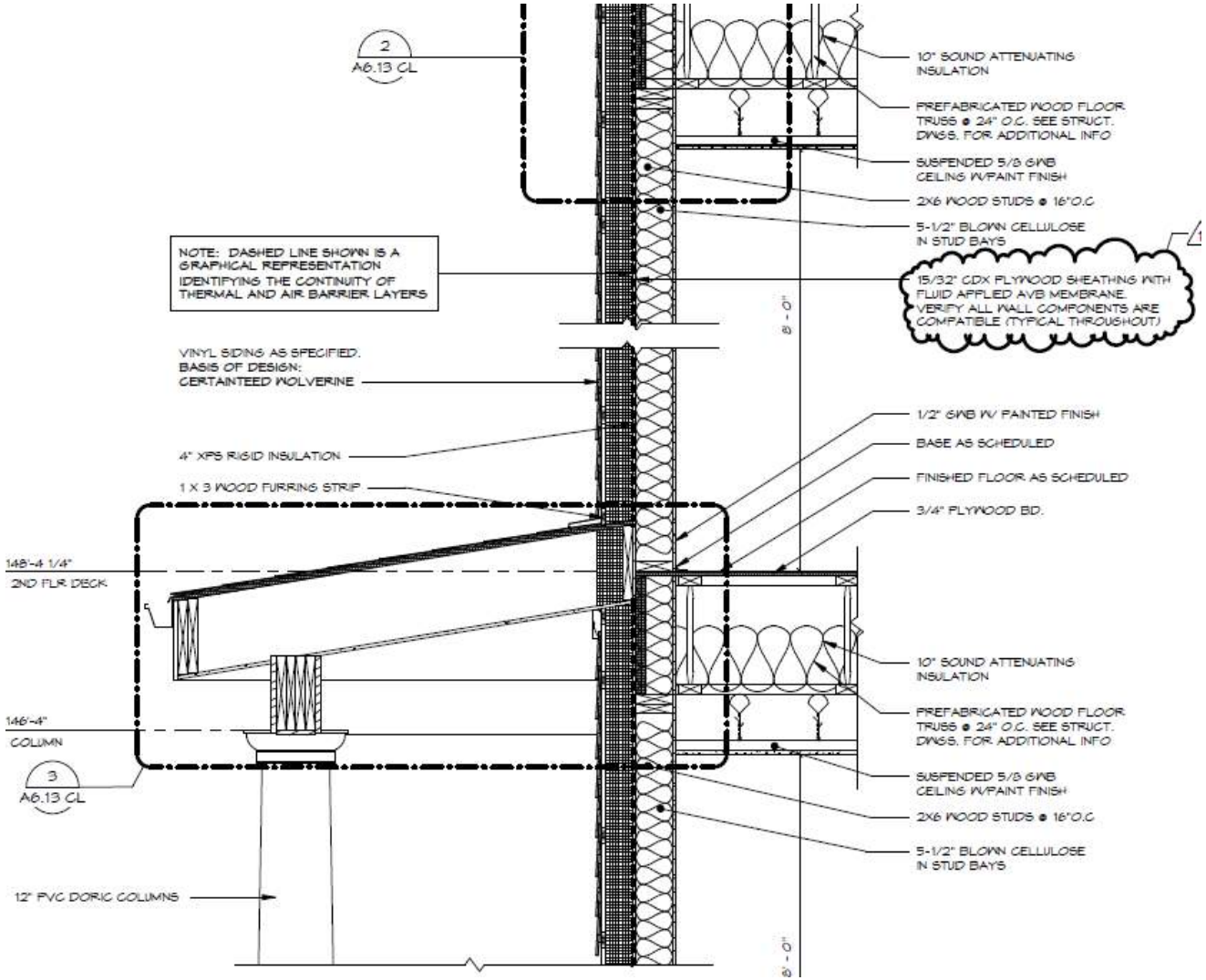


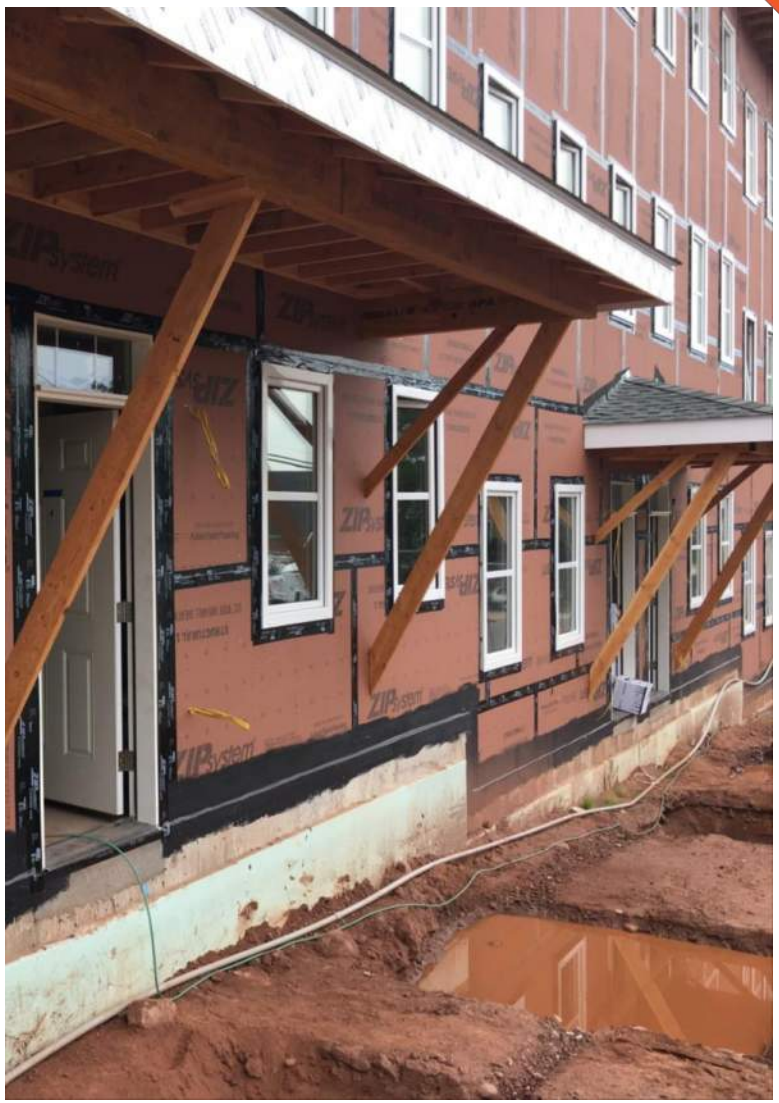


Wood Framed – Below Grade to Above

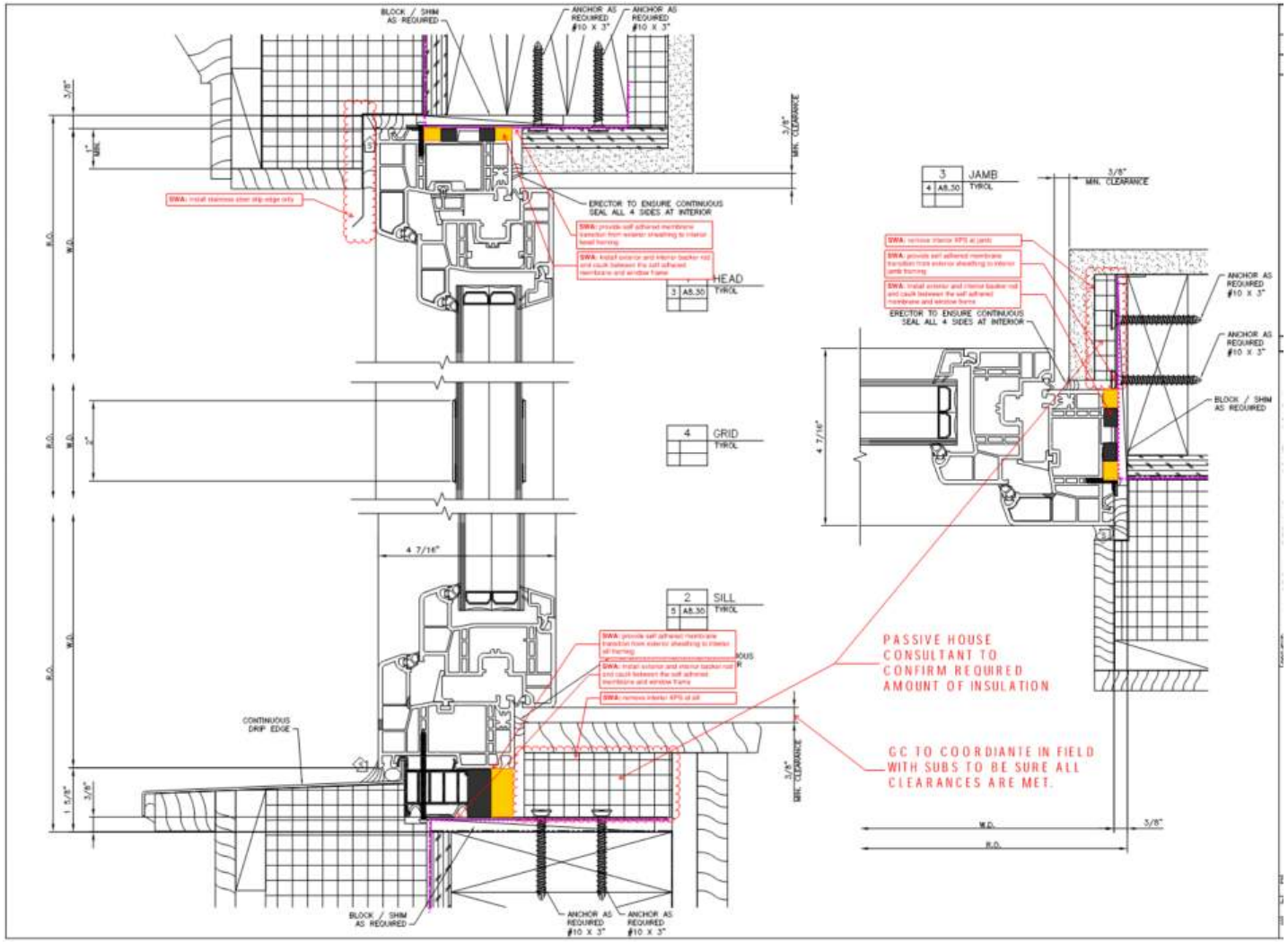


Wood Framed – Above Grade & Overhangs





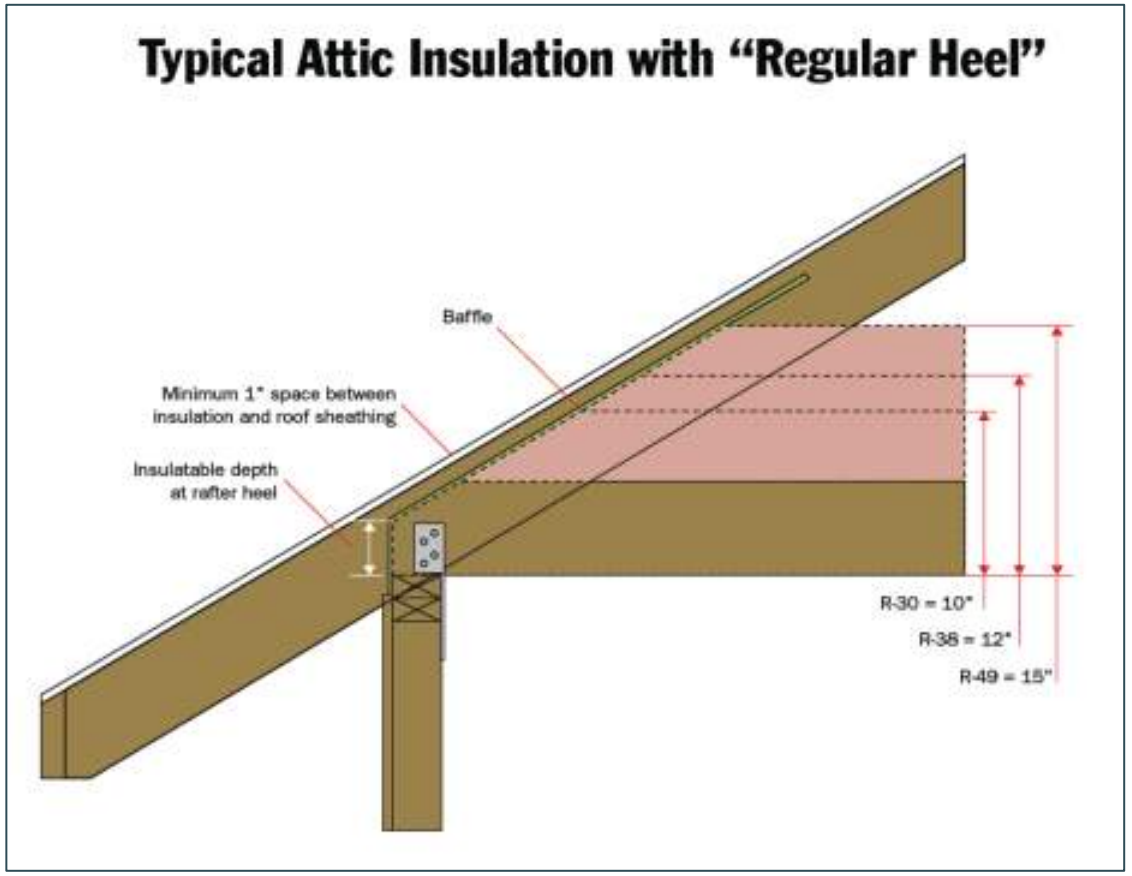
Wood Framed – Window Frame Overinsulation

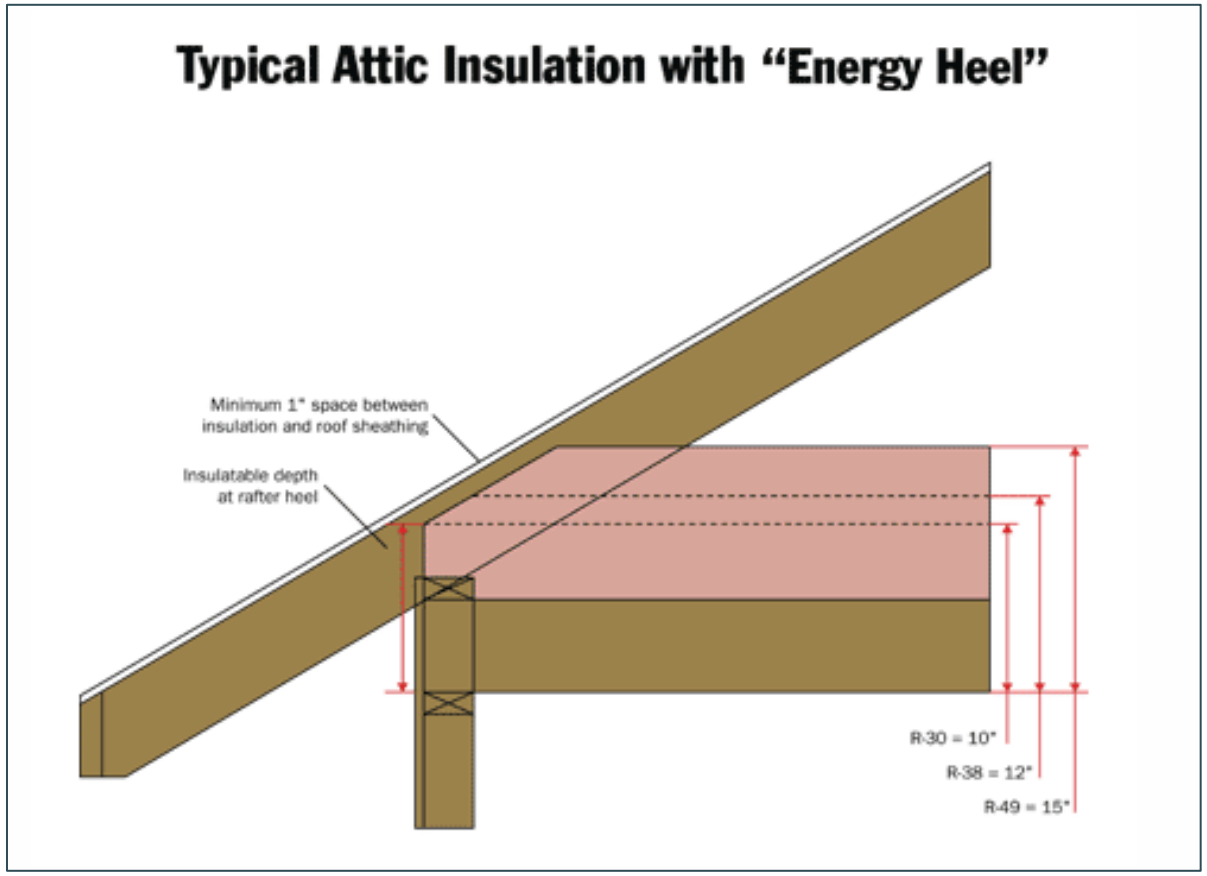


Wood Framed – Air Barrier vs Insulation Install Sequencing

Wood Framed – Air Barrier vs Insulation Install Sequencing

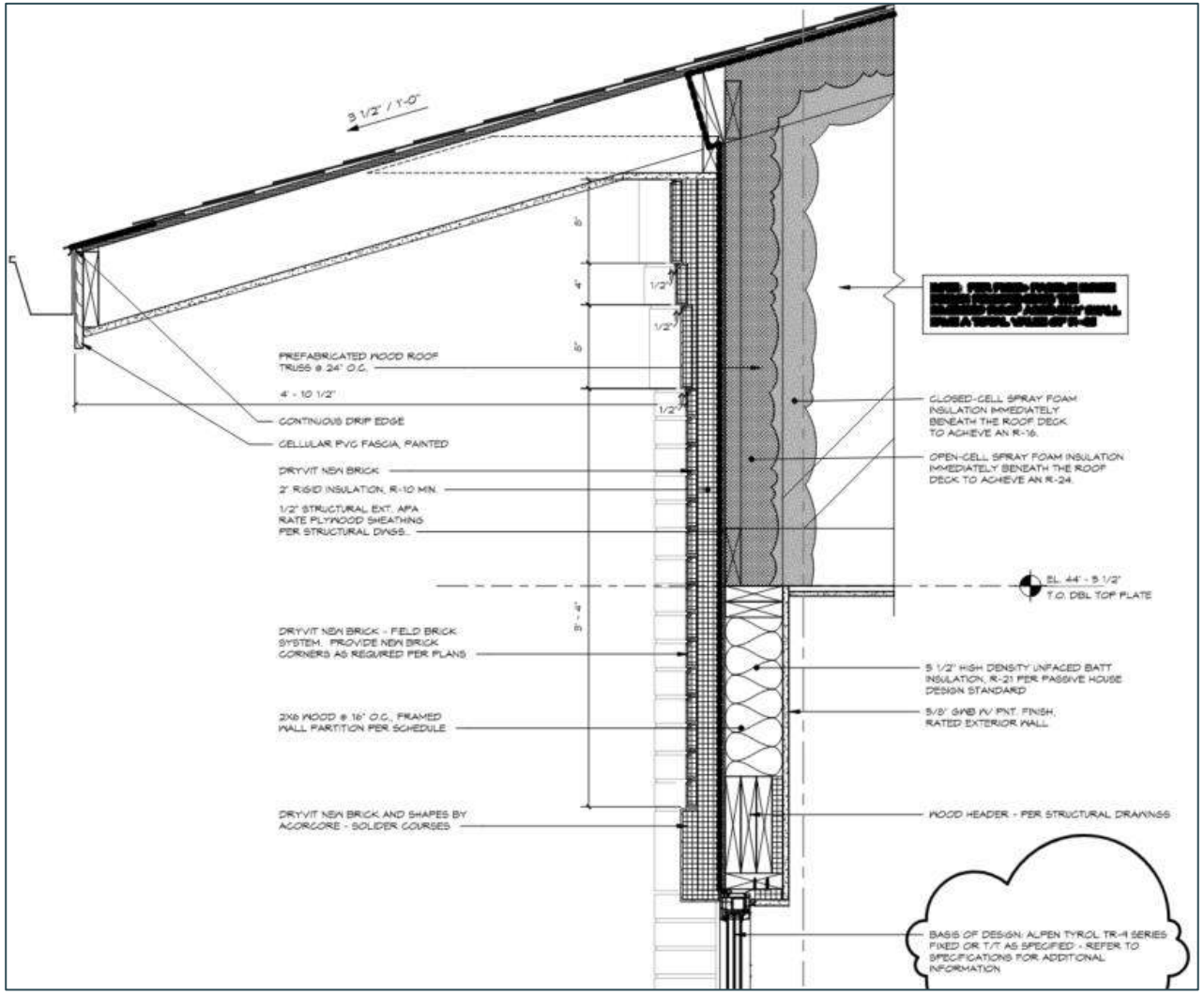
Wood Framed – Energy Heel



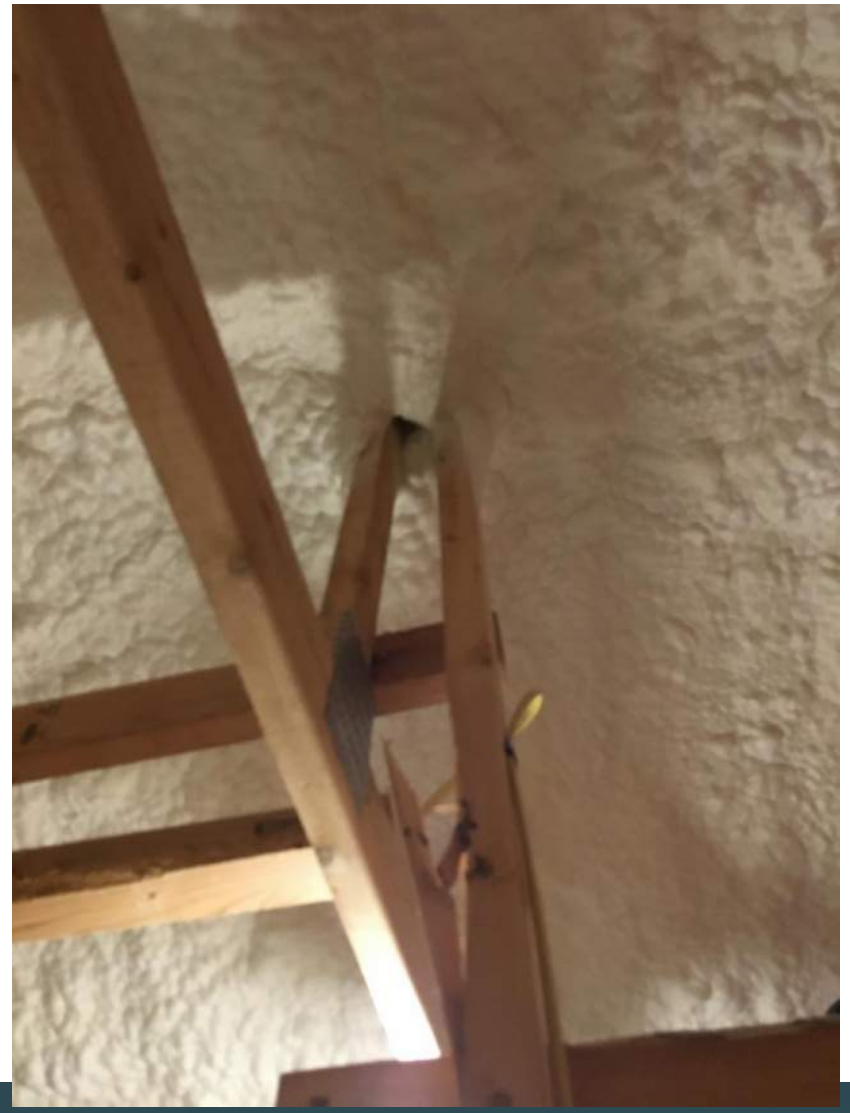


Credit: BSC

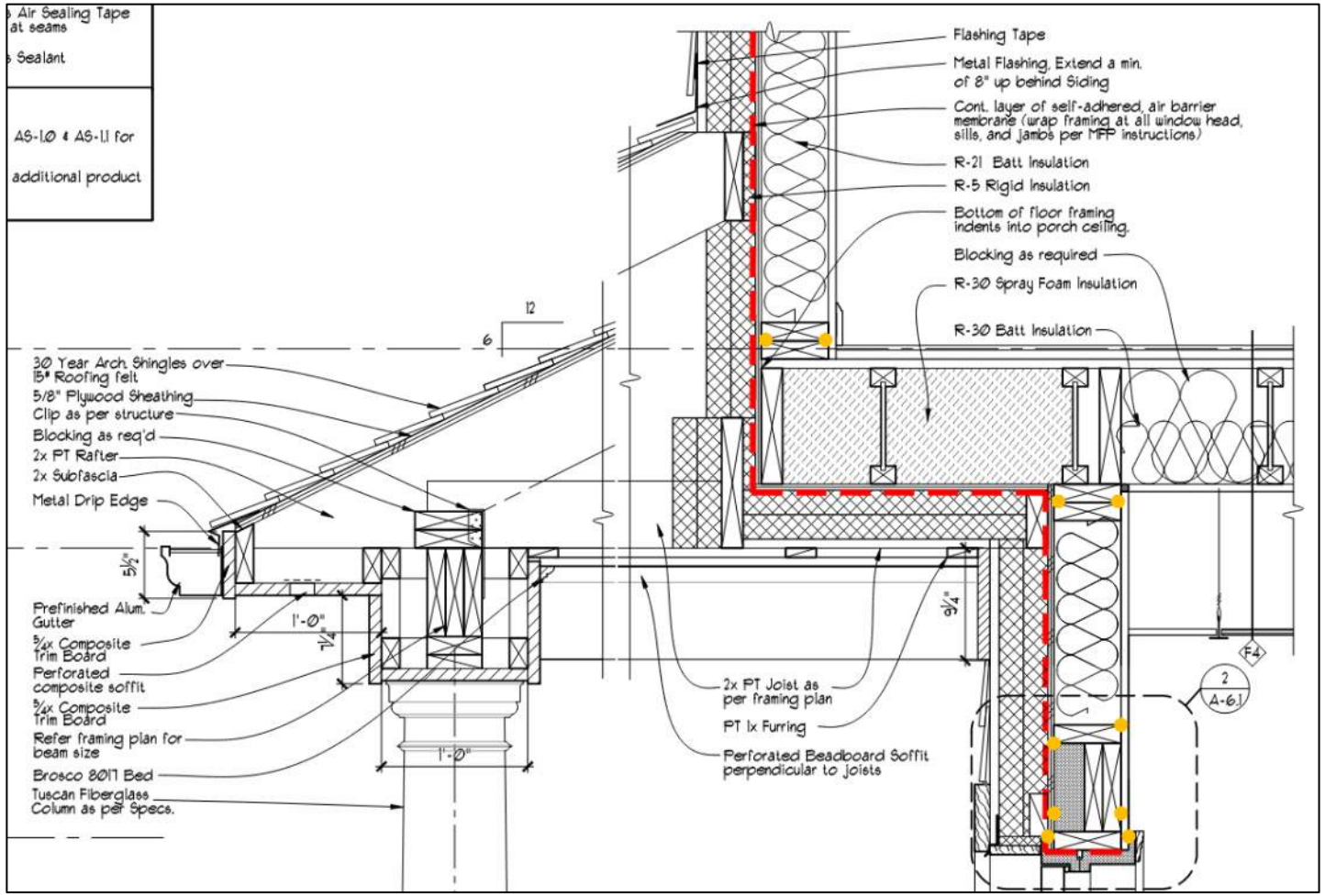
Wood Framed – Above Grade to Roof

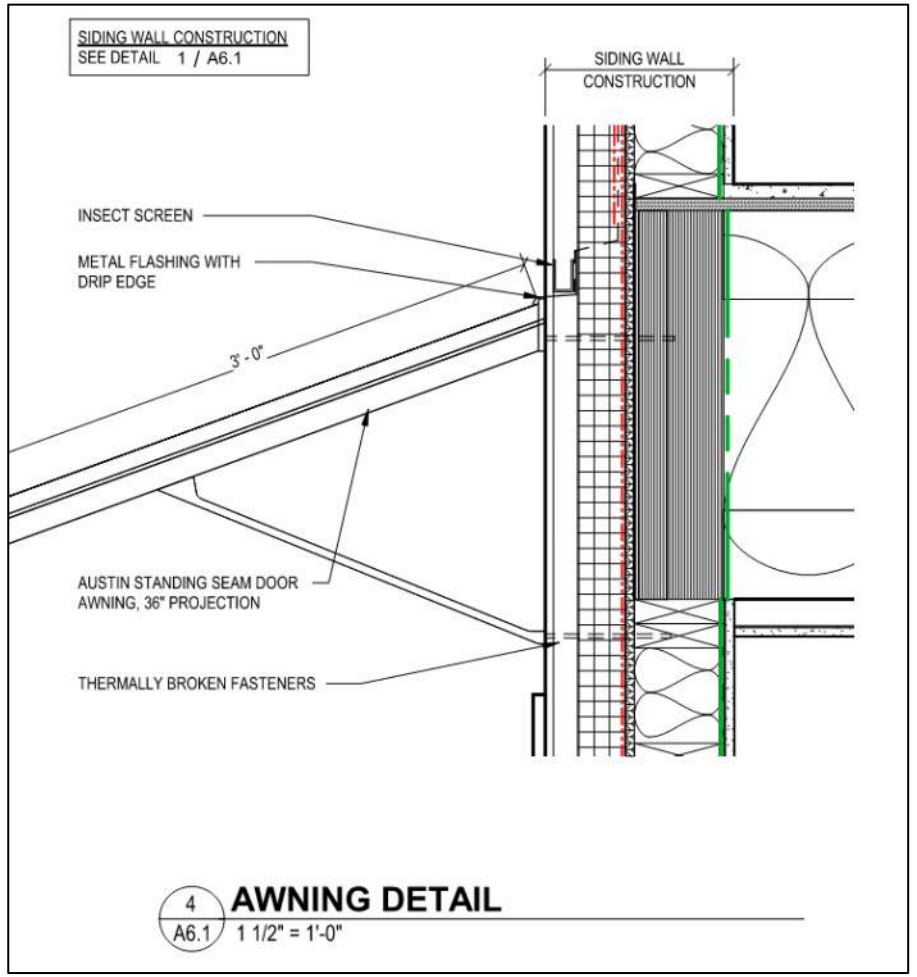


Wood Framed – Challenges

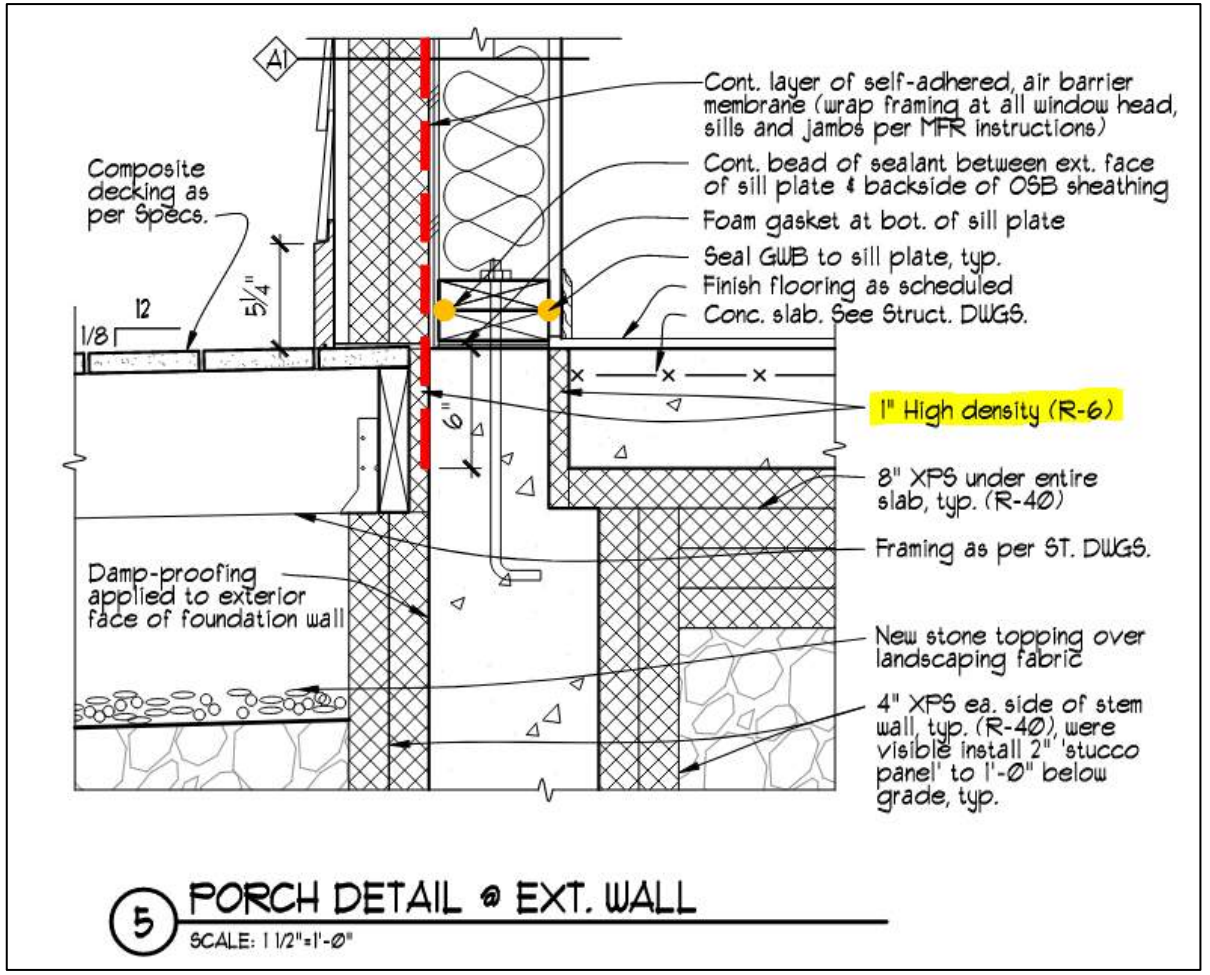


Wood Framed – Tricky Areas





Wood Framed – Porches, Balconies

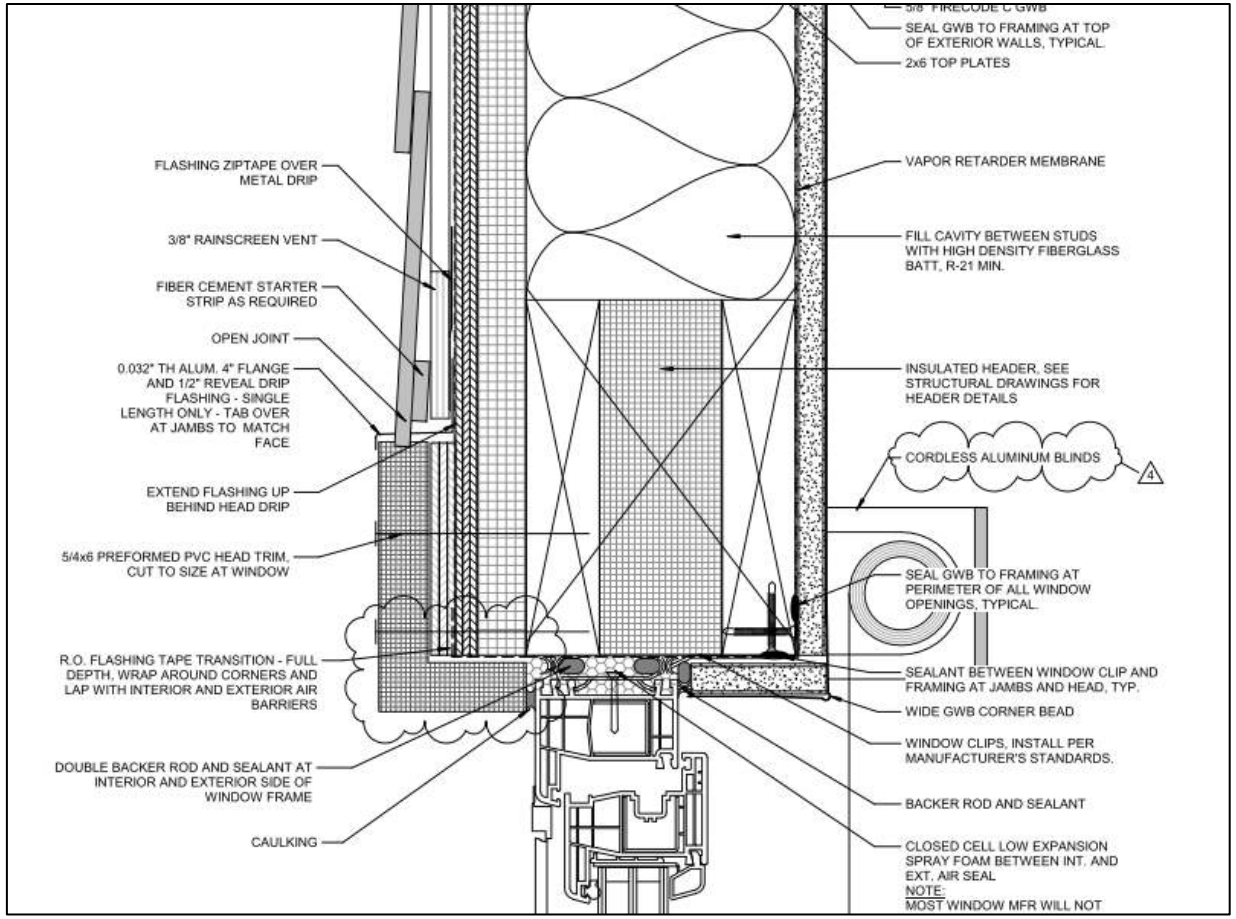


Wood Framed – Insulated Headers

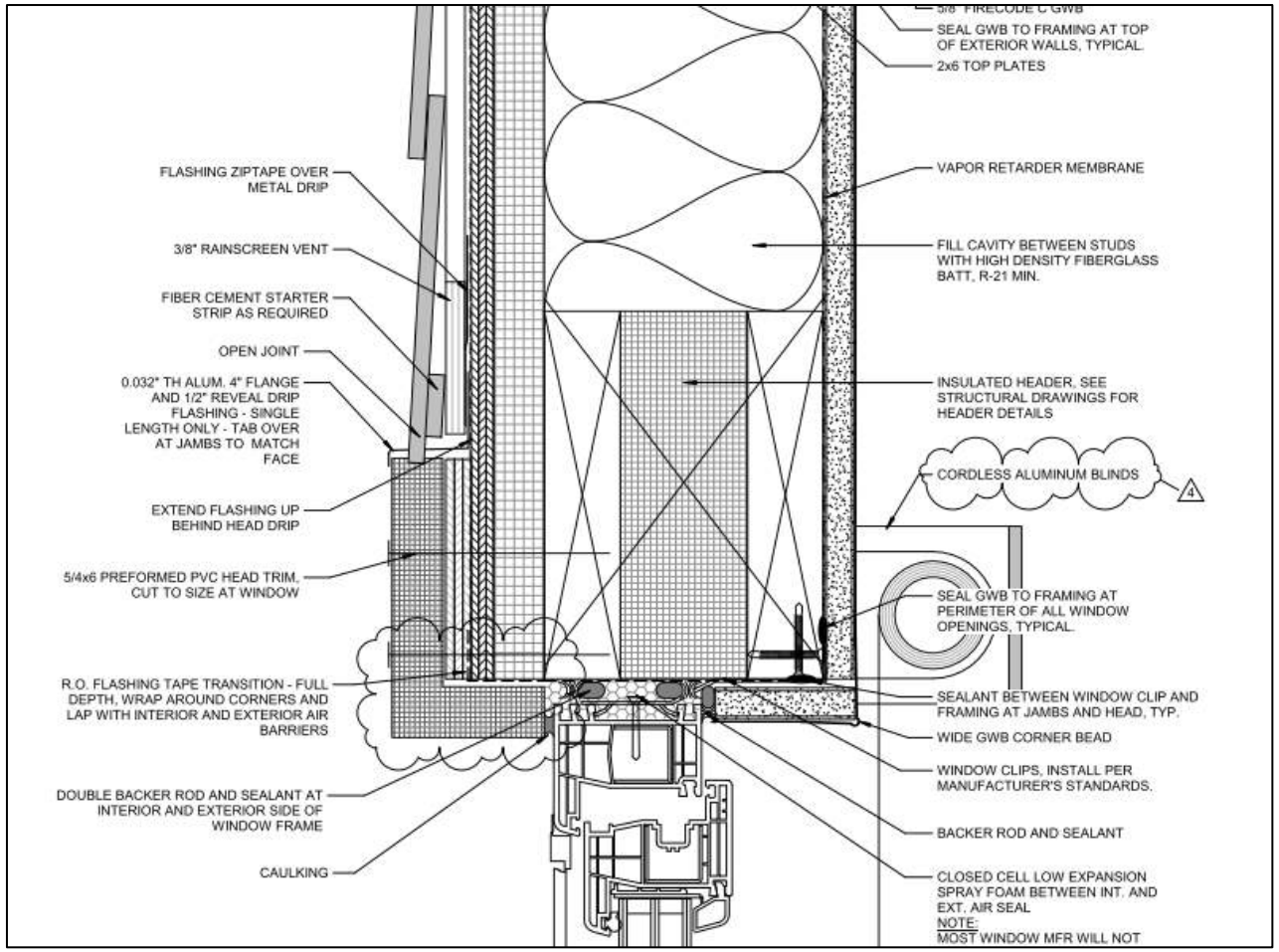
- Window headers are a prevalent thermal bridge in wood framed construction.

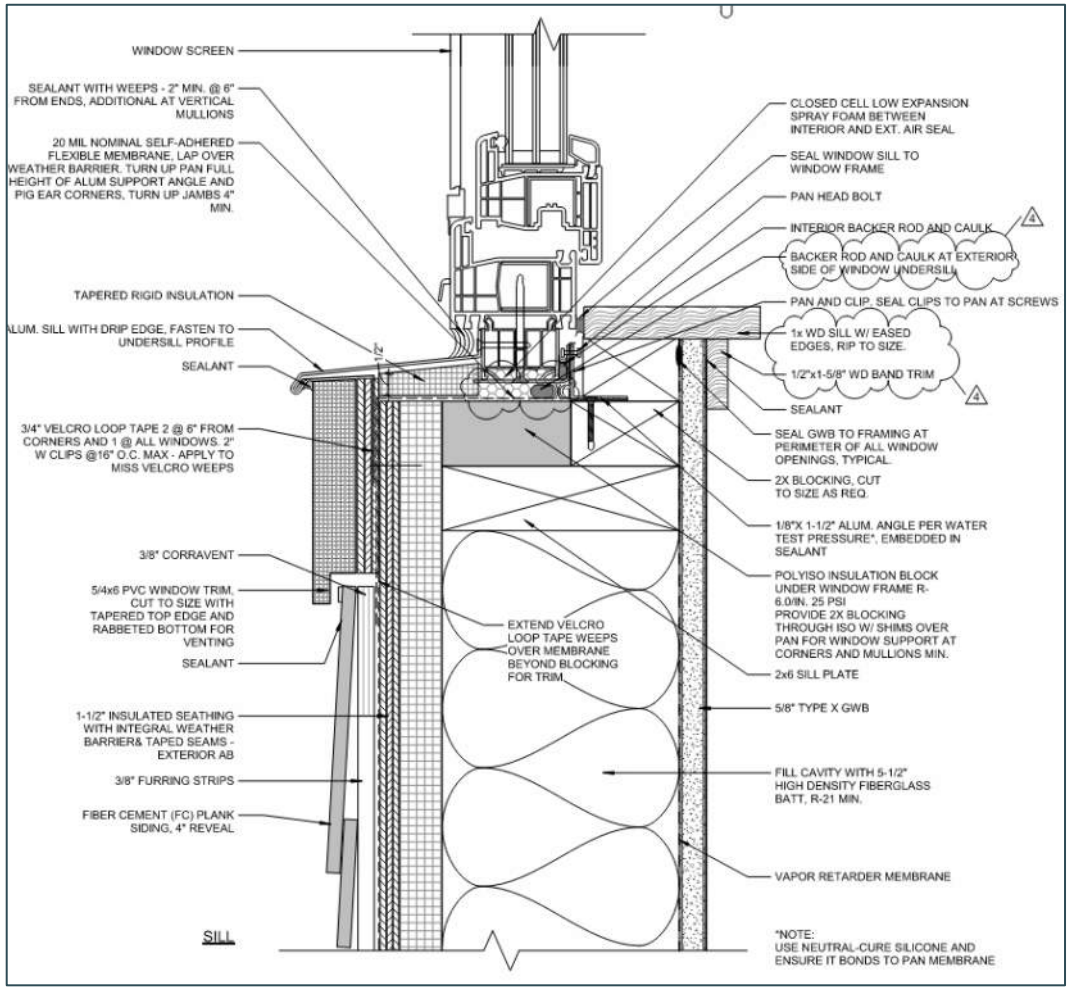
Mitigation strategies include

- Spray foam
- Rigid insulation sandwiched between header framing
- Prefabricated insulated headers

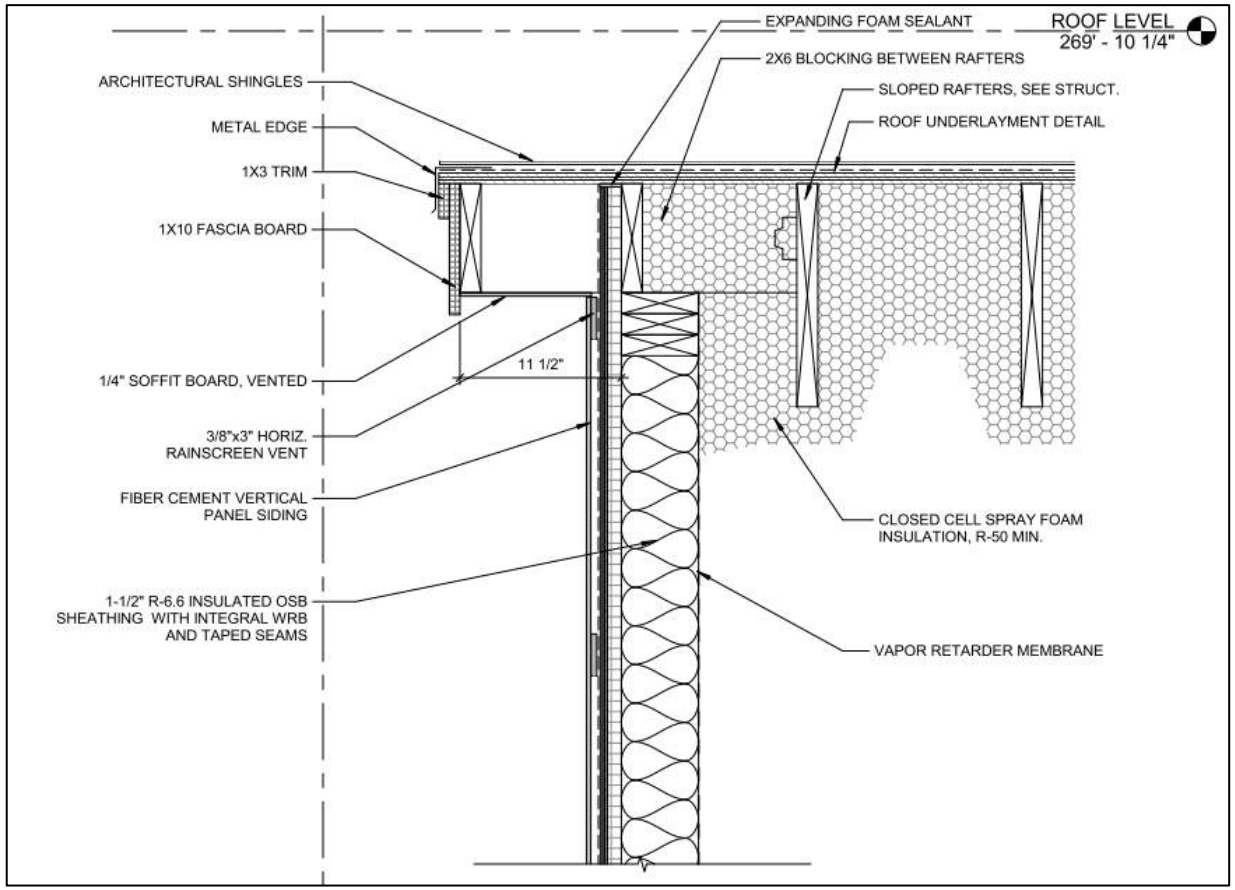


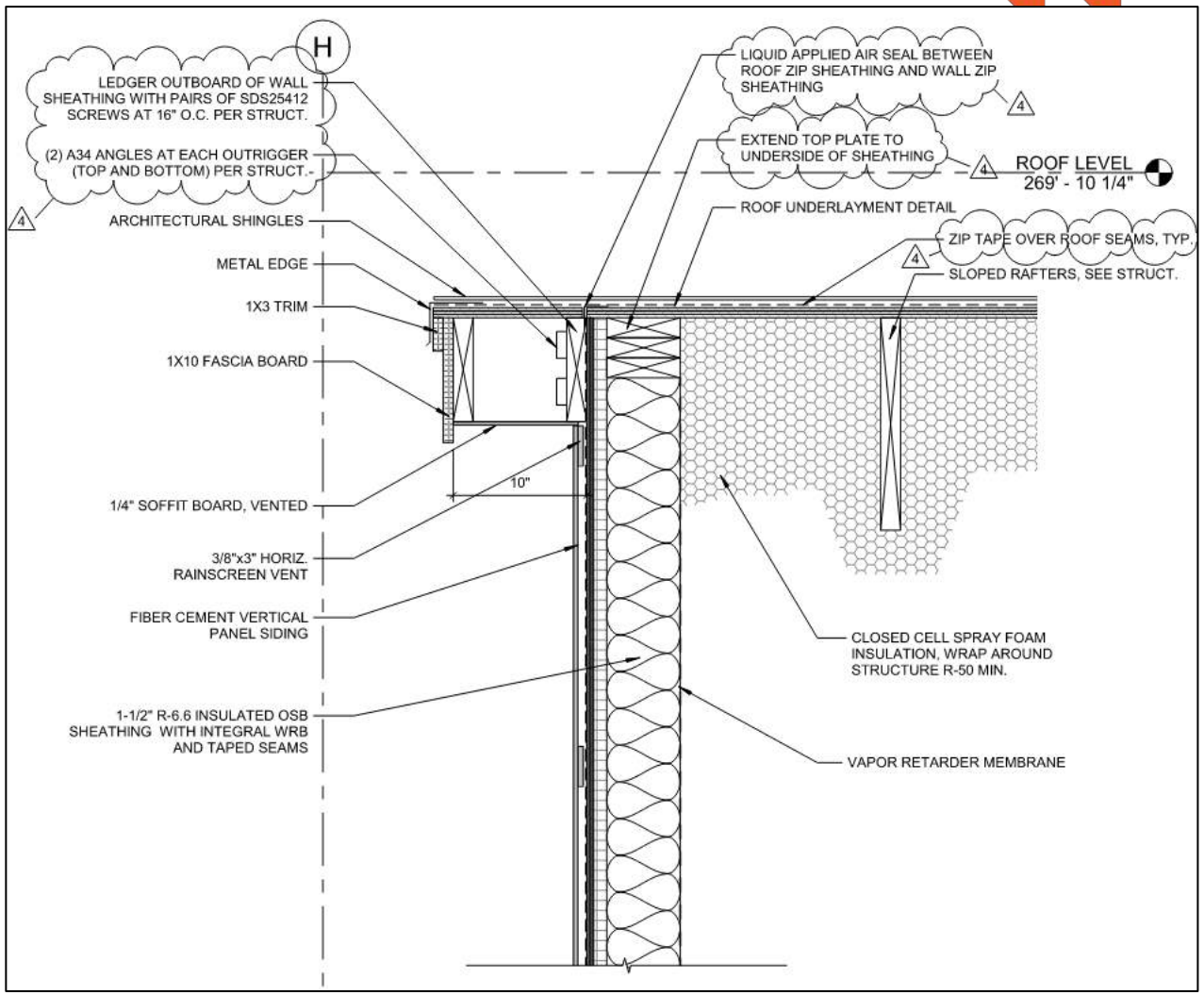
Wood Framed – Insulated Headers & Sill





Wood Framed – Wall to Roof Sequencing





Updated Detail – “Monopoly” framing

Wood Framed – Wall to Roof Sequencing

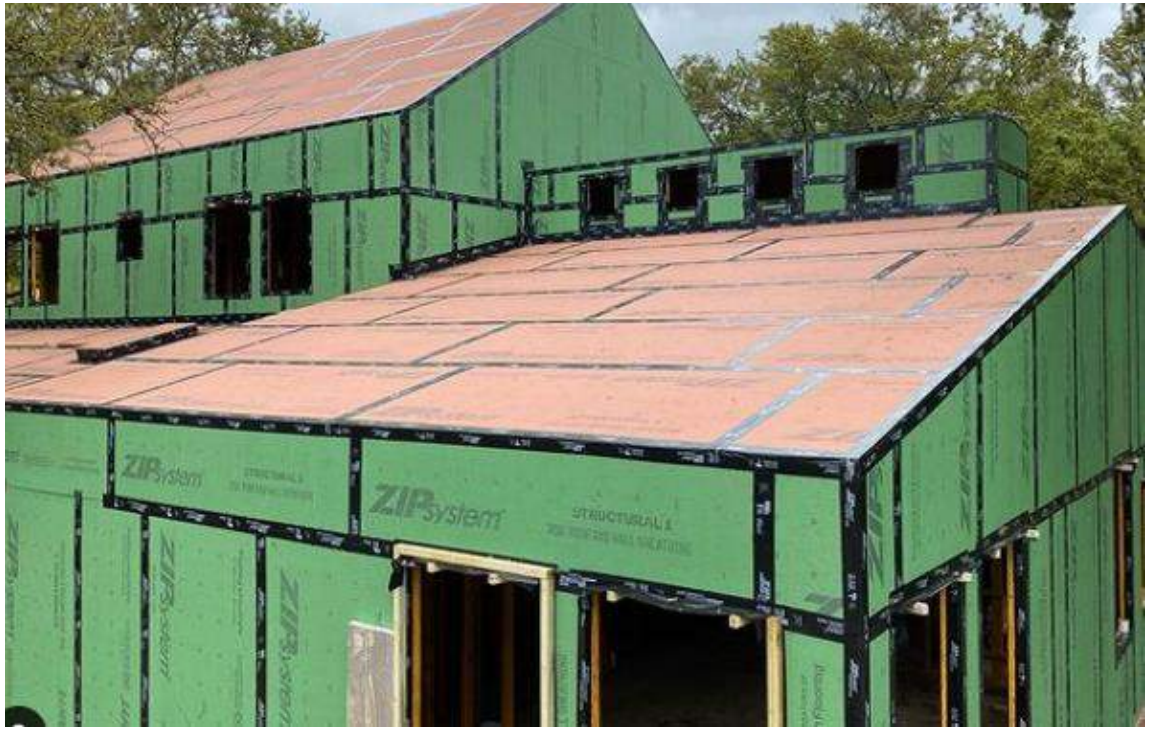
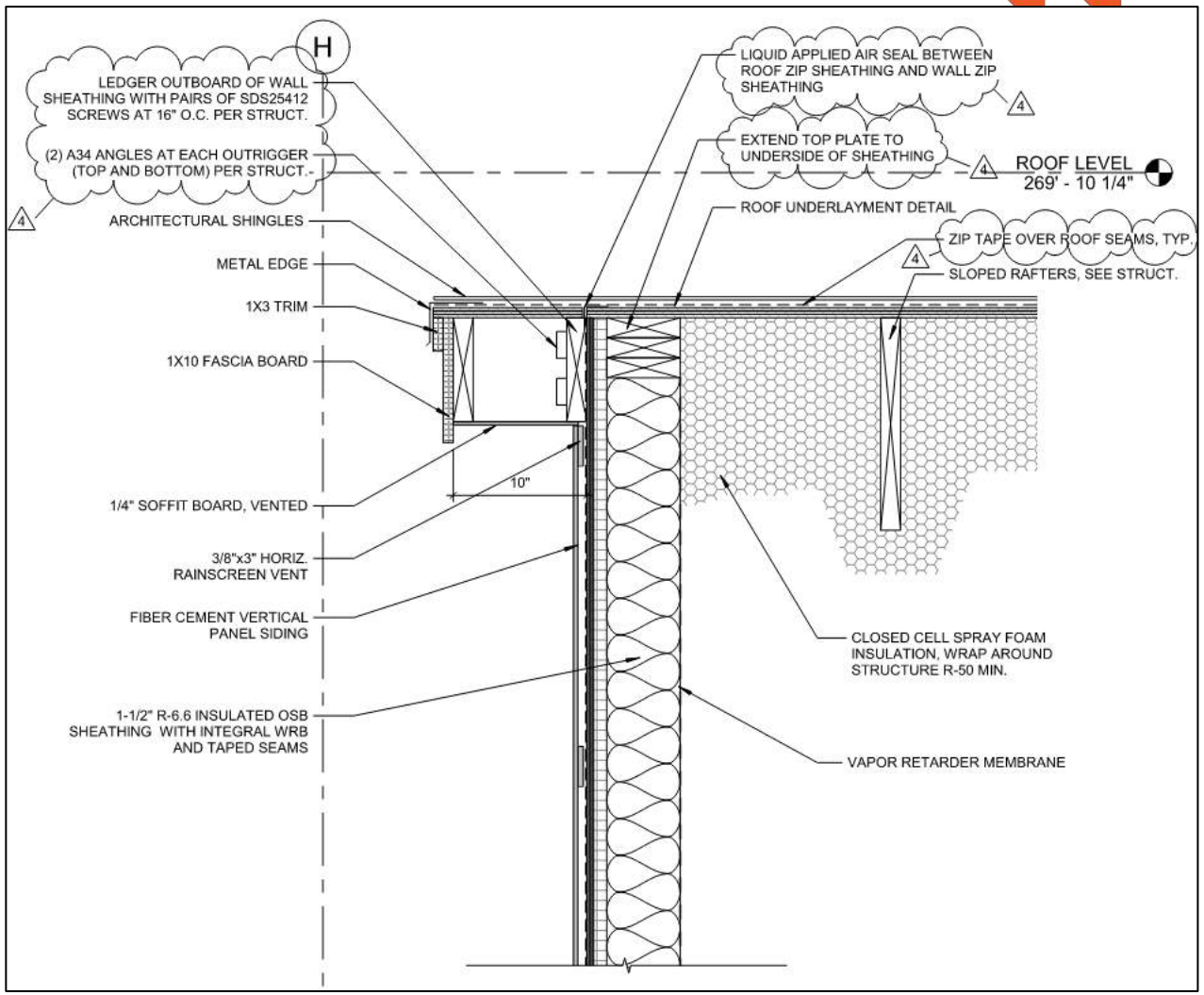
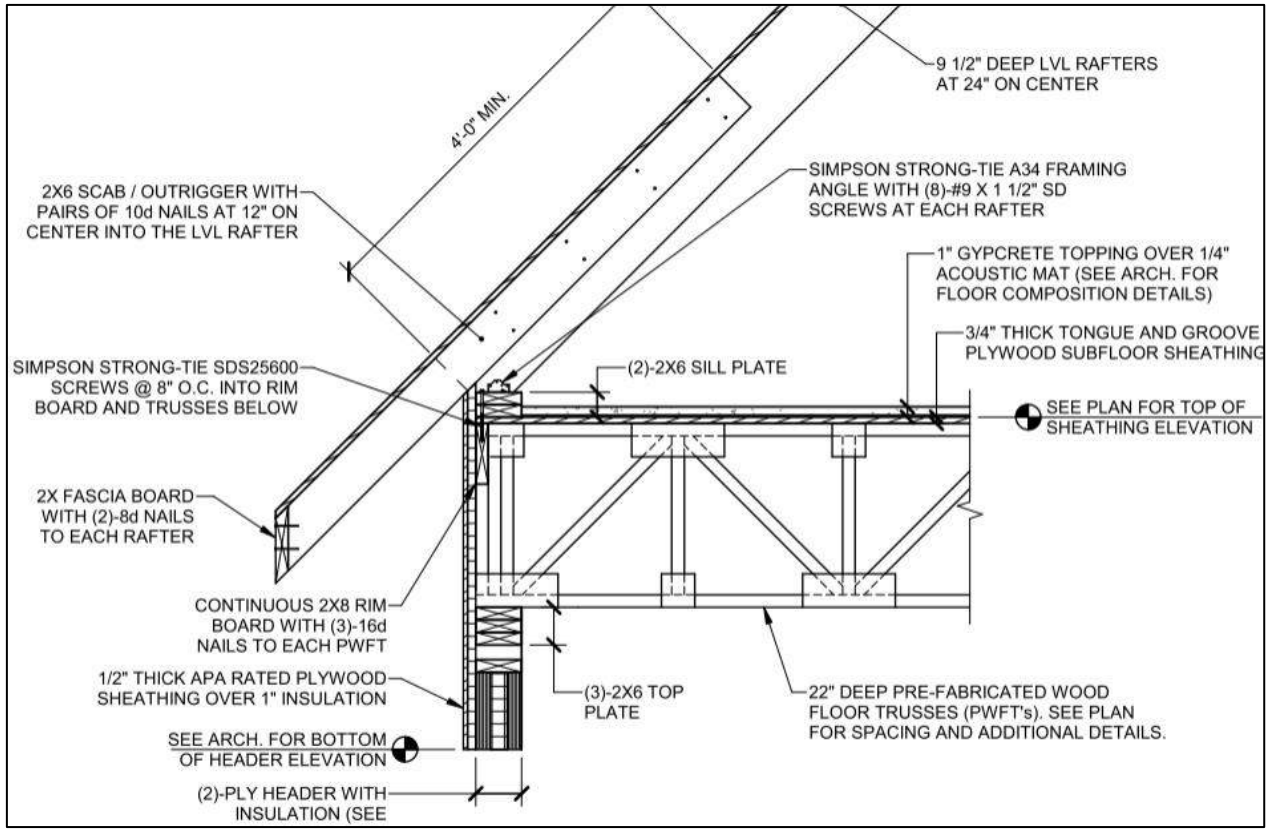
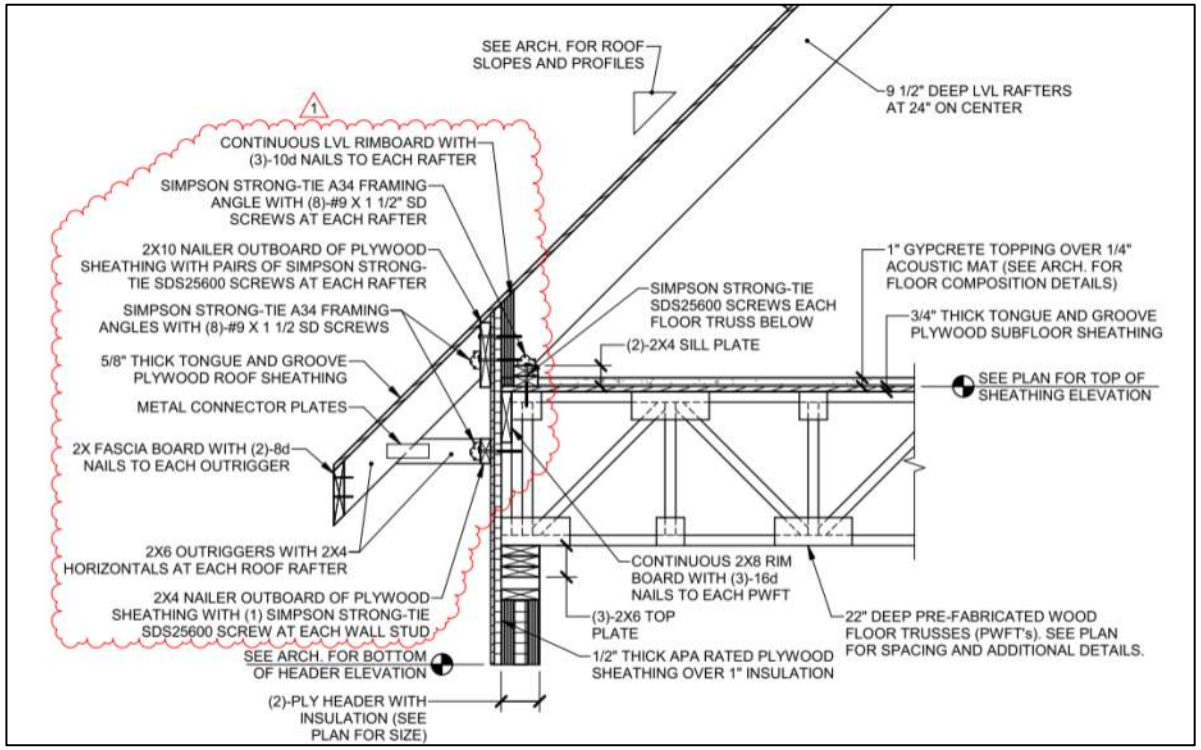


Image Credit: Risinger Build



Wood Framed – Wall to Roof Sequencing

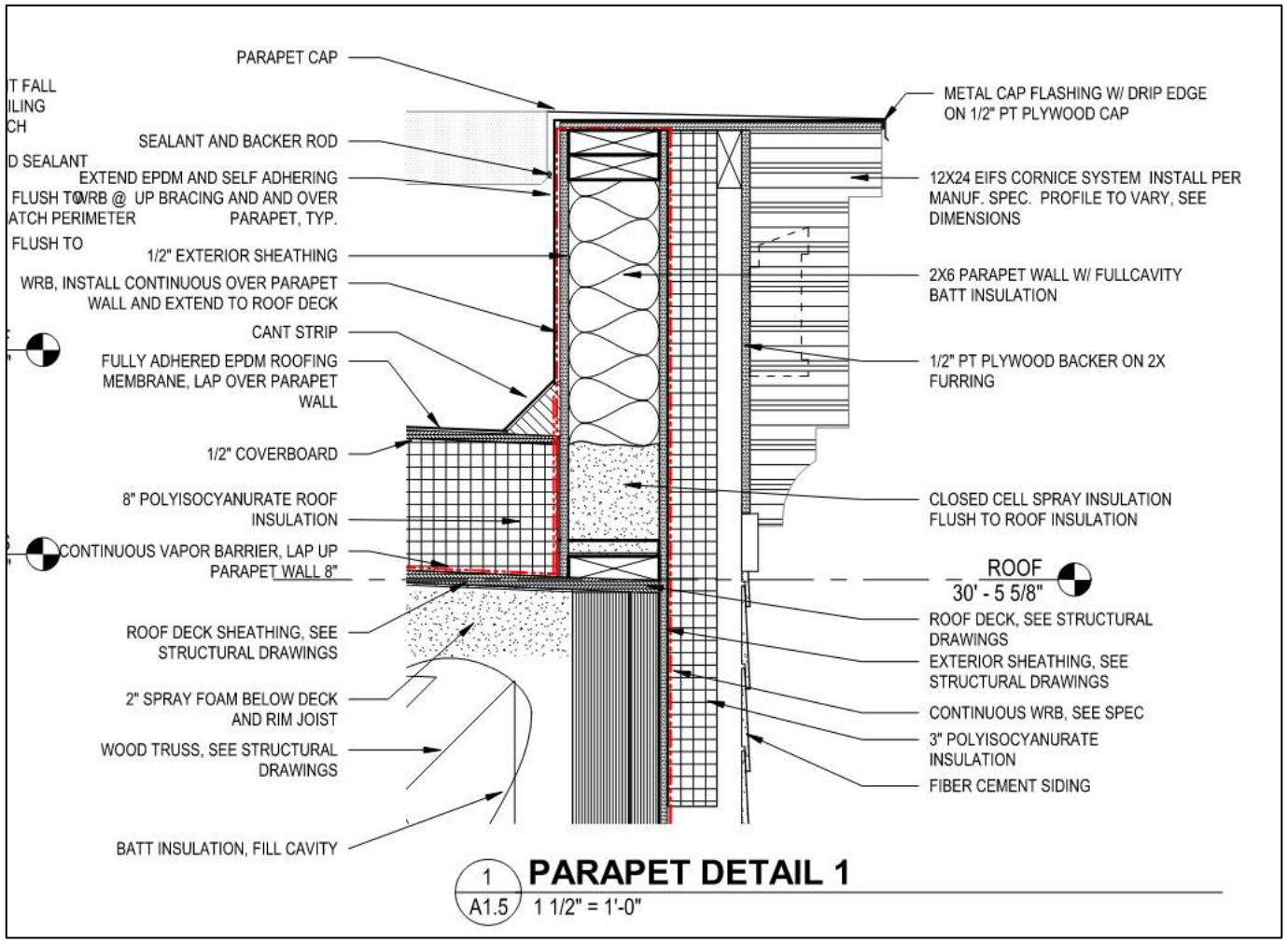




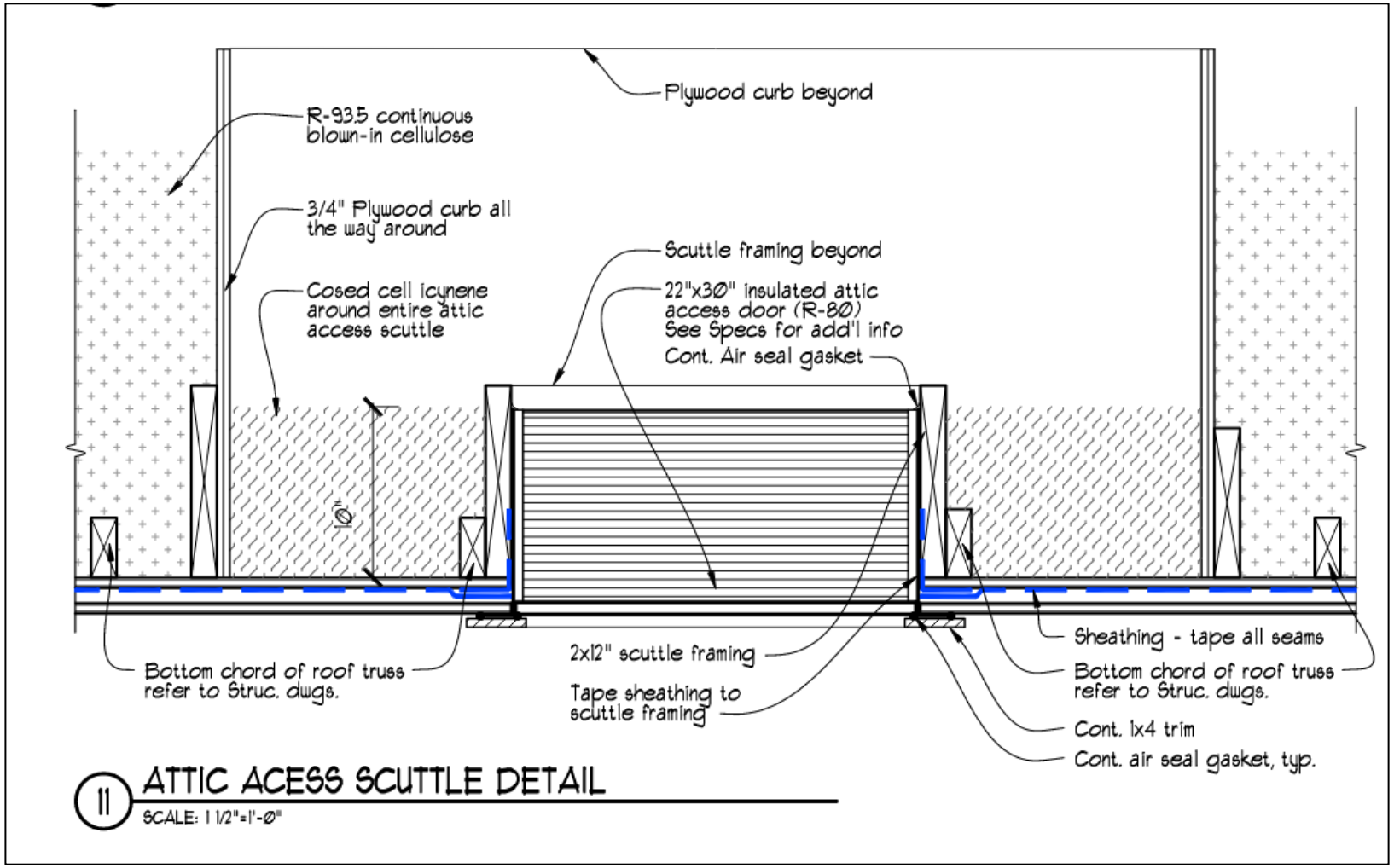
Updated Detail – "Monopoly" framing

Old → New

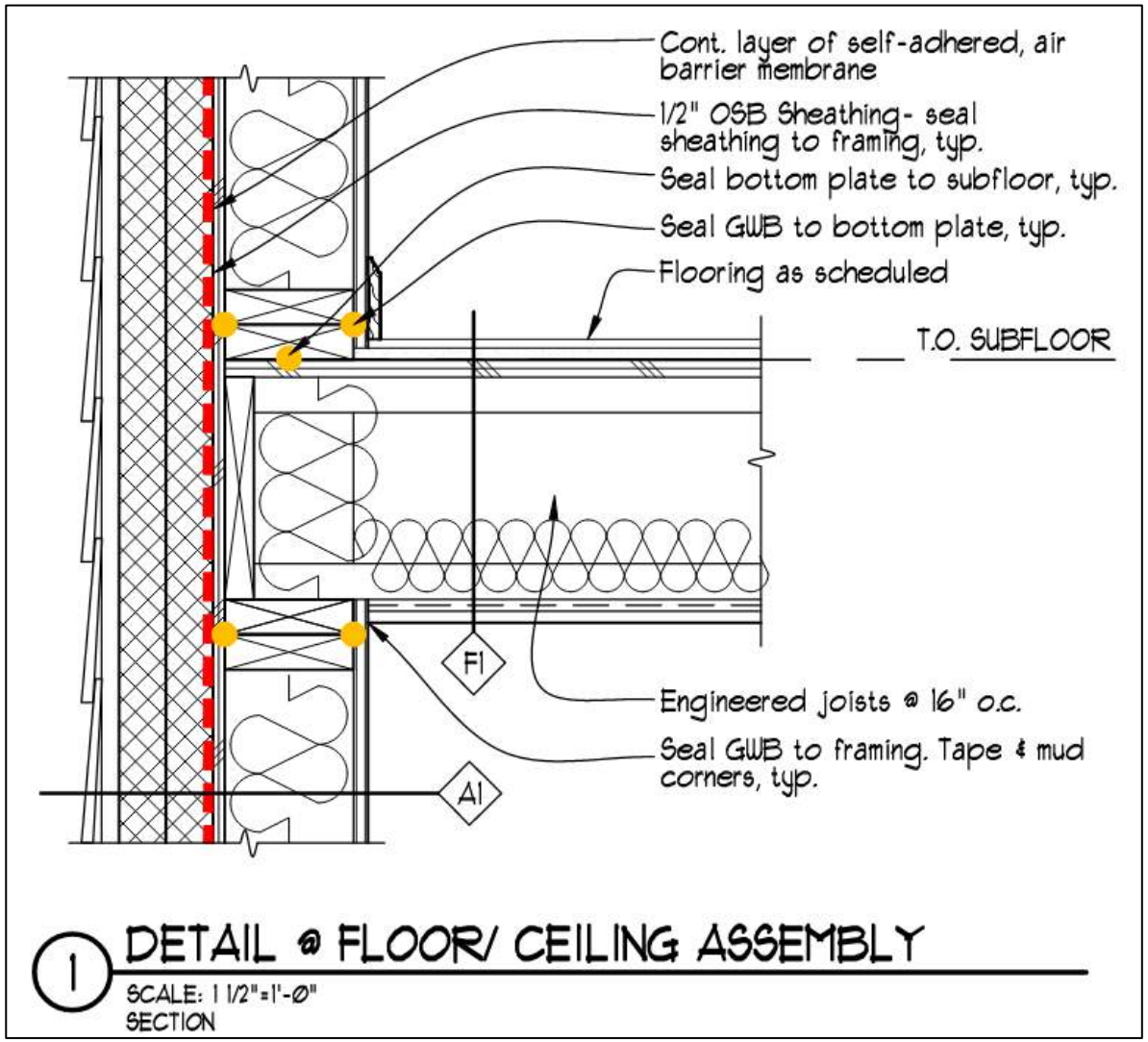
Wood Framed – Parapet

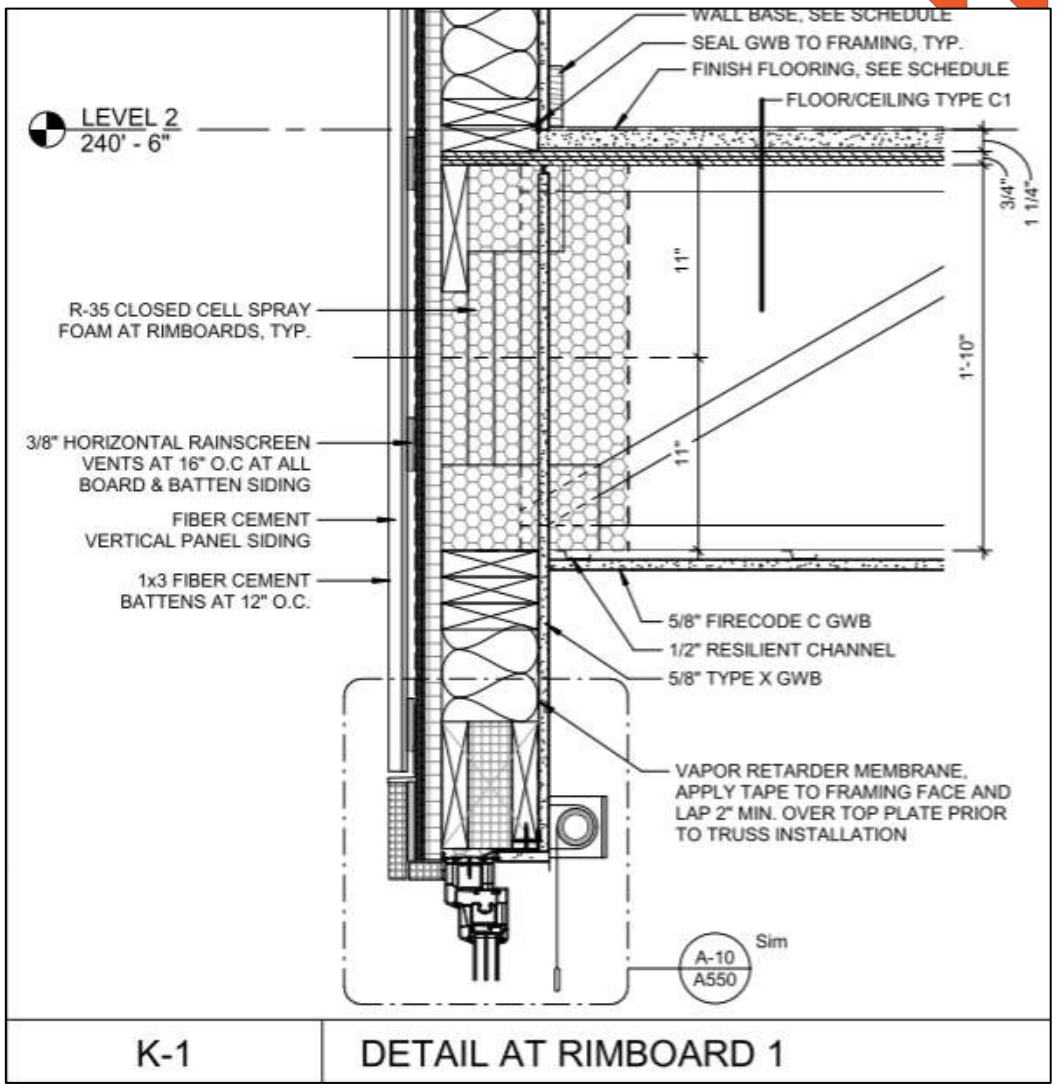


Wood Framed – Attic Hatch

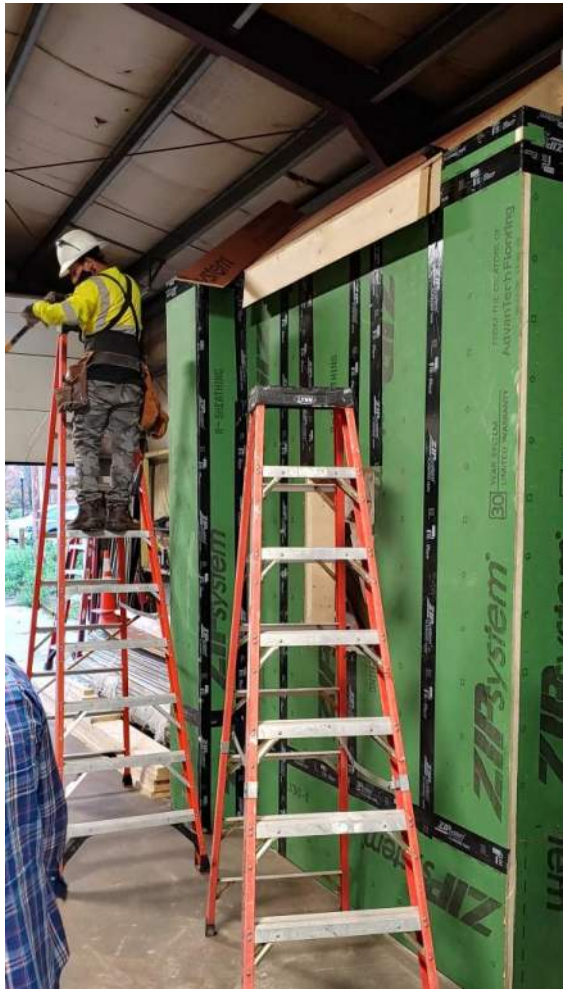


Thermal Rim & Band Joist Insulation





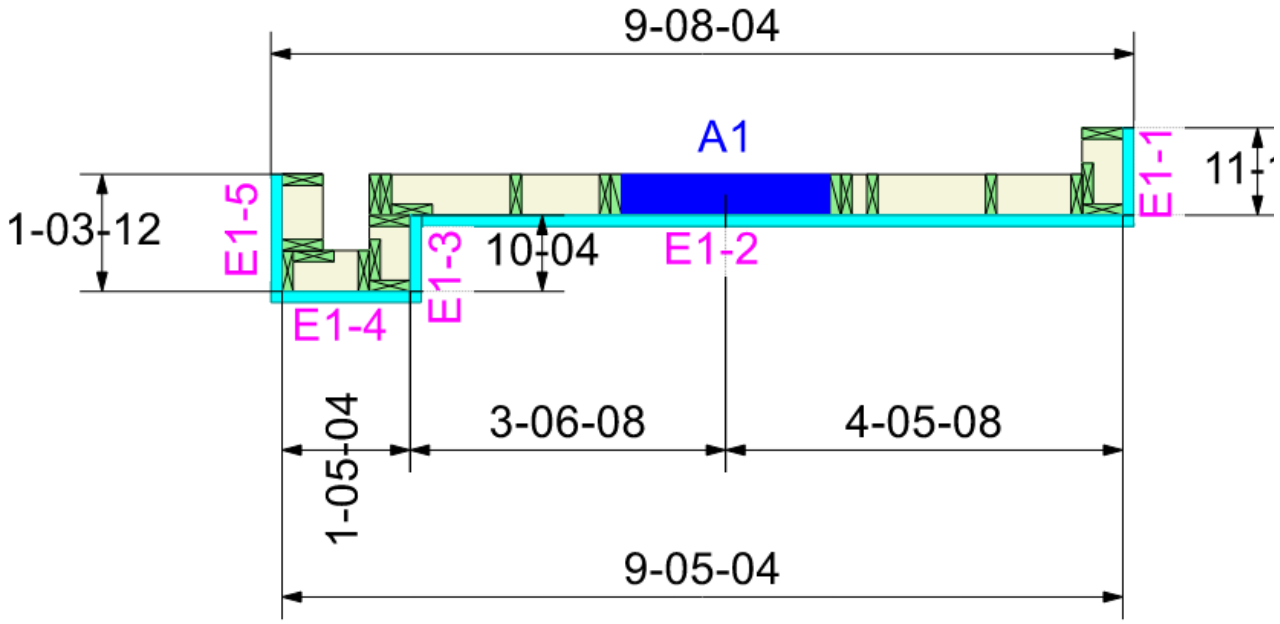
Wood Framed – Getting the Details Right



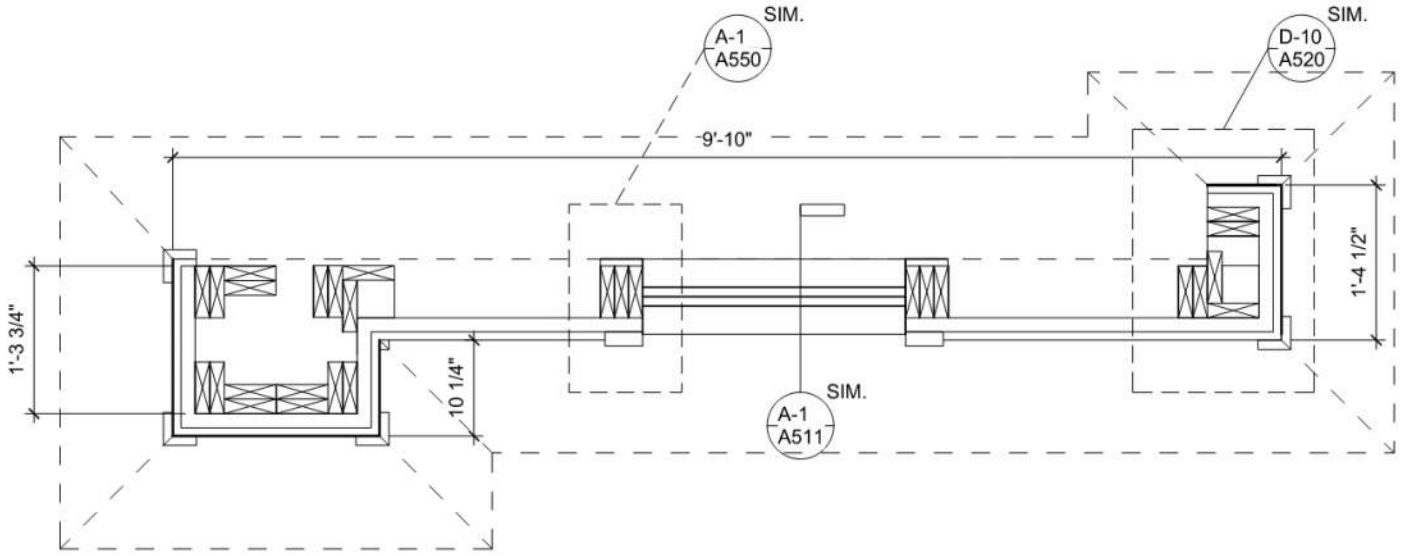
Mock-ups are critical to see firsthand the project specific details.

Wood Framed – Mock-ups

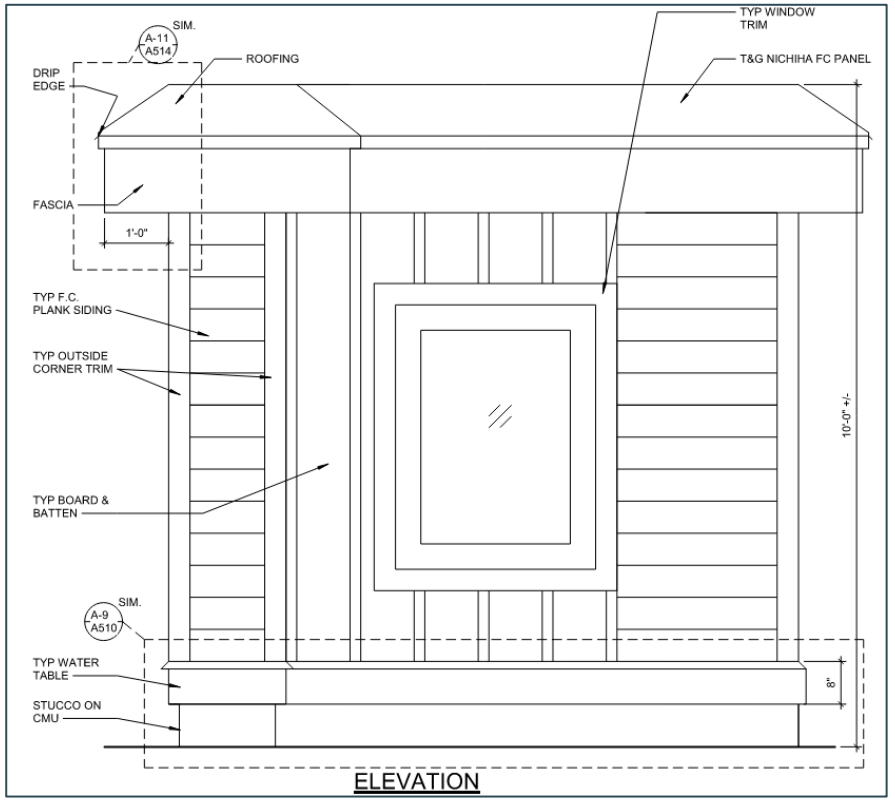
Window							
Quantity	Label	Width	Height	Header Height	Header Material	King Stud (L - R)	Jack Stud (L - R)
1	A1	2-04-00	3-04-00	6-06-00	2x8 SPF No.2	1 - 1	1 - 1



Wood Framed – Mock-ups



PLAN



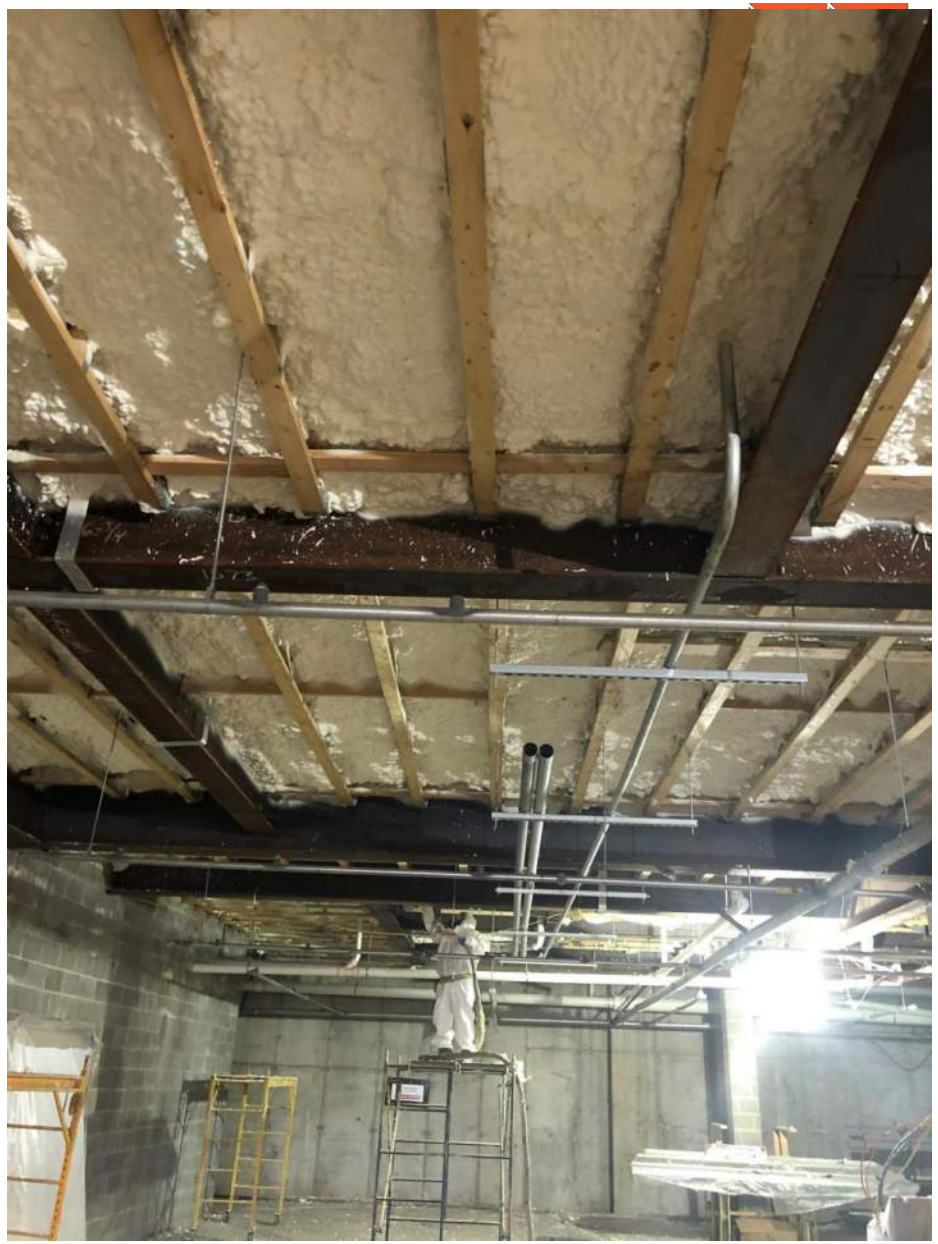
ELEVATION

- Mock-up of critical junctures
  - Inside/outside corners
  - Window installation
  - Roof to wall connection
  - Foundation to wall connection
- Project specific details, components and trades

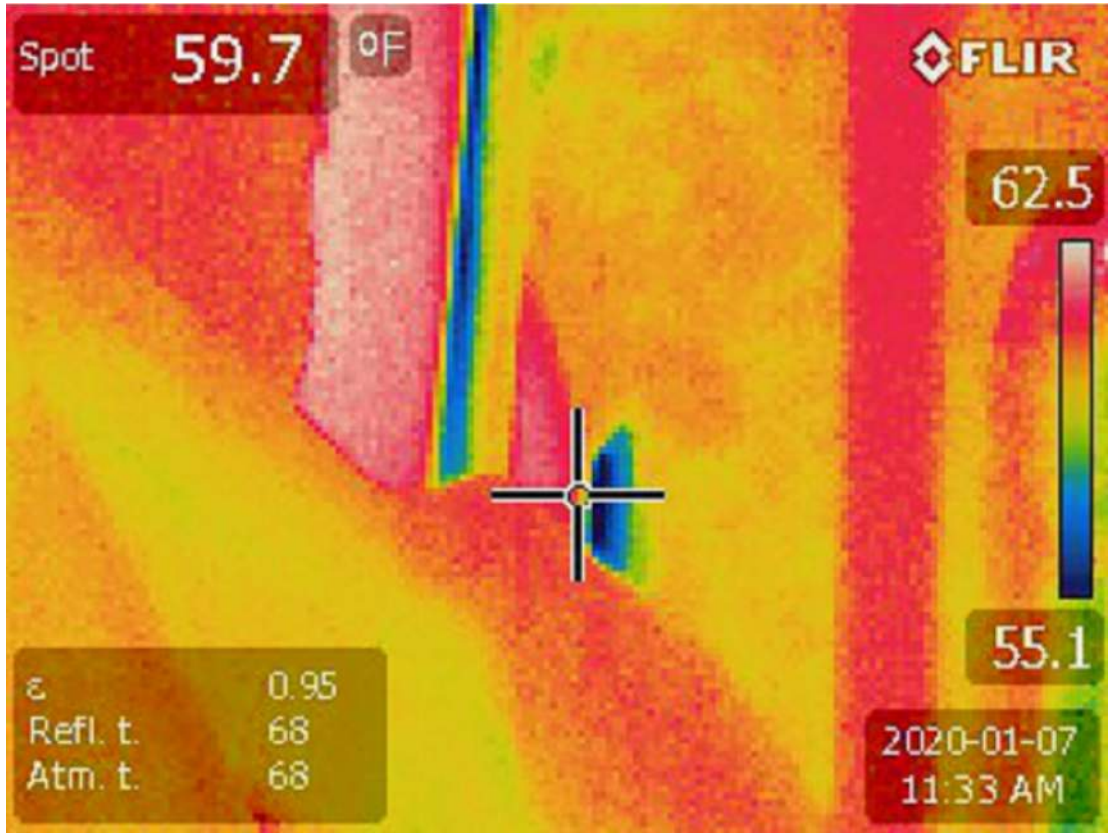
Why do you think continuous insulation is so hard to achieve? (hint: link words with an underscore)

Spray Foam - Installation

- Challenging details must be carefully and systematically addressed by spray foam installer
  - Spray foam is not a bulletproof approach to air sealing
- Installed at minimum thicknesses indicated on drawings & continuously

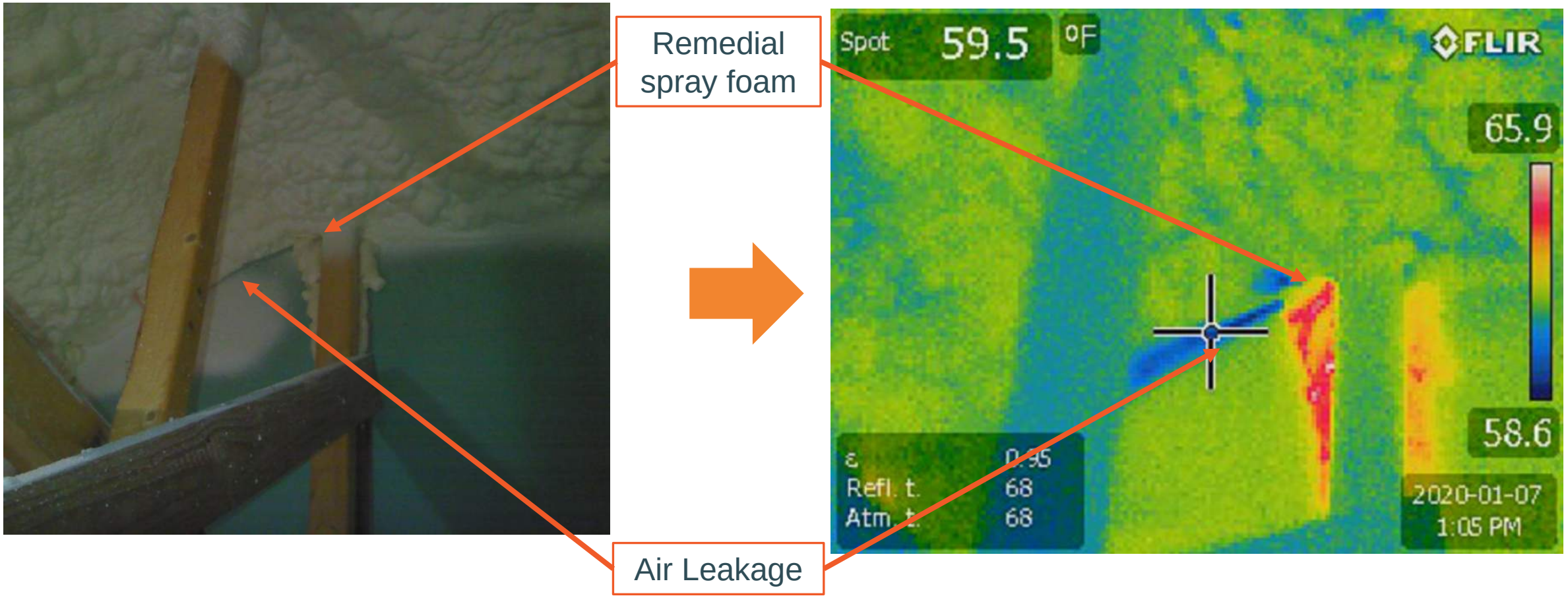


Spray Foam – Challenging Details



During final whole building blower door IR images show air leakage where spray foam is missed.

Spray Foam – Challenging Details



During final whole building blower door IR images show air leakage where spray foam is missed.

Spray Foam – Coverage

What are your final thoughts and takeaways from the presentation today? (hint: link words with an underscore)

Questions & Final Discussion

Join Us for More Trainings!

- **Workshop 1:** Continuous Insulation
- **Workshop 2:** Air Sealing and Insulation for Homes
- **Workshop 3:** High Performance Ventilation Systems for Homes

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