



Building Solutions



Construction Fixed: Conquering Home Performance Errors

2017 RESNET

Brian Lieburn

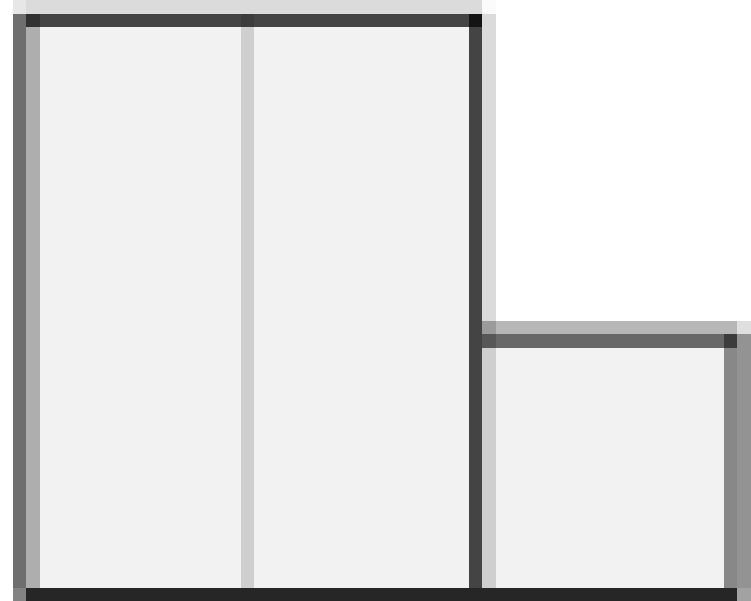
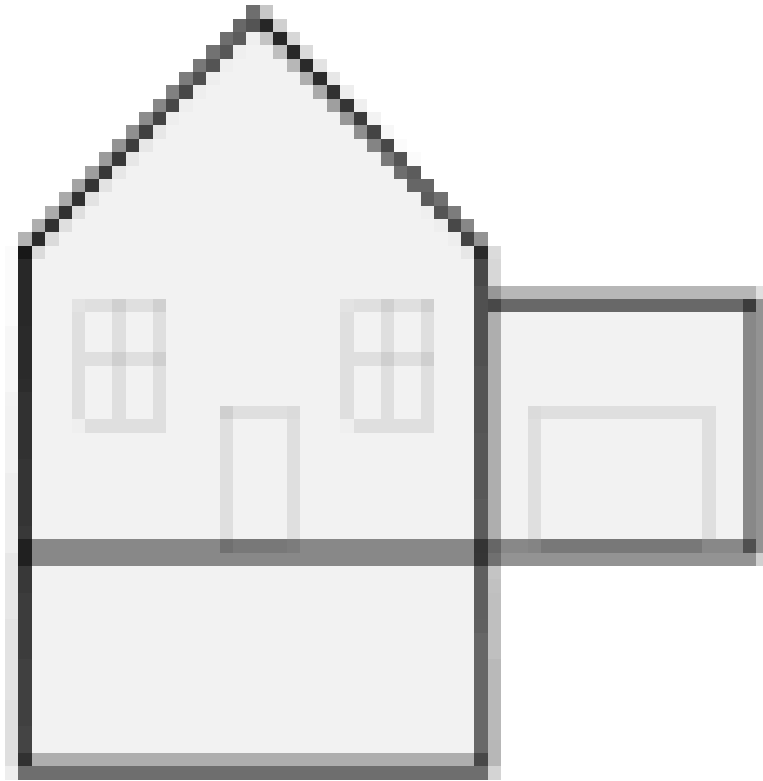
- Research Scientist
 - Residential Application Development
- Dow Building Solutions since 2010
- 25 Years in Production Homebuilding
- BS from University of Wisconsin - Stout



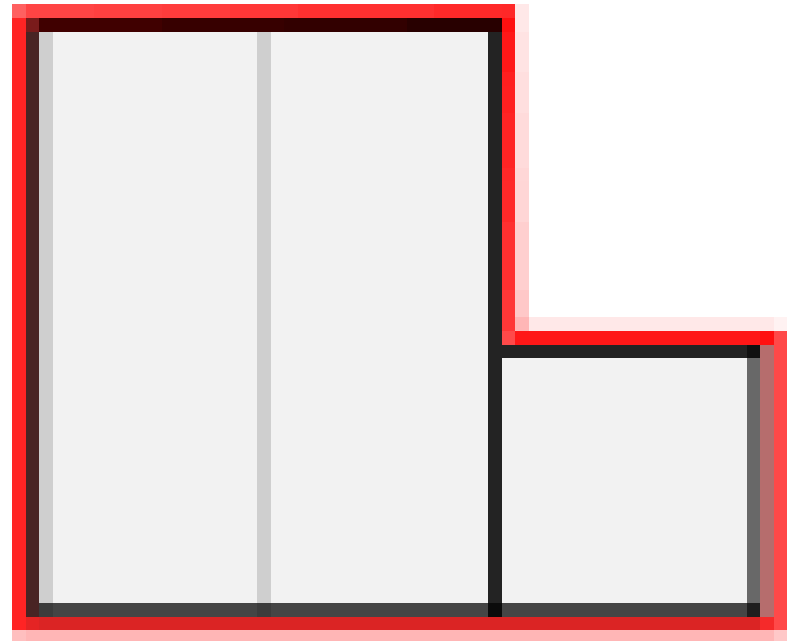
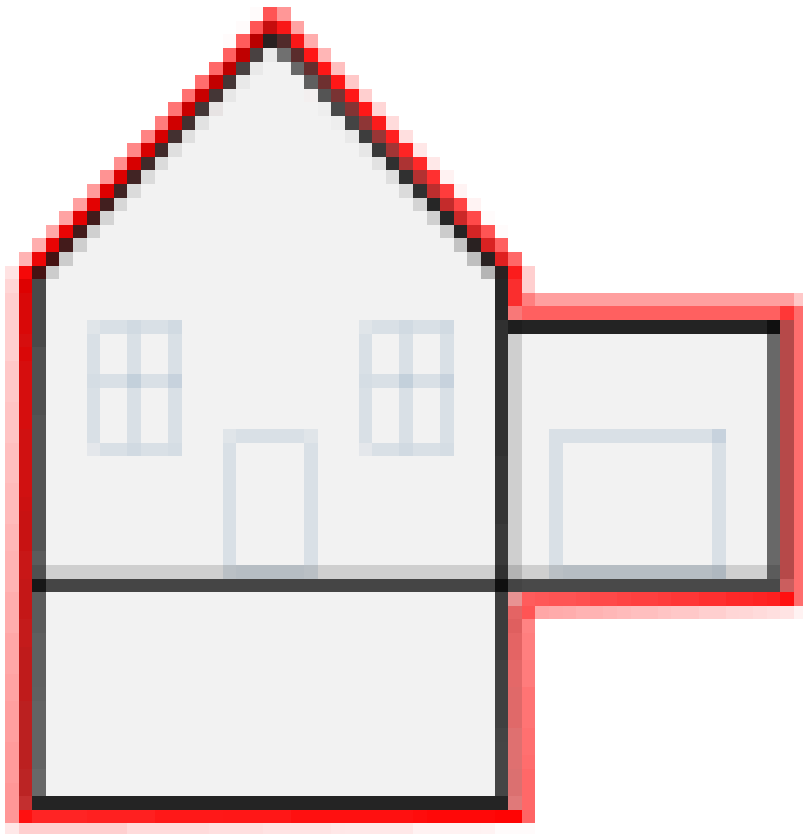
— **Why this Presentation?**

Building Elements Overview

Structural Element



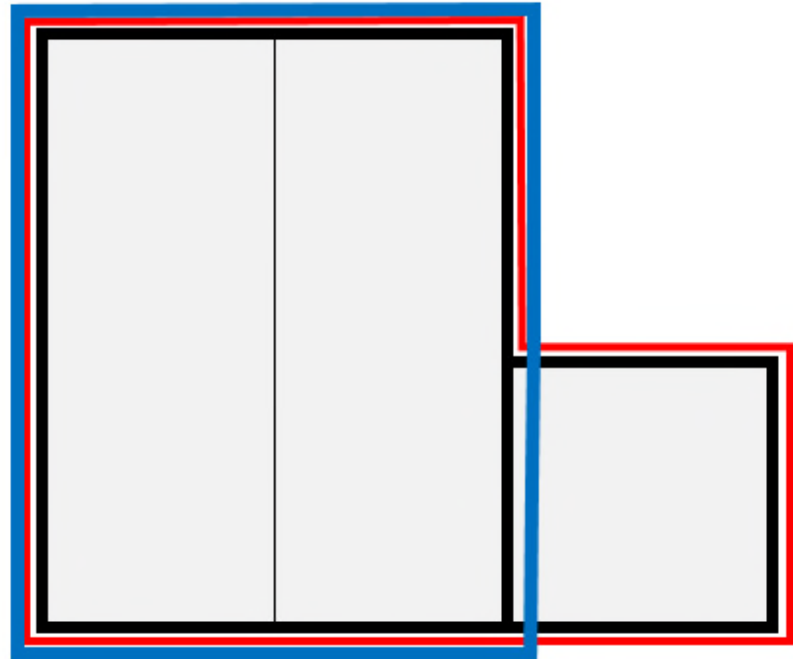
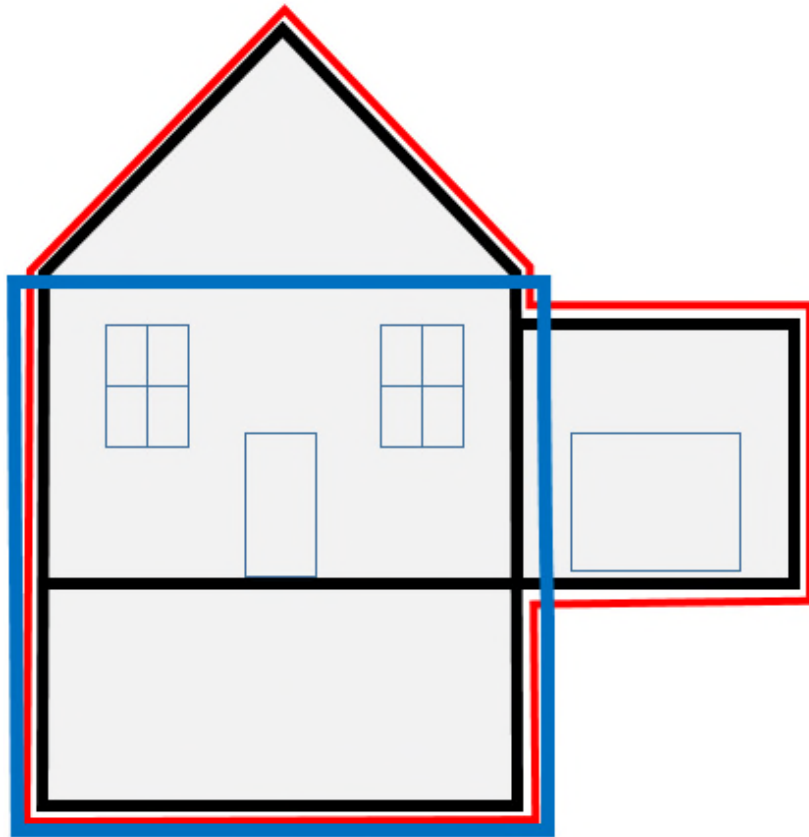
Water Control Layer – Red Line



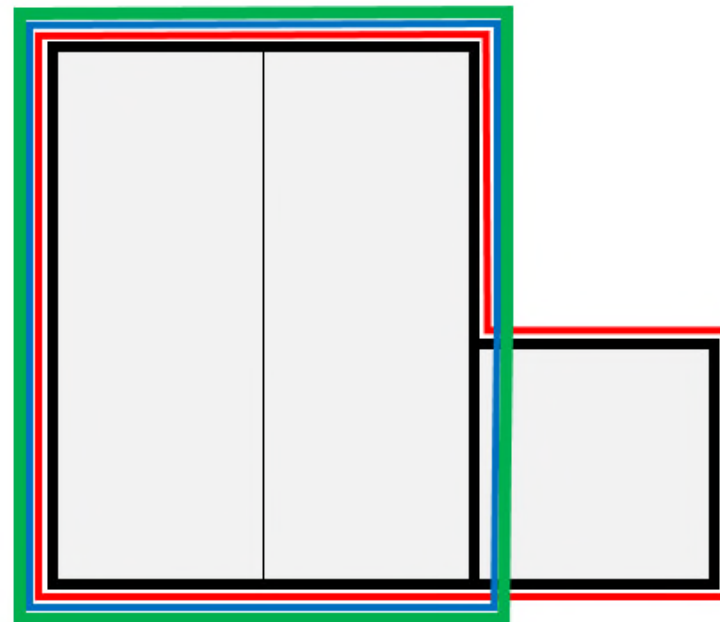
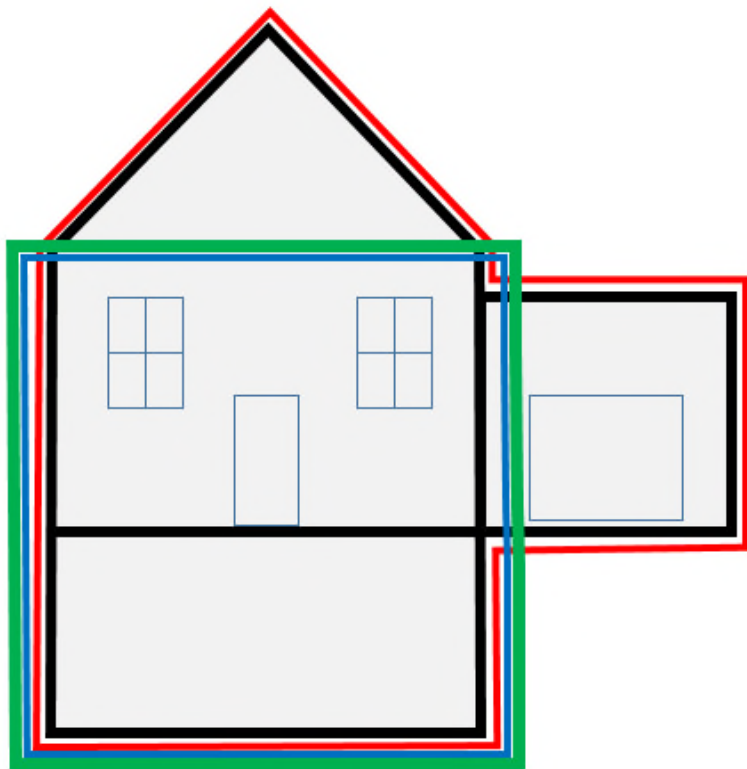
Water Control Layer



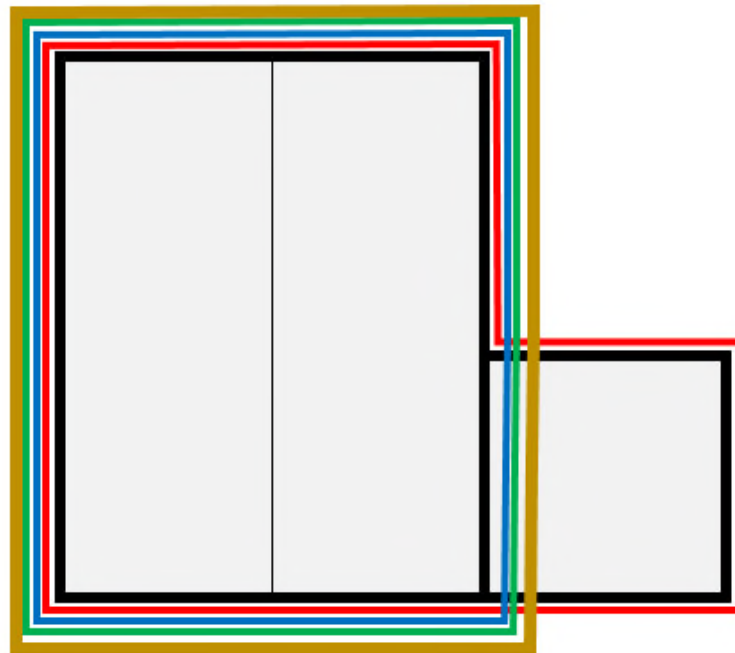
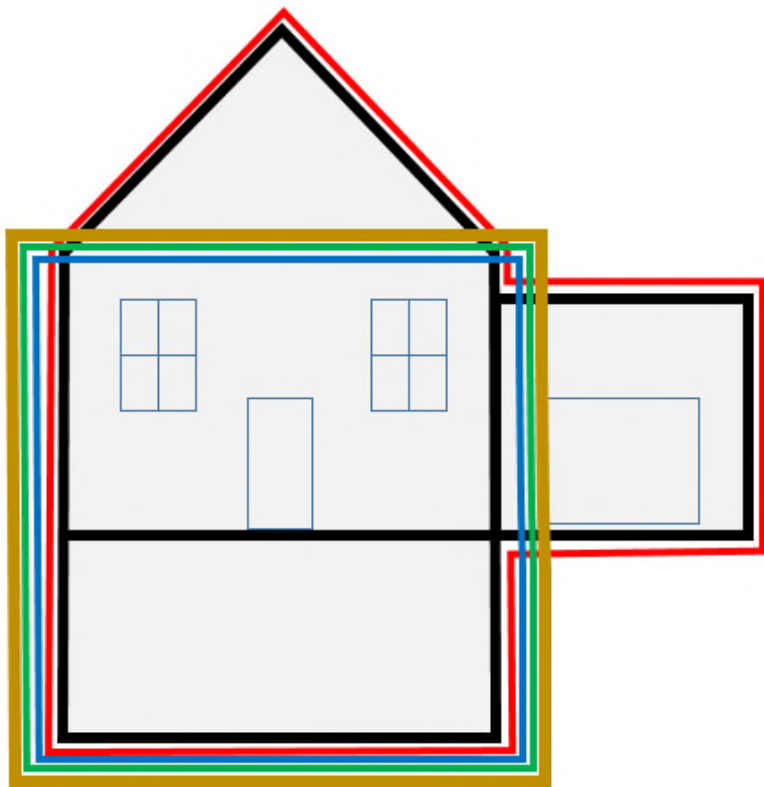
Thermal Control Layer – Blue Line



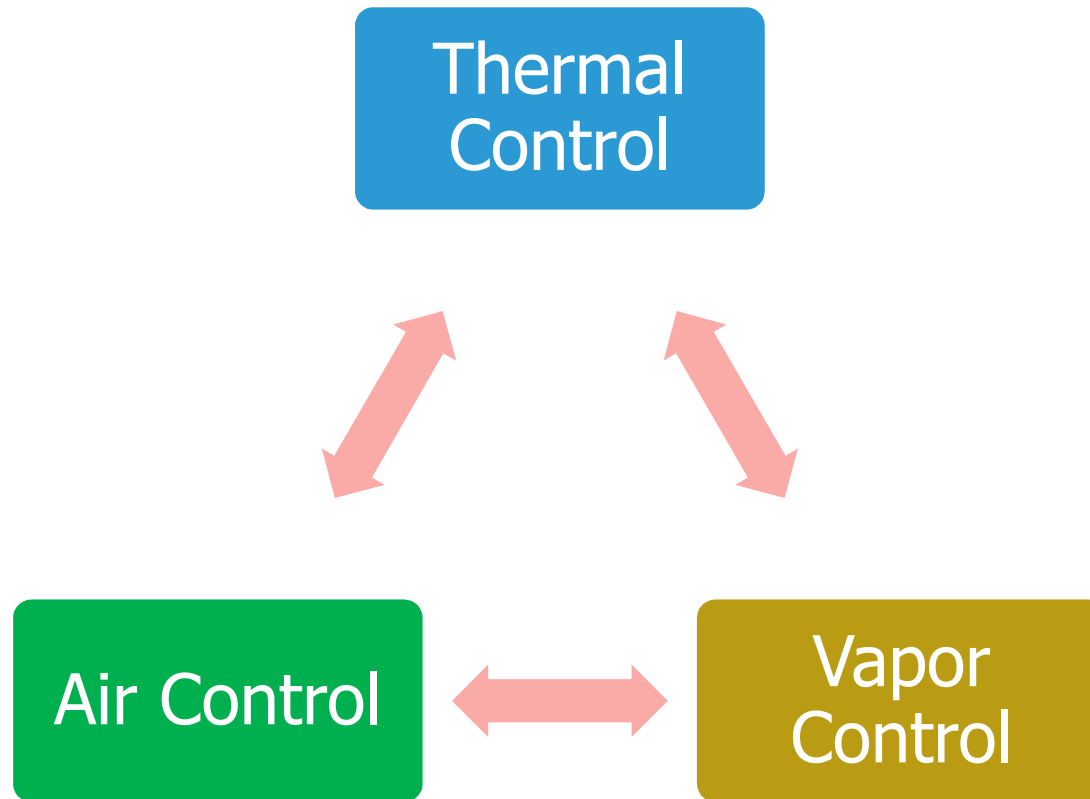
Air Control Layer – Green Line



Vapor Control Layer – Gold Line



System Effect on Performance

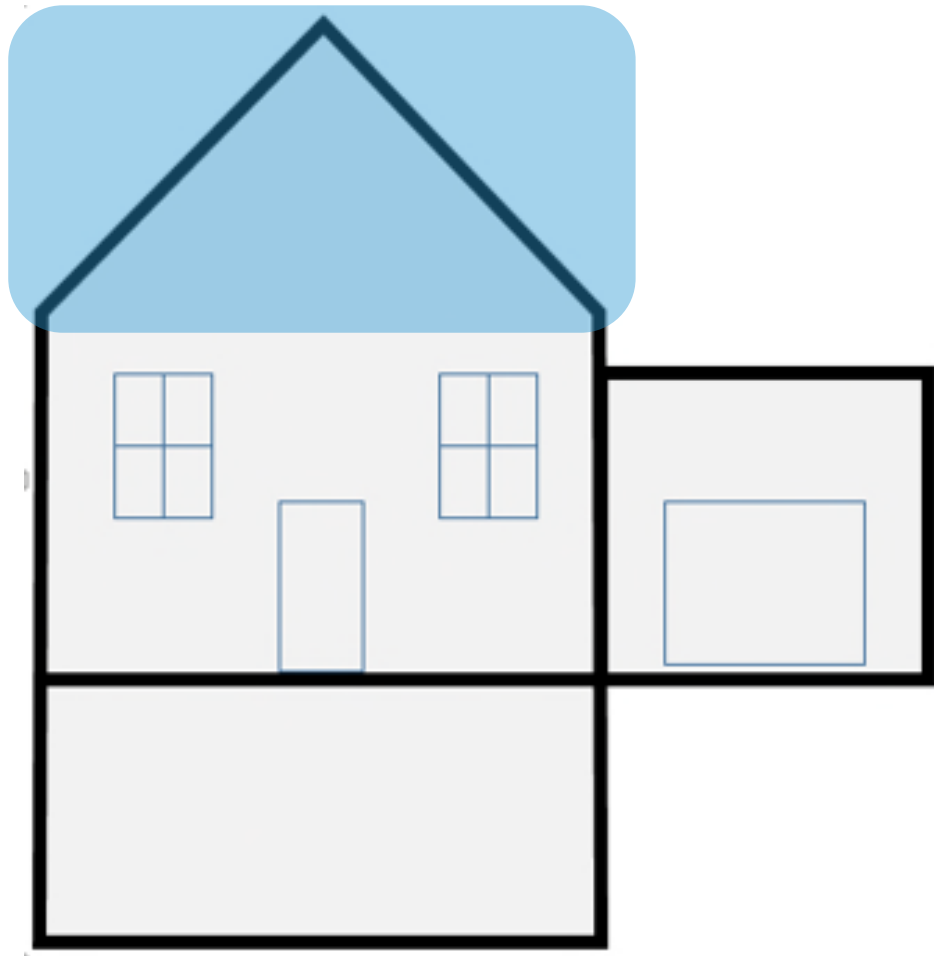


Energy & Moisture



— Problems and Solutions

Attic



Adequate Insulation at Truss/Rafter Heel

- Energy loss
- Ice Dams

PROBLEM



Adequate Insulation at Truss/Rafter Heel

SOLUTIONS

Raised Heel Trusses



Higher R-value Insulations

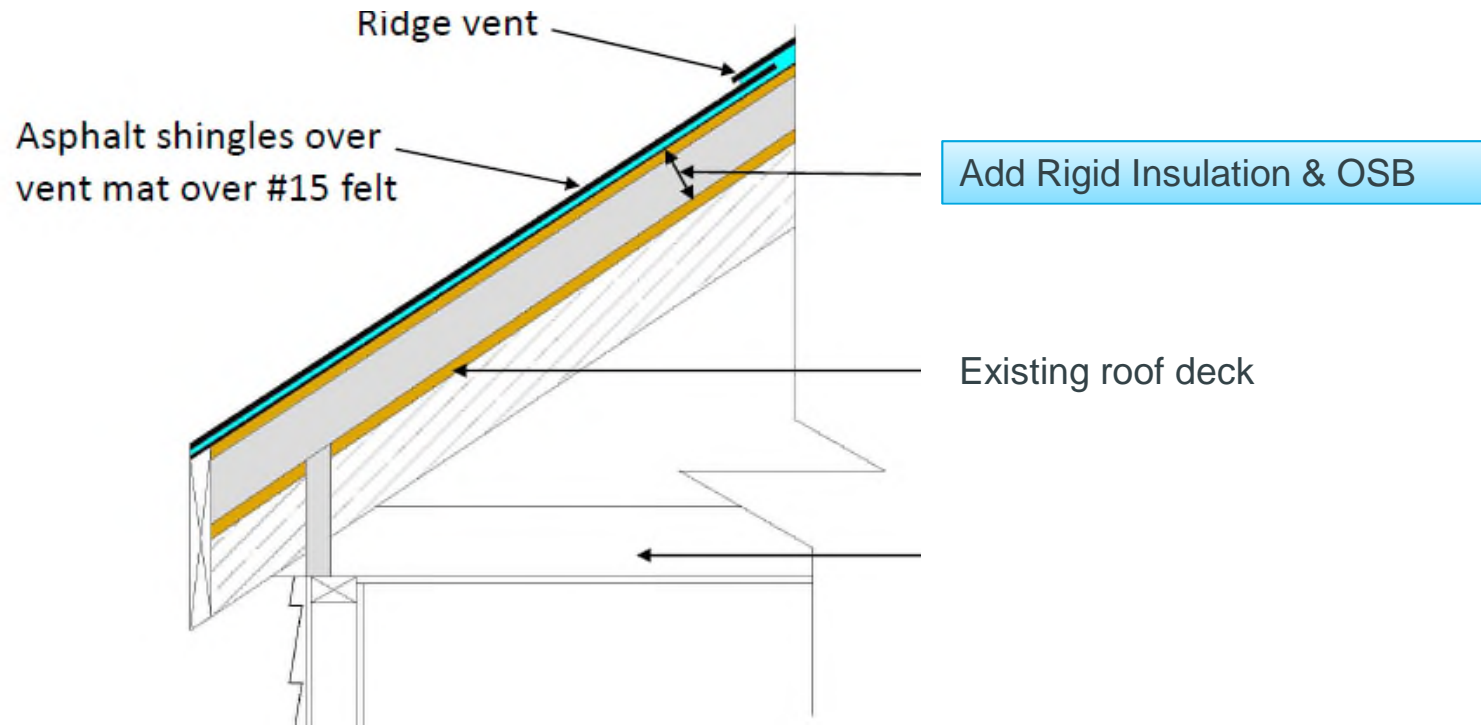


Unvented Attics



Truss/Rafter Heel – Re-Roof Application

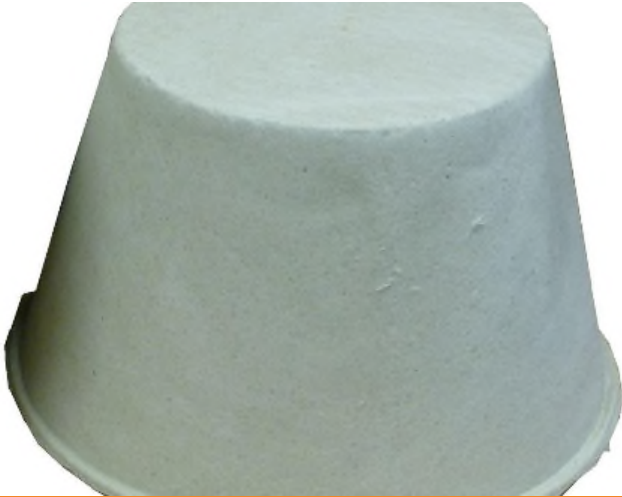
SOLUTIONS



Ceiling Penetrations

PROBLEMS & SOLUTIONS

Can Lights



Bath Fans



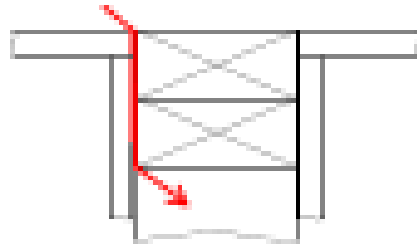
Duct Boots



Air Leaks & Appropriate Insulation Over

Top Plate Air Sealing

- Significant source of energy loss*
 - *Wolf, Dave; Characterization of Air Leakage in Residential Structures
- Durability issues



PROBLEM



Top Plate Air Sealing

SOLUTIONS

Caulk or Drywall Adhesive



Gasket, Sill Seal,



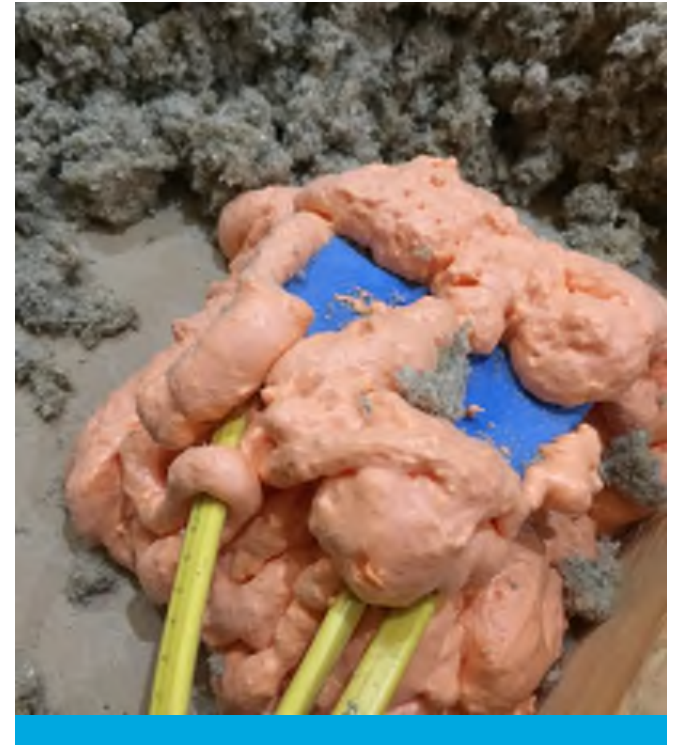
SPF on Top



CONSIDER: Inspection of solutions

Ceiling Penetrations

PROBLEMS & SOLUTIONS



Common Wall Heat Loss

- Adjacent walls each insulated with R-13 FG that only has 5 sides of contact
- Adjacent trusses have 2 layers of 5/8" Type "X" gypsum per fire code
- Allows heat loss through common walls to stack right up to roof deck
 - Energy loss
 - Condensation on underside of roof sheathing

PROBLEM



Common Wall Heat Loss

- Air seal to prevent heat loss from conditioned common wall area to unconditioned attic area
- Fireblocking is required!!
- Air barrier on the back side of these walls.

SOLUTIONS



Venting to Soffits

- Allows warm humid air to be pulled back into attic space



PROBLEM



Venting to Soffits

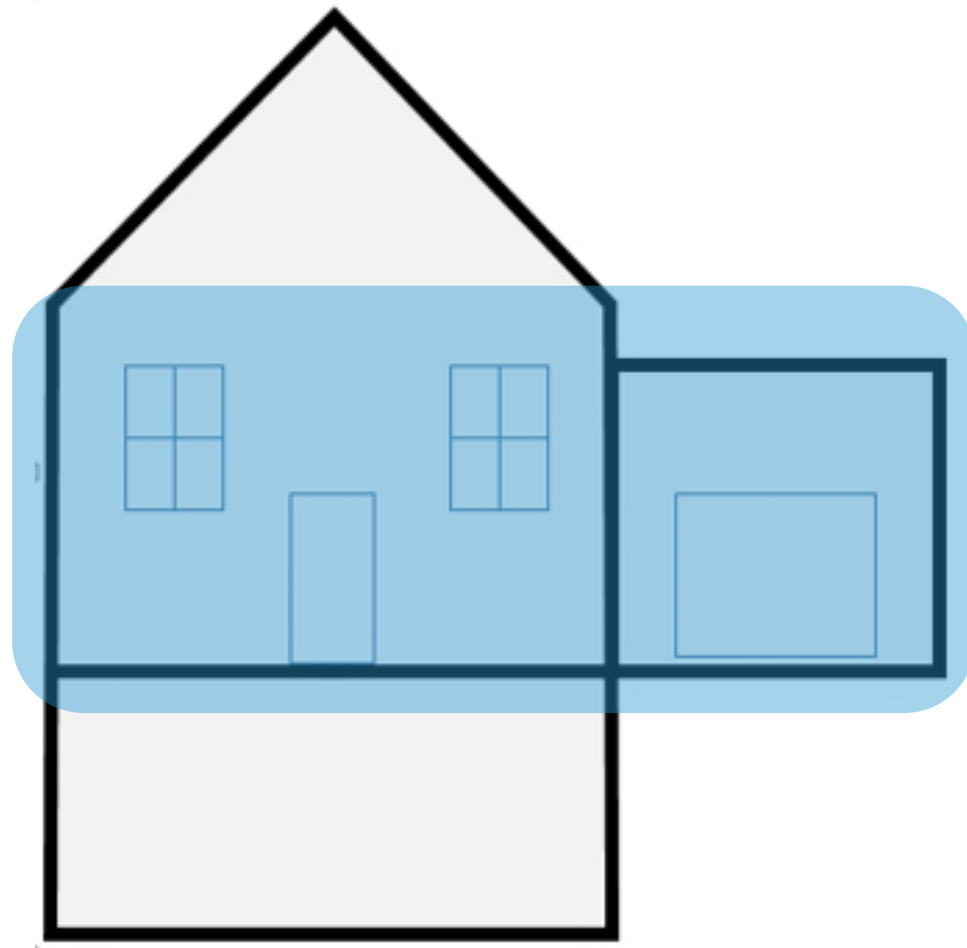
- Don't exhaust through soffit



SOLUTIONS



Above Grade



Thermal Bridging

PROBLEM



Energy Performance Research Neighborhood

Midland Michigan Climate Zone 5-6

The map shows a residential neighborhood with several houses highlighted in colored ovals. A red oval highlights house 48 (Somerset), a yellow oval highlights house 51 (Kendall), a green oval highlights house 50 (Preston), a blue oval highlights house 53 (Preston), a light green oval highlights house 54 (Preston), a light blue oval highlights house 55 (Somerset), a light blue oval highlights house 59 (Preston), and a light blue oval highlights house 58 (Somerset). A north arrow is located at the bottom left of the map.

2006 IECC

- 49-Kendall
- 48-Somerset
- 50-Preston

2012 IECC

- 51-Kendall
- 53-Preston
- 52-Somerset

2012 IECC Premium

- 54-Preston
- 55-Somerset
- 56-Kendall

Beyond 2012 IECC

- 59-Preston
- 58-Somerset
- 62-Kendall



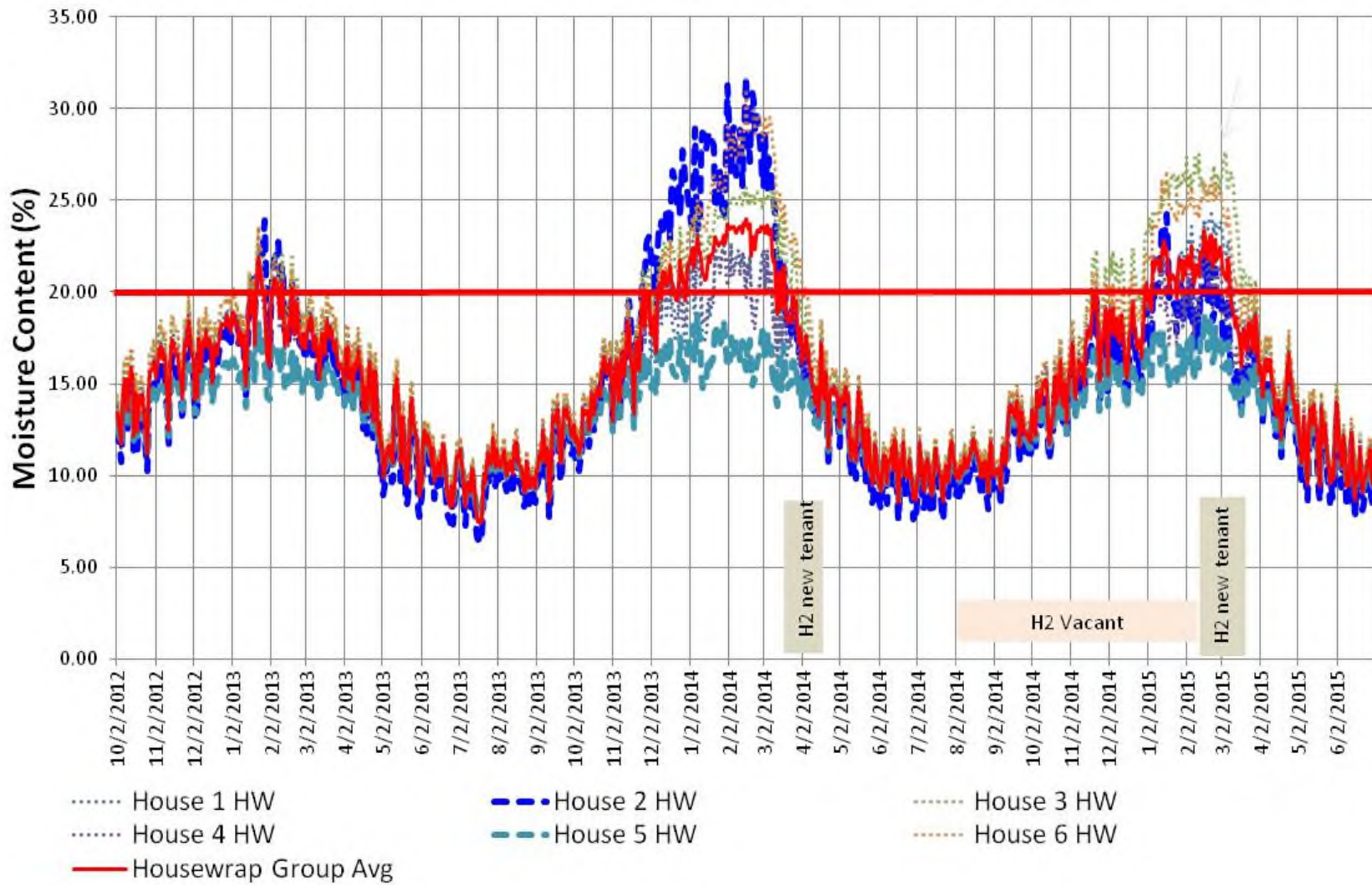
Continuous Insulation vs Cavity Only



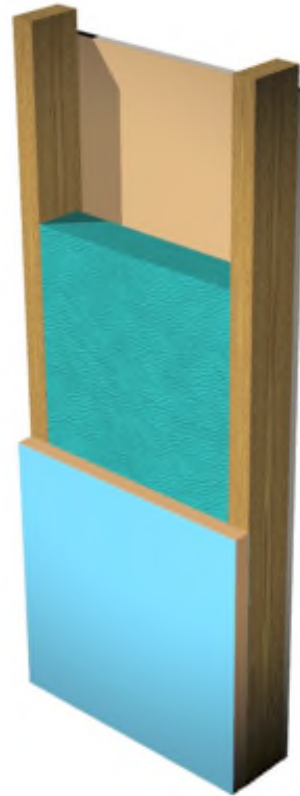
2x6 OSB & HW

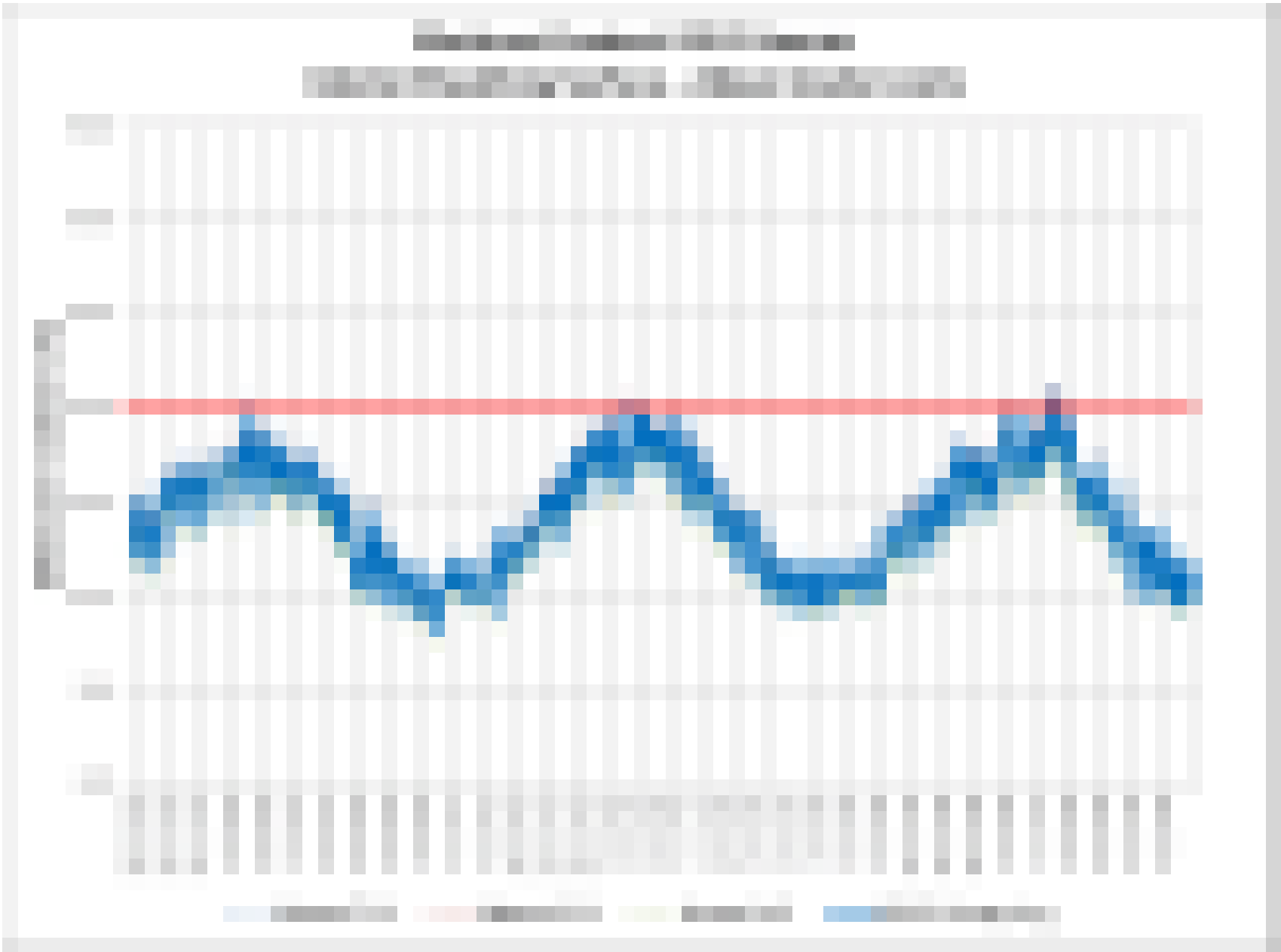


Moisture Content - Housewrap Houses Interior Sheathing Surface - Above Grade Cavity



2x4 R5 ci & R16 SPF





Thermal Bridging

SOLUTION





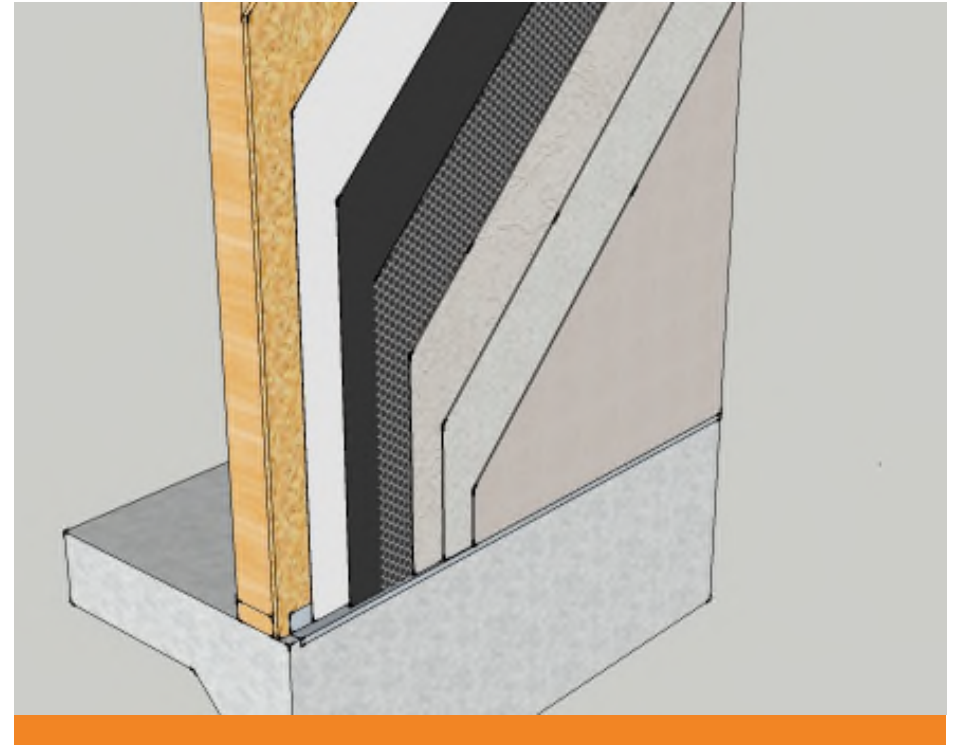
Stucco & Adhered Masonry

Photo: Building Science Corp.

Inward Vapor Drive

- Rain causes cladding to absorb water
- Sun causes drying in both directions
 - Outward Good
 - Inward Bad -
- Temperature drop in evening causes condensation on sheathing surface

PROBLEM



Effect of Decay on Strength of Wood

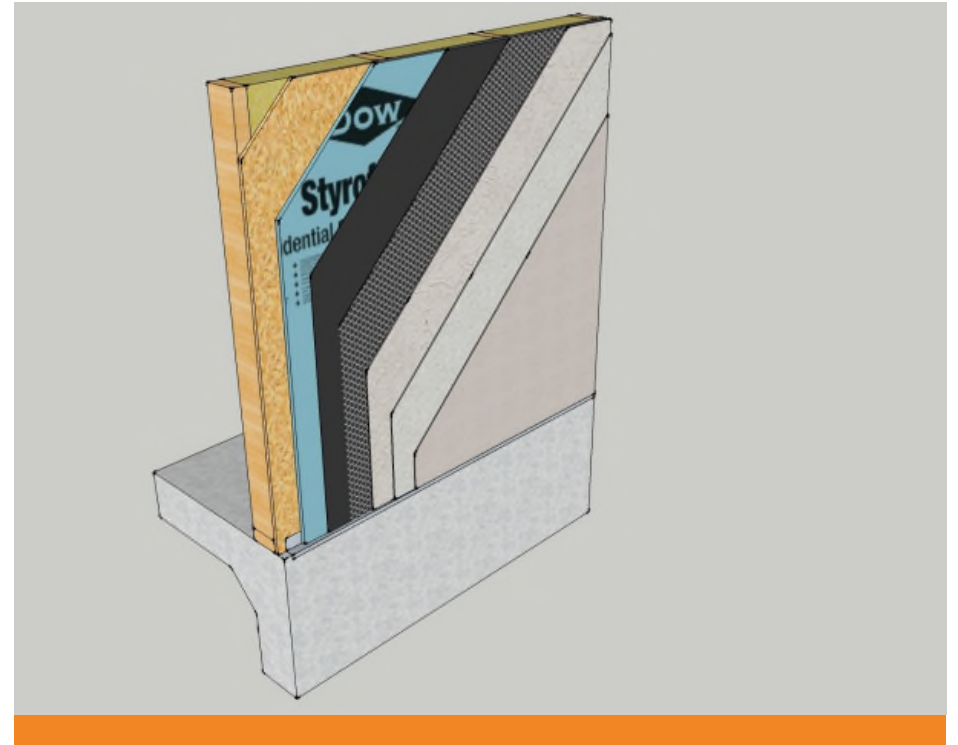
Decay initially affects toughness, or the ability of wood to withstand impacts. This is generally followed by reductions in strength values related to static bending. Eventually, all strength properties are seriously reduced.

Strength losses during early stages of decay can be considerable, depending to a great extent upon the fungi involved and, to a lesser extent, upon the type of wood undergoing decay. In laboratory tests, losses in toughness ranged from 6% to >50% by the time 1% weight loss had occurred in the wood as a result of fungal attack. By the time weight losses resulting from decay have reached 10%, most strength losses may be expected to exceed 50%. At such weight losses (10% or less), decay is detectable only microscopically. It may be assumed that wood with visually discernible decay has been greatly reduced in all strength values.

Inward Vapor Drive

- Ventilation space
- Low perm CI or WRB

SOLUTIONS



FROG's (Finished Rooms Over Garages)

- Difficult to keep comfortable
 - Why?
- Surrounded by exterior on 5 of 6 sides
- Long duct runs
- Inadequate Insulation
 - Dropped ceilings in garages
 - Heat runs
 - Plumbing chases
 - Knee walls
 - Sloped rafters

PROBLEM



FROG's (Finished Rooms Over Garages)

SOLUTIONS

- Floor
 - Spray foam in floor
 - Continuous insulation on underside of joists
 - Hardwood floor issues
 - Completely fill void with insulation
- Ducts
 - Manual J, D, & S
 - Commissioning
- Rafters
 - Fur down to achieve R-value



Knee Walls

- Comfort Issues
- Energy loss

PROBLEM



Knee Walls

- Spray foam
- Air Barrier on exposed side of attic
- Continuous insulation on exposed side of attic

SOLUTIONS



Cantilevers

- Frozen pipes
- Continuity of air barrier
- Difficult to insulate effectively

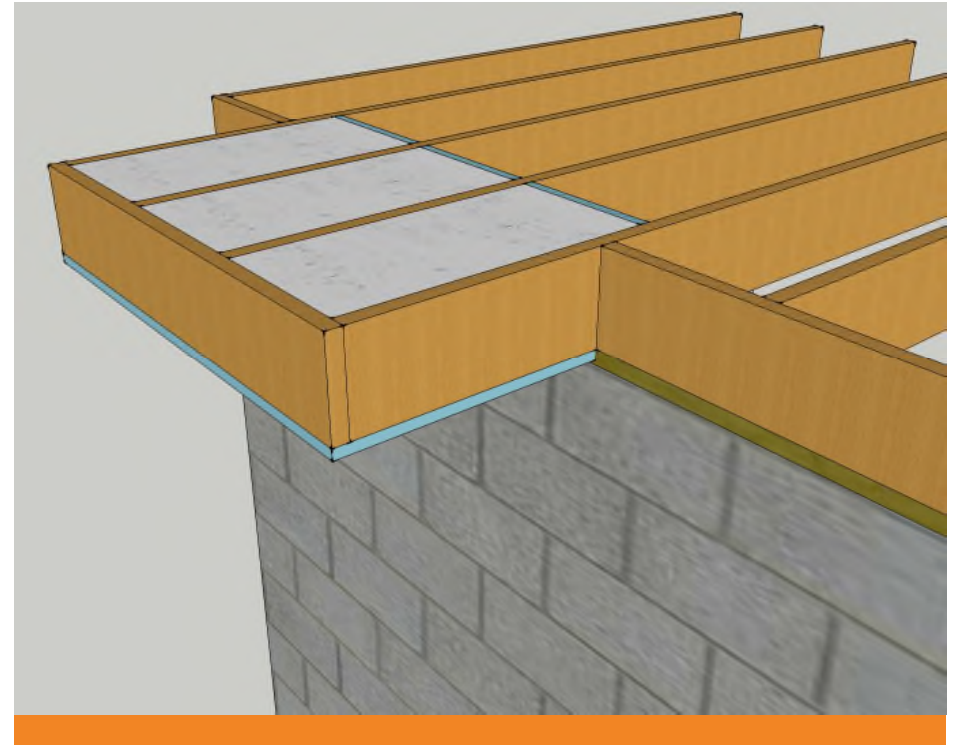
PROBLEM



Cantilevers

- Spray foam
- Dense pack insulation
- Air barrier all six sides insulation
- Continuous insulation on underside of joists

SOLUTIONS



Dormers & Bay Windows

- Complex - difficult to air seal
- Difficult to adequately insulate to prevent condensation

PROBLEM



Dormers & Bay Windows

SOLUTIONS

- Unvented attic
- Spray foam
- Fibrous insulation
 - Detailed Air Barrier
 - Vapor retarder (climate appropriate)
 - Adequate insulation
- Continuous insulation on top of roof deck
 - Keep roof deck above dew point

Bathroom Condensation

PROBLEM



Bathroom Condensation

- Properly sized bath fan
- Adequate bath fan exhaust duct
- Humidistat control
- Bath fan timer
- Air seal
- Insulation
- Occupant education

SOLUTIONS



Shower Surround – Mold Behind Tile

PROBLEM



Shower Surround – Mold Behind Tile

- Continuous insulation on exterior walls

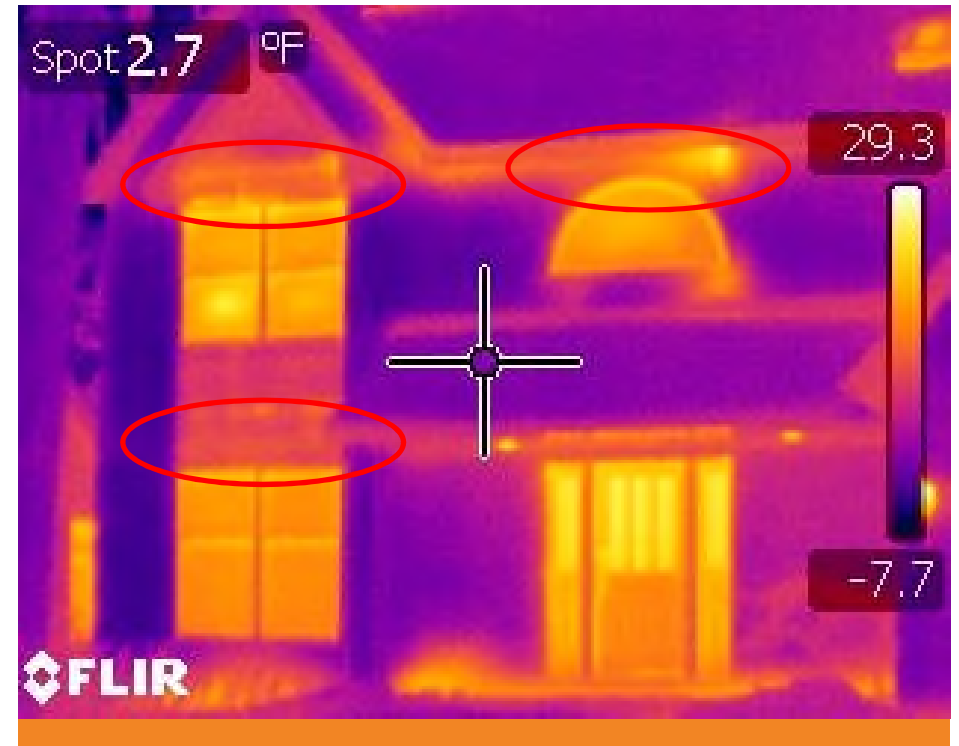
SOLUTIONS



Headers

- Inadequate insulation
- Fiberglass compressed in headers has reduced effective R-Value

PROBLEM



Headers

- Relocate to rim joist
- Size minimal
- Use higher R-value insulations
- Continuous insulation on exterior

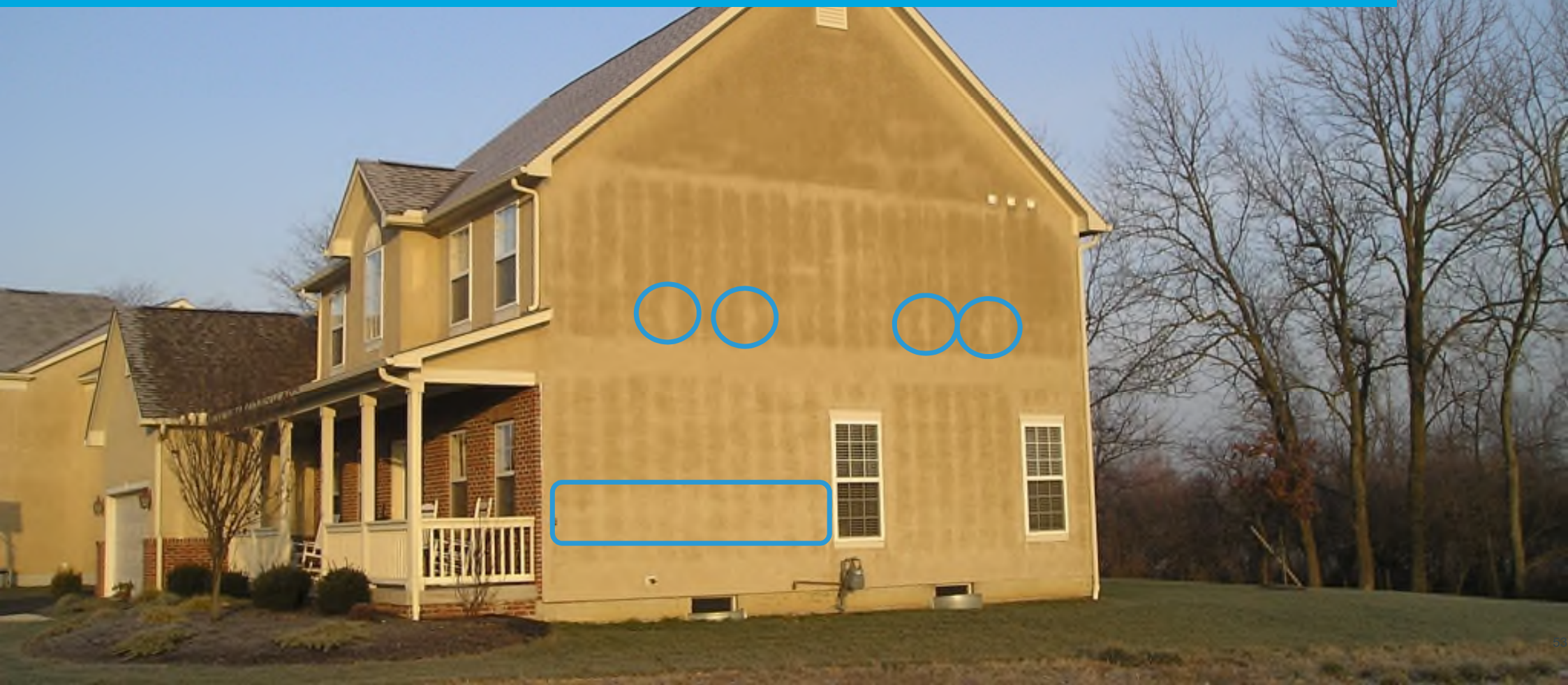
	OSB	1/2" XPS
2x4	R-3.5	R-6
	OSB + FG	2" XPS
2x6	R-10	R-13.5

SOLUTIONS



Electric Outlets

PROBLEM



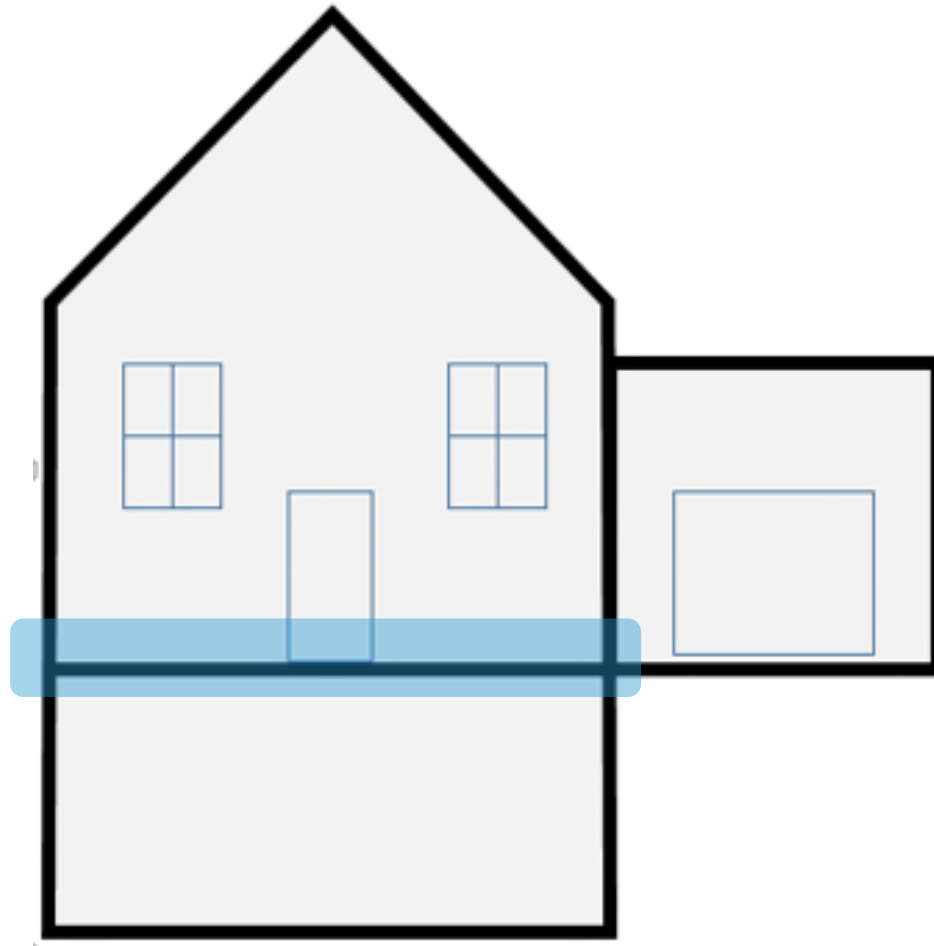
Electric Outlets

- Shallower boxes
- Higher R-value insulation behind
 - Rigid Foam between the box and sheathing
 - SPF
 - CI on exterior
- Air seal

SOLUTIONS



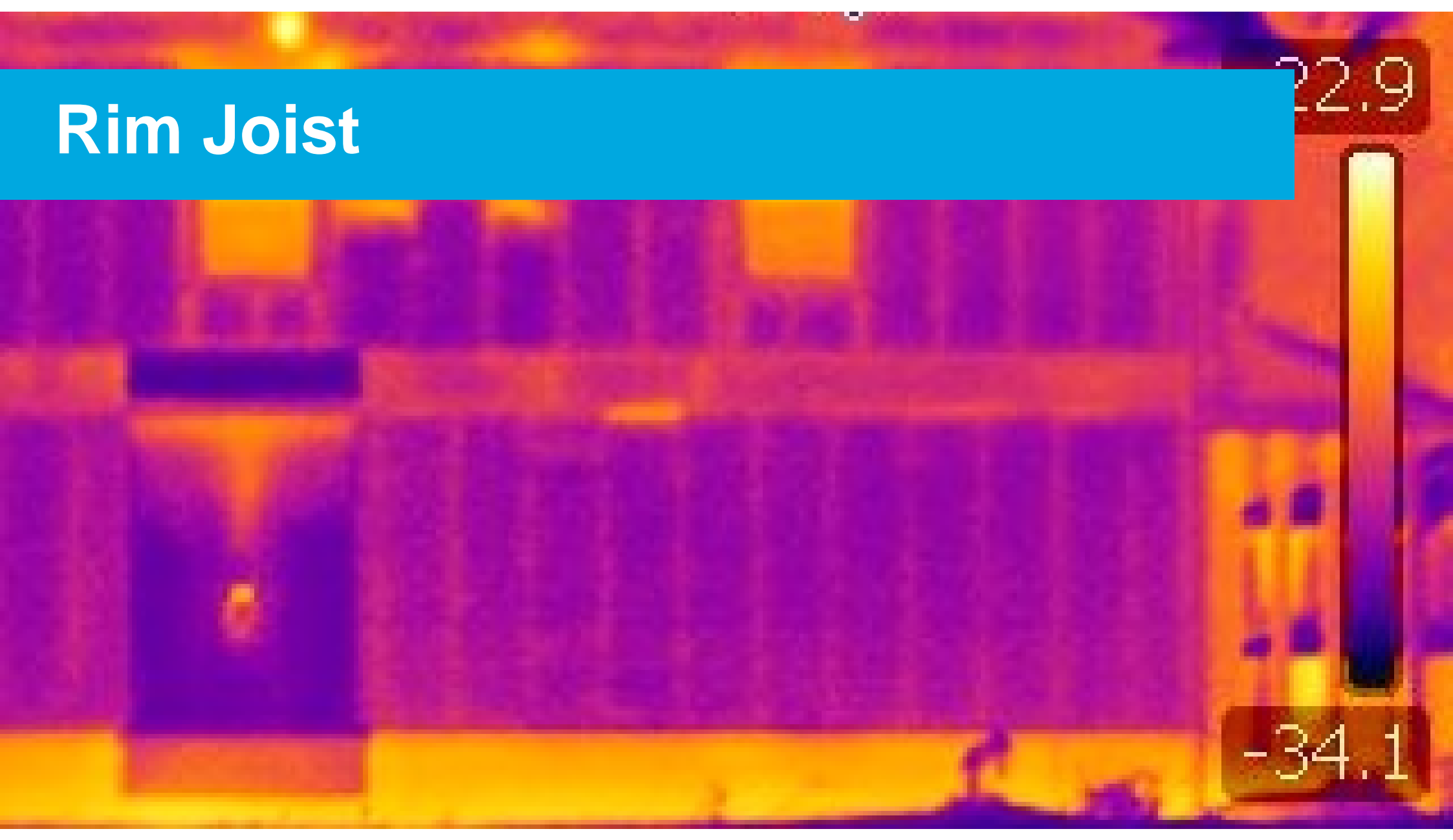
Rim Joist



Rim Joist

22.9

-34.1



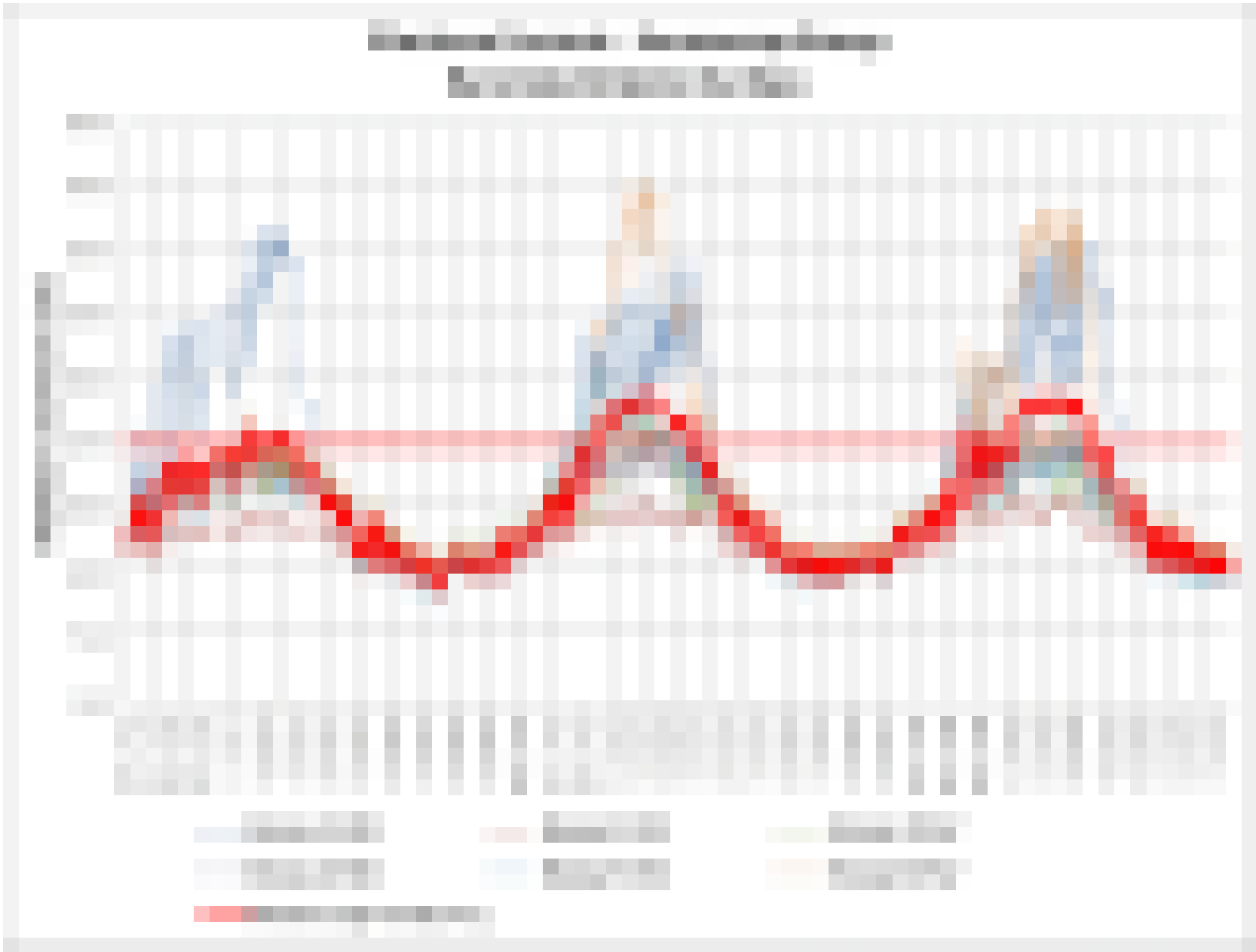
Rim Joist



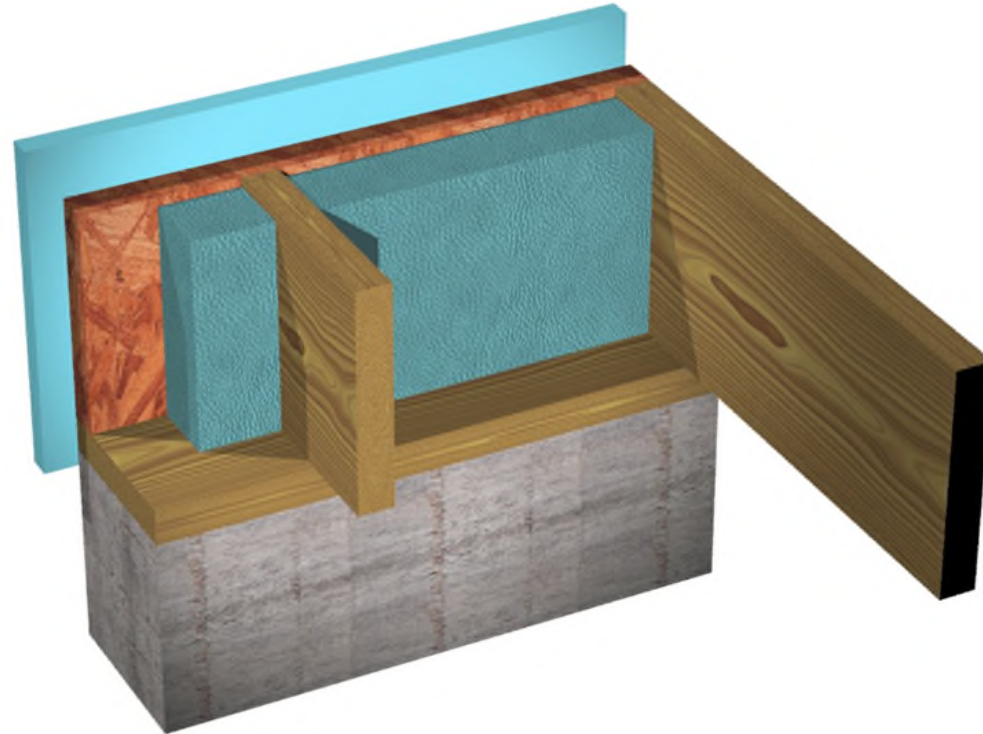


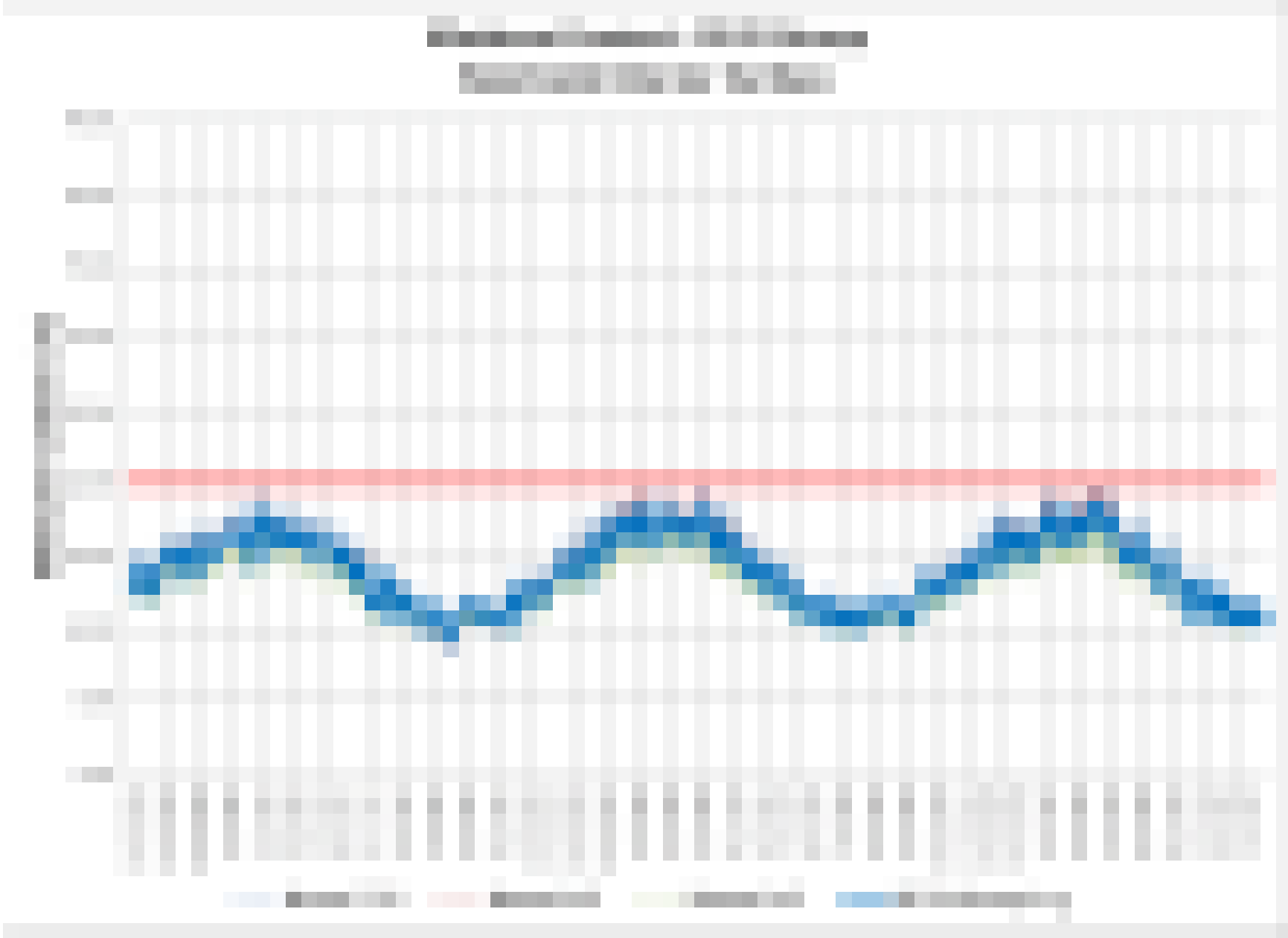
Warning: This facing will burn. Do not
be exposed. Cover with approved
insulating material in contact with facing.
Do not open flames and other heat sources
near this facing. See package for warning,
hazard and installation instructions or
1-419-248-8234.

Advertencia: Este revestimiento
se incendia. No lo deje expuesto.
Cubralo con material aprobado para
aislamiento que esté en contacto con el
revestimiento. Manténgalo alejado de
velas y otras fuentes de calor. Ver el
paquete para advertencias, peligro de
incendio, instrucciones de instalación o
al 1-419-248-8234.



Engineered rim joist R5 ci & SPF





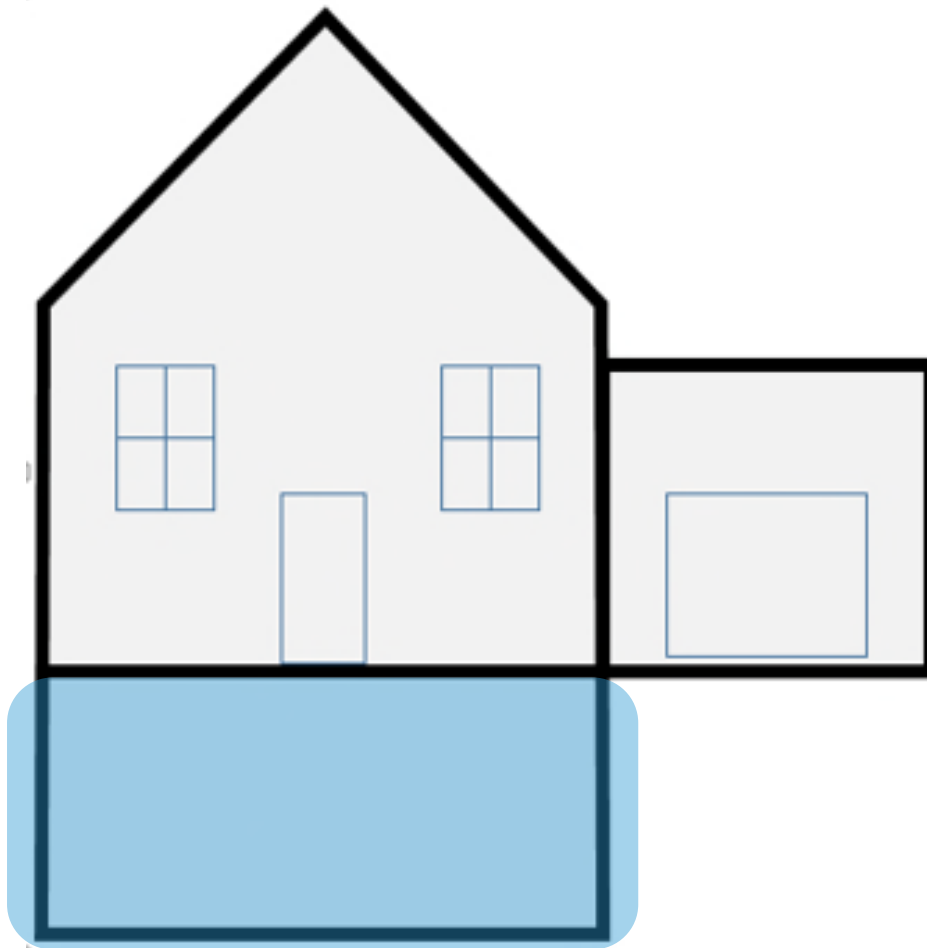


**Rim Joist pic
of Rigid foam picture framed**

Rim Joist – SPF

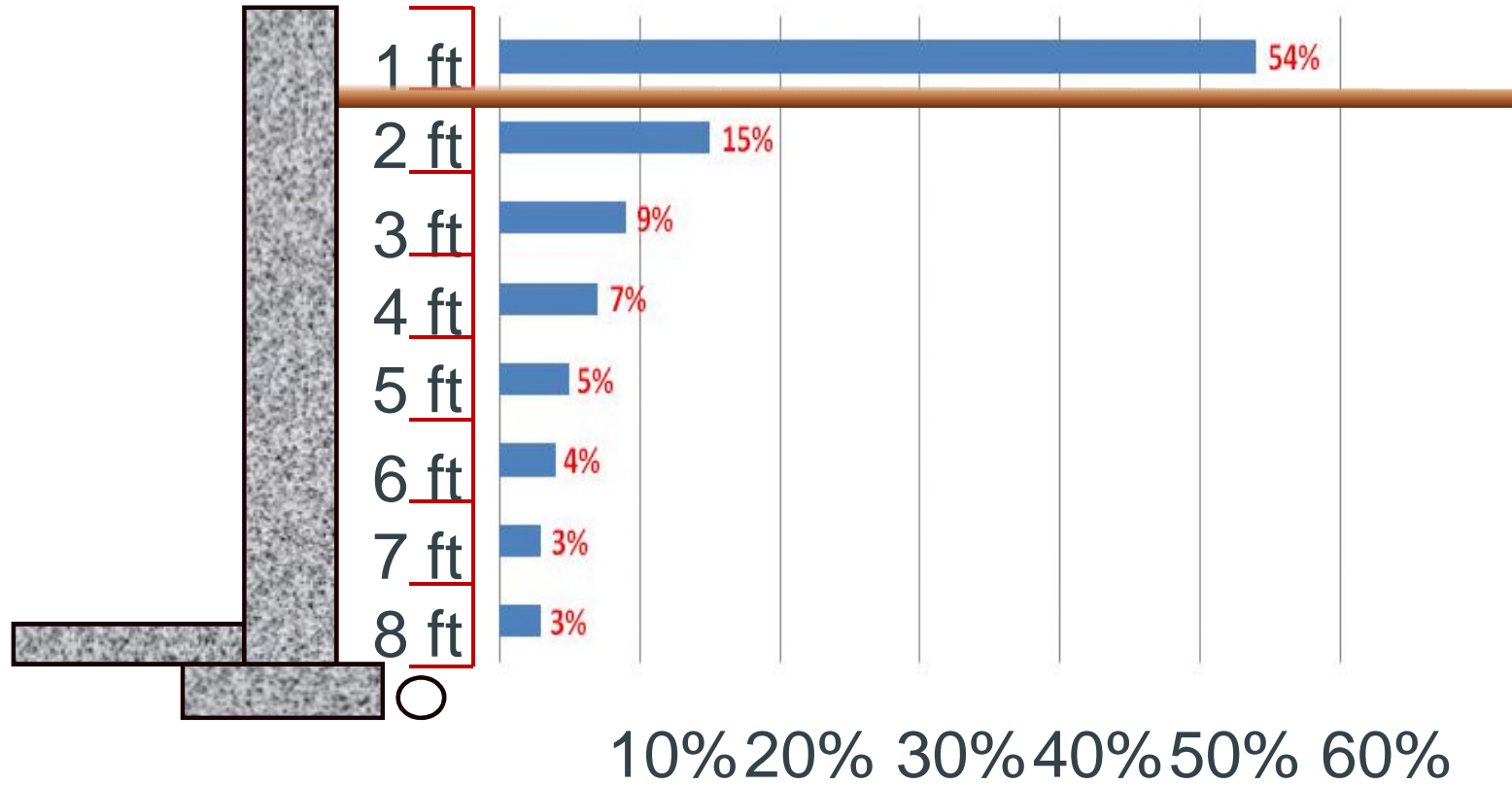


Below Grade Walls



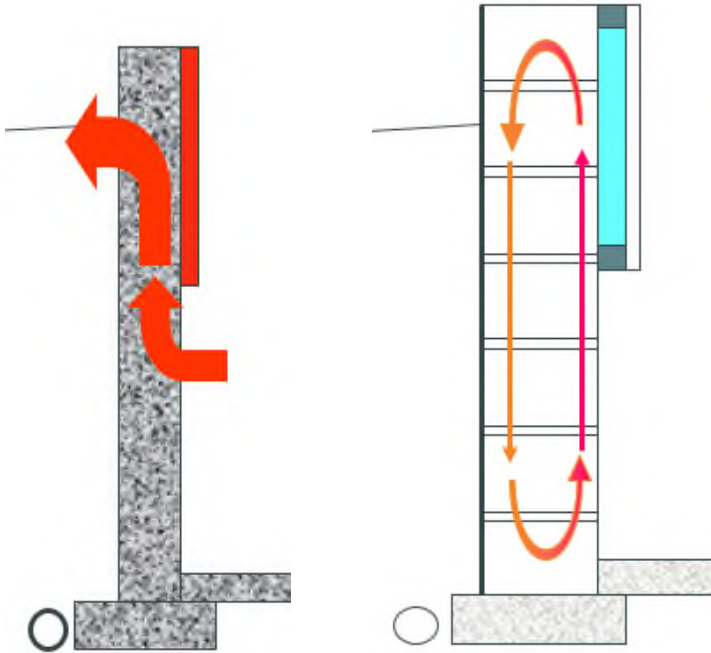
Why Insulate Foundations?

- Heat Loss from Basement Wall

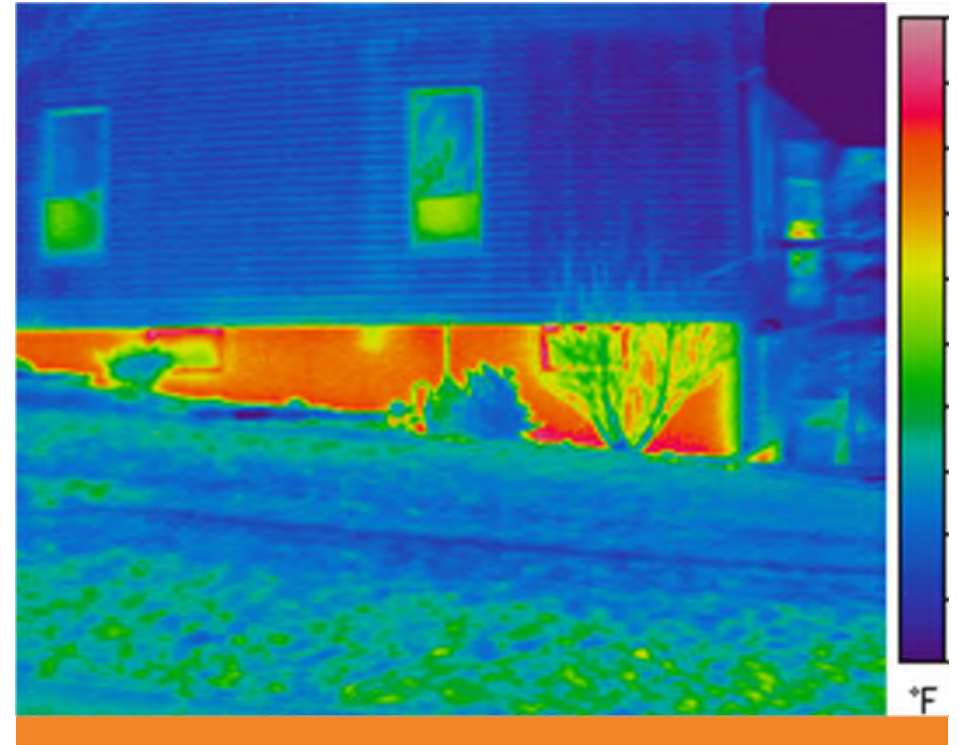


(Builders' Guide to Residential Foundation Insulation Kansas Corporation Commission - Energy Programs)

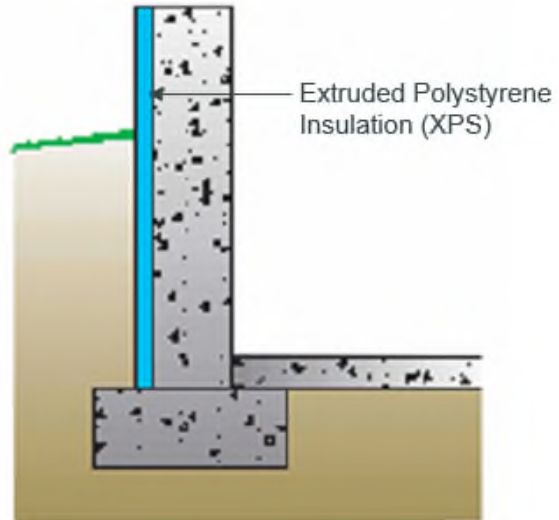
Basement Insulation



PROBLEM



Basement Insulation

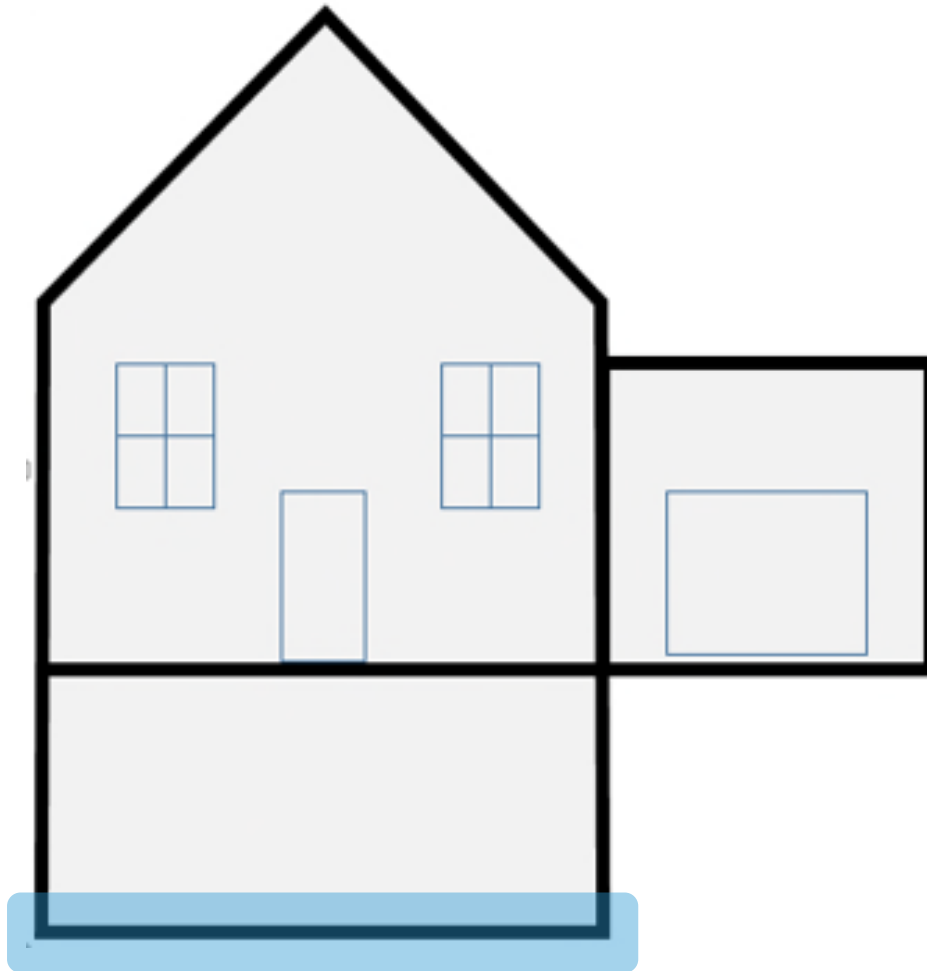


This picture is from "Basement Insulation Systems" by Building Science Corporation 2002.

SOLUTIONS



Below Grade Floors



PROBLEM



Basement Floor Insulation

- **CONDUCTIVE HEAT LOSS:**
- Uninsulated Basement Floor:
 - 1000 SFT X (65-54)/ R-1 = 11,000 BTU
 - Insulated Basement Floor (R-10 XPS)
 - 1000 SFT X (65-54)/ R-11 = 1,000 BTU
- **Largest uninsulated surface left in the home!**

SOLUTIONS



Other Common Problems?





Thank
You