Building Durability into High-Performance Buildings

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Presentation Rules

- Ask questions any time.
- This is a conversation not a lecture.

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Disclaimer

This presentation contains the best of my understanding and was developed using data gathered from the field. I've done my level best to be “data driven”. However, I learn new things every day, so I reserve the right to be wrong.

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“Normal Performance” Buildings Built by Professionals...

- Are safe.
- Are designed and built to suit the intended use.
- Are good investments for the clients.
- Have moderate utility costs.
- Require only modest annual maintenance.
- Have an expected lifetime of 30+ years.

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“High Performance” Buildings Built by Professionals...

- Are safe **and durable.**
- Are designed and built to **be comfortable for** the intended use.
- Are **excellent** investments for the clients.
- Have **low** utility costs.
- Require only **little** annual maintenance
- Have an expected lifetime of **100**+ years

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Holy Triangle, Part 1
Customer Expectations

Good

Fast

Cheap

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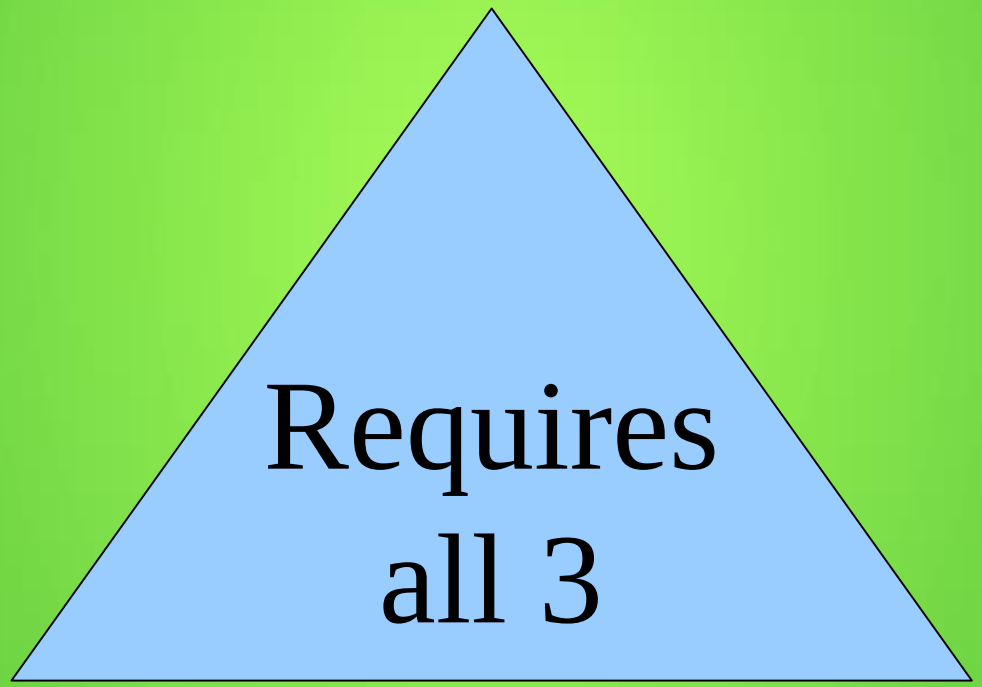
Holy Triangle, Part 2
Durability

Design



Materials

Construction

How to Make High Performance Buildings Durable

Accept that high-performance

buildings are different...

Different Materials

Different Heat Loss

Different Air Infiltration

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Different Materials

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Lower Heat Loss

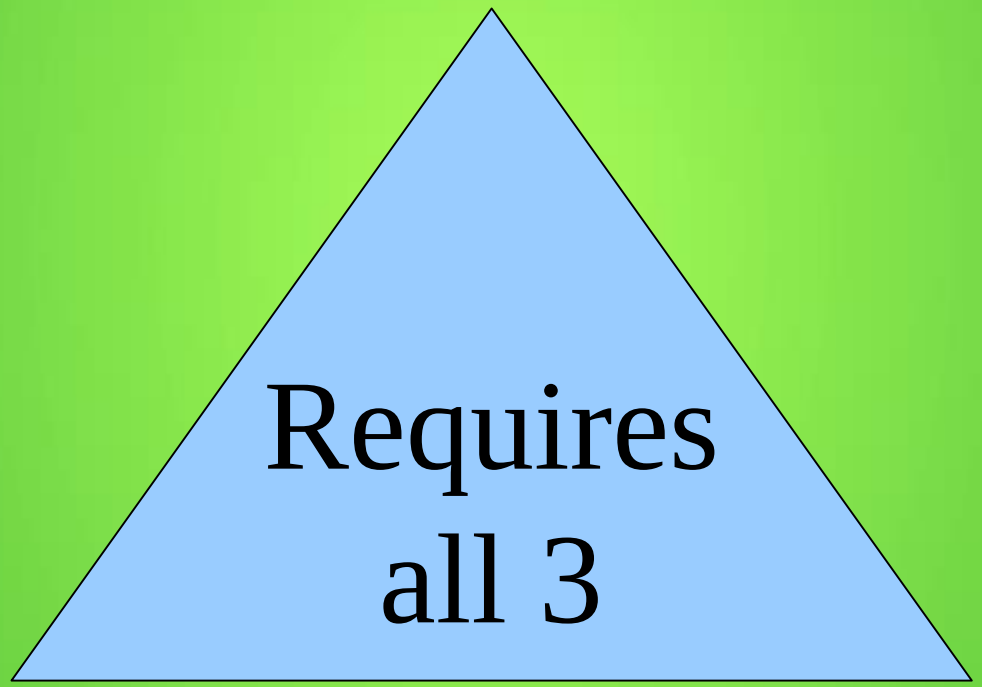
- Reduces Fuel Consumption
- Slows drying
- Permeance only applies to water vapor

Low Air Infiltration

- Requires ventilation for IAQ
- Slows drying

Holy Triangle, Part 2
Durability

Design



Materials

Construction

Design

- Architecture
- Structure
- Mechanical
- Detailing
- Material Specification

ho·lis·tic

/hōˈlistik/

adjective PHILOSOPHY

characterized by comprehension of the parts of something as intimately interconnected and explicable only by reference to the whole.

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Holistic Design

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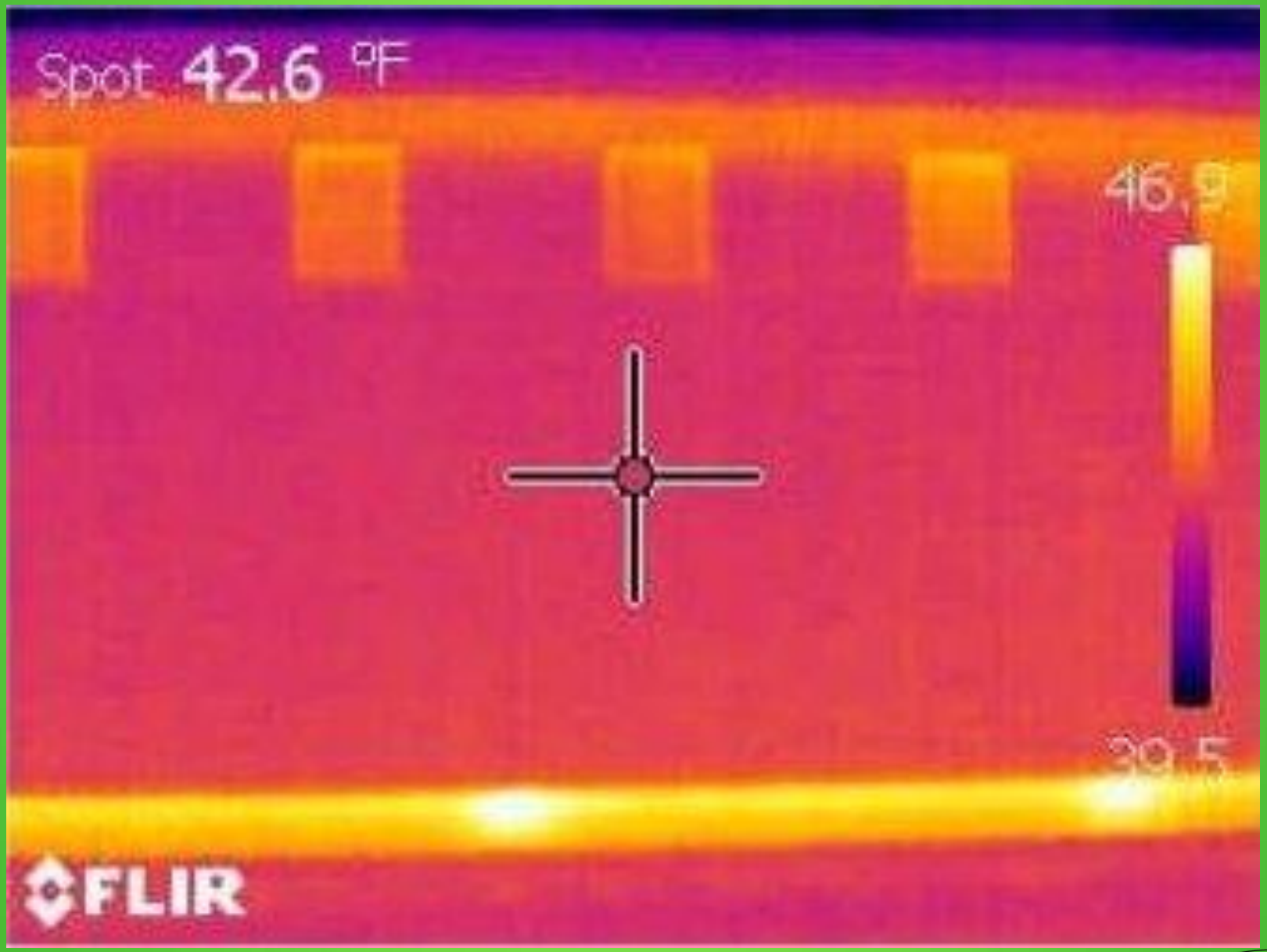
Holistic Design



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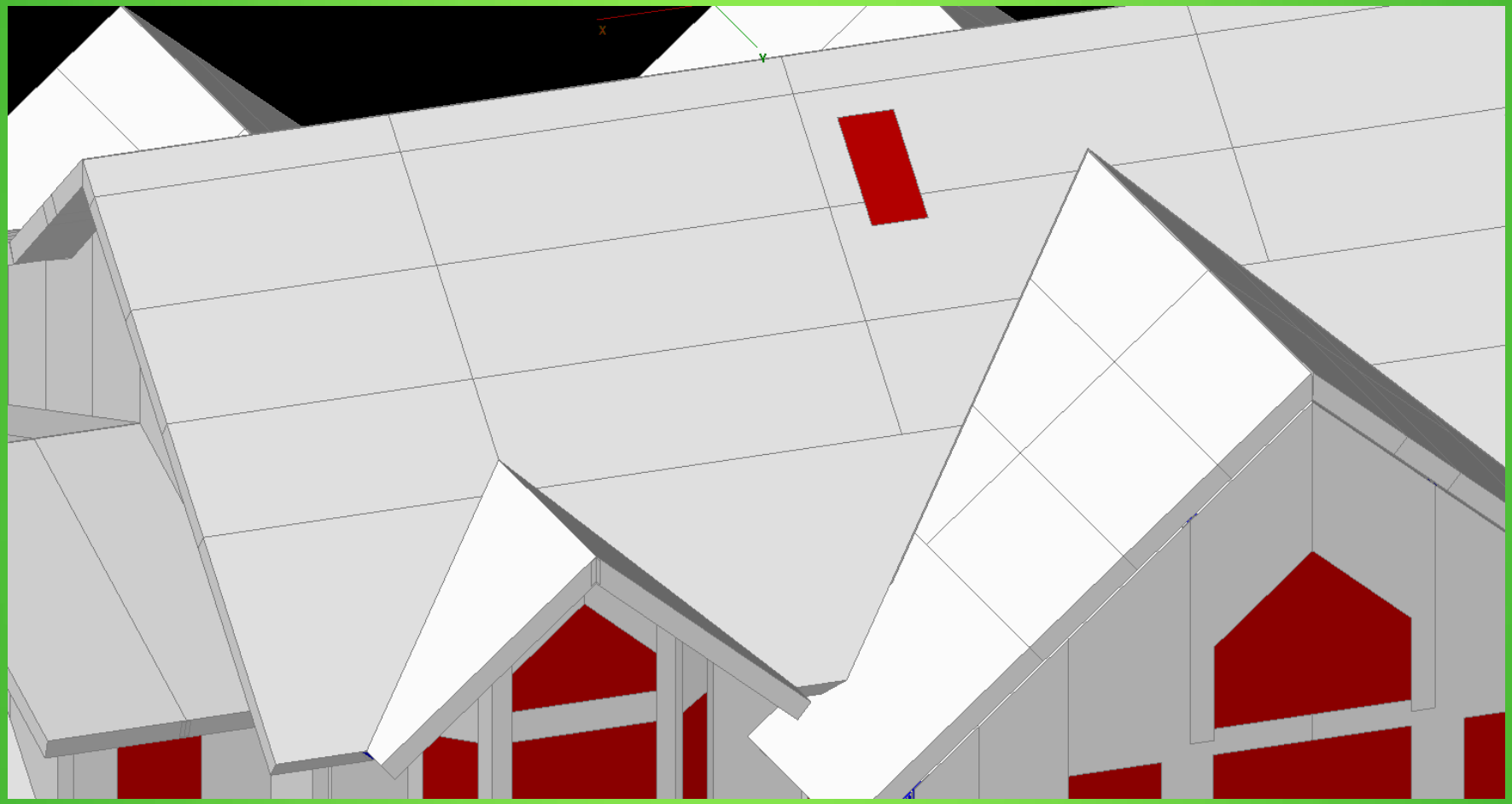
Design of Water Concentration



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Design of Water Concentration

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Roof/Dormer Design

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Structural Example: Snow

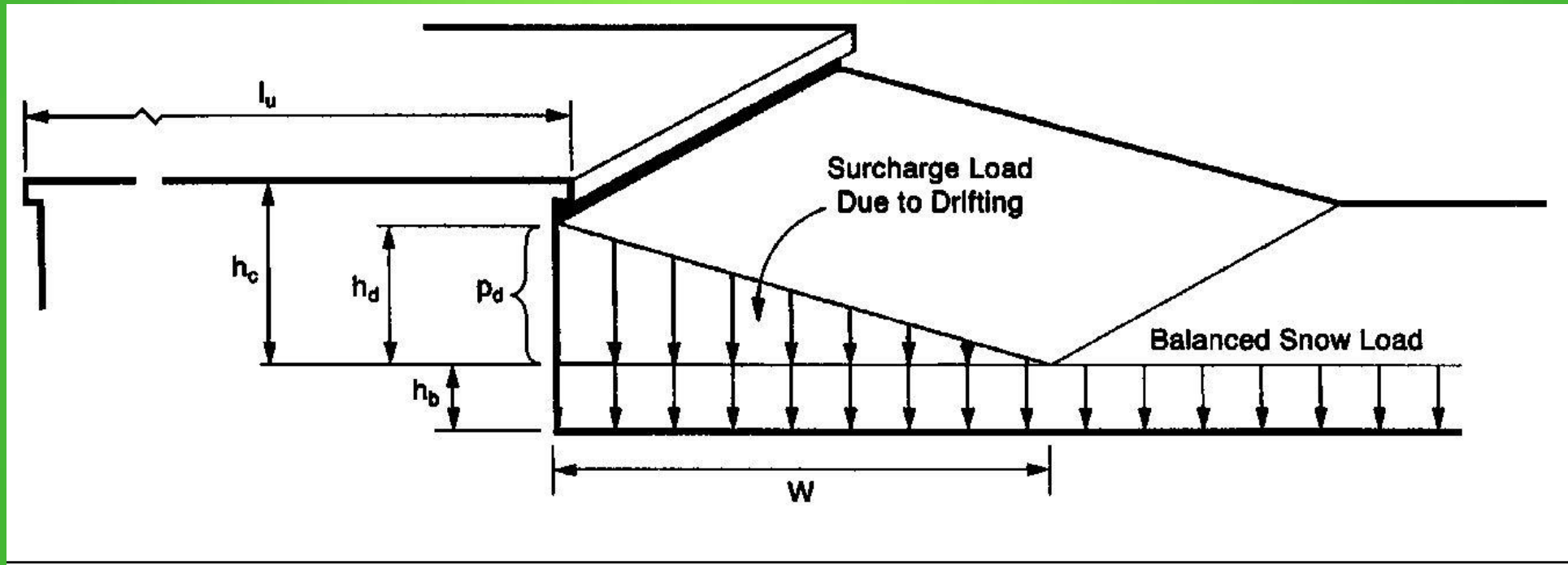

FIGURE 7-8 Configuration of Snow Drifts on Lower Roofs.

A properly designed building will never, ever need it's roof shoveled

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Structural Example: Snow

A properly designed building will never, ever need it's roof shoveled

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Design - Hidden Gutters

- Coast of Maine
- Construciton:
  - Timber Trusses
  - Urethane Panels
  - Peel-&-Stick
  - Cedar Shingles
  - Soldered Copper Gutters
- 6 years old

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Hidden Gutter Repair

Design - Water Concentration
Construction - Diverters, Flashing

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Design for Mechanicals

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Design -
Air Sealing For Shrinking Timber

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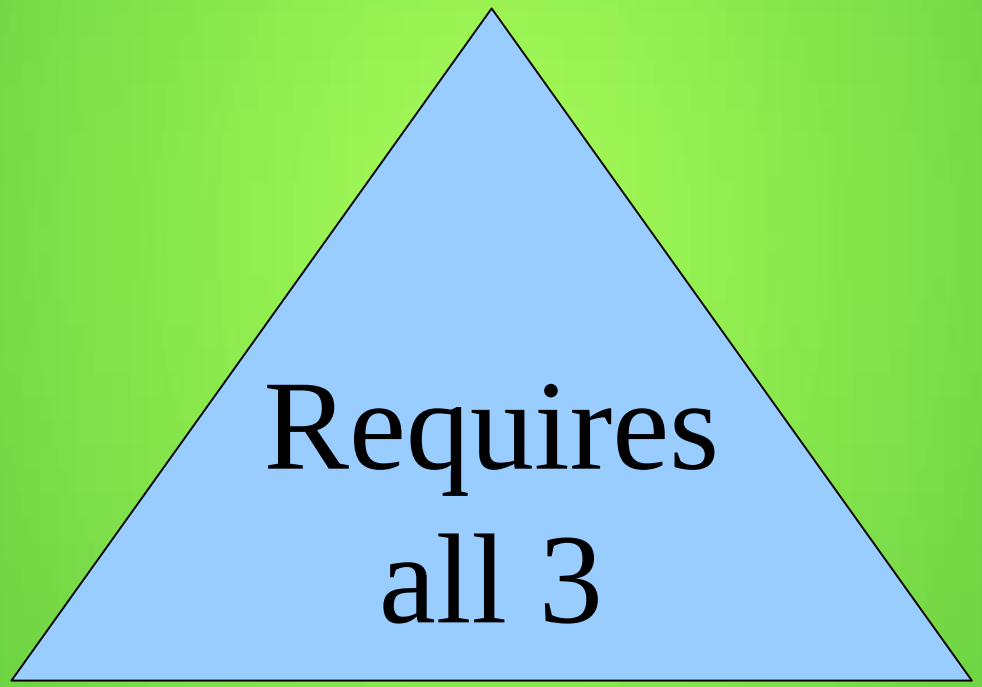
Holy Triangle, Part 2
Durability

Design



Materials Construction

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Material Compatibility

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Many high-performance envelopes have limited water capacitance.

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Limited Water Capacitance

- SIPs
- Stick & Spray Foam
- Stick & Flash/Batt*

Detail Appropriately

Some Materials Are Not Compatible

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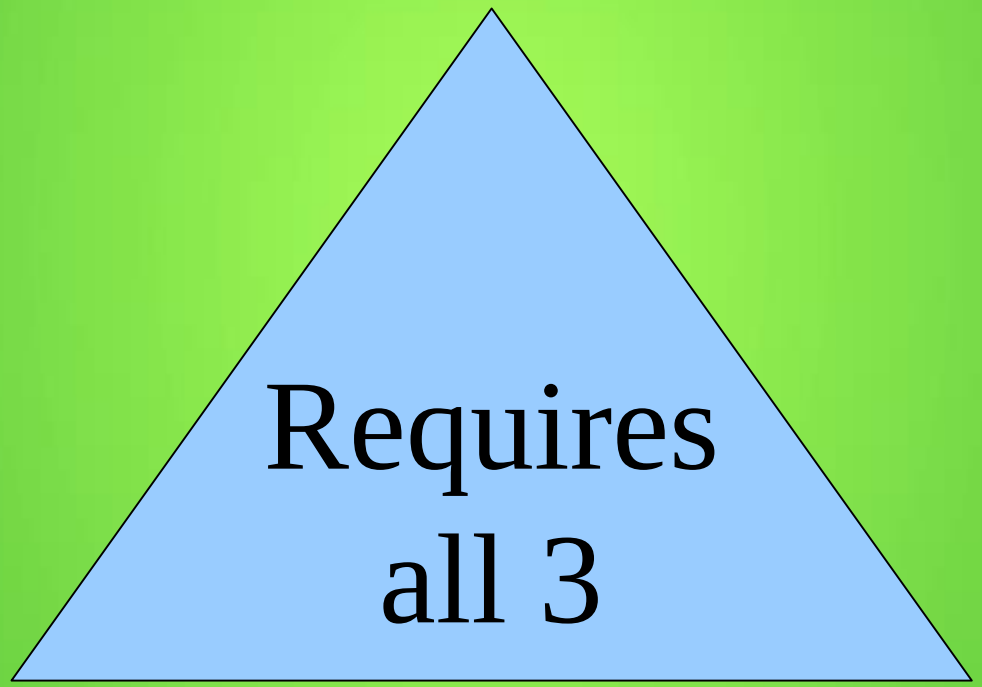
Holy Triangle, Part 2
Durability

Design



Materials

Construction

Construction

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Construction

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Design & Construction

- Design for Mechanicals
- Construction with Structural Sympathy

Be willing to ask designers/GCs for a plan!

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Construction

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High Performance Buildings are “Special”

- Reduced heat loss
  - Less energy to evaporate water
  - Water stays liquid longer
  - Requires more conservative detailing

“Normal” Detailing of High-Performance Buildings

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“Normal” Detailing of High-Performance Buildings

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Avoiding Disaster

- Good Design
- Compatible Materials
  - Correct Building Science
- Quality Construction
  - High-Performance Detailing

Design

- Little/No Water-Concentration
- Large Overhangs
- Large Grade-to-Sill Distance
- Vented Roof and Walls
- No Roof Rotters

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Design & Detailing

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Building Science - Dew Point

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Dew Point

- Pure Water Vapor: Steam
- Water Disolved in Air: Humidity

- Relative Humidty (RH)

  actual water in volume of air

  - vs -

  max disolved water in volume

Dew Point

- The amount of water that can be disolved in air depends on temperature
  - Lower temp air holds less water
  - Higher temp air holds more

Building Science - Dew Point

Air: 70°F, 40% RH

Beer: 35°F

Surface of Glass: 36°F

Air: 40°F --> 100% RH

Dew Point

Indoor Air: 70°F & 40% RH

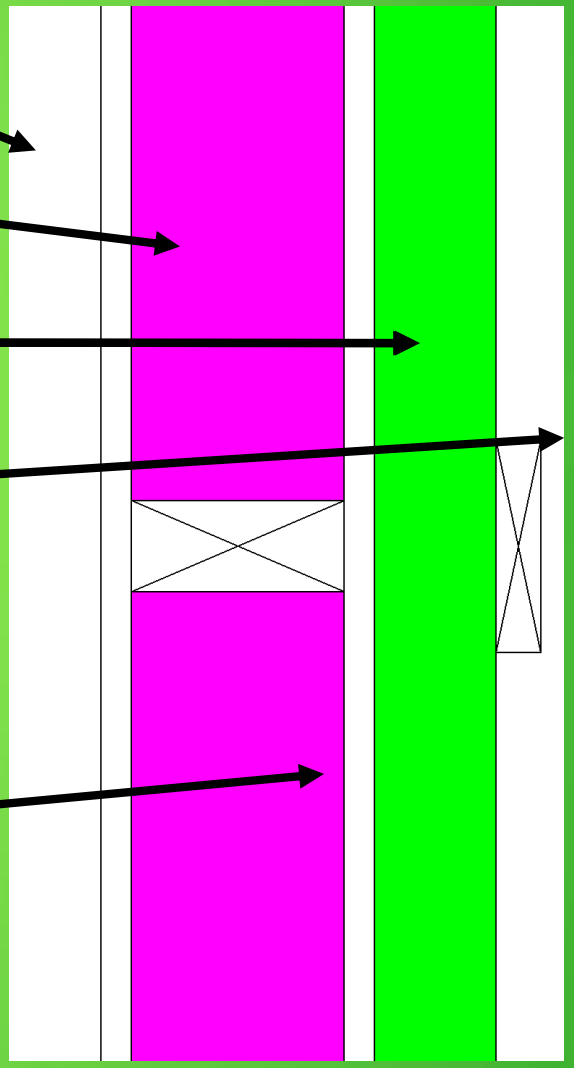
R21 Infill

R10 Continuous

Outdoor Air: 20°F

35°F & 100% RH

(Condensation)



Solutions

- The air control layer must be warmer (farther interior) than the dew point.
- Don't trap wood between hydrophobic layers

Solutions:
Interior-Side Air sealing

Solutions: More Air Sealing

Solutions: Testing

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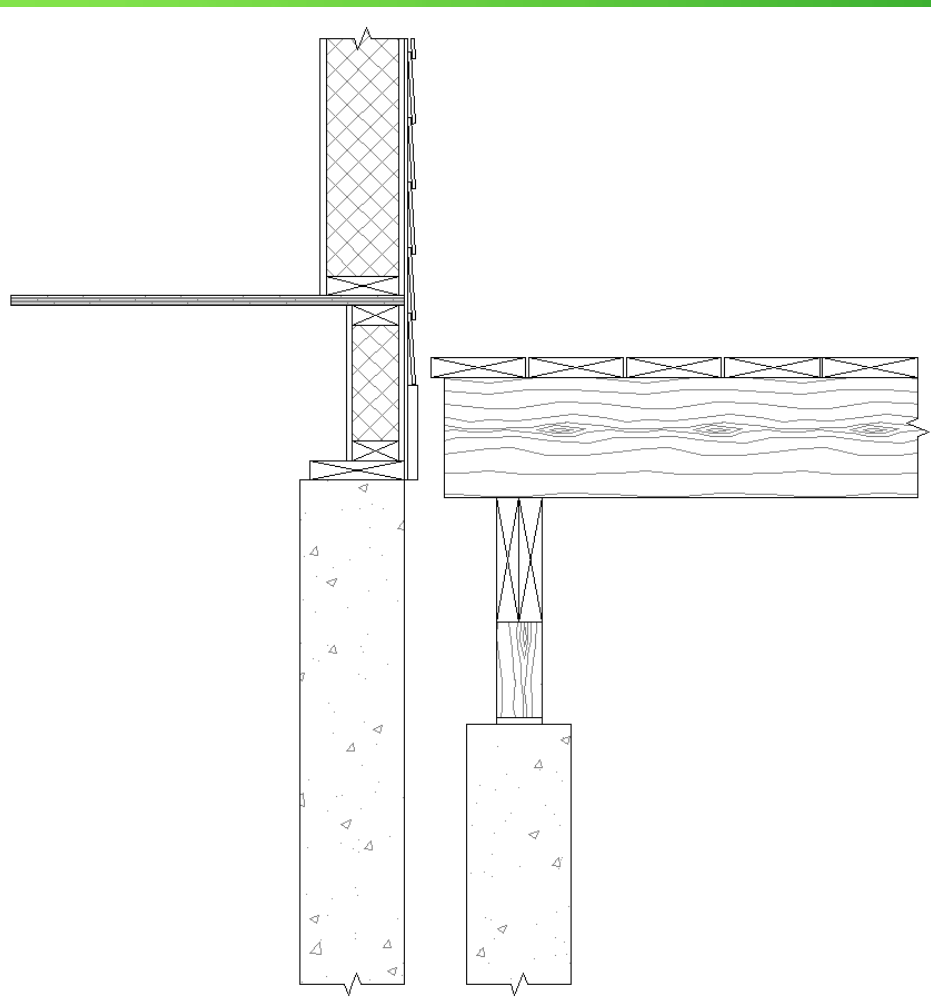
Solutions:



Let Everything Dry

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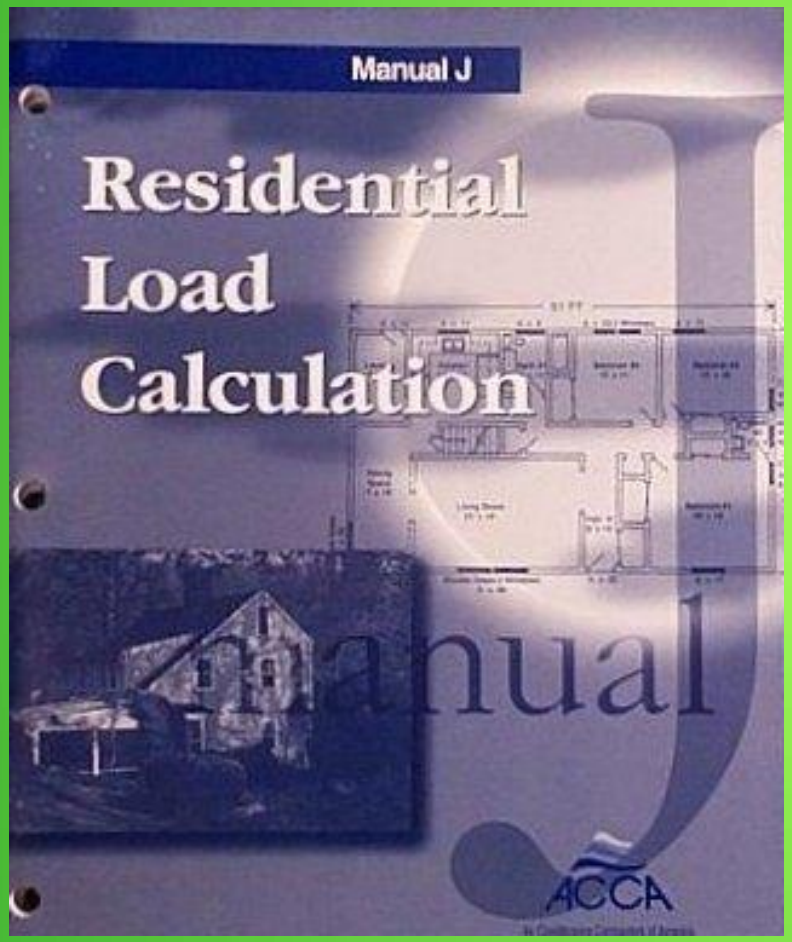
Solutions:
Design is more than architecture



- 2 choices
  - Design
  - Guess

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Solutions:
Intuition Doesn't Work

equal

- 12,000 sqft
- 16' clear
- 170kBTU/hr @ D. D.

- 200 kBTU/hr
- 500 W max

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Solutions:

- Design FIRST
- Build SECOND

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Design First

- Design = Decision-Making
  - Architectural
  - Structural
  - Mechanical
- Document & Review

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Solutions

- Materials, techniques, and details are all climate dependent.

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Solutions

- Beware of marketing claims
- Do your own critical thinking
- Beware of group-think
  - At one time, everyone thought asbestos was great, too.

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