RAiNA
RAINSCREEN ASSOCIATION IN NORTH AMERICA

Rocket Science: Understand the Modern Cladding Support System

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AIA Learning Credits: 1.0 LU/HSW
RAiNA AIA Provider #: 502111378
Course #: RAiNA-CONF24-1

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Brian Nelson

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Knight Wall Systems

Presenter Bio

With 16 years of experience, Brian began his career in Portland, Oregon, after earning dual Bachelor degrees in engineering from Oregon State University. During 14 years at Knight, he's excelled in product management and business development, securing multiple patents. Brian co-chairs RAiNA's Codes Committee, leveraging his engineering and construction expertise. He consistently collaborates with project teams, providing solutions to complex challenges.

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Learning Objectives

- Design cladding attachments that comply with key code requirements.
- Identify thermal bridging in rainscreen wall assemblies, magnitude of thermal loss with various cladding attachment methods and strategies to minimize the loss.
- Understand how cladding type, orientation and layout impact the attachment system.
- Review structural implications.

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SECTION 1

Rainscreen & Modern Wall Assembly

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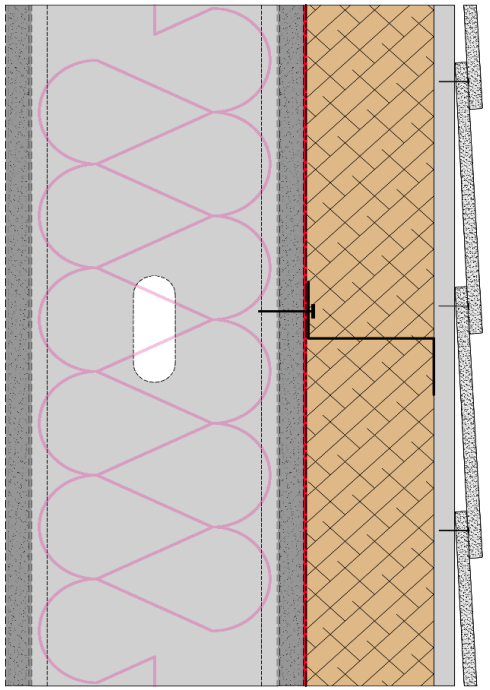
What is a Rainscreen?



- An assembly applied to an exterior wall which consists of, at minimum, an outer layer, an inner layer, and a cavity between them sufficient for the passive removal of liquid water and water vapor.

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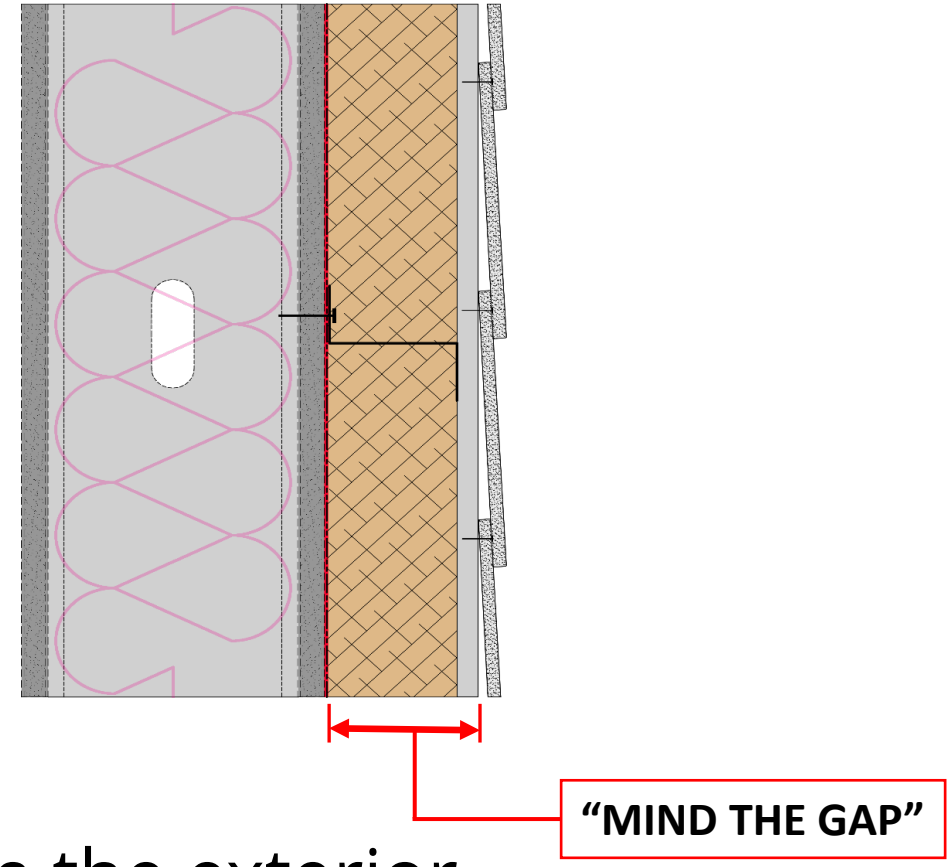
What is a Rainscreen?



- Some/all insulation is on the exterior
- Cladding attached via a system of rails, girts or brackets

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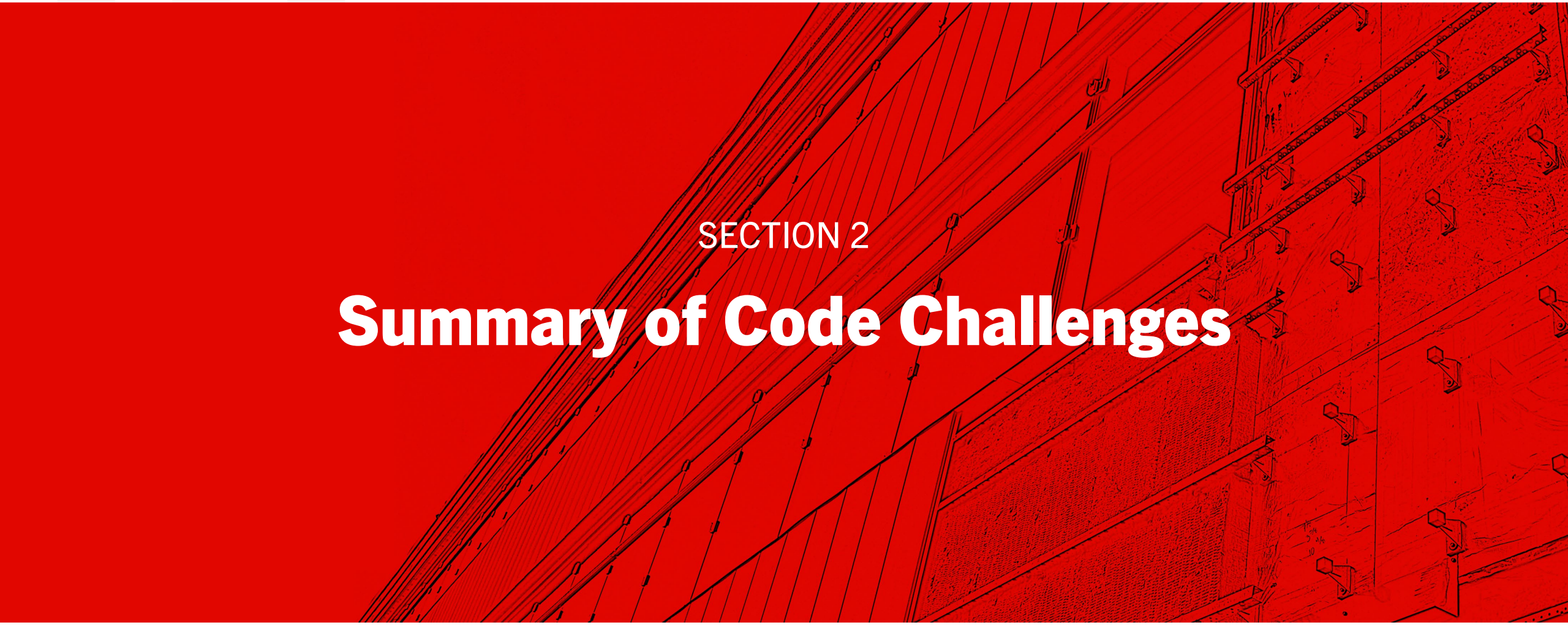

SECTION 2

Summary of Code Challenges

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Code Challenges

- Codes are changing

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Code Challenges

- Rainscreen systems in whole have been absent from the code
  - Must comply with Chapter 14
- Elements of rainscreens have their own code requirements
  - MCM Panels (Section 1406)
  - HPL Panels (Section 1408)
  - Among others…

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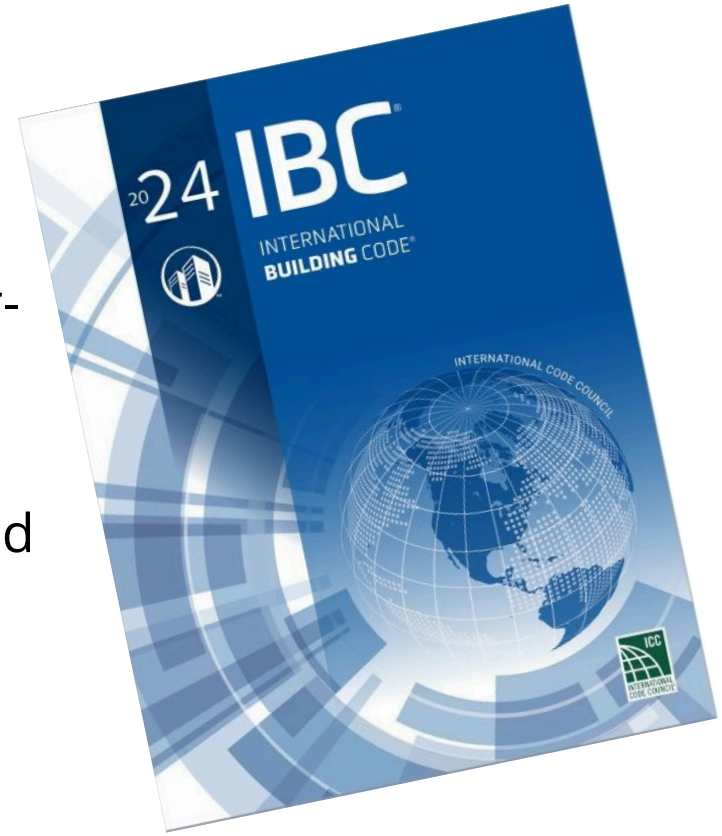
Code Challenges

- RAiNA Definition now included in IBC 2024.
- **EXTERIOR WALL COVERING.**
  - A material or assembly of materials applied on the exterior side of *exterior walls* for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, *veneers*, siding, *exterior insulation and finish systems*, *rainscreen systems*, architectural *trim* and embellishments such as cornices, soffits, fascias, gutters and leaders.
- **EXTERIOR WALL ASSEMBLY.**
  - A system including the exterior wall covering, framing, and components such as…



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Code Challenges

- **IBC Chapter 14 – Exterior Walls**
  - **1402.3 Structural:** Exterior walls, exterior wall coverings, exterior soffits and fascias, and the associated openings, shall be designed and constructed to resist safely the superimposed loads required by Chapter 16.
- **System design evaluates** (typically):
  - Wind Load
  - Dead Load
  - Seismic Load

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Code Challenges

- Rainscreen system is defined.
- Exterior Wall Covering = Rainscreen Systems
- Exterior Wall Assembly includes Rainscreen Systems
- Rainscreen systems must be designed to safely resist superimposed loads.

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Code Challenges

FIRE

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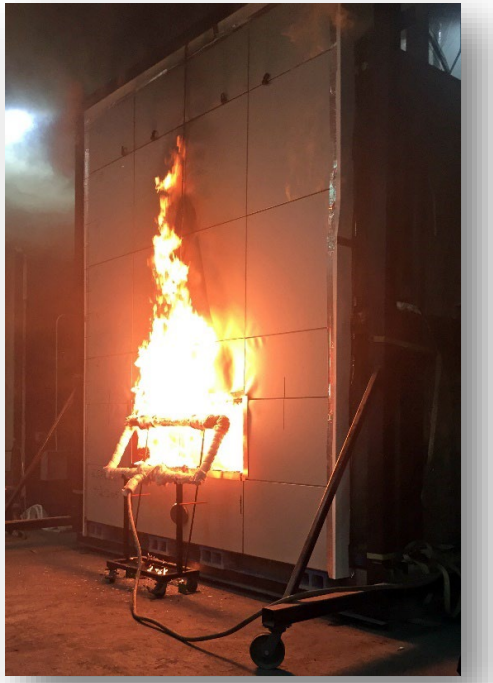
Code Challenges



- NFPA 285 exterior wall assembly test
- Multiple code requirements including:
  - Insulation type
  - Cladding type
  - Building Height (>40 feet high)
  - WRB

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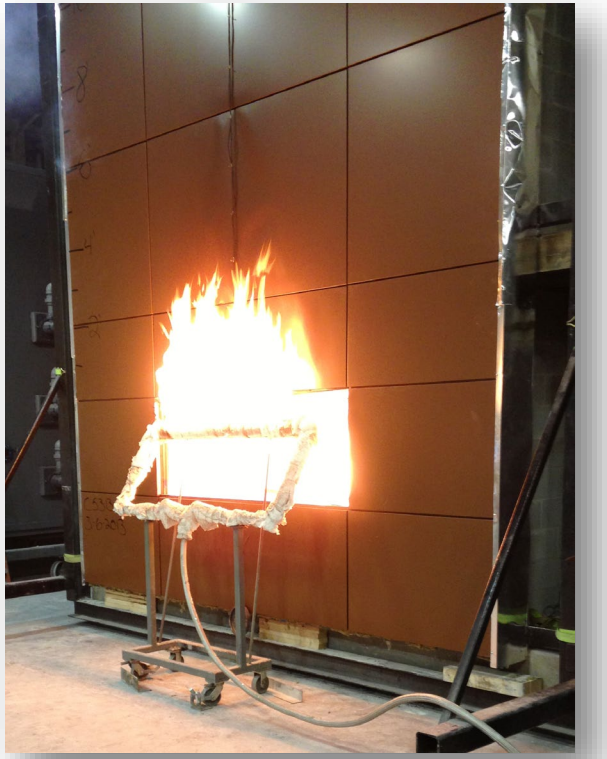
Code Challenges



- IBC 2024
  - Clarified testing requirements in 1402.5 (pointers)
  - Clarified NFPA 285 compliance methods in 1402.8

  - **Note: Fully combustible cladding support systems can impact 285 test results.**

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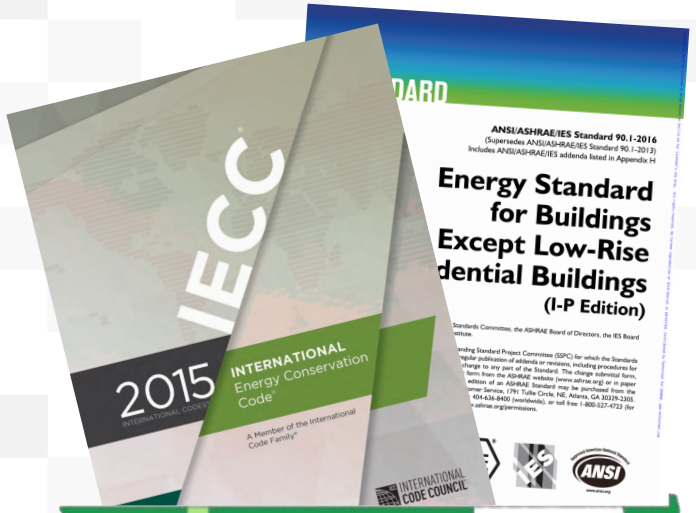
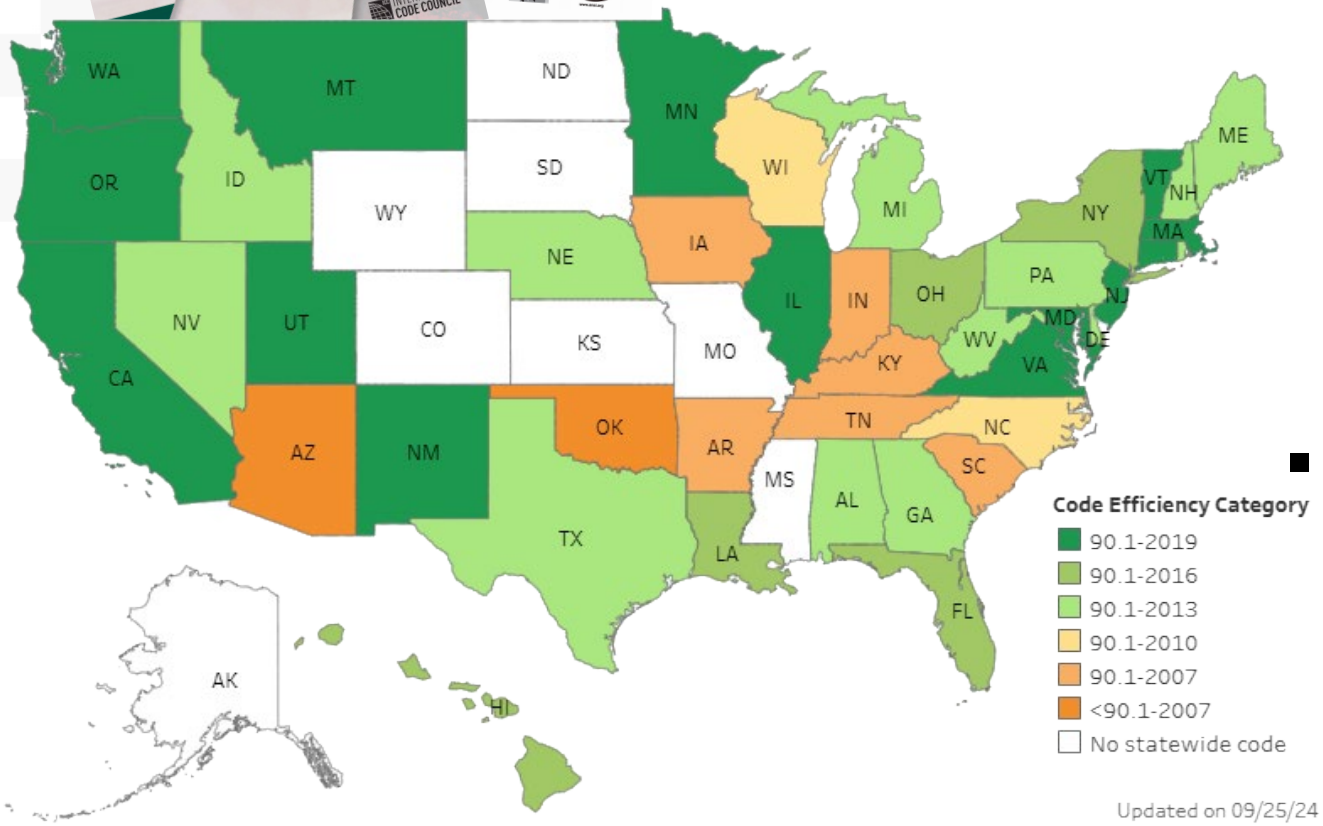
Code Challenges





- **Increased insulation**
  - **EFFECTIVE INSULATION!**
- **Goal: Reduce energy consumption**
  - Walls are the largest source of thermal transfer
  - More than half of energy consumed (on average) is for heating and cooling of modern buildings
- **Result: Reduced operating cost**

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Code Challenges

Timeline of Prescriptive Insulation Requriements for Steel Framed, Above Grade, Walls								
Code/Standards	CLIMATE ZONE							
	1	2	3	4	5	6	7	8
2024 IECC								
2021 IECC								
2018 IECC								
2015 IECC								
2012 IECC								
2009 IECC								
2006 IECC								

No Continuous Insulation | <1" Continuous Insulation | ~1" Continuous Insulation | ~1.5" Continuous Insulation | >2" Continuous Insulation

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SECTION 3

“Real”-Value of Various Wall Assemblies

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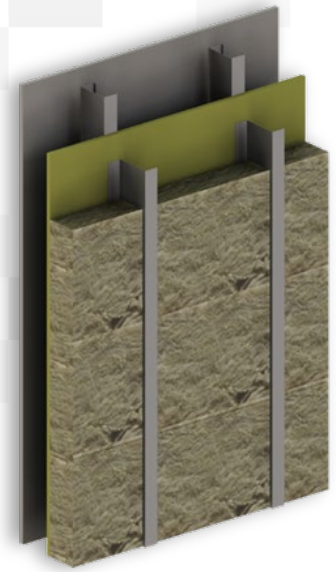
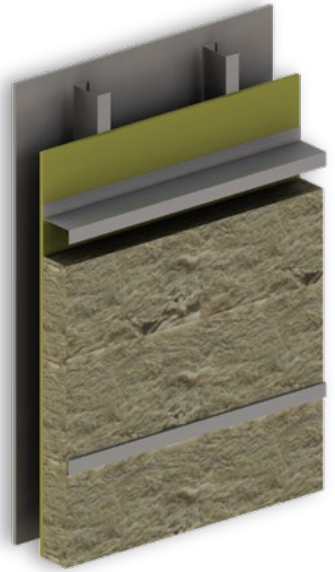
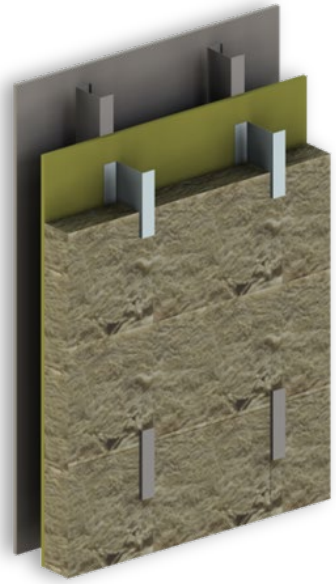
“Real”-Values



Vertical Z-Girt



Horizontal Z-Girt



Brackets (Aluminum)

Assembly:
Interior Gypsum; Steel Studs 16” OC; Exterior Gypsum, R-16.8 Insulation

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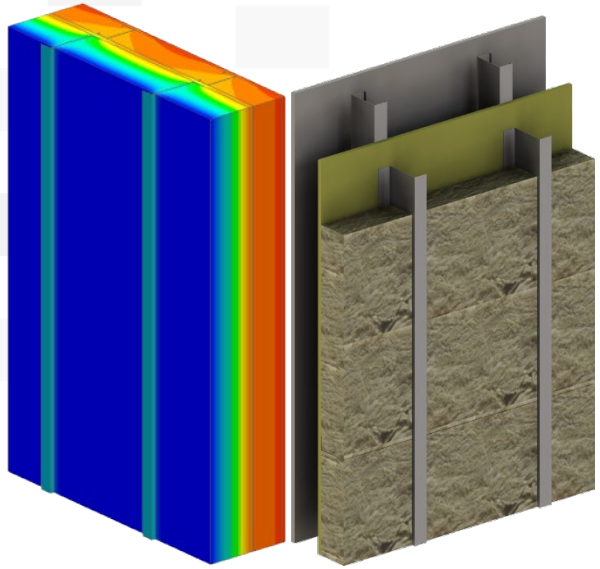
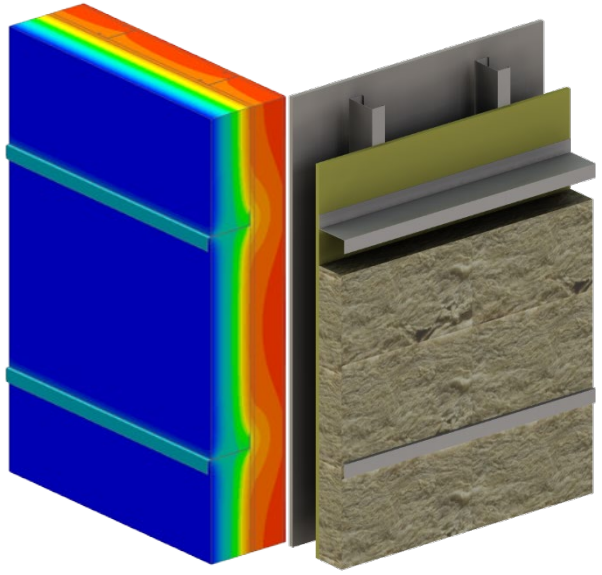
“Real” R-Values

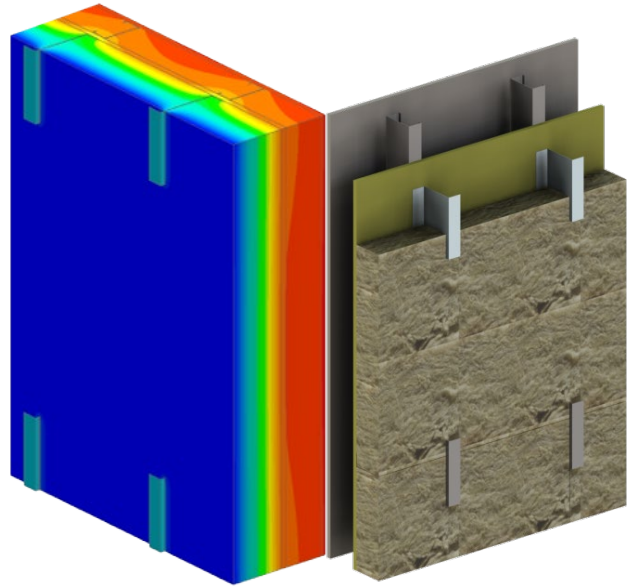
How well do they work at reducing thermal bridging?



R-10.3
Loss ~50%



R-12.3
Loss ~40%



R-13.9
Loss ~32%

Source: ASHRAE RP-1365 (Calibrated 3D thermal modeling by Morrison Hershfield)

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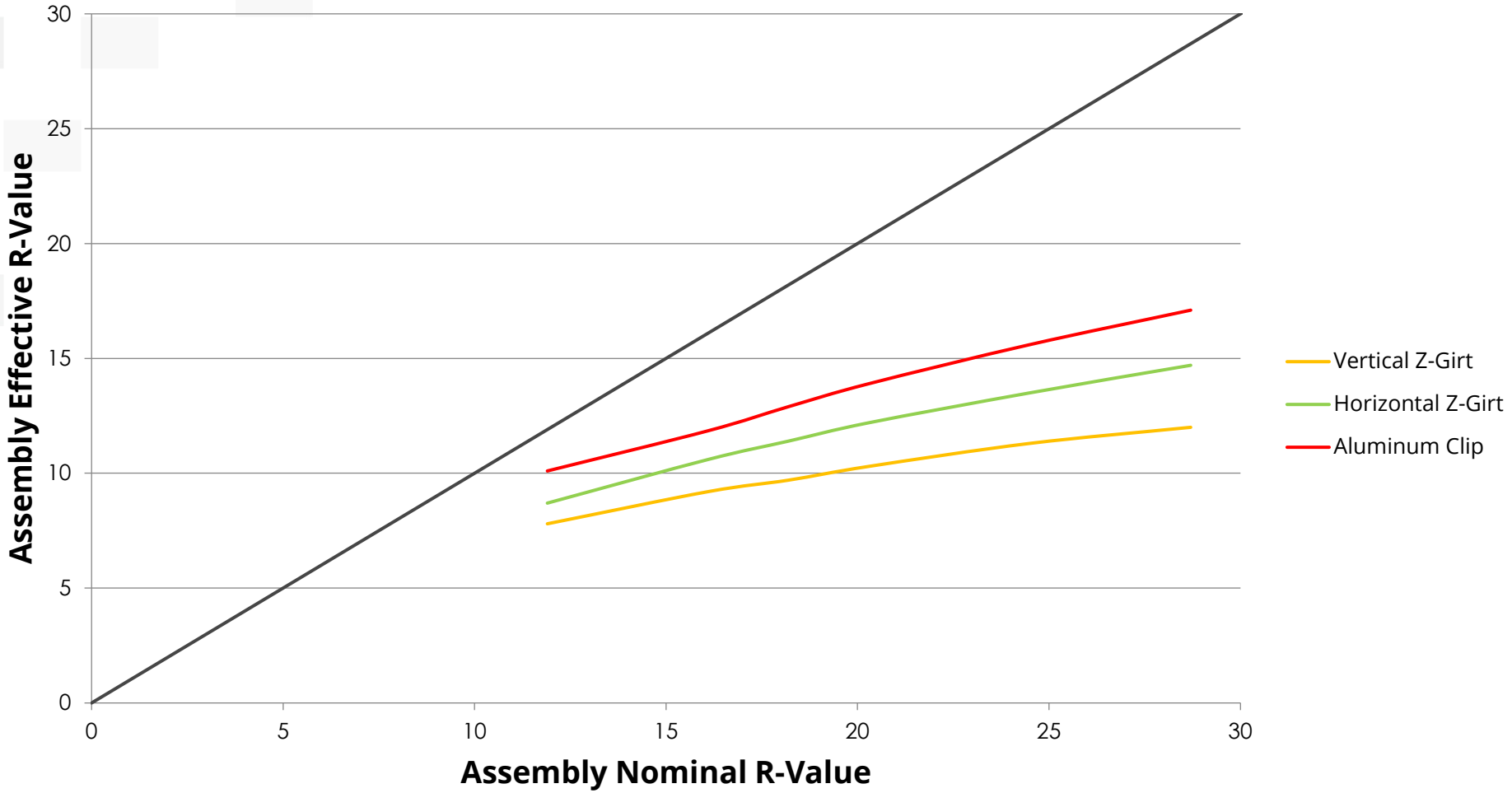
“Real” R-Values

What We Got vs What We Bought



Source: ASHRAE RP-1365 (Calibrated 3D thermal modeling by Morrison Hershfield)

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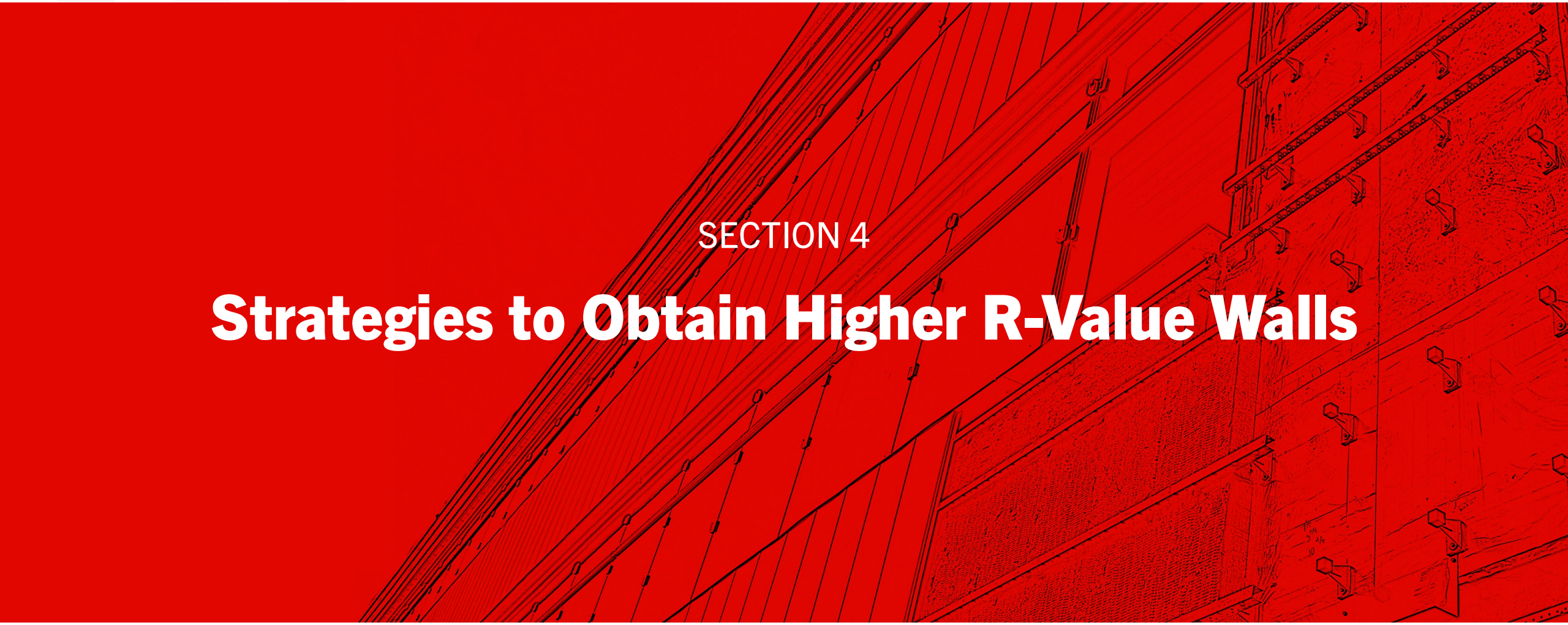
SECTION 4

Strategies to Obtain Higher R-Value Walls



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Adding (R) Value

- How do we obtain higher EFFECTIVE R-Value walls?
- More insulation?
- Maybe other means of attaching cladding?

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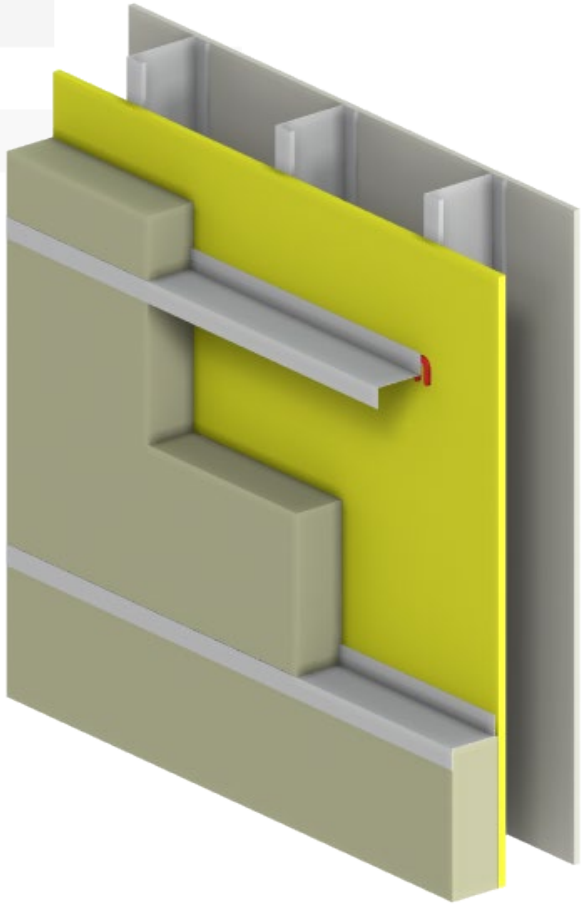
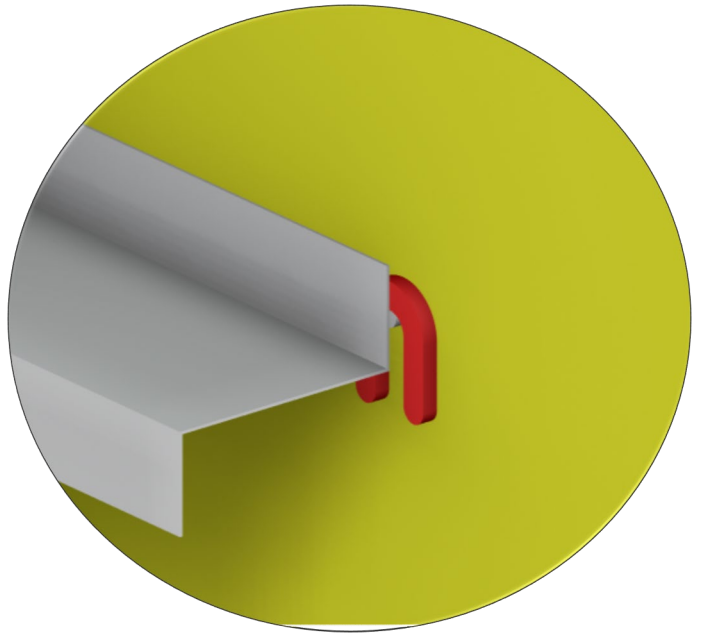
Adding (R) Value





Thermally Isolated Z?

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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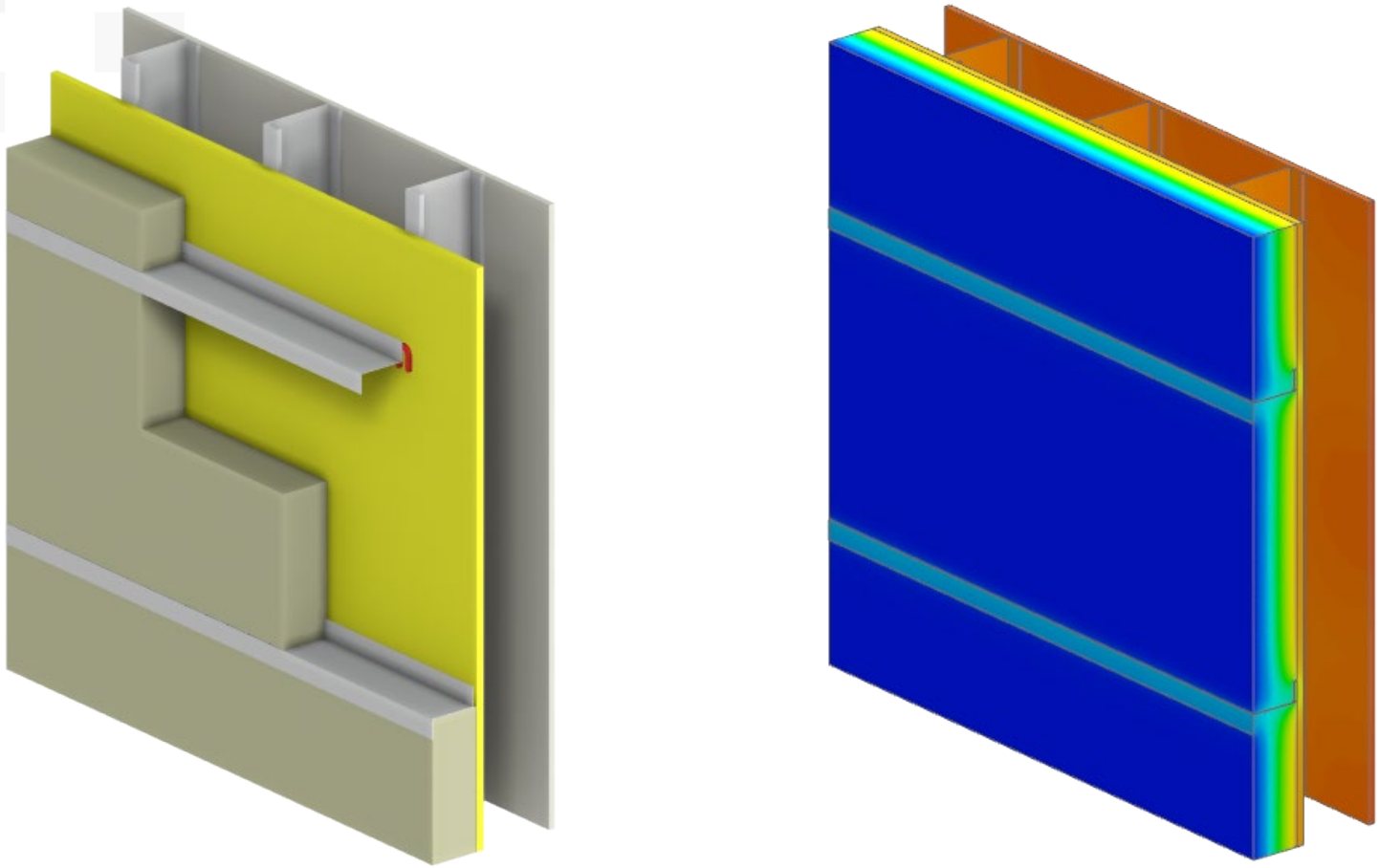
Adding (R) Value



R-13.5 (Loss ~34%)

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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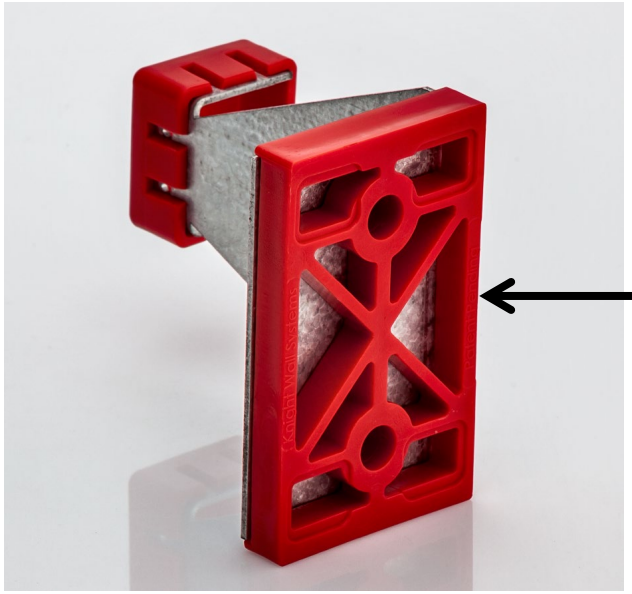
Adding (R) Value

- Thermally Isolate Brackets
- Reduction in contact area with the exterior wall.
- Reduce cross sectional area of metal within the insulation.

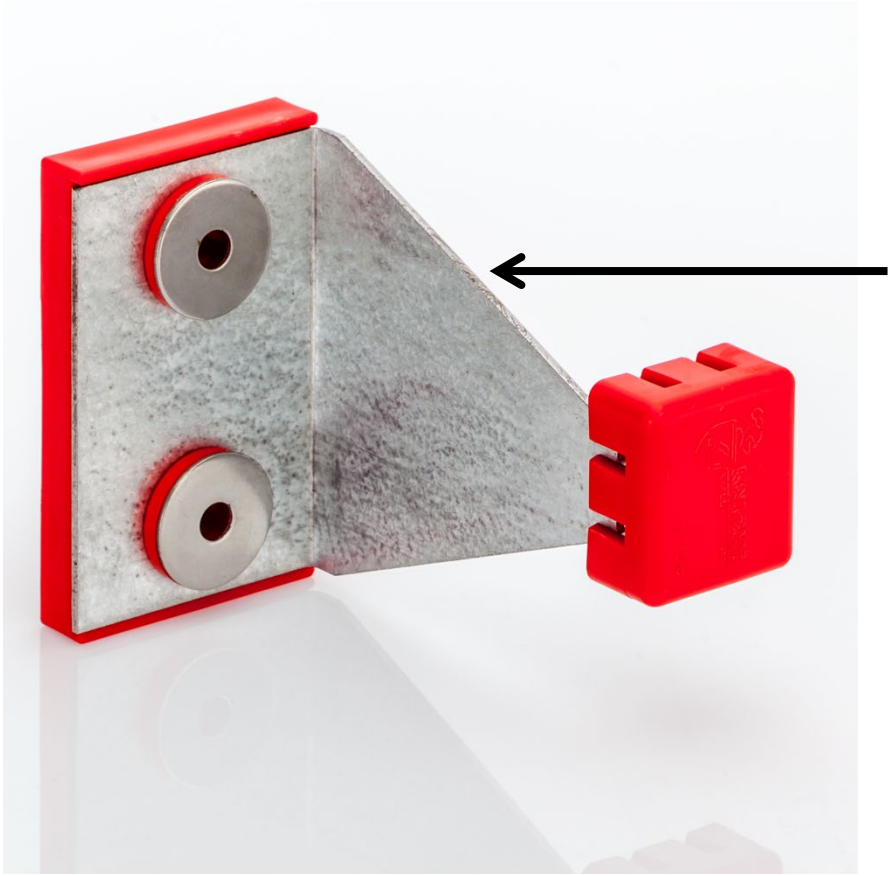


3.07 in² webbed base

vs

7.8 in² solid base

60% Reduction!



6.43 in² Triangular

vs

10.16 in² Rectangular

37% Reduction!

Product ‘K’…

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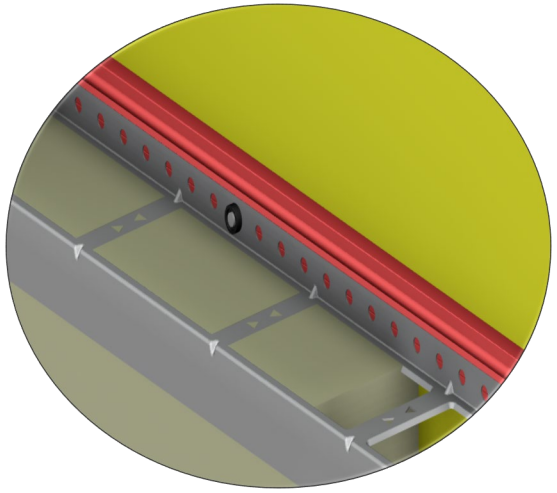
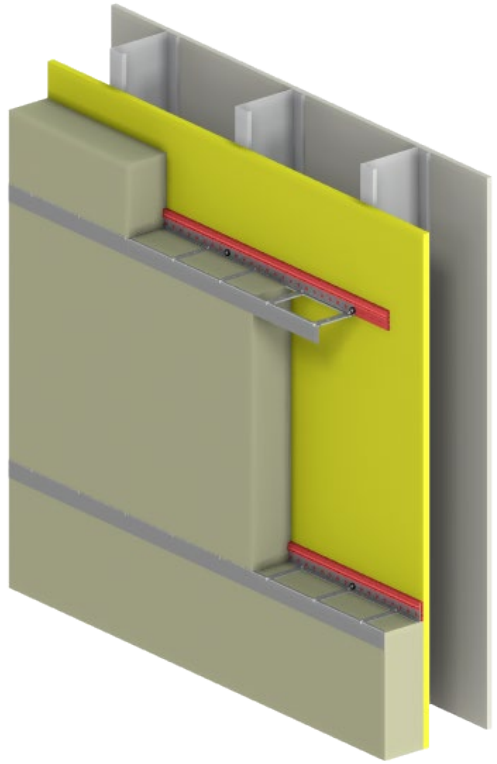
Adding (R) Value

Product ‘TZ’…





Assembly: Interior Gypsum; Steel Studs 16” OC; Exterior Gypsum, R-16.8 Insulation

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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Adding (R) Value

R-17.2
Loss ~15%

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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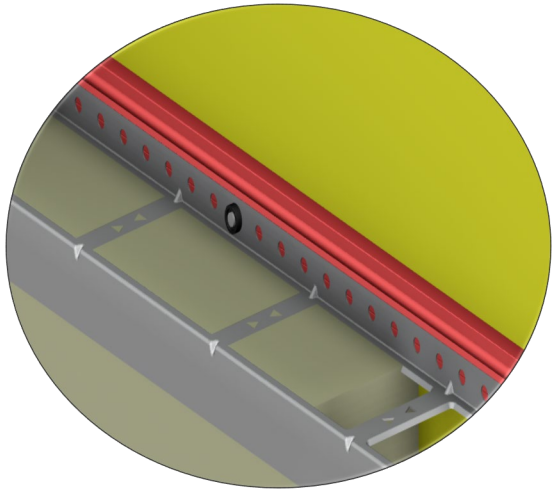
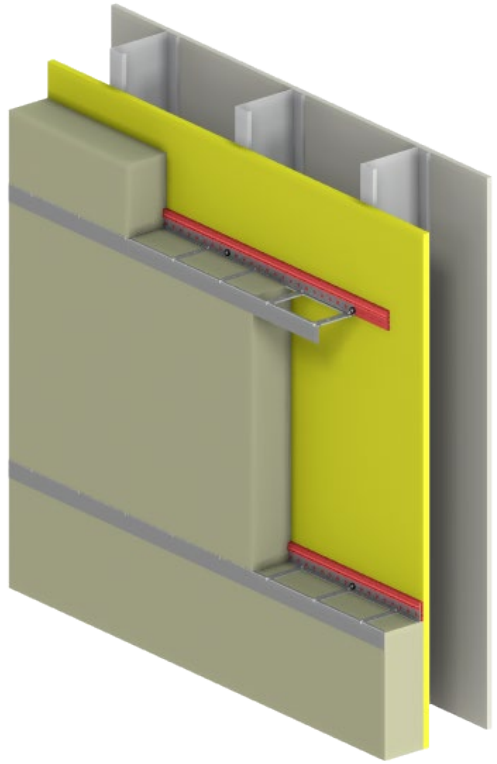
Adding (R) Value

Product ‘TZ’…





R-17.2
Loss ~15%

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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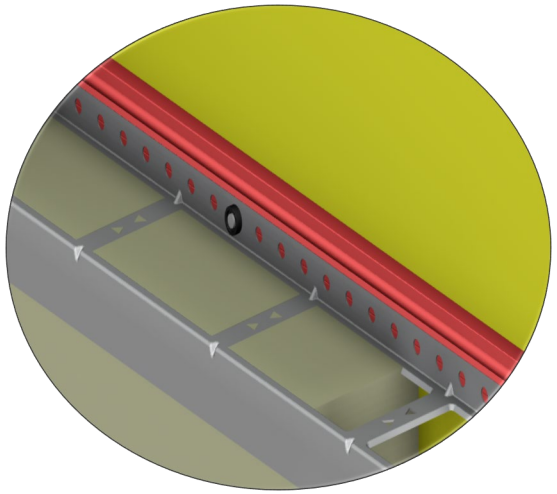
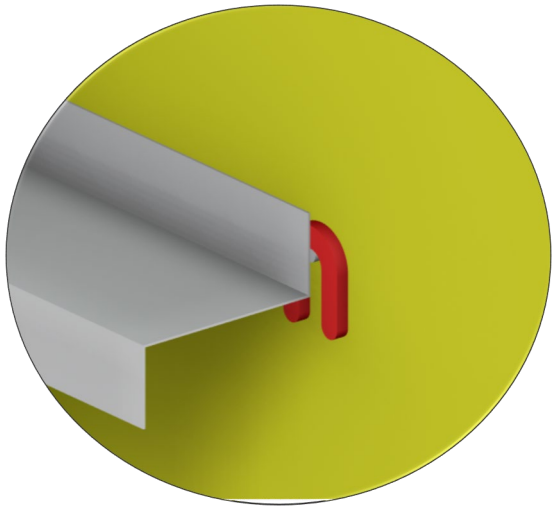
Adding (R) Value



R-17.2
Loss ~15%



R-13.5
Loss ~34%

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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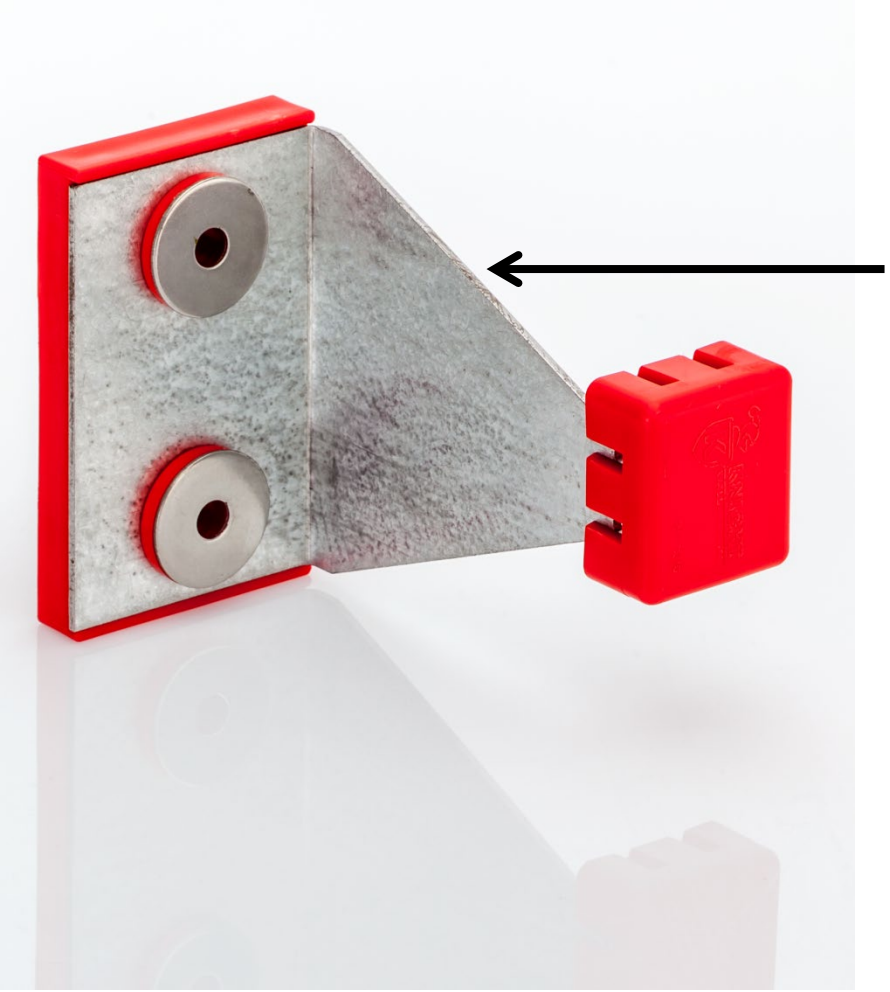
Adding (R) Value

- Changing material
- Price
- Structural implications



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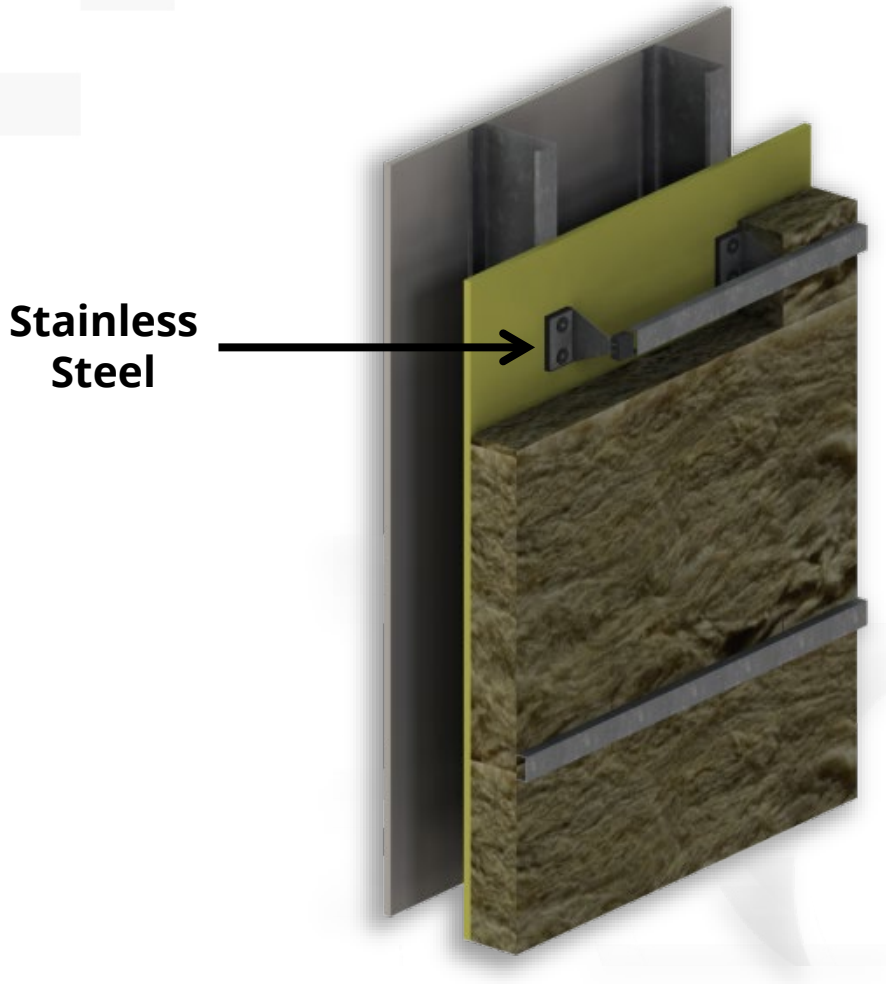
Adding (R) Value



R-18.4
Loss ~8%

Source: Calibrated 3D thermal modeling by Morrison Hershfield

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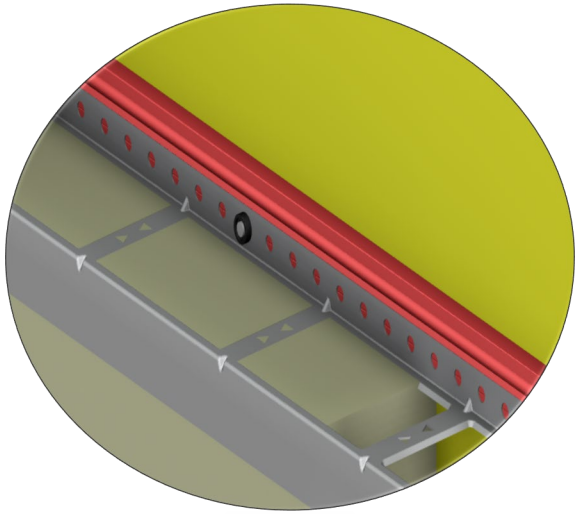
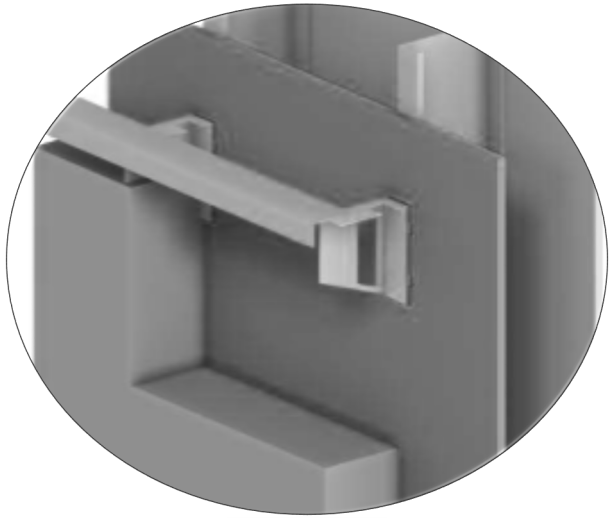
Adding (R) Value

- Not all systems are created equal
- But some are more equal than others…

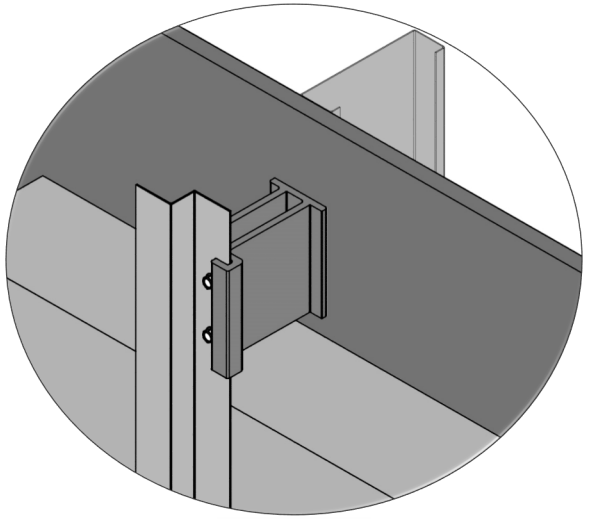
Product ‘K’



Product ‘TZ’



Product ‘IC’



Product ‘CC’

NOTE: These are randomly assigned identifying letters

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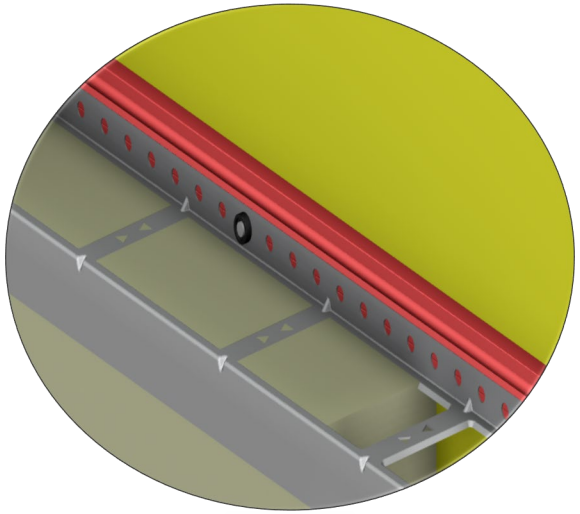
Adding (R) Value

- Not all systems are created equal
- But some are more equal than others…

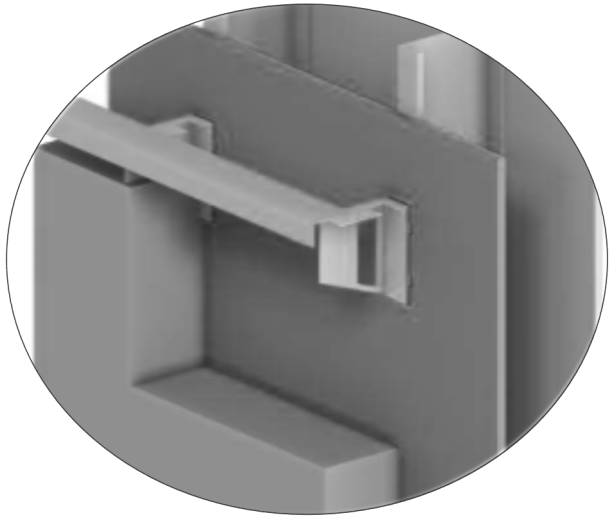
Product ‘K’

R-17.2
Loss ~15%



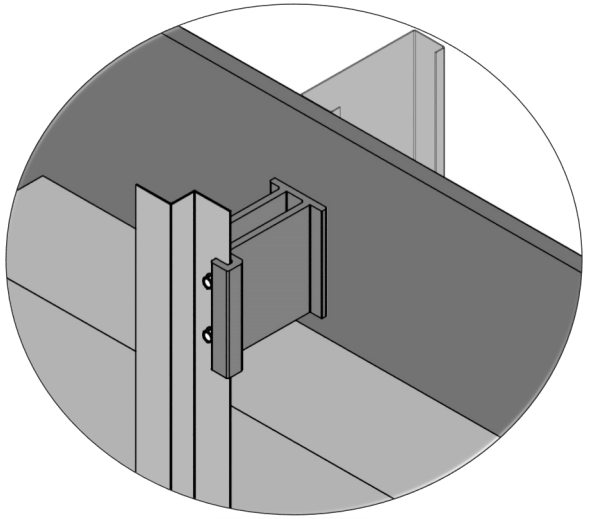
Product ‘TZ’

R-17.2
Loss ~15%



Product ‘IC’

R-15.5
Loss ~22%



Product ‘CC’

R-15.7
Loss ~21%

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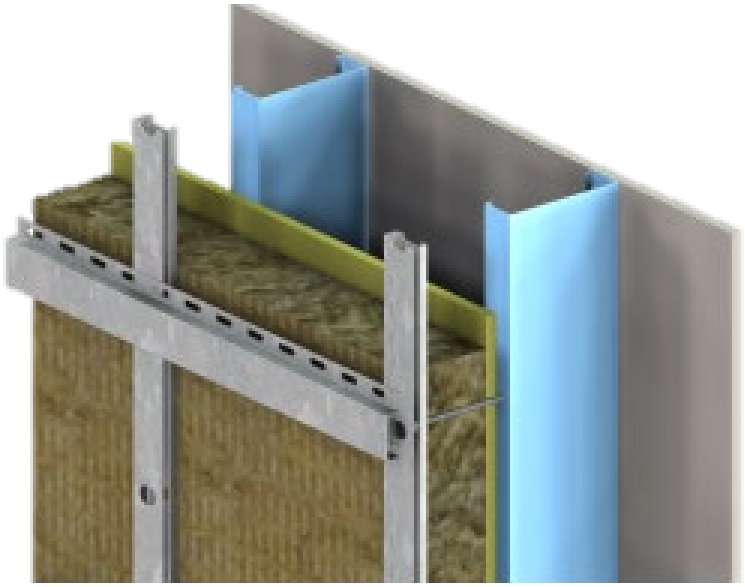
Adding (R) Value

Continuous Insulation?



R-18.2
Loss ~5%

Assembly:
Interior Gypsum; Steel Studs 16” OC; Exterior Sheathing R-16 Rigid Mineral Wool Insulation

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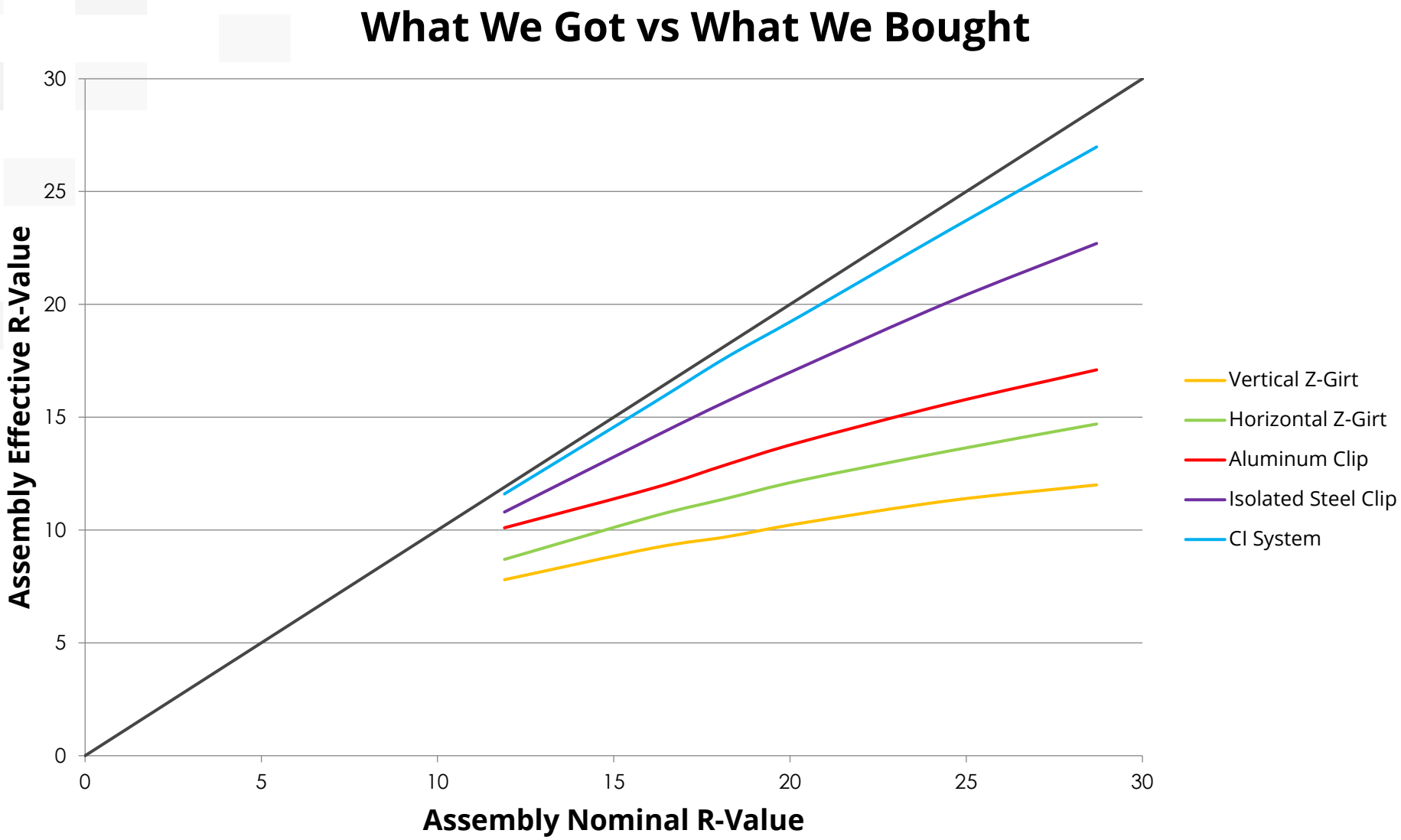
Adding (R) Value



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SECTION 5

Cladding Impact on Attachment System

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The Science

- **Cladding attachment isn't rocket science**
- **But there are some complexities and considerations:**
  - What are the wind pressures?
  - How heavy is the cladding?
  - How does the cladding attach? Clips? Direct fasten?
  - Do the panels have requirements of vertical or horizontal framing members?
  - Is there a specific panel layout intent that must be met?
  - What is the orientation of the panels?

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The Science

- **Typical guidelines:**
  - Framing members run perpendicular to the orientation of the panels
  - Vertical Oriented Panels = Horizontal Rails
  - Horizontal Oriented Panels = Vertical Rails

V = H then H = V

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The Science

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The Science

- **Typical guidelines:**
  - Single-layer or double-layer?

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- **Typical Guidelines:**
  - Single-Layer ⟶ Simple span panels/siding or concealed fastened panel system* or adhered veneer.

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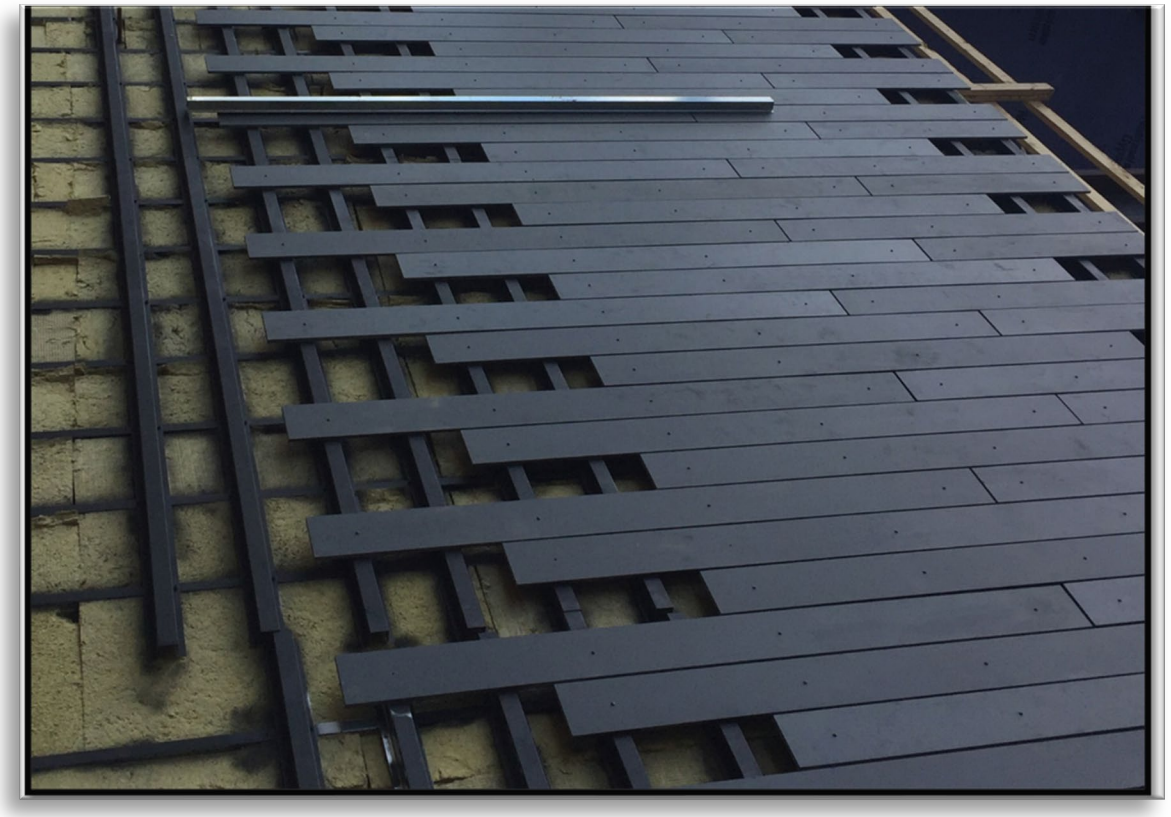
The Science

- **Typical Guidelines:**
  - Double-Layer ⟶ Face Fastened Panels.



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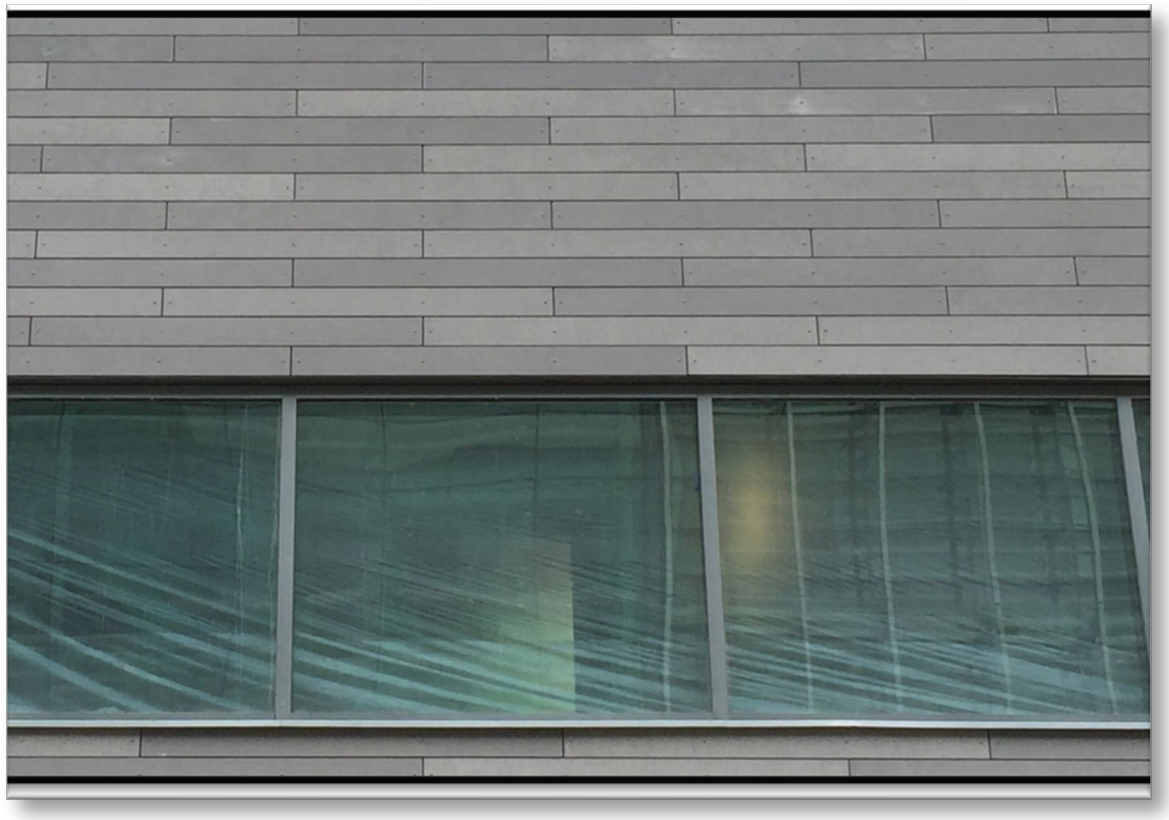
The Science

- **Typical Guidelines:**
  - Face fastened panels need a double layer framing system.



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The Science

- **Typical Guidelines:**
  - Face fastened panels need a double layer framing system.
  - Panel layout and/or fastener layout will NOT align with stud layout.

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The Science

- Cladding weight matters
  - Featherweight (<3 PSF) is too easy
    - Single Skin Metal
    - Some Fiber Cements
    - Thin Composites
  - Welterweight (4-9) not a cause for concern
    - Other Fiber Cements
    - HPL Panels
    - UHPC Panels

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The Science

- Cladding weight matters
  - Light Heavyweight & Heavyweight (>9 PSF) is possible – may have additional requirements
    - 3-Coat Stucco
    - Adhered Veneer
    - Stone
    - Terra Cotta
  - Super Heavyweight
    - Good luck!

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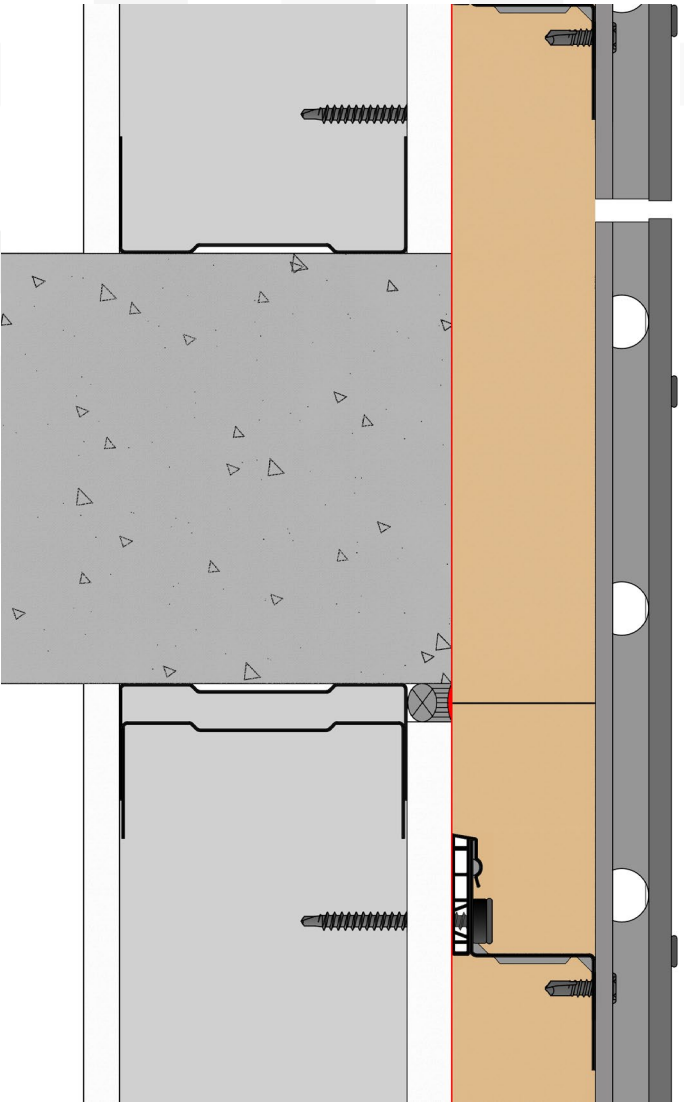
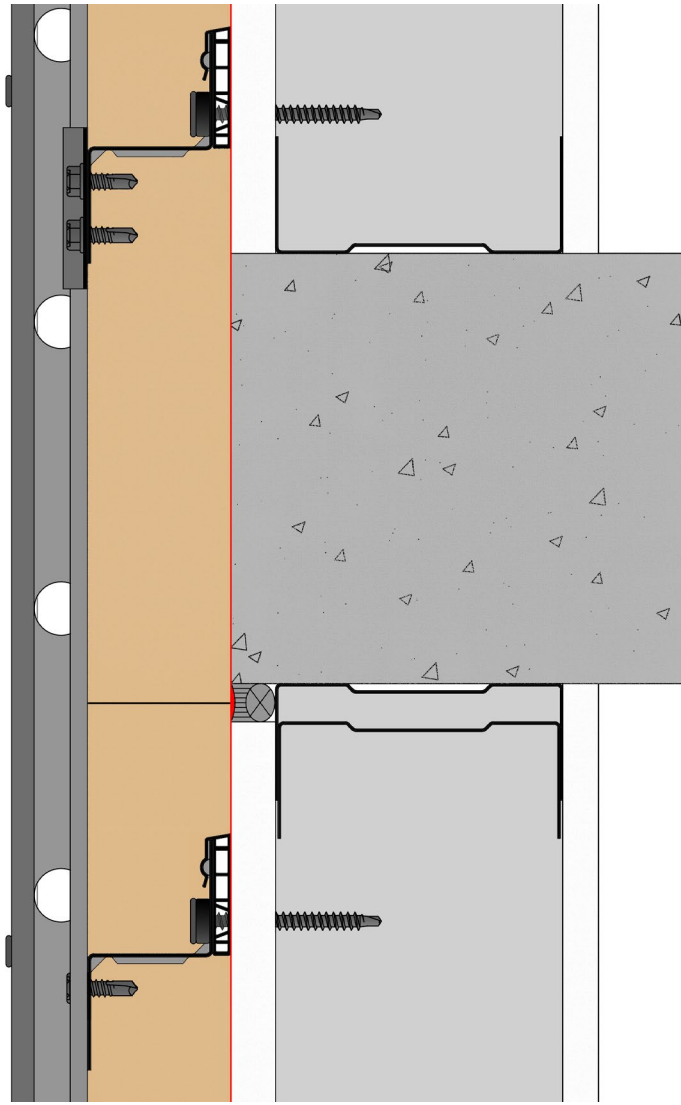
The Science



- Floor Deflection
- Exterior must mimic interior conditions
- If floors deflect (move) and exterior systems can’t 'absorb’ the movement, then damage or failure will occur in cladding system.



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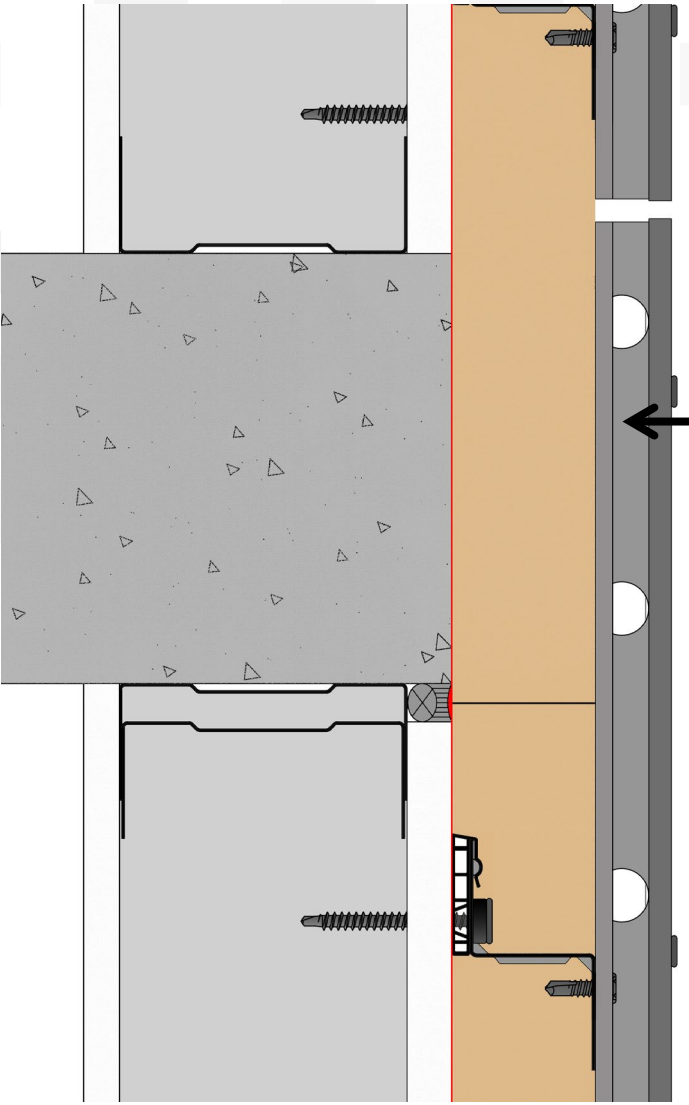
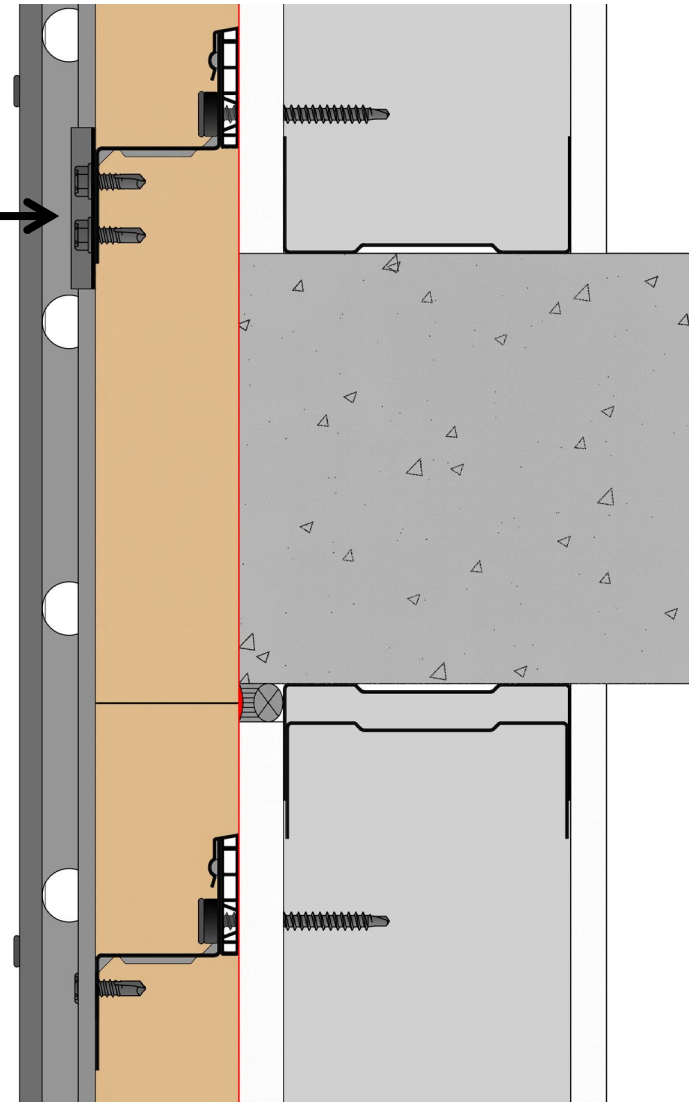
The Science





- Ways to ‘absorb’ movement
- Cantilevered Rail
- Slotted connection
- Movement Clip

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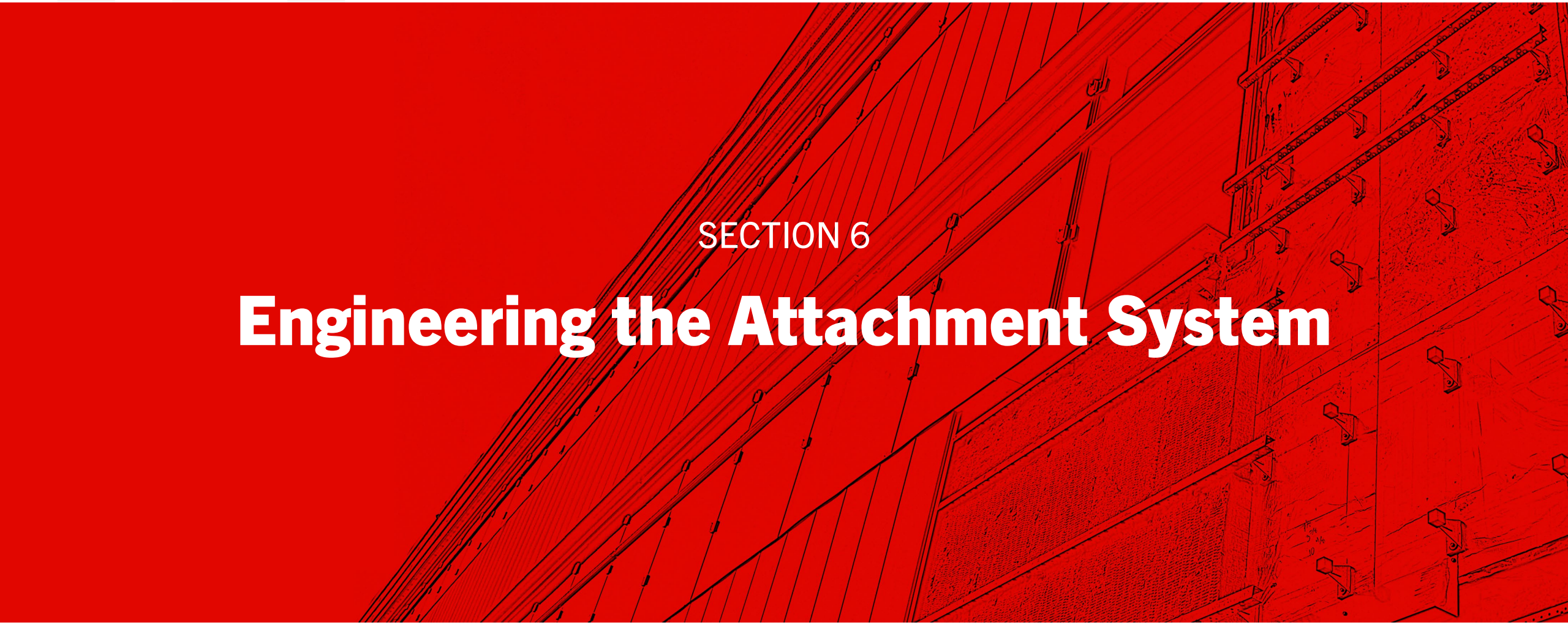
SECTION 6

Engineering the Attachment System



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The Engineering

- **Typically, delegated design**
  - Require signed & sealed structural engineering submittal
  - Extent of delegated design
    - Be careful of increased contracting costs
- **Engineered by the manufacture**

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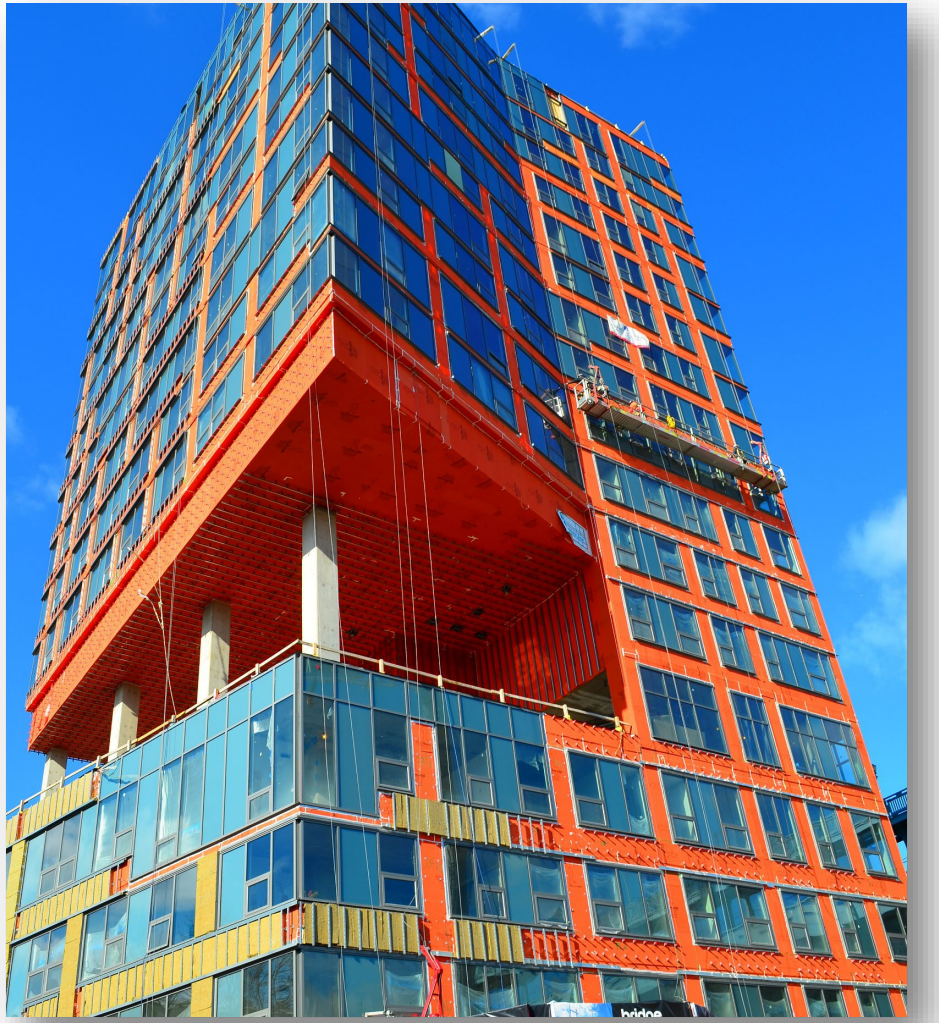
The Engineering

- **What matters most:**
  - Wind load governs (typically)
  - Dead load
  - Seismic load
  - Total stand-off (depth) dimension
  - Bracket/Girt Design



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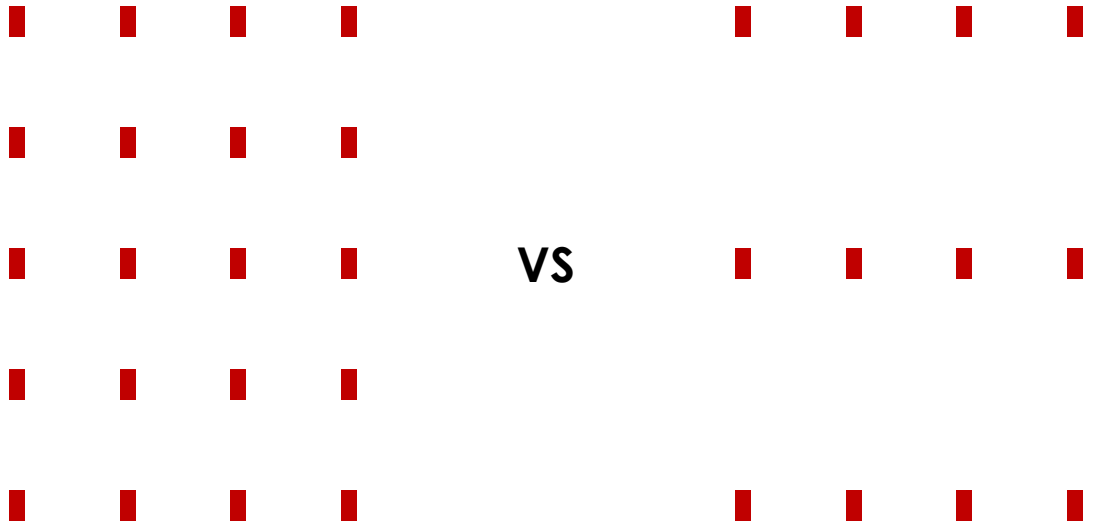
The Engineering

- Spacing ⟶ Cost
- Larger spacing = less cost
  - Less material
  - Less labor
  - Less time



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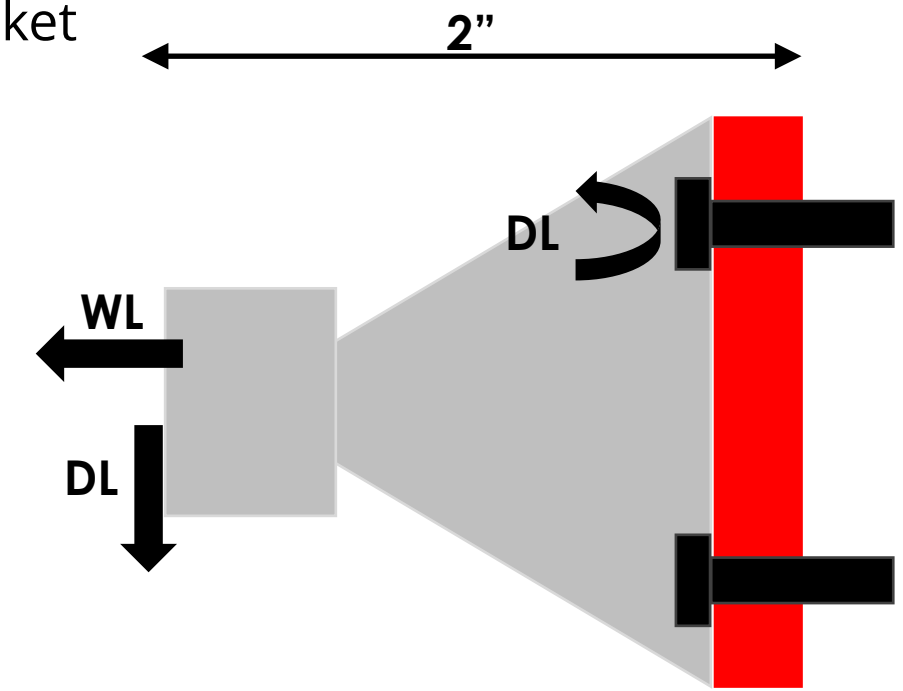
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 30 PSF → 152 lbs Tension/Bracket
  - Dead load: 5 PSF → 30 lbs Tension/Bracket
  - Total stand-off (depth) dimension: 2”

16” O.C. x 40” O.C. Spacing



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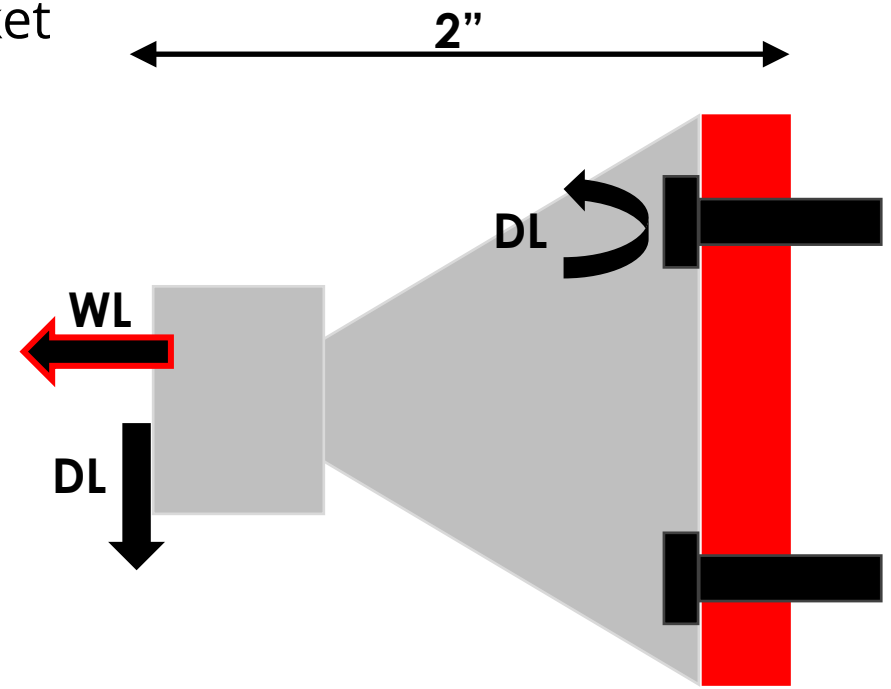
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 60 PSF → 304 lbs Tension/Bracket → BAD
  - Dead load: 5 PSF → 30 lbs Tension/Bracket
  - Total stand-off (depth) dimension: 2”

~~16” O.C. x 40” O.C.~~

16” O.C. x 22” O.C.

Spacing



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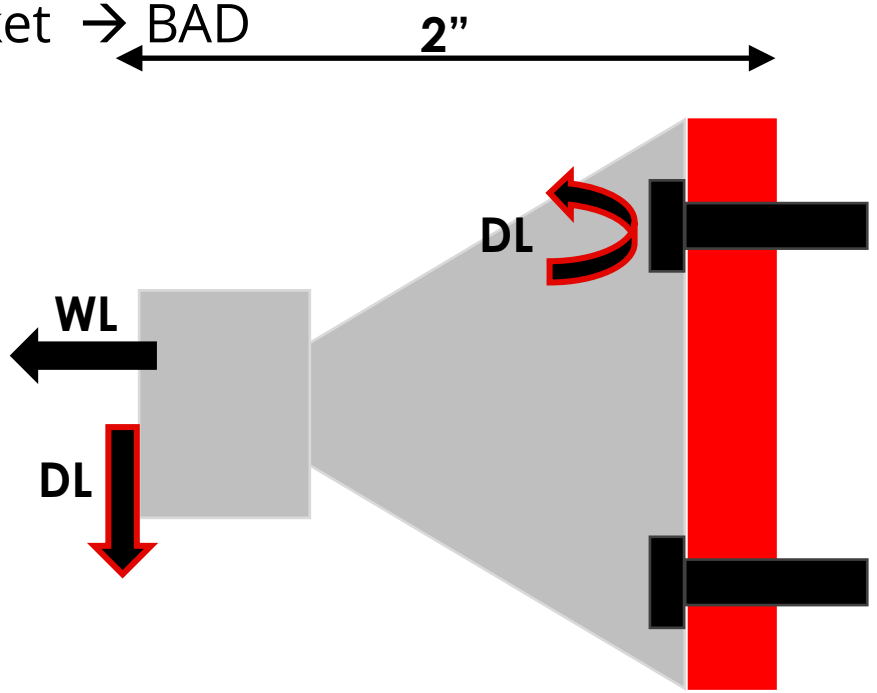
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 30 PSF →152 lbs Tension/Bracket
  - Dead load: 15 PSF → 89 lbs Tension/Bracket → BAD
  - Total stand-off (depth) dimension: 2”

~~16” O.C. x 40” O.C.~~

16” O.C. x 30” O.C.

Spacing



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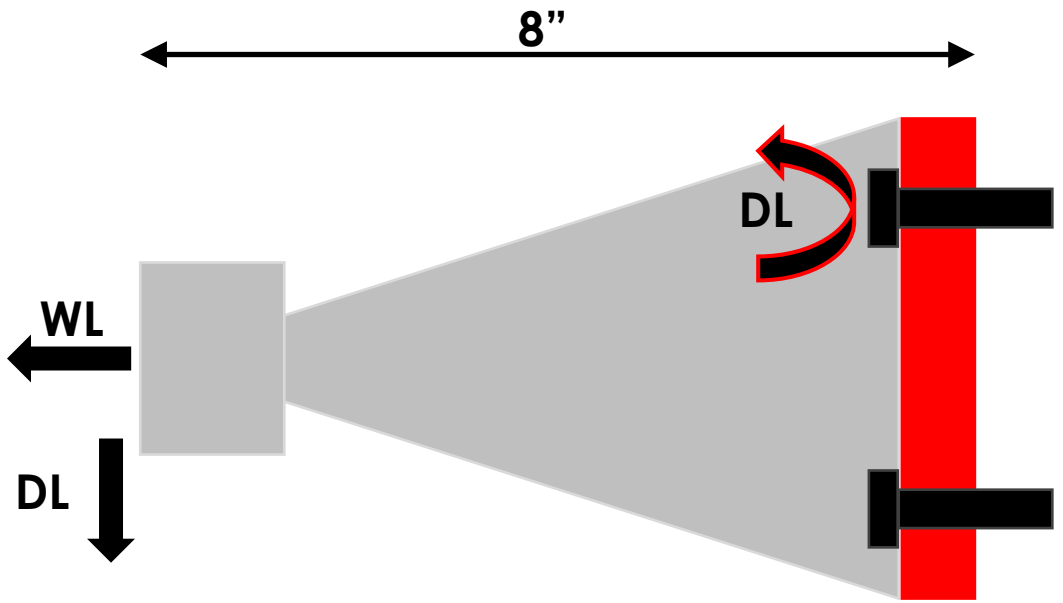
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 30 PSF → 152 lbs Tension/Bracket
  - Dead load: 5 PSF → 119 lbs Tension/Bracket → BAD
  - Total stand-off (depth) dimension: 8”

~~16” O.C. x 40” O.C.~~

16” O.C. x 20” O.C.

Spacing



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The Engineering

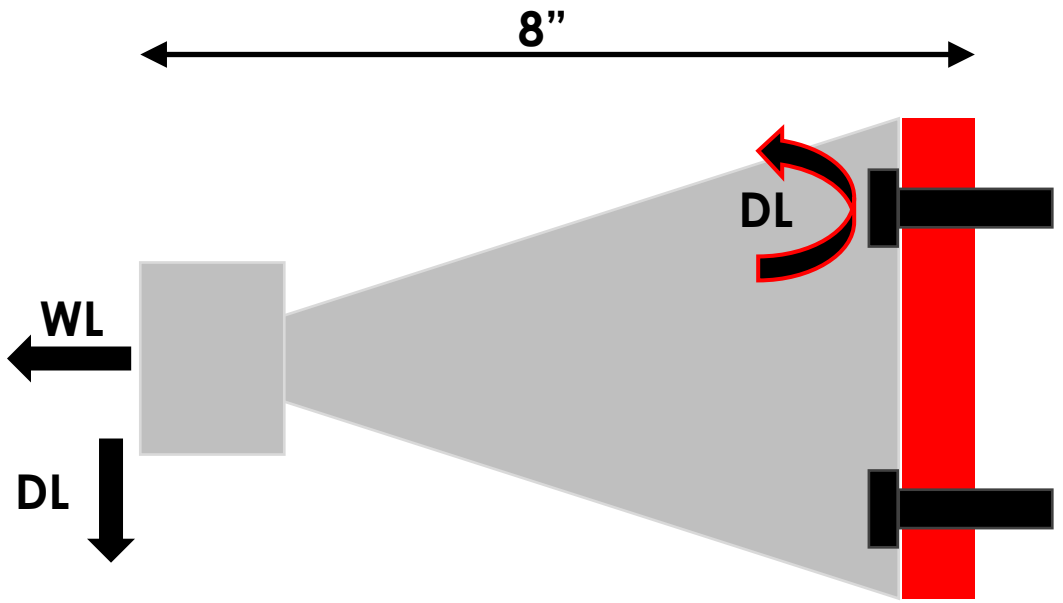
- Example:
  - Assume a simple panel system
  - Wind load: 60 PSF → 304 lbs Tension/Bracket
  - Dead load: 15 PSF → 265 lbs Tension/Bracket
  - Total stand-off (depth) dimension: 8”

~~16” O.C. x 40” O.C.~~

16” O.C. x 10” O.C.

…or *16” O.C. x 16” O.C.*

Spacing



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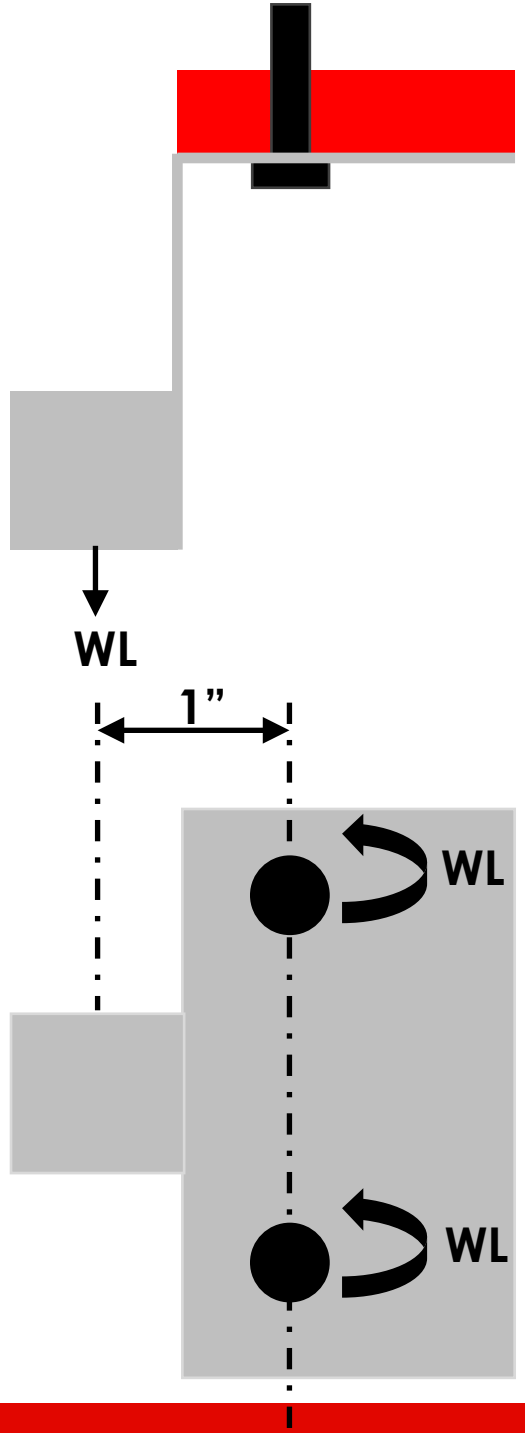
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 30 PSF → 152 lbs Tension/Bracket
  - Dead load: 5 PSF → 30 lbs Tension/Bracket
  - Total stand-off (depth) dimension: 2”
  - Prying Action

16” O.C. x 40” O.C.
Spacing



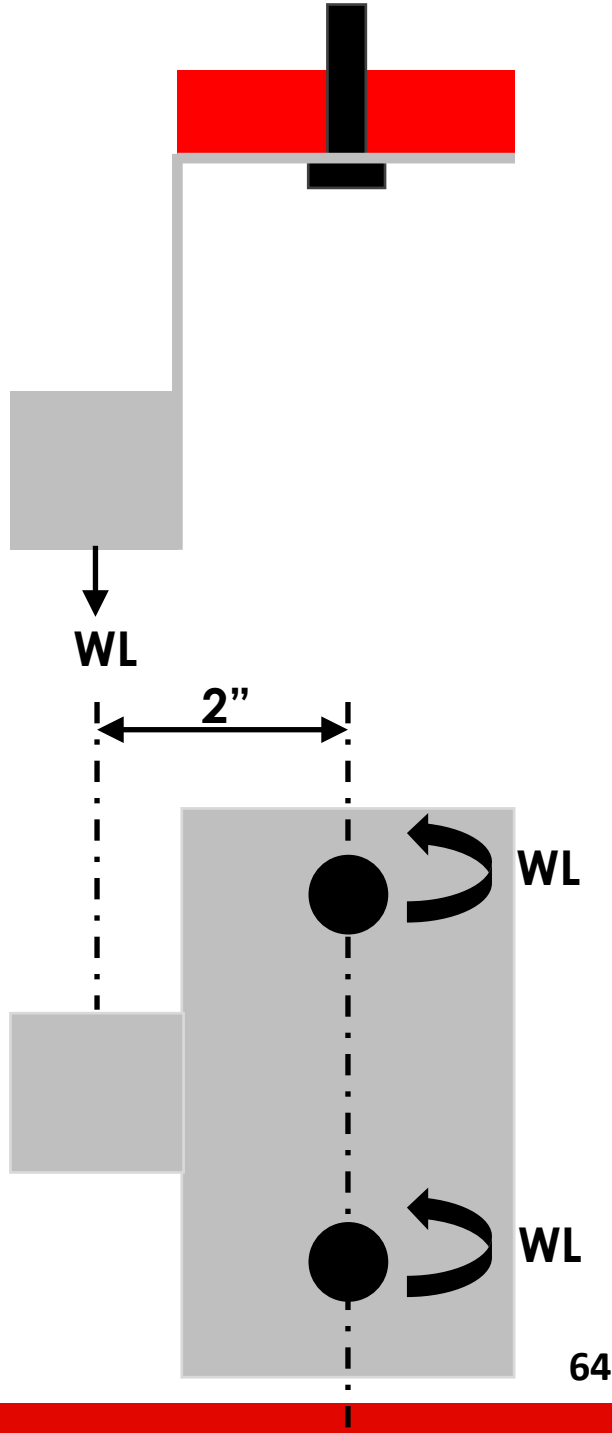
The Engineering

- Example:
  - Assume a simple panel system
  - Wind load: 30 PSF → 211 lbs Tension/Bracket
  - Dead load: 5 PSF → 30 lbs Tension/Bracket
  - Total stand-off (depth) dimension: 2”
  - Prying Action

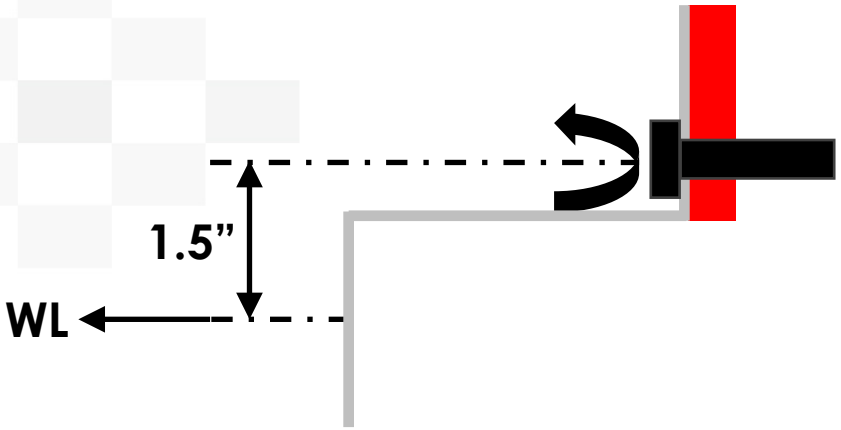
~~16” O.C. x 40” O.C.~~

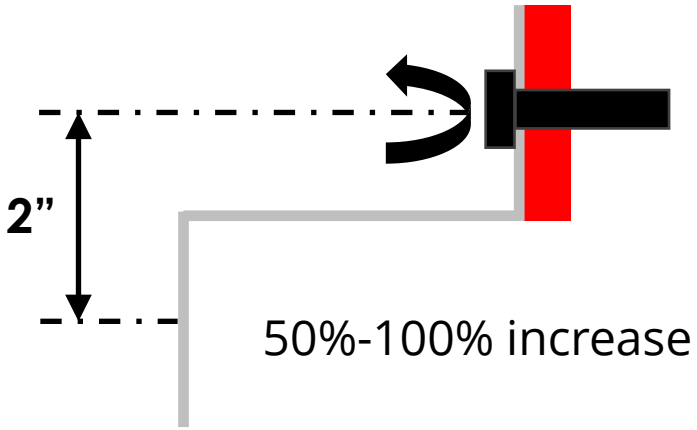
16” O.C. x 30” O.C.

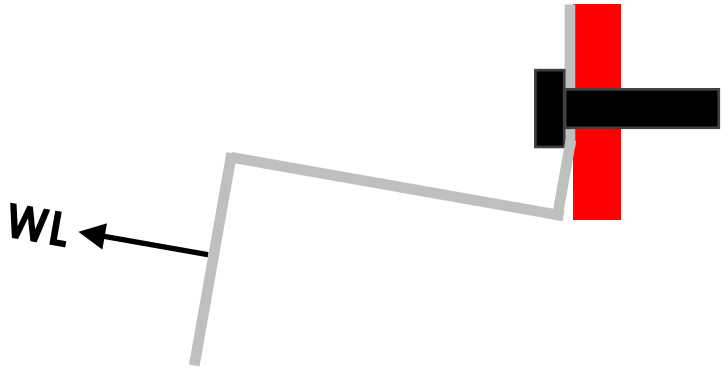
Spacing



The Engineering







More Prying…in Action

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Summary

- Reduction in thermal bridging becoming mandatory
- Cladding attachment can become confusing
  - Single-layer vs double-layer?
  - Cladding weight?
  - Rail layout?
- What effects the cost & budget?
  - Wind pressures
  - Cladding weight
  - Stand-off dimensions

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