BUILDING INNOVATION 2019
National Institute of BUILDING SCIENCES
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National Institute of Building Sciences

Provider Number: G168

SPECIFYING CLADDING ATTACHMENT SYSTEMS:
The Holistic Approach

TU-2C-2

Neil Norris

Tuesday January 8th, 2019

CONTINUING EDUCATION AIA

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

With increasing requirements for the building enclosure in energy codes, many building projects are moving towards using exterior insulated building assemblies. Exterior insulated systems allow for increased thermal performance but much of that depends on the design of the exterior cladding attachment system. There are a wide variety of secondary structural attachment systems in the North American market competing to provide better thermal performance, which can be overwhelming for designers to compare for use on their projects. While direct comparisons of components ("clip to clip") may show two systems to be equivalent, it is not until additional project requirements are brought into the comparison that significant differences in performance can arise. These additional requirements include structural considerations, like wind and dead loads, which dictate the spacing of components, combustibility restrictions on components and installation flexibility. The perceived advantages in performance from one system over another may not actually turn into tangible benefits in reality once these other design requirements on the project are also satisfied. The intent of the presentation will be to provide the necessary background information, calculations, methodologies and available resources to guide designers in making informed decisions for selecting the right cladding attachment systems for their projects.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the market factors driving envelope designs towards greater thermal performance

2. Identify differences in the design approach for typical cladding attachment systems

3. Understand the impacts of structural requirements of the cladding on the thermal performance of the system

4. Recognize how to appropriately compare system designs while considering all other major design factors

Specifying Cladding Attachment Systems

The Holistic Approach

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Cladding Design Overview

- Cost
- Architectural
- Structural Support
- Fire Protection
- Moisture and Durability
- Constructability
- Thermal Performance

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- Constructability
- **Thermal Performance**

ENERGY STANDARDS

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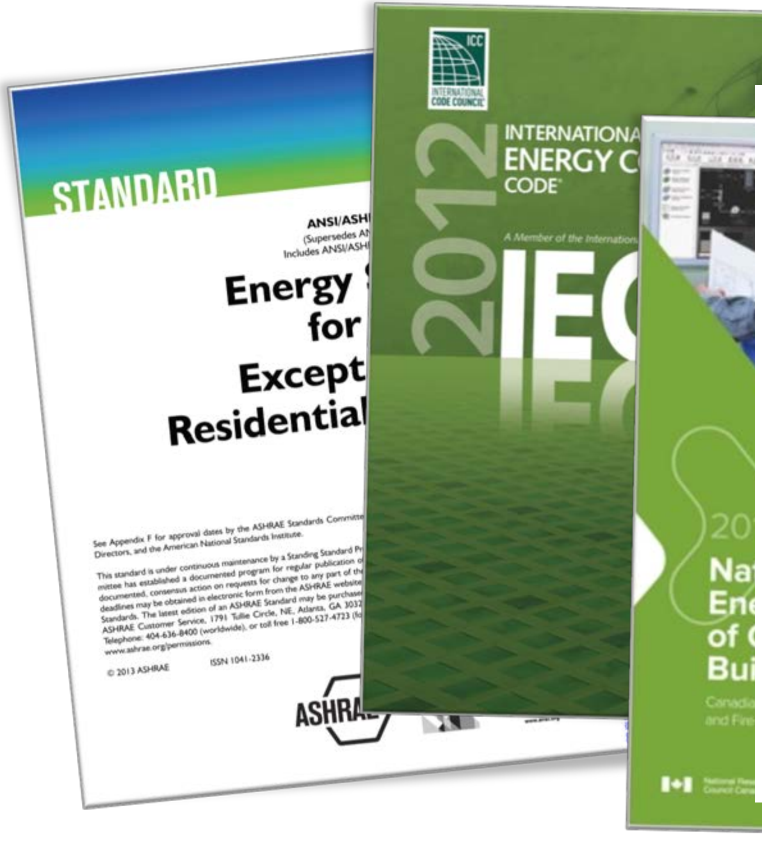
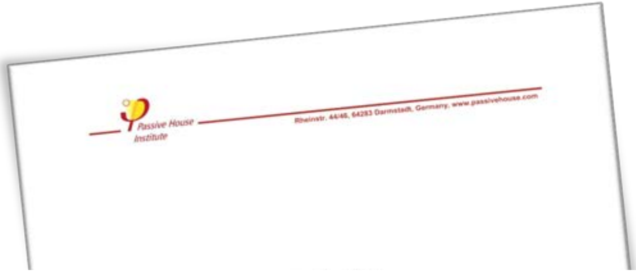
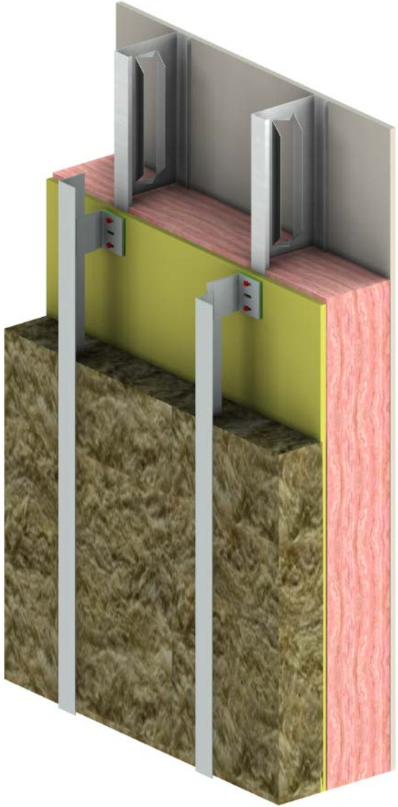




- Energy codes are driving increased performance from the envelope across North America
- Envelope R- and U-values becoming more stringent. More thermal bridging recognized
- Greater need to address thermal performance of envelope to meet project requirements (ie: energy model assumptions)

EXTERIOR INSULATED ASSEMBLIES

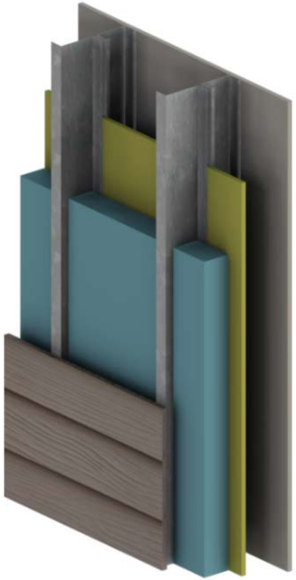


Where are we headed?

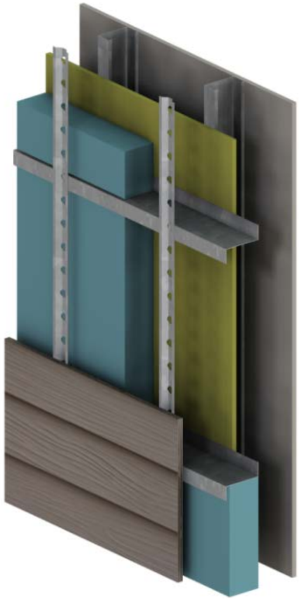
- Market shift to **exterior insulated assemblies** and intermittent attachment systems with more and more on the exterior
- Support both more insulation *and* cladding
- Better (or sometimes only option) for increased assembly thermal performance
- Additional benefits for moisture control, air tightness

TRADITIONAL GIRT VS CLIPS

4” of
Mineral
Wool
(R-16.8)

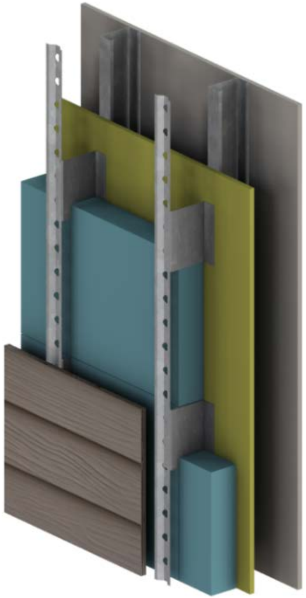


Vertical Z-Girts



Horizontal Z-Girts

Mixed Z-Girts



Intermittent Steel Clip 24”o.c.

R-19.8
No Thermal Bridging

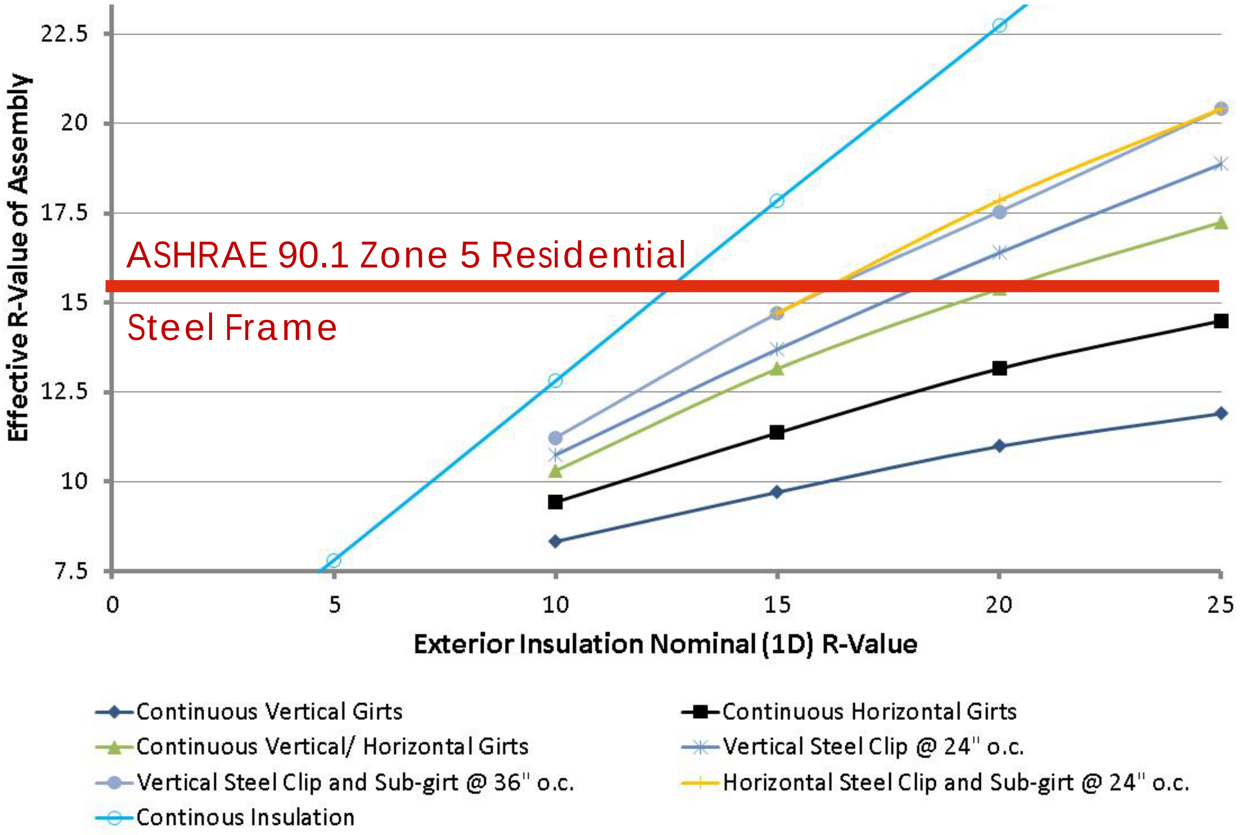
R_{eff}-10.3
52%
Effective

R_{eff}-12.2
61%
Effective

R_{eff}-14.1
71%
Effective

R_{eff}-14.9
75%
Effective

CLIP SYSTEM THERMAL PERFORMANCE



Still have to meet structural AND thermal requirements

Traditional systems may not be able to do both

Impacts on Design

Shift to Thermal Performance

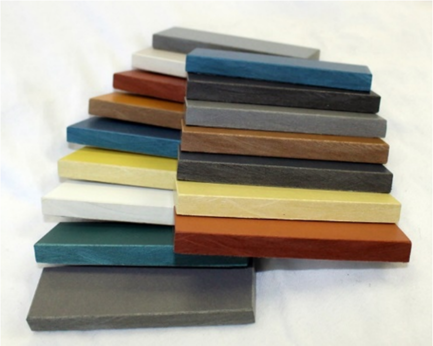
- Leads to both synergies and competition between different aspects of the cladding design
- Iterative process
- May appear to add complications to pre-tender building design
- Does not have to if looked at holistically

- Cost
- Architectural
- Structural Support
- Thermal Performance
- Fire Protection
- Moisture and Durability
- Constructability

Issues

ARCHITECTURAL

Light



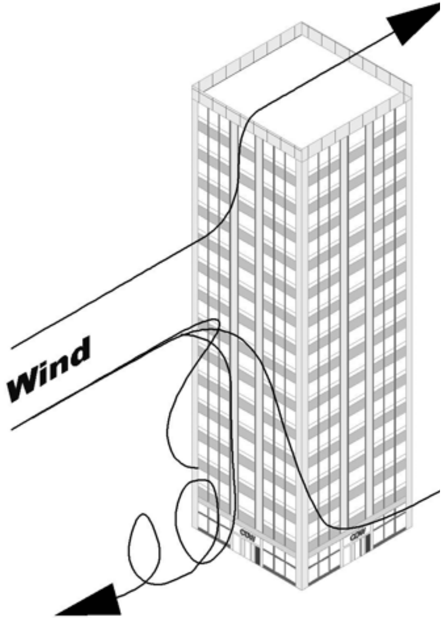
Medium

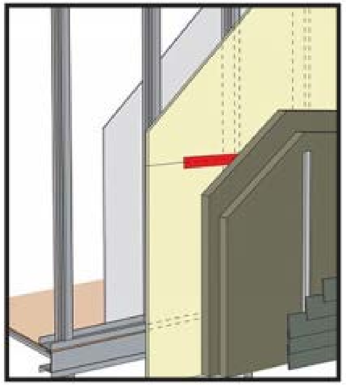
Heavy

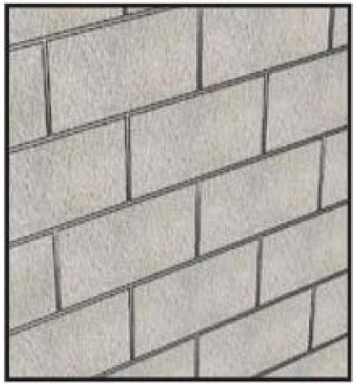
Cladding Selection affects more than cost and aesthetics!

- STRUCTURAL LOADS AND CAPACITY
- CLADDING ATTACHMENT ORIENTATION
- THERMAL PERFORMANCE
- INSULATION OPTIONS AND THICKNESS
- WALL THICKNESS
- CONSTRUCTABILITY

STRUCTURAL







Structural still Reigns for Rainscreens

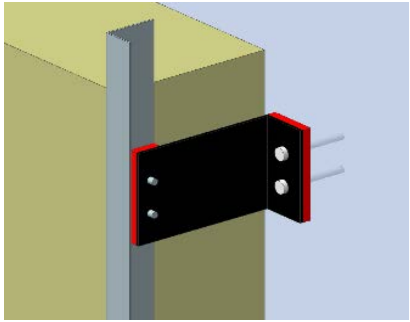
- Design wind pressure
- Seismic
- Substrate
- Cladding Type
    - Dead load
    - Deflection limits
- Insulation depth
- Thermal and live load Movement
- Governing factors
    - Connections
    - Rails
    - Bracket capacity

STRUCTURAL

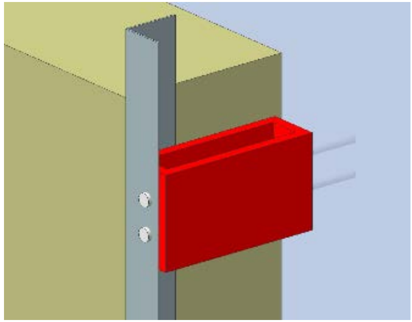
4.0 DESIGN CRITERIA:

1.	The design loads are in accordance with the aforementioned building code and the project's structural drawings.	
2.	Building Risk Category	II
3.	Dead Load:	
	a. Zinc Metal Panels and aluminum sub-framing:	3.0 psf
4.	Live Load:	N/A
5.	Snow Load:	N/A
6.	Wind Load (Components and Cladding):	
	a. Basic Wind Speed (3-second gust):	98 mph
	b. Building Exposure:	C
	c. Wind Importance Factor, I_w	1.00
	d. Directionality Factor, K_D:	$K_D = 0.85$
	e. Topographic Factor, K_{ZT}:	$K_{ZT} = 1.0$
	f. Internal Pressure Coefficient:	± 0.18
	g. Bulkhead Height:	33'-10"
	h. C&C Design Wind Pressures:	See Table 1

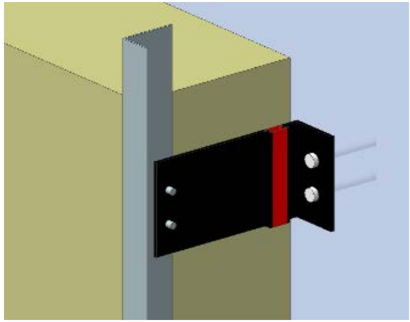
Types of Cladding Attachments



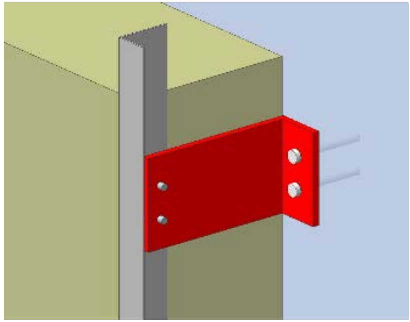
Metal Brackets with Thermal Break Pads



Low Conductivity Spacer with Through Fasteners



Metal Brackets with Integrated Glazing Style Thermal Break

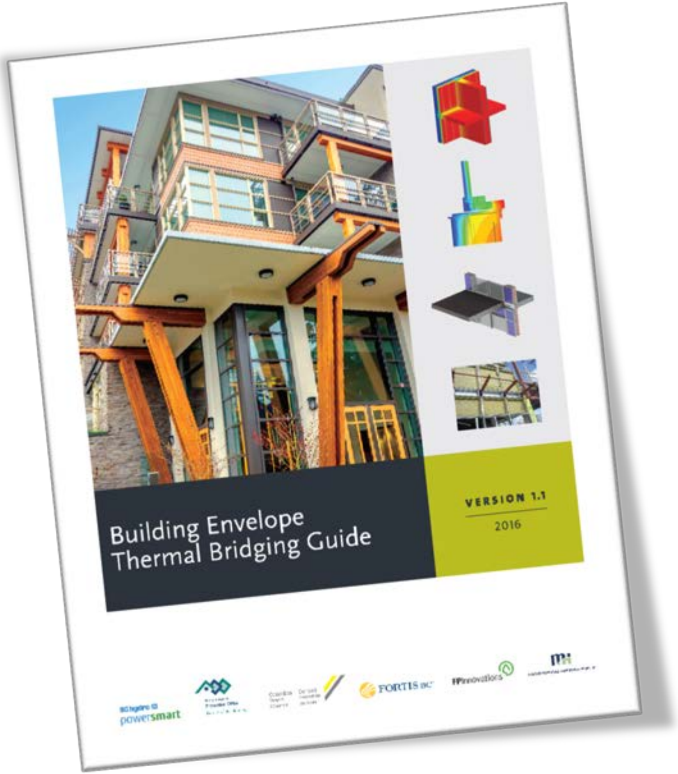


Low Conductivity Spacer with Fasteners Behind Insulation

Clip System Selection

- Onsite solutions can work, but may have a lot of unknowns
- Numerous proprietary systems available, but how to choose the right one? Can be overwhelming from choice
- Cannot just select a system without reconciling structural and thermal performance

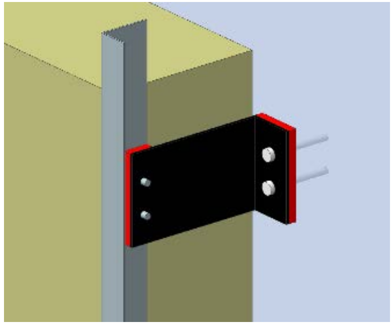
CLIP SYSTEM SELECTION

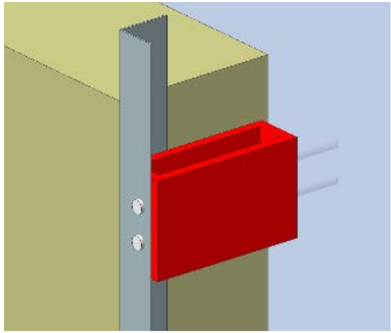


- Manufacturers reports may contain thermal performance information by spacing
- May also include structural analysis
- Or, may provide a “standard” series of systems for specific loading conditions that are pre-engineered
- How do we compare cladding attachment systems appropriately?

System Comparison – Clip to Clip

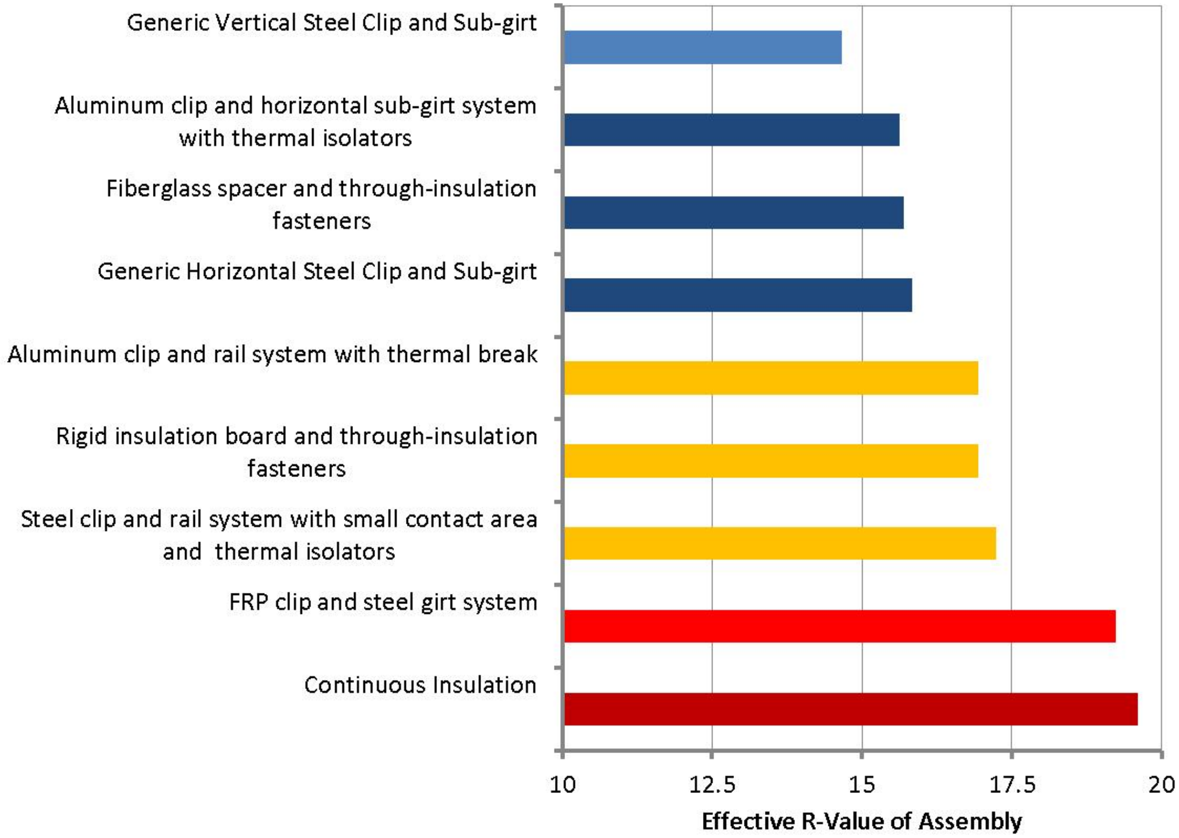
Insulation Depth	Vertical Spacing	Aluminum Bracket and Girt	Fibreglass Spacer with Steel Fasteners
4 inch	24" o.c.	R-16.4 (82%)	R-18.1 (91%)
	48" o.c.	R-17.9 (90%)	R-19.1 (96%)
5 inch	24" o.c.	R-19.2 (79%)	R-21.3 (88%)
	48" o.c.	R-21.4 (88%)	R-22.9 (94%)
6 inch	24" o.c.	R-21.7 (76%)	R-24.6 (86%)
	48" o.c.	R-24.6 (86%)	R-26.6 (93%)





- Aluminum System – 76 to 90%
- Fiberglass System – 87 to 96%

SYSTEM COMPARISON – CLIP TO CLIP

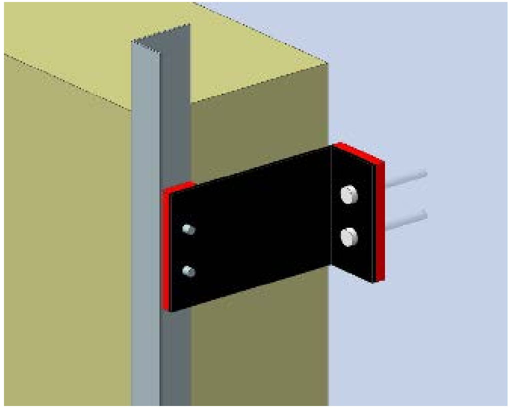


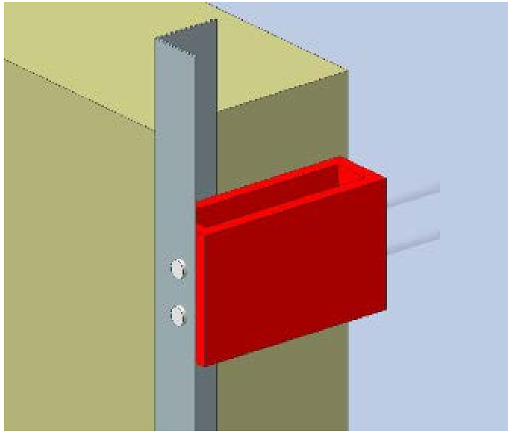
- 4”, R-16.8 Exterior Insulation
- Clips/sub-girts at 24” o.c.

System Comparison – Clip to Clip

Is looking at clips
at the same spacing
really an appropriate
comparison?

System Comparison - Holistic

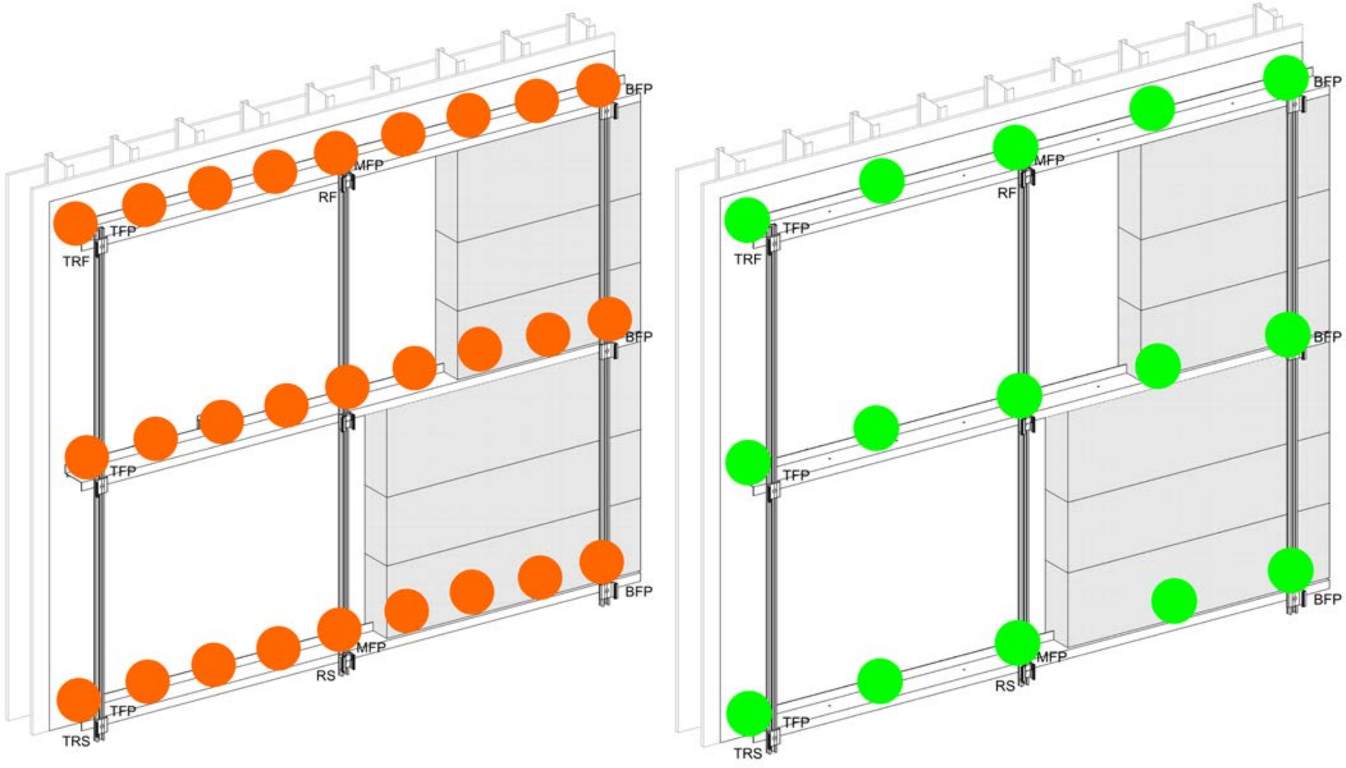




What Impacts Component Spacing?

- Material capacity
- Pull out strength of fasteners
- Connections between components
- Dead loads
- Wind Loads
- Deflection limits of cladding
- Insulation thickness

System Comparison - Holistic

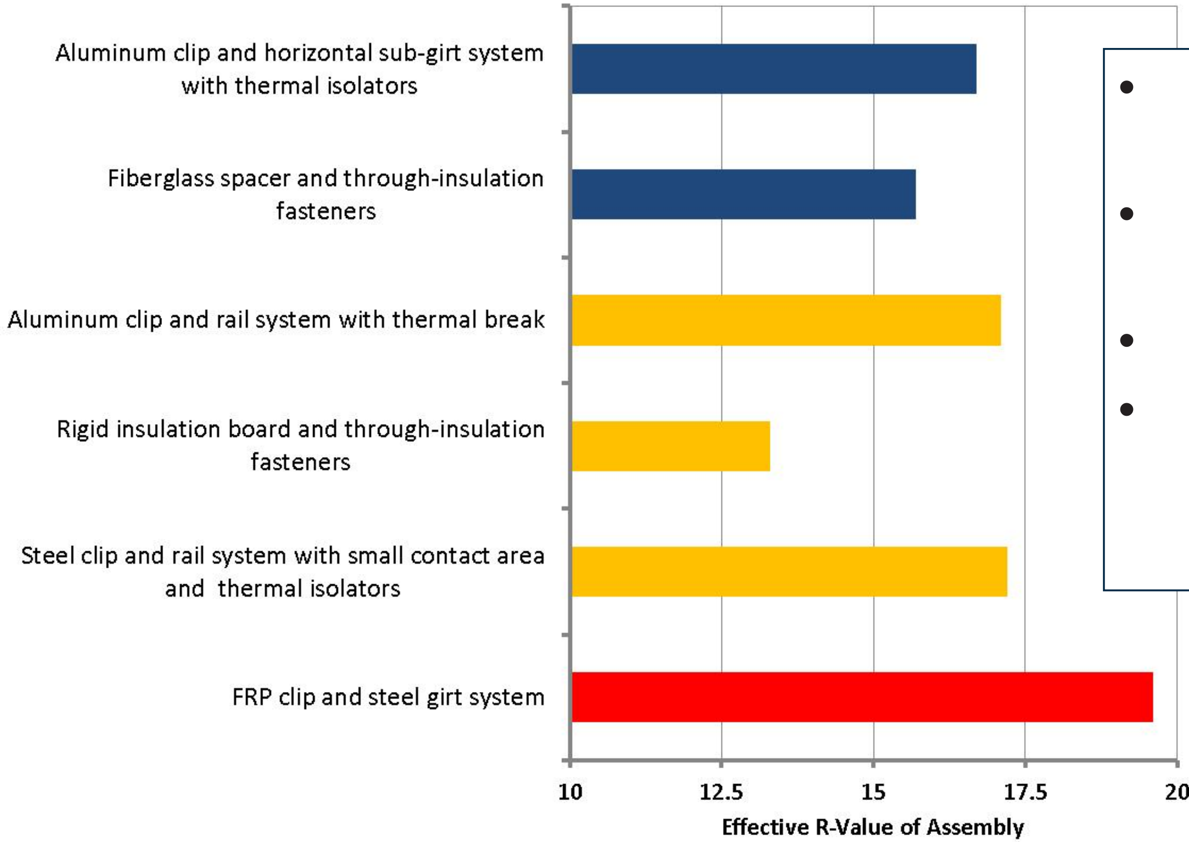


Less Structural Capacity

More Connections Per Area

More Thermal Bridging

SYSTEM COMPARISON - HOLISTIC



- 4”, R-16.8 Exterior Insulation
- Lightweight cladding (5 psf)
- 40 psf Wind
- Components spaced for structural load

Structural and Thermal Values

Clip Vertical Spacing in	Exterior Insulation Thickness in	Exterior Insulation Nominal R-Value[2] $h \cdot ft^2 \cdot {}^\circ F/Btu$ ($m^2 \cdot {}^\circ K/W$)	Effective U-Value $Btu/h \cdot ft^2 \cdot {}^\circ F$ ($W/m^2 \cdot {}^\circ K$)	Effective R-Value $h \cdot ft^2 \cdot {}^\circ F/Btu$ ($m^2 \cdot {}^\circ K/W$)
24	2	R-8.4 (1.48)	0.110 (0.622)	**R-9.1** (1.61)
	3	R-12.6 (2.22)	0.073 (0.416)	**R-13.7** (2.41)
	4	R-16.8 (2.96)	0.057 (0.323)	**R-17.6** (3.09)
36	2	R-8.4 (1.48)	0.108 (0.612)	**R-9.3** (1.63)
	3	R-12.6 (2.22)	0.070 (0.397)	**R-14.3** (2.52)
	4	R-16.8 (2.96)	0.056 (0.317)	**R-17.9** (3.15)
48	2	R-8.4 (1.48)	0.107 (0.606)	**R-9.4** (1.65)
	3	R-12.6 (2.22)	0.069 (0.393)	**R-14.4** (2.54)
	4	R-16.8 (2.96)	0.054 (0.307)	**R-18.5** (3.26)

120
10.9 (275.7)
27.0 (685.8)

Structural and Thermal Values

- Steel Stud Wall
- 4 psf Cement Board Cladding
- Deflection L/240
- Site Wind Load 60 psf
- Thermal Target U-value = 0.064 BTU/hrft^2°F (R-15.6)

Dead Load (psf)		4				10			
Nominal Wind Load (psf)		30	60	90	120	30	60	90	120
Component	Deflection Requirement	Maximum Vertical Spacing in (mm)							
Clip	L/360	52.0 (1320.8)	38.0 (965.2)	31.0 (787.4)	27.0 (685.8)	43.4 (1103.0)	21.7 (551.5)	14.5 (367.7)	10.9 (275.7)
	L/240	52.0 (1320.8)	38.0 (965.2)	31.0 (787.4)	27.0 (685.8)	52.0 (1320.8)	38.0 (965.2)	31.0 (787.4)	27.0 (685.8)

STRUCTURAL AND THERMAL VALUES

- Thermal Target U-value = 0.064 BTU/hrft^2°F (R-15.6)
- Maximum 38”o.c. vertical spacing

Clip Vertical Spacing in	Exterior Insulation Thickness in	Exterior Insulation Nominal R-Value[2] h·ft^2·°F/Btu (m^2·°K/W)	Effective U-Value Btu/h·ft^2·°F (W/m^2·°K)	Effective R-Value h·ft^2·°F/Btu (m^2·°K/W)
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	4	R-16.8 (2.96)	0.054 (0.307)	**R-18.5** (3.26)

Structural and Thermal Values

- Clip calculators

backup wall	Steel Studs
deflection limit	L/360
horiz spacing	16 in
bracket depth	5.9 in
rail length	10 ft
dead load	4 psf
wind pressure	45 psf
cavity insulation	R-12.0
ext thickness	4.0 in
ext insulation	R-16.8

Structural and thermal results

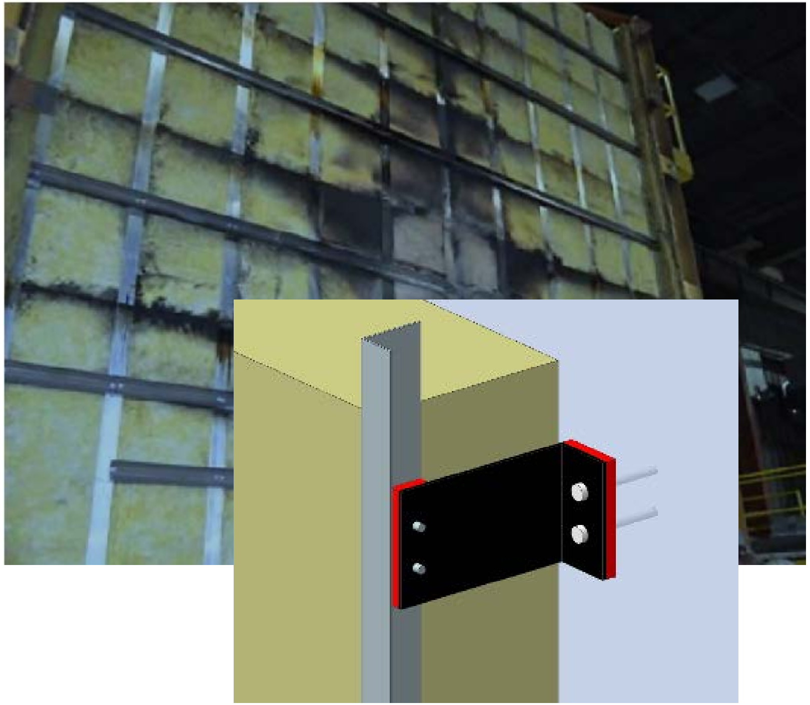
Maximum vertical bracket spacing

42 in

Maximum effective insulating value

R-22.4

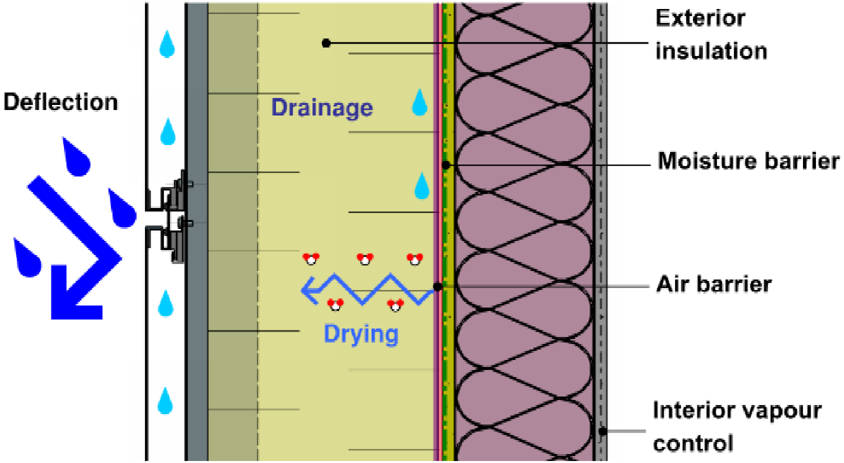
Fire protection and Combustibility



Requirements by Jurisdiction

- Insulation type
  - Mineral wool
  - Polyiso
- Cladding Type
- Components
  - Metal
  - Minor combustible
- Fire Blocking
- Testing required?

Moisture and Durability



Design Parameters

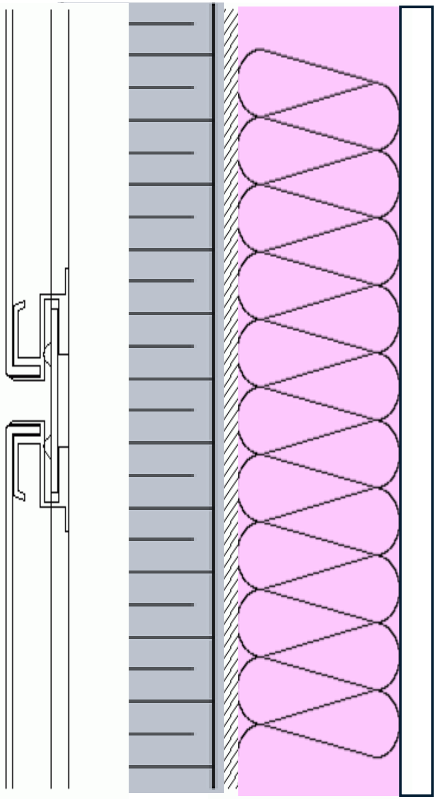
- Rain-screen
- Wind washing
- Membranes
- Insulation ratios
- Minimizing Moisture Accumulation
- Corrosion protection

CONSTRUCTABILITY

Cost and Installation

- EASE OF CONSTRUCTION
  - SPEED OF INSTALLATION
  - MEASUREMENTS AND ALIGNMENT
- ADJUSTABILITY – LOCATION AND TYPE
  - SHIM
  - OUTER GIRT
- NUMBER OF COMPONENTS AND FASTENERS NEEDED
  - MORE MATERIALS – MORE COST

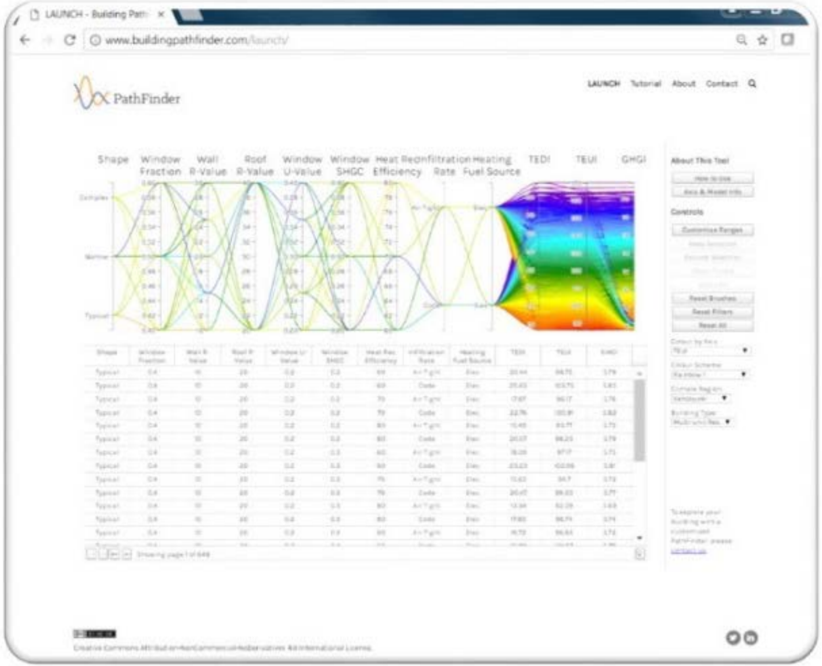
Wall Thickness



How much is a thin wall worth?

- Site or Architectural constraints
- Thicker walls inevitable
- Split insulation
- Help maximize floor area

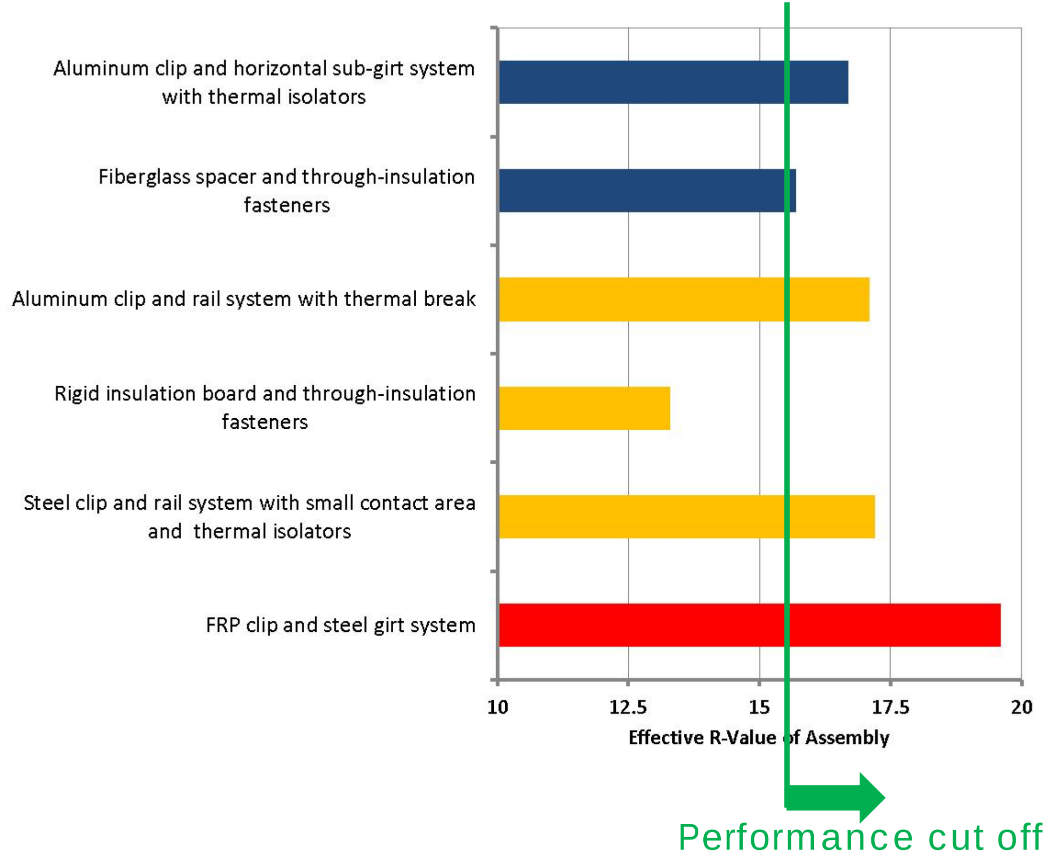
Optimization



Benefits

- Less materials/waste
- Faster construction
- Better performance
- More cost effective

PERFORMANCE SPECIFICATIONS



Setting Project Expectations

- BECOME FAMILIAR WITH DIFFERENT ATTACHMENT SYSTEMS IN ORDER TO PROVIDE REALISTIC VALUES
- CAN SET PROJECT STRUCTURAL, THERMAL AND WALL THICKNESS REQUIREMENTS
- ENCOURAGE OPTIMIZATION BY TRADES WHILE MEETING EXPECTATIONS
- LEVEL PLAYING FIELD BASED ON CONSISTENT INFORMATION

THANK YOU

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