Designing and Detailing AB Connections at Windows, Curtain Walls, and Storefronts

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Learning Objectives

- Understand Code requirements brought about by the 2012 and 2015 IBC
- Understand the most common AB materials utilized in commercial construction
- Understand basic fenestration types
-Understand design and detailing required at fenestrations to maintain AB CONTINUITY.

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Presentation Outline

1. Construction Delivery Process
2. Code Requirements
3. AB Materials
4. General Window Types
5. General CW and SF Types
6. Design and Detailing (Windows, and Curtainwalls and Storefronts)

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1.

Construction Delivery Process

- Design / Bid / Build
- Design / Build

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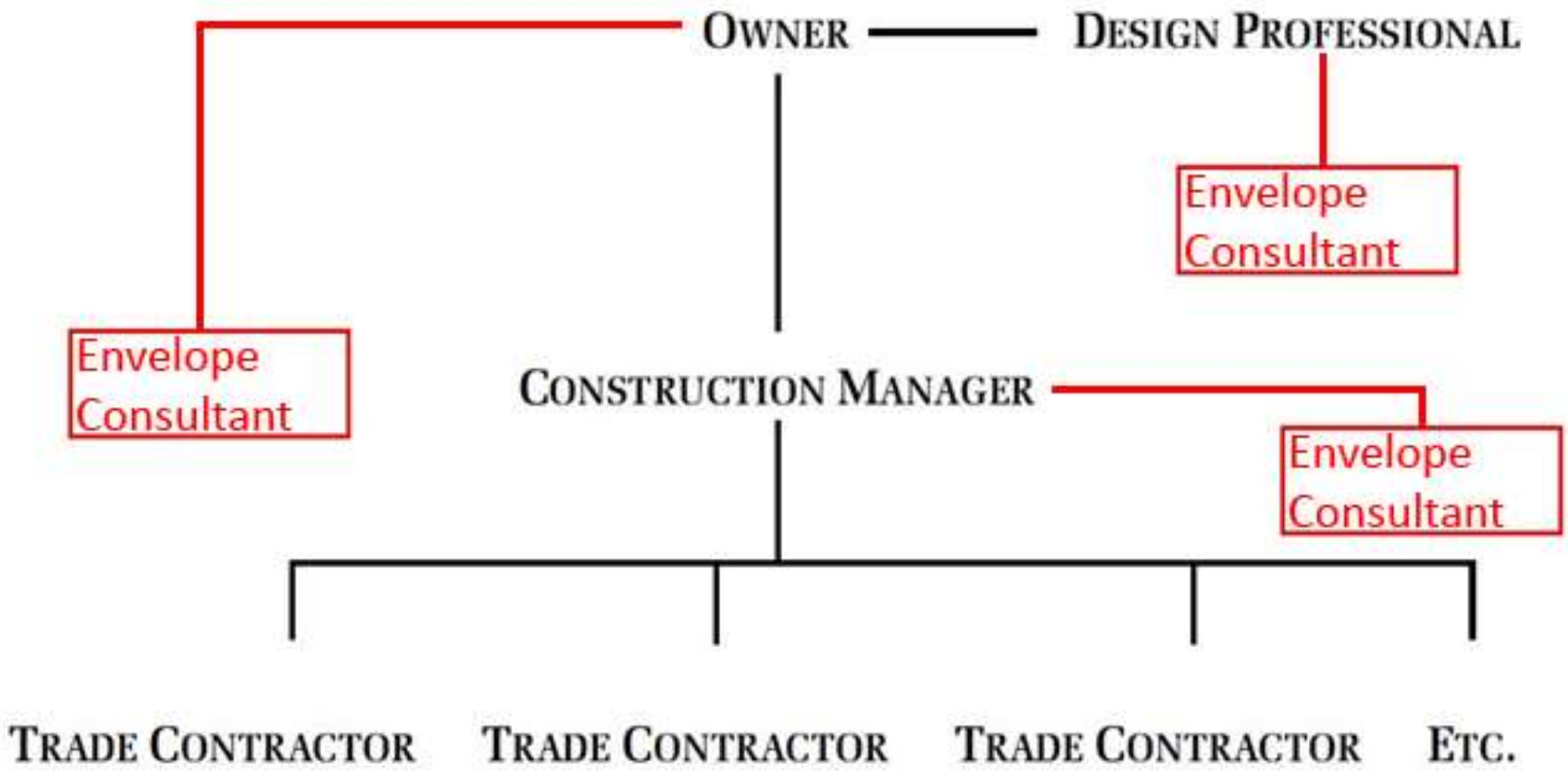

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FIGURE 3. CONSTRUCTION MANAGER AT RISK ORGANIZATIONAL CHART

2.

Code Requirements

- International Building Code (IBC)
- International Existing Building Code (IEBC)
- International Energy Conservation Code (IECC)
- Energy Standards for Buildings, except low-rise residential buildings (ASHRAE 90.1)
- Optional Code: International Green Conservation Code (IGCC)

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IBC 2015

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CHAPTER 13
Energy Efficiency

SECTION 1301
GENERAL

1301.1 Criteria. Buildings shall be designed and constructed in accordance with the International Energy Conservation Code (IECC)

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CHAPTER 14
EXTERIOR WALLS

SECTION 1401
GENERAL

1401.1 Scope. The provisions of this chapter shall establish the minimum requirements for exterior walls; exterior wall coverings; exterior wall openings; exterior windows and doors; architectural trim; balconies and similar projections; and bay and oriel windows.

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Chapter 4
Commercial Energy Efficiency

C401.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings.

C401.2 Application. **Commercial buildings shall comply with ONE of the following:**

- **The requirements of ANSI/ASHRAE/IES 90.1.**
- The requirements of Sections C402, C403, C404 and C405. In addition, commercial buildings shall comply with either Section C406.2, C406.3 or C406.4.
- The requirements of Section C407, C402.4, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C405.7. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

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IECC 2012 (Continued)

C402.4 Air Leakage (Mandatory). The thermal envelope of buildings shall comply with Sections C402.4.1 through C402.4.8.

C402.4.1 Air Barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope. located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.4.1.1 and C402.4.1.2.

Exception: Air barriers are not required in buildings located in Climate Zones 1, 2 and 3.

C402.4.1.2.2 Assemblies. Assemblies of materials and **components** with an average air leakage **not to exceed 0.04 cfm/ft2** (0.2 L/s m2) under a pressure differential of 0.3 inches of water gauge (w.g.) (75Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. . .

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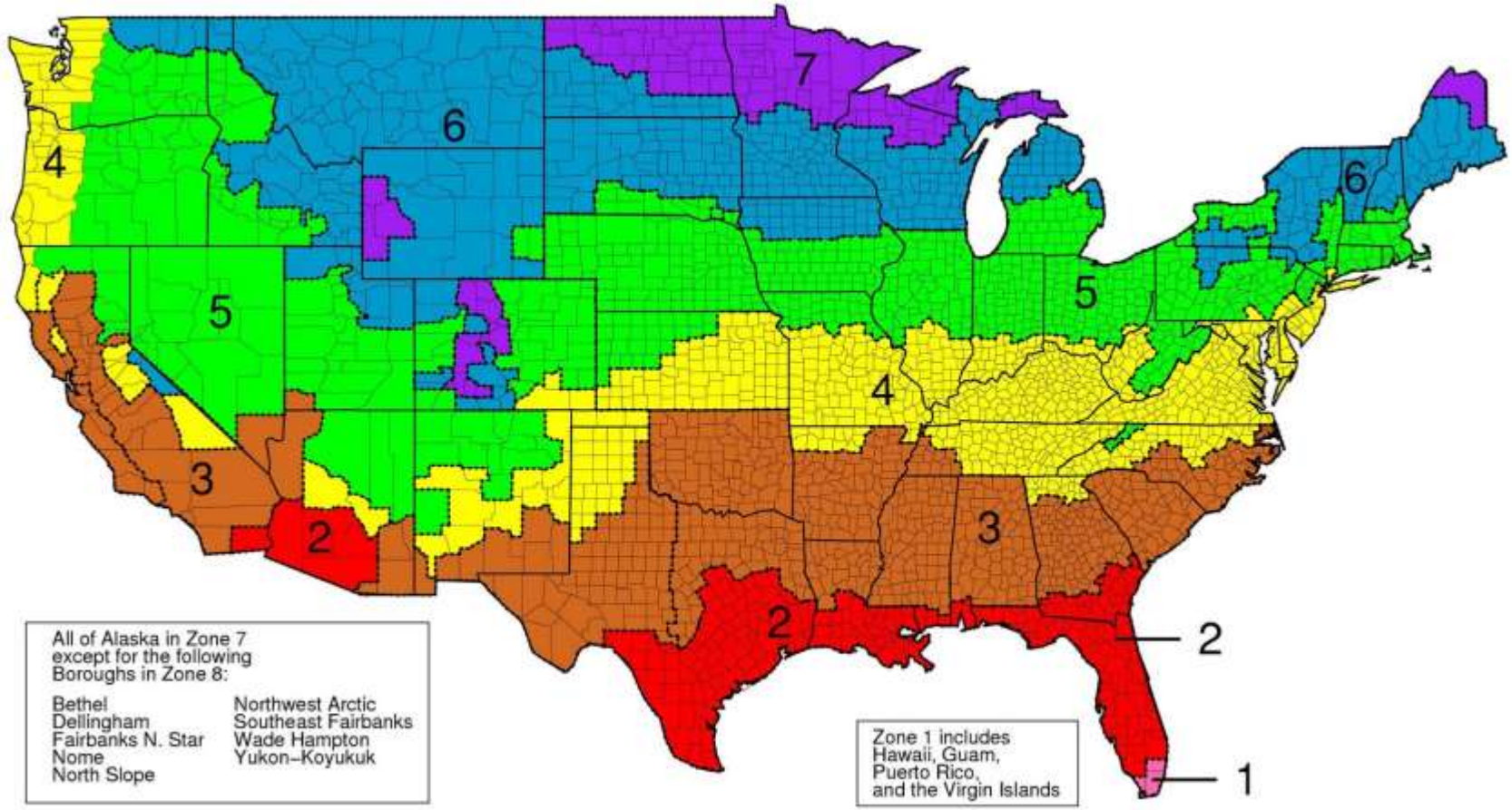
CLIMATE ZONES



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IECC 2012 (Continued)

C402.4.1.2.3 Building Test. The completed building shall be TESTED and the air leakage rate of the building envelope shall not exceed 0.40 cfm/ft at a pressure differential of 0.3 inches water gauge (2.0 L/s · m2 at 75 Pa) (1.75 psf) in accordance with ASTM E 779 or an equivalent method approved by the code official.

ASTM E779: Determining air leakage rate by fan pressurization.

ASTM E283: Rate of air leakage through exterior windows, curtain walls and doors.

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IECC 2015

C402.5 Air Leakage. Thermal envelope (Mandatory). The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft2 (0.2 L/s · m2)

C402.5.1 Air Barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

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CURRENT TREND Whole Bldg < .40
New net zero Bldg - 0.15 cfm/ft2

IECC 2015

C402.5.1 Air Barrier Construction. The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies
2. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Penetrations of the air barriers shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals associated with penetrations shall be sealed in the same manner or taped or covered with moisture vapor-permeable wrapping material.

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IECC 2015 Air Leakage Summary

C402.5 Air Leakage - Thermal Envelope
total Envelope - **.40 CFM/sf**

C402.5.1.2.1 Materials
Materials - **.004 cfm/sf.**

C402.5.1.2.2 Assemblies
Assemblies - **.04 cfm/sf.**

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IECC 2015 Air Leakage Testing Summary

ASTM E 283
Standard Test Method for Determining Rate of Air Leakage through Exterior Windows, CW &Doors under pressure differential

ASTM E 779
Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.

ASTM E 783
Standard Test Method for Field Measurements of Air Leakage Through Installed Exterior Windows and Doors.

ASTM E 1105
Standard Test Method for Determination of Water penetration of installed Exterior Windows, CW & Doors by uniform or cyclic static air pressure difference.

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IECC 2015 (continued)

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINI

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Roofs									
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	
Metal buildings[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	I
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	
Walls, above grade									
Mass	R-5.7ci[e]	R-5.7ci[e]	R-5.7ci[e]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	I
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	

Walls unchanged for 2012

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ASHRAE 90.1 (2013)

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)*

Opaque Elements	Nonresidential		2010 VALUE	Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value		Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
Roofs							
Insulation Entirely above Deck	U-0.032	R-30 c.i.	R-20.0ci	R-30 c.i.	U-0.093	R-10 c.i.
Metal Building[a]	U-0.037	R-19 + R-11 Ls or R-25 + R-8 Ls	R-13.0+R-13.0	R-19 + R-11 Ls or R-25 + R-8 Ls	U-0.082	R-19
Attic and Other	U-0.021	R-49	R-38.0	R-49	U-0.034	R-30
Walls, above Grade							
Mass	U-0.104	R-9.5 c.i.		R-11.4 c.i.	U-0.580	NR
Metal Building	U-0.060	R-0 + R-15.8 c.i.	R-19.0	R-0 + R-19 c.i.	U-0.162	R-13
Steel Framed	U-0.064	R-13 + R-7.5 c.i.	R-13 + R7.5ci	R-13 + R-7.5 c.i	U-0.124	R-13
Wood Framed and Other	U-0.064	R-13 + R-3.8 c.i. or R-20	R-13.0	R-13 + R-3.8 c.i. or R-20	U-0.089	R-13

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IEBC 2012

IEBC - INTERNATIONAL EXISTING BUILDING CODE

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CHAPTER 5
CLASSIFICATION OF WORK

SECTION 503
ALTERATION –LEVEL 1

503.1 Scope. Level 1 alterations include the removal and replacement or the covering of existing materials, elements, equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose.

5.03.2 Application. Level 1 alterations shall comply with the provisions of Chapter 7.

SECTION 504
ALTERATION –LEVEL 2

503.1 Scope. Level 2 alterations include the reconfiguration of space, the addition or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional equipment.

SECTION 505
ALTERATION –LEVEL 3

503.1 Scope. Level 3 alterations apply where the work exceeds 50% of the aggregate area of the building.

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IEBC 2012

SECTION 707
ENERGY CONSERVATION

707.1 Minimum requirements. Level 1 alterations to existing buildings or structures are permitted without requiring the entire building or structure to comply with the energy requirements of the IECC or the IRC. The alterations **shall conform to the energy requirements of the IECC** or the IRC as they relate to new construction.

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3.

Air Barrier Materials

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What is an Air Barrier?

A group of assemblies made of materials and accessories designated to prevent or retard the flow of air through a building envelope

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What is a Vapor Barrier?

A material designated to prevent or retard the flow of moisture through a building assembly

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Air Leakage

Moisture travels in the air as it freely passes through wall cracks and penetrations

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Vapor Diffusion

Moisture is driven through a material by vapor pressure

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Is it more effective to control moisture transport via air flow or vapor diffusion?

If vapor transport due to air flow is not properly dealt with, the vapor barrier in the building enclosure system can easily become ineffective!

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Why Stop the Flow of Air?

Can transport 30 to 200 times more moisture into the building than vapor diffusion

Can cause concentrated condensation, mold, corrosion and premature failure

Causes the HVAC system to use more energy

Reduces the effectiveness of thermal insulation, increasing heating and cooling costs

Disrupts mechanical system pressurization

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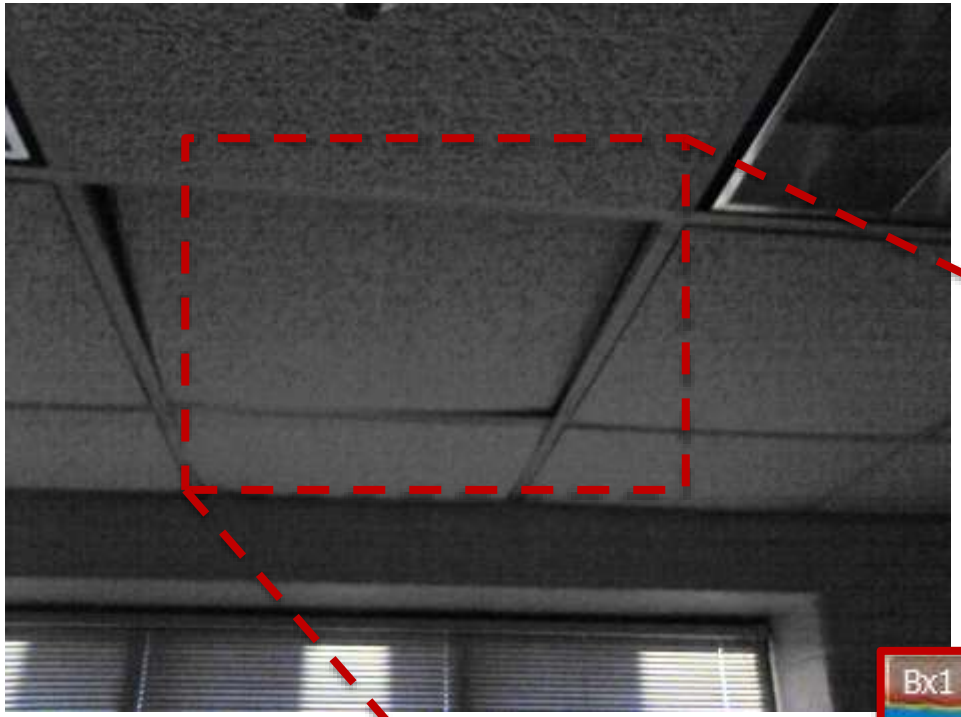
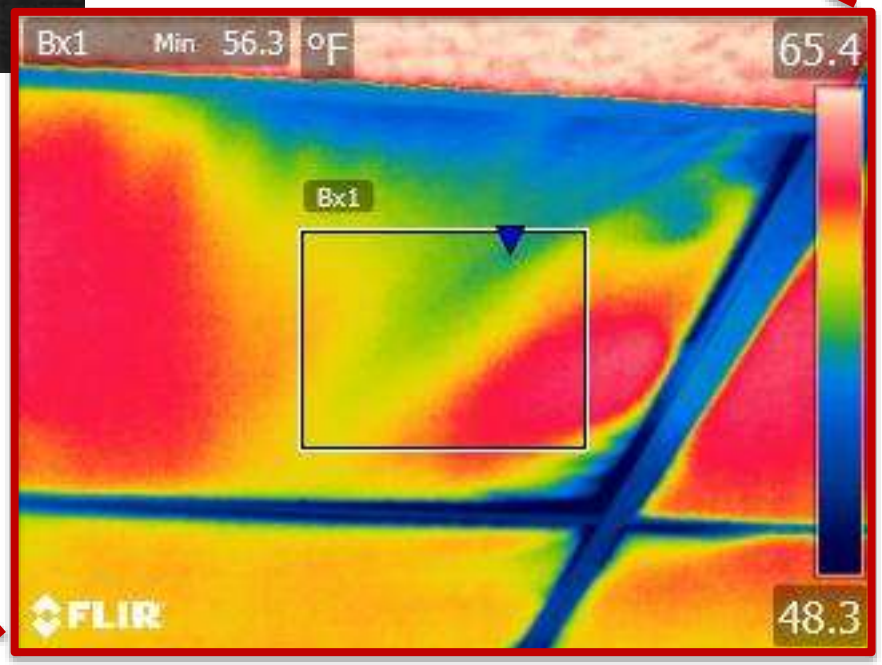
Infrared Air Leaks





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Deteriorated Wall Substrates

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Mold Growth

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AB/VB Location

Vapor Barrier	On the predominately warm side of the heat barrier (insulation layer)
Air Barrier	Anywhere in the assembly

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Basic Principles of Air Barriers

- Continuous
- Durable and maintainable
- Withstand positive / negative wind/fan/stack pressures
- Air permeability -0.004 cfm/sf under pressure differential of 0.3 in water
- Transfer load to the structure
- Accommodate movement in the structure

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Types of Air and Vapor Barriers

- Liquid applied membranes - spray, roll
- Sheet applied - self adhering, wall transition, flashing
- Spray polyurethane foam (SPF) - air barrier and insulation all in one
- Other - Board stock taped insulation or sheathing and house wraps

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Liquid Applied

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Liquid Applied - Spray

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Liquid Applied - Roller

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Advantages of Liquid Applied

- Lower labor costs (fewer steps)
- Quicker application(saves time)
- More production (4-5 x more than sheet)
- Substrate priming not required
- Monolithic membrane (no seams)

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Disadvantages of Liquid Applied

- Doesn't bridge substrate gaps
- High initial equipment cost
- Temp. dependent
- Difficult quality control

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Sheet-Applied Membranes

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Sheet-Applied Membranes

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Sheet-Applied Membranes

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Advantages of Sheet Applied

- Self-sealing capabilities
- Low temp. application
- Doesn't require expensive equipment
- Bridges small voids/gaps
- Easier quality control

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Disadvantages of Sheet Applied

- Higher labor costs
- Slower application (more steps)
- Typically needs primer
- Not easily manageable (attention to detail)
- Terminations (end of day / cut edges / end joints)

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Spray Polyurethane

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Spray Polyurethane Foam

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Spray Polyurethane Foam

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Advantages of SPF

- Can be the AC & CI
- Easily Applied in Tough to Reach Spots
- Saves Time
- Bridges Minor Substrate Gaps
- Either Side of Wall System
- Less Coordination Between Sub Trades

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Disadvantages of SPF

Air barriers are critical to limit air flow from inside to outside or outside to inside

If possible, consider integrated membrane transitions from curtainwalls/windows to air barrier

Know the applicable code requirements (e.g. IECC 2015)

Require a mock-up

Be familiar with system / assembly types

In situ testing – test as you go

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Other – Foam Sheathing

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Other – Taped Sheathing

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Other – House Wrap

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4.

Window Types

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Window Classifications

AAMA (2010) classifications

R – Residential (15psf)
LC – Light Commercial (25psf)
CW –Commercial (30psf)
AW – Architectural (40psf)

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Window Anchorage

- Clips
- Receptors
- Straps
- Through Jamb (insert window)
- Concealed Clips

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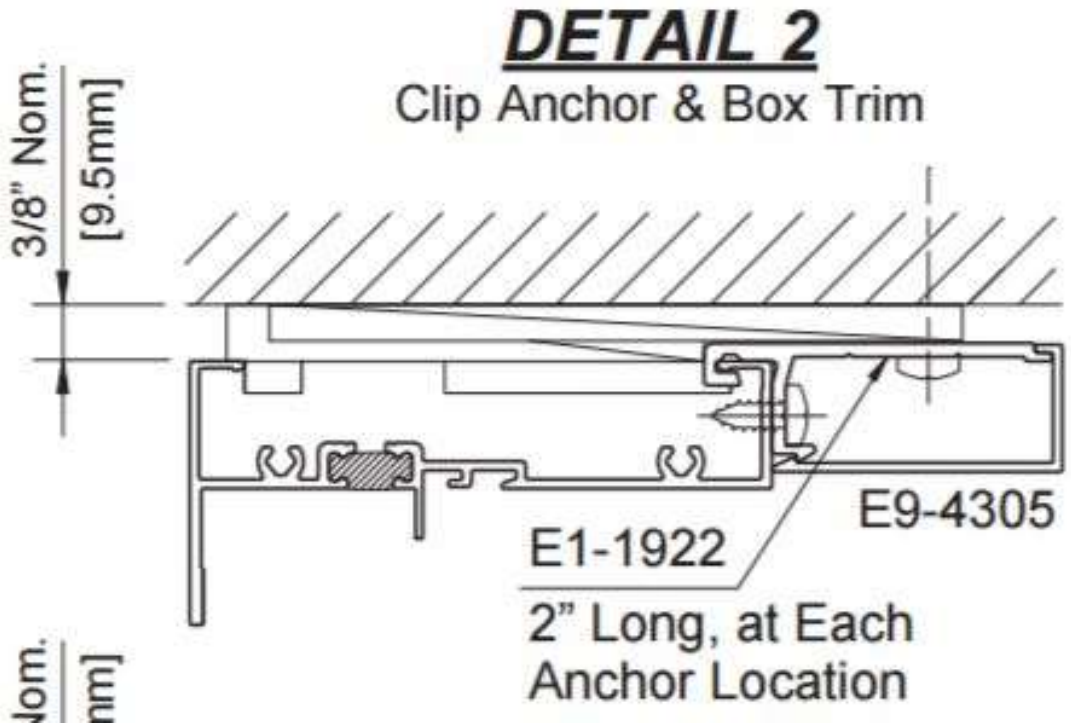
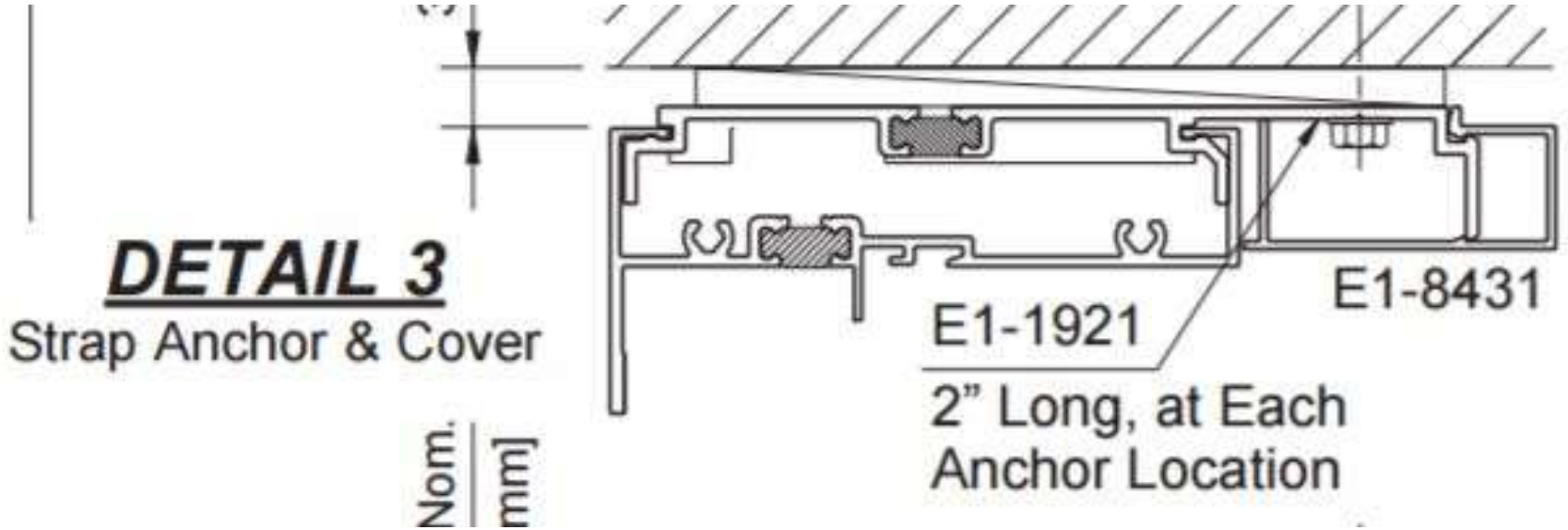
Clip/Strap Systems





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Concealed Clip Systems

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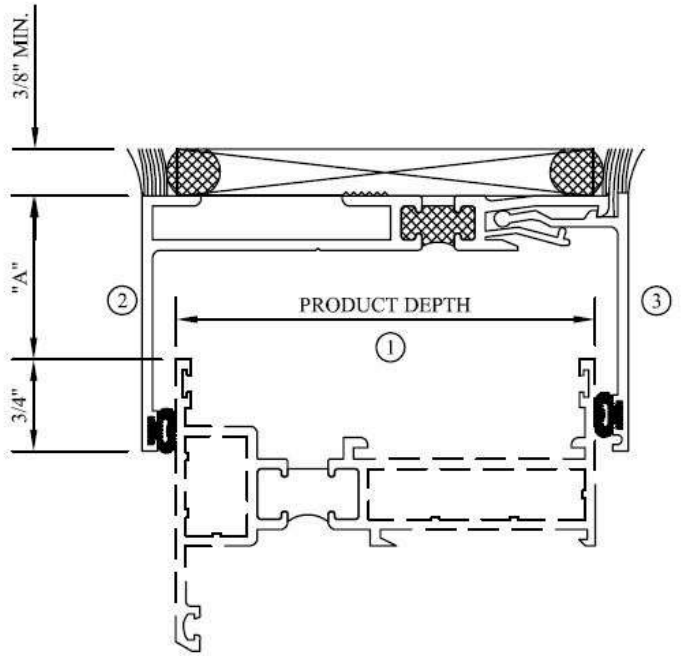
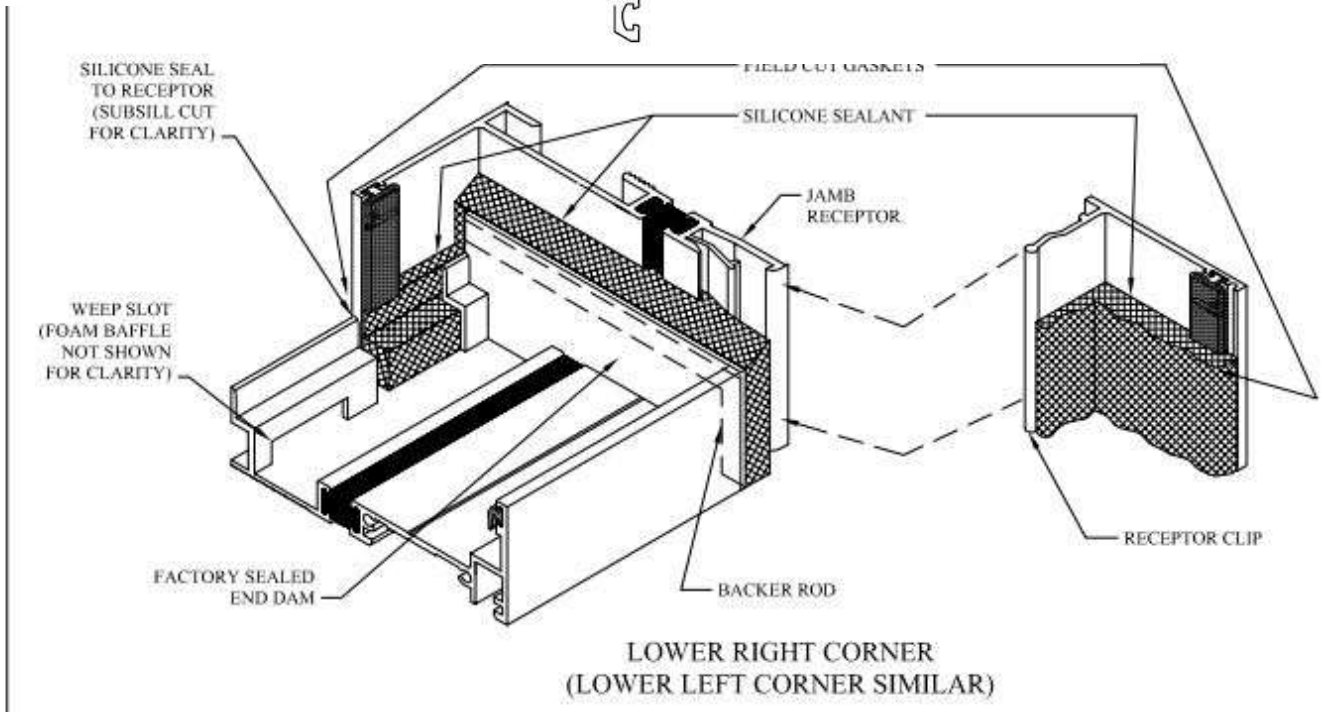
Receptor Systems





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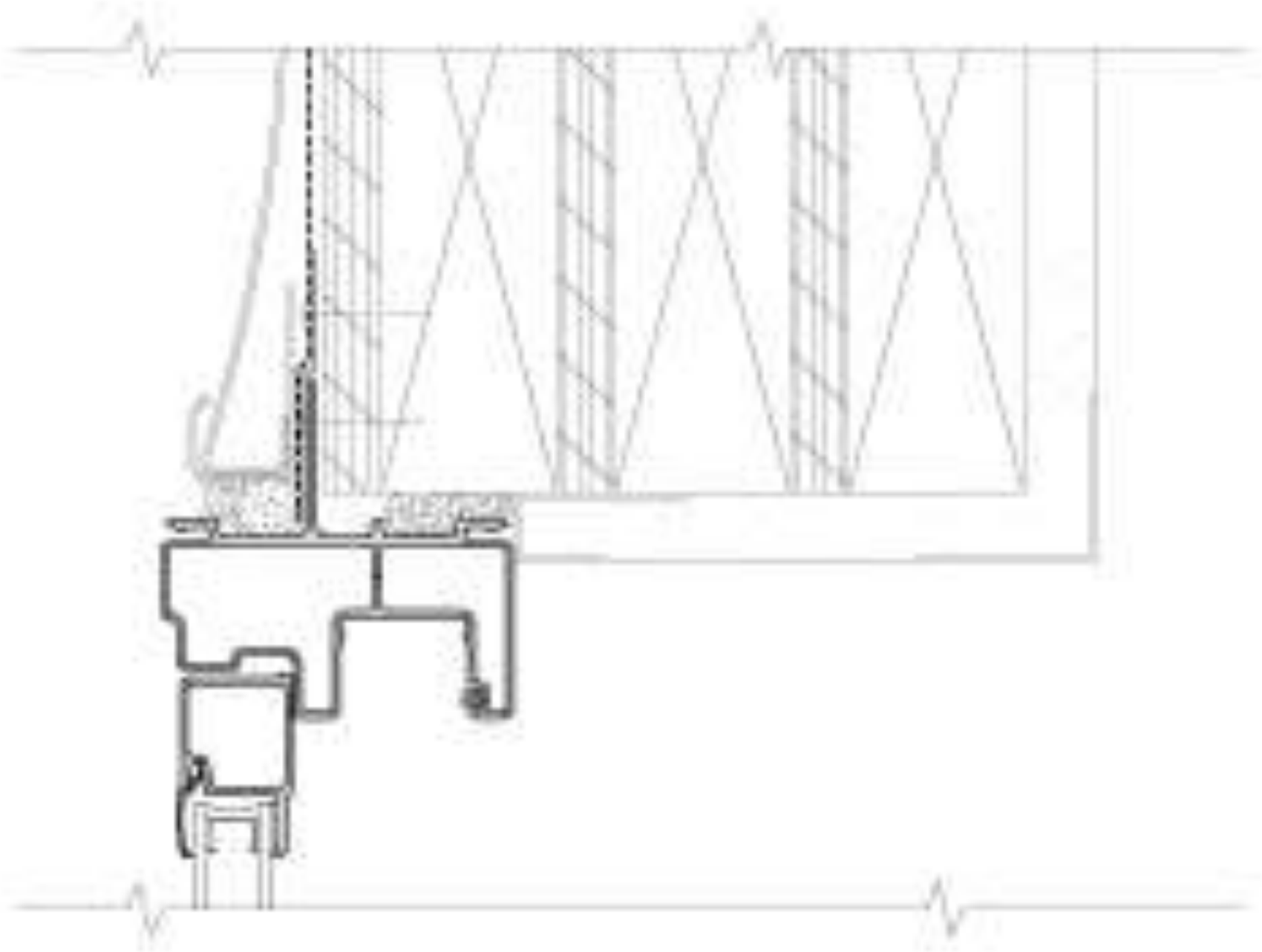
http://www.kawneer.com/kawneer/adm_traco/400_Accessories%20-%20TR%20Product%20Accessories/050_Receptors/050_Receptors.pdf

Integral Fins



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5.

Curtain Wall / Storefront Types

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North American Fenestration Standard defines ***curtainwall*** as, "... a non-load bearing exterior wall cladding that is hung to the exterior of the building, usually spanning from floor to floor."

The standard goes on to note, "...Curtain wall systems can be factory-glazed or designed to accommodate field fabrication and glazing, including optional structural glazing. Curtain wall employs deep rectilinear framing profiles (approximately 150 mm [6 in] or greater), which are often made available in "stock lengths". Curtain wall vertical framing members run past the face of floor slabs, and provision for anchorage is typically made at vertical framing members only.... curtain wall systems often need to meet additional performance

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- **Combination of vision glass and spandrel panels.**
- **Moisture managed – moisture which infiltrates the system is drained out.**
- **Barrier systems – predicated on no moisture in the system (ie. sealant dependent)**
- **Stick built, unitized, and screw-spline assemblies**
- **Additional design considerations:**
  - Sun shades
  - Rain screens
  - Operable vents
  - Louvers
  - Frit
  - Shadow boxes (do not recommend)

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NAFS, defines *storefont* as, "...a non-residential, non-load bearing assembly of commercial entrance systems and windows usually spanning between the floor and the structure above, designed for high use/abuse and strength."

The standard goes on to note, "...Storefront systems are typically designed to accommodate field fabrication and glazing and employ exterior glazing stops at one side only. Storefront employs shallow rectilinear framing profiles (approximately 150 mm [6 in] or less), which are often made available in 'stock lengths.' Vertical framing members run between the top of the floor slab and structure above, with provision for anchorage at all perimeter conditions."

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NAFS defines *window wall* as, "...a non-load-bearing fenestration system provided in combination assemblies and composite units, including transparent vision panels and/or opaque glass or metal panels, which span from the top of a floor slab to the underside of the next higher floor slab."

The standard goes on to note, "...Primary provision for anchorage occurs at head and sill conditions. Receptor systems can be designed as a part of drainage and movement accommodation provisions."

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Basic Assembly Types

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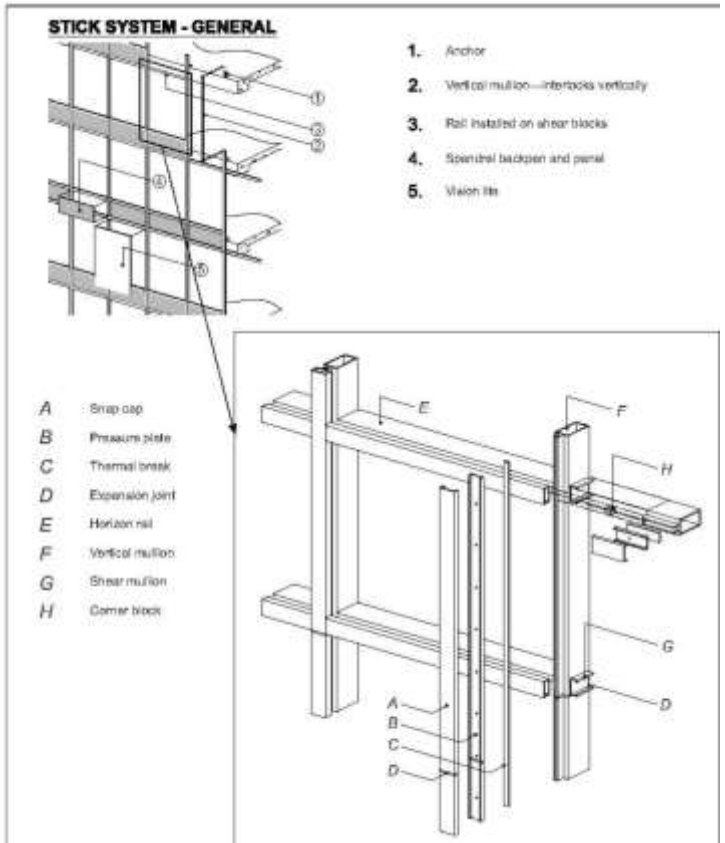
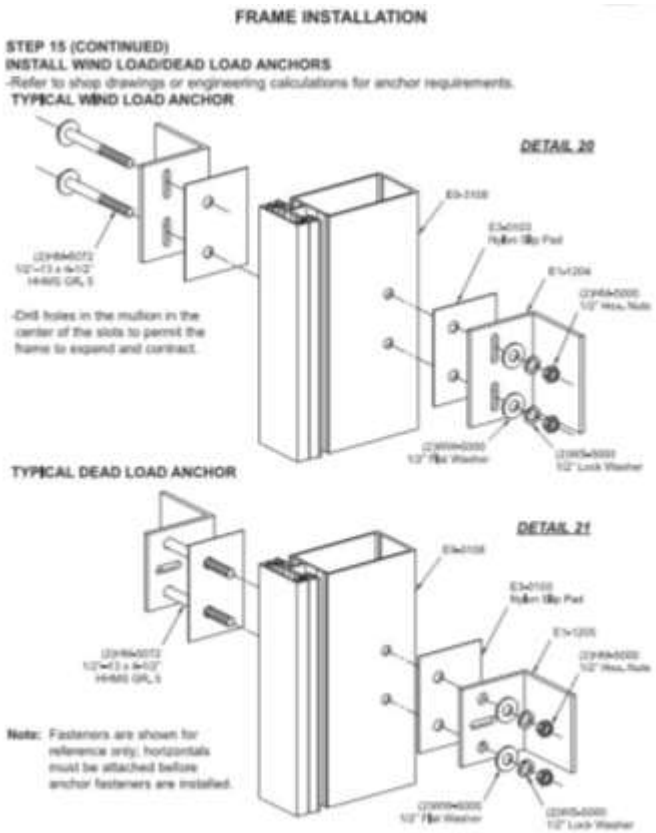
Stick System:

- Mullions and rails assembled on site
- Field glazed
- Potential quality control issues





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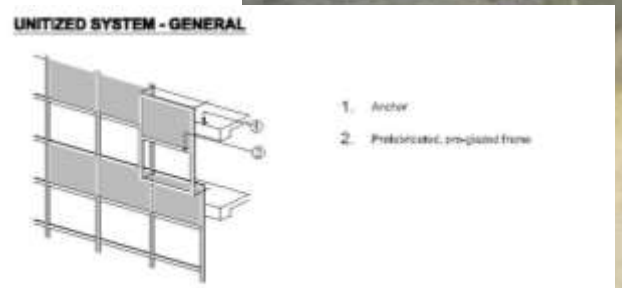
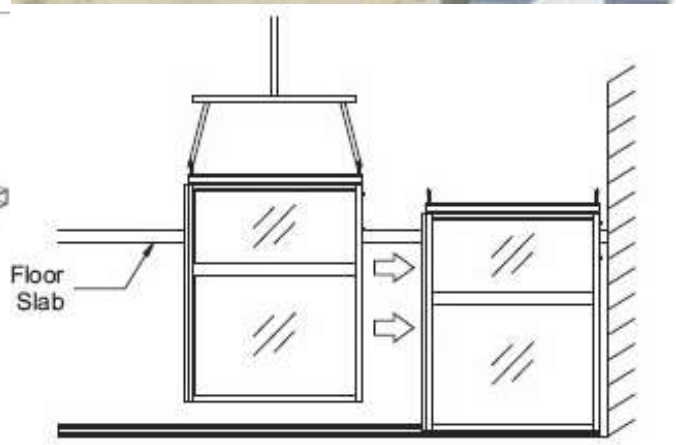
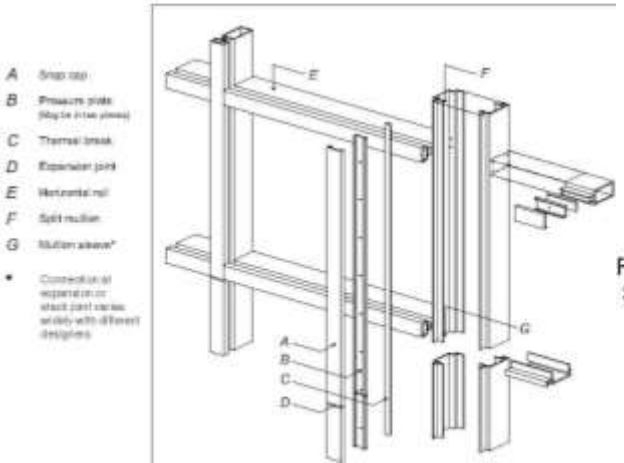
Unitized System:

- Shop fabricated
- Shop or field glazed
- Field installed as panels
- Better factory QC







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Captured Glazing

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Structural Silicone Glazing

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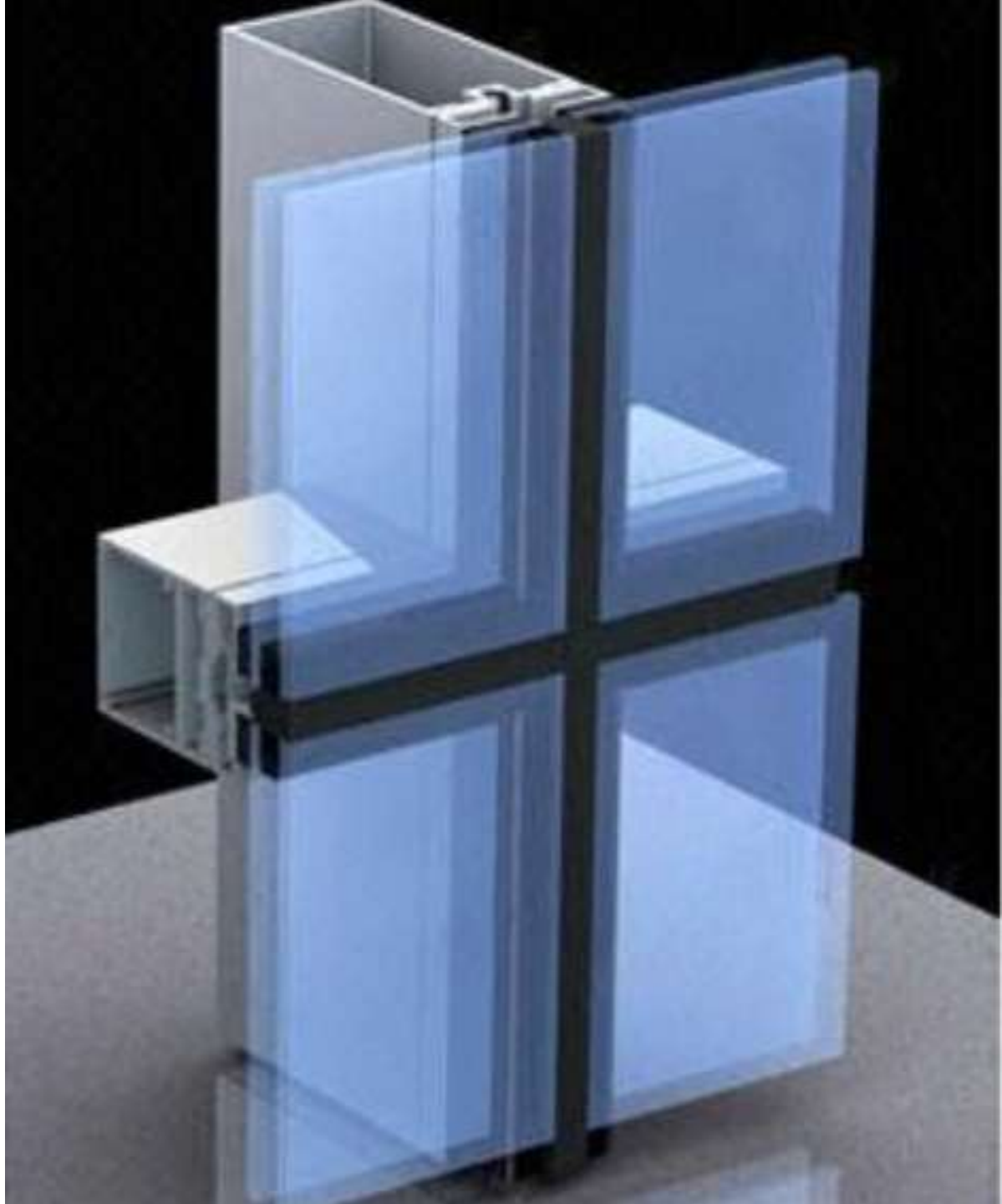

6.

Design & Detailing – Windows / Curtainwalls

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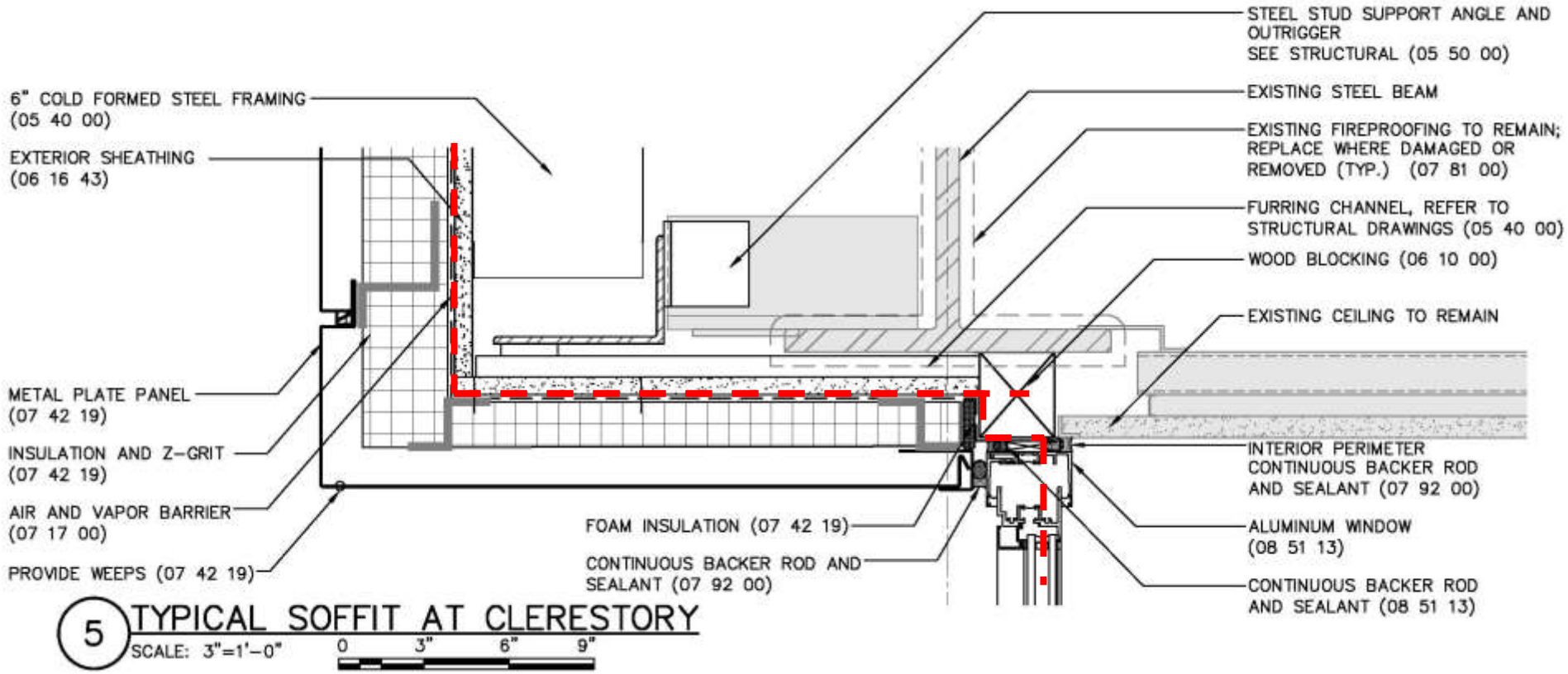
Continuity



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Design Considerations

- **Two points of contact between fenestrations and Air Barrier**
- **Connections should be flexible and durable**
- **In general, most air barriers should not be exposed to UV.**
  - Use UV stable materials if exposed (i.e.. rain screens)

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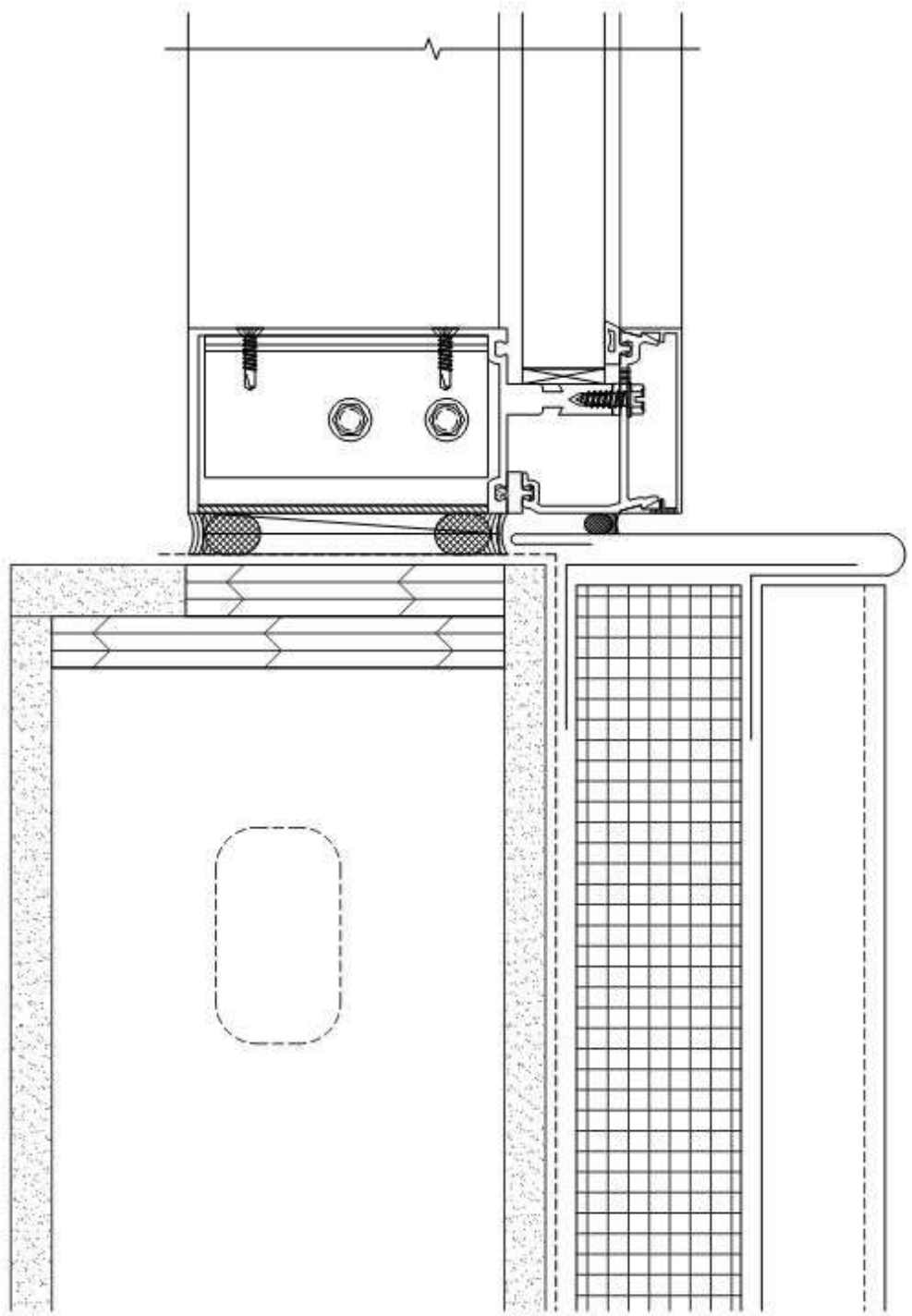
Detailing



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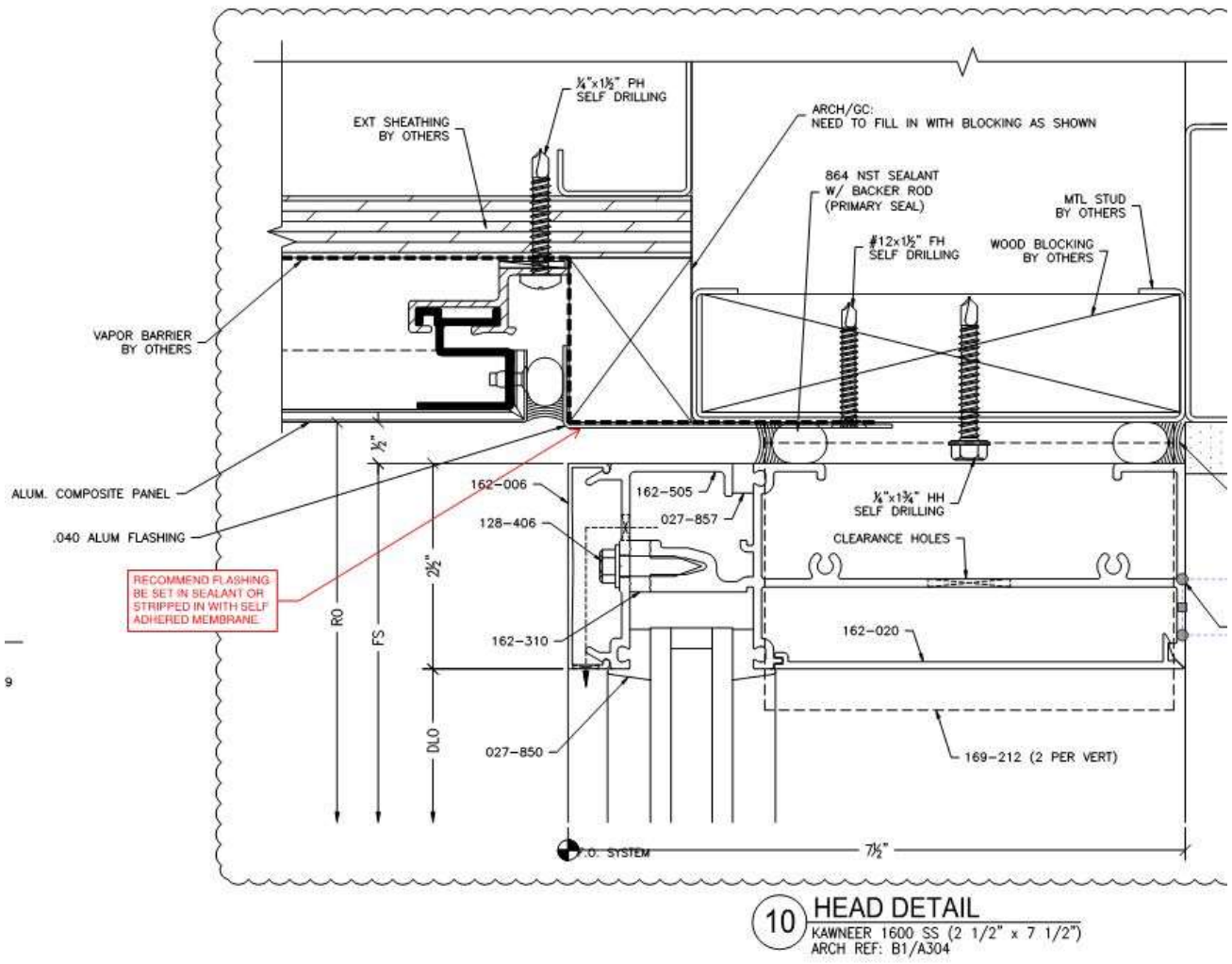

10 HEAD DETAIL
KAWNEER 1600 SS (2 1/2" x 7 1/2")
ARCH REF: B1/A304

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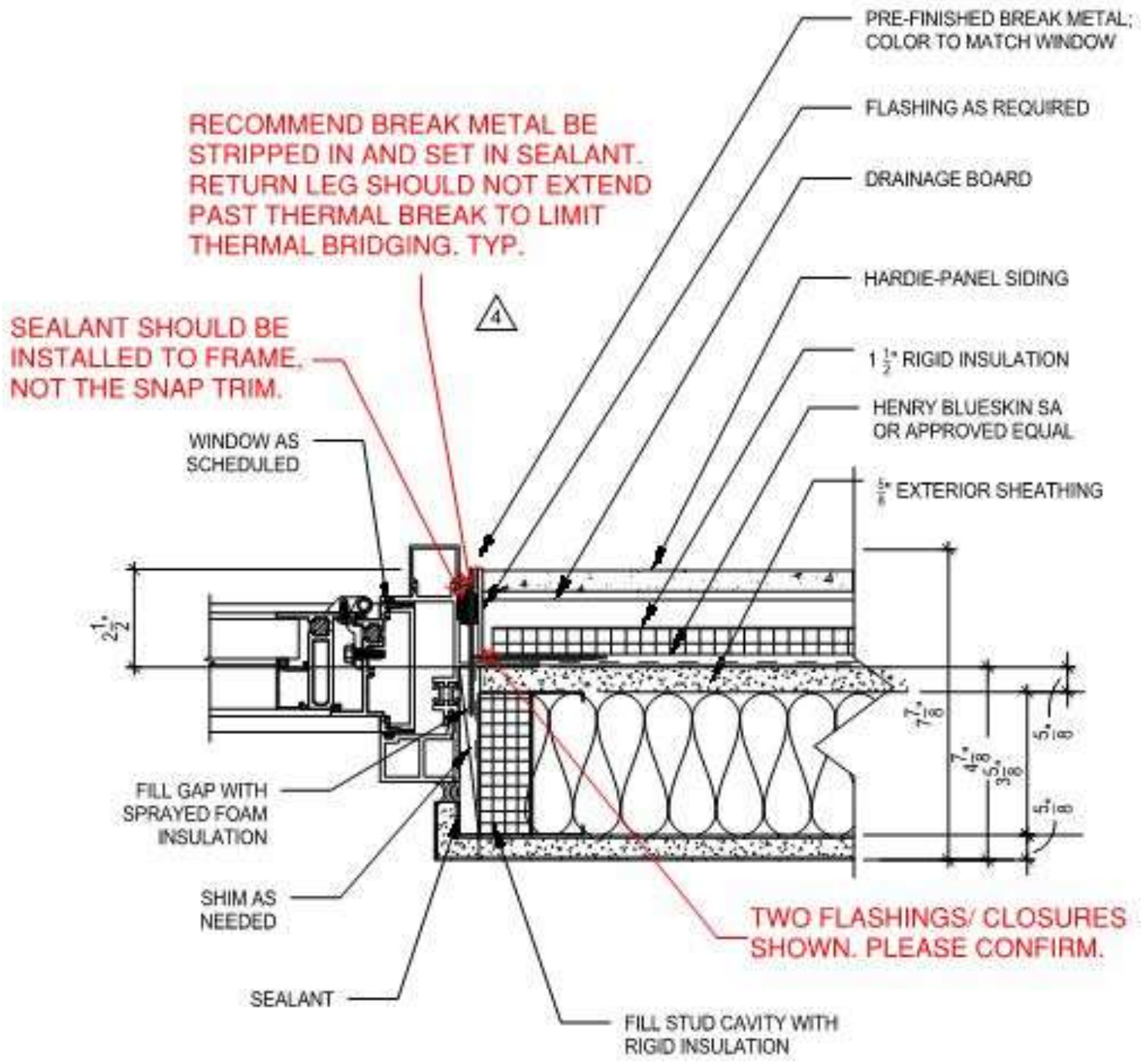

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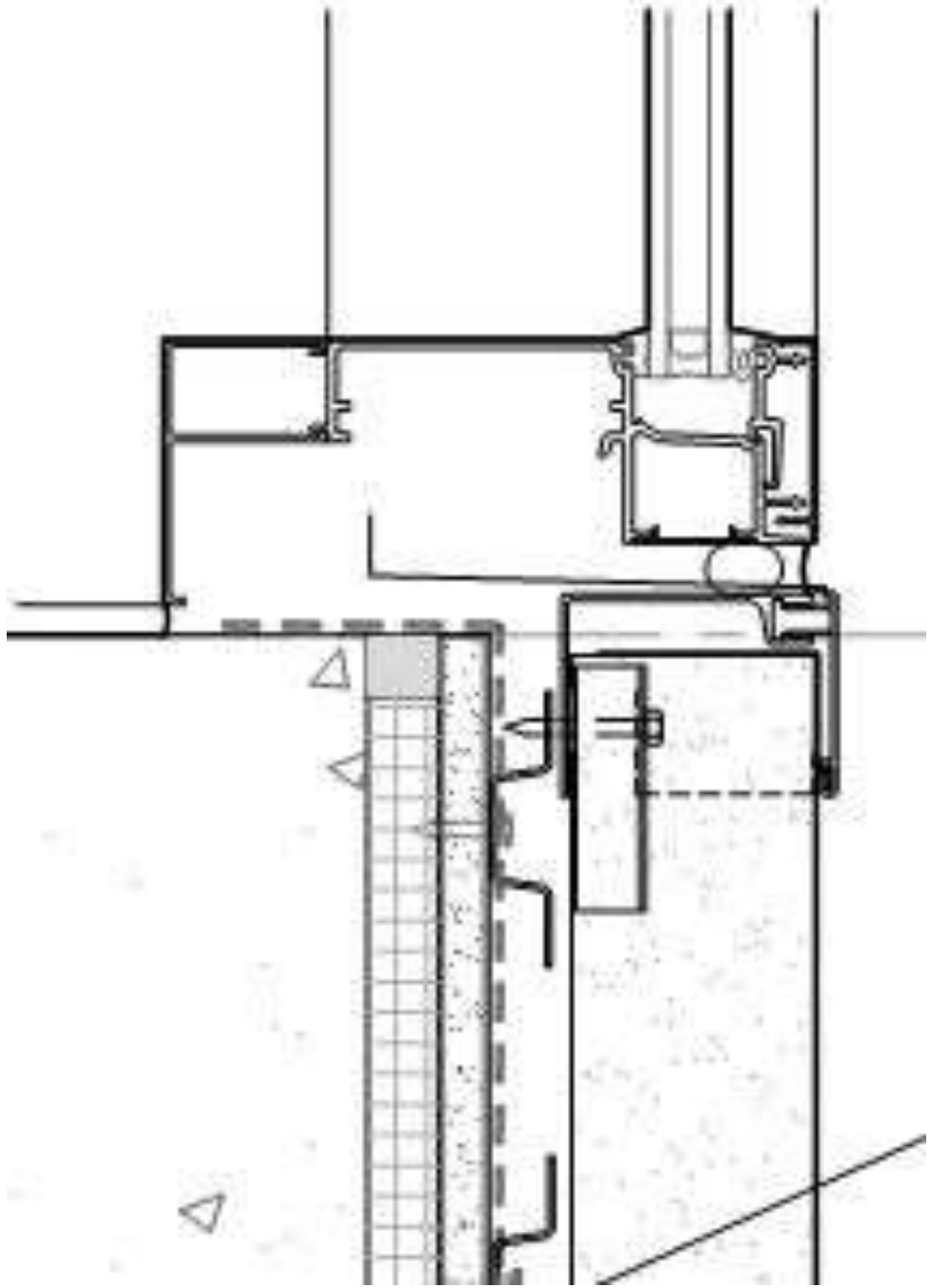
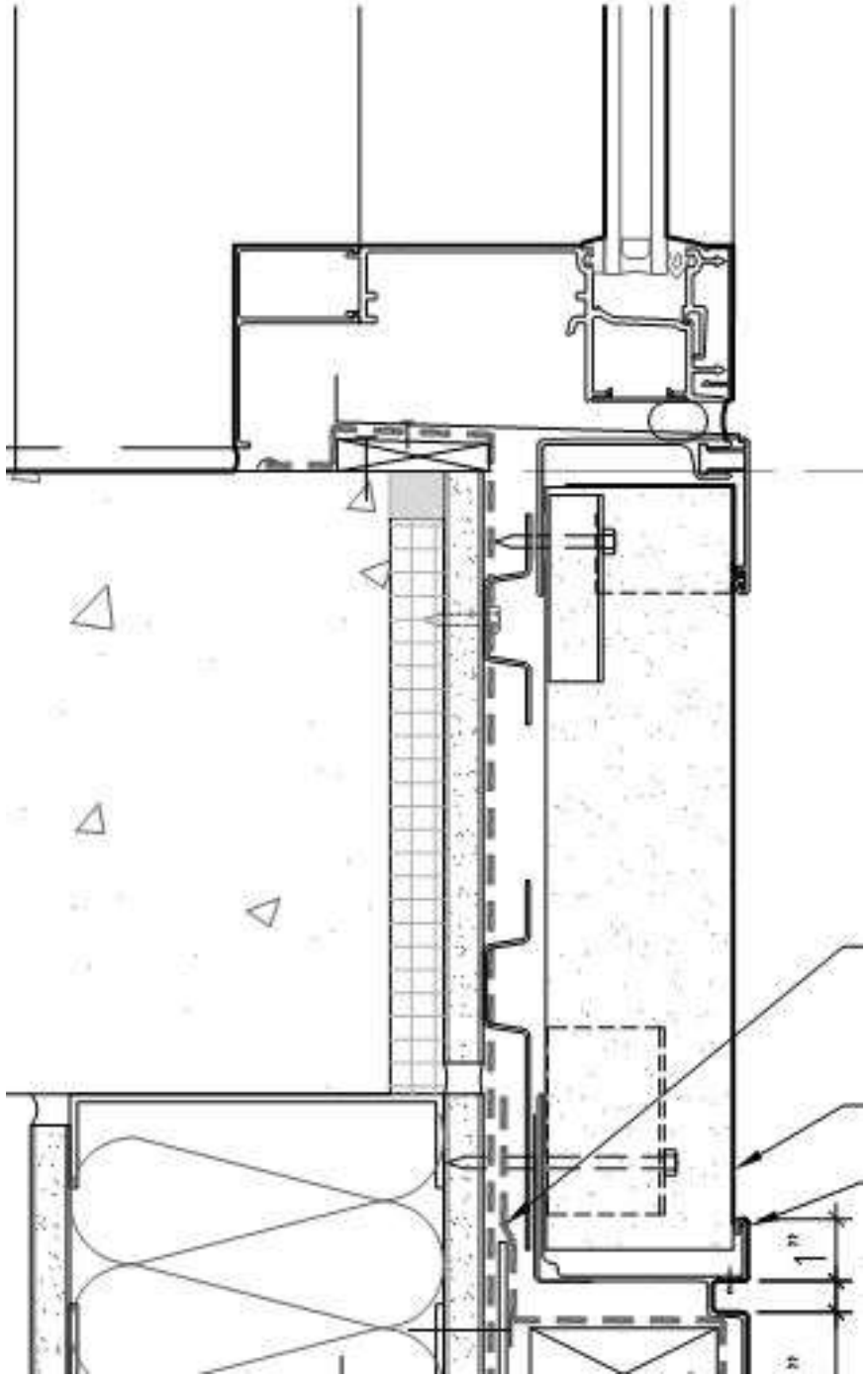




Detailing

EXTERIOR WALL ASSEMBLY
- METAL PLATE PANEL (07 42 19)
- Z-GIRT (07 42 19)
- INSULATION (07 42 19)
- AIR AND VAPOR BARRIER (07 27 00)
- EXTERIOR SHEATHING (06 16 43)

6" COLD FORMED STEEL FRAMING HEADER SEE STRUCTURAL (05 40 00)

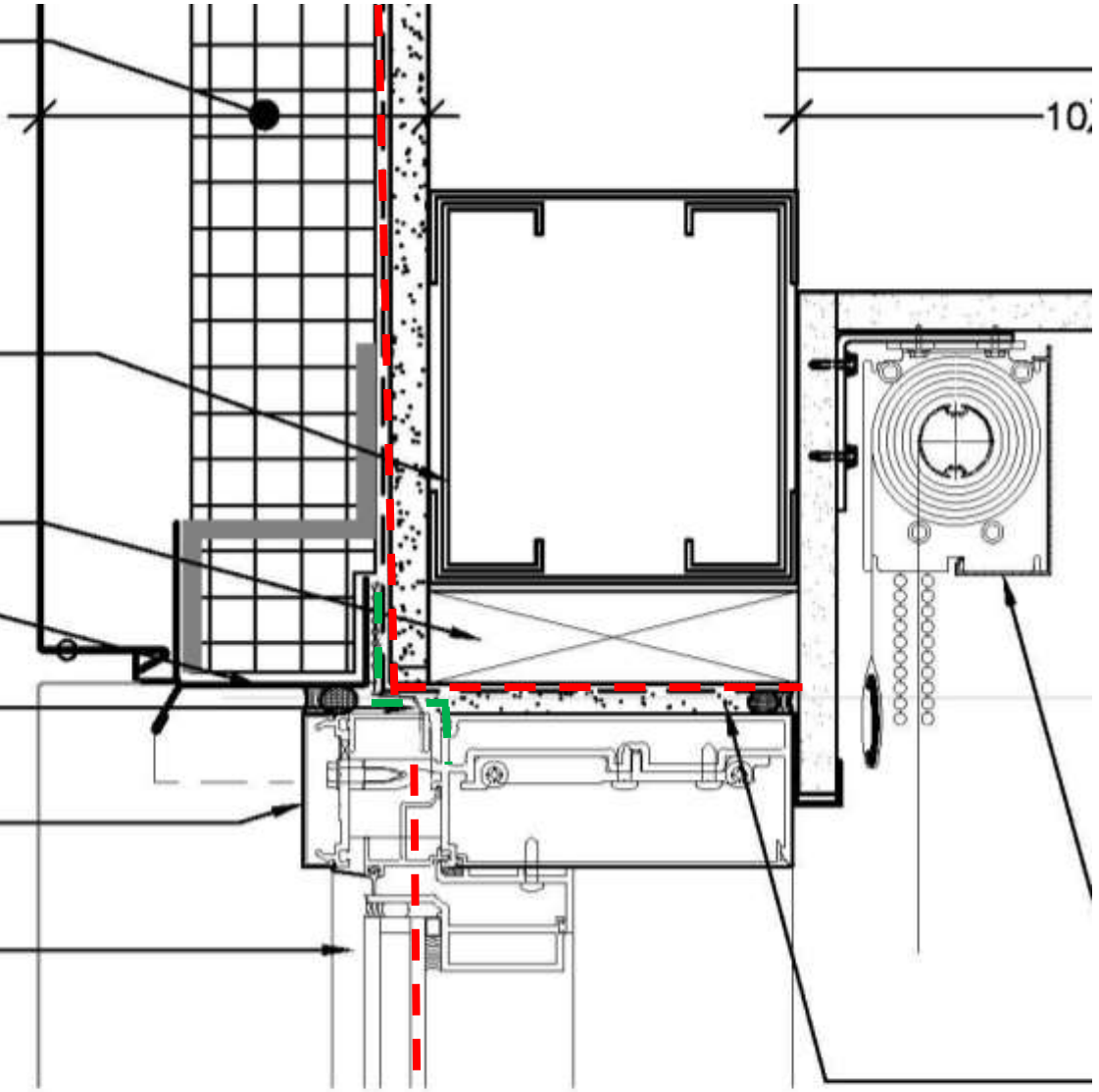
WOOD BLOCKING (06 10 00)

HEAD FLASHING (07 42 19)

SILICONE TRANSITION MEMBRANE – SET IN SEALANT – BOTH SIDES (08 41 13)

THERMALLY BROKEN CURTAIN WALL MULLION (08 41 13)

INSULATED LOW-E GLAZING (08 80 00)



3 TYPICAL WINDOW HEAD DETAIL

SCALE: 3"=1'-0"

0 3" 6" 9"

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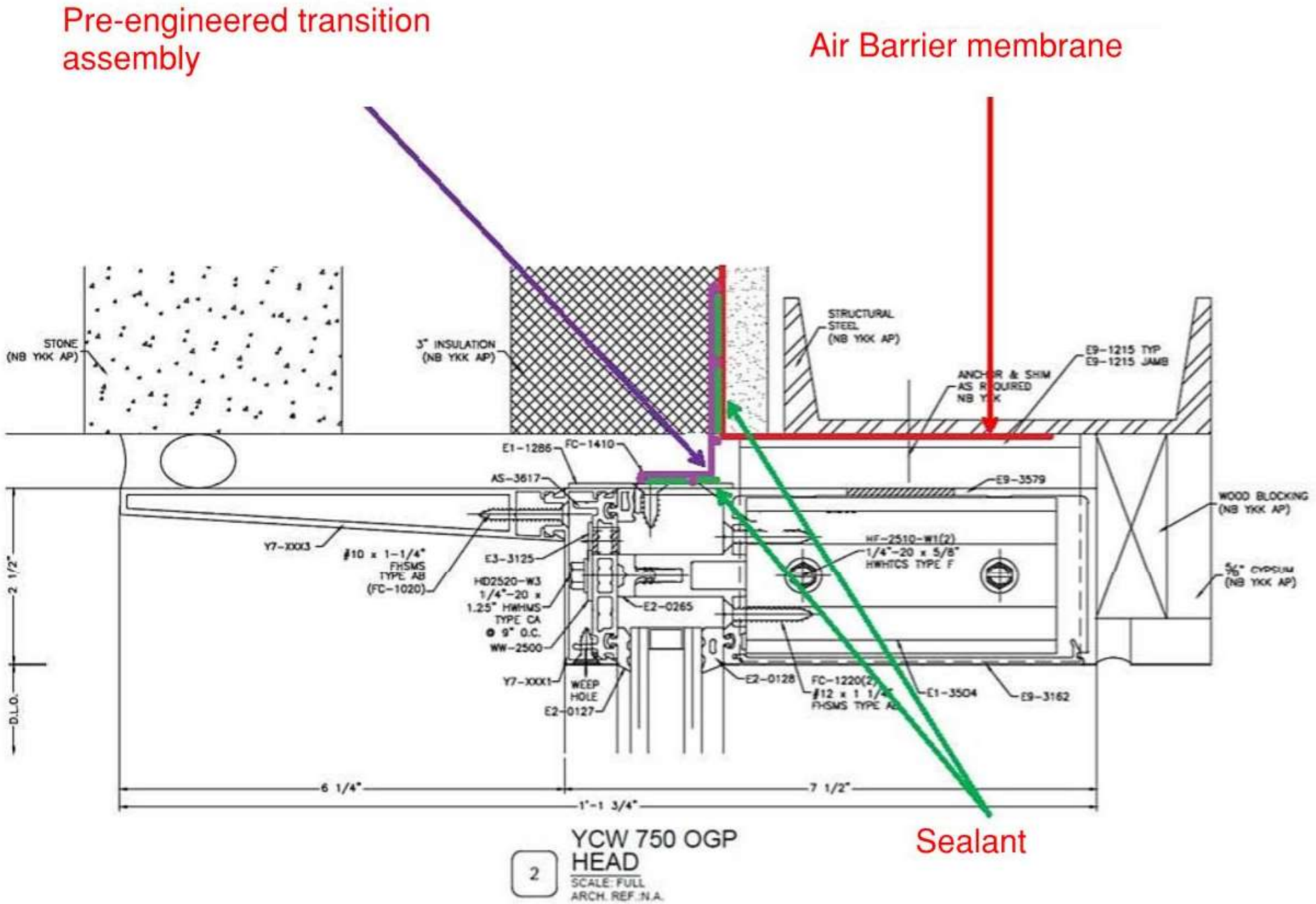

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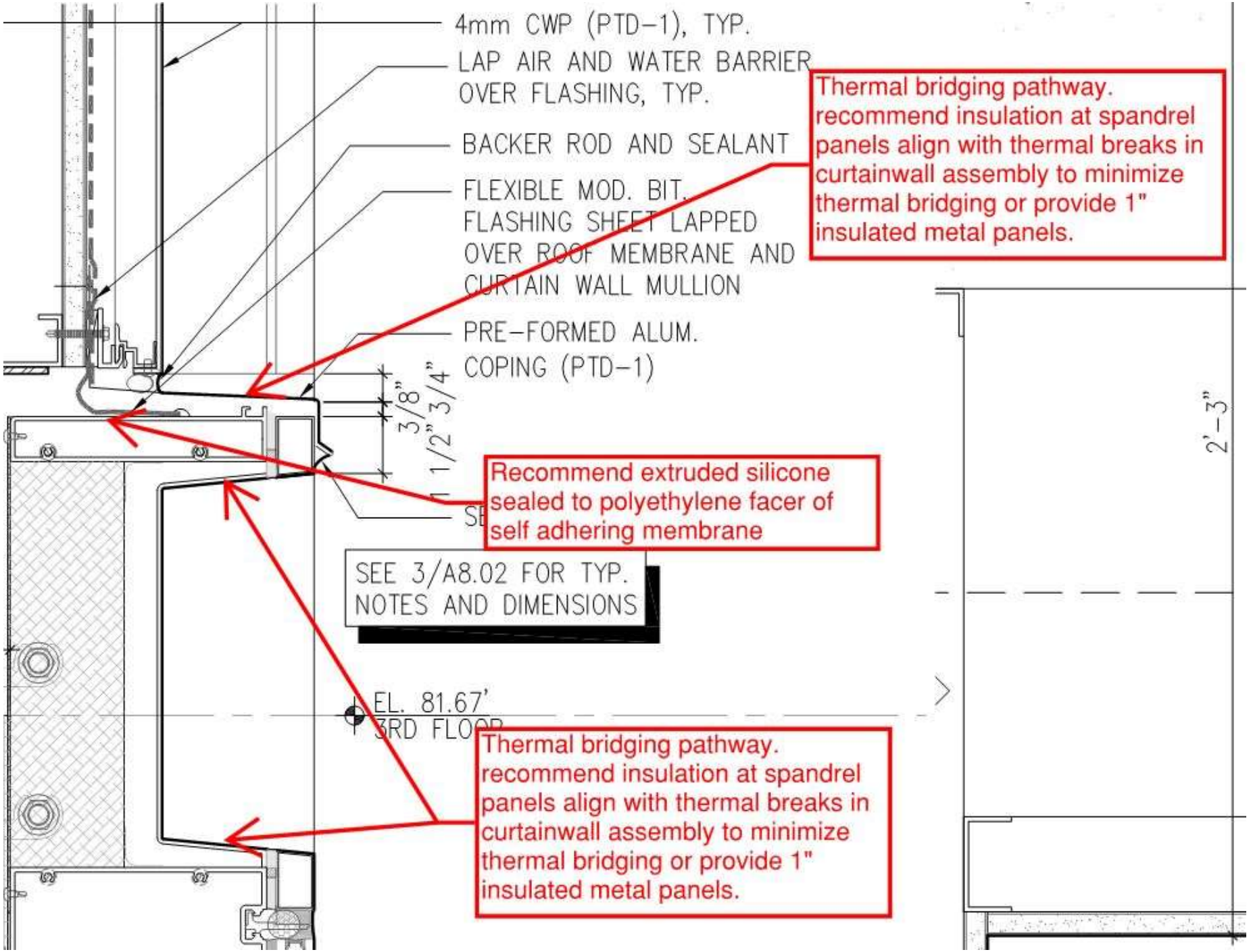

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Transition Material at Curtain Wall and AVB

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Transition Material at Curtain Wall and AVB

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Mock-up

- Include typical details
- Any areas of concern (i.e. transitions)
- Require onsite crew to perform mock-up

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Mock-Up

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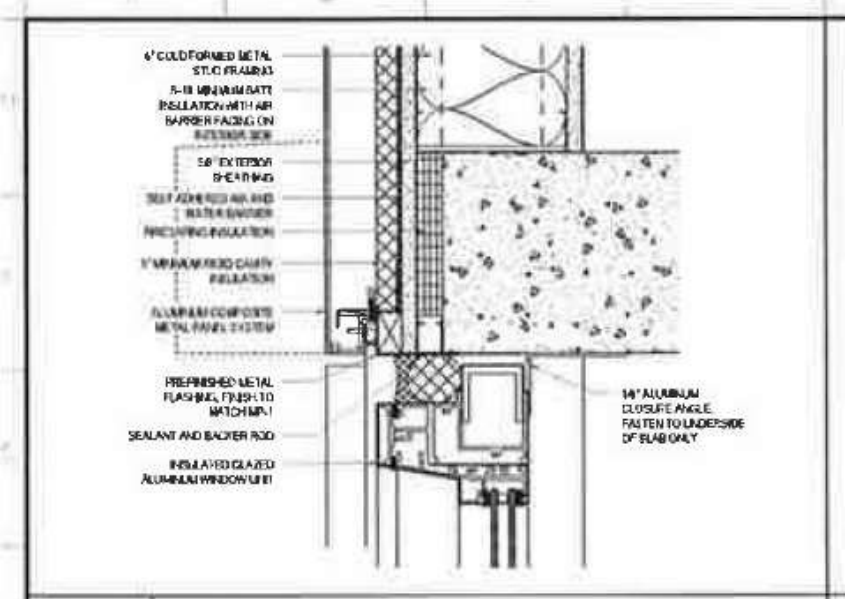
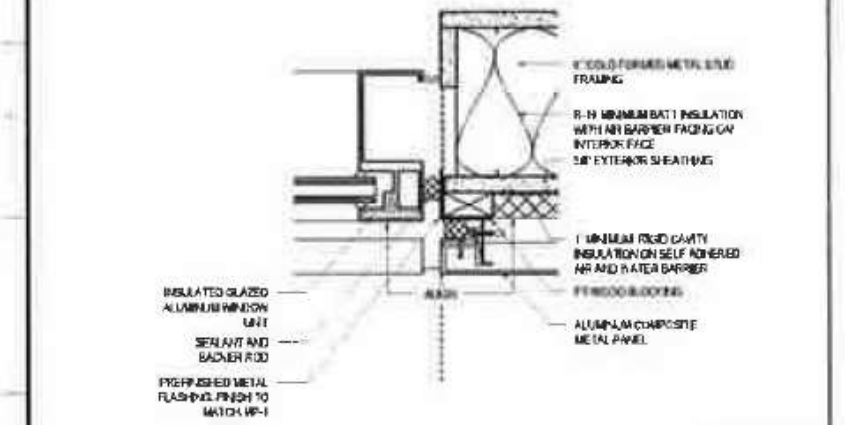
Window Detailing

- Difficult transitions



R.1 WINDOW "WUA" HEAD DETAIL

3" = 1'-0"



M.1 WINDOW "WUA" JAMB DETAIL

3" = 1'-0"

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Window Detailing

- Difficult transitions

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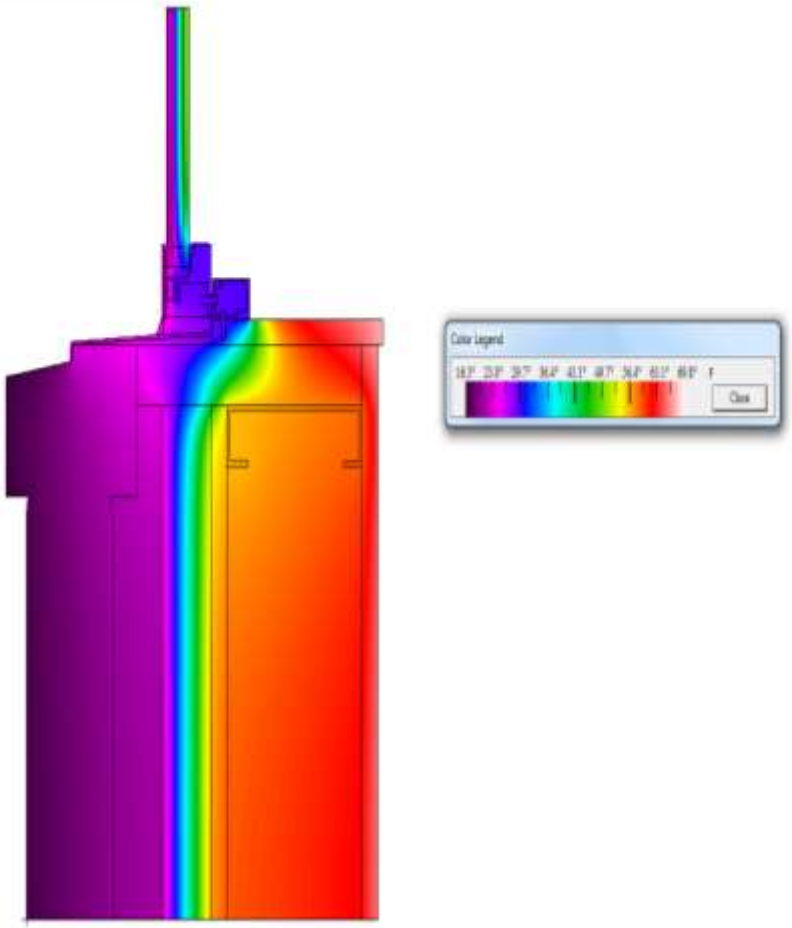
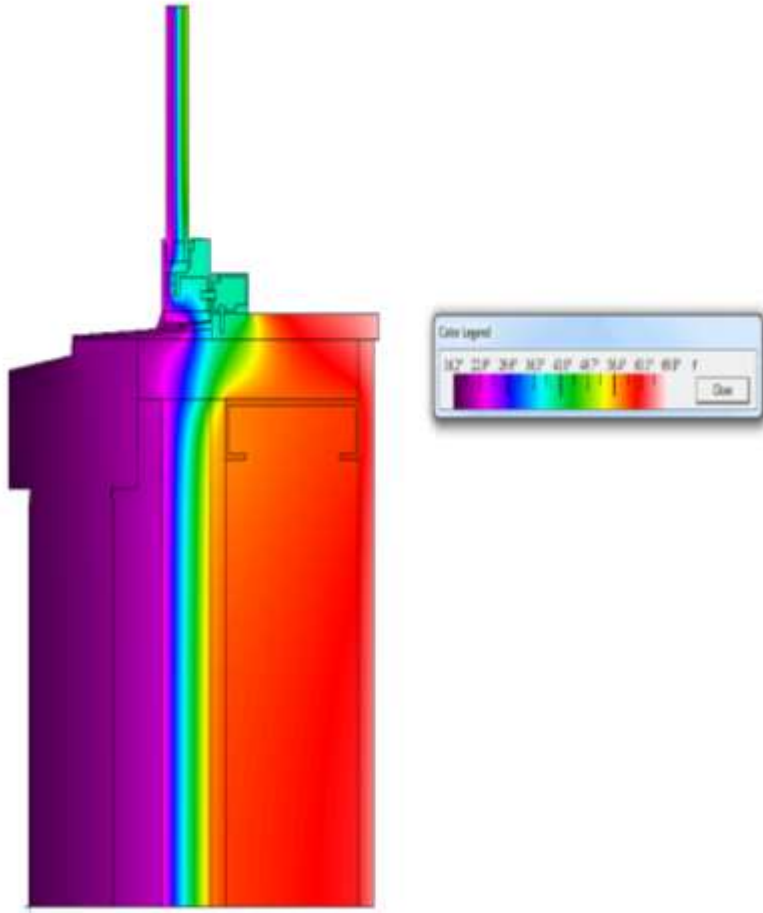
Placement and Window Configuration





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Source: Midwestern Sustainable Design

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The Devil is in the Details!

Thank You!


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