

The Art & Science of Design Reviews for Building Enclosure

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

Learning Objectives

1. Distinguish between the human-centric components of building enclosure design reviews and the scientific.
2. Discuss the role of communication, building relationships and teamwork.
3. Appraise the applicable reference standards
4. Illustrate the fundamentals of control layers for water, air, thermal and vapor.
5. Verify materials compatibility and resilience

Course Description

Third-party design reviews set the stage for achieving high-performing building enclosures.

Creating relationships, and effective communication are half of the formula to meet the Owner's Project Requirements.

This leads the way to facilitate solutions as plans and specifications are analyzed scientifically per reference standards, and engineering principles.

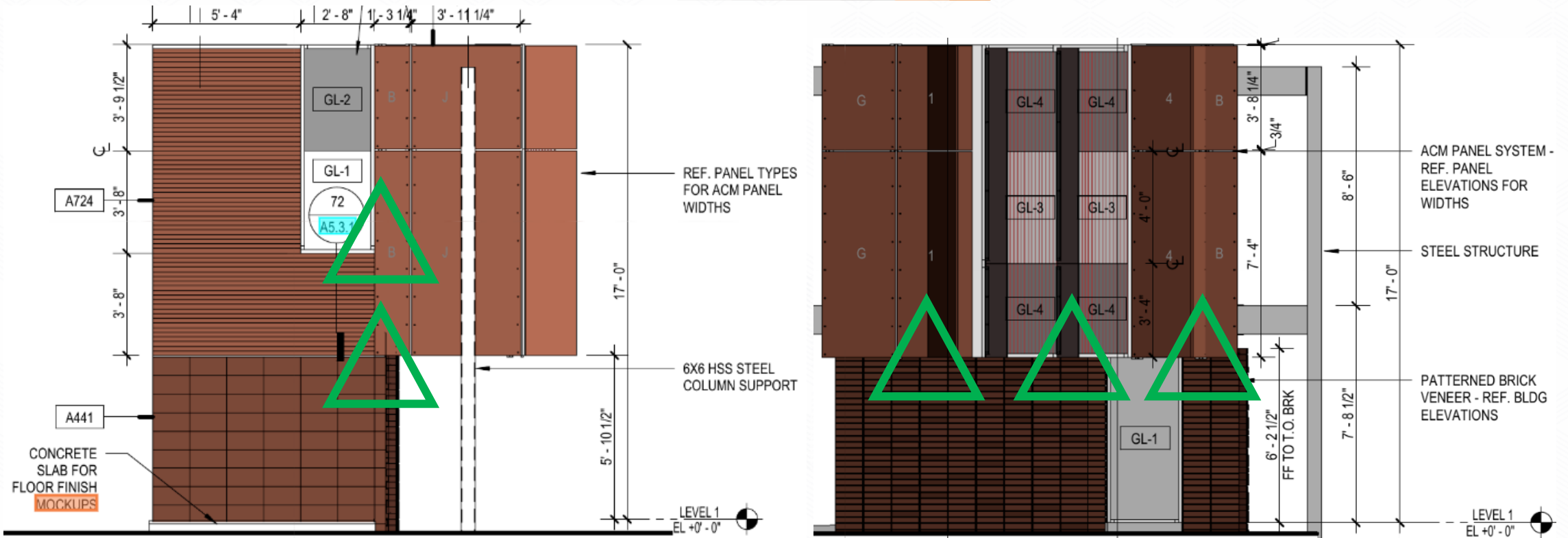
Ultimately, the building enclosure system is the product of teamwork between the Owners, Designers, Contractors, and Commissioning Providers.

Successful Building Enclosure Commissioning



FIGURE 1. The University of Arizona marked the completion of construction and opening of the \$85 million Applied Research Building (ARB), a one-of-a-kind advanced research facility that further solidifies and advances the university's reputation in space research. *Image courtesy of SmithGroup*

ART – Integrated Project Delivery method - IPD



Mock-up Review Comments:

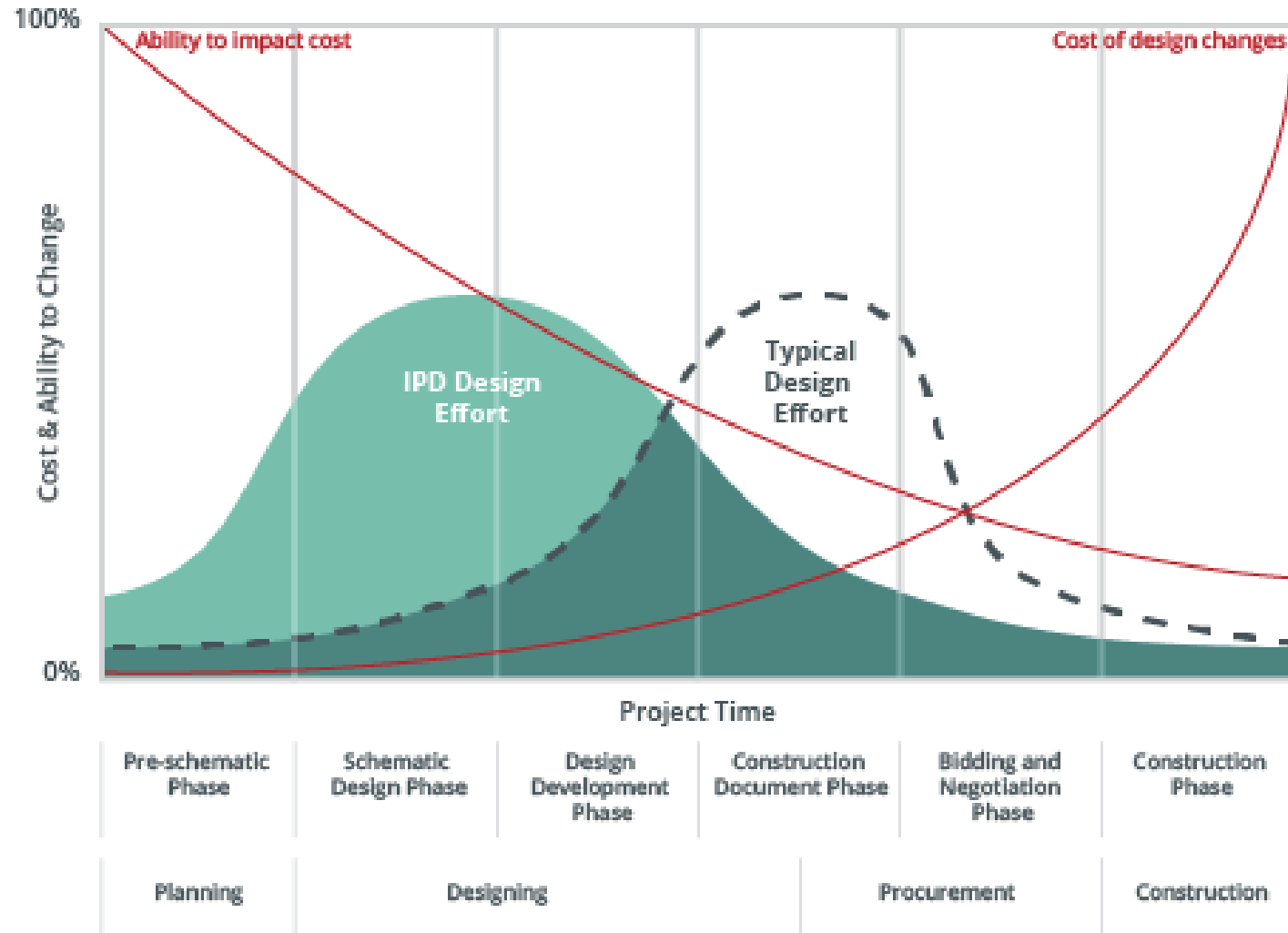
Opportunities to reduce scale based on conditions we want to test.
Can remove middle 1/3 of any component there for testing purposes.

ART – IPD & LEED

PRECONSTRUCTION CHECKLIST

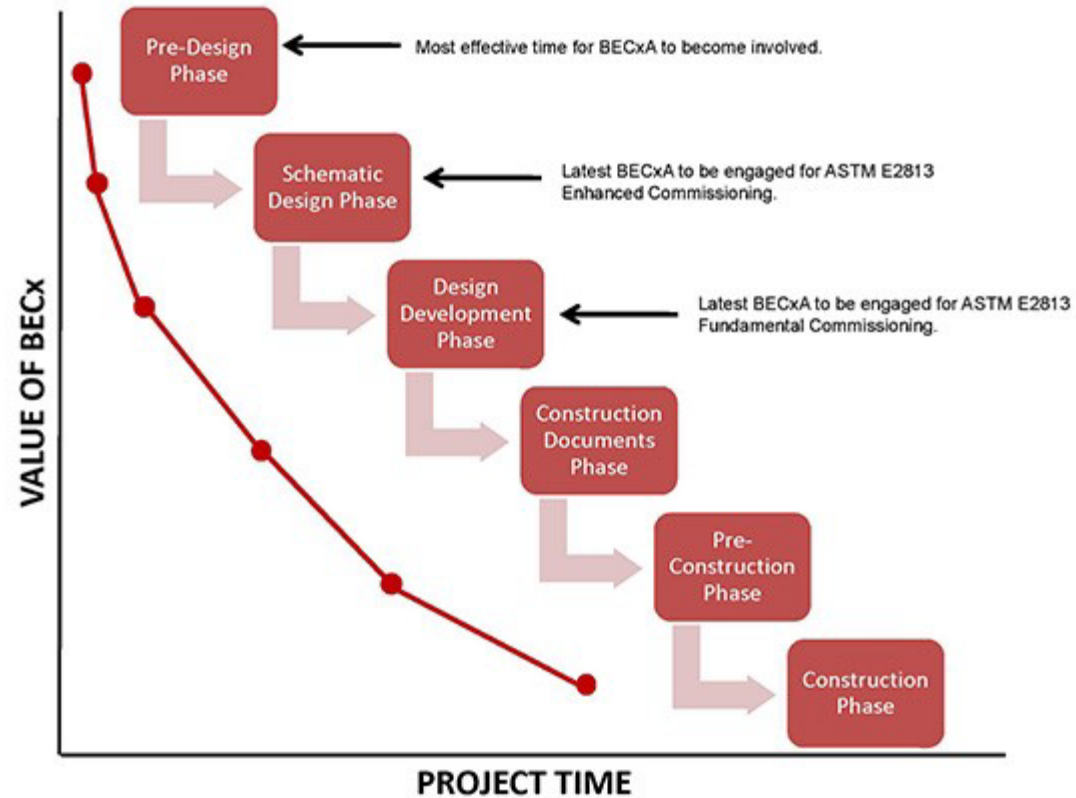
- ☐ Review BOD vs. OPR
- ☐ Integrated Review of Design docs
- ☐ Coordinate BE rqmts among BE Cx team members
- ☐ BE CxP develops BE Cx spec for inclusion into project manual once accepted by Owner & Architect/Engineer of Record.
- ☐ BE Cx reviews BE Cx process with prospective bidders
- ☐ BE Cx reviews tech. proposals; assists with tech. evaluation of bids to meet rqmts of OPR

ART – Integrated Project Delivery (IPD)



ART – Communication

Develop lines of communication between CxP, Owner, Facilities Management, Design team, and Contractors.



ART – Communication

Regular meetings
enable all
interested parties
to weigh in on
details from
parapet
to foundation.

The screenshot displays a software interface for reviewing design documents. The top half shows a technical drawing of a building section. The bottom half features a table of review comments.

Author	Comment	Page Label	Creation Date	Checkmark	Color	Layer	Comments
Donna English, DSA Initial Architect (2)	Donna English, DSA Initial Architect	AS-401 PART...	3/5/2016 9:33:47 AM				
Donna English, DSA Initial Architect	Donna English, DSA Initial Architect	AS-401 PART...	3/5/2016 9:33:47 AM				
Shelley Kishinsky, AECOM (4)	Violence of Appl...	Q-001 COVER...	3/15/2016 10:01:47...				
Shelley Kishinsky, AECOM	Notes to DP	Q-001 COVER...	3/15/2016 10:01:47...				

Review Comments 2.2.6

Violence of APPLICATION
F24, C24, provided that should the consent drawings not be filed for recordation within 10 business days after the date of issue of the final design review, the applicant shall be required to submit a new application for review. The applicant shall be required to submit a new application for review within 10 business days after the date of issue of the final design review.

Notes to the Design Professional
All plan review comments must be addressed in a letter to your local check-approval with the Director of the State Architect (SA). Any comments and/or copies of drawings with plan review comments must be submitted with the plan review letter to the SA. The plan review process is a continuous process. The design professional must be familiar with the project and the plan review process. The design professional may be contacted and required to provide information to the plan review, with assistance of the design professional. The plan review team (review team) will be assigned to review the plan review letter and the plan review letter. The design professional must be familiar with the project and the plan review process. The design professional may be contacted and required to provide information to the plan review, with assistance of the design professional. The plan review team (review team) will be assigned to review the plan review letter and the plan review letter.

ART – Communication

Sheet	Detail	Comment
A5.2.3	1	Constructability Concern: recommend creating a wall section at X for Team review. FV
A5.3.2	7	Enlarged detail needed at horizontal façade transition. FV
A6.2.1	14	Recommend calling out corner flashing material and detail all metal flashing lapped with weather barrier transition material – typical. FV
A6.3.1	Gen'l	Consider extending air barrier through wing. An water barrier extending around the wing (behind the cladding) is needed but the air barrier should follow the thermal plane. Intertek
A6.3.1	6	Updated intent is that the GFRC panel will act at the air barrier plane. Based on this, penetrations (e.g. lights) need to be considered as holes in the air barrier plane. Intertek
A6.3.2	Gen'l	Integration between the GFRC panel and roof air barrier needs to be developed to provide continuity. Compatibility and sequencing should be carefully considered. Intertek.
Gen'l		Vapor retarder is not necessary for this climatic region. Let's discuss in next meeting.

Sample comments above courtesy of Field Verified and Intertek

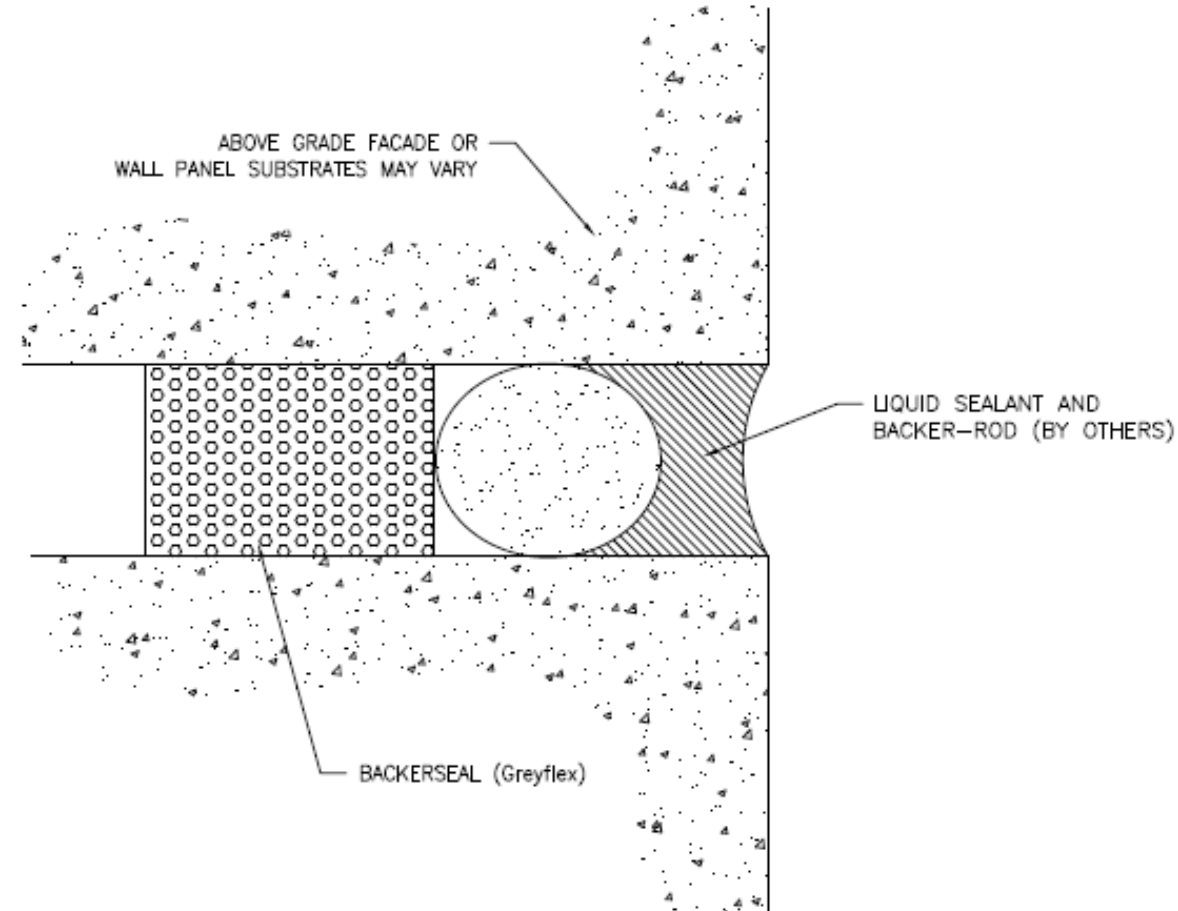
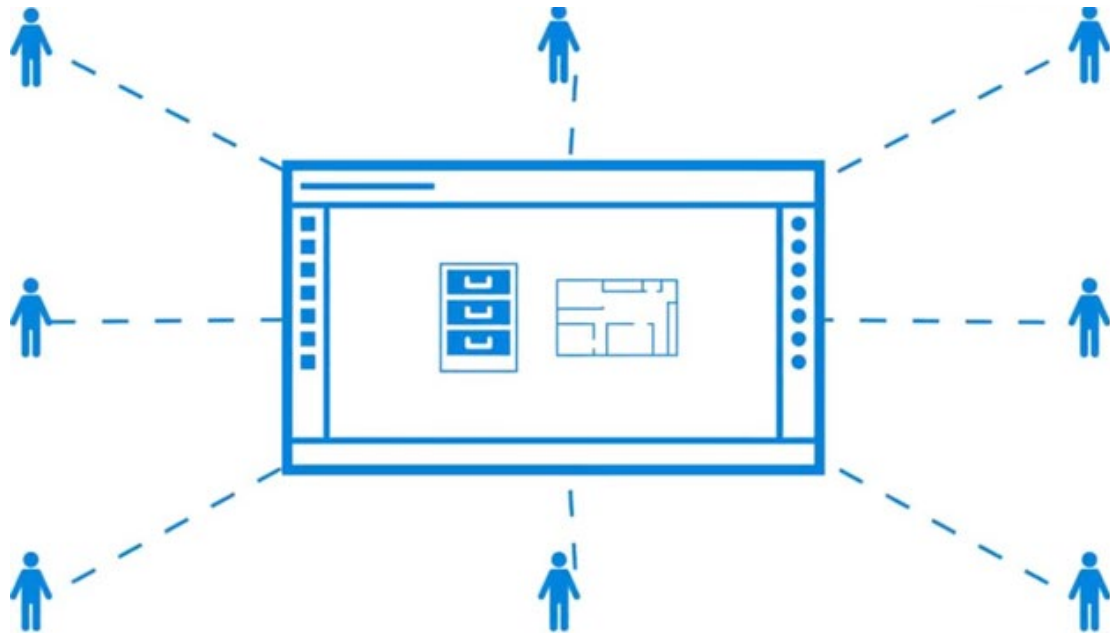
ART – Communication

Inclusive Knowledge Transfer: Bluebeam & Discussions vs. email



ART – Communication

- Constructability and Resilience
 - Mitigate potential issues
 - Include FM staff for input on durability.



SCIENCE —

01

Reference Standards

02

Control Layer Fundamentals

Moisture Migration

Heat Transfer

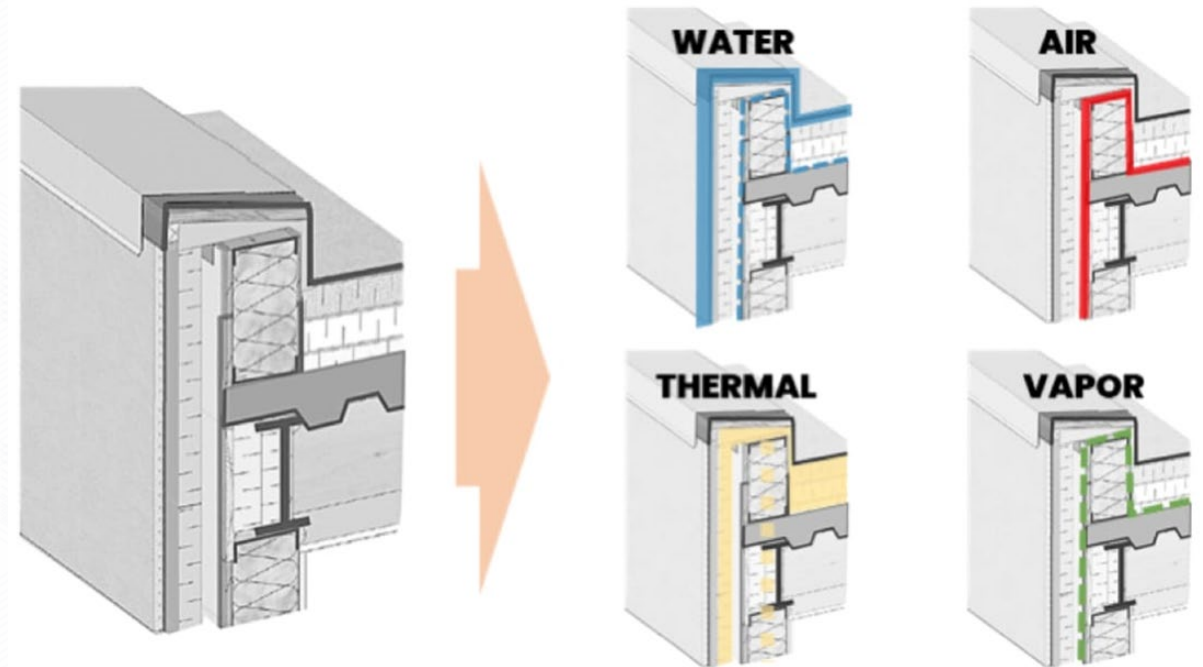
Air Leakage

03

Compatibility

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Resilience



SCIENCE – Reference Standards

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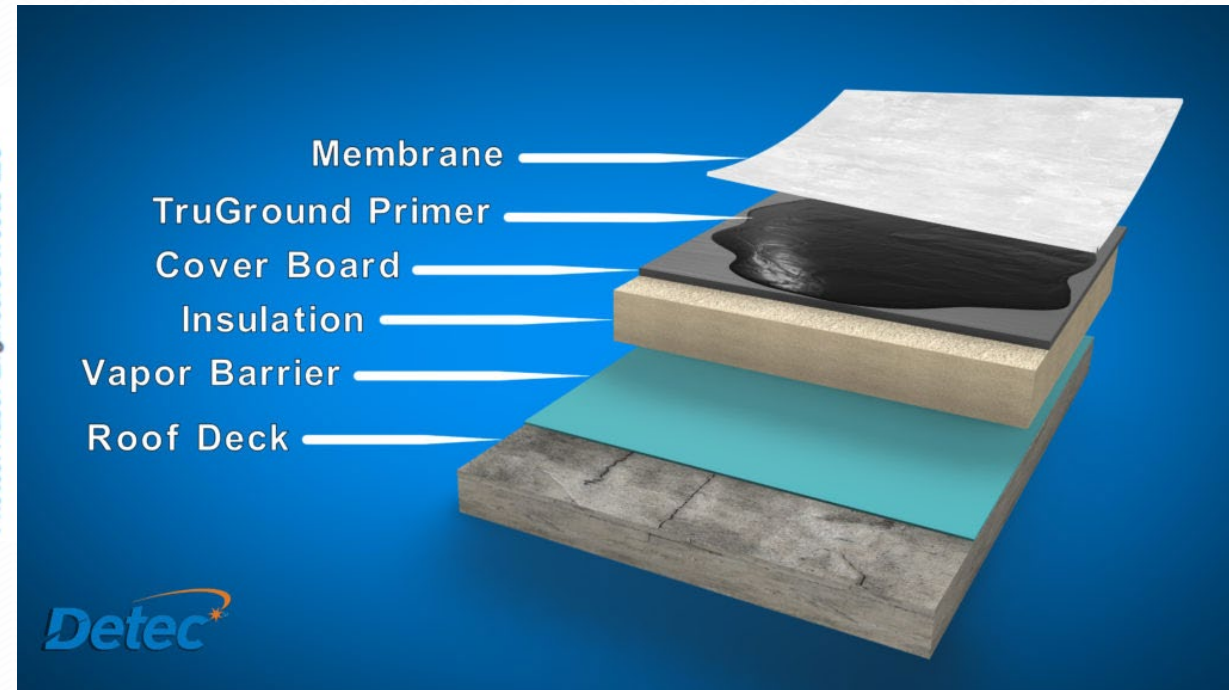
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Photos: Huber Engineered Woods LLC



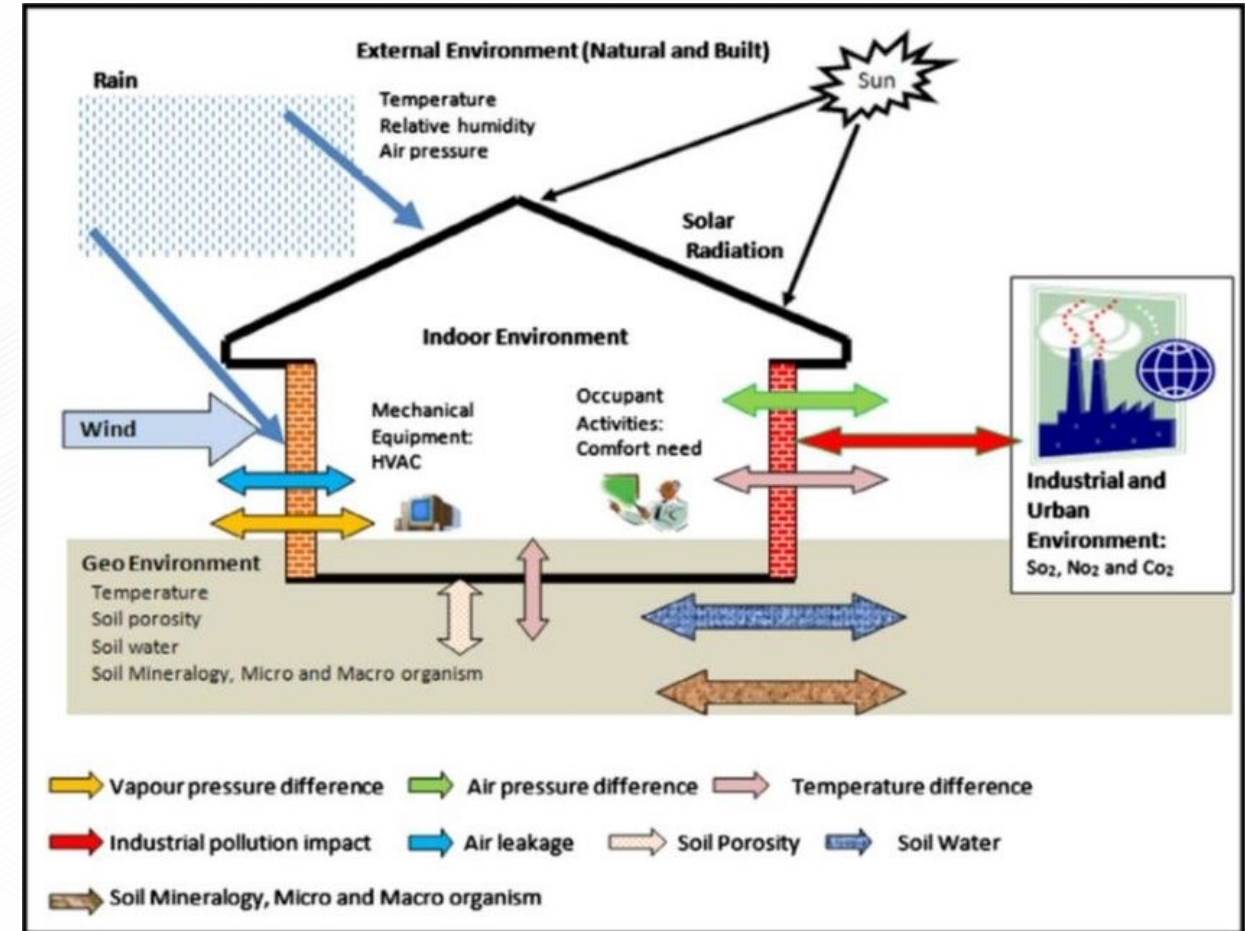
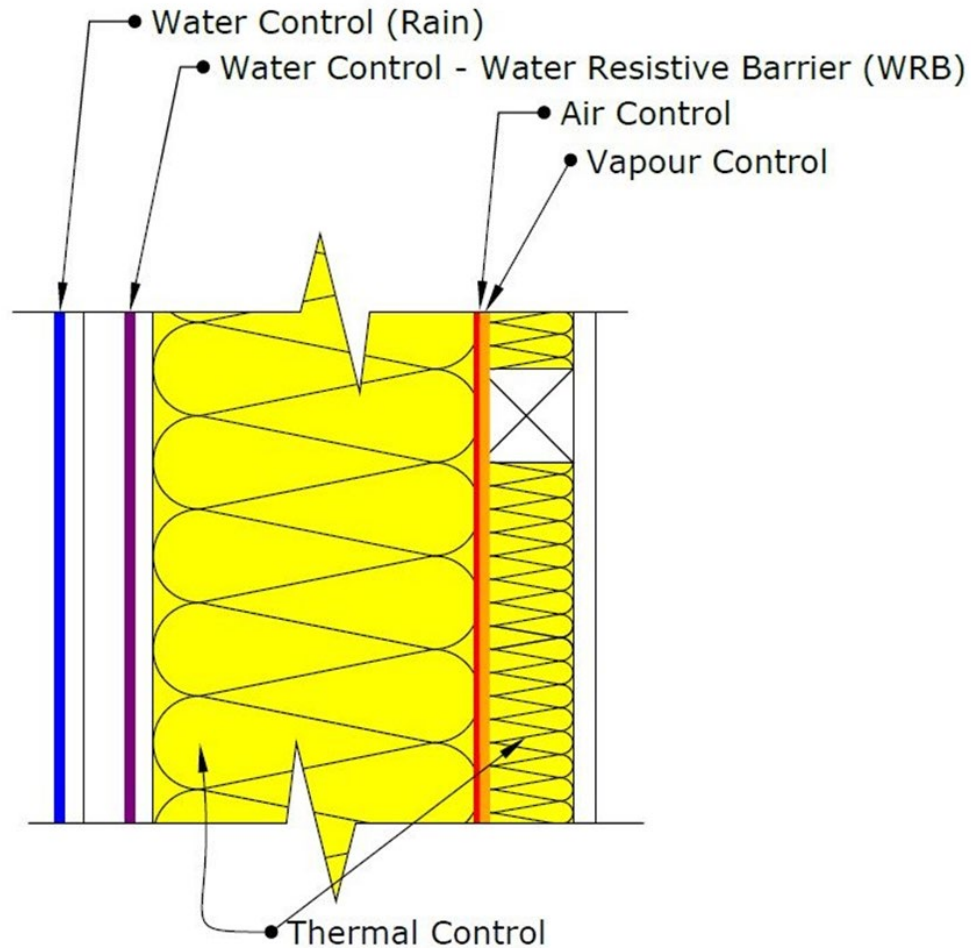
SCIENCE – Control Layer Fundamentals

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SCIENCE – Moisture Migration

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CONTROL FUNCTION	PHYSICAL MECHANISM	CONTROL STRATEGY
Moisture Migration	<i>Bulk Water</i>	Shedding Conveyance Drainage Storage & Drying Drain-Screen Rain-Screen Dynamic Buffer Zone Perfect Barrier
	<i>Capillary Water</i>	Capillary Barrier Capillary Break
	<i>Vapour Diffusion</i>	Vapour Barrier Thermal Insulation
	<i>Air Leakage</i>	Air Barrier System

SCIENCE – Moisture Migration

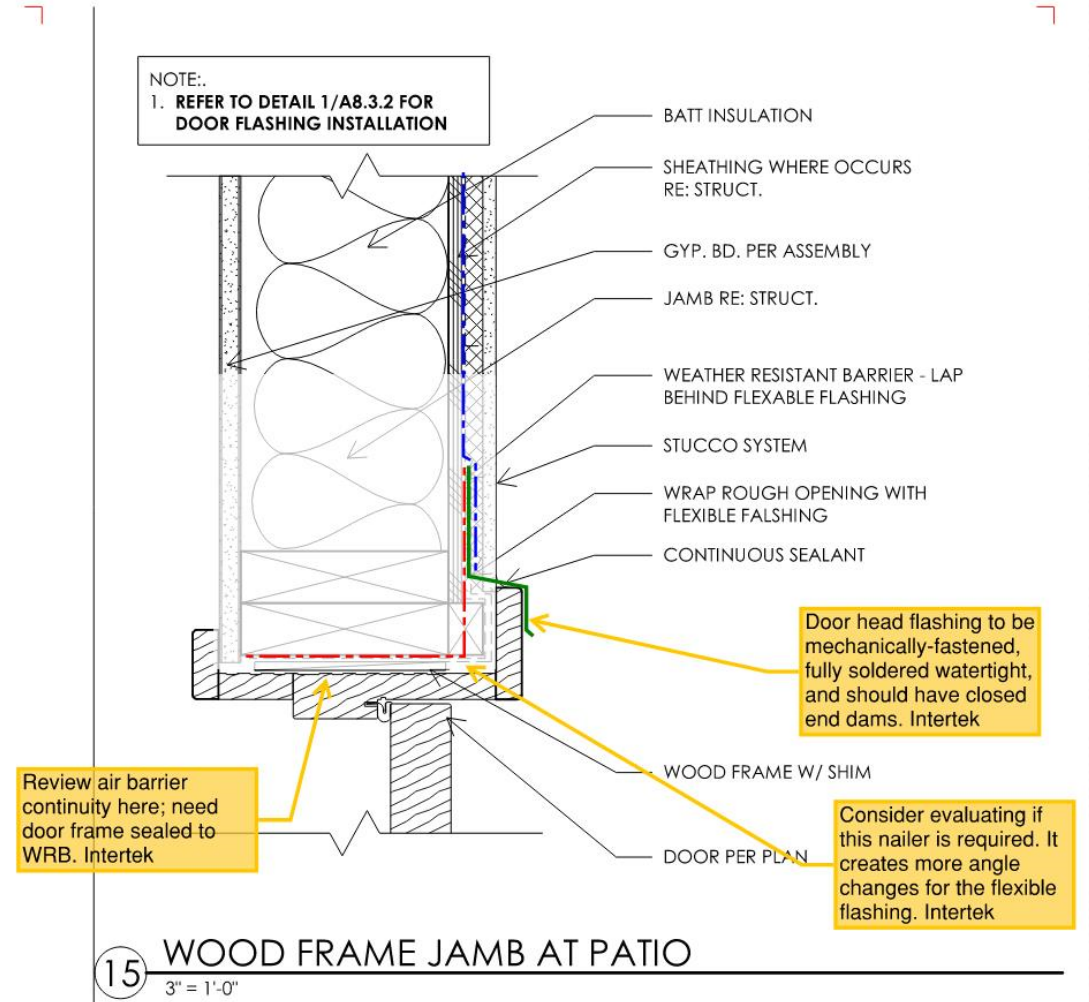
01 77% of post-construction litigation concerns water intrusion

(Design Professionals Insurance Company Study)

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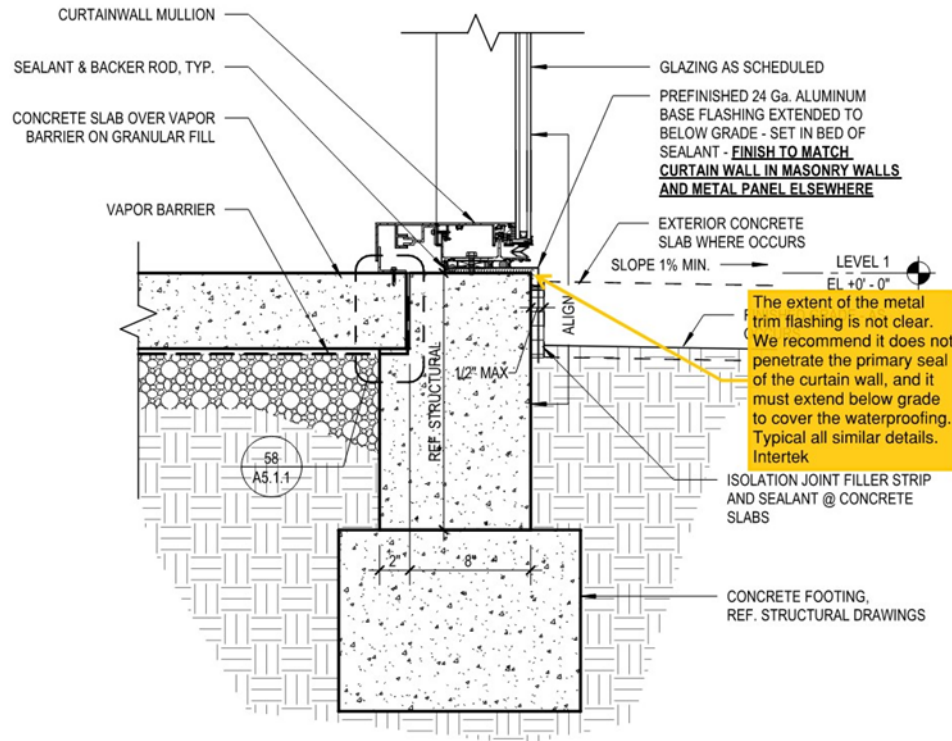
SCIENCE – Moisture Migration

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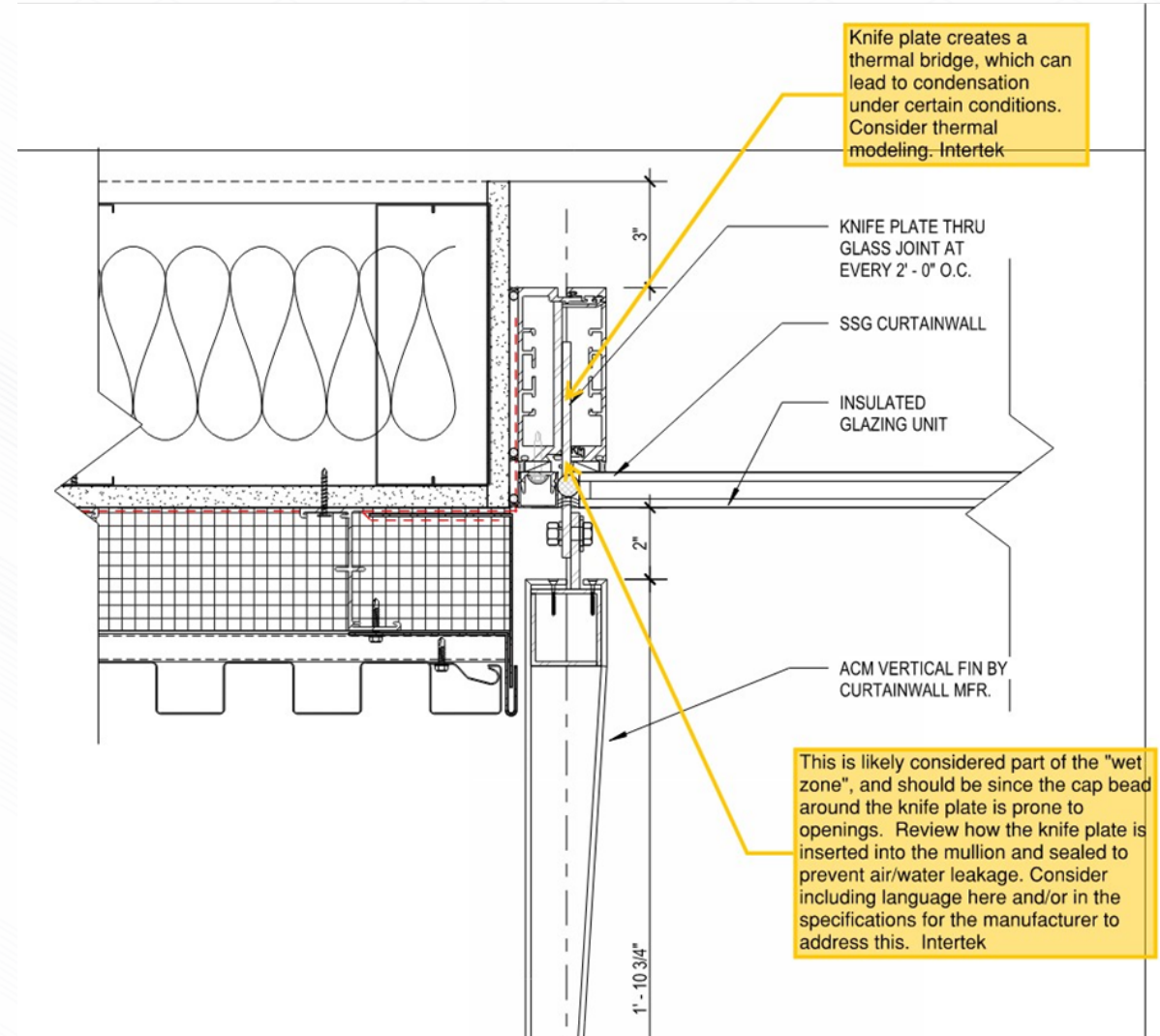
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SECTION DETAIL - TYPICAL CURTAINWALL SILL @ SLAB EDGE

SCALE: 1 1/2" = 1'-0"



SCIENCE – Vapor

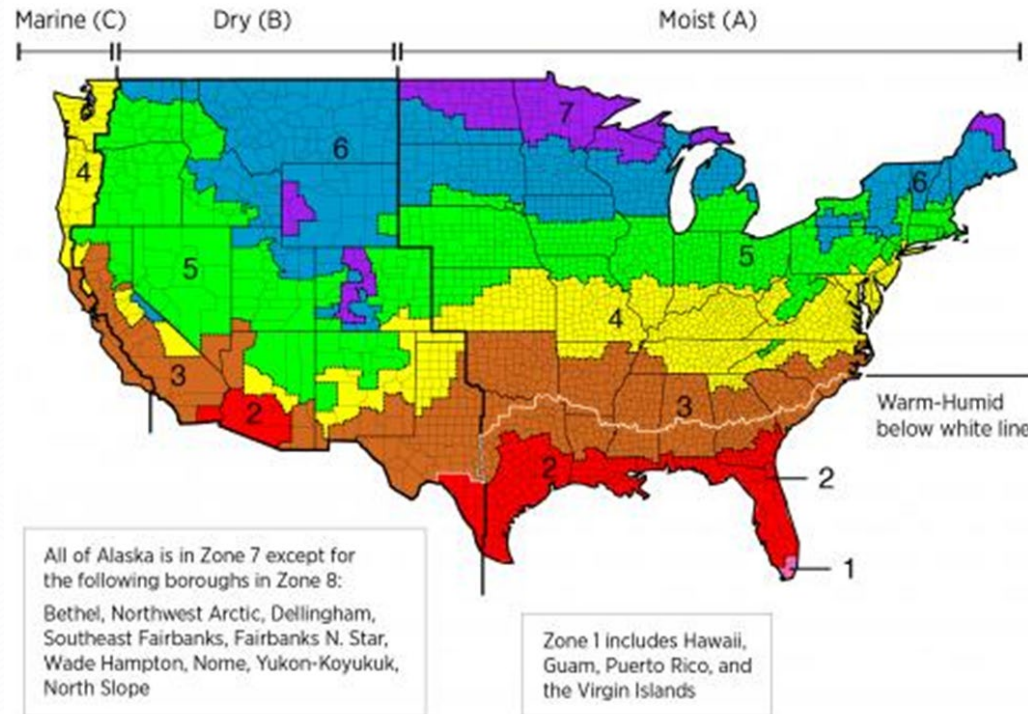
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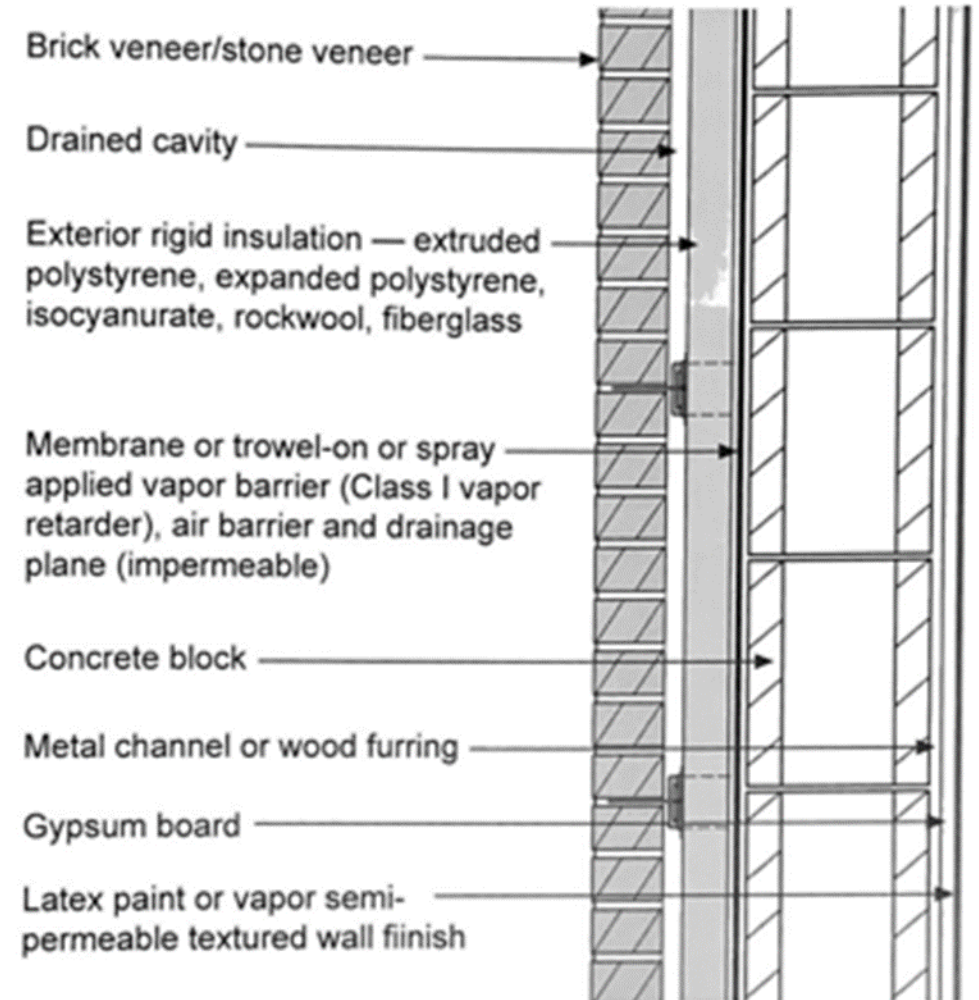
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IECC climate zone map



Reference: 2012 IECC - International Energy Conservation Code



(Figure 4.5 from p 101 of High-Performance Enclosures by John Straube)

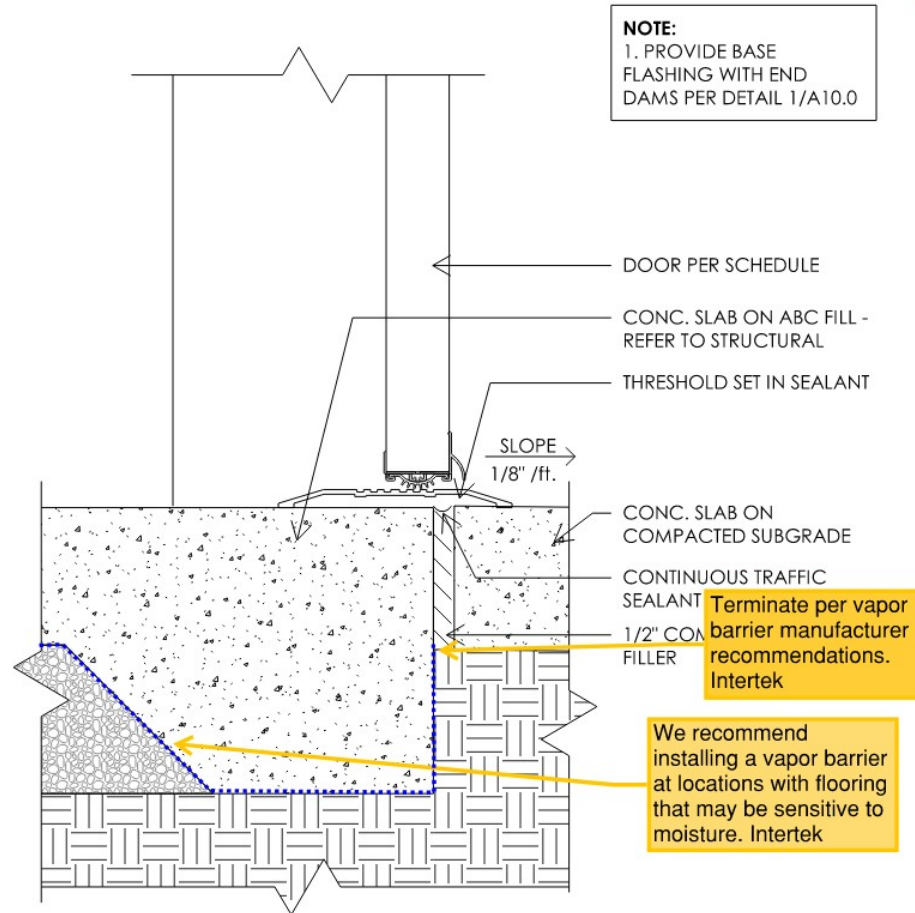
SCIENCE – Vapor

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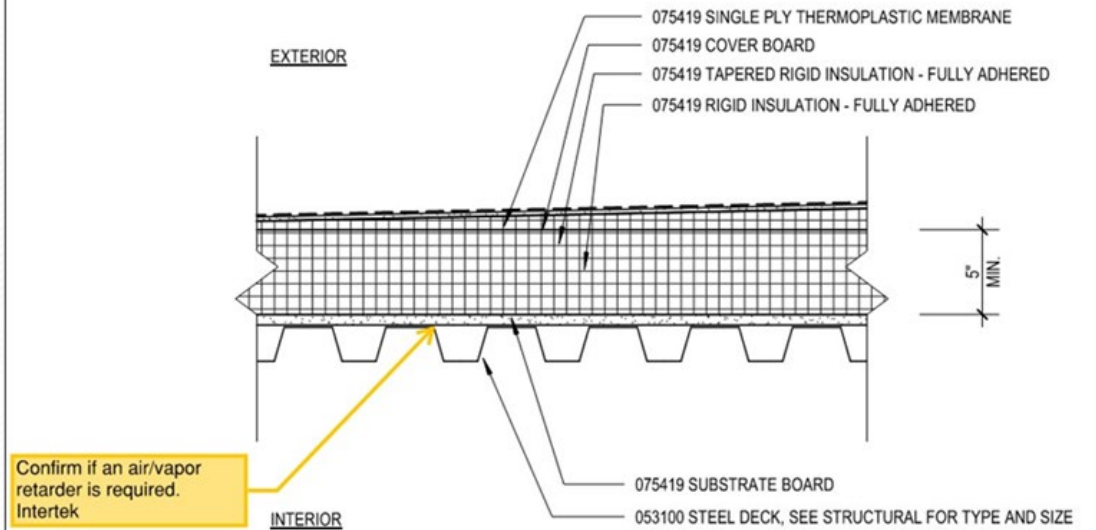
04



DOOR THRESHOLD

3" = 1'-0"

R313 TYPICAL ASSEMBLY



R313

ROOF ASSEMBLY
SINGLE PLY THERMOPLASTIC (PVC) MEMBRANE - R-30 MIN
FULLY ADHERED
LEVEL STEEL DECK WITH SHEATHING

SCIENCE – Heat Transfer

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CONTROL FUNCTION	PHYSICAL MECHANISM	CONTROL STRATEGY
Heat Transfer	<i>Conduction</i> <i>Radiation</i> <i>Convection</i>	Thermal Insulation Radiation Barrier Air Barrier System

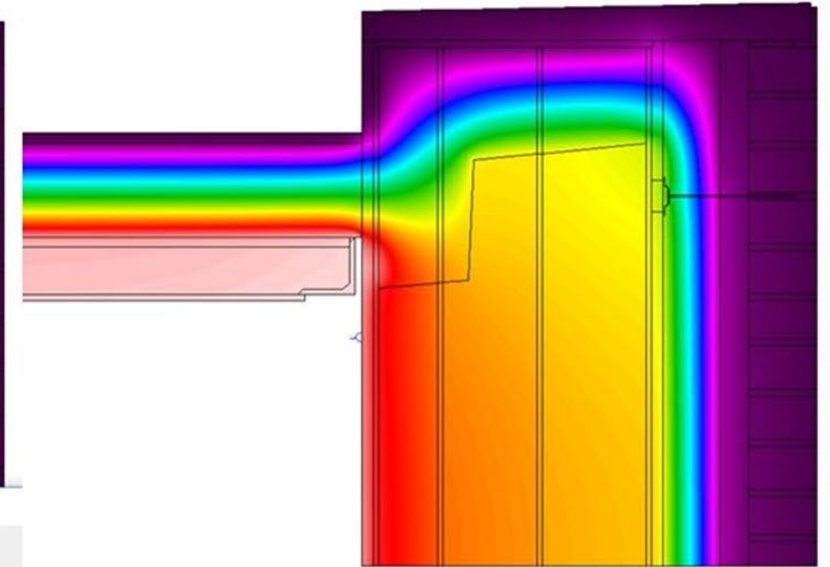
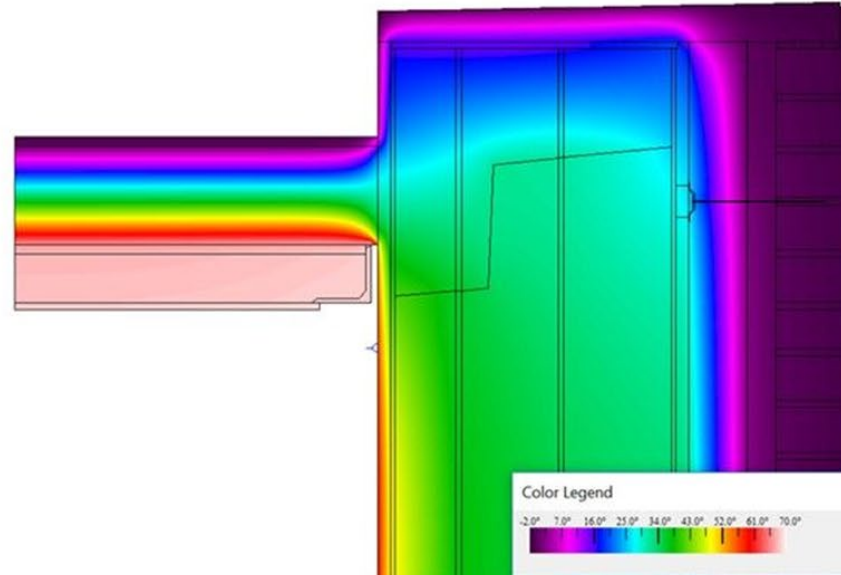
SCIENCE – Heat Transfer

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Continuous Insulation “ci”

Must not be bridged by studs, hats, zeos. (Clips and fasteners are OK)

ASHRAE Zone	Wall Type	Continuous Insulation Code Requirement							
		ASHRAE 90.1				IECC			
		2007 ASHRAE 90.1	2010 ASHRAE 90.1	2013 ASHRAE 90.1	2016 ASHRAE 90.1	2009 IECC	2012 IECC	2015 IECC	2018 IECC

SCIENCE – Heat Transfer

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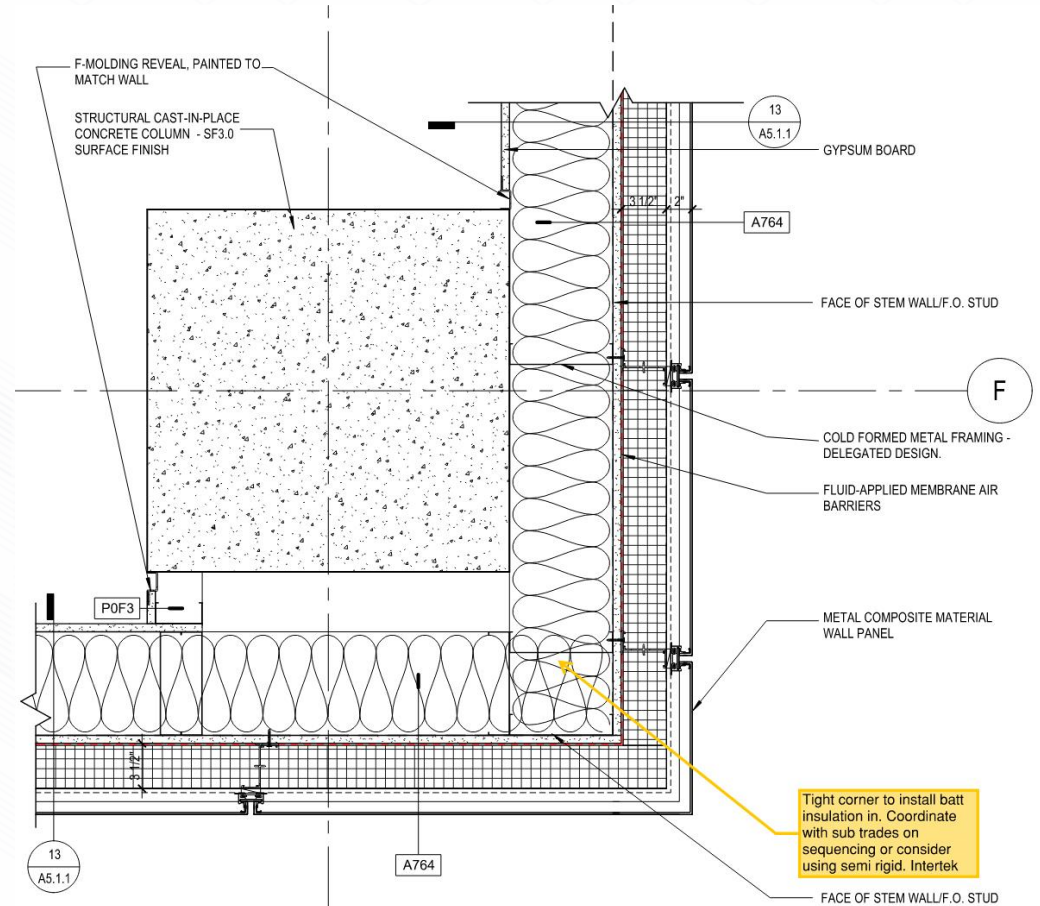
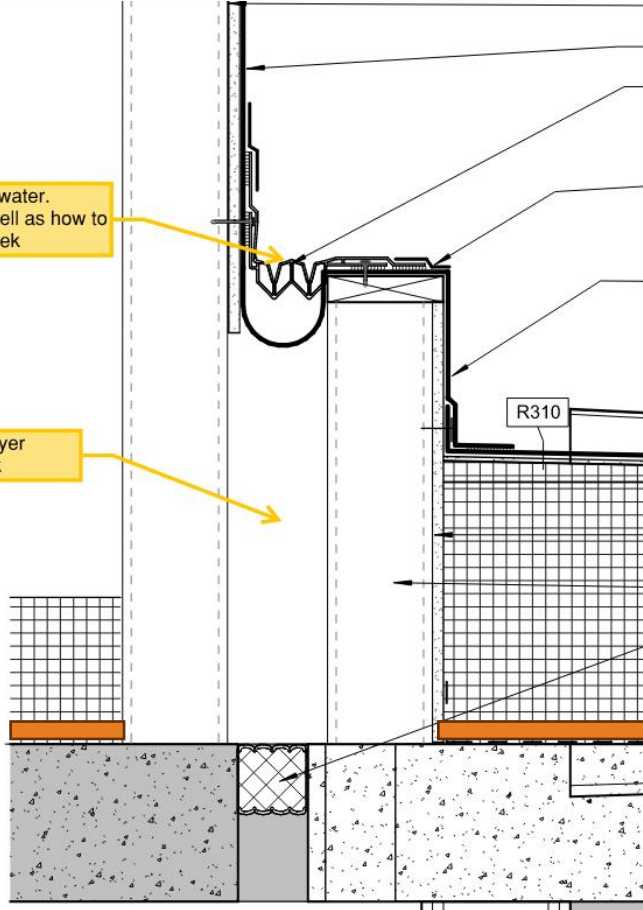
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This condition is flat and will hold water. Consider a sloped condition, as well as how to integrate some redundancy. Intertek

Review thermal layer continuity. Intertek



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LEVEL 1 PLAN DETAIL - METAL PANEL @ CL 10.1-F

SCALE: 1 1/2" = 1'-0"

SCIENCE – Air Leakage

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CONTROL FUNCTION	PHYSICAL MECHANISM	CONTROL STRATEGY
Air Leakage	<i>Stack, Wind, and Mechanical Effects</i>	Air Barrier System

SCIENCE – Air Leakage

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CRETE
JOIST
SHEATHING

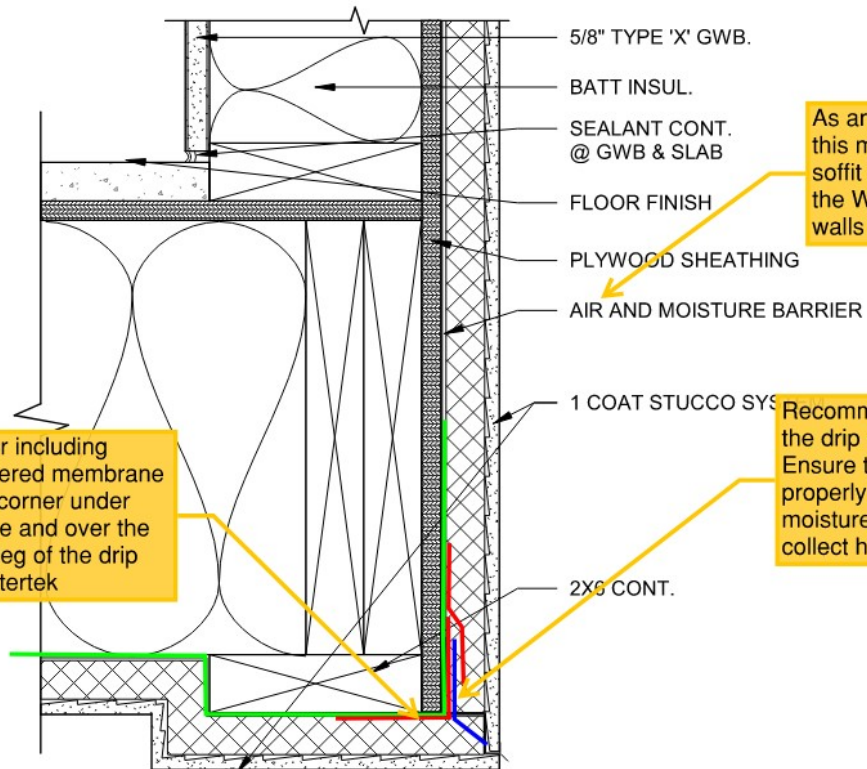
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Consider including self-adhered membrane at soffit corner under drip edge and over the vertical leg of the drip edge. Intertek

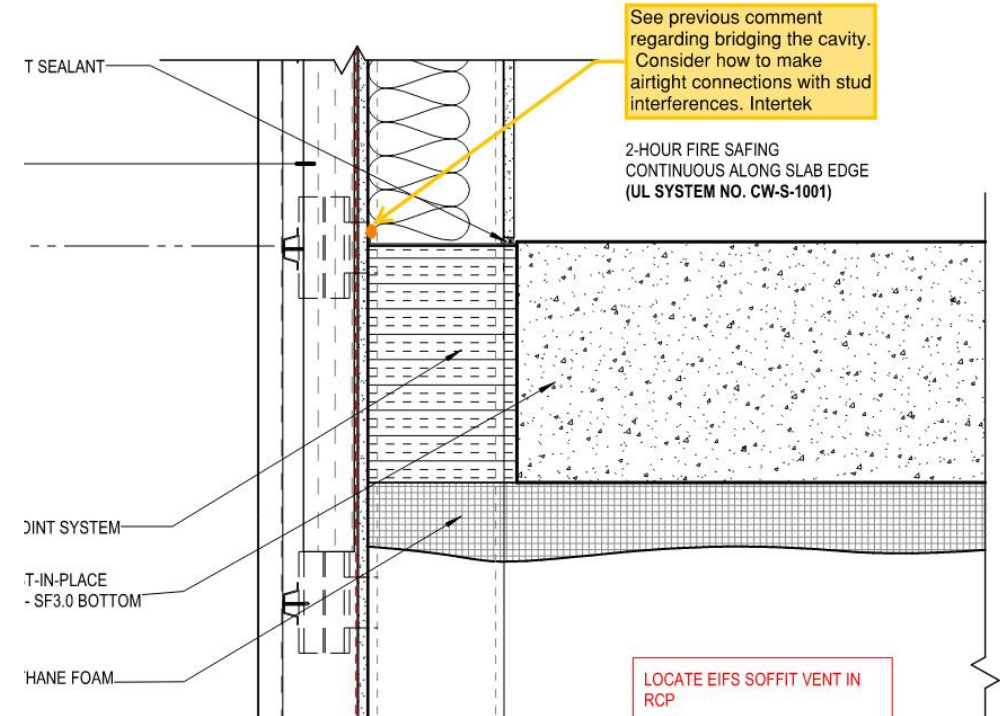


As an air barrier system, this must wrap into the soffit and integrate with the WRB on the balcony walls below. Intertek

Recommend calling out the drip metal here. Ensure this metal is properly sloped so moisture does not collect here. Intertek

10

SOFFIT DRIP DETAIL
3" = 1'-0"



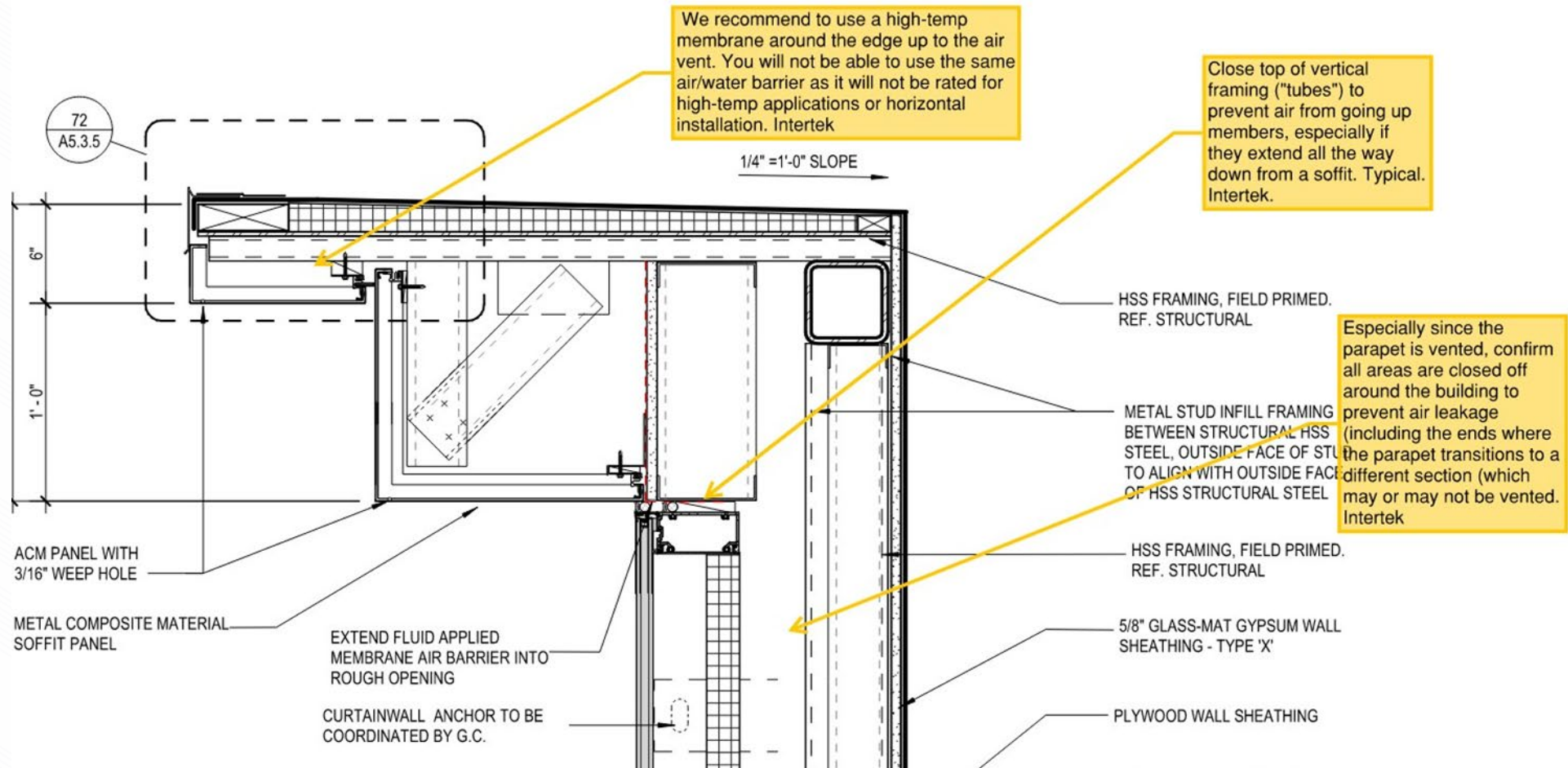
SCIENCE – Air Leakage

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SCIENCE – Compatibility

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1.1 CHEMICAL RESISTANCE

- SENTINEL® PVC membranes have been evaluated for exposure and compatibility to the following materials:
 - Acrylic paint
 - Bleach
 - Copper sulfate
 - Detergent solutions
 - Ferric chloride
 - Fertilizer solutions
 - Fiberglass matting
 - Fruit juices
 - Furnace residues
 - Hydrogen peroxide
 - Latex paint
 - Linseed oil
 - Lard (animal fats)
 - Masonry cleaner
 - Muriatic acid
 - Oleic acid
 - Phosphoric acid
 - Polypropylene
 - Sodium hydroxide
 - Zinc chloride
- Inadvertent exposure to foreign materials, debris and other contaminants should be addressed by proper removal and cleaning. Refer to [Section 1.2](#).
- The following roofing materials are incompatible with SENTINEL® PVC:
 - Asphalt-based roofing and flashing products
 - Coal tar pitch
 - Un-faced extruded and expanded polystyrene.



SCIENCE – Resilience

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Conclusion

Risk overcommunication! Meet early & often.

Review Plans, Specifications and mock-up designs!

Reference Scientific Standards.

Trace every Control Layer.

Review compatibility & resilience of all materials.