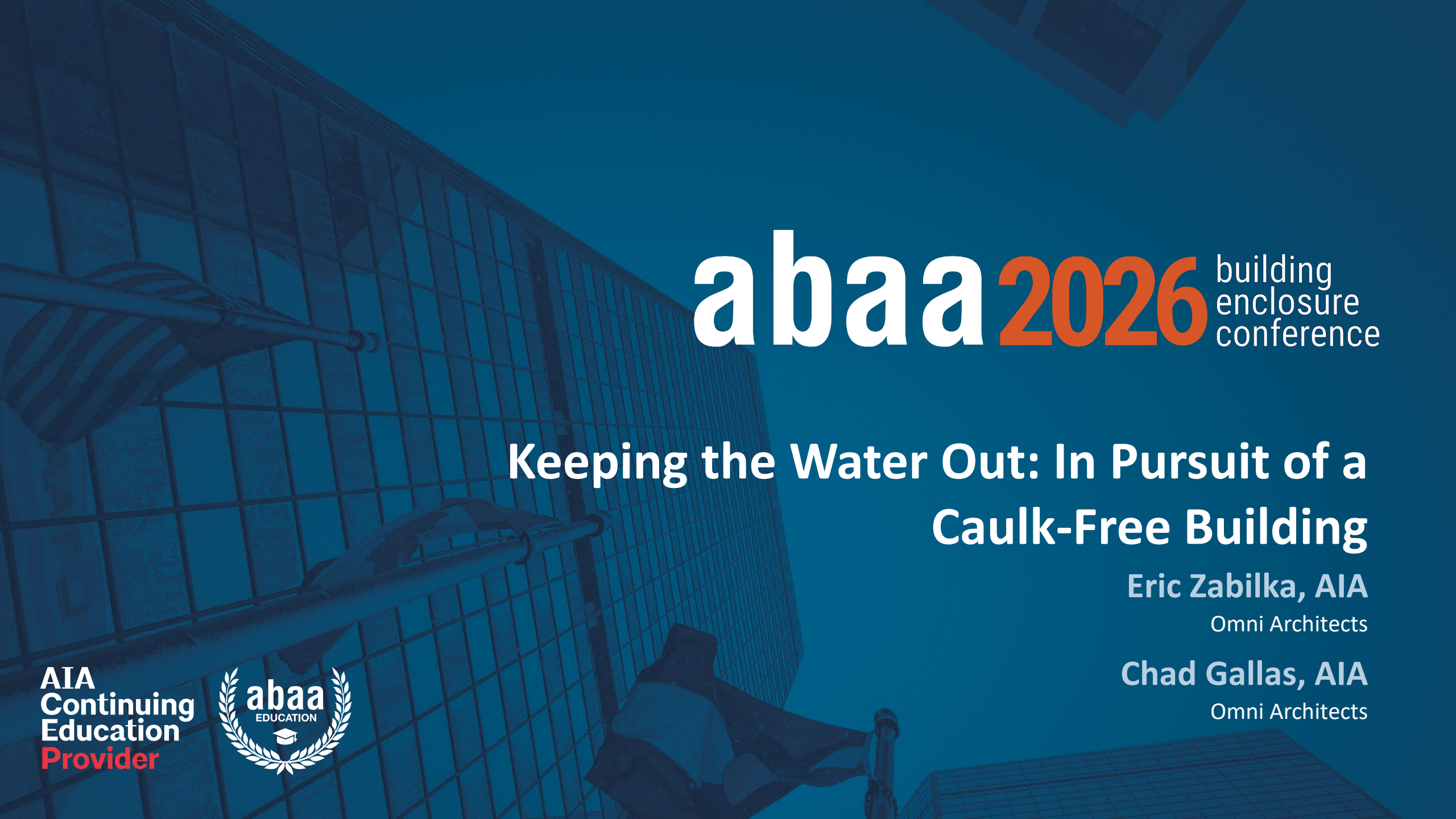

abaa 2026 building enclosure conference

Keeping the Water Out: In Pursuit of a Caulk-Free Building

Eric Zabilka, AIA
Omni Architects

Chad Gallas, AIA
Omni Architects

AIA Continuing Education Provider

abaa EDUCATION

Keeping the Water Out: In Pursuit of a Caulk-Free Building

Keeping water out of a building is one of the biggest challenges architects face. Wind-driven rain can penetrate the tiniest of openings, damaging the building, and contributing to an unhealthy interior environment. Caulk has traditionally been the first line of defense in preventing water and air infiltration. However, caulk has an in-service lifespan that is much shorter than the majority of exterior materials, and building owners rarely implement maintenance plans to replace joint sealants before failure.

As the profession pushes towards more energy-efficient, resilient, and high-performance buildings, strategies for detailing the weather envelope have fundamentally changed. Today's finish systems are much more complex, posing new challenges to both designers and trade contractors, and challenging the traditional methods used for construction. While the benefits of a high-performance building envelope are significant, the higher standards mean that the weak link in the system – caulk – is more important than ever.

Learning Objectives

1. Analyze the causes and impact of water infiltration on occupant health and building durability.
2. Compare traditional caulking systems to alternative detailing strategies that reduce long-term maintenance needs and improve envelope integrity.
3. Evaluate impact of new materials and complex finish systems on weatherproofing detailing and the implications for construction and performance.
4. Apply design practices that enhance infiltration control without relying on caulk, using case studies.

abaa EDUCATION

Eric Zabilka, AIA

President/Partner
Omni Architects

Chad Gallas, AIA

Partner
Omni Architects

1 Why Does this Matter?

2 Our Challenge and Response

3 Some Basic Concepts

4 Our Evolving Details

5 Successes

6 Struggles

1 Why Does this Matter?

This Old House

PLAN PROJECT WATCH & LISTE

We may be compensated if you purchase th

This Old House Foundations

Water Dama

Join the 4,492 people who rec

Clicking "Get Your Estimate" submits yo the All

Written by Stephanie Minasian-Ko

In This Article

- Number of Annual Water Damage Claims
- Flood Damage Statistics
- Types of Water Damage
- What Does Water Damag Look Like?
- Top Causes of Water Da
- How To Prevent Water Damage
- Our Conclusion
- FAQ About Water Da Statistics

buildings

MDPI

Protocol

NIOSH Dampness and Mold Assessment Tool (DMAT): Documentation and Data Analysis of Dampness and Mold-Related Damage in Buildings and Its Application

Ju-Hyeong Park * and Jean M. Cox-Ganser

Respiratory Health Division, National Institute for Occupational Safety and Health Centers for Disease Control and Prevention, Morgantown, WV 26505, USA; jjc8@cdc.gov
* Correspondence: gzp8@cdc.gov

Abstract: Indoor dampness and mold are prevalent, and the exposure has been associated with various illnesses such as the exacerbation of existing asthma, asthma development, current asthma, ever-diagnosed asthma, bronchitis, respiratory infection, allergic rhinitis, dyspnea, wheezing, cough, upper respiratory symptoms, and eczema. However, assessing exposures or environments in damp and moldy buildings/rooms, especially by collecting and analyzing environmental samples for microbial agents, is complicated. Nonetheless, observational assessment (visual and olfactory inspection) has been demonstrated as an effective method for evaluating indoor dampness and mold. The National Institute for Occupational Safety and Health developed an observational assessment method called the Dampness and Mold Assessment Tool (DMAT). The DMAT uses a semi-quantitative approach to score the level of dampness and mold-related damage (mold odor, water damage/stains, visible mold, and wetness/dampness) by intensity or size for each of the room components (ceiling, walls, windows, floor, furnishings, ventilation system, pipes, and supplies and materials). Total or average room scores and factor-or component-specific scores can be calculated for data analysis. Because the DMAT uses a semi-quantitative scoring method, it better differentiates the level of damage compared to the binary (presence or absence of damage) approach. Thus, our DMAT provides useful information on identifying dampness and mold, tracking and comparing past and present damage by the scores, and prioritizing remediation to avoid potential adverse health effects in occupants. This protocol-type article describes the DMAT and demonstrates how to apply it to effectively manage indoor dampness and mold-related damage.

Keywords: dampness and mold; DMAT; indoor environments; observational assessment; visual and olfactory assessment; data analysis and application; water damage

check for updates

Citation: Park, J.-H.; Cox-Ganser, J.M. NIOSH Dampness and Mold Assessment Tool (DMAT): Documentation and Data Analysis of Dampness and Mold-Related Damage in Buildings and Its Application. *Buildings* **2022**, *12*, 1075. https://doi.org/10.3390/buildings12081075

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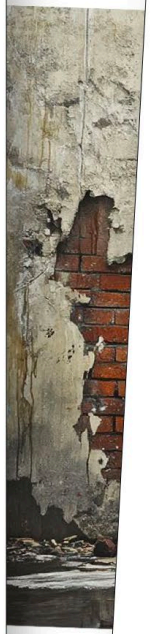
1. Introduction

Water leaks, construction faults, indoor condensation, the malfunction of ventilation systems, or flooding from extreme weather events could lead to damp indoor environments under which microbes can proliferate as available water increases in building materials [1,2]. Although there is no absolute definition of dampness and mold (hereafter, dampness/mold), it commonly includes four water-damage-related aspects such as visible wetness or dampness, water damage or stains, visible mold, and mold odor [3,4]. The prevalence of dampness/mold in indoor environments varies widely (10–50%), depending on continents, countries, and regions within countries [2]. The most recent 2019 American Housing Survey of the U.S. Census indicated that 9.4% of U.S. homes had exterior water leakage and 7.6% had interior water leakage [5]. A study of 831 residential homes from 75 different locations in the U.S. reported that 24% of the surveyed homes had moisture or mold problems [6]. Although there are no national data on the prevalence of dampness/mold in U.S. residential buildings, the population-weighted average prevalence of dampness/mold estimated from several published studies was 47% [7]. There is also a lack

The True Cost of Water Dam
Repo

Mar at 4:38 p



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Resources About

Understanding the Costs of Water Leaks in Commercial Buildings

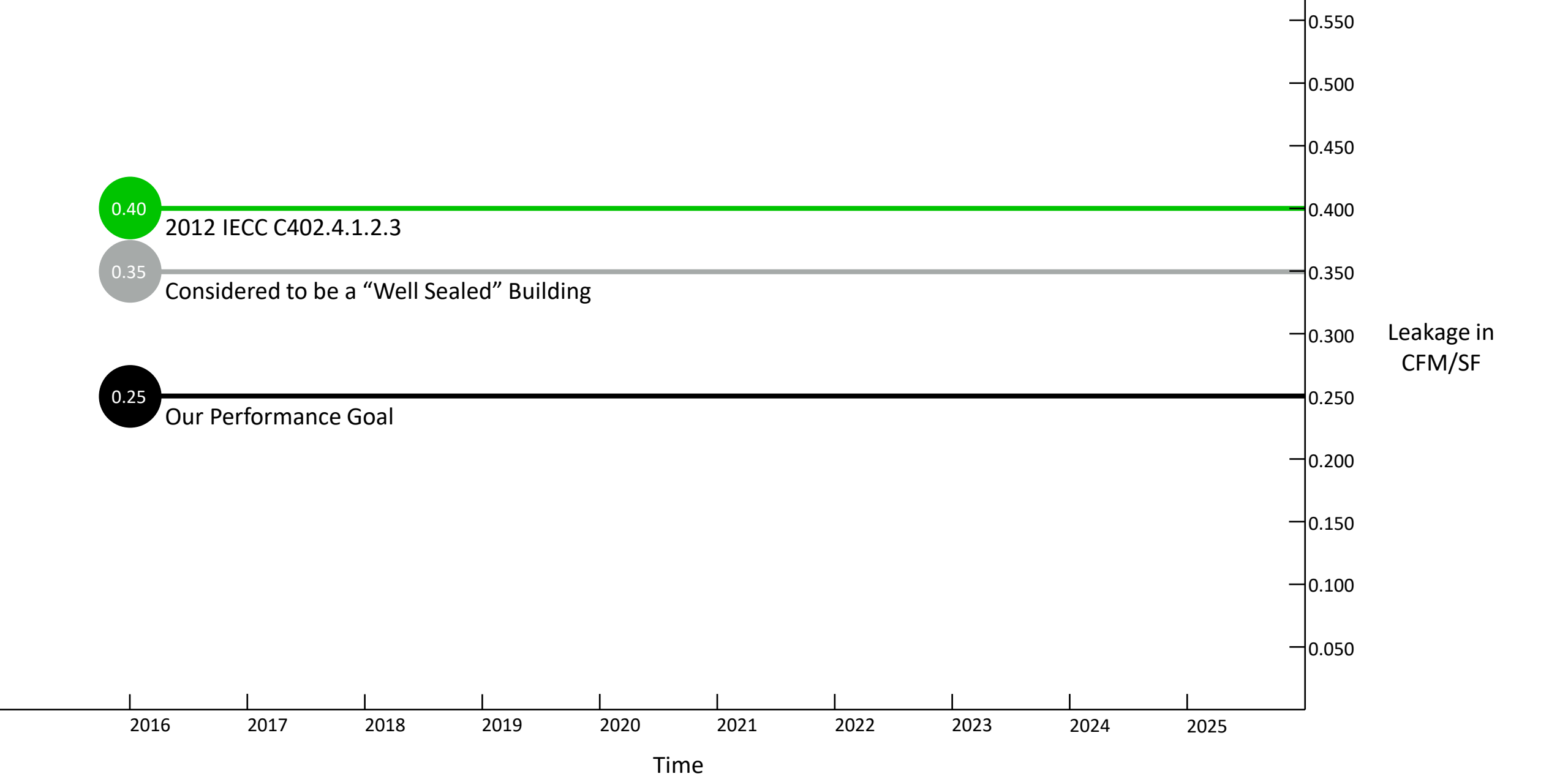
Bryan Mitchell

How to protect your organization from expensive water damage caused by unexpected leaks

Water leaks in commercial buildings can

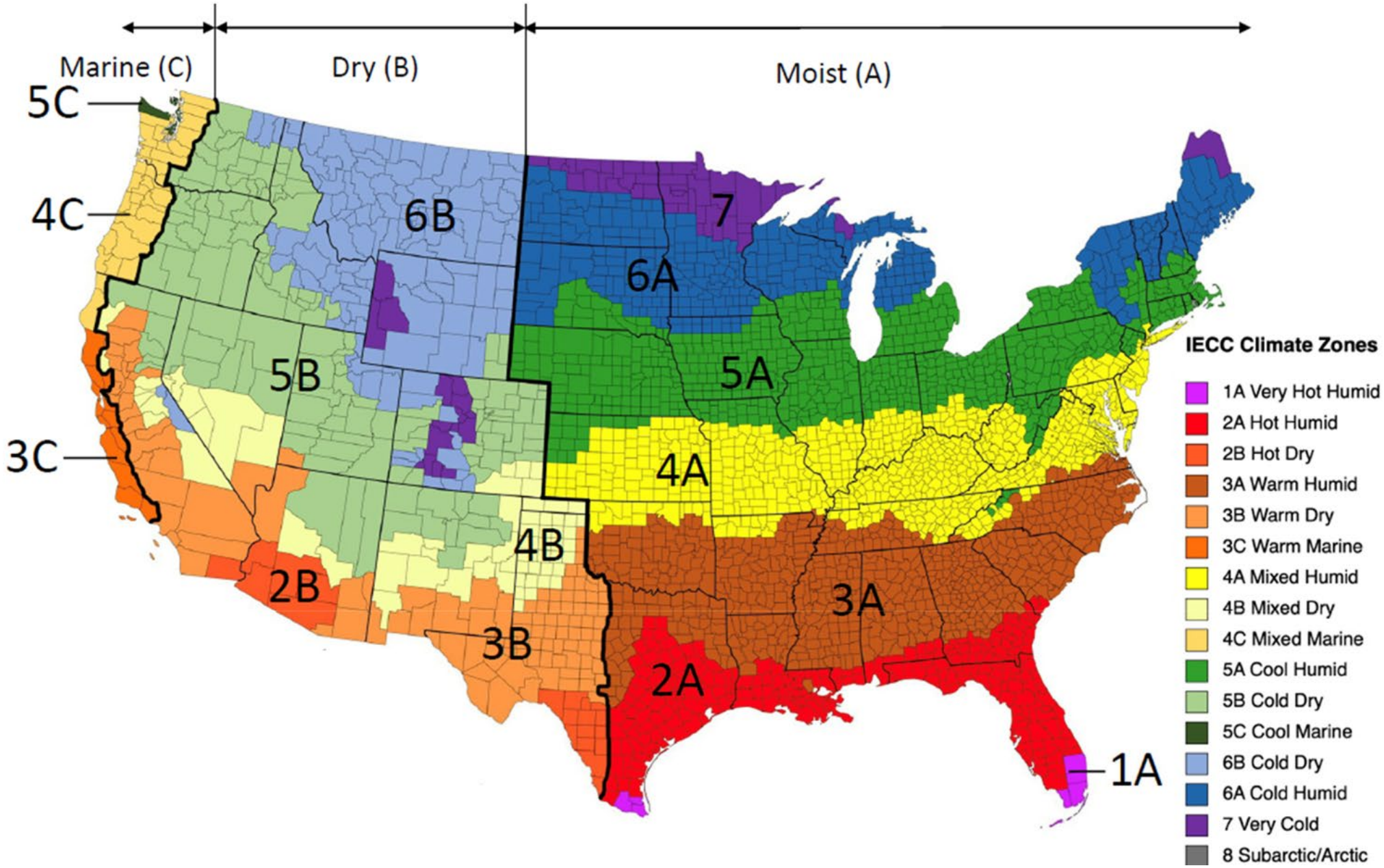

CROWN HALL

2 Our Challenge and Response

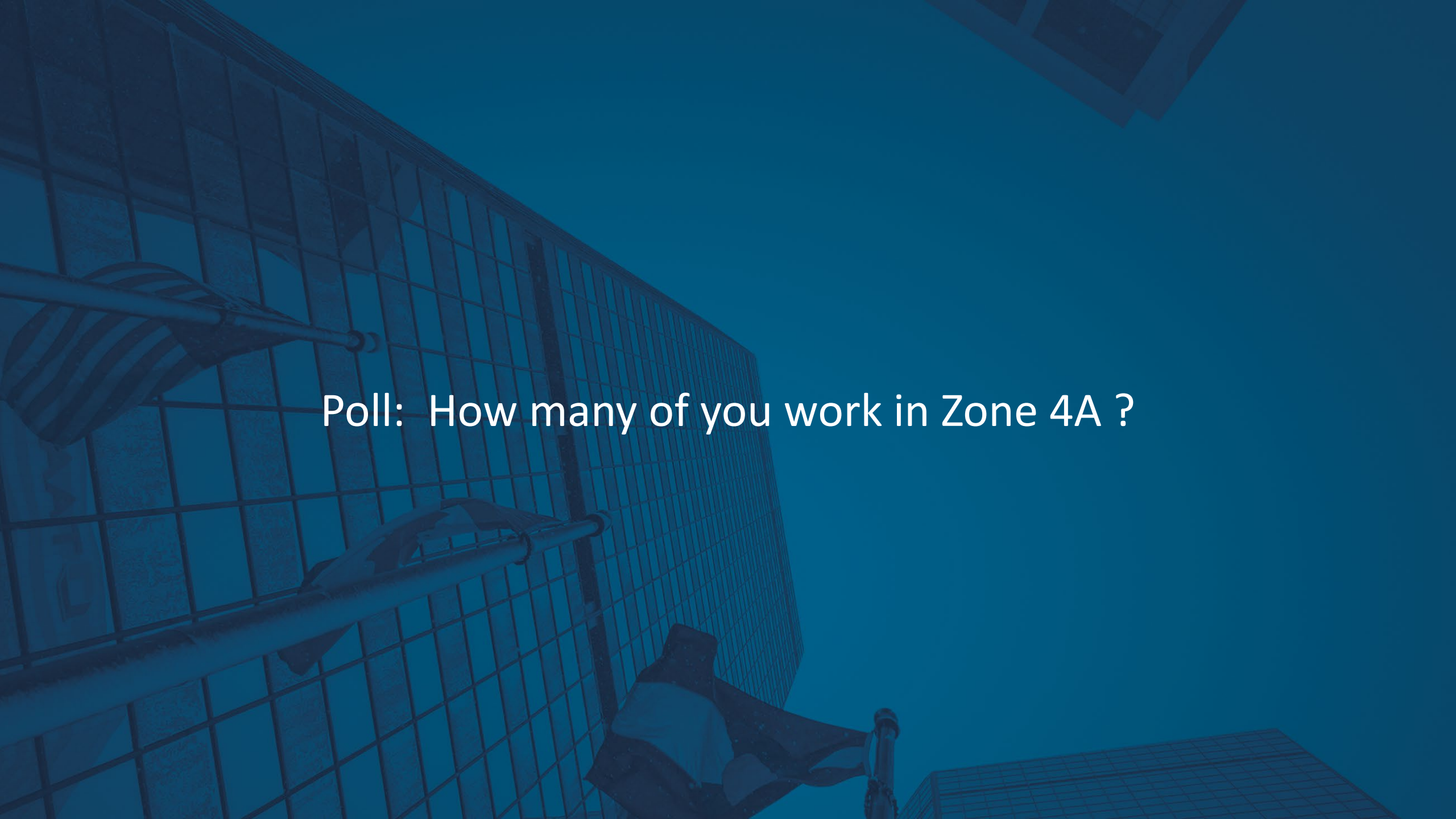


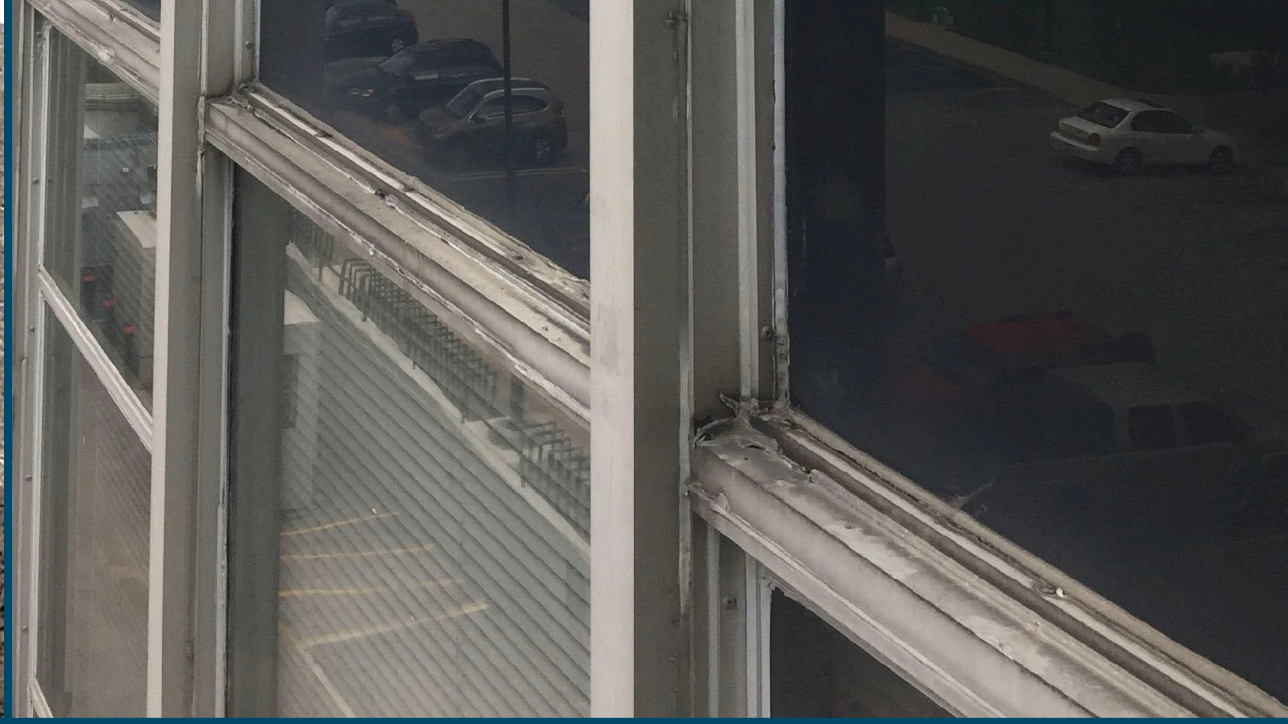
Performance Goals

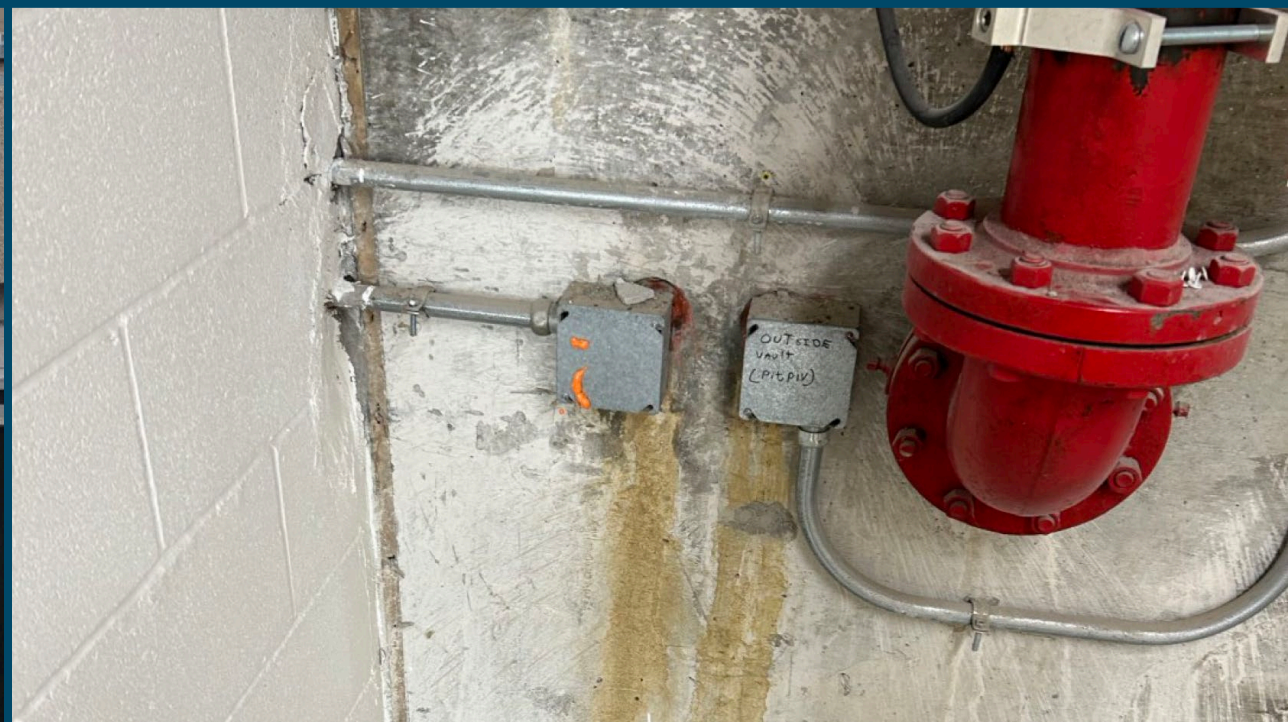

BARNES&NOBLE
Bookstore and Cafe



U.S. Climate Zones


Poll: How many of you work in Zone 4A ?

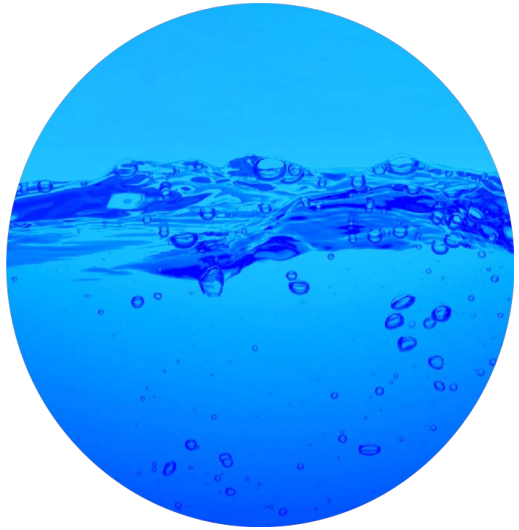



OUTSIDE
VAULT
(PIT PIV)

So What Can We Do?

1. Reduce the risk of failure in the system due to a lack of maintenance.
2. Eliminate reliance on caulk as the primary barrier between the interior and exterior environment.
3. Provide redundancy in the building envelope so that if any one component fails, its back-up will still perform.
4. Protect the primary weather/air barrier from damage from UV radiation, wear and tear, etc.

3 Some Basic Concepts



Liquid Water: Leaks

Water Vapor: Leaks

Condensation: Cold Surfaces

Types of Water Infiltration

Air Barrier

Weather Barrier

Thermal Barrier

How to Control ?

Air Barrier

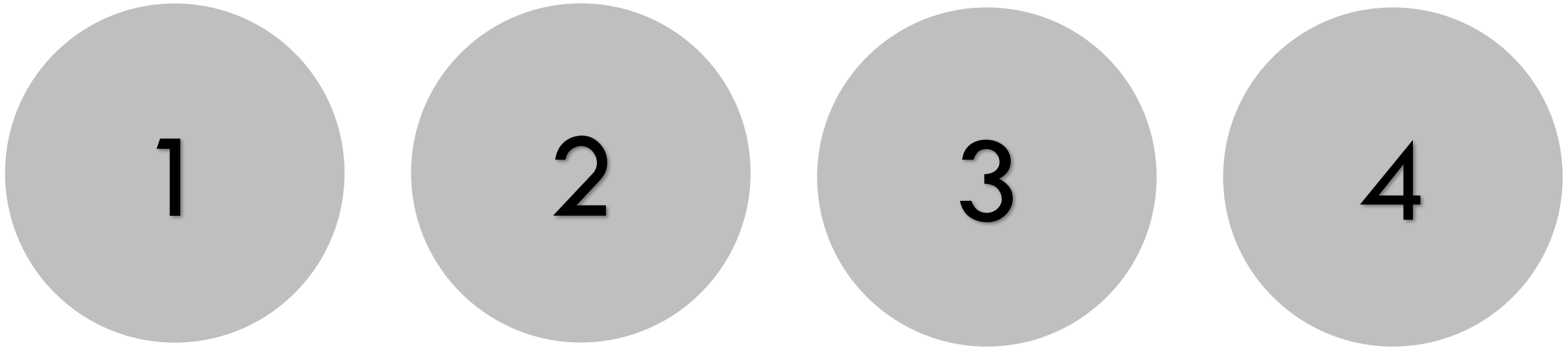
Weather Barrier

Thermal Barrier

Water Barrier

How to Control ?

These should be continuous around the building!



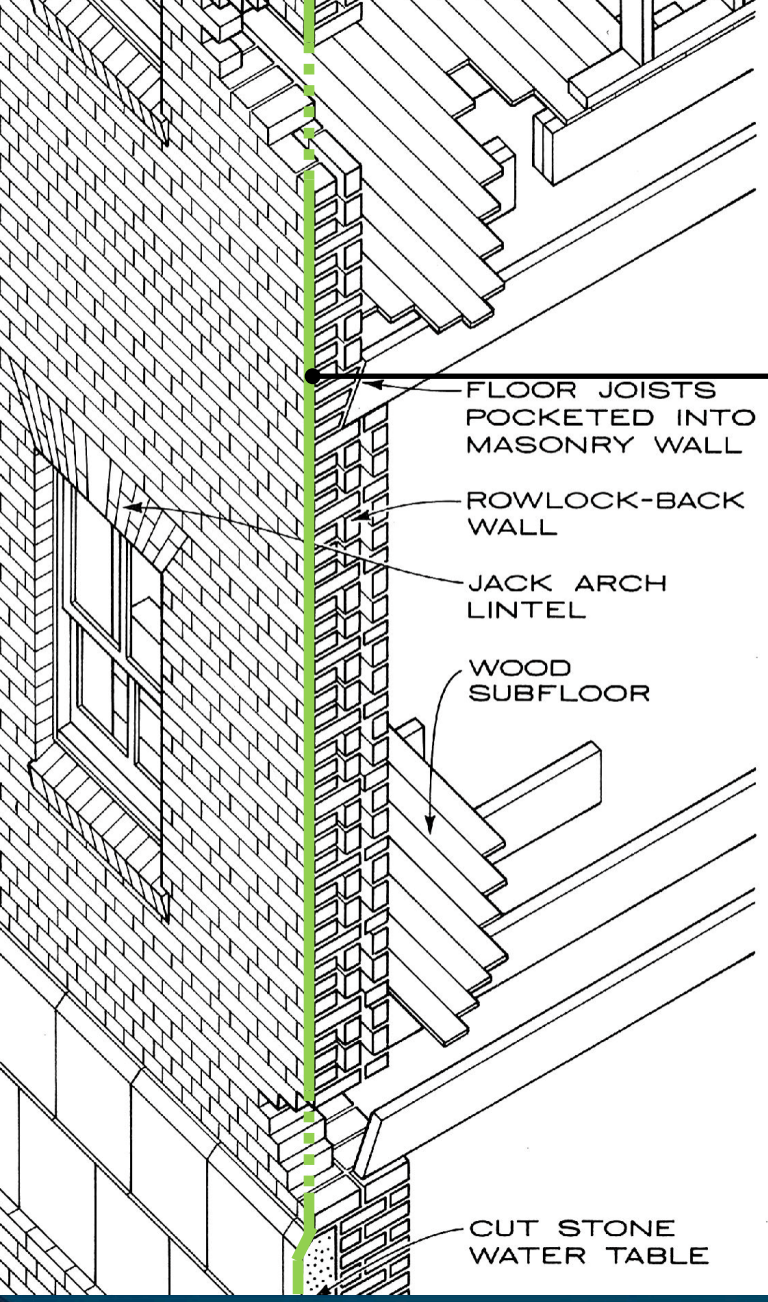
Air Barrier

Weather Barrier

Thermal Barrier

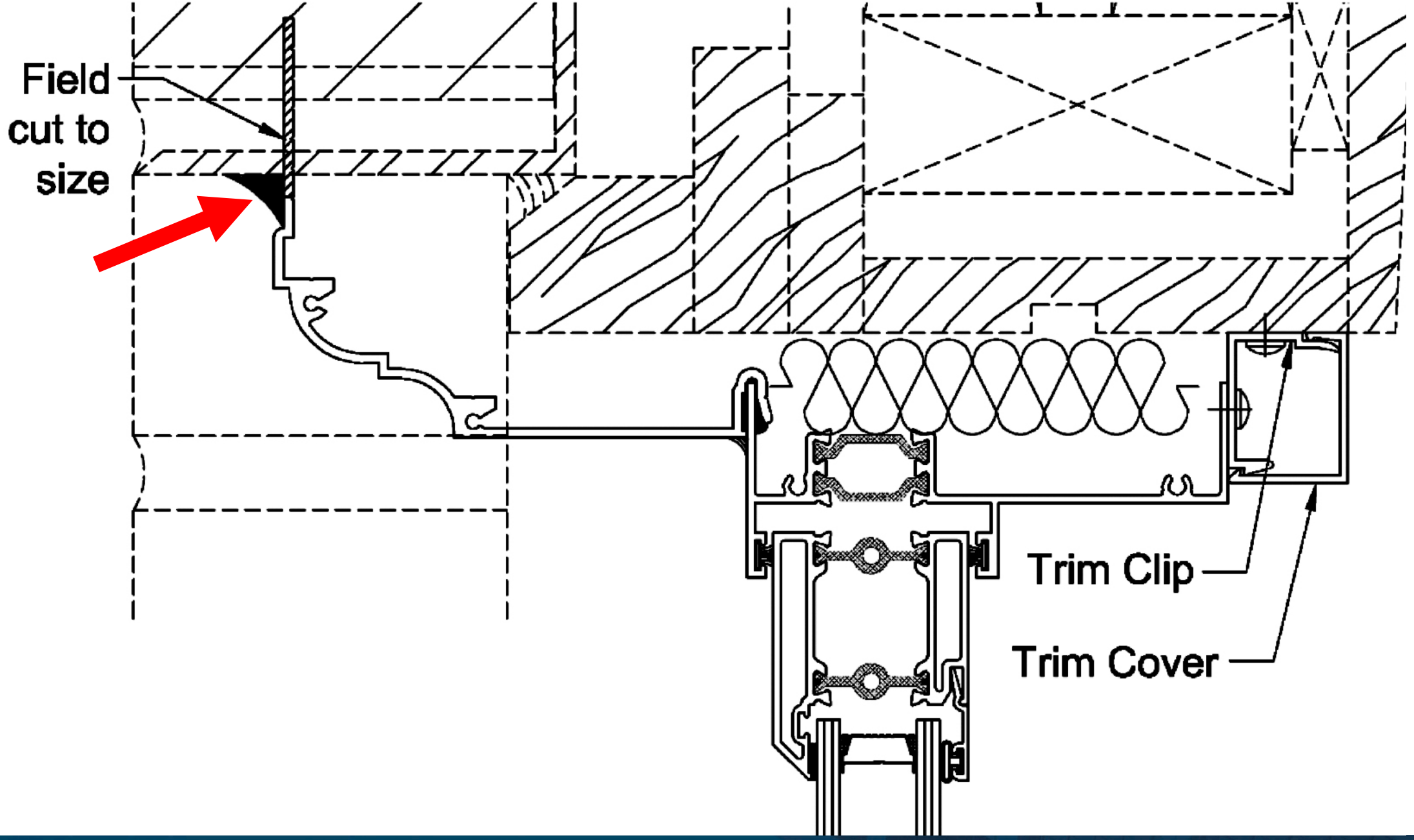
Water Barrier

How to Control ?

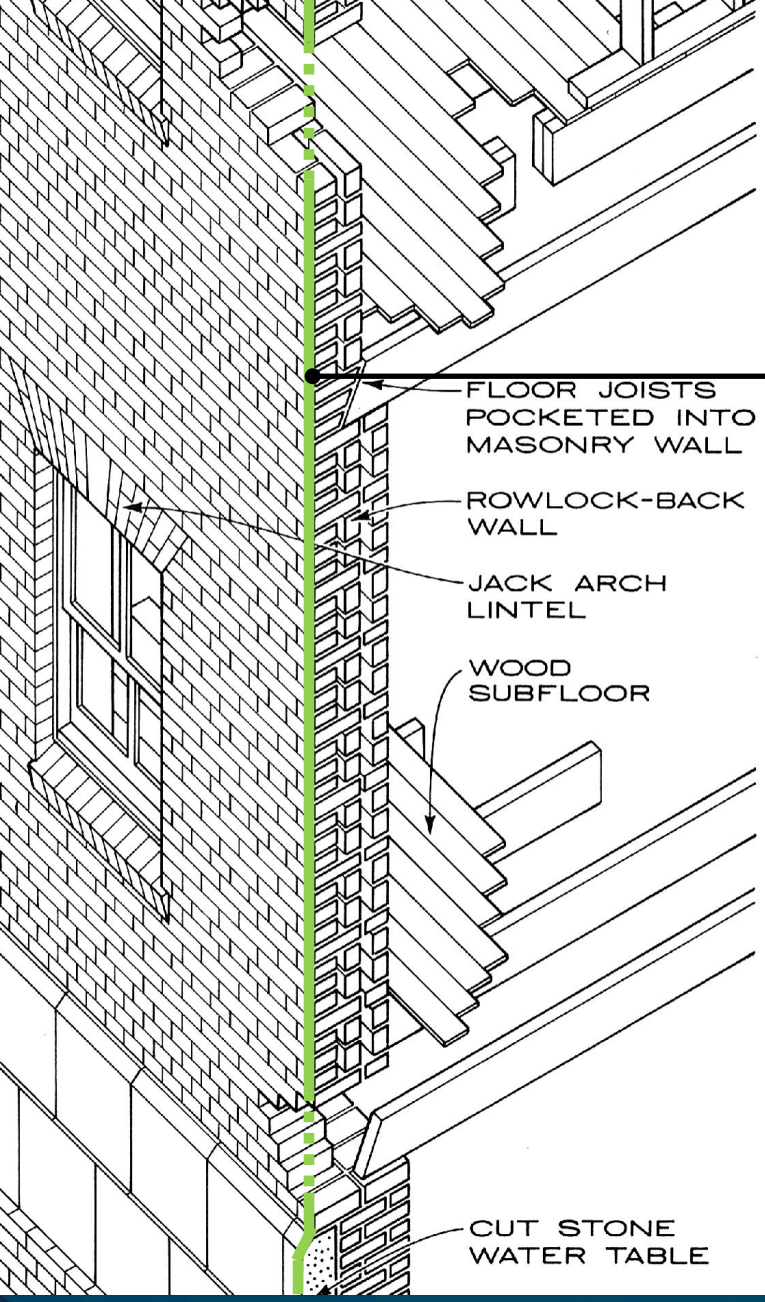


Historical

The green line separating exterior from interior is at the exterior face of the wall


Field
cut to
size
Trim Clip
Trim Cover

Rainscreen

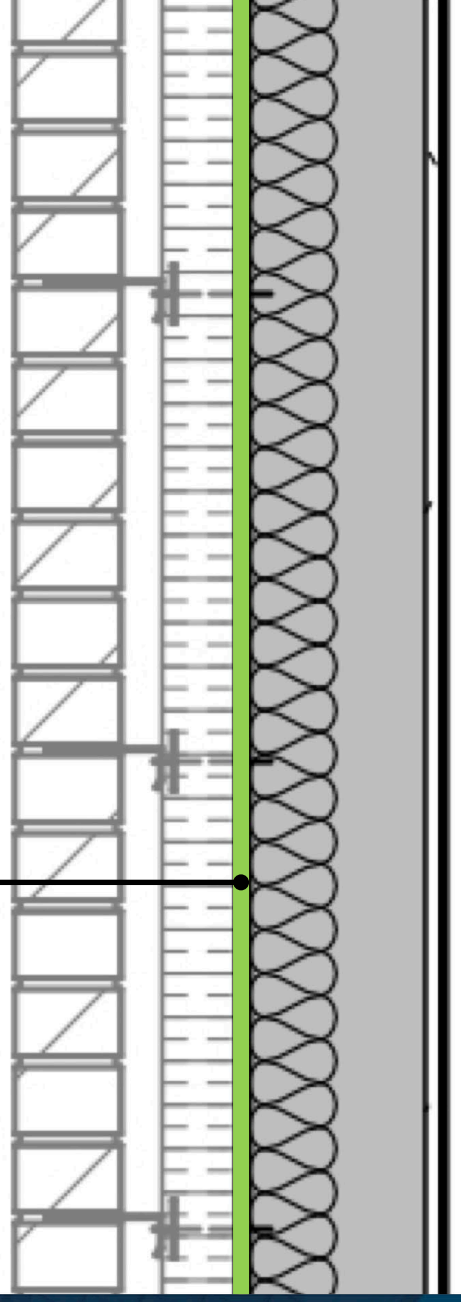


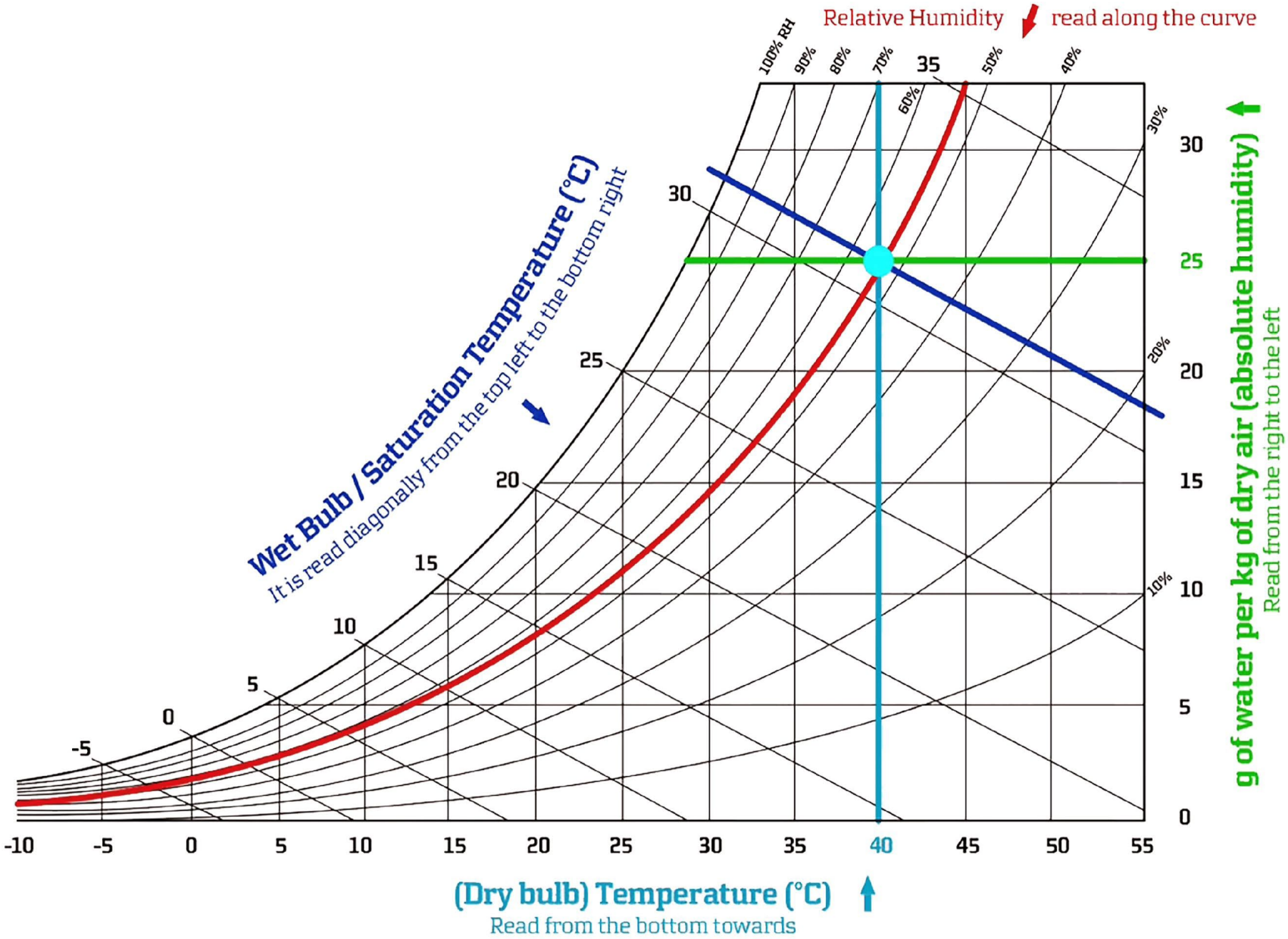
Historical

The green line separating exterior from interior is at the exterior face of the wall

The green line separating exterior from interior in the wall assembly behind a “rain screen”

Contemporary





Understanding Dewpoint

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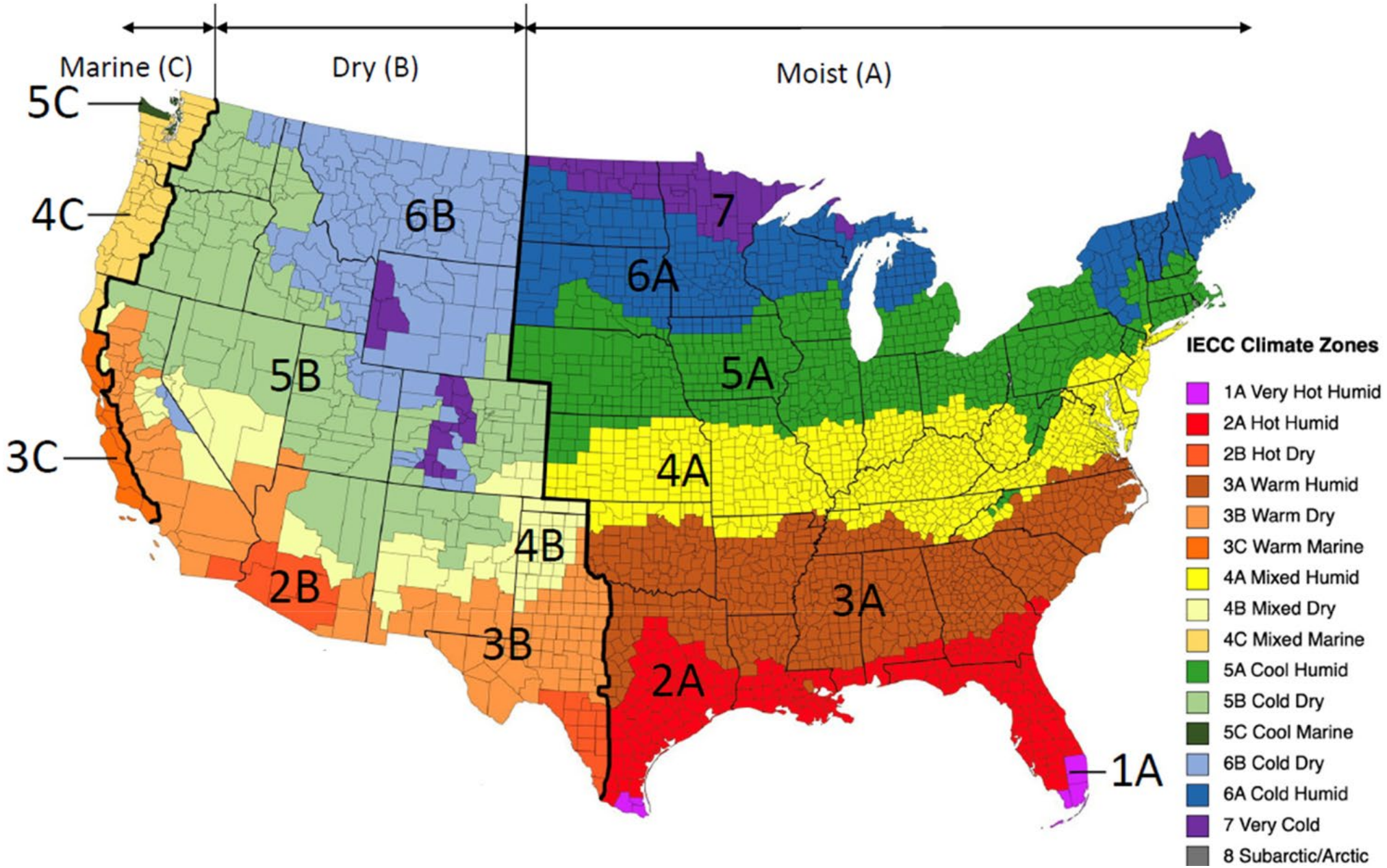


Understanding Dewpoint

Vapor Drive

Warm and Humid

Dewpoint

Cold and Dry

20° F

Exterior

70° F

Interior

Dewpoint in Winter

Vapor Drive

Warm and Humid

Dewpoint

Cold and Dry

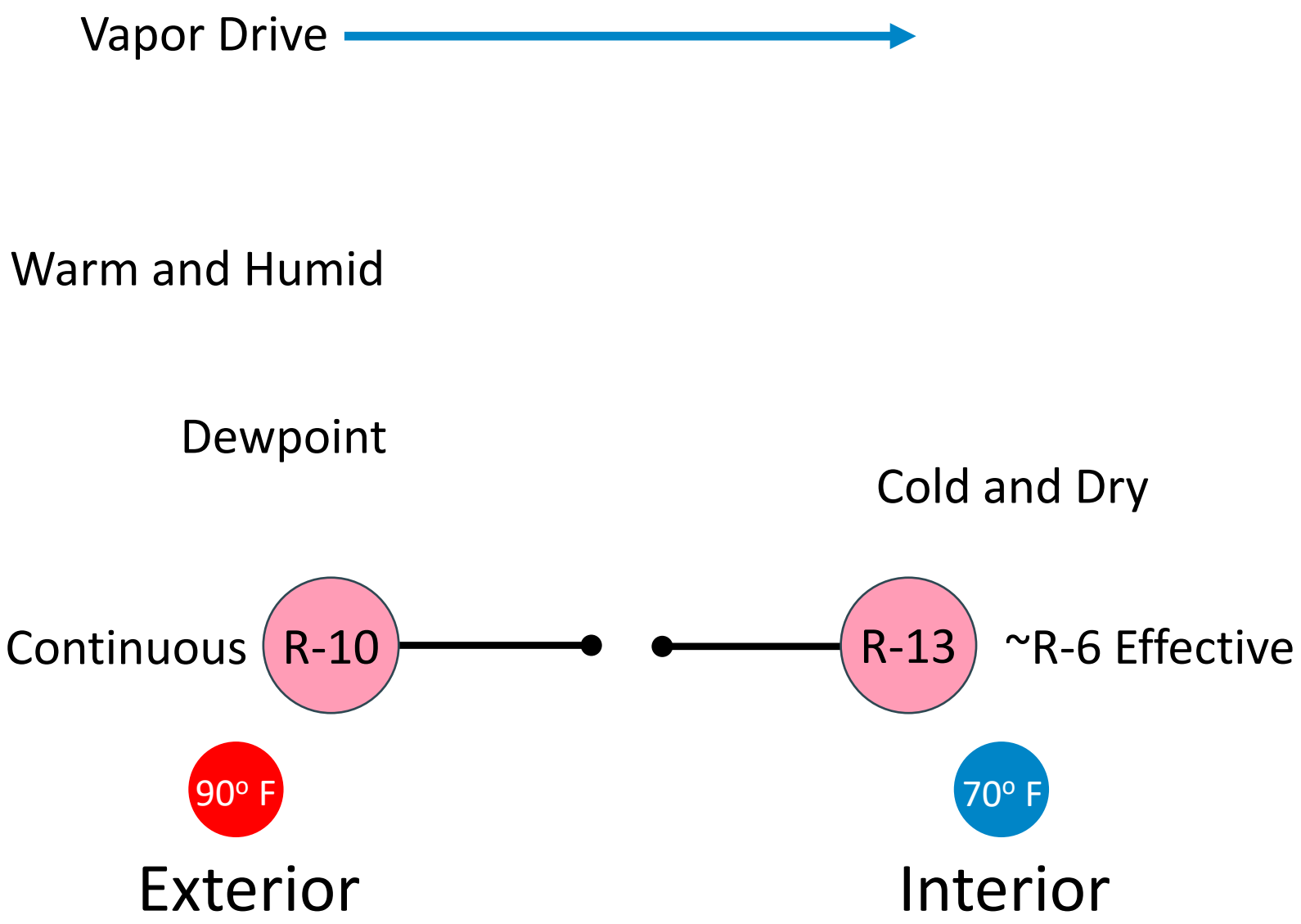
90° F

Exterior

70° F

Interior

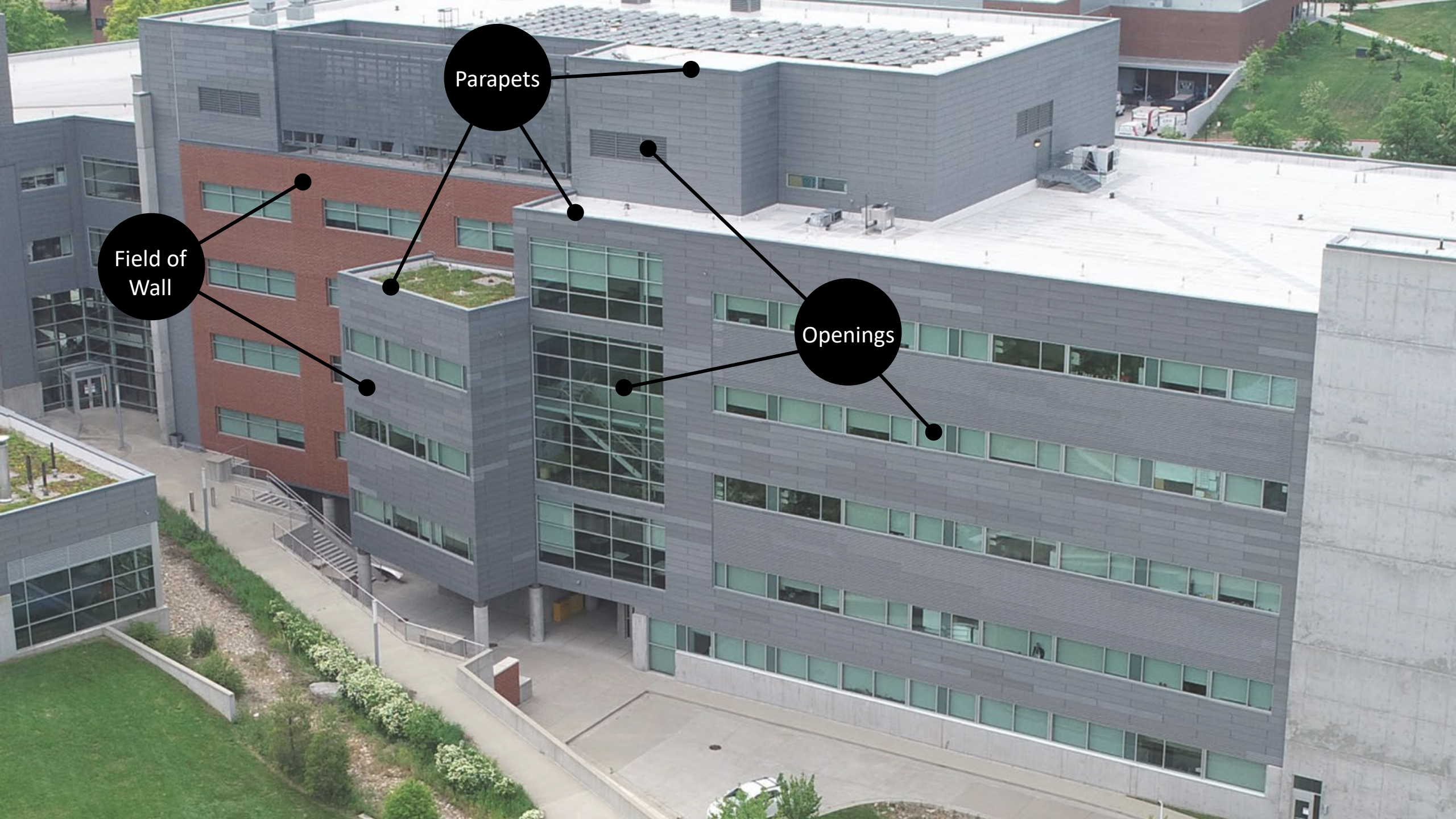
Dewpoint in Summer



Dewpoint in Summer

Condensation Management

4 Our Evolving Details


Parapets
Field of Wall
Openings

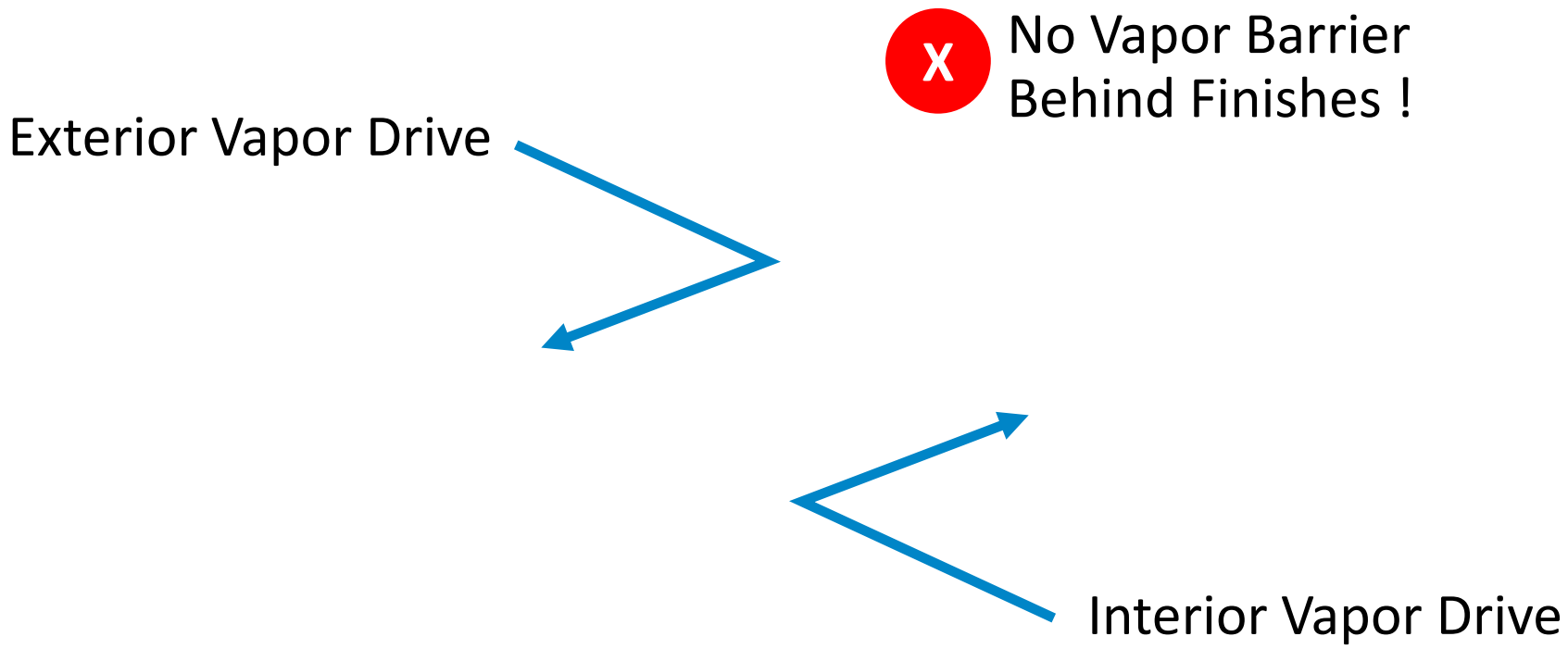

Field of
Wall

It’s All About the Air Barrier !

Uncontrolled Vapor Drive ?

Exterior

Interior



How Does the Wall Breathe ?

Type of Air/Weather Barrier ?

Type of Air/Weather Barrier ?

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Step 1: The Right Product

Walls" and 08 4423 "Structural-Sealant-Glazed Curtain Walls."

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Letter of Compatibility: Provide written confirmation that fluid-applied membrane air barrier materials are compatible with cold fluid-applied waterproofing materials, and with roofing system materials.

1. Include written confirmation that fluid-applied membrane air barrier materials are compatible with preformed silicone flashing.

C. Sustainable Design Submittals:

1. Environmental Product Declaration (EPD): For each product.
2. Product Data: For coatings, indicating VOC content.

Step 2: The Right Compatibility

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Verify that curtain wall frames are in place and are ready to receive preformed silicone flashing in glazing pocket.

B. Acceptance of Substrate: Installation may not proceed without written acceptance of the substrates, signed by both the Installer and by the air barrier manufacturer's technical personnel, verifying that the substrate conditions are in compliance with the air barrier manufacturer's standards of good practice and warranty requirements.

1. Proceed with installation only after unsatisfactory conditions identified at the time of examination have been corrected and re-examined by the Installer and the air barrier manufacturer's technical personnel.
2. Written Acceptance of Substrate shall specifically identify and acknowledge acceptance of corrective measures taken to correct unsatisfactory conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other

Step 3: The Right Substrate

Step 4: The Right Qualifications

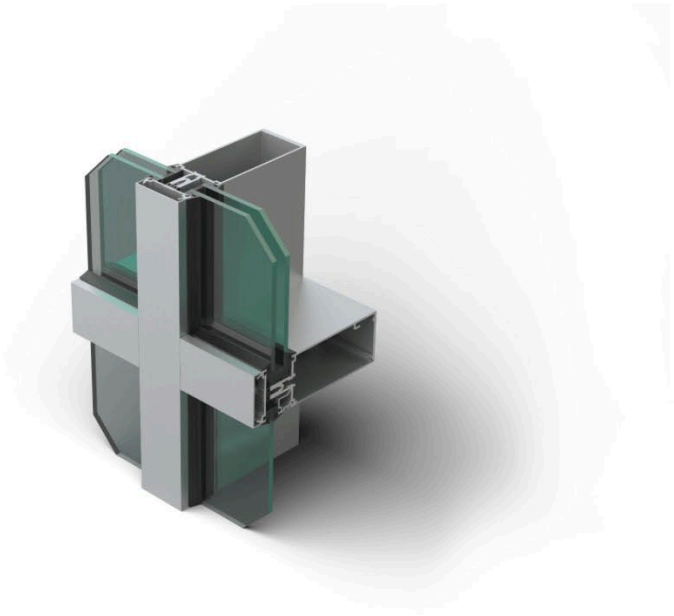
Step 5: The Right Verification

Step 6: The Right Documentation

Types of Insulation ?

Types of Insulation ?


Openings



CURTAIN WALL

WALL SYSTEM®1 CURTAIN WALL

The Curtain Wall is ideal for low- to mid-rise applications. Hurricane and impact resistant, the Wall System®1 can be used independently or integrated with Wall System®2 Curtain Wall for enhanced visual impact.

Click here to view our range of curtain wall cover options.

- 2-1/2″ (63.5mm) sightline
- 6″ (152.4mm), 7-1/2″ (190.5mm) or 10-1/2″ (267mm) depth
- Thermal performance
- Seismic (AAMA 501.4 and 501.6 standards)
- Low- to mid-rise applications
- Blast mitigation, hurricane resistance



Window Details

Step 1: Construct the framed wall, seal the sheathing joints and fasteners, and apply the fluid-applied air/weather barrier.

Extending the air/weather barrier to the interior face of the wall provides a surface for later materials to seal against.

Step 2: Secure the curtainwall frame in the rough opening and install the back-up caulk joint between the curtainwall frame and the air barrier.

Step 3: Adhere the flexible silicone flashing to the air/weather barrier at the perimeter of the opening.

Step 4: Lap the silicone flashing into the glazing pocket in the curtainwall and clamp in place with the glazing pressure plate as the window glass is installed.

At this point the wall is “weathered in.”

Step 3: Adhere the flexible silicone flashing to the air/weather barrier at the perimeter of the opening.

Step 4: Lap the silicone flashing into the glazing pocket in the curtainwall and clamp in place with the glazing pressure plate as the window glass is installed.

At this point the wall is “weathered in.”

Technical Data Sheet

Contractors Silicone Strip

FEATURES & BENEFITS

- Easy to install
- Recommended for use with Silicone Weatherproofing Sealant
- Available in clear for ease of quality control and assurance of good sealant application
- Mechanical fastening is not required

COMPOSITION

- Preformed silicone elastomer

Preformed silicone seal for general building applications.

APPLICATIONS

Contractors Silicone Strip is a general purpose pre-formed silicone extrusion. It is available in 3, 4, 6, 9, and 12 inch widths and can be applied and adhered solely with silicone sealant.

TYPICAL PROPERTIES

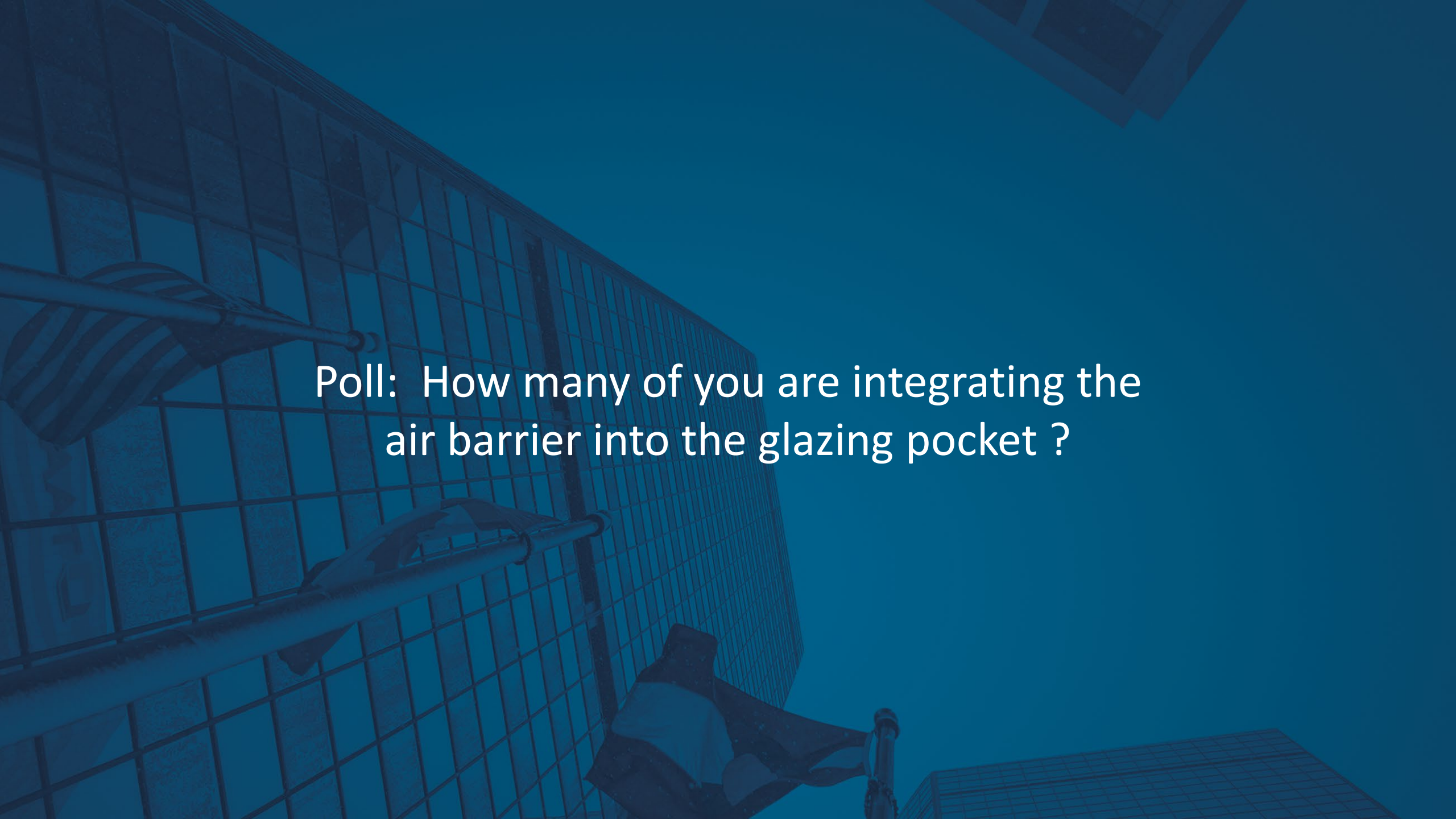
Specification Writers: These values are not intended for use in preparing specifications.

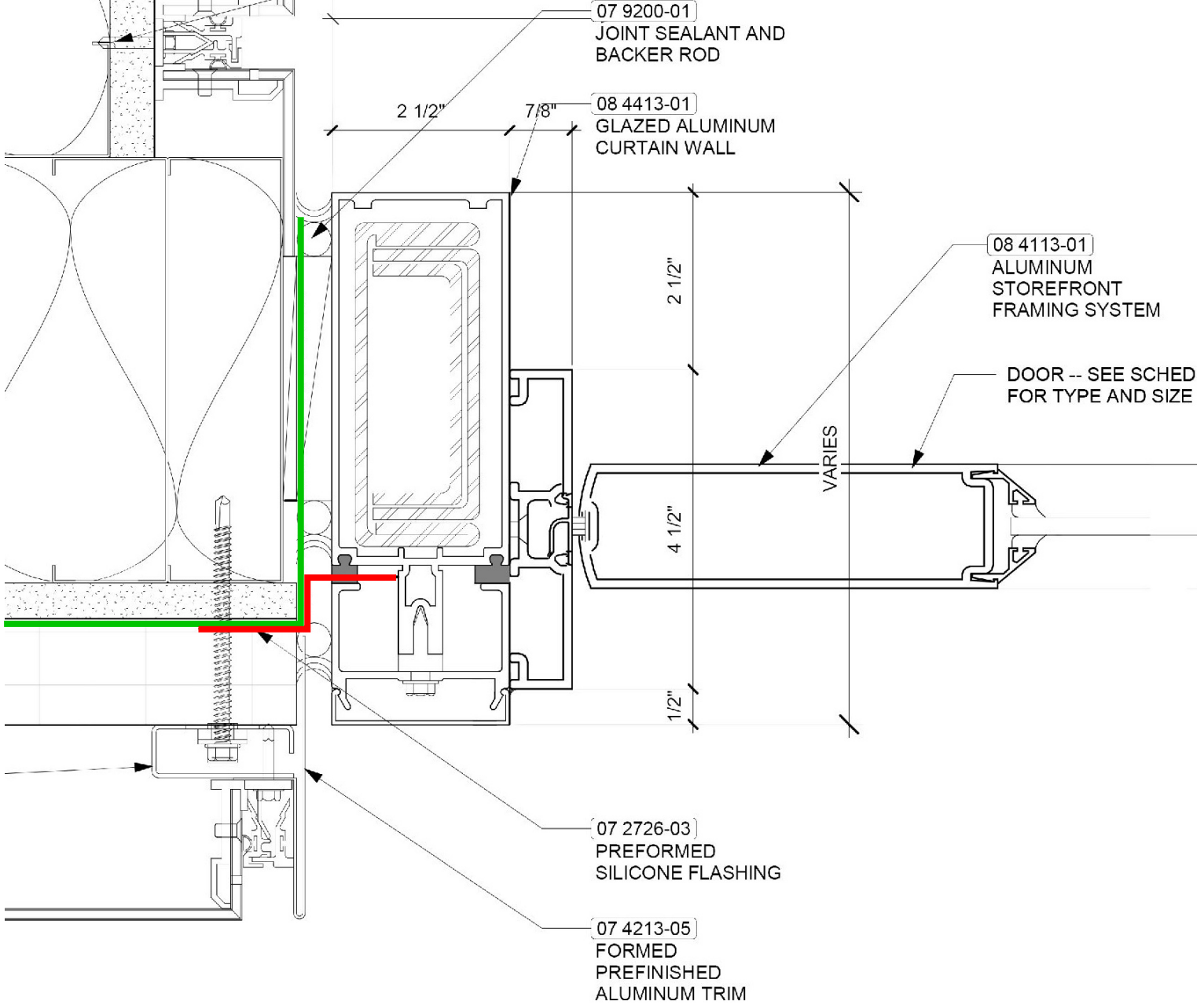
Test*	Property	Unit	Result
As Supplied – Cured Rubber Extrusion			

Window Details

Step 5: Install interior and exterior finishes, along with the exterior and interior sealant joints at the perimeter.

The exterior sealant joint protects the silicone flashing from UV exposure and damage, and must be installed behind the weeps in the bottom of the curtainwall mullion cover.


Poll: How many of you are integrating the
air barrier into the glazing pocket ?



Door Details

Louver Details

abaa building enclosure conference

Louver Details

Louver Details


Parapets

Parapet Details

Step 1: Construct the framed wall, seal the sheathing joints and fasteners, and apply the fluid-applied air/weather barrier.

Extending the air/weather barrier over the top of the wall and onto the back of the parapet protects the wall assembly during construction.

Step 2: Install wood blocking assembly on top of wall and install roofing system.

Step 3: Cover wood blocking with membrane flashing, and lap onto both the air/weather barrier and the roofing system.

The membrane flashing protects the wood blocking from deterioration, and provides redundancy against leakage at the top of the wall.

At this point the wall is “weathered in.”

How do we test our details ?

Integrated Envelope Mock-Ups

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AMERICAN ARCHITECTURAL

AAMA 501.2-09
(editorially revised)

Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

MANUFACTURERS ASSOCIATION

In-Place Water Spray Testing

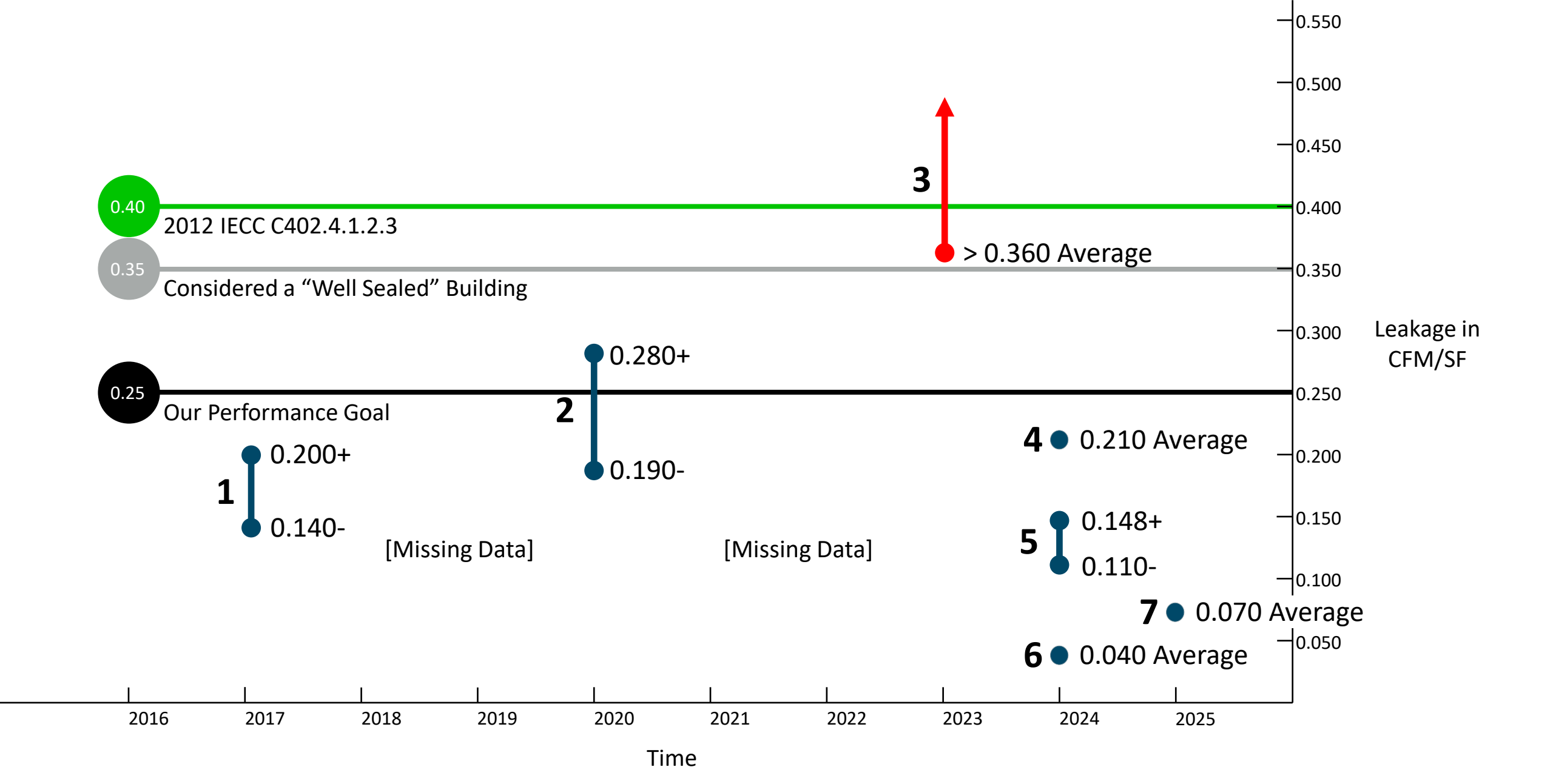

RainWand

5 Successes

We Have Fewer Problems !

But the Proof is in the Test Results !

Blower Door Testing



Our Results Over Time

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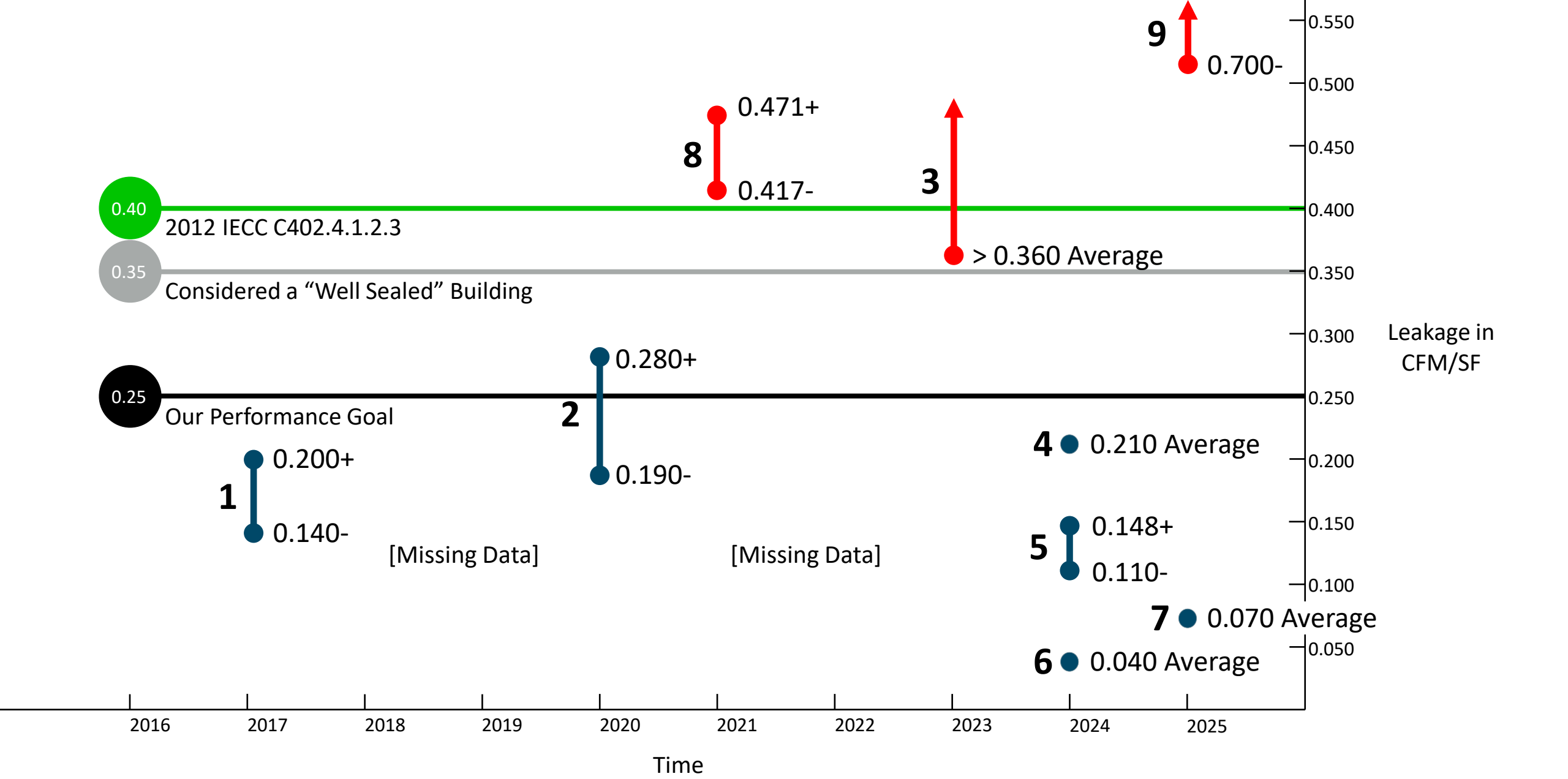
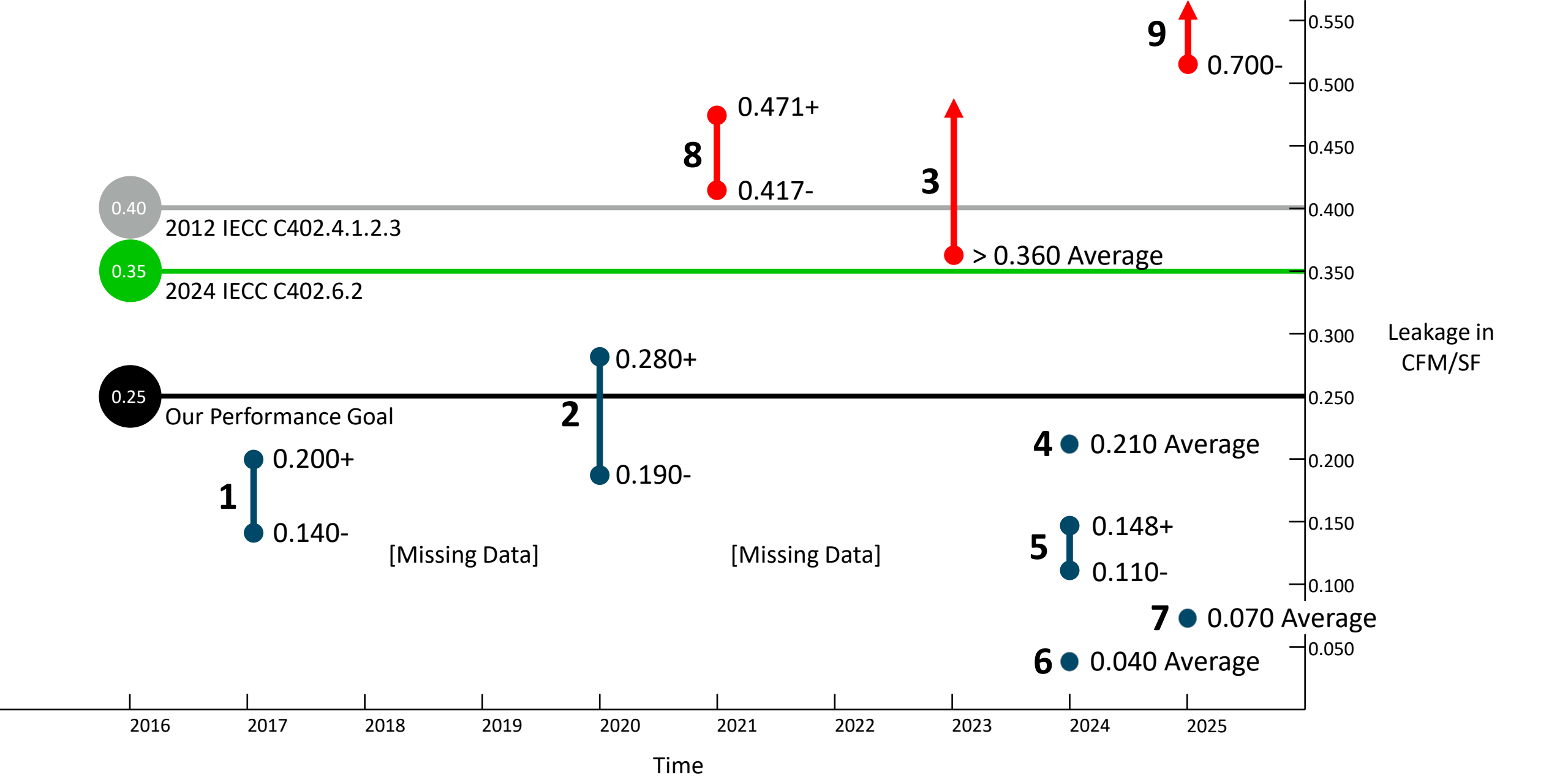


Our Results Over Time

abaa building enclosure conference

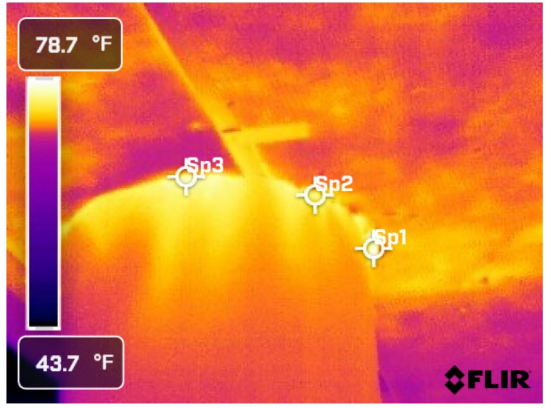


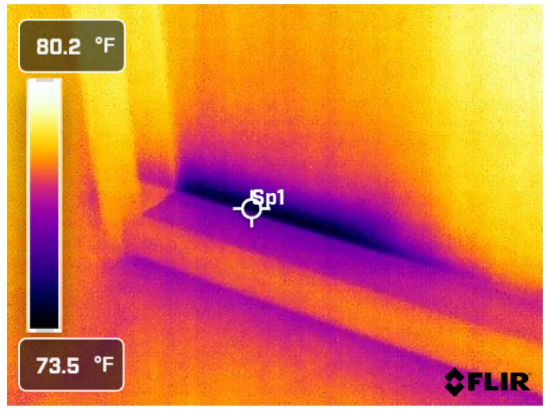
Our Results Over Time

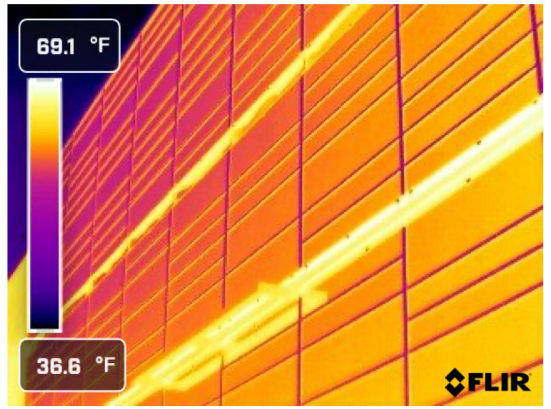
abaa building enclosure conference

Simple smartphone tools allow real-time evaluation of completed work as progress is made.

Official results always part of the final building Commissioning reports.







Real-Time Thermography

6 Struggles

Unintended Consequences

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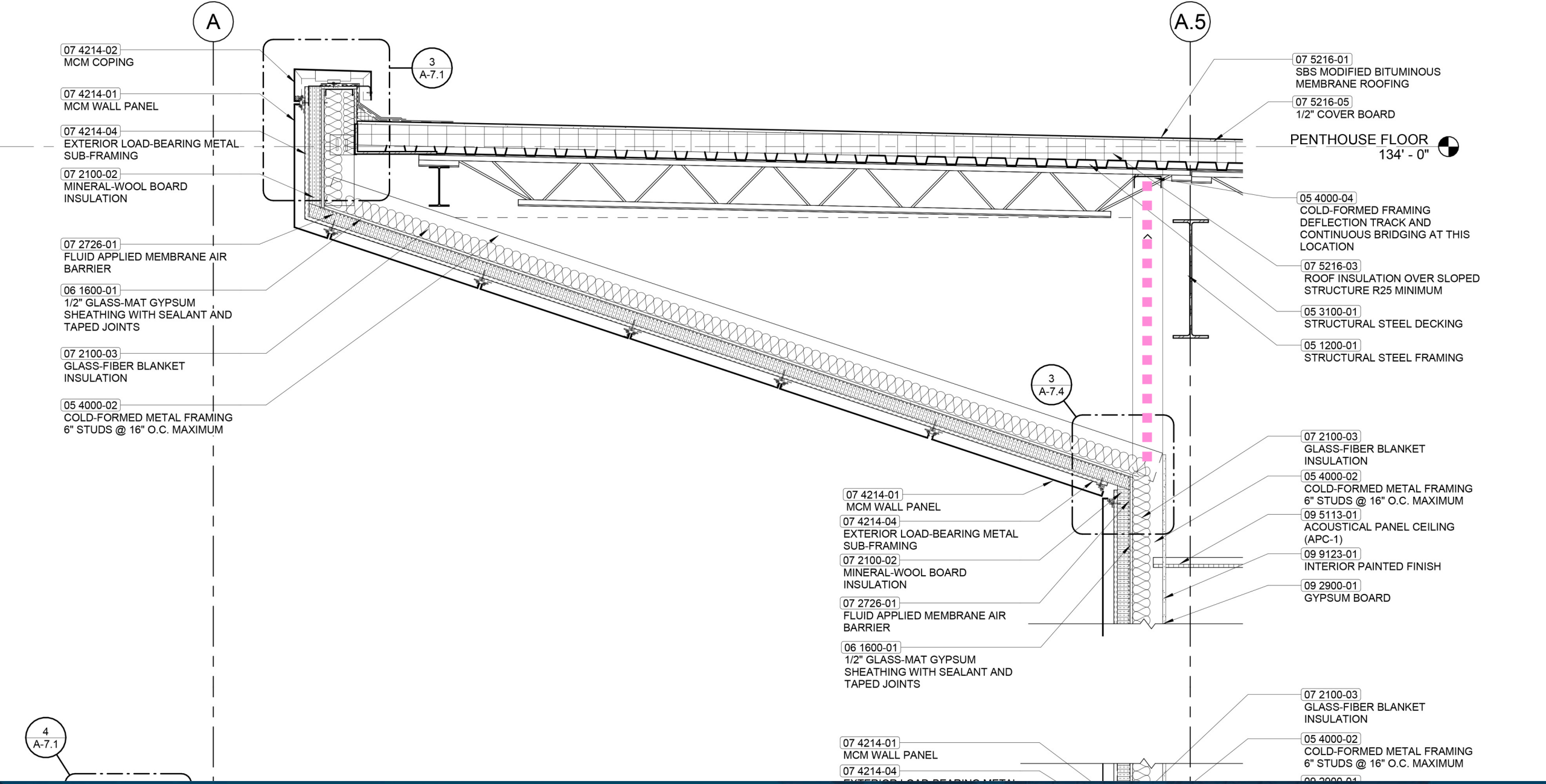
Unintended Consequences

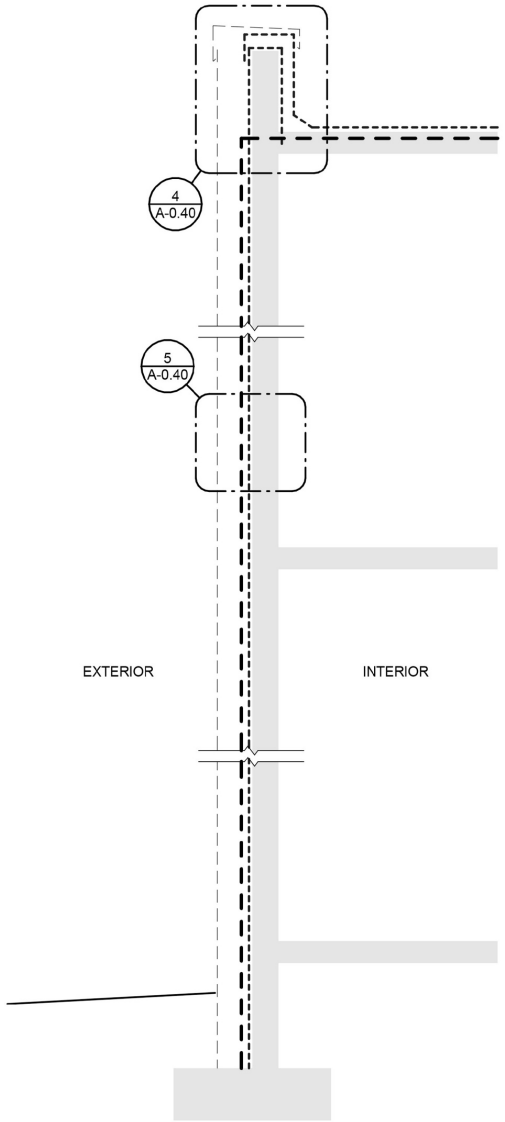


Lack of Understanding

Lack of Understanding

Lack of Understanding

abaa building enclosure conference



THIS DRAWING IS DIAGRAMMATIC REFER TO WALL SECTIONS FOR ACTUAL CONDITIONS

2 A-0.40 WALL SECTION DIAGRAM
NTS

PURPOSE

- WEATHER BARRIER TO BE CONTINUOUS AND WATERTIGHT OVER ENTIRE EXTERIOR FACE OF BUILDING AND WITHOUT GAPS OR INTERRUPTIONS.

- THERMAL BARRIER TO BE CONTINUOUS WITHOUT BRAKES OVER ENTIRE SURFACE OF BUILDING.

- EVERY ELEMENT ON THE WEATHER BARRIER IS TO HAVE BOTH "BELT AND SUSPENDERS" SO THAT THE BUILDING IS NOT RELYING ON ONE SINGLE LINE OF DEFENSE.

- THE DETAILING OF THE WEATHER AND THERMAL ENVELOPE IS DESIGNED TO KEEP THE BUILDING DRY DURING CONSTRUCTION. PROVIDE TEMPORARY PROTECTION AS REQUIRED TO MINIMIZE WATER GETTING INTO THE ASSEMBLY OR TO TRAP WATER INSIDE THE WALL ASSEMBLY.

REQUIREMENTS

GENERAL CONTRACTOR TO COORDINATE A MEETING WITH ALL RELATED TRADES TO ESTABLISH A STEP-BY-STEP SEQUENCE FOR WEATHER ENVELOPE DETAILS THAT ARE ESSENTIAL TO PROVIDING DESIGN INTENT.

1. APPLY COMPOUND & TAPE TO ALL SHEATHING JOINTS AS SHEATHING IS INSTALLED PRIOR TO APPLYING WEATHER BARRIERS.

2. FLUID APPLIED AIR BARRIER TO BE CONTINUOUS AND WATERTIGHT WITHOUT BREAKS, AND SHALL EXTEND FULL DEPTH AND INTO ALL HEAD/ JAMB/ SILL CONDITIONS.

3. COVER TOP OF WALL ASSEMBLY WITH FLUID-APPLIED AIR BARRIER SYSTEM AS SOON AS POSSIBLE DURING CONSTRUCTION, TYPICAL.

4. WEATHER BARRIERS SHALL NOT BE EXPOSED TO THE ELEMENTS OUTSIDE OF COMPLIANCE WITH MANUFACTURER'S RECOMMENDATIONS AND/OR REQUIREMENTS.

5. ALL PENETRATIONS THROUGH THE EXTERIOR ENVELOPE SHALL BE SEALED AND FLASHED.

6. ALL JOINTS BETWEEN ROOFING AND AIR BARRIER SYSTEMS TO BE LAPPED AND CONTINUOUSLY SEALED TO FORM AN AIR AND WATER-TIGHT BUILDING ENVELOPE, TYPICAL.

7. ALL OPENINGS, BRICK RELIEF ANGLES, ETC. TO BE PROPERLY FLASHED TO MAINTAIN AIR AND WATER-TIGHT ENCLOSURE.

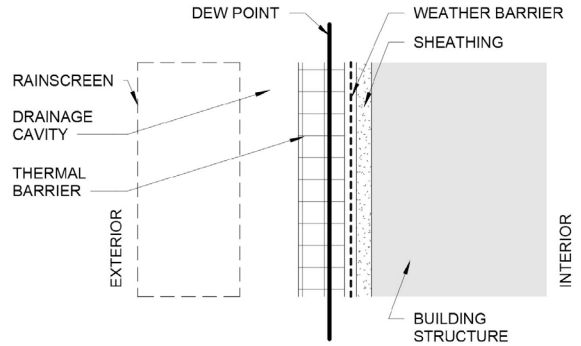
8. CAREFULLY SEQUENCE INSTALLATION OF FLEXIBLE SILICONE SHEET FLASHING WITH INSTALLATION OF CURTAIN WALL PRIOR TO OTHER BUILDING ENVELOPE MATERIALS (SUCH AS MASONRY AND METAL PANELS).

9. PROVIDE CONTINUOUS INSULATION WITHOUT INTERRUPTIONS.

10. DURING SEQUENCING IT IS ESSENTIAL TO TEMPORARILY COVER TOP OF WALL EACH NIGHT WHEN "CAVITY" IS OPEN TO THE ELEMENTS.

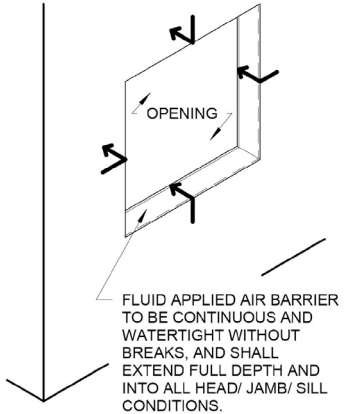
LEGEND

- THERMAL BARRIER
- WEATHER BARRIER
- RAINSCREEN
- BUILDING STRUCTURE (WALL, ROOF, FLOOR ASSEMBLIES)

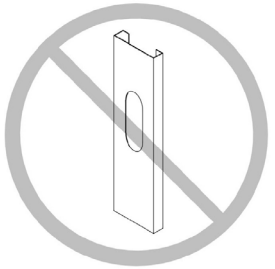


REFER TO WALL TYPES AND WALL SECTIONS FOR ACTUAL WALL CONSTRUCTION

5 A-0.40 SECTION @ DEW POINT
3" = 1'-0"



6 A-0.40 3D VIEW @ AIR BARRIER AND OPENINGS
NTS



NO PUNCHED STUDS AT JAMB, SILL, OR HEAD OF ANY OPENINGS. THIS IS CRITICAL FOR INSTALLATION OF FLUID APPLIED WEATHER BARRIER.

7 A-0.40 NO PUNCHED STUDS @ EXTERIOR OPENINGS
NTS

Lack of Understanding

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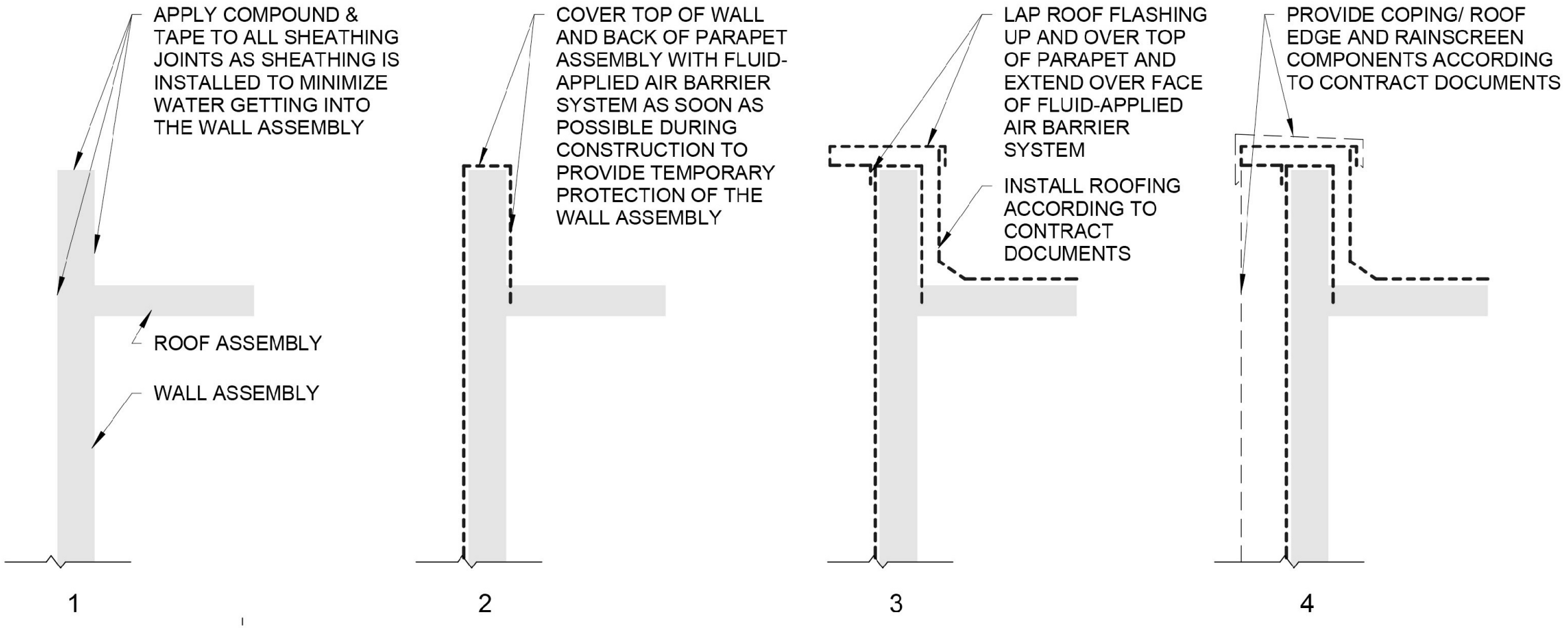

4
A-0.40

PARAPET/ TOP OF WALL SEQUENCE

NTS

Lack of Understanding

Our detailing sometimes forces work to be installed in an unfamiliar sequence, leading to confusion.

Multiple mobilizations are expensive and wasteful.

Construction Sequencing Changes

Construction Sequencing Changes

Sequence:

1. Construct the framed wall.
2. Install the sheathing.’
3. Apply the air barrier.

Typically two or three separate trade contractors up to this point.

At this point the clock starts ticking on the weather/air barrier exposure limit.

Sequence:

4. Curtainwall frame set by glazing contractor.

Glazing contractor will install the joint sealant between the window frame and the weather/air barrier at the perimeter.

The weather/air barrier installer may be off site at this point.

Sequence:

4. Curtainwall frame set by glazing contractor.

Who installs the flexible silicone flashing; glazing contractor or weather/air barrier installer?

If weather/air barrier installer, they will need to work in conjunction with the glazing contractor on each opening.

Contractors often assume that what matters the most is the appearance of the finished wall assembly.

While this is certainly true, the performance of the air barrier is just as important, if not more so !

Quality of Work

Quality of Work

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Quality of Work

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Detailing Issues / Coordination

The Bottom Line ?

Our Goals:

1. Reduce the risk of failure in the system due to a lack of maintenance.
2. Eliminate reliance on caulk as the primary barrier between the interior and exterior environment.
3. Provide redundancy in the building envelope so that if any one component fails, its back-up will still perform.
4. Protect the primary weather/air barrier from damage from UV radiation, wear and tear, etc.

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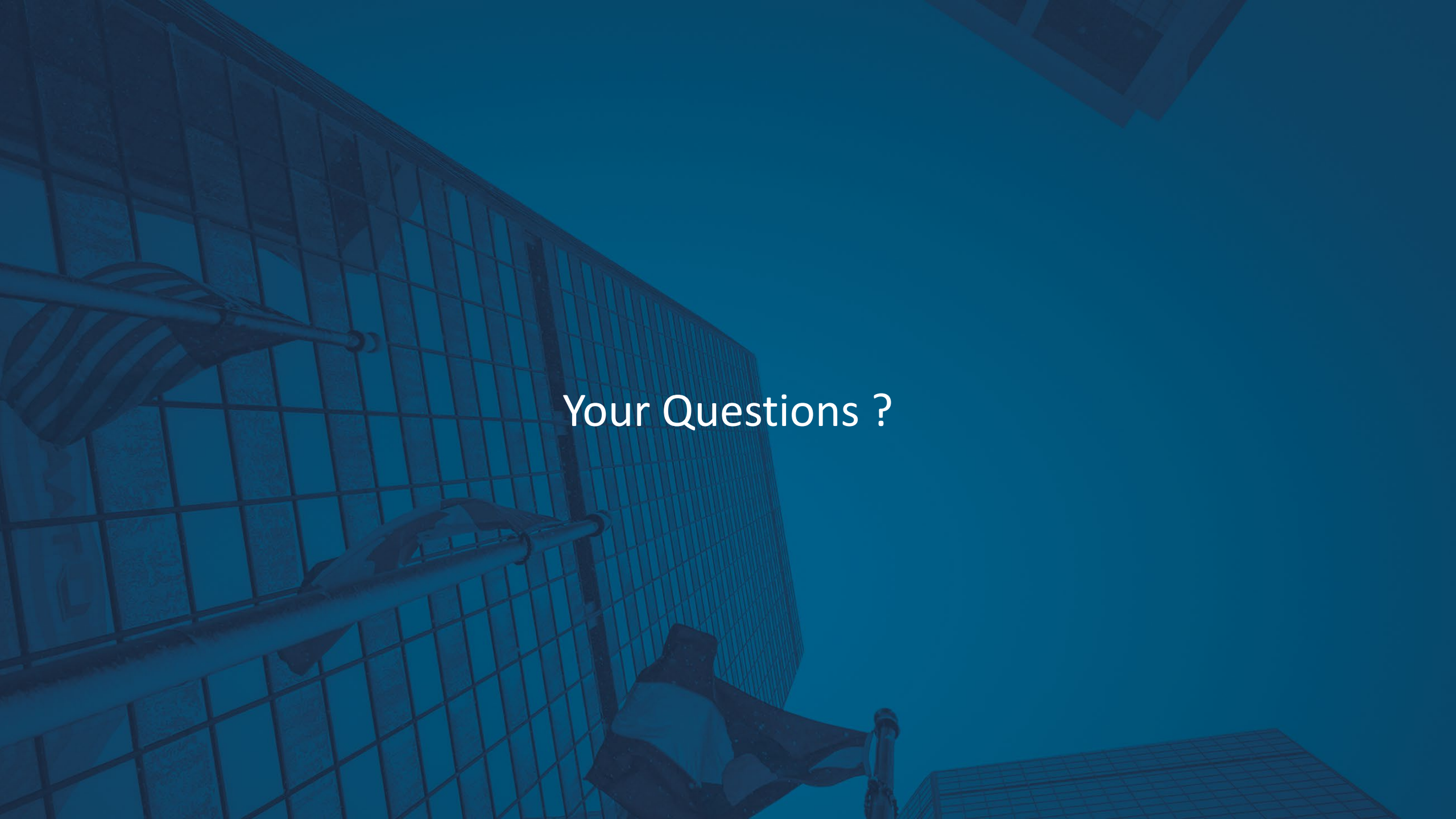
Your Questions ?


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