

# Repair of a Wellness Center Air Barrier

Jennifer Schneider and Sarah Sinusas

*Wiss, Janney, Elstner Associates, Inc.*

Air Barrier Association of America (ABAA) is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.



# Jenny Schneider

Senior Associate

WJE - Chicago

[jschneider@wje.com](mailto:jschneider@wje.com)

312-372-0555

# Sarah Sinusas

Senior Associate

WJE – New Haven

[ssinusas@wje.com](mailto:ssinusas@wje.com)

203-944-9424

air barrier  
**abaa**  
association of  
america  
**BUILDING  
ENCLOSURE  
CONFERENCE**

**2022**  
**RESTON**  
**VA**

# Thank You Sponsors!

 **DÖRKEN**

**DELTA®**

HIGH PERFORMANCE AIR & MOISTURE BARRIERS

**TMI®**  
AIR BARRIER TESTING

**NCFI**  
POLYURETHANES



We **finish** strong.  
**Master Wall Inc.®**  
Building a Culture of Excellence

**Henry®**

A **CARLISLE** COMPANY



HOHMANN & BARNARD, INC

**CARLISLE**  
COATINGS & WATERPROOFING

 **PROSOCO**

**BE** BUILDING  
ENCLOSURE

air barrier  
**abaa**  
association of  
america

 **XCELUS**

 **Telligent**  
Masonry Construction

**Architect's  
Newspaper**



# Roadmap to this Case Study

---

- Building introduction
- Discuss the investigation with periodic digressions to discuss relevant building science principles
- Illustrate how the principles guided the repairs



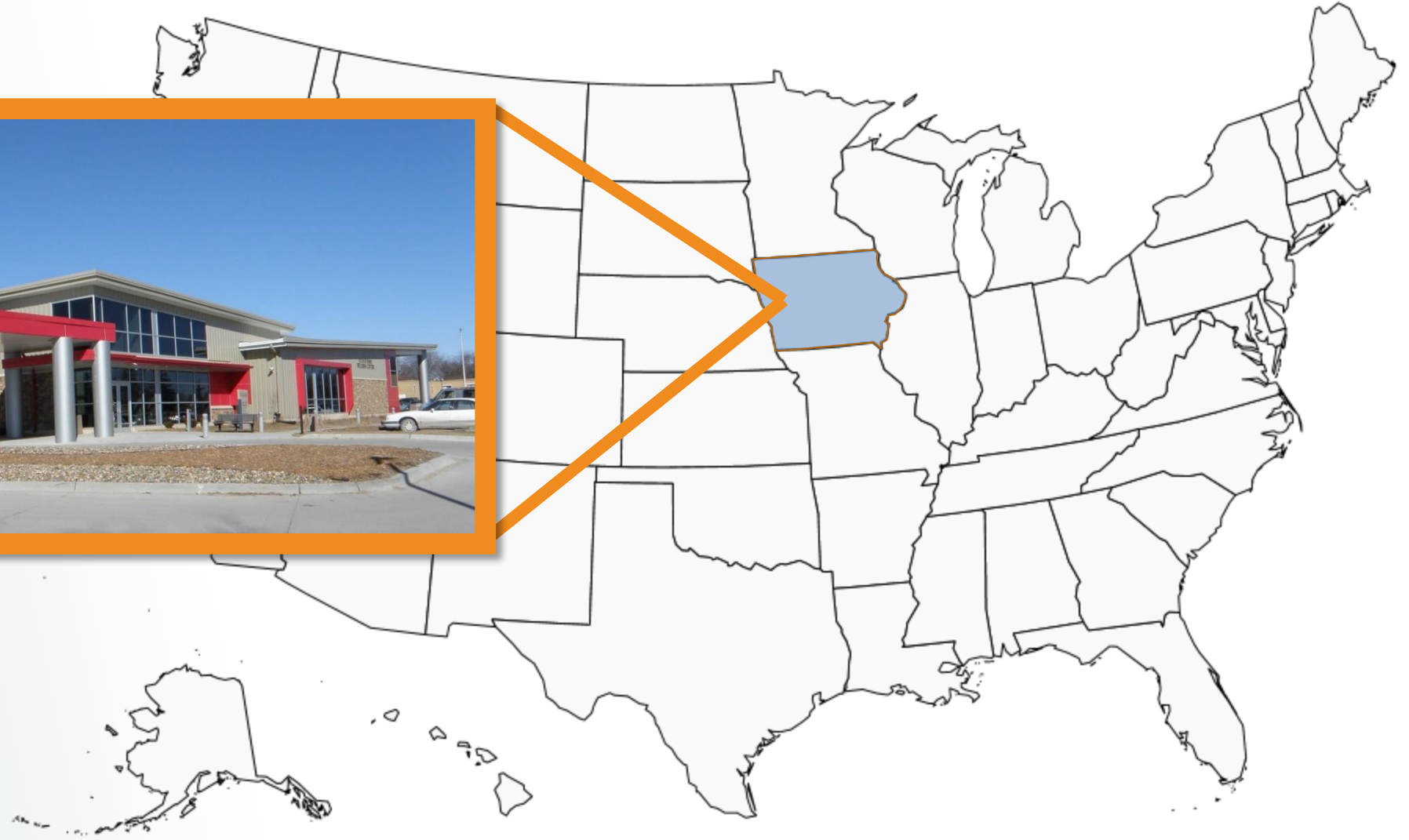
# Learning Objectives

---

- Understand how Heat, Air and Moisture (HAM) move through the building envelope
- Recognize the difference between rainwater and HAM water leaks
- Comprehend the different functions of air and vapor barriers
- Appreciate the use of spray polyurethane foam as a repair material

# Wellness Center

---









# The Problem

---

- Moisture Problems
  - Roof system during construction
  - Icicles
  - Interior water damage
- Mechanical system unable to maintain the desired temperature and humidity in the pool space



# For a moisture problem to occur...

---

- Need a moisture source (precipitation, plumbing leaks, soil & groundwater, outdoor air, construction, interior humidity)
- Need a route for moisture to travel (holes, etc.)
- Must be driving force to cause movement (gravity, air, capillarity, diffusion, convection)
- Material must be susceptible to moisture damage

# Moisture Sources

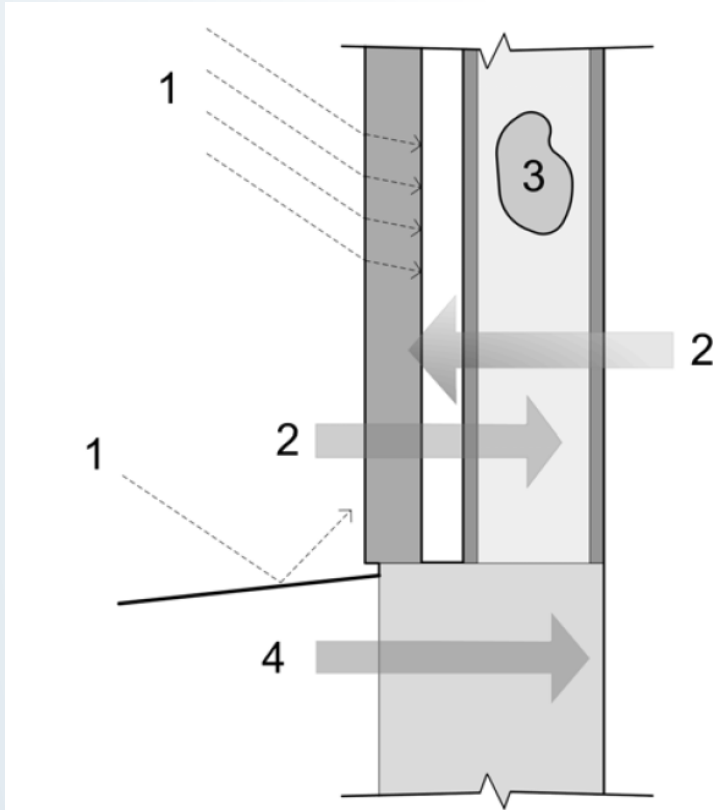
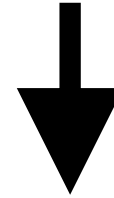
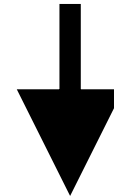


Figure 9.3: Moisture sources for the enclosure

Construction moisture (3)  
groundwater (4) &  
rainwater (1)



Air movement (2)



Vapor Diffusion (2)

# Two Building Types

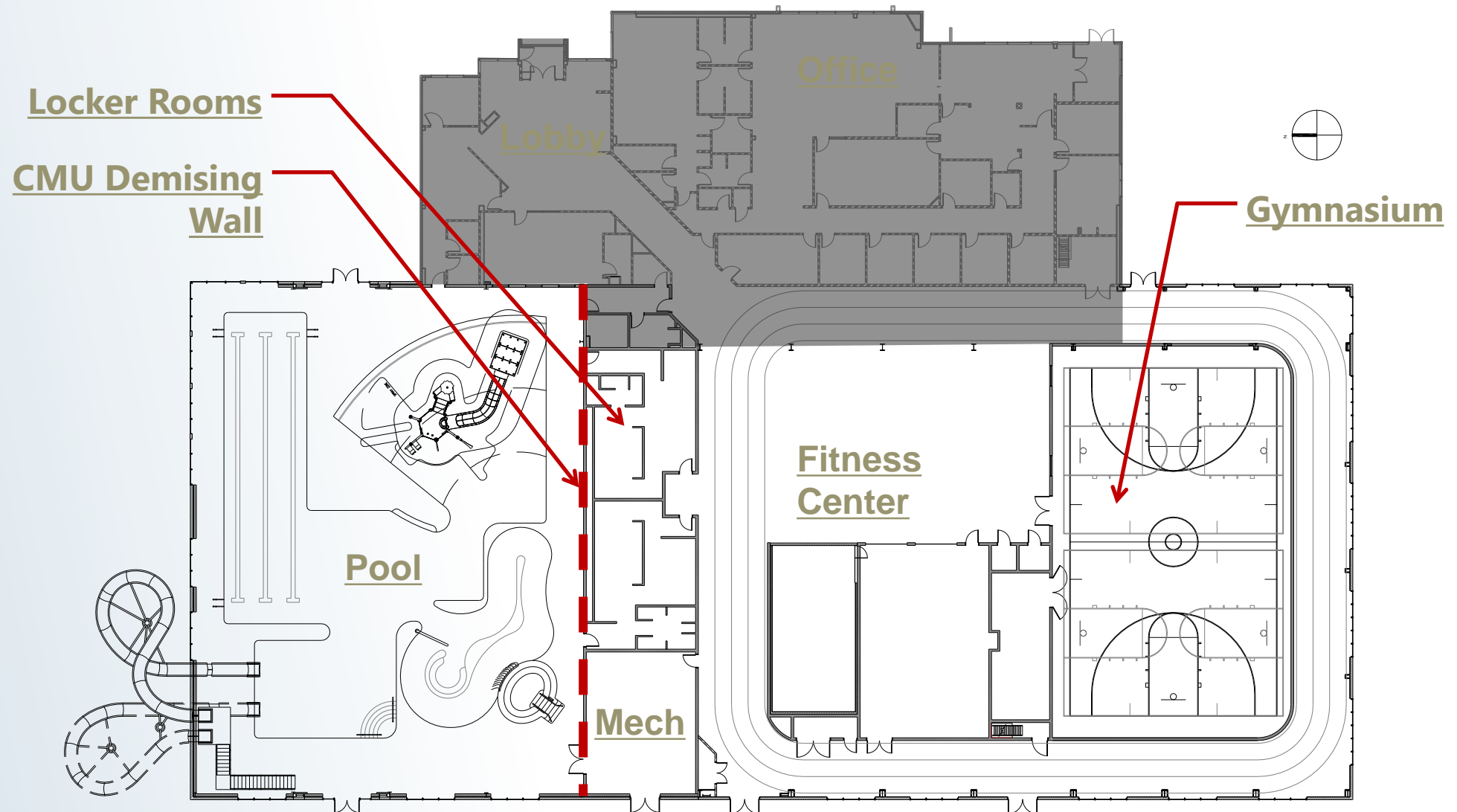
---

- Pre-engineered metal building
- Conventionally framed



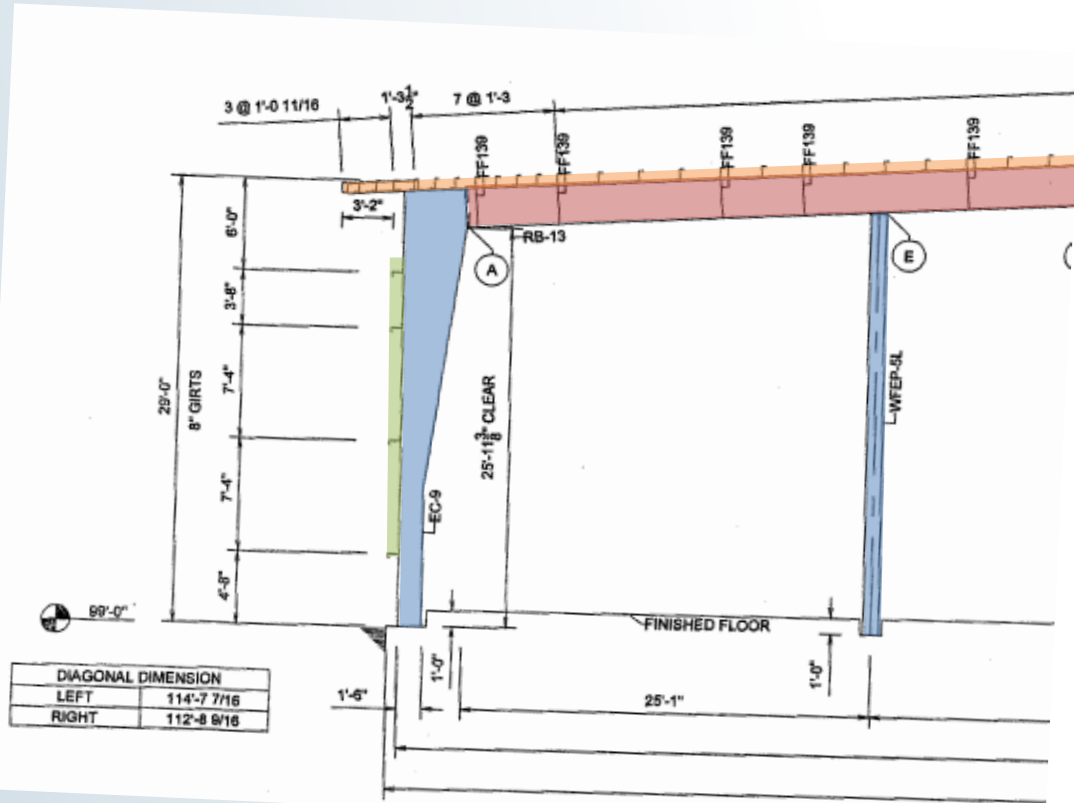








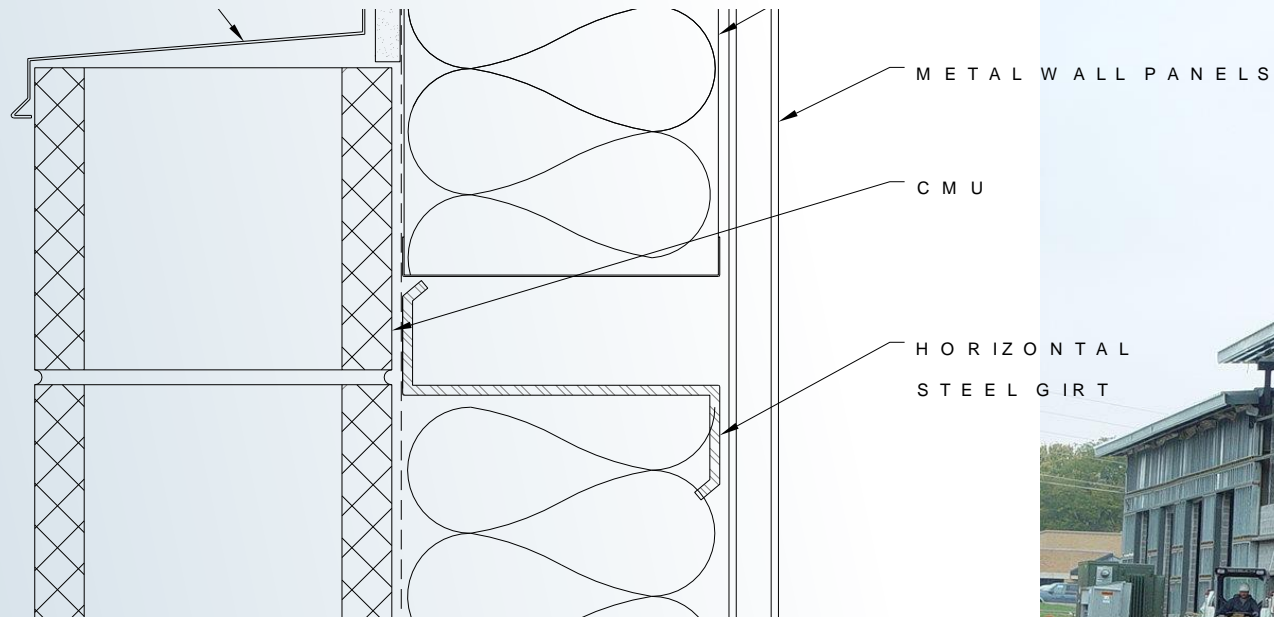
# Pre-Engineered Building Structure



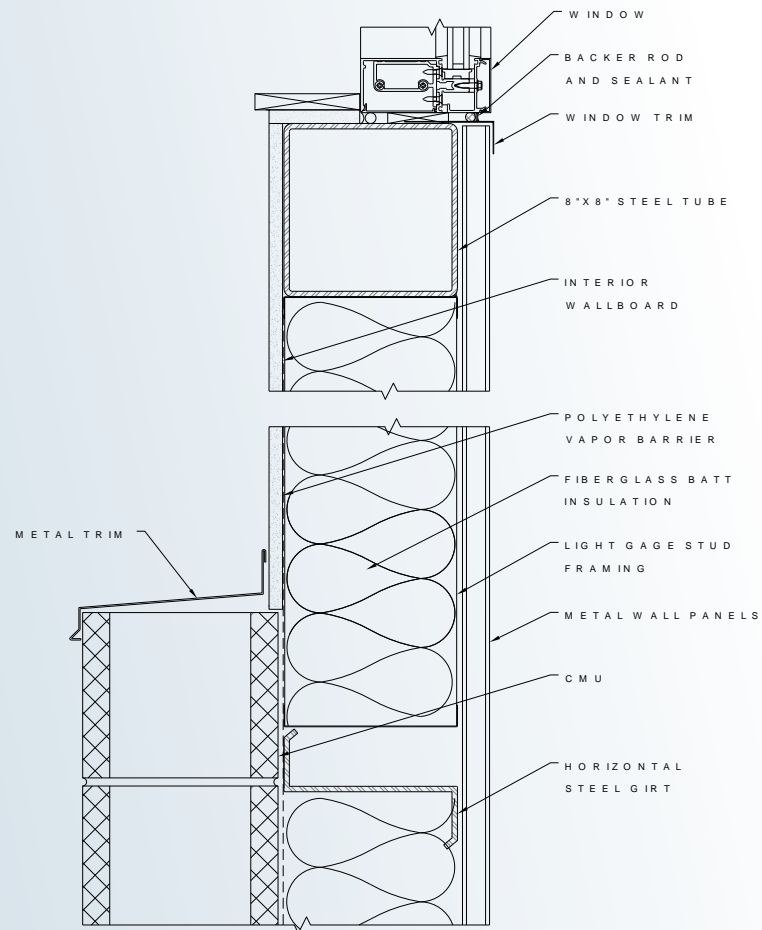


# Pre-Engineered Building Structure

---

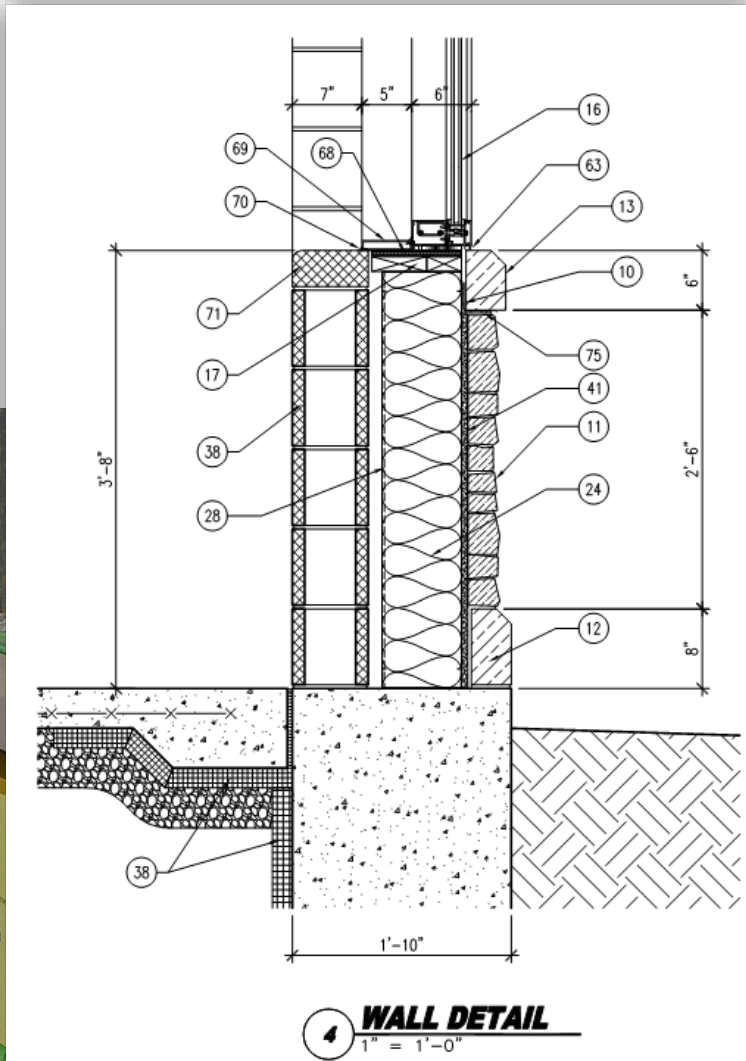


# Pre-Engineered Building Structure

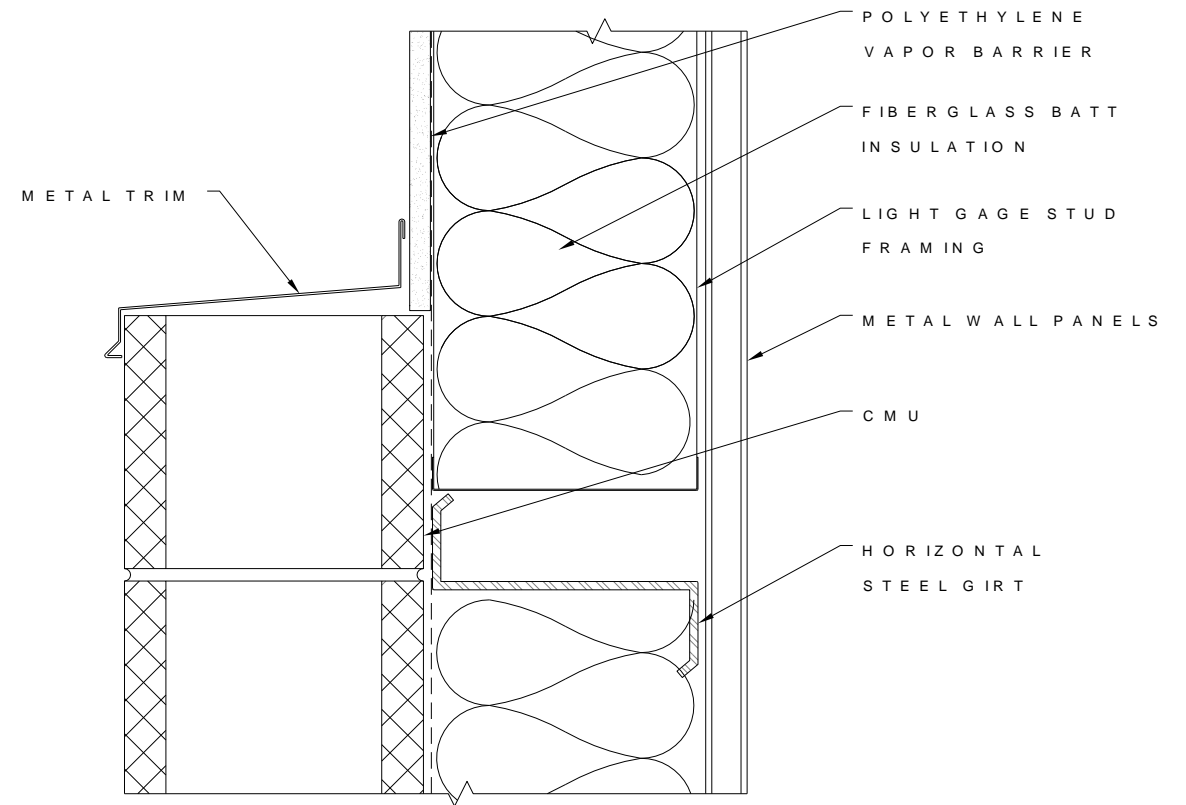




# Existing Wall Assembly – Masonry Veneer

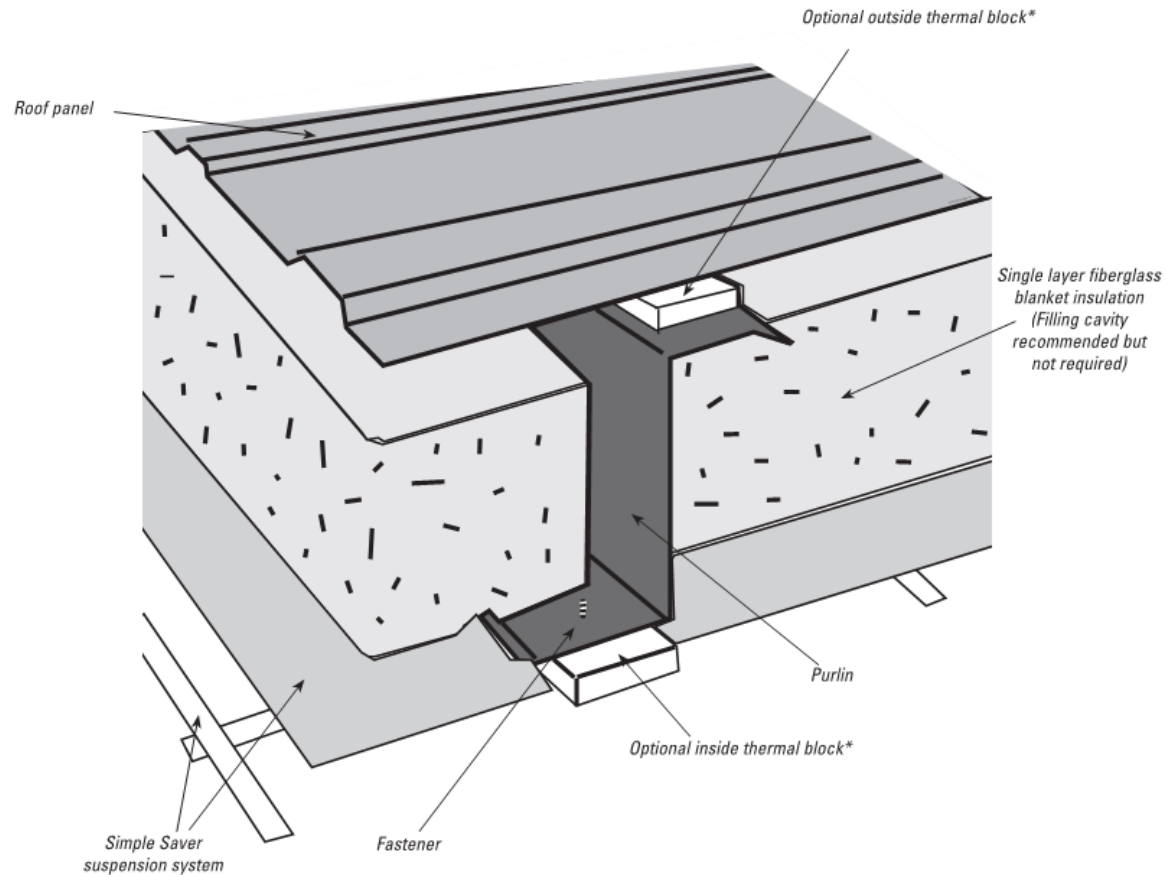


# Existing Wall Assembly – Metal Panel





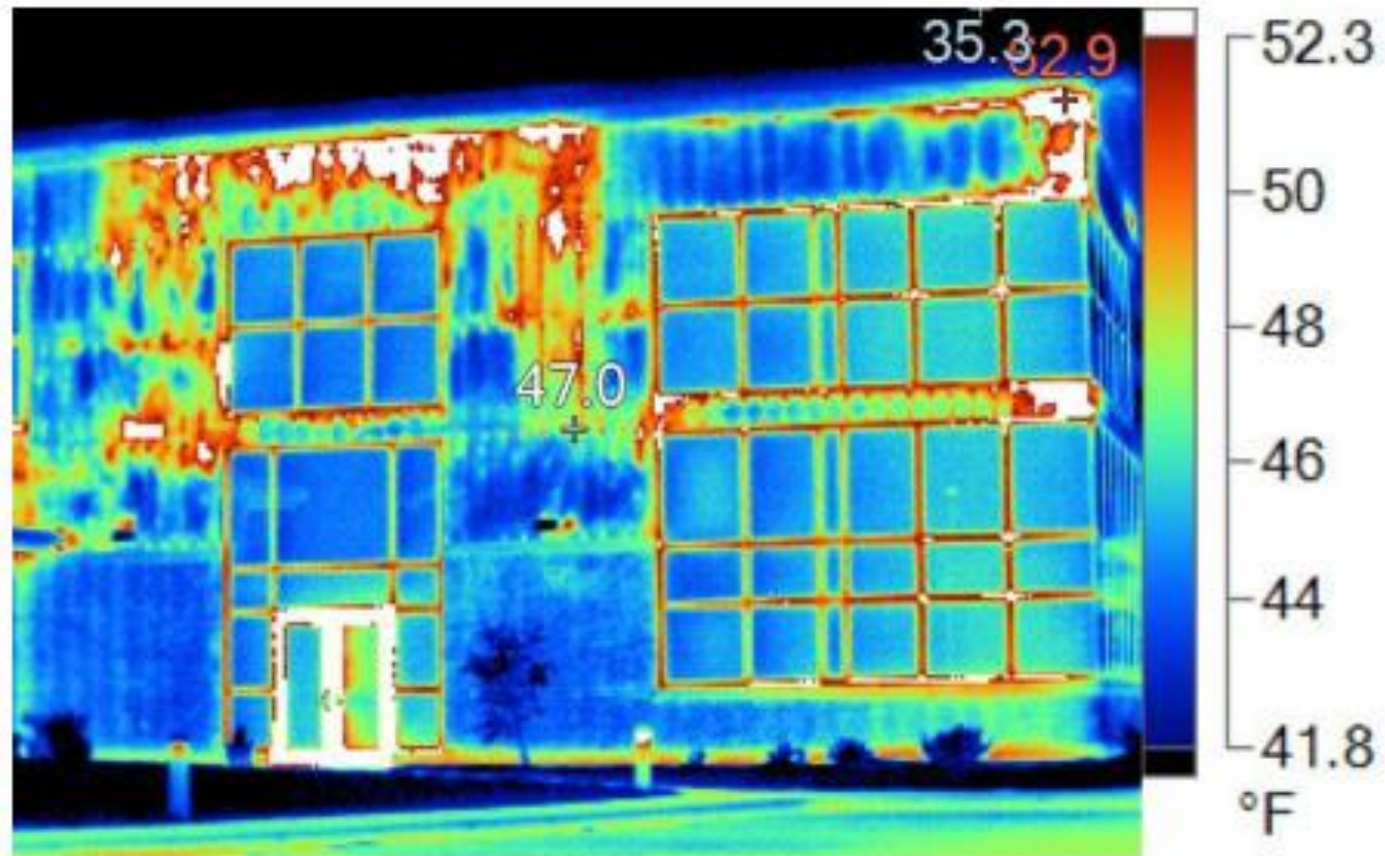
# Existing Roof Assembly





# The Investigation

---























# Vapor Movement

---

- Diffusion
- Warm to cold
- **HIGHER** pressure (more) to *lower* pressure (less)





# Vapor Control: Vapor Barriers

---

- Objective: Control water vapor diffusion
- Careful placement is necessary – must NOT allow moisture to accumulate faster than wall can dry
- Vapor barrier need not be perfect to work
- Vapor permeance varies – i.e. kraft paper vs polyethylene
  - Vapor impermeable (Class I) < 0.1 perms
  - Vapor semi-impermeable (Class II) 0.1 to 1 perm
  - Vapor semi-permeable (Class III) 1 to 10 perms
  - Vapor permeable > 10 perms

# Vapor Barrier Design

---

- Avoid vapor retarders where possible to promote drying
- Must have in...
  - Floor slabs on grade
  - In roofs with concrete decks
  - In enclosures with high interior RH
- Avoid
  - Double vapor retarders

# Common Vapor Barrier Defects

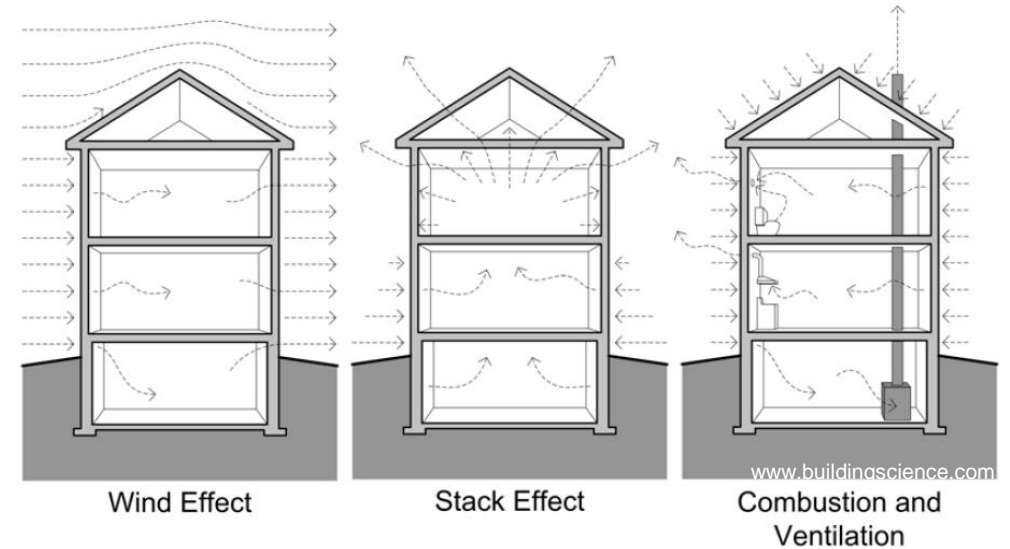
---

- Misplacement
- Too impermeable
- Double vapor barriers



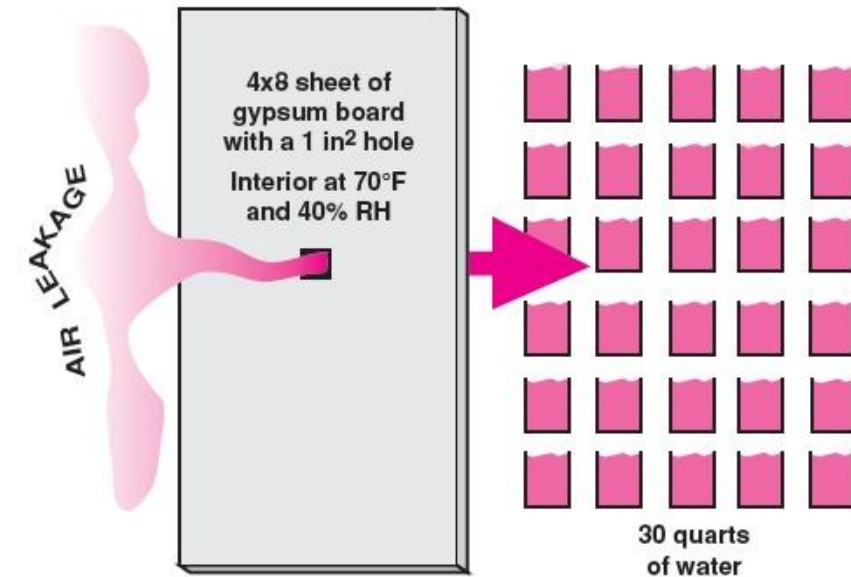
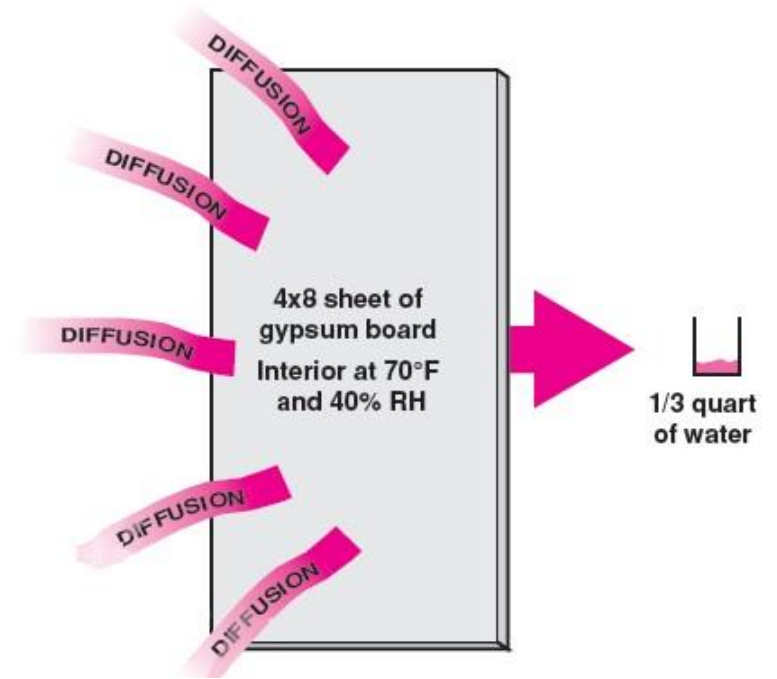
# Air Movement

- **HIGHER** pressure to *lower* pressure
- Driving forces are stack pressure, wind pressure, and pressure differences induced by the mechanical system
- Air transports **heat** and **vapor**



# Air Barriers vs. Vapor Barriers

- Often one system performing the function of both an air barrier and vapor retarder, leading to confusion
- Vapor retarders are meant to simply control the rate of water vapor diffusion
- Air barriers must be continuous while vapor retarders can have minor discontinuities and still remain effective in most situations. Moisture laden air movement carries far more water vapor than diffusion alone



# Air Barriers

---

- Objective: Control airflow between conditioned and unconditioned space
- Important because....
  - Air removes heat → energy loss
  - Air carries moisture → condensation
    - Carries 100s of times more moisture than by diffusion
  - Improve occupant comfort and safeguard health → drafts and sick building syndrome



# Air Barriers

---

## ■ Compliance Options

### 502.4.1.2.1

#### Materials

- ASTM 2178
- 0.004 cfm/ft<sup>2</sup> @ 0.3 in water (75 Pascals)
- Materials Listing

### 502.4.1.2.2

#### Assemblies

- ASTM 2357
- ASTM 1677
- ASTM 283
- 0.04 cfm/ft<sup>2</sup> @ 0.3 in water
- Listed assemblies

### 502.4.1.2.3

#### Building Test

- ASTM E-779
- 0.4 cfm/ft<sup>2</sup> @ 0.3 in water

# Air Barriers

---

Iowa  
follows  
**2006**  
IBC/IECC

The diagram features a large orange arrow pointing downwards, containing the text 'Iowa follows 2006 IBC/IECC'. Below this arrow is a horizontal light orange ribbon with a small orange circle in the center. Below the ribbon is the year '2009' and the text 'Building Constructed'. To the right of the ribbon is a large light orange arrow pointing to the right, which contains a text box with the title 'C502.4.3 Sealing of the Building Envelope' and a paragraph of text.



2009

Building Constructed

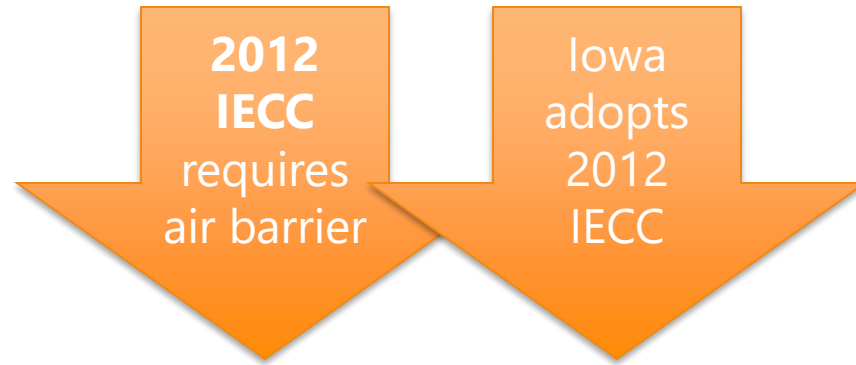
## **C502.4.3 Sealing of the Building Envelope**

Openings and penetrations in the building envelope shall be sealed with caulking materials or with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.



# Air Barriers

---



2009

Building Constructed

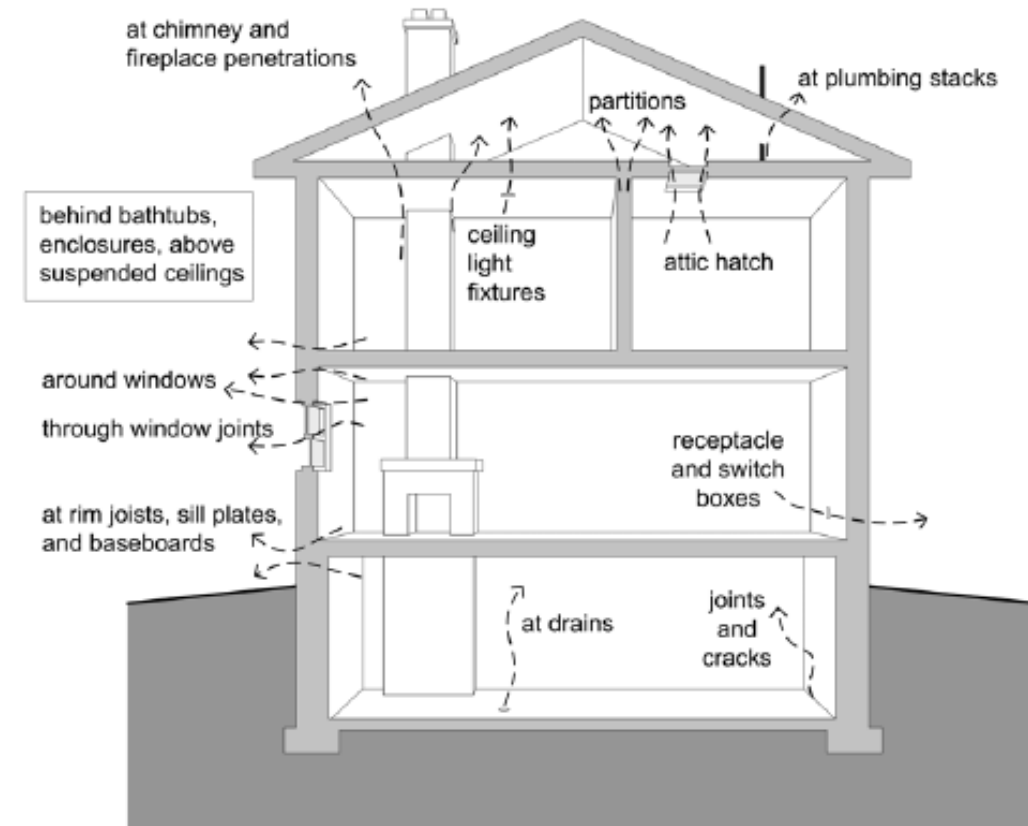


2014

WJE Investigation

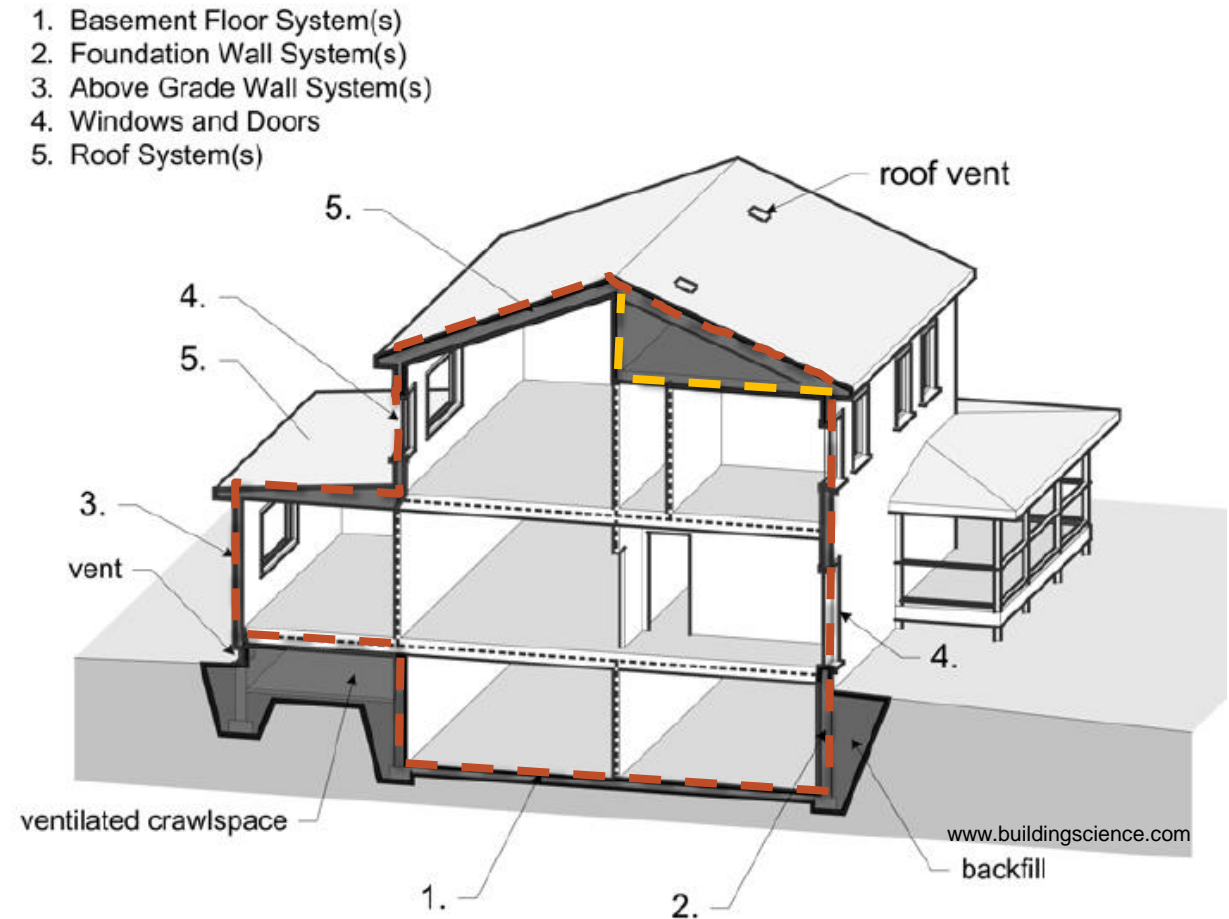
# Air Barrier Design

- Prevent condensation and provide energy efficiency
- Make continuous (must be perfect to work)
- Can be vapor impermeable or vapor permeable (need depends on location)
- Strong enough to withstand window pressure



# Common Air Barrier Defects

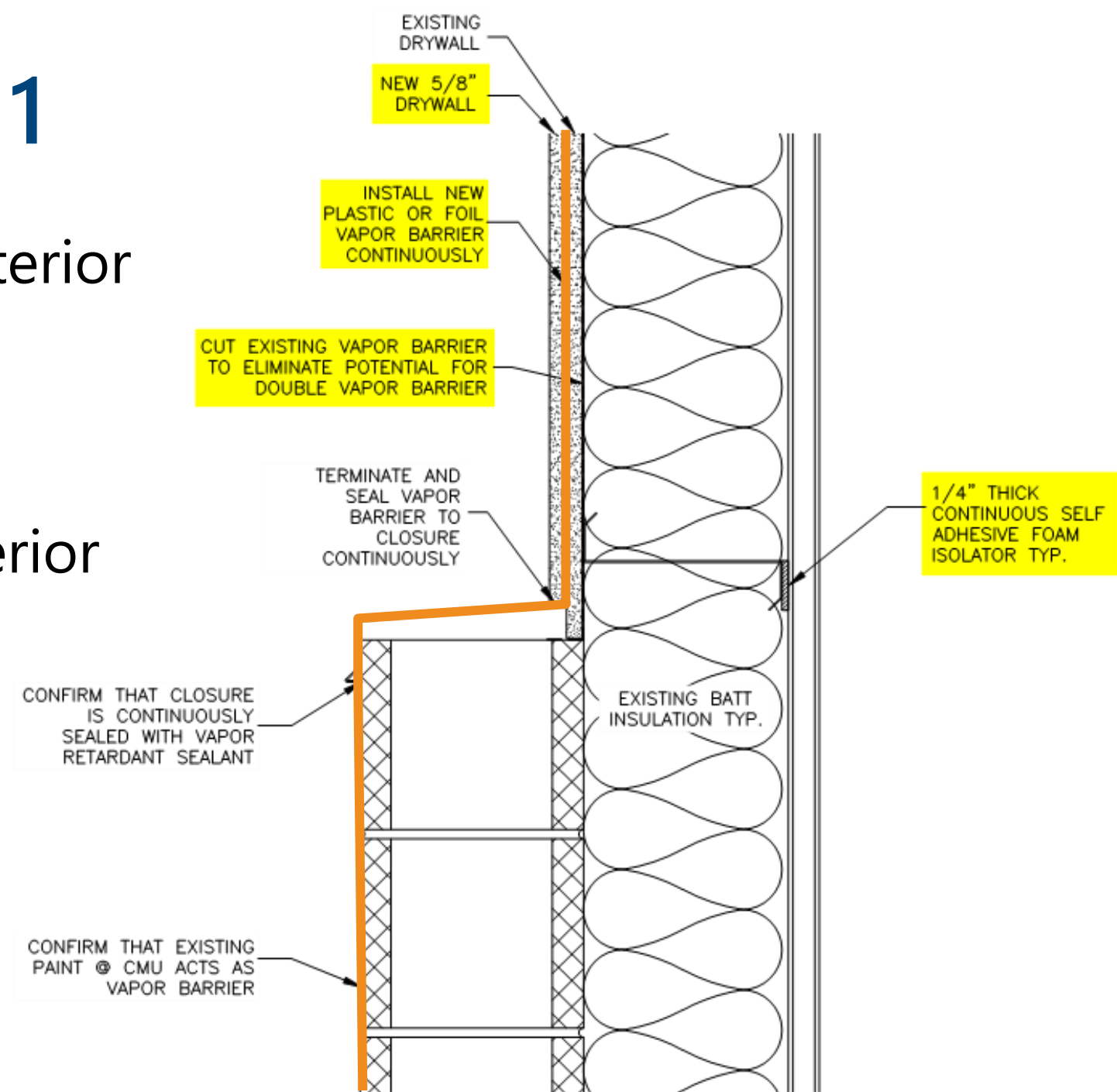
- Lack of identification of air barrier in drawings/specs
- Continuity
  - Windows
  - Parapets
  - Canopies/Overhangs
  - Small gaps, holes
- No air barrier in roofing system

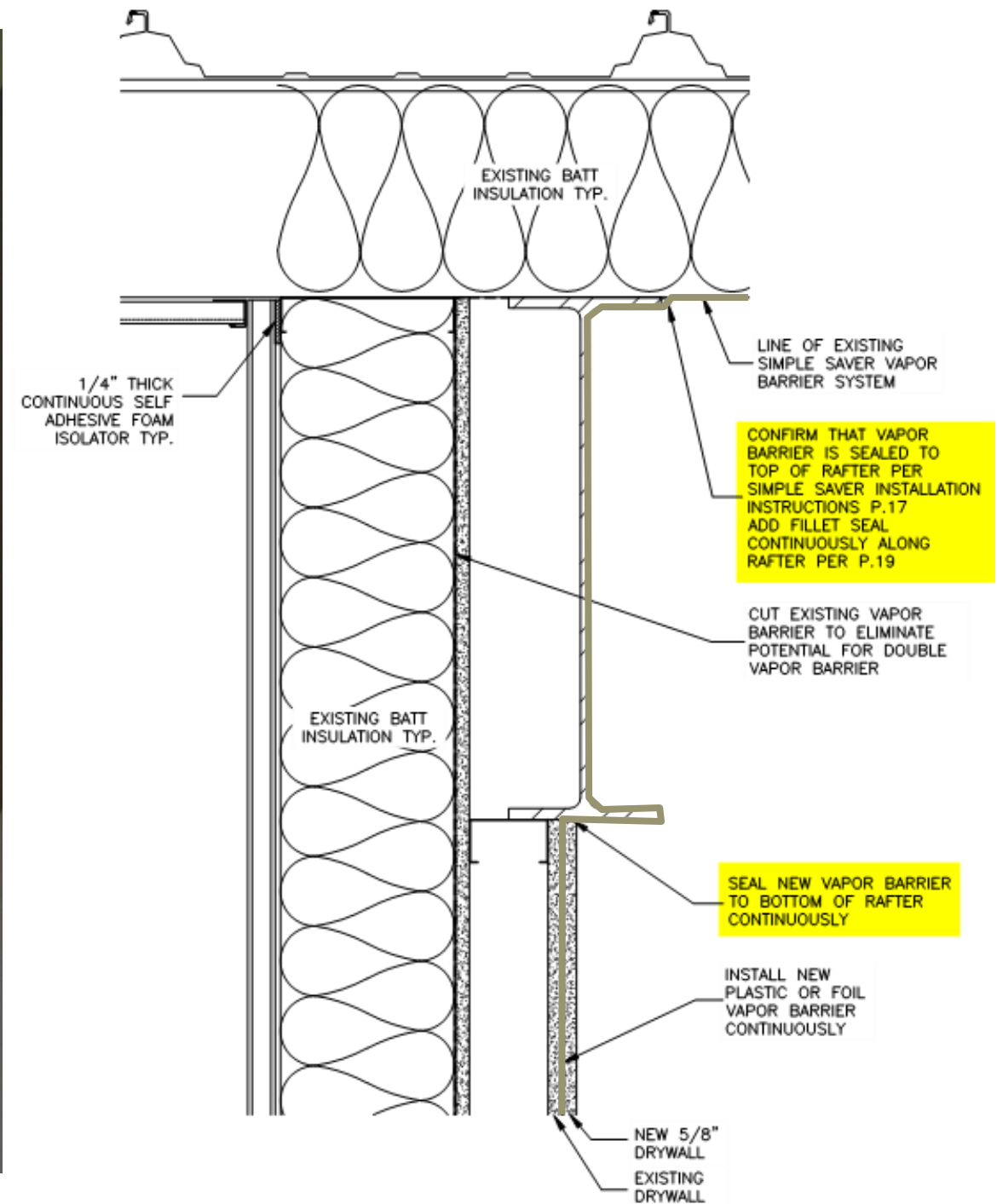




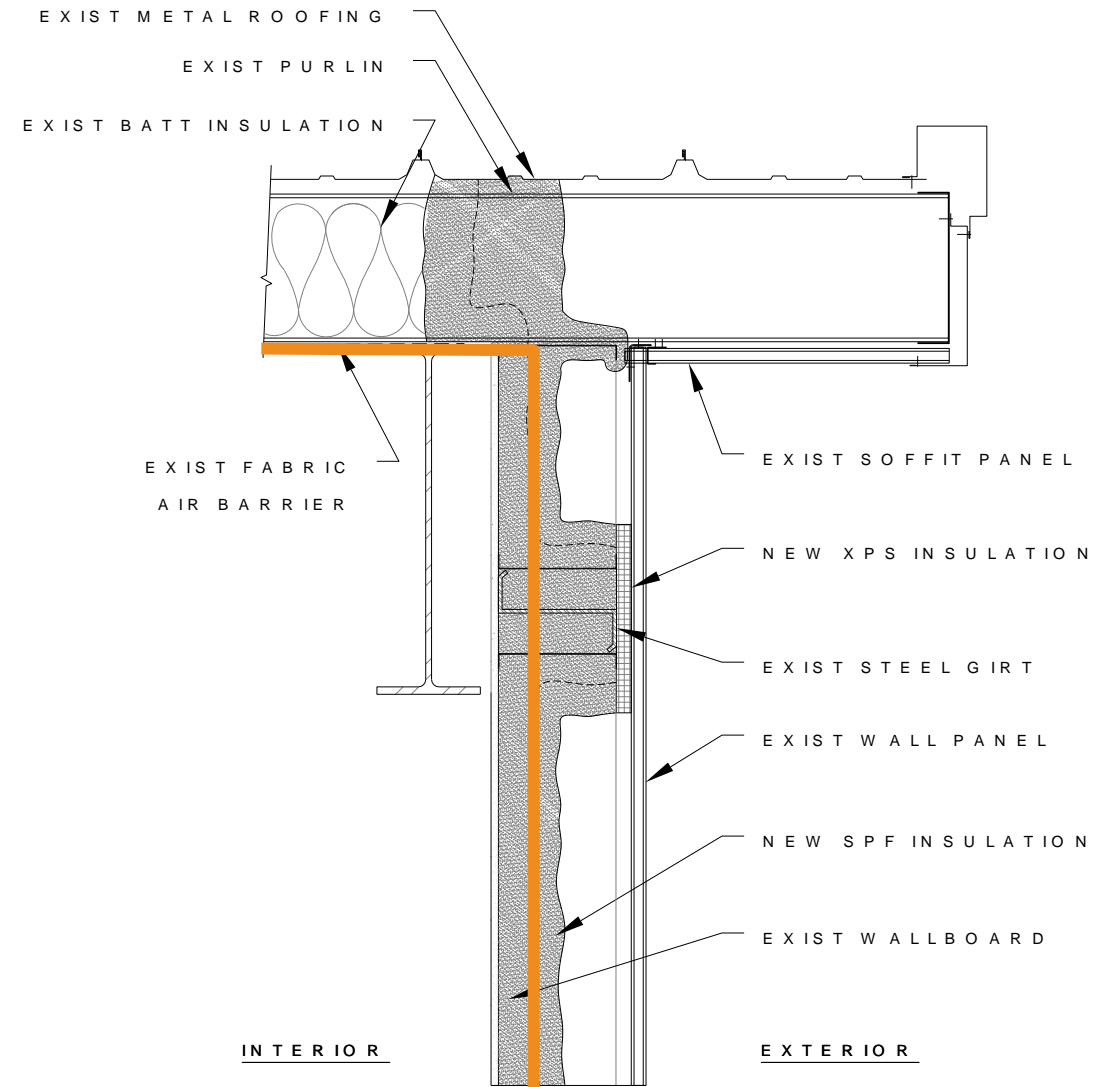
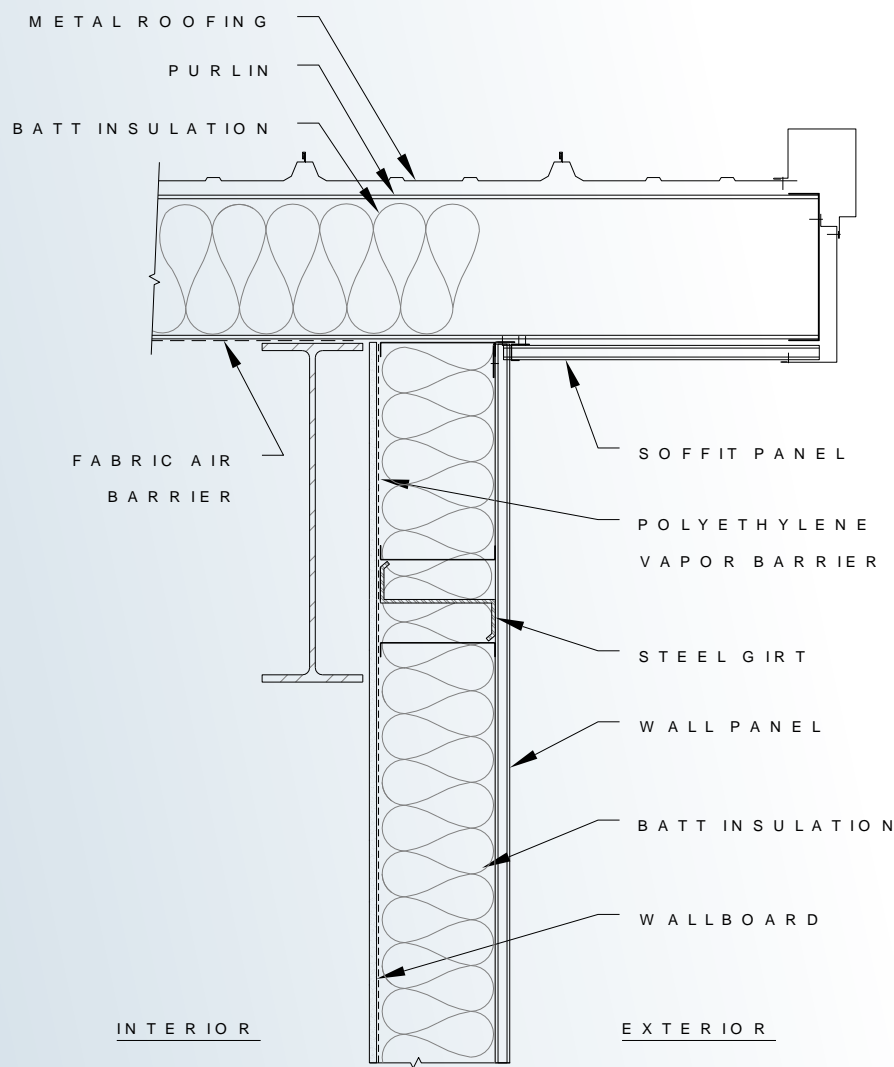
# Repair Option No. 1

- Perform primarily from interior
- New vapor barrier
- New interior drywall
- Foam isolator tape at exterior





# Repair Option No. 2





# What is Spray Polyurethane Foam (SPF)?

---

- Two-part reactive foam
- Mixed at nozzle
- Expands upon contact with a substrate



# SPF Insulation - Advantages

---

- Good thermal insulating properties
  - (R-Value: Approx. 6 per inch)
- Water resistant
- Can perform as an air and vapor barrier
- Continuous and seamless
- Conforms to any shape substrate
- Spray applied with no fasteners

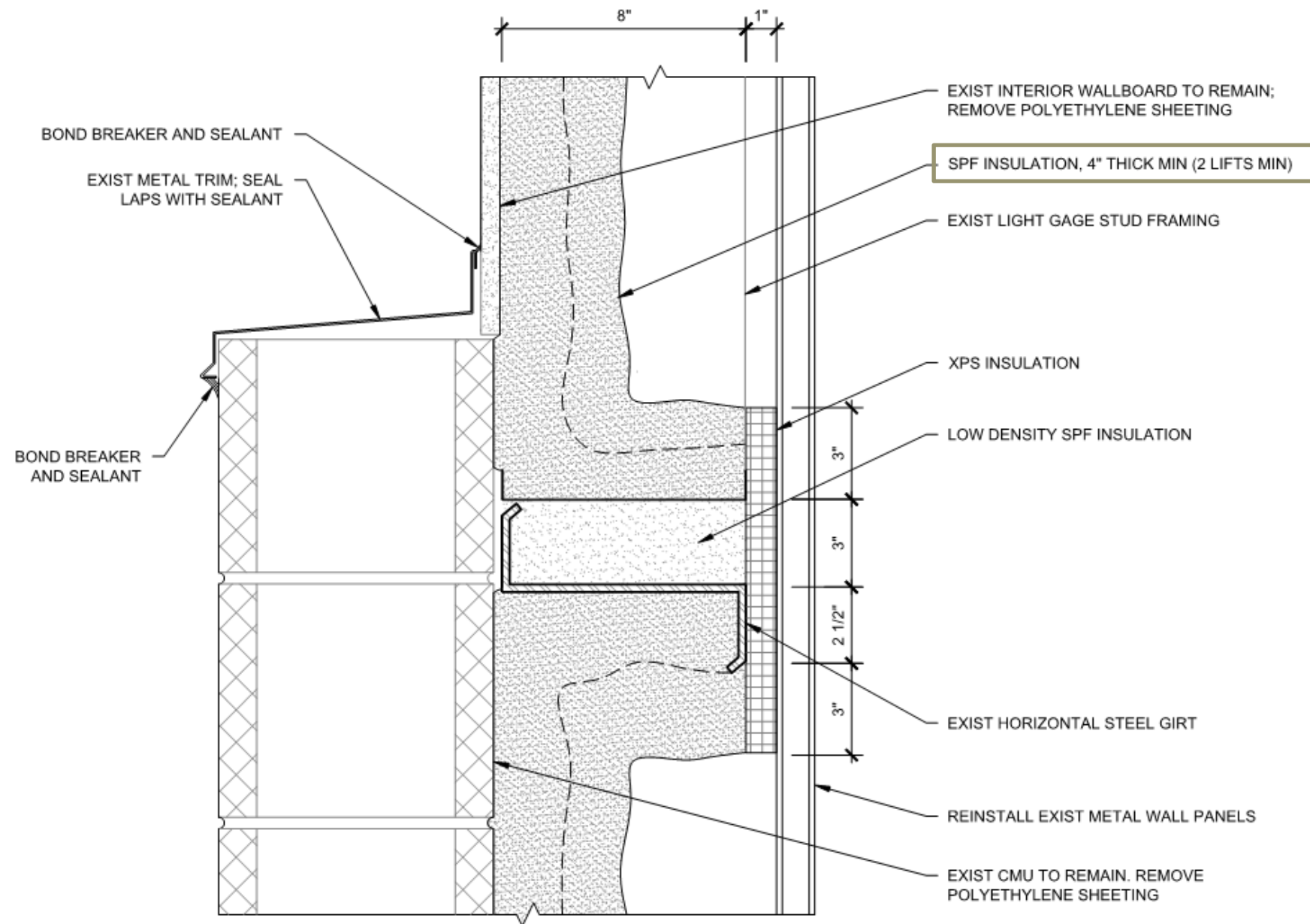


# SPF Insulation - Disadvantages

---

- Gaps must be filled prior to application
- Min and max required temperature of substrate and ambient temperature
- Combustible: need to check usage per code
- Hazardous during application: generates heat and fumes
- UV Sensitive
- Requires QC to maintain specified thickness



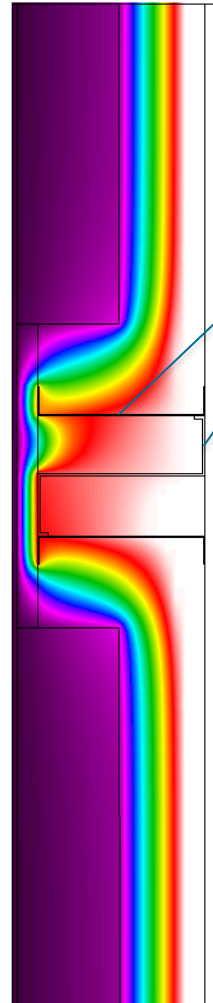


# Continuous Insulation



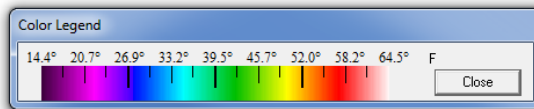
Exterior Temperature:  
14 deg F  
(avg Jan low for Omaha)

Interior Temperature:  
82 deg F  
(actual reading in pool  
space)

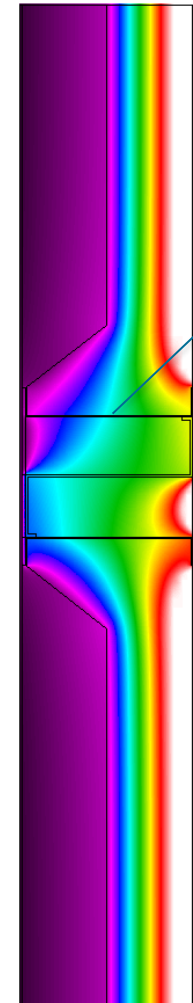


Surface 1: 59 deg F

Surface 2: 66 deg F

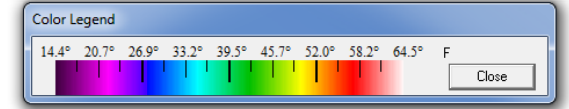


WJE Proposed Design at Pool  
1" XPS Thermal Break



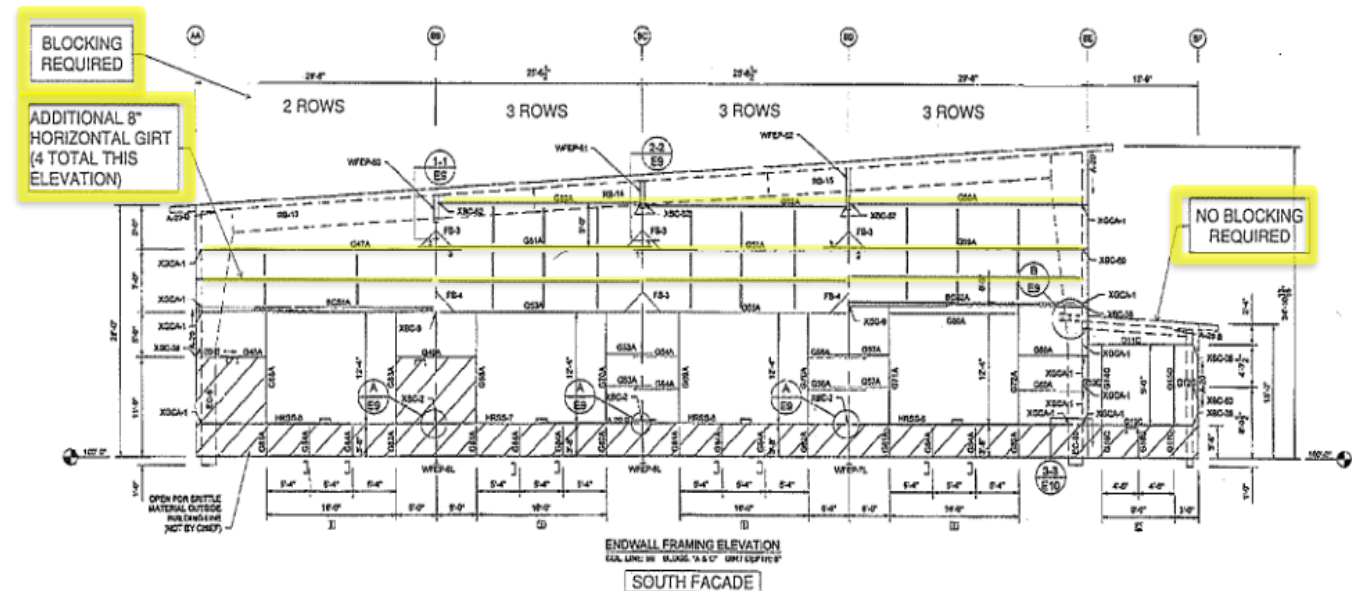
Surface 1: 35 deg F

Surface 2: 49 deg F



VE Proposed Design at Pool  
1/8" Foam Weather Stripping as Thermal Break

## Metal cladding acts at structural bracing

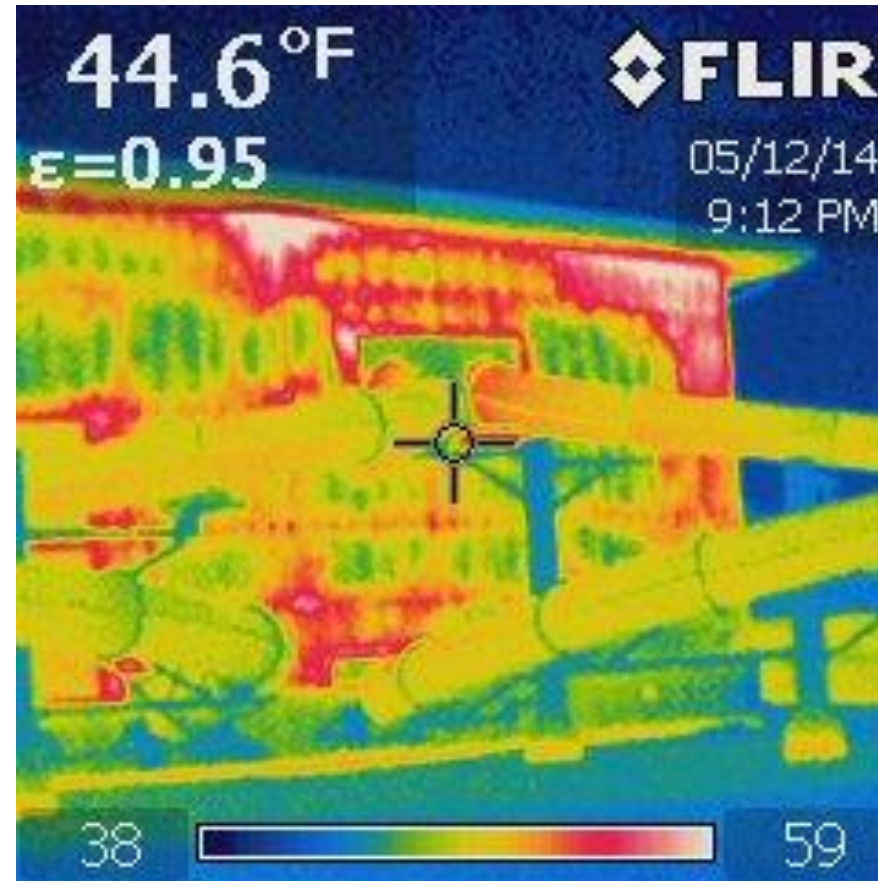
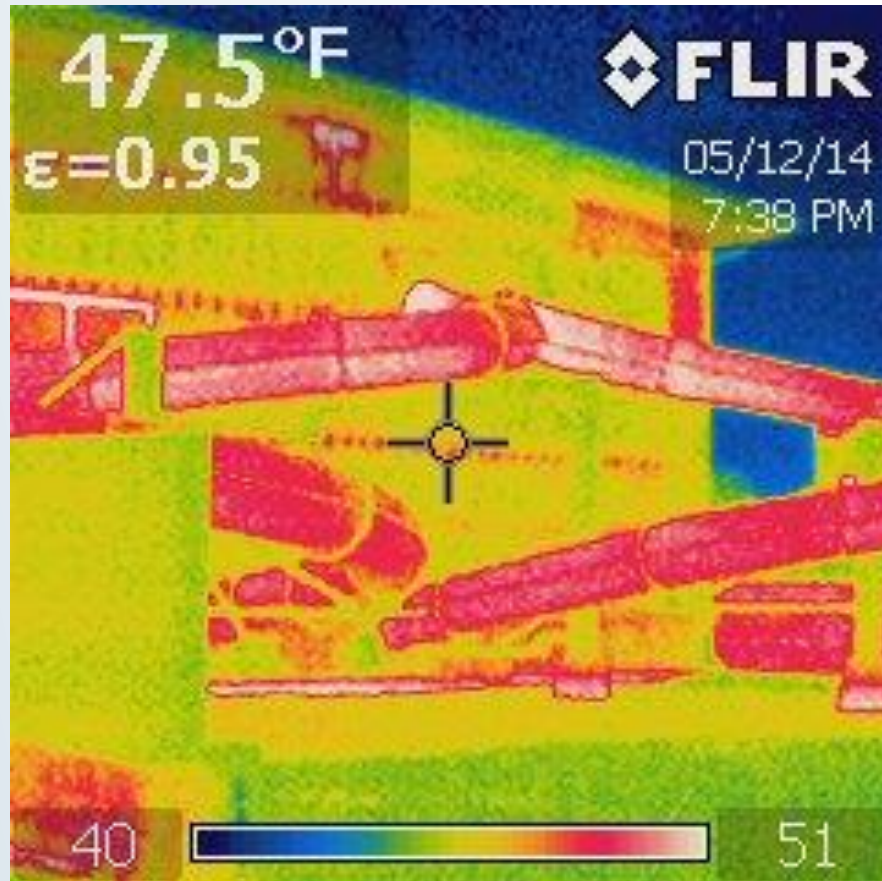






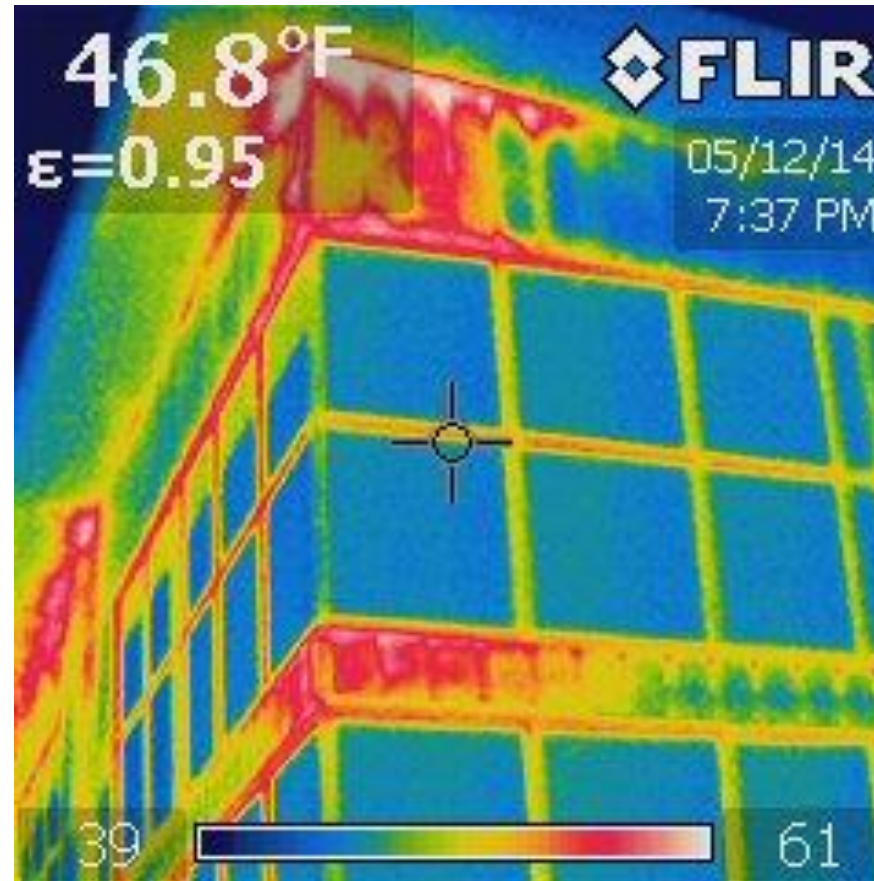
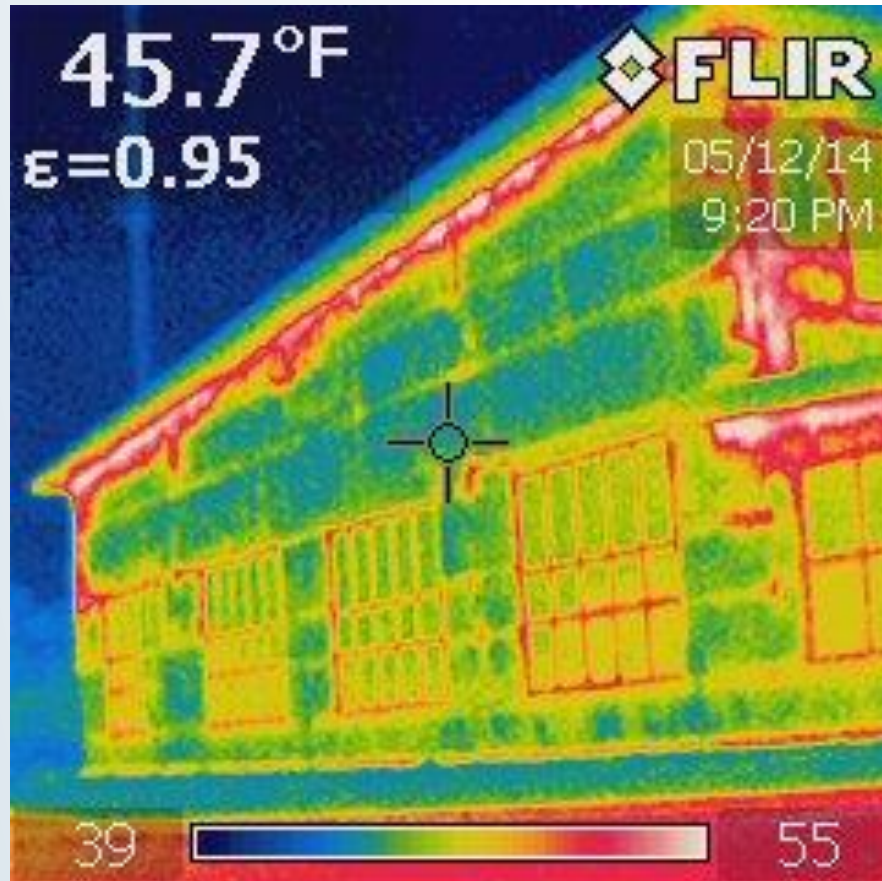
# Whole Building Air Test

---





# Whole Building Air Test





# Mockup

---













# Demolition

---





# Prep

---









# Installation of Insulation

---













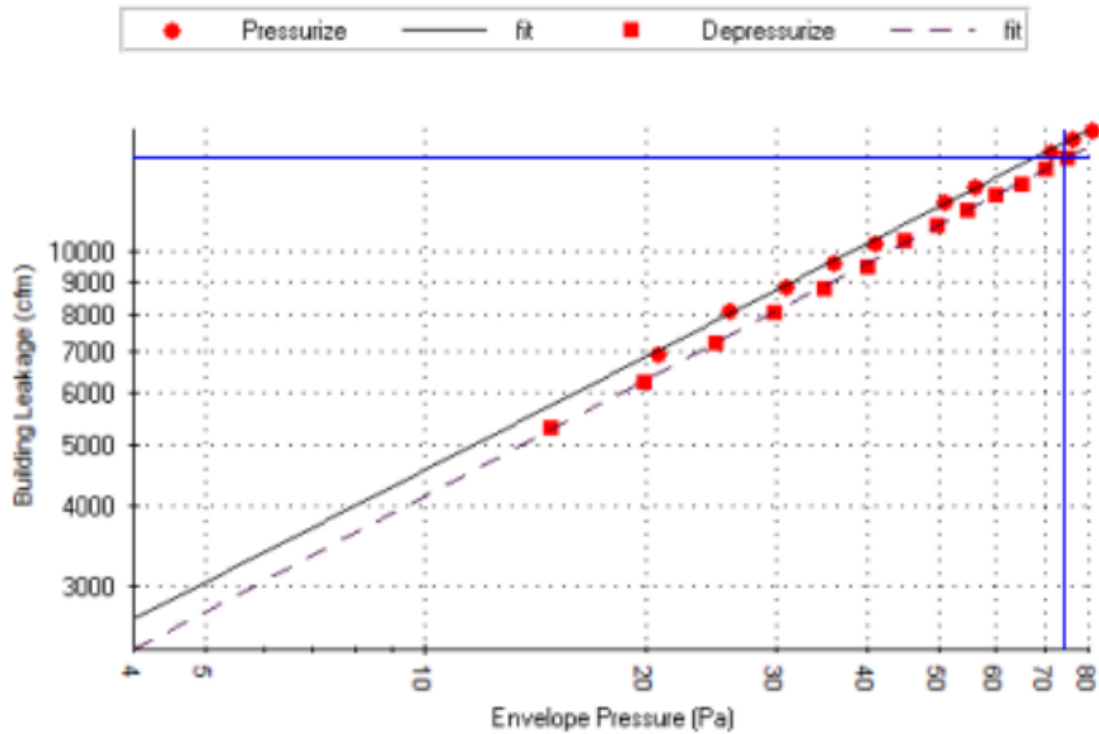








# Whole Building Air Test







## **Learning Objectives**

- Understand how Heat, Air and Moisture (HAM) move through the building envelope
- Recognize the difference between rainwater and HAM water leaks
- Comprehend the different functions of air and vapor barriers
- Appreciate the use of spray polyurethane foam as a repair material