

# Where Continuity Meets Vulnerability

## Wall Transition Essentials

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Siplast Building Enclosure Business Director



### Learning Units

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of completion will be sent electronically at the end of the presentation.

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

### Course Description

Explore fundamental building science principles for the continuity of moisture, air, vapor, and thermal performance for commercial building enclosures. "Where the building touches the sky" the continuity is essential at the vulnerable wall system to the roof system connection. This session discusses the impacts of whole building performance, design requirements, material & assembly requirements, and installation verification requirements during construction as well as wind resistance requirements at the critical wall-to-roof interface. We will review a series of design examples and discuss strategies to successfully navigate these often competing interests through design, specification, and construction sequencing without compromising the aesthetics or performance of the commercial wall systems.

### Learning Objectives

- 1 Discuss the requirements to manage moisture, air, vapor, and thermal continuity.
- 2 Recognize the changing building and energy codes, and interaction across building enclosure system interfaces.
- 3 Apply specific examples and air barrier systems to current and future project designs.
- 4 Outline design and specification requirements to set performance requirements for wall systems.

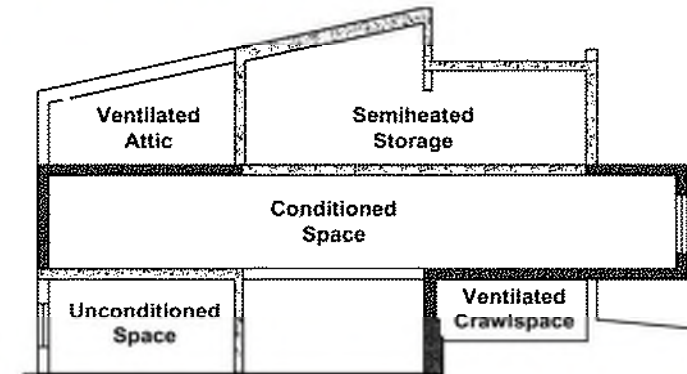
## Outline

- Control Layer Overview
- Example Conditions
- Codes and Performance
- Conclusion

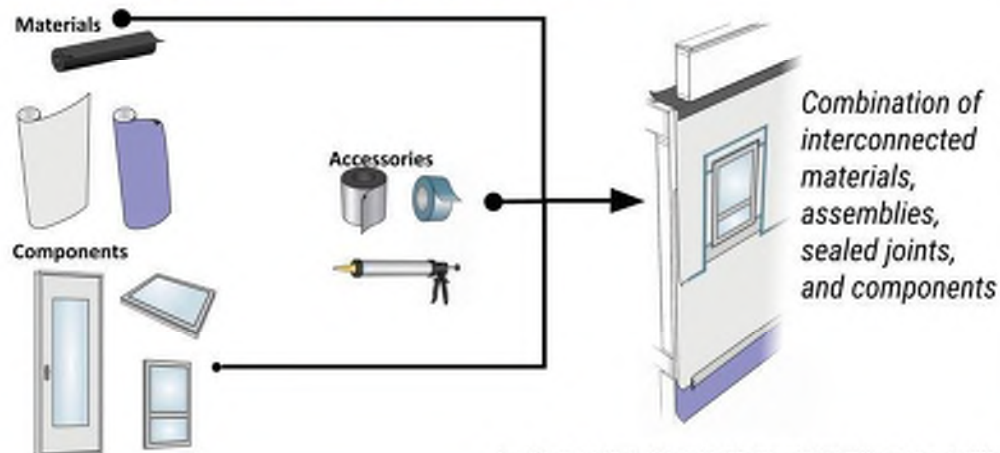
## Defining Building Enclosure

- Roof
- Fenestrations
- Above grade walls
- Below grade walls
- Floor systems

"ALL SIX SIDES"

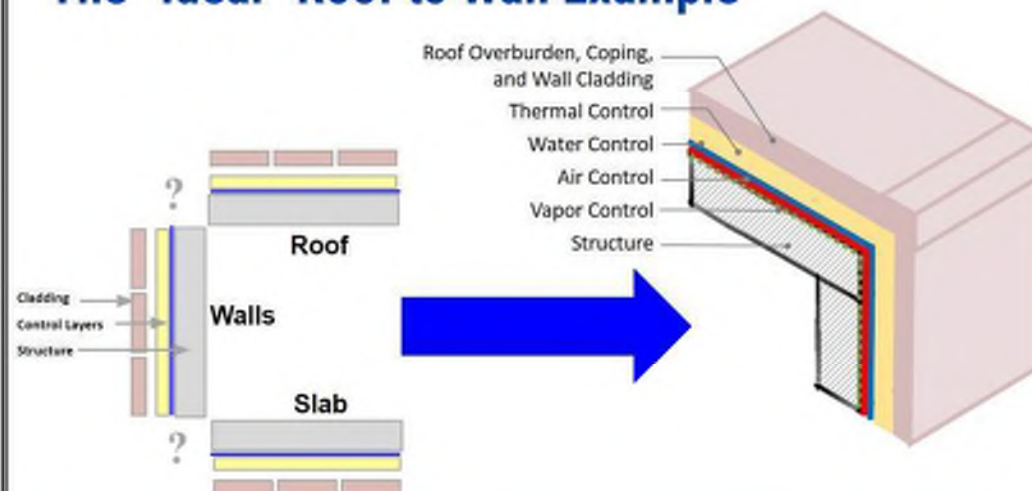


## Creating a Building Enclosure

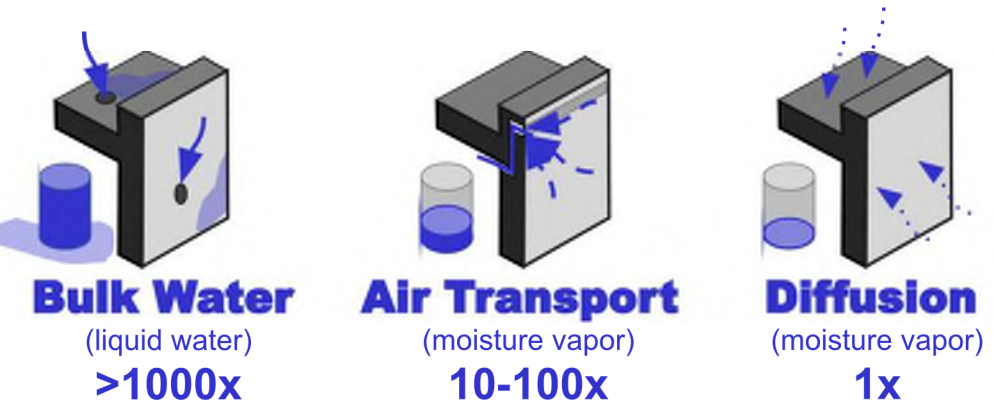


Images from Illustrated Guide - Achieving Airtight Buildings, published by BC Housing in September 2017.

## The "Ideal" Roof to Wall Example

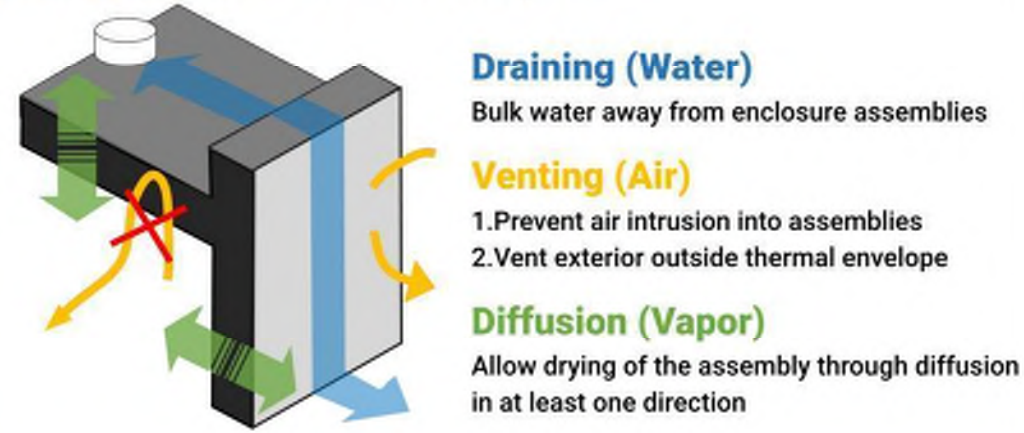


# Relative Moisture Risks



## Control Layer Overview

# WATER control – Principles



# WATER control – Performance Testing

| Materials                                                                             | Assemblies                                                                            | In Situ                                                                                  |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• AATCC 127</li><li>• AC 28, AC 212</li></ul>   | <ul style="list-style-type: none"><li>• ASTM E331</li><li>• AC 28, AC 212</li></ul>   | <ul style="list-style-type: none"><li>• ASTM E1105</li><li>• AAMA 501.1, 501.2</li></ul> |
|  |  |     |

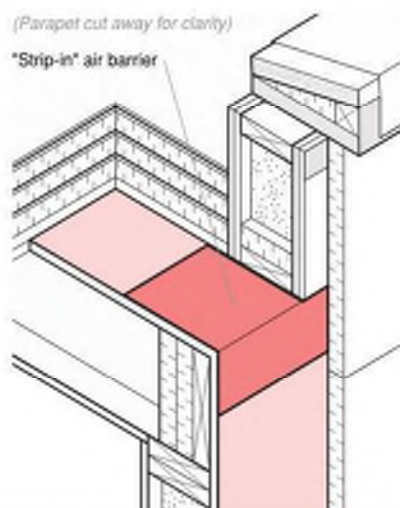


## AIR control – Principles

Continuity in Roofs and Walls

Responsibility of Registered Design Professional

IECC Section C103.2.1



## AIR control – Air Barrier Testing

### Materials

- ASTM 2178



### Assemblies

- ASTM E2357, ASTM E1677, ASTM E1680, ASTM E283



### Whole Building

- ASTM E779, E1827, ASTM E3158

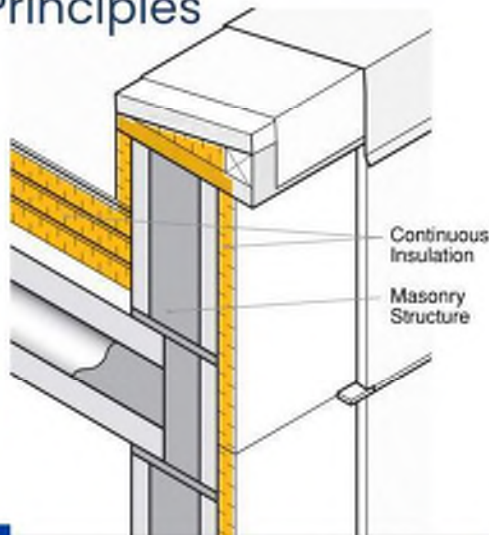


## THERMAL control – Principles

Continuity of Thermal Control Layers in Roofs and Walls

Transfer of Thermal Movement

Thermal Envelope Depiction - IECC C103.2



## THERMAL control – Impacts



Looking up inside parapet - Balloon Framed

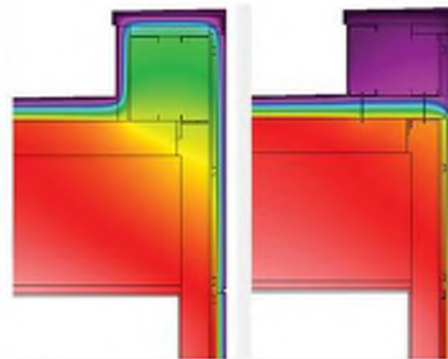


Image courtesy of Payette

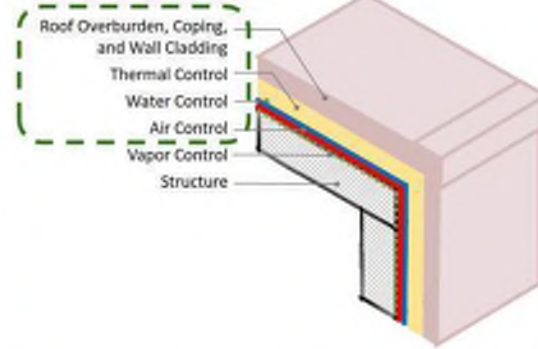
## VAPOR control – Principles

Continuity of Vapor Control Layers in Roofs and Walls

Permeability & application appropriate for assembly, location and occupancy

Avoid placement of *unintended* vapor barriers within assemblies

**Solve these FIRST!**



## VAPOR control – Materials

| Material                  | Perm Rating | Classification                               |
|---------------------------|-------------|----------------------------------------------|
| Built-Up Roofing Membrane | 0.00 – 0.02 | Impermeable (Vapor Proof)<br>$\leq 0.1$ Perm |
| Single-Ply Membrane       | 0.03 – 0.06 |                                              |
| Polyethylene Film         | 0.06 – 0.08 |                                              |
| Asphalt Felt              | 0.3 – 0.8   | Semi-Impermeable<br>$> 0.1 \leq 1.0$ Perm    |
| Polyiso Roof Insulation   | 1.0         |                                              |
| Extruded Polystyrene      | 1.0         |                                              |
| Expanded Polystyrene      | 1.2         | Semi-Permeable<br>$> 1.0 \leq 10.0$ Perm     |
| Wood Fiber                | 3.0 – 5.0   |                                              |
| Gypsum Board              | 30.0 – 50.0 | Permeable<br>$> 10.0$ Perm                   |

Graphics courtesy of Griffin & Frickias (2006)

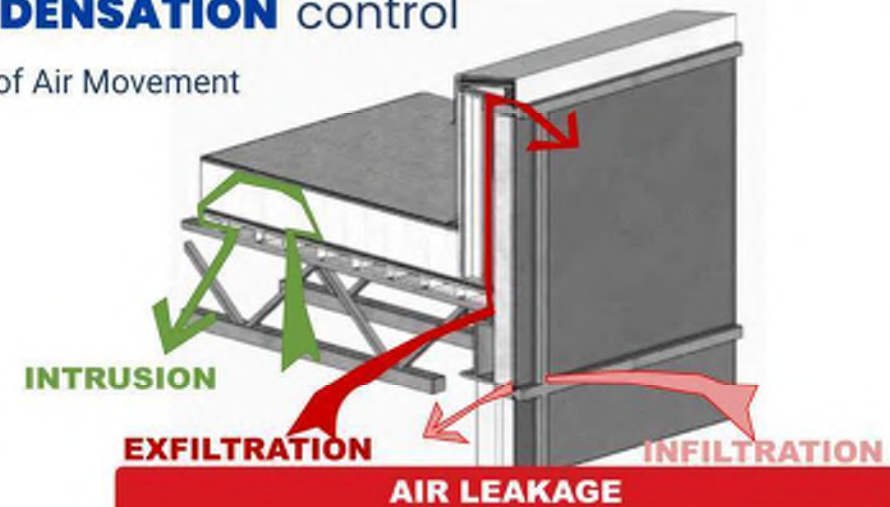
**Vapor Diffusion** occurs when water molecules (vapor) in the air pass through a solid material due to a pressure differential (high to low) on either side of the material.

## CONDENSATION control



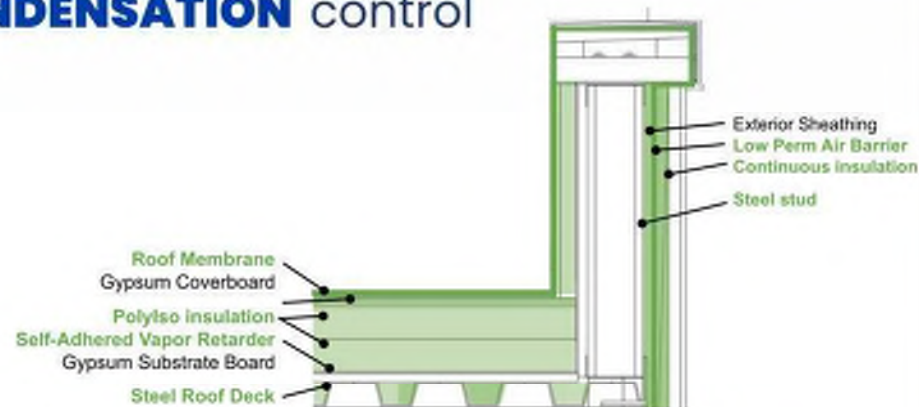
## CONDENSATION control

Types of Air Movement



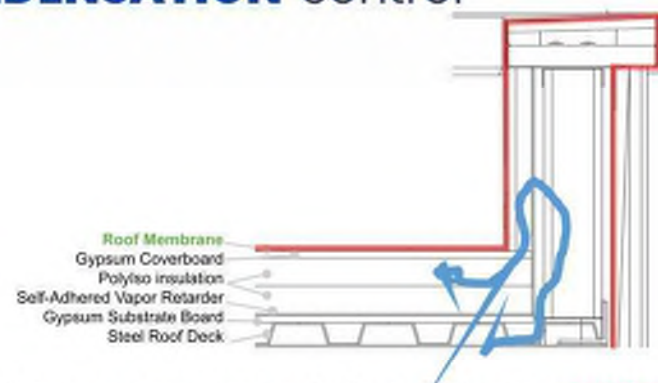


## CONDENSATION control



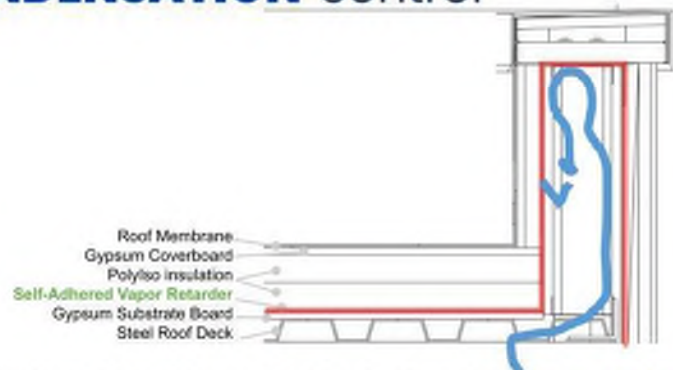
**MOST** of the materials in assembly "**Limit Vapor Diffusion**"  
(less than 10 US perms), But which one **STOPS condensation** ?

## CONDENSATION control



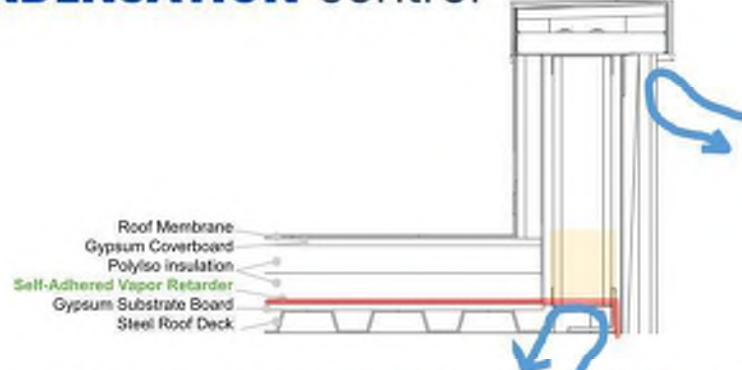
If the **roof membrane** is designed as the **continuous air barrier**,  
then **AIR INTRUSION** can cause condensation on cold surfaces  
in the roof assembly

## CONDENSATION control



If the **Self-Adhered VR** is designed as the **continuous air barrier**,  
then **AIR INTRUSION** is limited, but may condensation on cold  
surfaces elsewhere

## CONDENSATION control



**AFTER** dynamic **Air Leakage** and **Air Intrusion** is managed,  
**THEN** a steady-state Hygrothermal analysis can be helpful to  
determine if there is risk of **condensation**

## Example Conditions

## Example Conditions

Investigate 3 Critical Wall Transition Conditions

At Each Condition:

- 3D review of the assembly
- Control layer evaluation
- Sequencing demonstration



Casey O. Study Junior High

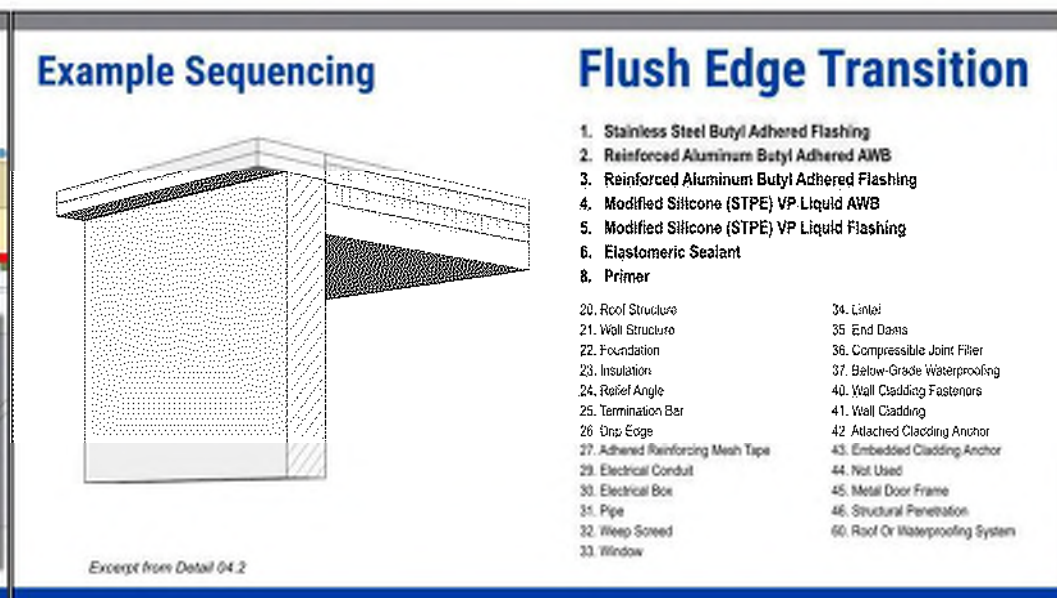
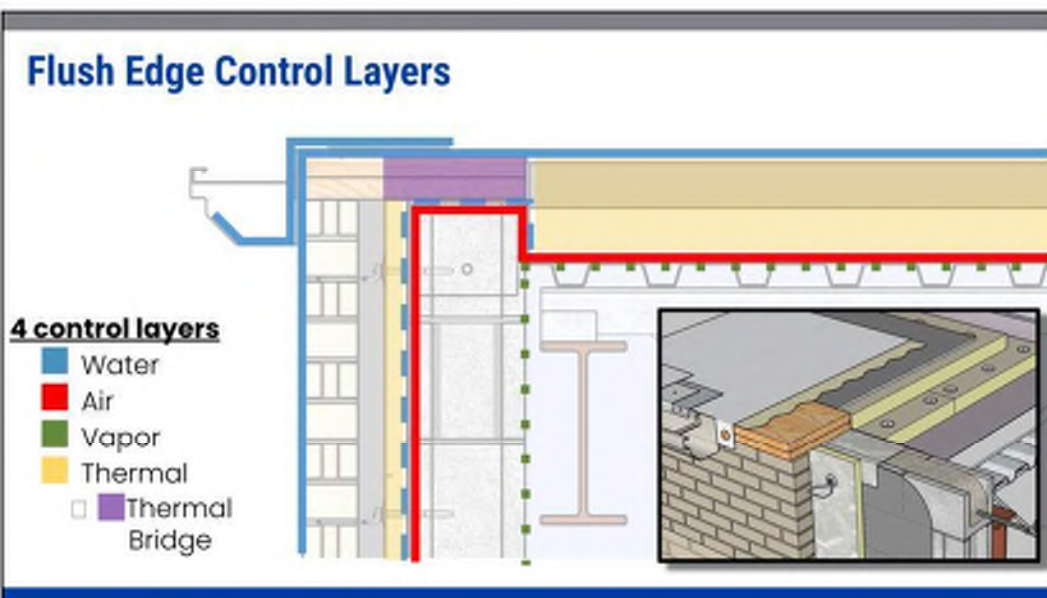
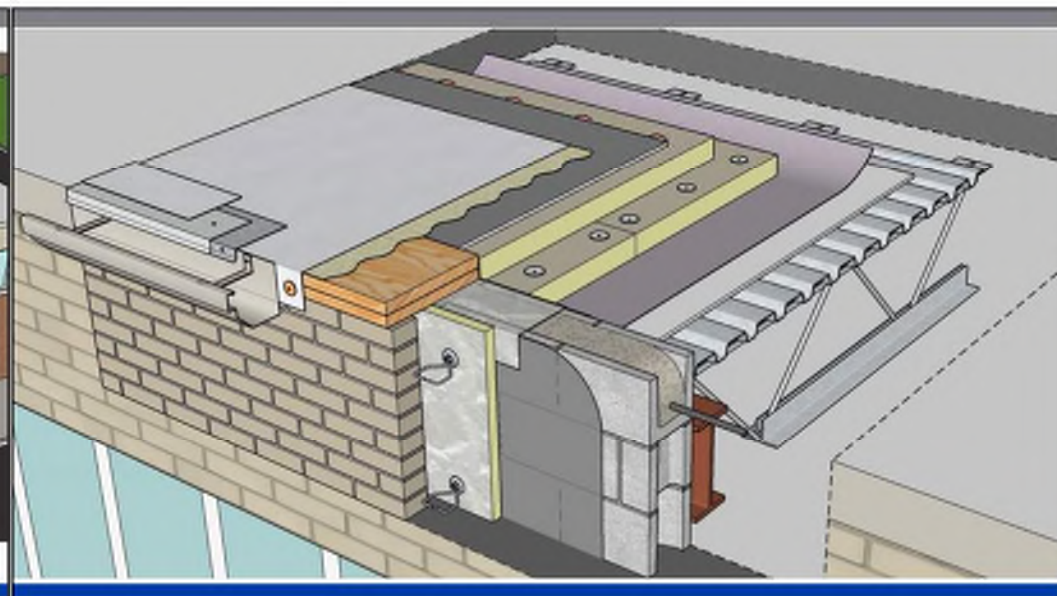
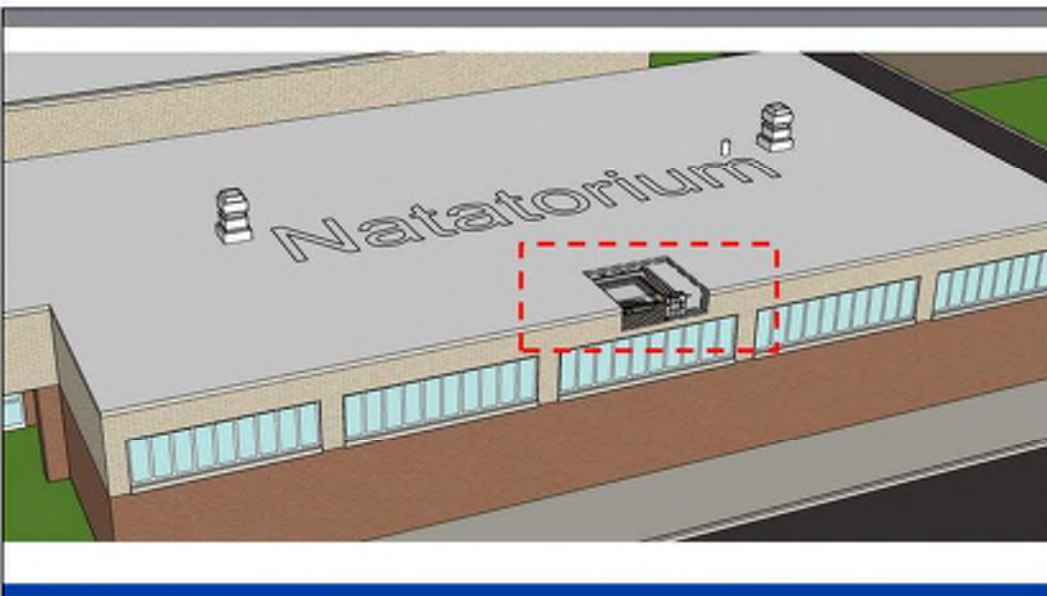
## Casey O. Study Junior High



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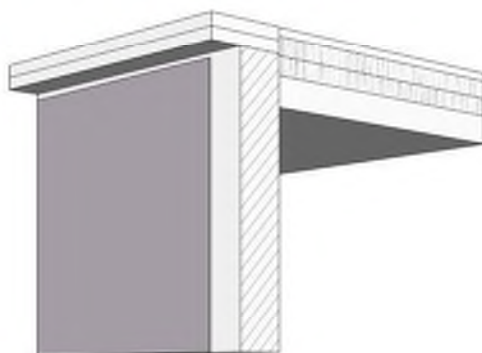








## Example Sequencing

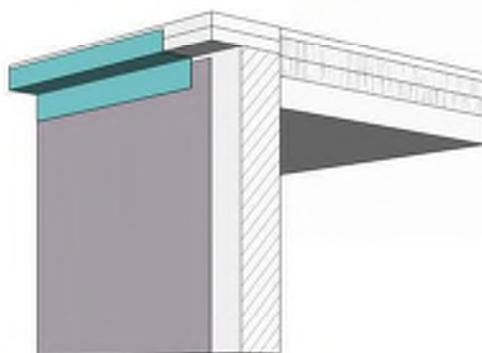


Excerpt from Detail 04.2

## Flush Edge Transition

1. Stainless Steel Butyl Adhered Flashing
2. Reinforced Aluminum Butyl Adhered AWB
3. Reinforced Aluminum Butyl Adhered Flashing
4. Modified Silicone (STPE) VP Liquid AWB
5. Modified Silicone (STPE) VP Liquid Flashing
6. Elastomeric Sealant
8. Primer
20. Roof Structure
21. Wall Structure
22. Foundation
23. Insulation
24. Relief Angle
25. Termination Bar
26. Drip Edge
27. Adhered Reinforcing Mesh Tape
29. Electrical Conduit
30. Electrical Box
31. Pipe
32. Weep Screed
33. Window
34. Lintel
35. End Dams
36. Compressible Joint Filler
37. Below-Grade Waterproofing
40. Wall Cladding Fasteners
41. Wall Cladding
42. Attached Cladding Anchor
43. Embedded Cladding Anchor
44. Not Used
45. Metal Door Frame
46. Structural Penetration
60. Roof Or Waterproofing System

## Example Sequencing

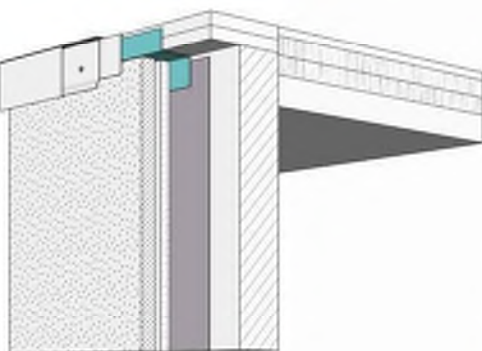


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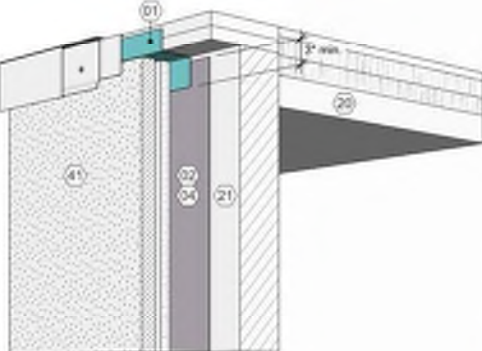


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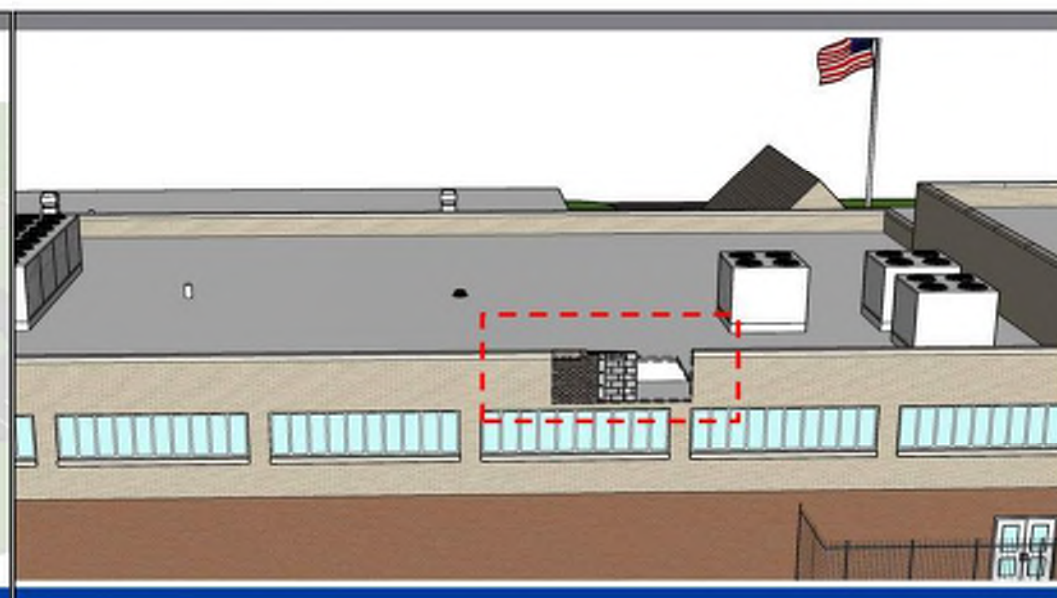
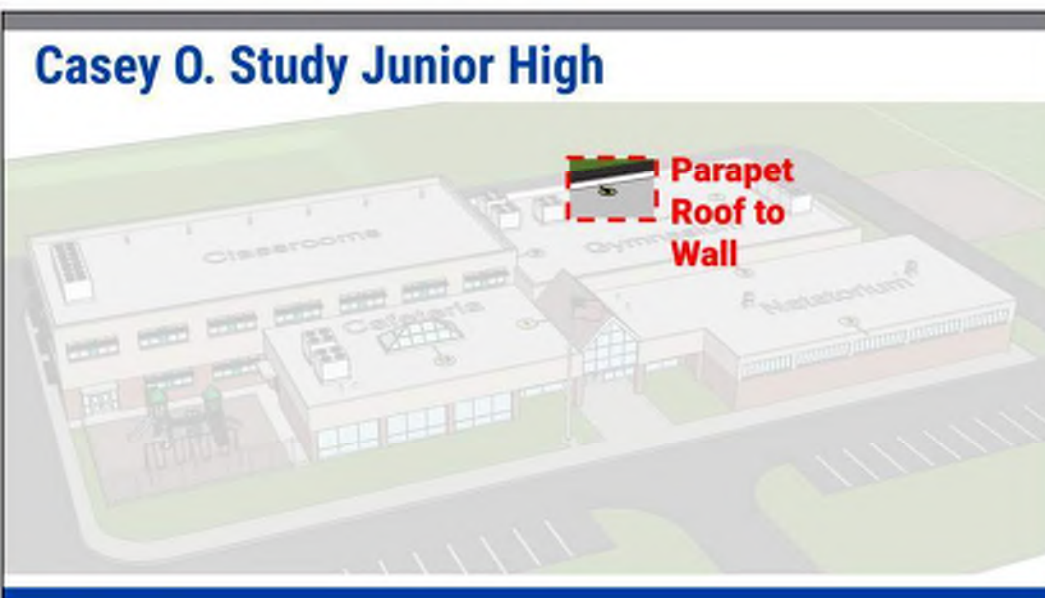
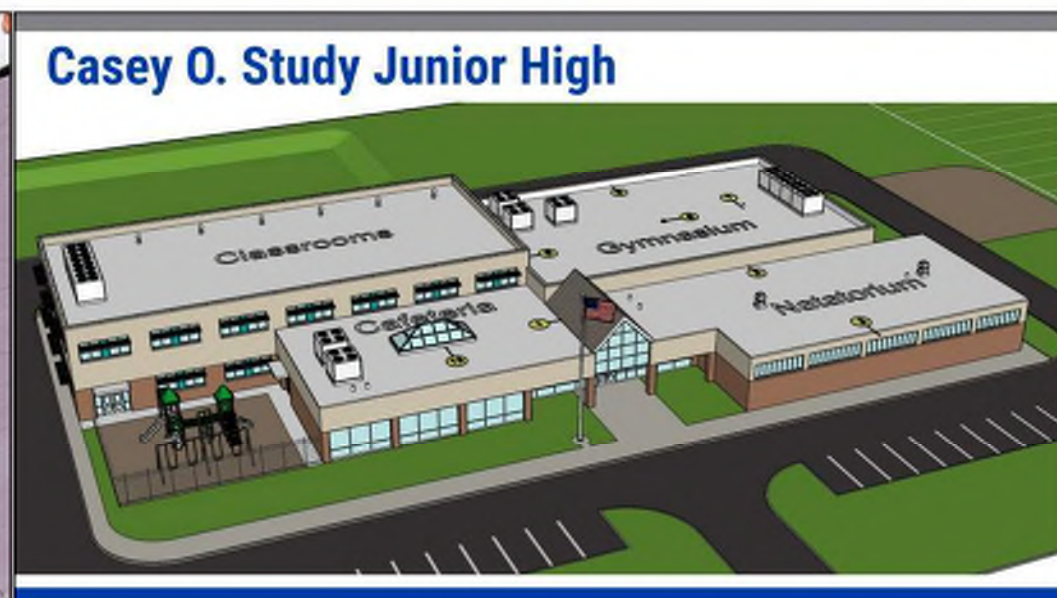
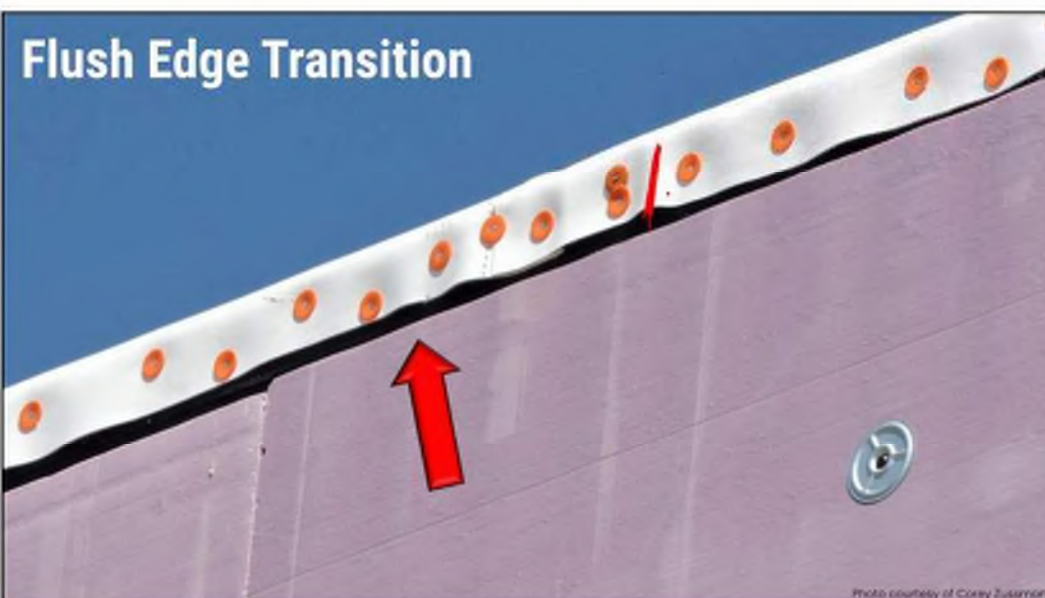
## Example Sequencing



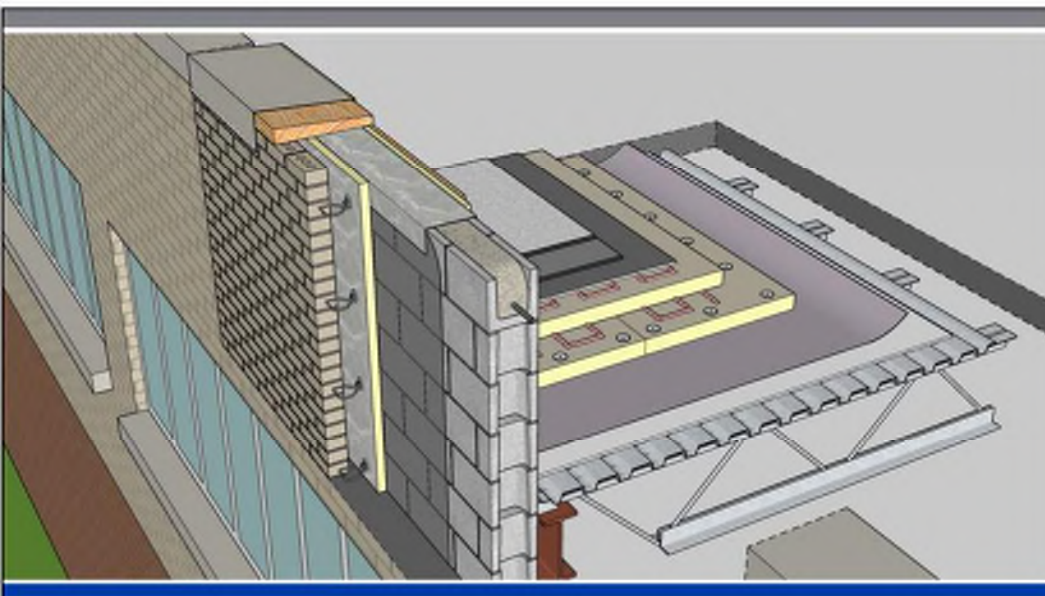
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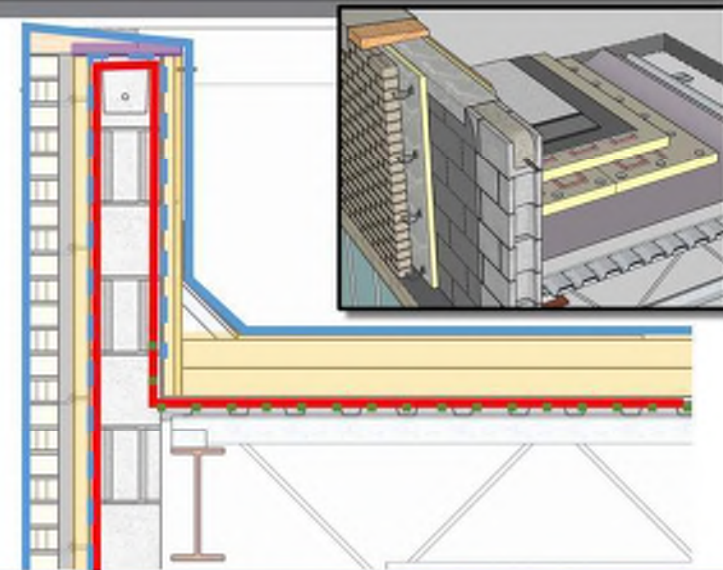




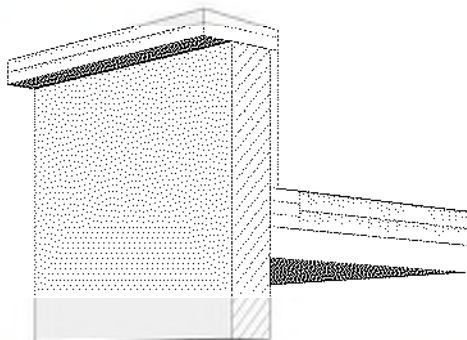
## Parapet Control Layers

### 4 control layers

- Water
- Air
- Vapor
- Thermal
- Thermal Bridge



## Example Sequencing

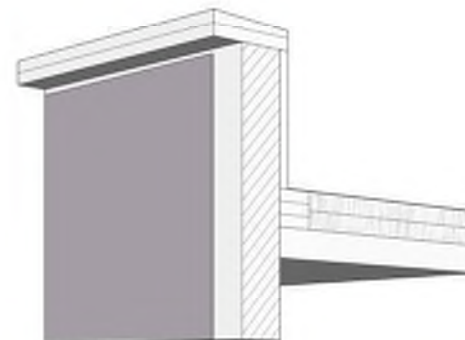


Excerpt from Detail 04.1

## Parapet Transition

- |                                                |                                  |
|------------------------------------------------|----------------------------------|
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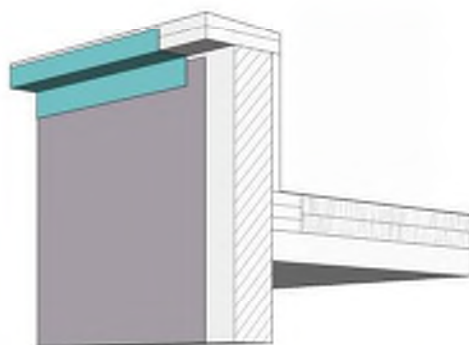


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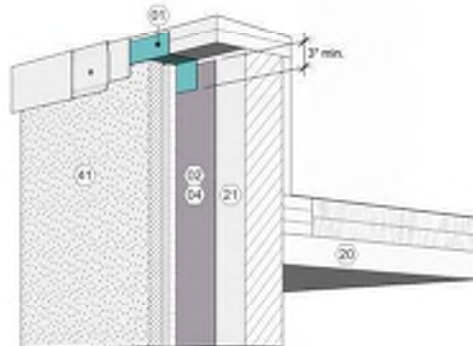


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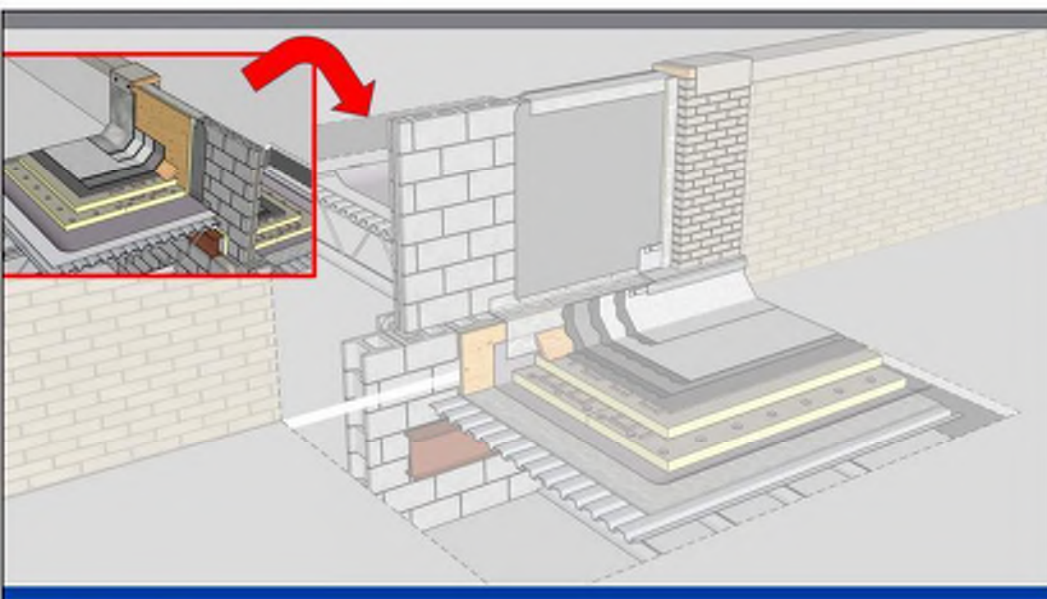
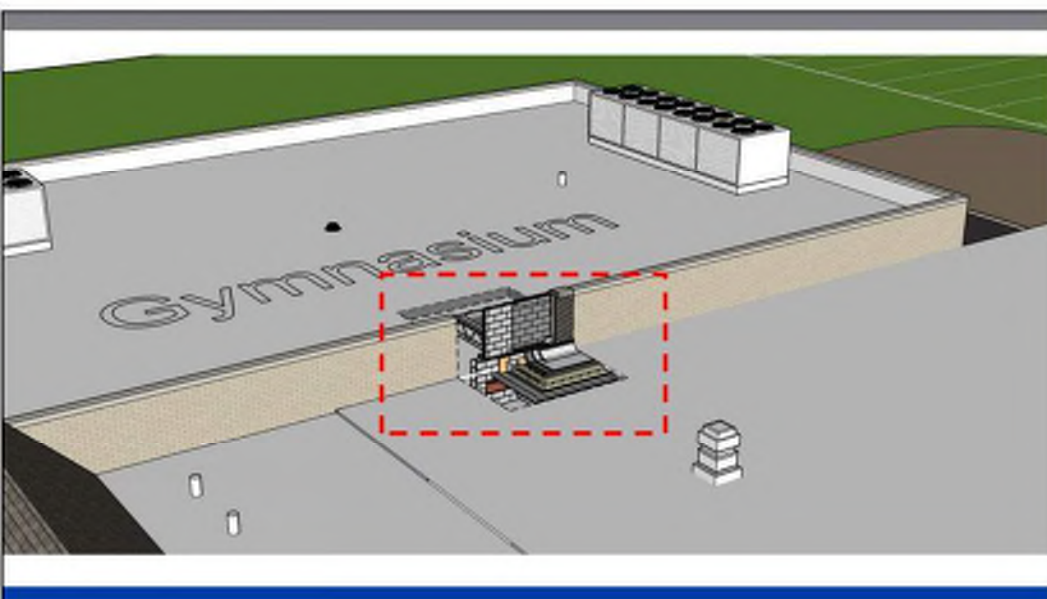
## Casey O. Study Junior High



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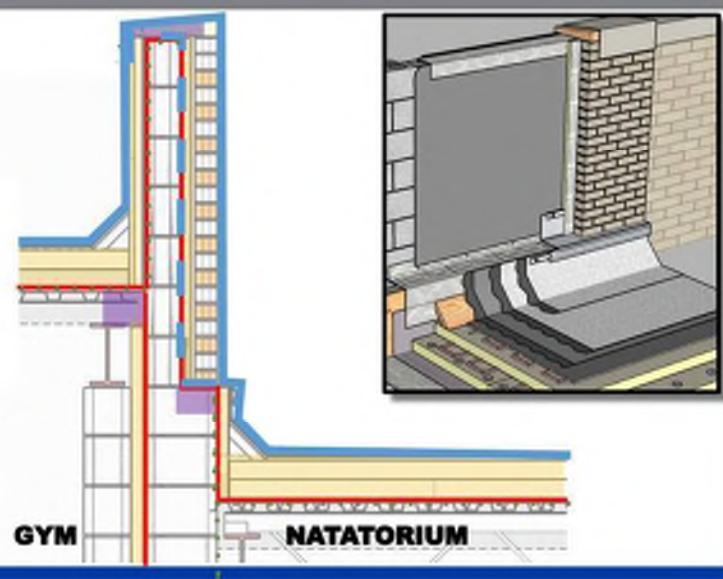


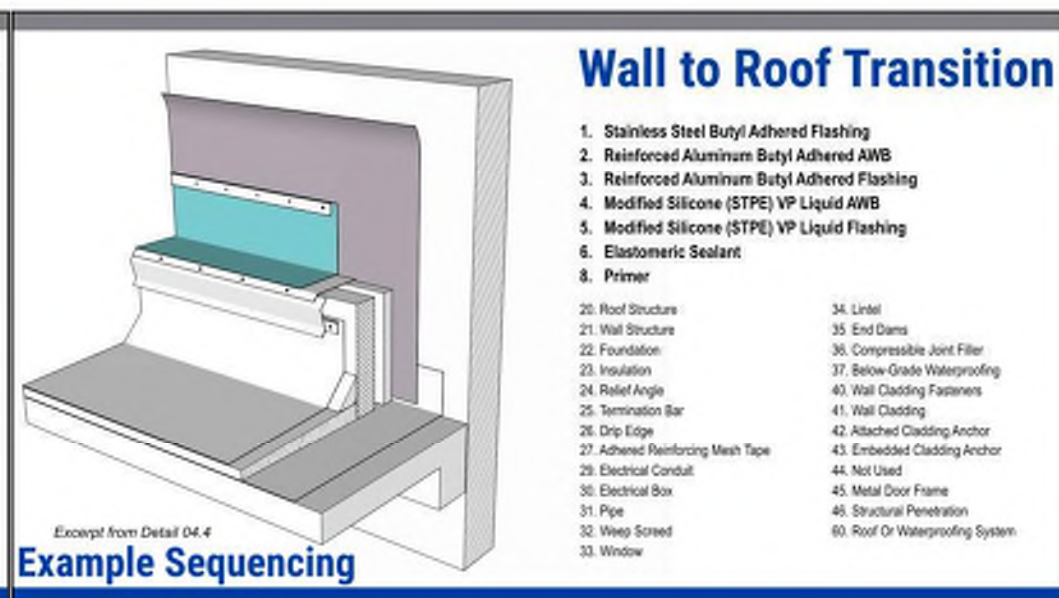
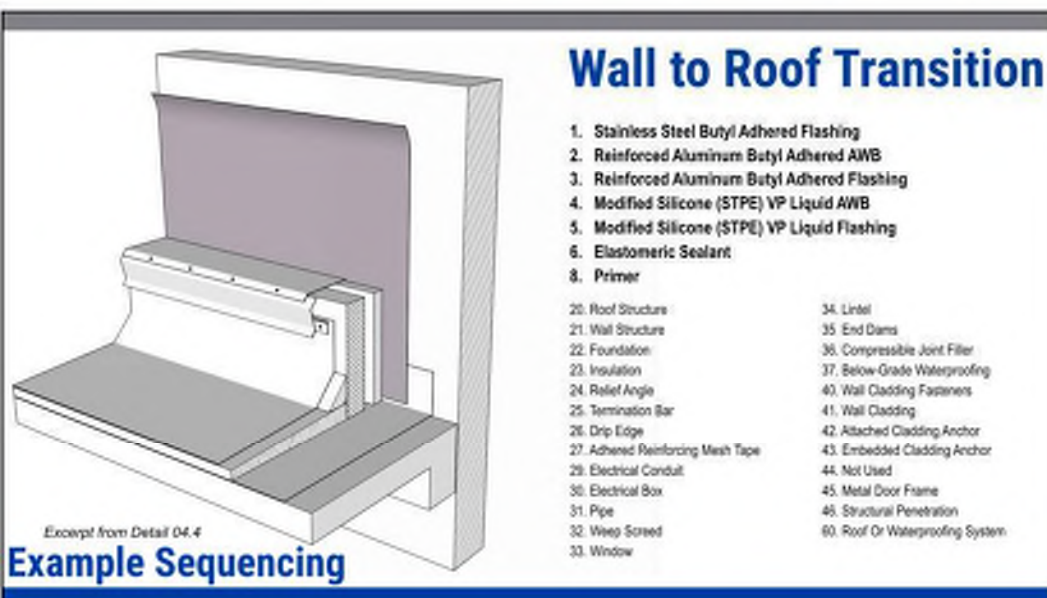
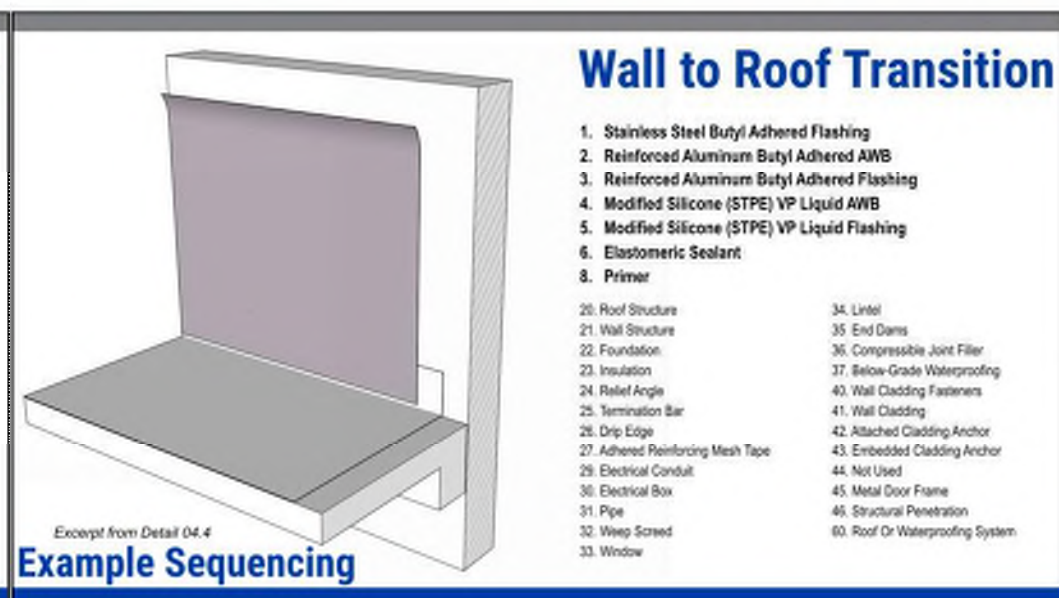
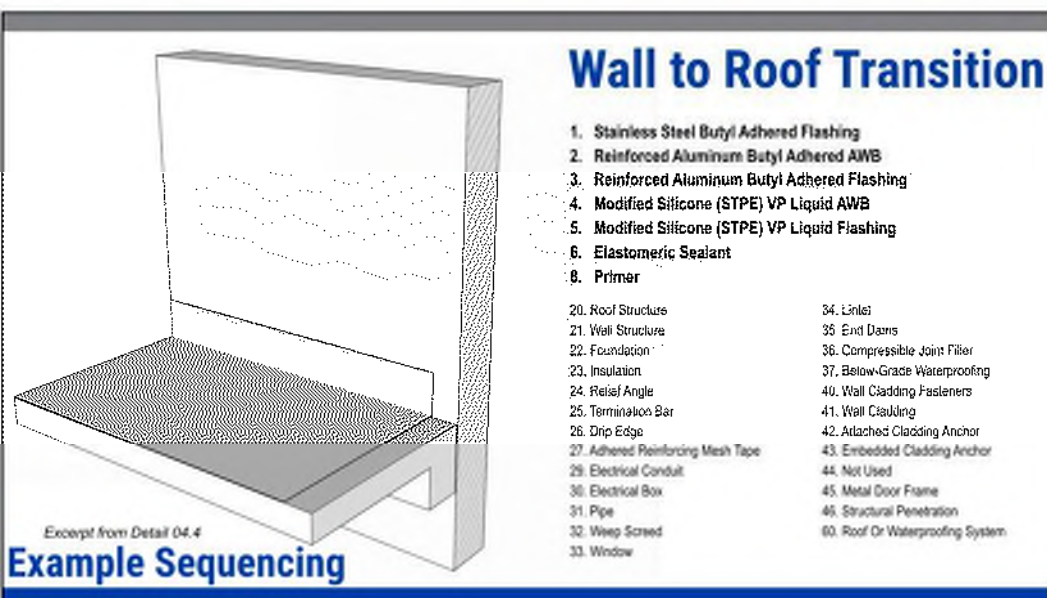


## Wall to Roof Control Layers

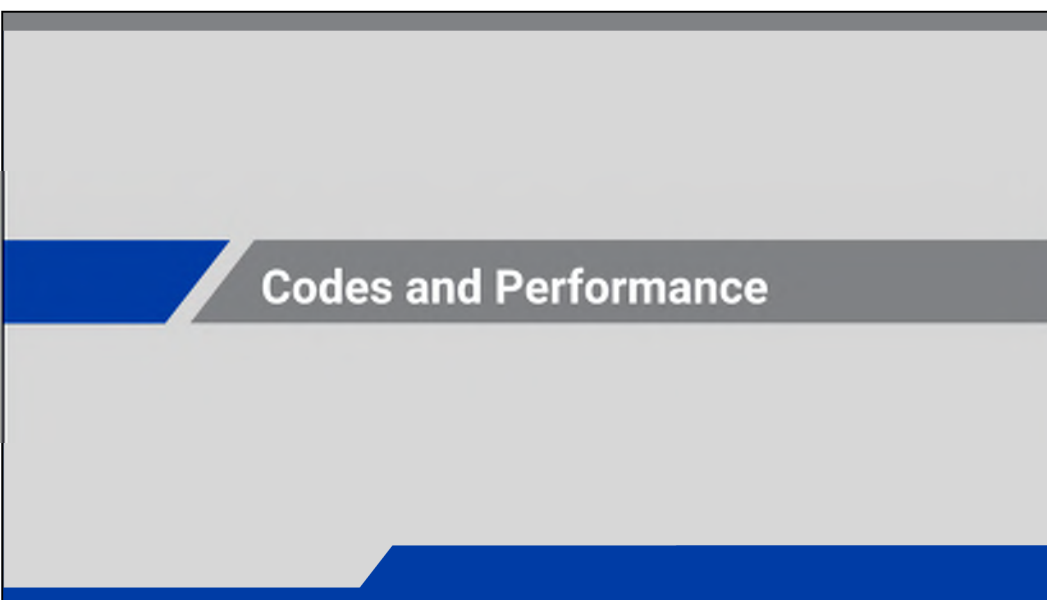
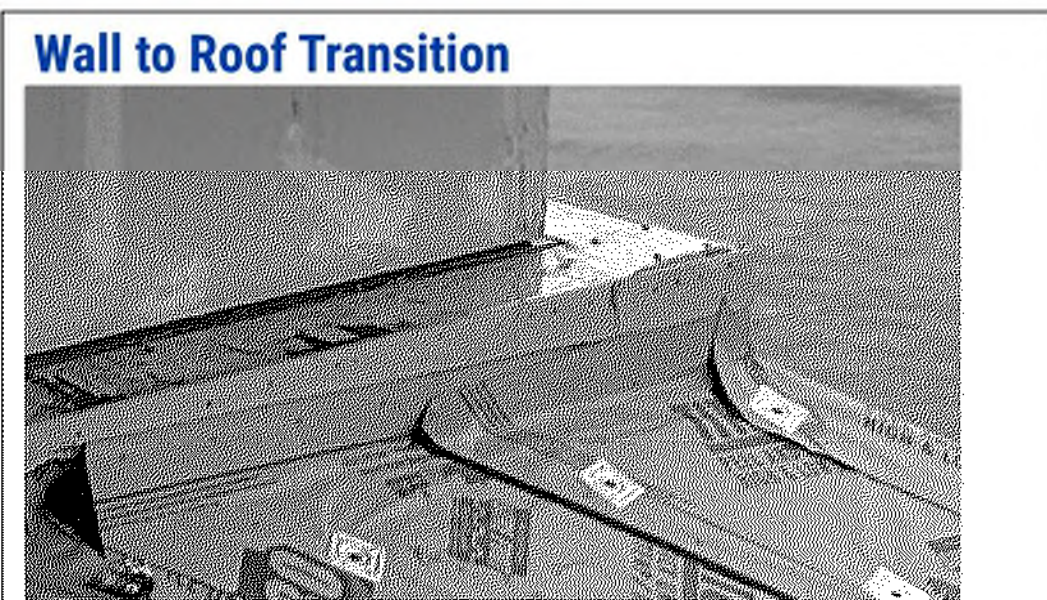
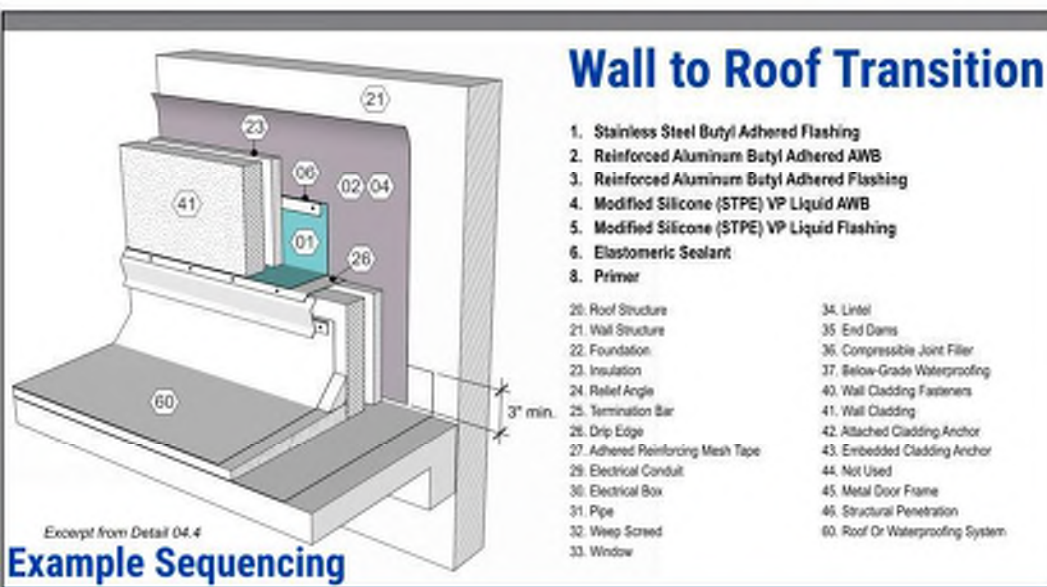
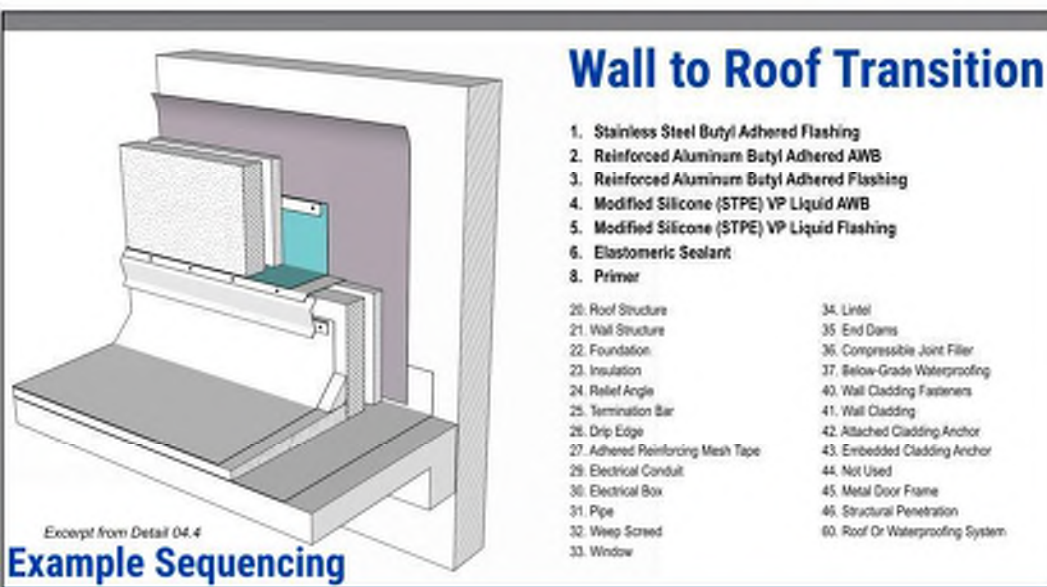
### 4 control layers

- Water
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- Vapor
- Thermal
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# Code Requirements Overview

**"Flashing shall be installed ... to prevent moisture from entering the wall or to redirect that moisture to the exterior."**

## Exterior Walls (Ch.14 IBC)

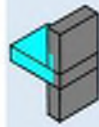


Weather Protection (IBC 1402.2)  
Vapor Retarders (IBC 1404.3)  
Flashing (IBC 1404.4)

## Energy Efficiency (IECC & ASHRAE 90.1)

Thermal (C402 & 90.1 Ch.5)  
Air Barrier - (IECC C402.5 & 90.1-5.4.3.1)

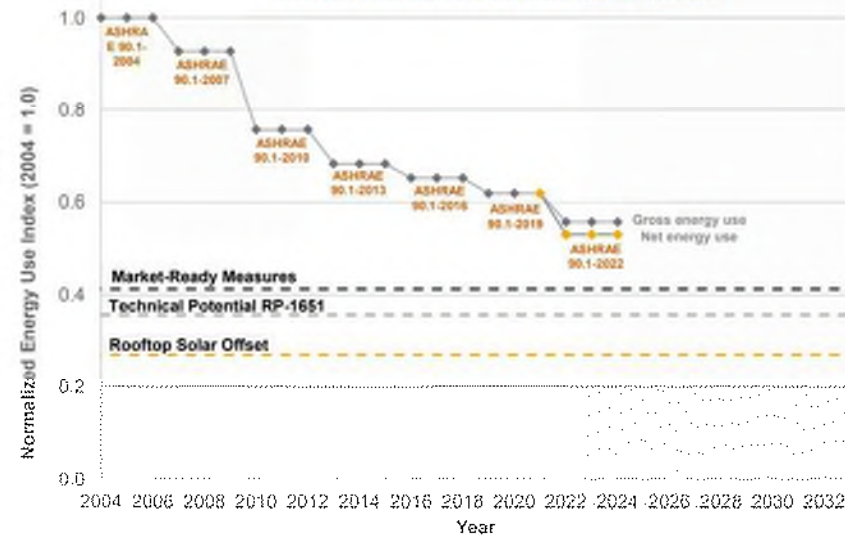
## Roof Assemblies (Ch.15 IBC)



Weather Protection (IBC 1503)  
Rqmts for Roof Coverings (IBC 1507)  
Flashing (IBC 1503.2)  
Coping (IBC 1503.3)  
Wind Resistance (IBC 1504.1 & ASCE 7)  
Edge Securement (IBC 1504.5 SPR1 ES-1)

**ASHRAE 90.1 is the Federal minimum code for commercial buildings**

Improvement in ASHRAE Standard 90.1  
Historic Advances and Reduction Potential

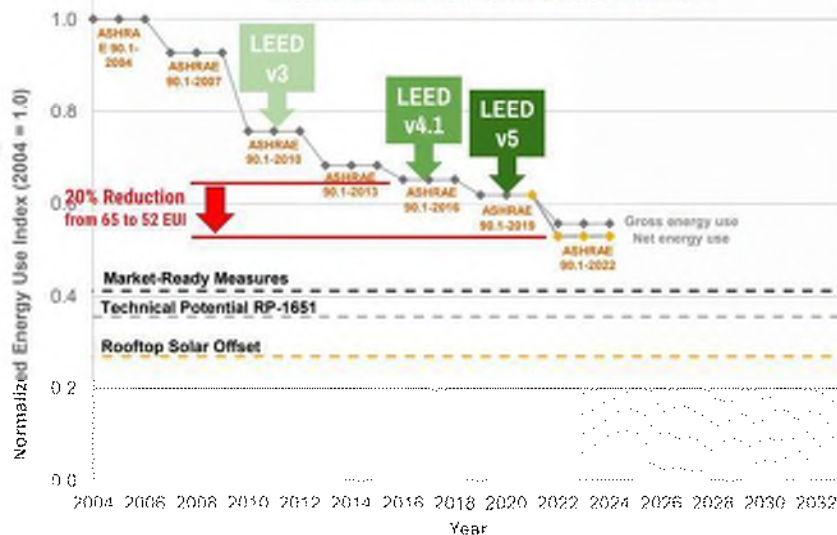


## LEED v4.1

Enhanced Commissioning, Opt 2 BECx

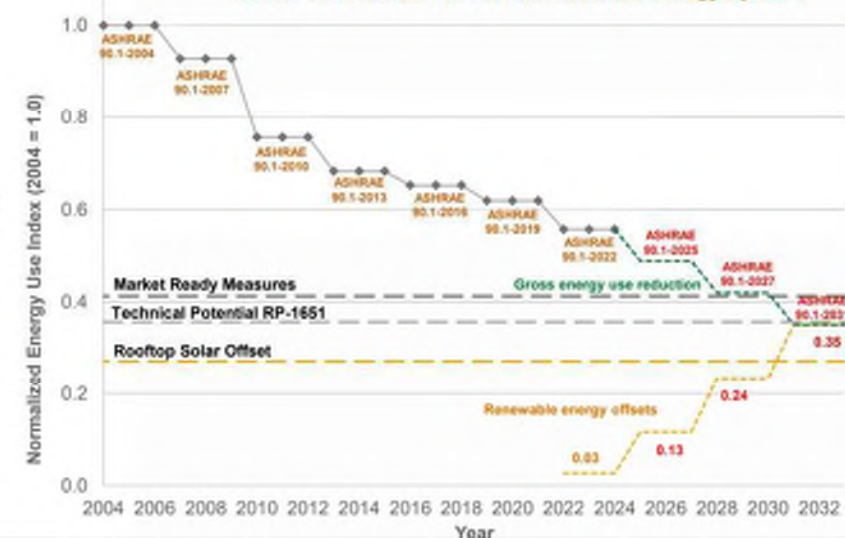
EA Credit: Optimize Energy Performance Based on 90.1-2016 (4 pts ~ 20% savings with 90.1-2022)

Improvement in ASHRAE Standard 90.1  
Historic Advances and Reduction Potential



**ASHRAE 90.1 is on a path to Net Zero**

ASHRAE Standard 90.1  
Needed Advancements to Achieve Zero Energy by 2031

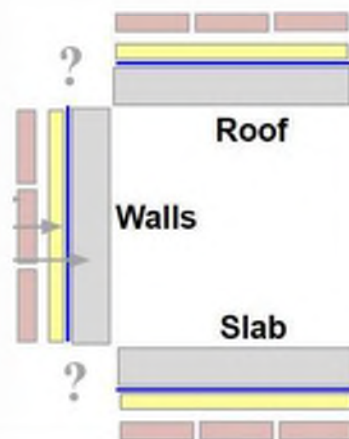




## 90.1-2022 Air Barrier Requirements

### Design to:

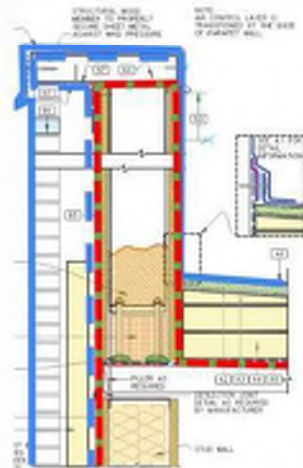
- Extend and be continuous across the below-grade areas, walls, fenestration, doors, and roofs.
- Resist positive and negative pressures from wind, stack effect, mechanical ventilation, and allow for anticipated movements.
- *Third party design review*



## 90.1-2022 Air Barrier Requirements

### Construction Documents, clearly identify:

- Air Leakage Compliance Method and targets: (a. WBAT or b. verification)
- Field inspection plan: Schedule, scope, and reporting (b)
- Air barrier components, joints, interconnections, and penetrations
- Air barrier position within of each building envelope assemblies



## 90.1-2022 Air Barrier Requirements

### During Construction

- Verification and testing (V&T) provider doc review, and field inspections of materials and installation (b)
- Building envelope shall be wrapped, sealed, caulked, gasketed, or taped
- Whole Building Airtightness testing (a)

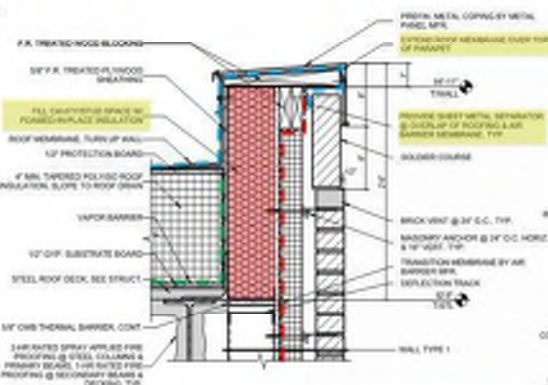
### After Construction

- Within 90 days of completion, air leakage compliance results Report



## Conclusion

## Design vs Reality



## Designing for Success

### Drawings

- Detail continuous control layers
- Identify material and system transitions
- Sequenced details for complex conditions
- Account for maintenance & replacement

### Specifications

- Material and system compatibility
- Shop drawing / submittal requirements
- Define complete scope and systems
- Quality Assurance, such as mockups & testing



## Ensure Success: Process

### Quality Control / Quality Assurance

- Building Enclosure Commissioning

### Contractor Involvement

### Manufacturer Involvement

### Specification Requirements

- Performance specs in addition to materials



THANK YOU!



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Building Enclosure Business Director

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