

abaa2024 building
enclosure
conference

What if?

Case Study Reviews for Low-Slope Roof Selection

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AIA
Continuing
Education
Provider



What If? Case Study Reviews for Low-Slope Roof Selection

It's just a roof, right? And buildings or designs never change. Not quite. Roofing plays an important role in protecting the building from the elements as well as insulating to preserve occupant comfort. With a wide variety of roof systems used on commercial buildings, selecting low-slope roofing assemblies can be complicated. Starting with four unique roofing case studies to review design team considerations and decisions, we will ask the infamous question "What if?". You will leave this interactive session with a better understanding of best practices in low-slope roof system design and selection, including ways to establish air tightness, reduce moisture intrusion, and lower the overall risk of failure to ensure you are able to appropriately evaluate design change requests on your next project.



Learning Objectives

1. Understand how design parameters, such as building and rooftop use, as well as climate and building location influence roof design decisions.
2. Recognize the basic components of low-slope roofing including different insulations, coverboards, and membrane types.
3. Differentiate between attachment methods of roofing systems including insulations and membrane attachment options.
4. Utilize case studies to understand how decisions made during the design process can impact the performance of the roof.





Kristin Westover

Technical Manager,
Specialty Installations



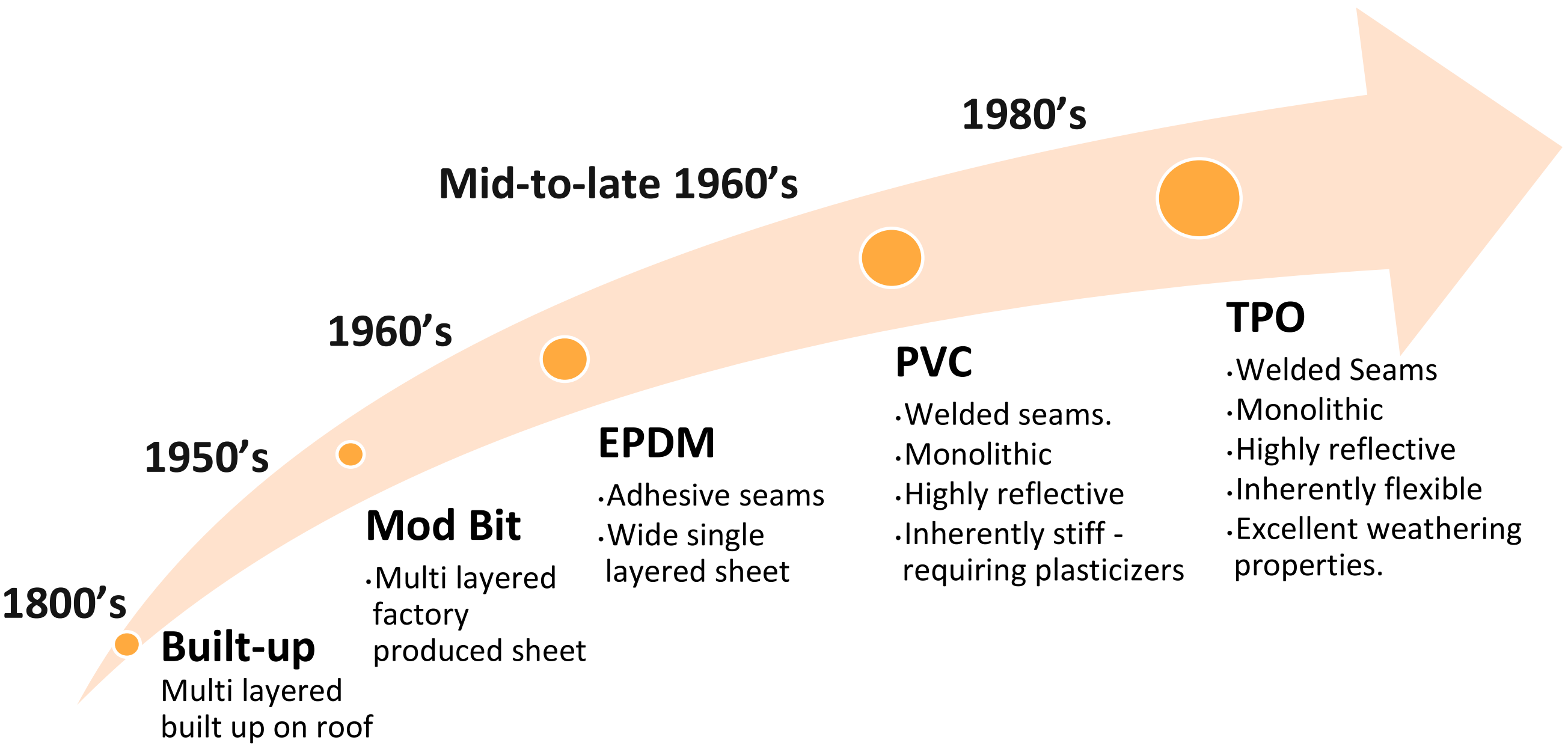
**Andi Wagner
Watts**

Building Science
Education Manager

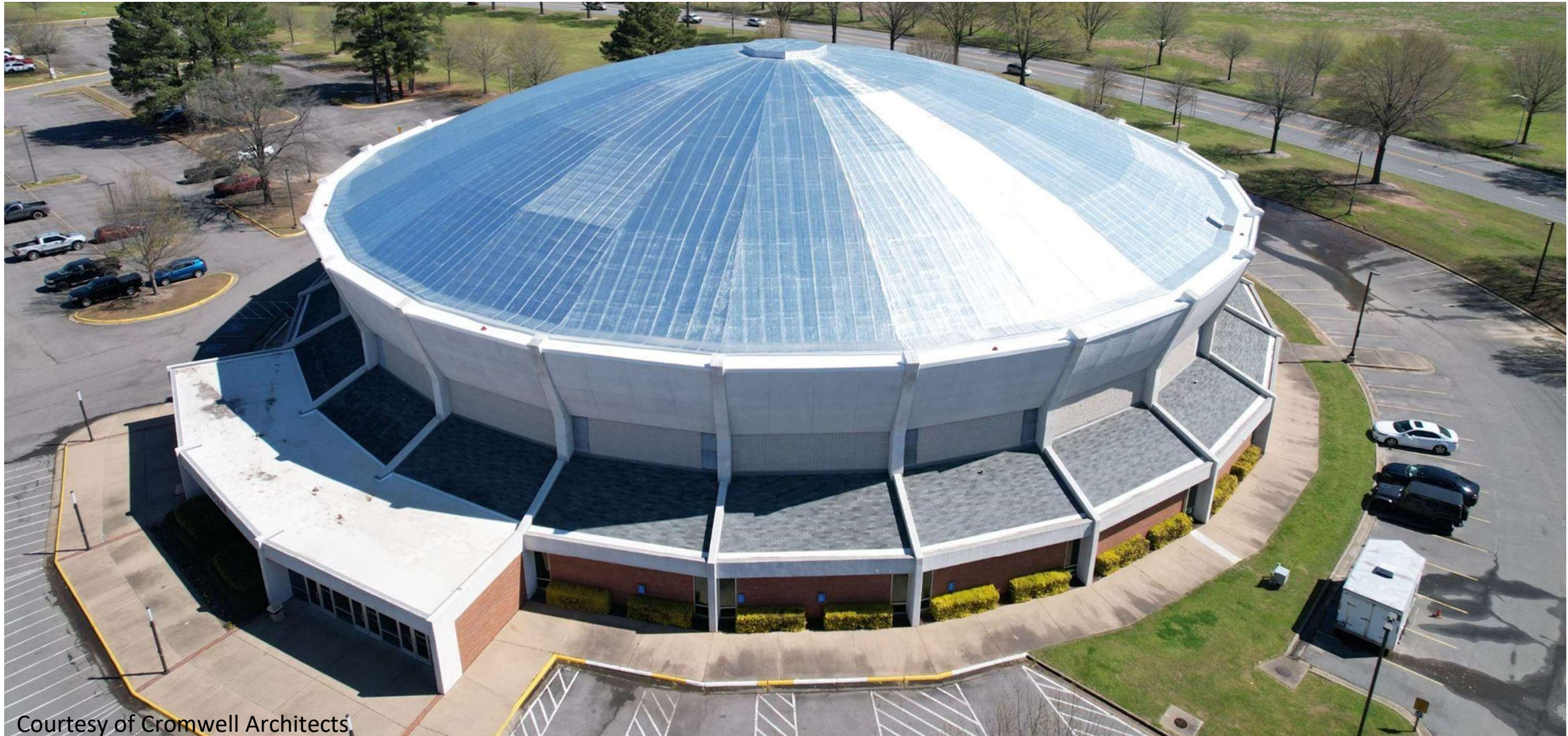


Building & Roofing Science





Arkansas Tech University, Russellville, AR



Courtesy of Cromwell Architects

Arkansas Tech University, Russellville, AR



Torch applied
aluminum clad SBS
modified bitumen
cap sheet

Torch applied SBS
modified bitumen
base sheet

Existing/Repaired
Tectum Deck

Mechanically
attached SBS
modified bitumen
base sheet

**What if
another membrane type was
used?**

Asphaltic Roofs

Built-up

Mop Applied

APP

★ Torch Applied

Cold Applied

Self Adhered

SBS

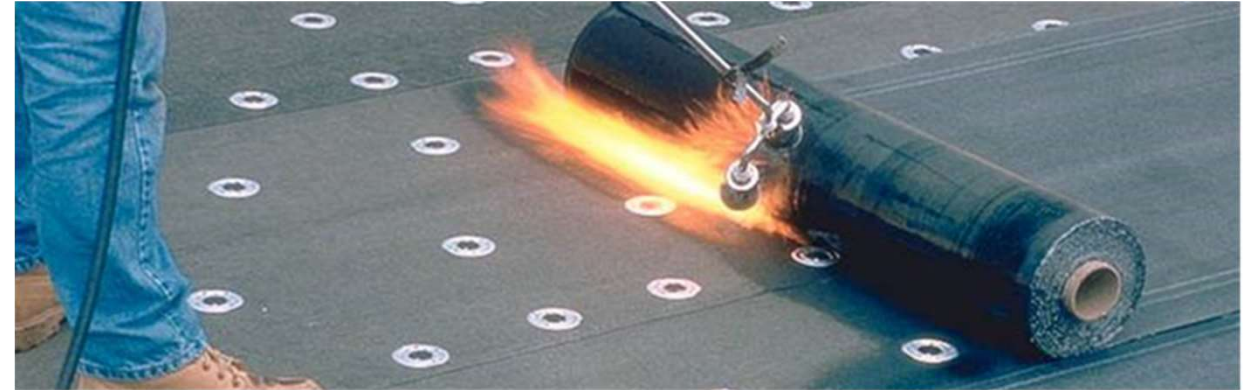
Torch Applied

Cold Applied

Mop Applied

Self Adhered

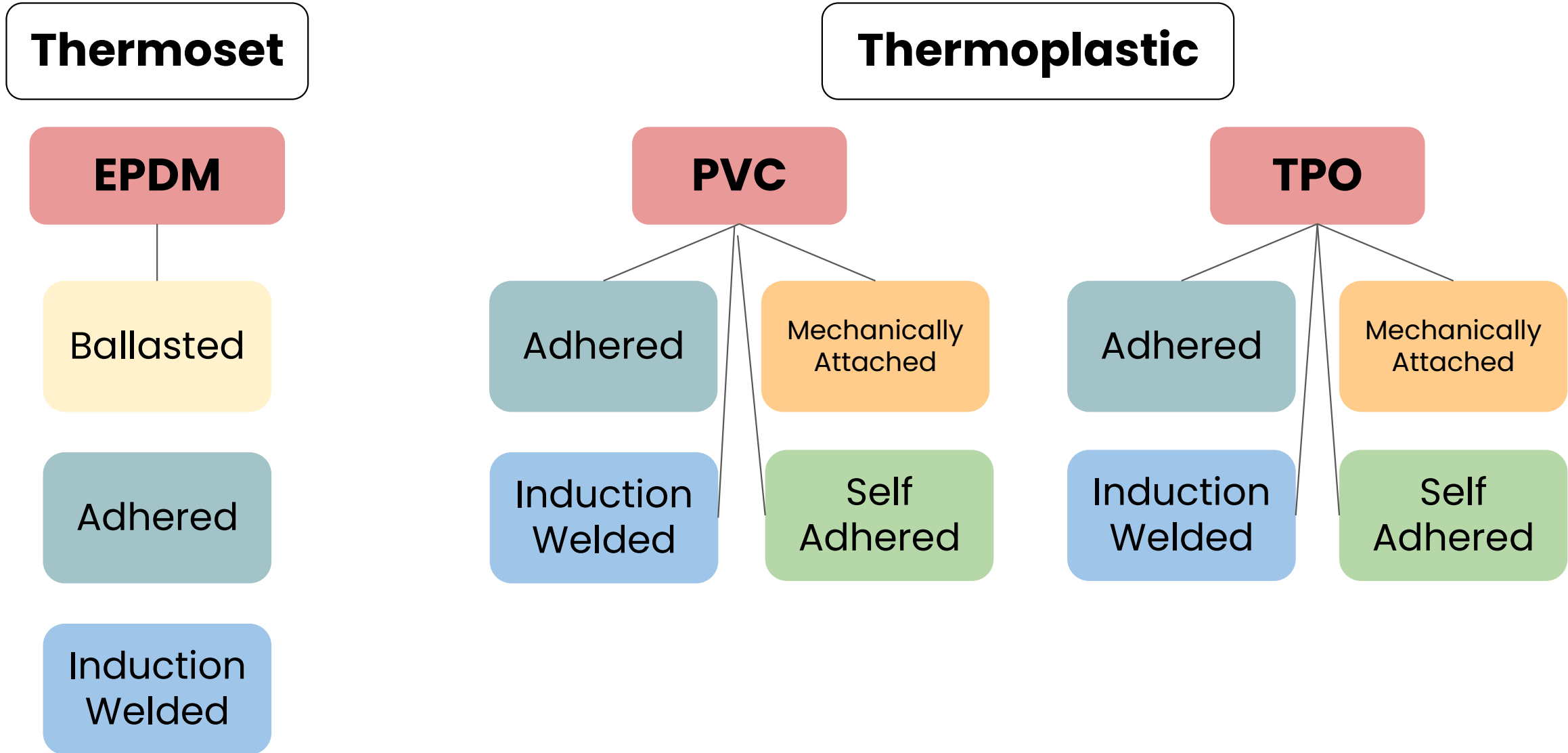
Hot Applied



Cold Applied



Single-Ply Attachment Methods



Single-Ply Membranes



**What if
it was a different roof deck?**

Insulation Attachment

Deck Type	Preferred Attachment
Steel	Mechanical Fasteners
Wood	Mechanical Fasteners
Concrete	Adhesive



Best Practice:

Fasten first layer, adhere others

Why did they mechanically attach to the tectum deck on this project?



What if
the basic wind speed changed?

Wind Speeds



	Russellville, Arkansas		
Risk Category	ASCE 7-10	ASCE 7-16	ASCE 7-22
I	105 mph	99 mph	99 mph
II	115 mph	106 mph	106 mph
III	120 mph	113 mph	113 mph
IV	120 mph	118 mph	118 mph

Wind Pressures

- **Basic wind speed (mph)**
- Wind directionality factor
- Exposure
- Topographic factor
- Ground elevation factor
- Velocity pressure
- Gust-effect factor
- Enclosure classification
- Internal pressure coefficient
- Building use (Importance/Risk)
- Building height

= PSF ≠ MPH

WORLDWIDE EXCHANGE

#TRENDING

VIRAL VIDEO ALERT
ROOFING CRASHES ONTO CAR

Subscribe

0:08 / 1:28

⏮ ⏪ 🔊 0:08 / 1:28 ⏩ ⏭ ⏸ ⏹

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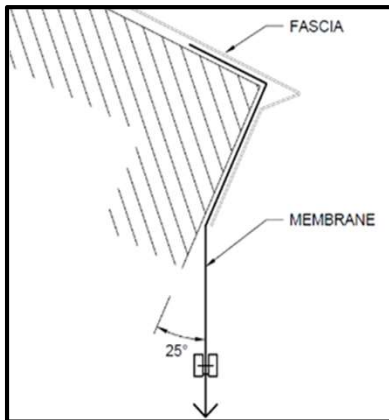
CNBC

Edge Metal

Edge securement for low-slope roofs is required* to be tested in accordance with RE-1, RE-2, and RE-3 of ANSI/SPRI ES-1

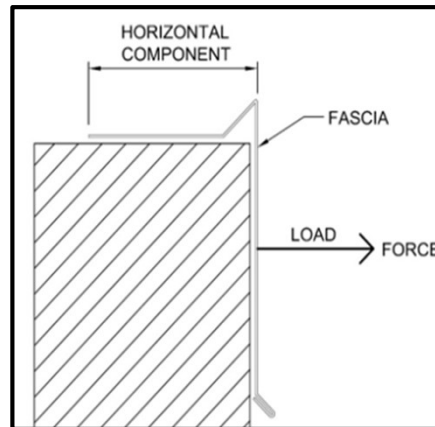
RE-1

Ballasted and MA membrane systems



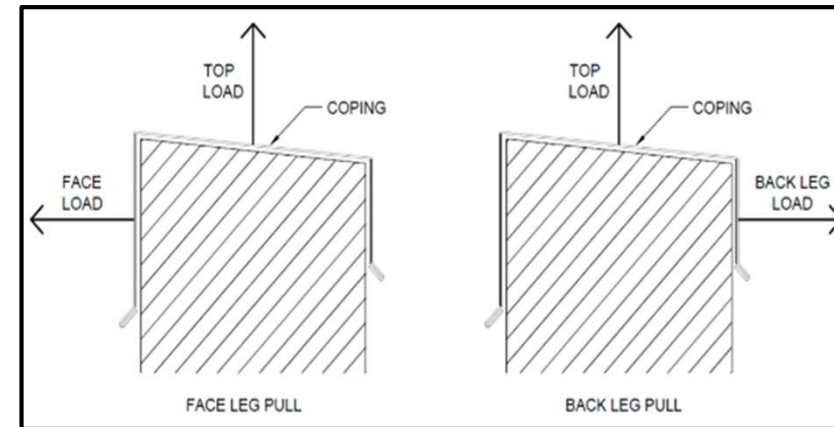
RE-2

Horizontal component is 4



RE-3

Coping caps of parapet walls

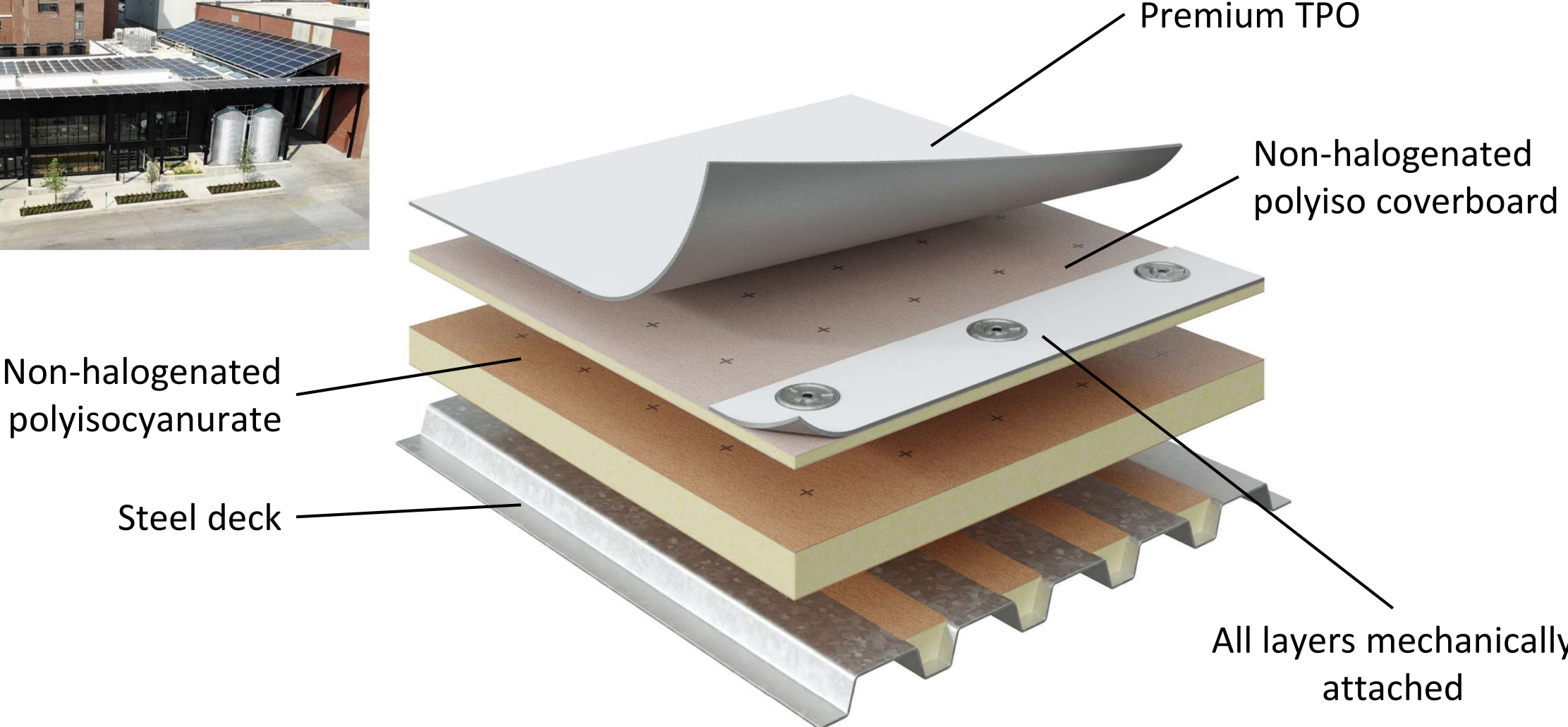


*2018 International Building Code (IBC) Section 1504.5 and and 2021 IBC Section 1504.6

Stanley Center, Muscatine, IA

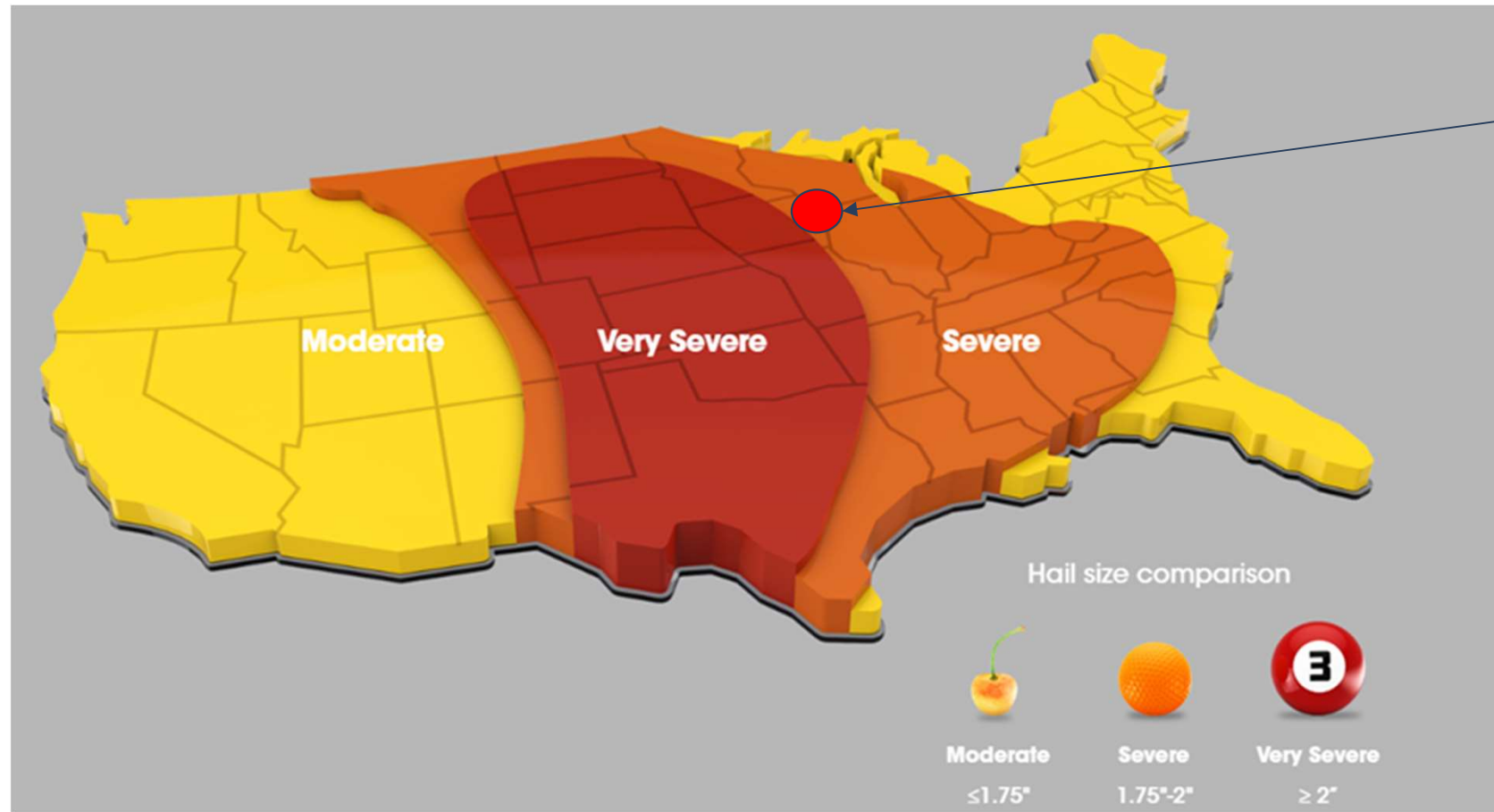


Stanley Center, Muscatine, IA



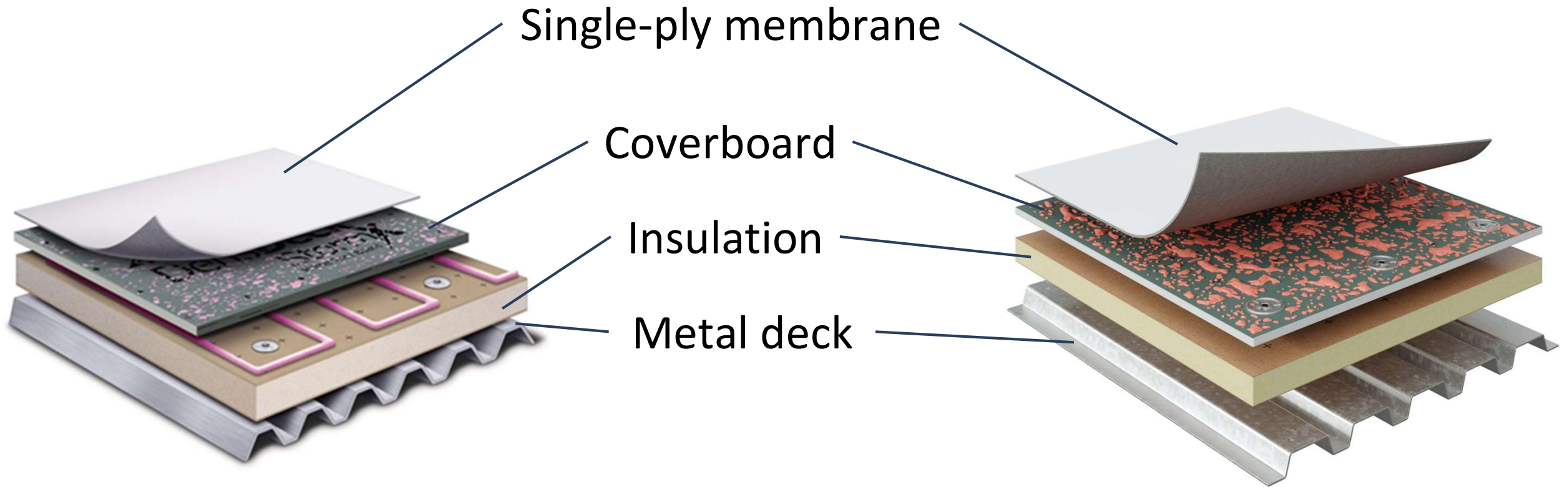
**What if
the building was in a very severe
hail zone?**

FM

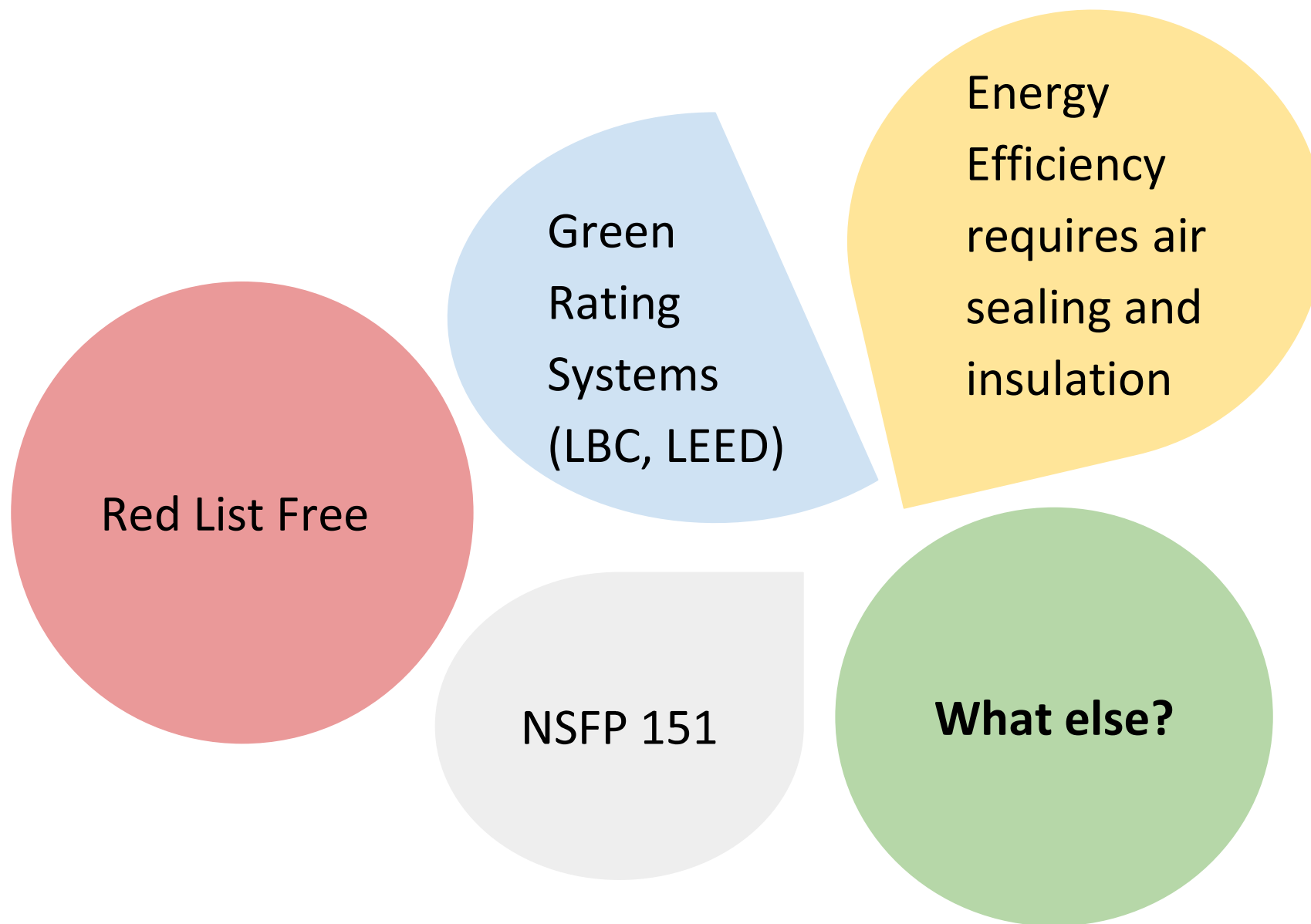


<p>Moderate Hail Zone based on an equivalent hail size of $\leq 1.75''$ (44mm) over a 15-year return period</p>	<p>Severe Hail Zone based on an equivalent hail size of $> 1.75''$ (44mm) and $\leq 2''$ over a 15-year return period</p>	<p>Very Severe Hail Zone based on an equivalent hail size of $> 2''$ (51mm) over a 15-year return period</p>
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Coverboards



**What if
sustainability is a priority?**



Sustainability - Third-Party Certifications



GreenCircle Certified Recycled Content* - Annual audited operations and third-party certified recycled content for PVC, TPO, and polyiso



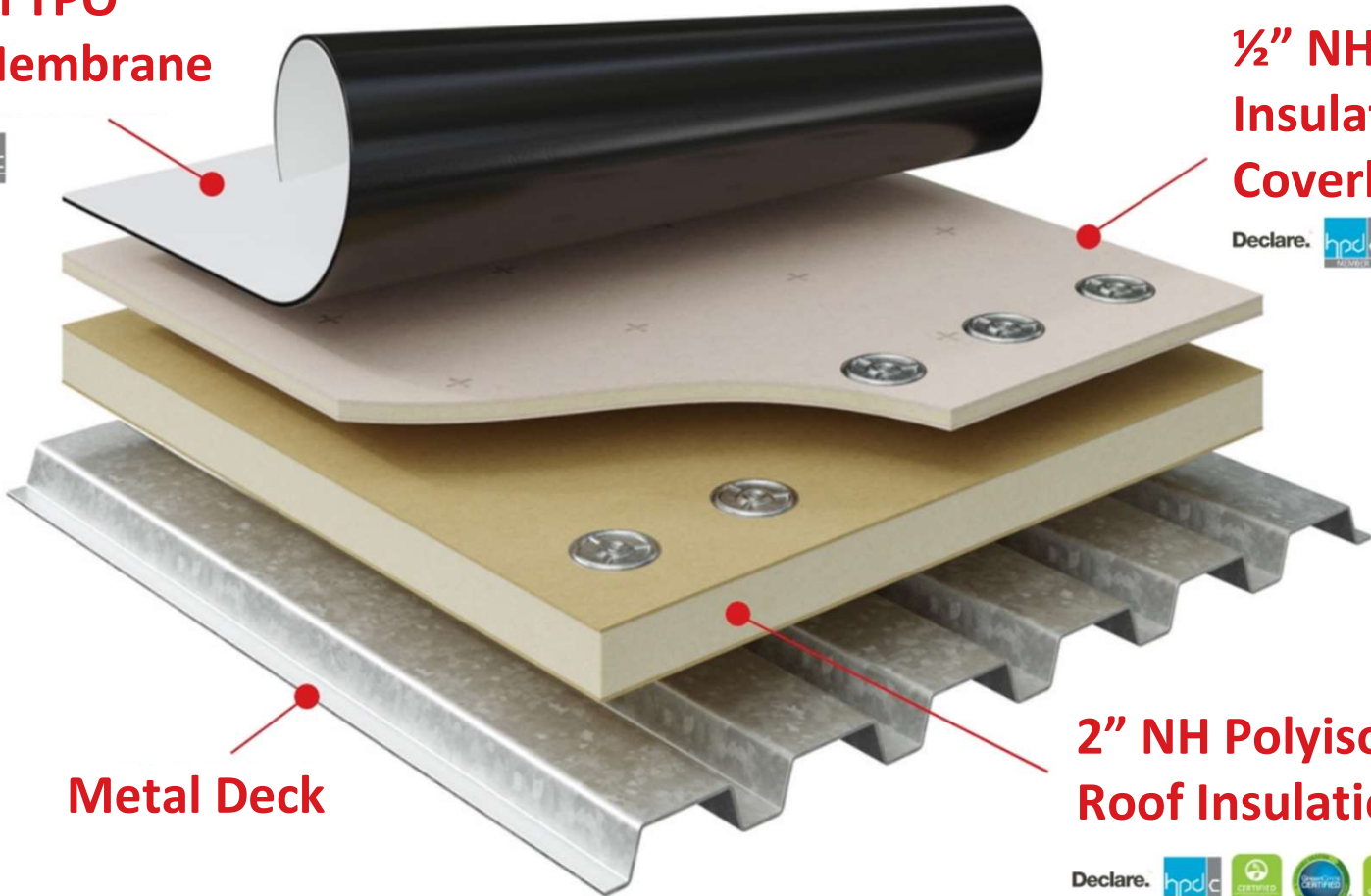
Greenguard GOLD certification* denotes products that give off only low levels of volatile organic compounds (VOCs).



NSF P151 certification for Extreme TPO means the product can safely be used in rainwater catchment systems

Sustainability

Premium TPO
60-mil Membrane



1/2" NH HD Polyiso
Insulation
Coverboard



2" NH Polyiso
Roof Insulation



Metal Deck

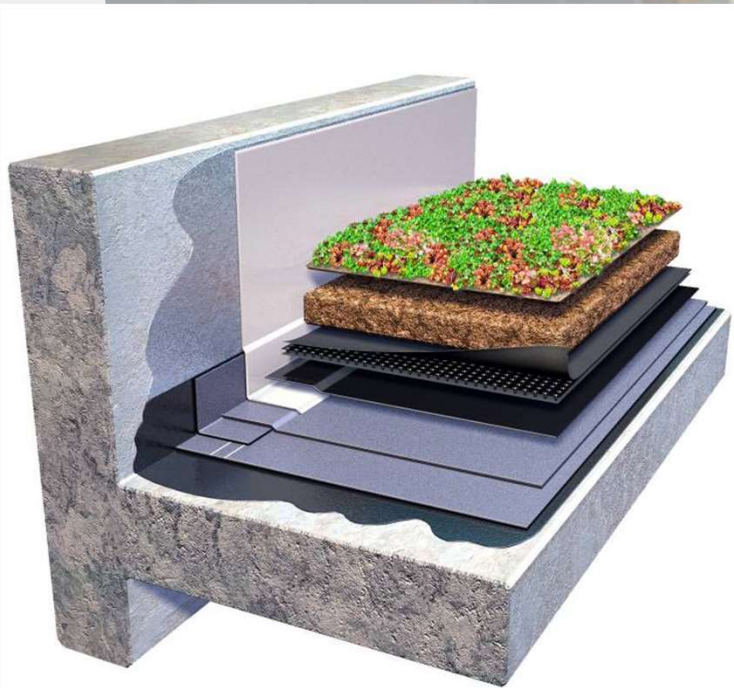
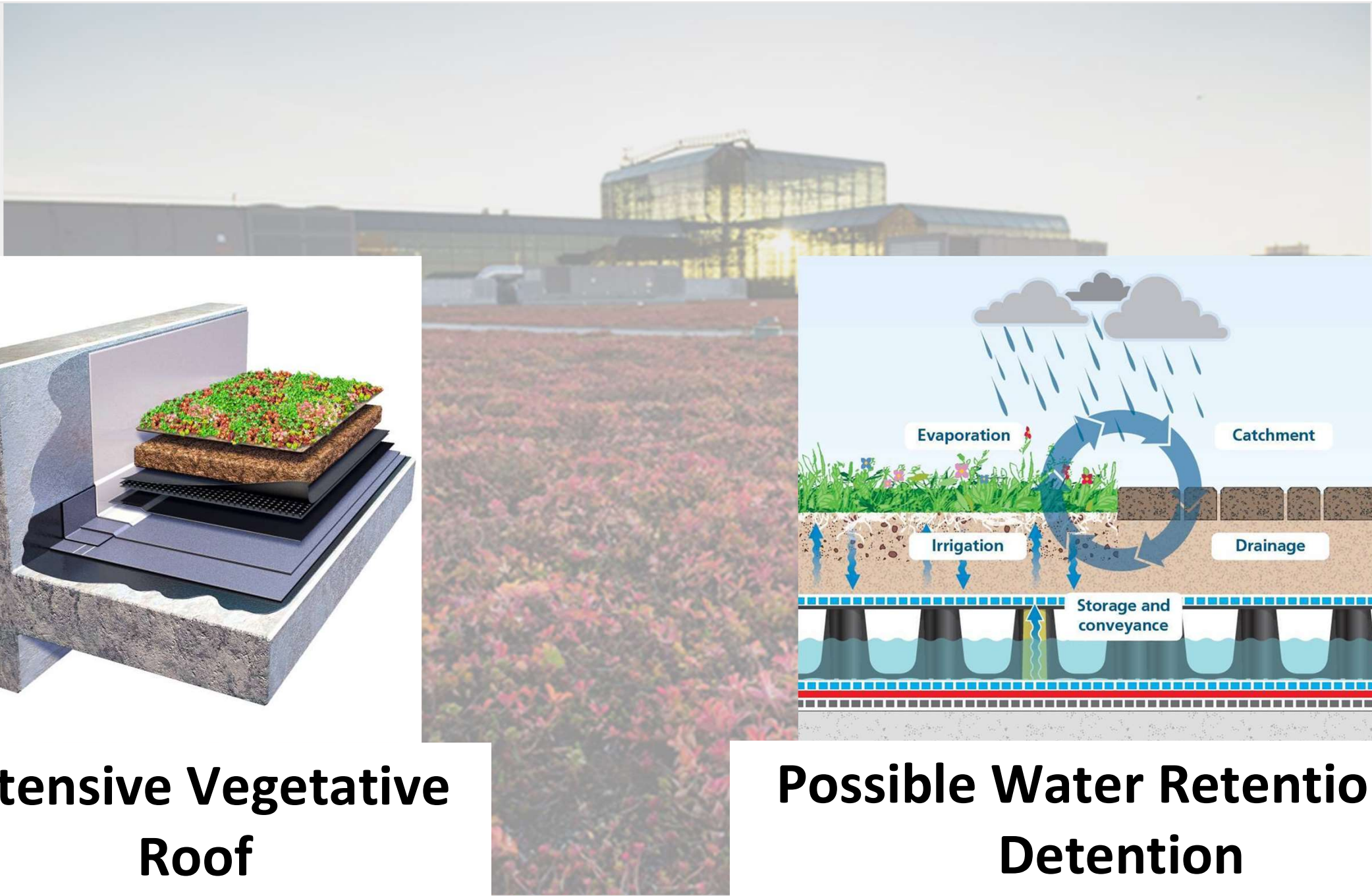
**What if
a vegetative roof was installed
instead of solar?**

Slide 31

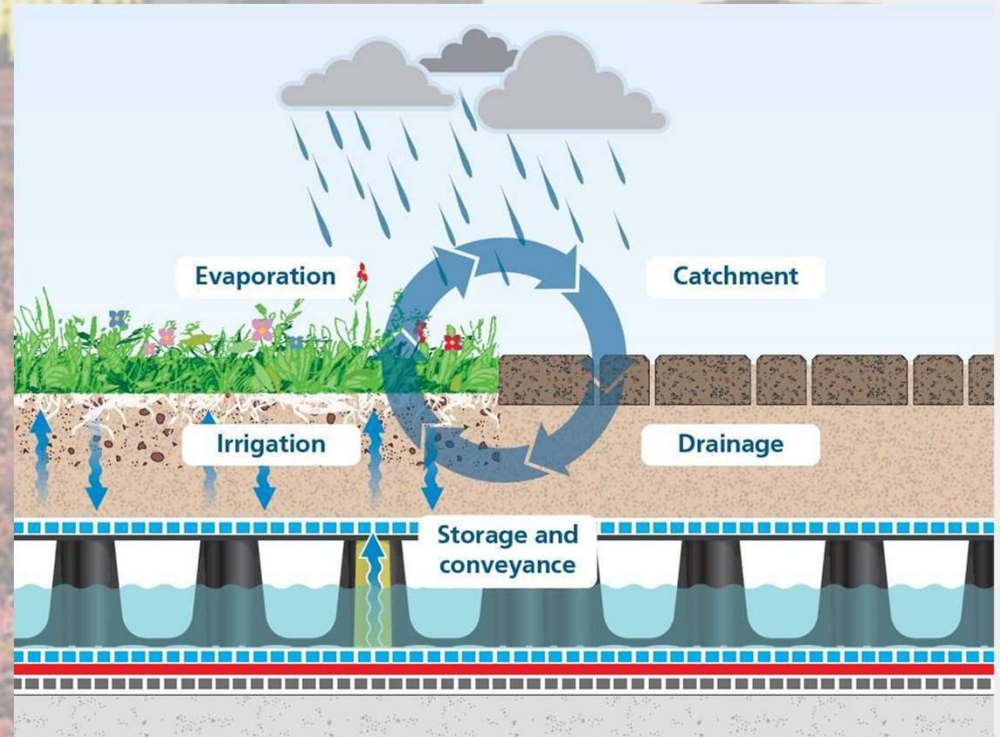
4

@andrea.watts@gaf.com What was the point of this slide?

Kristin Westover, 4/18/2024



Extensive Vegetative Roof

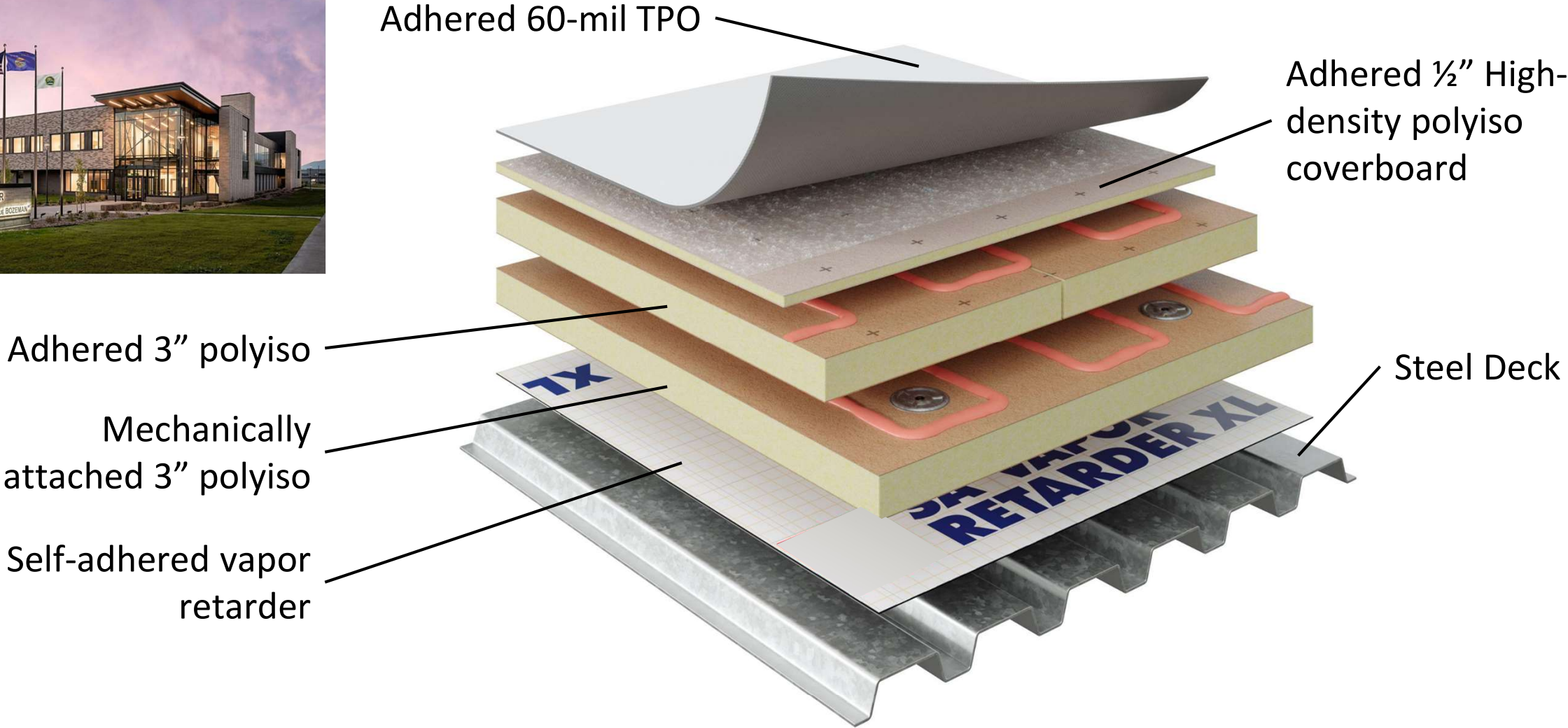


Possible Water Retention or Detention

Bozeman Public Safety Center, Bozeman, MT



Bozeman Public Safety Center, Bozeman, MT



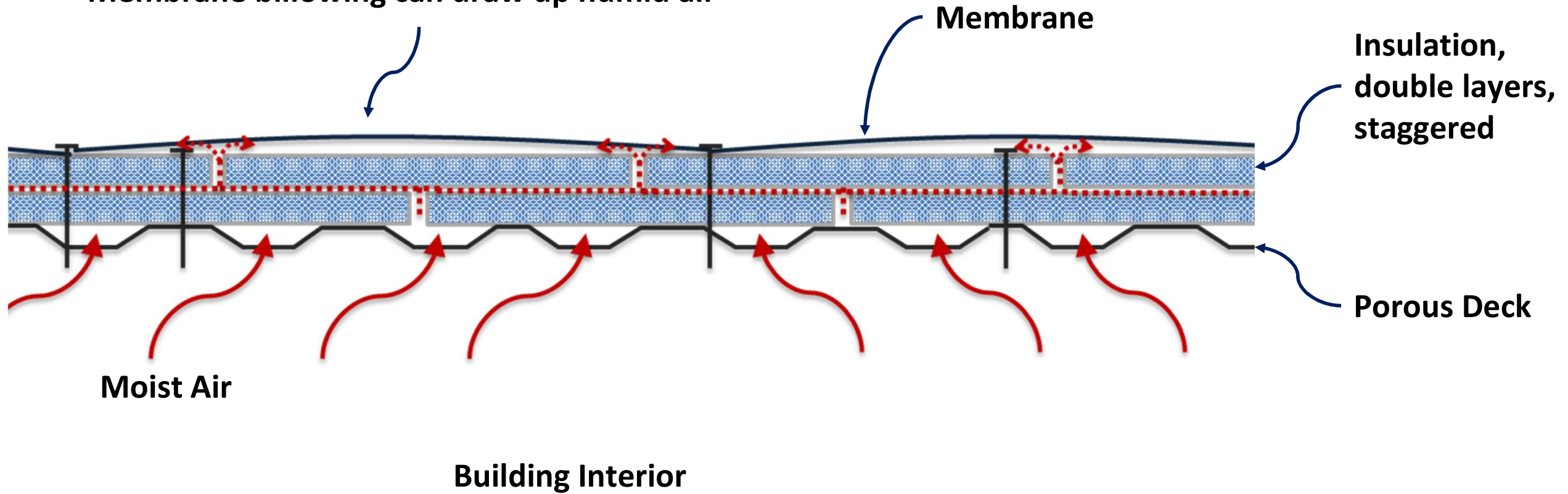


**What if
adhesives could not be used?**



Outside

Membrane billowing can draw up humid air



Membrane

Insulation,
double layers,
staggered

Porous Deck

Moist Air

Building Interior

What is the risk?

1. Vapor retarder installed

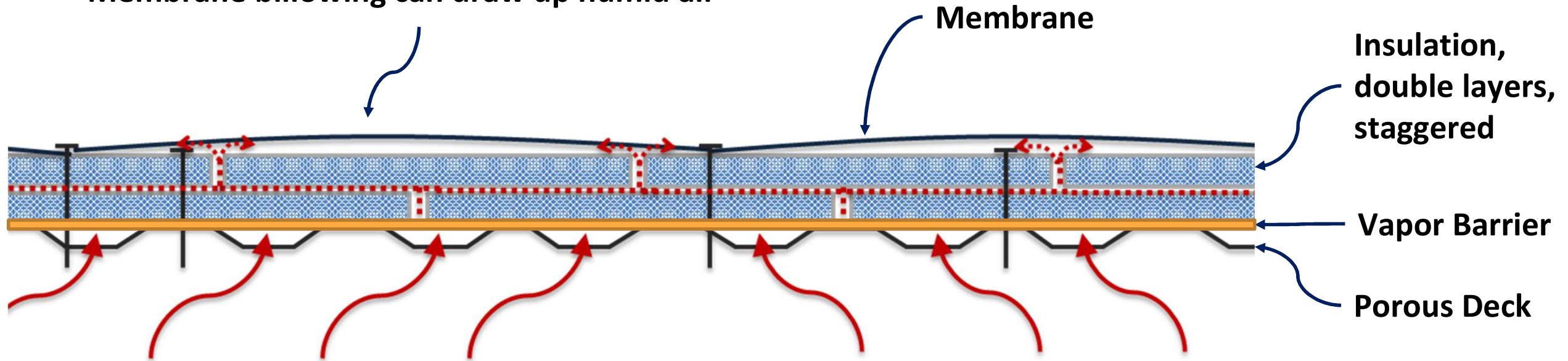


3

Add condensation under billowing graphic
Andrea Watts, 4/19/2024

Outside

Membrane billowing can draw up humid air



Insulation,
double layers,
staggered

Vapor Barrier

Porous Deck

Moist Air

Building Interior

What is the risk?

1. Vapor retarder installed
2. Induction welding vs. traditional fastener options

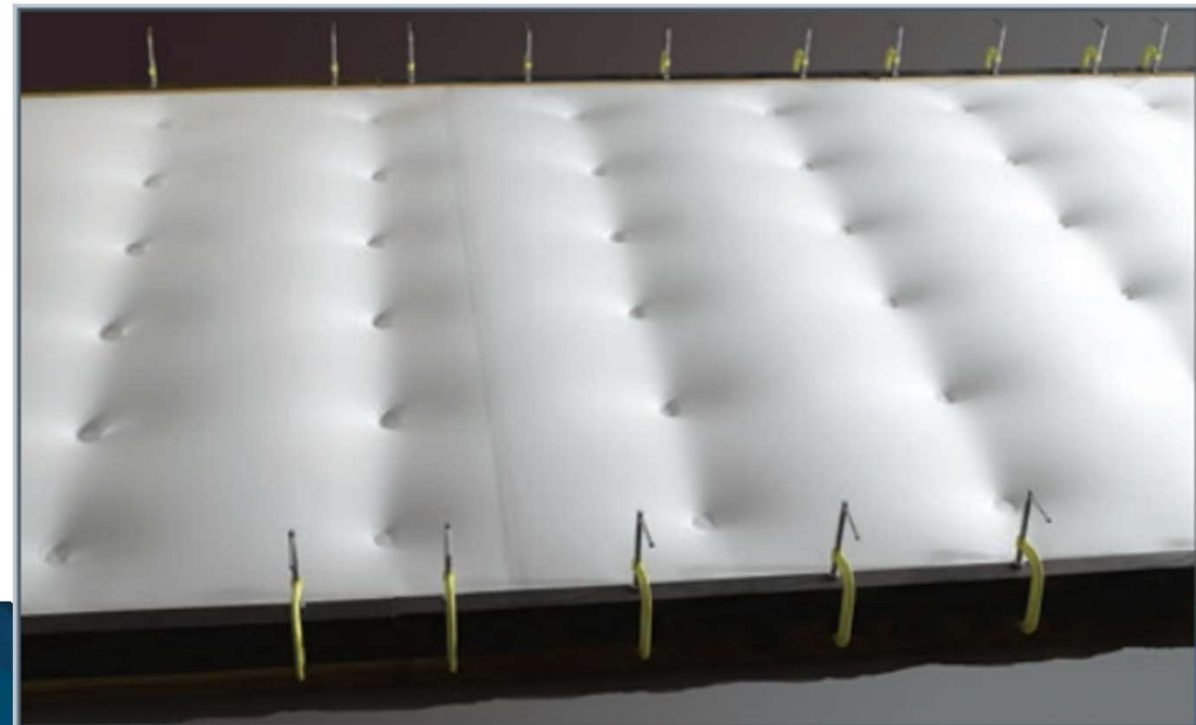
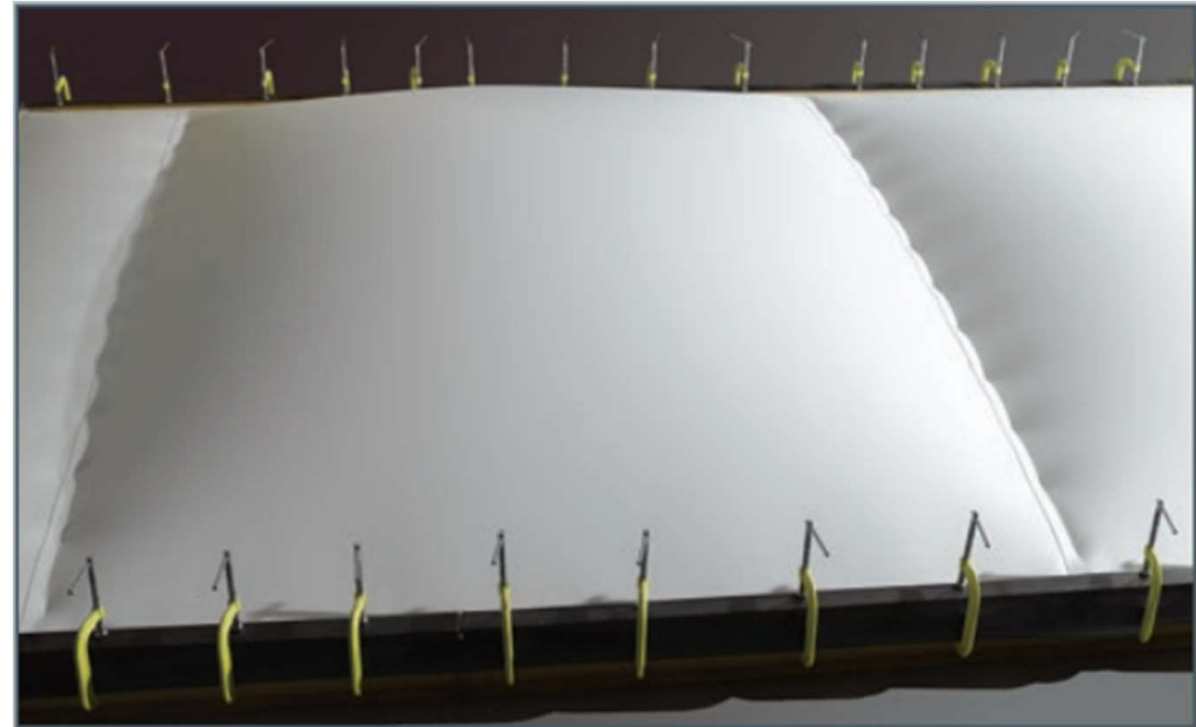


Image Courtesy of OMG Roofing

What is the risk?

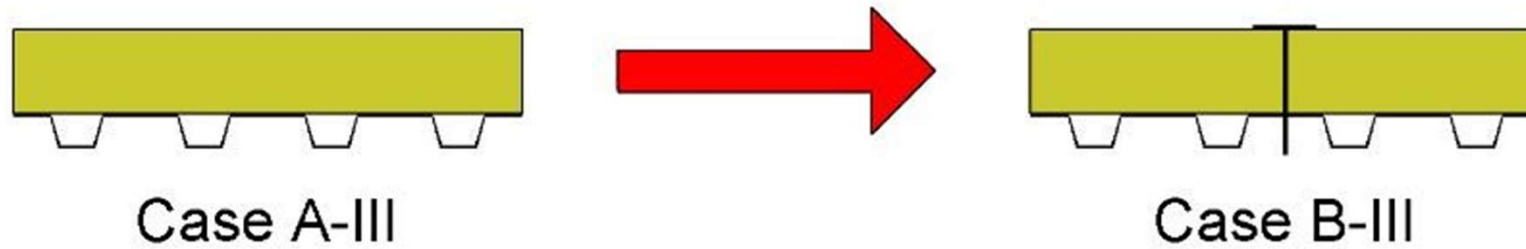
1. Vapor retarder installed
2. Induction welding vs. traditional fastener options
3. Reduced Effective R-value



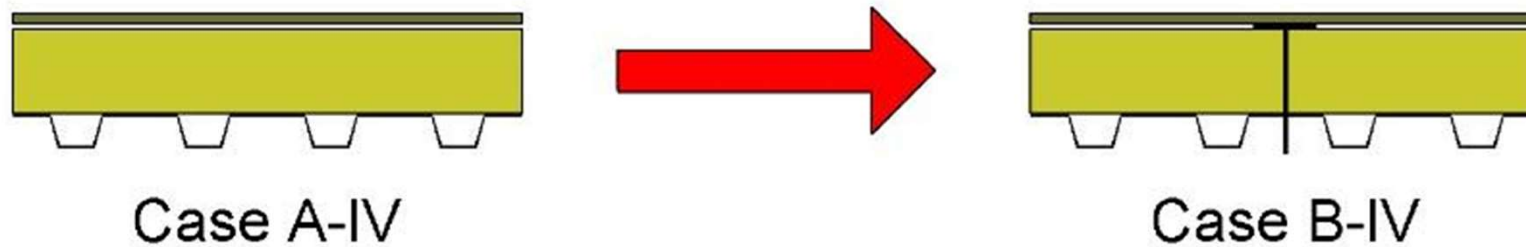
Photo courtesy of Simpson Gumpertz & Heger Inc.

Effective R-Value Impact of Fasteners

11%, 4.6% drop in R-value

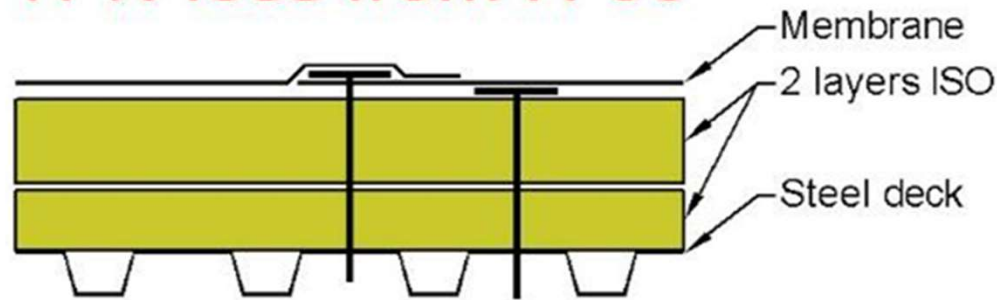


6.1%, 4.2% drop in R-value



Effective R-Value Impact of Fasteners

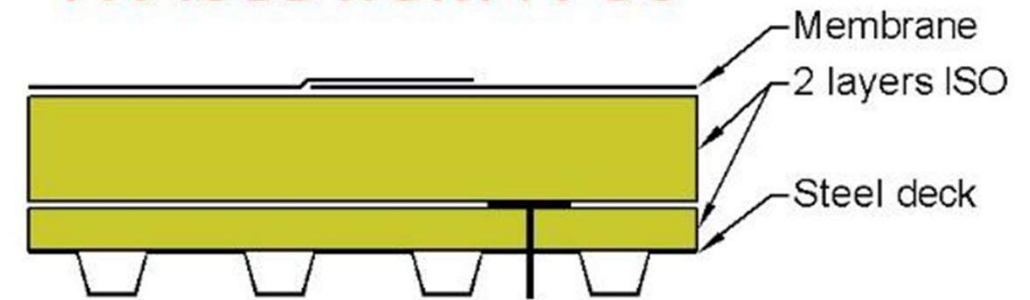
17% loss from R-30



Mechanically attached

R-25

4% loss from R-30

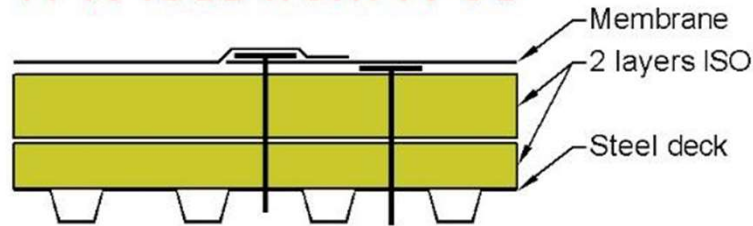


Top layer of polyiso adhered

R-28.7

Effective R-Value Impact of Fasteners

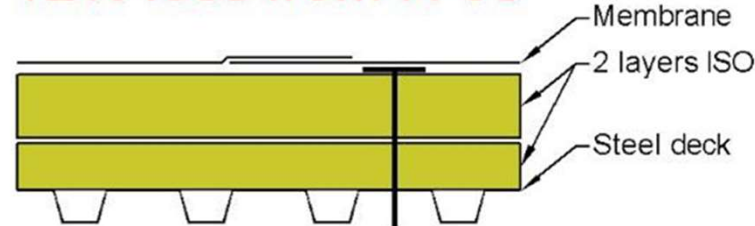
17% loss from R-30



Mechanically attached

R-25

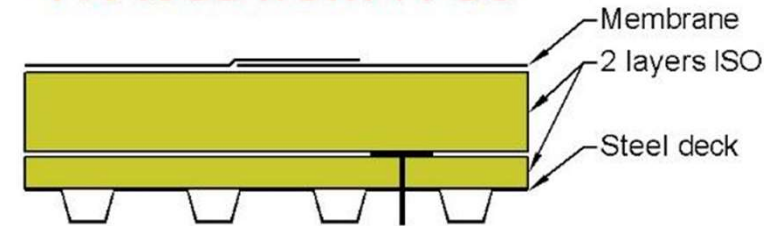
12% loss from R-30



Induction-welded

R-26.5

4% loss from R-30



Top layer of polyiso adhered

R-28.7

4

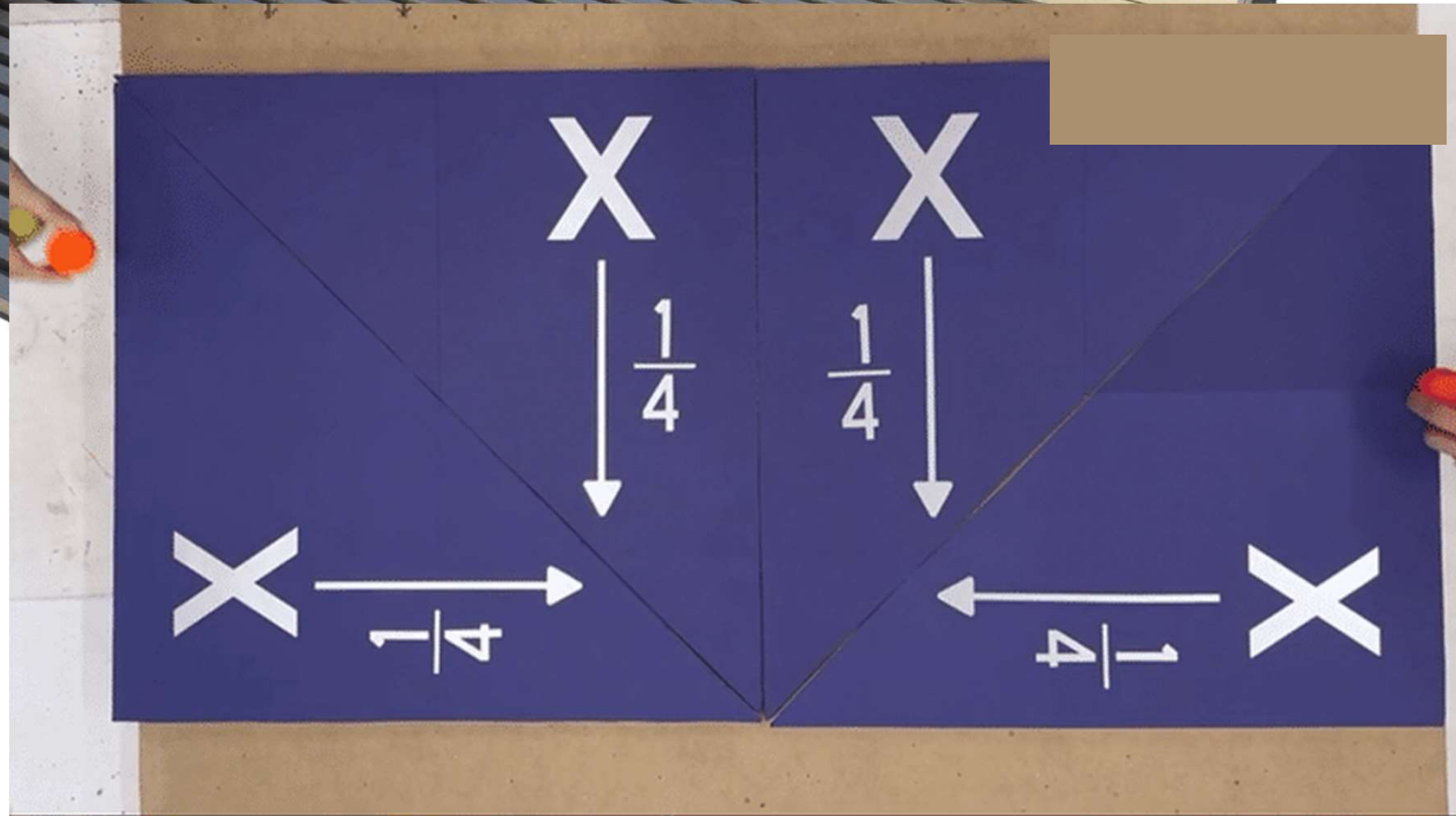
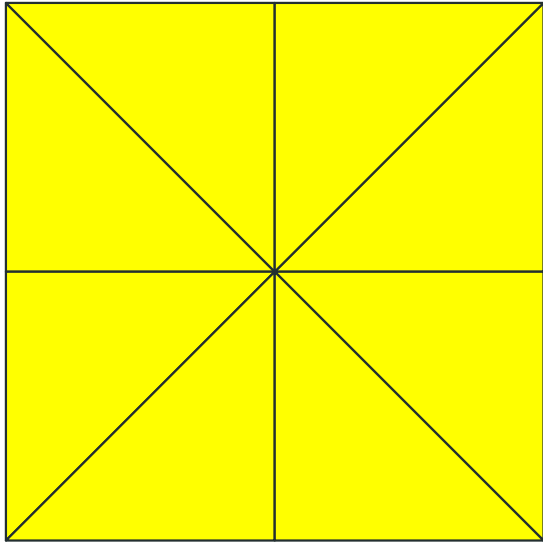
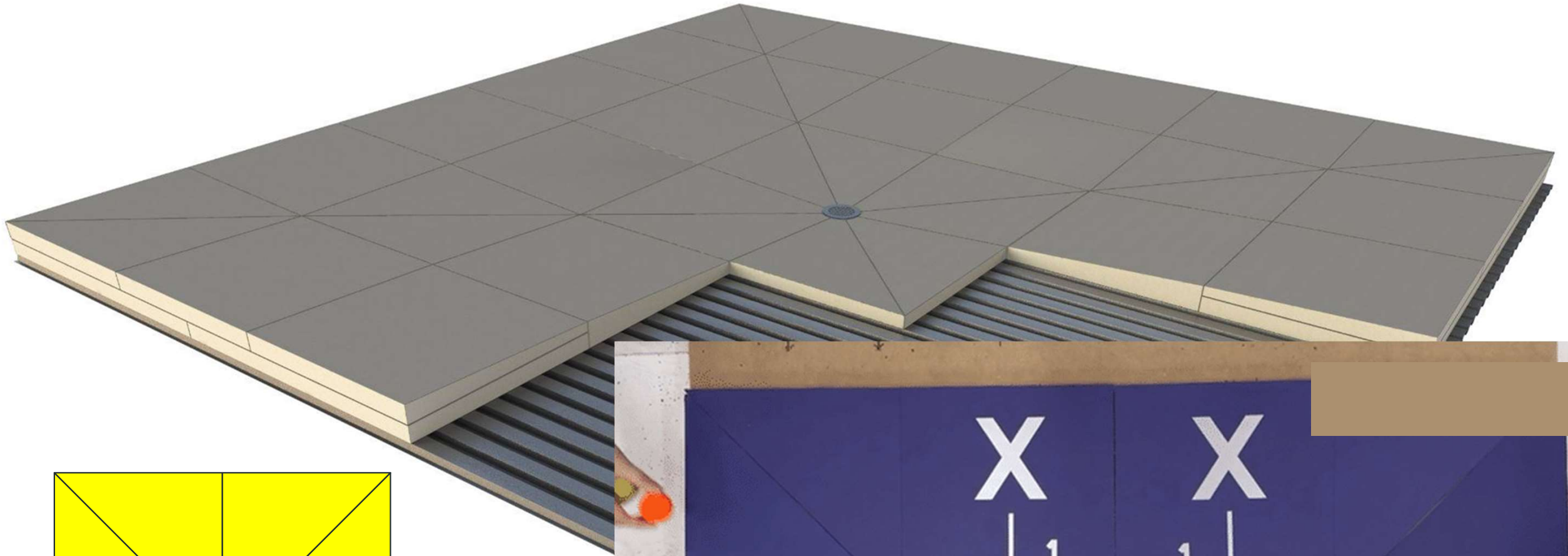
insert morph

Andrea Watts, 4/11/2024

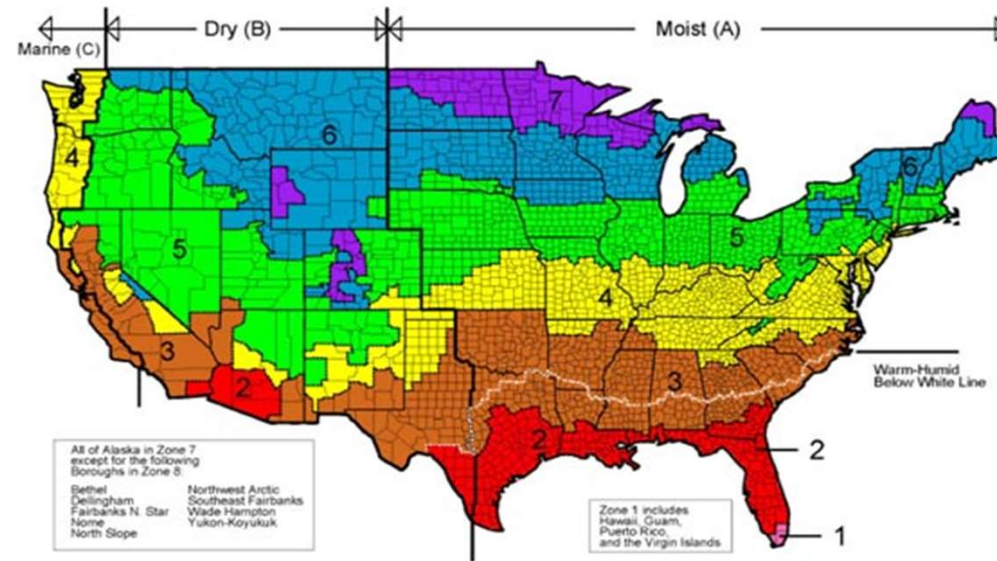
**What if
the roof deck had no slope?**

Tapered Insulation





Building Code on Insulation



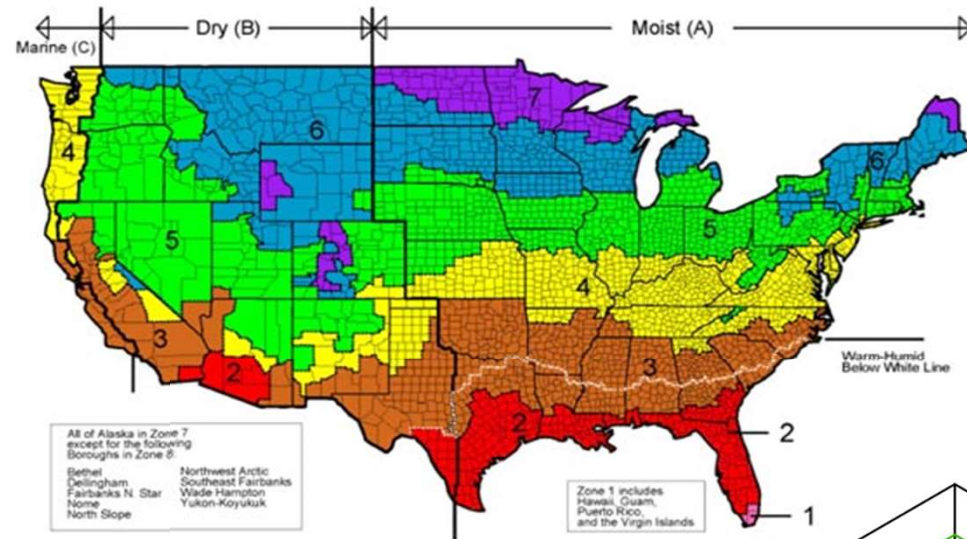
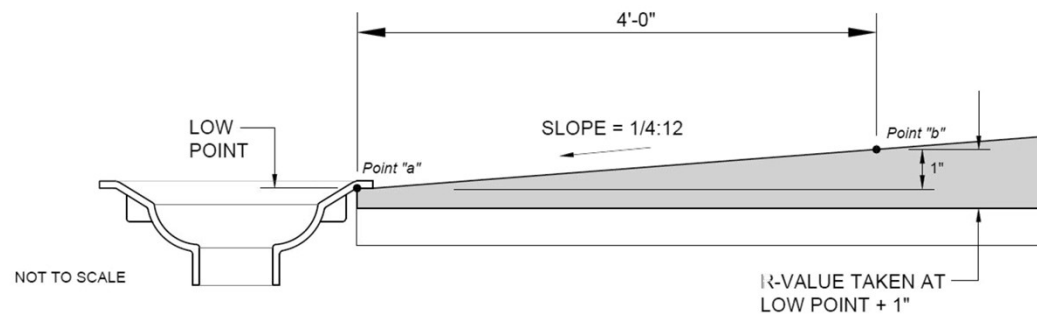
IECC 2021 Table C402.1.3 Opaque Thermal Envelope Insulation Component Minimum Requirements, R-Value Method (Non-R Occupancy)

Climate Zone	0 and 1	2	3	4 Except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation Entirely above roof deck	R-20ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci
Metal Buildings	R-19 + R11 LS	R-19 + R11 LS	R-19 + R11 LS	R-19 + R11 LS	R-19 + R11 LS	R-25 + R11 LS	R-30 + R11 LS	R-25 + R-11 + R11 LS
Walls								
Metal Frames	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci	R-13 + R-12.5ci	R-13 + R-12.5ci	R-13 + R-18.8ci

Building Code on Tapered Insulation

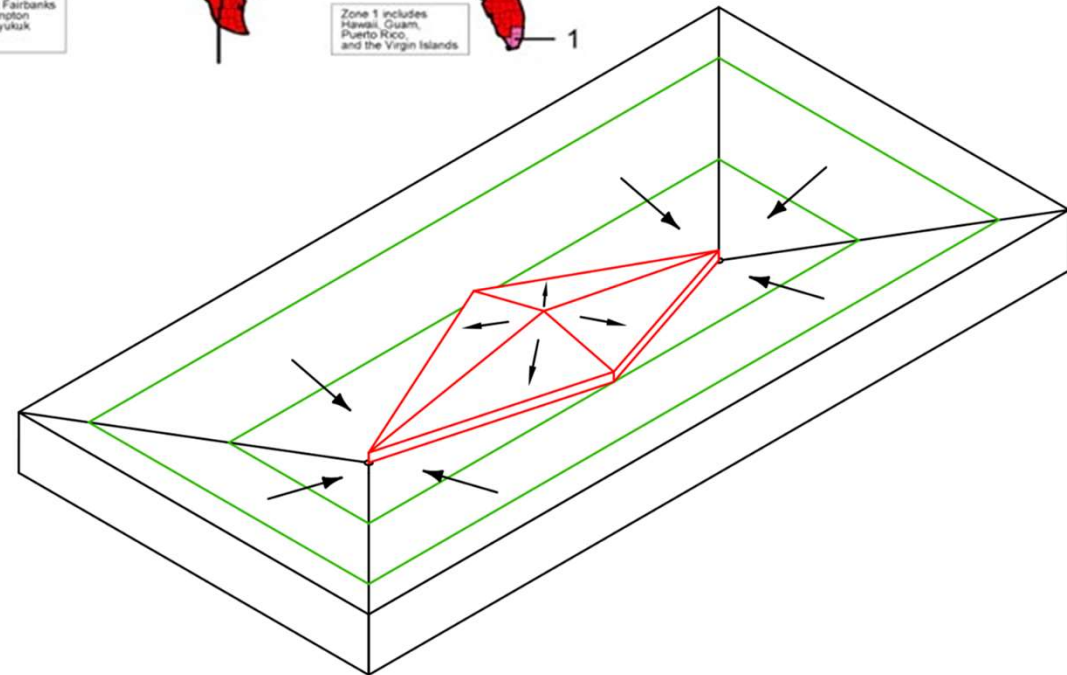
IECC 2015, 2018

Graphically Depicted
Example with a roof slope = 1/4:12

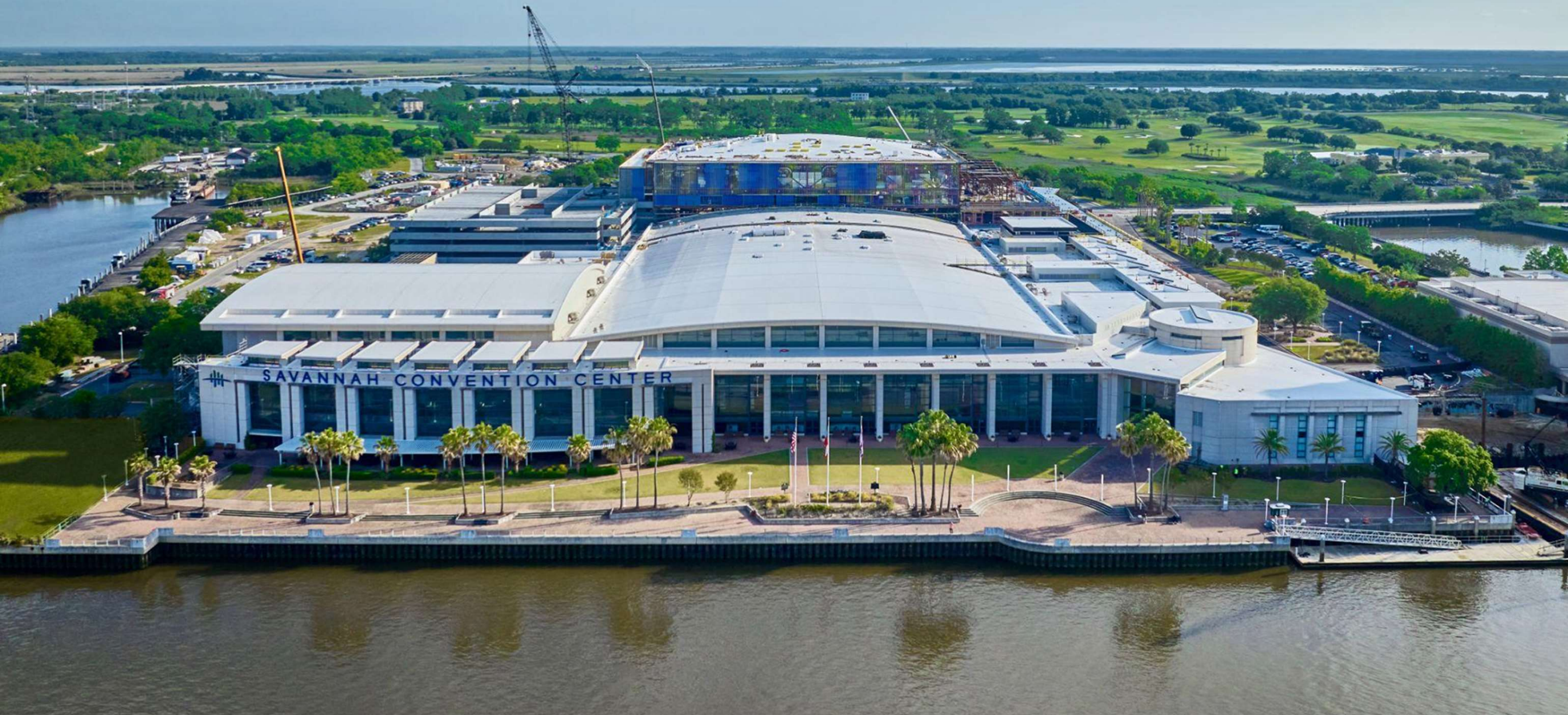


IECC 2021

402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the sloped roof insulation ***R*-value contribution** to that calculation **shall use the average thickness** in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *R*-value compliance as prescribed in Section 402.1.3



Savannah Convention Center, Savannah, GA



Savannah Convention Center, Savannah, GA



I specify PVC on projects like this, "because of the long-term durability and maintainability of the product."

Alexis AuBuchon, Hansen Architects, P.C.

Savannah Convention Center, Savannah, GA



Adhered 60-mil PVC

Mechanically
Fastened ½”
gypsum
coverboard

2 layers mechanically attached
2.6” polyiso insulation

SBS Self-adhered
base sheet

Gypsum substrate
board

Steel Deck



What if
there was no the vapor retarder?

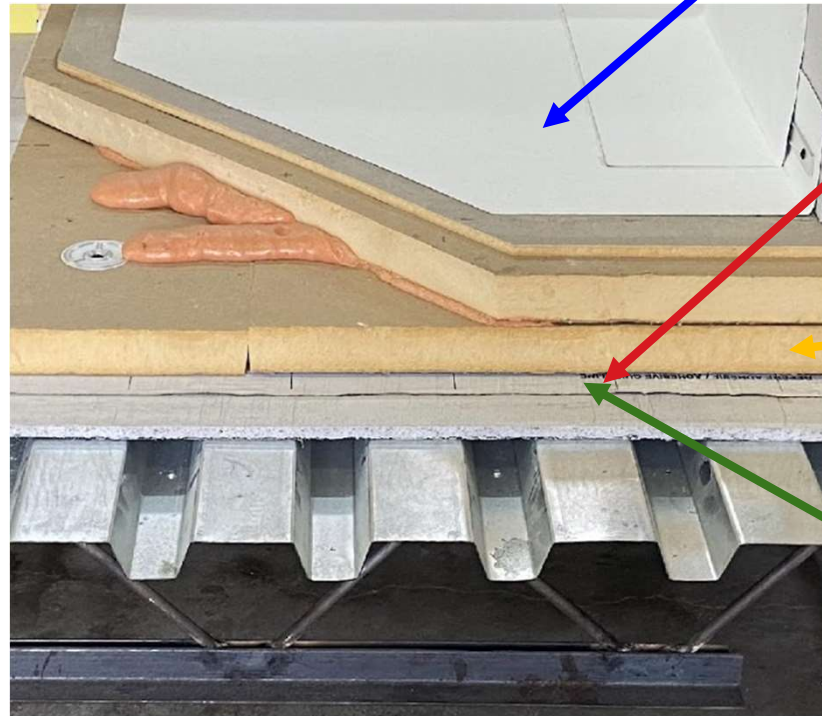
Continuous control layers

Liquid Water

Air

Thermal

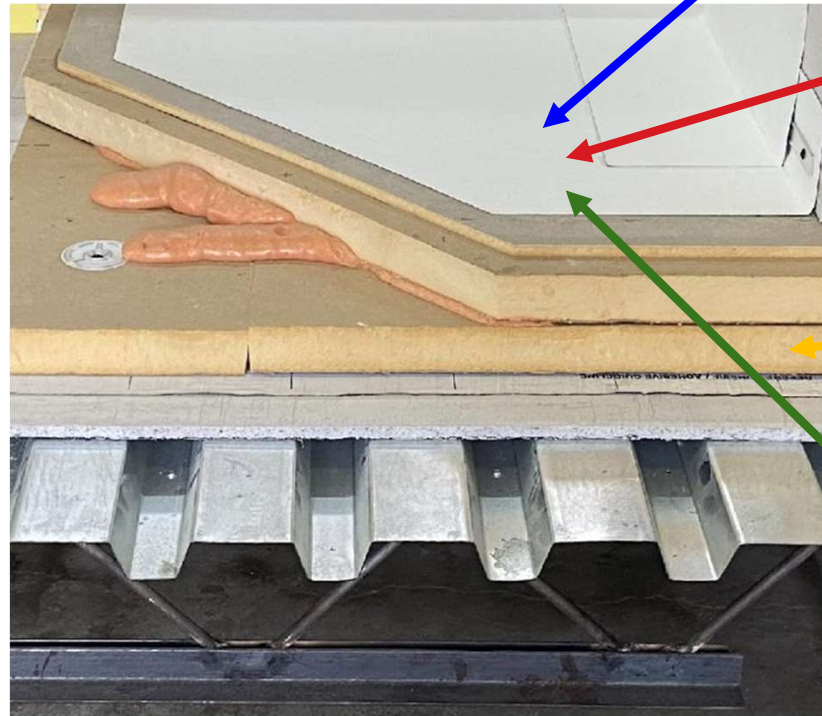
Water Vapor



Vapor Retarder Classes

Material	Perm Rating	Classification	
Built-Up Roofing Membrane	0.00 – 0.02	Impermeable (Vapor Proof) ≤ 0.1 Perm	Includes foil faced poly iso
Single-Ply Membrane	0.03 – 0.06		
Polyethylene Film	0.06 – 0.08		
Asphalt Felt	0.3 – 0.8	Semi-Impermeable > 0.1 ≤ 1.0 Perm	Includes plywood, ccSPF>2” Kraft paper
Polyiso Roof Insulation	1.0		
Extruded Polystyrene	1.0		
Expanded Polystyrene	1.2	Semi-Permeable > 1.0 ≤ 10.0 Perm	Includes ocSPF, Painted GWB, 15# felt
Wood Fiber	3.0 – 5.0		
Gypsum Board	30.0 – 50.0	Permeable > 10.0 Perm	Includes fiberglass

Continuous control layers



Liquid Water

Air

Thermal

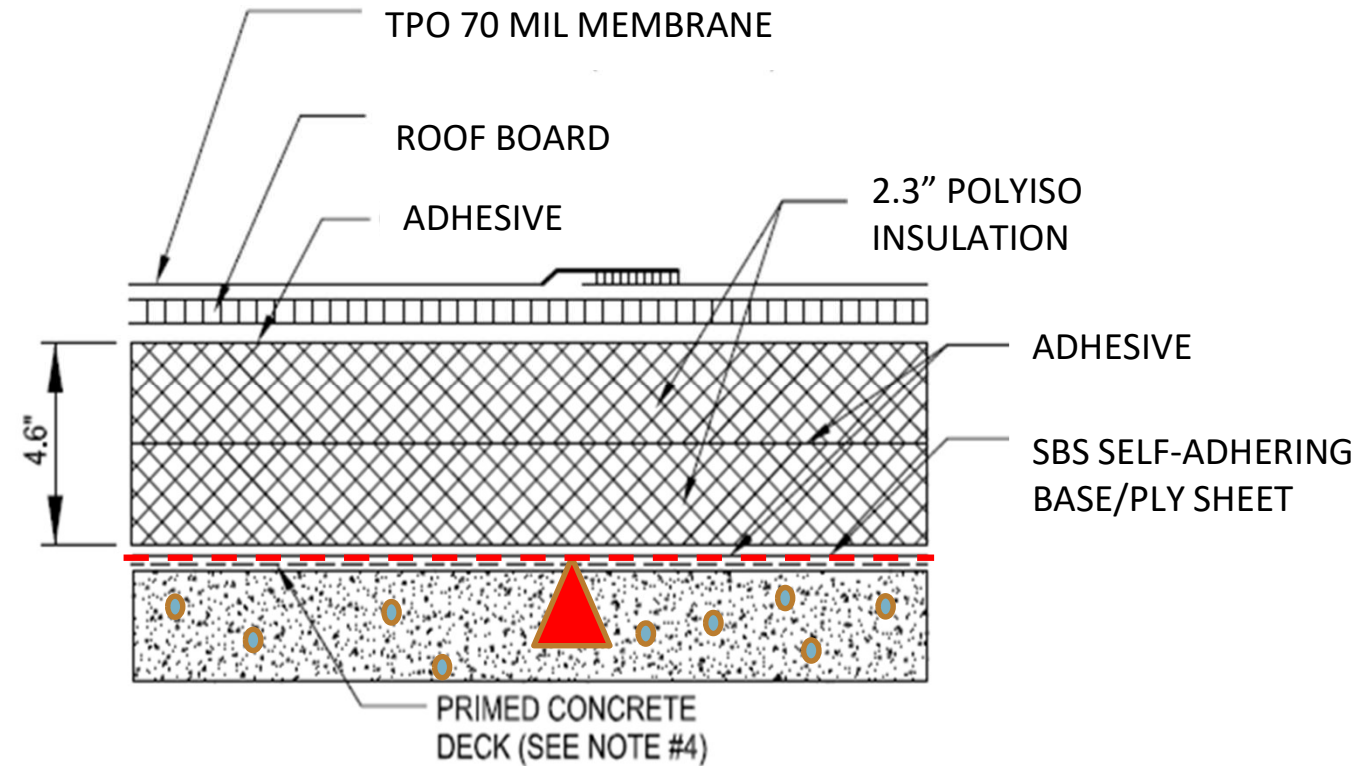
Water Vapor



Jay Smith

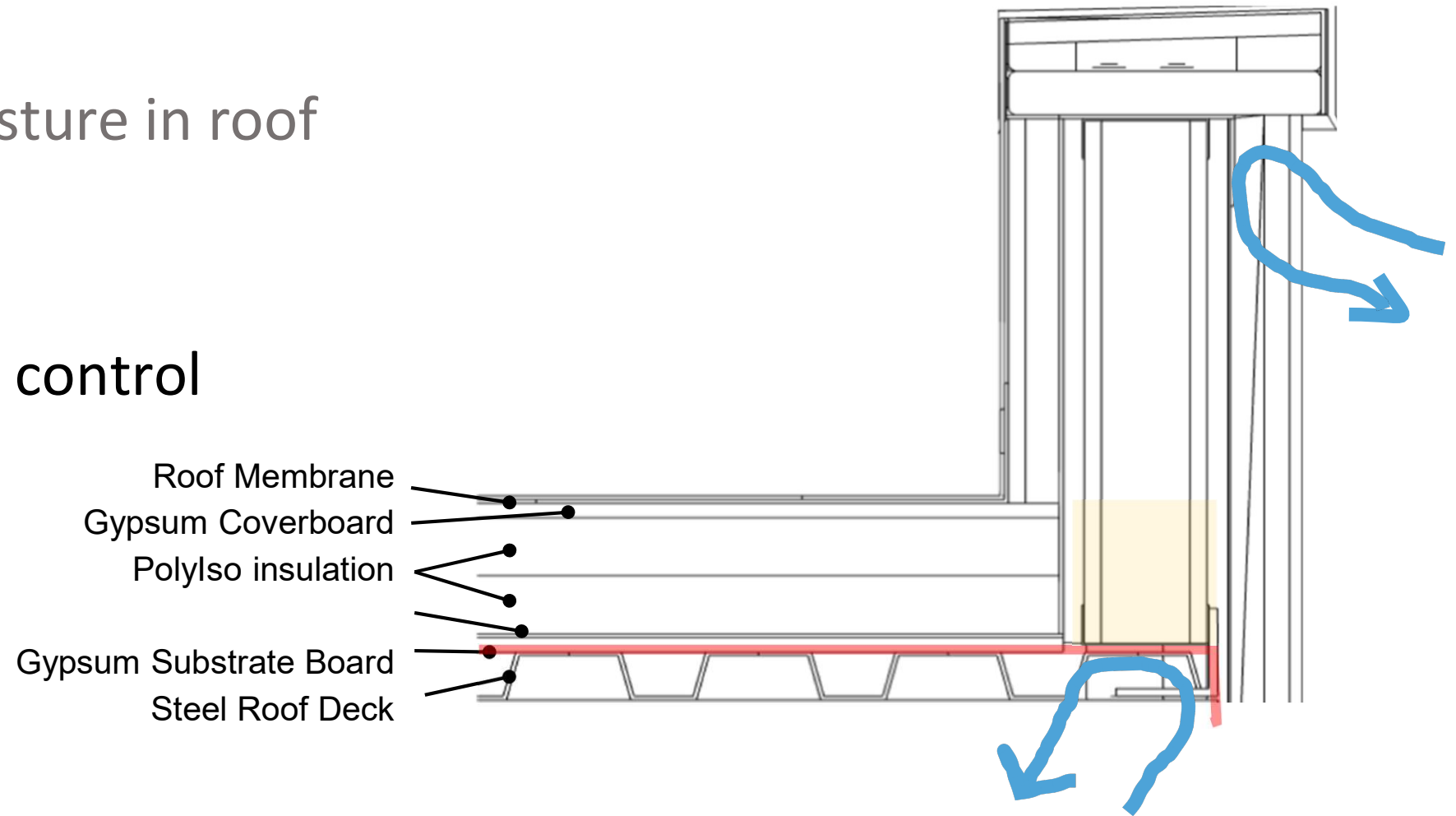
What is the value in a separate dedicated air and vapor retarder?

- Minimize moisture in roof assembly



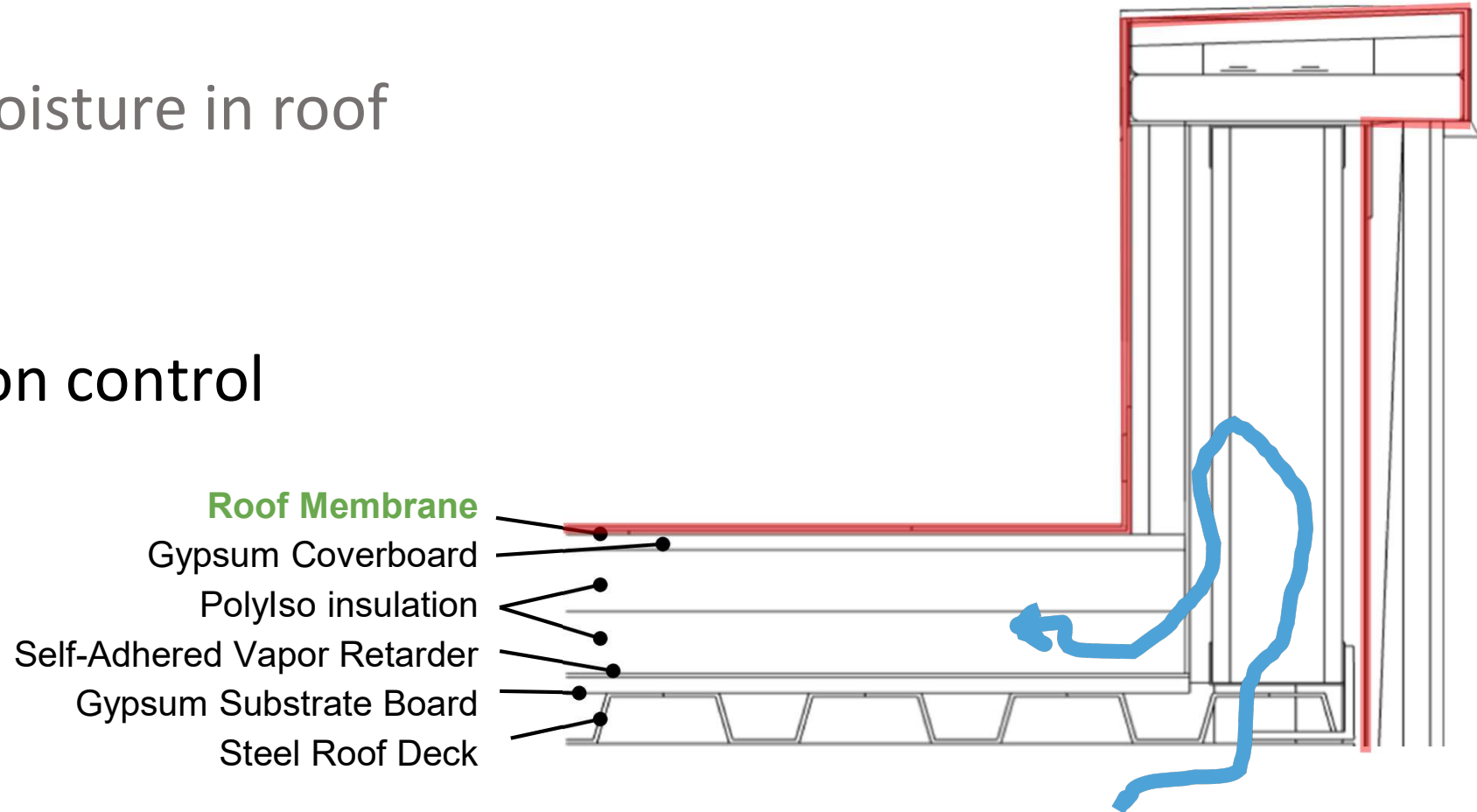
What is the value in a separate dedicated air and vapor retarder?

- Minimize moisture in roof assembly
- Condensation control



What is the value in a separate dedicated air and vapor retarder?

- Minimize moisture in roof assembly
- Condensation control



What is the value in a separate dedicated air and vapor retarder?

- Minimize moisture in roof assembly
- Condensation control
- Minimize uplift



What is the value in a separate dedicated air and vapor retarder?

- Minimize moisture in roof assembly
- Condensation control
- Minimize uplift
- Temporary roof



Key Takeaways

No roof is “best” for EVERY project.

Consider project objectives when selecting materials.

Decide roof performance priorities early in the project.

Consider the “What Ifs” when looking at design options.

abaa2024 building enclosure conference

THANK YOU!

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Building & Roofing Science