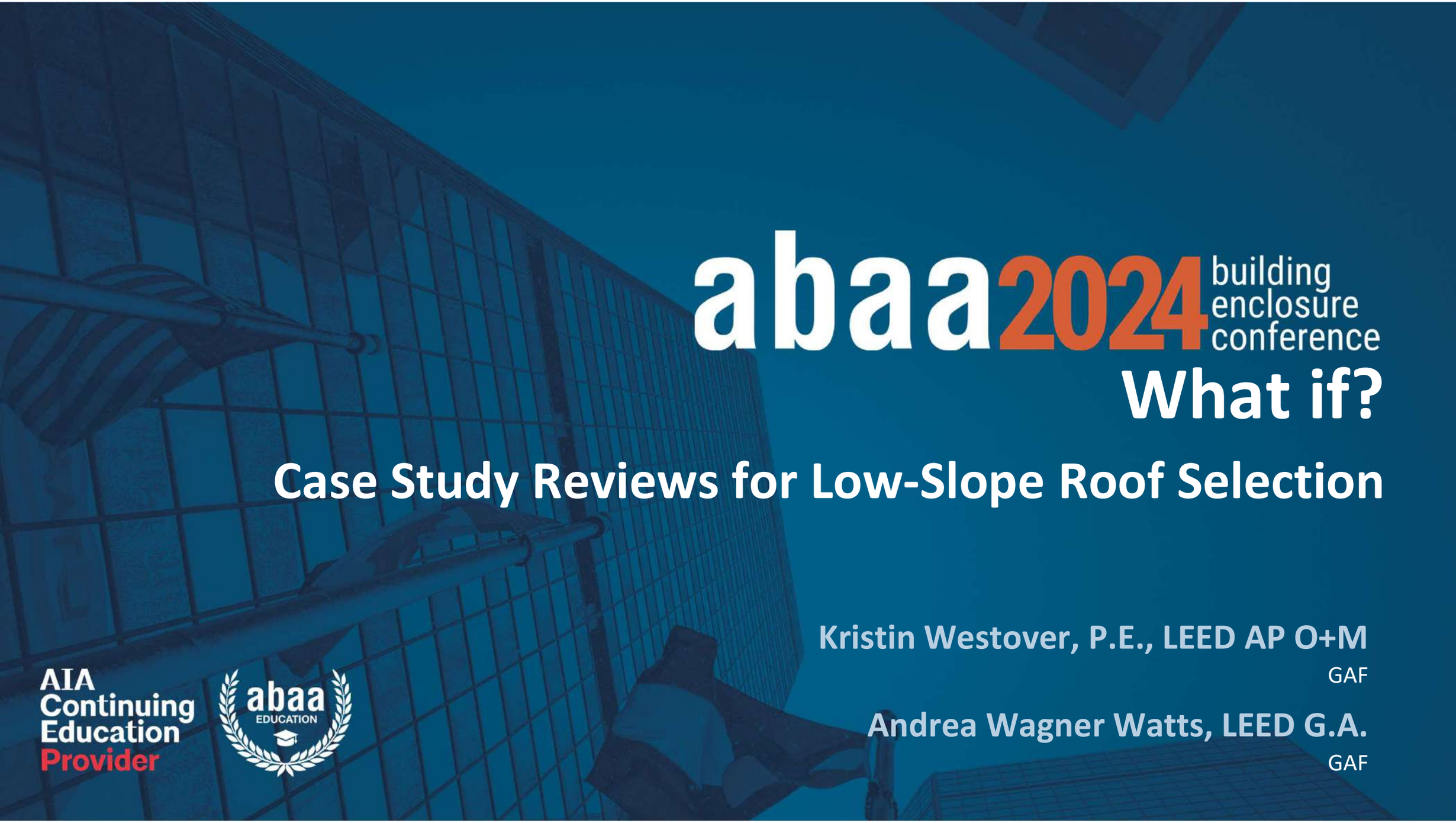


abaa2024 building enclosure conference

What if?

Case Study Reviews for Low-Slope Roof Selection

AIA Continuing Education Provider

abaa EDUCATION

Kristin Westover, P.E., LEED AP O+M
GAF

Andrea Wagner Watts, LEED G.A.
GAF

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.

abaa building enclosure conference

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.

abaa EDUCATION

Kristin Westover

Technical Manager,
Specialty Installations

Andi Wagner Watts

Building Science
Education Manager

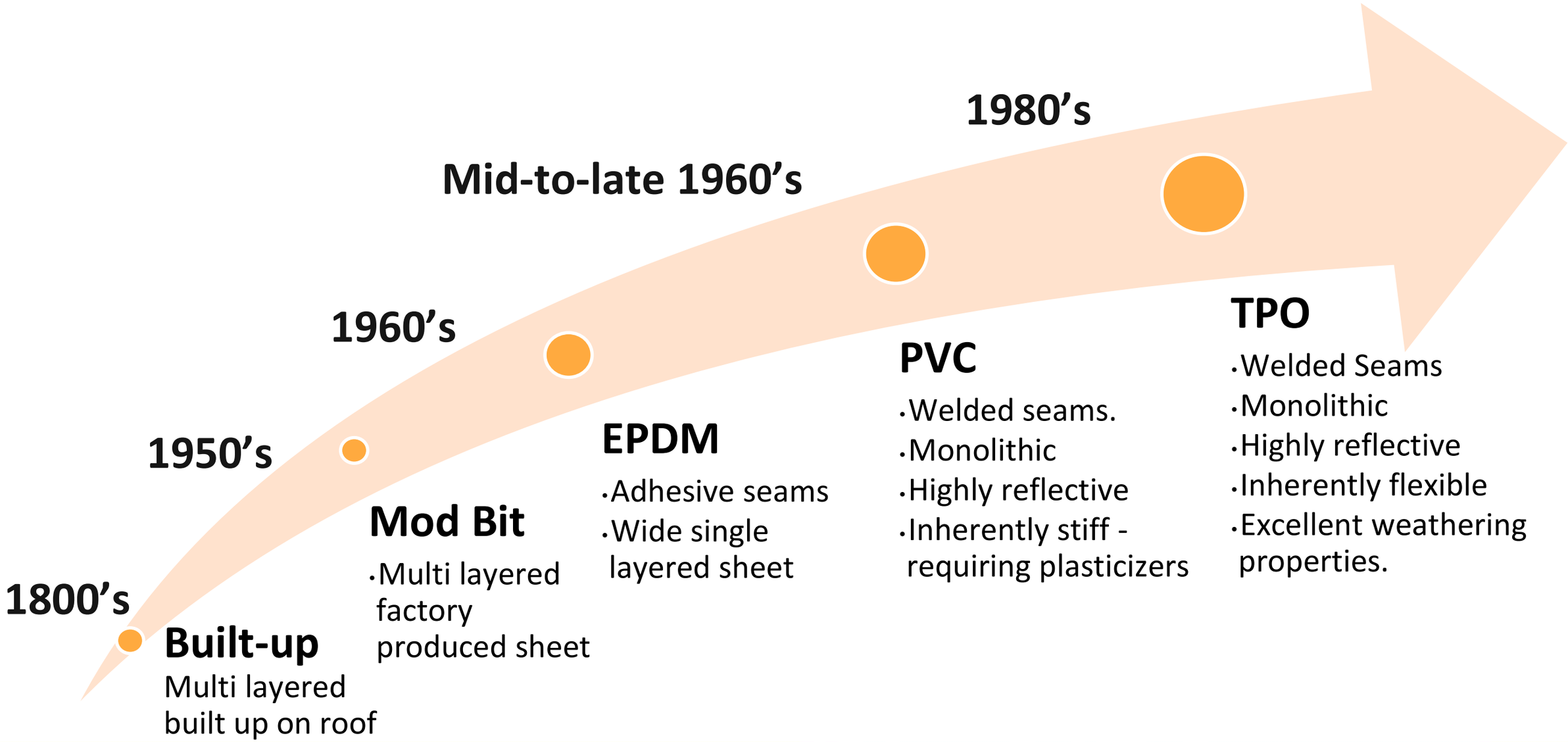
GAF | siplast®

Building & Roofing Science


Stanley Center
FOR PEACE AND SECURITY


BOZEMAN PUBLIC SAFETY CENTER
901 NORTH ROUSE AVENUE BOZEMAN


SAVANNAH CONVENTION CENTER


1800's
Built-up
Multi layered built up on roof
1950's
Mod Bit
•Multi layered factory produced sheet
1960's
EPDM
•Adhesive seams
•Wide single layered sheet
Mid-to-late 1960's
PVC
•Welded seams.
•Monolithic
•Highly reflective
•Inherently stiff - requiring plasticizers
1980's
TPO
•Welded Seams
•Monolithic
•Highly reflective
•Inherently flexible
•Excellent weathering properties.

Arkansas Tech University, Russellville, AR

Courtesy of Cromwell Architects

Arkansas Tech University, Russellville, AR

Torch applied aluminum clad SBS modified bitumen cap sheet

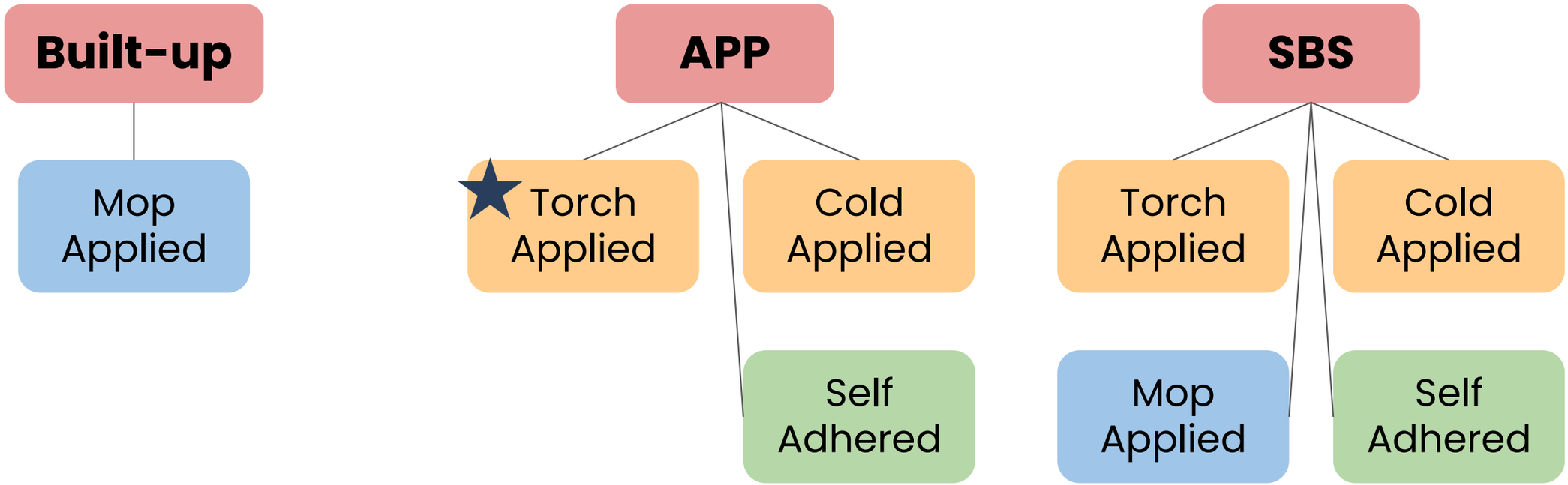
Torch applied SBS modified bitumen base sheet

Existing/Repaired Tectum Deck

Mechanically attached SBS modified bitumen base sheet

What if
another membrane type was used?

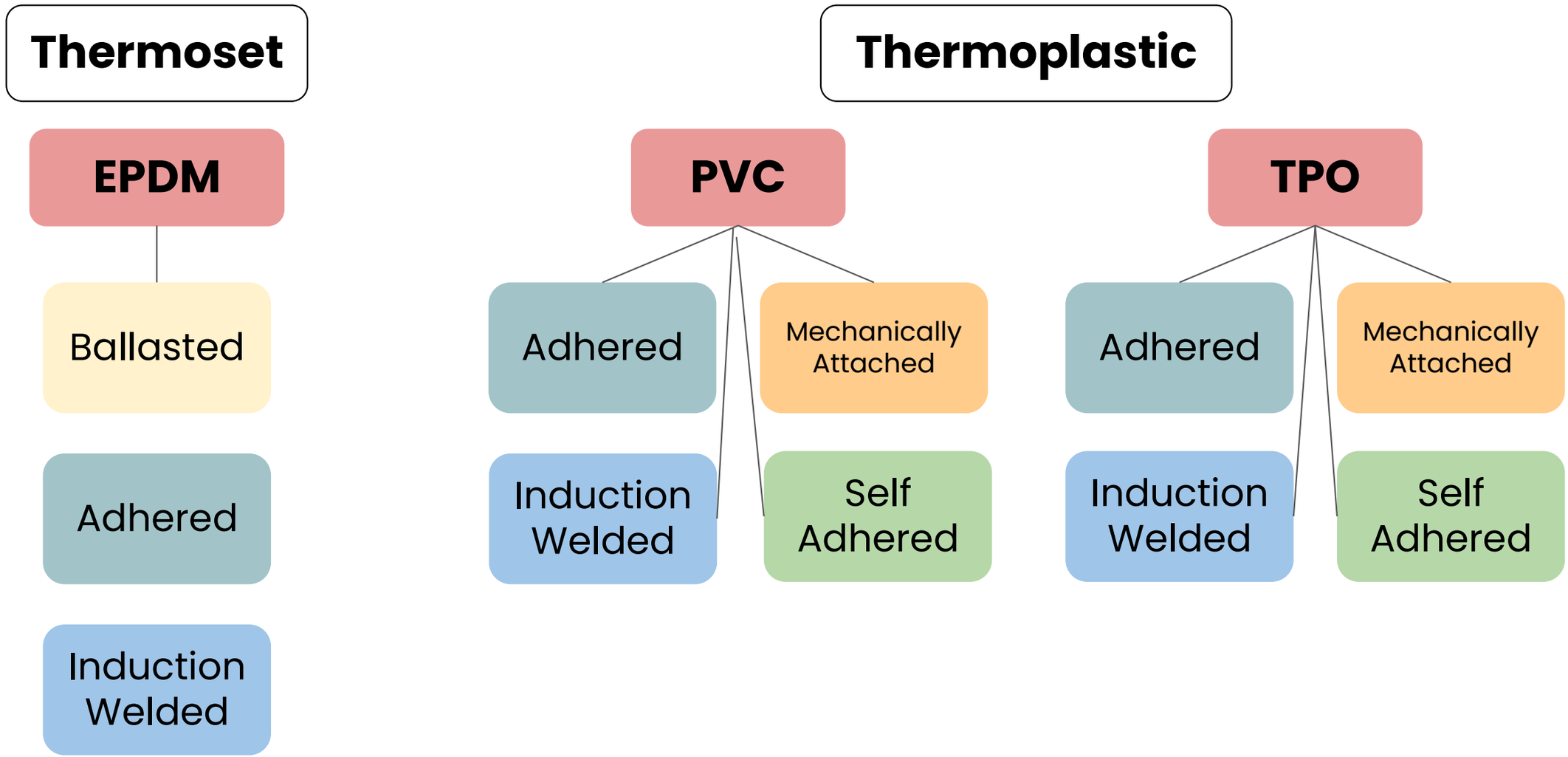
Asphaltic Roofs



Hot Applied

Cold Applied

Single-Ply Attachment Methods



Single-Ply Membranes

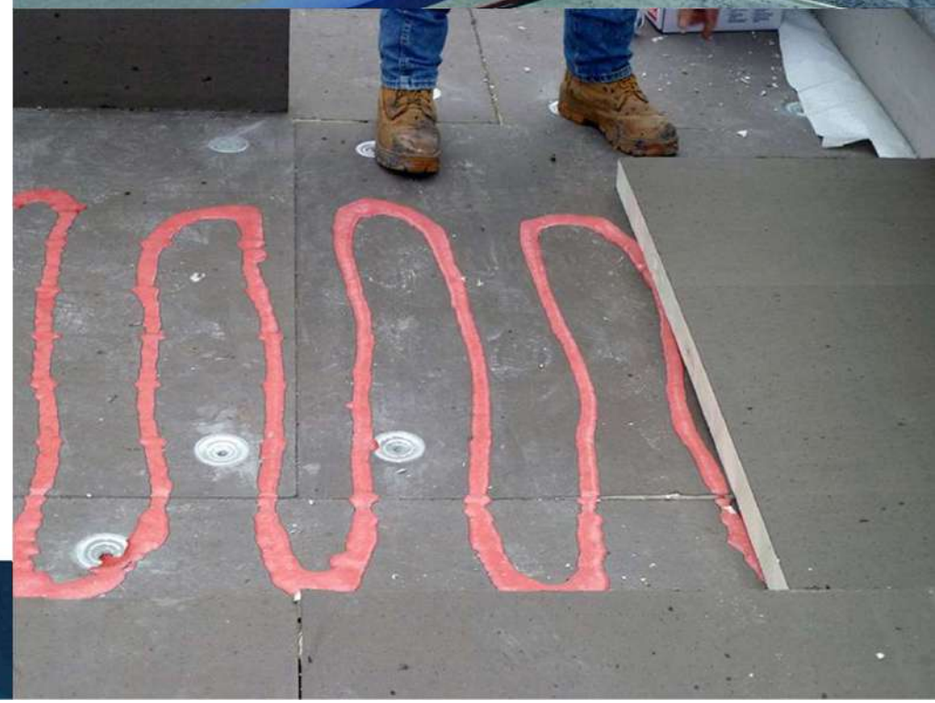
What if
it was a different roof deck?

Insulation Attachment

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

Best Practice:

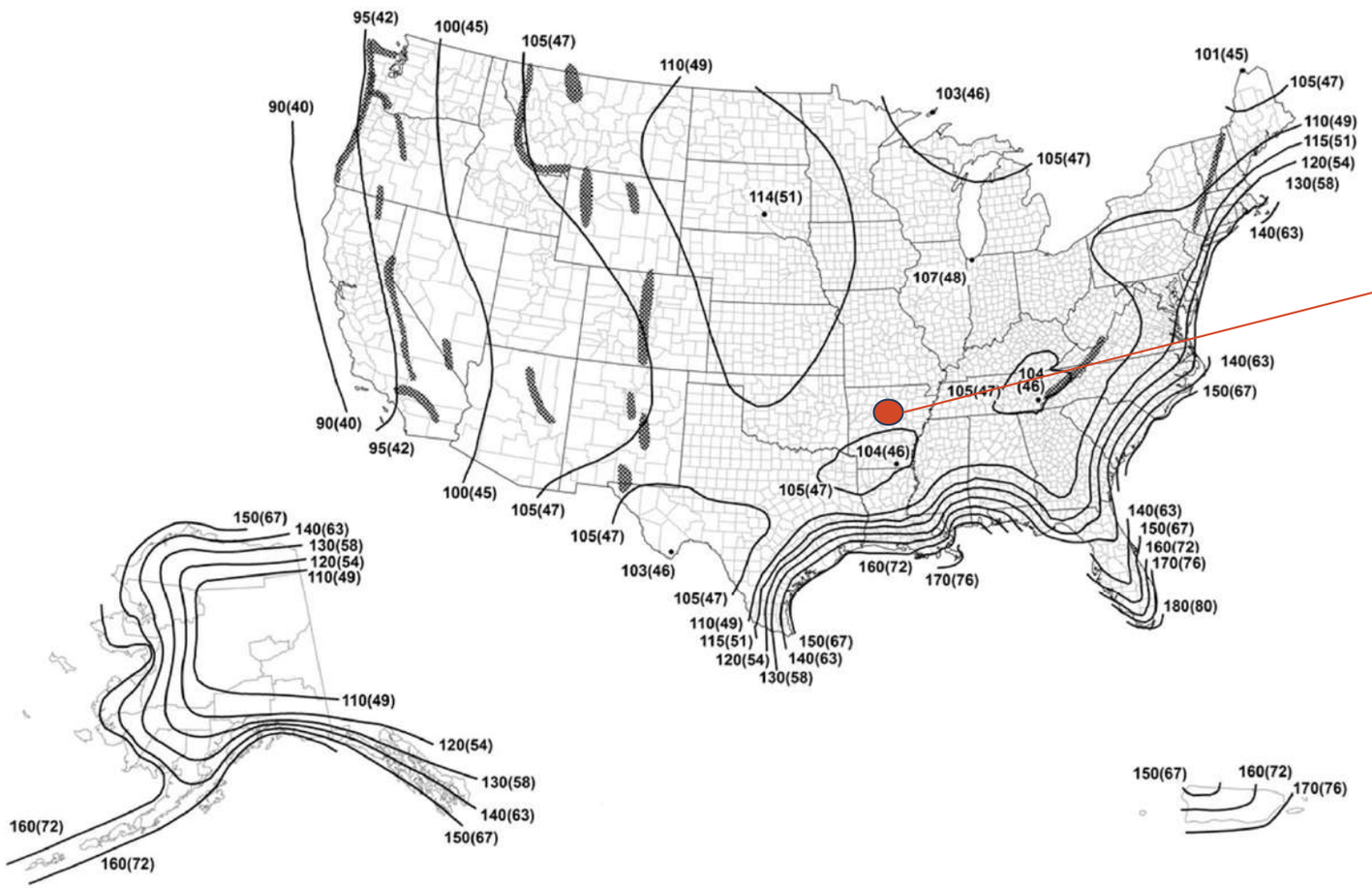
Fasten first layer, adhere others



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

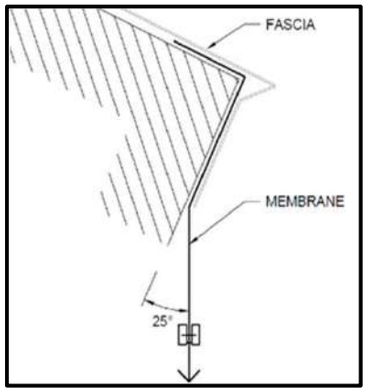

WORLDWIDE
CHANGE
#TRENDING
VIRAL VIDEO ALERT
ROOFING CRASHES ONTO CAR
Subscribe
0:08 / 1:28
CC
CNBC

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

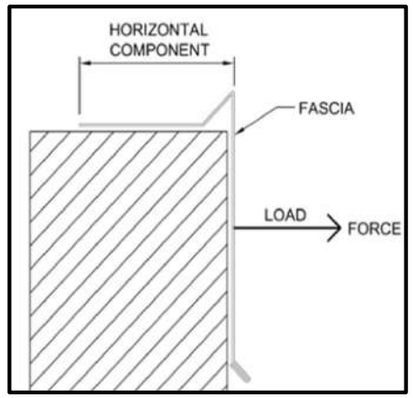
RE-1

Ballasted and MA membrane systems



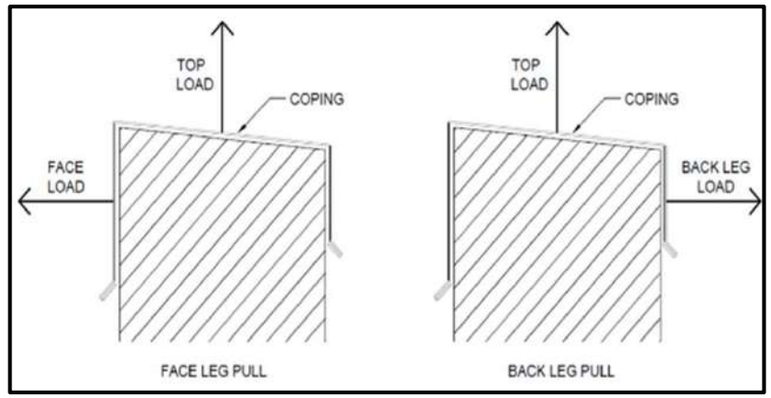
RE-2

Horizontal component is 4



RE-3

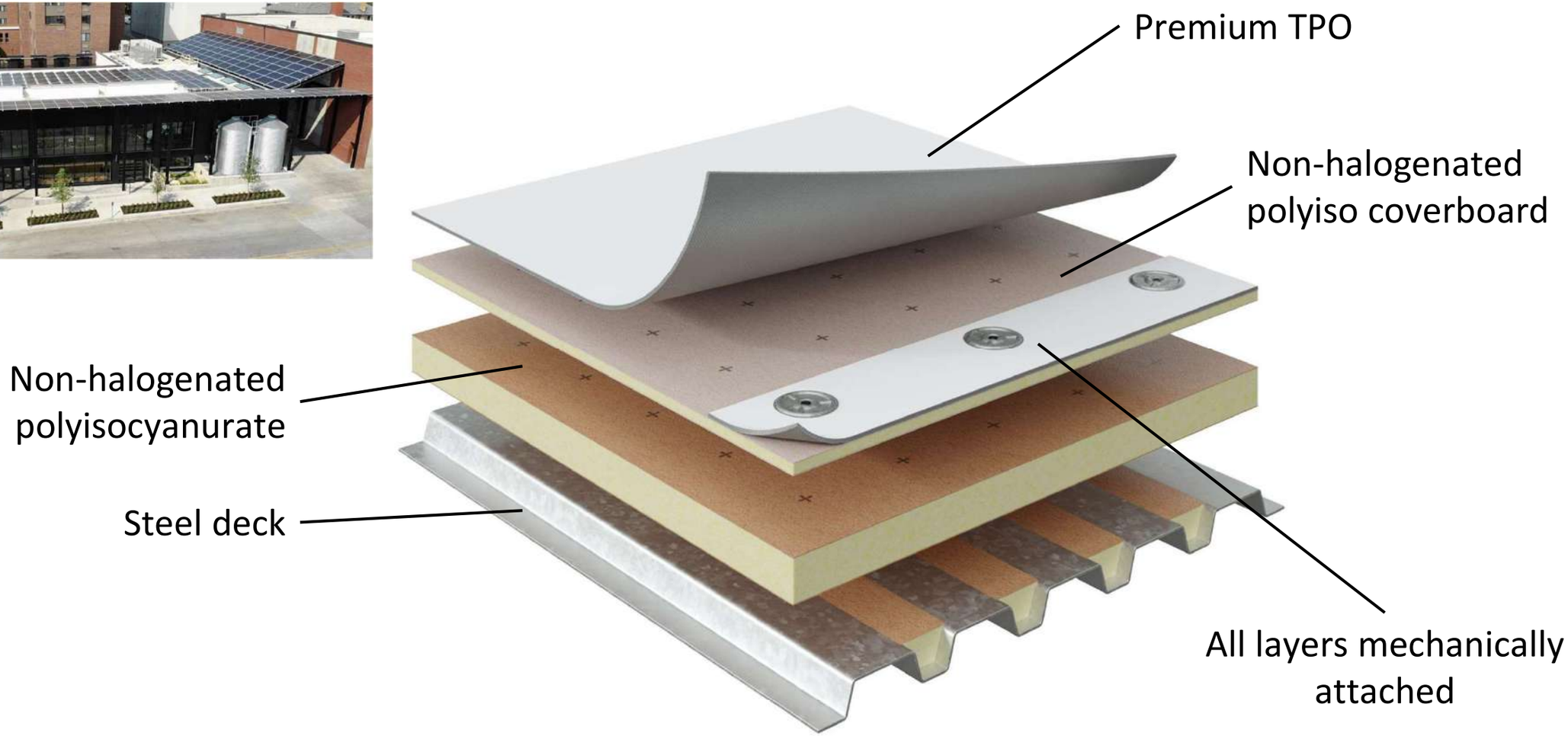
Coping caps of parapet walls



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

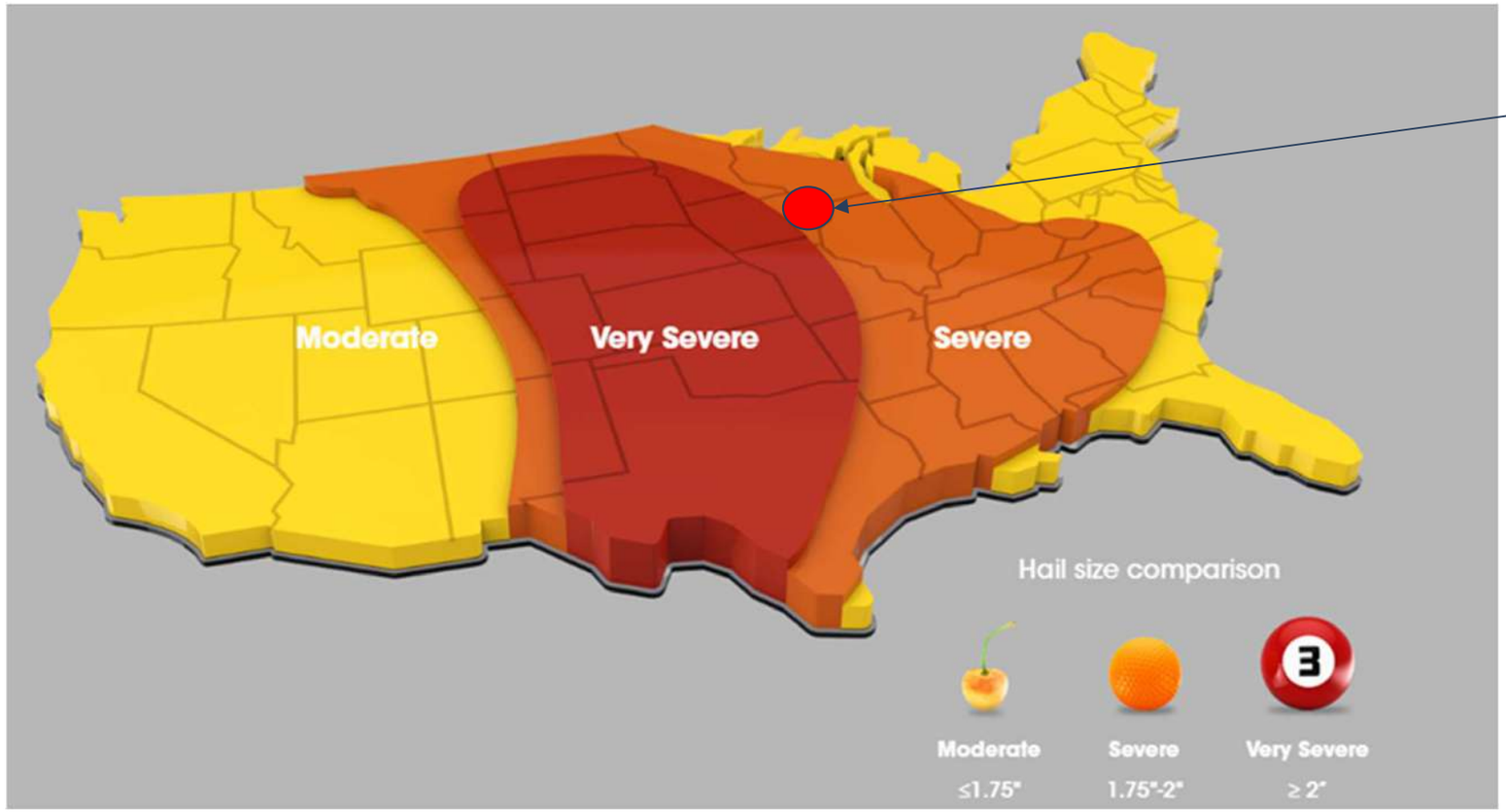
Stanley Center, Muscatine, IA

Stanley Center, Muscatine, IA



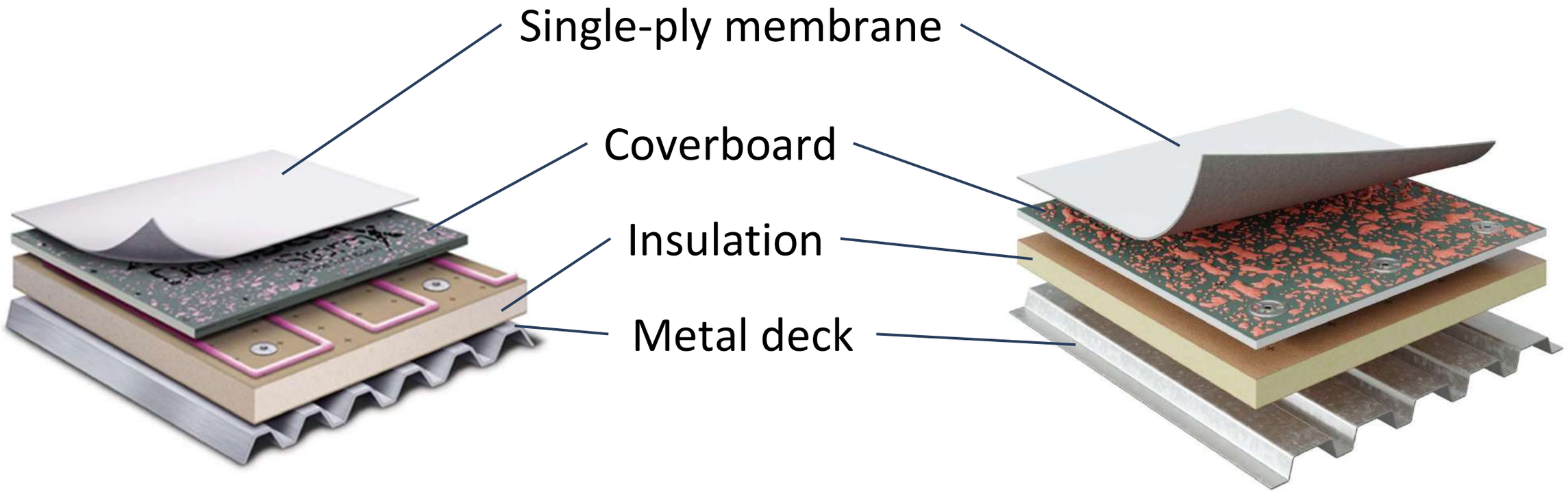
What if
the building was in a very severe hail zone?

FM

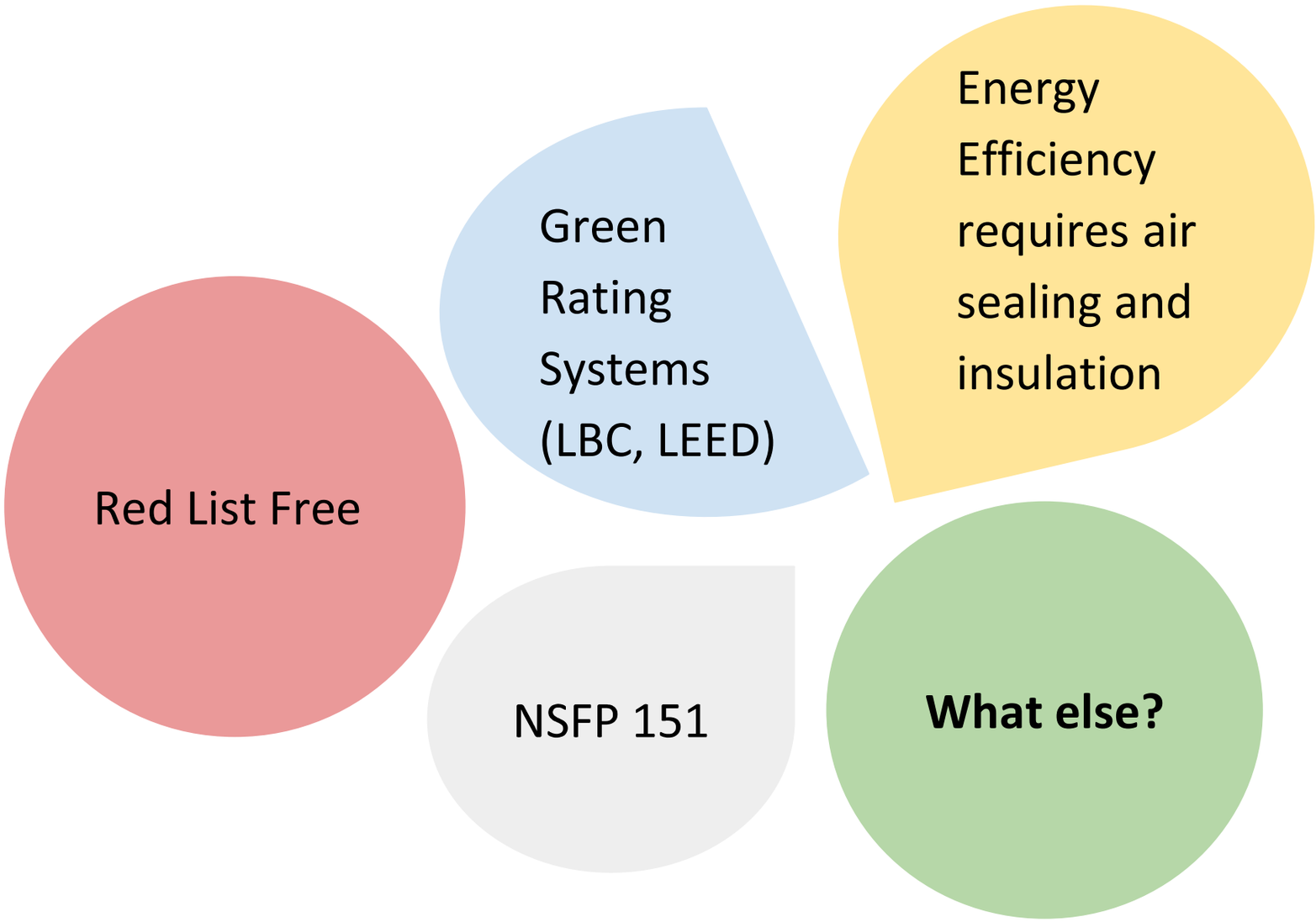


Moderate Hail Zone	**Severe Hail Zone**	**Very Severe Hail Zone**
based on an equivalent hail size of ≤ 1.75” (44mm) over a 15-year return period	based on an equivalent hail size of > 1.75” (44mm) and ≤ 2” over a 15-year return period	based on an equivalent hail size of > 2” (51mm) over a 15-year return period

Coverboards



What if
sustainability is a priority?


Red List Free
Green Rating Systems (LBC, LEED)
Energy Efficiency requires air sealing and insulation
NSFP 151
What else?

Sustainability - Third-Party Certifications

Declare.

EnergyGuard™ NH HD Polyiso
GAF

Final Assembly: Statesboro, Georgia, USA; Cedar City, Utah, USA; Gainesville, Texas, USA
Life Expectancy: 25 Year(s)
End of Life Options: Salvageable/Reusable in its Entirety, Recyclable, Landfill

Ingredients:

Facer: Limestone; Acrylic Polymer; Glass Fiber; **Foam:** Polyisocyanurate Foam; **Blowing Agent:** Iso-Pentane; n-Pentane; **Catalyst 1:** Hexanoic acid, 2-ethyl-, potassium salt; **Catalyst 2:** Potassium Acetate; **Catalyst 3:** Pentamethyldiethylenetriamine; **Surfactant:** 1,2-Propanediol, Polymer with Ethyloxirane and Oxirane, Potassium Salt

Living Building Challenge Criteria: Compliant

I-13 Red List:
■ LBC Red List Free
□ LBC Red List Approved
□ Declared

% Disclosed: 100% at 100ppm
VOC Content: Not Applicable

I-10 Interior Performance: Not Applicable
I-14 Responsible Sourcing: Not Applicable

GAF-0004
EXP. 01 APR 2022
Original Issue Date: 2017

INTERNATIONAL LIVING FUTURE INSTITUTE™ living-futures.org/declare

A SUSTAINABLE SOLUTION
GreenCircle CERTIFIED
RECYCLED CONTENT ®

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

UL
GREENGUARD
PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818
GOLD

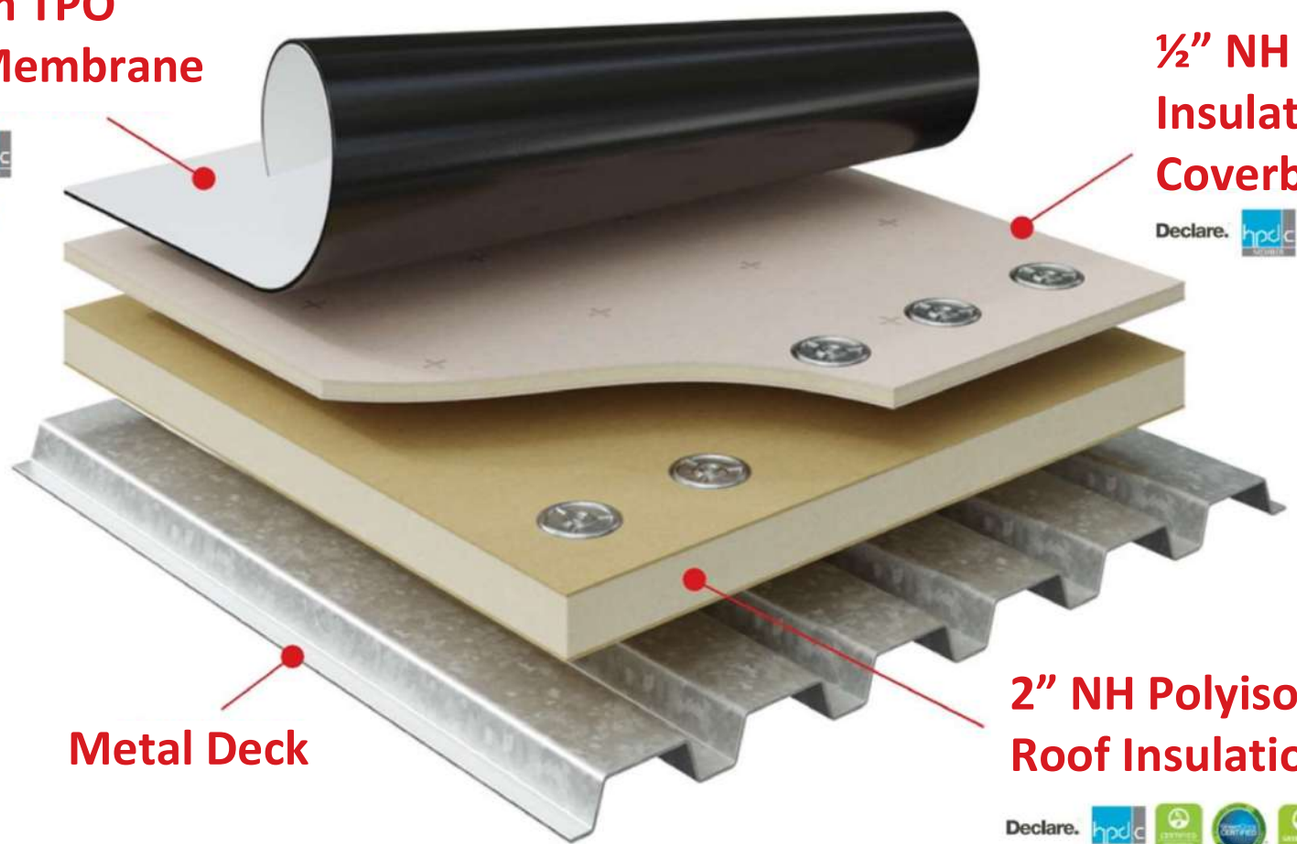
Greenguard GOLD certification* denotes products that give off only low levels of volatile organic compounds (VOCs).

NSF®

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

Sustainability

Premium TPO
60-mil Membrane



½” NH HD Polyiso
Insulation
Coverboard

2” NH Polyiso
Roof Insulation

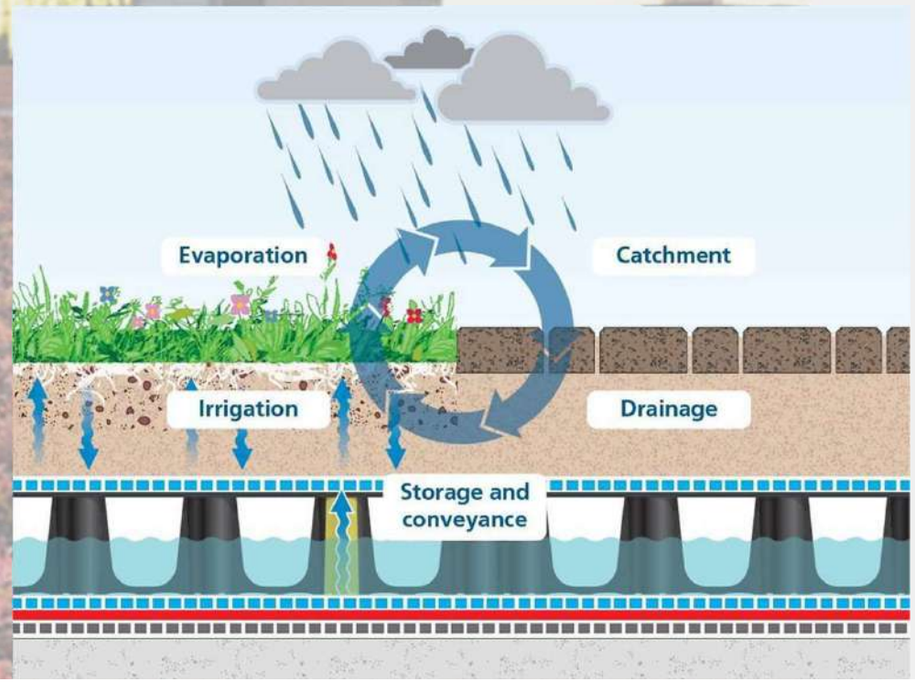
Metal Deck

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

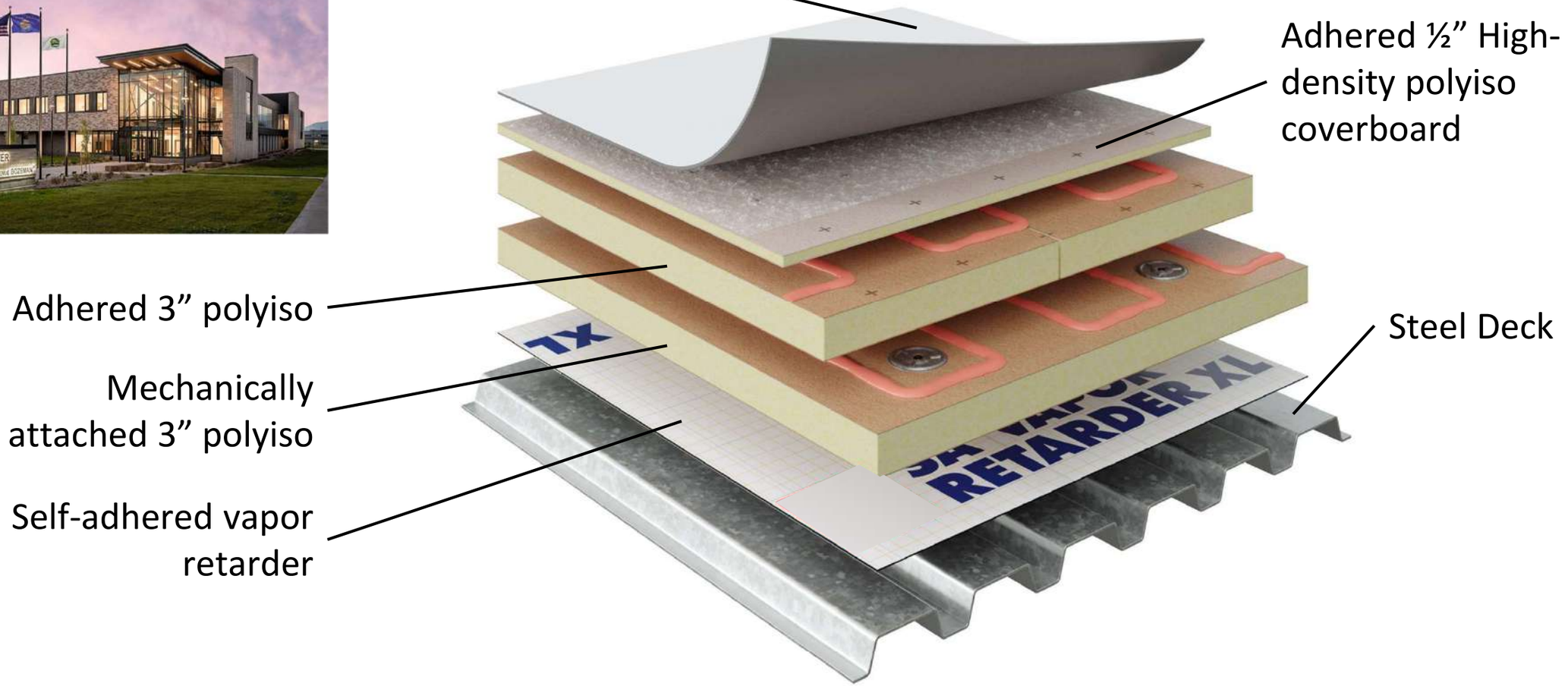
Extensive Vegetative Roof



Possible Water Retention or Detention

Bozeman Public Safety Center, Bozeman, MT

Bozeman Public Safety Center, Bozeman, MT



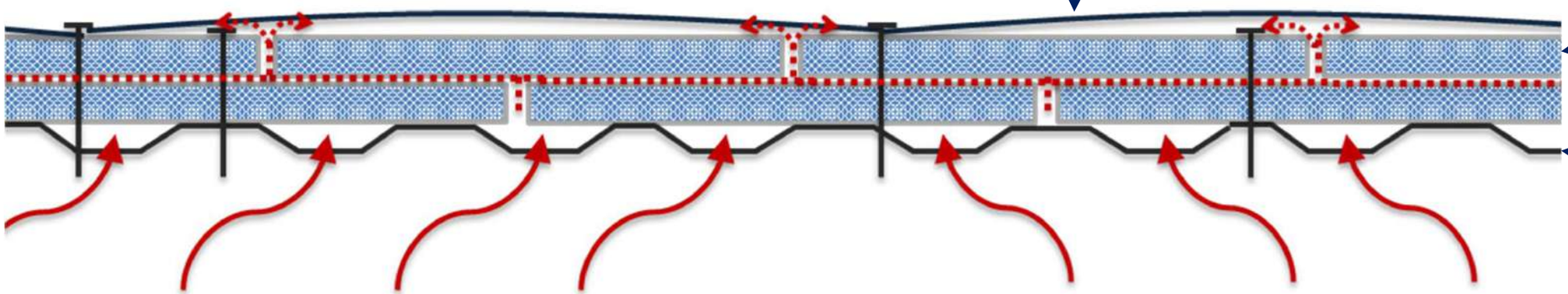
What if
adhesives could not be used?

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

Slide 39

3 Add condensation under billowing graphic

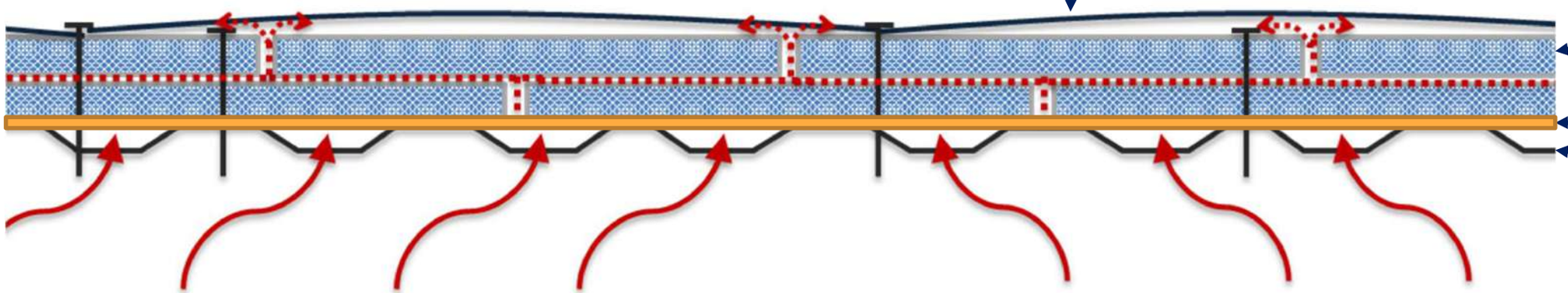
Andrea Watts, 4/19/2024

Outside

Membrane billowing can draw up humid air

Membrane

Insulation, double layers, staggered



Vapor Barrier

Porous Deck

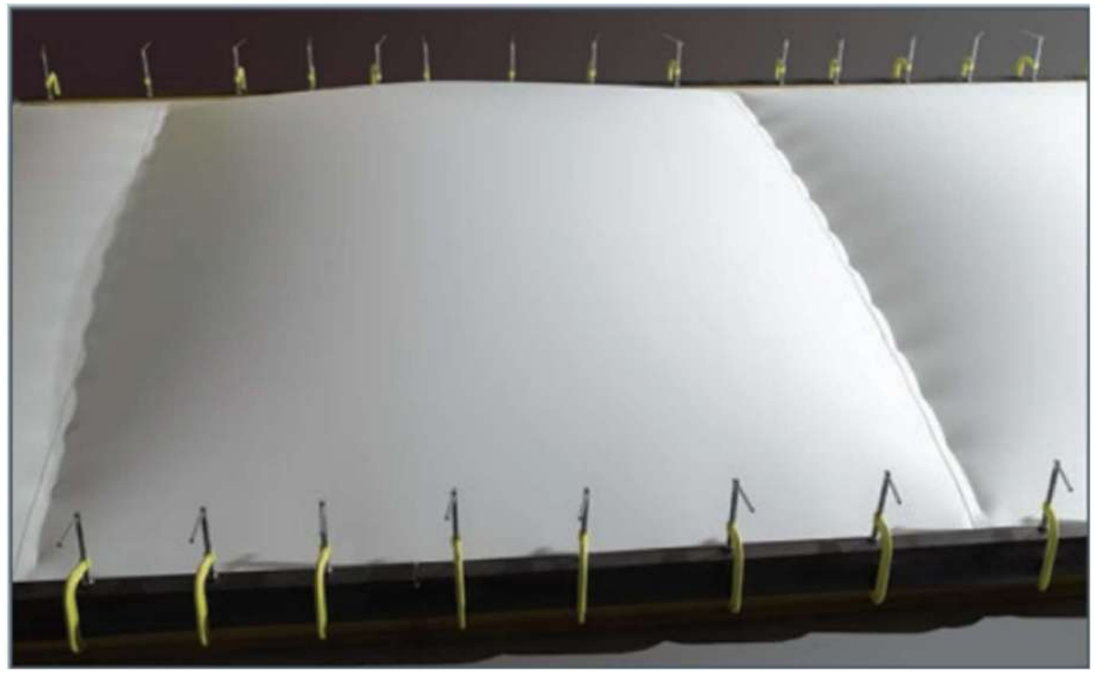
Moist Air

Building Interior

What is the risk?

1. Vapor retarder installed

2. Induction welding vs. traditional fastener options



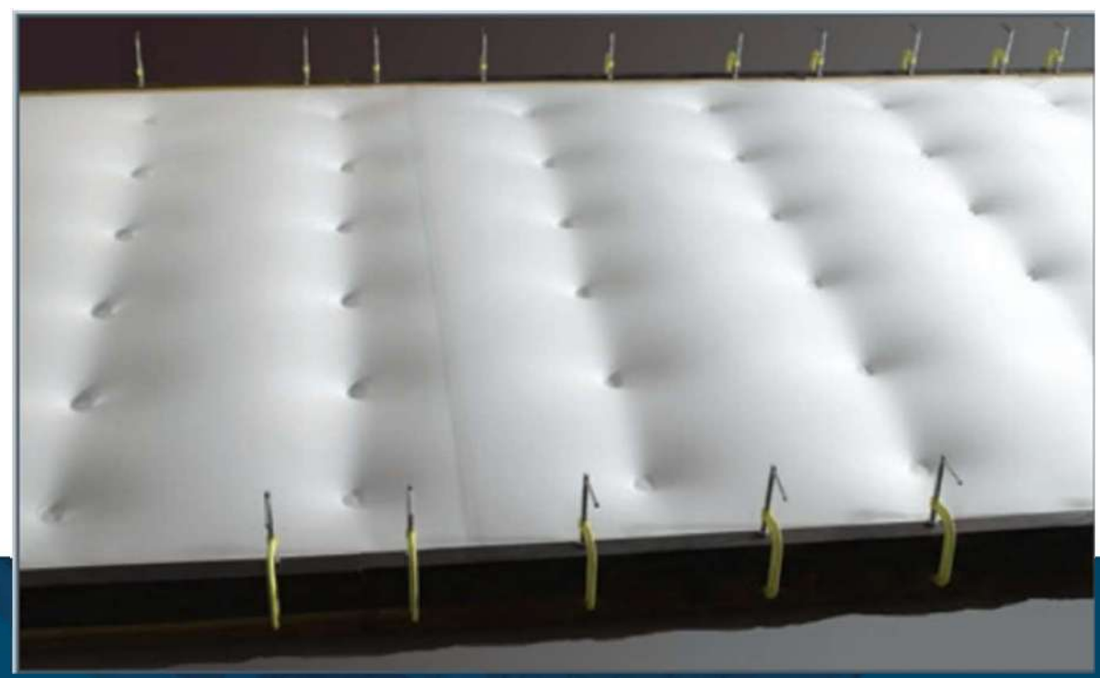


Image Courtesy of OMG Roofing

What is the risk?

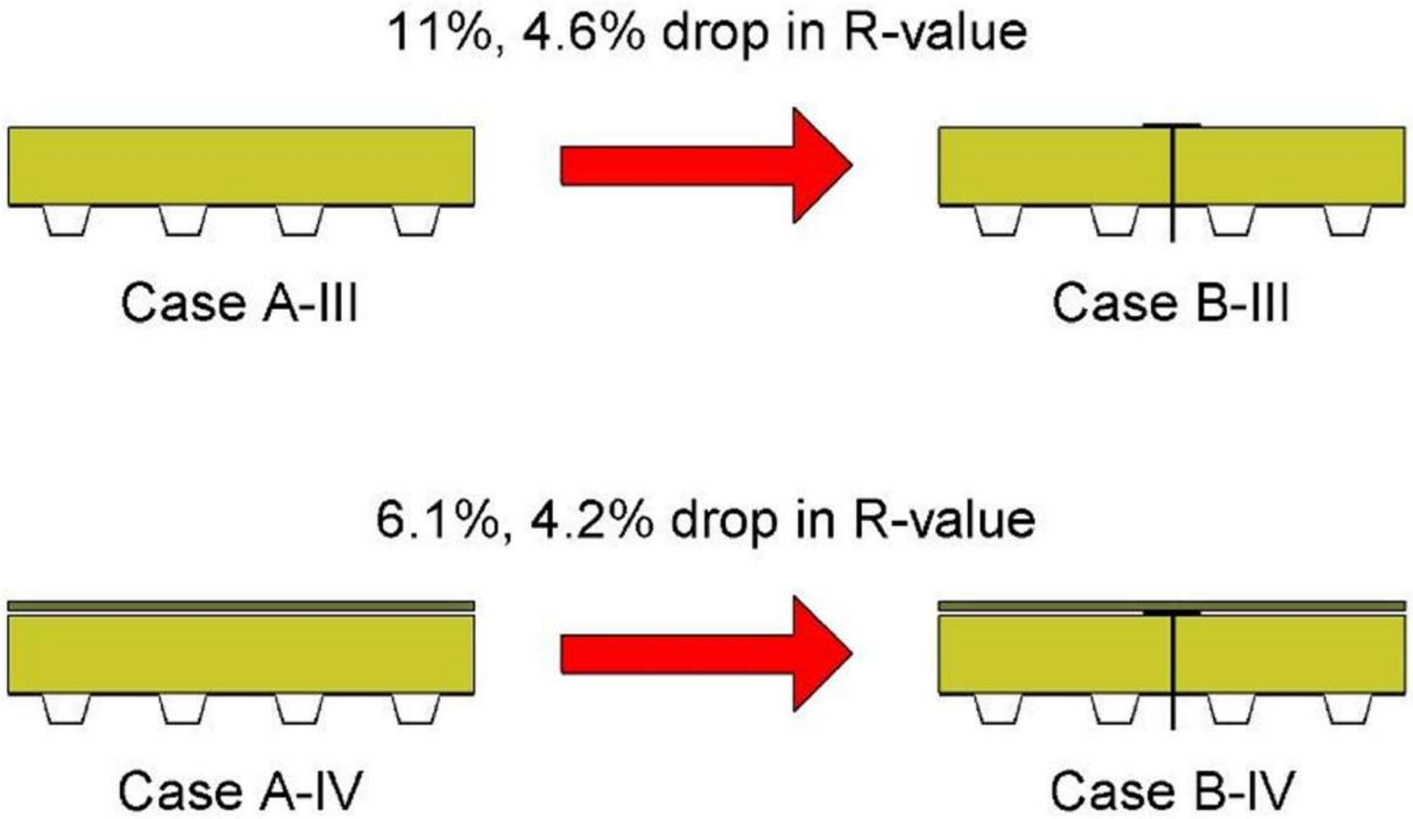
1. Vapor retarder installed

2. Induction welding vs. traditional fastener options

3. Reduced Effective R-value

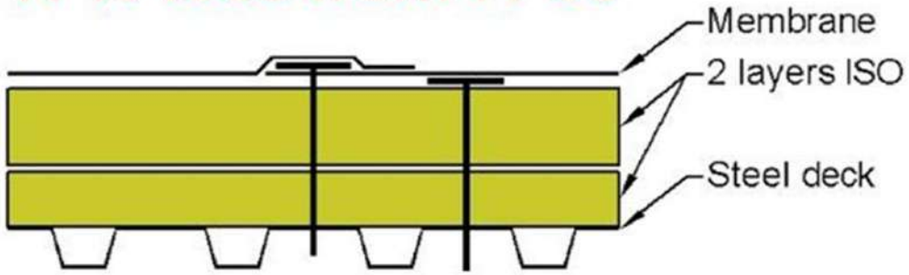
Photo courtesy of Simpson Gumpertz & Heger Inc.

Effective R-Value Impact of Fasteners



Effective R-Value Impact of Fasteners

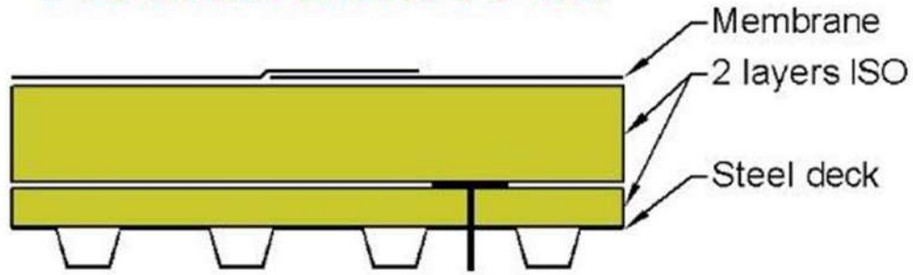
17% loss from R-30



Mechanically attached

R-25

4% loss from R-30

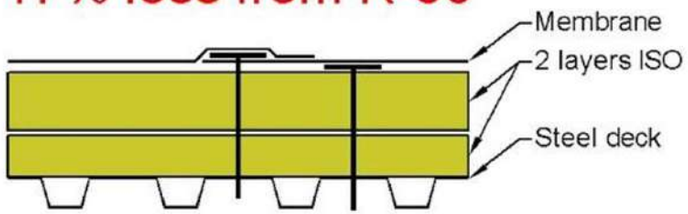


Top layer of polyiso adhered

R-28.7

Effective R-Value Impact of Fasteners

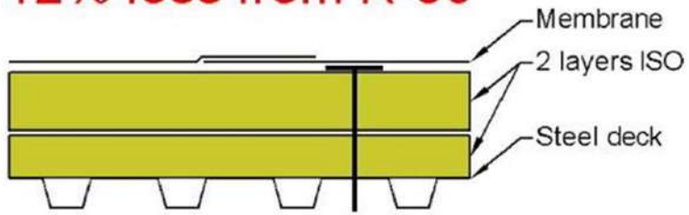
17% loss from R-30



Mechanically attached

R-25

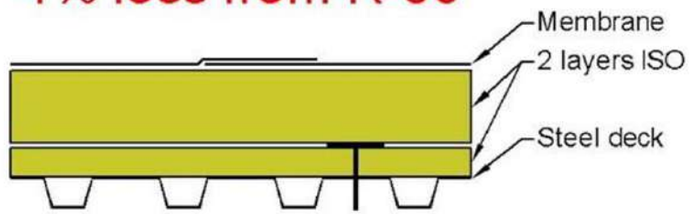
12% loss from R-30



Induction-welded

R-26.5

4% loss from R-30



Top layer of polyiso adhered

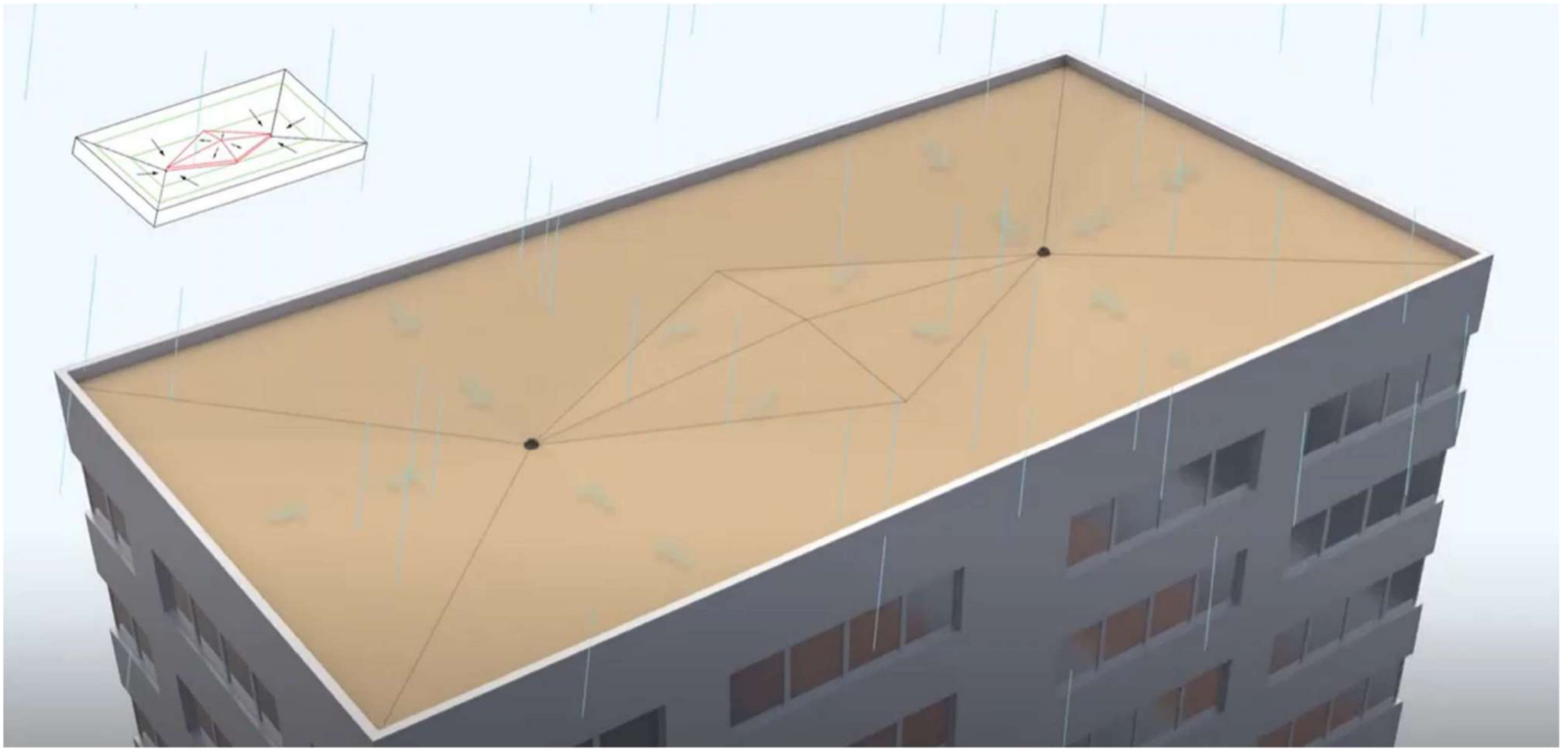
R-28.7

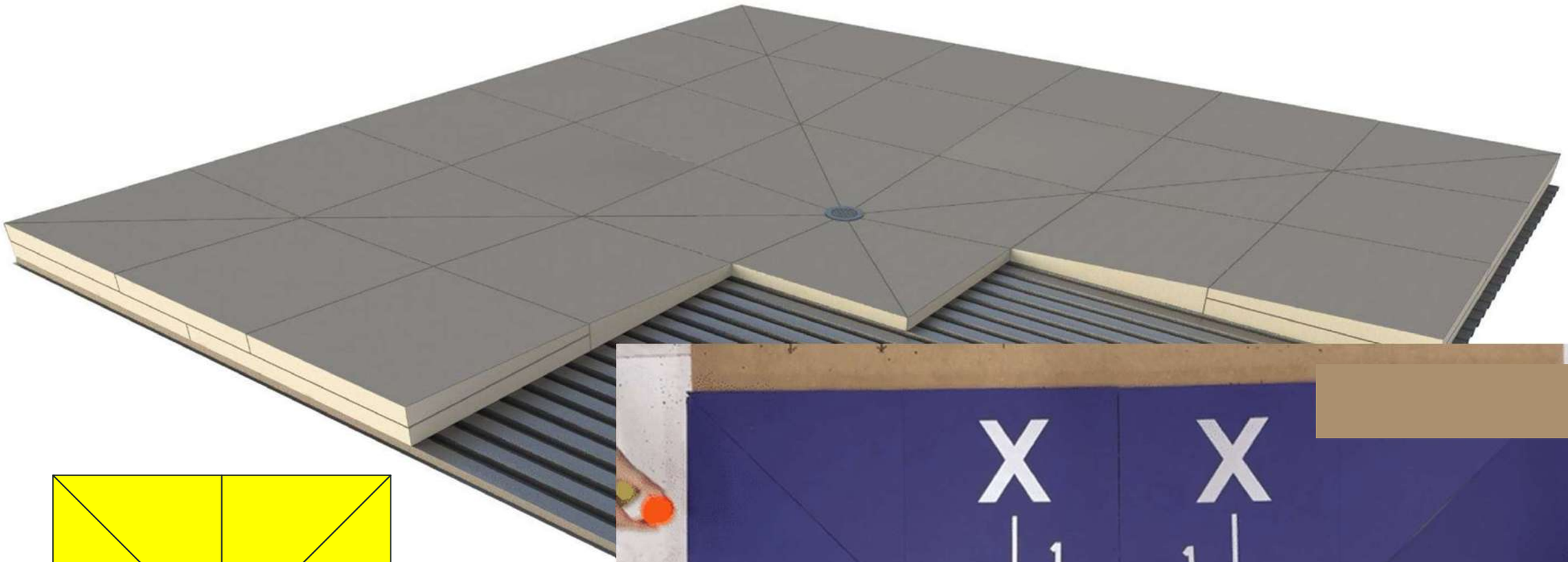
4 insert morph

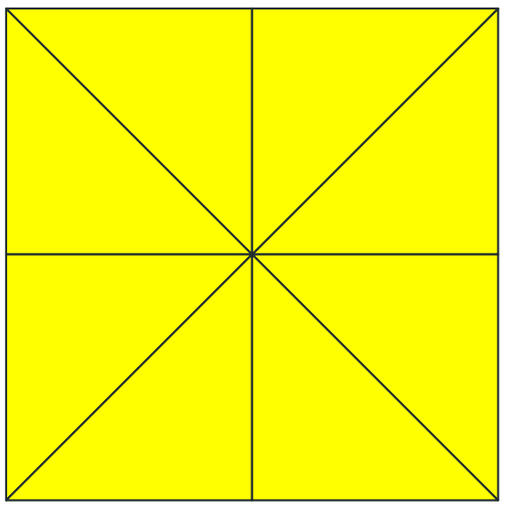
Andrea Watts, 4/11/2024

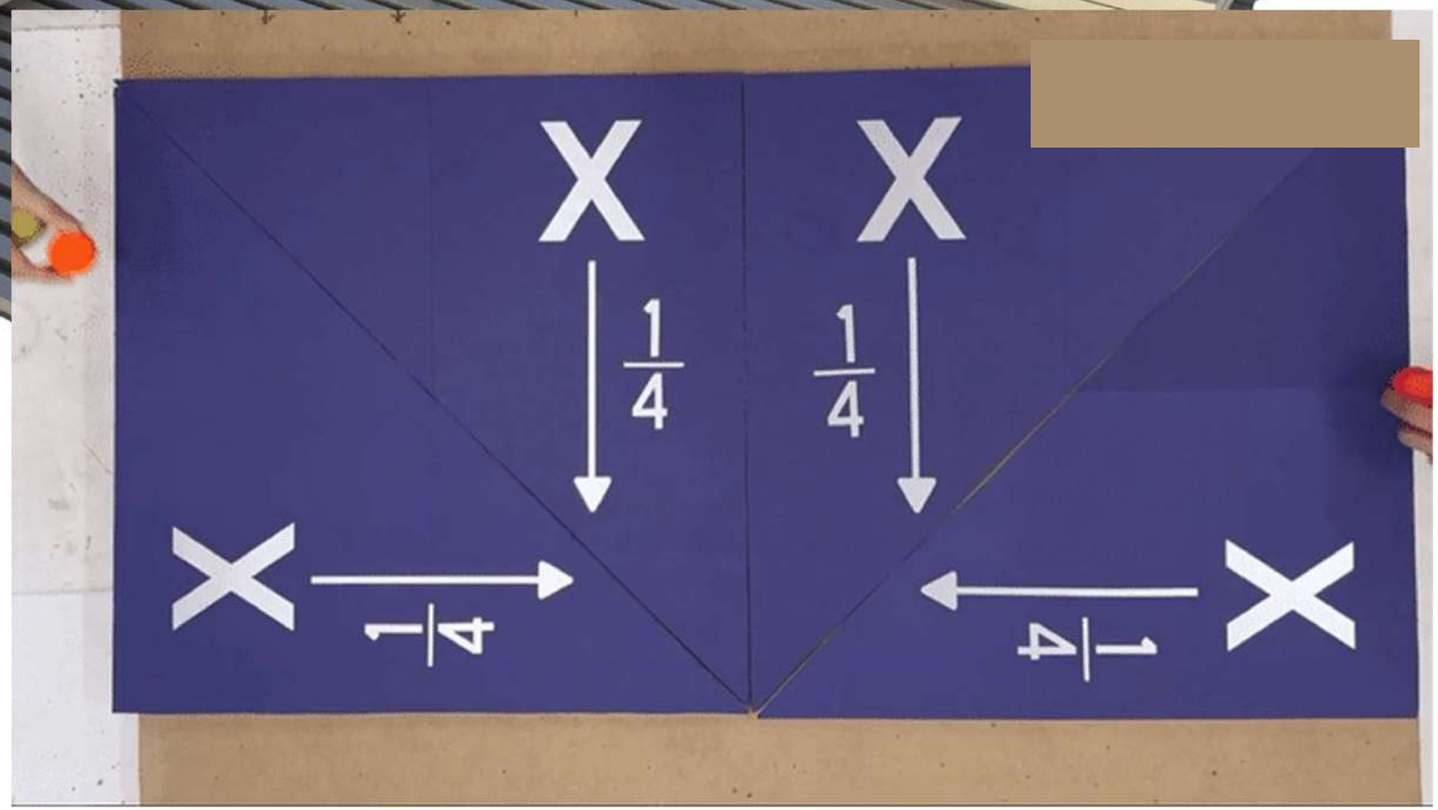
What if
the roof deck had no slope?

Tapered Insulation

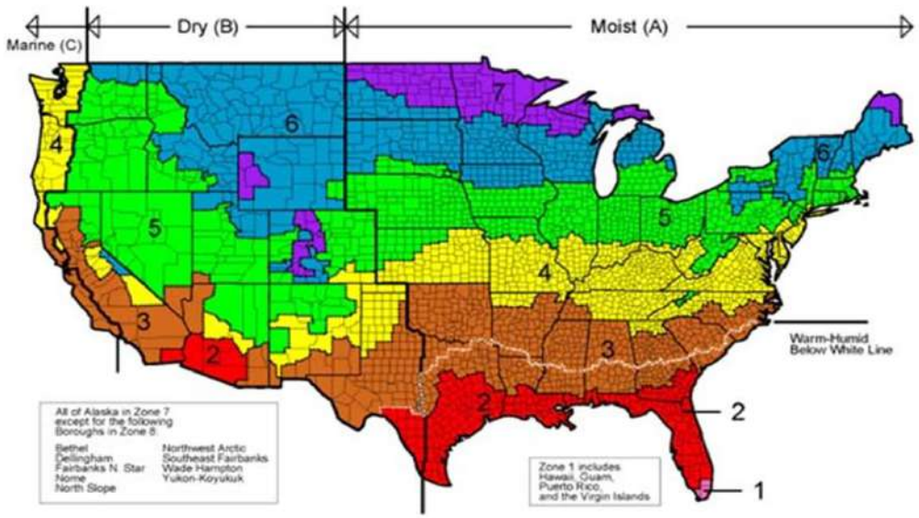







X
1/4
X
1/4
X
1/4
1/4
X

Building Code on Insulation

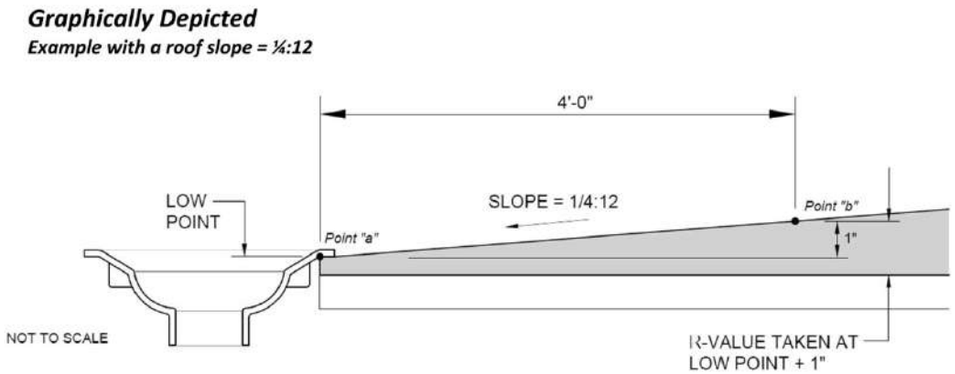


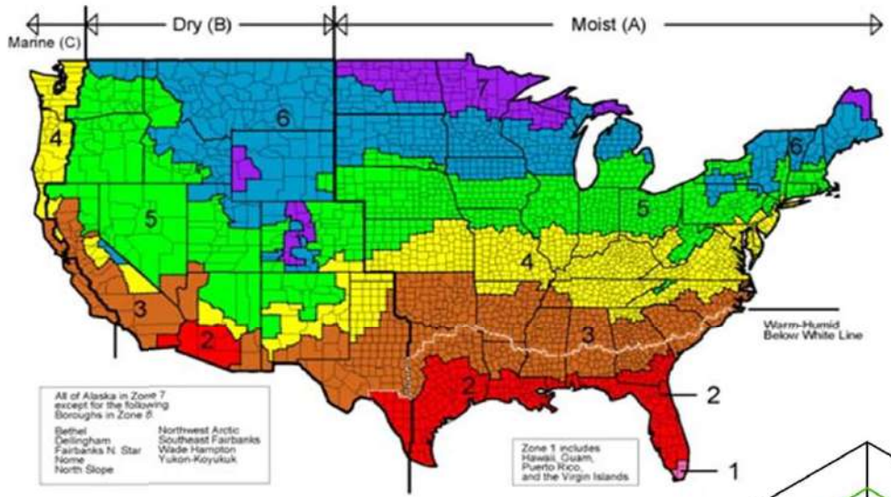
IECC 2021 Table C402.1.3 Opaque Thermal Envelope Insulation Component Minimum Requirements, R-Value Method (Non-R Occupancy)

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

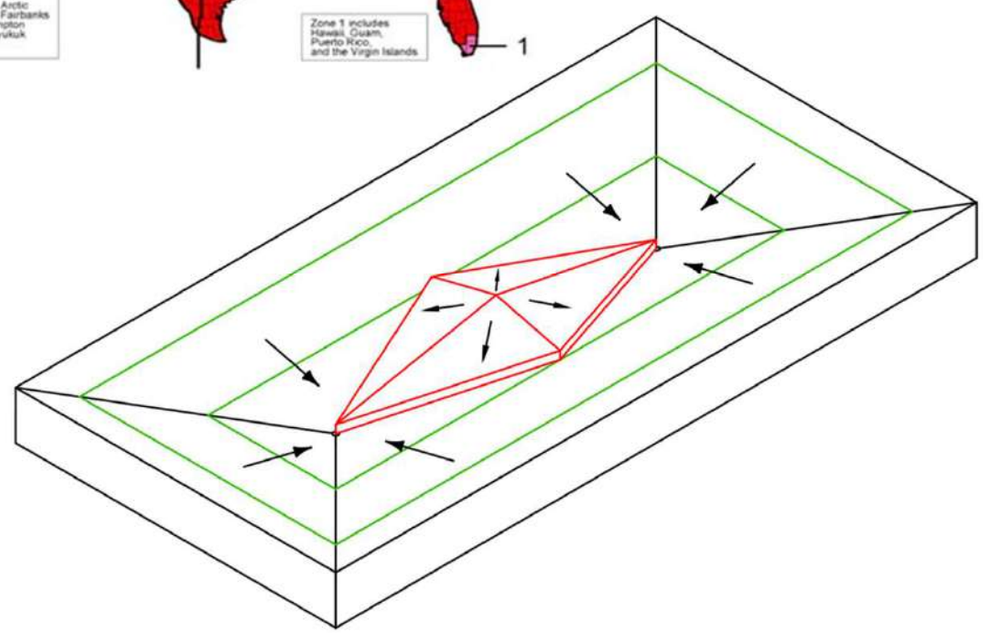
IECC 2015, 2018



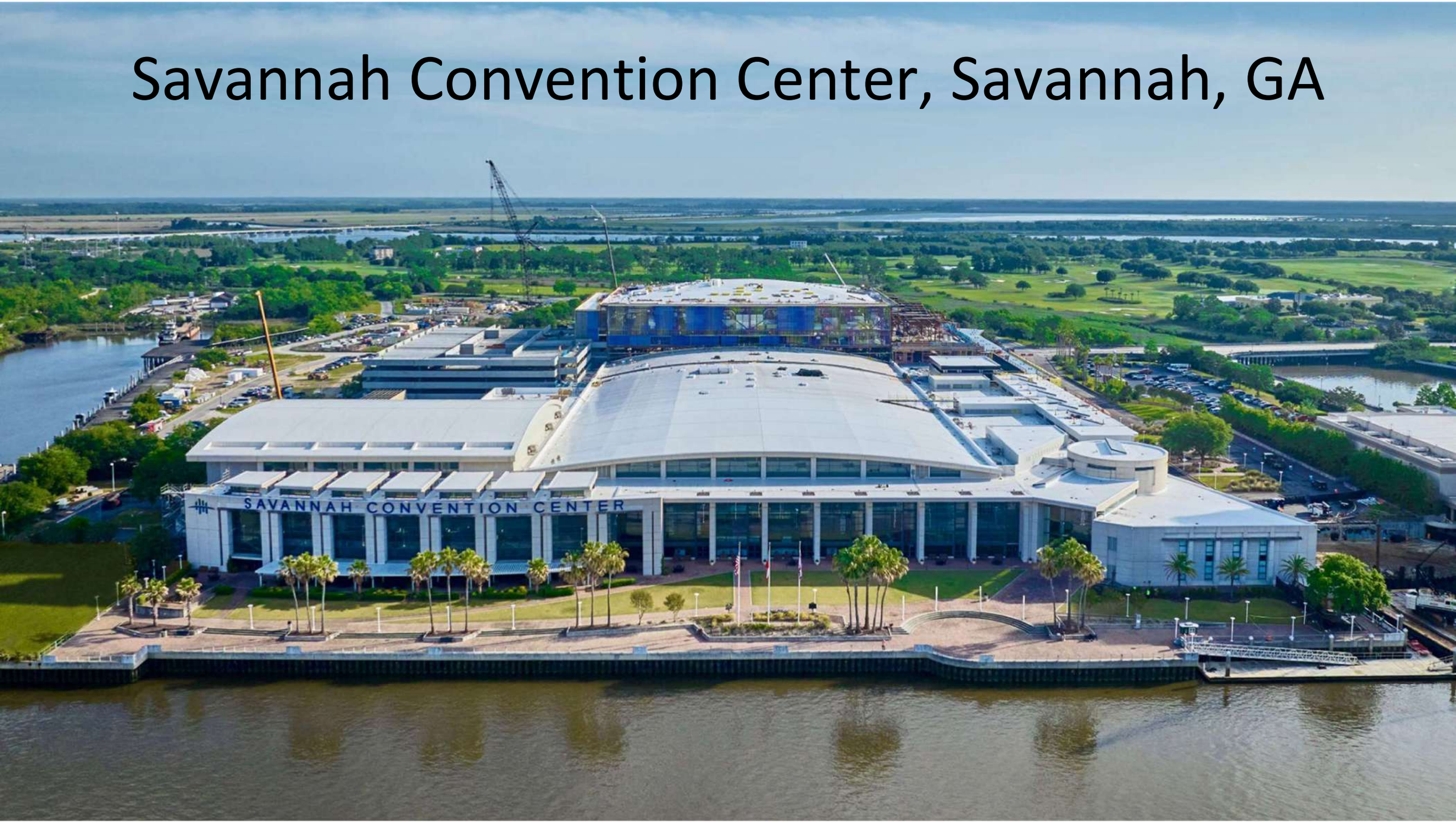


IECC 2021

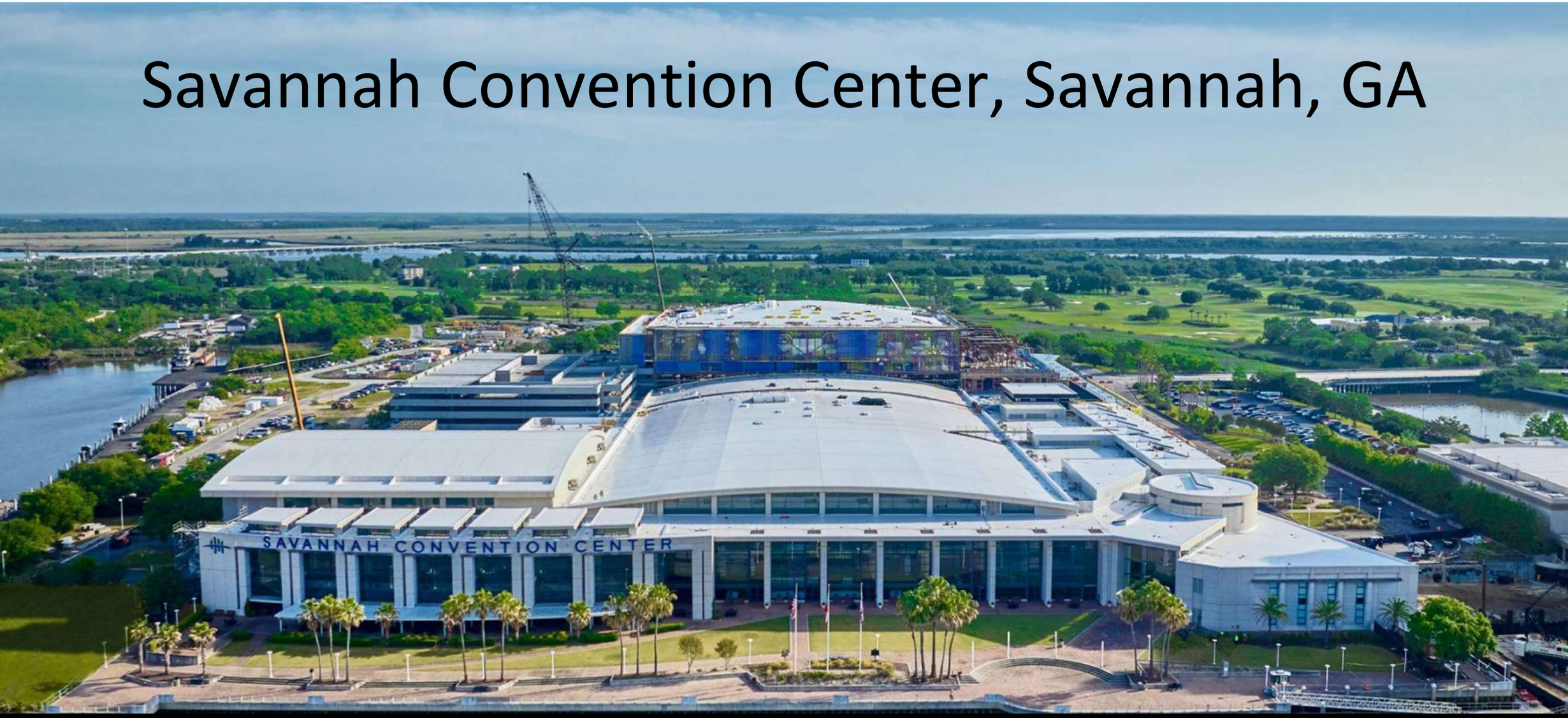
402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a roof/ceiling assembly *R*-value calculation, the sloped roof insulation ***R*-value contribution** to that calculation **shall use the average thickness** in inches (mm) along with the material *R*-value-per-inch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



Savannah Convention Center, Savannah, GA



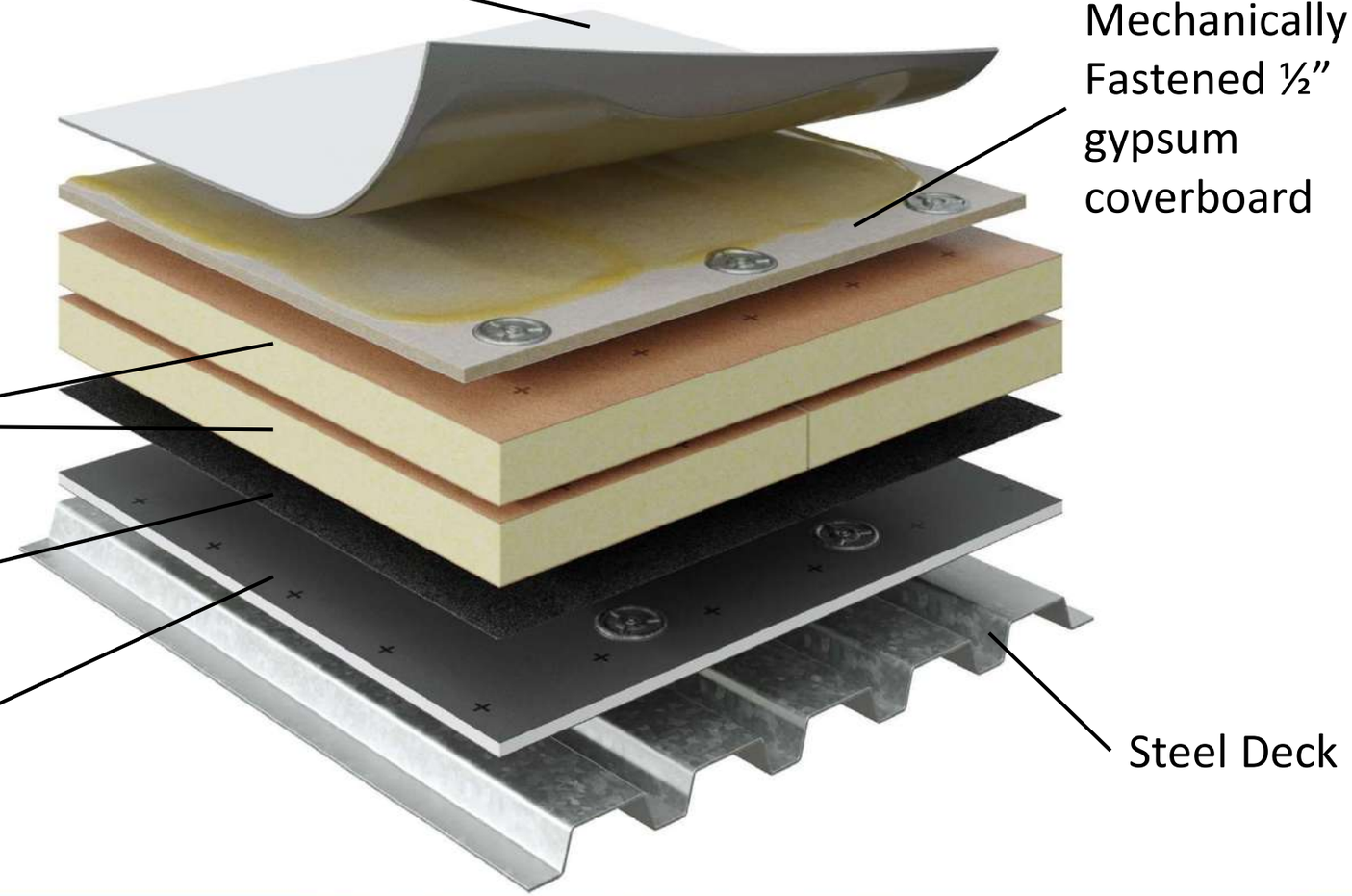
Savannah Convention Center, Savannah, GA



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

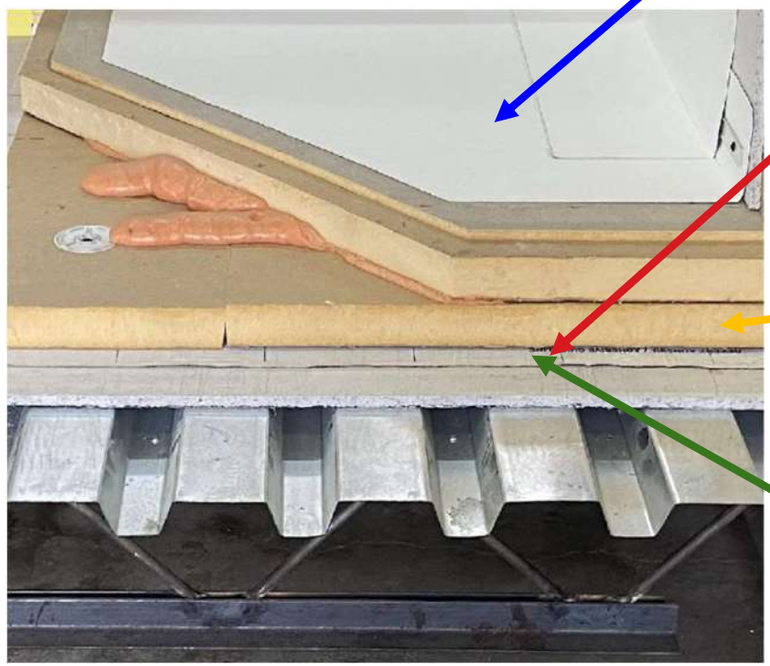
Alexis AuBuchon, Hansen Architects, P.C.

Savannah Convention Center, Savannah, GA



What if
there was no the vapor retarder?

Continuous control layers



Liquid Water

Air

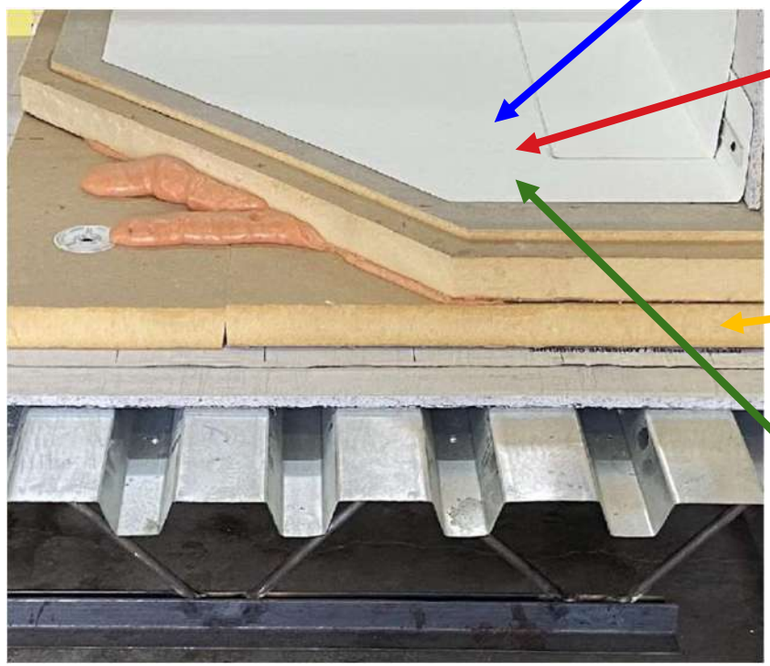
Thermal

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

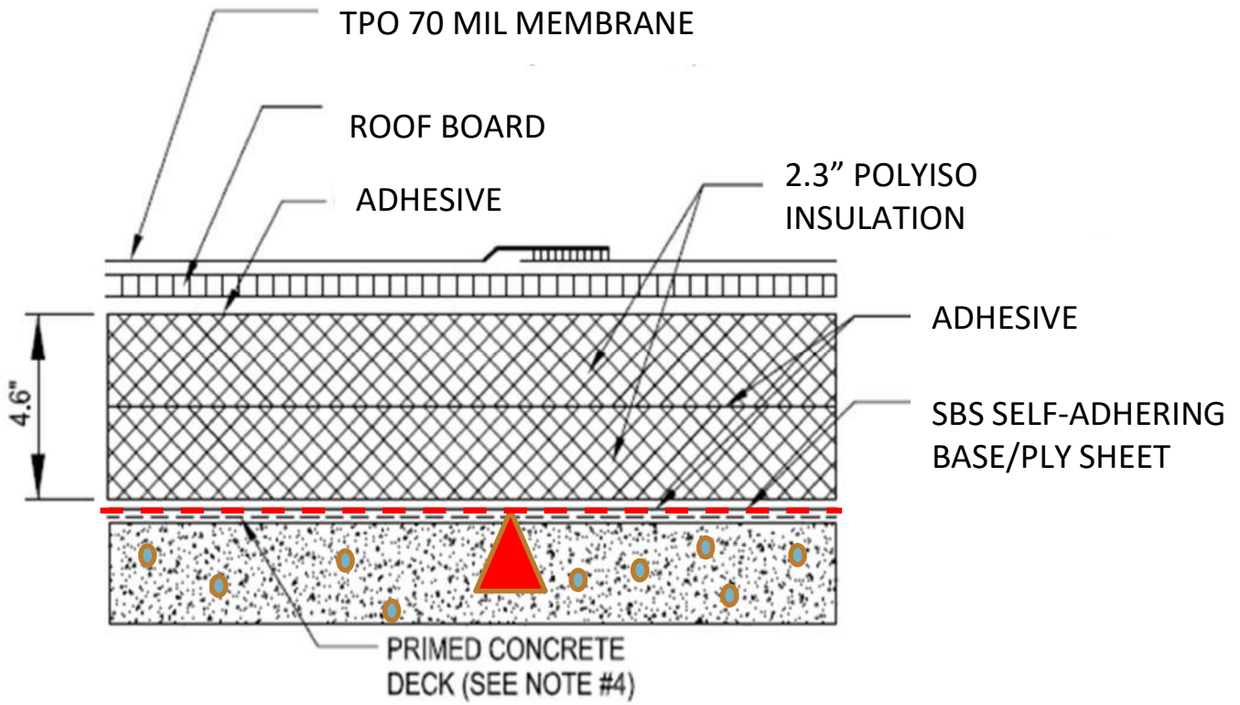
Thermal

Water Vapor


Jay Smith

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

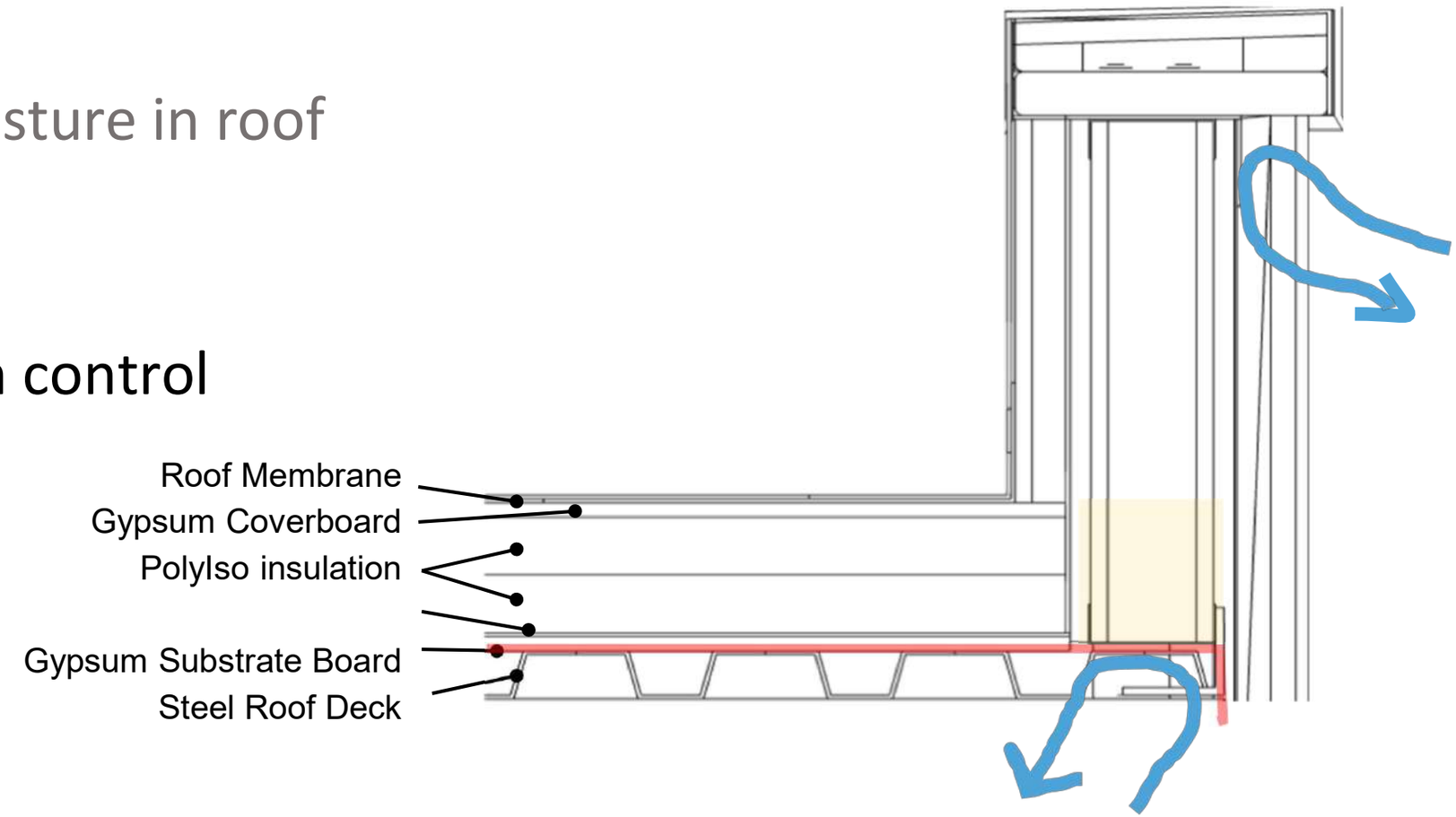
- Minimize moisture in roof assembly



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

- Minimize moisture in roof assembly

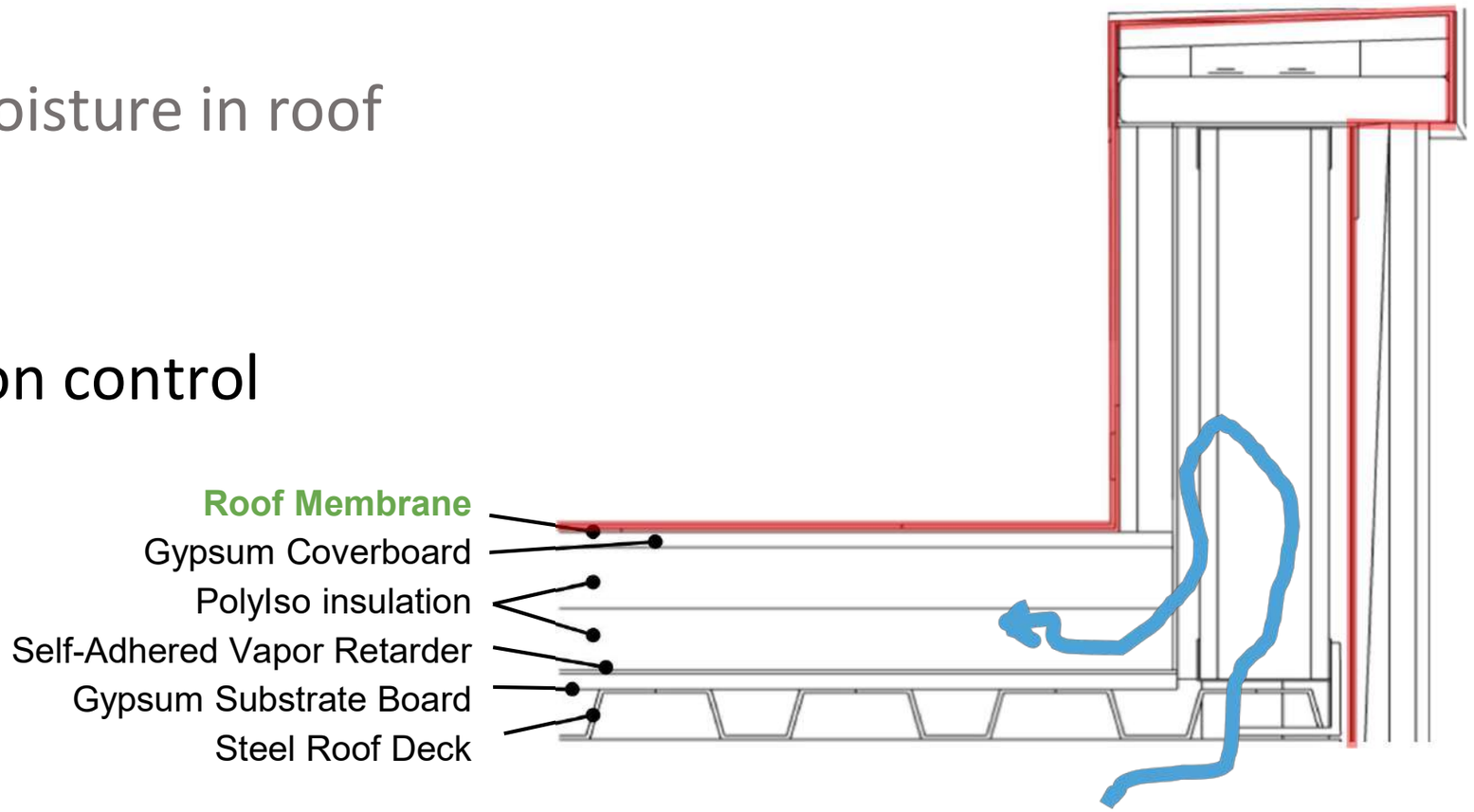
- Condensation control



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

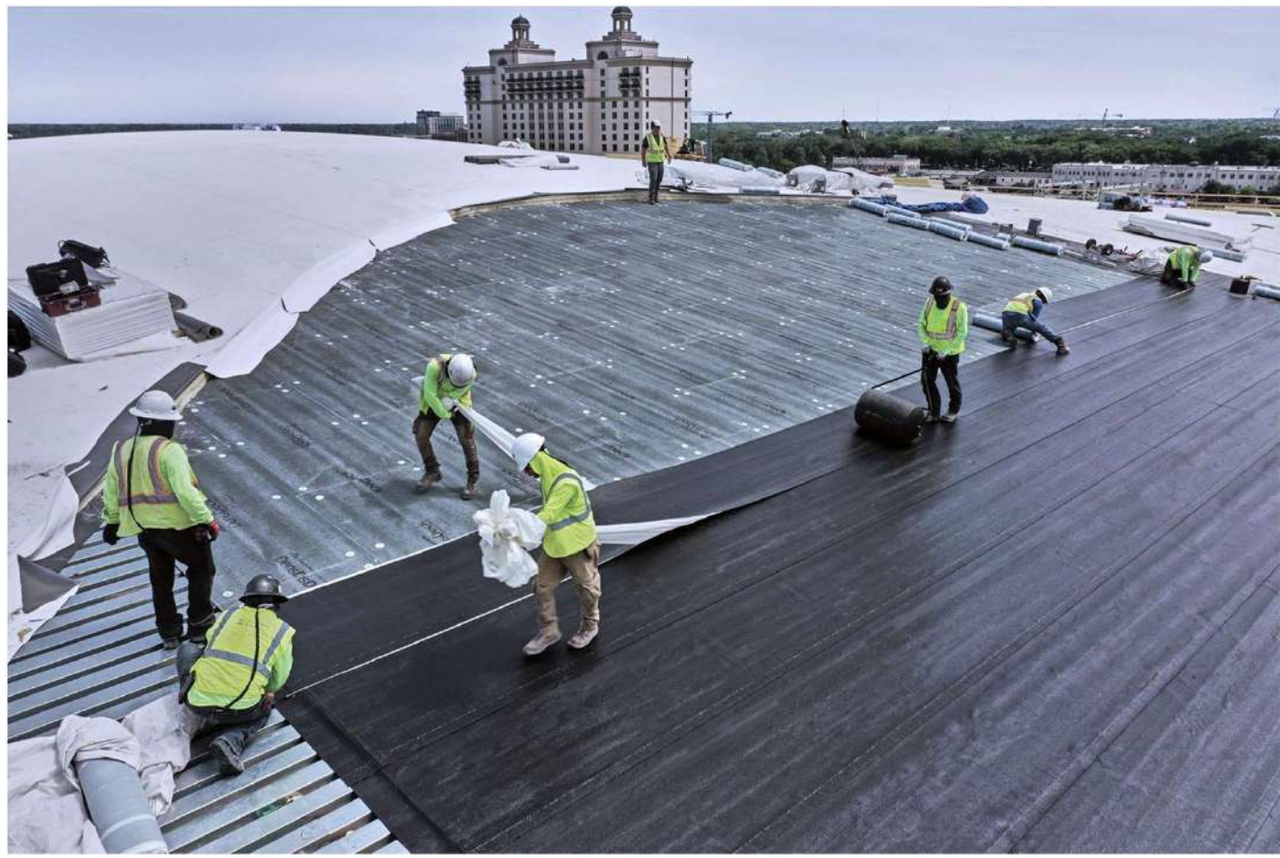
- Minimize moisture in roof assembly

- Condensation control



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

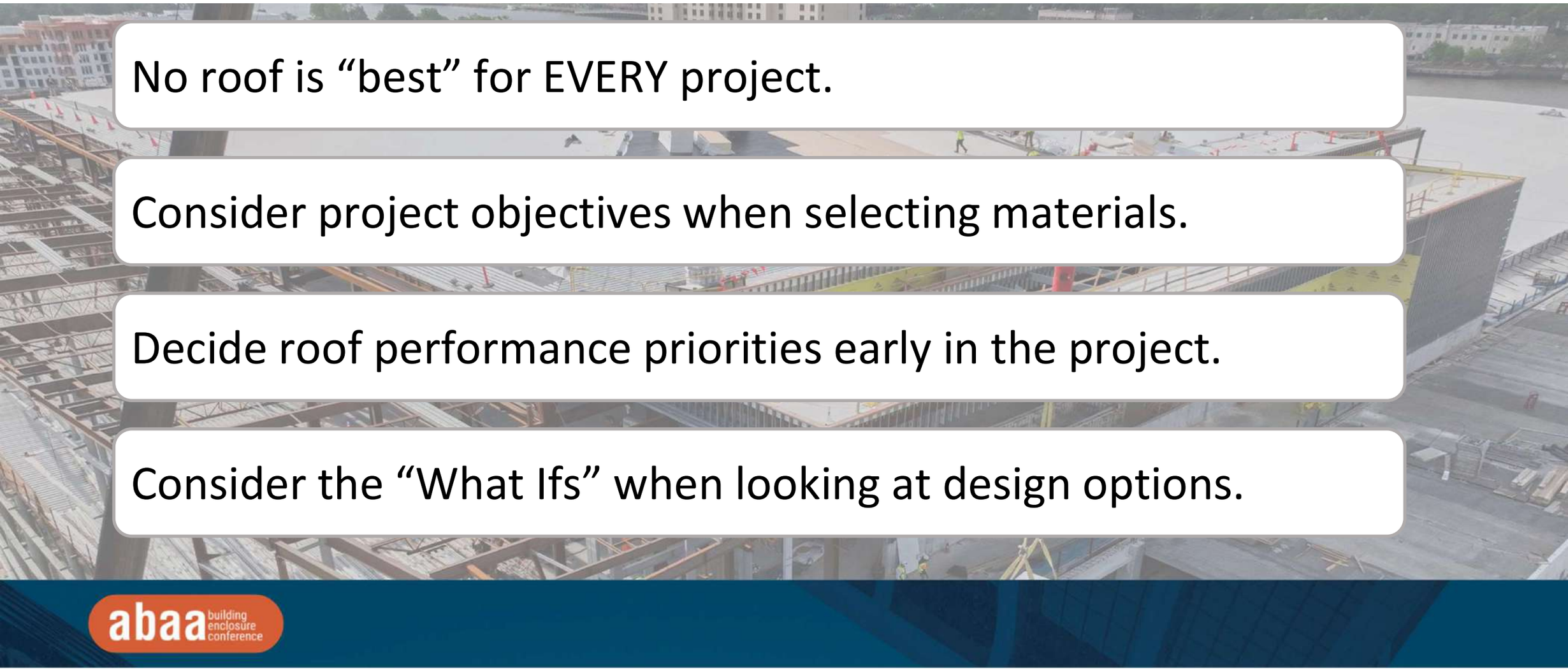
- Minimize moisture in roof assembly
- Condensation control
- Minimize uplift



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.

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THANK YOU!

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