abaa 2025 building enclosure conference

Sink or Swim: Effective Natatorium Envelope Design Thru Case Study

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Q. Jonnie Hasan
Innovative Metals Company (IMETCO)

Sink or Swim: Effective Natatorium Envelope Design Thru Case Study

Participants will gain an understanding of the potential risks associated with roof assembly design over pools and caustic environments. Proper design solutions for controlling moisture damage by controlling air, temperature and vapor will be reviewed. Critical roof assembly components including metal decks, fasteners, air/vapor barriers and insulation will be discussed.

Q. Jonnie Hasan,

M. Eng. (Sustainable Development), Professional Engineer (P.E. Structural), BECxP, CxA+BE

abaa EDUCATION

Qualifications:

- 24 years of experience in commercial construction, design-build, and cladding industry.
- Building envelope designer, WUFI analyst, sustainable smart building engineer.
- Certified Building Envelope Commissioning Provider & Commissioning Authority
- Assist in most cost effective and efficient product application.
- Registered Professional Engineer with numerous patents

Learning Objectives

- Explain how moisture intrudes and affects roof assemblies over pools and caustic environments.
- Summarize the typical materials of construction, and advantages associated with material selection in metal deck assemblies.
- Identify the functional performance-based characteristics of a high-performance roof enclosure system.
- Analyze various preferred natatorium roof assembly details and applications.

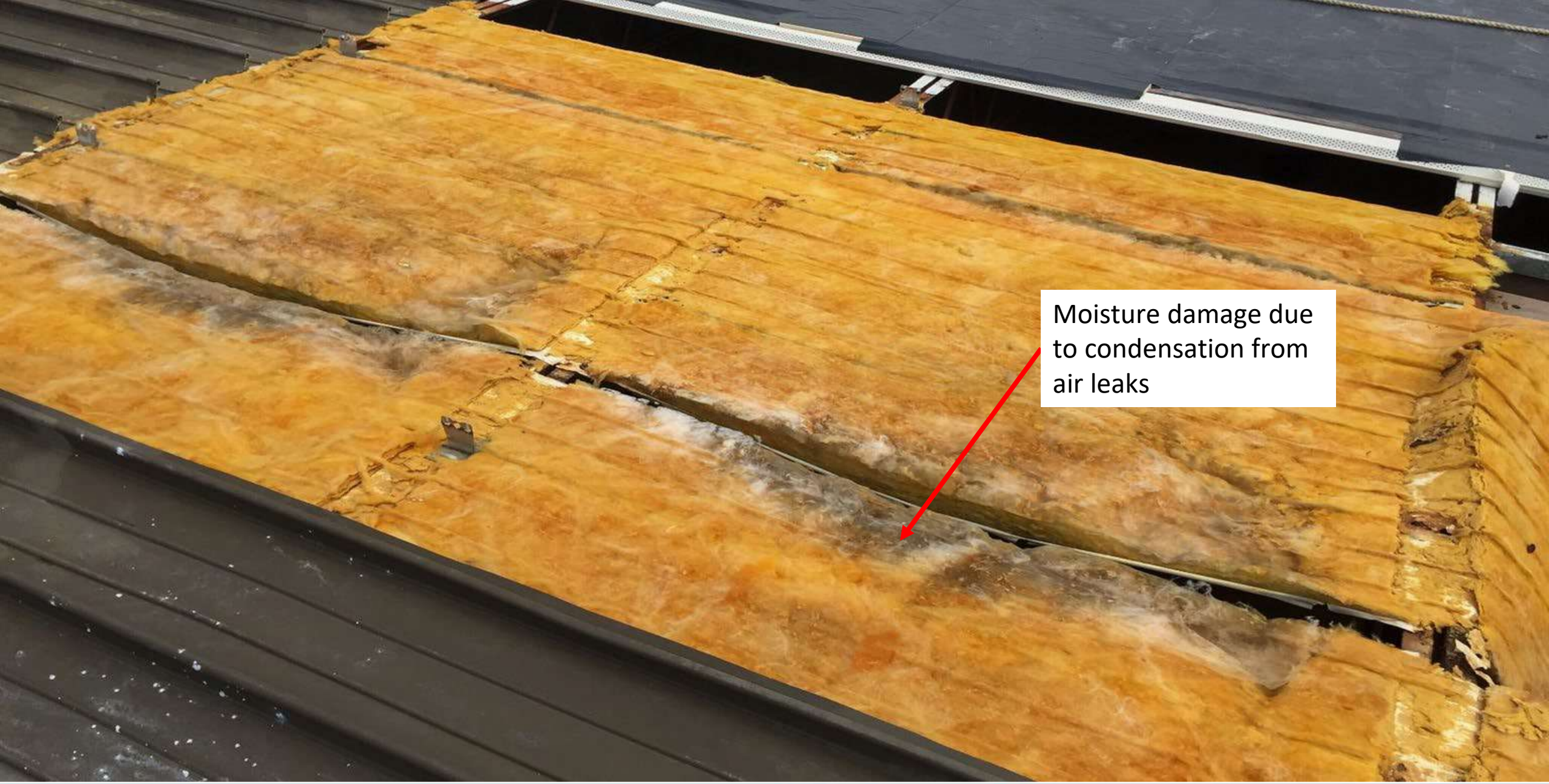
A POOL FULL OF ‘POTENTIAL’ PROBLEMS…

Why Do Roof Enclosures Fail on Natatoriums?

WHY DO ROOFS ON NATATORIUMS FAIL?

Extreme Environment!

- 50 – 60% Constant Relative Humidity
  Pools can contain up to 660,000 gallons of “chlorinated” water
- 85 Degrees Maintained Air Temperature / Low Exterior Temp
- Moisture, Vapor and Heat = 3 Perfect Contributors to Failure


Moisture damage due to condensation from air leaks

WHY DO ROOFS ON NATATORIUMS FAIL?

- Too Many Natatoriums Designed With Standard Materials/Details
- Air Leaks and Thermal Bridging Lead to Condensation
- Condensation Moisture Leads to Premature Corrosion and Failure

CONDENSATION AT WORK

- Air Leaks and Thermal Bridging of the Steel Structure Leads to Severe Corrosion Problems

WHY DO ROOFS ON NATATORIUMS FAIL?

Primary Failure = Condensation Moisture

- The Failure to Control Air and Temperature Exchange Between:
  - Deck
  - Air/Vapor Retarder
  - Insulation
  - Waterproofing Layers

COULD BE HIDDEN IN ROOF ASSEMBLY

- Insulation Can Serve to Collect Moisture
- If the Roof Deck is Concealed, Problems Can Go Unnoticed For Years
- Moisture is Never Friendly When Left Unchecked
- Unchecked Moisture Can Lead to the Concealed Corrosion of Metal Framing Components and Premature Failure of Roof Enclosure Components

COURTESY OF BSC.

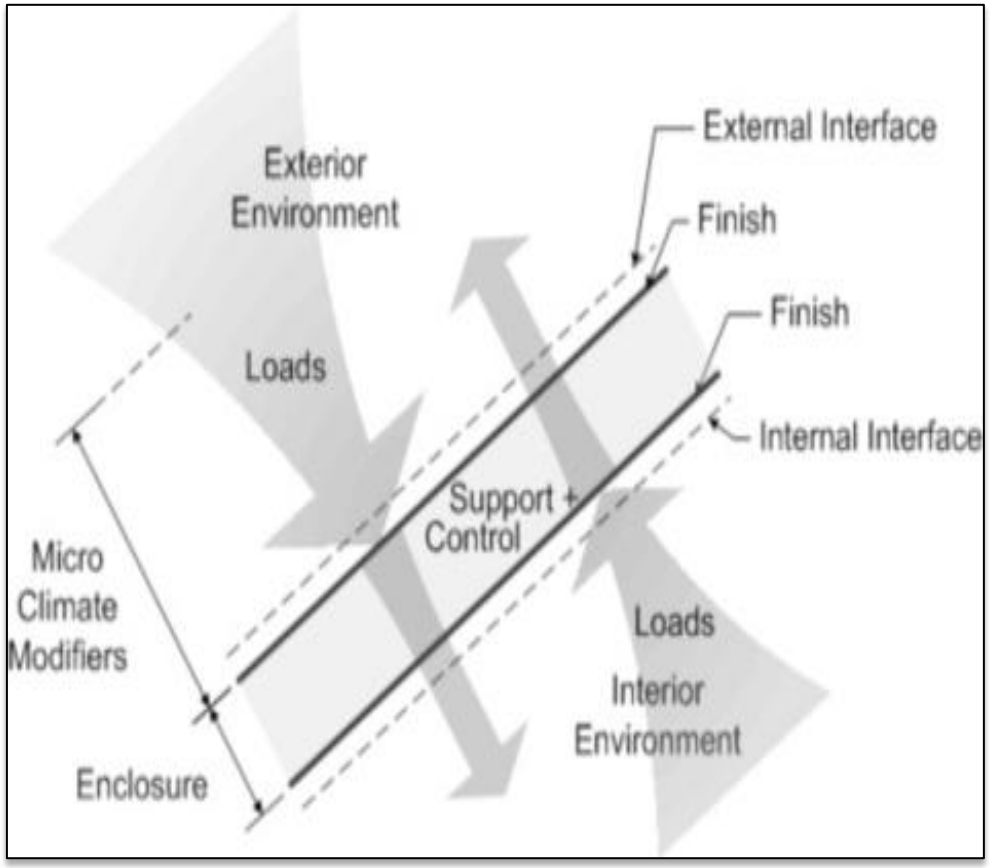
SWEAT THE DETAILS

An Ounce of Prevention Can Help Avoid a Pool Full of Problems…

FUNCTIONS OF THE BUILDING ENCLOSURE

Function of Building Enclosure Layers Can be Grouped into Three Sub-Categories

- **Support Functions:** Handles structural loads from interior, exterior, enclosure, and building itself.
- **Control Functions:** Regulates flow of mass (air, moisture) and energy (heat, sound) between interior and exterior.
- **Finish Functions:** Ensures enclosure surfaces meet aesthetic, durability, and performance standards for both interior and exterior.



Reference: Building Science Corporation – Building Science Digests 018: The Building Enclosure by John Straube (2006)

MOISTURE LOADS & CONTROL

Water Leakage

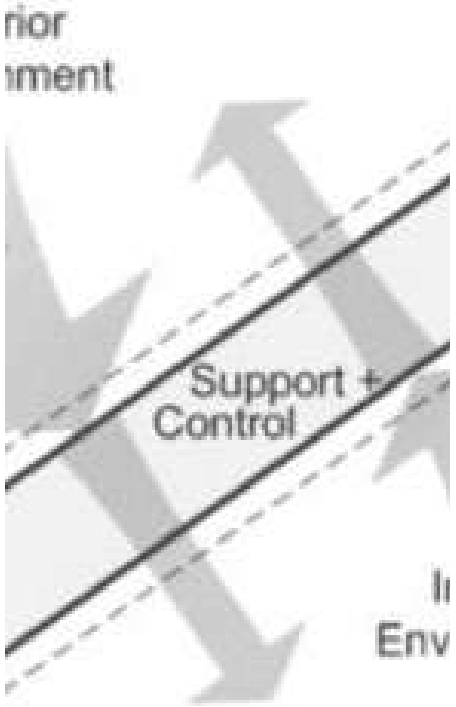
- Water Finds a Path Into Building
- Controlled by Proper Waterproofing

Water Vapor Diffusion

- Movement of Water Vapor Driven by Vapor Pressure Differentials
- Controlled by Vapor Retarder

Airflow

- Main Contributor to Water Vapor and Heat Transport in Buildings
- Controlled by Air Barrier System
- HVAC - High Performance Systems



SWEAT THE DETAILS – To Avoid Sinking

Prevent Corrosion to Exposed Metal With (High Risk)

Galvanized Steel - G90 with High Performance Coating System

Stainless Steel Roof Deck - 316

Corrosive Resistant Fasteners

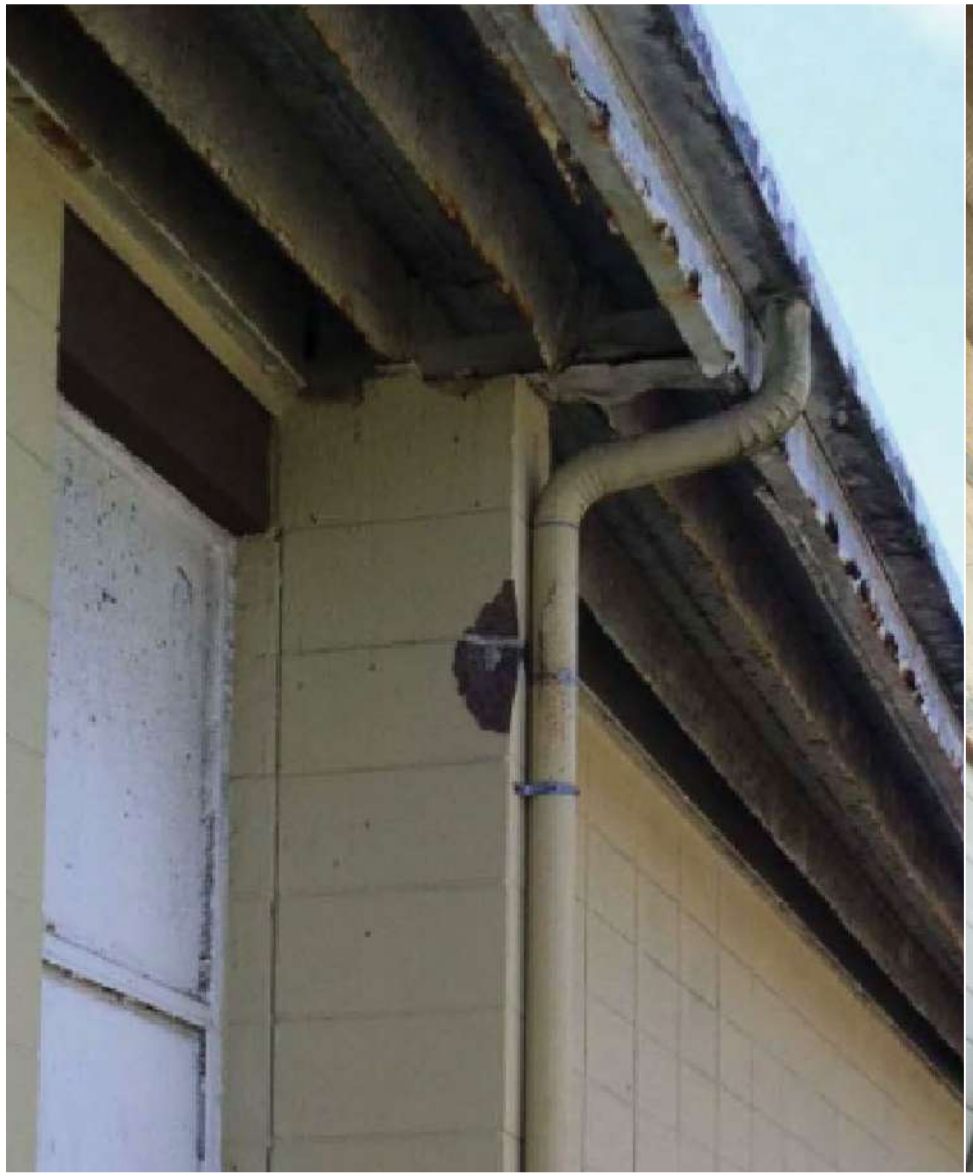
AWB Management

Write Tight Specs for Air/Vapor Barrier System

Proper detailing of vapor barrier at walls and roof openings

Write Tight Specs for high quality “Continuous Insulation”

Balance Mechanical Systems and Air Movement (HVAC)



CORROSION RESISTANT FASTENERS

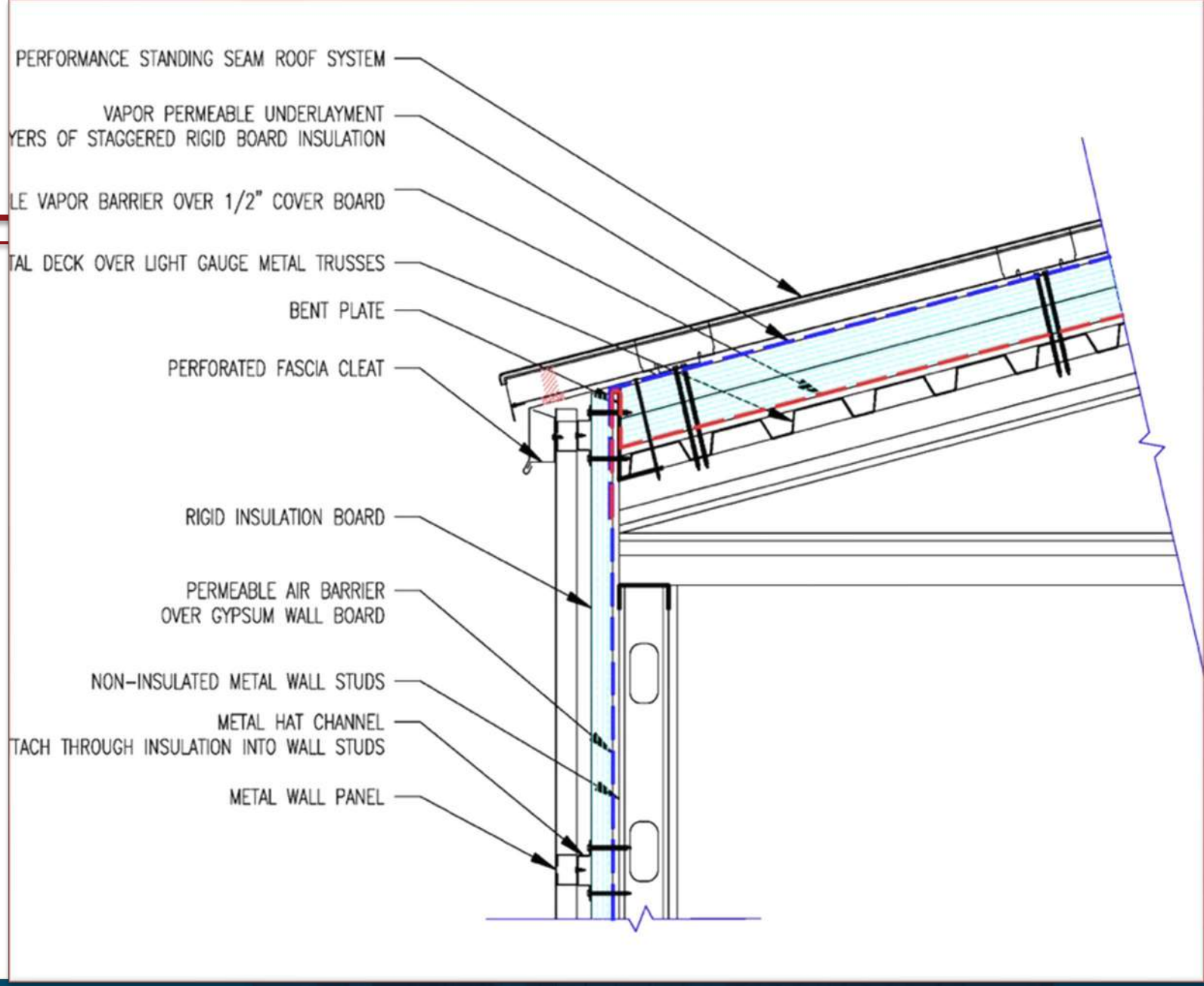
“Sweat the Details”

- Coated Base With Zinc Tip - Rigorously Cycle Tested Against Caustic Exposure
- Self-Drilling
- Exposed to Interior - If Corrosion Happens, it Will be Visible
- Field Coat With Metal Deck After Installation
- Must Have Solid Redundant Base Coating on Threads
- Ceramic Topcoat

AWB Terminations: Roof to Wall

"Sweat the Details"

- Hygro-thermally Design AWB Type
- Show Termination and Requirement for Terminations
- AWB Is a SYSTEM
- What ABOUT The Other Side?



How Do I Close The Rake to Wall Condition @ Metal Deck

A: Do Nothing

B: Engage MFG Expert for proper termination

C: Leave it up to GC to “FIX” it

D: It’s a Pool, its gon’na leak anyway

OPTION C:

- Run to Hardware store
- Grap spray and expand products
- Spray it in?
- **WAIT TO BE SERVED**

OPTION B: AWB Terminations: AIR VAPOR BLOCKS & PLUGS

EPDM/SBR Air and Vapor Closures Fitted for Roof Deck Profile

Keep Air and Caustic Vapor Blocked From Moving Layers

- Close Cell Structure
- Resistant to Chlorine
- Very Stable
- Very Low Water Permeance
- Remains Flexible
- Best Double Stacked
- Include Rectangular Perimeter Blocks

CLOSURE PROFILE		PITCH	HEIGHT	LENGTH	PIECES PER CARTON
A-PANEL	SM	12"	1¼"	36"	100
	LG	12"	1⅛"	36"	100
SPANLINE 36	SM	12"	1⅛"	36"	100
	LG	12"	1⅛"	36"	100
MULTI-RIB	SM	12"	1 3/16"	36"	100
	LG	12"	1 3/16"	36"	100
SR-36	SM	12"	1¼"	36"	100
	LG	12"	1¼"	36"	100
VARCO PRUDEN HI-RIB	SM	12"	1¼"	36"	100
	LG	12"	1¼"	36"	100
HI-RIB	SM	12"	1¼"	36"	100
	LG	12"	1¼"	36"	100
"R-PANEL	SM	12"	1¼"	36"	100
	LG	12"	1¼"	36"	100
BUTLER RIB II	SM	12"	1½"	36"	100
	LG	12"	1½"	36"	100
SHADOW RIB					

CLOSURE PROFILE		PITCH	HEIGHT	LENGTH	PIECES PER CARTON
B-DECK	OUTSIDE	6"	1½"	36"	100
	INSIDE	6"	1½"	36"	100
N-DECK	OUTSIDE	8"	3"	24"	100
	INSIDE	8"	3"	24"	100
2" FLOOR DECK		12"	2"	36"	100
3" FLOOR DECK		12"	3"	36"	100
VERTICAL (RECTANGULAR) 1" X 1" X 36"		N/A	1"	36"	100
VERTICAL (RECTANGULAR) 3/4" X 1" X 36"		N/A	3/4"	36"	100

OTHER RECTANGULAR SIZES AVAILABLE

PLUG PROFILE		PITCH	DEPTH	LENGTH	PIECES PER CARTON
B-DECK	OUTER SMALL	N/A	1½"	N/A	100
	INNER LARGE	N/A	1½"	N/A	100
N-DECK	OUTER SMALL	N/A	3"	N/A	100
	INNER LARGE	N/A	3"	N/A	100
2" FLOOR DECK PLUG		N/A	2"	N/A	100

KNOW YOUR OPTIONS

Swimming thru the products

KNOW YOUR OPTIONS

Types of Roof Deck Construction

- Composite Panels
- Wood Plank on Glu-Lam Supports
- Precast Concrete Roof Decks
- Stainless Steel Roof Decks
- Steel Roof Decks w/ Duplex Coating
  - Steel Roof Deck Profiles (Good, Better, Best, Premium)

WOOD PLANK ON GLU-LAM SUPPORTS

Preferred assembly

- A layered system (e.g., wood deck) with continuous insulation and an air/vapor barrier.

Key considerations:

- Labor-intensive installation
- High maintenance due to re-coating
- Prone to brittleness without proper care
- Limited acoustic performance
- Aesthetic appeal with hidden fasteners
- Supports longer spans
- May need specialized trades for installation

PRECAST CONCRETE ROOF DECKS

Long-Term Performance Recommendations:

(Hollow Core Panels, Double Tee Panels)

- Offers a history of strong structural integrity.
- Allows for continuous insulation and air/vapor barrier with separate components.
- Be mindful of its heavy construction and limited to low-slope use.
- Relies on special sealants and coatings for durability.
- Minimal acoustic benefits but allows for long spans.

STEEL ROOF DECK

Long-Term Performance: Steel Roof Deck

- Lightweight structure
- Various profiles with coated galvanized options
- Acoustical component availability
- Enables continuous air/vapor barrier and insulation
- Slightly higher cost but durable
- Requires specific specifications and installation oversight

STEEL ROOF DECK

Benefits of Stainless Steel

- Readily Available - 304 and 316 Grades
- Reliable long-term performance
- Lightweight as compared to other options

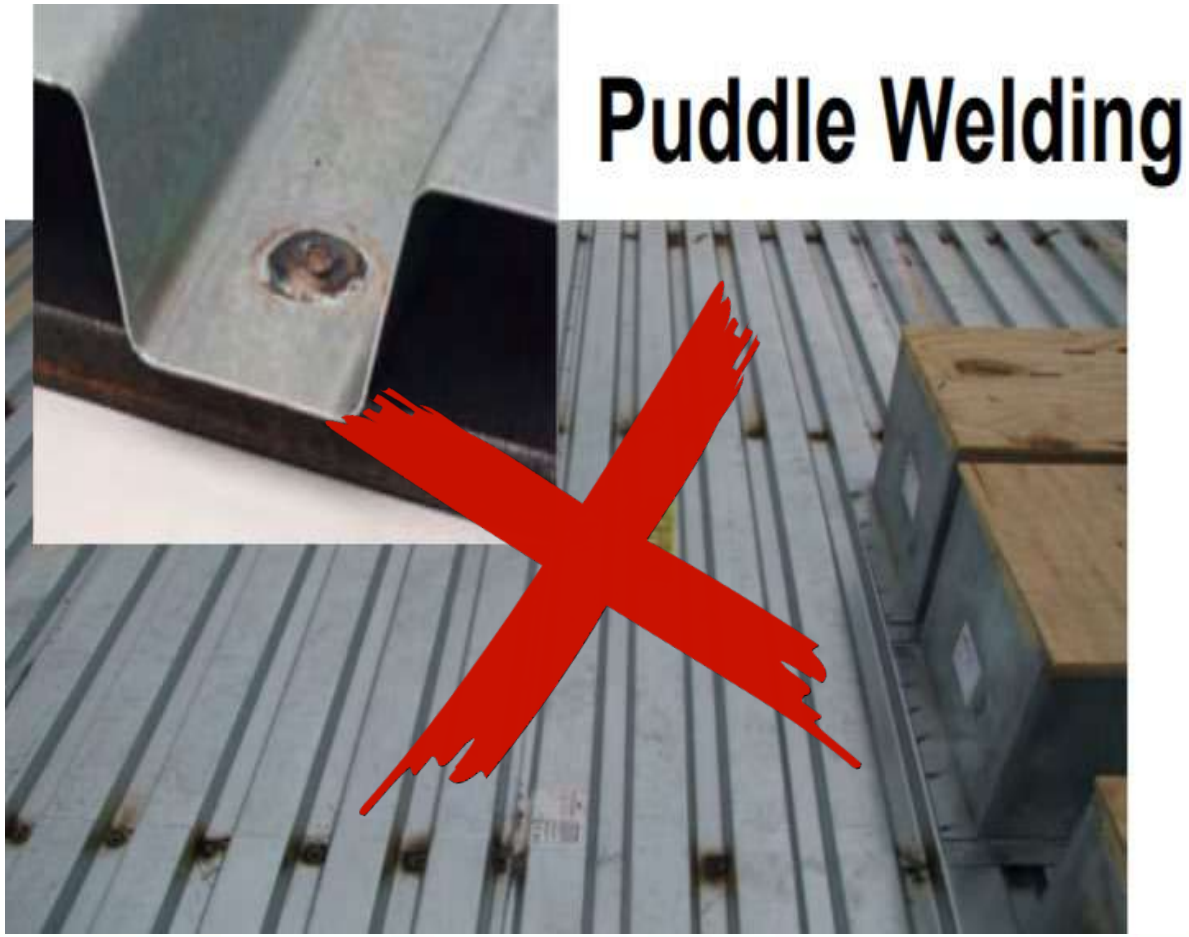
Problems With Stainless Steel

- Expensive
- Limited line of Profiles Available
- Acoustical Options Not Available
- Not as Structurally Strong as Carbon Steel
- Bar Joists Still Need High-Performance Field Applied Finish

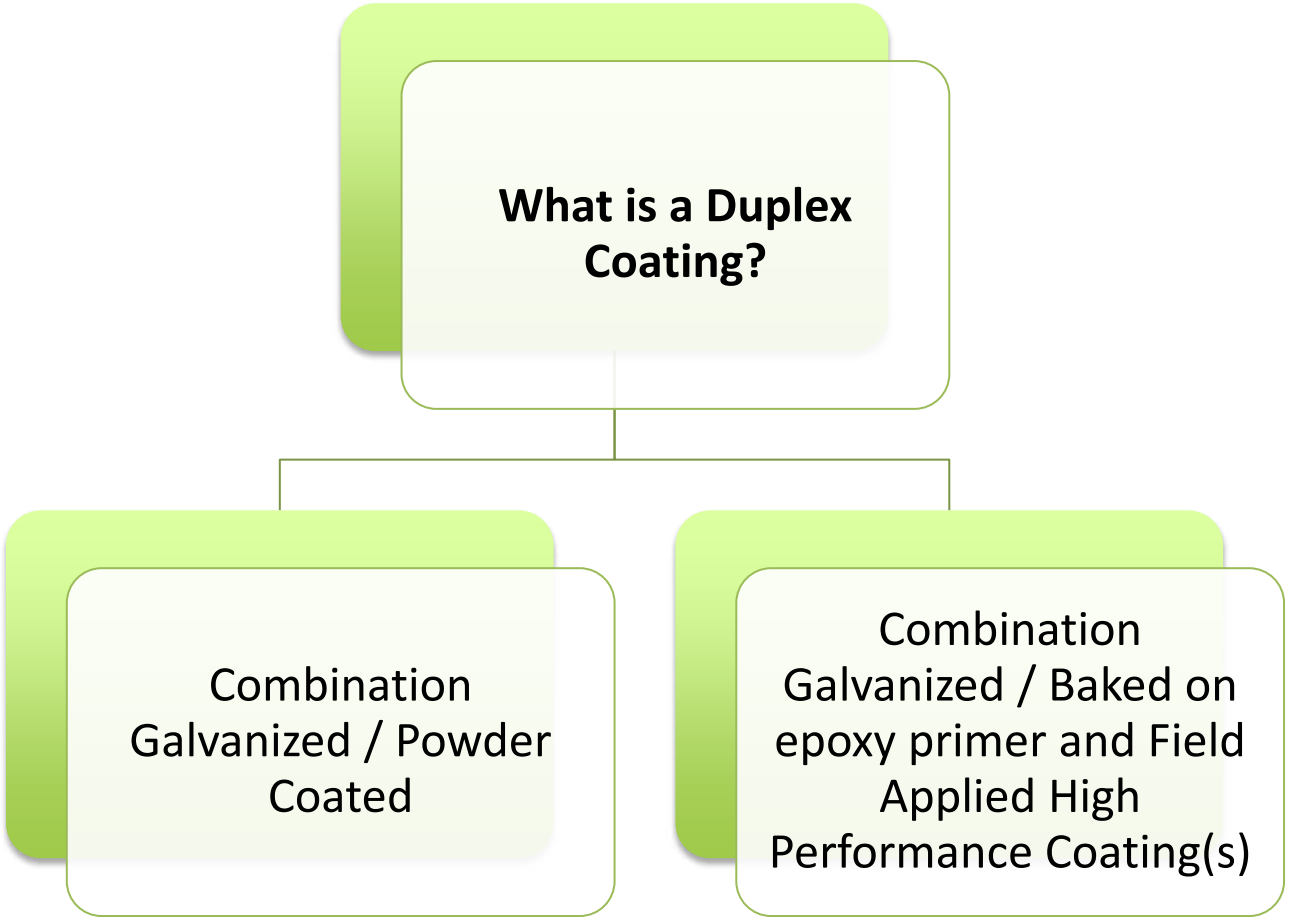
WELDING STEEL DECK

Do Not Weld Steel Deck!

- Will Corrode Quickly
- Cannot Assure Proper Coating
- Very Labor Intensive to Coat
- Lengthy Process



STEEL ROOF DECKS WITH DUPLEX COATING



STEEL ROOF DECKS WITH DUPLEX COATING

Combination Galvanized / Powder Coated

Thermoplastic Powder Coatings When Combined With HDG G90 Coating is Excellent For Long-Term Protection

- Robust Thermoplastic Polymer Coating Provides Added Protection From Chlorine Vapor
- Lightweight Solution
- LEED Credits Available
- No Wasted Paint
- Color and Gloss Finishes Available

STEEL ROOF DECKS WITH DUPLEX COATING

Combination Galvanized + Baked on epoxy primer + Field Applied HPC

- **Duplex System** : Galvanized steel with baked-on epoxy primer & field-applied high-performance coatings.
- **High Corrosion Resistance** : Ideal for harsh environments like natatoriums.
- **Lightweight & Durable** : Proven long-term performance.
- Field Coating Compatibility: Matches steel framing requirements.

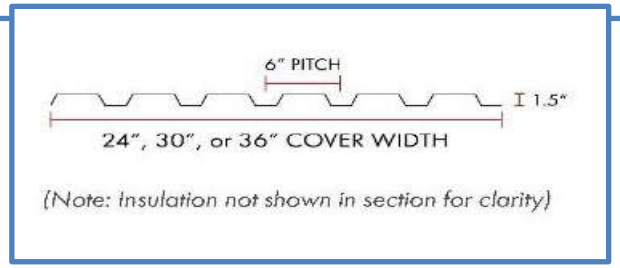
STEEL ROOF DECKS WITH DUPLEX COATING

Application Details:

- **Two-Coat System:** Hydrophobic acrylic & polyamide epoxy (polyamide epoxy may need a urethane top coat).
- **Bond Strength:** Strong adhesion to prime metal deck & supports.
- **Enhanced Protection:** Synergy between coatings and galvanizing for superior corrosion resistance.

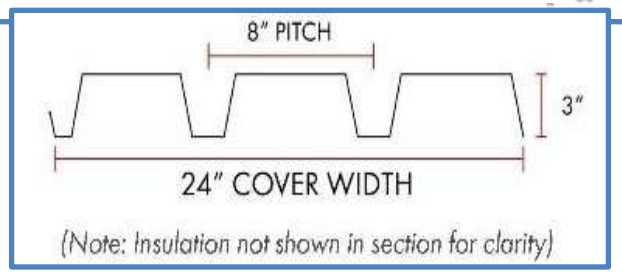
In Harsh Environments Where Galvanizing or Paint Coatings Alone Have Difficulty Protecting the Steel, Utilizing a Duplex System Can Provide the Necessary Corrosion Resistance

Good, Better, Best



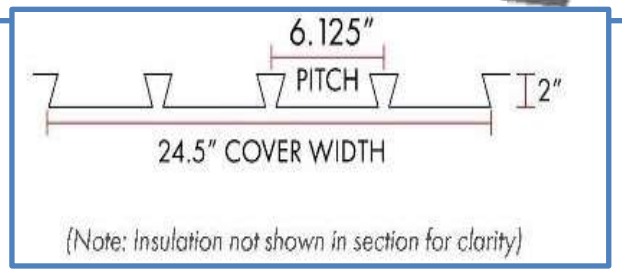
1.5” BA Metal Deck

Acoustical - NRC 0.80, Exposed Fastener



3” NA Deck

Longer Spans, NRC 0.70



2” or 3.5” DTA

Longest Spans, NRC 0.85, Premium Look

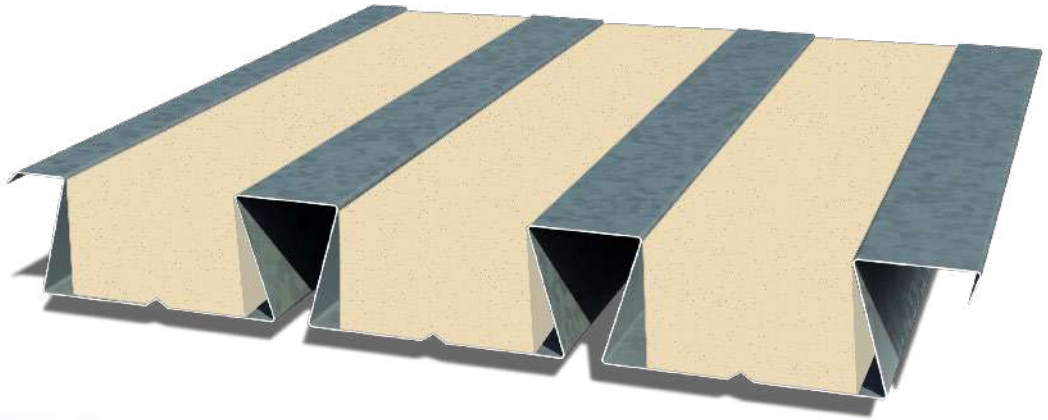
RECOMMENDED ASSEMBLIES

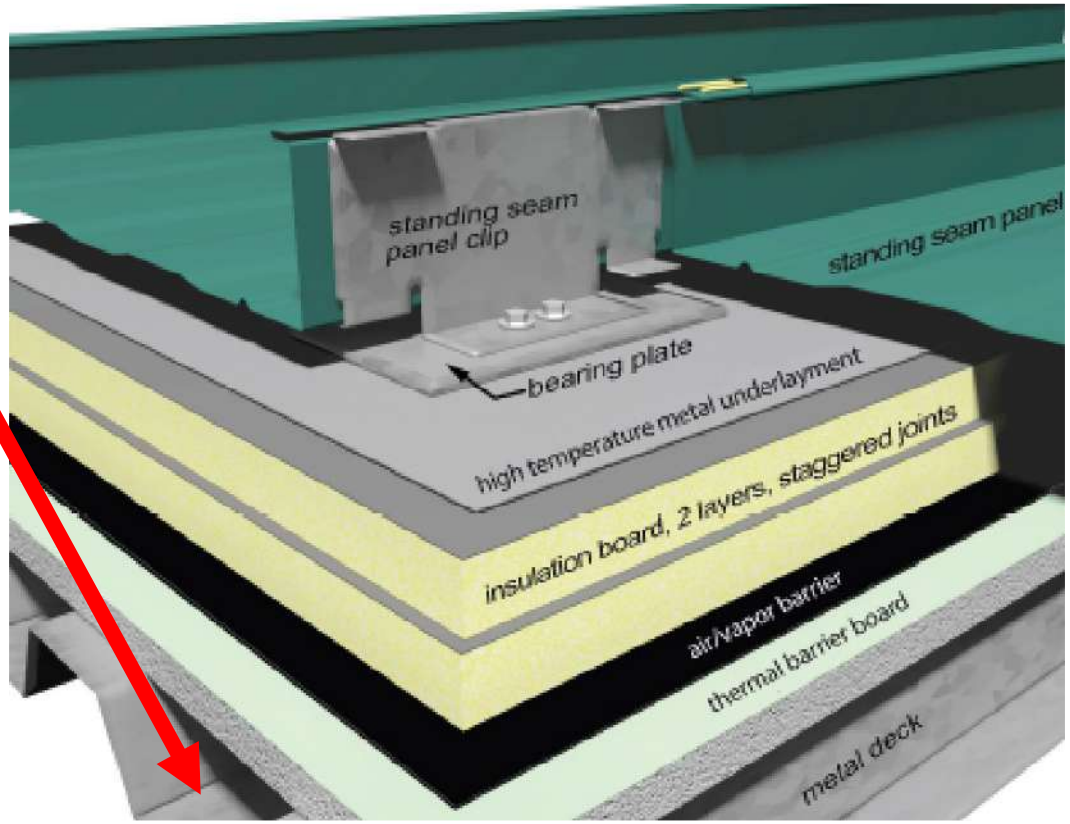
Proven With a Track Record of Success, These Assemblies Work

PROPER ASSEMBLY DESIGN

G90 Galvanized Deck

- PVDF Factory Coated (Primed)
- Subsequent Coating Opportunities Including High Performance Coatings

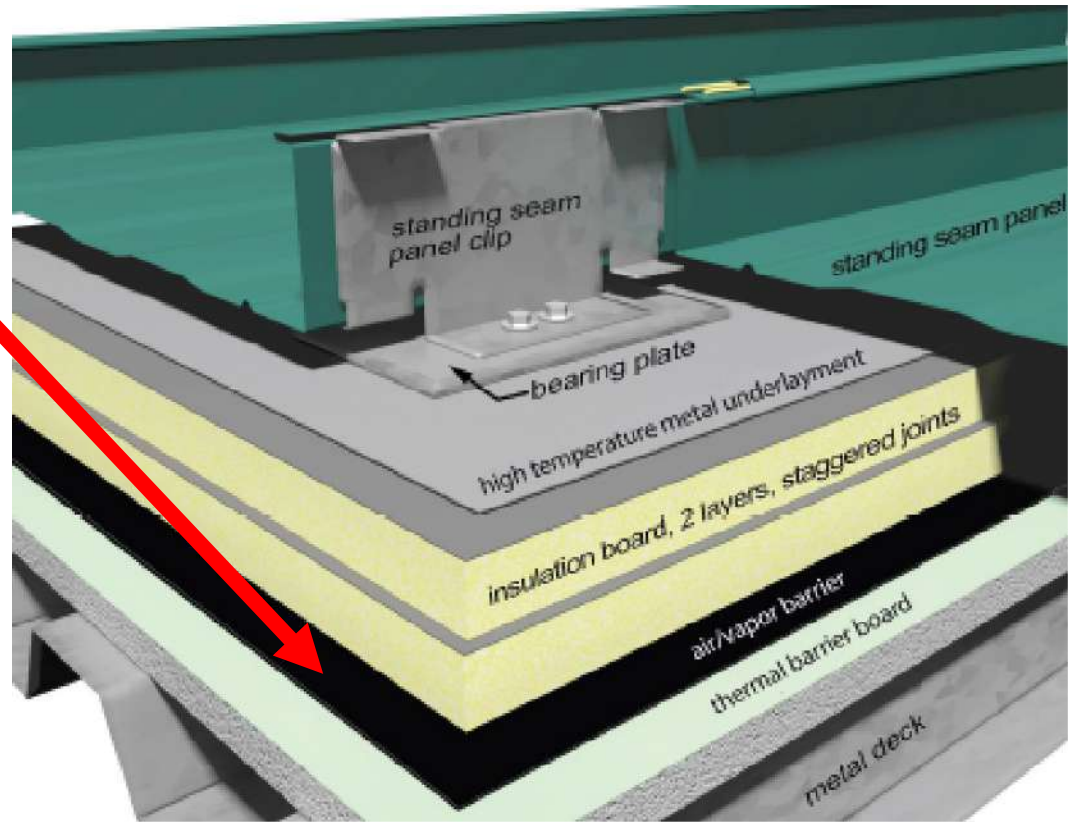




PROPER ASSEMBLY DESIGN

Base Air/Vapor Barrier

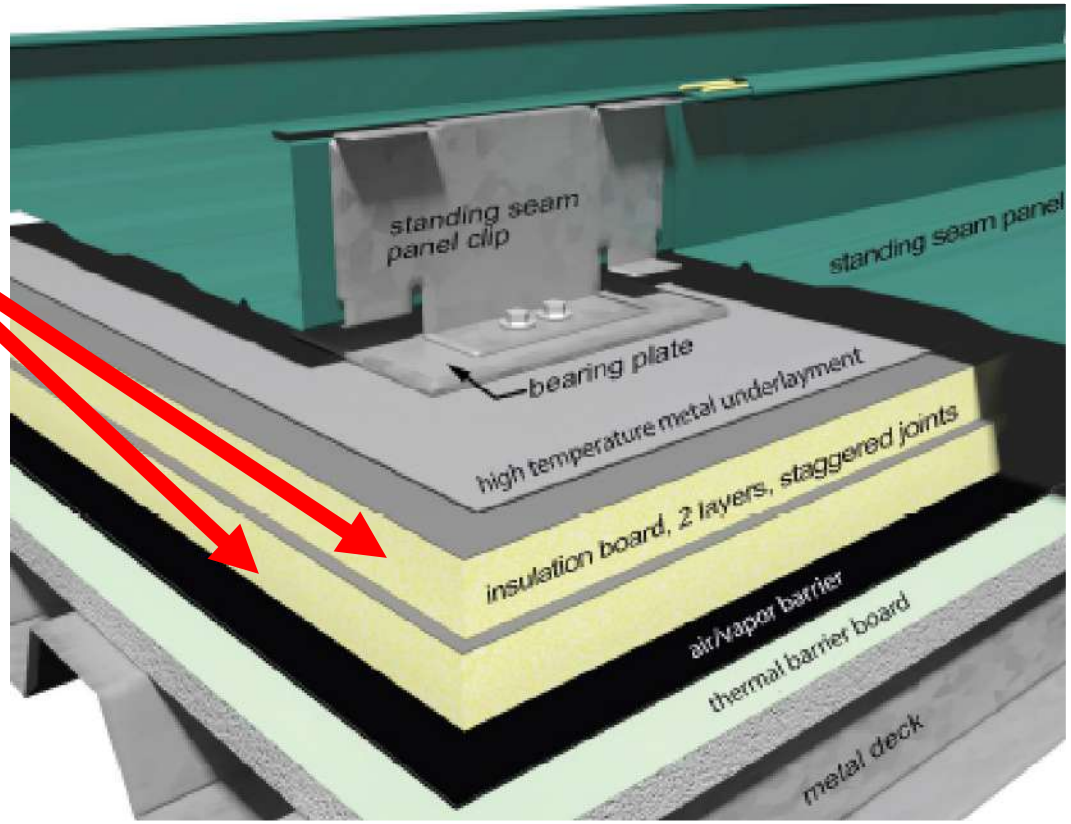
- Non-Vapor Permeable < 0.1 Perms
- Minimum 50 mil Membrane or Multi-ply Application
- Must be Fully Adhered and Sealed Throughout Roof Area and Roof Flashings



PROPER ASSEMBLY DESIGN

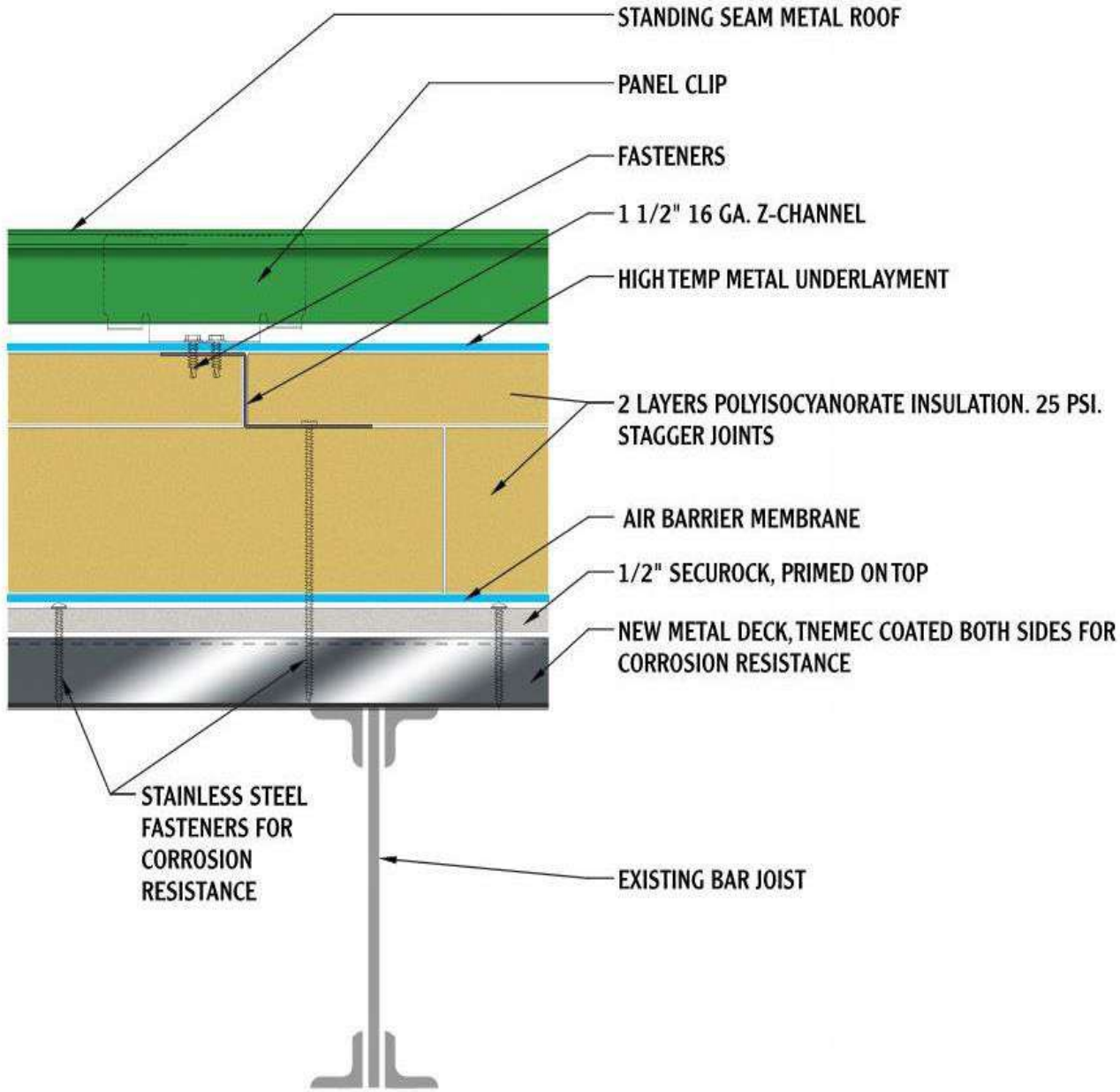
Insulation Board

- Minimum Two (2) Layers With Staggered Joints
- Minimum Compressive Strength of 20 psi
- Min R-Values Based on ASHRAE 90.1 and Energy Conservation Code



THERMAL BRIDGING ?

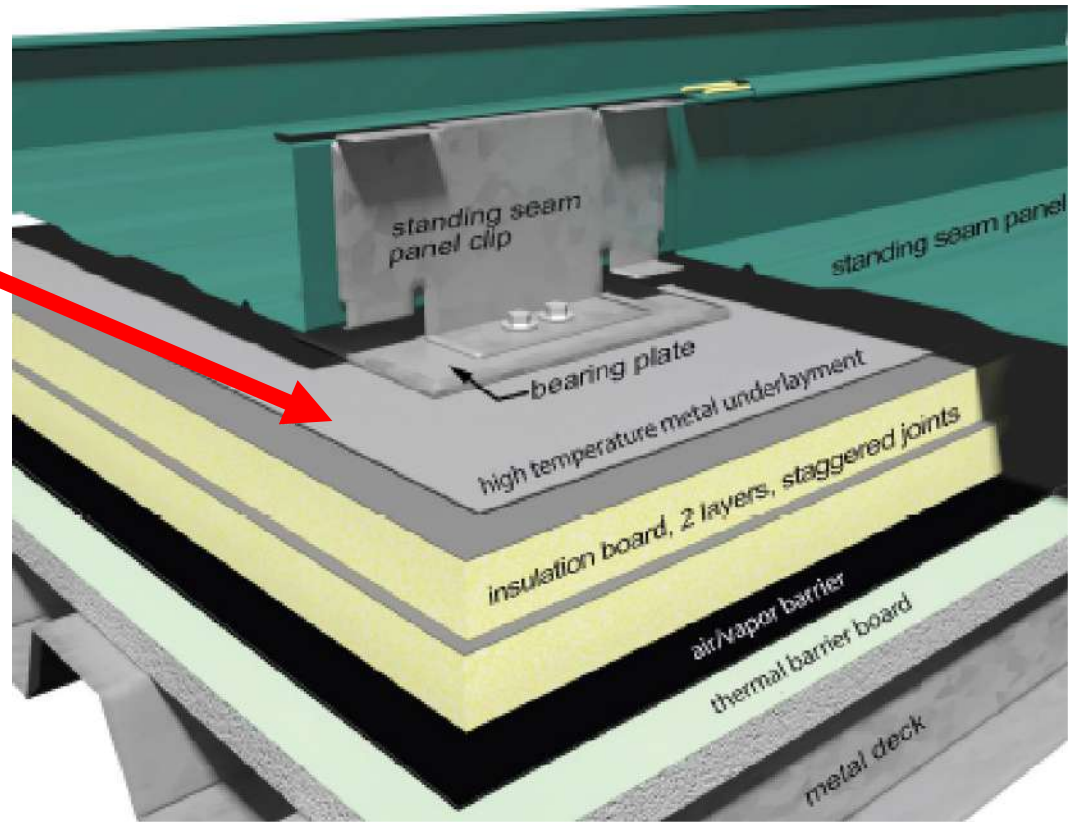
- Perforated Z Sub Framing
- Stainless-Steel Fasteners
- Reduced Thermal Bridging



PROPER ASSEMBLY DESIGN

Top Air/Vapor Barrier

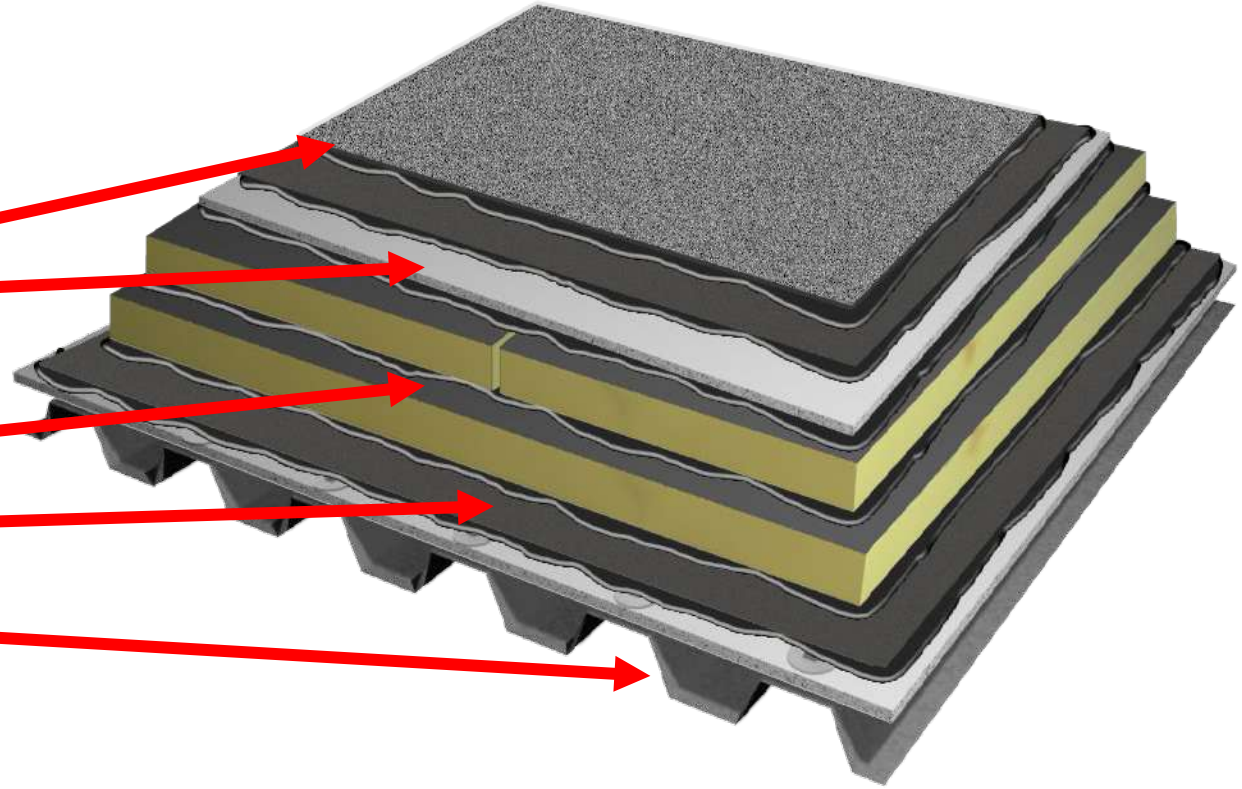
- Vapor Permeable (High Temp)
- Minimum 40 mil Membrane or Multi-ply Application
- Must be Fully Adhered and Sealed Throughout Roof Area and Roof Flashings
- Must be walkable (tear resistant)



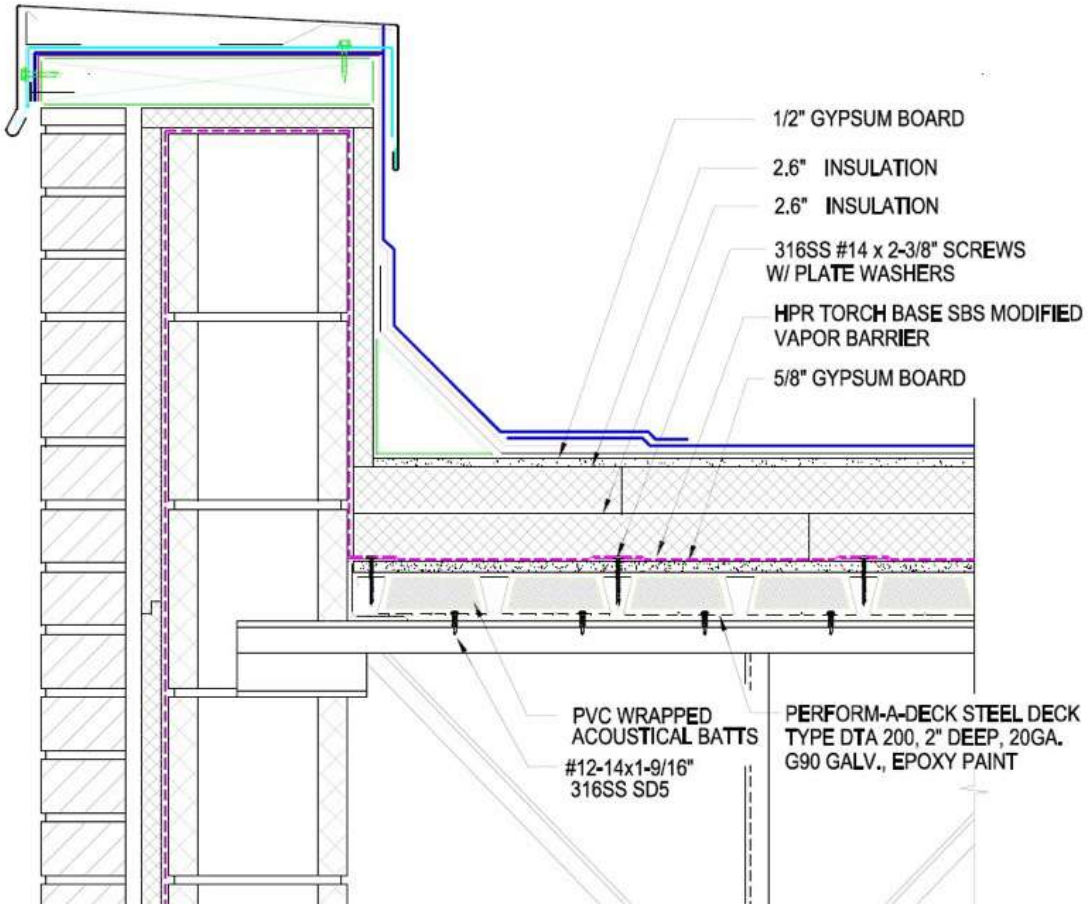
PROPER ASSEMBLY DESIGN

Modified Bitumen (fully bonded) Roof System

- Two-Ply Modified Bitumen Roof System
- Cover board
- Insulation
  - Two Layers (joints staggered)
- Air/Vapor Barrier
- G90, Coated Deck



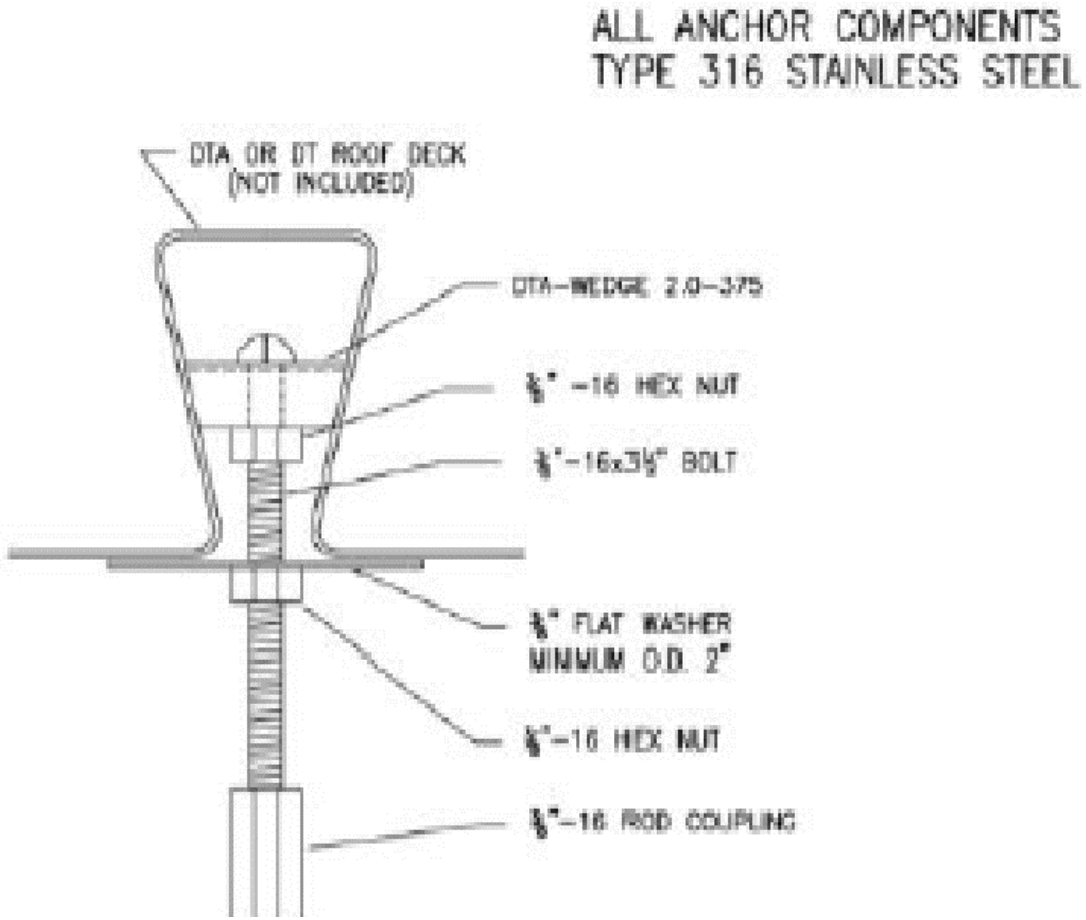
LOW SLOPE MEMBRANE ROOF



- All 316 Fasteners Below the AWB
- No Penetrations Through the AWB
- Continuous Insulation
- Various Profiles of Metal Deck
- CI for Fully Ahered AVB and Roofing
- Full System or Metal Deck System Warranty

PROPER ASSEMBLY DESIGN

- Efficiently Hang Fixtures
- No Cumbersome Supports
- All 316 Stainless Steel



Case Study

Why Design If You Can't Build It

SYCAMORE HIGH SCHOOL POOL BUILDING, Montgomery, OH

- Existing Roof Leaking - Exposed fasteners and laps
- Interior Rusted – High humidity leaks thru AWB
- Inside Rain – They are blessed??? No, hygrothermal modelling

Design Strategy

Analyze

Figure out problems and their solutions

Run Models

Specify

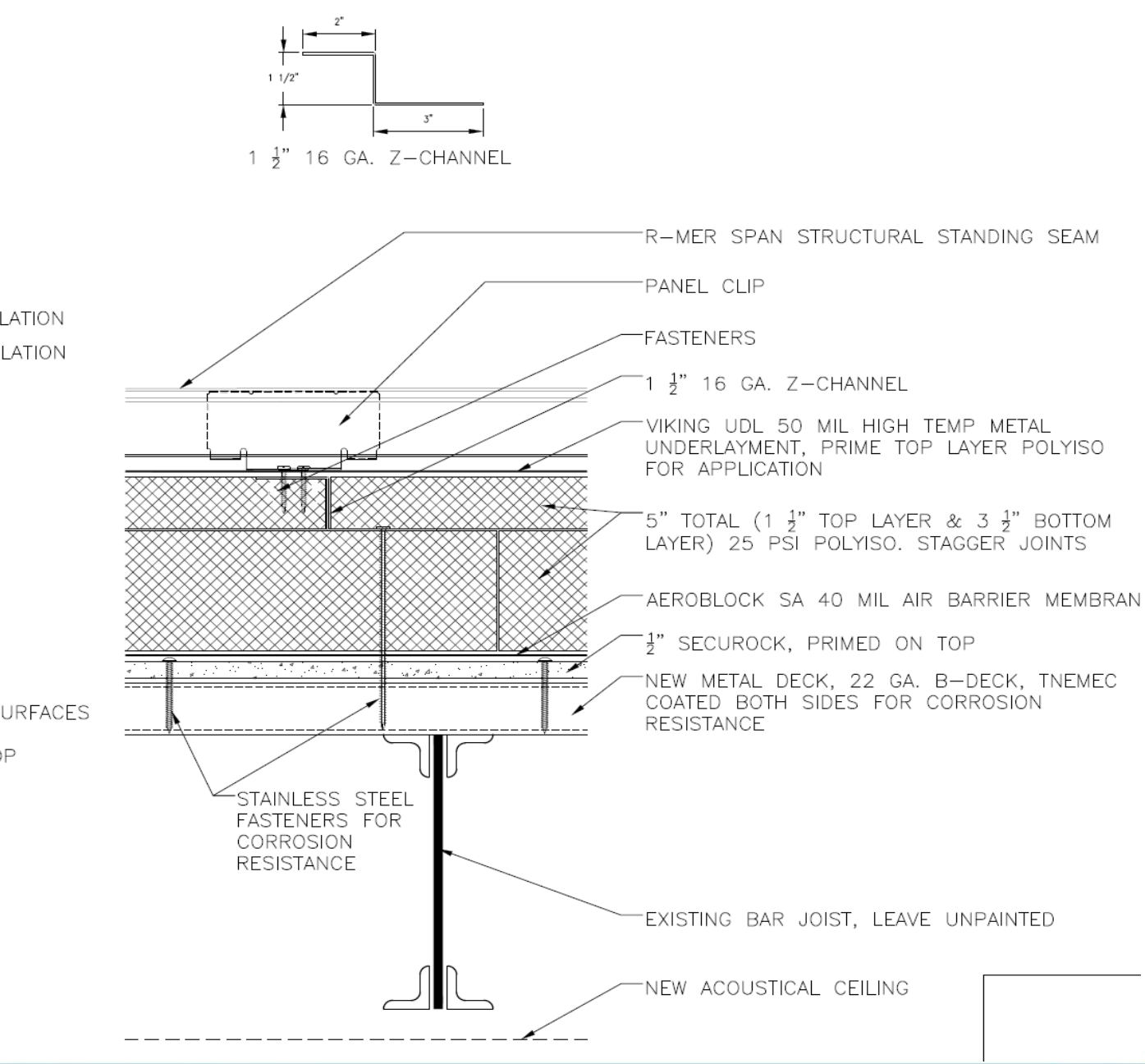
Specify Products, not generic

Field Verify

Mockup,

Inspect and

Approve



Designing the Assembly

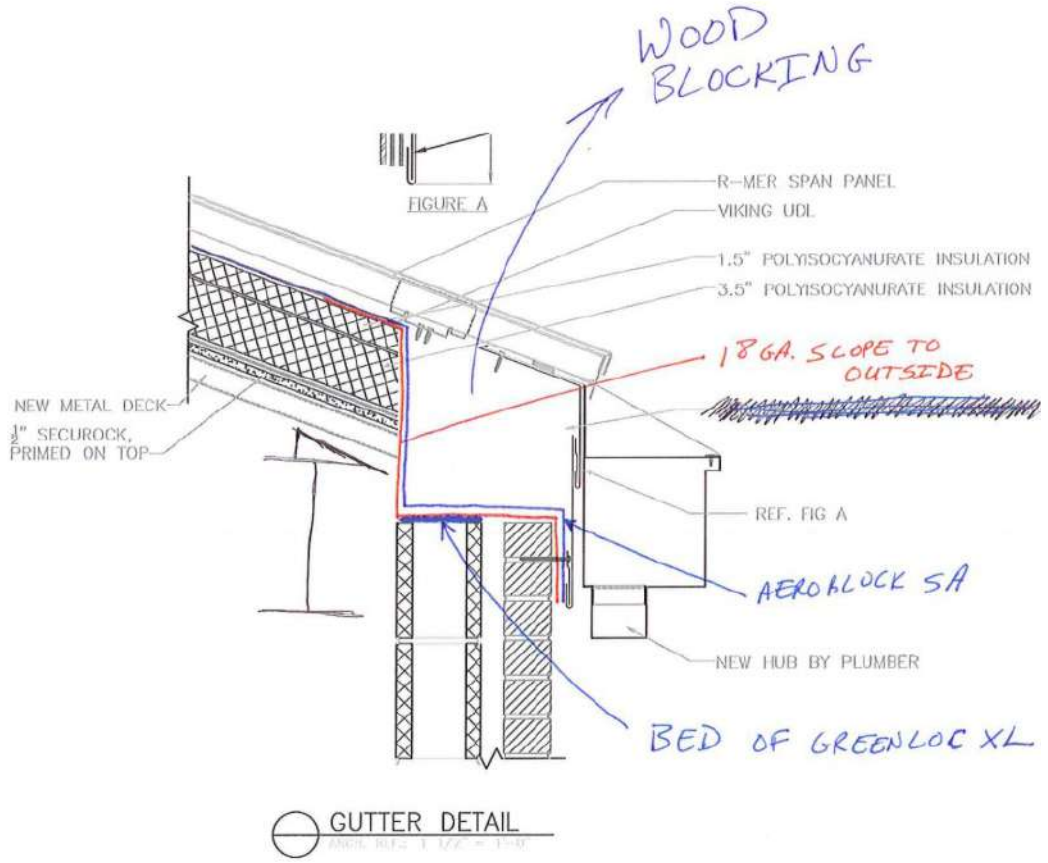
- Minimize Vapor Drive
- WUFI Model or Other Vapor Drive Model
- Selection of Products (Basis of Design)
- Detail each termination
- Specify AWB System (not component and Basis of Design)
- Use MFG's (Basis of design) Details
- Ask for a Full Assembly Warranty, from Deck up.

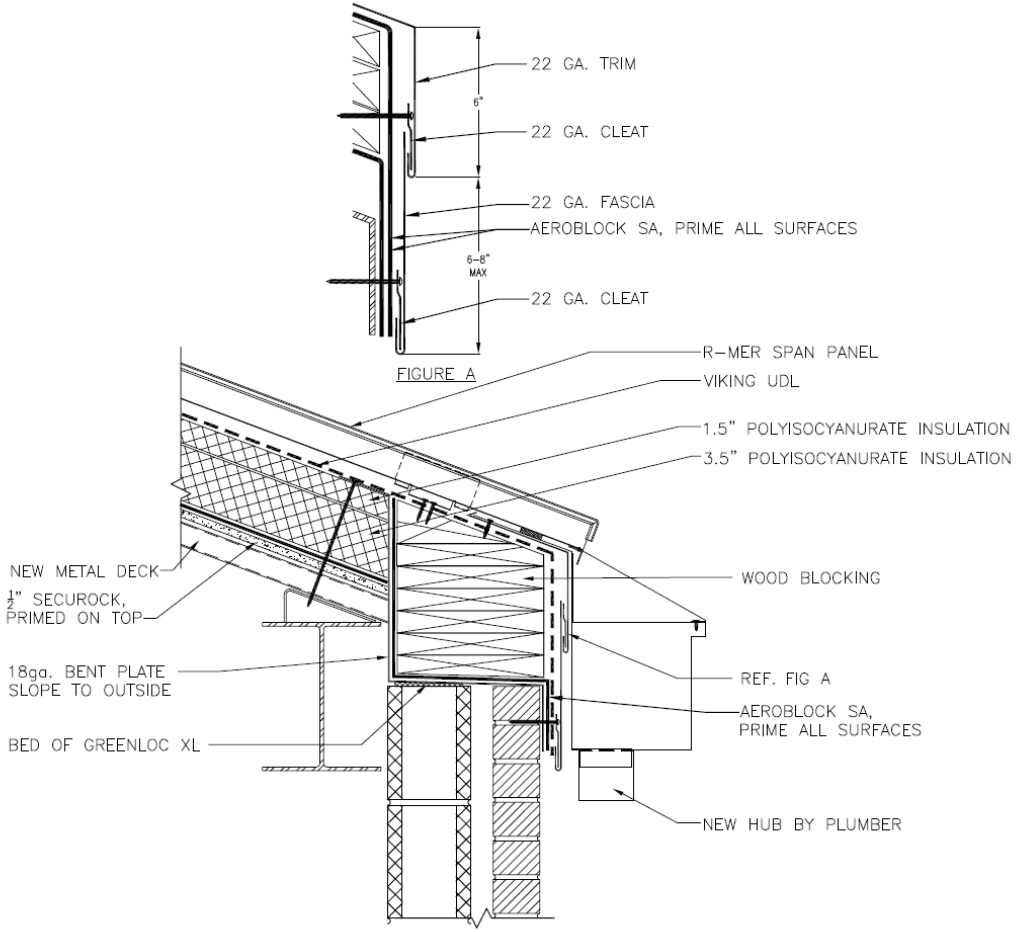
Outcome

- Inspections are easy
- Pre-approved mfg details, so less RFI
- Mockup Required

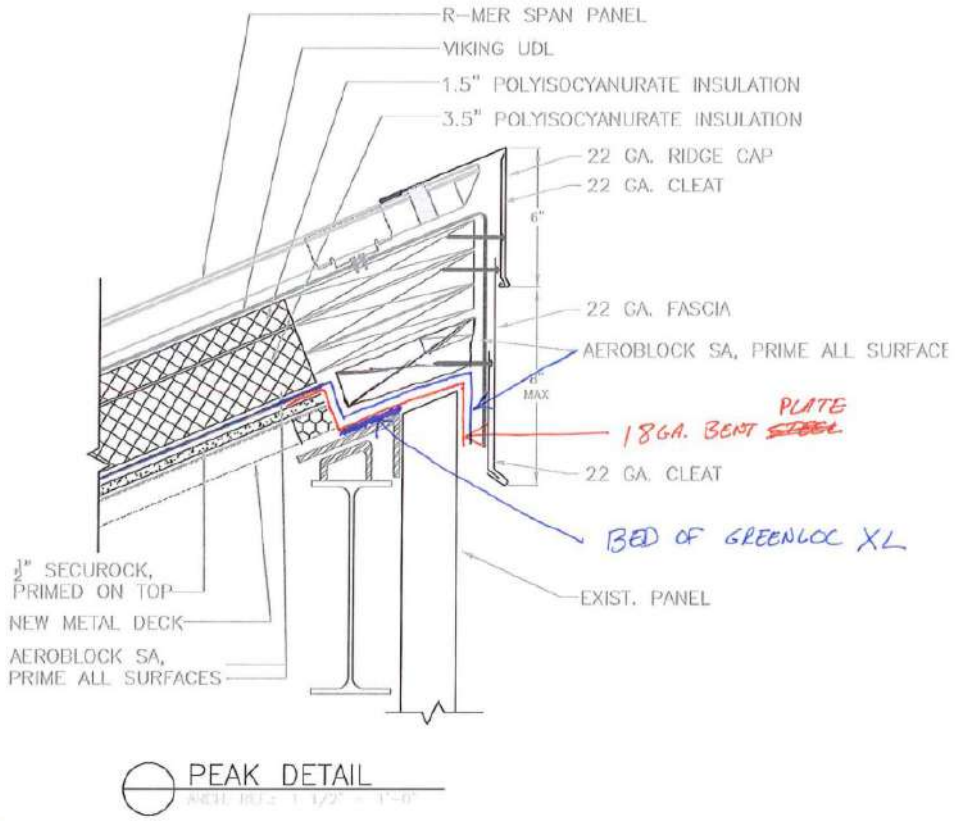
AND YOU DON'T GET SUED

Work Thru Details

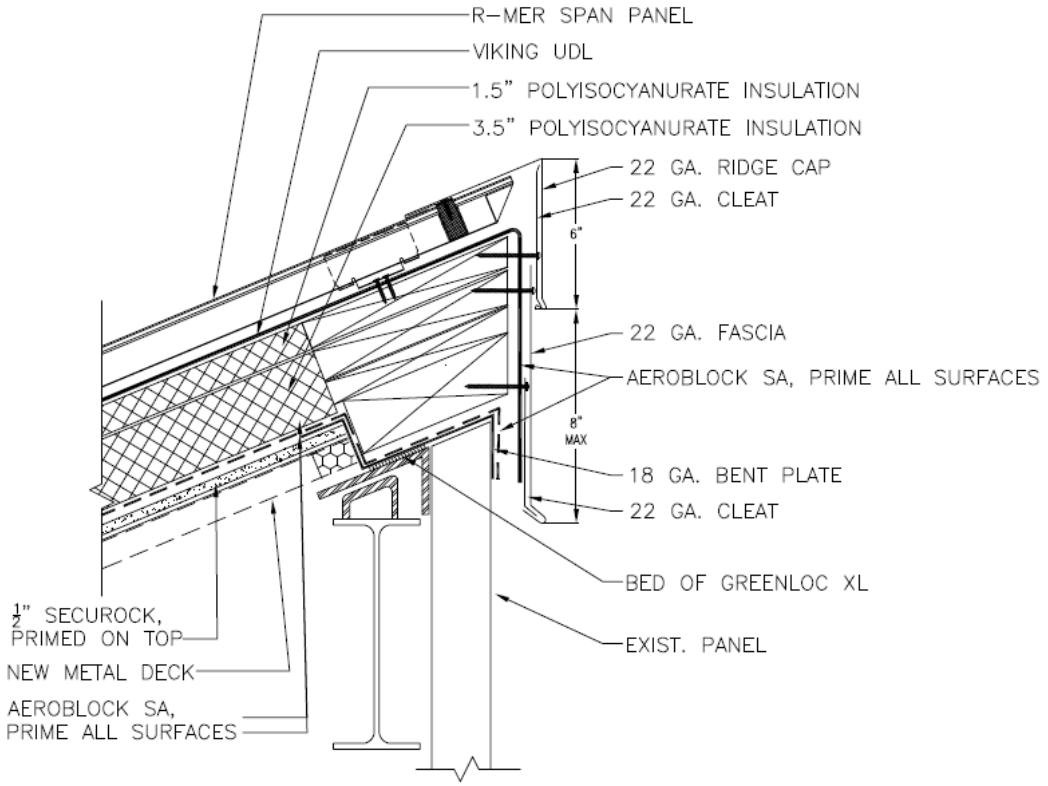




Work Thru More Details

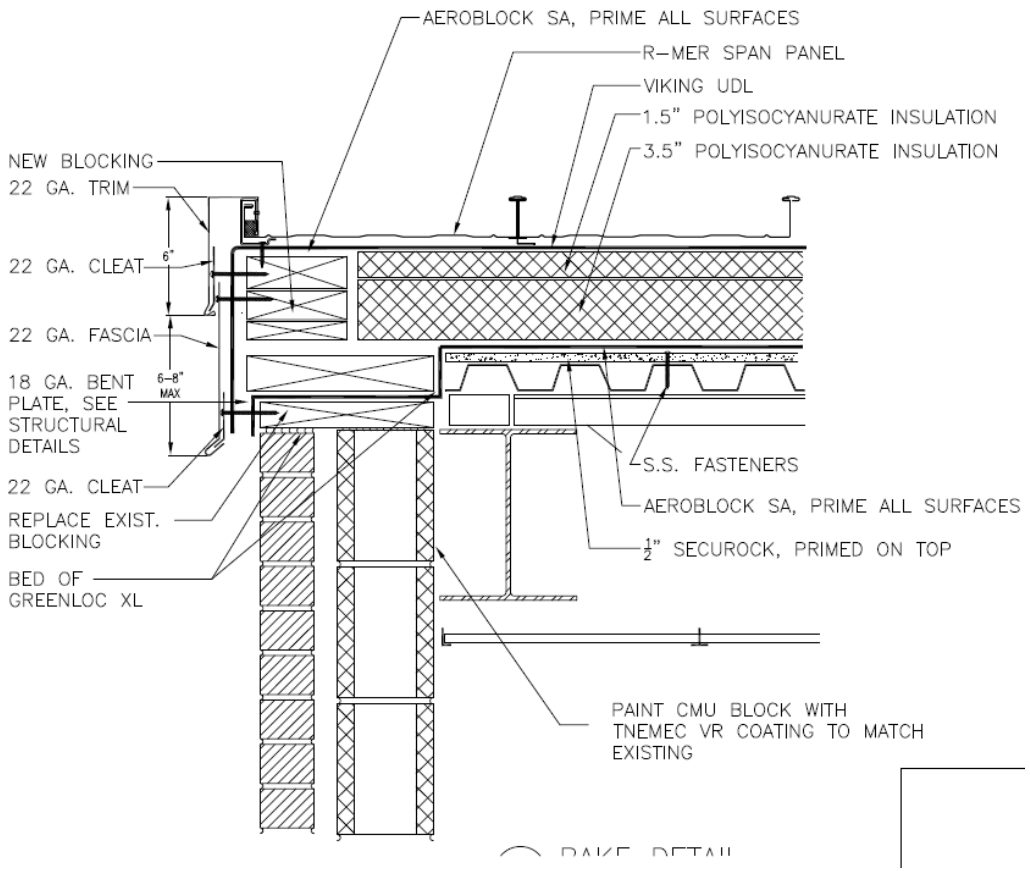


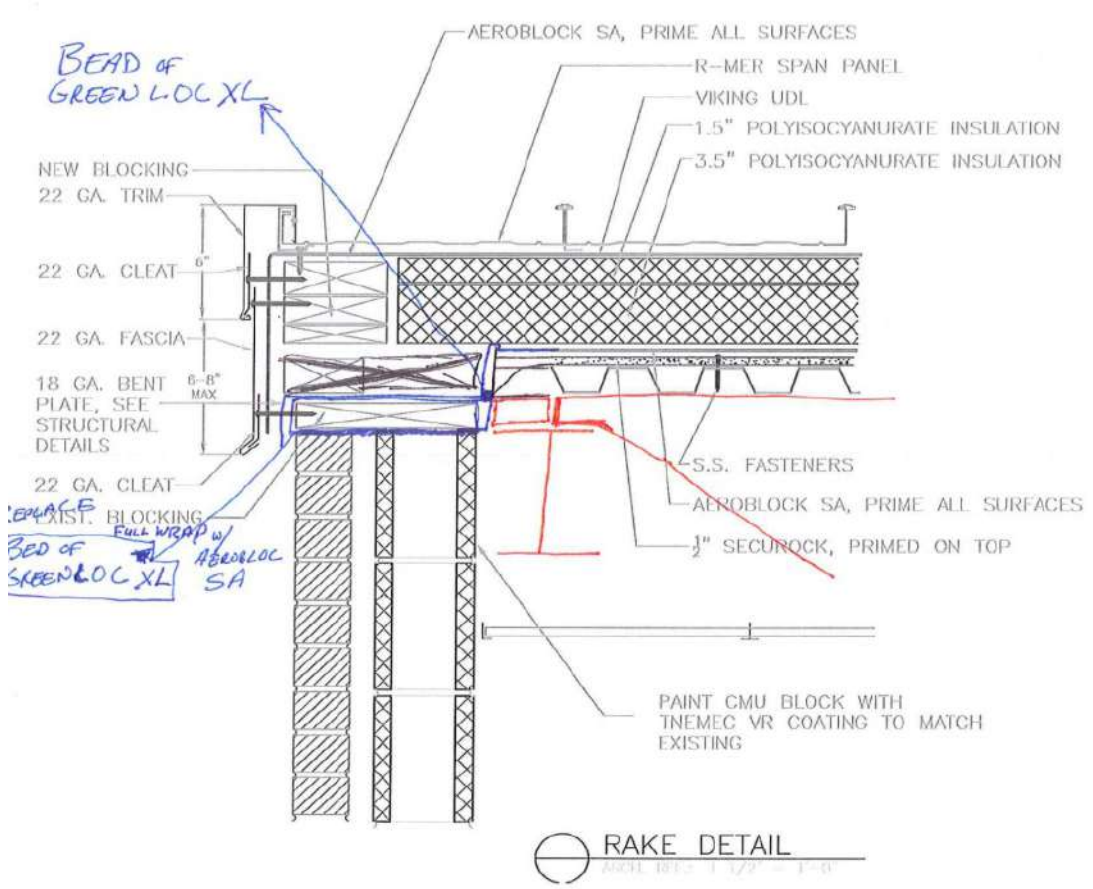
PEAK DETAIL

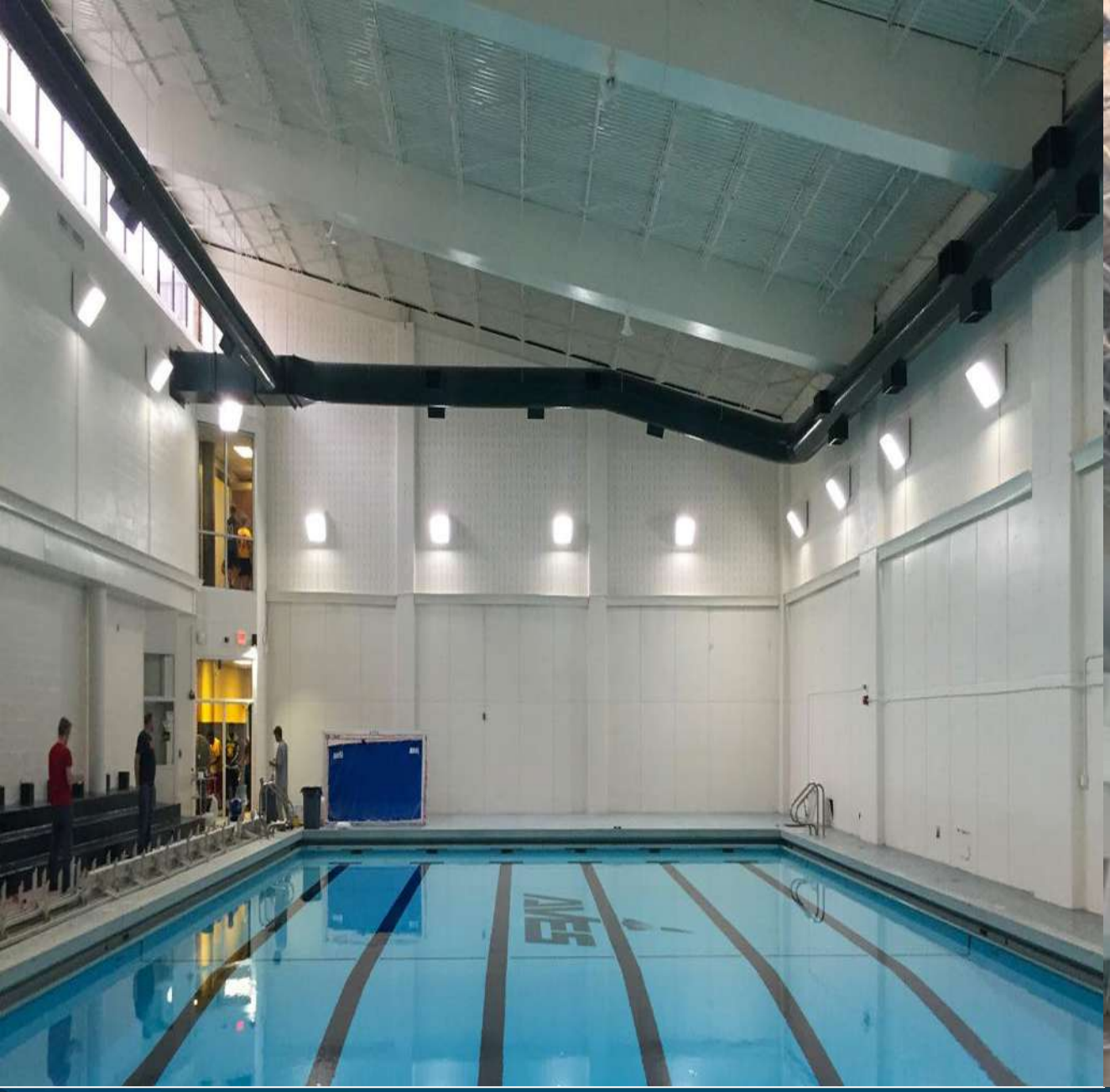


B/4 FIXED SHED RIDGE
ARCH. REF. : NA

Don’t Get Sued Detail







Lather, Rinse and Repeat

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Phillips Andover Athletic Center Pool Roof Enclosure

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Cape Ann YMCA Pool Roof Enclosure

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METCO's engineering team brings a wide-range of expertise in project evaluation, design assistance, product testing, and installation support to assist you at every stage of your project.

Our engineers and technical staff will help you bring design ideas to reality with IMETCO metal building envelope systems backed by a variety of value-added engineering services.

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