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MAY 8-9
2018
SALT LAKE
CITY

AIR BARRIER EDUCATION TRACKS FOR
THE CONSTRUCTION INDUSTRY

Design, Materials & Installation

The 3 Facets of an Integrated Weather Barrier

Gary Williams PMP

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Gary Williams PMP
Senior Project Manager

gwilliams@conleygroup.com

817-929-1984

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Today's Speaker
Gary Williams PMP

- Skilled Client Executive and Project Manager
- Extensive background with K-12 schools, commercial buildings, sports facilities, and historic structures
- Skill set includes Facility Asset Management Planning, Building Envelope design, Project Management and Construction Administration
- Member of the Project Management Institute
- Project Management Professional Certification (PMP)
- Member Roof Consultants Institute (RCI)
- Educational Presentation Speaker at 2015 NFMT Orlando, 2016 RCI, 2017 TAPPA, 2017 BOMA, & SCUP, 2018 ABAA
- Guest speaker for numerous technical training programs and lunch & learn events for Building Owners, Trade Associations, A/E Firms, & General Contractors

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Learning Objectives:

1. Define and develop a better understanding of the Building Envelope.
2. Define and develop a better understanding of the Integrated Weather Barrier and how it impacts the performance and sustainability of buildings.
3. Define and develop a better understanding of Design, Materials & Installation processes and how they are related.
4. Explore the process of proactive coordination between Design, Materials and Installation models to achieve an Integrated Weather Barrier.

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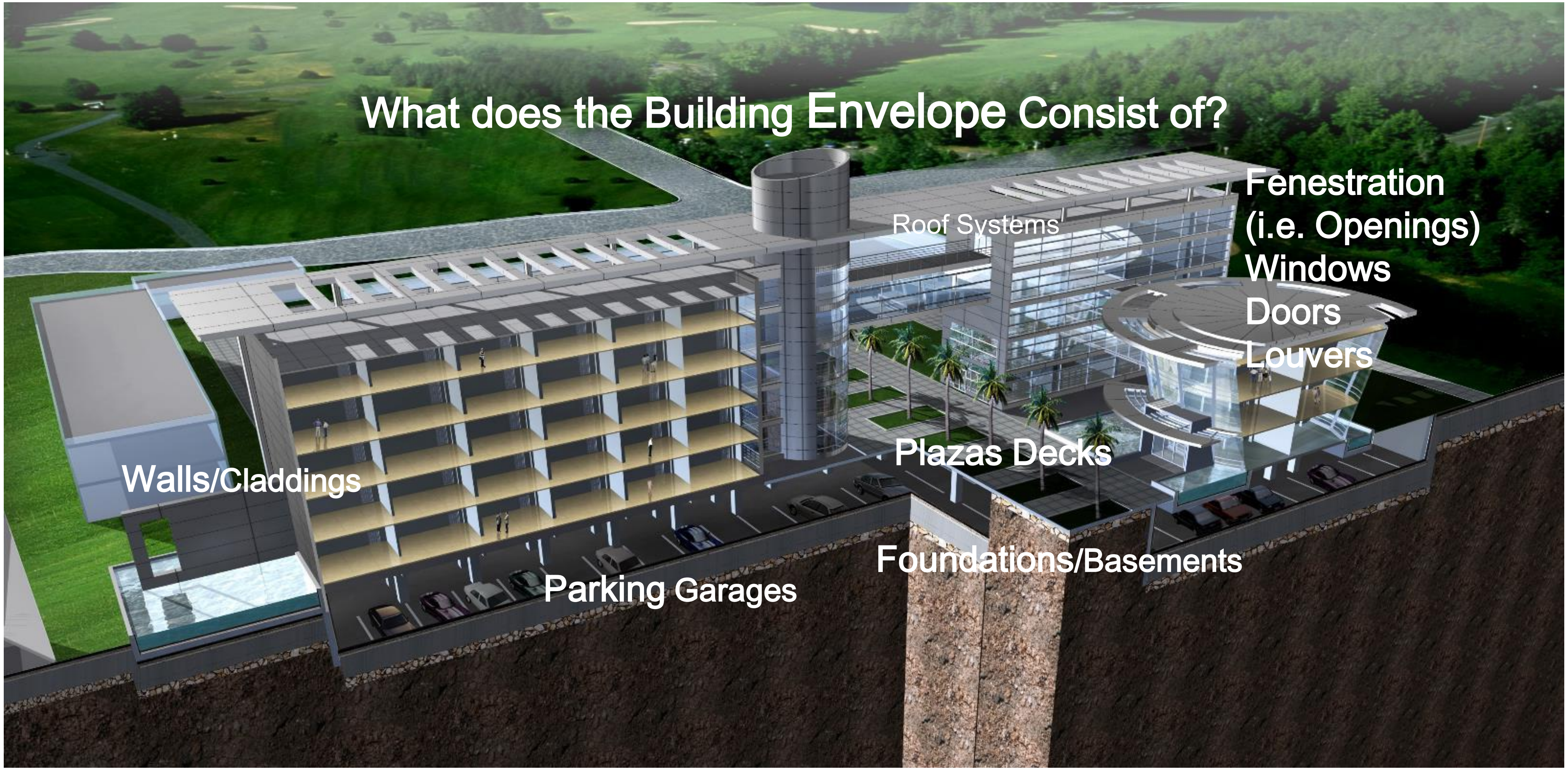
How Do We Use Buildings?

- Live
- Work
- Play



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How is the Building Envelope Defined?

IECC 2015 - BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

AAMA - The assembly or assemblies of materials and components that enclose building spaces and are exposed to exterior space or separate conditioned interior space from unconditioned interior space.

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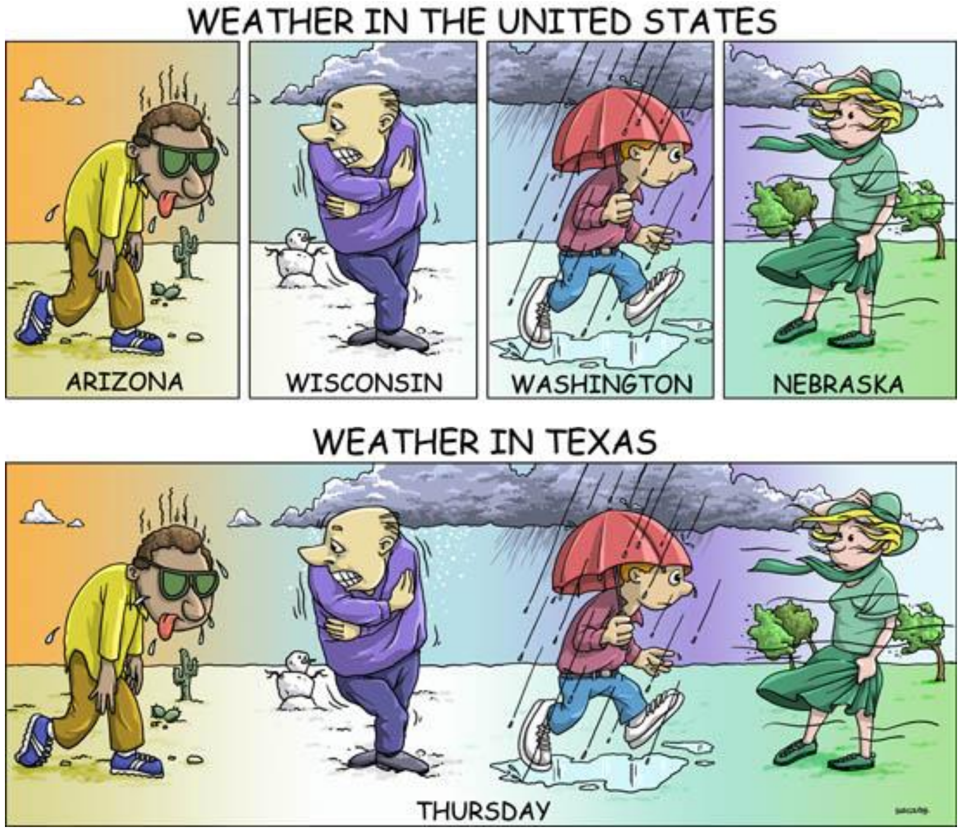
What Do Buildings Control?

- The Environment
- Buildings Keep the Outside Environment Out And the Inside Environment In
- "Environment"… what do you mean?
  - Radiation
    - Sun
  - Water
    - Solid (snow, hail, ice)
    - Liquid (rain)
    - Gas (vapor)
  - Air - Wind



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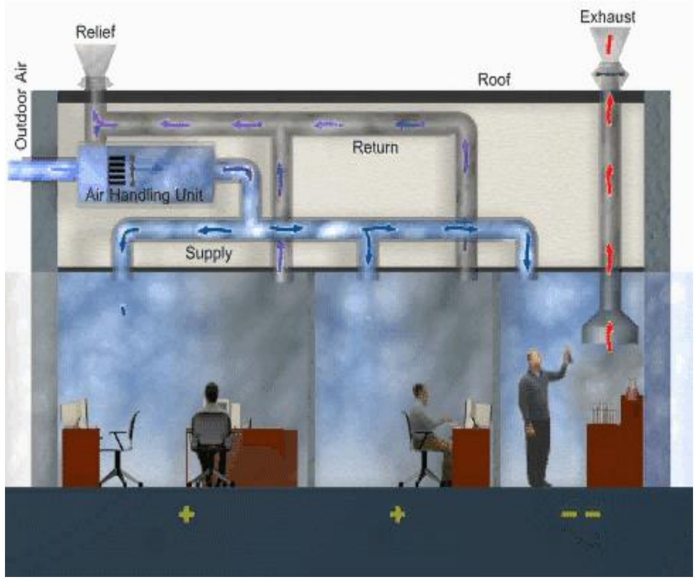
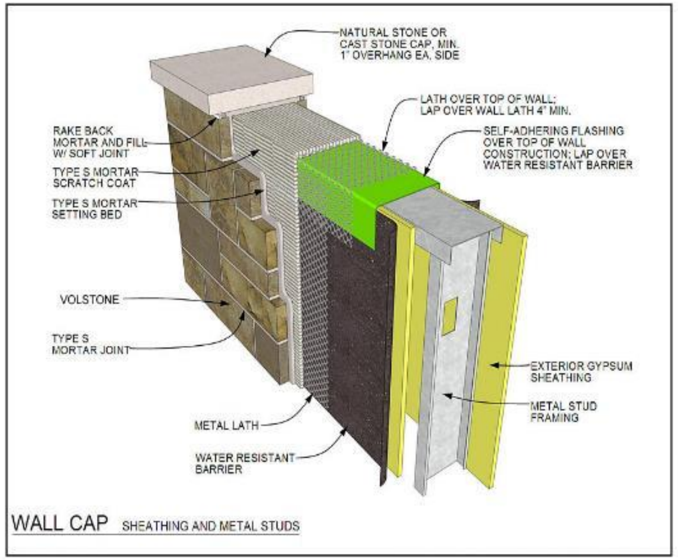
We have been constructing buildings for thousands of years—what's different today?

Demands	Expectations	Technology
		

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Examples of Changing Demands

- 2009 – IECC does not address Air Barriers. Windows, Doors, & Sealing Penetrations Addressed
- 2010 – ASHREA creates Air Barrier Standard – 5.4.3.1 Continuous Air Barrier: The entire building envelope shall be designed and constructed with a continuous air barrier.
- 2012 IECC – 502.4.1: A Continuous air barrier shall be provided throughout the building thermal envelope (Exception: Not required in Climate Zones 1, 2, 3)
- 2015 IECC - C402.5.1 A continuous air barrier shall be provided throughout the building thermal envelope. (Exception Climate Zone 2B, i.e. S. W. Texas, S.W. Arizona, S.E. California)

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Examples of Changing Demands

- Recent and Proposed Code Changes for Energy Efficiency
  - Increased R-value, U, C, & F Factor Requirements
  - Roof Deck Insulation R-Value
    - 2006 - Climate Zone 3 - R-15, Climate Zone 4 - R-15
    - 2009 - Climate Zone 3 - R-20, Climate Zone 4 - R-20
    - 2012 - Climate Zone 3 - R-20, Climate Zone 4 - R-25
    - 2015 - Climate Zone 3 - R-25, Climate Zone 4 - R-30
  - 2014 – LTTR Values change for PolyISO (6.0 per inch to 5.7 per inch)
  - Envelope Air Leakage - IECC 2015, prescriptive compliance or test with ASTM E779 (Standard Test Method for Determining Air Leakage Rate by Fan Pressurization)
  - Commissioning Requirements for HVAC Performance, Controls, Lighting, & Day Lighting Requirements
  - NFPA 285

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IECC 2015 - Section C402
Building Envelope Requirements

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 2 of Section C401.2

C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the R-value-based method of Section C402.1.3; the U, C, and F-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof Solar Reflectance and Thermal Emittance comply with Section C402.3.
3. Fenestration in Building Envelope Assemblies shall comply with Section C402.4.
4. Air Leakage of Building Envelope Assemblies shall comply with Section C402.5.

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Example of Changing Demands

ASHRAE U.S.
Climate Zone Map
2013 90.1

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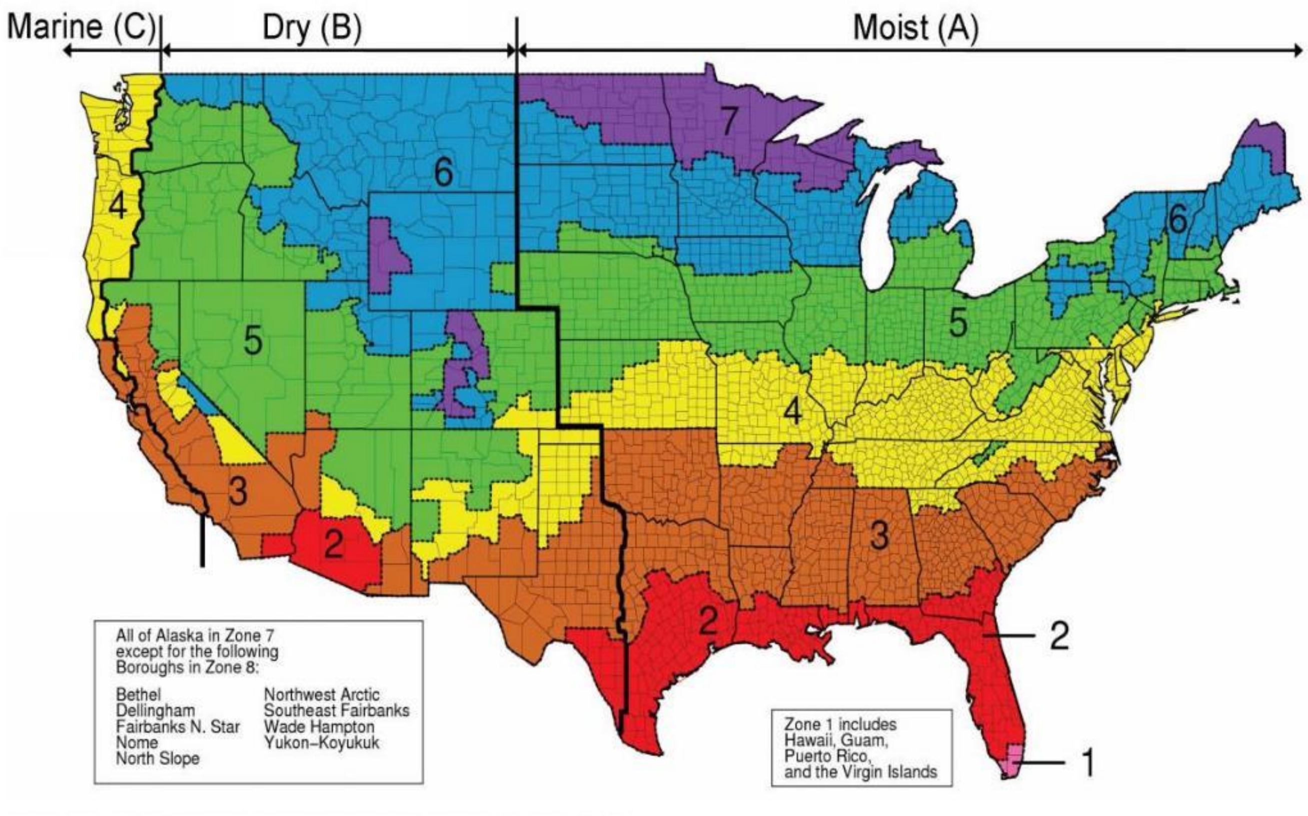

Figure B1-1 U.S. climate zone map (*ASHRAE Transactions*, Briggs et al., 2003).

ANSI/ASHRAE/IES Standard 90.1-2013 (SI Edition)

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Example of Changing Demands

IECC 2015
U.S. Climate
Zones

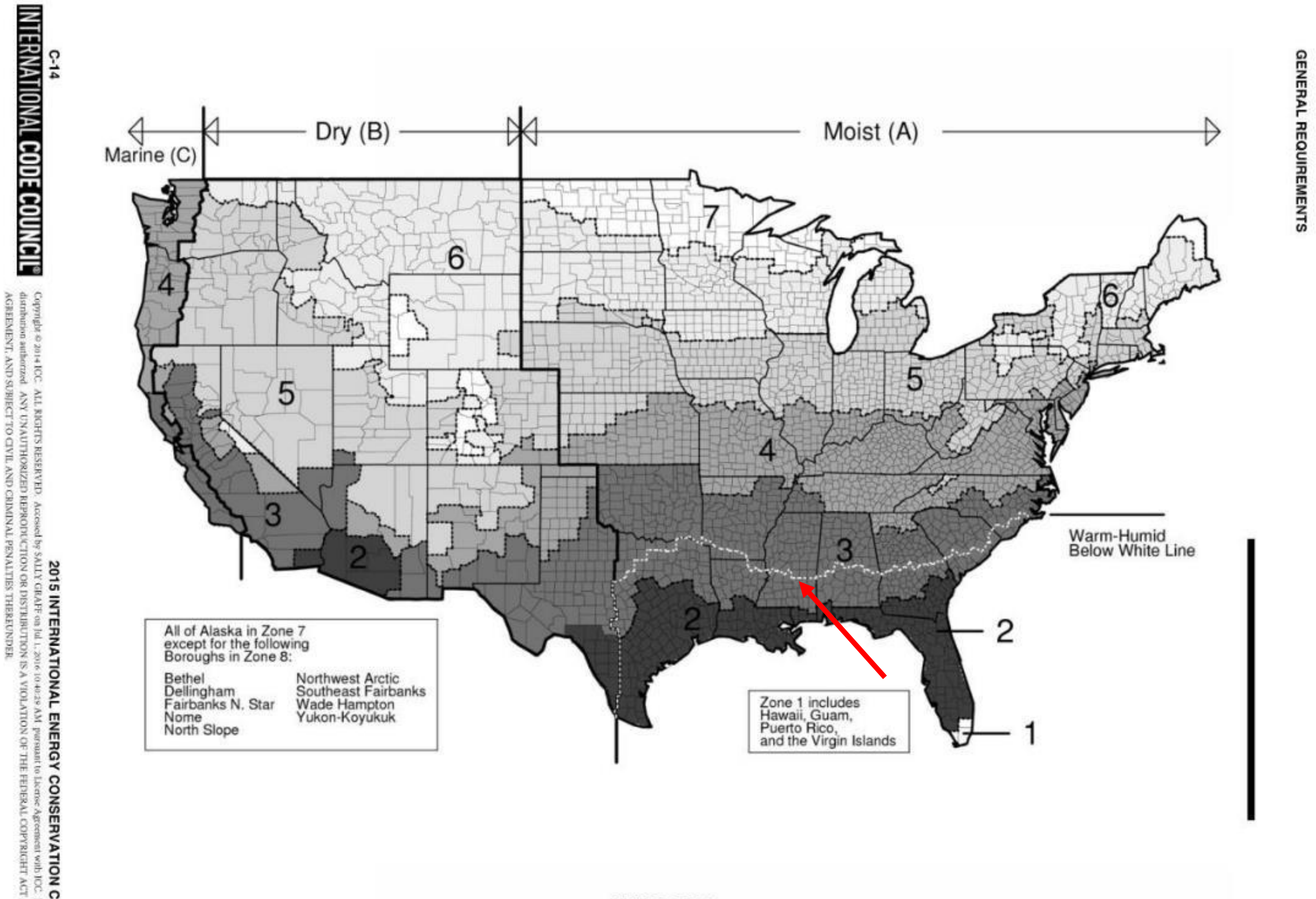

FIGURE C301.1
CLIMATE ZONES

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OK…we do things different now, how does this apply to my projects or my clients building?

Kids Clubhouse – Denison, TX

Guggenheim Museum – Bilbao Spain

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Demands & Expectations

Office/Manufacturing Warehouse
McKinney, Texas (Frank Gehry Concept)

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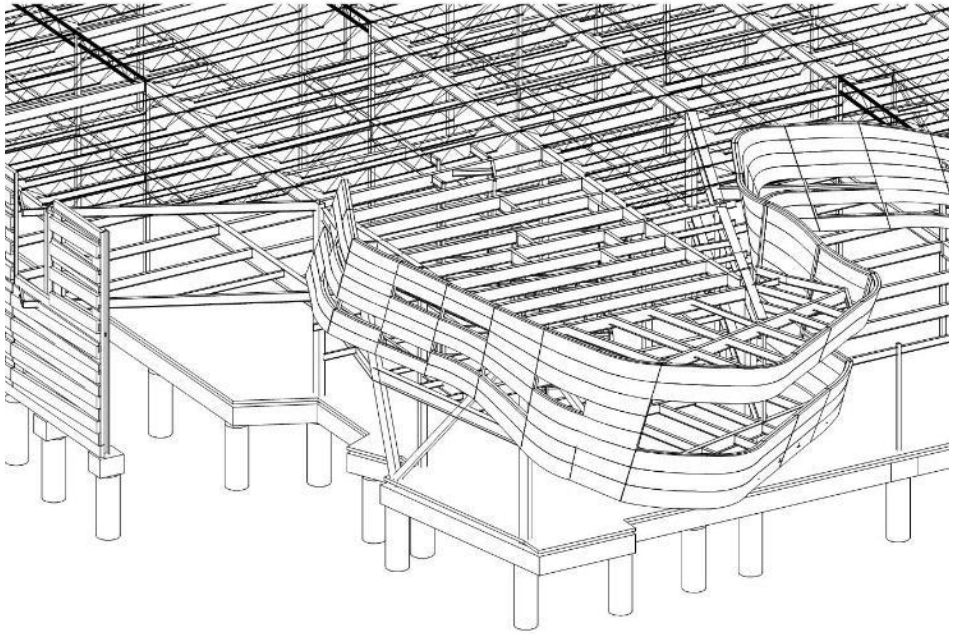
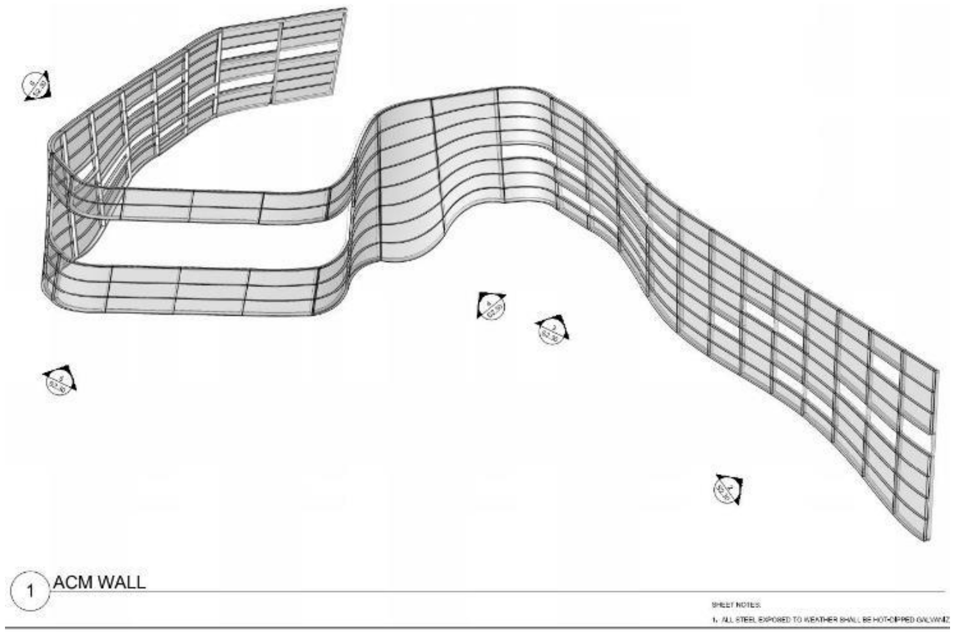
Demands & Expectations

Concept Details for ACM Cladding





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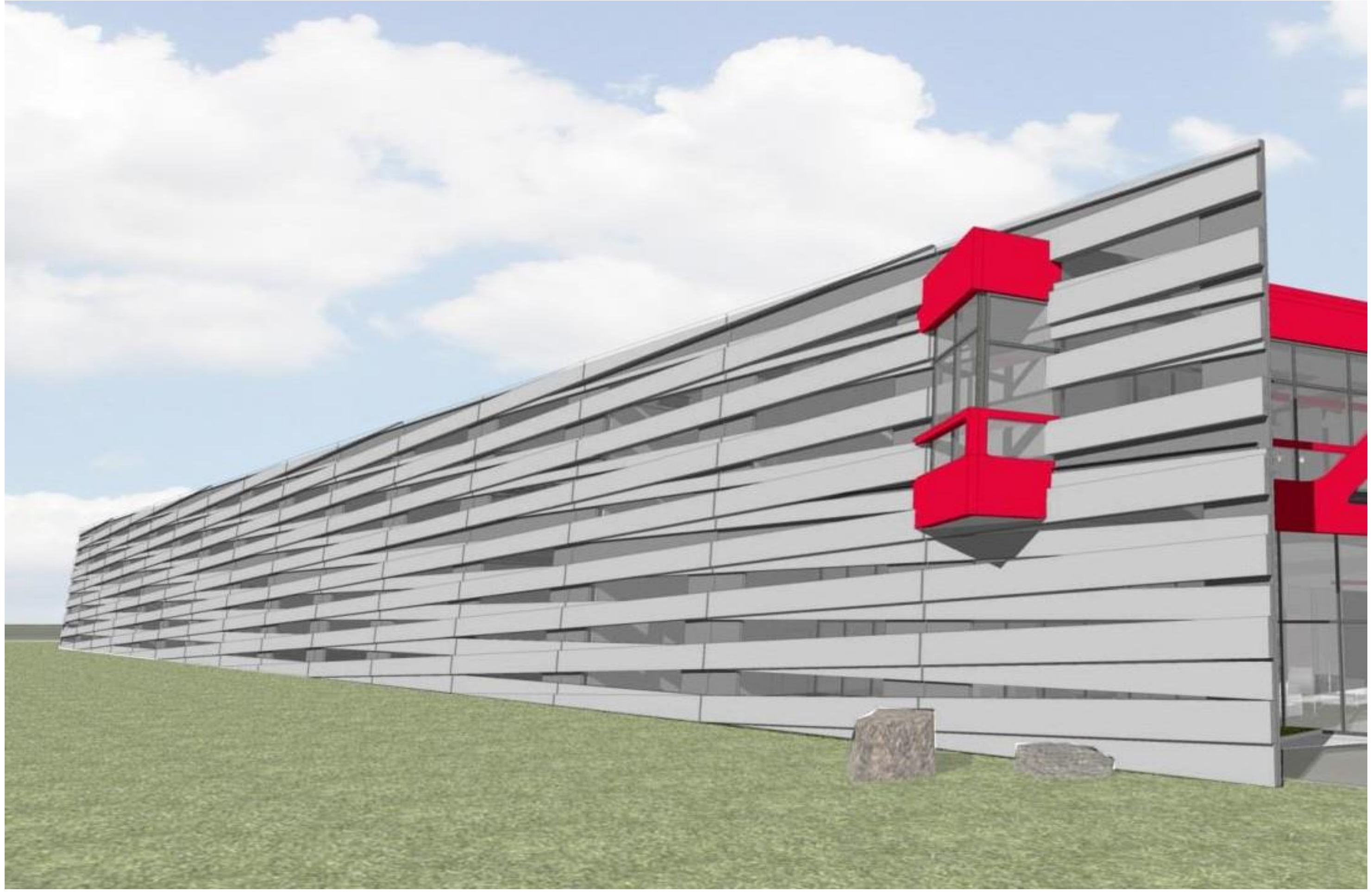
Demands & Expectations
Tilt Panel Relief Features



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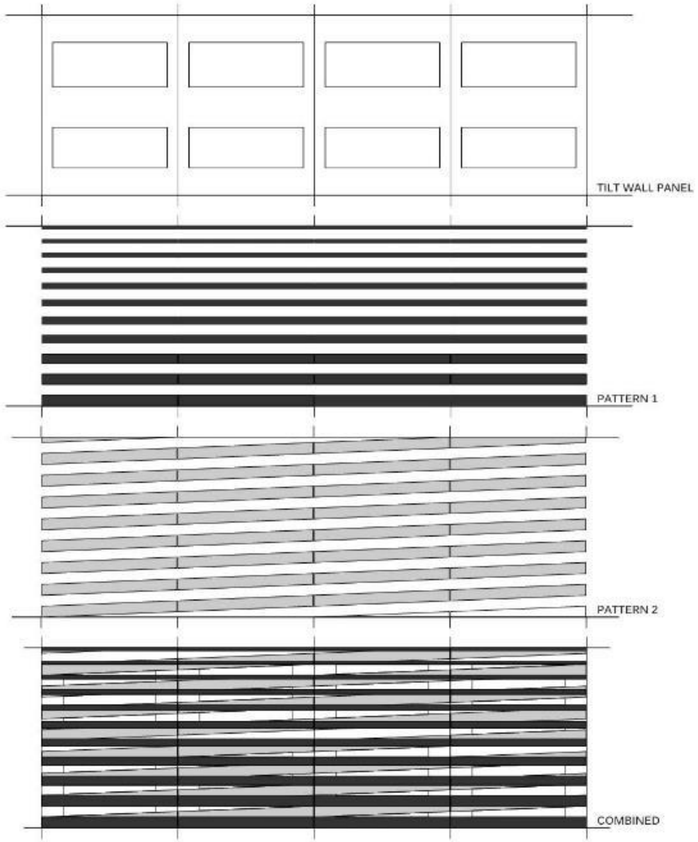
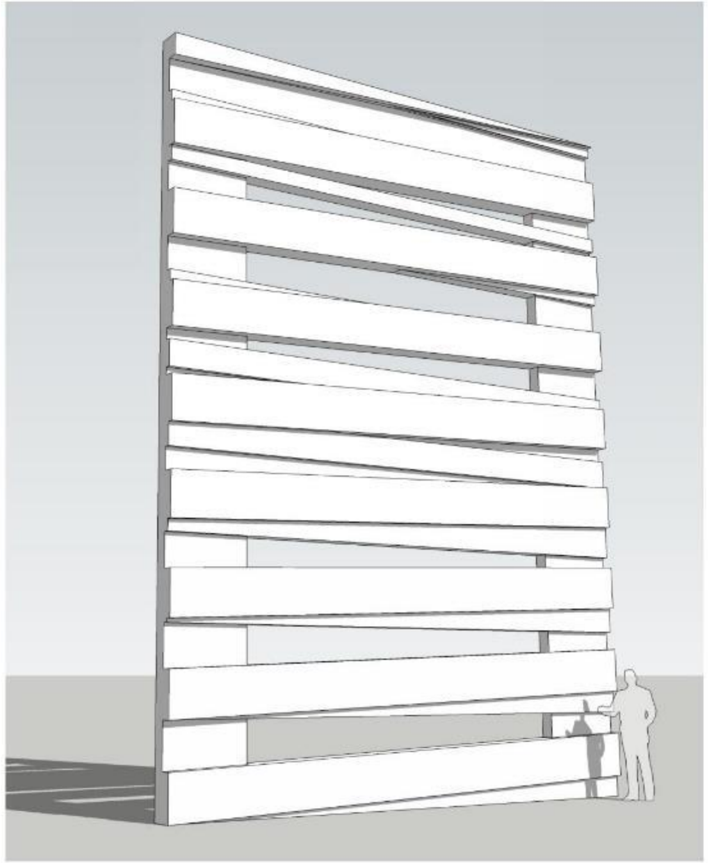
Demands & Expectations
Tilt Panel Relief Features





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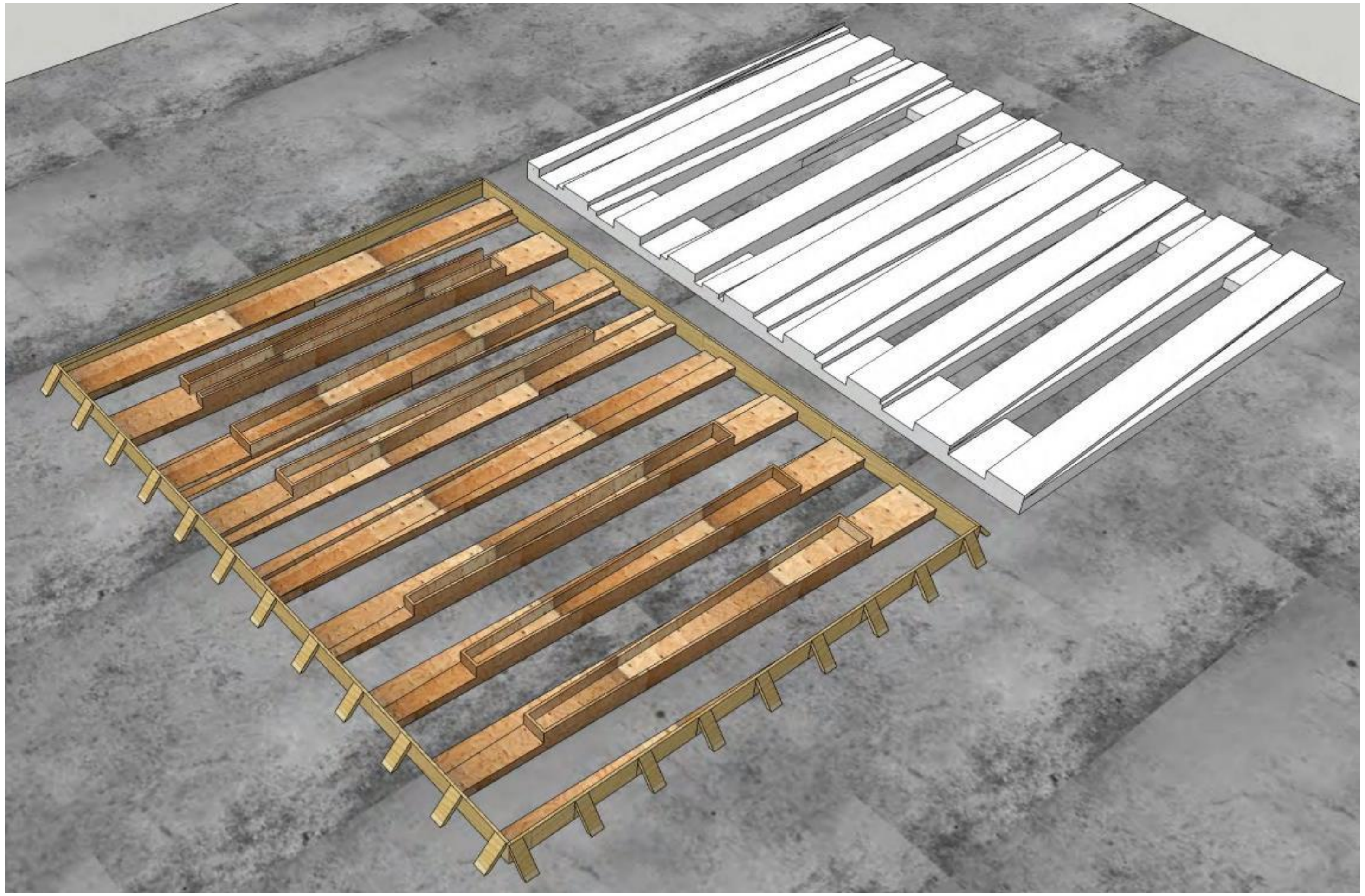
Demands & Expectations

Tilt Panel Formwork



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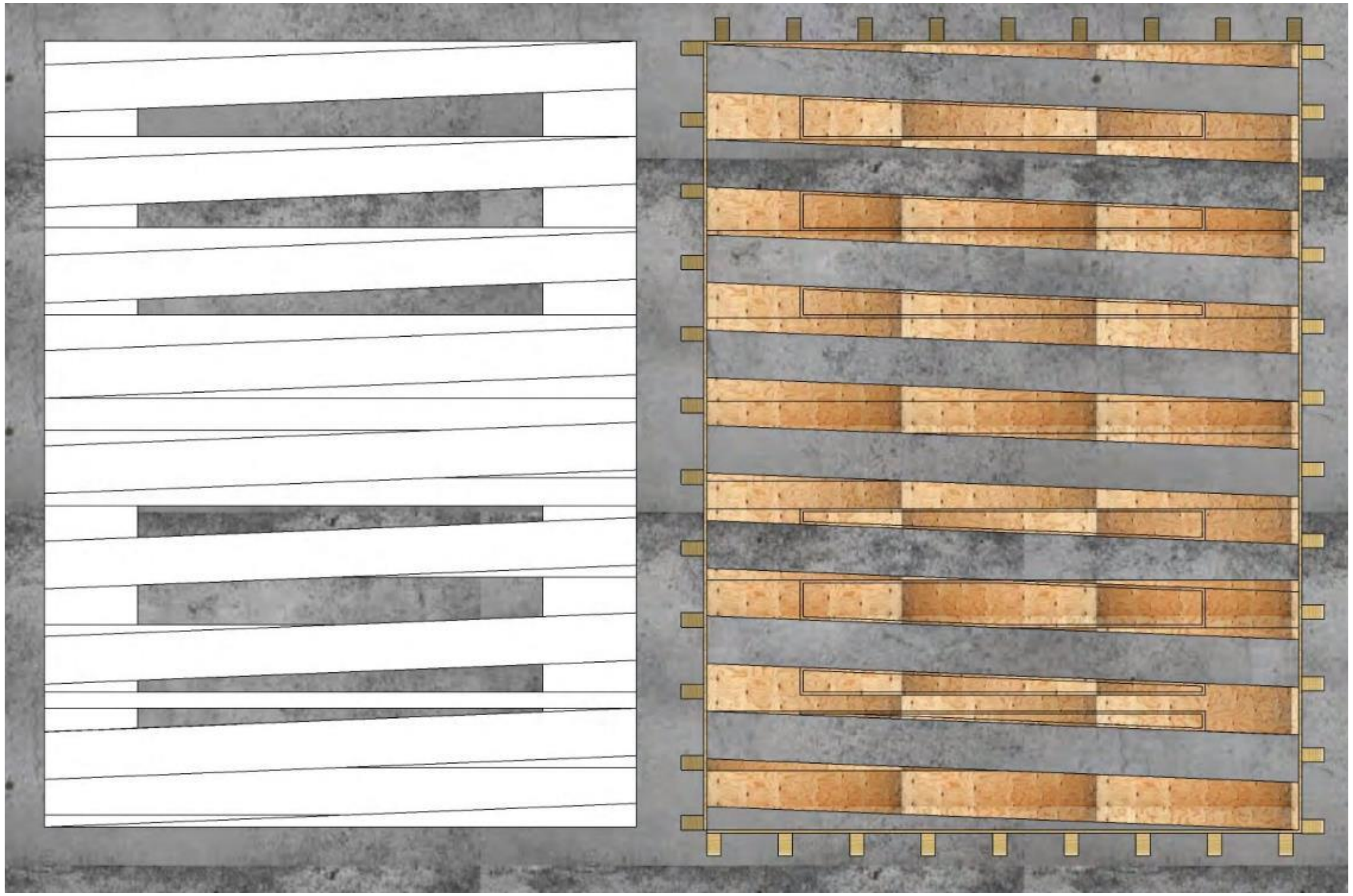
Demands & Expectations

Tilt Panel Formwork



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Demands & Expectations

Also Depend on
Existing Conditions

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Also Depend on
Existing Conditions

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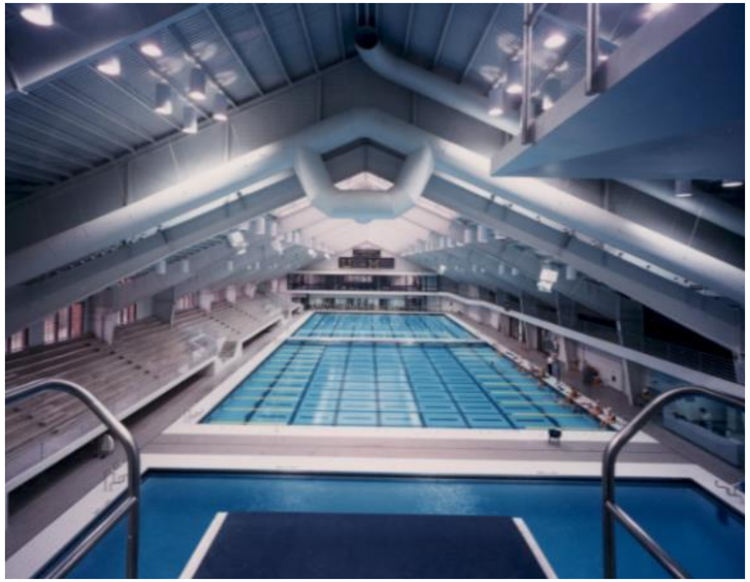
Demands & Expectations

Also Depend on Building Usage



Natatorium

Data Center

Surgical Center

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Demands & Expectations

Also Depend on
Code Requirements

Glazing & Cladding

Roof & Wall Insulation

Air Barrier

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Examples of Changing Technologies

- Air Barriers
  - Building Wraps
  - Sheet Goods
  - Fluid Applied
  - Factory Applied (Board Stock)
- Wall Claddings
  - Masonry (Brick, CMU, Stone, Engineered Stone, Granite, Carrera Marble)
  - Metal Panel (ACM, MCM, Standing Seam, External Fastened)
  - Fiber Cement Board (Panels, Siding)
  - EFIS/DAFS
  - Stucco (1, 2, 3, Coat Systems)

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Examples of Changing Technologies

- Roof Systems
  - Built-up Roofing
  - Modified Bitumen (Mopped, Torch, Cold Process, Peel & Stick)
  - Single ply (PVC, TPO, EPDM, Peel & Stick)
  - Fluid Applied
  - Tile (Clay, Slate, Concrete)

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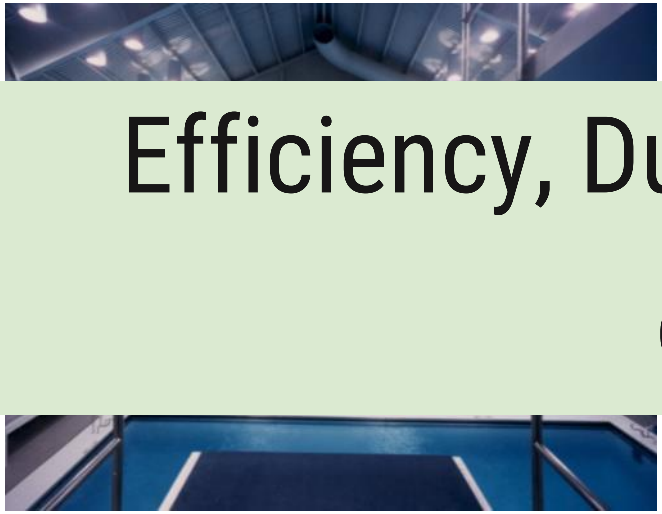
Demands | Expectations | Technology
Building Usage & Type |
Energy Efficiency | Existing Conditions
Contribute to…



Efficiency, Durability, & **Sustainability**

of Buildings

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Efficiency, Durability, & Sustainability Create…

Value

Value - The worth of all the benefits and rights arising from ownership. Two types of economic value are (1) the utility of a good or service, and (2) power of a good or service to command other goods, services, or money, in voluntary exchange.

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Value is Determined by…

- Where Owner Expectations Achieved
- Did Project Deliverables Meet Contract Requirements
- Were Projects Delivered within Cost, Time & Scope

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If we are so advanced, why do buildings still leak?

Terminations

Penetrations

Transitions

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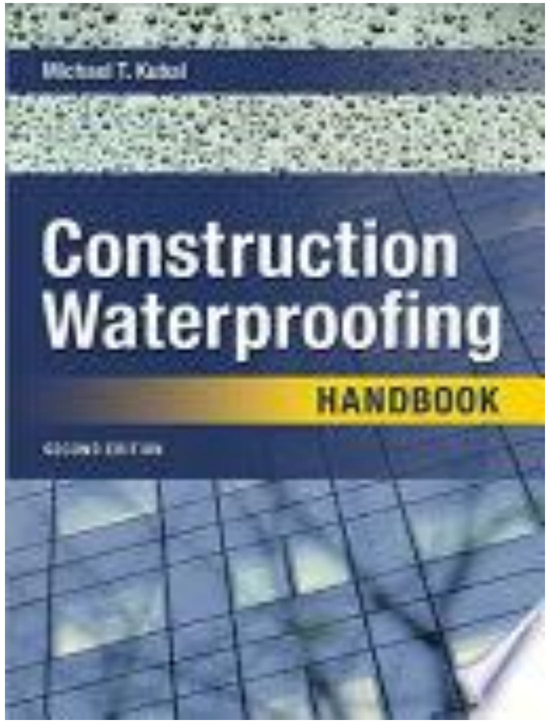
Michael T. Kubal – Construction Waterproofing Handbook



Two Important Waterproofing Principals

90%/1% Principal

99% Principal

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The Most Important Waterproofing Principal

THE MOST IMPORTANT WATERPROOFING PRINCIPLE

Each separate envelope trade contractor's work, regardless of its being thought of as a waterproofing system or not (e.g., exterior mechanical apparatus), must become part of a totally watertight building envelope. Equally important, all individual envelope systems must be adequately transitioned into other components or provided with watertight terminations. Often the tradesworkers completing this work are not aware of, trained in, or supervised in enveloping a building properly. And this is the number one cause of water infiltration in all types of structures.

The resulting improper attention to details is responsible for countless problems in construction. Properly detailing a building's envelope presents an enormous task. From inception to installation, numerous obstacles occur. Highlighting this interrelationship of various envelope systems is the most important principle of waterproofing:

The 90%/1% principle: 90 percent of all water intrusion problems occur within 1 percent of the total building or structure exterior surface area.

This 1 percent of a building's exterior skin area contains the termination and transition detailing, as discussed previously with Fig. 1.9. This 1 percent area all too frequently leads to breaches and complete failure of the effectiveness of the building envelope and is the main cause of all waterproofing problems.

Industry members, including contractors, designers, and manufacturers, now are recognizing the importance of the 90%/1% principle first introduce by the author. Architects must

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2nd Most Important Waterproofing Principal

THE SECOND MOST IMPORTANT PRINCIPLE OF WATERPROOFING

The inattention to detail is often exacerbated by overall poor workmanship that presents the next most important principle of waterproofing:

The 99% principle: Approximately 99 percent of waterproofing leaks are attributable to causes other than material or system failures.

When considering the millions of square feet of waterproofing systems installed, both barrier and drainage systems, and miles of sealant involved in building envelopes, it can be estimated that only 1 percent of envelope failures and resulting leakage is actually attributable to materials or systems actually failing. The reasons typically involved in failures include human installation errors, the wrong system being specified for in-place service requirements (e.g., thermal movement encountered exceeds the material's capability), the wrong or no primer being used, inadequate preparatory work, incompatible materials being transitioned together, and insufficient—or in certain cases such as sealants, too much—material being applied.

Today, with quality controls and testing being instituted at the manufacturing stage, it is very infrequent that actual material failures occur. For example, it is rare to have an outright material failure of a below-grade liquid-applied membrane, as presented in Chap. 2. More

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So you told us where buildings leak, but still haven’t said why?

Specialization

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Specialization Occurs in All Areas of Building Construction

Architects, Engineers, Consultants	Manufacturers	Contractors
		
Design	Materials	Installation

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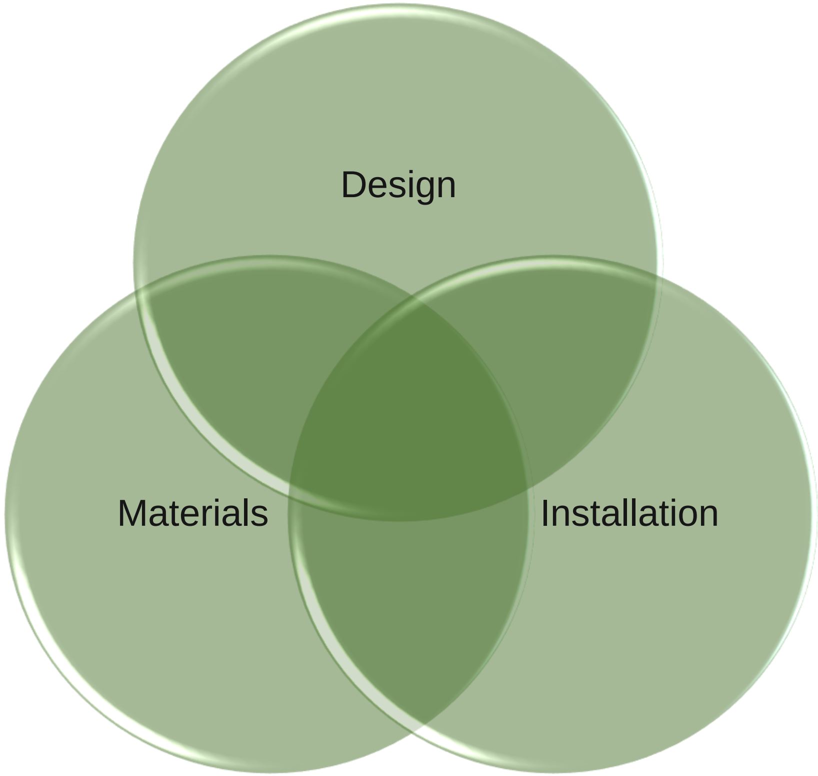
If we know where and why leaks happen, what's the solution?

We need to expand our understanding of the Building Envelope Concept and develop a better understanding of …

The Integrated Weather Barrier!



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Integrated Weather Barrier Concept Seems Good How is That Possible in the Real World?

- To understand this concept we need to discuss and understand the relationships between the Three Facets (Components) of Every Project
  - Design
  - Materials
  - Installation

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Projects Limited by Relationships Between Design, Materials, & Installation

- **Design**
  - Limited by constraints (i.e. time, cost, scope/stake holder requirements, & existing conditions).
  - **Key Concept - <u>Solve Issues While it's Still a Paper Mess</u>**
- **Materials**
  - One type/size/idea definitely does not fit all conditions
  - Material Compatibility - the application and performance of the materials selected, must be appropriate for the intended conditions, readily available, and consistently applicable in field conditions (sealant example)
- **Installation**
  - Being expert at installing product X does not equate to being expert at installing product Y (Specialization)

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Now we know where and why leaks happen, what's the solution?

- Consider building envelope components collectively!
- Design and construct an Integrated Weather Barrier
- Identify & coordinate all stakeholders (owner, designer, manufacturers, contractors, etc.) to fully develop project requirements and create buy-in at conceptual design phases (SD & DD)
- Identify project risks associated with design, materials, and installation and establish appropriate plans & contingencies to mitigate risks

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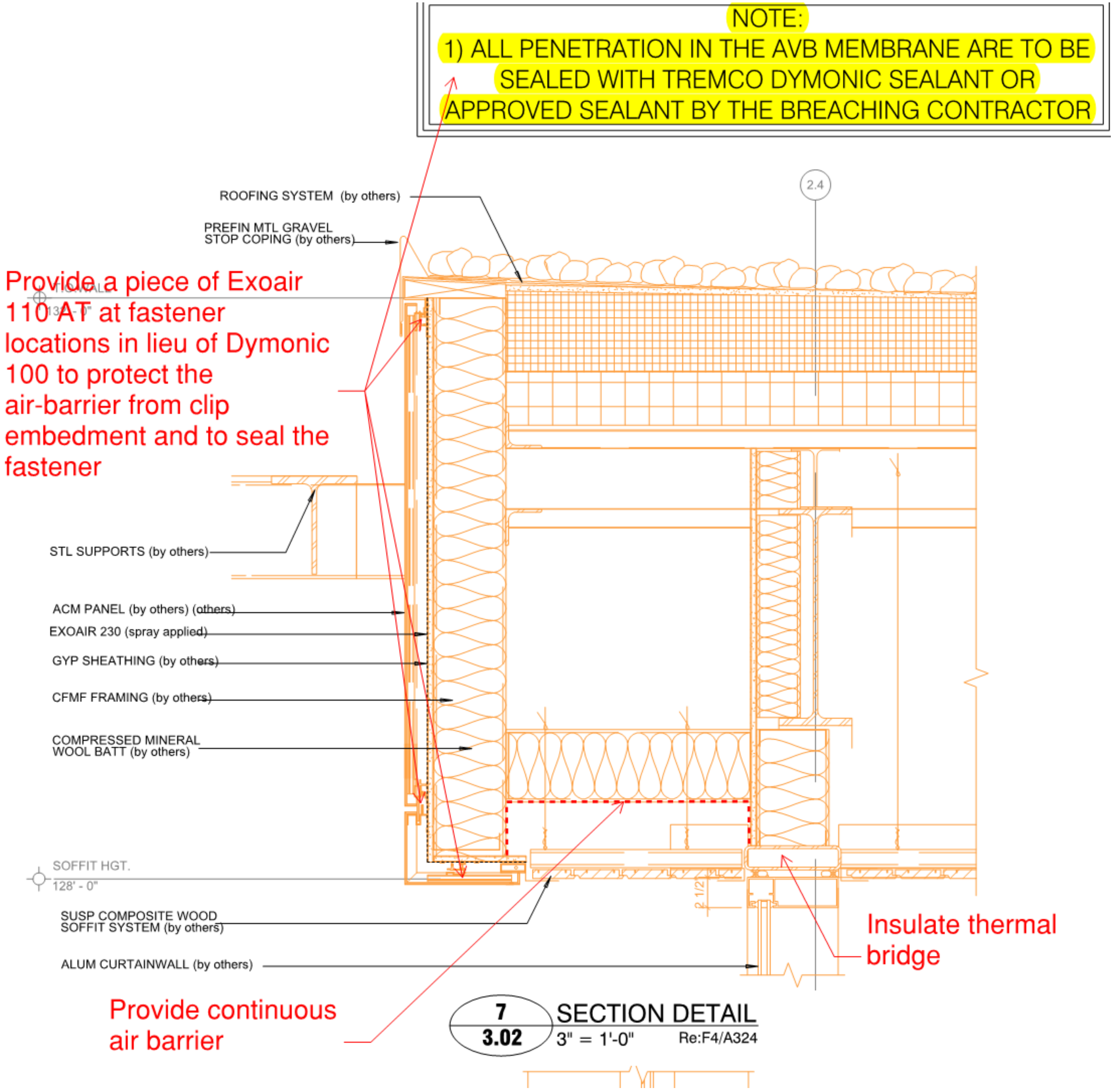
Review Design, Materials, & Feasibility of Installation Prior to Construction



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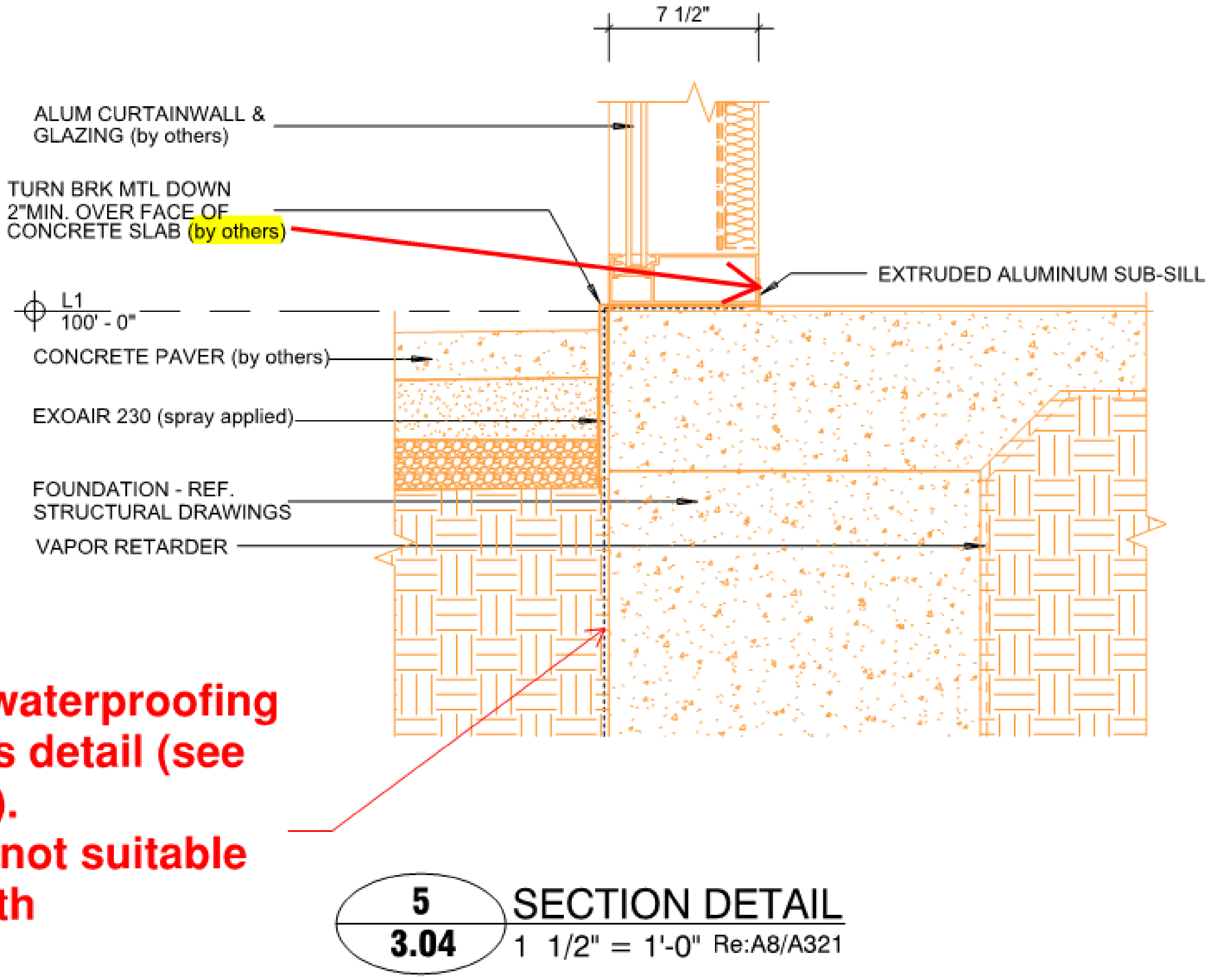
Review Design, Materials, & Feasibility of Installation Prior to Construction



Provide below grade waterproofing and drain board at this detail (see spec section 07 13 26).
Confirmed product is not suitable for this application with manufacturer.

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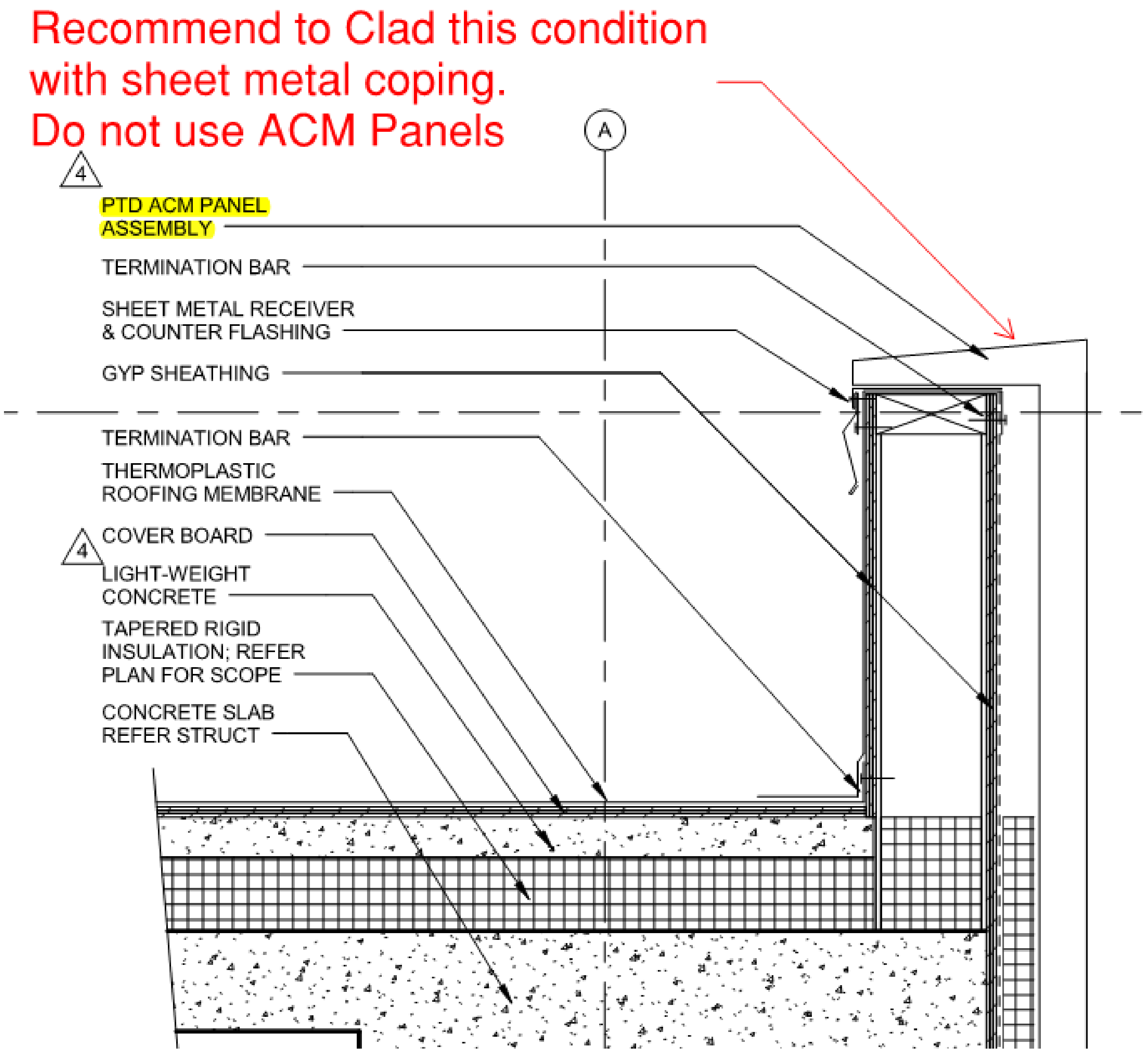
Review Design, Materials, & Feasibility of Installation Prior to Construction



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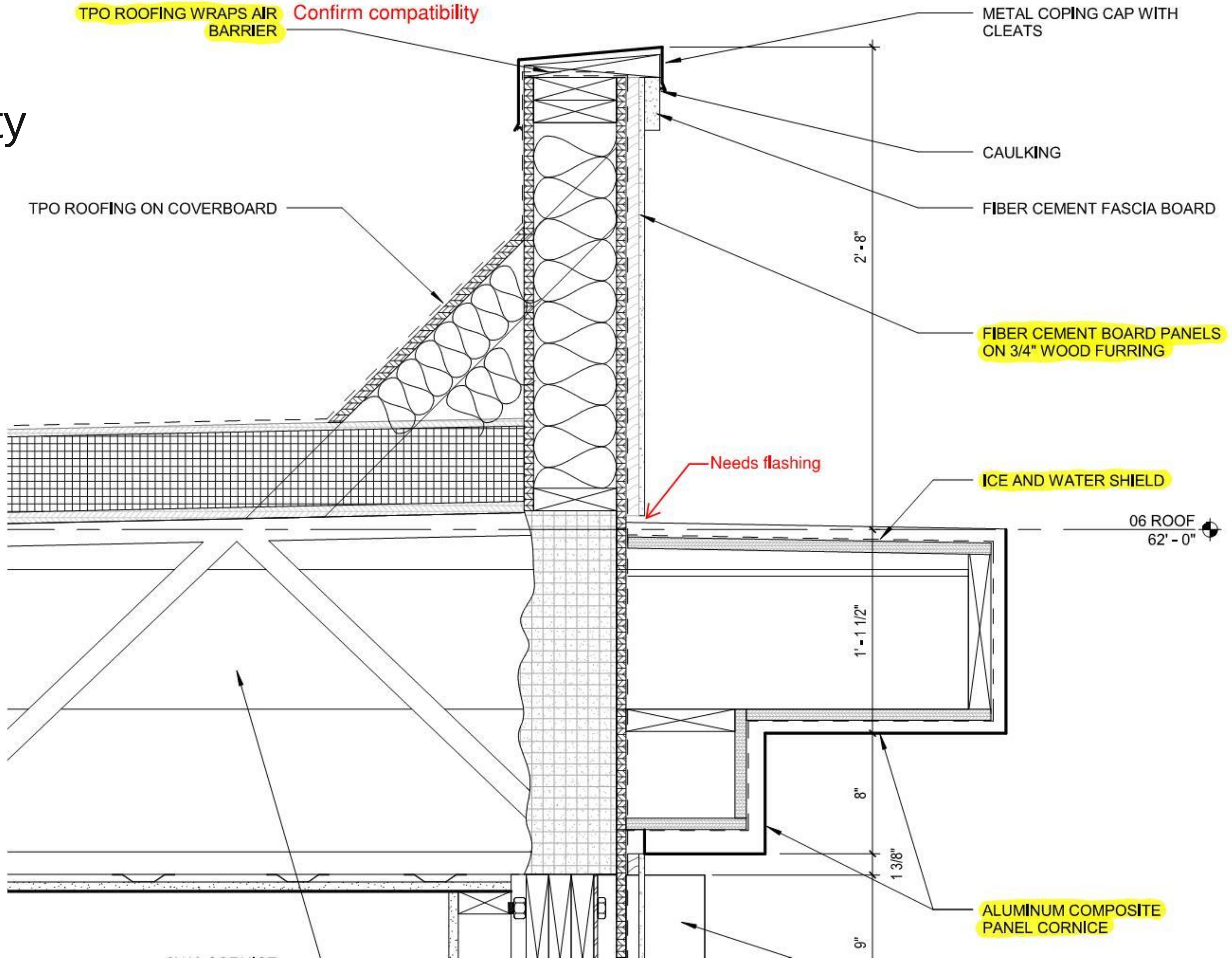
Review Design, Materials, & Feasibility of Installation Prior to Construction



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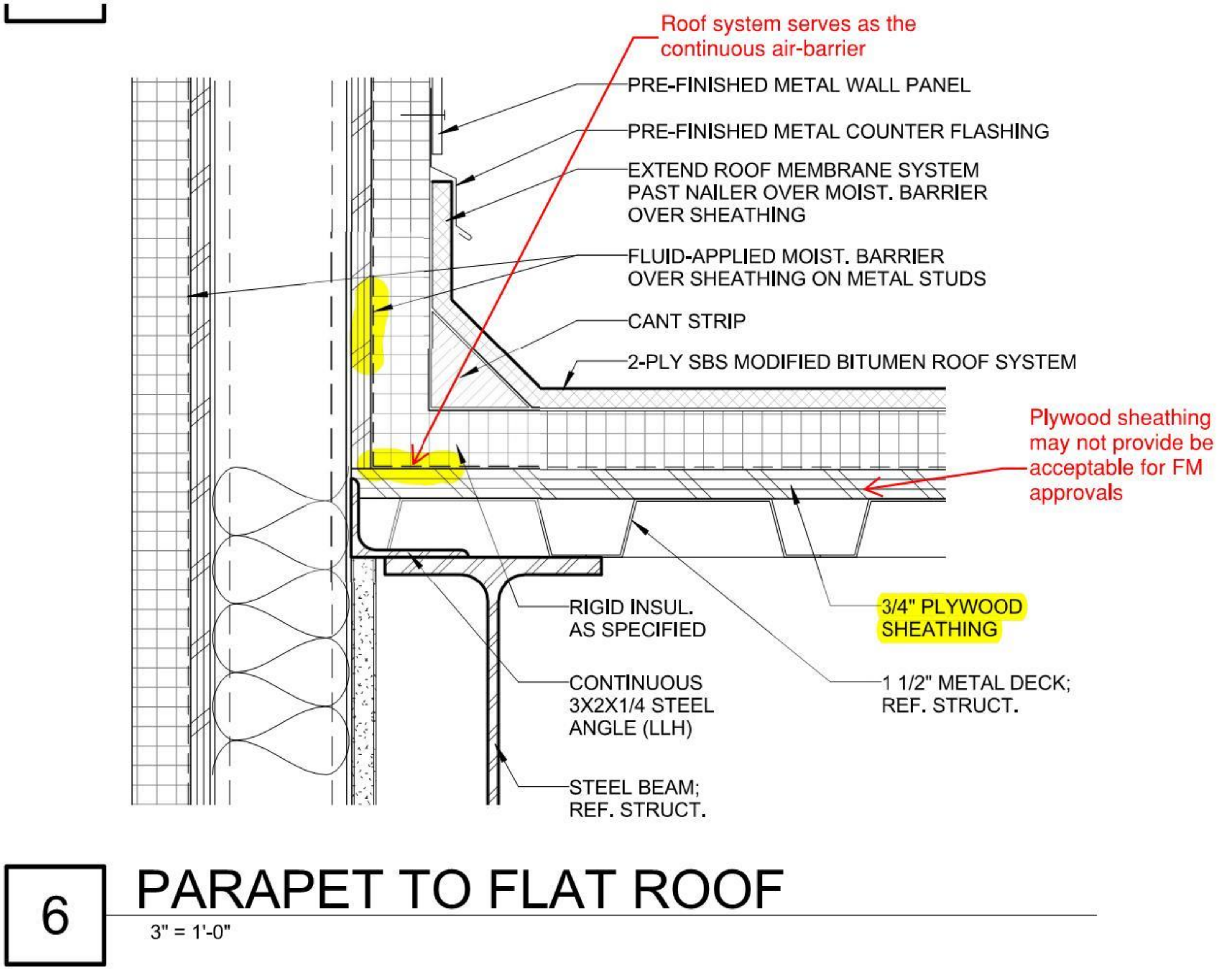
Review Design, Materials, & Feasibility of Installation Prior to Construction



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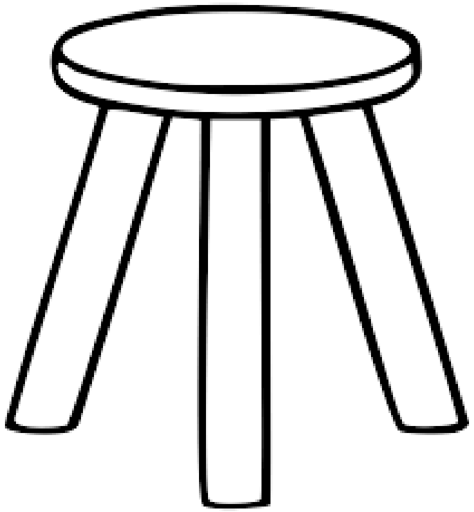
The Three-Legged Stool Project Model

Owner – Holds Resources, Desires Deliverables

If one of the legs collapses, project deliverables effected, Owner suffers



Designer Team
- Architect
- Engineer
- Consultant

General Contractor
Sub-contractors

Manufacturers

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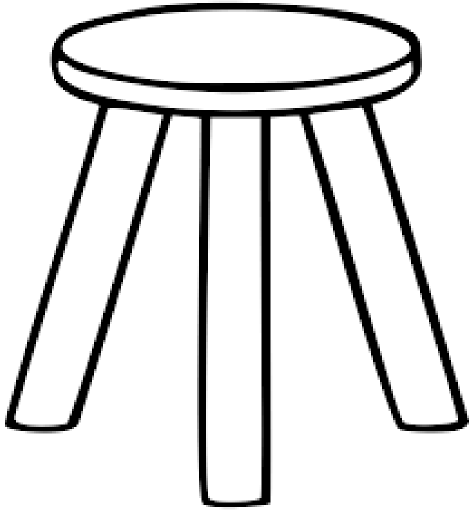
Three-Legged Stool Resource Model

Constrained Project Resources

Owner



Cost

Time

Scope/Quality

If one of the legs collapses, project deliverables effected, Owner suffers

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Sounds great for new construction, what about existing buildings?

- The 3 facets for <u>every</u> project
- Design
- Materials
- Installation
- The main difference between renovation and new construction– Good Forensics!
- Existing structures require comprehensive evaluation to understand the existing conditions

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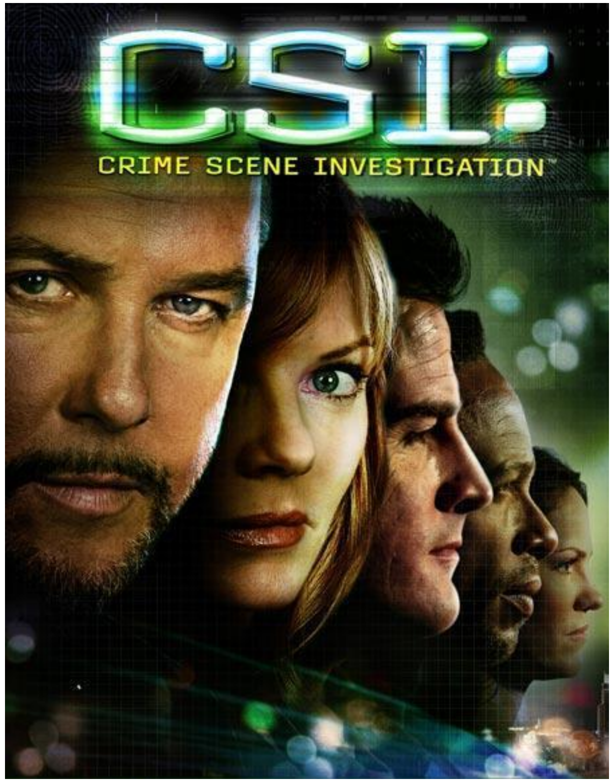
Evaluating an Existing Building is Like Being a Crime Scene Investigator…



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Evaluate & Confirm Existing Conditions Prior to Design

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Evaluate & Confirm Existing Conditions Prior to Design

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Post Design
As-Built Conditions

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Post Design
As-built Conditions

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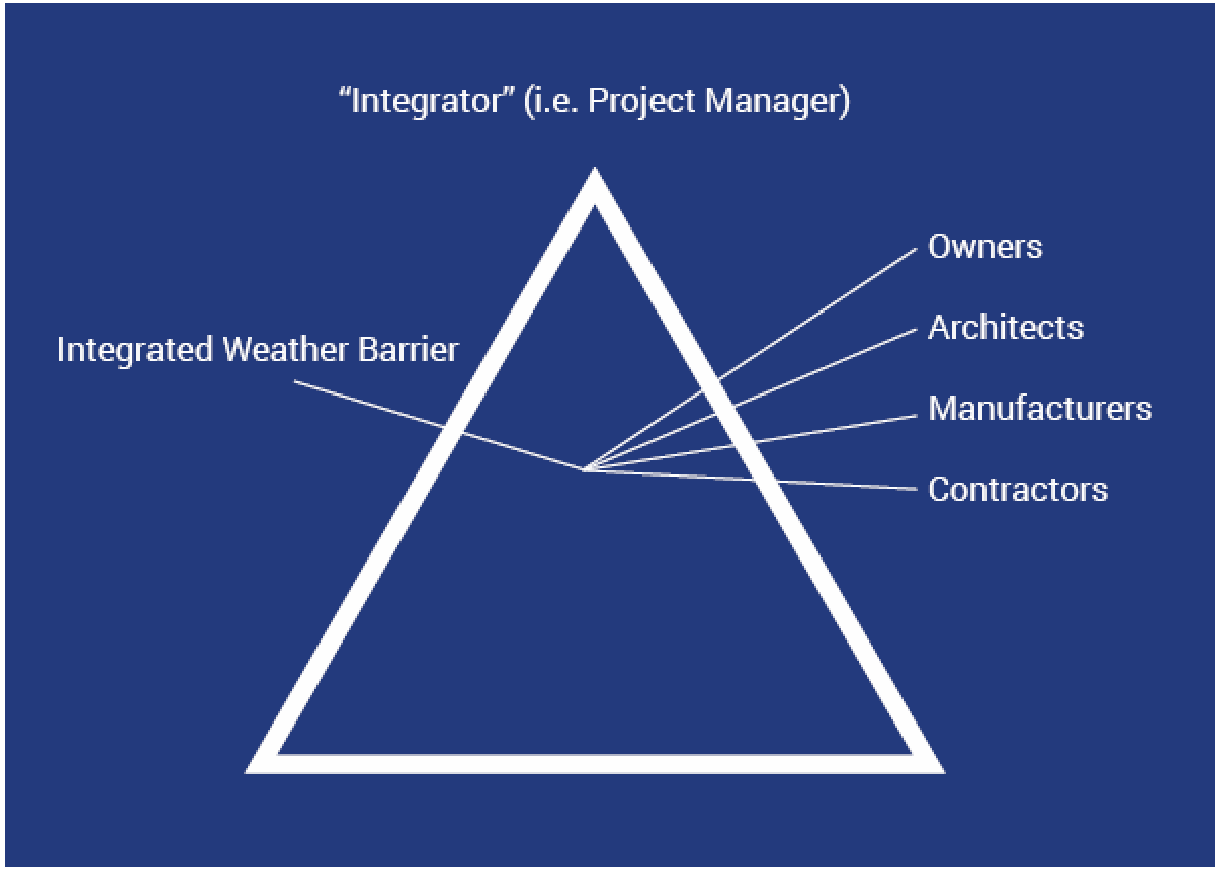
How do we put Integrating the Weather Barrier into practice?

Select, Develop, and Resource, and Support a Project Integrator



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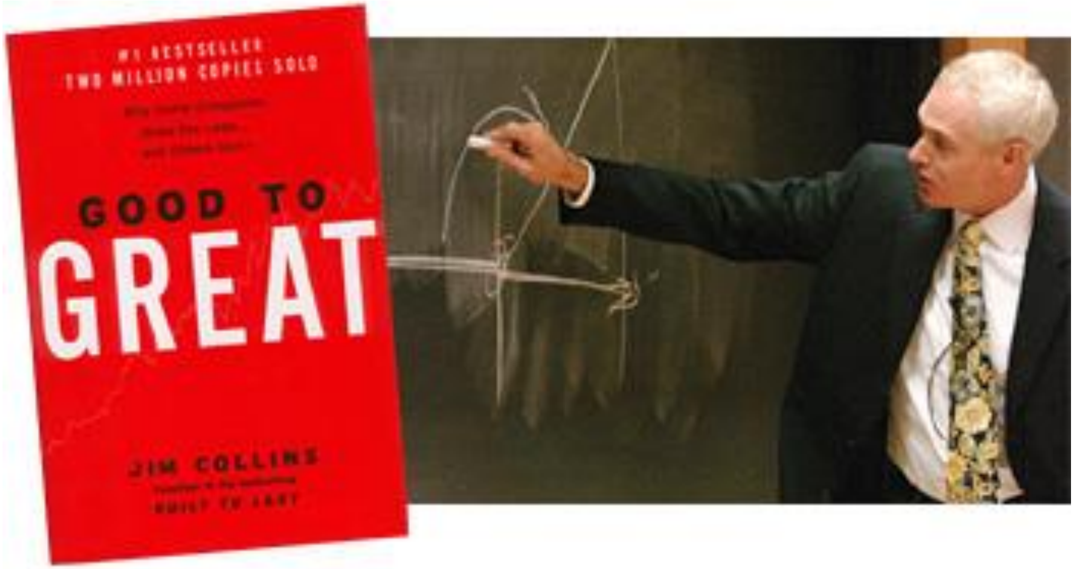
Recommended Practices

1. Build a Integrated Weather Barrier team and have a dedicated “Integrator”

Jim Collins – “Get the right people on the bus…” because people aren’t your #1 asset – the Right people are!”



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Recommended Practices

1. Establish an Integrated Weather Barrier as a top priority with Owner buy-in and hold to it!
2. Use value engineering judiciously

Benjamin Franklin – "The bitterness of poor quality remains long after low pricing is forgotten"

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Recommended Practices

3. Clearly define that the goal of an Integrated Weather Barrier is everyone's responsibility

King Solomon
Proverbs 29:18 –
“Where there is no vision the people perish”
KJV

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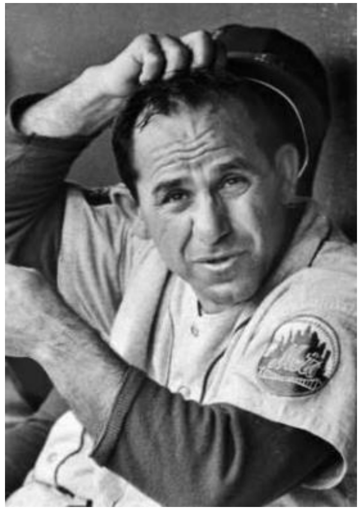
Recommended Practices

4. Implement a process that coordinates all parties on the team.

Yogi Berra – " We made too many wrong mistakes"

On why the Yankees lost the 1960 series to the Pittsburgh Pirates.



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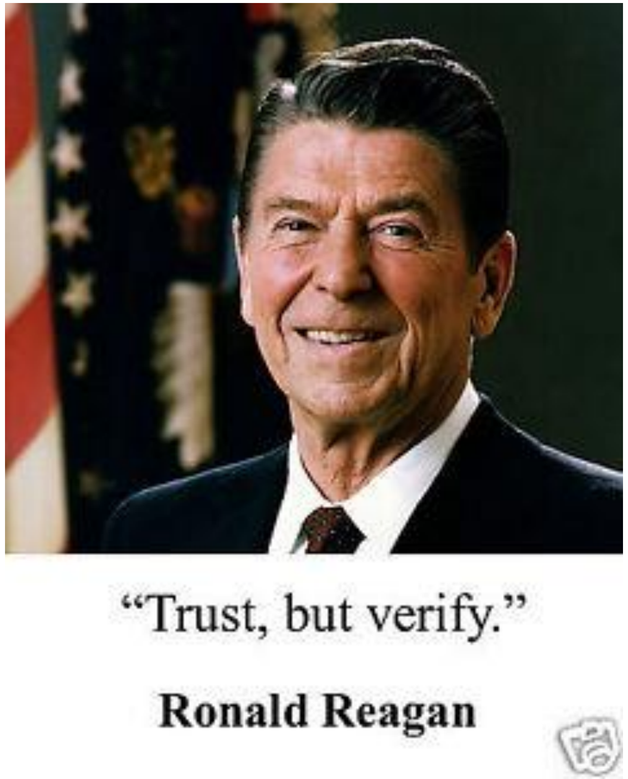
Recommended Practices

5. Have Accountability for every phase of the project

Russian Proverb

Доверяй, но проверяй

“Trust, but verify”



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A Call to Action

1. Commit to the process
2. Collaborate with the team
3. Connect the pieces

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Thank you for your time today!

Questions?