Air Barrier Training for Owners, Architects, Construction Managers, and General Contractors

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WDP & Associates Consulting Engineers, Inc.

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CONTINUING EDUCATION
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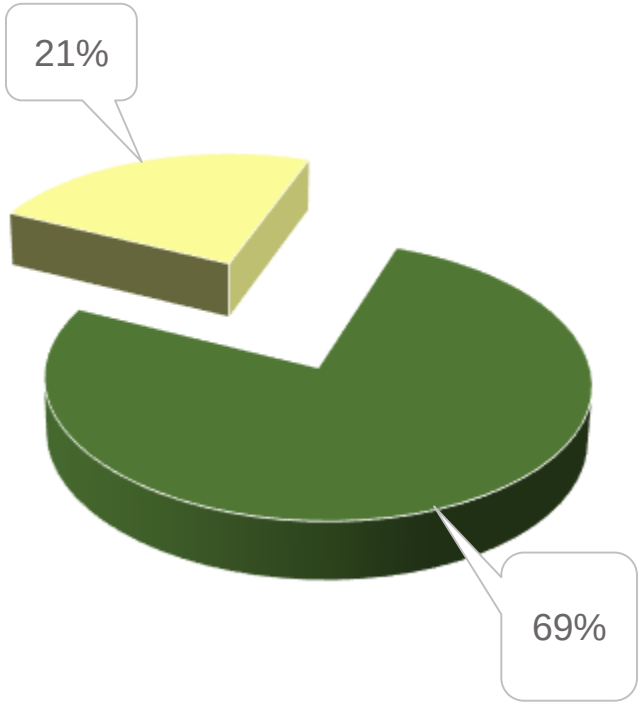
Why Air Barriers – Construction Claims

2007 Survey Data from 6 of the
7 largest U.S. Sureties:

- 84% Moisture Related
- 69% Moisture Related Issues with Building Envelope



K.R. Grosskopf, Ph.D.; P. Oppenheim, Ph.D., P.E; and T. Brennan. "Preventing Defect Claims in Hot, Humid Climates." July 2008.

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Why Air Barriers?

- Impacts to Operations

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Why Air Barriers?

- Impacts to Operations

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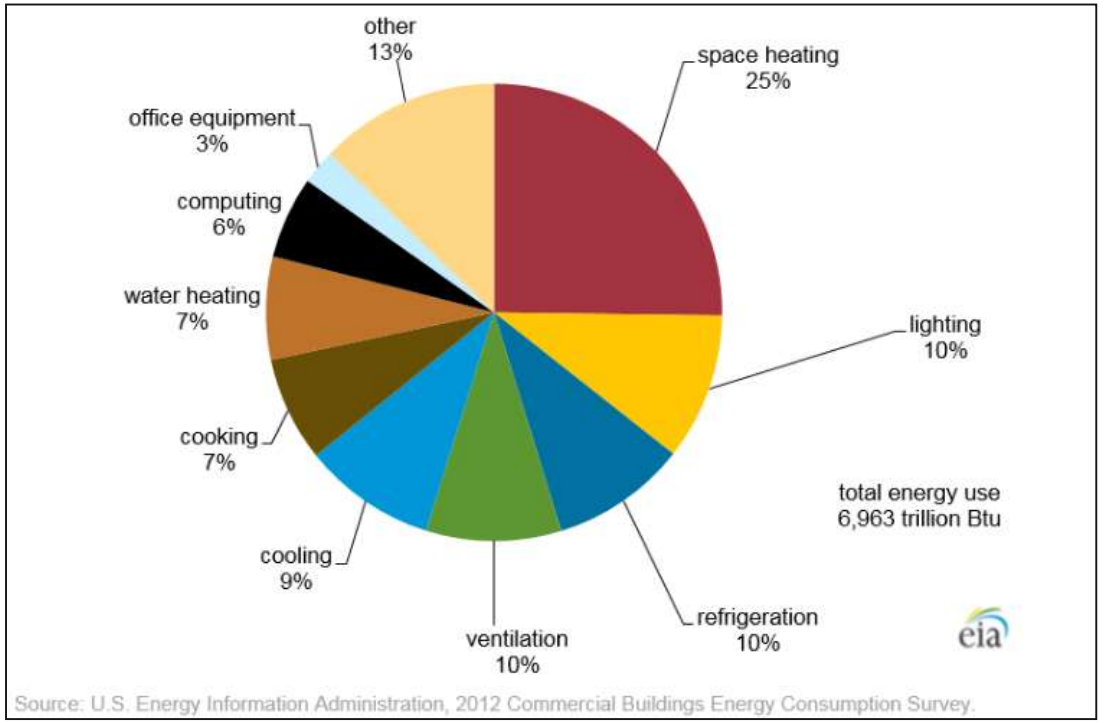
Why Air Barriers

- 44% of Energy Consumption is tied to HVAC and the Building Envelope



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Why Air Barriers

- Performance - control movement of heat and moisture
  - Impacts Durability
  - Impacts Operation Costs
  - Impacts Occupant Comfort

- Codes and Standards

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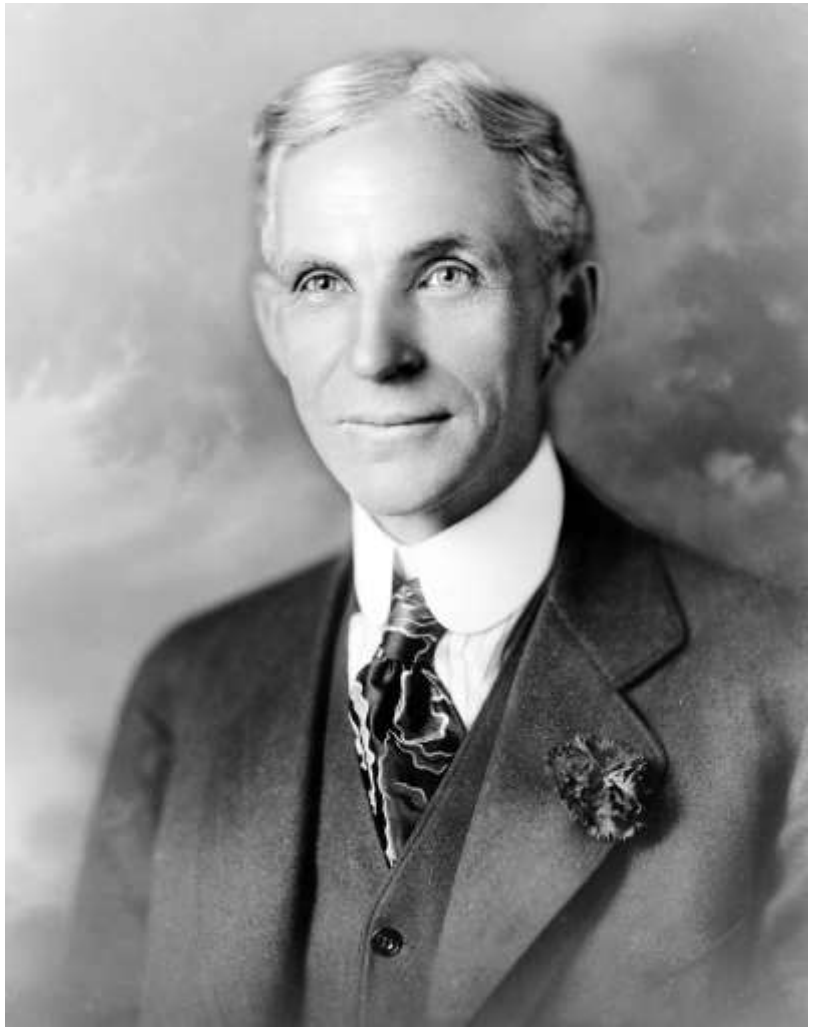
Successful Incorporation of Air Barriers Requires Collaboration

“Coming together is a beginning, staying together is progress, and working together is success” – Henry Ford



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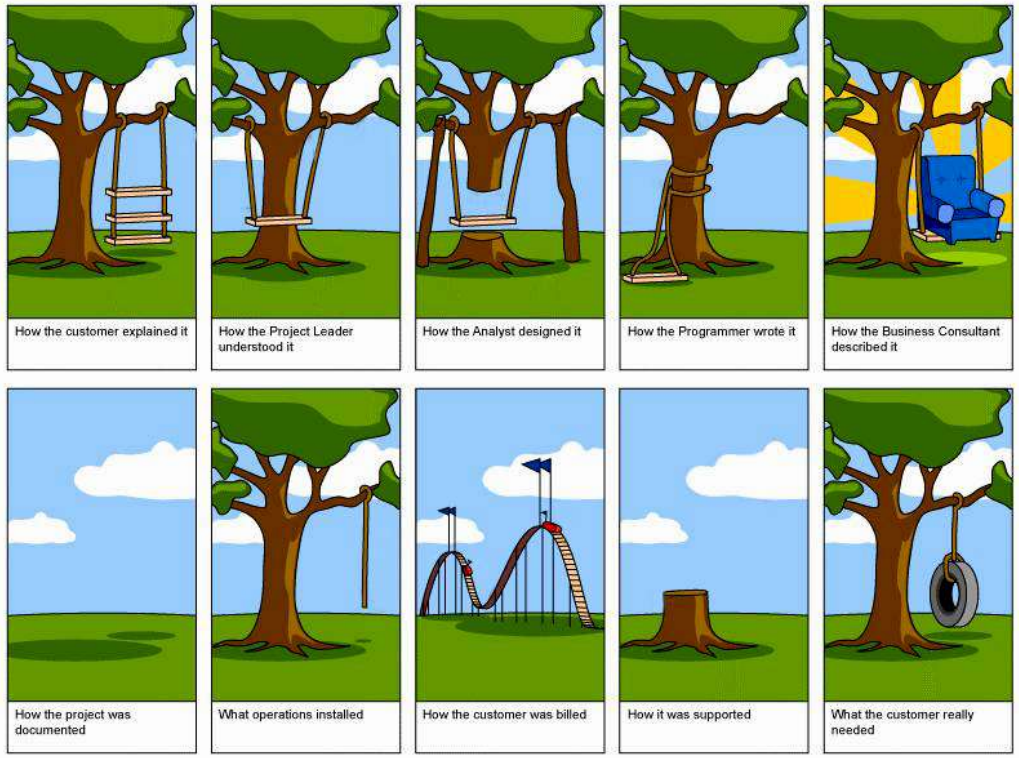
Owner Responsibilities

Owner Must Establish Expectations

- Anticipated Life Cycle
- Energy Goals
- Certification and Accreditation Goals
- Code Compliance Options



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Owner Responsibilities

Expectations should be:

- Defined Early
- Documented and Referenceable
- Distributed to Project Team

Tools:

- BECx
- OPRS
- Design Guidelines

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Owner Responsibilities - OPRs

- Can be specific or general
- Provide a reference document for project decisions

Examples

- Air barrier materials shall have an air permeability <0.004 cfm/ft² at pressure of 0.3 inches of water.
- All shop drawing submittals should show air barrier integrations and be coordinated between trades
- Project shall follow ABAA QAC Plan

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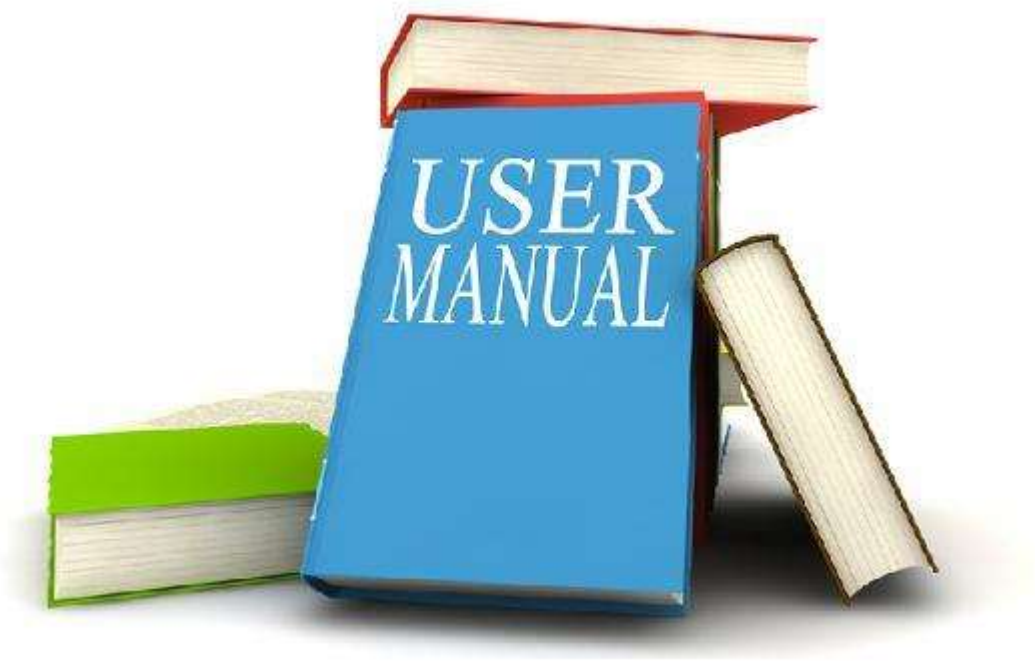
Owner Responsibilities – Design Guidelines

- Set standards for materials, procedures, and aesthetics
- Include material requirements
- Include QAC and field testing requirements



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Designer Responsibilities

- Interpret and Communicate Owner Expectations in Design Elements
- Proper Material Selection
- Incorporate necessary checks to ensure expectations are met

Tools

- Schematic Design and Programming meetings
- Hygrothermal Analysis
- Division 01 40 00 – Quality Requirements
- ABAA QAP
- Coordinated Shop Drawings
- Mockups
- Field Testing

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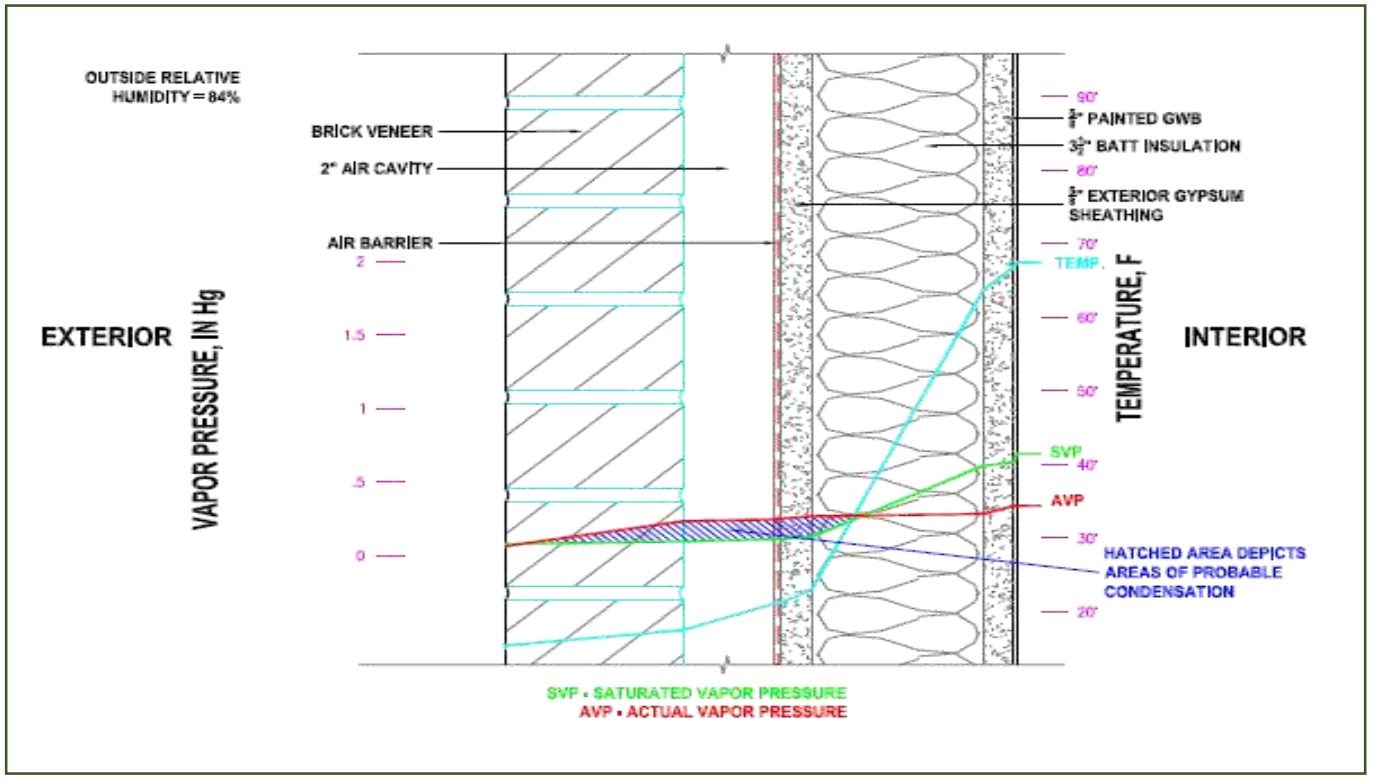
Material Selection Using Steady State Analysis

Single Point-in-Time analysis of heat and moisture movement across wall assembly based when exposed to a thermal and vapor gradient.



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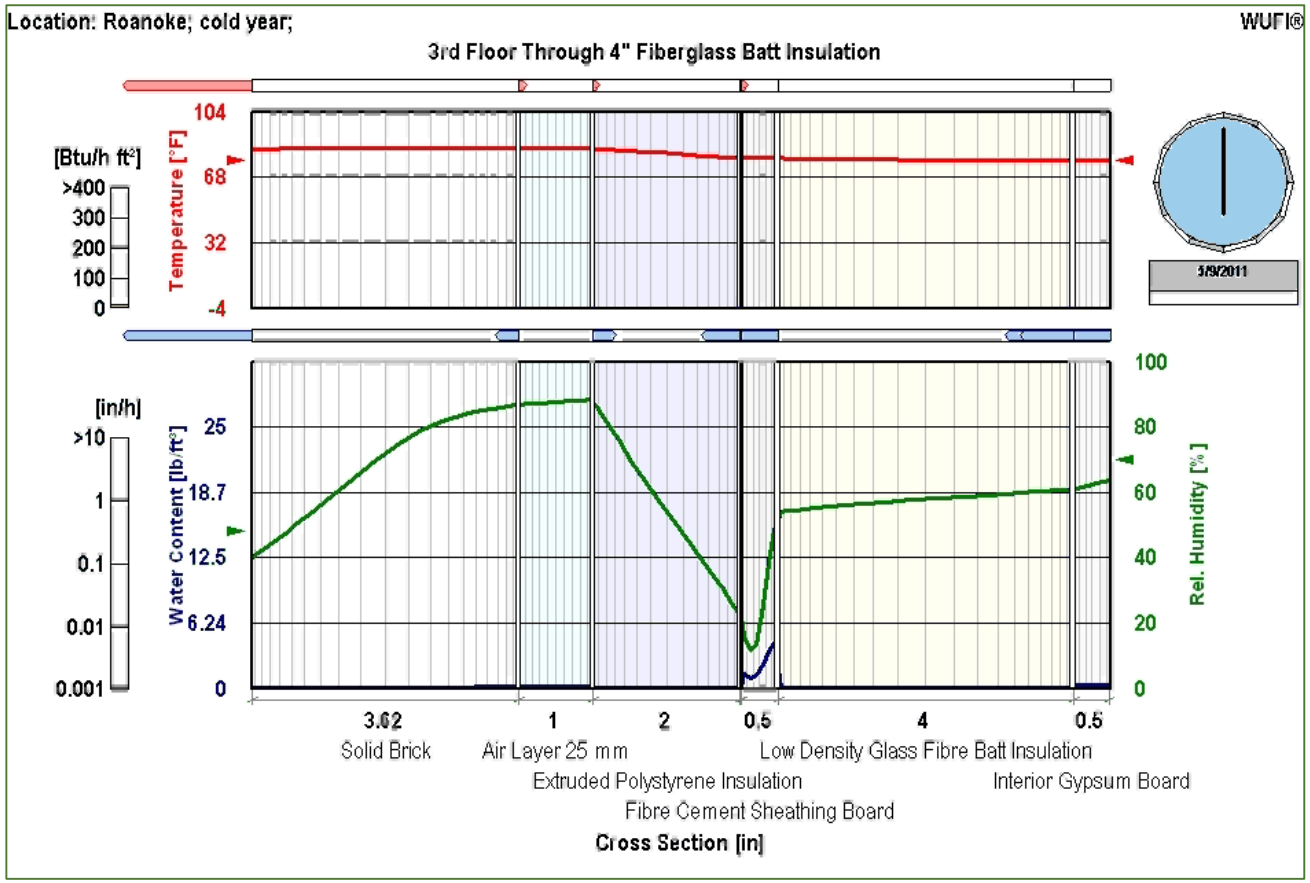
Material Selection Using Transient Hygrothermal Analysis

Dynamic analysis of heat and moisture movement across wall assembly based when exposed to a thermal and vapor gradient.



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Designer Responsibilities – 01 40 00 Spec

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner,[**Commissioning Authority,**] [**Construction Manager,**] or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 012100 "Allowances" for testing and inspecting allowances.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect[**or Construction Manager**].

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to

QUALITY REQUIREMENTS 014000 - 1

Standard Section

- Contractor Quality Control Plan
- Laboratory and Field Testing Standards
- Report Requirements
- Third Party Testing and Inspection Standards
- Integrated Exterior Mockups

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Designer Responsibilities – ABAA QAP

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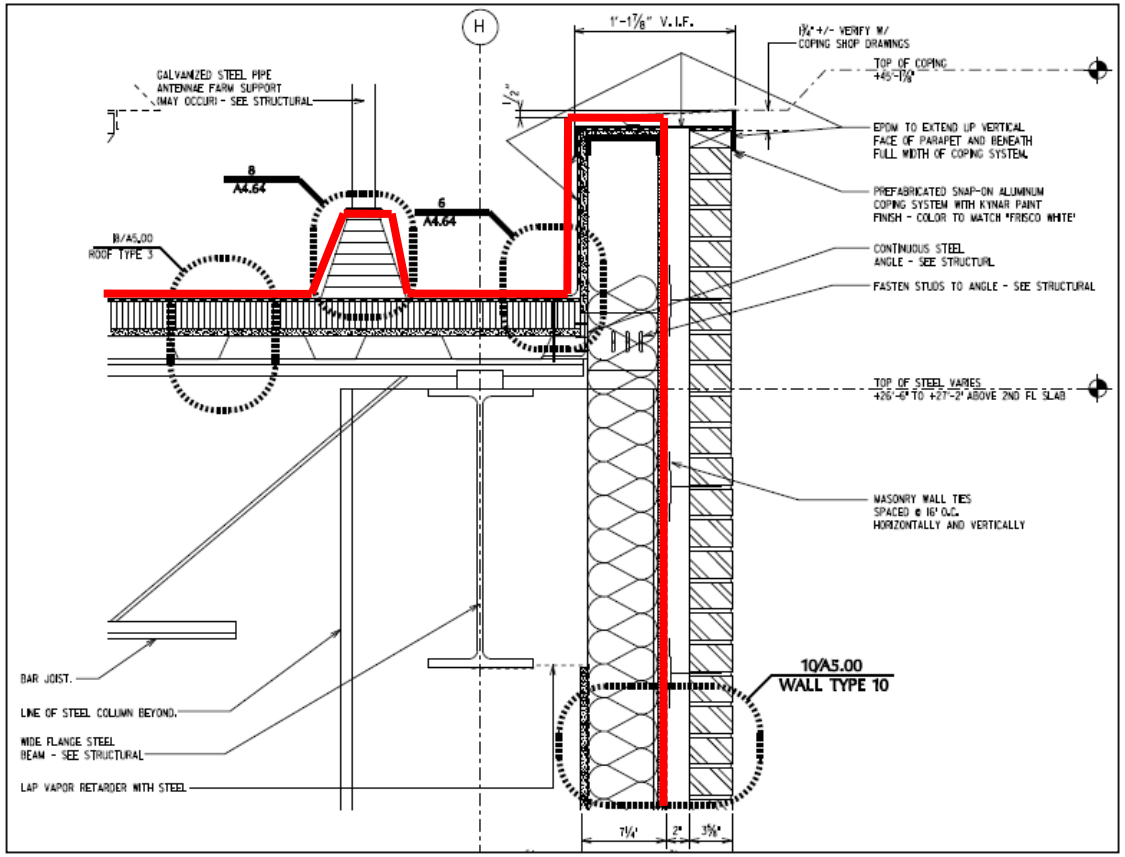
Benefits

- Decreased Liability
- Assurance that the installation meets the specification requirements
- Providing the best for your client in an emerging industry
- Support from an impartial body
- Detailed records of each project from start to finish
- Assistance in project discrepancies
- Technical resources for architects

Designer Responsibilities – ABAA QAP

Limitations

- Does not require Designer Accreditation
- Does not include 3rd Party Shop Drawing Review
- Often applied only to exterior wall air barrier installer



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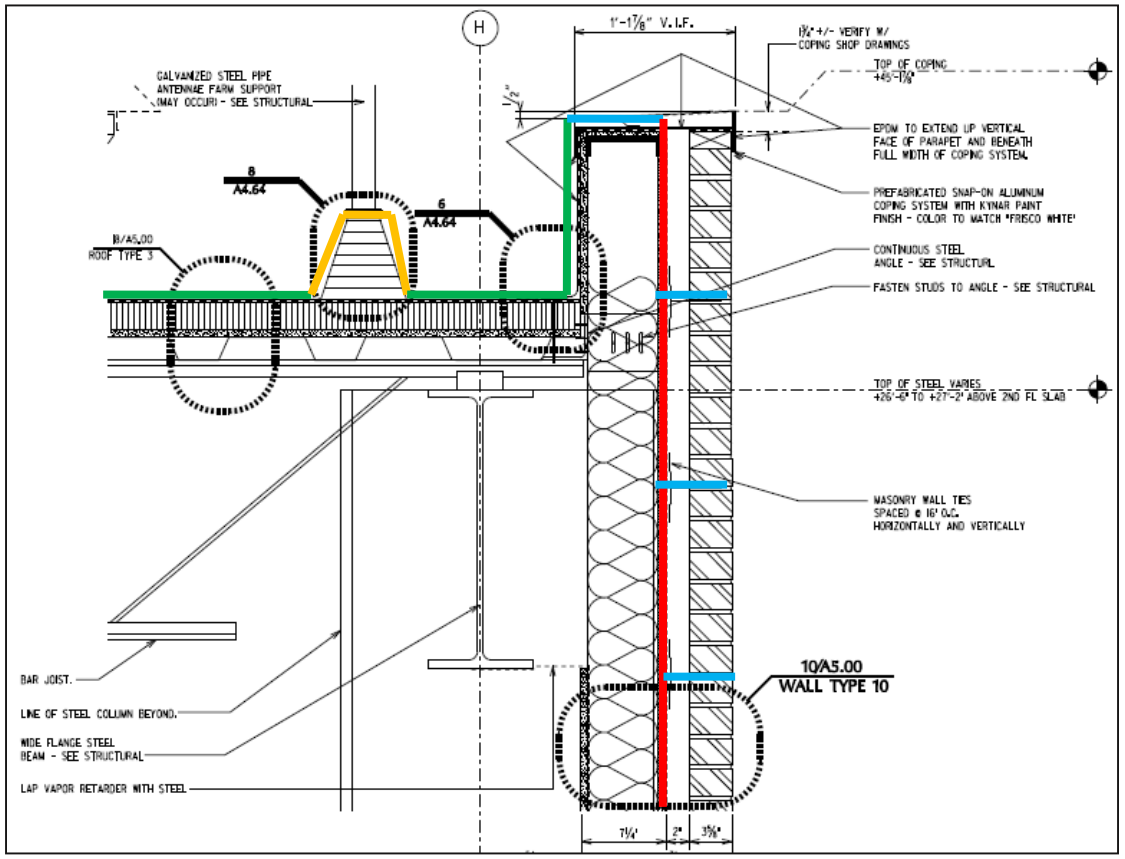
Designer Responsibilities – Coordinated Shop Drawings

Ensuring Continuity of Air Barrier

- Multiple trades responsible for building air barrier
- Most challenges and issues occur at transitions and integrations
  - Understand how Spec Requirements help GC/CM



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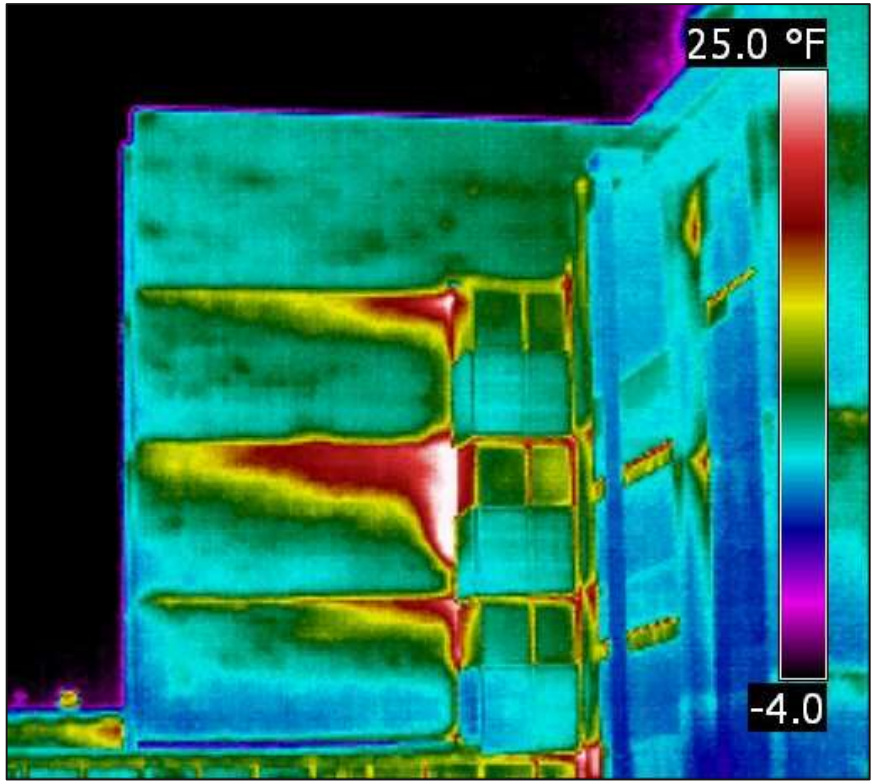
Designer Responsibilities – Coordinated Shop Drawings



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Designer Responsibilities - Mockups

Key Considerations

- Consistency with Building
- Critical Details
- Frequency of Conditions
- Aesthetic Considerations
- Testing Procedures
- Cost, Schedule

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Designer Responsibilities - Mockups

- Establish reference for quality throughout Project
- Identify detailing conflicts and issues
- Encourage early submission of air barrier products

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Designer Responsibilities – Field Testing

Materials

- Many air barrier materials are formed on site
- Actual material properties are based on proper installation
  - Difference between vapor retarder and vapor permeable is a fine line

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Designer Responsibilities – Field Testing

Key Properties to be Verified

- Fluid Applied Membranes – Mil Thickness, adhesion
- SPF – Thickness, density, adhesion
- Self-Adhered Membranes - Adhesion

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Designer Responsibilities – Field Testing

Membrane Adhesion Testing

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Designer Responsibilities – Field Testing

Assemblies

- Many air barrier conditions are reliant upon multiple parts
- Performance of individual parts may not be indicative the whole
  - Air leakage through glass ≠ Air leakage through window

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Contractor Responsibilities

Assess Risks Affecting Air Barrier

- Installation Sequence
- Value Engineering/Budget
- Substrates
- Schedule
- Coordination of Trades
- Varied experience levels
- Post Installation Damage
- Weather
- Inaccurate Design Assumptions

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Contractor Responsibilities

Installation Sequence

- What materials become vulnerable based on the sequence of installation
- Develop plan to include temporary protection

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Contractor Responsibilities

Value Engineering/Budget

- Impacts Material Selection
- Impacts Redundancy
- Impacts Constructability

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Contractor Responsibilities

Substrates

- Air Barrier Installation begins with concrete, masonry and steel subs
- Must meet Division 03, 04 requirements and Air Barrier Specifications

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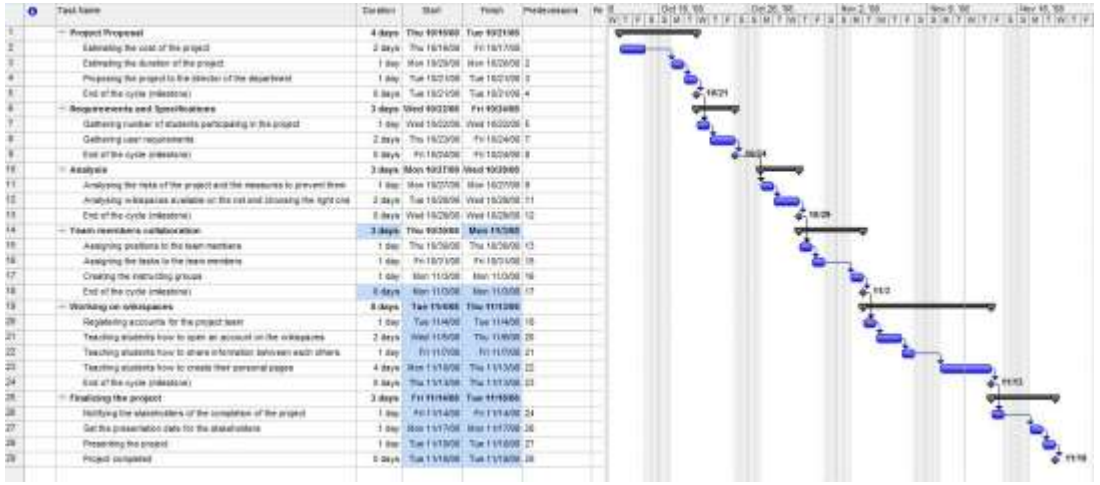
Contractor Responsibilities

Schedule

- Understand and plan for less than ideal sequences
- Verify moisture content and curing limitations early and plan accordingly
    - Early installation may not result in schedule recovery



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Contractor Responsibilities

Coordination of Trades

- GC/CM should have Responsible Party
- Collaborative Pre-Installation Meetings
  - Include AE & Owner
- Coordinated Shop Drawings

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Contractor Responsibilities

Coordination of Trades

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Contractor Responsibilities

Varied Experience Levels

- Construct mockups with installers that will be working on actual project
- Air Barrier Kickoff Meeting
- Weekly site walks with subs
  - Include Foreman and Laborers

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Contractor Responsibilities

Post Installation Damage

- Promote Subcontractor QC
- Inspect Work for Damage and Protection
- Establish Reporting an Tracking Procedures

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Contractor Responsibilities – Post Installation Damage

Construction Activities

UV Exposure

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Contractor Responsibilities

Weather

- Protocol for installation and inspection of temporary weather protection
- Understand installation limitations

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Contractor Responsibilities

Inaccurate Design Assumptions

- Access
- Material availability
- Anchor Requirements

Contractor Responsibilities

- Communicate Challenges
- Suggest Equal Alternatives
- Identify Requirements for sealing penetrations

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10 Ways to Reduce Risk

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1. Building Enclosure Coordination Process

- Require GC/CM to develop a building enclosure coordination process based on project specific conditions

- Identify Roles and Responsibilities
  - Individual or Individuals responsible for coordination of air barrier trades
- Outline requirements for documentation and tracking of issues
- Process for Shop Drawing Development and review by trades
- Pre-Installation Meetings

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2. Integrated Specifications

- Cross link specification requirements to ensure coordination between associated trades

- Specifications for air barrier substrates should include air barrier substrate requirements
- Fenestration perimeter seal materials should reference air barrier materials at RO for compatibility and adhesion

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2. Integrated Specifications - Continued

- Cross link specification requirements to ensure coordination between associated trades
- DIV 01 should include mockup, performance testing, submittal, and shop drawing requirements
  - Include processes for handling deficiencies
  - Schedules for inspections and testing

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3. Responsibility Matrix

- Ensure each member of the Project Team understands their role, responsibilities, and how to best impact change
  - Use as a tool to guide development of First Level QC, testing and documentation protocol for project

Starts with Requirements of Section 01 40 00

TASK	OWNER	A/E	CMGC	BECP	BECx
Design Schematic Design		X			
Design Documents OPR, BOD	X	X			X
Construction Documents	X	X			X
Bidding Project		X	X		X
Preconstruction – BE Mockup Testing		X	X	X	X
BE Preconstruction Meetings		X	X	X	X
BE Submittals/Shop Drawings		X	X	X	X
BE Filed Observations		X	X	X	X
Field Performance Testing		X	X	X	X
BE Training		X	X	X	X
10-Month Warranty Walk-Through		X	X	X	X

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4. Performance Specifications

Forces Evaluation of Project Specific Requirements

- Product Air Leakage Requirements
- Material Compatibility and Adhesion Checks
  - Lab and Field
- Substrate Requirements

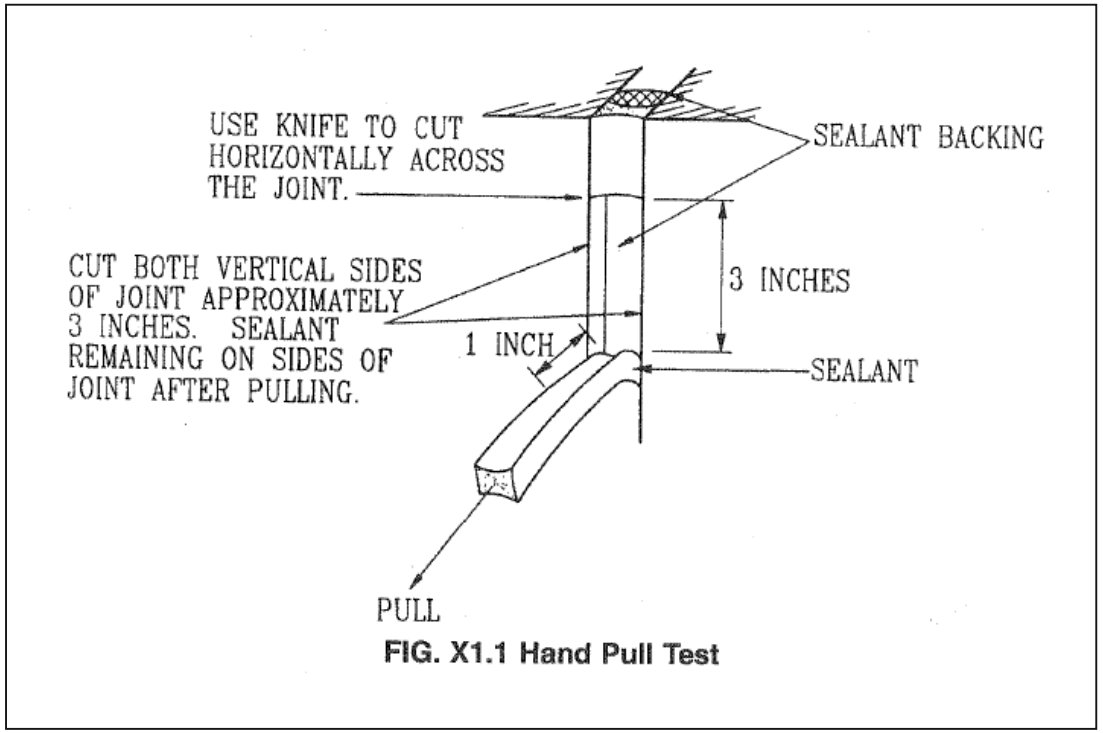

FIG. X1.1 Hand Pull Test

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4. Performance Specifications

- Field Testing Requirements
  - Process for non-conformance
- Movement Capabilities

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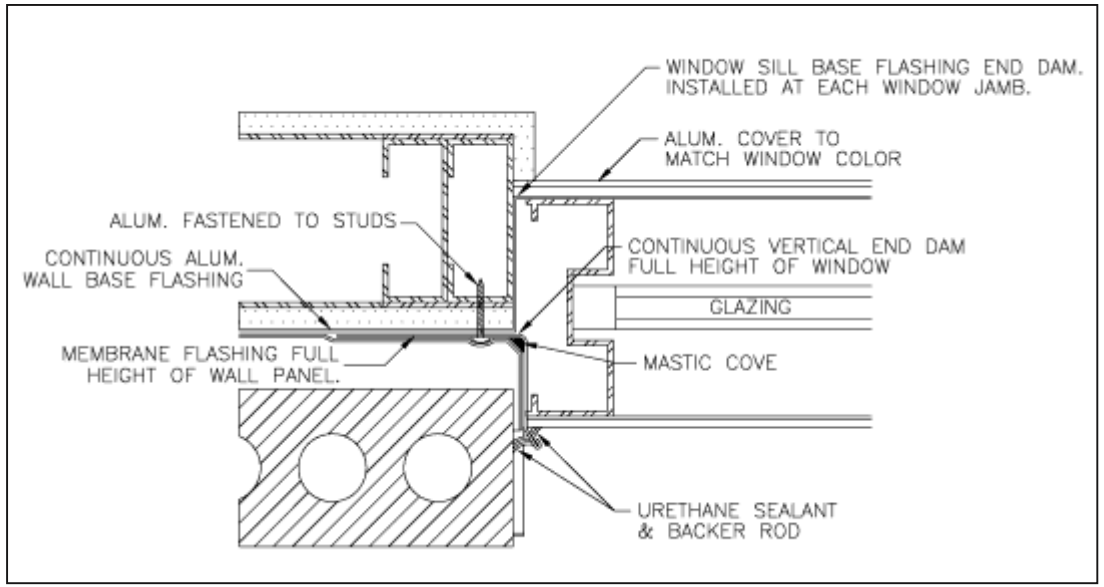
5. Coordinated Shop Drawings

- Require Submission of Coordinated Shop Drawings
  - The coordination between trades is similar to above ceiling coordination for Mechanical, Plumbing, Electrical, Fire Protection, and Communications



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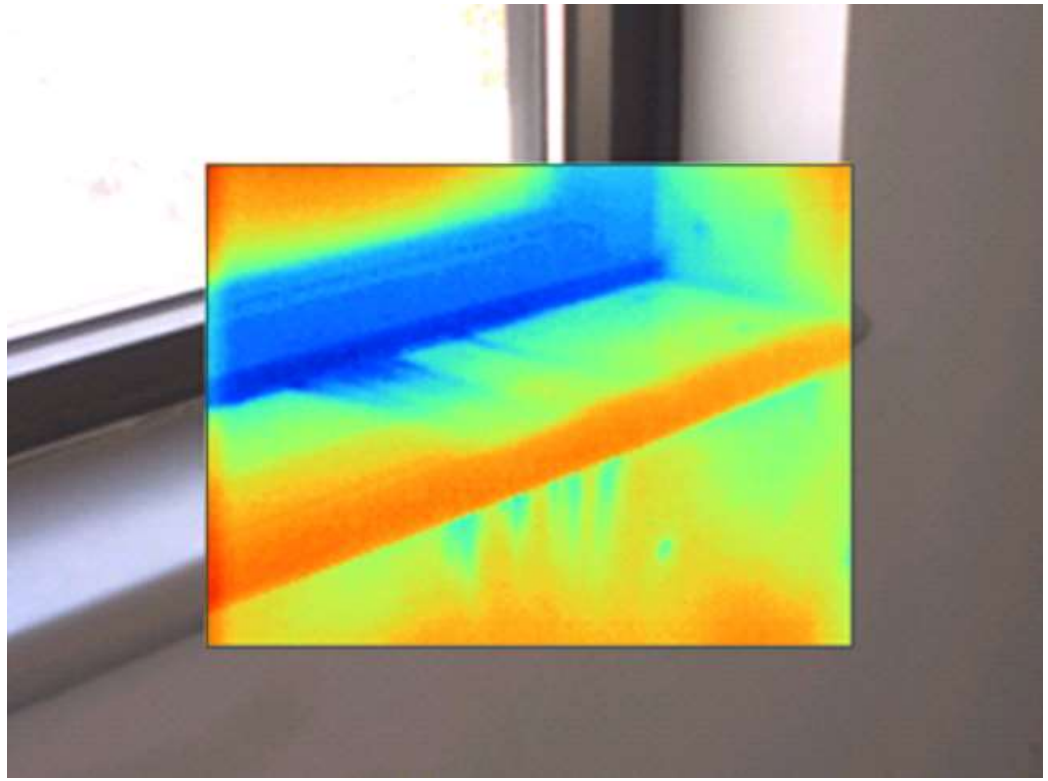
5. Coordinated Shop Drawings

- Owner Expectations will be based on the performance of the whole so why should shop drawings only show discrete elements?



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6. GC/CM Take Ownership of 1st Level QC

- Create and implement a non-conformance process to inspect, document, track and require formal submittals for approval prior to field repairs.
- When possible photograph repairs
- Link issues and status updates to drawings

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7. Pre-Installation Meetings

- Require Pre-installation meetings after shop drawings have been approved
- Allow time for coordination, changes, and discussion of resolutions prior to start of work
- Include all associated trades, AE, Owner, GC/CM Party responsible for Air Barrier, and all associated consultants
- Discuss installation, details, process for documenting deficiencies, distribution of reports, and process for resolution of issues

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8. Mockups that are Field Tested

- Utilize Separate Mockup Section in Division 01
- Outline Milestones for Inspection and Testing
- Incorporate actual project details and materials

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9. Field Performance Testing

- Verify material properties that affect performance
- Testing frequency to capture first installation and periodic verification of consistency

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9. Field Performance Testing

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9. Field Performance Testing

Cost Considerations

- Always better to find an issue before occupancy
- How much is it worth to know Owner expectations are being met?
- How much does it cost to repair post occupancy issues?
  - Labor costs
  - Material costs
  - Reputation
  - Legal Fees
  - Non-Billable Time

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10. O&M Transition Meeting

- Require a meeting between AE, Contractor, Owner, and Facilities Personnel to review air barrier inspection and maintenance requirements
- Review reports, logs, punchlists, product data, and other documentation related to the air barrier
- Discuss value engineering decisions to ensure impacts to inspection and maintenance is understood

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