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CONTINUING EDUCATION
AIA

Achieving a High Performance Air Barrier System

Proper Design, Installation and Field Quality Control

Presented by Mr. Peter Spafford
Air Barrier Association of America

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members will be available on-line approximately 6-8 weeks after the program.

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COURSE DESCRIPTION

Air Barriers are an extremely important component of a high performance building enclosure system. For the most part, these systems are non-maintainable components and repairs can typically only be made with the removal of the exterior cladding system.

To ensure a performing system, proper design, detailing and ultimately the proper installation of these systems is extremely important. You have one chance to get it right.

Come learn about important design considerations, how to properly detail critical interfaces, key items to include in your specifications and the proper installation techniques, quality control and testing parameters for a variety of air barrier systems in use today.

LEARNING OBJECTIVES

- Discuss how air barriers are part of a high performance building and how they control air movement, moisture movement, improve insulation performance and reduce energy needs of buildings.

LEARNING OBJECTIVES

- Review key design considerations, critical interfaces for continuity, material performance requirements and specification language for the proper design and selection of the air barrier assembly.

LEARNING OBJECTIVES

- Identify the typical installation requirements of a variety of air barrier materials and assemblies and common installation issues observed in the field.

LEARNING OBJECTIVES

- Discuss the importance of proper construction sequencing, coordination of sub-trades, testing and inspection criteria and how to identify installation defects and remedial action required ***during*** the construction phase.

WHY AIR BARRIERS

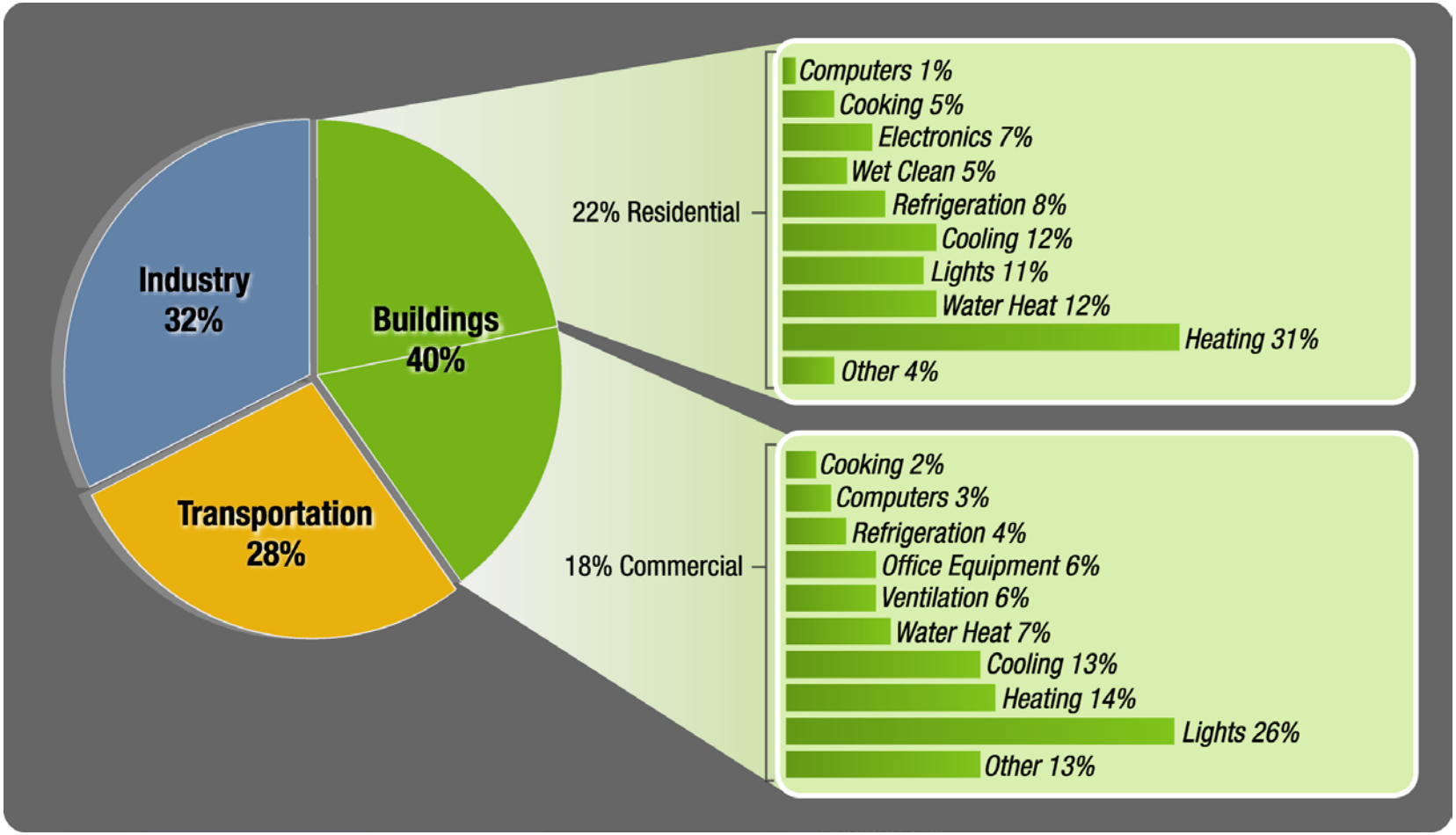
- Successfully shown to significantly reduce air leakage in a building for energy savings

https://www.airbarrier.org/technical-information/energy-savings-calculator/

- Part of a successful moisture management plan

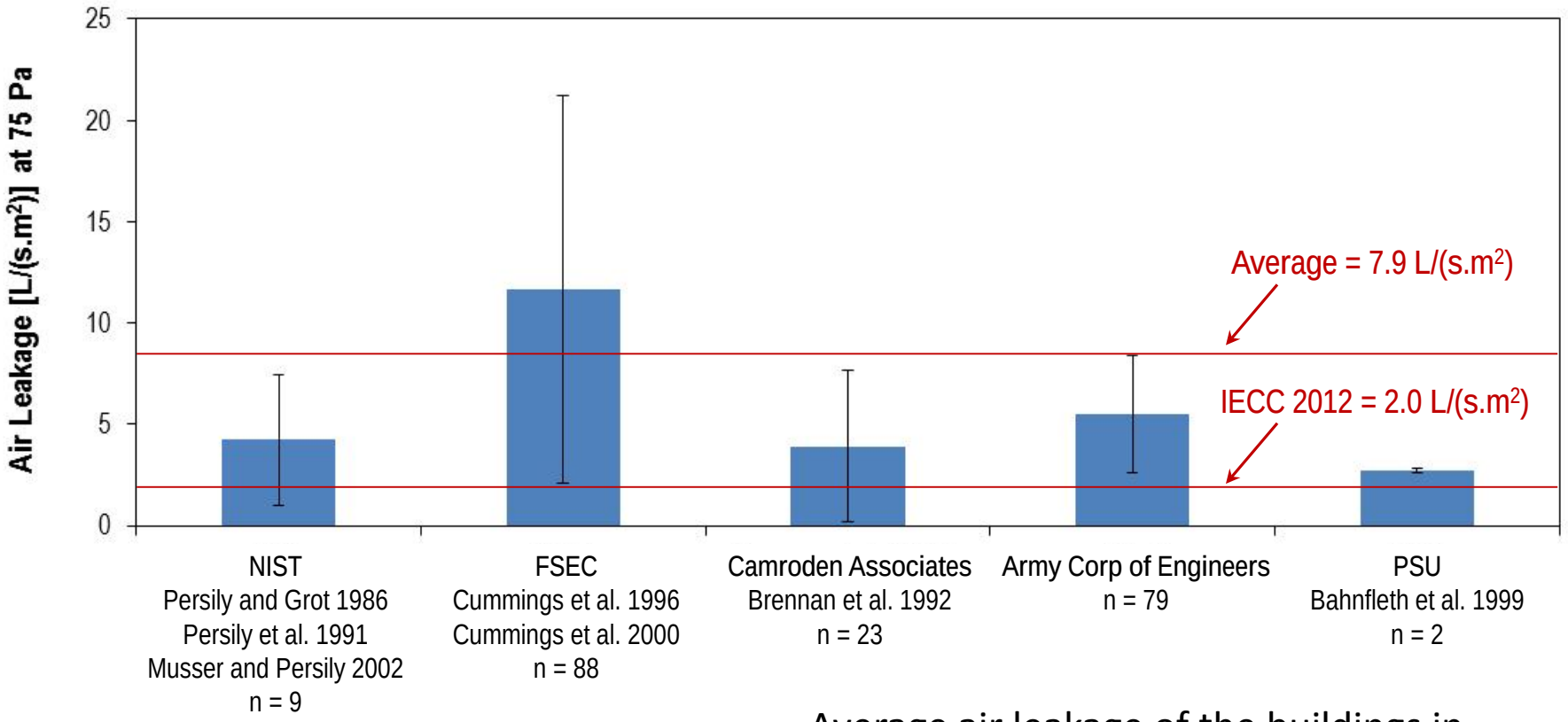
- Code requirement in some states and will be soon in others

- Building Science helps us understand that we need to control water, air, vapor and thermal performance of the wall assembly



- 40% of total US prime energy expended
- 70% of all US electric energy used

Air Leakage in Existing Buildings



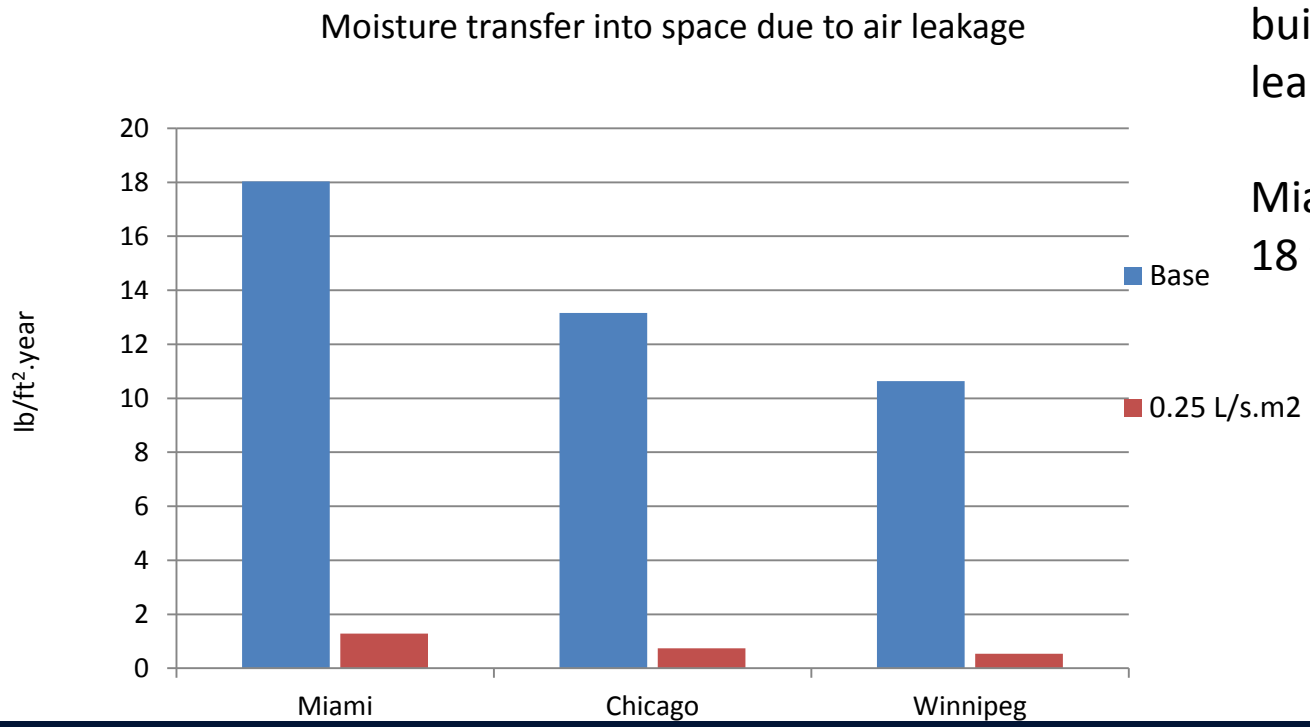
NIST: National Institute of Standards and Technology
FSEC: Florida Solar Energy Center
PSU: Penn State University

Average air leakage of the buildings in these studies are 7.9 L/s which is 1.58 CFM/ft² at a pressure difference of 1.56 lbs/ft²

AIR BARRIERS

AIR LEAKAGE IMPACTS ON MOISTURE

- Increase moisture with building enclosure



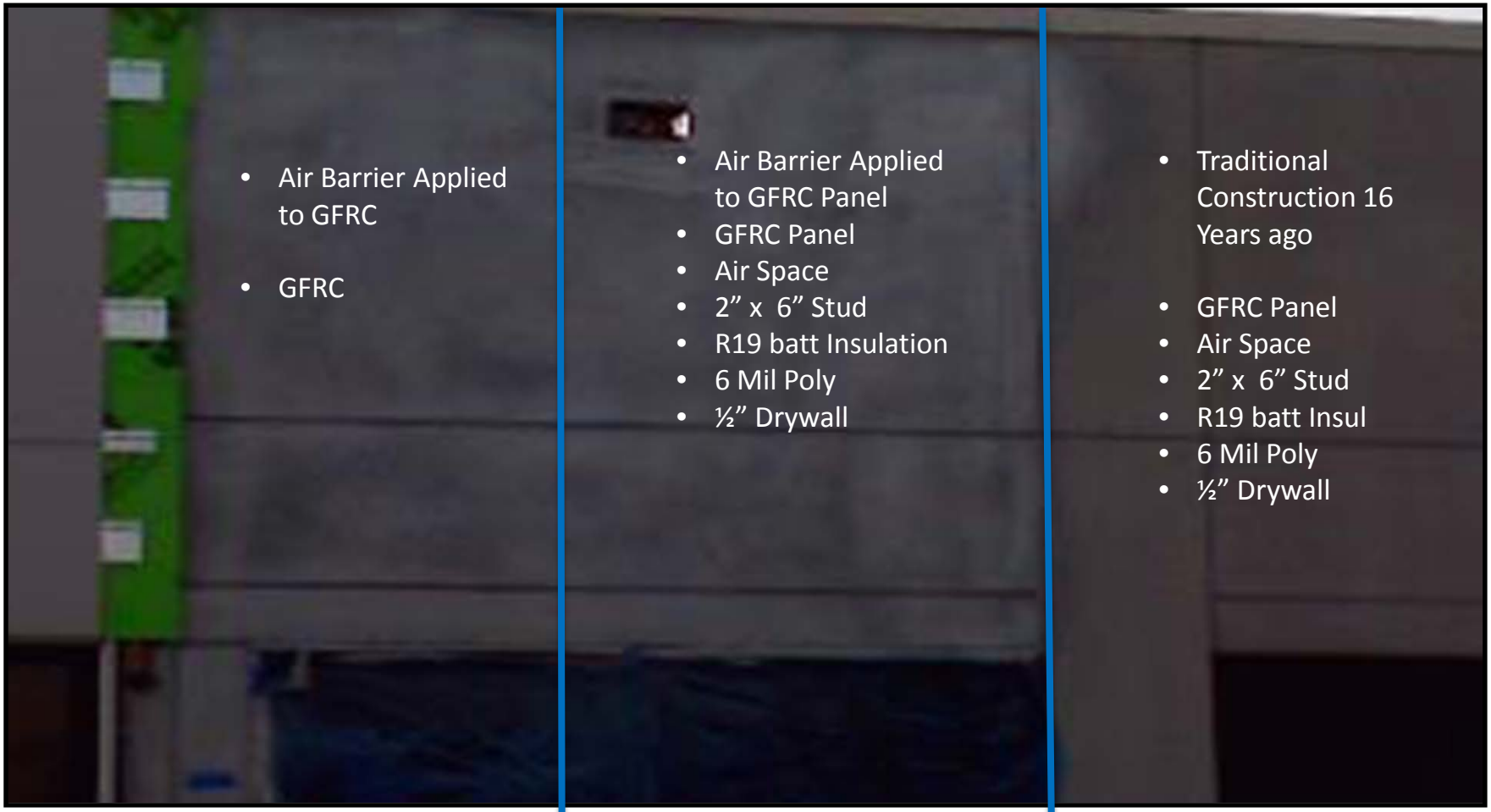
Taking the air barrier energy calculator and estimating the amount of moisture through air leakage between base (standard building with no air barrier – or ineffective one) compared to a very tight building. Whole building air leakage rate.

Miami: order of magnitude of 18 times.

BUILDING SCIENCE

INSULATION PERFORMANCE

Outside Temperature = 15°F

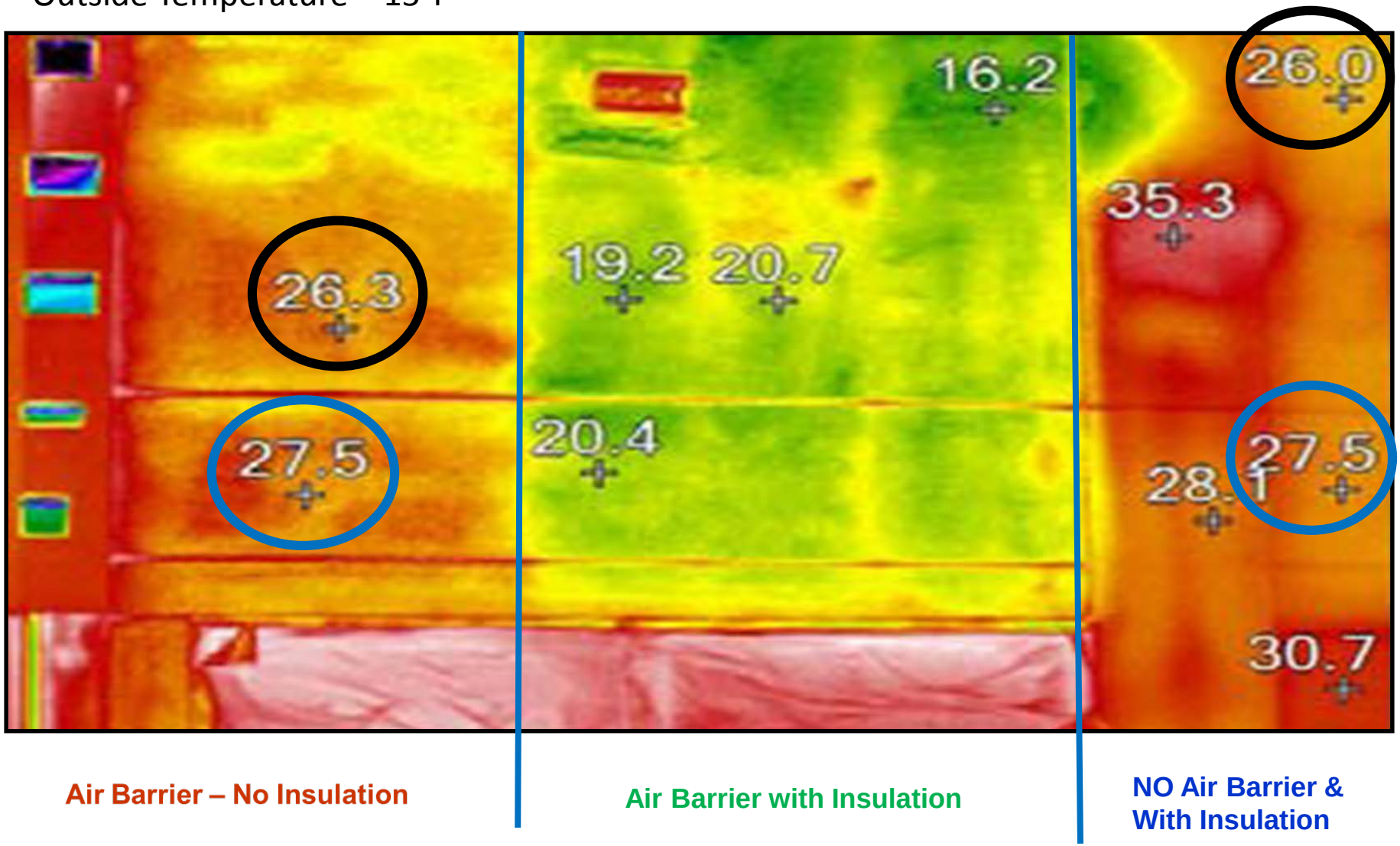


Air Barrier – No Insulation

Air Barrier with Insulation

NO Air Barrier & Insulation

Outside Temperature = 15°F



Air Barrier – No Insulation

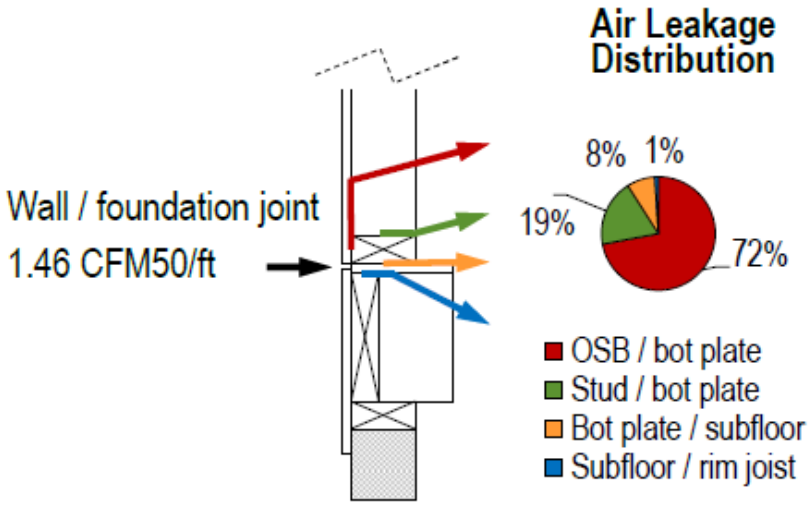
Air Barrier with Insulation

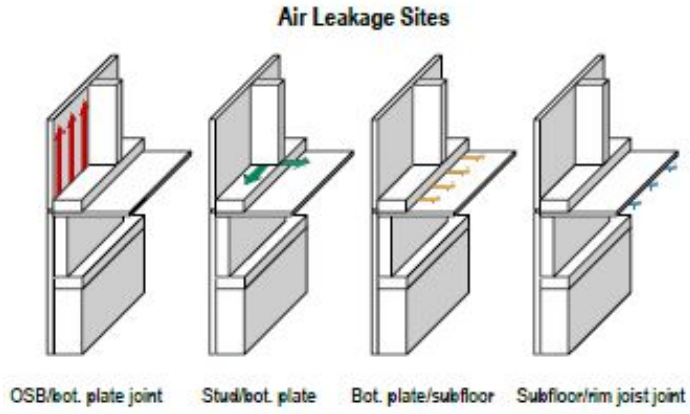
NO Air Barrier &
With Insulation

AIR BARRIERS

AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Average 2,500 square foot house has more than ½ mile of cracks and crevices

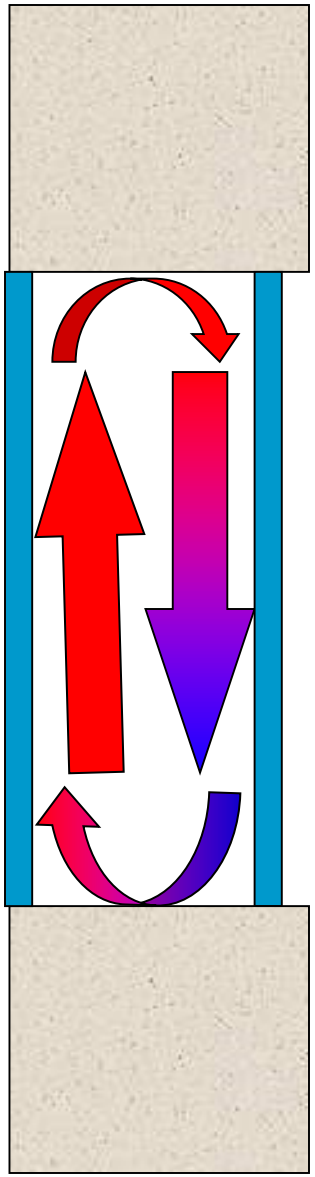




AIR BARRIERS

AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Airflow reduces thermal insulation through convective loops within the wall cavity



AIR BARRIERS

AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Wind-Washing through permeable insulations
  - Movement of unconditioned air around and through building

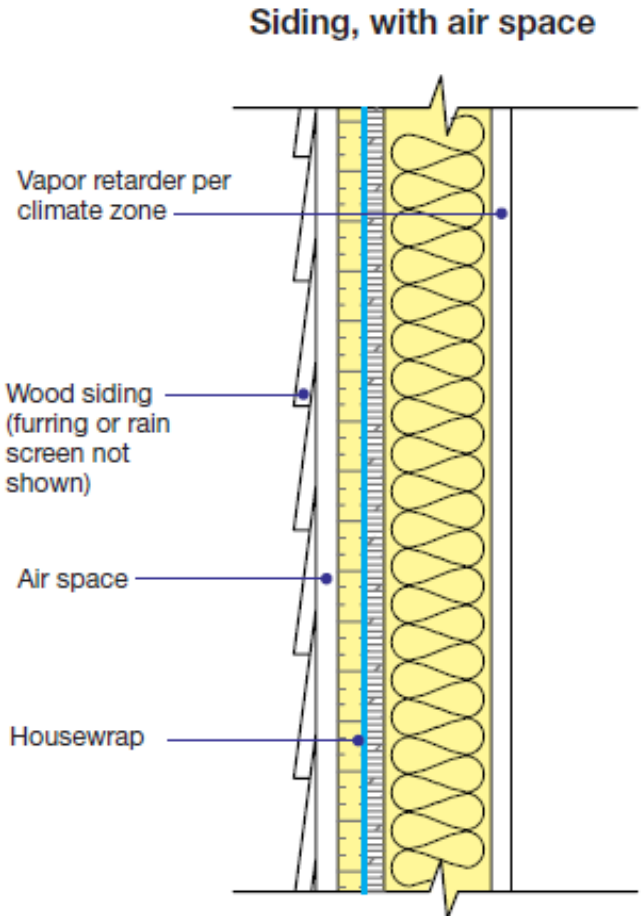
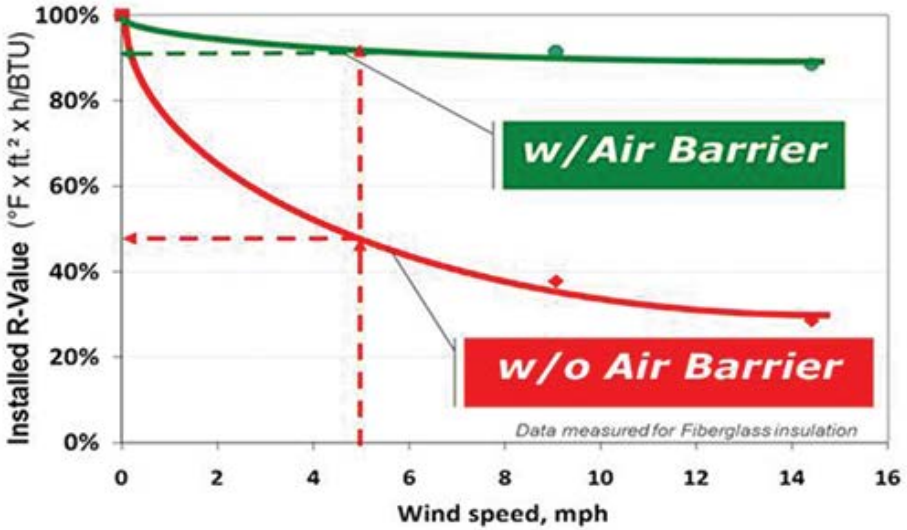


Photo courtesy of NYSERDA

AIR BARRIERS

AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Installed R-Value Decreases



Graph 1: Wind Washing Effect on Thermal Insulation Performance

Source: Impact of Airflow on the Thermal Performance of Various Residential Wall Systems utilizing a calibrated hot box, Thermal Envelopes VI/ Heat Transfer in Walls – Principles

BUILDING ENCLOSURE

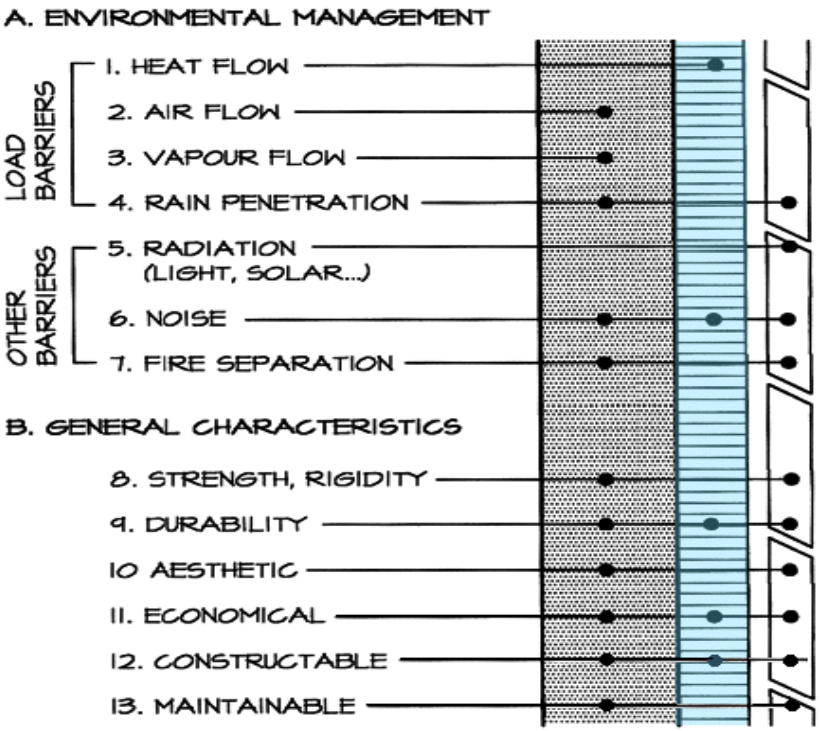
SYSTEMS APPROACH

Air Barriers cannot be dealt with without understanding that they are part of a wall assembly"

N.B. Hutcheon's CBD-48 - **Requirements for Exterior Walls**

BUILDING ENCLOSURE

SYSTEMS APPROACH



ENVELOPE REQUIREMENTS (PRIMARY FUNCTIONS)

AIR BARRIERS

KEY REQUIREMENTS

- Air impermeable material
- Continuous
- Strong: resist positive and negative loads
- Durable

AIR BARRIERS

IMPERMEABLE MATERIAL

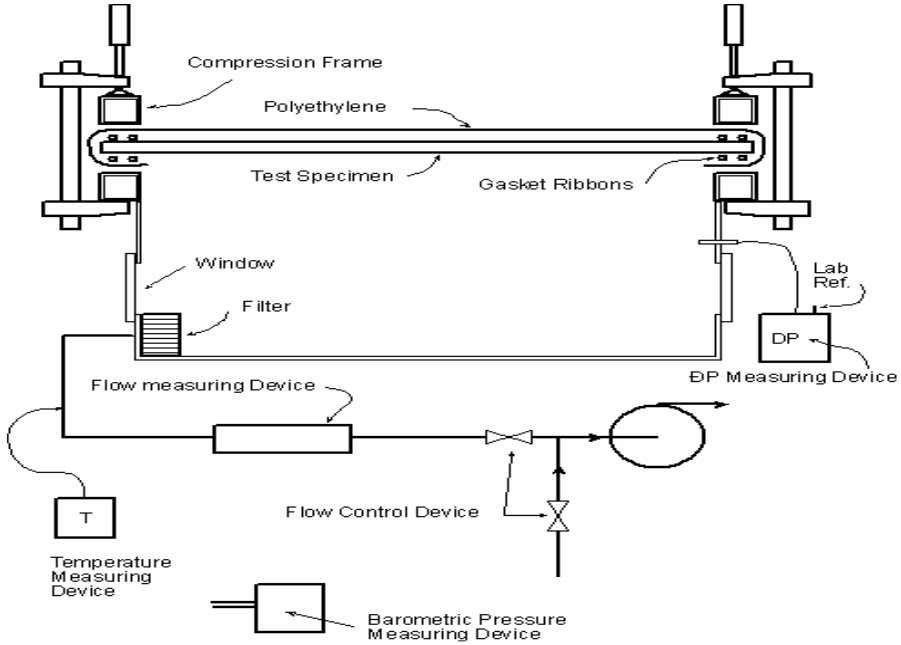
- A material that has been designated to provide the primary function of controlling the movement of air through a building assembly and when tested in accordance with ASTM E2178-01 and has a air permeance of less than:

  0.02 L/s/m^2 @ 75 Pa

  0.004 CFM/ft^2 @ 1.56 lb/ft^2

AIR BARRIERS

IMPERMEABLE MATERIAL



AIR BARRIERS

CONTINUOUS

- The air barrier shall be joined in an air-tight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connections shall be made between:
  - foundation and walls
  - walls and windows or doors
  - different wall systems
  - walls and roof
  - wall and roof over unconditioned spaces
  - walls, floors, and roofs across construction, control and expansion joints

AIR BARRIERS

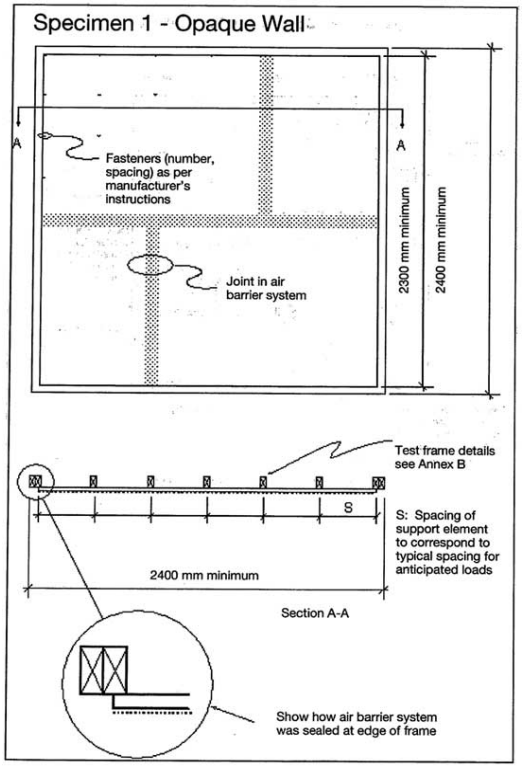
CONTINUOUS

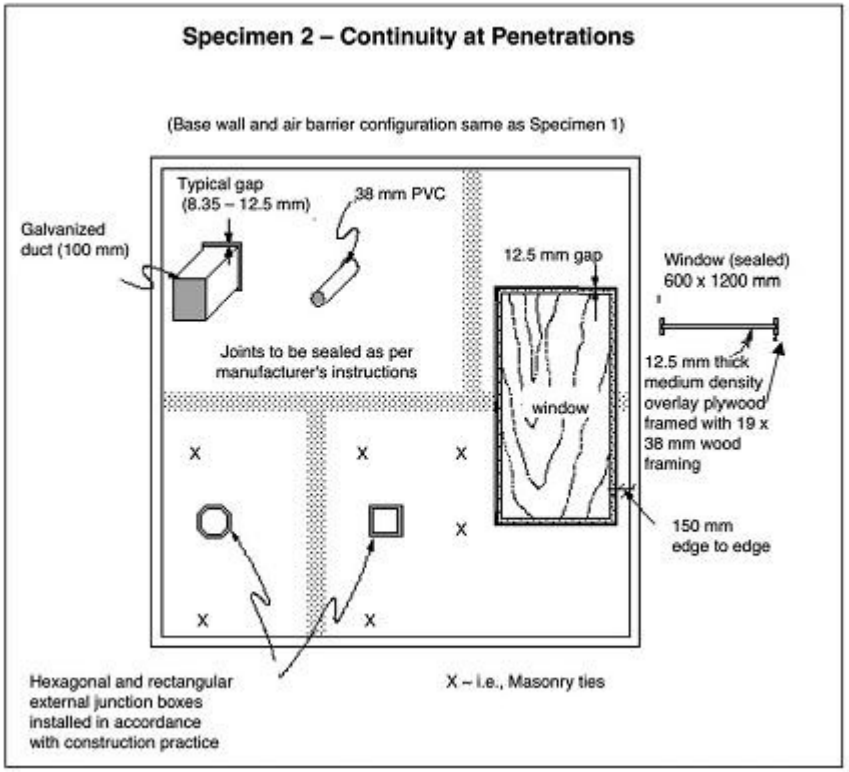
- All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight

AIR BARRIERS

CONTINUOUS

- ASTM 2357





AIR BARRIERS

CONTINUOUS

- ASTM 2357

AIR BARRIERS

STRONG

- Withstand positive and negative loads due to wind, stack and mechanical pressures
- Not to displace other building enclosure components
- ASTM 2357 test method applies both positive and negative pressures to specimen to simulate wind gusts and pressures from stack and mechanical

AIR BARRIERS

DURABLE

- Materials are typically installed as a non-maintainable components within the wall assembly
- Need to last the life of the enclosure and be resilient
- Durable to deal with moisture, temperature, building movement over the intended life span

AIR BARRIERS

AIR LEAKAGE PERFORMANCE REQUIREMENTS

- Material - 0.004 CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E 2178)
- Accessory – tapes, strips, caulking, etc - 0.004 CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E 283)
- Component – windows, doors, skylights, etc. - 0.04 CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E 283)
- Assembly (Wall assembly, roof assembly, foundation assembly)- 0.04 CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E 2357)
- System (Whole Building) - 0.40 CFM/ft²@ 1.56 lbs/ft² pressure difference (ISO 9972, **ASTM E 779**, CGSB 149.10)

AIR BARRIERS

OTHER TEST CRITERIA ESTABLISHED BY ABAA

- Other test methods developed for each material type as part of ABAA evaluation process

- Currently developed for:

  - Self Adhered Membranes
  - Liquid Applied Membranes
  - Medium Density Sprayed Polyurethane Foam
  - Board Stock – Rigid Cellular Thermal Insulation Board
  - Factory Bonded Membranes to Sheathing
  - Mechanically Fastened Commercial Building Wraps

AIR BARRIERS

OTHER TEST CRITERIA ESTABLISHED BY ABAA

5.3 Fluid Applied Membranes

All testing shall be conducted with the applied liquid material within the minimum / maximum range. The specific thickness of the material which was used when conducting the following tests shall be recorded on the test report and shall be the site installed thickness.

Product Property	Test Standard	Test Standard Title	Unit	Requirement	
				Min	Max
Air Permeance	ASTM E2178-11	Standard Test Method for Air Permeance of Building Materials	cfm /ft^2 at a pressure differential of 1.57 psf (L/(s·m²) at a pressure differential of 75 Pa)	- -	0.004 (0.02)
Water Resistance	AATCC 127 - 2008	Water Resistance: Hydrostatic Pressure Test for 5 h	inches (cm)	22 (55)	-
Self Sealability	ASTM D1970 / D1970M - 11	Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection - Section 8.9 Nail Sealability	-	Pass or specify sealing detail around fasteners	-
Pull Adhesion	ASTM D4541-09e1	Modified Version of Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete using Portable Pull-Off Adhesion Testers– Specify substrates and surface preparation for glass fiber faced gypsum sheathing and concrete block. Declare failure mode.	psi (kPa)	16 (110) or report value at substrate failure	-
Crack Bridging	ES-AC 212	Acceptance Criteria for Water-Resistive Coatings used as Water-Restive Barriers over Exterior Sheeting	-	Pass	-
		OR			
	ASTM C1305-08	Standard Test Method for Crack Bridging Ability of Liquid Applied Waterproofing Membrane– Report thickness and joint treatment (158° for 2 weeks)	-	Pass	-
Water Vapor Permeance (at applied thickness)	ASTM E96/E96M-10 (Desiccant and Water Methods)	Standard Test Methods for Water Vapor Transmission of Materials	US Perms (ng/(Pa·s·m²))	Declare	

AIR BARRIERS

OTHER TEST CRITERIA ESTABLISHED BY ABAA

- In process evaluation criteria:
  - Open Cell Sprayed Polyurethane Foam
  - Engineer Polymer Films for Interior Application
  - The specific evaluation criteria for each material can be found on the ABAA website.

www.airbarrier.org/technical-information/evaluated-assemblies/

DESIGN CONSIDERATIONS

DESIGN CONSIDERATIONS

GENERAL

- Type of building
- Expected service life of building
- Climate region
- Intended or resultant interior conditions
- Type of construction
- Type of building enclosure system

DESIGN CONSIDERATIONS

TYPE OF BUILDING

- Different interior environments within the building
- High rise or low rise
- High end or low end

DESIGN CONSIDERATIONS

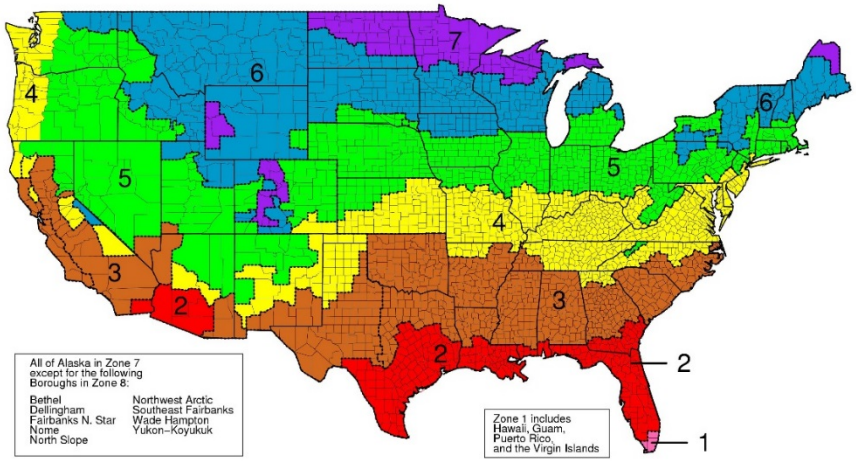
EXPECTED SERVICE LIFE

- Buildings: Condos built by project specific LLC's
- Twenty to Thirty Year Buildings: Rentals, strip malls, retail space
- Fifty Year Buildings: Commercial Office Space
- One Hundred Year Buildings: Academic, Institutional and Government Buildings

DESIGN CONSIDERATIONS

CLIMATE REGIONS

- Heating and cooling needs
- Moisture loads of climate region
- Wind loads
- Solar heat loads
- Local building code requirements



DESIGN CONSIDERATIONS

INTERIOR MOISTURE CONDITIONS

- Moisture loads due to occupancy
- HVAC System
- Humidified or not
- Ventilation Systems

DESIGN CONSIDERATIONS

WALL TYPE

- Wood framed
- Concreate Masonry Units
- Light Gauge Metal Framing
- Concrete framed

DESIGN CONSIDERATIONS

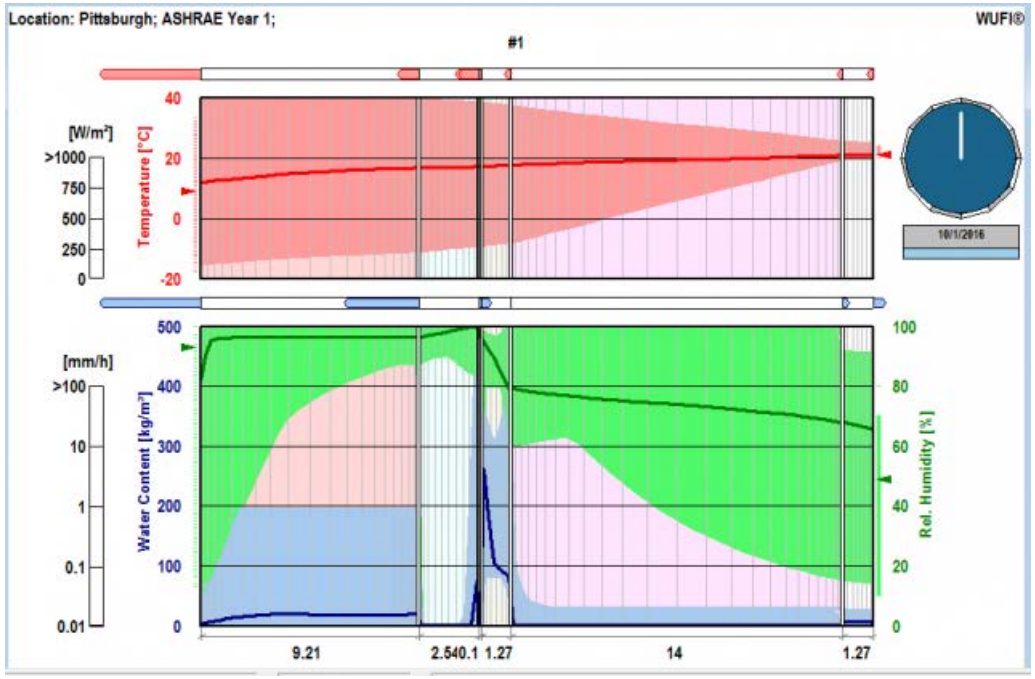
VENEER ATTACHMENT SYSTEM

DESIGN CONSIDERATIONS

BUILDING ENCLOSURE SYSTEM – MOISTURE LOADS

- Hygrothermal performance of components
- Hygrothermal performance of assembly
- Durability of components
- Solar heat gain / reflectivity of veneer layer

The graph is from a program called "WUFI". This takes a look at moisture content of a wall over a period of time. It helps to model moisture.



DESIGN CONSIDERATIONS

MATERIAL SELECTION

Consider Carefully:

- Properties of the air barrier material
- Compatibility with other building envelope components – *physical and chemical*
- Adhesion / Fastening to substrate
- In service loads and stresses

DESIGN CONSIDERATIONS

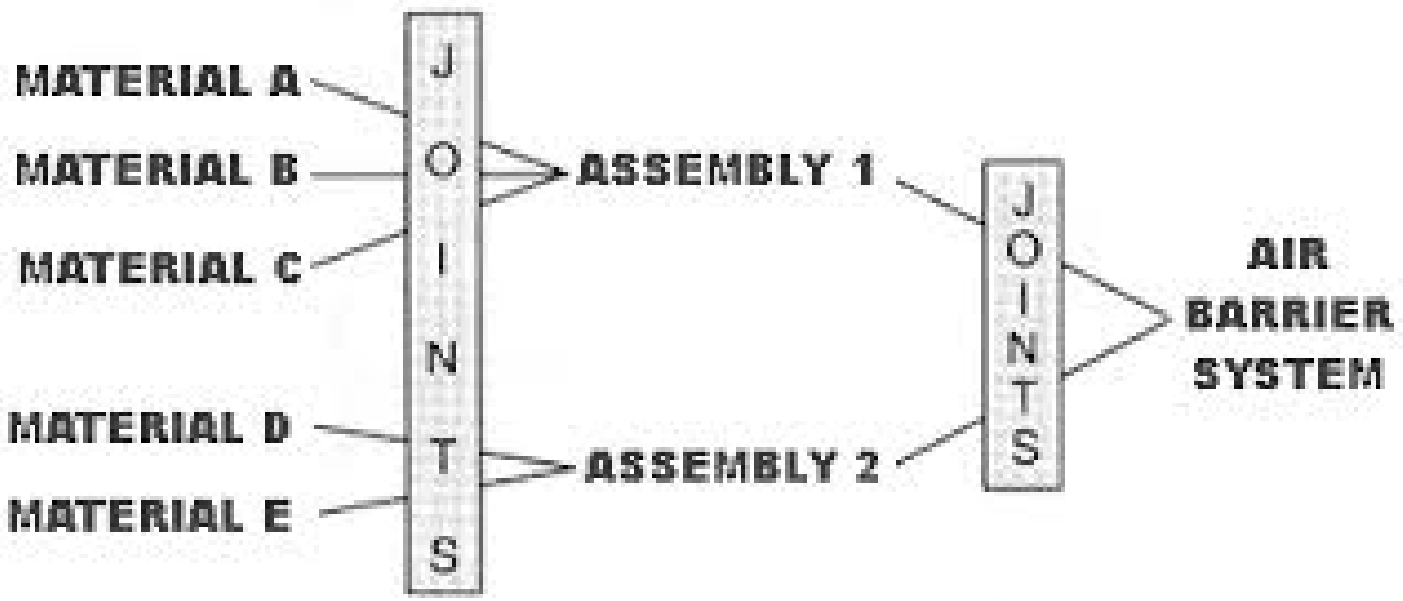
DETAILING

- The concept is to select and target a component of the wall that is ***air impermeable*** and to deliberately make it an airtight "assembly" by sealing the ***joints and penetrations***.

- Pen test: can you follow the identified air barrier layer through out the building enclosure without lifting you pen ?

DESIGN CONSIDERATIONS

DETAILING



DESIGN CONSIDERATIONS

MATERIAL CHOICES

DESIGN CONSIDERATIONS

CHOOSING THE MATERIAL

- Ensure material meets the 4 basic requirements of an air barrier material
- Determine if it will perform other functions – it probably does
- Ensure compatibility and integration with other building enclosure materials

Flashing	Arcylic LAB	Asphalt LAB	Polyether LAB	Silicone LAB	Peel & Stick Asphalt Membrane	Peel & Stick Butyl Membrane	Spray Polyurethane Foam	Polystyrene board	Polyiso Board	Building Wrap
Copper										
Stainless Steel										
Galv Steel (corrosive)										
Aluminum (corrosive)										
Copper fabric (asphalt)										
Copper fabric (non-asphaltic)										
Copper Asphalt										
Copper Paper										
Copper Drainage										
PVC										
PVC Kee										
PVC Kee SA (asphalt)										
EPDM										
EPDM SA (butyl)										
Peel & Stick (asphalt)										
Vinyl										

Not Compatible
Caution
Compatible
need mor info

DESIGN CONSIDERATIONS

CHOOSING THE MATERIAL

- Types of materials that are air barriers:
  - Self-adhered membranes (permeable and non-permeable)
  - Liquid applied membranes (permeable and non-permeable)
  - Medium density closed cell sprayed polyurethane foam
  - Insulating board stock / Non-insulating board stock
  - Commercial Building Wraps
  - Important to check Perm rating of material (ASTM E-96)
  - (New) Factory Bonded membranes to sheathing

DESIGN CONSIDERATIONS

CHOOSING THE MATERIAL

- You may have air barrier materials in your building that you did not even know:
  - Metal
  - Poured Concrete
  - Steel
  - Wood
  - Some types of Insulation
  - Water resistive barriers

DESIGN CONSIDERATIONS

FUNCTIONS

MATERIAL	AIR	VAPOR	WRB	INSULATION
Self-Adhered	X	Maybe	X	
Liquid/Fluid	X	Maybe	X	
MD SPF	X	Maybe	X	X
Board Stock – Insulating	X	Maybe	X	X
Boar Stock – non-insulating	X		X	
Building Wrap	X		X	

DESIGN CONSIDERATIONS

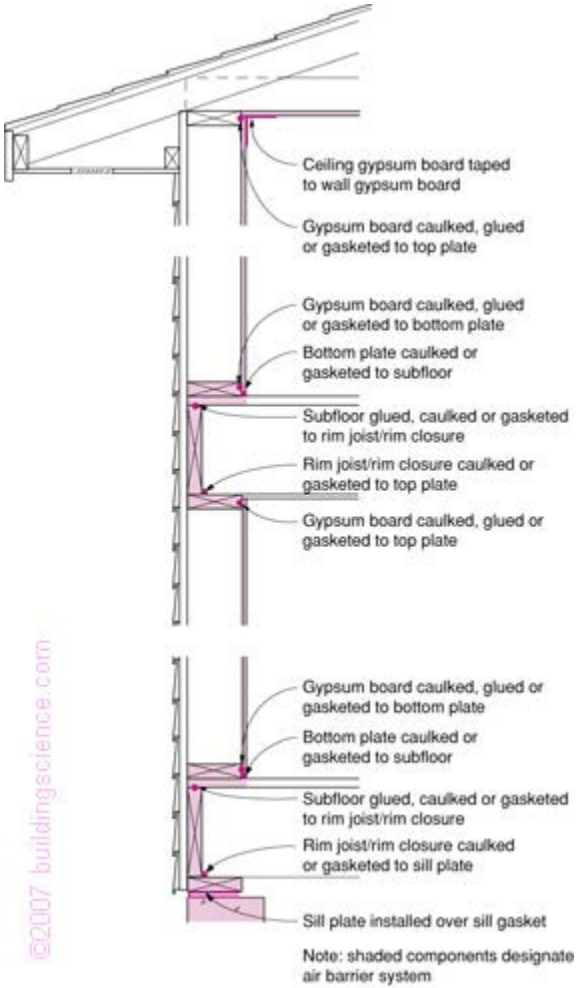
LOCATION OF AIR BARRIER

- Can be located anywhere within the wall assembly if it is just performing the role as the air barrier and not the vapor barrier
- If providing the vapor barrier function also, need to locate on warm side of wall.
- Different types of materials may or may not perform the vapor barrier function also

DESIGN CONSIDERATIONS

LOCATION OF AIR BARRIER

- Interior Application



DESIGN CONSIDERATIONS

LOCATION OF AIR BARRIER

- Exterior Application

DESIGN CONSIDERATIONS

DETAILING

Critical interfaces for continuity:

- Roof / Wall
- Foundation / Wall
- Window, Doors, Curtain wall, storefronts
- Change in Substrate
- Seismic and Expansion joints
- Floor to Floor
- Floor over unconditioned space
- Penetrations (utility, pipe, ducts)

DESIGN CONSIDERATIONS
DETAILING – ROOF/WALL

Remember:

- Compatibility of air barrier and roof membrane
- Sequence of Construction

Single Ply Systems
(PVC, TPO, EPDM)

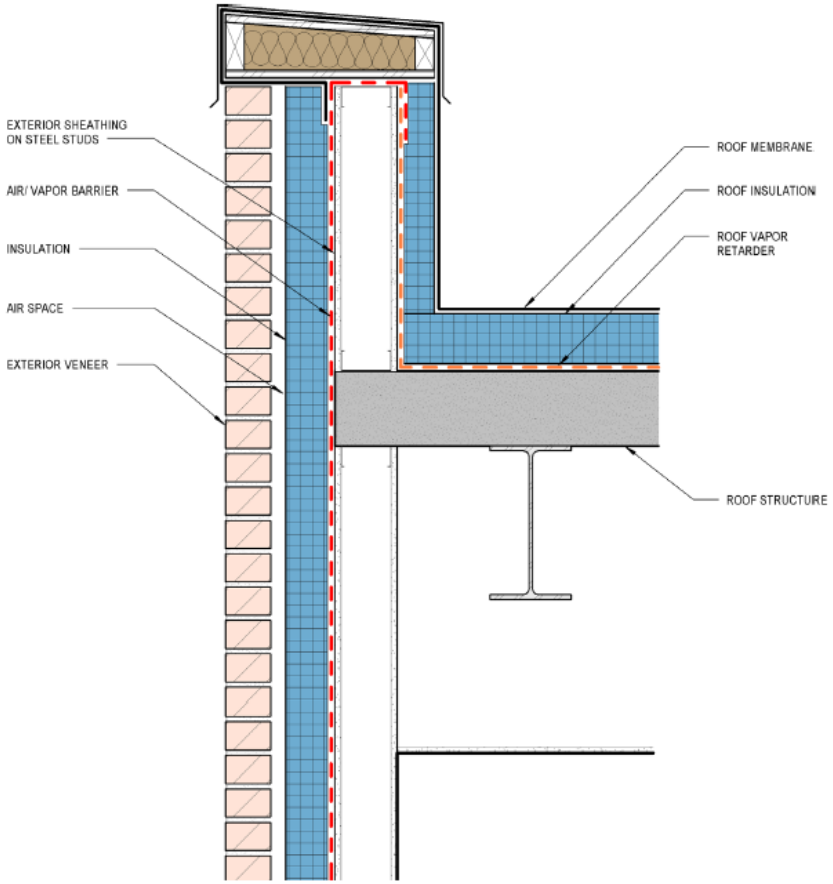


Photo courtesy of Andrew Dunlap, Smith Group

DESIGN CONSIDERATIONS
DETAILING – ROOF/WALL

Do not forget the other roof !

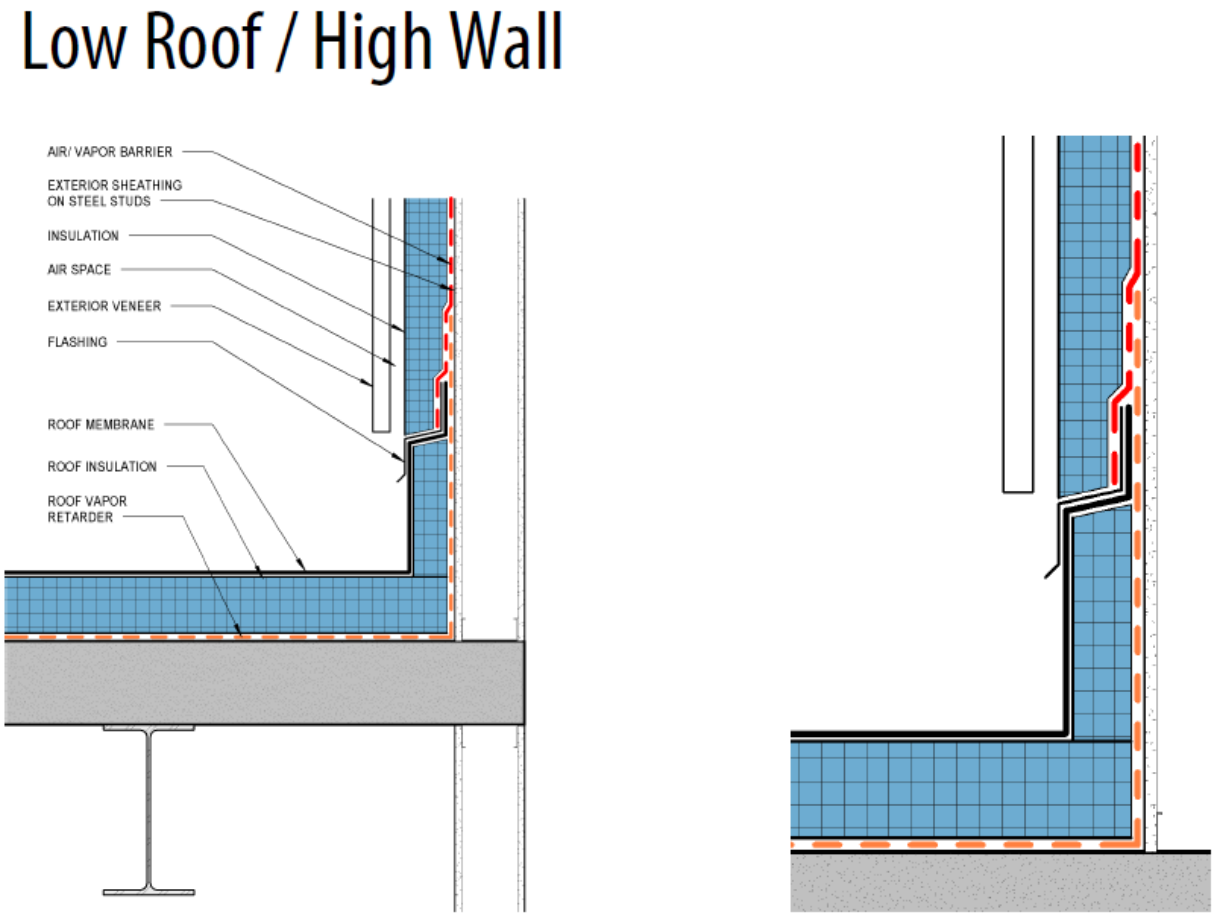
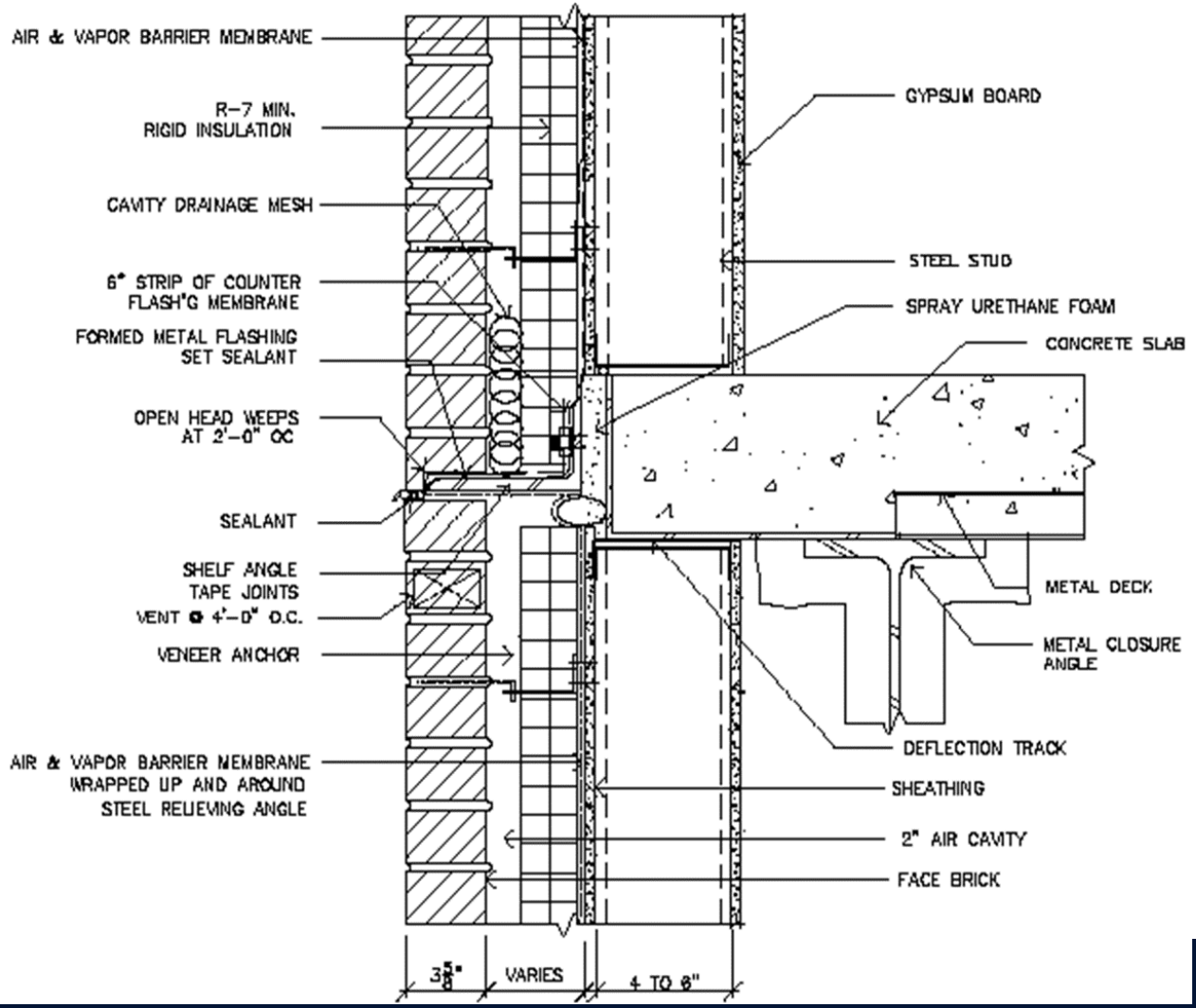


Photo courtesy of Andrew Dunlap, Smith Group

DESIGN CONSIDERATIONS
DETAILING – FLOOR TO FLOOR

Remember:

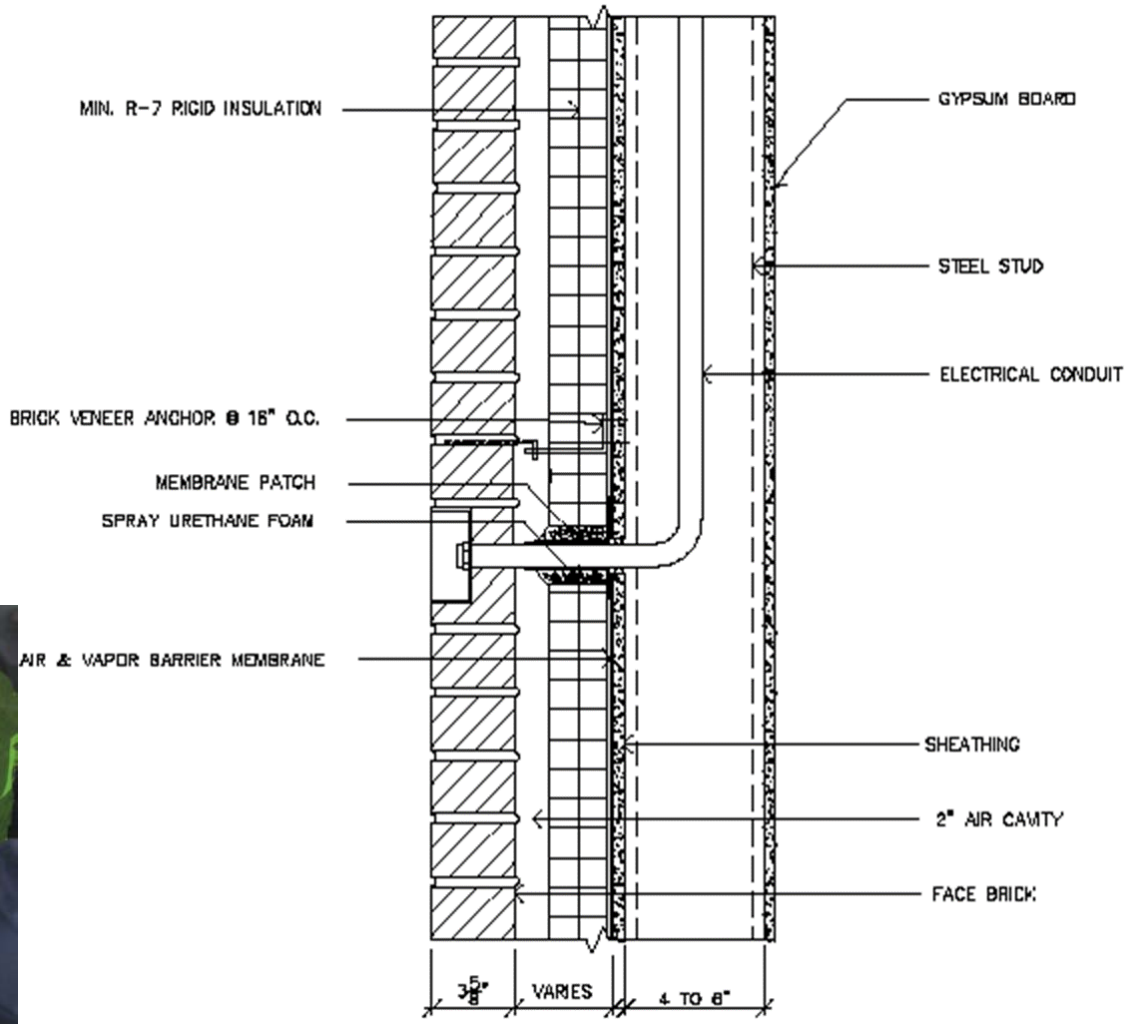
- Integration with Flashing
- Movement between different substrates



DESIGN CONSIDERATIONS
DETAILING – PENETRATIONS

Remember:

- Sequence of construction
- Before or after air barrier

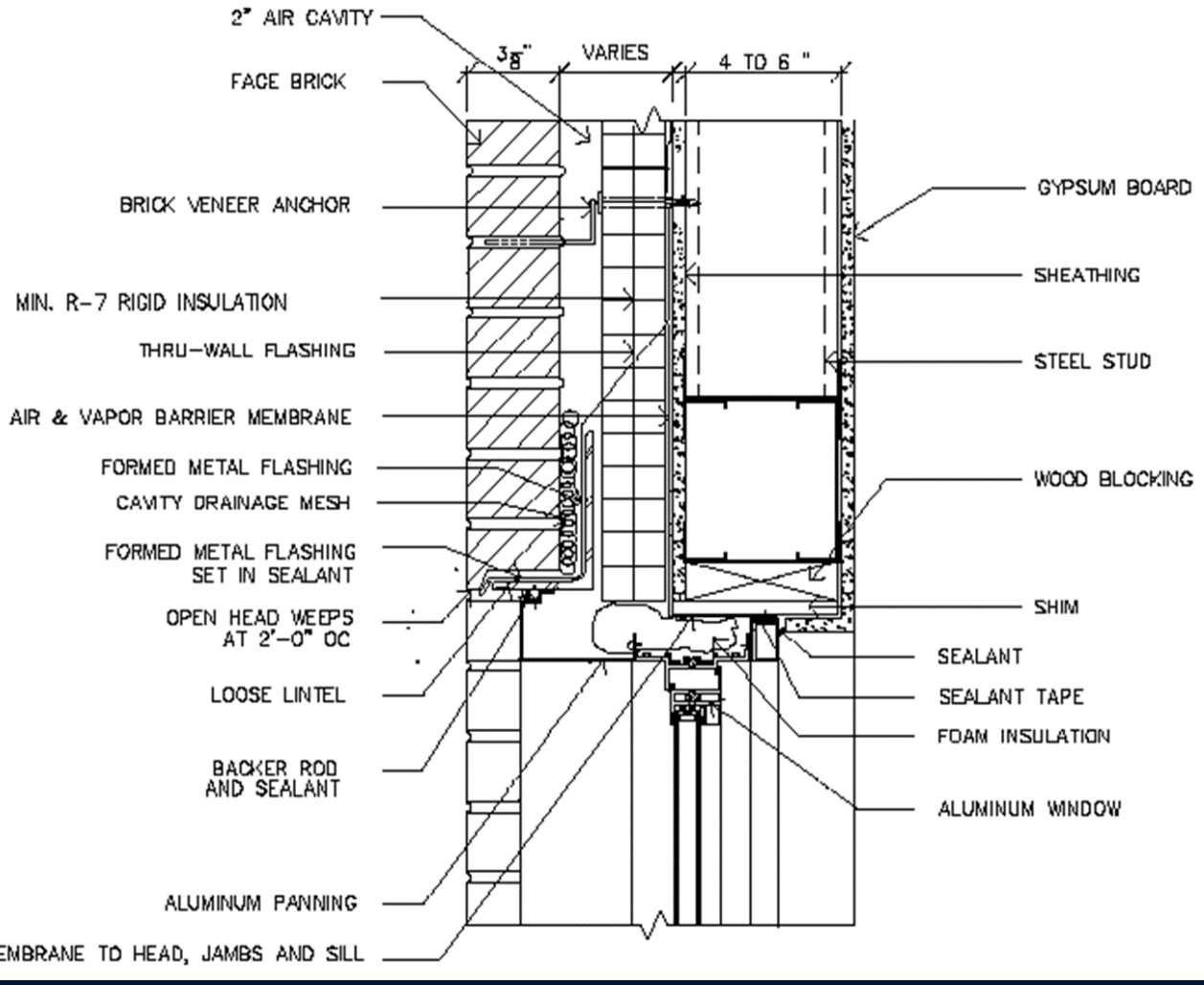


DESIGN CONSIDERATIONS

DETAILING – WINDOW / WALL

Remember:

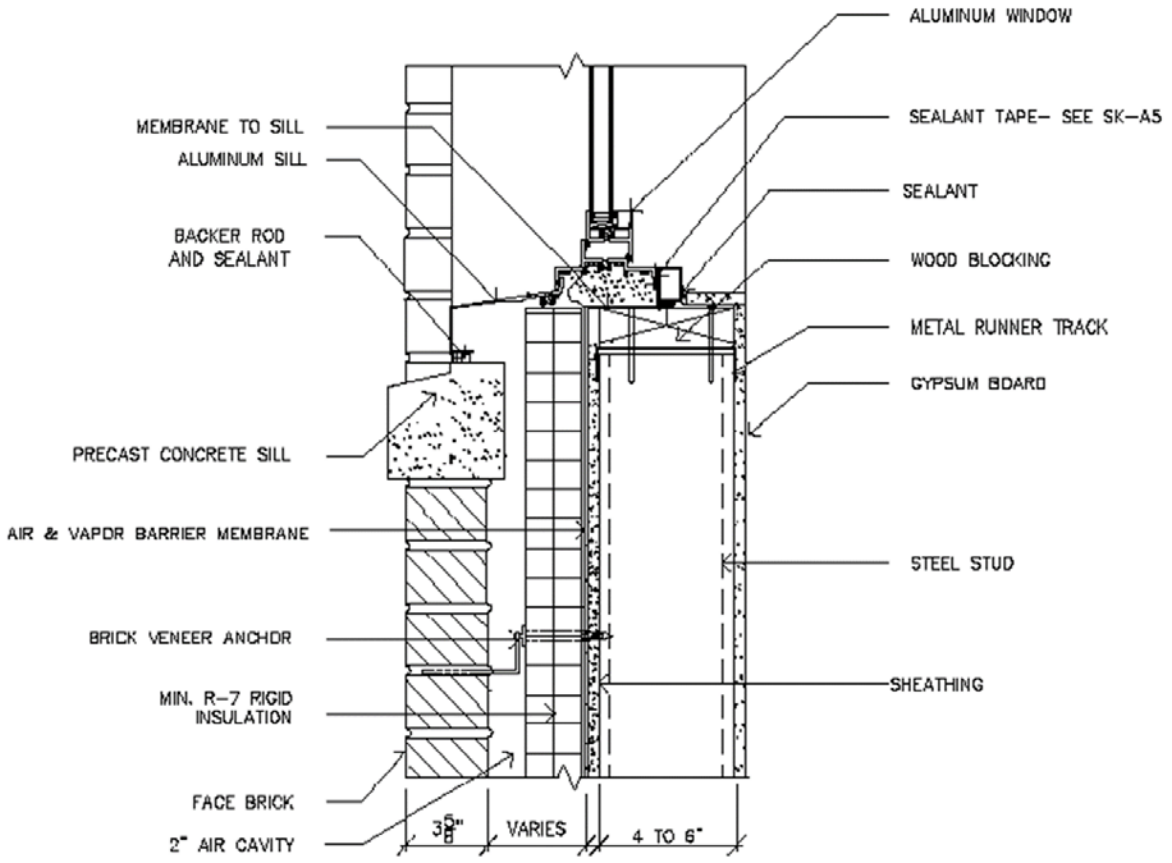
- Sequence of construction
- Identify location of where air barrier connects to window frame



DESIGN CONSIDERATIONS
DETAILING – WINDOW / WALL

Remember:

- Integration of Flashing
- Compatibility of Sealants
- Water Drainage



DESIGN CONSIDERATIONS
DETAILING – WINDOW / WALL

What it might look like during construction

DESIGN CONSIDERATIONS
DETAILING – WINDOW / WALL

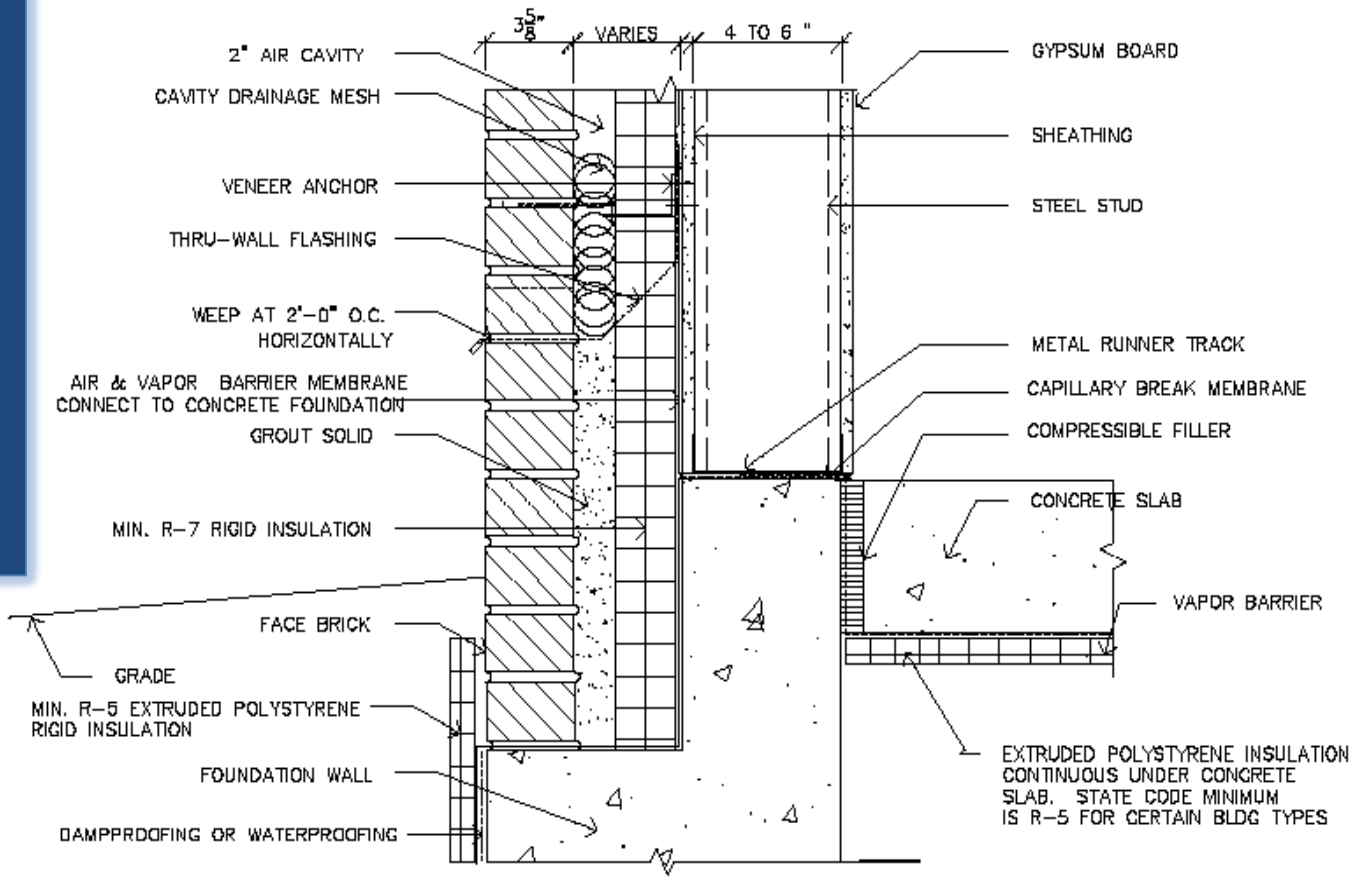
Some Continuity Issues:

- Non sufficient landing length of membrane into window opening
- Structural attachments and shims provide discontinuity with perimeter seals and backer rod
- Reliance on single line of perimeter sealant as an air barrier
- Reliance on perimeter sealants as the PRIMARY termination to window/curtainwall from opaque wall

DESIGN CONSIDERATIONS
DETAILING – FOUNDATION / WALL

Remember:

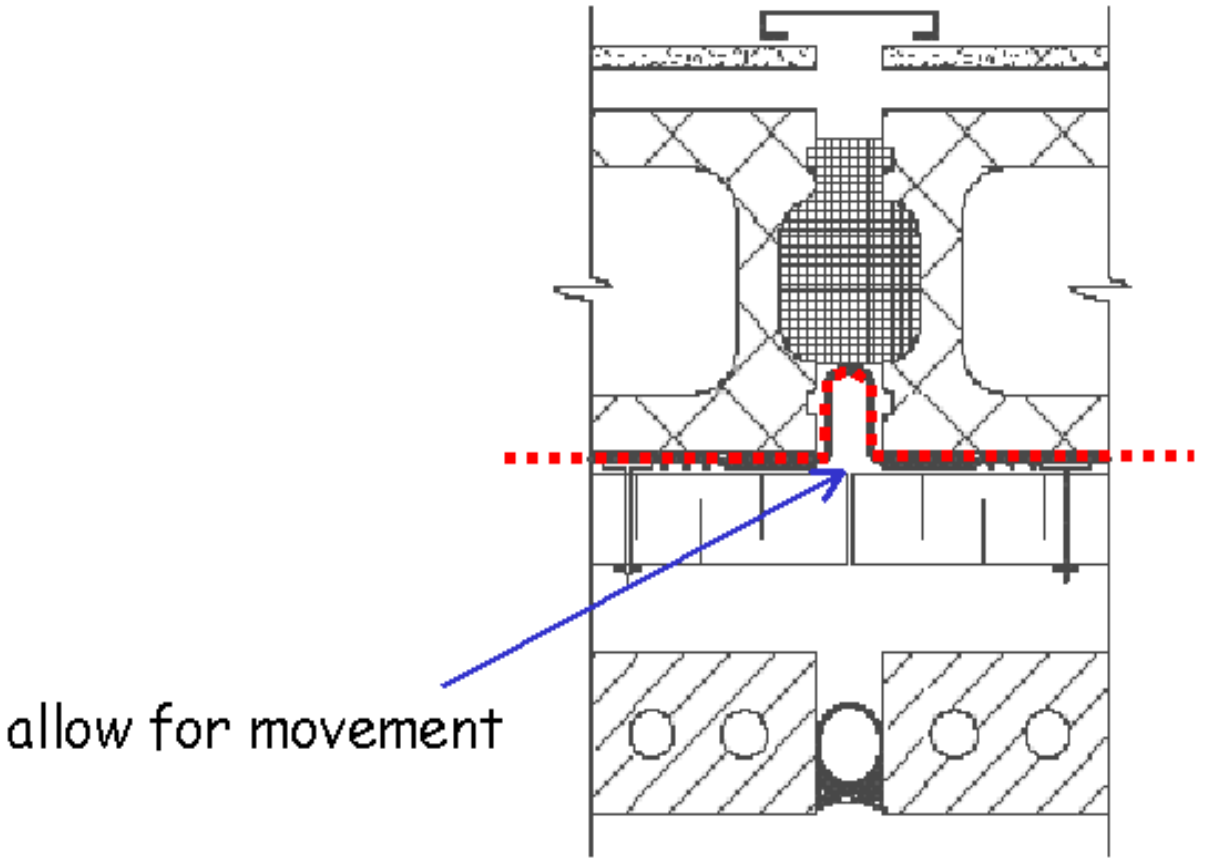
- Integration of Flashing
- Compatibility with below grade waterproofing



DESIGN CONSIDERATIONS
DETAILING – JOINTS

Remember:

- Buildings move
- Need to allow for redundancy



DESIGN CONSIDERATIONS

SPECIFICATIONS

- Key Items to consider:
  - Ensure material performance requirements are identified
  - Ensure assembly performance requirements are identified
  - Pre-construction meetings
  - Mock-up testing
  - Coordination with other trades

DESIGN CONSIDERATIONS

SPECIFICATIONS

- Key Items to consider:
  - Sub-trade qualifications
  - Field Quality Control

DESIGN CONSIDERATIONS

SPECIFICATIONS

Material Performance:

- *Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot **(0.004 cfm/ft2 @ 1.57 psf)**, [0.02 liters per square meter per second under a pressure differential of 75 Pa (0.02 L/(s•m2) @ 75 Pa)] when tested in accordance with **ASTM E2178** (unmodified).*

- Identify water vapor permeance (ASTM E-96)

DESIGN CONSIDERATIONS

SPECIFICATIONS

Assembly Performance:

- *Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot **(0.04 cfm/ft^2 @ 1.57 psf)** [0.2 liters per square meter per second under a pressure differential of 75 Pa (0.2 L/(s·m^2) @ 75 Pa)] when tested in accordance with **ASTM E2357**.*

- Current ABAA evaluated assembly

www.airbarrier.org/technical-information/evaluated-assemblies/

DESIGN CONSIDERATIONS

SPECIFICATIONS

Pre-construction meetings:

- Construction and testing of mock-up
- Sequence of construction
- Coordination with substrate preparation
- Compatibility of materials, coordination with installation of adjacent and covering materials
- Details of construction

DESIGN CONSIDERATIONS

SPECIFICATIONS

Mock Up Testing:

- Primary air barrier assembly, back up wall, typical penetrations, accessory materials

DESIGN CONSIDERATIONS

SPECIFICATIONS

Mock Up Testing:

- ASTM E1186 (determine location of leak)
- ASTM E783 (determine leakage rate)
- ASTM E1105 (water penetration)
- ASTM D4541 (adhesion)

DESIGN CONSIDERATIONS

SPECIFICATIONS

Mock Up Testing:

DESIGN CONSIDERATIONS

SPECIFICATIONS

Sub-trade qualifications:

- Air Barrier Subcontractor Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation, period by the Air Barrier Association of America (ABAA) whose Installer(s) are certified in accordance with the site Quality Assurance Program used by ABAA.

INSTALLATION

VARIOUS AIR BARRIER MATERIALS

INSTALLATION

TYPICAL AIR BARRIER MATERIALS

- Self Adhered Membranes
- Liquid Applied Membranes
- Medium Density Sprayed Polyurethane Foam
- Board Stock – Rigid Cellular Thermal Insulation Board
- Factory Bonded Membranes to Sheathing
- Mechanically Fastened Commercial Building Wraps

INSTALLATION

TYPICAL AIR BARRIER MATERIALS

- Substrate Prep is key to all materials !

INSTALLATION

SELF ADHERED MEMBRANES

- Proper Substrate Preparation
  - Dry, free of moisture
  - Smooth, no large voids or protrusions
  - Priming of substrate (if required)

INSTALLATION

SELF ADHERED MEMBRANES

- Key Installation:
  - Proper overlap of joints and seams
  - Seal around all penetrations with mastic/sealant
  - Provide backing at deflection and control joints
  - Do not span gaps larger than recommended by manufacturer
  - Roll membrane to enhance adhesion

INSTALLATION

SELF ADHERED MEMBRANES

- Common Field Issues
  - “Fish mouths”, wrinkles
  - Unadhered material
  - Inadequate substrate preparation
  - Exposed to UV past limits

INSTALLATION

LIQUID APPLIED MEMBRANES

- Proper Substrate Preparation
  - Dry, free of moisture
  - Treatment of joints and seams in exterior drywall
  - Masonry walls: struck flush, no protrusions
  - Detail openings, connections, penetrations

INSTALLATION

LIQUID APPLIED MEMBRANES

- Key Installation
  - Ensure all detailing is completed before or after liquid material
  - Watch temperature limitations for application
  - Spray evenly and consistent and avoid slumping of material
  - Ensure thickness meets specifications

INSTALLATION

LIQUID APPLIED MEMBRANES

- Common Field Issues
  - Insufficient thickness
  - Slumping of material
  - Missed detailing
  - Poor substrate preparation
  - Blisters or pin holing
  - Application over gaps that have not been pre-treated

INSTALLATION

MEDIUM DENSITY SPF

- Proper Substrate Preparation
  - Dry, free of moisture
  - Detailing of transitions, joints and intersections
  - Primers or adhesives may be required on galvanized steel and/or cleaning to remove oils
  - Ensure transition membranes are adhered well

INSTALLATION

MEDIUM DENSITY SPF

- Key Installation
  - Environmental conditions (wind, temperature, humidity)
  - Health and Safety of applicator and work site
  - Thickness of passes
  - Equipment settings (pressure, temperature, 1:1 ratio)

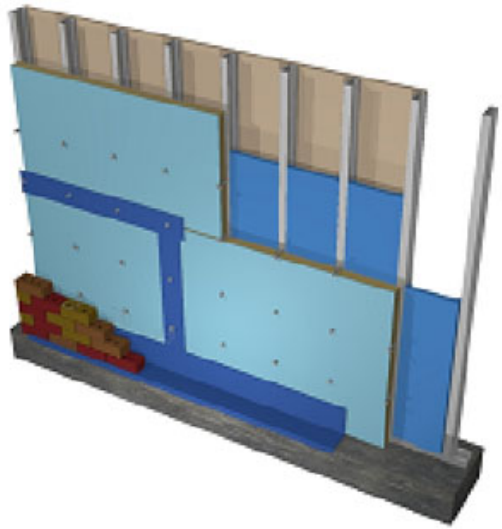
INSTALLATION

MEDIUM DENSITY SPF

- Common Field Issues
  - Insufficient thickness
  - Off-ratio
  - Adhesion to transition membranes and substrate
  - Other trades entering spraying area
  - Missing transition membrane at window openings, roof/wall intersection

INSTALLATION

BOARD STOCK CELLULAR INSULATION

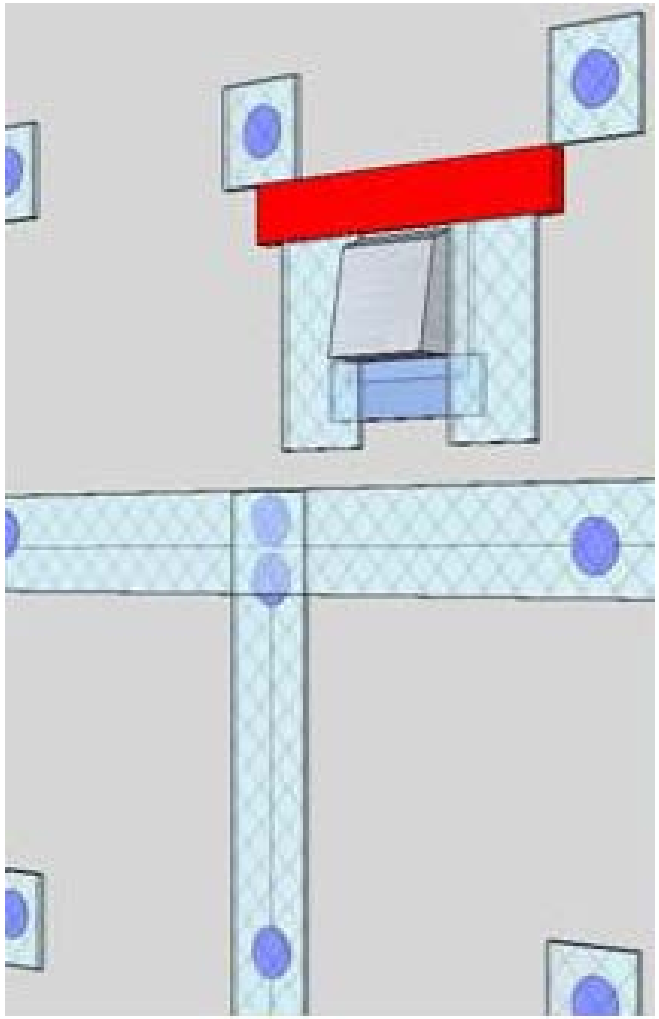


- Proper Substrate Preparation
  - May be substrate if fastened directly to framing members
  - For application over substrate, ensure smoothness and no sharp projections
  - Verify compatibility of sealants

INSTALLATION

BOARD STOCK CELLULAR INSULATION

- Key Installation
  - Treating of seams, edges, end joints and through wall penetrations
  - Sealing penetrations and panel defects with sealant
  - Fastening of boards and types of fasteners
  - Integration with thru-wall flashing



INSTALLATION

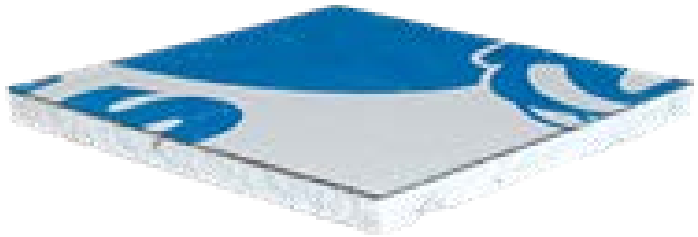
BOARD STOCK CELLULAR INSULATION

- Common Field Issues
  - Lack of connection to windows, door and other details
  - Penetrations installed post-installation (electrical, mechanical)
  - Improper fasteners or sealants
  - Adhesion of tapes to board joints

INSTALLATION

FACTORY BONDED MEMBRANES TO SHEATHING

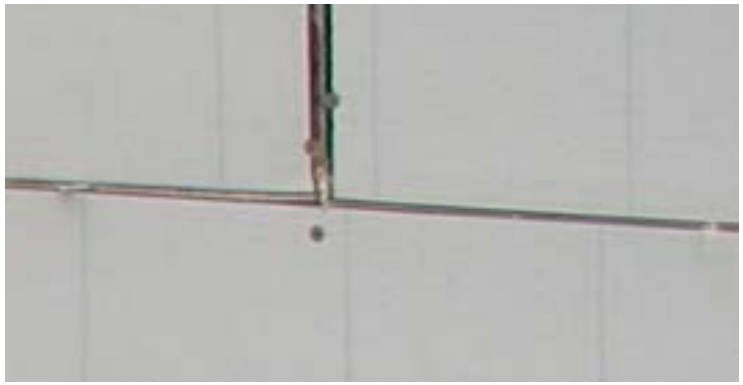
- Proper Substrate Preparation
  - Product is substrate (either self-adhered membrane or fluid applied)
  - Proper fastening to substrate with recommended fasteners

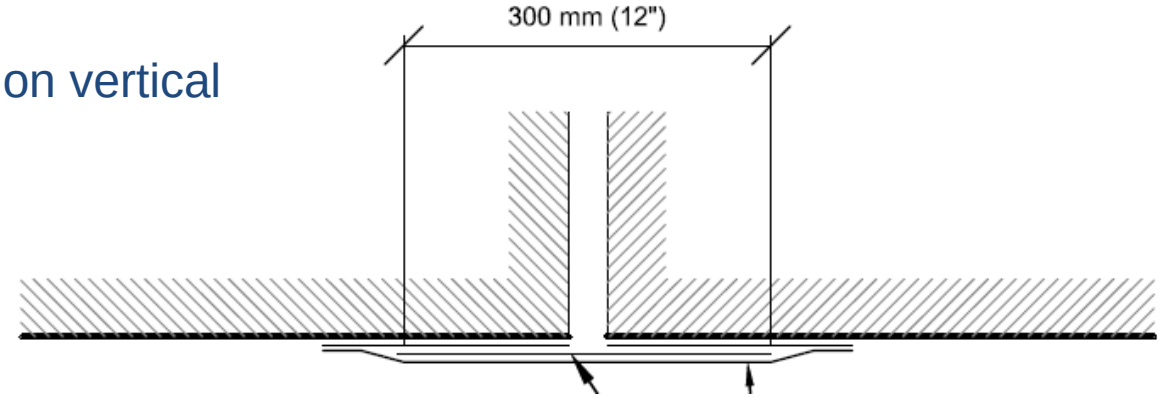


INSTALLATION

FACTORY BONDED MEMBRANES TO SHEATHING

- Key Installation
  - Treating of seams, edges, end joints and through wall penetrations with membranes
  - Off-set vertical joints
  - Membrane installation on vertical joints, then horizontal





INSTALLATION

FACTORY BONDED MEMBRANES TO SHEATHING

- Common Field Issues
  - Missed transition membranes or insufficient overlap
  - Over driven fasteners
  - Lack of primer for transition membranes

INSTALLATION

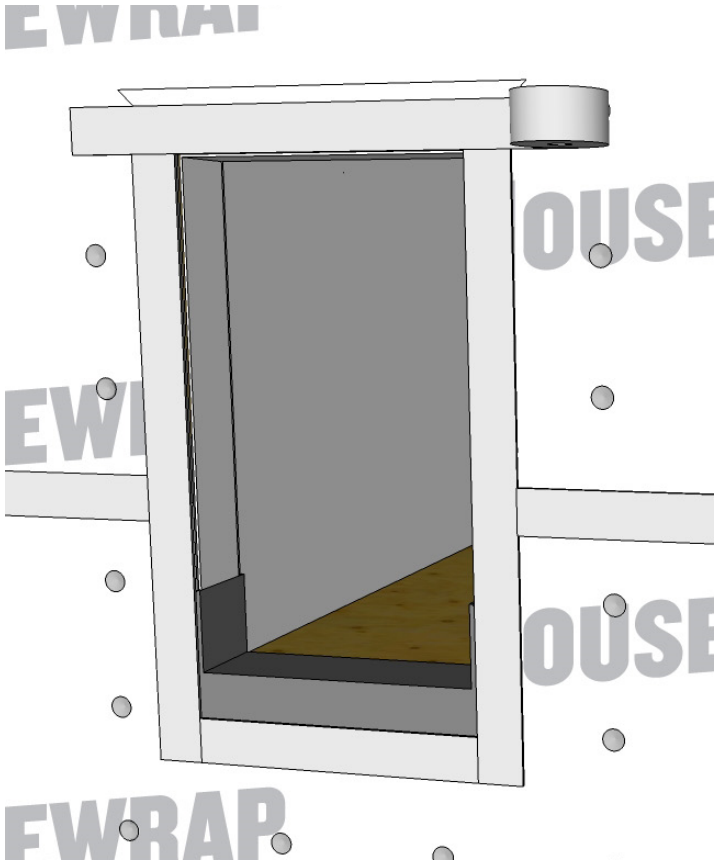
MECHANICALLY FASTENED COMMERCIAL BUILDING WRAP

- Proper Substrate Preparation
  - Address protrusions that might puncture material

INSTALLATION

MECHANICALLY FASTENED COMMERCIAL BUILDING WRAP

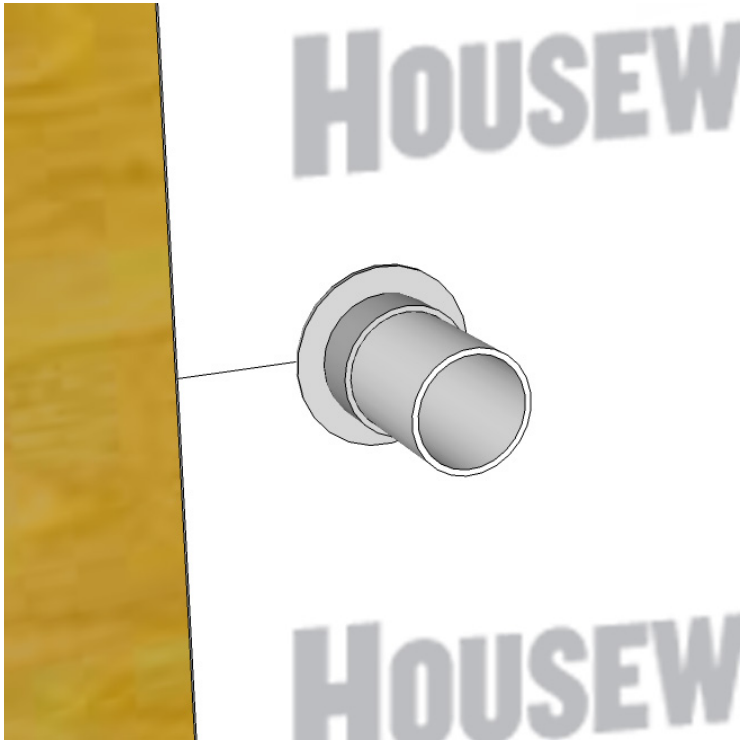
- Key Installation
  - Proper type of fasteners and fastening pattern
  - Proper overlap of seams and corners
  - Taping all seams
  - Detailing penetrations and details (windows, doors, etc)



INSTALLATION

MECHANICALLY FASTENED COMMERCIAL BUILDING WRAP

- Common Field Issues
  - Damage and tears during construction
  - Installation over sharp objects
  - Insufficient overlap of seams
  - Lack of integration into windows, doors and other openings



Thank you for your time!

Question and Answer Period

This concludes The American Institute of Architects
Continuing Education Systems Course

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