WHAT THE HECK ARE AIR BARRIERS, VAPOR BARRIERS AND WATER-RESTIVE BARRIERS?

AIA # WHA2025

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Laverne has promoted high performance durable building both in North America and Internationally, He started the Air Barrier Association of America in 2001 which has grown into a whole industry and air barriers have become a Building Code requirement.
He continues to work on developing standards and in implementing site quality assurance programs in the construction industry.

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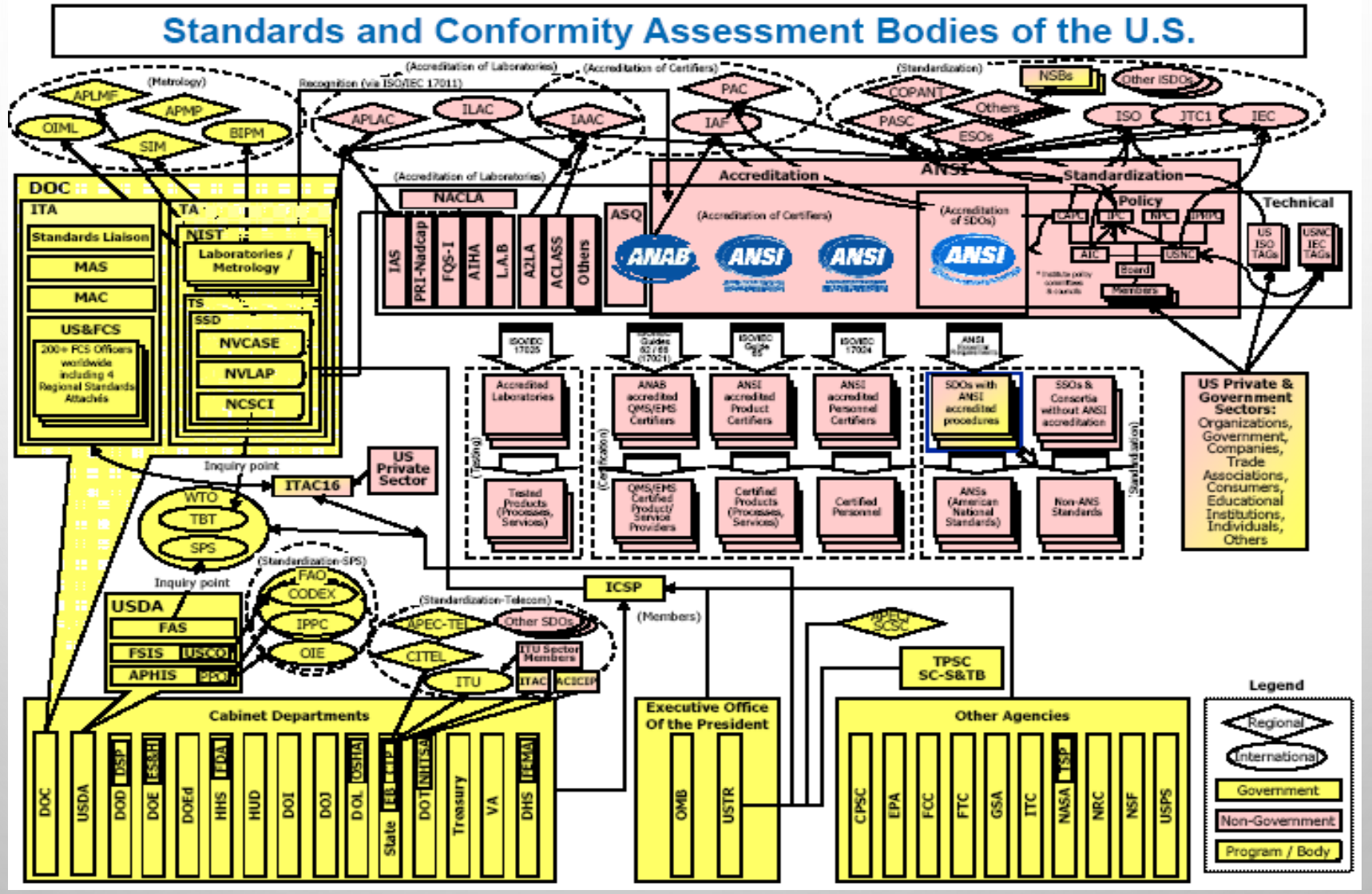
Standards and Conformity Assessment Bodies of the U.S.
(Metrology)
APLMF
APMP
OIML
BIPM
SIM
(Accreditation of Laboratories)
Recognition (via ISO/IEC 17011)
APLAC
ILAC
IAAC
(Accreditation of Certifiers)
PAC
IAF
(Standardization)
COPANT
PASC
Others
ESOs
NSBs
Other ISDOs
ISO
JTC1
IEC
ANSI
Accreditation
Standardization
Policy
Technical
DOC
ITA
Standards Liaison
MAS
MAC
US&FCS
200+ FCS Officers worldwide including 4 Regional Standards Attachés
TA
NIST
Laboratories / Metrology
TS
SSD
NVCASE
NVLAP
NCSCI
NACLA
IAS
PRI-Nadcap
FQS-1
AIHA
L.A.B
A2LA
ACLASS
Others
ASQ
ANAB
ANSI
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ANSI
(Accreditation of SDOs)
CAPC
IPC
NPC
IPPPC
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USNC
Board
Members
US ISO TAGs
USNC IEC TAGs
Inquiry point
ITAC16
US Private Sector
WTO
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USCOL
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(Standardization-SPS)
FAO
CODEX
IPPC
OIE
(Standardization-Telecom)
APEC-TEL
Other SDOs
CITEL
ITU
ITU Sector Members
ITAC
ACICIP
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(Members)
APEC SCSC
TPSC SC-S&TB
Accredited Laboratories
Tested Products (Processes, Services)
(Testing)
ANAB accredited QMS/EMS Certifiers
ANSI accredited Product Certifiers
ANSI accredited Personnel Certifiers
QMS/EMS Certified Product/ Service Providers
Certified Products (Processes, Services)
Certified Personnel
(Certification)
SDOs with ANSI accredited procedures
SSOs & Consortia without ANSI accreditation
ANSs (American National Standards)
Non-ANS Standards
(Standardization)
US Private & Government Sectors: Organizations, Government, Companies, Trade Associations, Consumers, Educational Institutions, Individuals, Others
Cabinet Departments
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OSHA
State
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EXIM
DOT
NHTSA
Treasury
VA
DHS
FEMA
Executive Office Of the President
OMB
USTR
Other Agencies
CPSC
EPA
FCC
FTC
GSA
ITC
NASA
TSP
NRC
NSF
USPS
Legend
Regional
International
Government
Non-Government
Program / Body

What are Air Barriers, Vapor Barriers and Water-Resistive Barriers?

- Air barriers, Vapor barriers. Water-resistive barriers are all the same right?
- No – So why is there some much confusion?
- The answer is also confusing

What are Air Barriers, Vapor Barriers and Water-Resistive Barriers?

- **Abstract:** these terms are really simple, so why confusion? This presentation will cover what they are, when they are not and when they may be more than one. That is when the confusion comes in. Some barriers are critical, and some are not, how do you know? When can a single material be different just because where it is installed in the building envelope?

What are Air Barriers, Vapor Barriers and Water-Resistive Barriers?

Learning objectives:

- Define each of the barriers
- Determine the various means water enters the building
- Explain why what you do not see can hurt you the most
- Show what can be a critical barrier

WHAT IS AN AIR BARRIER, VAPOR BARRIER OR WATER-RESISTIVE BARRIER?

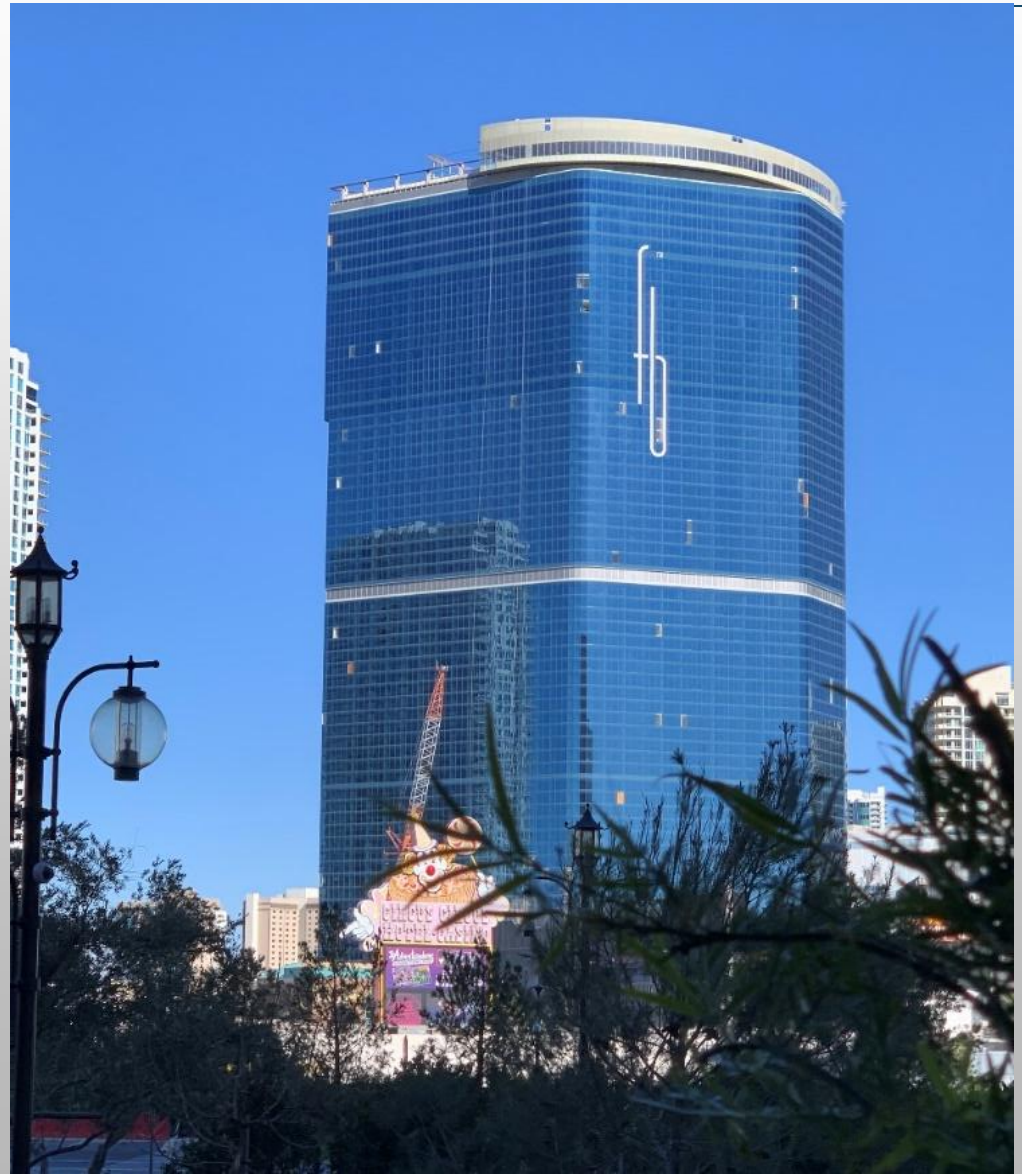
AIR BARRIER MATERIAL – REDUCES AIR GOING THROUGH A MATERIAL

- **VAPOR BARRIER MATERIAL –** REDUCES WATER VAPOR GOING THROUGH A MATERIAL
- **WATER-RESISTIVE BARRIER MATERIAL –** STOPS LIQUID WATER GOING THROUGH A MATERIAL
- **HEAT BARRIER (THERMAL INSULATION) –** SLOWS THE HEAT FLOW THROUGH A MATERIAL

- VERY SIMPLE RIGHT? **BUT…..**

THE FUTURE

WE BUILD A LOT OF BUILDINGS RIGHT, SOME NOT SO GOOD



THE FUTURE

WHAT WE USE TO BUILT

WHAT WE ARE BUILDING

WHAT WE BUILT

WHAT WE ARE BUILDING

THE FUTURE

WE ARE BUILDING THE SAME, BUT BUILDINGS HAVE CHANGED

THE FUTURE

WE ARE BUILDING THE SAME, BUT OUR WORKFORCE HAS CHANGED

WHAT IS AN AIR BARRIER, VAPOR BARRIER OR WATER-RESISTIVE BARRIER?

Very simple right? **But…..**

1. Many materials can do more than one function
2. Many material properties change when temperature and humidity changes
3. Many material properties change when they are part of a building assembly
4. Installation requirements can dictate when a material provides a material property

WHAT IS AN AIR BARRIER, VAPOR BARRIER OR WATER-RESISTIVE BARRIER?

For any of these barriers, the material must be

a. designed

b. selected

c. installed

To function as intended

THE HISTORY OF AIR BARRIERS

1940's University of Minnesota researched why water was coming into walls – resulted in #15 felt being installed as a water-resistive barrier

1960's More insulation was being put into buildings resulting in water in the walls – resulted in a vapor barrier being installed in walls

THE HISTORY OF AIR BARRIERS

1970's/80's Water was still showing up in walls – research was done on water vapor by air transport resulted in air leakage being shown as the cause

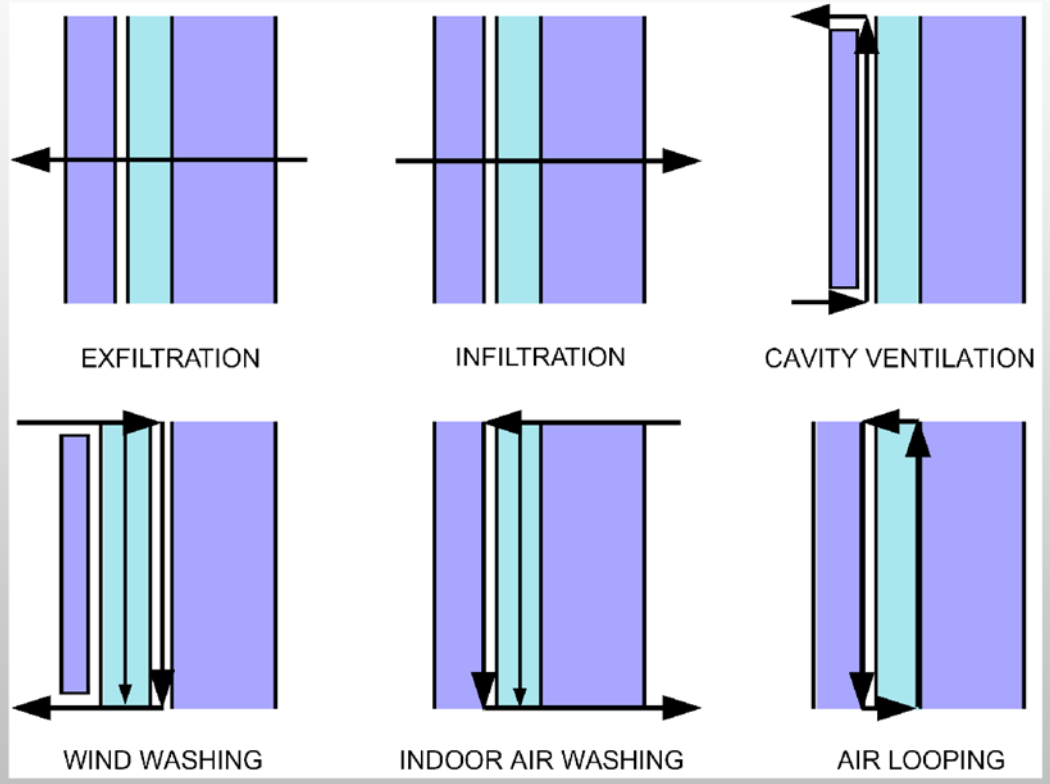
1990 National Building Code of Canada required an air barrier to be installed in buildings

2001Commonwealth of Massachusetts requires an air barrier in buildings

THE HISTORY OF AIR BARRIERS

All this work was done to deal with water in buildings

WHAT IS AN AIR BARRIER?

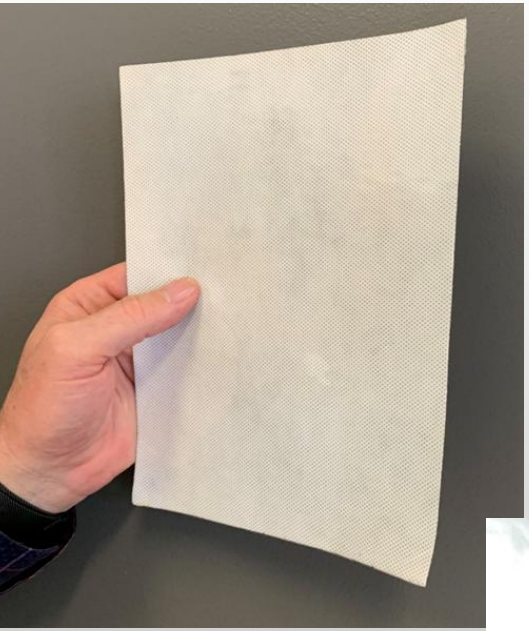


WHAT IS AN AIR BARRIER? (VERB)

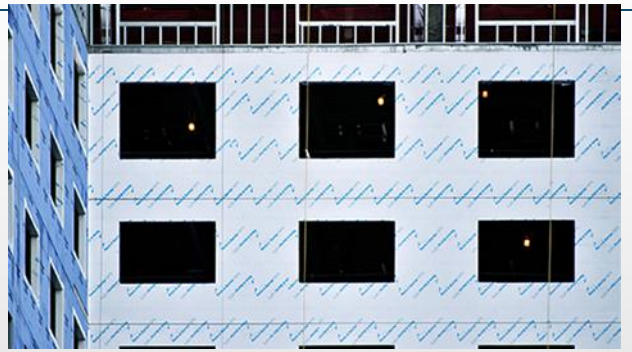
What is the performance requirement for an air barrier?

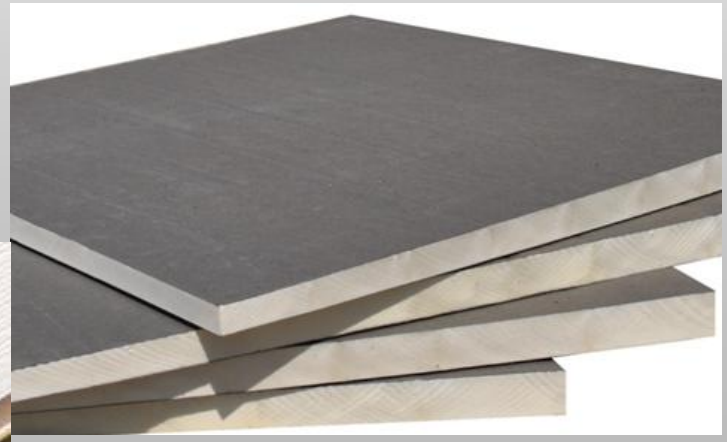
- Depends on
  - **Material** – the main part of an air barrier assembly
  - **Accessory** – material or products that are used with the material
  - **Sub-Assembly** – portion of an assembly used to confirm performance
  - **Assembly** – made up of material(s) and accessories – roof assemblies, wall assemblies and foundation assemblies
  - **Component** – items which are manufactured and simply installed on site – doors, windows, etc.
  - **System** – all six sides of a building, made up of the assemblies

WHAT IS AN AIR BARRIER?



What are some Air Barrier Materials?

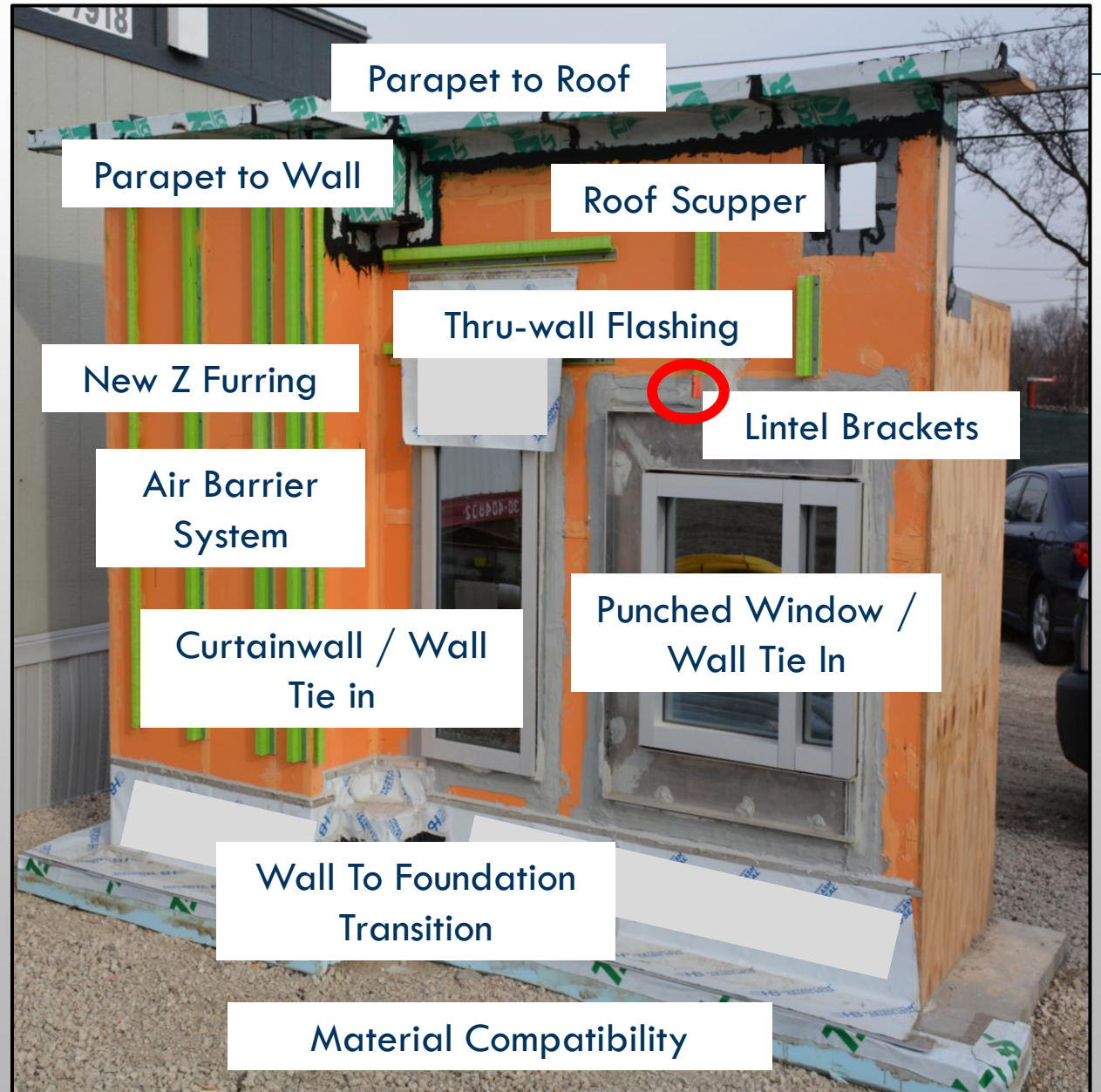




What is an Air Barrier?

Air barrier requirements	
Air Barrier Material - the big pieces	**0.004** CFM/ft²@ 1.56 lbs/ft² pressure difference (ISO 14857 ASTM E2178)
Air Barrier Accessory – tapes, strips, caulking, etc.	**0.004** CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E283)
Air Barrier Component – windows, doors, skylights, etc.	**0.04** CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E283)
Air Barrier Assembly - wall assembly, roof assembly, foundation assembly	**0.04** CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E2357)
Air Barrier System - Whole Building	**0.10*** CFM/ft²@ 1.56 lbs./ft² pressure difference (ISO 9972, ASTM E 779 ABAA AB-001)
*proposed maximum air leakage rate	

Why are air barriers hard to do?
Hundreds of opportunities for air leaks



$14 M Project

On Site Simple Wall Mock Up = $12,500.

Mock Up = 0.09% of Construction Costs

What is a Vapor Retarder (Barrier)?

Air Barrier Performance Requirements

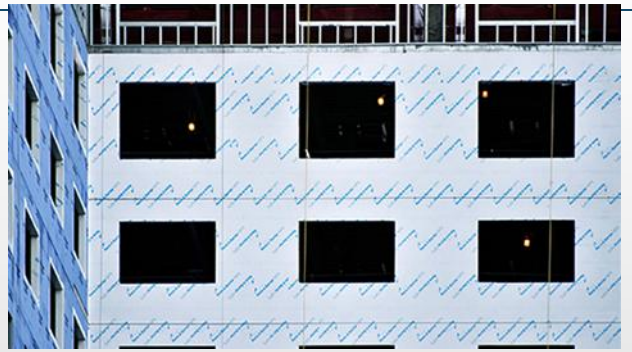
- **Material** designated to reduce the water vapor transmission rate through the material
- Notice we have specifically identified a material – **NO** accessories, sub-assemblies, assemblies or systems
- Every construction material has a water vapor transmission rate, so all materials are vapor retarders of some sort

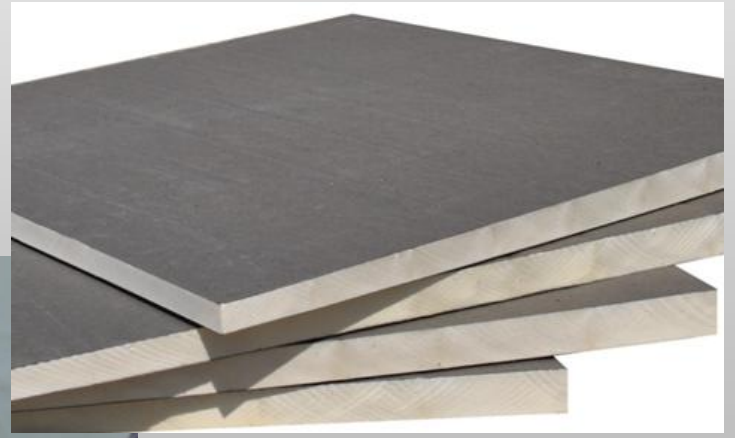
What is a Vapor Retarder (Barrier)?

Vapor Retarder (Barrier) Code Performance Requirements		
Vapor Retarder (Barrier) Material - the big pieces, there are only pieces – big or small		
International Building Code Table 1404.3(2)	Climate Zone 1,2 3,4 (except Marine 4) Marine 4, 5,6,7,8	Vapor Retarder Class III II,III I, II, III (Table 1404.3(3)
A vapor retarder should be the simplest control layer in a building assembly, but it is the most complex		

Class I	less than or equal to 0.1 Perm
Class II	greater than 0.1 Perm and less than or equal to 1.0 Perm
Class III	greater than 1.0 perm and less than or equal to 10.0 Perms

What is a Vapor Retarder Material (Barrier)?





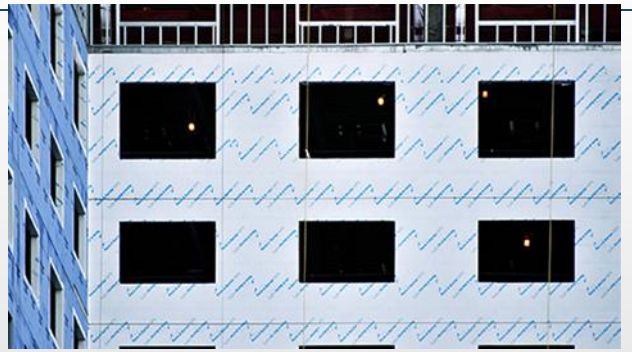
What is a Water-Resistive Barrier?

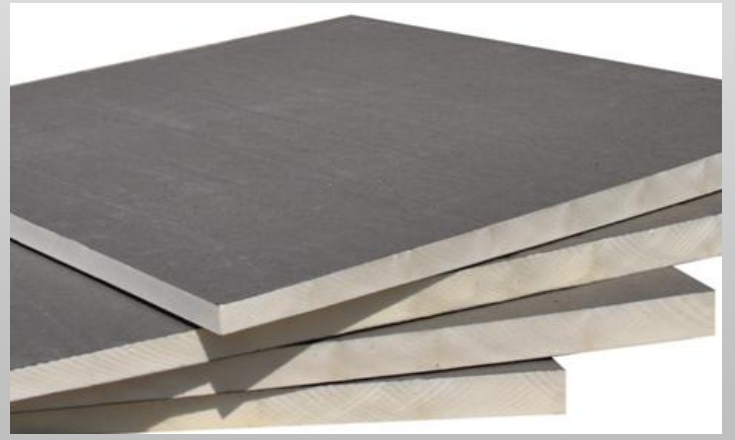
- "Assembly of materials and accessories behind an exterior wall covering that is intended to resist the further intrusion of liquid water that has penetrated the exterior covering into the exterior wall assembly"
- Code has got this right – it's an **ASSEMBLY**
- **Material and Accessories** have to be combined into a control layer

What is a Water-Resistive Barrier?

Water-Resistive Barrier Performance Requirements	
Water-Resistive Barrier Material - the big pieces	No liquid water through the material
Water-Resistive Barrier Accessories - Flashings, etc.	No liquid water through the material
Water-resistive barriers seems to be straight forward – keep water out	

What is a Water-Resistive Barrier Material?





Now the Confusing Part

Materials use change depending on whether the material has been designed and installed to provide a specific performance

Why do we care?

MOLD

CORROSION

WOOD ROT

Air Barrier Technologies

WHY DO WE HAVE PROBLEMS?

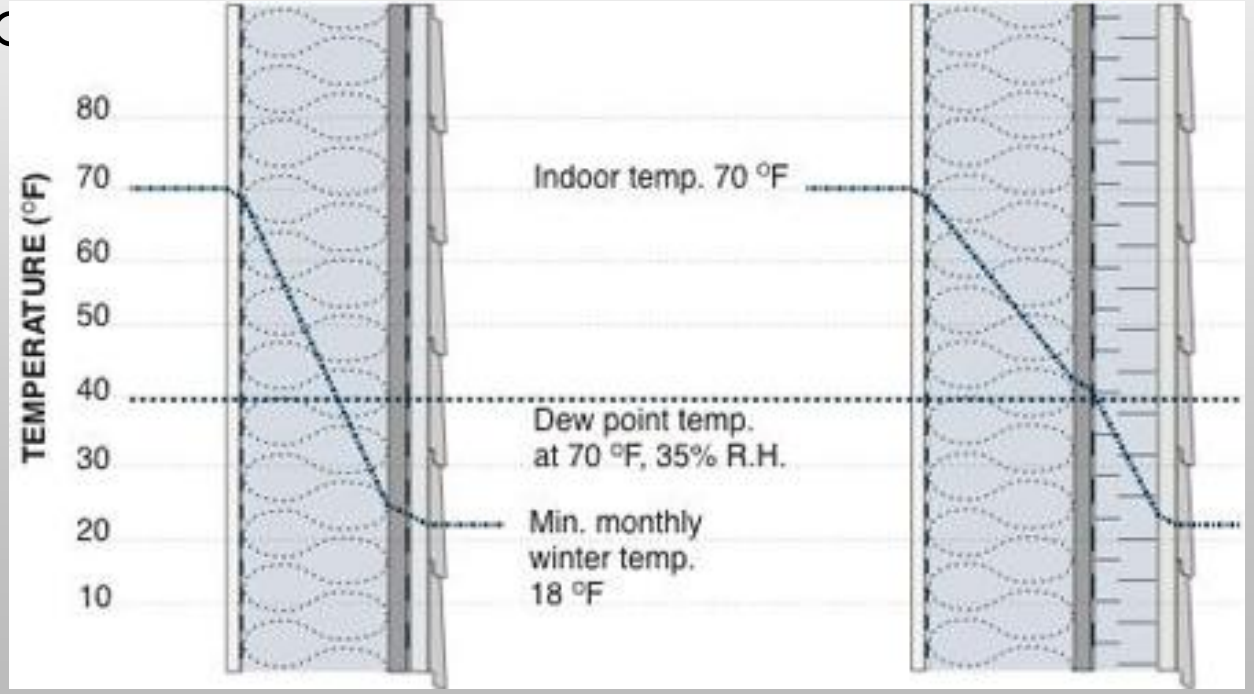
- **A SINGLE MATERIAL CAN PROVIDE MORE THAN ONE FUNCTION**
- SOME MATERIALS CAN PROVIDE ONE FUNCTION - AIR BARRIER
- SOME MATERIALS CAN PROVIDE TWO FUNCTIONS – AIR BARRIER AND VAPOR BARRIER
- SOME MATERIAL CAN PROVIDE THREE FUNCTIONS – AIR BARRIER, VAPOR BARRIER AND WATER-RESISTIVE BARRIER
- SOME MATERIAL CAN PROVIDE FOUR FUNCTIONS – AIR BARRIER, VAPOR BARRIER, WATER-RESISTIVE BARRIER AND HEAT BARRIER

WHY DO WE HAVE PROBLEMS?

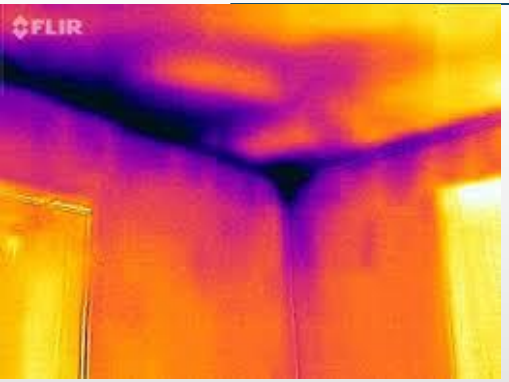
- **IF A MATERIAL CAN PROVIDE MORE THAN ONE FUNCTION, DO THEY AUTOMATICALLY PROVIDE THOSE FUNCTIONS?**
- **NO – NOT UNLESS THEY ARE DESIGNED AND INSTALLED TO PROVIDE THAT FUNCTION**

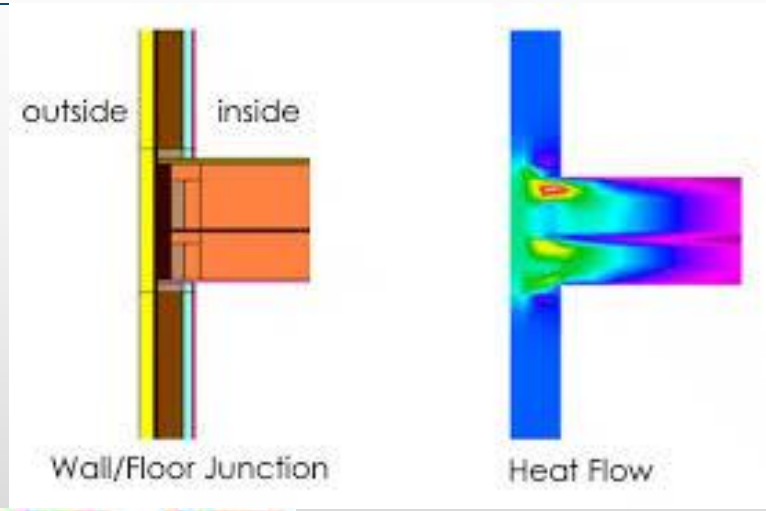
WHY DO WE HAVE PROBLEMS?

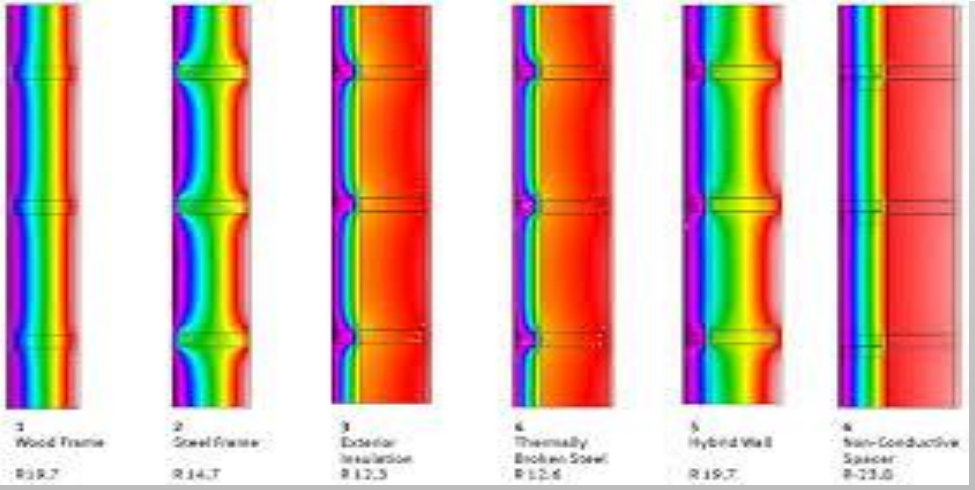
- EACH MATERIAL THAT IS PART OF A WALL ASSEMBLY MUST BE CONSIDERED IN THE ENVIRONMENT THEY ARE PLACED
- MOVING A MATERIAL TO A DIFFERENT PLACE IN AN ASSEMBLY WITH CHANGE THE PERFO



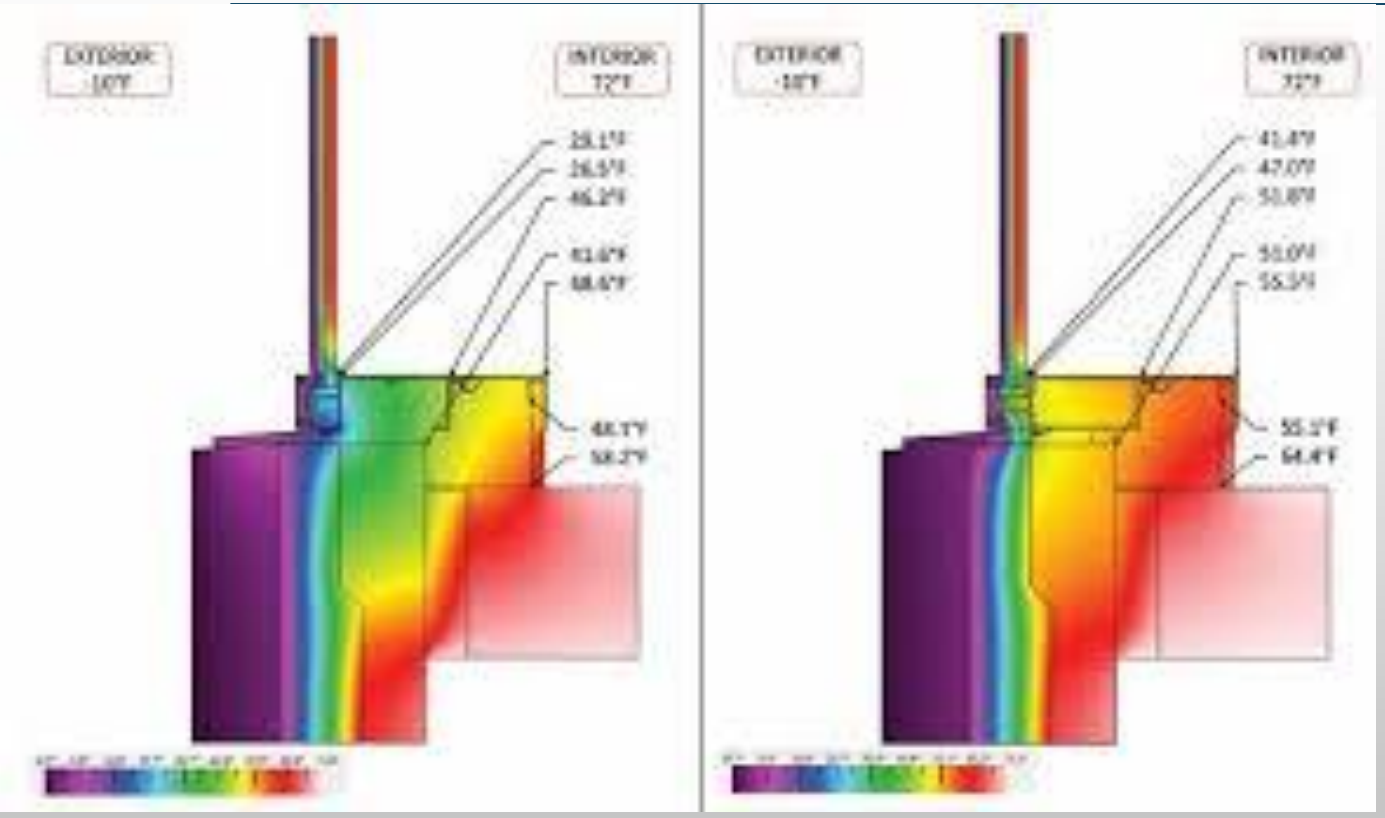
WHY DO WE HAVE PROBLEMS?

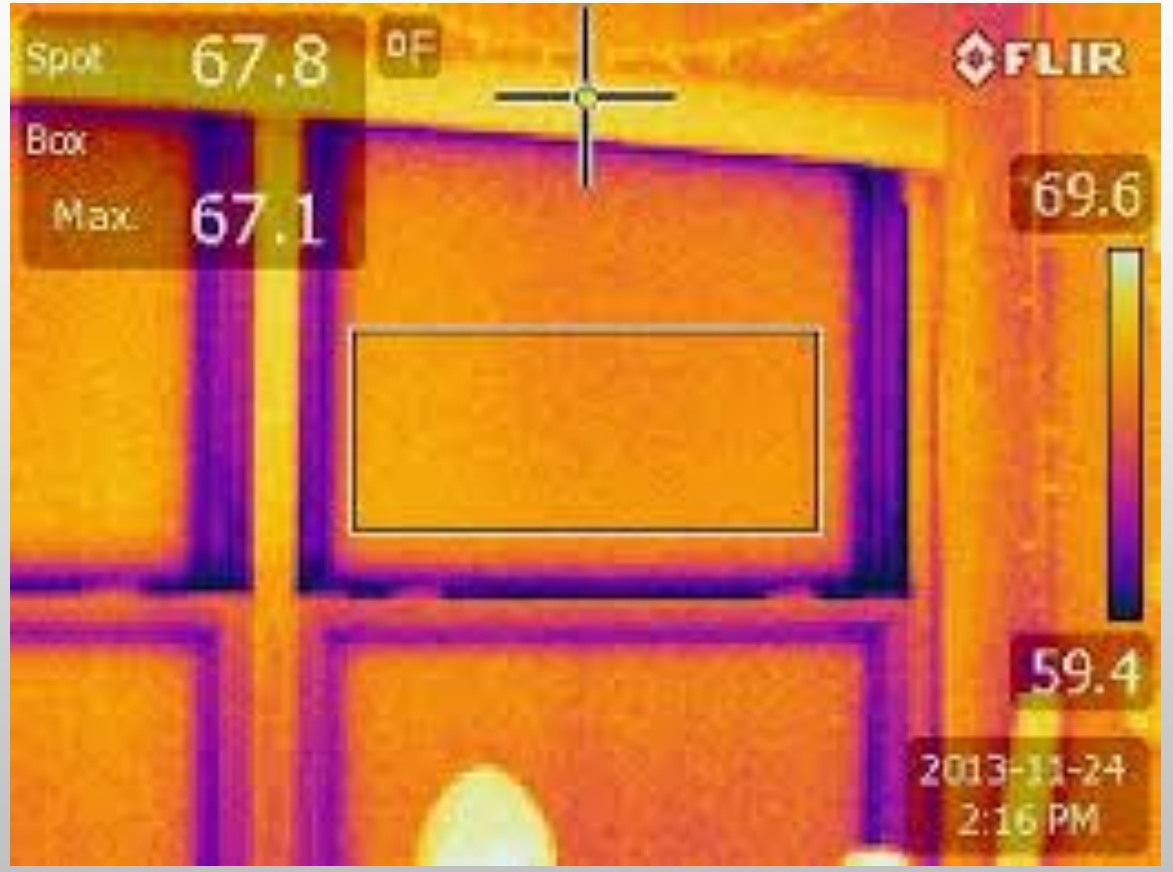






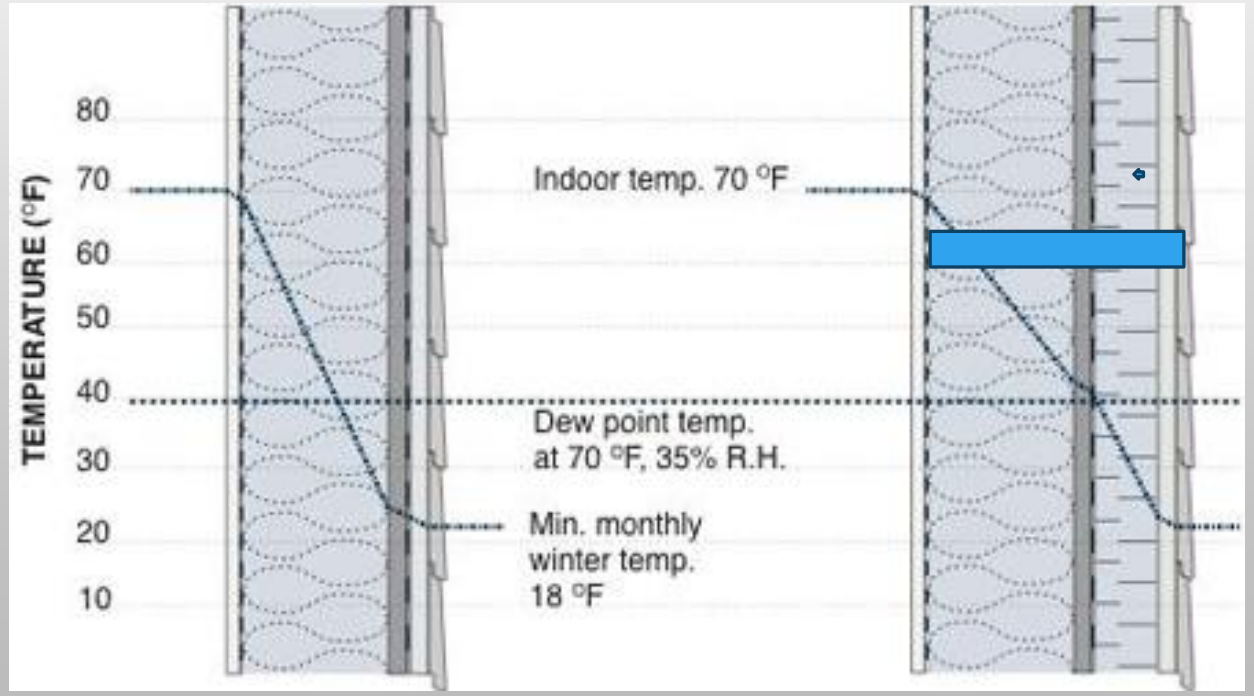
WHY DO WE HAVE PROBLEMS?





WHY DO WE HAVE PROBLEMS?

A THERMAL BRIDGE SHORT CIRCUITS THE INSULATION AND INCREASES HEAT FLOW WHICH REDUCES THE TEMPERATURE IN A BUILDING ASSEMBLY

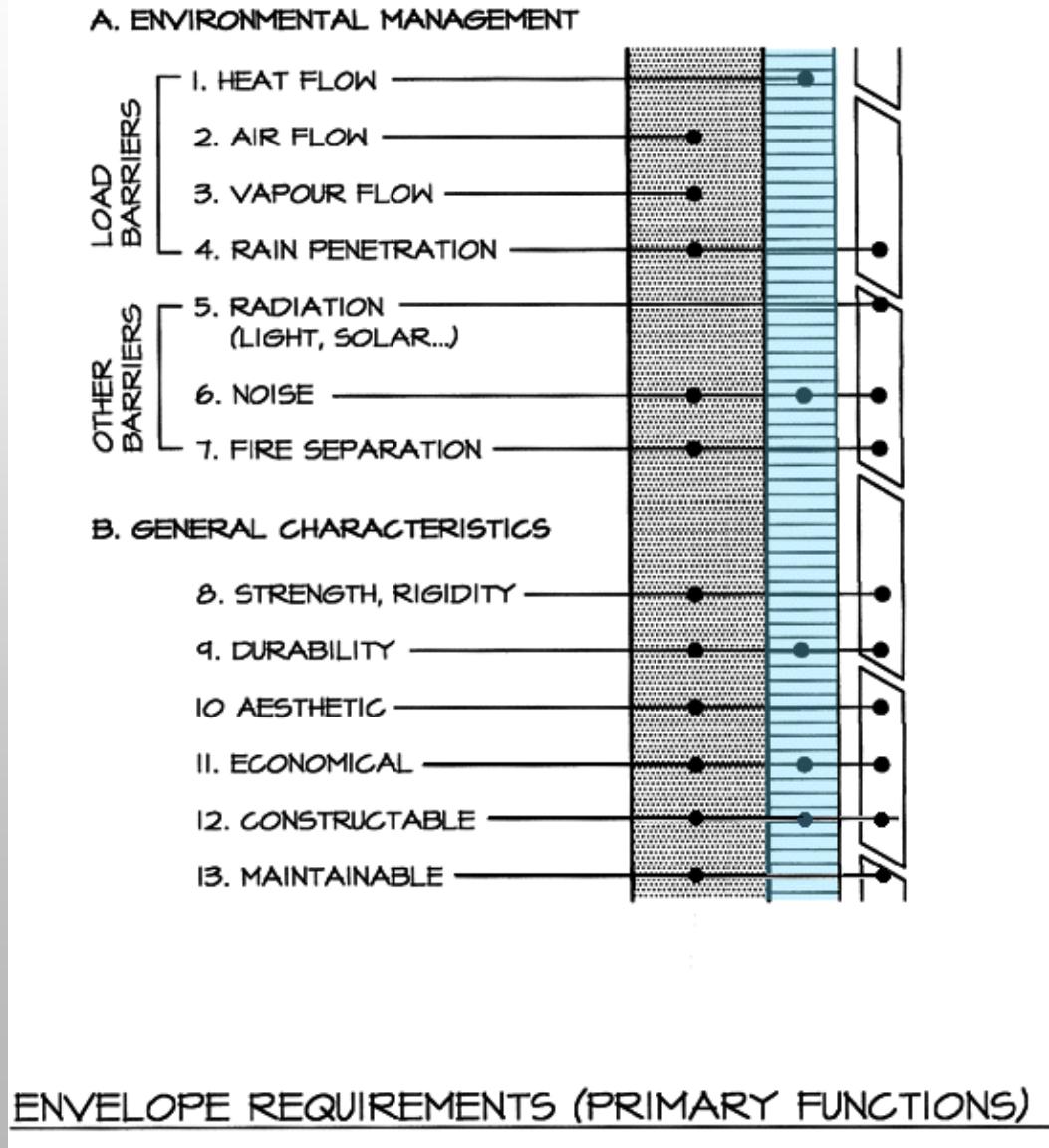


WHY DO WE HAVE PROBLEMS?

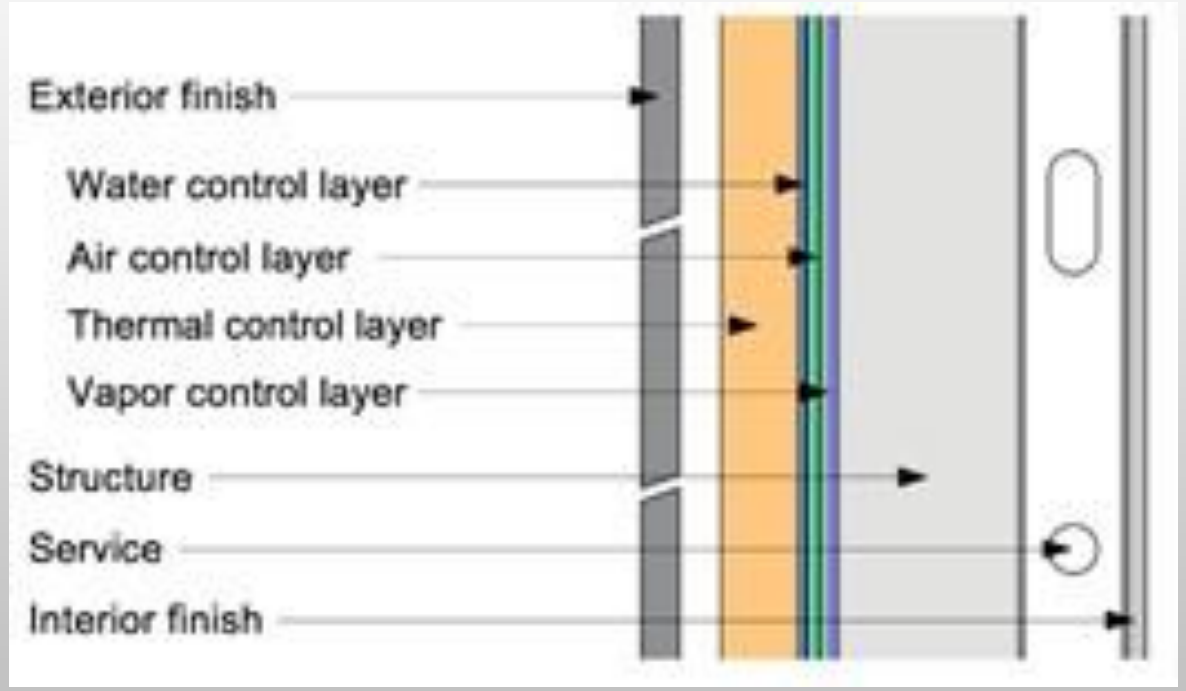
The four control layers must be considered together in the following order

1. Liquid Water flow
2. Air Flow
3. Heat Flow
4. Vapor Flow

Yet we focus on the water vapor transmission of a single material



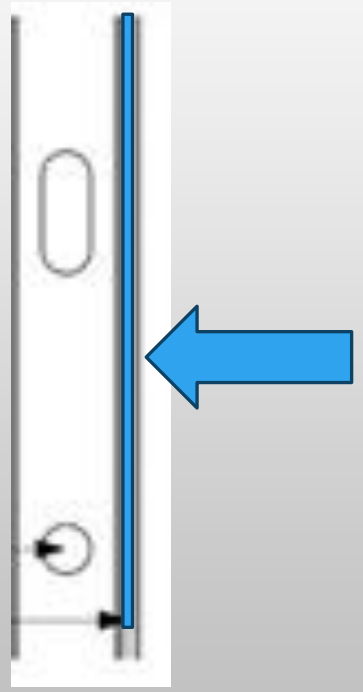
A SIMPLE WALL CONSTRUCTION



A SIMPLE WALL CONSTRUCTION

- INTERIOR FINISH
  - ½ INCH GYPSUM BOARDS ARE AN AIR BARRIER MATERIAL AND **BUT** MUST BE COMPLETELY SEALED AN AIR BARRIER ASSEMBLY
  - PAINTED DRYWALL CAN PROVIDE A CLASS II VAPOR RETARDER
  - NO WATER-RESISTANCE

  EACH WILL AFFECT HOW THE BALANCE OF THE WALL WILL PERFORM



A SIMPLE WALL CONSTRUCTION

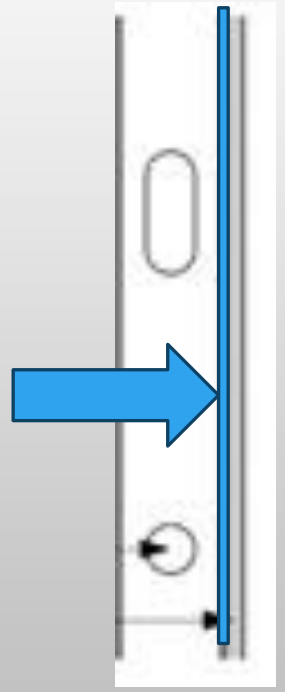
- INTERIOR VAPOR RETARDER

  POLYETHENE FILM OR OTHER SUCH MATERIAL IS A CLASS I VAPOR RETARDER

  IT IS AN AIR BARRIER MATERIAL **BUT** MUST BE COMPLETELY SEALED AND SUPPORTED TO BE AN AIR BARRIER ASSEMBLY

  CANNOT BE A WATER-RESISTIVE BARRIER AS IT IS INSTALLED ON THE INTERIOR

  THE MATERIAL WILL AFFECT HOW THE BALANCE OF THE WALL WILL PERFORM



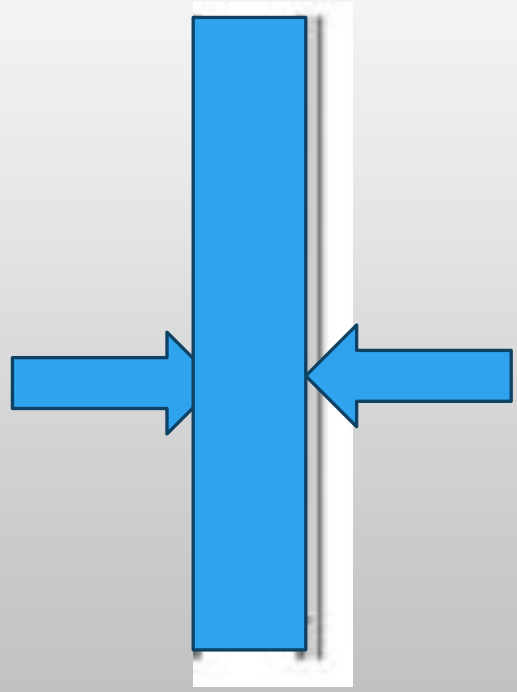
A SIMPLE WALL CONSTRUCTION

- INSULATION BETWEEN FRAMING MATERIALS
  - FIBROUS INSULATION IS NOT A AIR BARRIER, VAPOR BARRIER
  - OR WATER-RESTIVE BARRIER
  - IF CLOSED CELL MEDIUM DENSITY INSULATION IS

  USED, IT CAN BE AN AIR BARRIER MATERIAL, CLASS II

  VAPOR BARRIER IN ADDITION TO INSULATION **BUT** MUST BE

  COMPLETELY SEALED TO BE AN AIR BARRIER ASSEMBLY



THE MATERIAL WILL AFFECT HOW THE BALANCE OF THE WALL

WILL PERFORM

A SIMPLE WALL CONSTRUCTION

- STRUCTURE/BACKUP WALL/EXTERIOR SHEATHING
- GYPSUM, OSB SHEATHING AT A

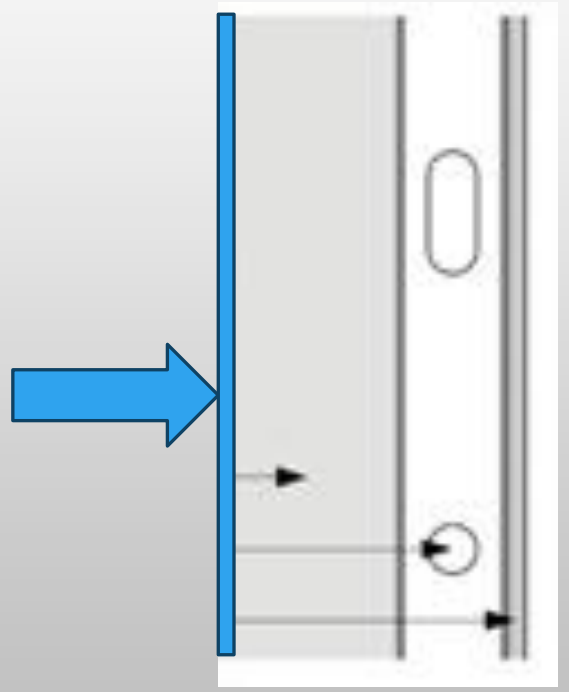
MINIMUM THICKNESS OR CAST IN PLACE

CONCRETE, THE EXTERIOR SHEATHING CAN

BE AN AIR BARRIER **BUT** MUST BE

COMPLETELY SEALED TO BE AN AIR BARRIER ASSEMBLY

- IF CMU, THE MATERIAL IS NOT AN AIR BARRIER



A SIMPLE WALL CONSTRUCTION

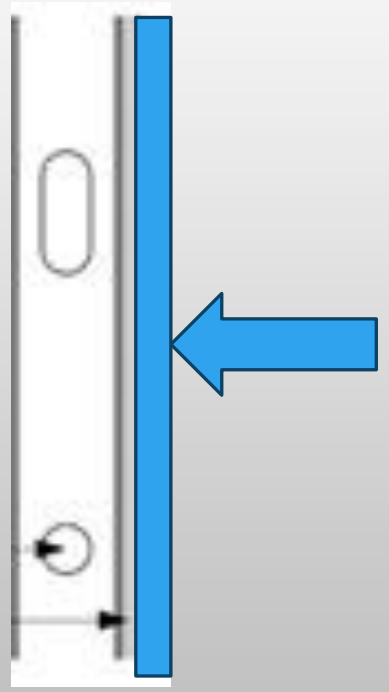
- INSULATION ON EXTERIOR
  - FIBROUS INSULATION IS NOT AN AIR BARRIER, VAPOR BARRIER
  - OR WATER-RESTIVE BARRIER
  - CELLULAR PLASTIC CAN BE AN AIR BARRIER, VAPOR BARRIER

  AND WATER RESTIVE BARRIER **BUT** MUST BE

  COMPLETELY SEALED TO BE AN AIR BARRIER ASSEMBLY

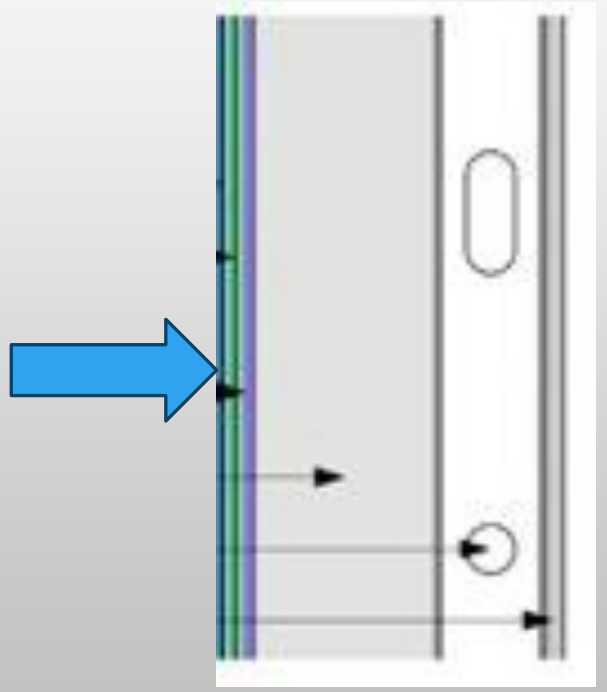
  THE MATERIAL WILL AFFECT HOW THE BALANCE OF THE WALL

  WILL PERFORM



A SIMPLE WALL CONSTRUCTION

- WATER CONTROL LAYER
  - MUST BE ON THE EXTERIOR NORMALLY BEHIND THE CLADDING
  - STOPS WATER INGRESS, MUST BE CONTINUOUS AND COMBINED WITH FLASHINGS
  - DEPENDING ON THE MATERIAL, IT COULD ALSO BE AN AIR BARRIER, A VAPOR RETARDER OR THERMAL INSULATION



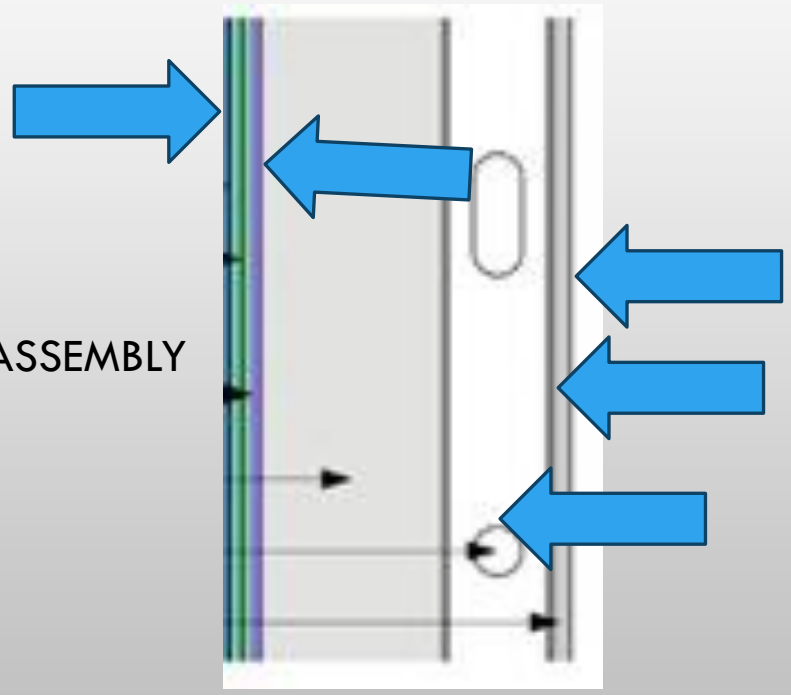
A SIMPLE WALL CONSTRUCTION

- AIR CONTROL LAYER
  - STOPS AIR LEAKAGE, MUST BE CONTINUOUS
  - DEPENDING ON THE MATERIAL, IT COULD

  ALSO BE A WATER-RESTIVE BARRIER, A

  VAPOR RETARDER OR THERMAL INSULATION

  IF ONLY THE AIR BARRIER CAN BE ANYWHERE IN THE ASSEMBLY



A SIMPLE WALL CONSTRUCTION

- VAPOR CONTROL LAYER
  - STOPS WATER VAPOR FROM MOVING

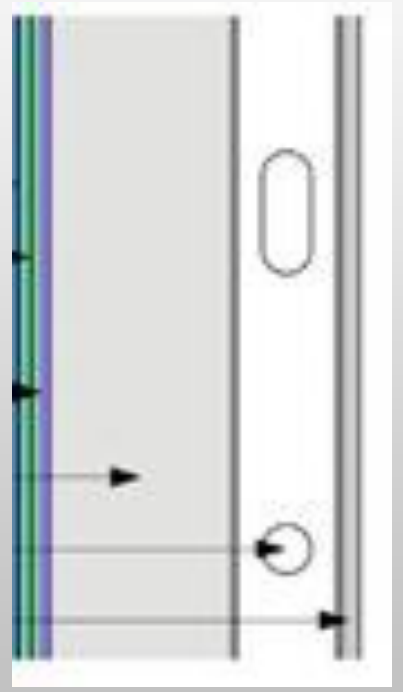
  THROUGH THE MATERIAL DOES NOT NEED

  TO BE CONTINUOUS
  - DEPENDING ON THE MATERIAL, IT COULD

  ALSO BE AN AIR BARRIER, A WATER-RESTIVE

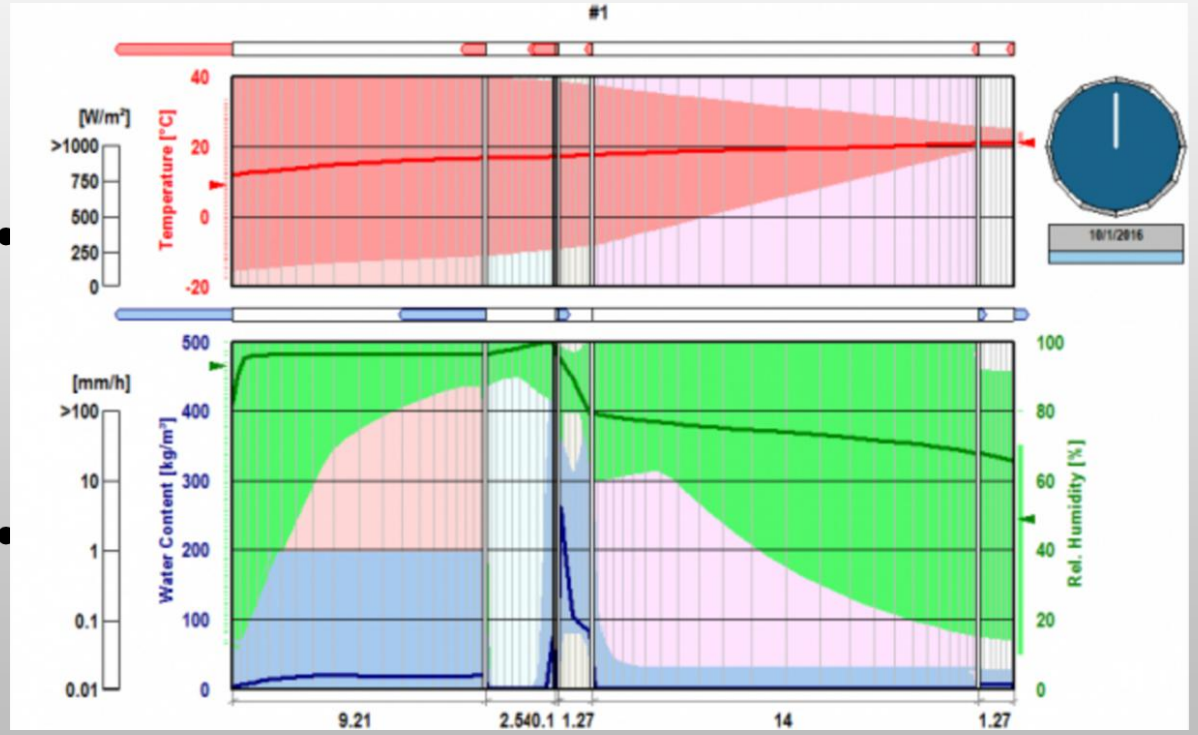
  BARRIER OR THERMAL INSULATION
  - NEEDS TO BE ON THE SIDE WITH HIGH VAPOR PRESSURE

  WHICH CHANGES CONTINUALLY



WATER VAPOR TRANSMISSION RATE OF ASSEMBLIES MODELING

- MORE REALISTIC APPROACH IS TO USE WUFFI MODELING FROM ORNL WHICH USES REAL WEATHER DATA TO PRODUCE REALISTIC CONDITIONS
- USES WVTR OF INDIVIDUAL MATERIALS
- REQUIRED MULTIPLE DATA POINTS TO DETERMINE THE CURVE



THIS IS WHY THERE IS CONFUSION

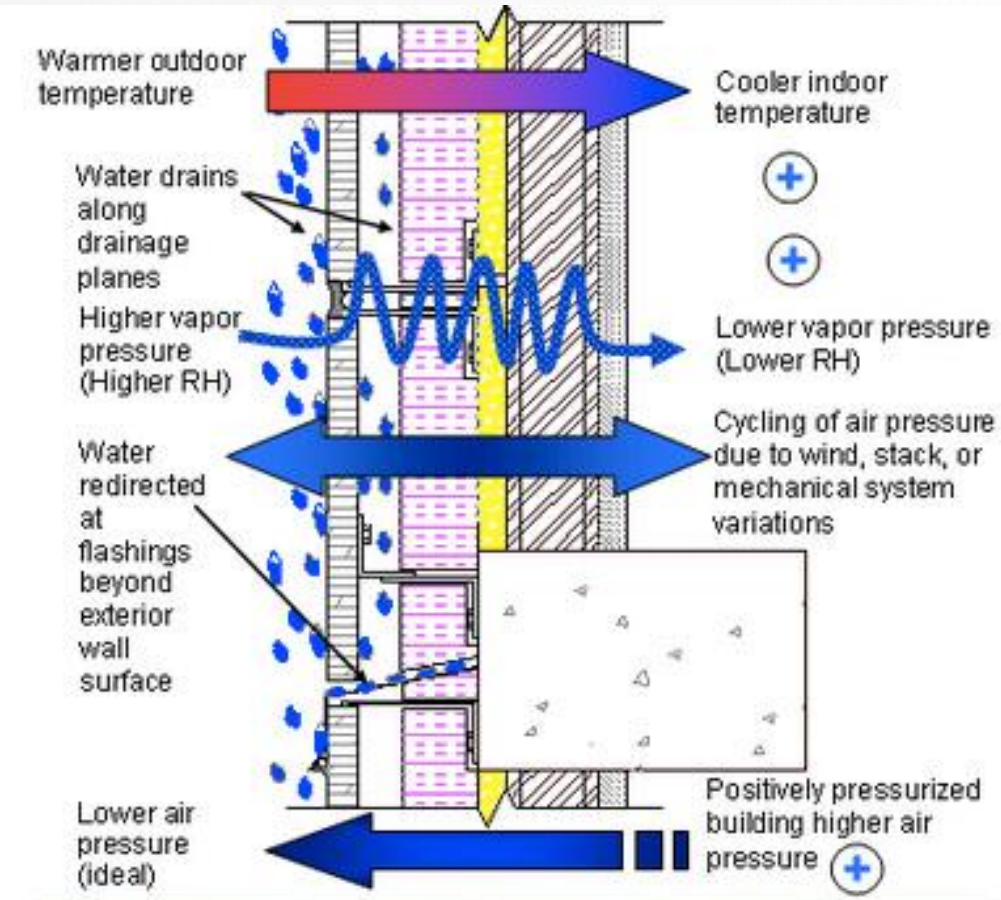
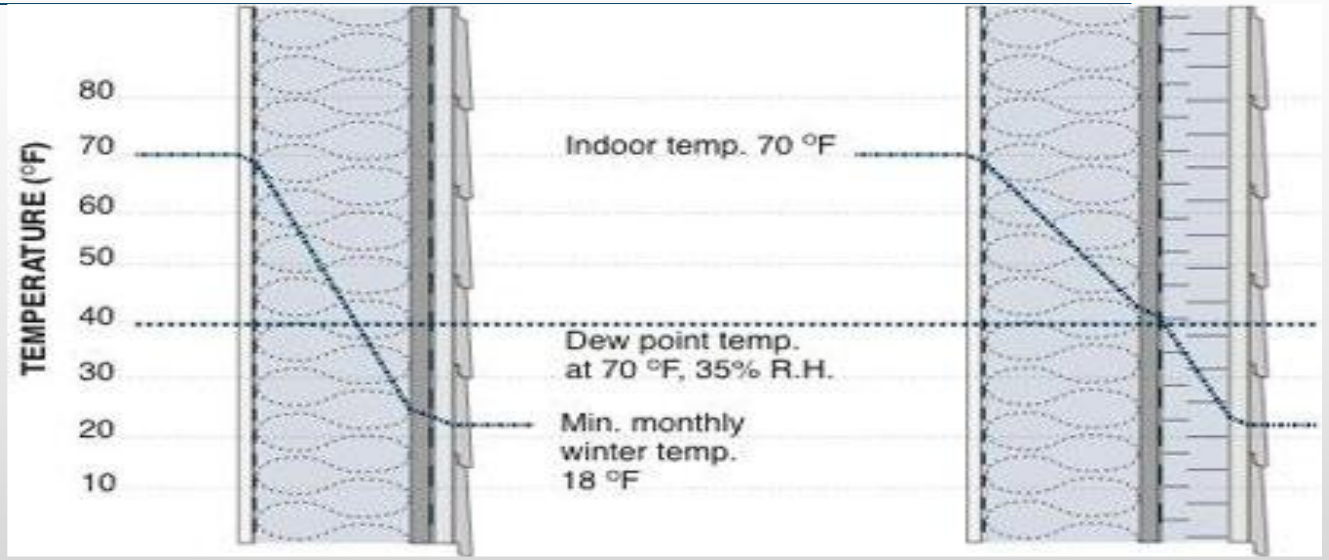


Figure 6. Moisture Transfer Diagram ("Hot-humid" climate shown)

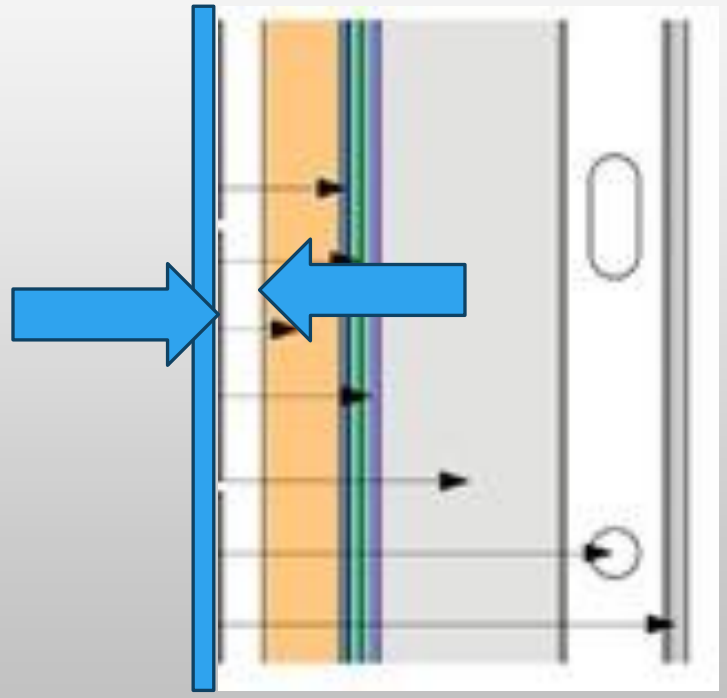
A SIMPLE WALL CONSTRUCTION

- EXTERIOR CONTINUOUS INSULATION
  - IMPACTS THE COMPLETE WALL BY CHANGING THE TEMPERATURE GRADIENT
  - DEPENDING ON THE MATERIAL, IT COULD ALSO BE AN AIR BARRIER, A WATER-RESTIVE BARRIER OR VAPOR RETARDER
  - CHANGES THE DEW POINT IN THE ASSEMBLY



A SIMPLE WALL CONSTRUCTION

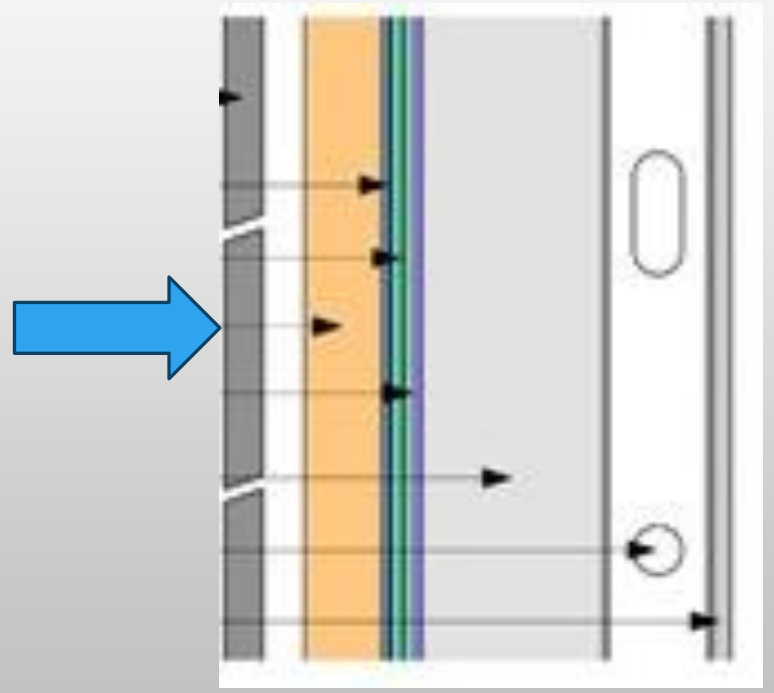
- AIRSPACE (RAINSCREEN)
  - BECOMING AN EXTREMELY IMPORTANT COMPONENT IS SOME WALL ASSEMBLIES
  - ALLOWS WATER TO DRAIN FROM THE WALL AND VENTILATION PROMOTES DRYING
  - MORE INSULATION IN A WALL, THE MORE IMPORTANT THE CAVITY



A SIMPLE WALL CONSTRUCTION

- EXTERIOR FINISH
  - THE LOOK OF THE BUILDING
  - SHEDS MUCH OF THE BULK WATER
  - NEEDS TO BE STRUCTURALLY

  ATTACHED WHICH CAN PUT HOLES IN THE WATER-RESTIVE BARRIER, AIR BARRIER AND CAUSES THERMAL BRIDGING IN THE INSULATION



A SIMPLE WALL CONSTRUCTION

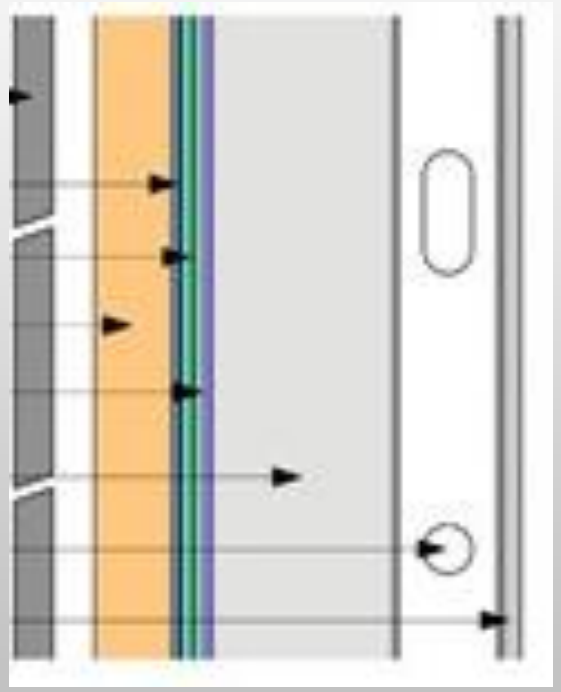
- SIMPLE WALL CONSTRUCTION
  - NO BUILDING ASSEMBLY IS SIMPLE
  - EVERY LAYER IN THE ASSEMBLY

  AFFECTS THE OTHER LAYERS
  - ONE VALUE ENGINEERED CHANGE

  NOTICE CAN RESULT IN CAUSING MAJOR

  DAMAGE TO THE BUILDING

  ENVELOPE



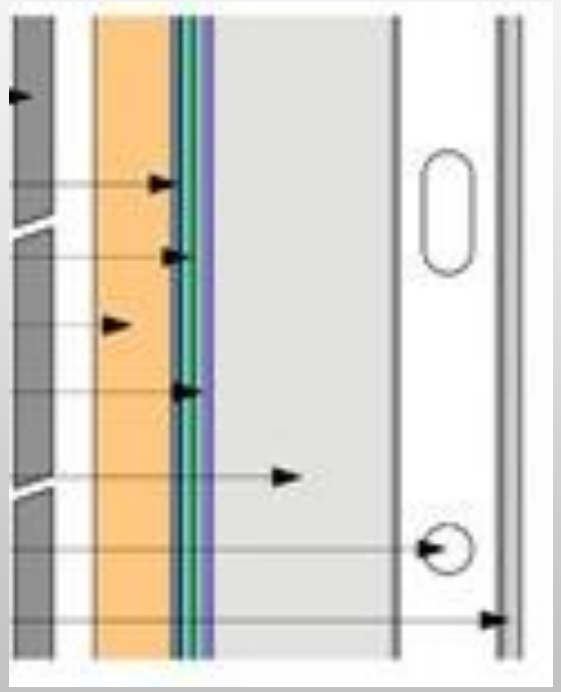
A SIMPLE WALL CONSTRUCTION

- SIMPLE WALL CONSTRUCTION
  - THE DESIGN PROFESSIONAL CAN DO

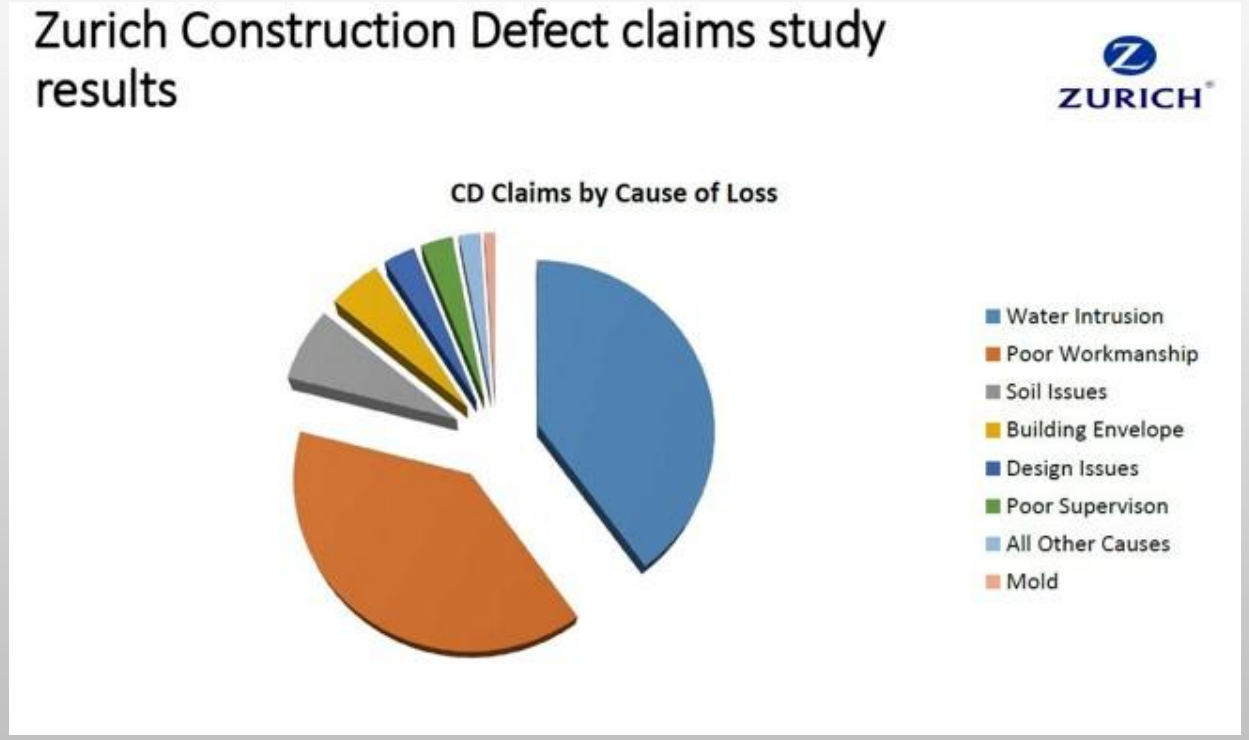
  A GREAT DESIGN OF A BUILDING

  ASSEMBLY, BUT IT WILL ONLY WORK

  AS INTENDED, IF INSTALLED PROPERLY



INSTALLATION



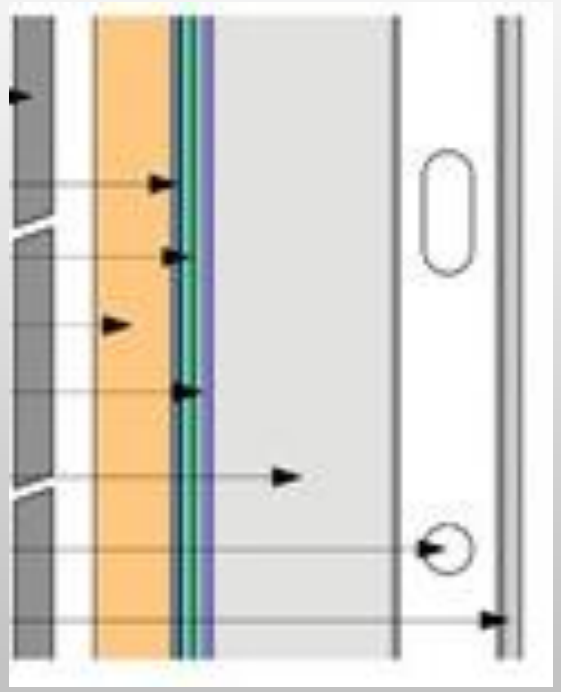
INSTALLATION

- MANY MATERIALS PROVIDE

THE INTENDED FUNCTION ONLY

IF INSTALLED AS REQUIRED FOR

THAT FUNCTION

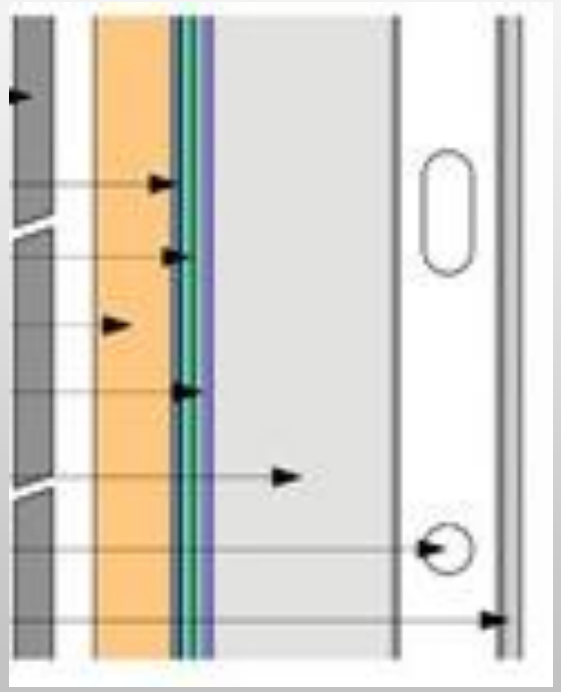


INSTALLATION

- WATER-RESTIVE BARRIER
  - ONLY KEEPS WATER OUT IF

  INSTALLED CONTINUOUSLY WITH

  NO HOLES, EVEN SMALL ONES

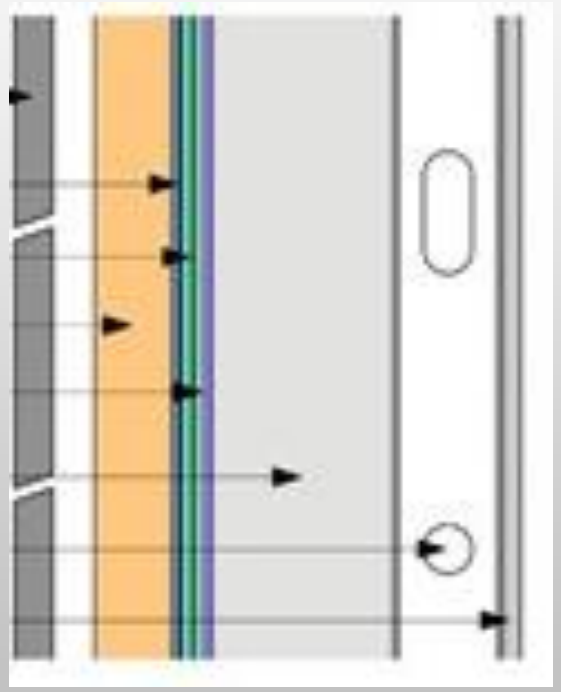


INSTALLATION

- AIR BARRIER
  - ONLY AN AIR BARRIER IF INSTALLED

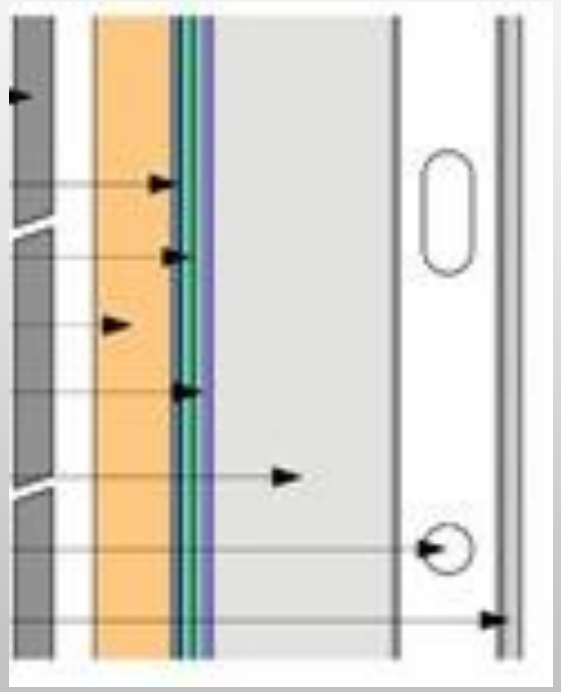
  CONTINUOUSLY WITH NO HOLES,

  EVEN SMALL ONES



INSTALLATION

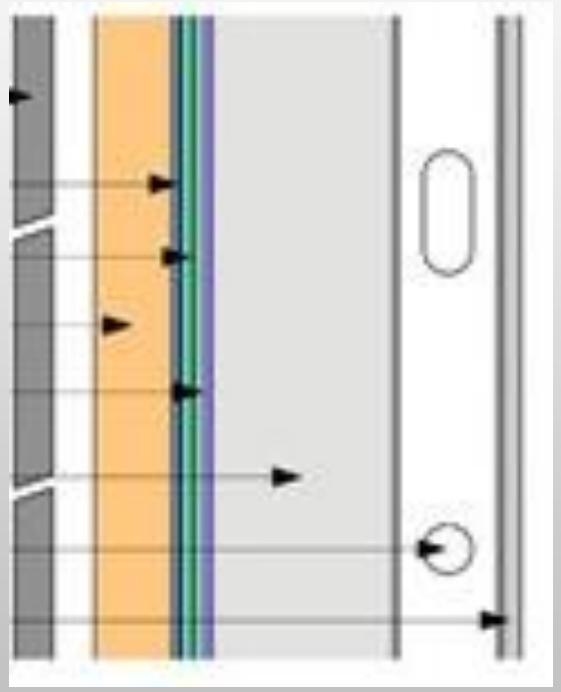
- THERMAL INSULATION
  - EFFECTIVENESS REDUCED IF AIR PASSES THROUGH, THERE ARE GAPS BETWEEN BOARDS OR THERMAL BRIDGES THROUGH THE MATERIAL
  - LEADS TO COLD SURFACES AND POTENTIAL FOR **CONDENSATION**




PACTIV
Nail every 16 inches
Use line as guide
energy
INSULATION
BOARD

INSTALLATION

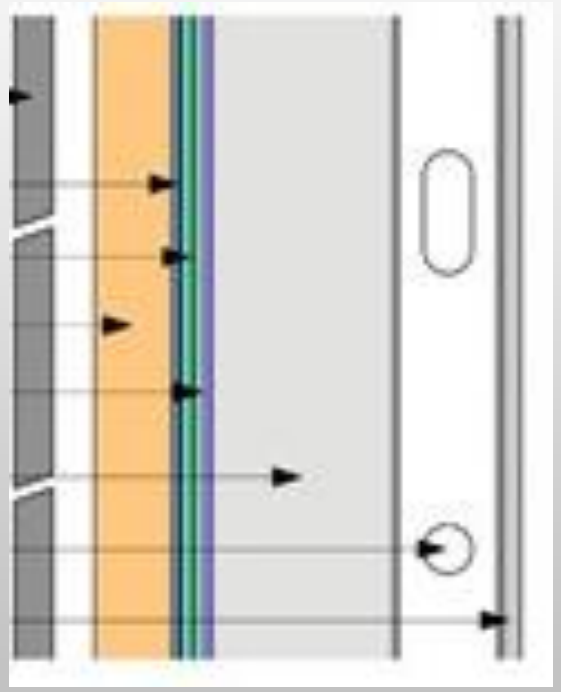
- VAPOR RETARDER
  - NOT AFFECTED AS MUCH BY BAD INSTALLATION
  - A LARGE HOLE IN THE VAPOR RETARDER MEANS MORE WATER VAPOR PASSING THROUGH, BUT NOT THAT MUCH



INSTALLATION

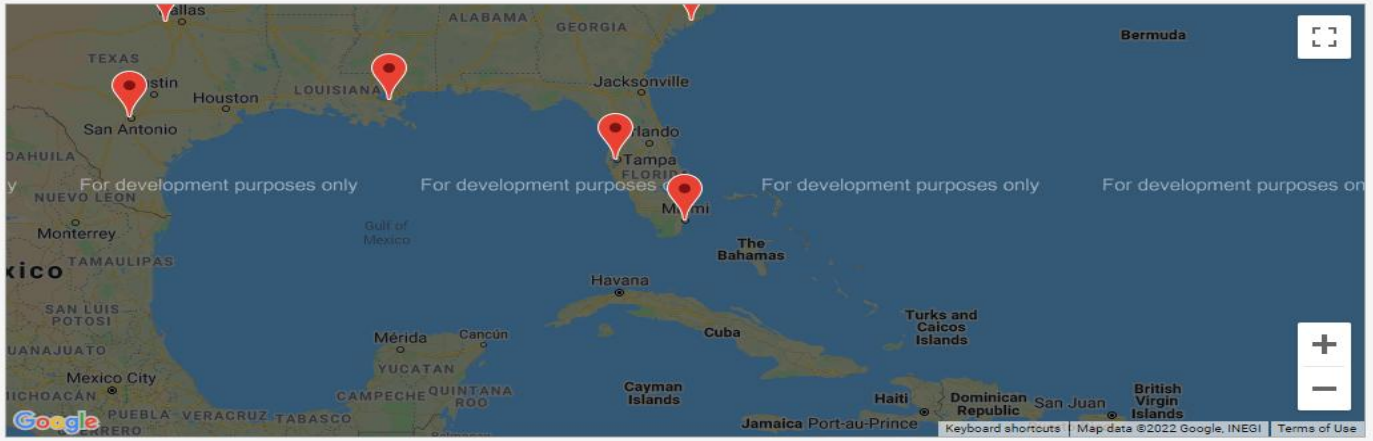
- VAPOR RETARDER VS AIR BARRIER
- WHICH IS MORE IMPORTANT TO

KEEP YOUR BUILDING DRY?



WATER VAPOR TRANSMISSION OF MATERIALS

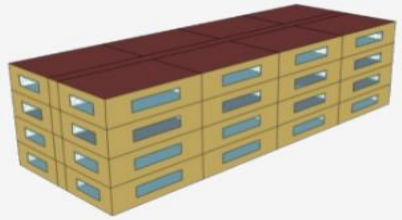
Infiltration Calculator



Location: United States | Florida | Miami

Building Type: Mid-Rise Apartment

Floor Area: ft² 33700



Leakage Rates: CFM/ft²

Base case: 4.32

Retrofitted building: 0.10

Energy Costs:

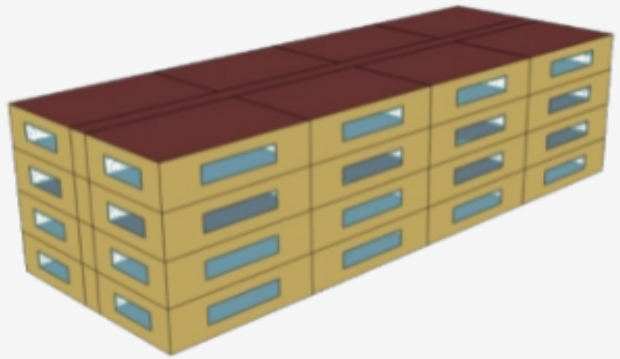
Electricity: ($/kWh) 0.09

Natural Gas: $/ 1000 ft³ 10.74

Calculate >>

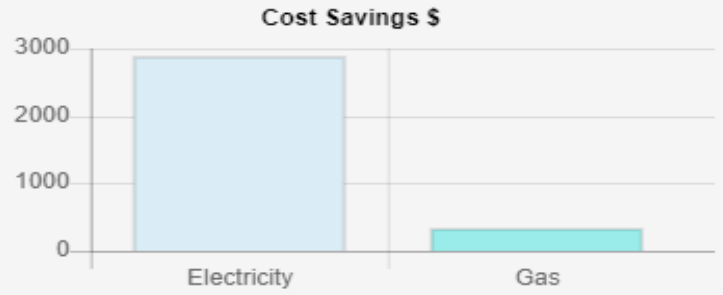
Infiltration Calculator Results

Building Type	Mid-Rise Apartment
Location	Miami FL USA
Floor Area	33700 ft²
Energy Price	Electricity 0.09$ /kWh, Natural Gas 10.74$ /1000 ft³

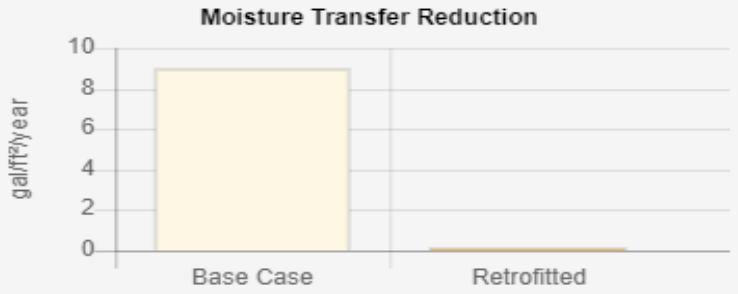


Leakage Rate		Equivalent Leakage Area	
Base Case	**Retrofitted Building**	**Base Case**	**Retrofitted Building**
4.32 CFM/ft² at 75 Pa	0.10 CFM/ft² at 75 Pa	42.40 ft²	0.99 ft²

Predicted Savings	Electricity	Natural Gas
Energy	32,029 kWh	32,317 ft³
Cost	$ 2,882.61	$ 347.08
Total Cost Savings	$ 3,229.69	



Moisture Transfer through the Wall Assembly due to Air Leakage	
Base Case	**Retrofitted Building**
9.00 gal/ft²/year	0.21 gal/ft²/year
303,221.39 gal/year	7,033.64 gal/year



WATER VAPOR TRANSMISSION OF MATERIALS

Moisture Transfer through the Wall Assembly due to Air Leakage	
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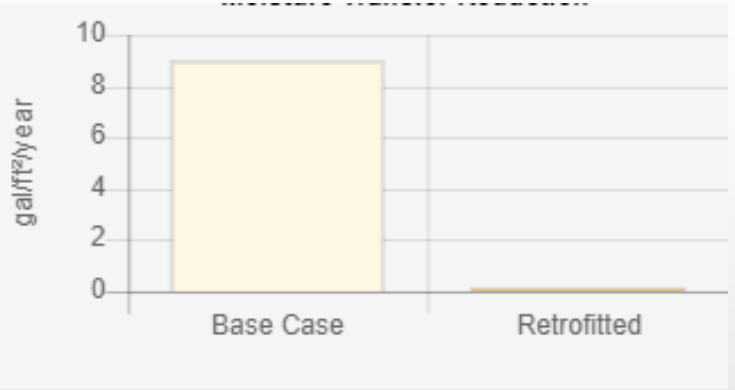


BASE 42.40 FT² = 6,105 IN² = 44.7 GALLONS/ IN²

303,221 GALLONS ÷ 6,105 PER YEAR

20 OUNCES / IN² /DAY

WATER VAPOR TRANSMISSION 10 PERM (570 NG/S · M²· PA) – **16 OZ/YEAR**

WATER VAPOR TRANSMISSION OF MATERIALS

A PERM IS EQUAL TO **57.2 NANOGRAMS METER^{-2} SECOND^{-1} PASCAL^{-1}** .

SINCE THERE ARE 31,536,000 SECONDS IN A YEAR,

2985PA OF VAPOR PRESSURE AT SATURATION,

1,000,000,000 NG PER GRAM

THE VAPOR PRESSURE FOR BOTH THE WET CUP (100%-50%RH) AND DRY CUP (50%-0%RH) IS 50% OF THE SATURATION VAPOR PRESSURE OR 1492PA,

THE WEIGHT OF WATER VAPOR GOING THROUGH ONE SQUARE METER OF A **0.1 PERM (INCH-POUND)** IN A YEAR WOULD BE 0.1*1492*31,536,000/1,000,000,000 OR 4.71 GRAMS (0.166 OUNCES).

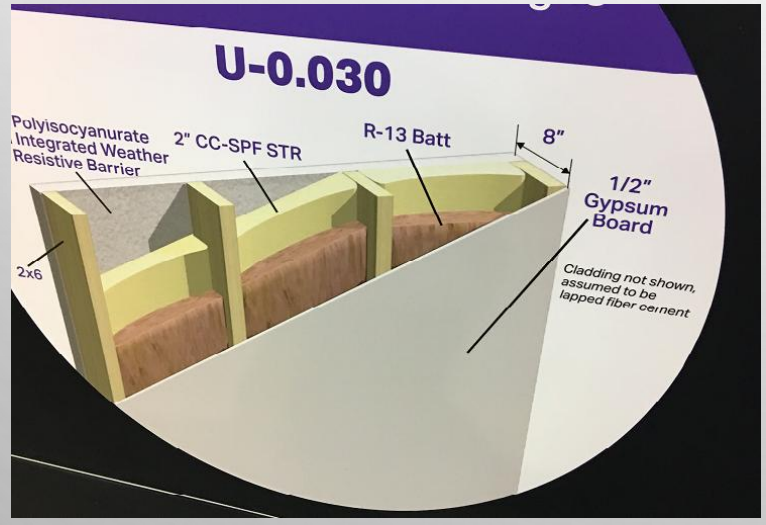
THE WEIGHT OF WATER VAPOR GOING THROUGH ONE SQUARE METER OF A **1.0 PERM (INCH-POUND)** IN A YEAR WOULD BE 1.0*1492*31,536,000/1,000,000,000 OR 47.1 GRAMS (1.66 OUNCES).

THE WEIGHT OF WATER VAPOR GOING THROUGH ONE SQUARE METER OF A **10 PERM (INCH-POUND)** IN A YEAR WOULD BE 10*1492*31,536,000/1,000,000,000 OR 471 GRAMS (16.60 OUNCES).

AIR BARRIERS, VAPOR BARRIERS, WATER-RESISTIVE BARRIERS, AND HEAT BARRIERS MUST WORK TOGETHER

THEY MUST BE DESIGNED, SELECTED AND INSTALLED PROPERLY TO PROVIDE THE INTENDED FUNCTION

A MATERIAL IS PART OF AN ASSEMBLY AND WILL PERFORM DIFFERENTLY DEPENDING ON WHAT IS IN THE ASSEMBLY AND WHERE IT IS IN THE ASSEMBLY



THE FUTURE

- HIGH PERFORMING BUILDING ENVELOPE ARE REQUIRED
- DESIGNS NEED TO WORK WITH ASSEMBLIES WITH THE WHOLE BUILDING IN MIND
- MANUFACTURERS NEED TO PROVIDE BUILDING ASSEMBLY PERFORMANCE NOT JUST MATERIALS
- CONTRACTORS NEED TO UPGRADE THE SKILL LEVELS OF NEW ENTRANCE TO THE WORKFORCE
- TRUST IN CONSTRUCTION PRACTICES BUT VERIFY

THANK YOU FOR YOUR TIME!

LAVERNE DALGLEISH

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