Construction Products Group

TREMCO™

Dryvit™

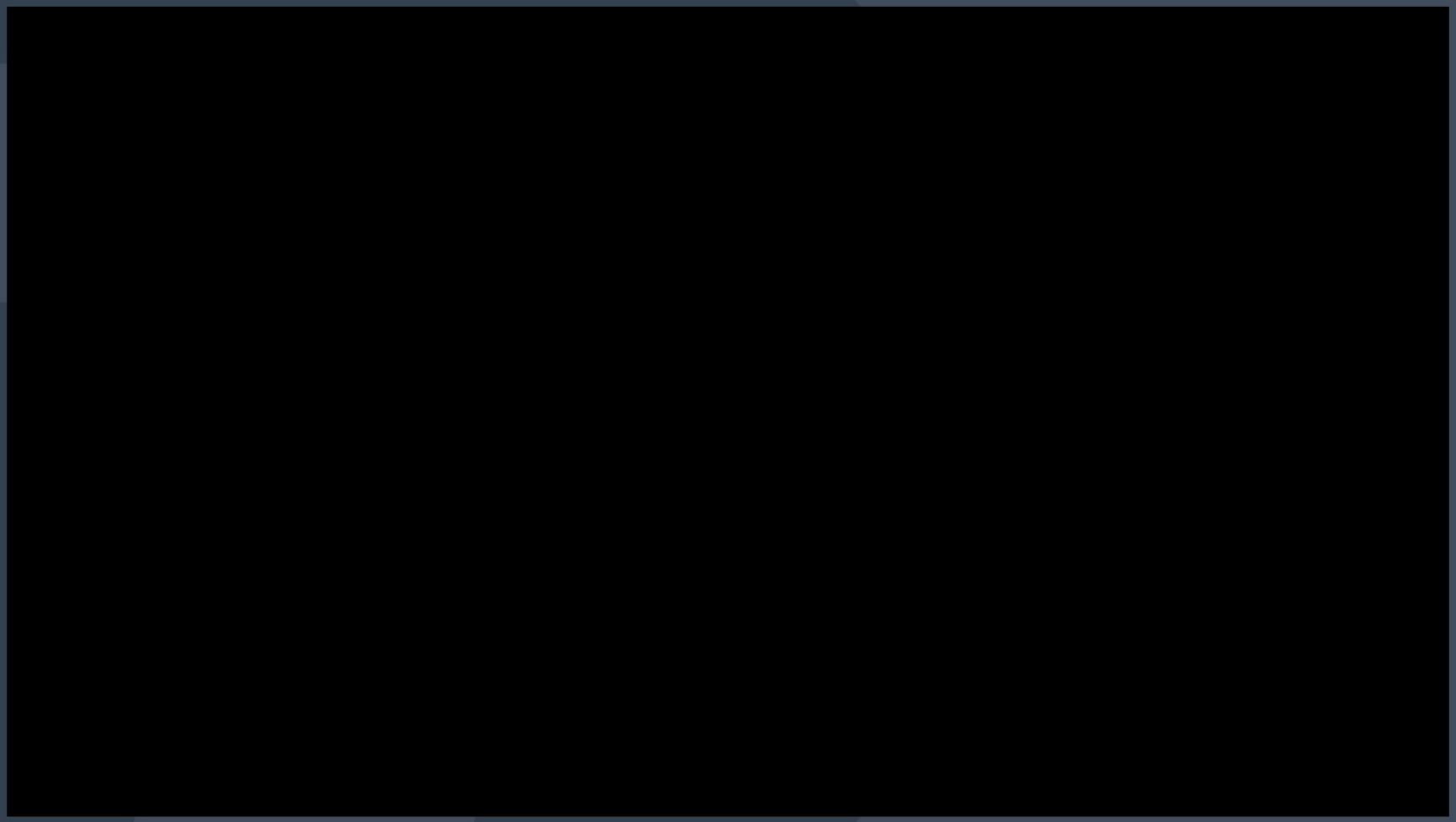
Nudura™

Willseal™

Testing that goes above and beyond code

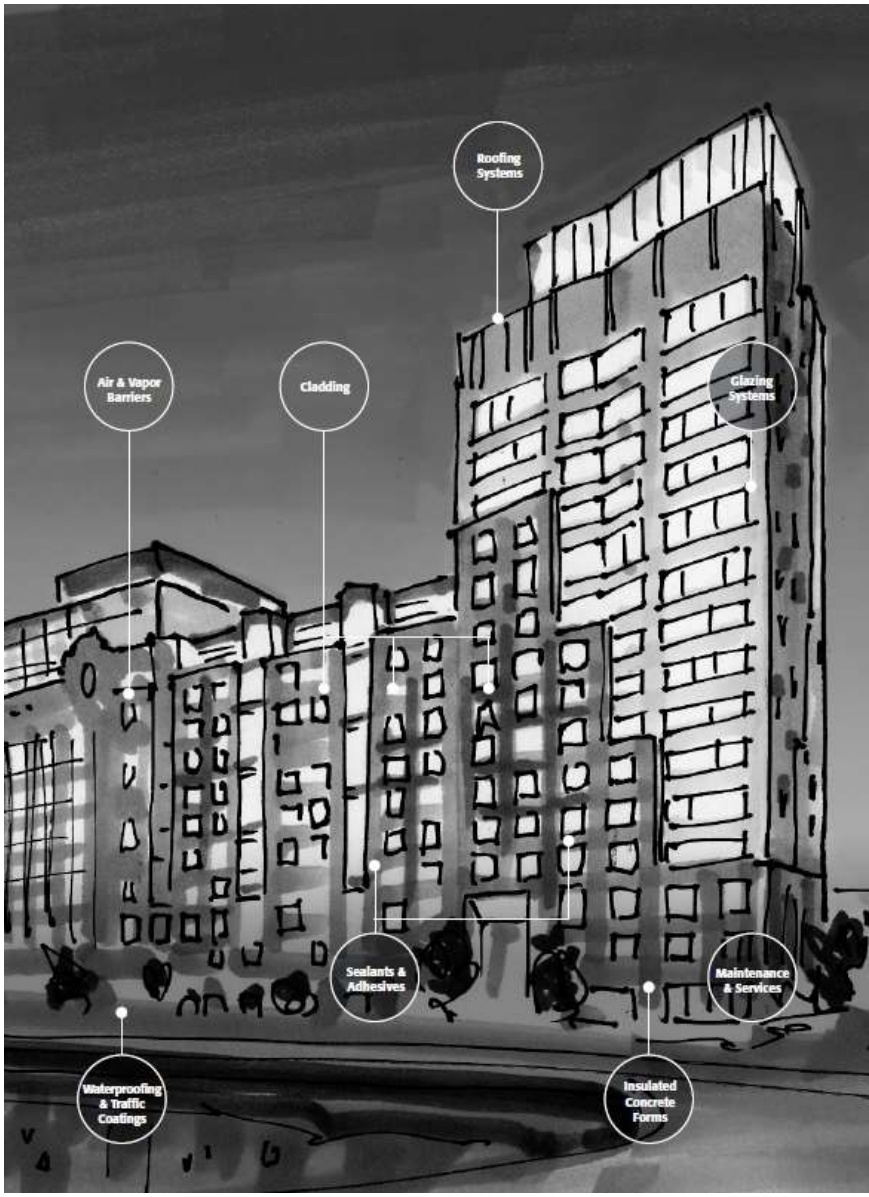
Marcy Tyler

Director of Building Science



Air, Water & Fire: A Building Science Medley

- **Learning Objectives**
  - Describe current International Building Code (IBC) requirements
  - Differentiate between the use of different wall assembly construction methods and detailing opportunities.
  - Compare high performance wall assemblies with code requirements and explain the performance impact of building beyond code.
  - Identify construction methods and materials that can be incorporated into specifications to help ensure the resulting structure achieves the desired performance levels for energy efficiency, indoor air quality, wind and water resistance, and overall resilience and durability.




AIR


WATER


FIRE

https://www.merriam-webster.com/dictionary/resilience

resilience

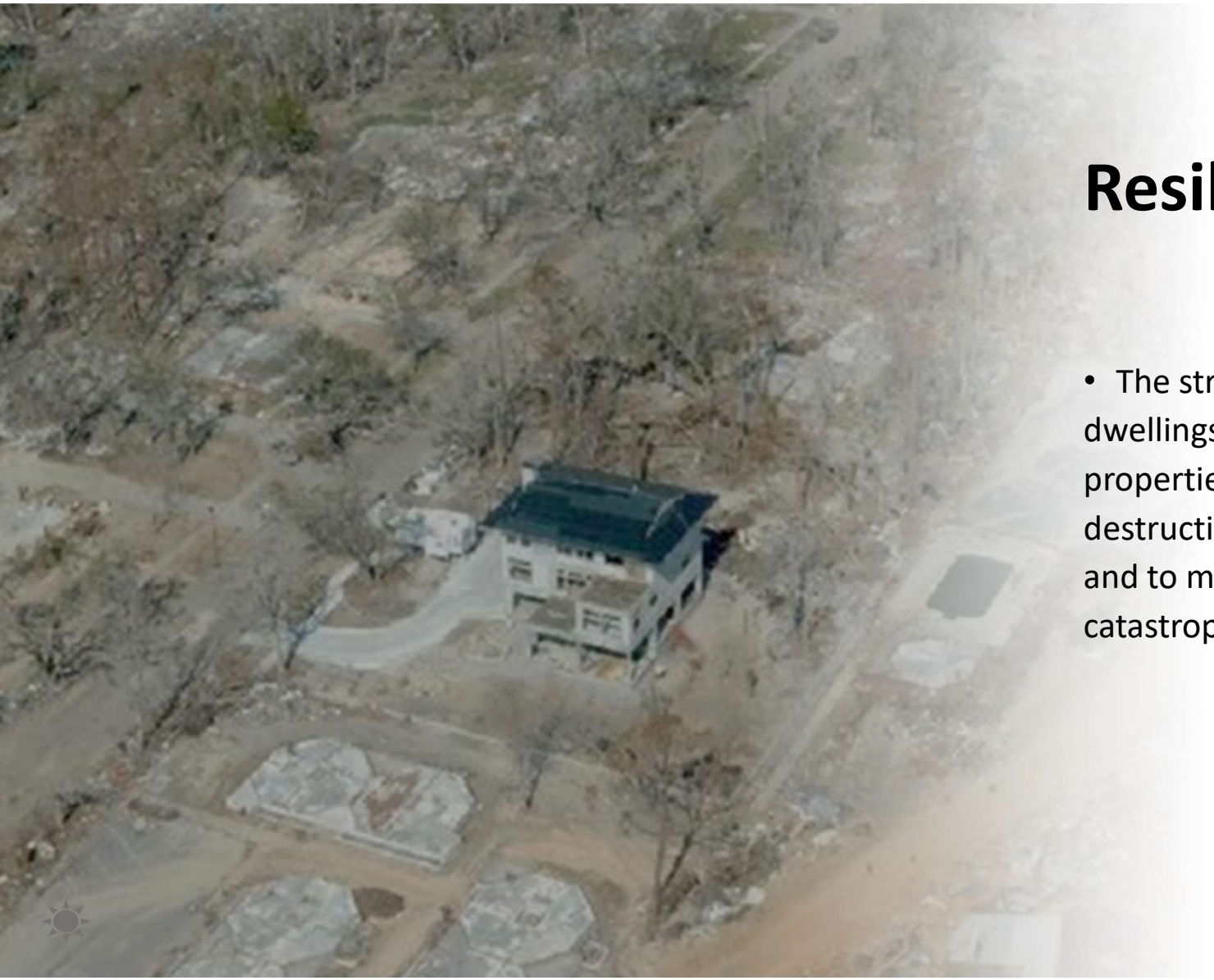
noun

re ·sil ·ience | \ ri-ˈzil-yən(t)s \

Definition of *resilience*

1: the capability of a strained body to recover its size and shape after deformation caused especially by compressive stress

2: an ability to recover from or adjust easily to misfortune or change



Resilience

- The strengthening of residential dwellings and commercial properties to minimize the destruction of personal property and to minimize loss of use post catastrophe.

Why is there a need?

Our industry needs to be thinking beyond “sustainability” – which focuses on energy-efficiency, occupant health and environmental safety – to structures’ ability to resist weather and other natural events. Stronger structures not only keep occupants safe but enable them to resume normal life sooner.

Journey to Resiliency

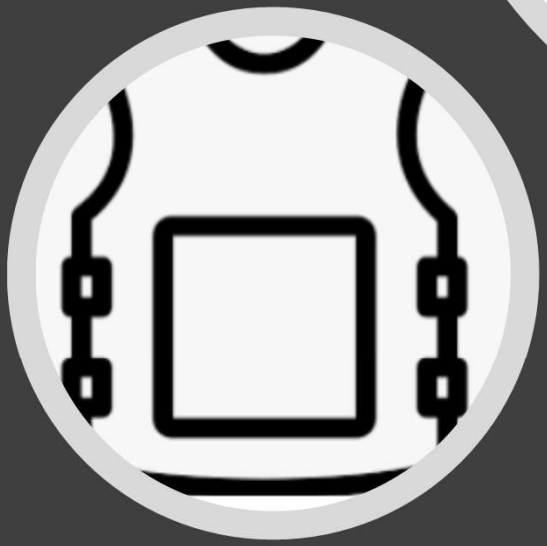
AIA
Continuing
Education
Provider

THE CODE OF HAMMURABI - 1772 B.C.

- Controlled building safety
- Protected occupants
- Nearly half the code dealt with matters of contract
- Harsh penalties for builders and contractors

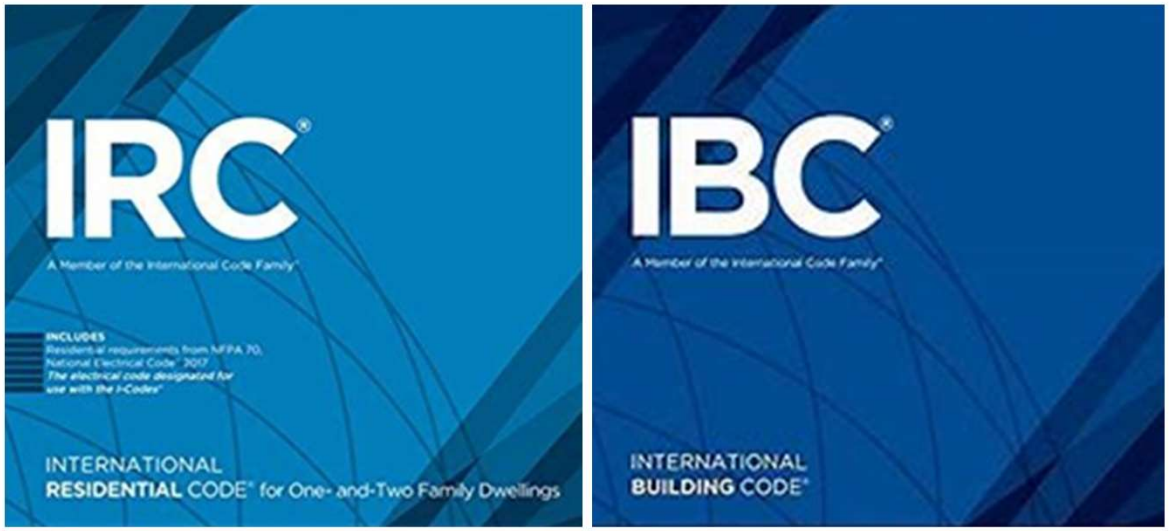
The Building Enclosure
A Jacket of Protection

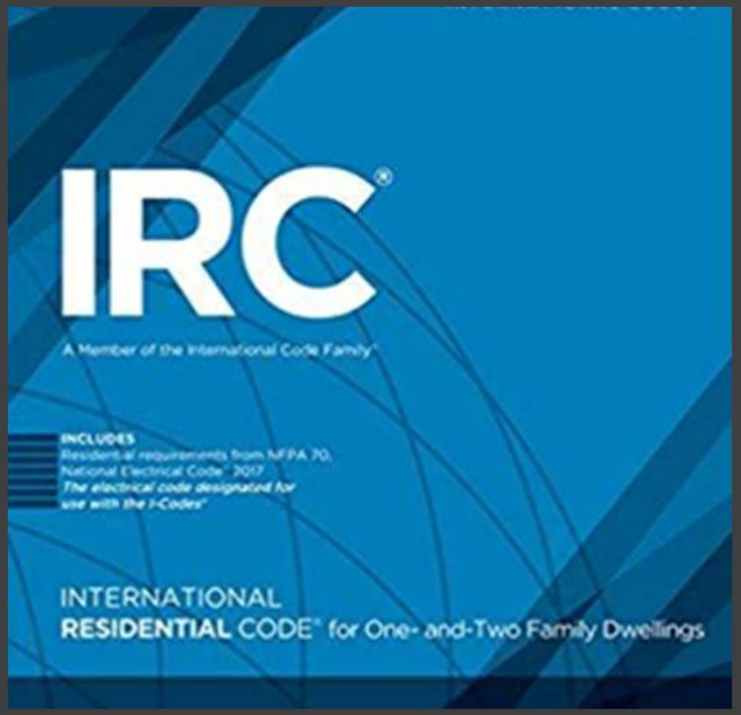
- Wind Resistance
- Water (both liquid & vapor) Resistance
- Thermal Resistance
- Fire Resistance
- Durability



AIA
Continuing
Education
Provider

Building to Code





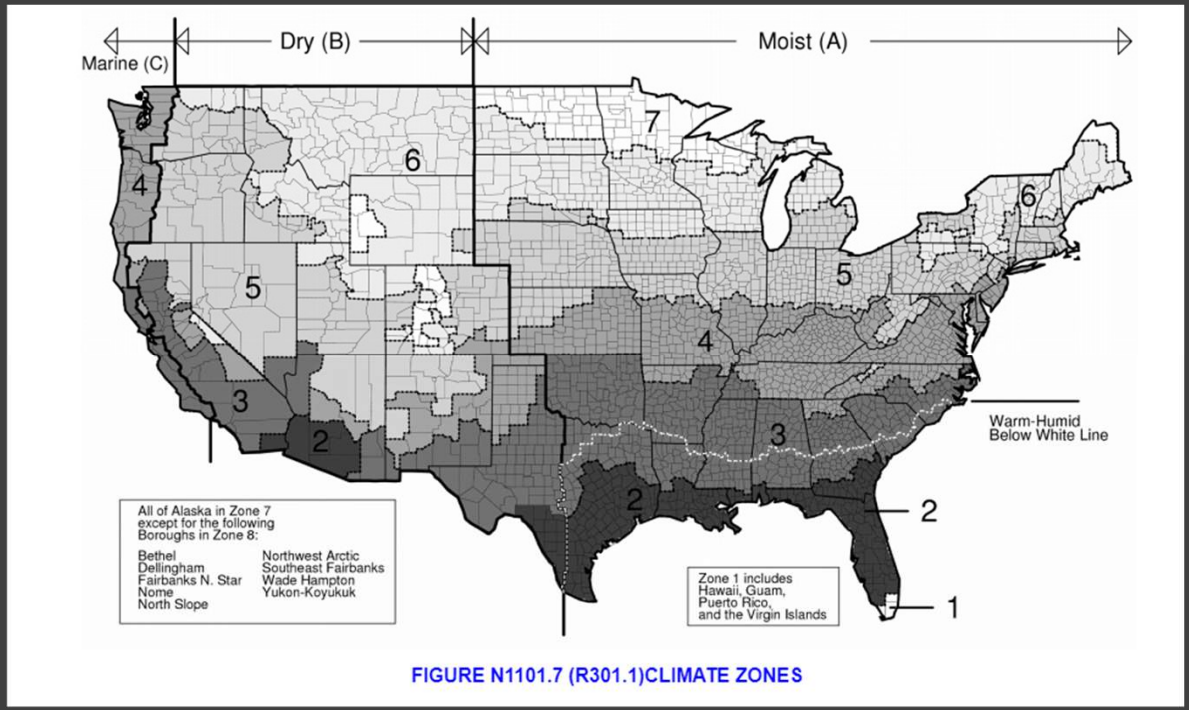


FIGURE N1101.7 (R301.1)CLIMATE ZONES

Chapter 11 – Energy Efficiency

- Provide minimum design requirements that will promote efficient utilization of energy in buildings
- Design of building envelops with adequate thermal resistance and low air leakage…

INTERNATIONAL BUILDING CODE

- **CHAPTER 14:** Exterior Walls

- Section 1401 – Exterior wall coverings shall be designed and constructed in accordance with the applicable provisions of this section.
- Section 1402 – Performance Requirements
- Section 1403 – Materials
- Section 1404 – Installation of Wall Coverings
- Section 1407 - EIFS

INTERNATIONAL BUILDING CODE

- **CHAPTER 14:** Exterior Walls

- Section 1402 – Performance Requirements
- 14202.2 Weather protection
  - Exterior wall envelop test assemblies shall include not fewer than one opening, one control joint, one wall / eave interface and one wall sill. Testing openings and penetrations shall be representative of the intended end-use configuration
  - ASTM E331 - Tested to a minimum pressure of 6.24 pounds per square foot (psf) for a duration of 2 hours.
  - Resist wind driven rain if water did not penetrate assembly including control joints, perimeters, openings, intersections, terminations

INTERNATIONAL BUILDING CODE

- **CHAPTER 14:** Exterior Walls
- Section 1402 – Performance Requirements
- 1402.5 Vertical and lateral flame propagation
  - NFPA 285 – Type I, II, III or IV construction that are greater than 40 feet in height above grade plane and contain a combustible water-resistive barrier
  - Fenestration products shall not be considered part of the water-resistive barrier
- Exemptions:
  - Walls where the water-resistive barrier is the only combustible component and is covered with brick, concrete, stone, terra cotta, stucco or steel (min thicknesses)
  - ASTM E1354 – heat release of less than 20 MJ/m² & effective heat of combustion of less than 18 MJ/kg and ASTM E84 Flame spread of 25 or less and smoke-developed index of 450 or less

INTERNATIONAL BUILDING CODE

CHAPTER 14: Exterior Walls

Section 1403 – Materials

1403.2 Water-resistive barrier

- Approved material, shall be attached to the studs or sheathing with flashing as described in 1404.4
- to provide a continuous water-resistive barrier behind the exterior wall veneer

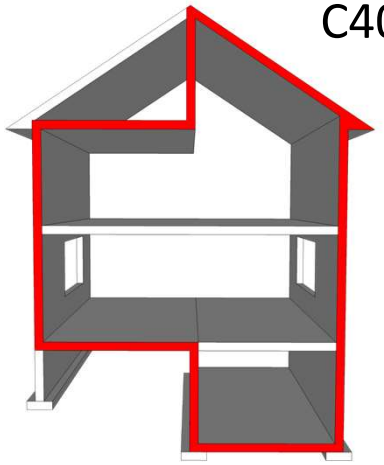
INTERNATIONAL ENERGY CONSERVATION CODE

IECC 2018 – Section C402.5 Air Leakage – Thermal Envelope (Mandatory)

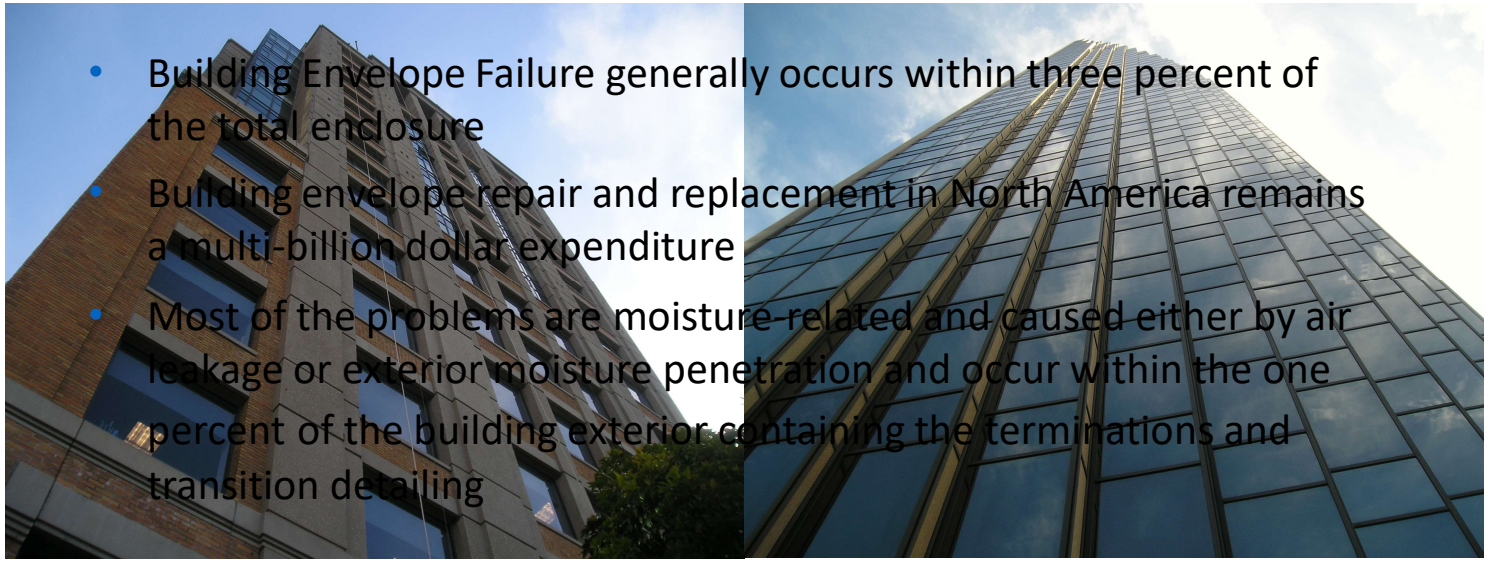
Must Comply with ASHRAE 90.1 or IECC Requirements

C402.5.1 Air Barriers

"A continuous air barrier shall be provided throughout the building thermal envelope."



Building Envelopes Today



- Building Envelope Failure generally occurs within three percent of the total enclosure
- Building envelope repair and replacement in North America remains a multi-billion dollar expenditure
- Most of the problems are moisture-related and caused either by air leakage or exterior moisture penetration and occur within the one percent of the building exterior containing the terminations and transition detailing

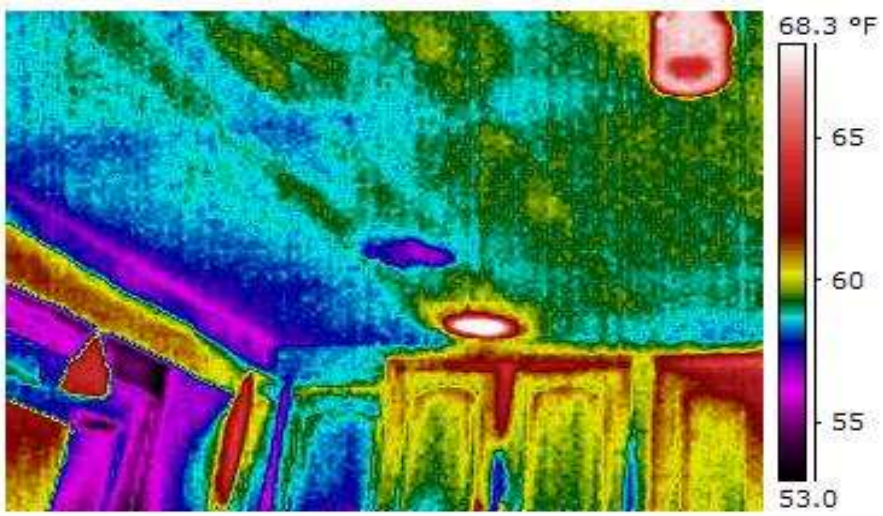
Lack of Performance

There is no single source of responsibility for:

- Quality control
- Spec enforcement
- Building envelope integrity
- Lowest price, technically acceptable
- **“BY OTHERS”**

Lack of Energy Efficiency

Moisture and energy leaks are common despite everything we know about the importance of a system approach to the building enclosure



Lack of Resiliency

- 90% of the time, it comes down to the transitions and terminations
- A failure in one component can and does affect other components in the building

Mold in school scatters its pupils

CAUTION
MOLD REMEDIATION
AUTHORIZED PERSONELL ONLY

Custodian Rhonda Rickey packs up papers and books from the desks of fourth-graders at Chavez Elementary School in Madison. The new school, which opened in September, was closed for the school year after mold was found growing inside. Now, Chavez students are being bused to other schools in the district. Top: A sign on protective plastic sheeting warns of the mold found in Chavez Elementary.

Opened in September, closed in November

By JESSICA HANSEN
of the Journal Sentinel staff

Every morning, students at Chavez Elementary School in Madison line up for the "Chavez shuffle."

It's a term students, teachers and staff members have coined to describe the chaotic poor air quality at the school have adopted to describe the chaotic shifting of classrooms and lives that has resulted since mold was found there in late November.

The school has since been closed and will remain so until next school year.

But at about 8:15 a.m. each day, students line up in the gym — they used to line up under outdoor tents — with each child under one of six signs with the name of his or her host school. Shifting in their shoes and trying not to pester their neighbors, they wait for the buses to arrive.

When the buses pull up, the more than 400 students climb aboard.

For Julie Padley, a kindergarten teacher at the school, that's when the race begins.

After hustling six groups of usually rambunctious kindergarteners onto buses, Padley rushes to her car in her own class, Padley sprints to her car.

It's then a mad dash through rush-hour traffic to Glen Stephen Elementary School, about five miles away. When it doesn't snow, Padley can usually make it to the school and find a place to park before her students arrive.

But it's usually close.

Padley is among dozens of teachers and hundreds of students whose lives for the last 117 days have been upheaved because mold was found at the new school.

Chavez Elementary opened in September in the southwestern part of Madison.

The $11 million public school is a wonderland where kids punch ID numbers into key pads to pick up their lunches, each classroom is equipped with an average of five computers and air conditioning eases the pain of hot school days.

But the building, Madison's first new elementary school in more than 30 years, was closed in late November after school officials found mold growing there.

Since then, mold continues to be found, the latest growths popping up just last week in cafeteria skylights, teachers and staff members said.

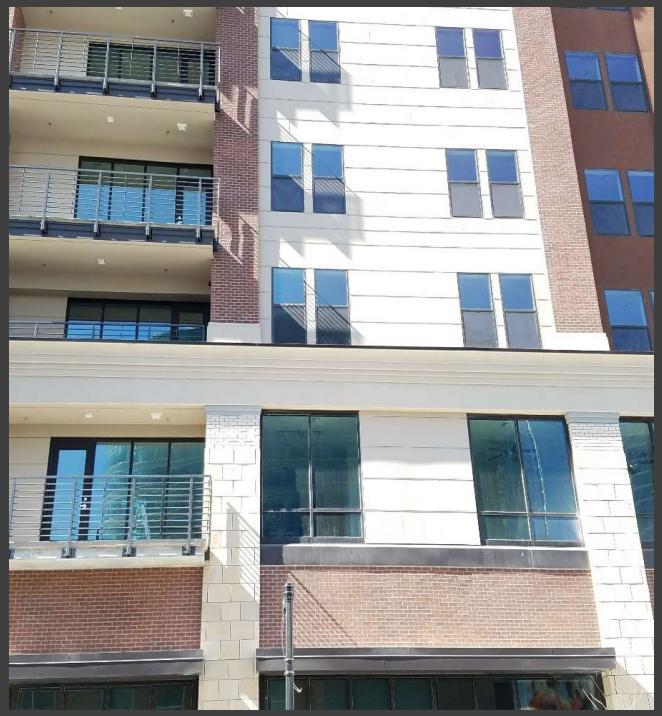
Chavez is not alone in dealing with mold. Other Wisconsin schools facing similar situations include:

■ Sections of Summit School in Oconomowoc

Please see MOLD, 5B

Existing Building Evaluation

AIA Continuing Education Provider



How many different products do we build with today?

Façade | Insulation | Air Barrier | Back Up Wall

How Many Products do we Build with Today

- 3 Different Types of Back Up Walls
  - Block, OSB, Exterior Sheathing
- 5 Different Types of AVB
  - Fluid, Self Adhered, SPF, Rigid, Mechanically Fastened
- 4 Different Types of Insulation
  - SPF, Extruded Poly, Poly Iso, Mineral Wool
- 4 Different Types of Exterior Cladding
  - Brick, Metal Panel, EFIS, Cement Board
- ***OVER 116* Wall Configurations**
  - This **DOES NOT** Consider all of the **Different Manufacturers** of each Item

The Evolution of Performance

AIA Continuing Education Provider

SUSTAINABLE BUILDING SOLUTIONS TEST FACILITY

TEST FACILITY TIMELINE

2010 | Tremco starts independent systems testing in Ashland, Ohio using a wooden test wall and a single directional blower.

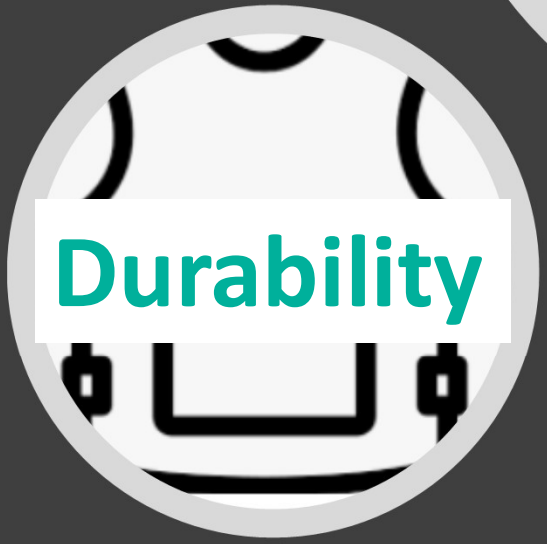
2012 | With help from the building science community, Tremco builds a state-of-the-art test wall in Cleveland, Ohio. Capabilities include space to test a 10' x 12' assembly, a multi-directional blower, and Labview controller-based software.

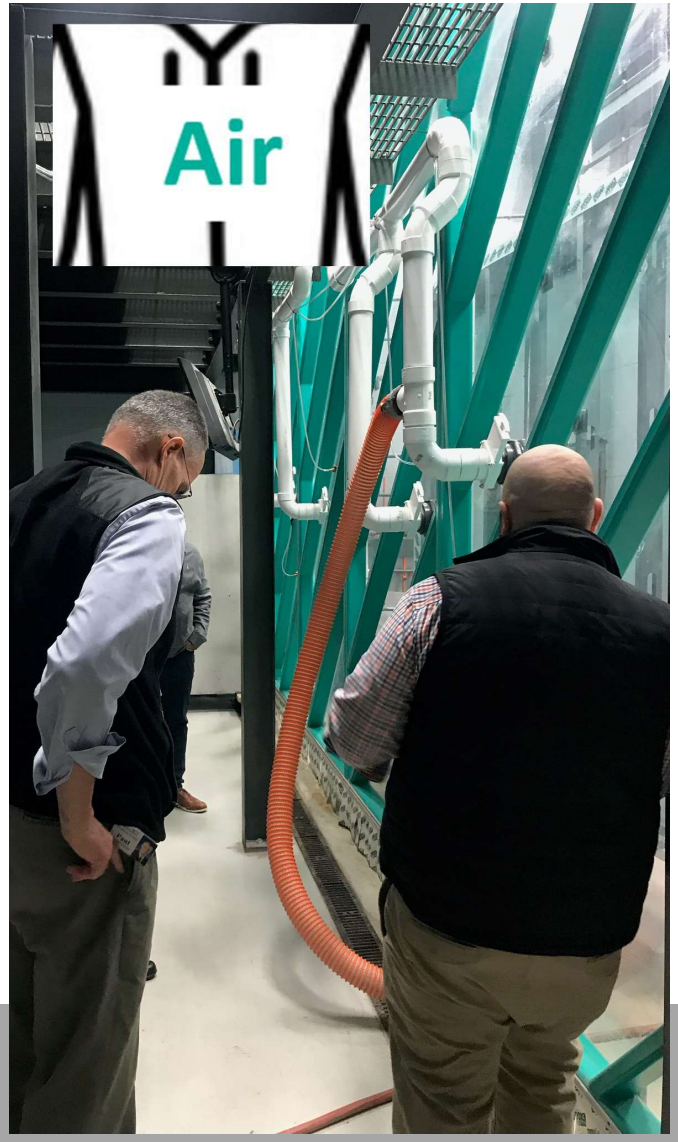
2015 | Due to increasing testing demand, the facility expands into an adjacent 3,600 ft² room with new capabilities including a 20' x 16' multi-directional, multi-blower test wall and a water recycling system.

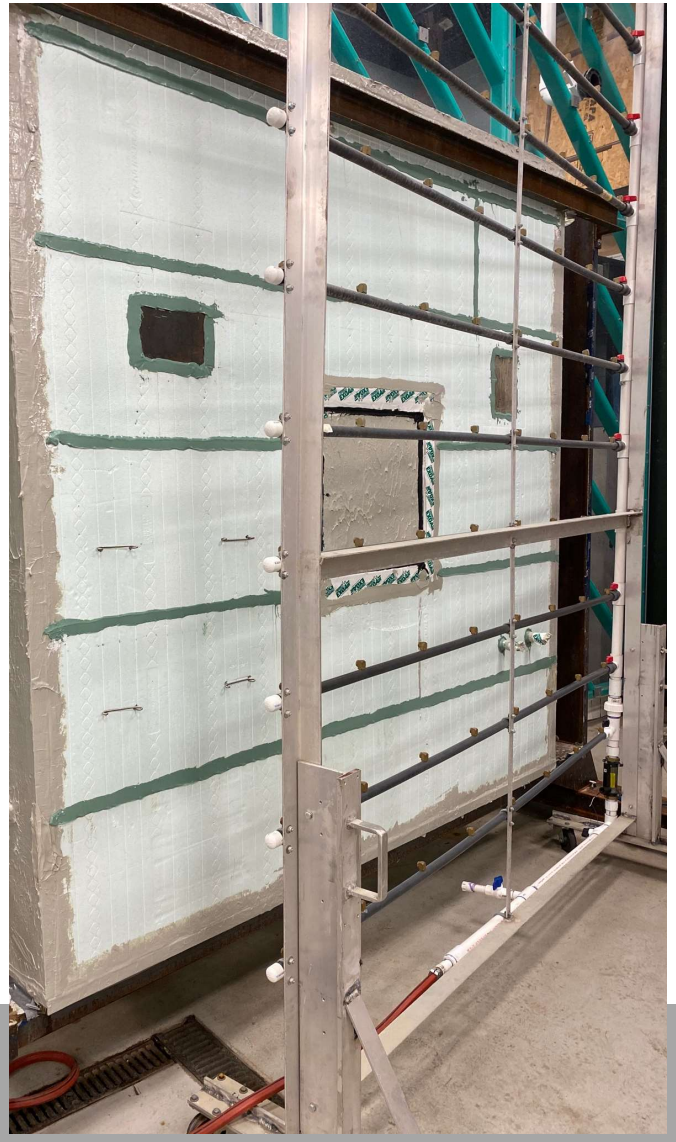
2020 | Testing expands again to include a new Thermal Environmental Chamber with 240 data acquisition channels, more BTUs than the harshest thermal radiation on earth, pressure differentials up to 25 PSF, temperature and humidity controls, and rain simulation of 200 g/hr.

The Building Enclosure: A Jacket of Protection for your Building

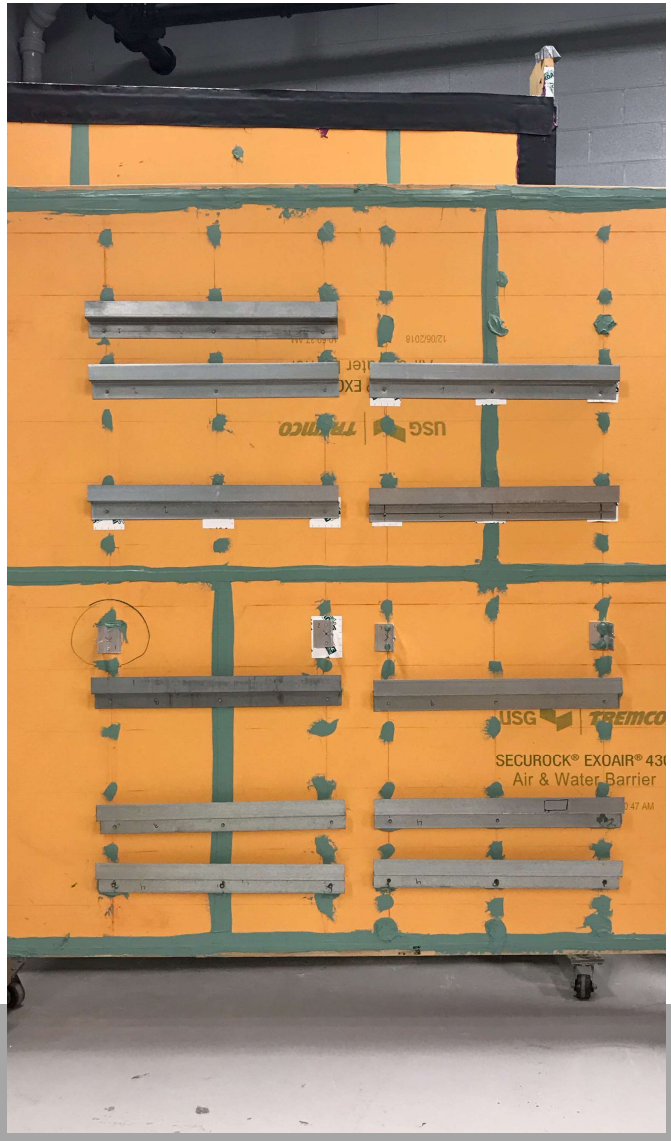
Just like a jacket can protect you from the elements, the building façade is intended to do the same for the inner structure of your building.

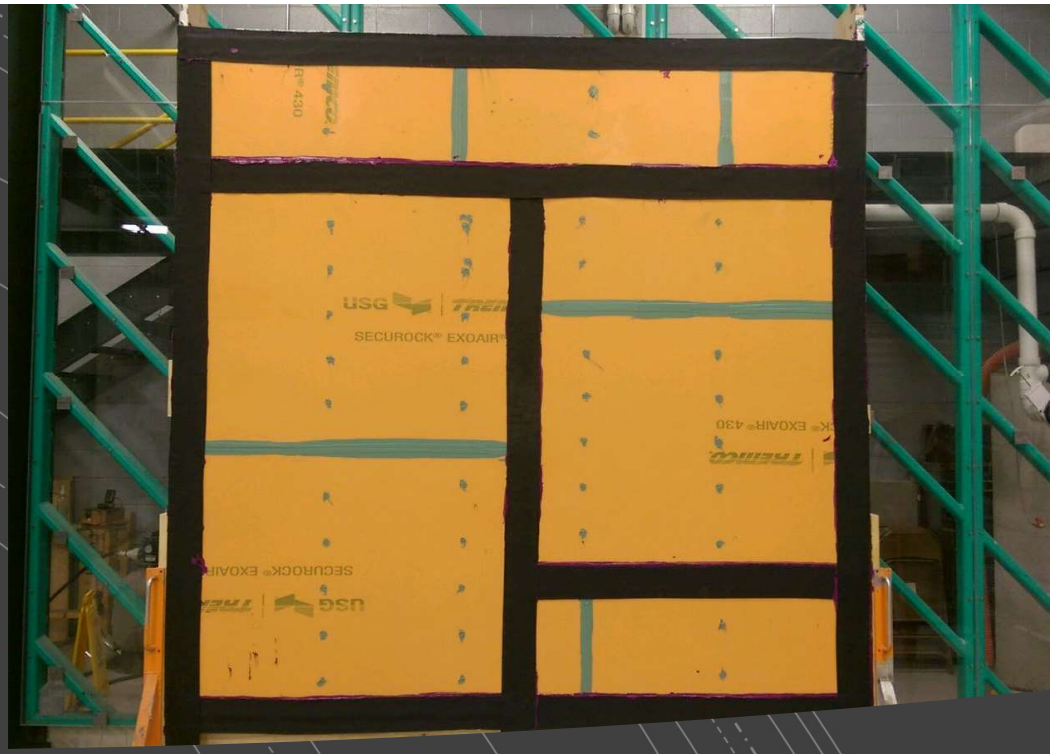



Air




USG
TREMCO
Water


USG
TREMCO
Air & Water Barrier



Air

Water

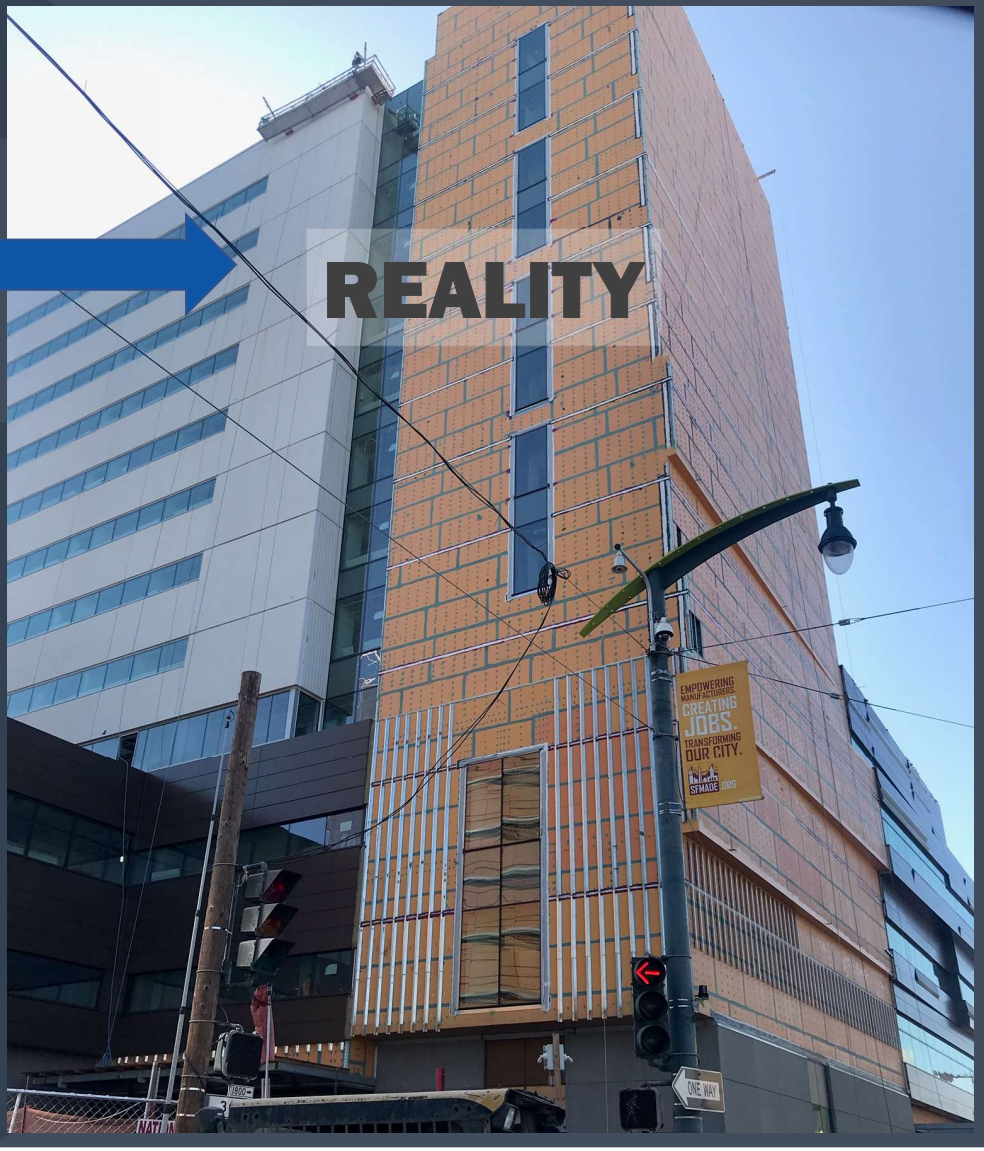
Mission Bay Block 33, San Francisco, CA

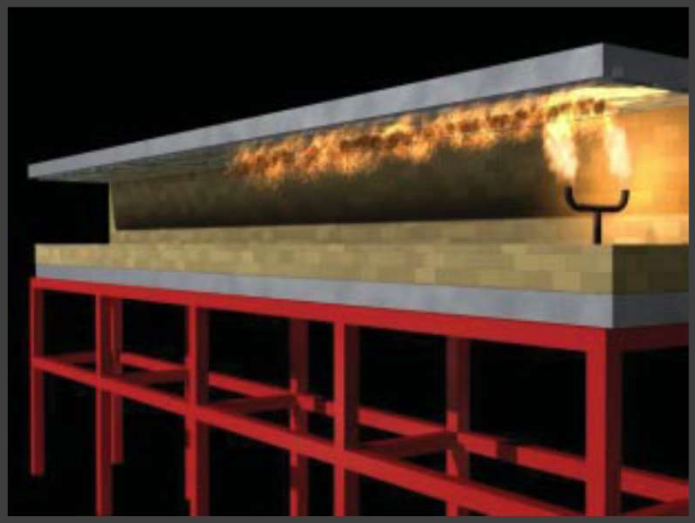
- UCSF Wayne and Gladys Valley Center for Vision
- Consultant did not want to use Tremco Expansion Joint Materials.
- Designed project specific mock-up to validate performance during earthquake.

Mission Bay Block 33, San Francisco, CA

CONCEPT

REALITY

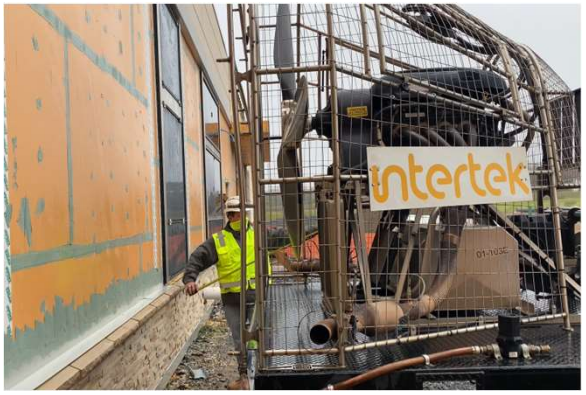




Fire


Fire Lab
UL790
Standard for Standard Test Methods for Fire Tests of Roof Coverings
CAN/ULC S107
Fire

Impact on Performance

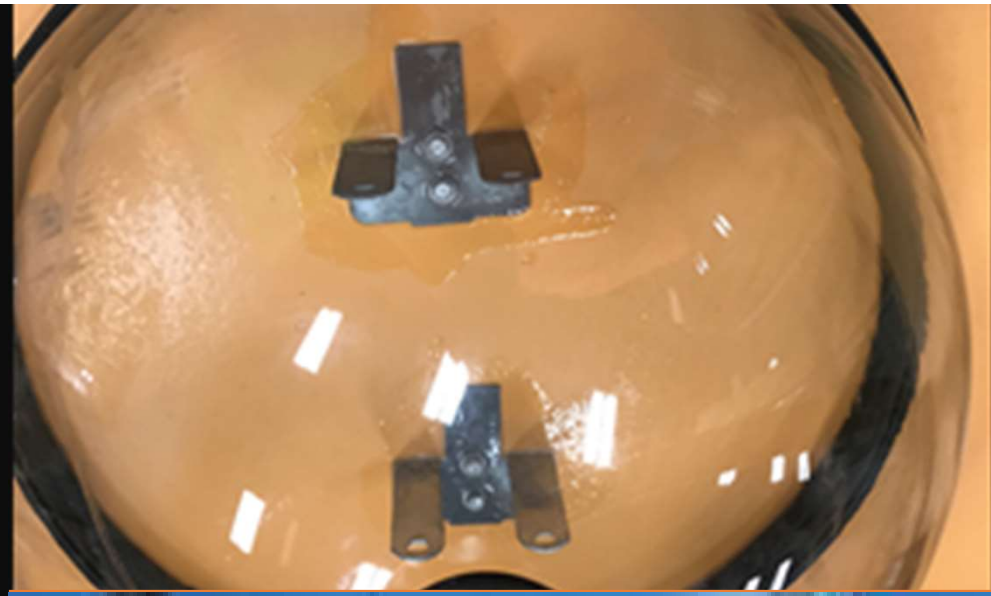


The Air Barrier System – Continuity

- Fluid-to-fluid system
- Consistent thickness
- Complete system, compatible accessories

ASTM E 1186

- Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
- Only rate of pressurization is specified in standard, not maximum or minium pressure.
- Selective, qualitative test
- “Gut Check”



Typical Façade Anchor Detail Methods


DAY 1
DAY 1

Factory-Applied Air Barriers – Time Study

Factory-Applied Air Barrier – 19:30
Peel & Stick – 36:47
Time Savings = 17 hours

Hours Saved	Panels	Sqft
1	3	100
10	31	1000
100	312	10000
200	625	20000
600	1875	60000

Render to Reality

EFFICIENT AIR BARRIER DELIVERY DRIVES CONSTRUCTION OF A CRUCIAL MEDICAL FACILITY

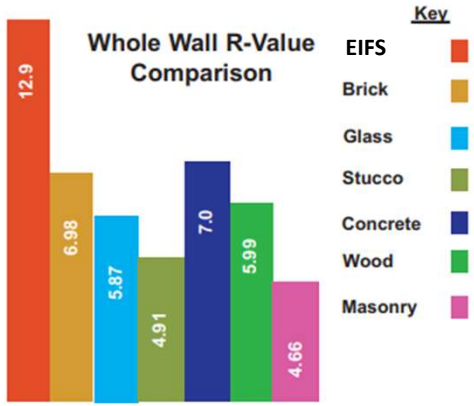
Thermal

Oak Ridge National Laboratory Study Determines EIFS 84% More Thermally Efficient Than Any Other Wall System

Dryvit walls out-perform all other cladding in independent tests conducted by ORNL

In a study released by the prestigious Oak Ridge National Laboratory (ORNL) in June of 2002, Dryvit walls were rated more thermally efficient than any competing wall system after being subjected to rigorous independent testing at the nation's pre-eminent scientific research company.

The recently released landmark report provides rich, new evidence of an important source of differentiation for choosing Dryvit EIFS in an environment where thermal efficiency is desired by the building owner.



The Findings

A clear wall comparison was performed by ORNL scientists at the ORNL facility in Oak Ridge, Tennessee. Seven common cladding types:

- Dryvit standard EIFS
- Brick
- Glass
- Stucco
- Concrete
- Wood
- Masonry

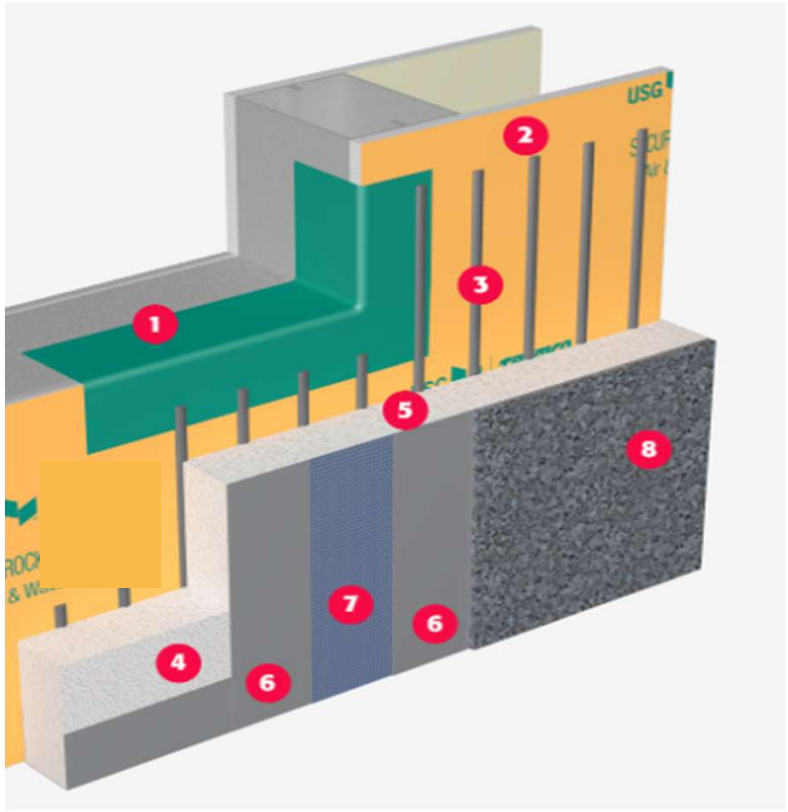
were evaluated to arrive at an effective "Clear Wall R-Value" for opaque wall performance for a typical building is then measured using the "Whole Wall R-Value" concept, which additionally included effects from transition details at areas such as windows and doors, roof and floor lines, foundation and corners and others.

The result?

FS achieved an

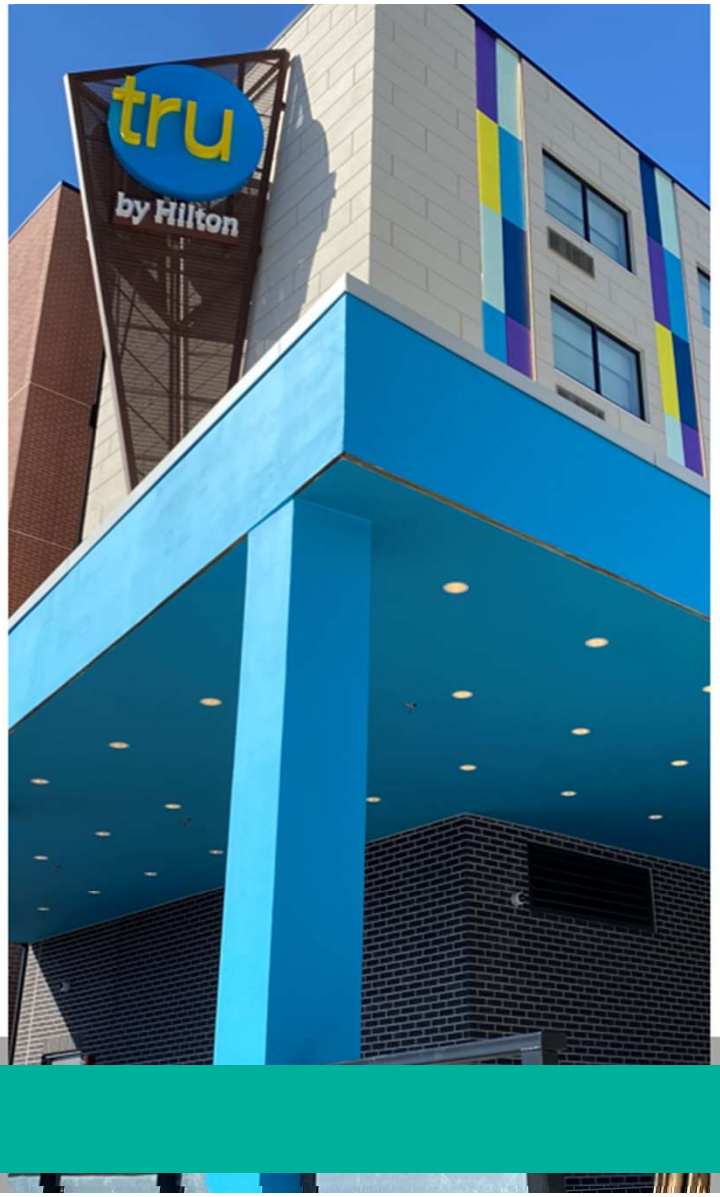
computer modeling were used to analyze steady state thermal performance of the clear wall area and wall interface details for the Dryvit wall system with 3 5/8-inch light gage steel framing.

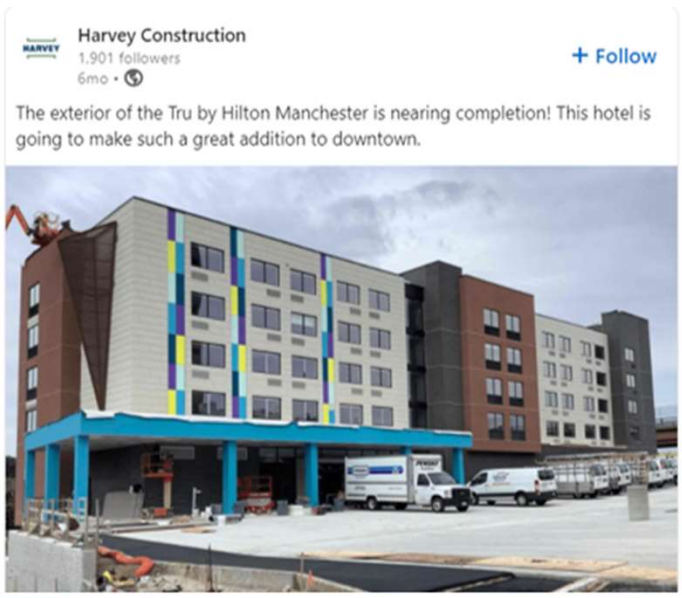
Guarded hot box tests formed the basis for a finite difference computer model calibration. This computer model was then used to calculate local R-values for all typical wall interface details and



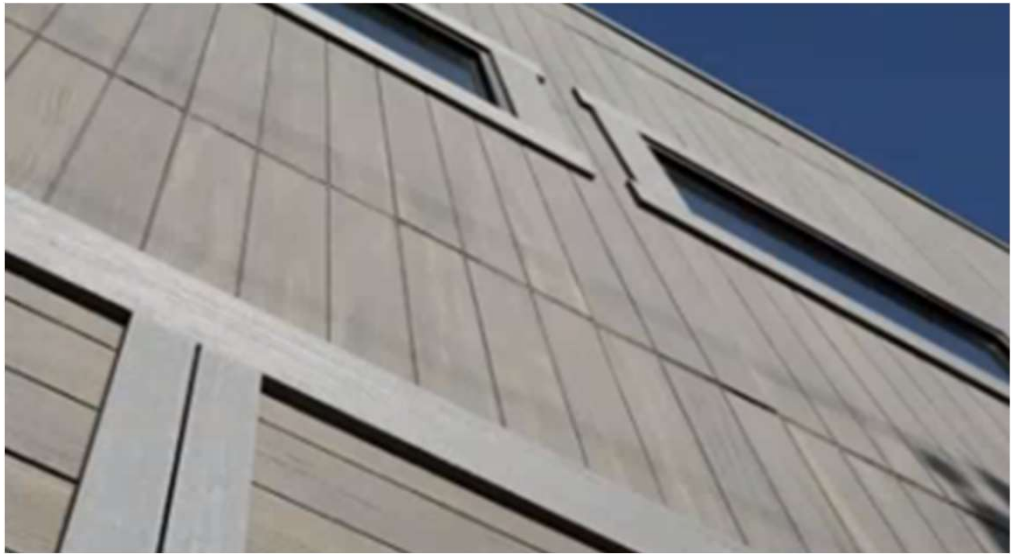
Pre-Applied Air Barrier with Continuous Insulation

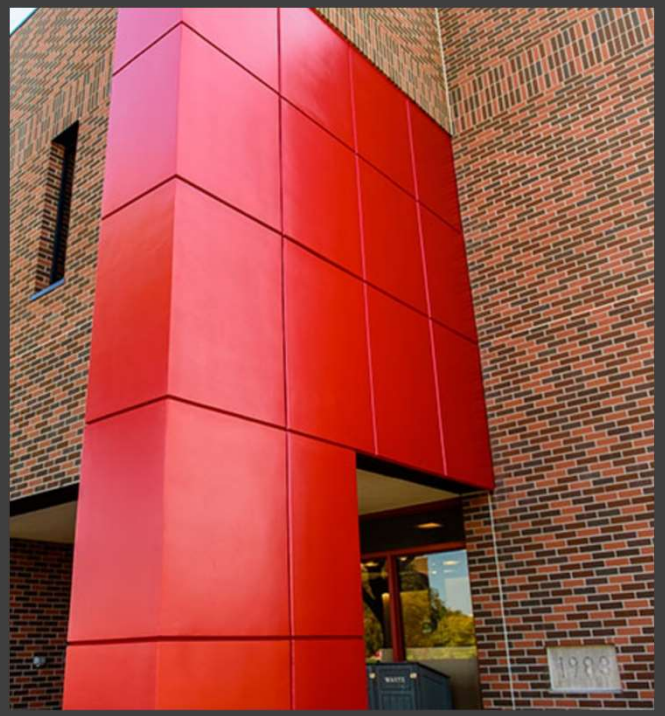
1. Fluid applied flashing
2. Pre—applied air / water barrier on exterior sheathing
3. Adhesive / Drainage
4. Pre-based starter board
5. EPS continuous insulation
6. Base Coat
7. Reinforcing mesh
8. Finish


tru
by Hilton


Harvey Construction
1,901 followers
6mo •
+ Follow
The exterior of the Tru by Hilton Manchester is nearing completion! This hotel is going to make such a great addition to downtown.


tru





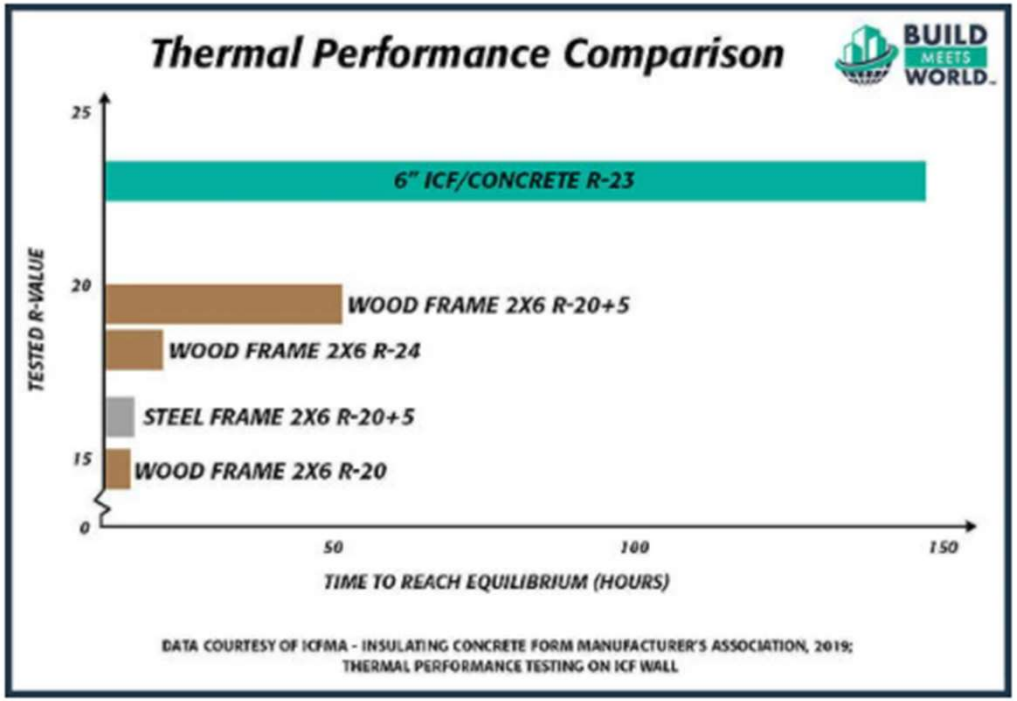
Owens Community College
Perrysburg, OH

- Overclad of their administration building
- Condensation issue of the brick shelf penetrating thermal barrier
- Solution: NewBrick and continuous insulation

ICFMA

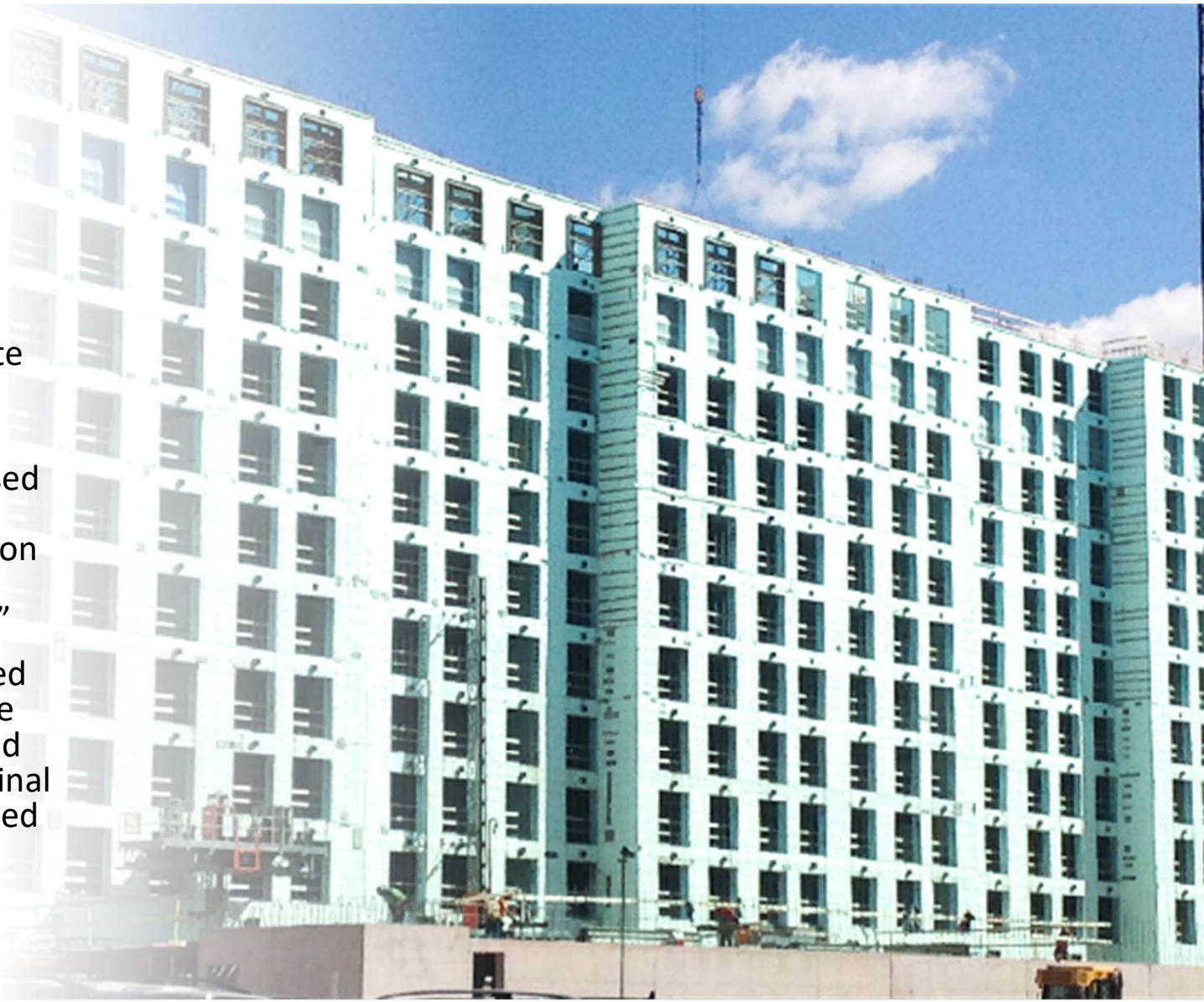
INSULATING CONCRETE FORMS MANUFACTURERS ASSOCIATION

Thermal



What Are ICFs?

- ICFs are stay-in-place concrete forms that allow for design versatility
- The concrete form is composed of two panels of expanded polystyrene (EPS) foam insulation that are held together with engineered cross ties or “webs”
- Reinforcement bars are placed horizontally and vertically in the ICF. Concrete is then poured and consolidated into the ICF. The final product is an insulated reinforced concrete wall.



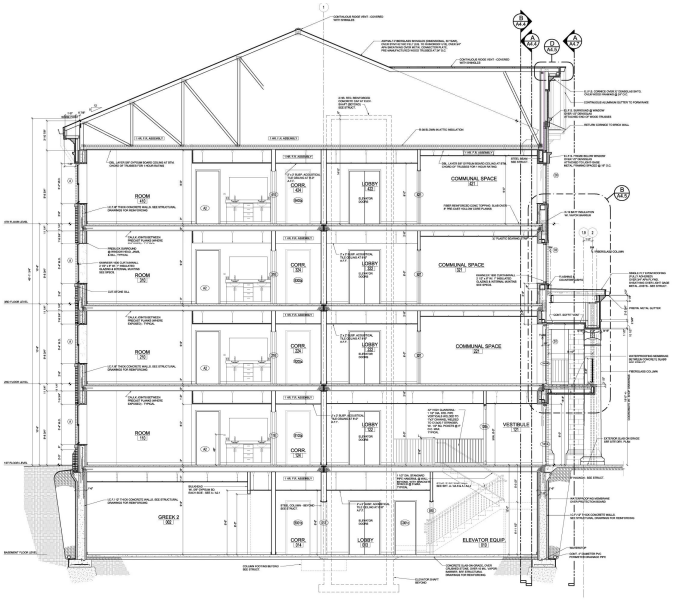
19 Story Luxe London – 1235 Richmond London, ON

University of Western Ontario

- Type: 19 Story 311 Units - 250 Bed Facility
- Size: 337,000 SF
- ICF Wall Area: 150,000 SF
- ICF Install: 5 months
- Cost: 55M
- GC: *Reid & Deleye Contractors*
- Architect: *SRM Architects Inc*
- Completed: 2014 – 19 months

Transylvania University Lexington KY

Scroll across and click to play video



Back

Dormitory

ICF Forms

Standard form dimension 48”L x 16”H x Various widths = 5.33 SqFt of wall

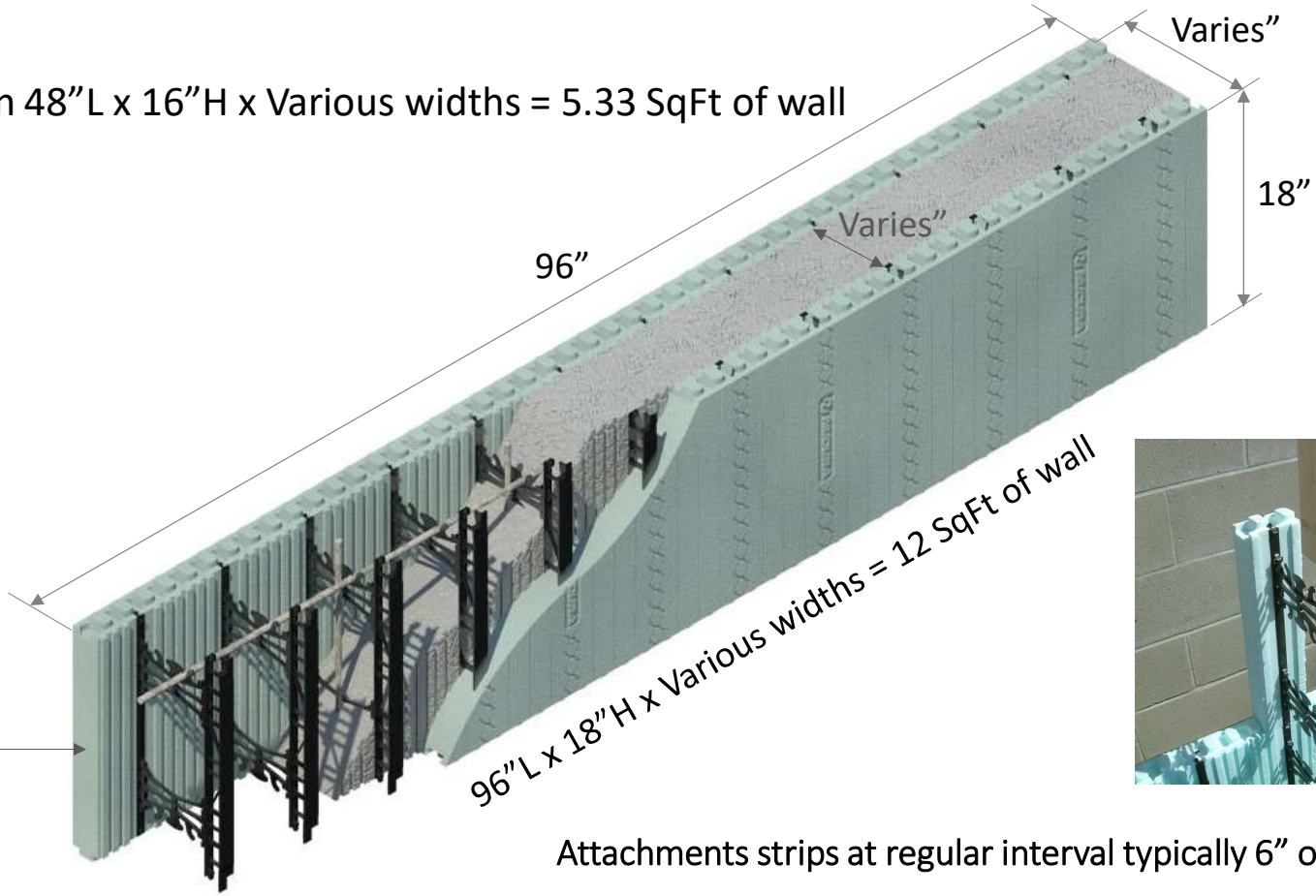
4” core = 9 ¼”

6” core = 11 ¼”

8” core = 13 ¼”

10” core = 15 ¼”

12” core = 17 ¼”



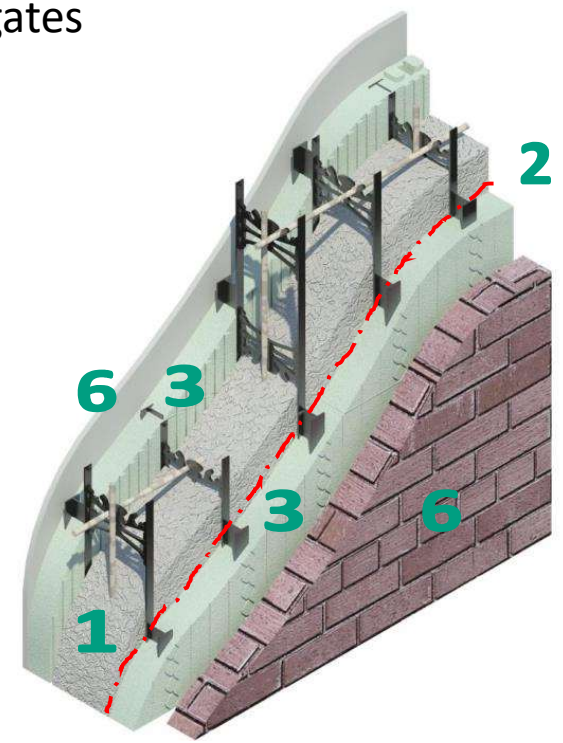
Typical ESP Panel thickness between 2 5/8” and 2 1/2”

Attachments strips at regular interval typically 6” or 8” O/C

Nudura ICF Building Envelope Performance

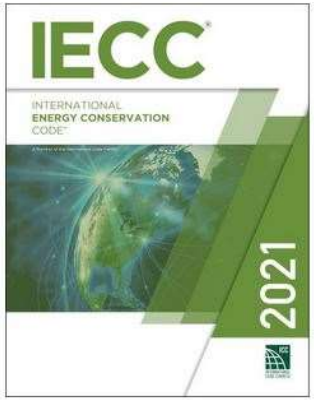
ICFs combine 7 building elements within 1 product; installed by 1 sub-contractor, increasing construction speeds, reduced scheduling delays & mitigates performance risk of wall assembly:

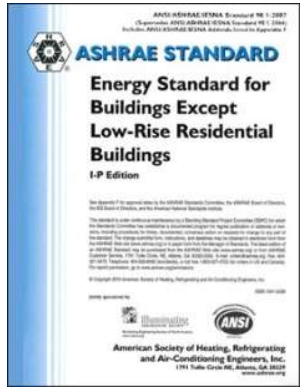
1. Structurally Reinforced Concrete
2. Continuous Air Barrier (Concrete & Foam)
3. Continuous Insulation R-23+ up to R 48+
4. Vapor Barrier (EPS) 0.624 perm-inch or applied membrane
5. UL Fire Rating 2 – 4 hours
6. Interior & Exterior attachment studs/strips
7. Sound Attenuation STC 50 up to STC 72

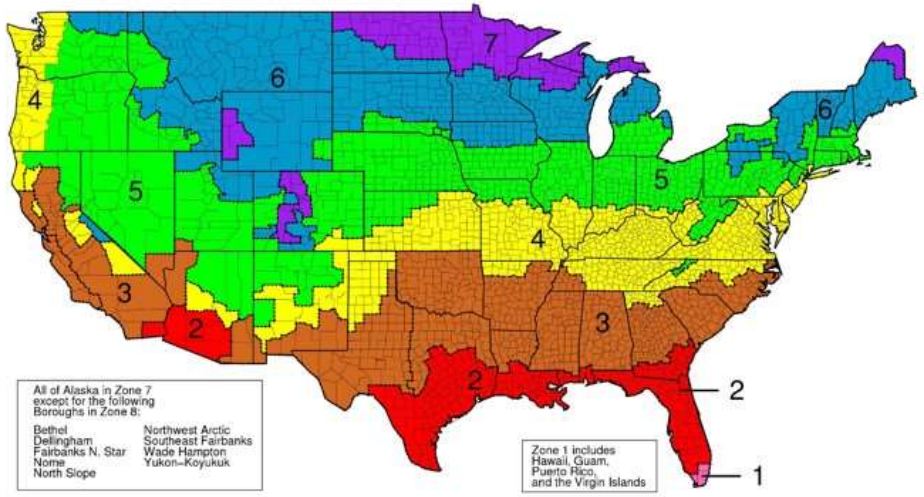


Thermal Resistance

- ICFs are considered by the IECC and ASHRAE 90.1 as mass walls with continuous insulation. Typically, a whole wall ICF assembly has an R-value of R-23 or U = 0.043 and less than 1.0 air changes per hour (ACH). ICFs exceed the requirements for all climate zones for commercial thermal envelopes above and below grade.
- As energy codes increase the requirements for higher R-values on traditional construction, ICFs are ahead of the curve in relation to energy efficiency for the building envelope.
- Most ICF systems have the ability to increase the R-value to more than R-40 for wall assemblies to meet specifications in northern areas of the US and Canada.







Richardsville Elementary School, Bowling Green, KY

- Customer: Warren County Board of Education
- Procurement: GC Bid - R.G. Anderson Inc.
- Size: 72,285 SF
- Capacity: 550 Students
- Cost: $14.9M - $206 SF
- Net-Zero
- Architect: Sherman-Carter-Barnhart
- MEP Eng: CMTA - EUI - 18.2 kBtu/sf/year
- Completed: 2010

$223,744 Savings Annually
First Net Zero Energy School in the U.S

Gary A. Walsingham Academy – Panama City Beach, FL

- Customer: Bay District Schools
- Size: 148,800 SF – 2 story
- ICF Wall Area – 130,000 SF
- Capacity: 800 Students
- Cost: $37.86M - $254.46 SF
- Architect: CRA Architects
- GC: RelientSouth Construction
- Completed: 2021/22

Educational Facility - K12

Seismic and Wind Resistance

- Greater impact resistance against Tornado's & Hurricane's for ICC-500 structures
- Solid concrete monolithic wall structure can be more easily designed to meet seismic criteria
- Cost effective resilient design solution for critical infrastructure

Scroll across and click to play video

Nudura ICF House located at Mexico Beach after Hurricane Michael 2018 - CNN

ICF House after Katrina 2005 - PCA

Portland Cement Association - PCA

The water line was at 28 ft. as indicated by the red line in this photo.

Hardened Structures

- 50 lb. of TNT
- 6” ICF, #4@16”oc
- Blast from 6’ Away

US Military - Quantico Blast Testing on ICF Walls

Scroll across and click to play video

Resiliency

- "We didn't pay attention to code," Dr. Lackey told CNN's "New Day", "we went above and beyond code, and we asked the questions: 'What would survive the big one?' And we consistently tried to build it for that"

January 15, 2020

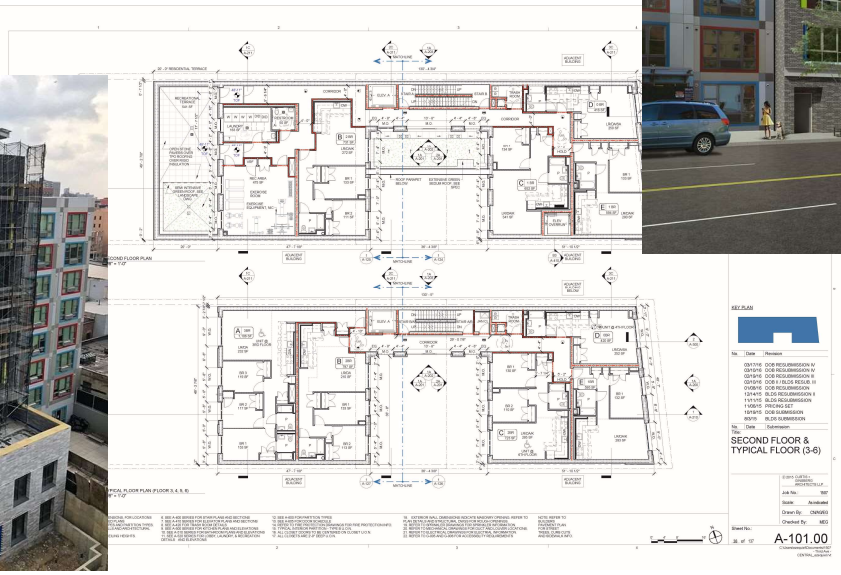
Nudura Insulated Concrete Form home survives hurricane Michael

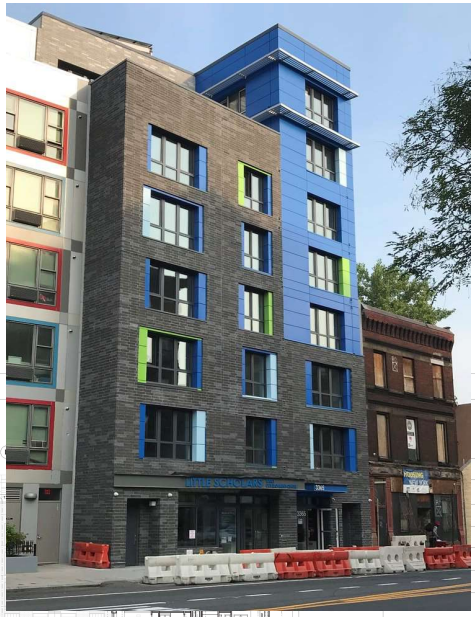
167 King Street Waterloo ON

- Type: 12 story, Off campus student housing
- Size: 100,000 SF, 41 Units with 205 beds
- Finish: Brick, stucco and curtain wall
- GC: *Protrend Arrow Construction*
- Architect: *Masrio O Architects*
- Completed: 2012

3365 Third Avenue Morrisania, Bronx NY

- Owner/Developer: BronxPro Group
- Type: 8 story, Affordable housing
- LEED: Platinum & Passive House (PHIUS)
- Size: 57,200 SF, 30 Units,
- Cost: $00 M - $00 SF
- Finish: Block & Dryvit EIFS
- GC: *C & S Construction*
- Architect: *Curtis + Ginsberg Architects*
- Completed: 2017





HOWLAND GREEN BUSINESS CENTER

MARKHAM, ONTARIO

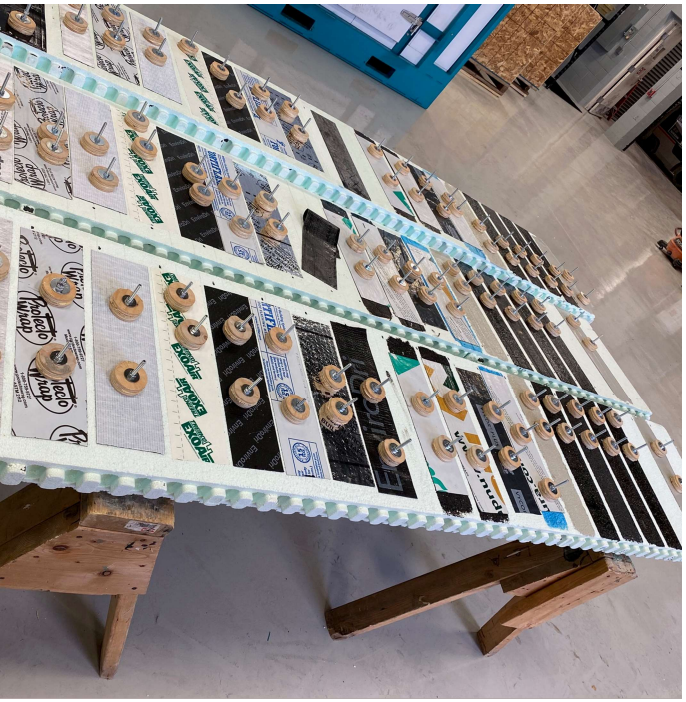
HOWLAND GREEN

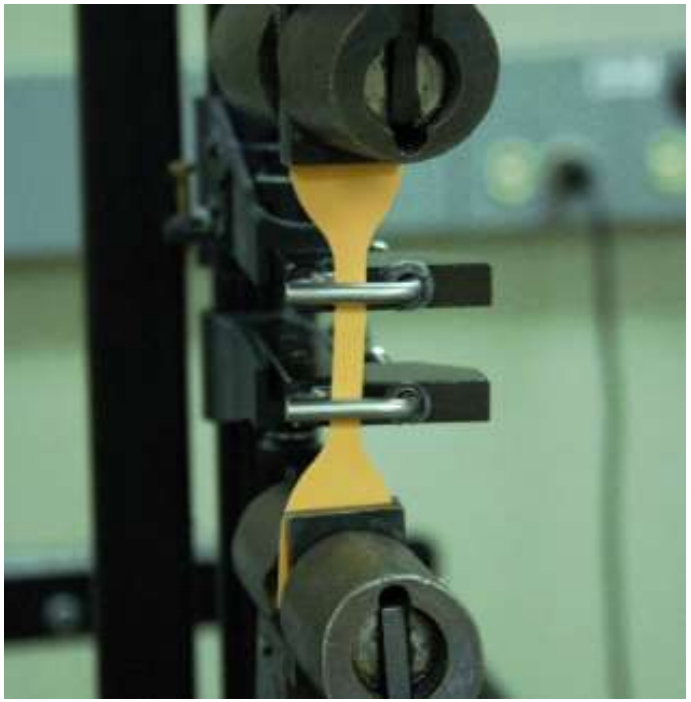
Cachet Woods Court, Markham Ontario

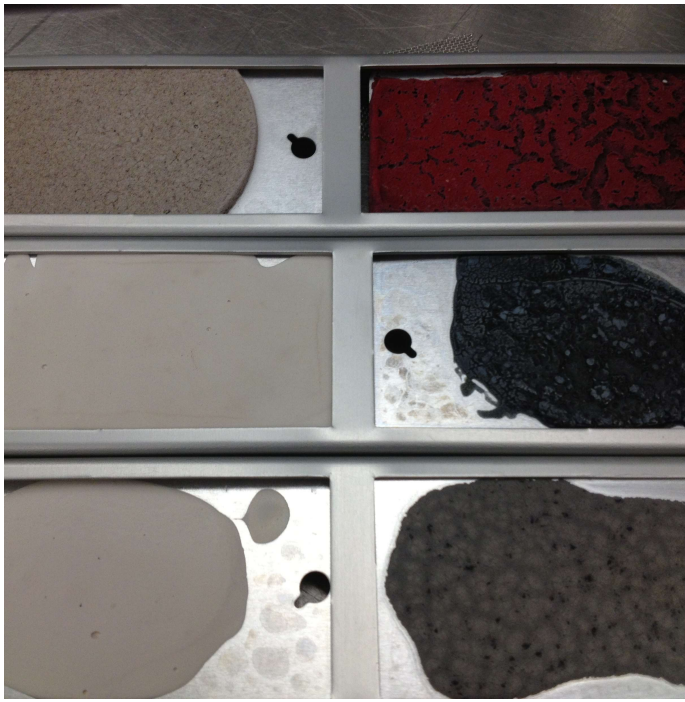
Making the Connections

AIA Continuing Education Provider

Building Enclosure

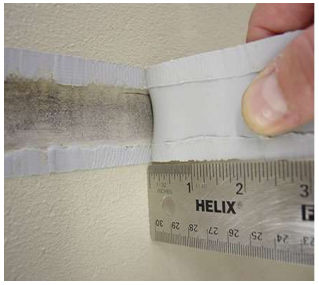






Impact of Exposure

- Adhesion
- Elongation & Tensile Strength
- Compatibility
- Long term performance

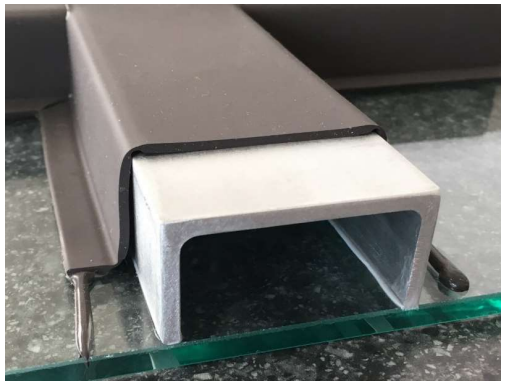

HELIX

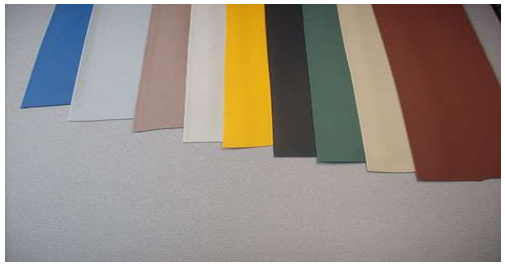

HELIX
FLEXIBLE
STAINLESS STEEL


LEAKING WINDOW HEADER


CONTROL & BUTT JOINTS,
PARAPET CAP

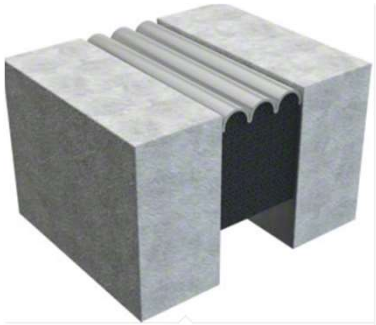

EXPANSION JOINTS

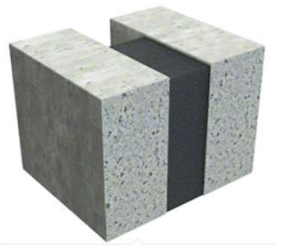


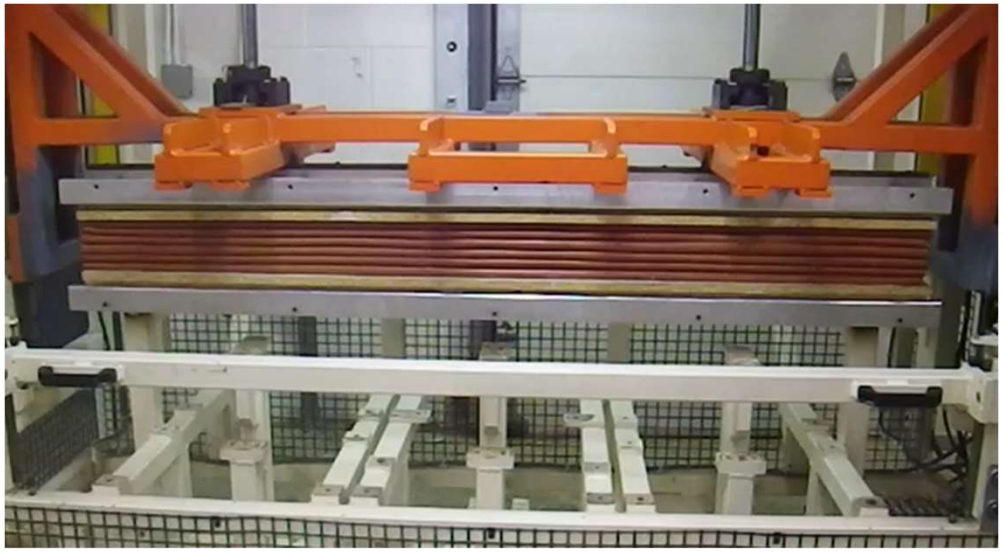


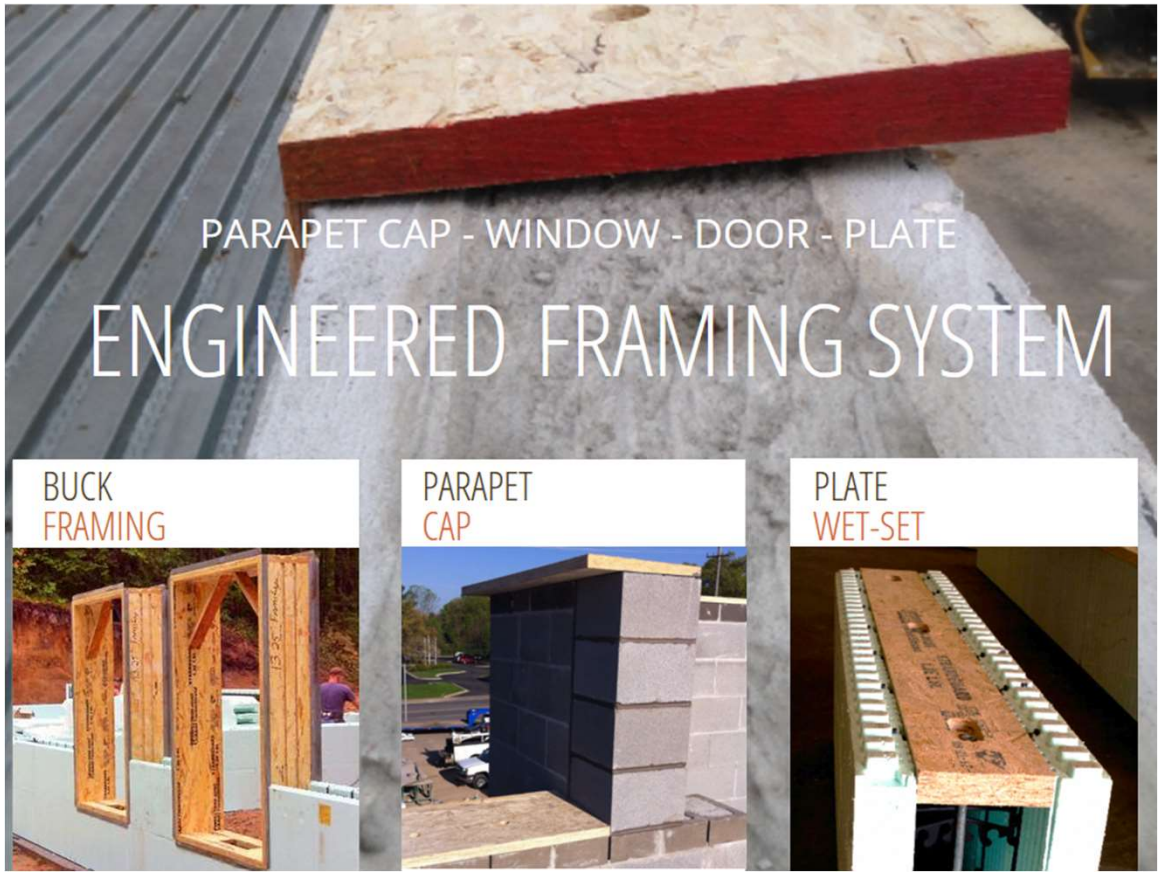
EXPANSION JOINTS & TRANSITION SEALANTS

Pre-Compressed, Acrylic-Impregnated Foams | Preformed Extrusions
Closed-Cell Foams | Monolithic Polyurethane Methacrylate | Gun-Grade Foams









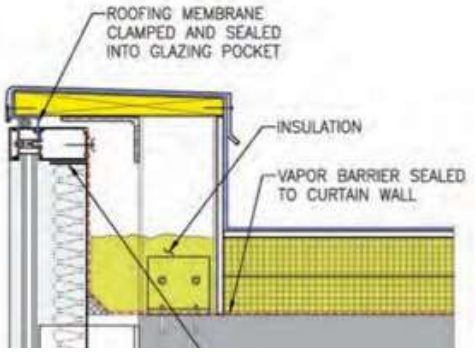
Benefits for Residential and Commercial Construction

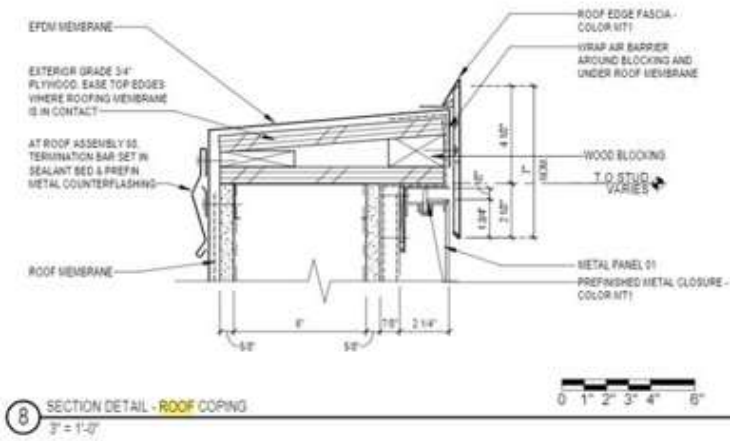
- Designed for direct contact with concrete
- Non-corrosive to metals
- Resistant to insects and decay
- Will not delaminate, become spongy or loose fastener holding strength when exposed in typical commercial construction
- Will not cup, warp or twist over time
- Engineered consistent, flat, stable framing material
- LSL bending strength reduces internal bracing before concrete pour

Engineered Wood Bucks

- Engineered wood buck using Laminated Strand Lumber (LSL)
- Exterior grade with termite resistant
- 1 ½” thickness and offered in various widths

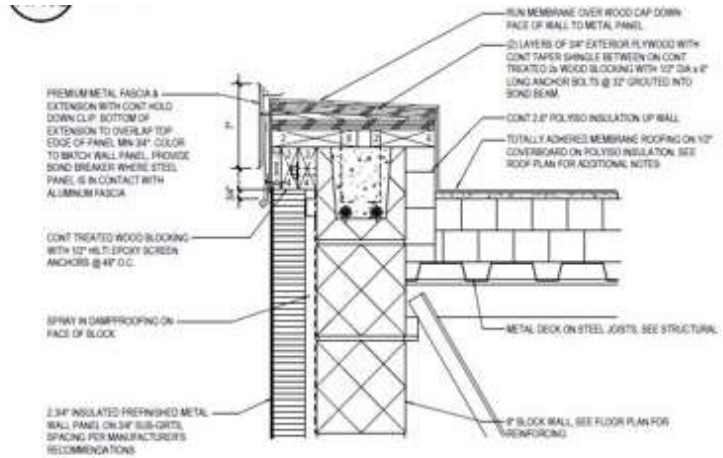
Parapet Caps



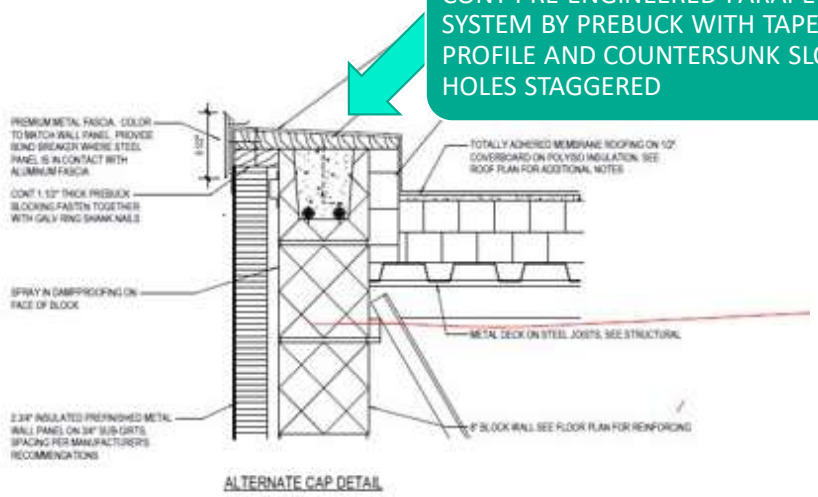


Common Details

- How does it come together?
- How do you get the appropriate slope?
- Who is responsible?
- Are the materials being used weather resistant?
- Will sealants and flashing materials adhere?



13 ROOF EDGE METAL PANEL / 8" BLOCK



ALTERNATE CAP DETAIL

Common Details

- Pre-engineered continuous parapet cap
- Pre-engineered with appropriate slope
- Can be easily installed
- Weather resistant construction
- Tenacious adhesion of Tremco sealants and membranes

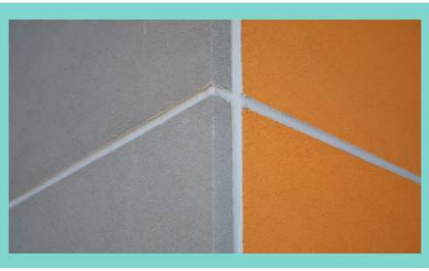
Bringing It All Together

AIA Continuing Education Provider

Performance

BEFORE

AFTER



500 Pacific Avenue, Bremerton, Washington

CHALLENGE

After a baseball-sized stone fell to the sidewalk from an exterior wall of this Class A office building, the owners took immediate action to protect occupants and passersby.

Originally constructed in 1965, the façade of the 75-foot tall structure used concrete panels with embedded granite stones. Fast forward fifty years and the structure faced substantial weathering and water damage, which led to mold growth, corrosion of the balconies and failure of the decorative exterior.

Energy Efficiency

BUILD MEETS WORLD

The Deep Energy Retrofit Initiative: The ABCs of DER

Resiliency

Building Science Lab is made available as a tool to replicate the exact design intent and evaluate installation practices.

BUILD MEETS WORLD™

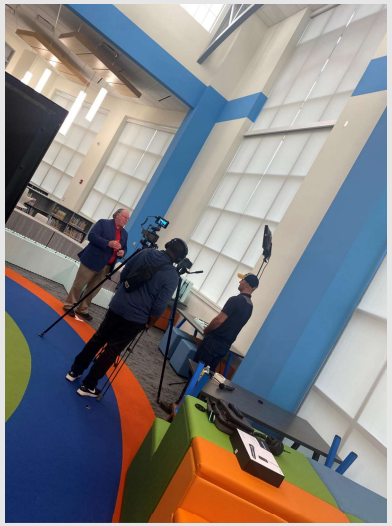
WRITTEN BY INDUSTRY EXPERTS FOR INDUSTRY EXPERTS

Blog & Broadcast Opportunity

Net-zero energy schools are old news in Kentucky

SHERMAN CARTER BARNHART ARCHITECTS

ALLIANCE CORPORATION
Builders & Managers



Want to join the conversation?

Interested in being a part of Build Meets World with your design challenge or solution, please feel free to reach out to me. We would be happy to host you on our broadcast.

Marcy Tyler
mtyler@tremcoinc.com