AIA San Diego

Waterproofing is Not Skin Deep

Karim P. Allana, P.E., RRC, RWC
President, Allana Buick & Bers, Inc.

Copyright Materials

ALLANA BUICK & BERS
Making Buildings Perform Better

Best Practice

Allana Buick & Bers, Inc. (ABBAE) is a Registered Provider with the American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that me be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

CONTINUING EDUCATION AIA

Karim P. Allana, PE, RRC, RWC

- **Education:** B.S., Civil Engineering, Santa Clara University
- **Registration:** P.E., Civil Engineering, California, Washington, Nevada, and Hawaii
- **Certification:** Registered Roof Consultant (RRC), Roof Consultants Institute, and Registered Waterproofing Consultant (RWC)
- **Overview:**
  - CEO and Senior Principal at Allana Buick & Bers.
  - Former Turner Construction Employee (Project Engineering and Superintendent)
  - Over 37 years experience providing superior technical standards in all aspects of building technology and energy efficiency.
  - Principal consultant in forensic investigations of building assemblies, failure analysis, evaluation and design of building infrastructure and building envelope evaluation and design.
  - Expert in all aspects of building envelope technology.
  - Completed numerous new construction, addition, rehabilitation, remodel and modernization projects for public and private sector clients.
  - Specialization in siding, roofing, cement plaster, wood, water intrusion damage, window assemblies, storefronts, below grade waterproofing, energy efficiency, solar engineering and complex building envelope and mechanical assemblies.

ABBAE Firm Overview

- Allana Buick & Bers (ABBAE) is an Architectural Engineering firm specializing in Building Envelope Systems
- ABBAE is one of the 5 largest building envelope consultants in the country
- ABBAE has over 33 years of experience & over 12,500 projects
- ABBAE is also a leading Forensic Defect firm with hundreds of forensic projects (litigation)
- Locations – 16 offices across California, Nevada, North Carolina, Oklahoma, Oregon, Texas, Virginia, Washington, Colorado and Hawaii

Staff & In-House Expertise

- Licensed Professional Engineers – Civil, Structural, and Mechanical
- Registered Architects
- Building Enclosure Commissioning Process Providers (BECxPs)
- Registered Building Envelope Consultant (RBEC)
- Registered Roofing Consultants (RRCs)
- Registered Waterproofing Consultants (RWCs)
- Registered Exterior Wall Consultant (REWCs)
- Registered Roof Observers (RROs)
- Certified Exterior Insulation and Finish System (EIFS) inspectors
- Curtain Wall Specialists
- ICC Certified Building Inspectors
- Quality Assurance Monitors
- Water Testing Experts
- Leak Investigation and Diagnosis Experts
- Infrared Imaging and Nuclear Moisture Scanning Experts

ABBAE Building Expertise

- Building Envelope Systems
  - Roofing Systems
    - High-Slope/Low-Slope Roofs
    - Green/Garden Roofs
    - Drainage Systems
    - Pedestrian Plazas
  - Exterior Wall Systems
    - Wall Cladding/Siding/GFRC/pre-cast
    - EIFS/cement plaster/stucco
    - Sheet Metal Flashings
  - Windows and Glazing Systems
    - Punched Windows
    - Curtain Wall/Window Wall Systems
    - Sliding Glass Doors
    - Skylights
- Building Envelope Systems (cont'd)
  - Roofing & Waterproofing Systems
    - Deck/Balcony/Lanai Waterproofing
    - Podium Waterproofing
    - Pool/Spa Deck Waterproofing
    - Above-Grade/Below-Grade Waterproofing
    - All types of low and steep sloped roofing
  - Commissioning BECx
    - OPR/BOD/Commissioning Plan
- Mechanical/HVAC Systems
  - HVAC design
  - Plumbing systems
  - Commissioning and testing

ABBAE Core Services

- Consulting and third-party peer review services
- Engineer of record for building envelope systems
- Contract administration services
- Inspection services (usually direct with owner)
- Air and water performance testing
- Mock-up design, observation, and testing
- Building assessments and forensic investigations
- Litigation support and expert witness services
- Educational seminars with AIA credits

Client Firms

- **Architects:** WLC, Martinez & Cutri, Joseph Wong Design Associates, Kanner Architects, Sprotte+Watson Architecture, Gensler, Perkins+Will, DMJMH+N Design, Fisher-Friedman Associates, Anshen+Allen Architects, Cody Anderson Wasney Architects, MBT Associates, Architectural Resources Group, Harris & Associates, tBP Architects,, Form 4 Architecture, KMD Architects, Sugimura & Associates Architects, Field Paoli Architects, HTI Inc., Studio Bergtraun Architects, WCIT Architecture, DES Architects & Engineers
- **Other Relevant Clients:** Alpine School District, Scripps Memorial Hospital, UC San Diego, Madison Marquette Realty Services, Garden Communities, PacBell/SBC, Woodlands La Jolla HOA, Mayfair Homes, Shadow Mountain Church, Villa Sevilla, Ocean Pointe HOA, DOMA Apartment Community, IBM, Hitachi Chemical, Sun Microsystems, Cisco Systems, Cushman Wakefield

SEMINAR OBJECTIVES

- Case Studies and Learning Objectives
  - EIFS Bull Nose Design and Construction Failure
  - Understanding thermal expansion issues in exterior walls
  - Moisture transmission through exterior stucco clad wall
  - Stucco design issues to consider
  - Below Grade Waterproofing Failure study
  - Issues to consider when designing Sodium Bentonite based below grade WP

- Waterproofing is not skin deep
  - Understanding how structural, civil and mechanical engineering is needed for waterproofing and building envelope design
  - Understanding new IBC and how it impacts Architects

Case Study #1
EIFS Bull Nose

- EIFS Bull Nose Failure
- Design Issues
- Thermal Modeling
- Lesson Learned

Case Study # 1, EIFS Bull Nose, Pleasanton CA

CHA-AL05795

Pleasanton, CA

DRYVIT OUTSULATION IS A BARRIER SYSTEM

There are 3 basic types of Dryvit EIFS system

- All Exterior Insulation & Finish Systems (EIFS) consist of a 1/16" cementious layer reinforced with a fiberglass mesh (lamina). The lamina is top coated with an acrylic texture and color coat. The thin layer of cement is the primary waterproofing for al EIFS systems.
- Dryvit Outsulation system (as installed on 5050 Hopyard) is a barrier system, i.e. this 1/16" layer is the only waterproofing on the exterior wall. No felt, no other means to weatherproof the building.
- Dryvit Outsulation Plus & Infinity Systems; in addition to the lamina, there is a waterproofing coating behind the EPS foam in both of these upgrade systems. This additional waterproofing membrane, if properly installed and drained can be an effective "secondary" barrier to water entry.

Typical Crack in EIFS Bull Nose

CHA-AL04351

Patterns of Cracking in Bull Nose

- There were two distinct pattern of cracking in the bull nose:
  - Horizontal cracks; always located between the flat and curved parts of the bull nose, on top or bottom of the bull nose. Horizontal cracks also located in the center of the bull nose curved shape.
  - Vertical cracks; Randomly located throughout the building and almost always present at the inside corner, at a jog in the exterior wall.
  - Few other cracks fell outside of this pattern where in the same locations there were both vertical and horizontal cracks

Vertical Crack at inside Corner

DEFECT: Lack of expansion joint at inside corners

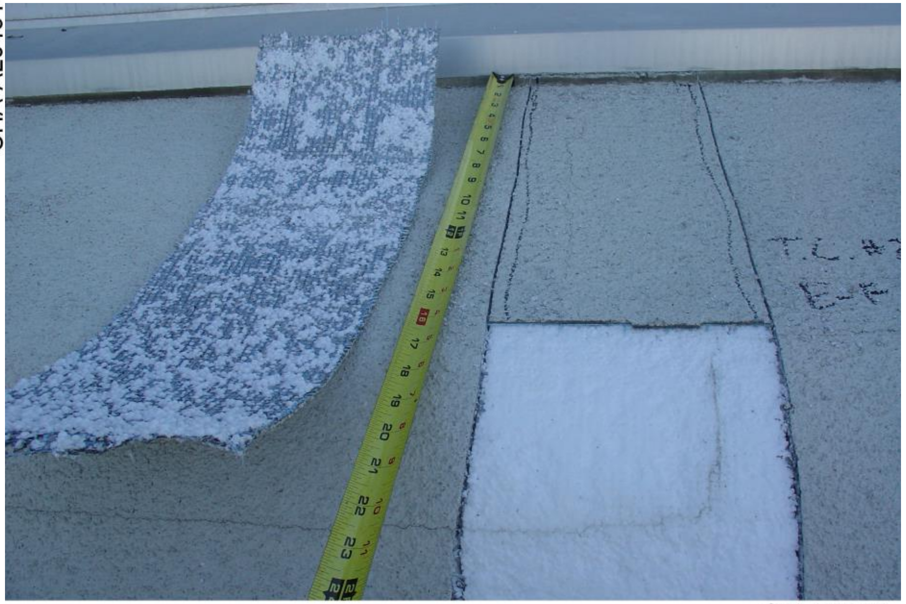
CHA-AL04435

Vertical Crack in the Field

CHA-AL03186

Multiple Cracks, horizontal and vertical

CHA-AL04314



CHA-AL04316

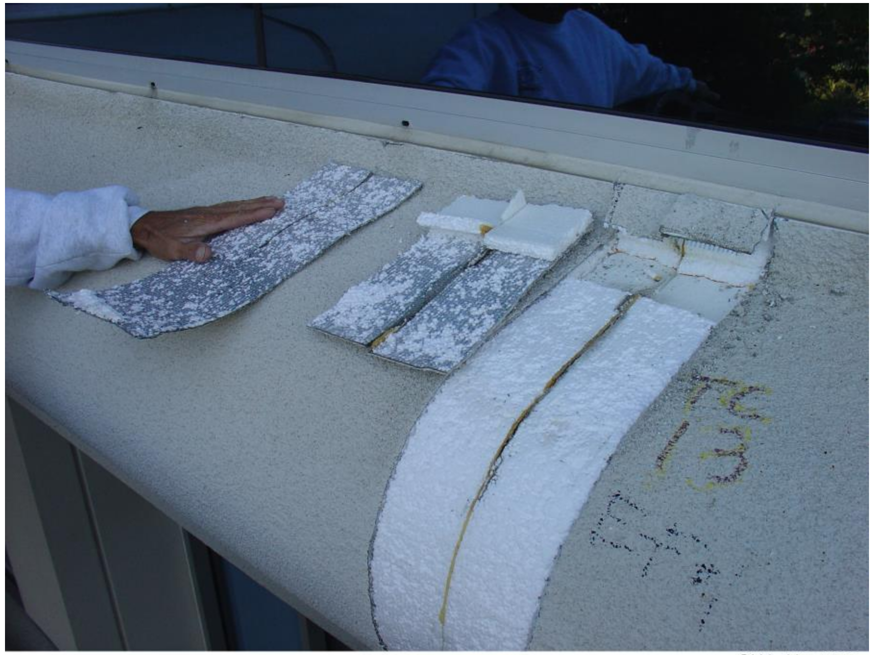
Typical Horizontal Crack Pattern

CHA-AL04355

Reasons for Vertical Cracks (Defect)

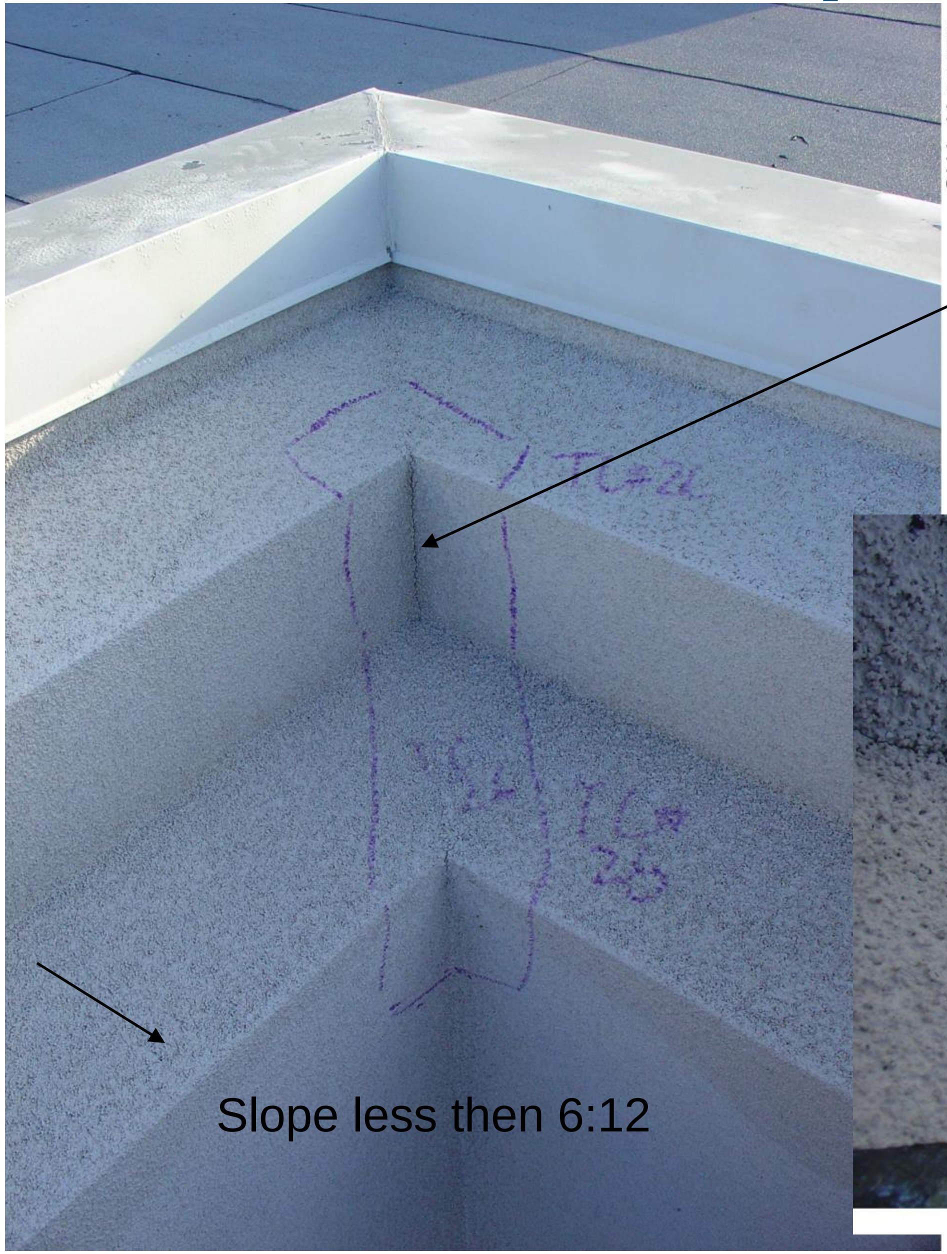
- Generally, vertical cracks were caused by “gaps” in EPS insulation. Gaps create areas where the cementious base coat collects and creates a discontinuity for thermal movement, causing a split
- In some cases, vertical cracks resulted due to lack of mesh embedment

CHA-AL02068



CHA-AL04479

Cracks at Parapet Wall; Lack of Slope



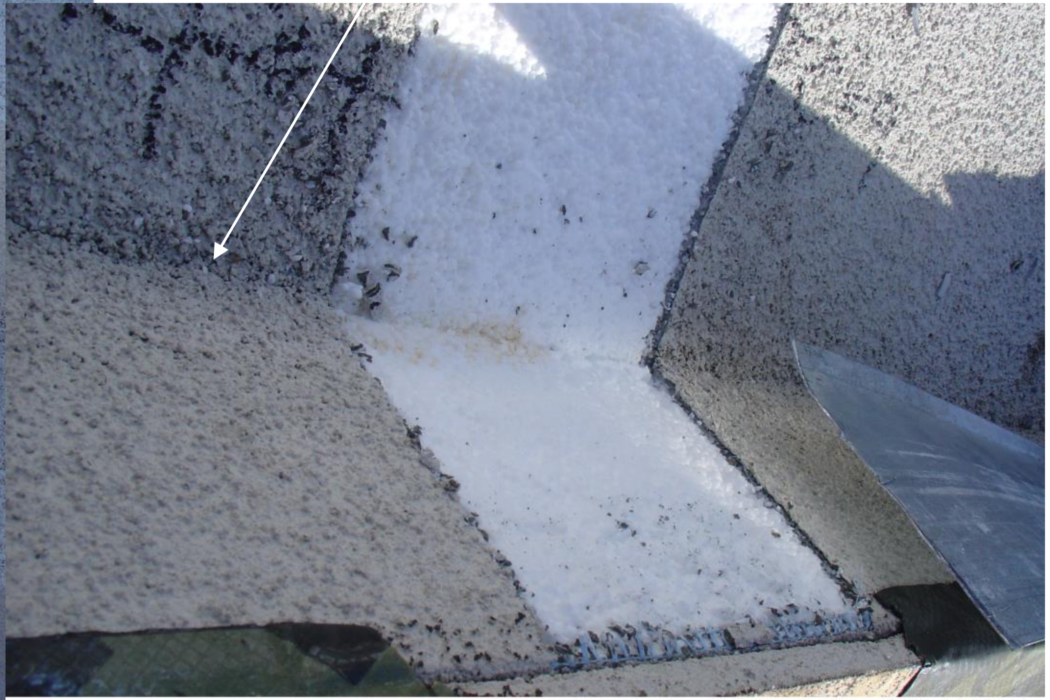
CHA-AL04472

Cracks and splits are caused due to lack for extra reinforcing mesh

Vertical Crack at inside corner

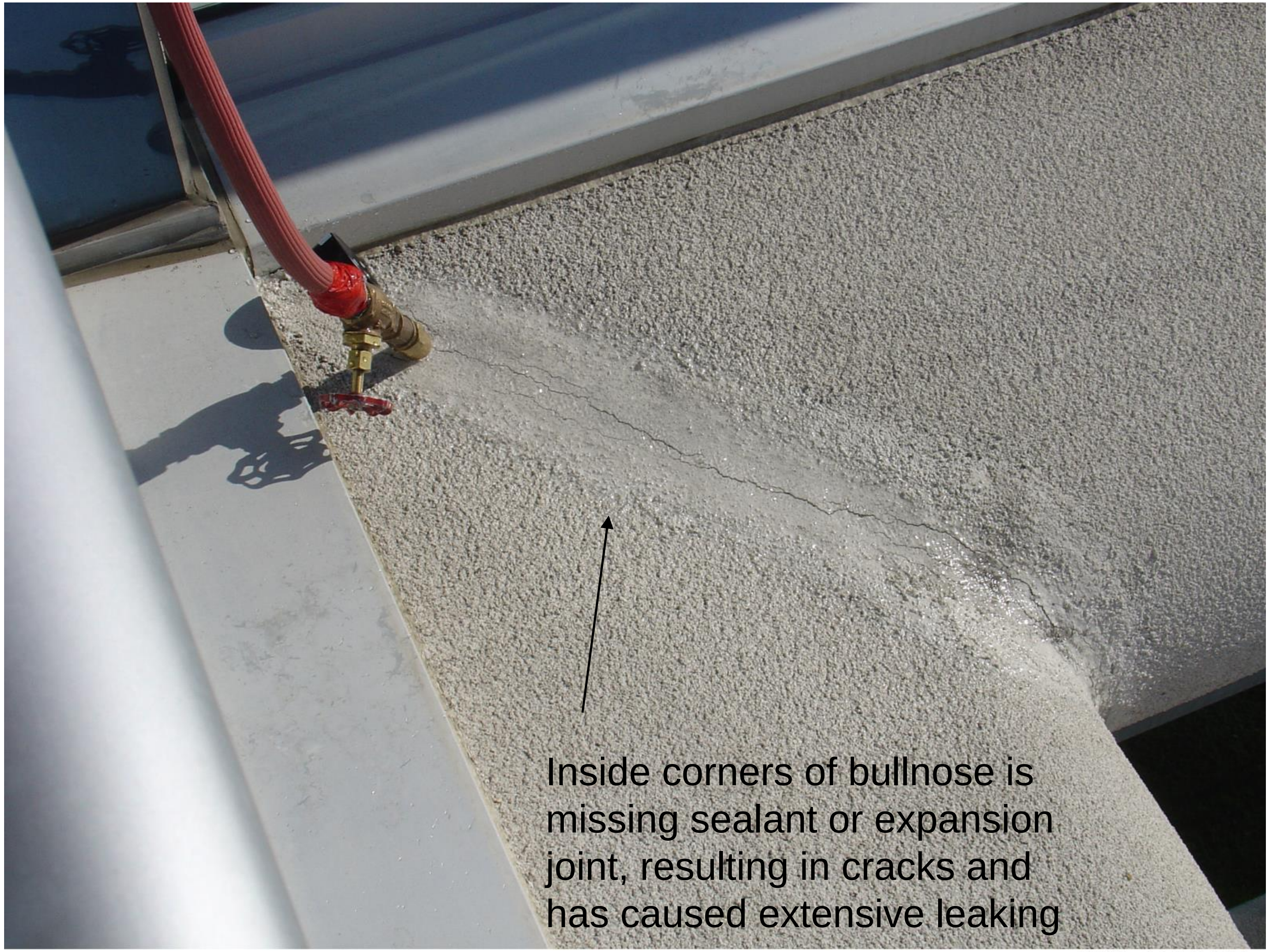
Horizontal Crack at inside corner. Notice water stains.

Slope less then 6:12



CHA-AL04406

Cracks and leaks at Inside Corner of bull nose



Leak Test Location #4 – Southeast Elevation – above 2nd floor

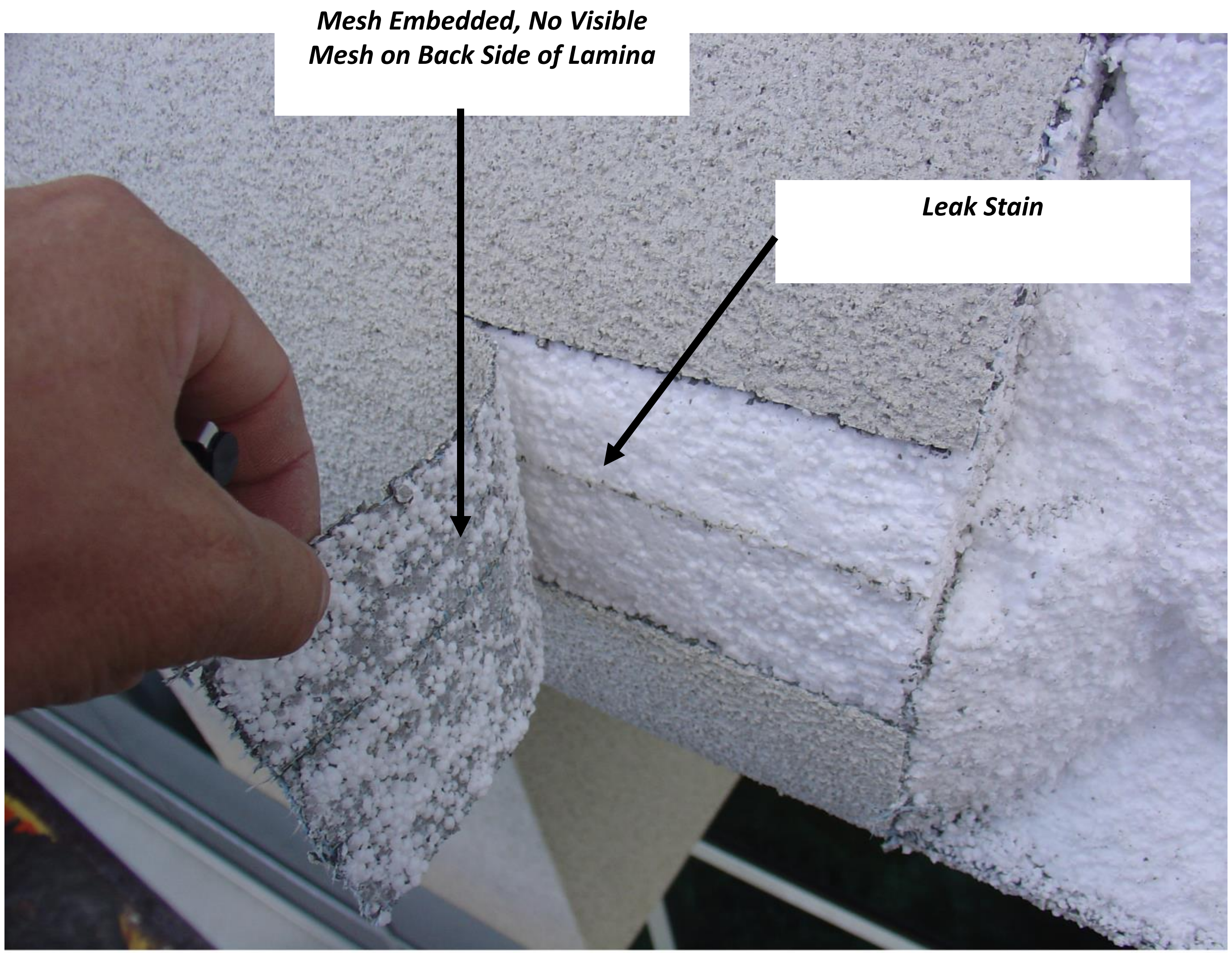
CHA-AL05487

Test Cut # 2, East Elevation.

CHA-AL05261

AUGUST 2004 TESTING

Test Cut #2– East Elevation – 3rd floor line EIFS Bullnose

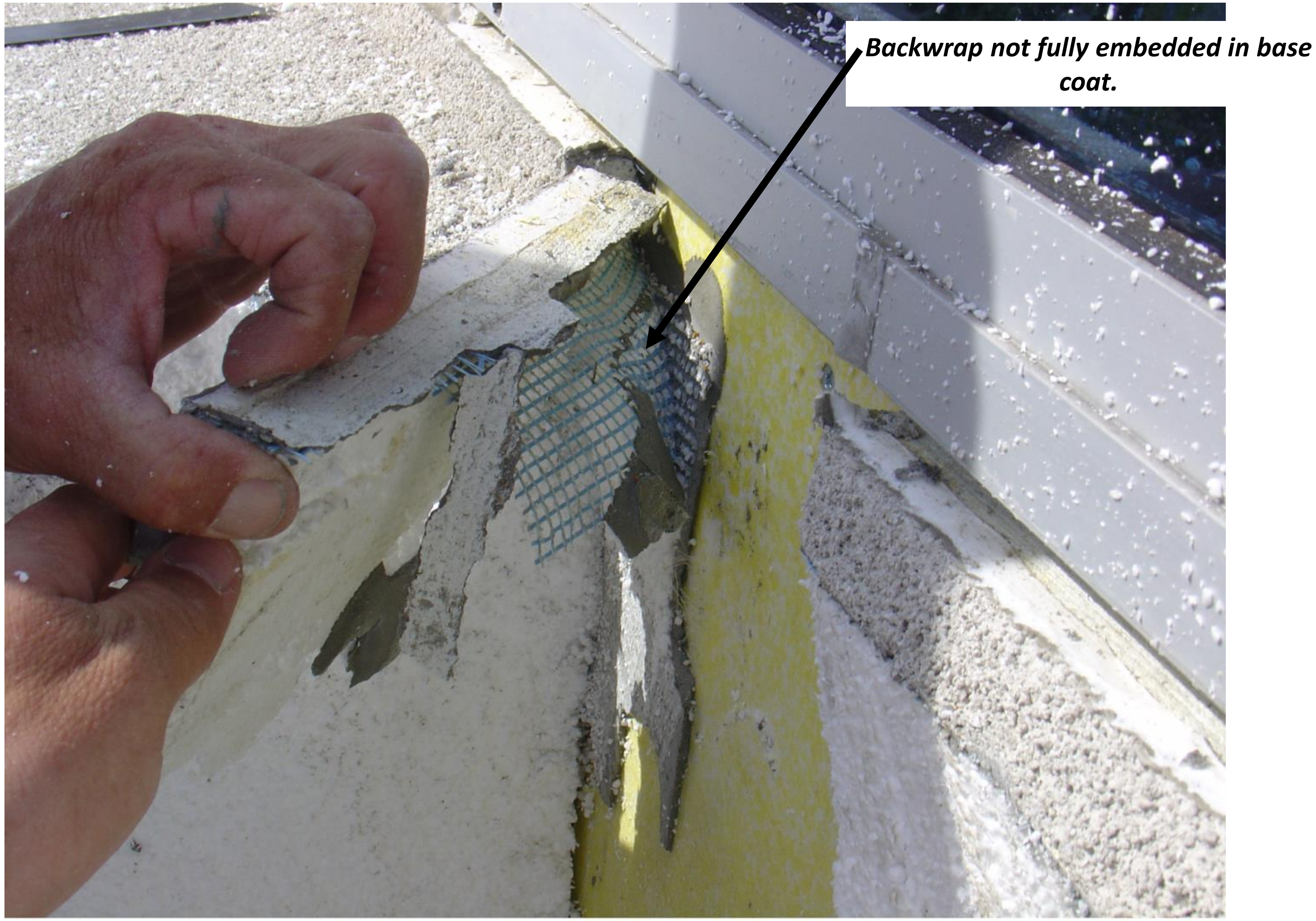


CHA-AL05272

Travel Path for Water Leak

- EIFS outsulation is a “barrier” system. The 1/16” Cementious skin is the only waterproofing barrier in the system. CRACKS = WATER INTRUSION & LEAKS
- Our testing showed that water leaks were occurring from both horizontal (longitudinal) and vertical (perpendicular) cracks in the lamina at the bull noses.
- In case of vertical cracks, there existed a gap between the foam and water was able to quickly and readily travel through the EIFS skin, and reach the interior sheathing or ceiling space.
- In case of the horizontal cracks, water traveled between the EIFS lamina and EPS (Expanded Polystyrene Foam), and very slowly moved around the bull nose and leaked to the interior space.

EIFS Defect: Lamina is not backwrapped



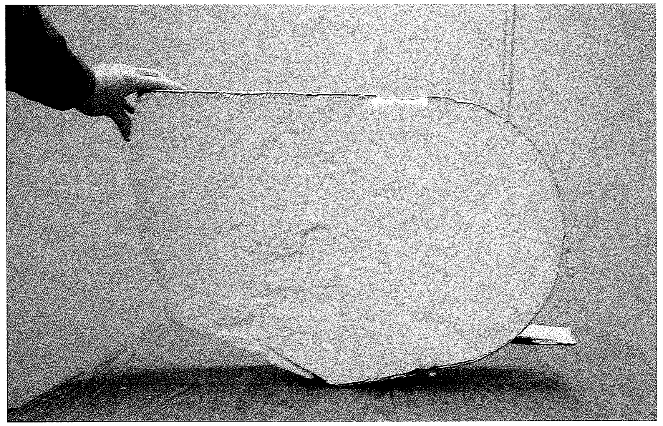
Test Cut #3– East Elevation – 4th floor line EIFS Bullnose. Required by Dryvit

FORENSIC ANALYSIS OF HORIZONTAL CRACKS

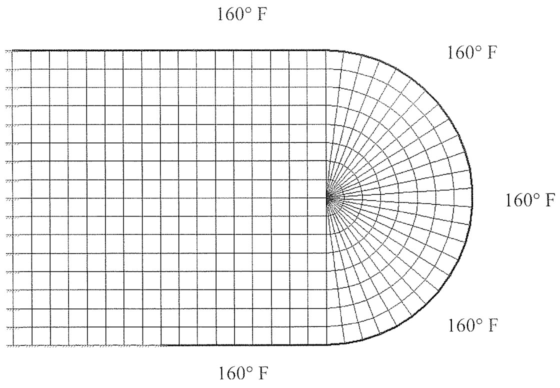
- In order to develop a suitable, sustainable, repair for this building, we analyzed the mode of failure.
- The horizontal crack pattern in the EIFS finish at the nose of the bull nose was unusual and distinct.
- Our structural engineering team performed thermal modeling of the bull nose panels to see what kind of forces we could develop.
- We also performed visual analysis of the lamina construction to ascertain the method of construction, rasping of the foam and embedment of mesh in the base coat.
- We looked at the numerous samples that we had gathered to see if there was a pattern.

THERMAL ANALYSIS WITH RISA 2D SOFTWARE

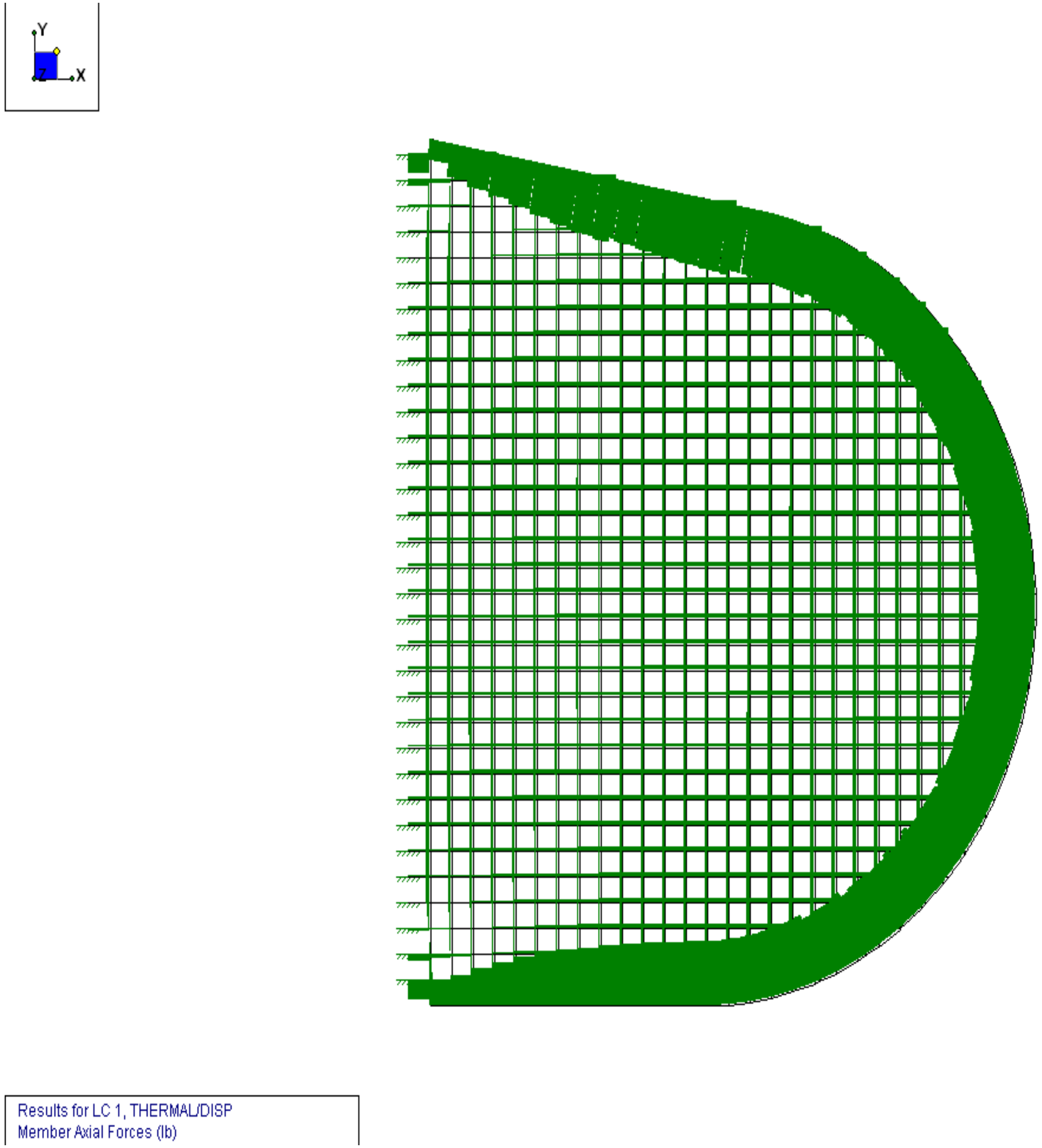
5050 Hopyard Preliminary Finite Element Analysis of EIFS bullnose assembly.



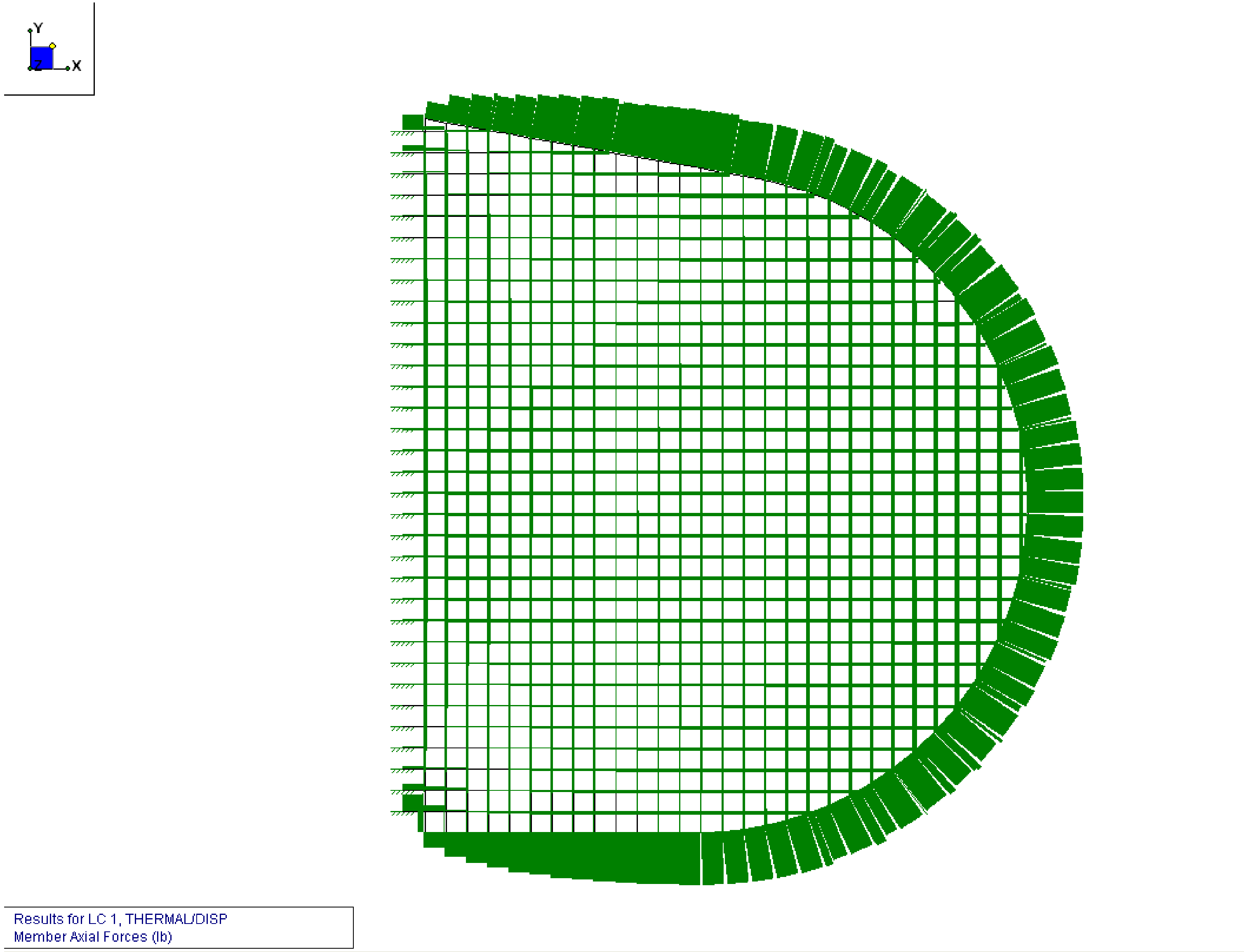
5050 Hopyard EIFS bull-nose specimen



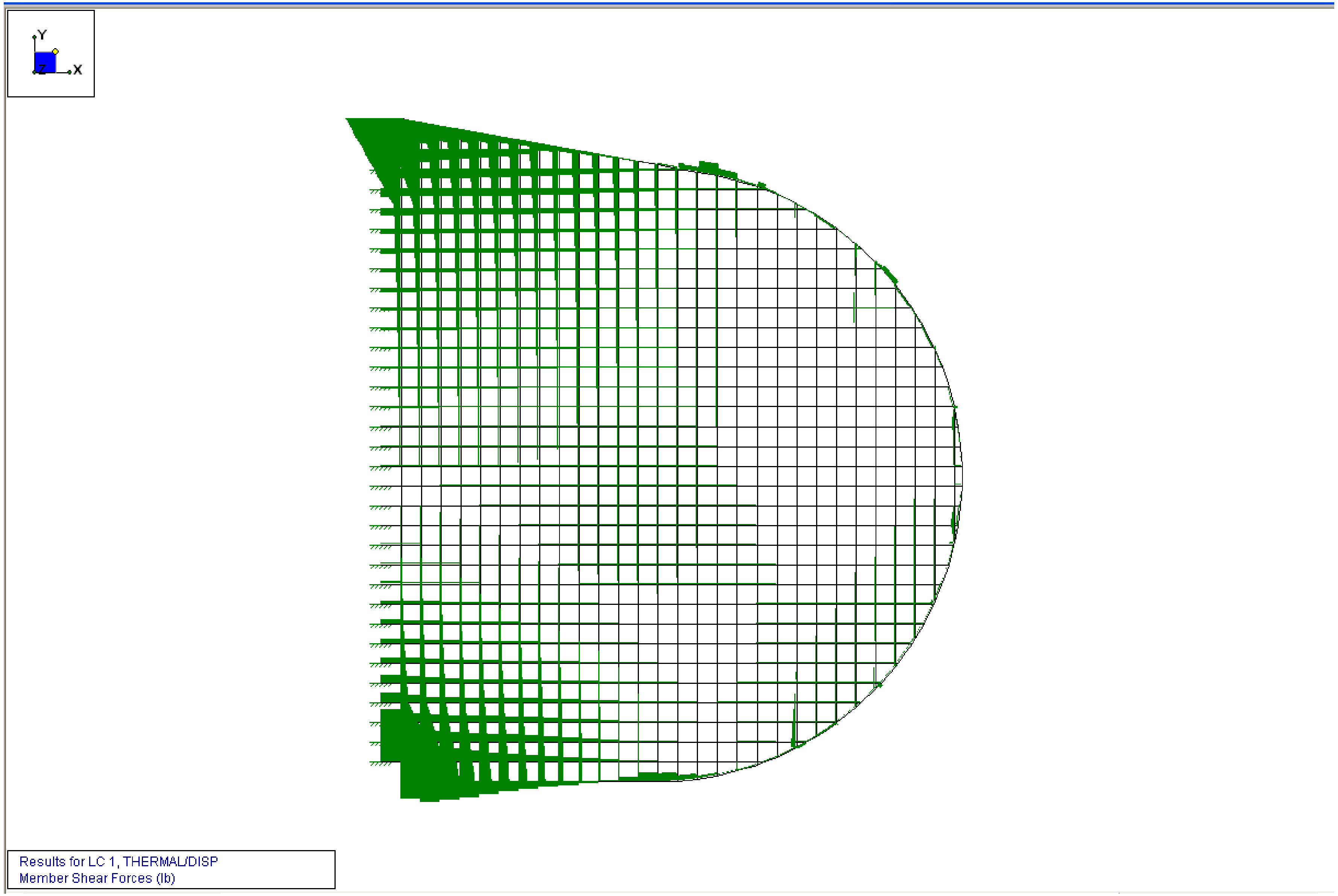
2D Finite Element Model of EIFS bull-nose Specimen: Model is subjected to a uniform thermal load of 160 F. Elements are 4 node quadrilaterals and are assigned the



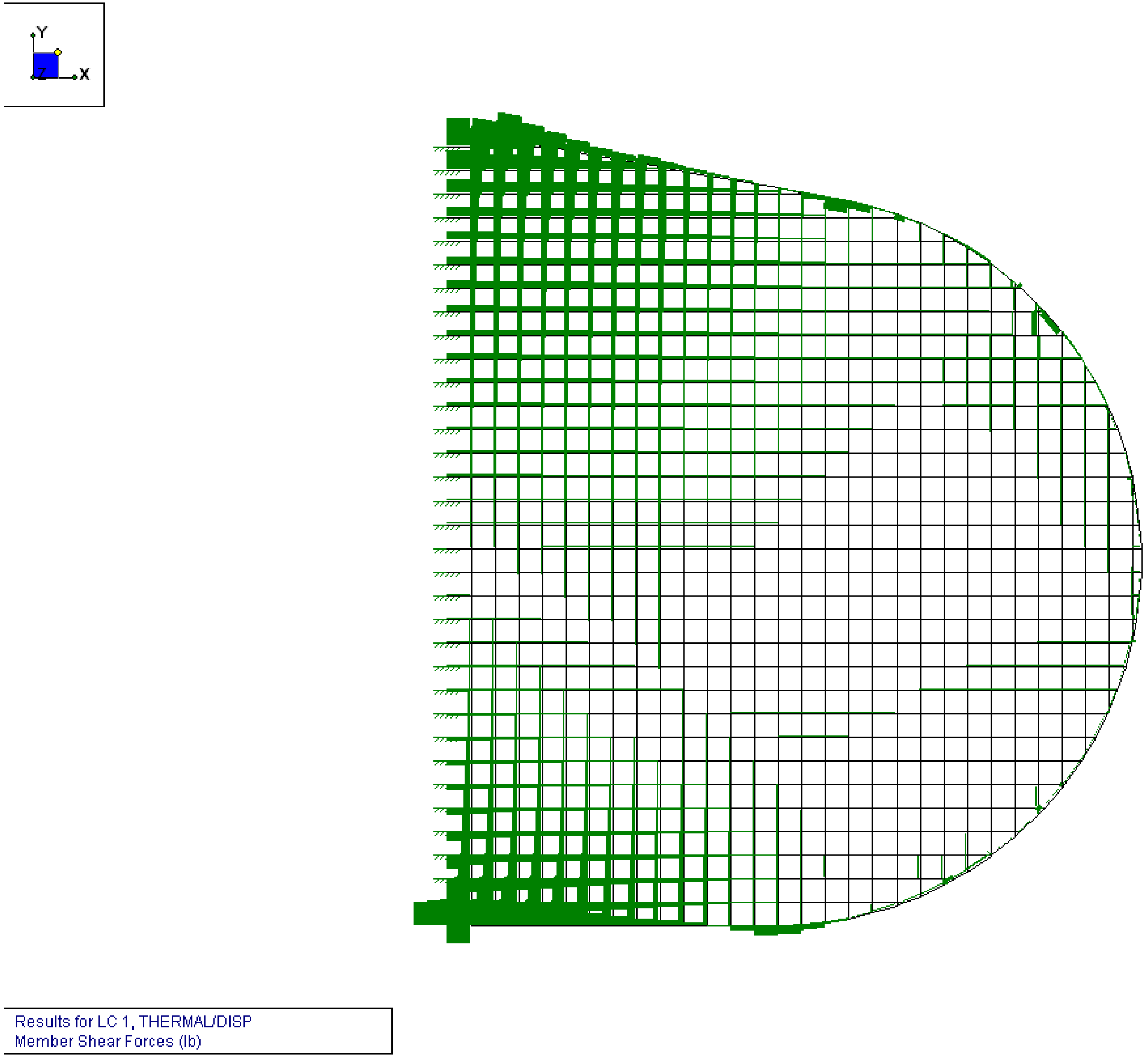
Axial Loads (lb) for 50°F Increase



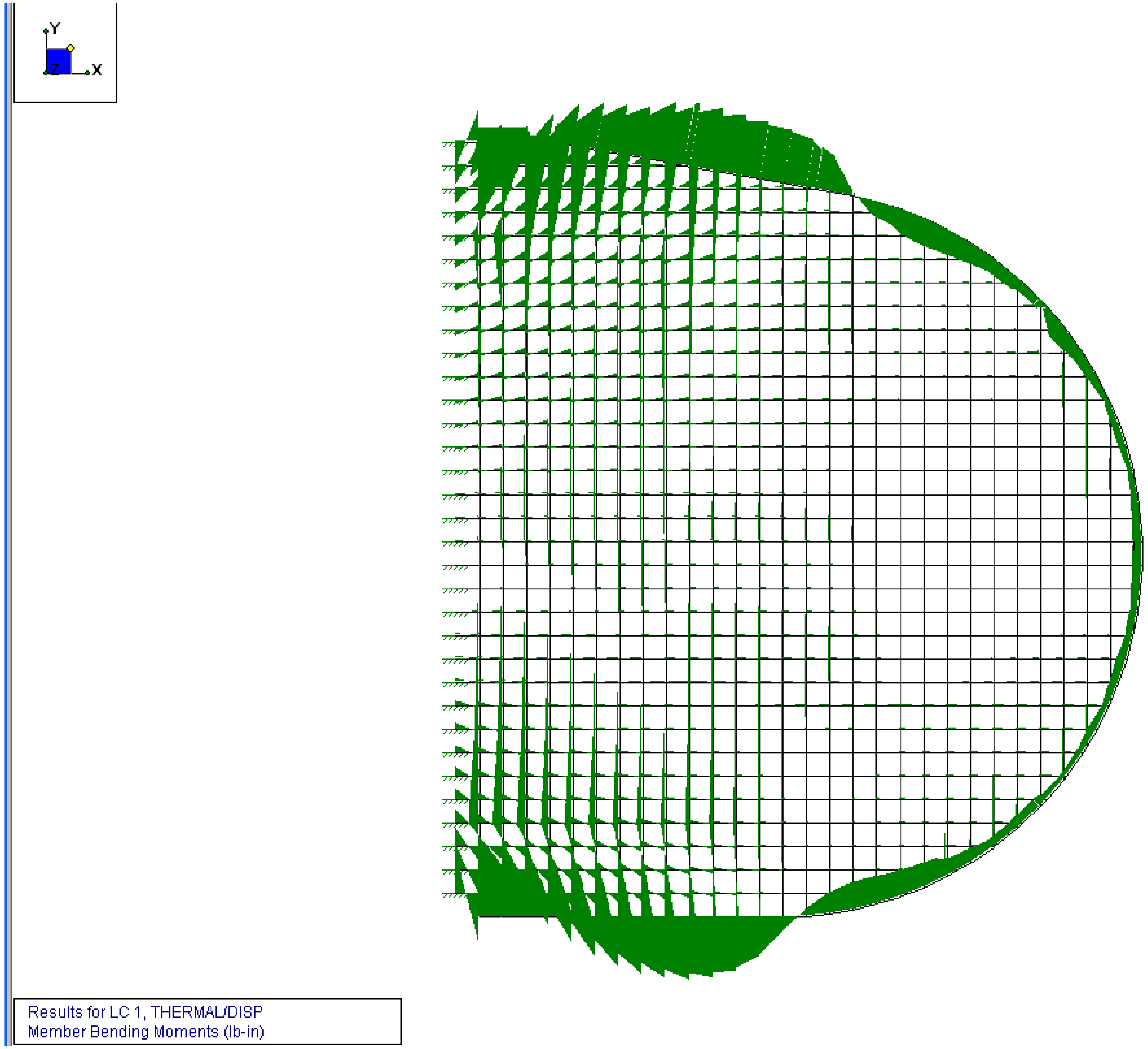
Axial Loads (lb) for 50°F Decrease



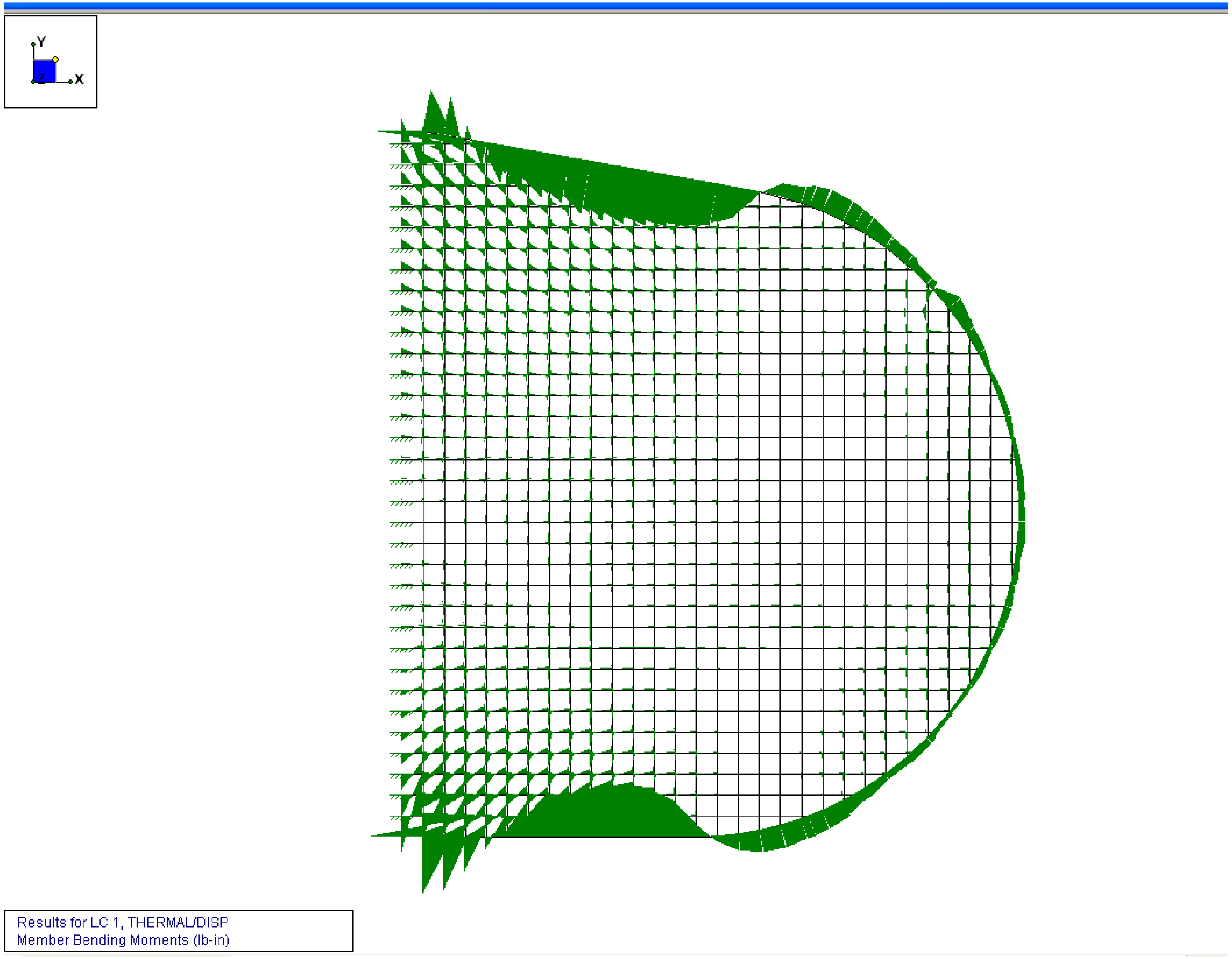
Shears (lb) for 50°F Increase



Shears (lb) for 50°F Decrease



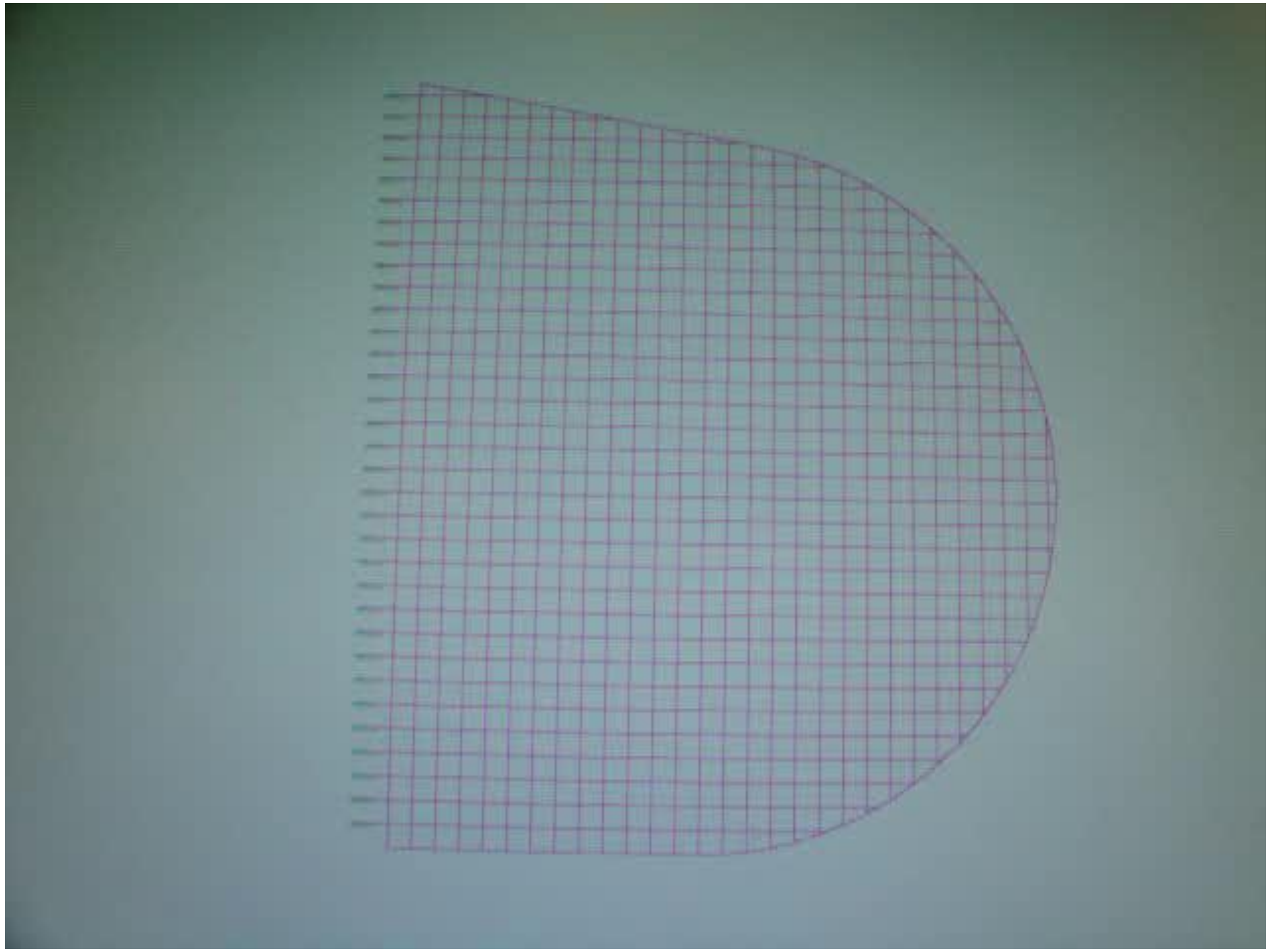
Moments (lb-in) for 50°F Increase



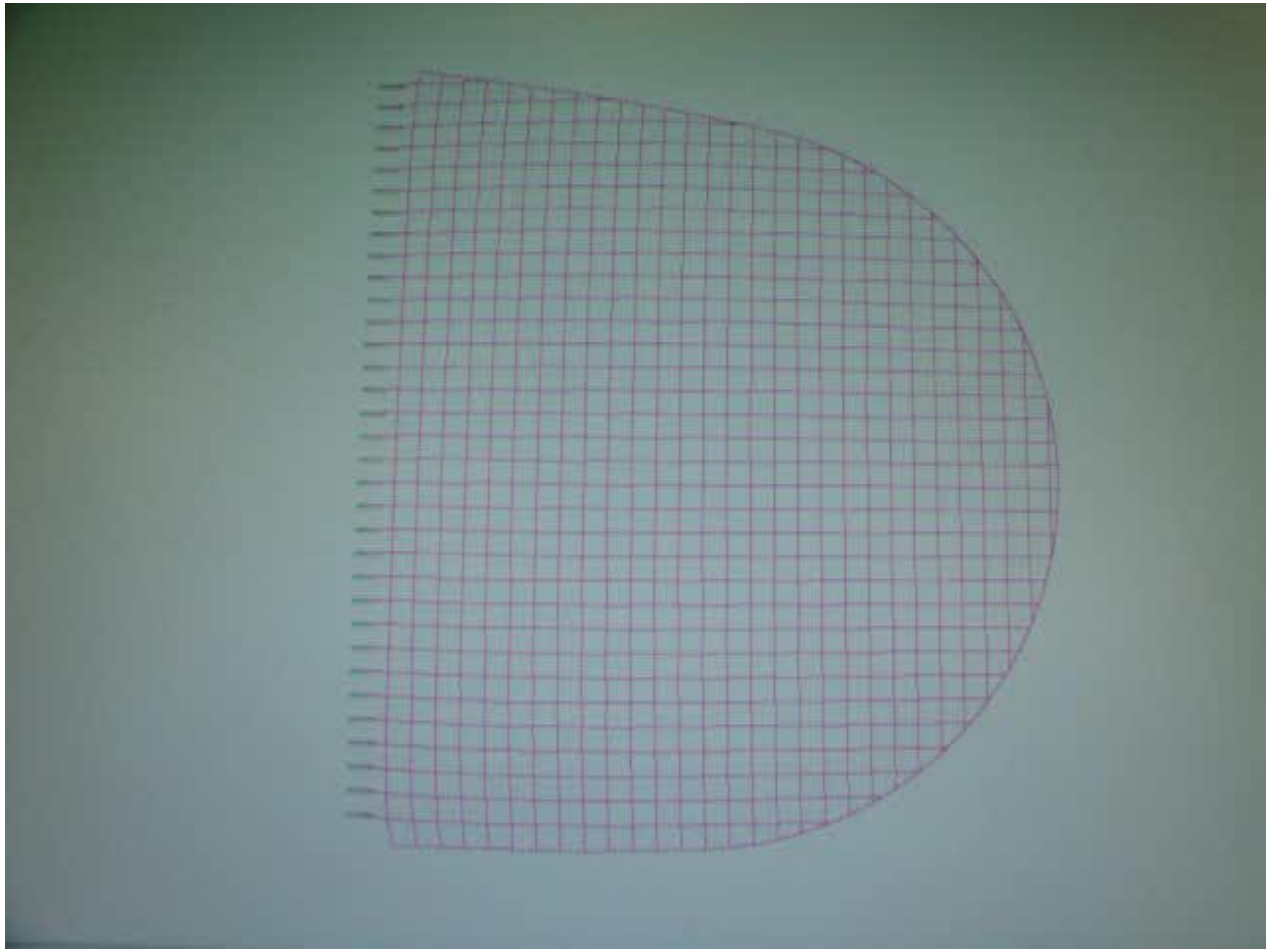
Moments (lb-in) for 50°F Decrease

THERMAL ANALYSIS (For Horizontal Cracks)

- All thermal stresses are concentrated at the shape change area
- Moment reverses at the shape change
- Maximum stress are at the curved portions of the bull nose
- Crack leads to water intrusion, UV and breakdown of the fiberglass mesh causing a split
- The lamina can withstand approximately 150 to 180 pounds of tension per linear inch, and our model shows there’s only 4-5 pounds of tension per linear inch, but there is still cracking



50°F Temperature Decrease (100°F to 50°F at 50x magnification)



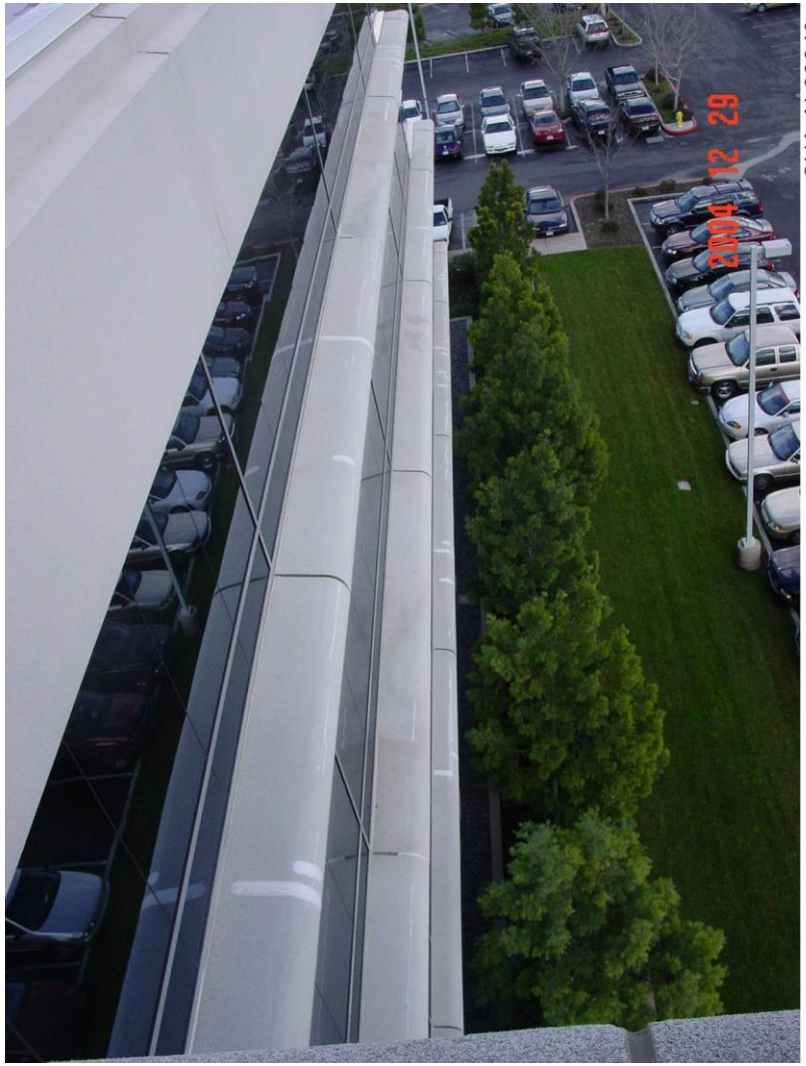
50°F Temperature Increase (100°F to 150°F at 50x magnification)

FAILURE ANALYSIS EIFS BULL NOSE

- Lamina also undergoes bending, from deformed shape which ultimately caused the failure.
  - If EIFS is modeled as a cementitious beam with compressive strength of 3,000 pounds per square inch (“psi”), the modulus of rupture, or “cracking stress” is 411 psi. ABB’s model showed that the maximum bending load of the lamina was .312 lb/in, which translates into 474 psi in the uncracked lamina section. Therefore, the maximum bending stress would exceed the “cracking stress” by 63 psi.

CAUSATION OF HORIZONTAL CRACKS

1. Size and geometry of the bull nose is producing concentrated stress where cracks are occurring.
2. Once lamina is cracked, it allows water intrusion.
3. UV and water degrade the exposed fiberglass mesh at a crack and cause it to split.
4. We explore ways of reducing the mass of the foam, to reduce thermal movement and stresses.



Case Study #2
Today's Cement Plaster

- Cement Plaster Wall
- Understanding Diffusion
- Vinyl Wall Paper
- Changes in Construction
- New Design Standards

OVERVIEW Case Study # 2

- Address the effects of incidental water intrusion in cement plaster wall and related water damage leading to rot and mold
  - Example of potential for leak damage due to poor diffusion of accumulated moisture vapor transmission through interior and exterior wall
  - Calculations for vapor barrier design and water accumulation due to condensation over given time period.

PERMEANCE

- Permeance is based on given thickness of material.

    - Unit of measure = Perm
    - Is measured in perms per square meter
    - Rating under 0.5 = vapor barrier

PERMEABILITY

- Permeability is based on a given thickness range of material.

  - Unit of measure = Perm.inch
  - Example, Permeability of concrete = 3.2 perm.in
  - Permeance of 6” thick concrete slab = 3.2 perm.in/6” = .53 perm

Figure 5

Material	Permeance (perm)	Permeability (perm•in)
Common roof membrane materials:		
Asphalt (hot applied, 2 lbs/100 ft^2)	0.5	
Asphalt (hot applied, 3.5 lbs/100 ft^2)	0.1	
Built-up membrane (hot applied)	0.0	
No. 15 asphalt felt	1.0	
No. 15 tarred felt	1.0	
Roll roofing (saturated and coated)	0.05	
Common insulation materials:		
Expanded polystyrene insulation		2.0 - 5.8
Extruded polystyrene insulation		1.2
Plastic and metal films and foils:		
Aluminum foil (1 mil)	0.0	
Kraft paper and asphalt laminated, reinforced	0.3	
Polyethylene sheet (4 mil)	0.08	
Polyethylene sheet (6 mil)	0.06	
Other common construction materials:		
Brick masonry (4 in. thick)	0.8	
Concrete (1:2:4 mix)		3.2
Concrete block (with cores, 8 in. thick)	2.4	
Gypsum wall board (plain, 3/8 in. thick)	50	
Hardboard (standard, 1/8 in. thick)	11	
Metal roof deck (not considering laps and joints)	0.0	
Plaster on metal lath	15	
Plaster on wood lath	11	
Plywood (Douglas fir, exterior glue, 1/4 in. thick)	0.7	
Plywood (Douglas fir, interior glue, 1/4 in. thick)	1.9	
Wood, sugar pine		0.4 - 5.4

Typical Water Vapor Permeance and Permeability Values[1,2]

Figure 4

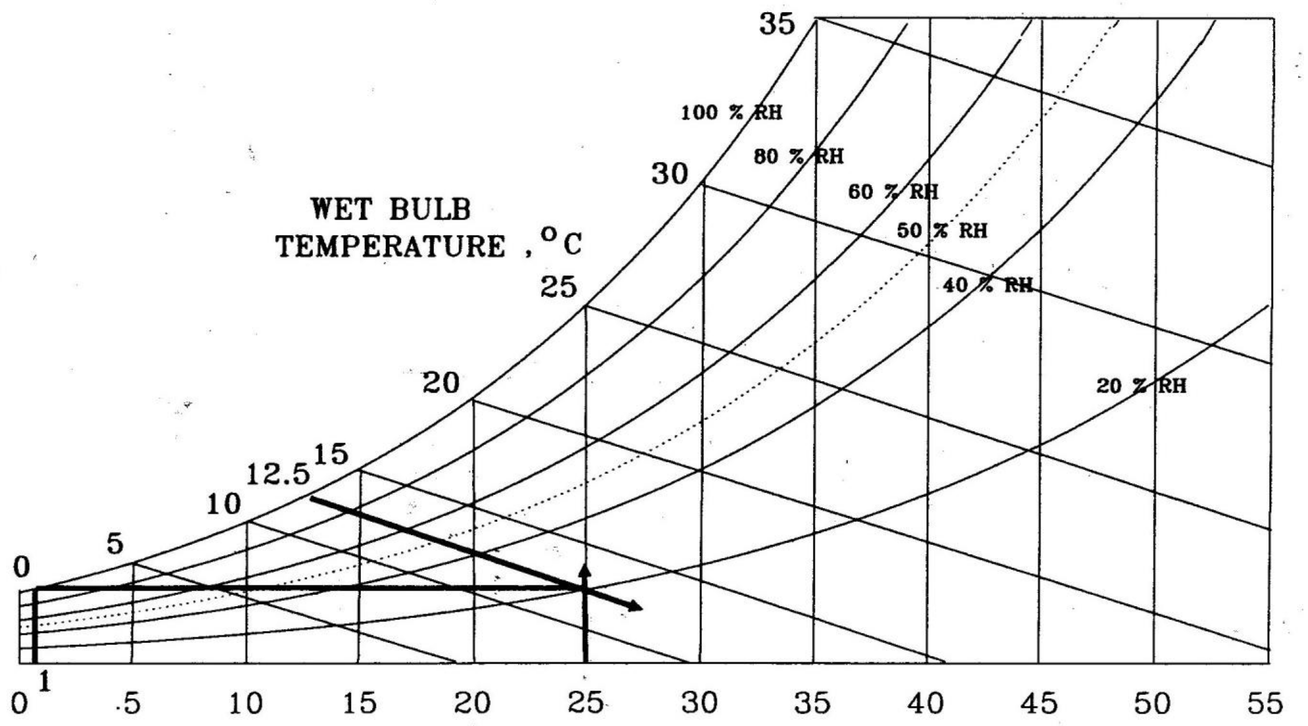


FIG. A4—Calculation of relative humidity and dew point temperature from psychrometric measurements.

WATER VAPOR PRESSURE

- Gases, including water vapor, exert pressure.
- The atmospheric pressure created by water vapor in the air.
- Water vapor will flow from the place of higher vapor pressure, to the place where the vapor pressure is lower
- Higher temperature = higher energy
- Pressure difference in building assemblies occurs in two typical conditions:
  - Cooling Climate, where exterior temperature and humidity is high
  - Warming Climate, where interior temperature and humidity is higher then exterior

Figure 1,Cooling Climate

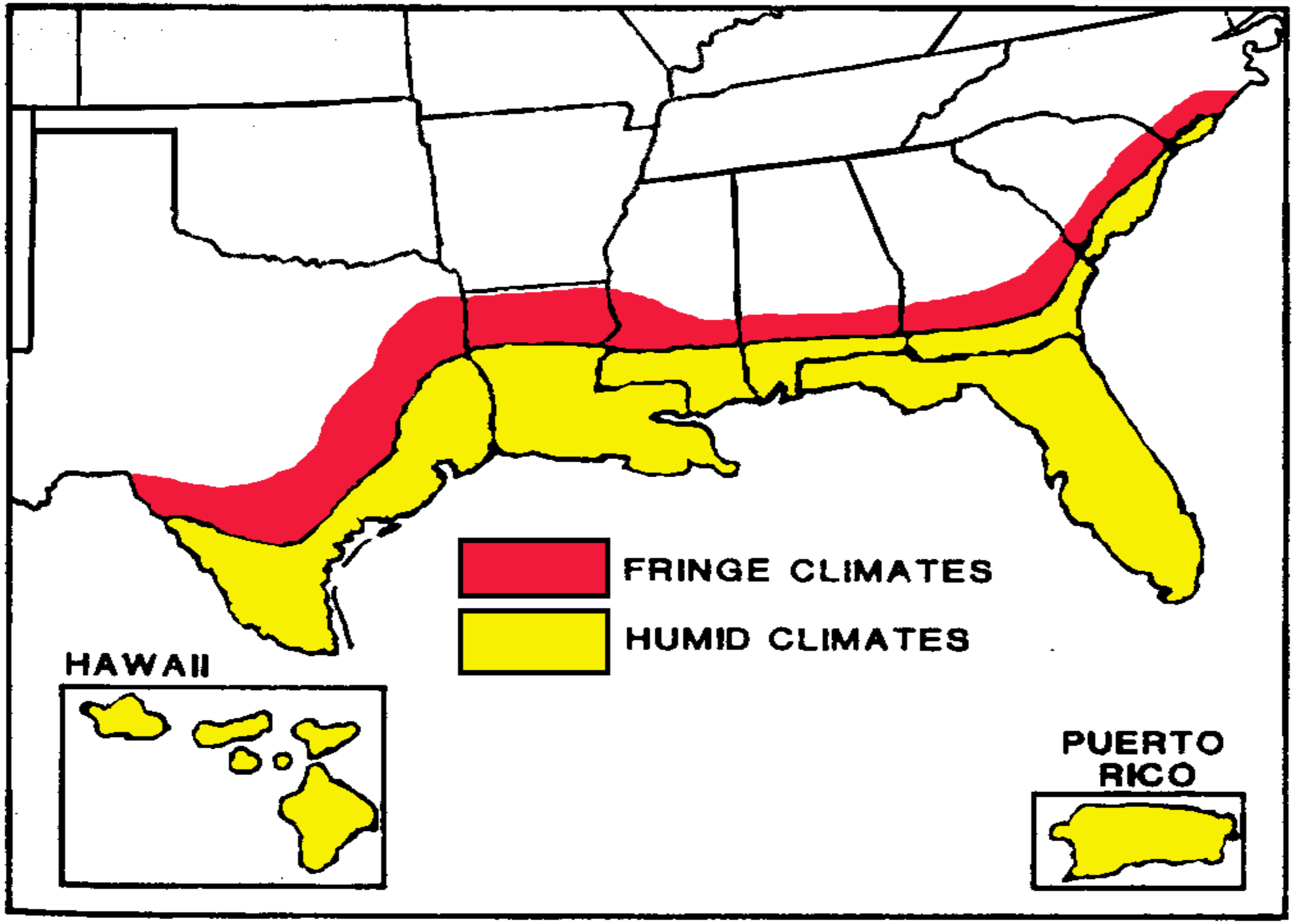


Figure 2, Warming Climate

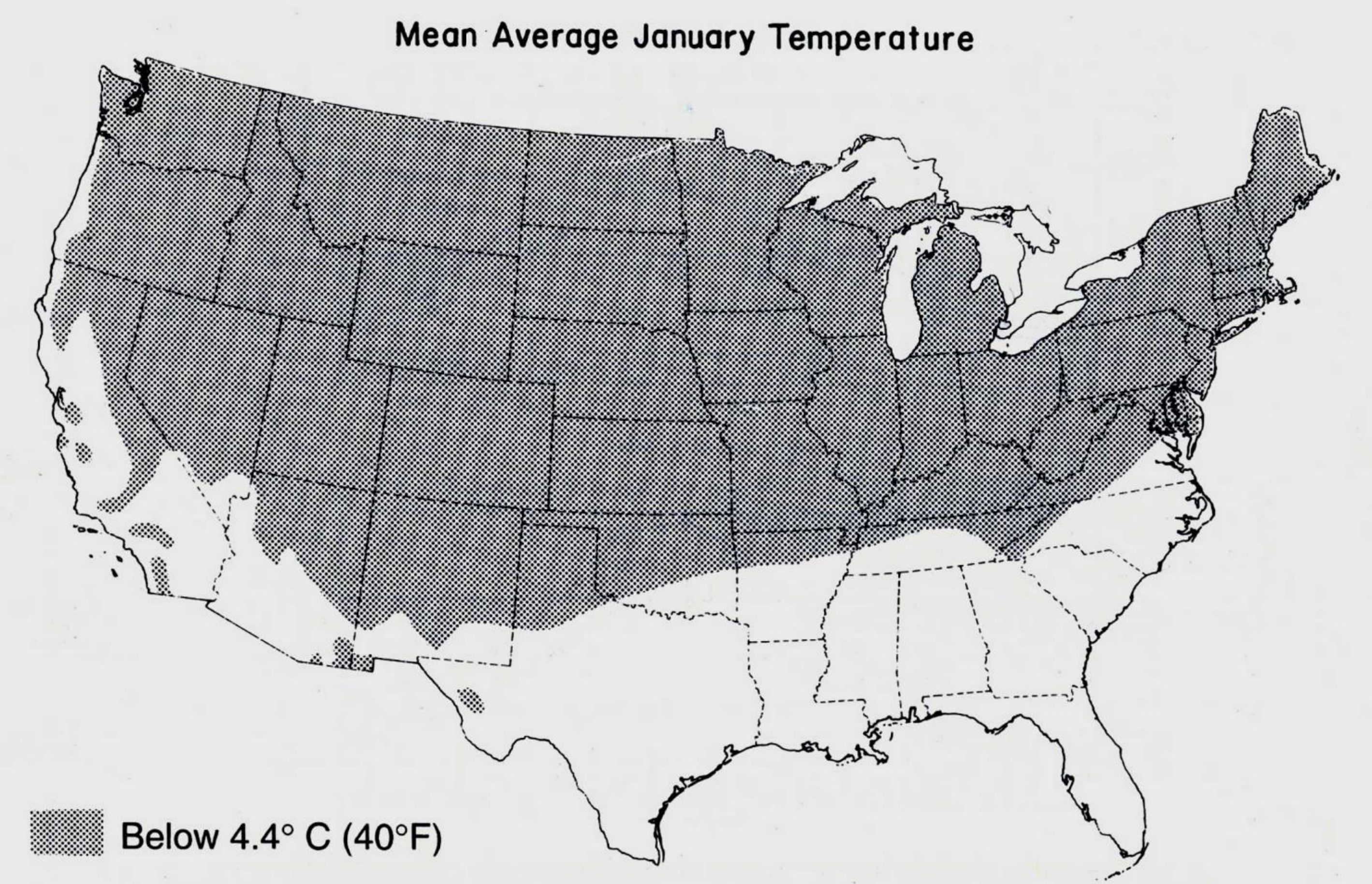
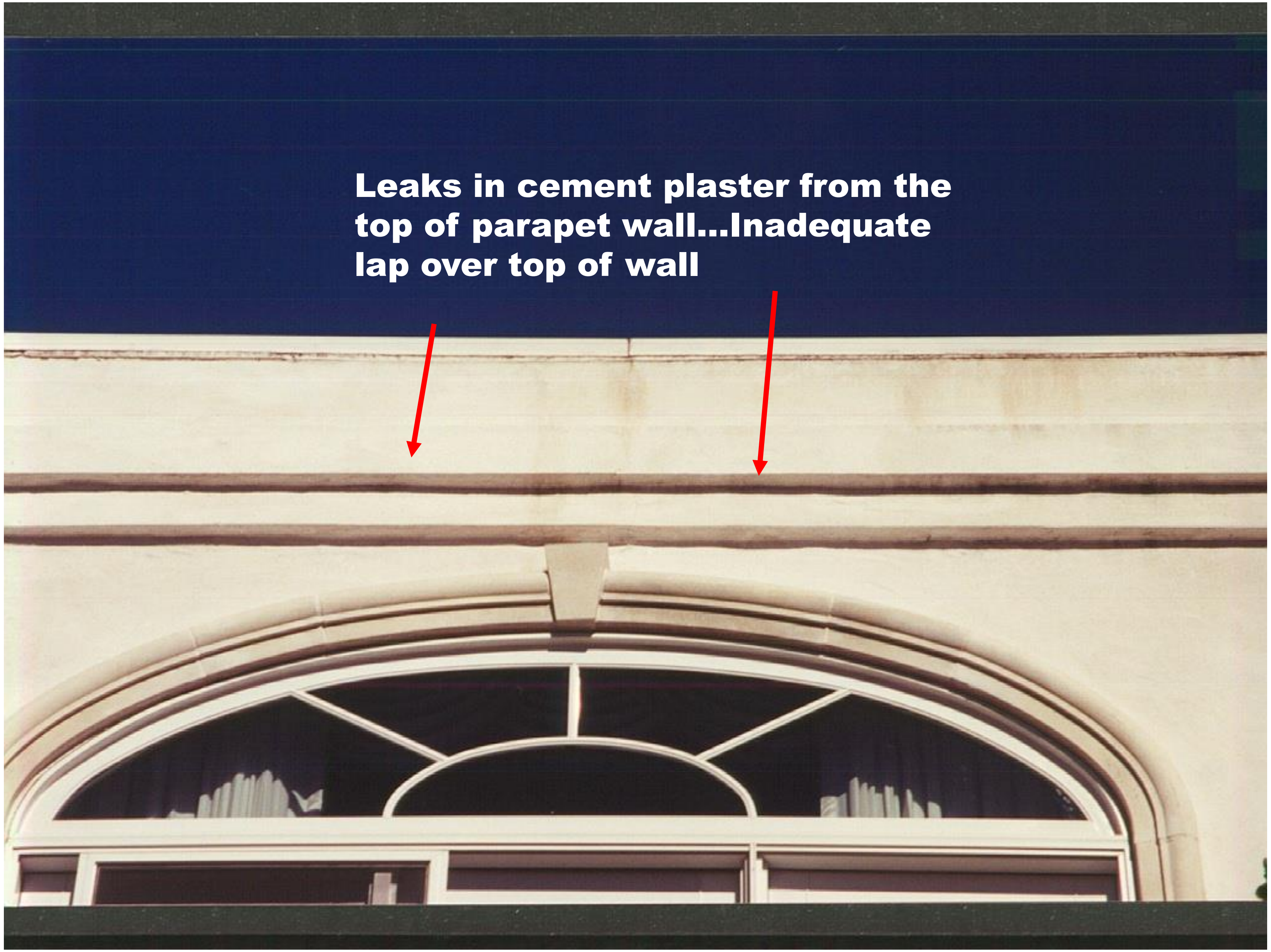
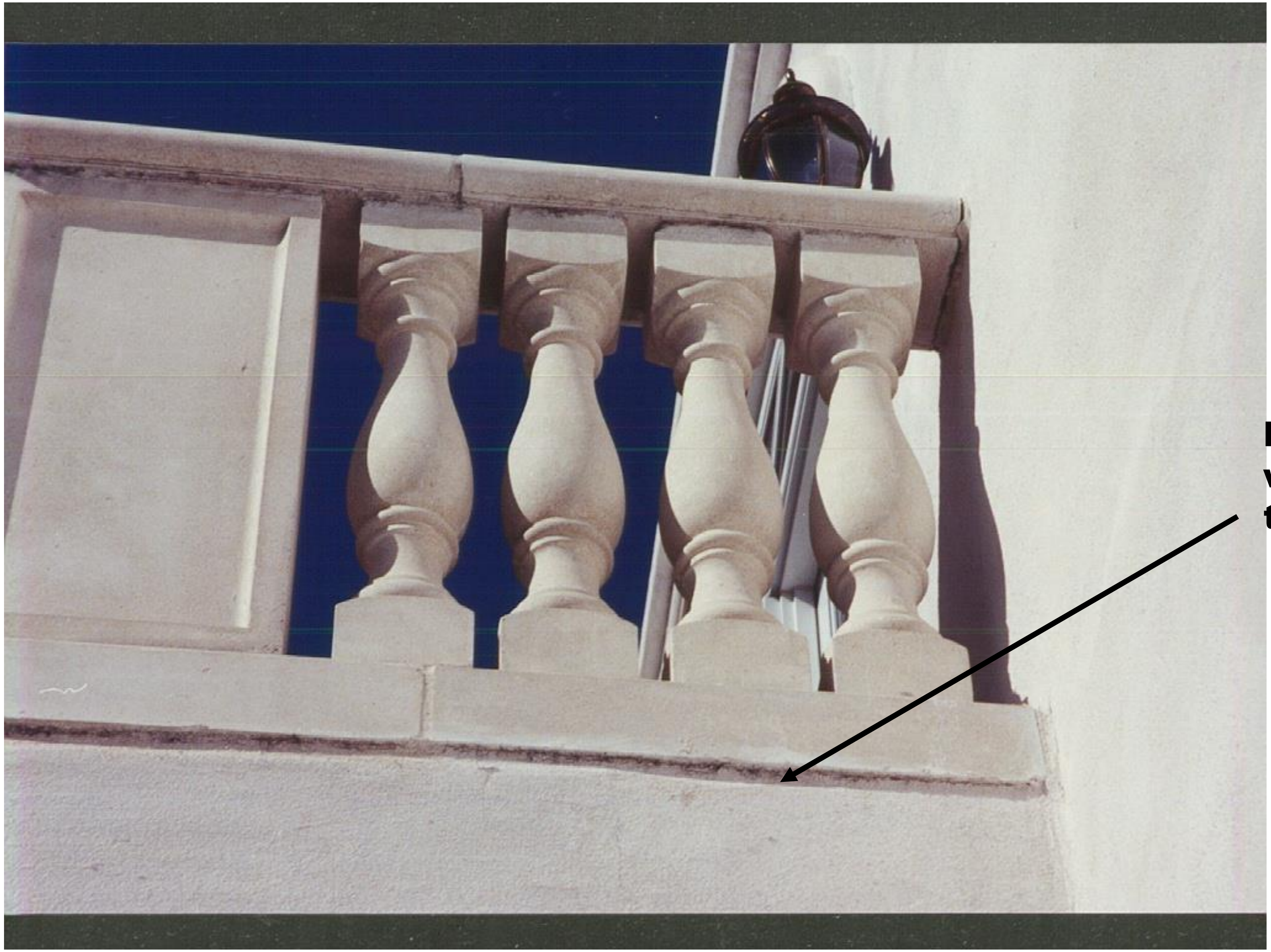
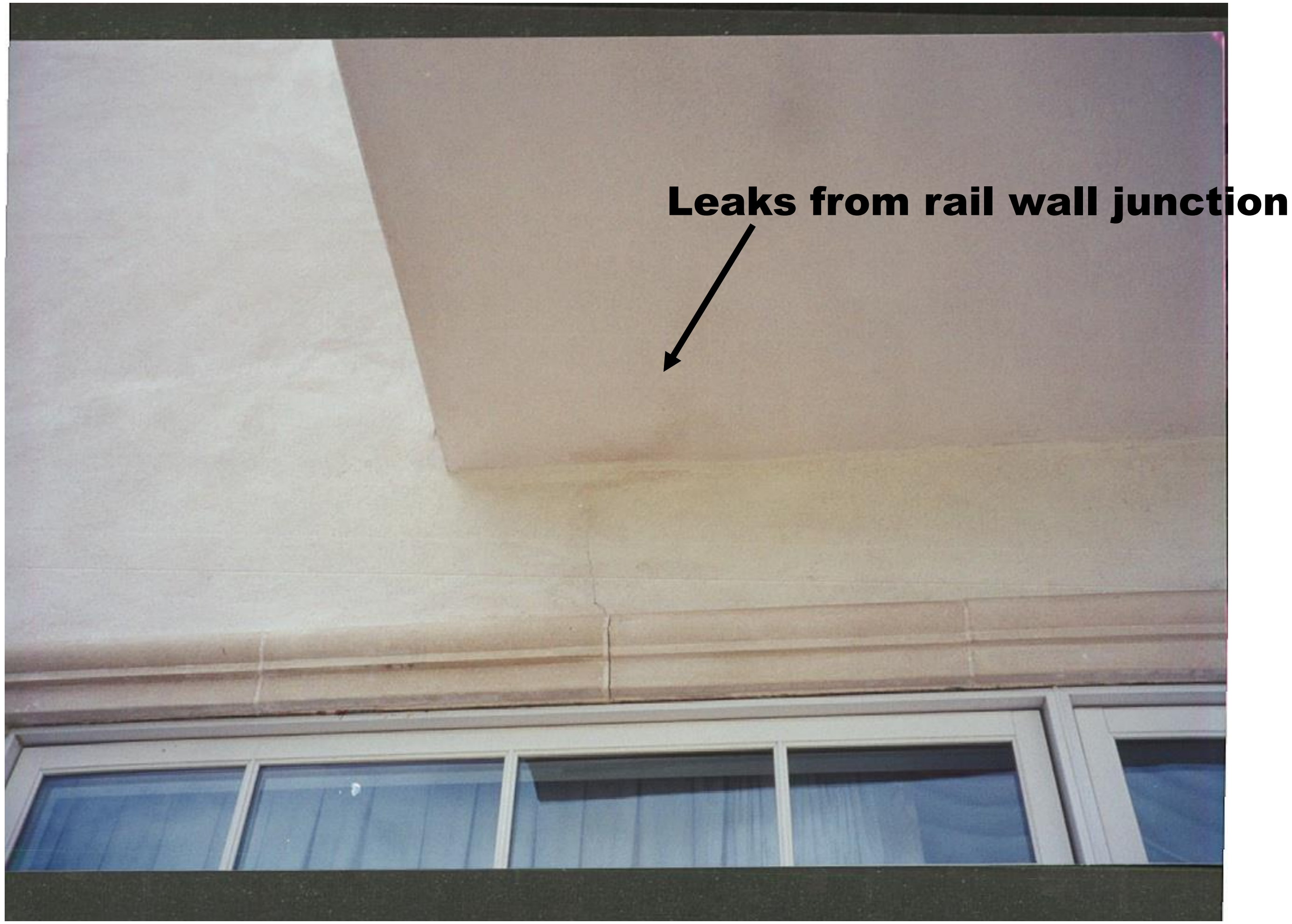


FIG. 10—Area of the United States that has a mean average January temperature below 4.4°C (40°F).


Leaks in cement plaster from the top of parapet wall…Inadequate lap over top of wall

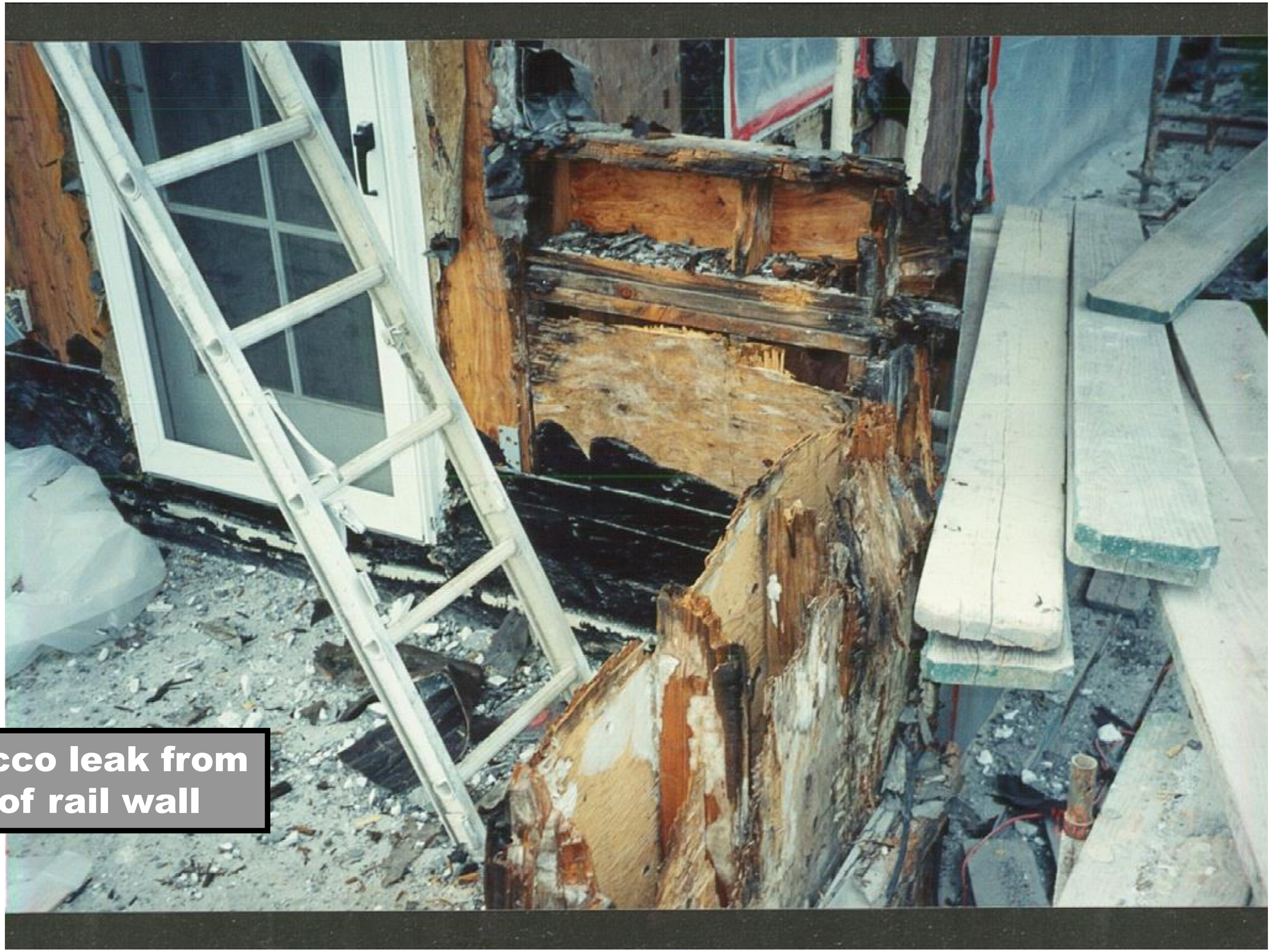


Leaks from rail wall junction at top of plaster

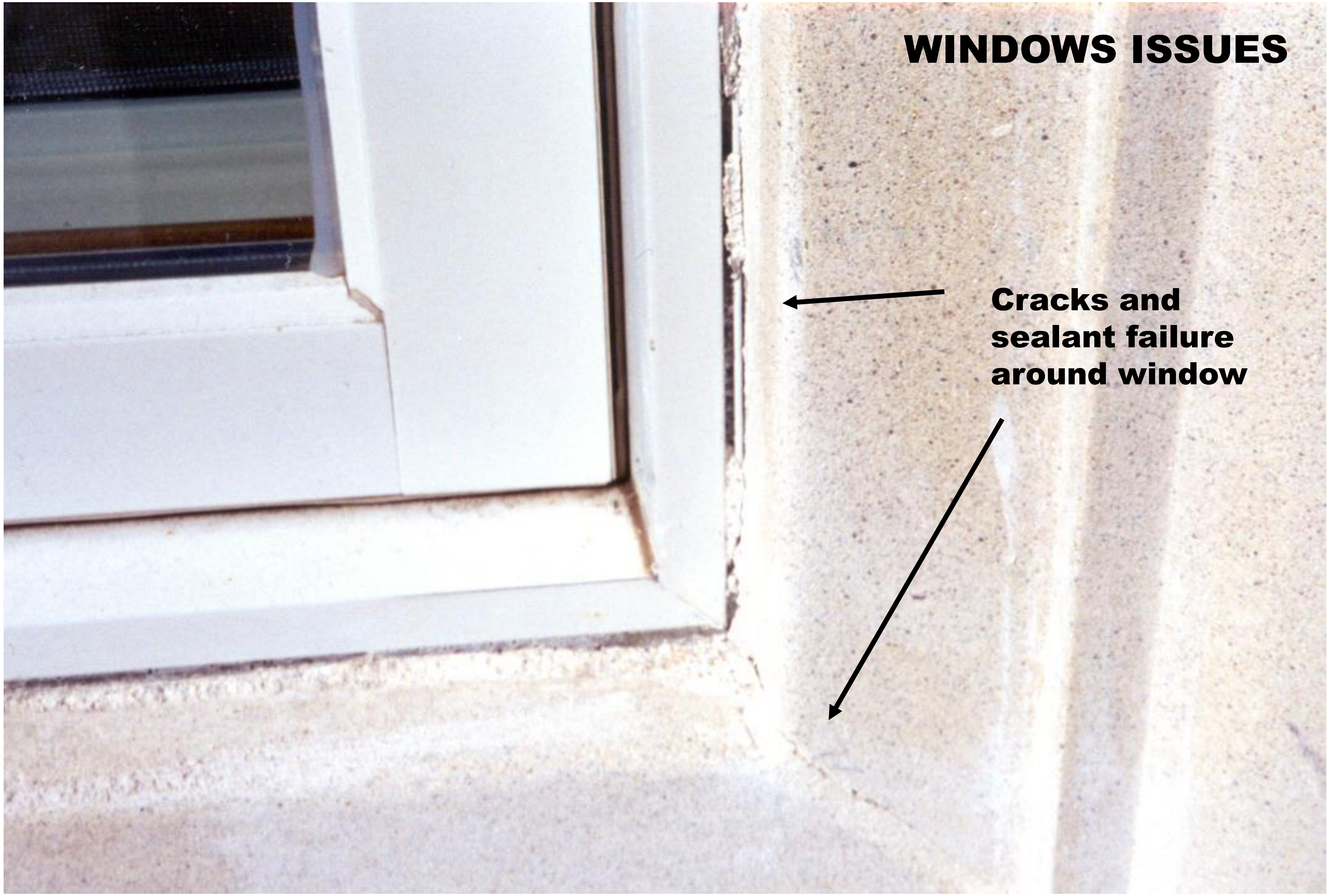

Leaks from rail wall junction

This innocent looking leak caused a lot of damage


'00 8 7



Stucco leak from top of rail wall


WINDOWS ISSUES
Cracks and sealant failure around window

Case Study # 2, Stucco Leak in wall. Study of slow diffusion

Few visible signs of distress

Relatively benign looking vinyl wall paper

Removal of a small area displayed evidence of some real problems

Case Study # 2, Slow diffusion due to vapor barrier on the inside face of wall

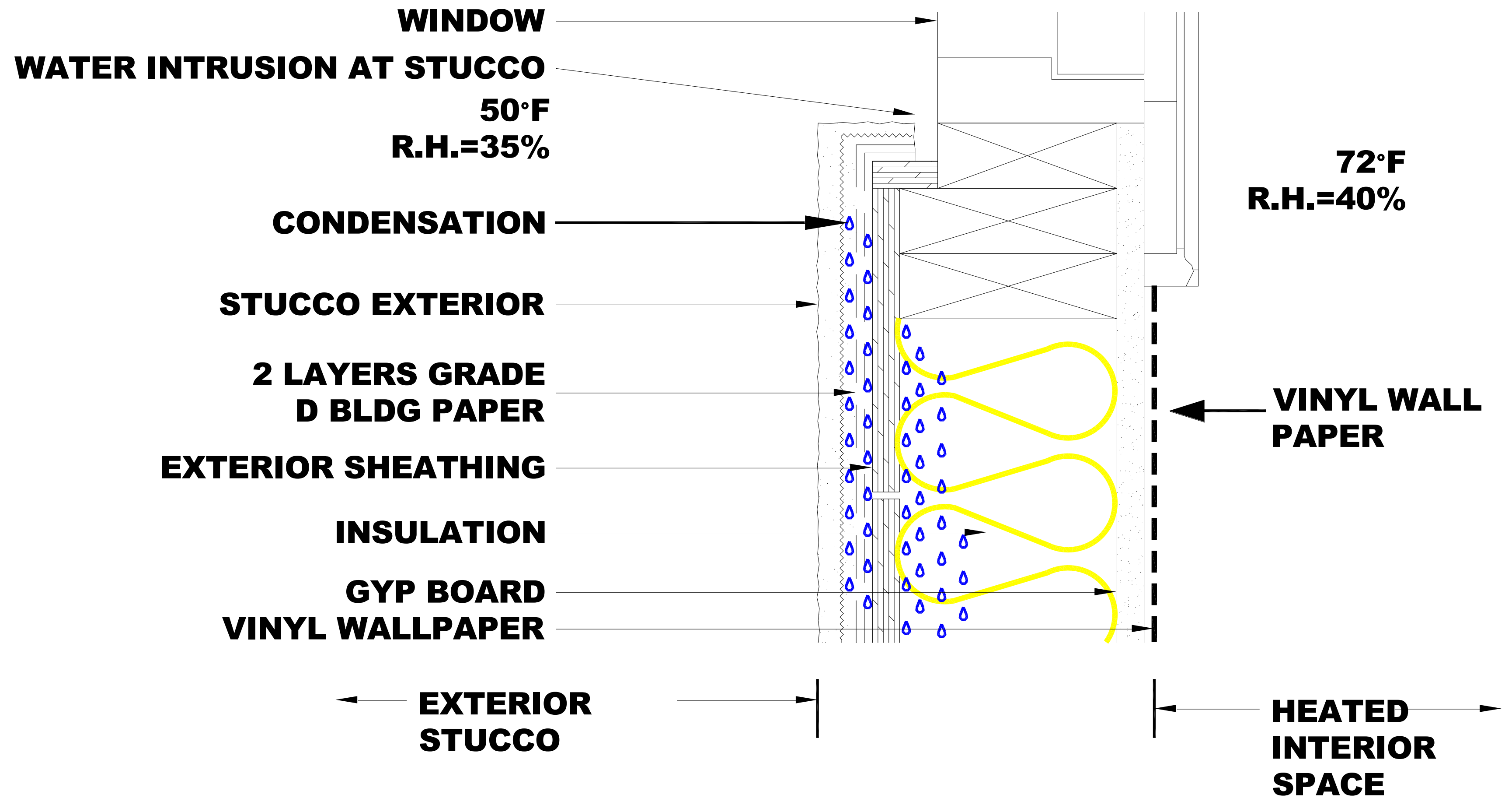
Mold and rot in the wall cavity

Case Study # 2, slow diffusion in wall can cause a lot of damage from leaks

Case Study # 2: Moisture trapped in different layers of a wall assembly, how long before it dries?

During the rainy season, water collects in a wall due to a window leak in the locations shown (see Figure 13). The affected area is 100 ft^2. Outside temperature and relative humidity are 50F and 35% respectively. The inside temperature and relative humidity are 72F and 40% respectively. Under these conditions, moisture will flow from inside to outside. How much time will it take for the water to leave the assembly in each of the locations? Each location has 1 gallon of water intrusion.

Case Study # 3, Diffusion. How long does it take for water to dry? (Fig 13)



Example: Moisture trapped in a wall from a window leak.

The permeance values for the materials in the wall are as follows:

- Stucco over metal lath = 15
- 2 layers 60 min. building paper = 5 ea.
- OSB sheathing = 2
- Insulation = 30
- Gypsum board = 50
- Vinyl wallpaper = 1

These values each need to be reciprocated to obtain Zmaterial for each material.

Example: Moisture trapped in a wall from a window leak.

The effective permeance, Zwall, is:

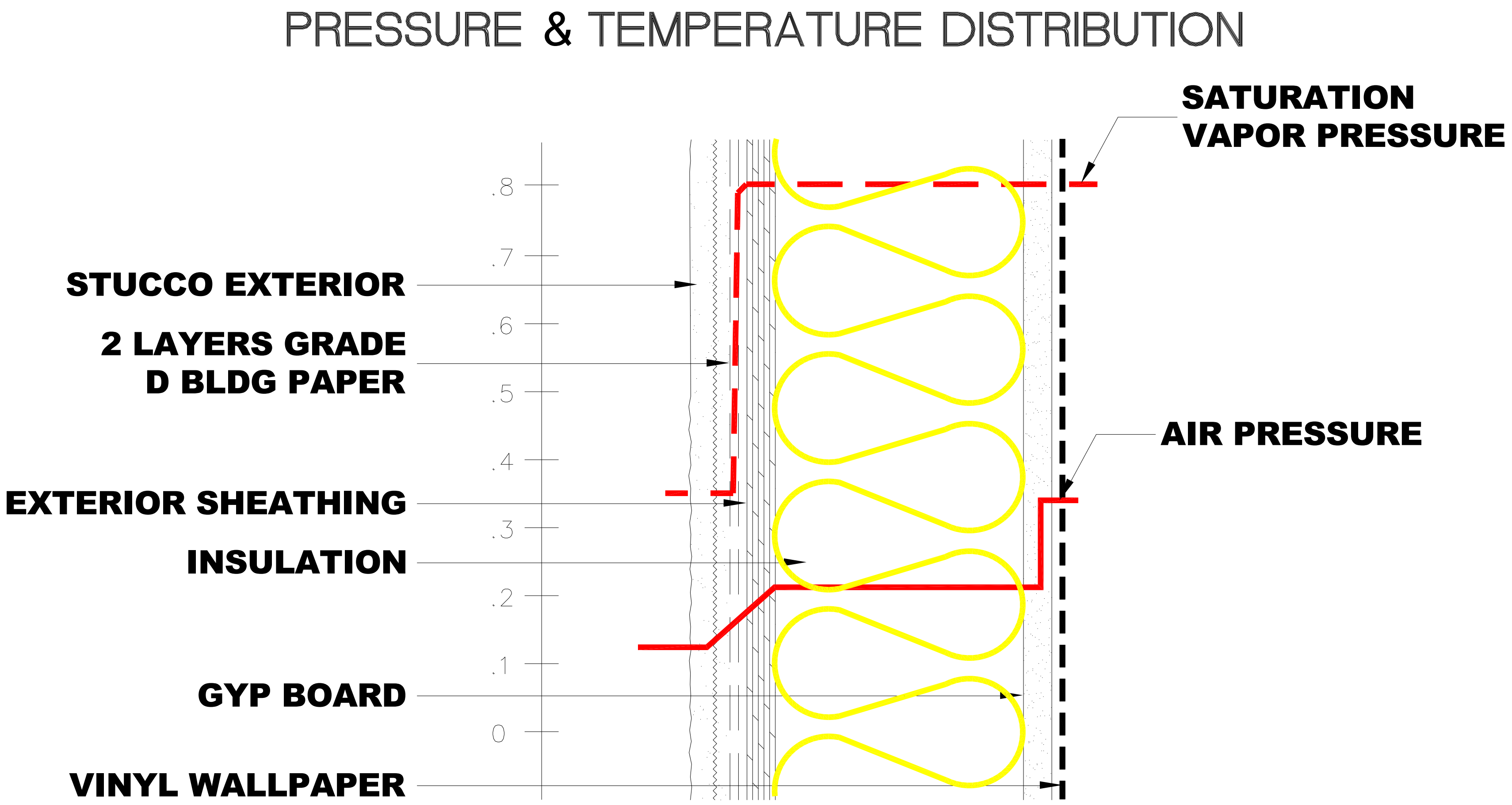
Zwall = 1/15 + 1/5 +1/5 + 1/2 + 1/30 +1/50 + 1/1

= 2.02 $perm^{-1}$

Now we can determine the pressure drops at each material layer in the wall system using the formula for pressure differential provided earlier:

ΔPmaterial = (Zmaterial/Zwall) x ΔPwall

Air and Saturation Pressure gradient: Figure 14



Example: Moisture trapped in a wall from a window leak.

The pressure distribution in the wall is tabulated:

Material	Pressure Drop	ΔP
		0.3165
Wallpaper	0.09386	0.22264
Gypsum	0.001877	0.22076
Insulation	0.003129	0.21763
OSB	0.046931	0.17070
Paper	0.0187723	0.15193
Paper	0.0187723	0.13315
Stucco	0.006257	0.12690

Case Study # 2: Moisture trapped in different layers in the wall

Determine the time required for diffusion at each location. Rearrange the Vapor Transmission Equation to isolate the time variable T:

$$VT = A \times T \times \Delta P \times \text{permeance}$$

$$T = VT / (A \times \Delta P \times \text{permeance})$$

Continue by applying the formula to each of the "wet" locations.

Case Study # 2: How long does it take for 0.1 Gallon of water to dry if trapped between paper & stucco?

Location 1- Moisture over the building paper:

From the pressure distribution,

$$\Delta P = 0.13315 - 0.12690 = 0.0066 \text{ in. Hg}$$

The effective Z value only takes into account the stucco since moisture will be driven out from inside the building/wall assembly.

$Z = 1/15 \text{ perm}^{-1}$

Permeance = 15 perm

Case Study # 2: How long does it take for 0.1 Gallon of water to dry if trapped between paper & stucco?

Therefore, converting gallons into grains (1/10 gallon = 5809 grains):

T = 5,809 gr/(100ft2 x 0.0066 in.Hg x 15 perm)

= 587 hours

= 24 days

Case Study # 2: Similarly, How long does it take for 0.1 Gallon of water to dry if trapped between OSB and paper?

T = 5,809 gr/(100ft2 x 0.0438 in.Hg x 2.143 perm)

= 619 hours

= 26 days

Case Study # 2: Similarly, how long does it take for 1 Gallon of water to dry if trapped between Insulation and OSB?

T = 58094 gr/(100ft2 x 0.0907 in.Hg x 1.034 perm)
= 6190 hours
= 264 days

The rate of diffusion did not change from location 2. This value didn't change much; the local pressure increased, however the perm rating at this point decreased. However, I increased the amount of water to 1 gallon to allow for insulation's ability to absorb water.

STUCCO LESSONS

- Old stucco system with just Grade “D” building paper and no consideration for managing excess water does not work.
- Acceptable tolerance for incidental water intrusion needs to be greatly reduced.
- Design should consider building cement plaster more as a “barrier” system.
- Alternatively, provide a layer of “water management” system such as rain screen or pressure equalized behind the cement plaster finish.

STUCCO DESIGN FUNDAMENTALS

- Wall stiffness minimum L/360. Tell your structural engineer!!!!
- Story drift joints? Provide expansion joints to handle seismic type of movement
- Moisture and water management. How the wall will handle incidental water, how it breathes?
- Thermal movement of metal studs can cause stucco to crack severely.
- High humidity and moisture can cause plywood and OSB to swell and stucco to crack.

The *"Perfect Storm"*

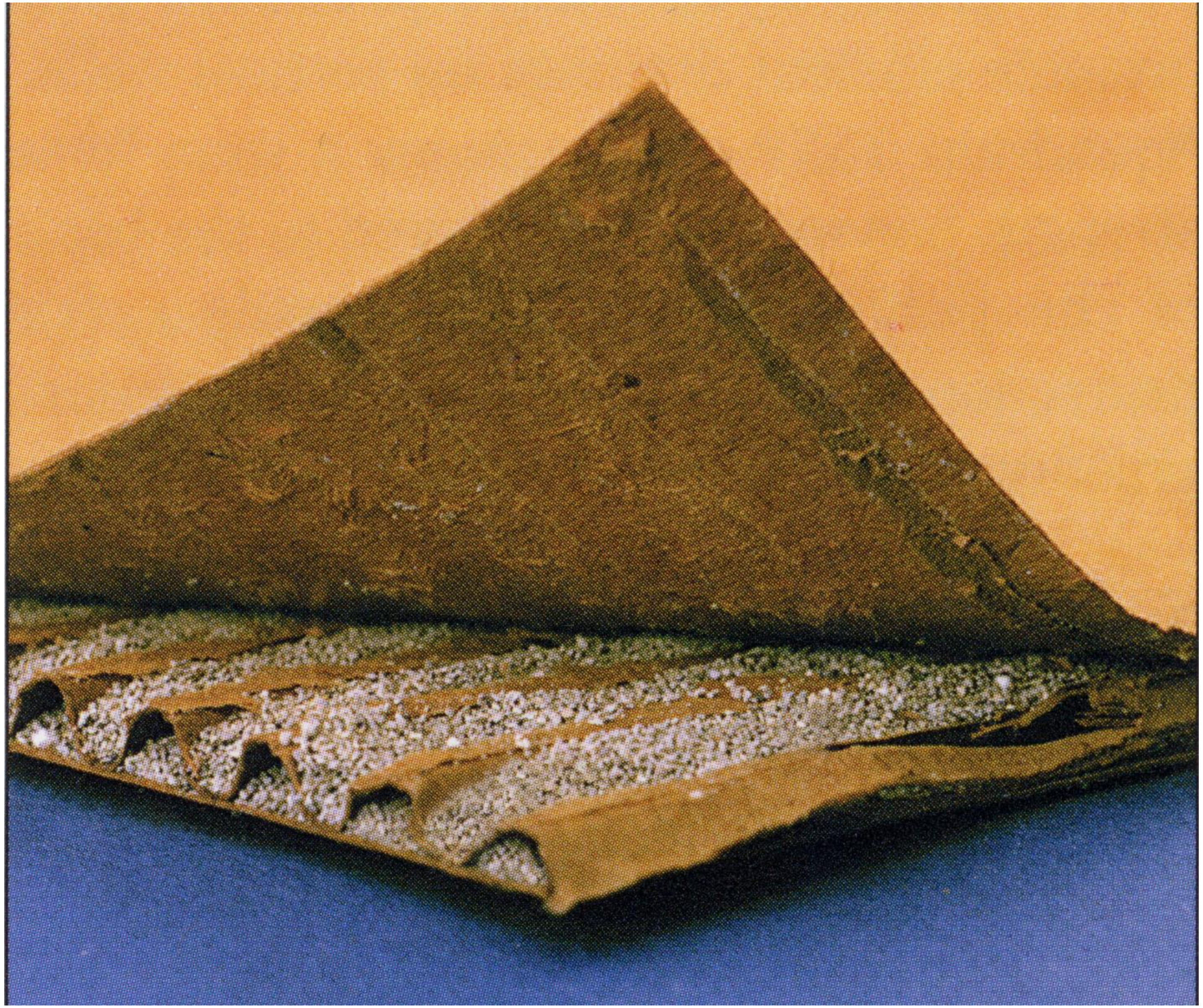
- Energy efficiency = sealed buildings, more air tight, breathe less, create more places for water vapor and moisture to condense, causing damage
- Today's new growth timber and composites like OSB are far less water resistant
- Sheet rock, carpet and other building materials are susceptible to mold
- Designers and Contractors are not keeping up with changes in "air tight" and "moisture sensitive" construction
- Work force knowledge base is more vertical as opposed to having a broad understanding of trade

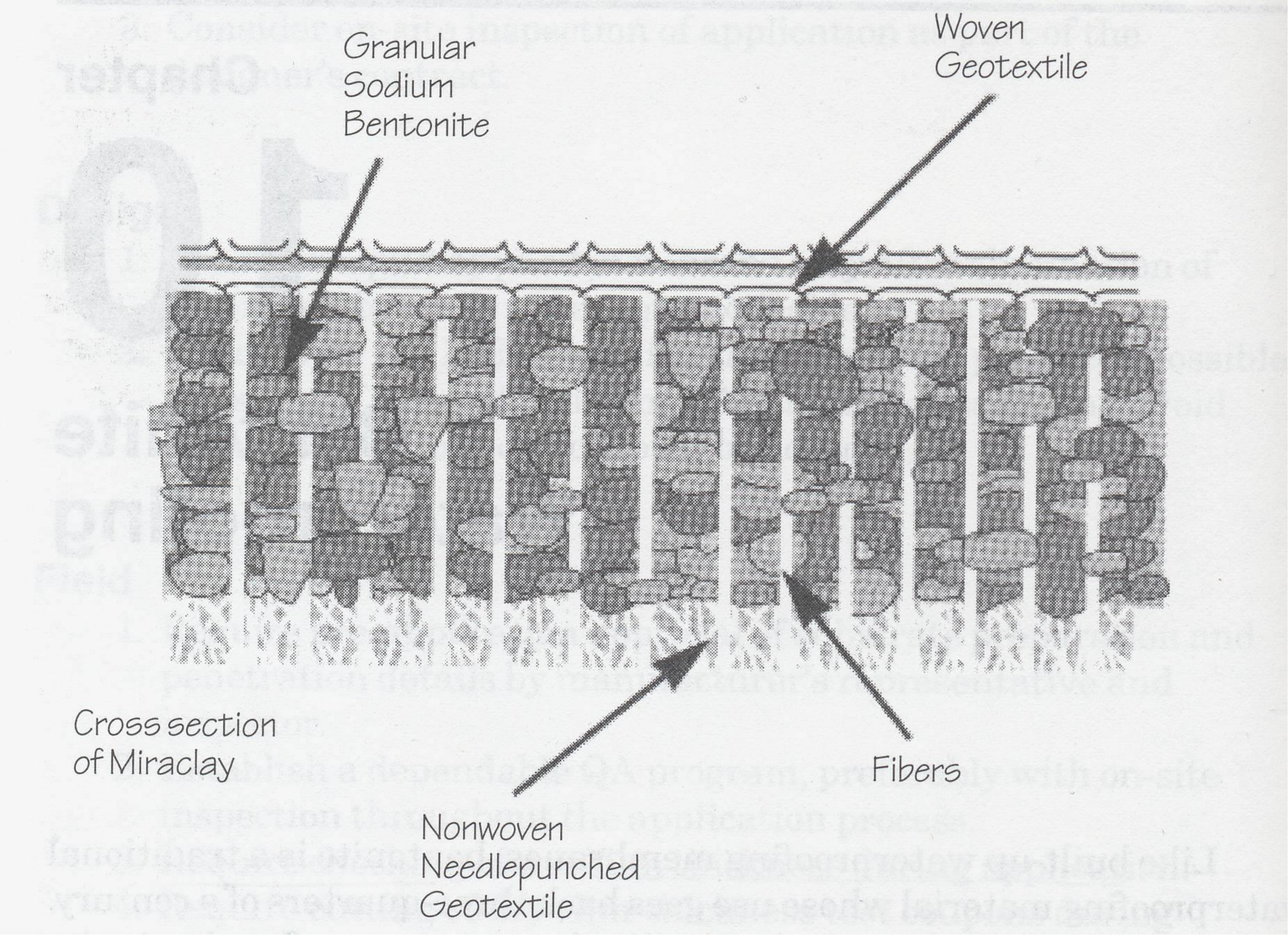
Case Study #3
Below Grade Waterproofing

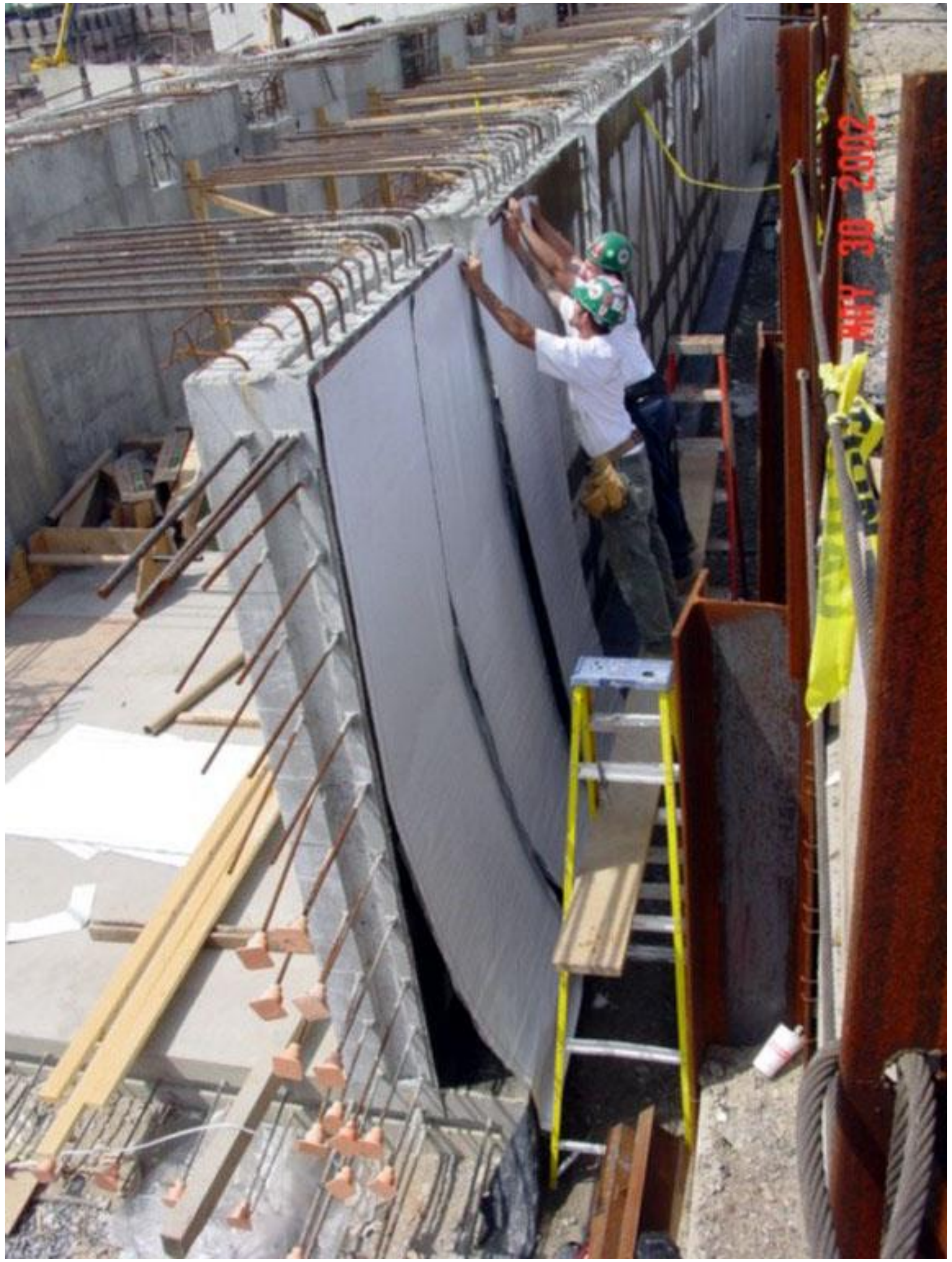
- Selection of Materials
- Lagging Issue
- Costly Repair

Bentonite Based Waterproofing

- Sodium Bentonite is a highly expansive Clay
- Available in either as rolled goods or panels
- Approx 1 lbs per square foot with geotextile and/or HDPE composite
- Applied in a shingle fashion on earth rentention system like lagging o on CIP concrete, below grade walls.
- Swells 6 to 8 times its volume when wet
- Requires earth pressure “confinement” to work
- Seals laps due to expansive forces and earth pressure confinement




Granular
Sodium
Bentonite
Woven
Geotextile
Cross section
of Miraclay
Fibers
Nonwoven
Needlepunched
Geotextile

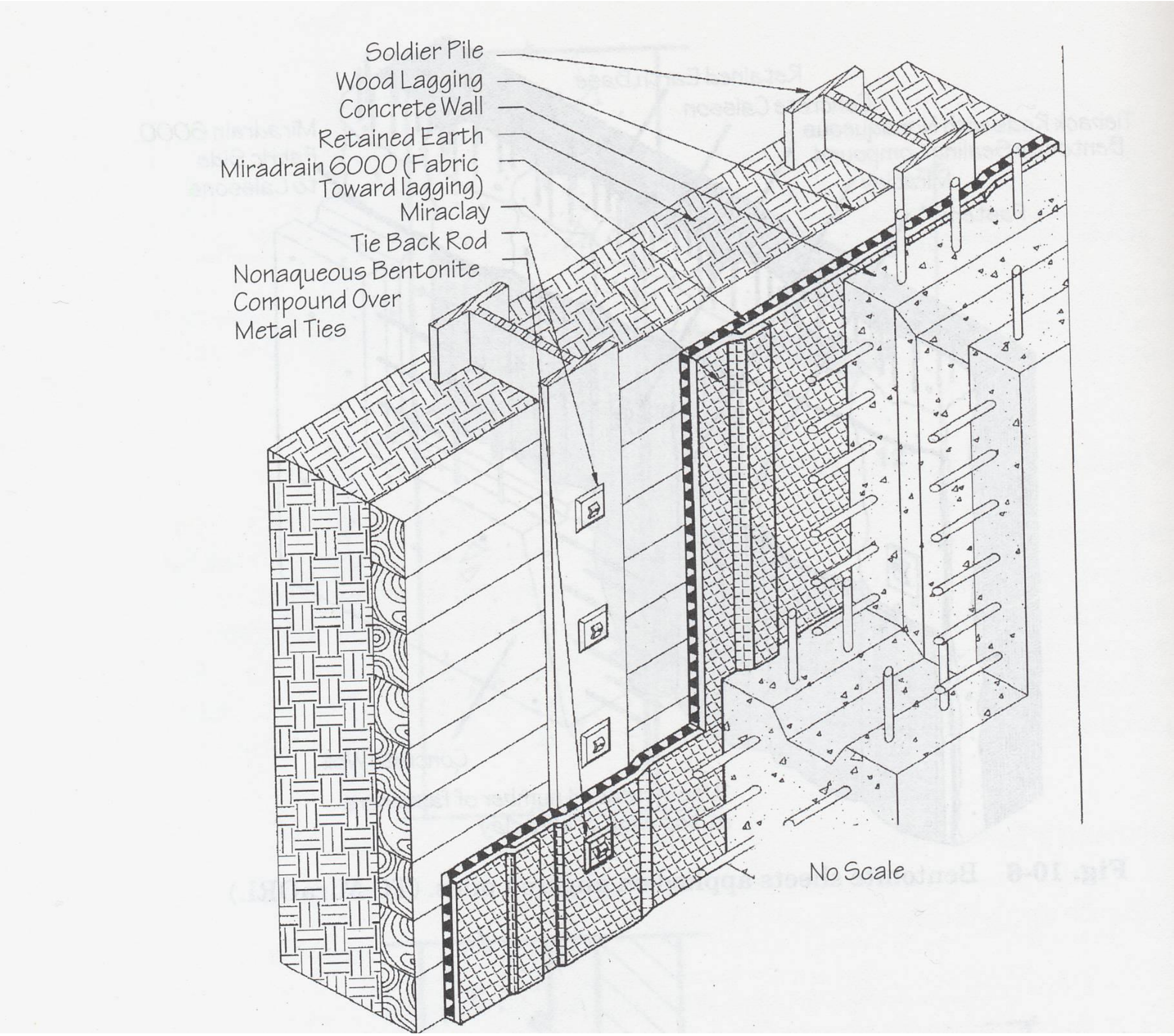

MAY 30 2002

Hydration during construction is a huge problem

DETAILS

- Penetrations: Tiebacks, tie bolts, misaligned soldier piles, whalers and bracking may all penetrate the Paraseal LG membrane and must be detailed properly.
- Protection:The Paraseal LG dual waterproofing system has a puncture resistant HDPE liner of 169-lb point load (76.6 kg) and does not require an additional protection course for most applications.
- Storage:Protect from moisture. Store on skid or pallet, cover with polyethylene or tarp. Do not double stack pallets.

Wood Lagging - Earth Retention System



Wood Lagging Issues with Bentonite

Excavation of the soil behind the wood lagging revealed that once the wood gets wet, it swells, bends and twists, especially if there are voids between the soil and wood.

Void between solder pile and foam protection board was also evident and may have contributed to the failure of the bentonite waterproofing system.

Lessons Learned from Failure

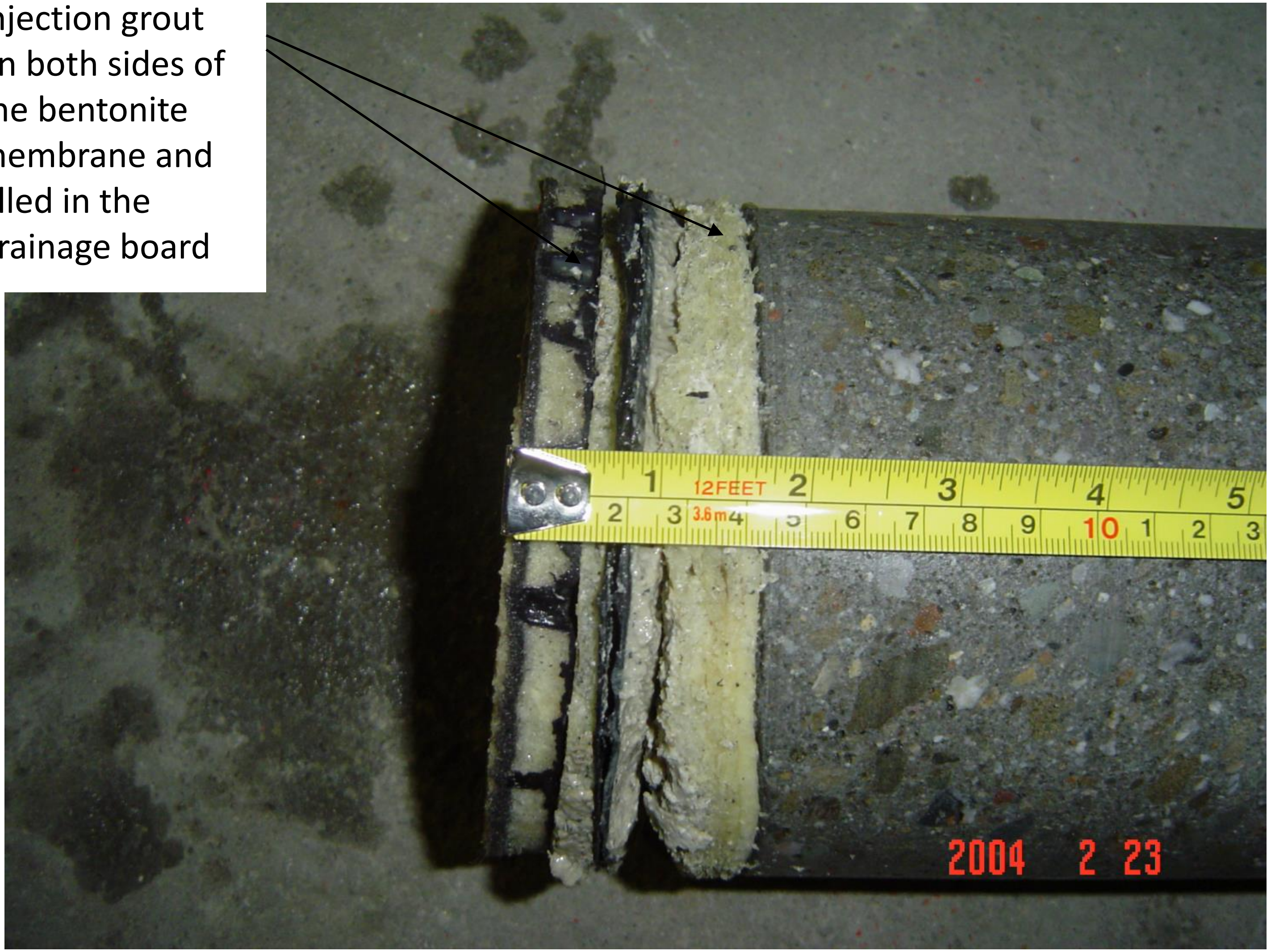
- Bentonite requires confinement to work
- Wood lagging can have gaps and voids in the behind it which can allow lagging to move back
- Wood twists and cups when it gets wet, leaving voids
- Protection board at solder pile left voids and potentially reduced the system's effectivenss

The Repair of Failed Below Grade $3M

Polyurethene grout injection 2’ on center at $35/SF

Concrete Core after Grout Injection

Injection grout on both sides of the bentonite membrane and filled in the drainage board



Waterproofing is Not Skin Deep

- New Code Impact for Architects
- Structural Engineering
- Civil/Geotech Knowledge in Waterproofing Design
- Moisture and Vapor Management

Waterproofing is not Skin Deep

- Exterior Wall Flexibility: Cement Plaster requires L/360. Tile veneer L/600
- Below Grade Waterproofing: Water table, earth retention system, soil, drainage
- Vapor Movement & Condensation: Know how your walls breathe, dry and manage water
- Roofing: Energy code compliance, wind uplift engineering, slope design, drainage
- Podium Waterproofing & Garden Roof: Continuous immersion in water, root barrier, drainage
- Warranties and Guarantees: Never base your design decisions on it!!!

New Code Changes

- IBC 2003 Section1405.2
- "The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly….."

- UBC 1997 Section 1708 (b)
- "Flashing and Counter flashing-Exterior openings exposed to the weather shall be flashed in such a manner as to make them weatherproof. "

New Code Changes

- IBC 2003 Section1405.2
- The new code places emphasis on "<u>design</u>" and "construction" properly to prevent water intrusion

- UBC 1997 Section 1708 (b)
- The old code was more vague and relied more on "proper construction" of the wall.

- <u>New code imposes more liability on designer</u>

IBC 2003

- **1403.3 Vapor retarder.** An approved vapor retarder shall be provided.
- **Exceptions:**
- 1. Where other approved means to avoid condensation and leakage of moisture are provided.
- 2. Plain and reinforced concrete or masonry exterior walls designed and constructed in accordance with Chapter 19 or 21, respectively.

International Energy Conservation Code

- **502.4.3 Sealing of the building envelope.** Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

Thank You

Questions?