

Building Diagnostics

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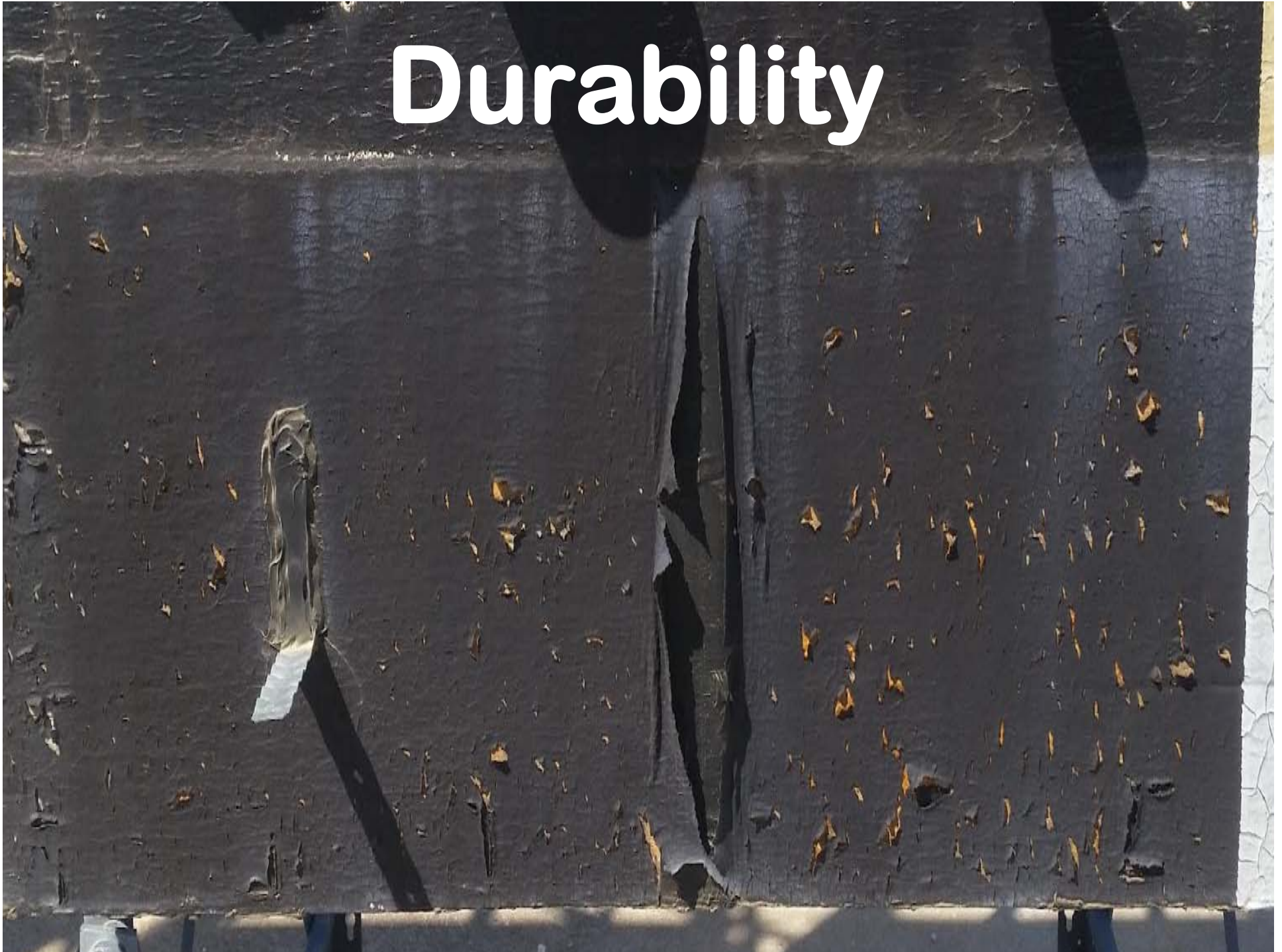
How Long Should It Last?

Water-Resistive Barrier Durability as a Factor in Construction Litigation

David H. Nicastro, P.E.



Durability



Durability

- Everyone understands *duration*
 - We want things to last
- Durability is “Green”
- Essence of sustainability
- Reduce waste and keep building materials out of landfill longer:
 - Select products with optimal *Design Life*
 - Prevent premature failures to achieve long *Service Life*



Water-Resistive Barriers

Liquid-Applied WRB



Or is it an air barrier?
Or a weather barrier?

**Biggest Problem:
(it's not air)**

Water



06/22/2006





Previous WRB Tests

- Many new liquid-applied WRBs
- They join crowded market:
 - Wraps
 - Self-adhered membranes
 - Felt and paper
- Researching 121 (!) products
- They cite 89 (!) different ASTM standards
- Some cite bogus standards

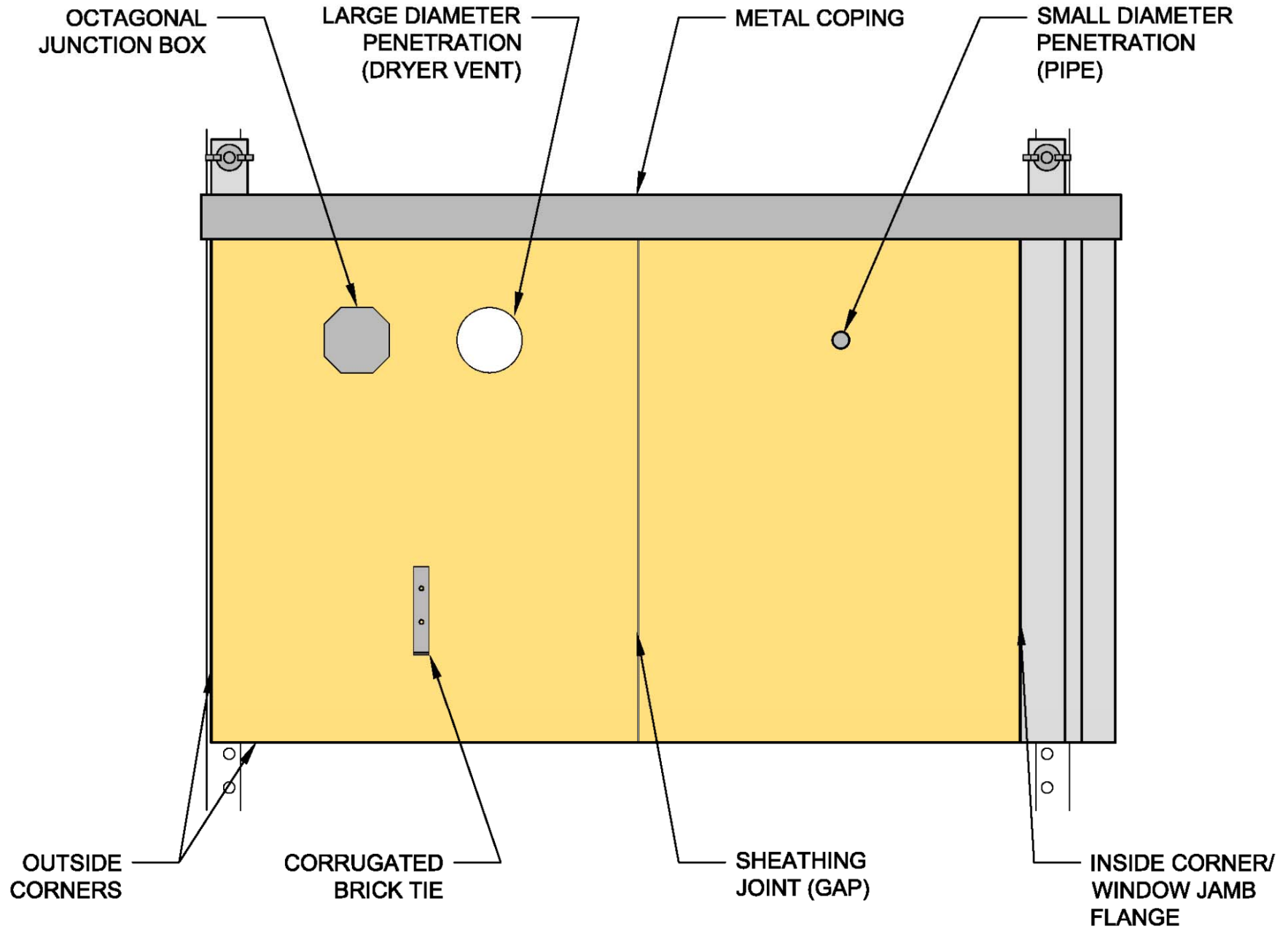
Durability Phase 1: Initial Factors

- How easy is it to use?
- Are the instructions okay?
- How long can it be exposed?
- How does it work on typ. details?
- What is the coverage rate?
- How well does it seal fasteners?



Test Design

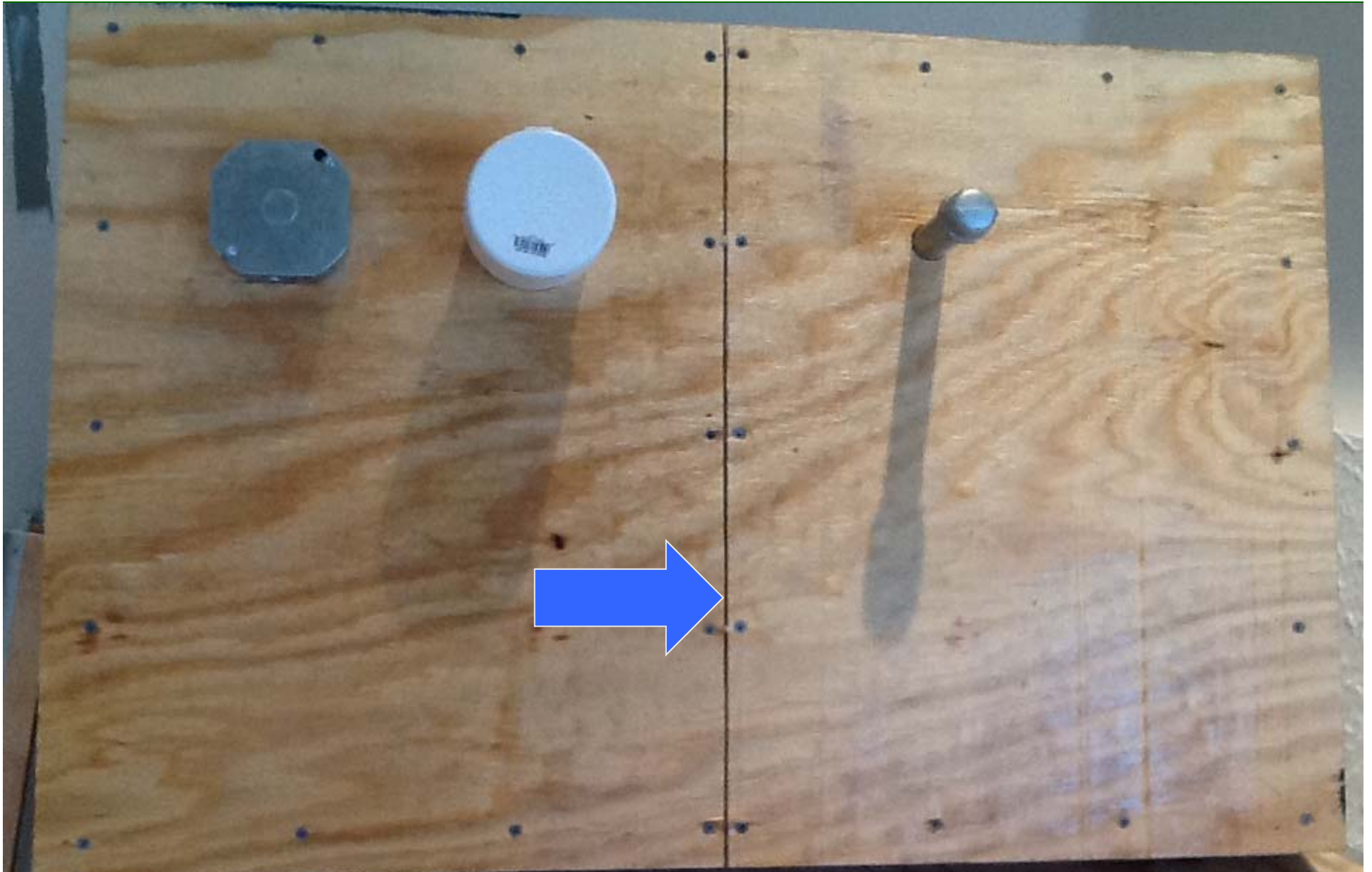
- Sloped at 25-degree angle would have max. solar exposure (faster)
- But gravity has major effect on WRBs, so test vertical
- Testing 31 primary products (plus their accessories)
- Also built code minimum “control” to compare





Accessories & Details

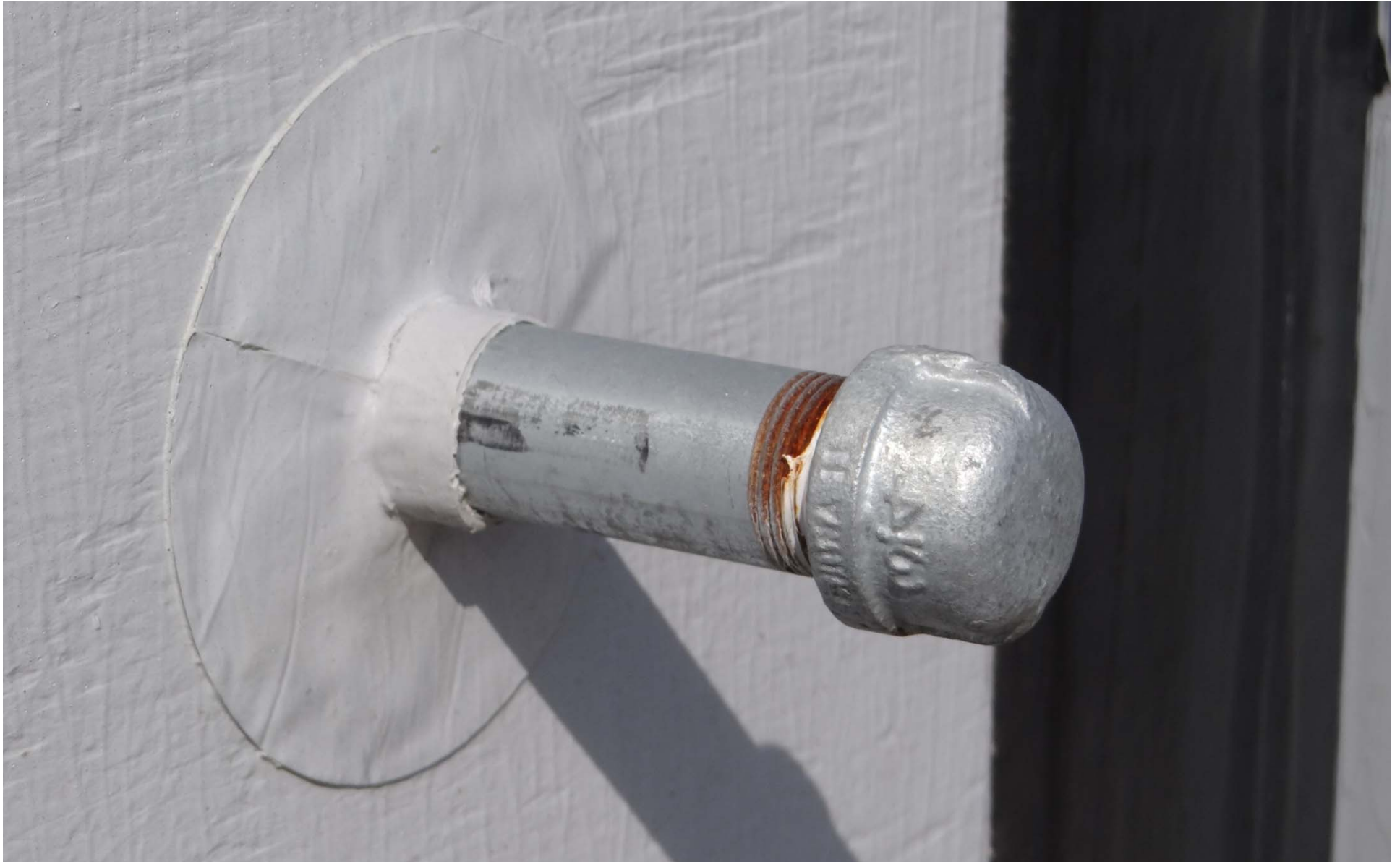
- We used products and details per each manufacturer's literature
- Contractor independently determined products and details
- We called manufacturer's reps to reconcile differences
- Other reps visited Lab:
 - Recommended different products!



Sheathing Joint



Outside Corner



Small Diameter Penetration



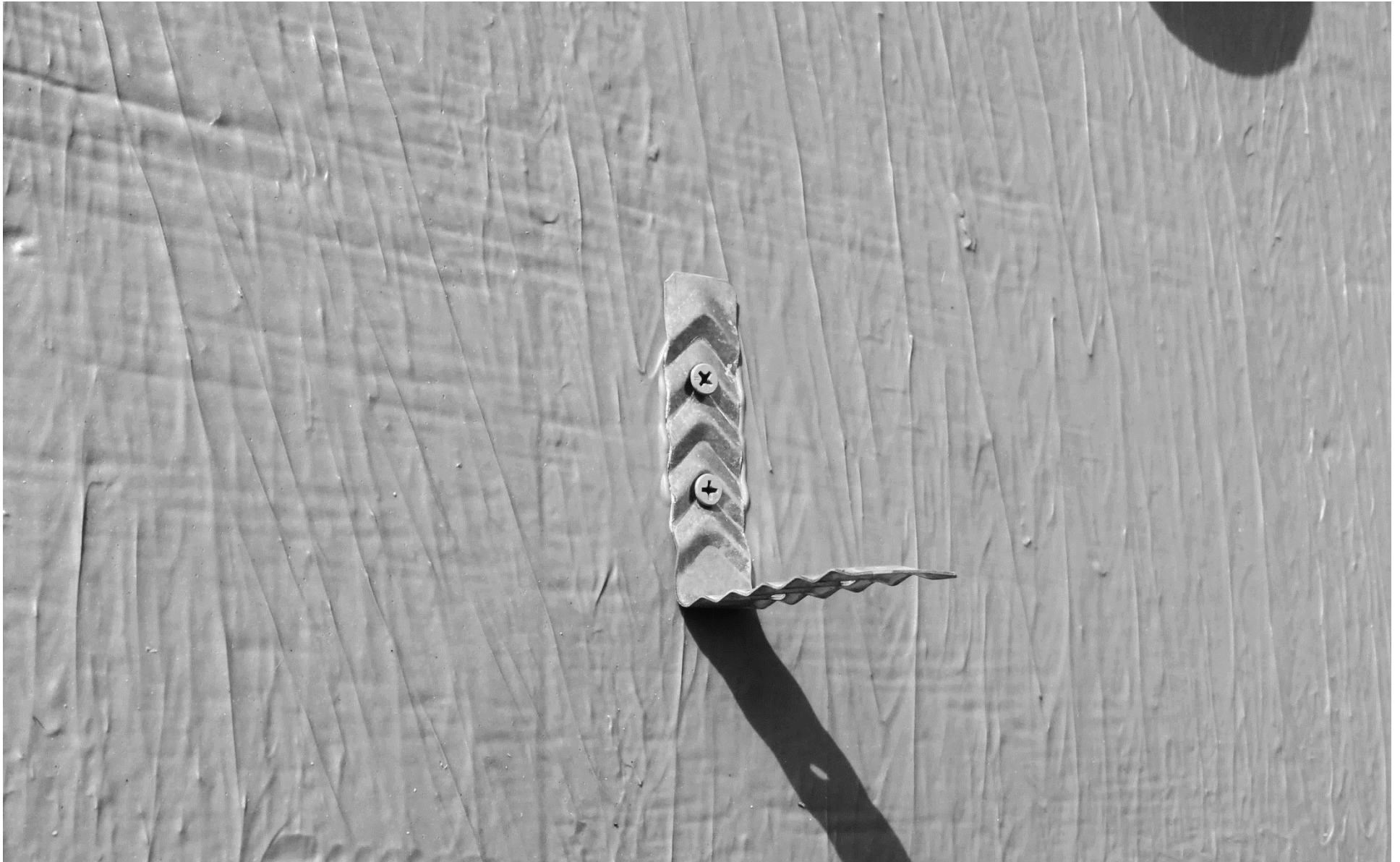
Large Diameter Penetration



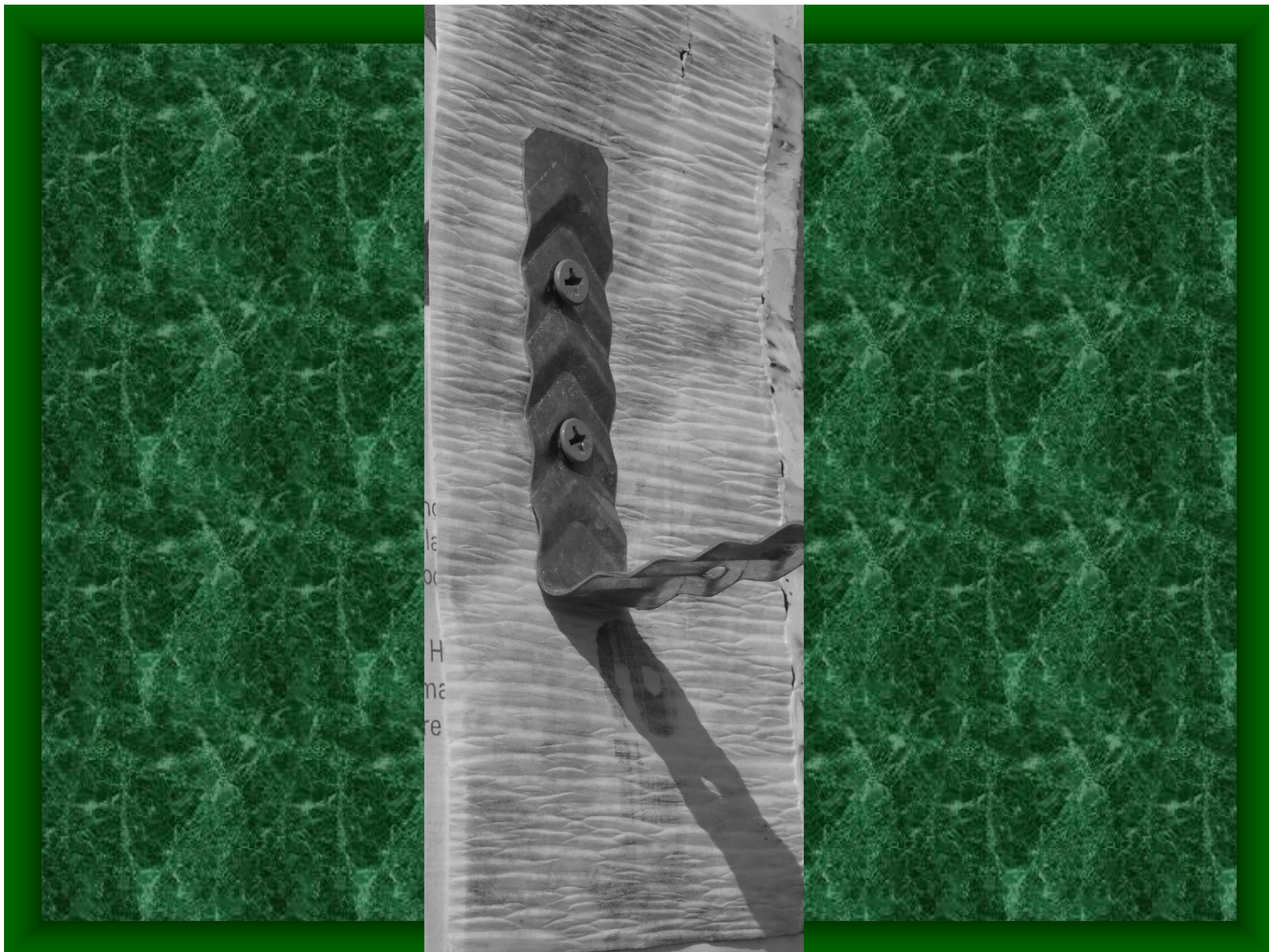
Octagonal Junction Box



Window Jamb



Brick Tie







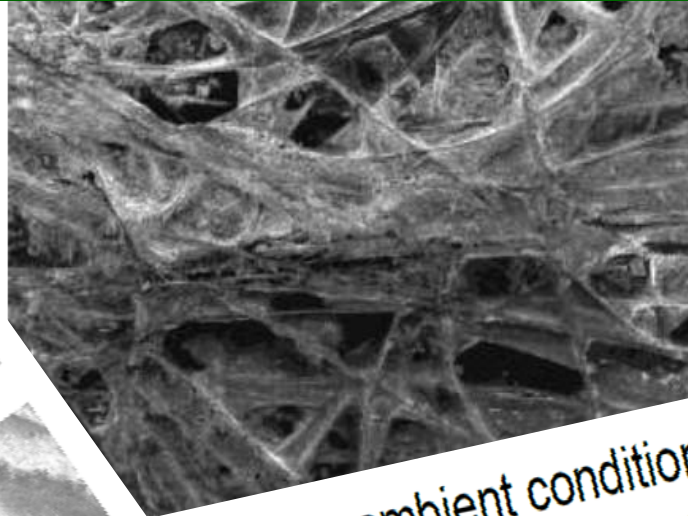
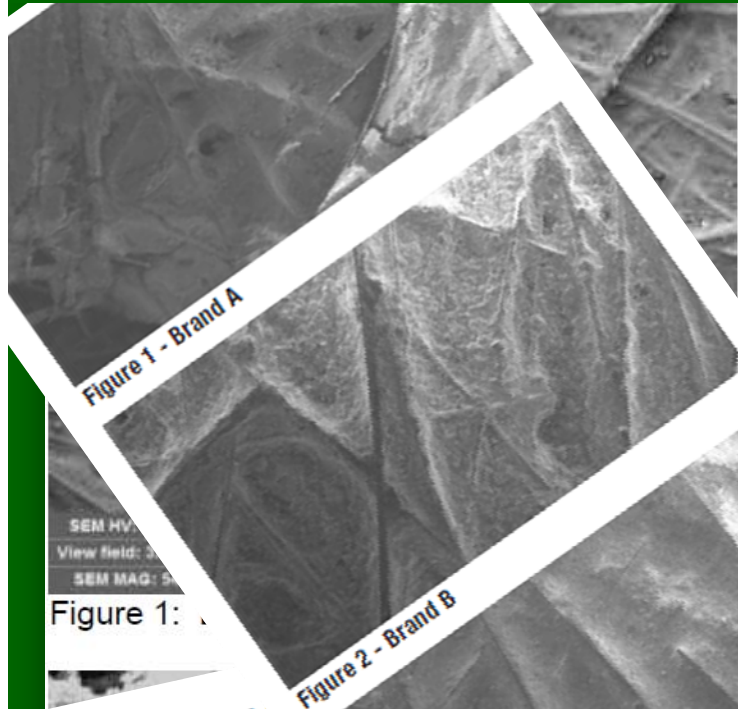
Coverage Rate Testing

Coverage Rate

- Relates to durability:
 - Affects crack-bridging ability
 - “Delamination more likely...”
- Difficult to measure precisely
- Depends on product formulation
- Depends on substrate
- Other variables
 - Ambient conditions
 - Sheathing batch variability

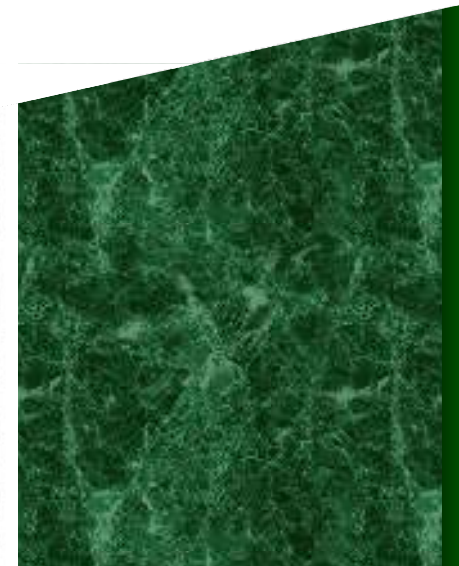
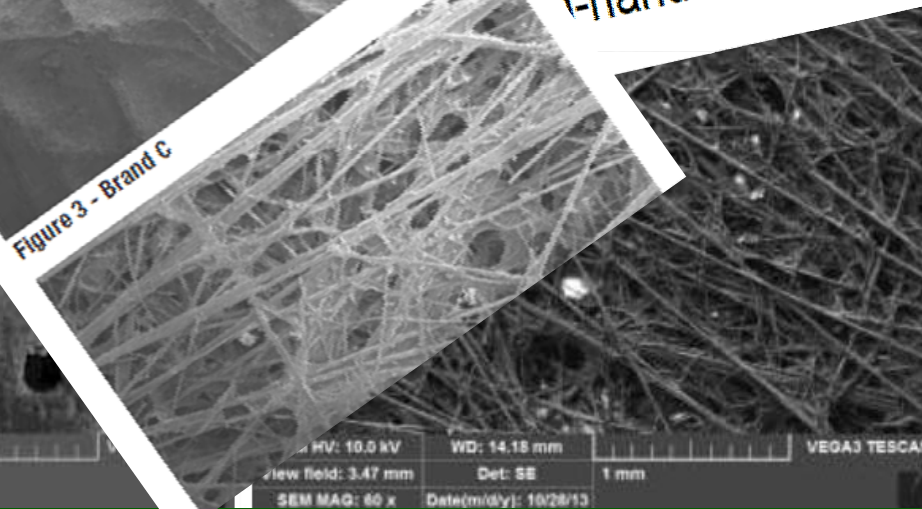
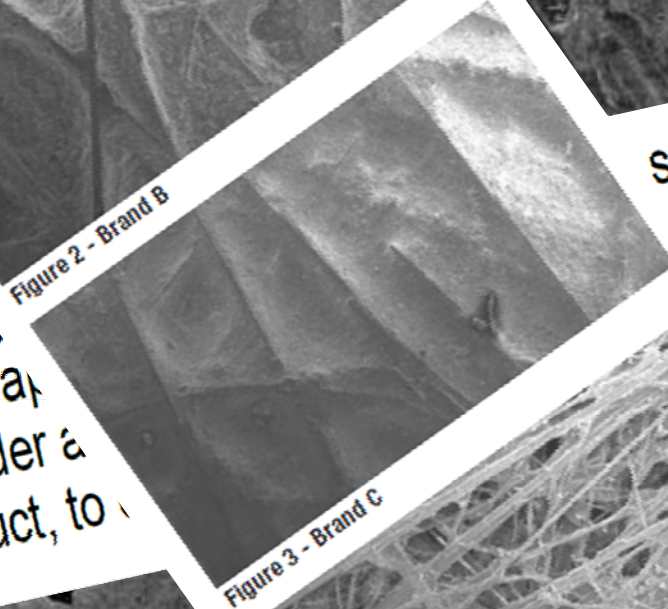


Tech Bulletin Warnings

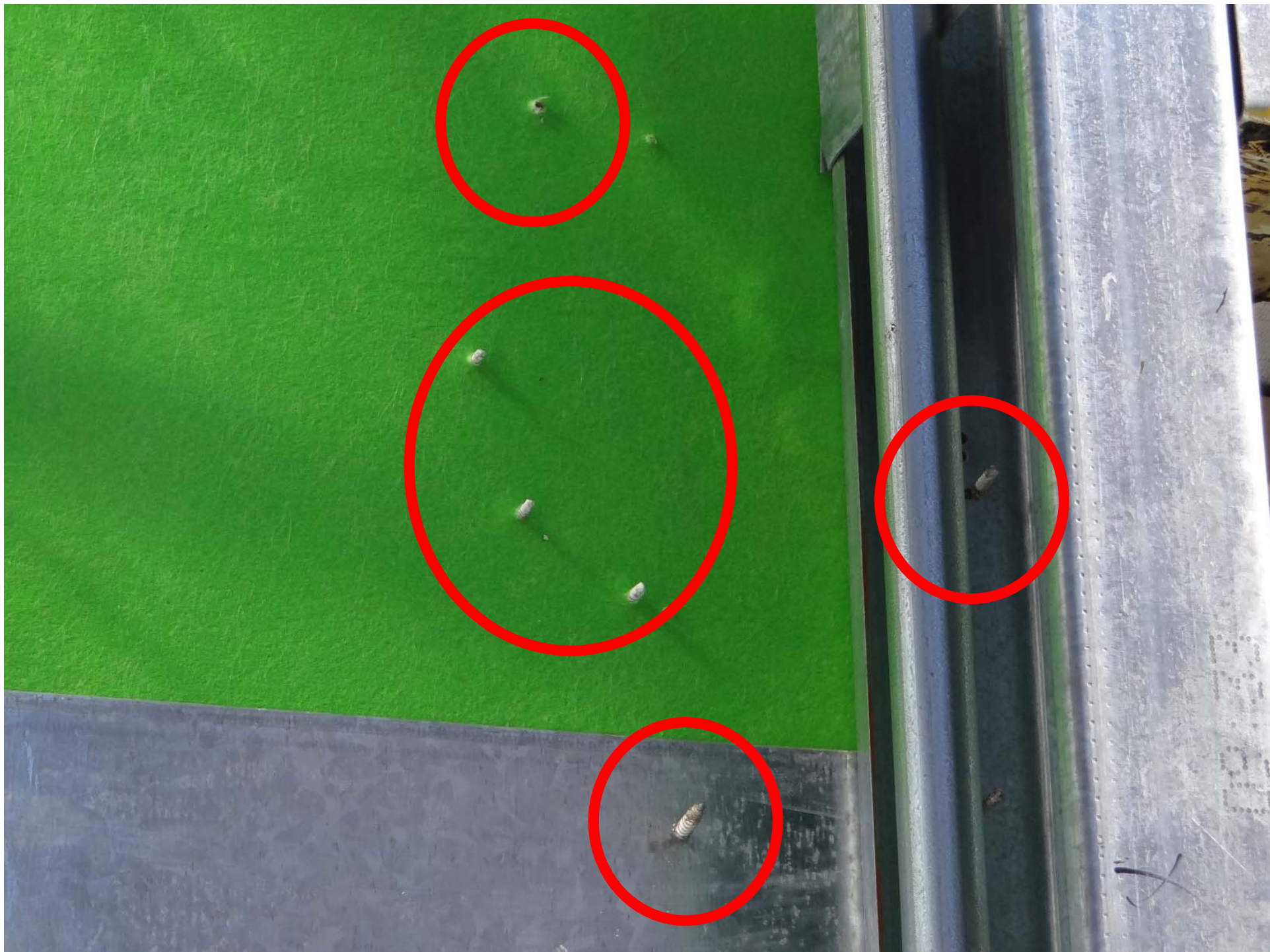


such as ambient conditions, substrate suggest a field coverage test to verify t, by the contractor who is applying the air n-hand.

Actual coverage condition and a coverage under a barrier product, to







Sealing Fastener Holes

- Self-sealing:
 - Seals around fastener shaft without additional treatment
 - Crucial property for WRBs
- Self-healing:
 - Repairs damage over time
 - Rare for WRBs
 - Erroneously used as a synonym for self-sealing

Sealing Fastener Holes

- Self-gasketing:
 - Seals under fastener head by compression
 - Emerging term
 - Downplays *intrinsic* self-sealing in favor of *extrinsic* gasketing
 - But no wall design has fastener heads against WRB

Sealing Fastener Holes

- No WRB seals *abandoned* fastener holes
 - Huge problem for construction industry (1 case: \$42M)
 - Worse with blind fastening through continuous insulation
- Least-bad best practice:
 - Disable reverse on screw gun

ASTM D1970 and D7349

- D1970: “Borrowed” roofing spec, includes nail sealability test
- Changed in 2014 to D7349
- No similar standard for WRBs yet
- Severe test: apply product to CDX plywood; pound in nails; submerge in cold water
- Products that *pass* cite D1970
- Products that *don't pass* cite...
Nothing

39°F, 3 days

5" Water

Specimen

Leak?



Nail Sealability Testing

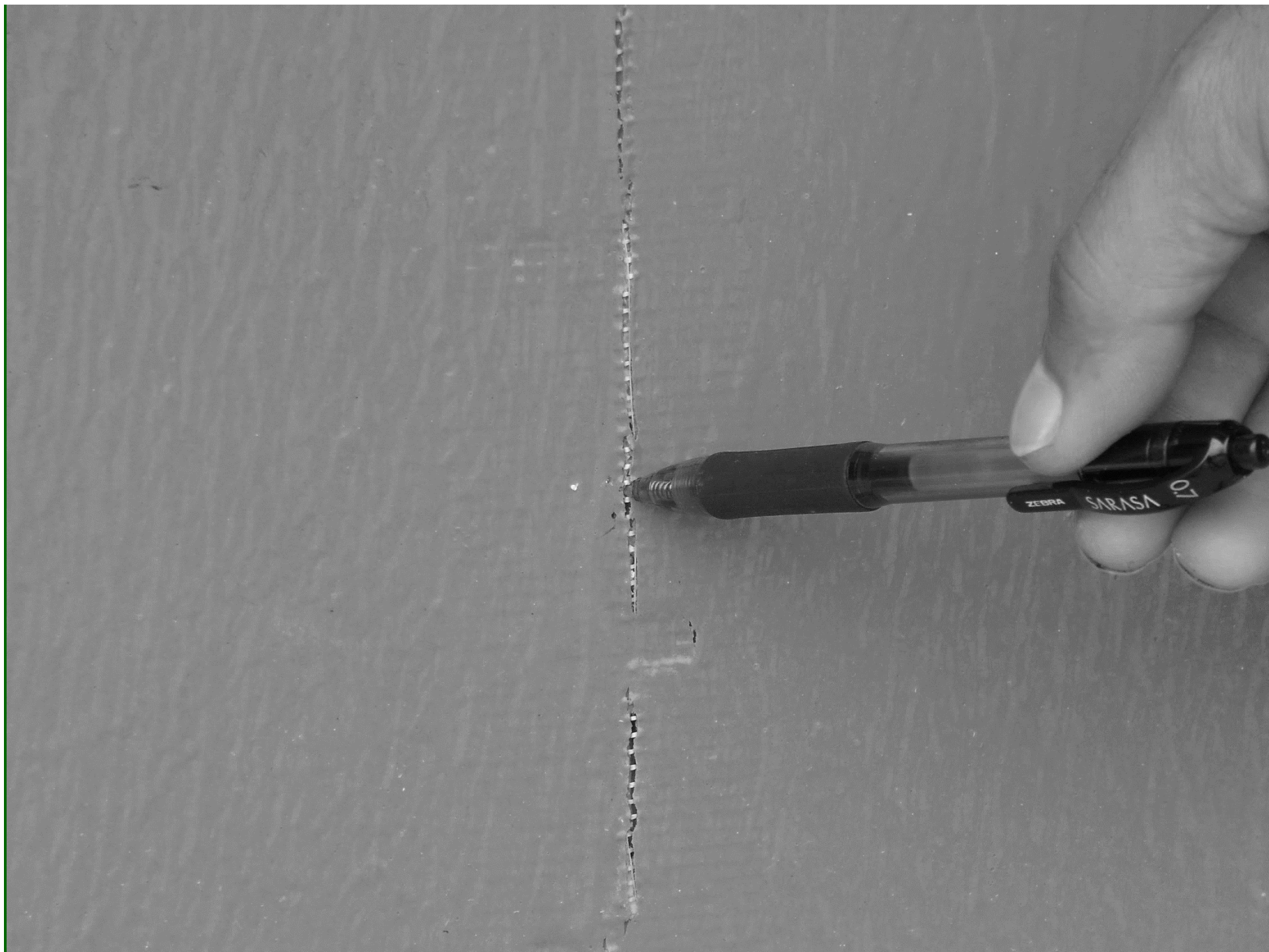


Nail Sealability Testing

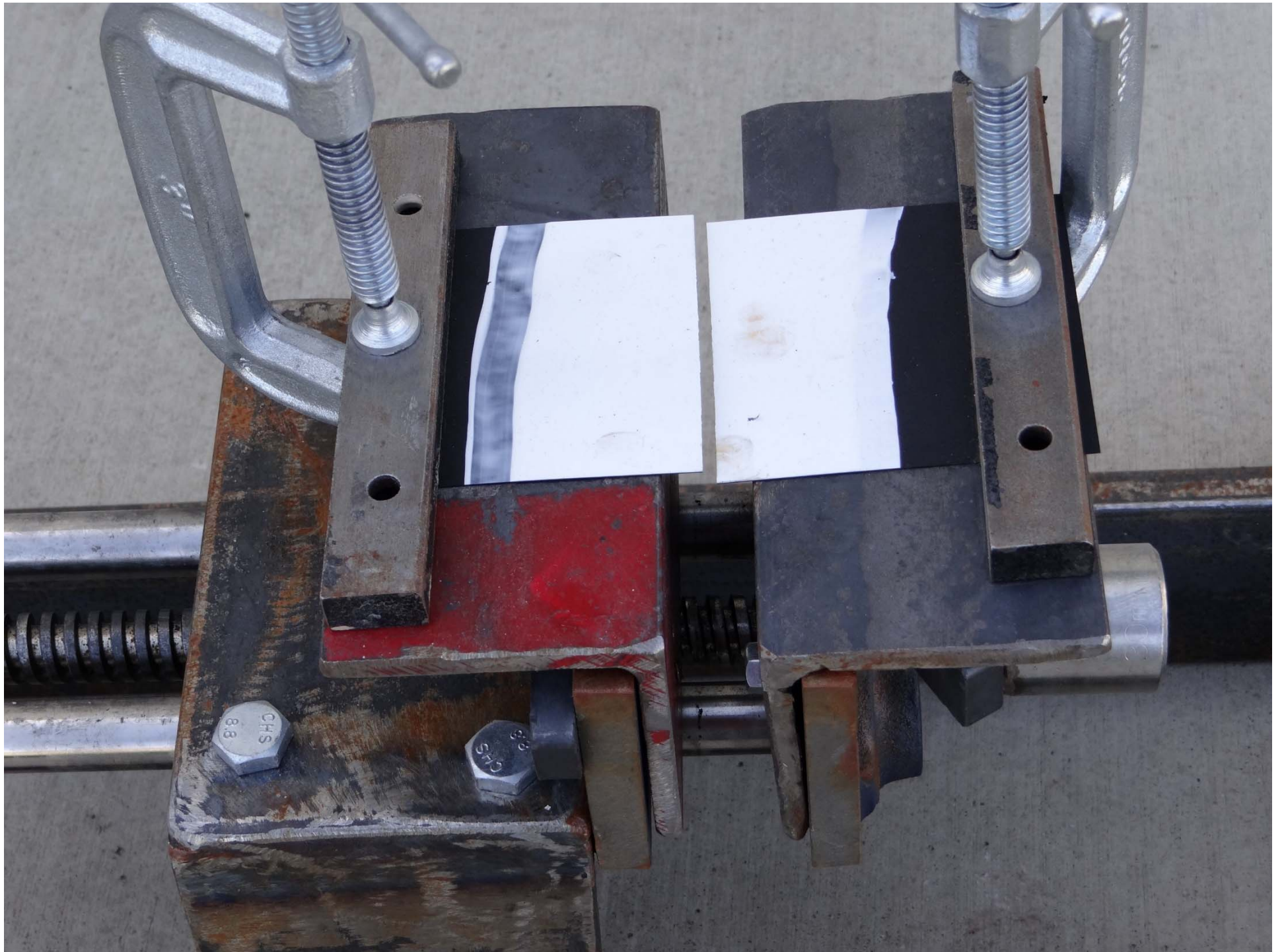
ASTM Standard	Products Tested	Results			
		Pass		Fail	
D1970 Until 2014	9	0	0%	9	100%
D7349 From 2015	18	5	28%	13	72%

Durability Phase 2: Factors Before Cladding

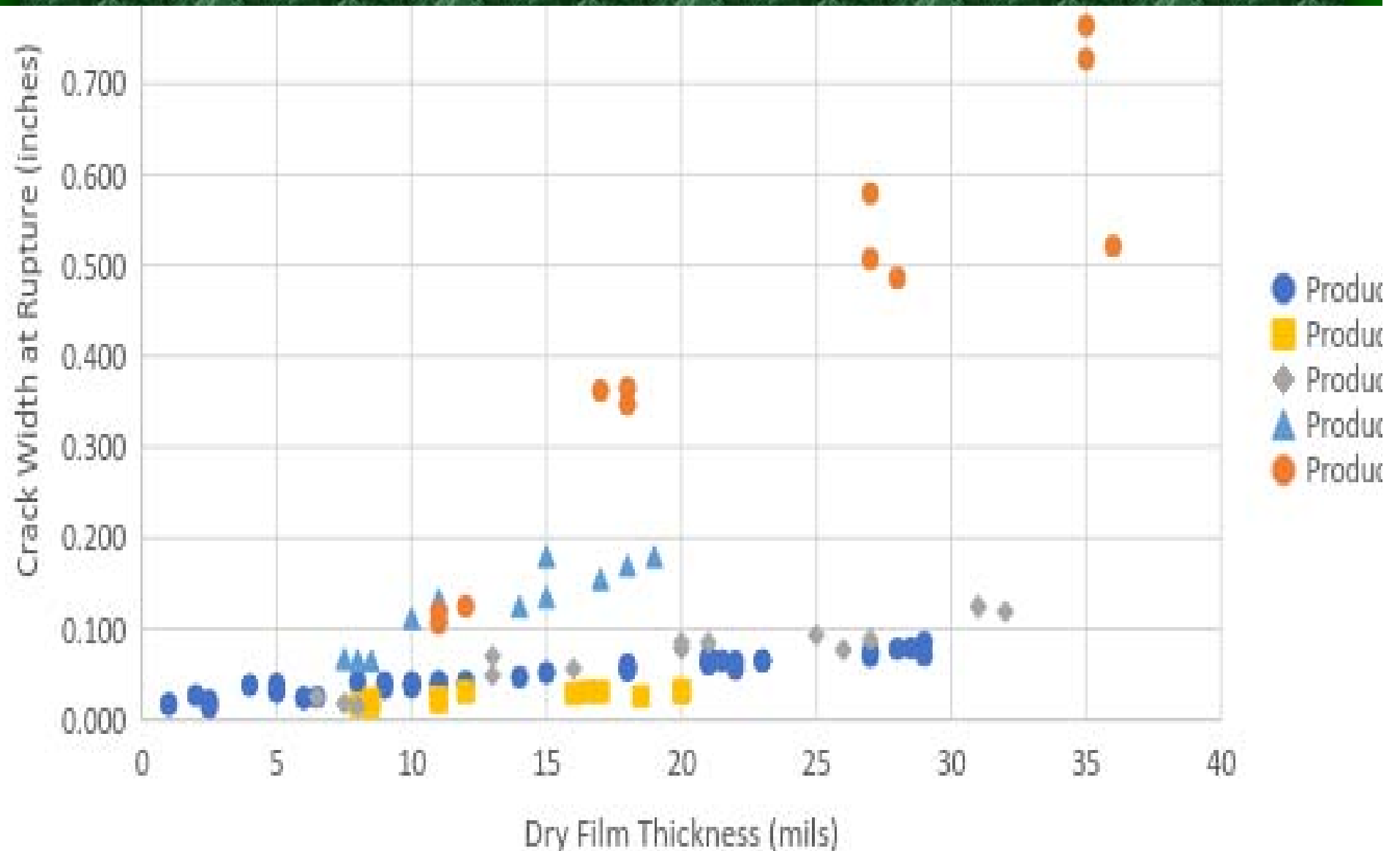
- **Crack-Bridging Ability**
- **UV Resistance**





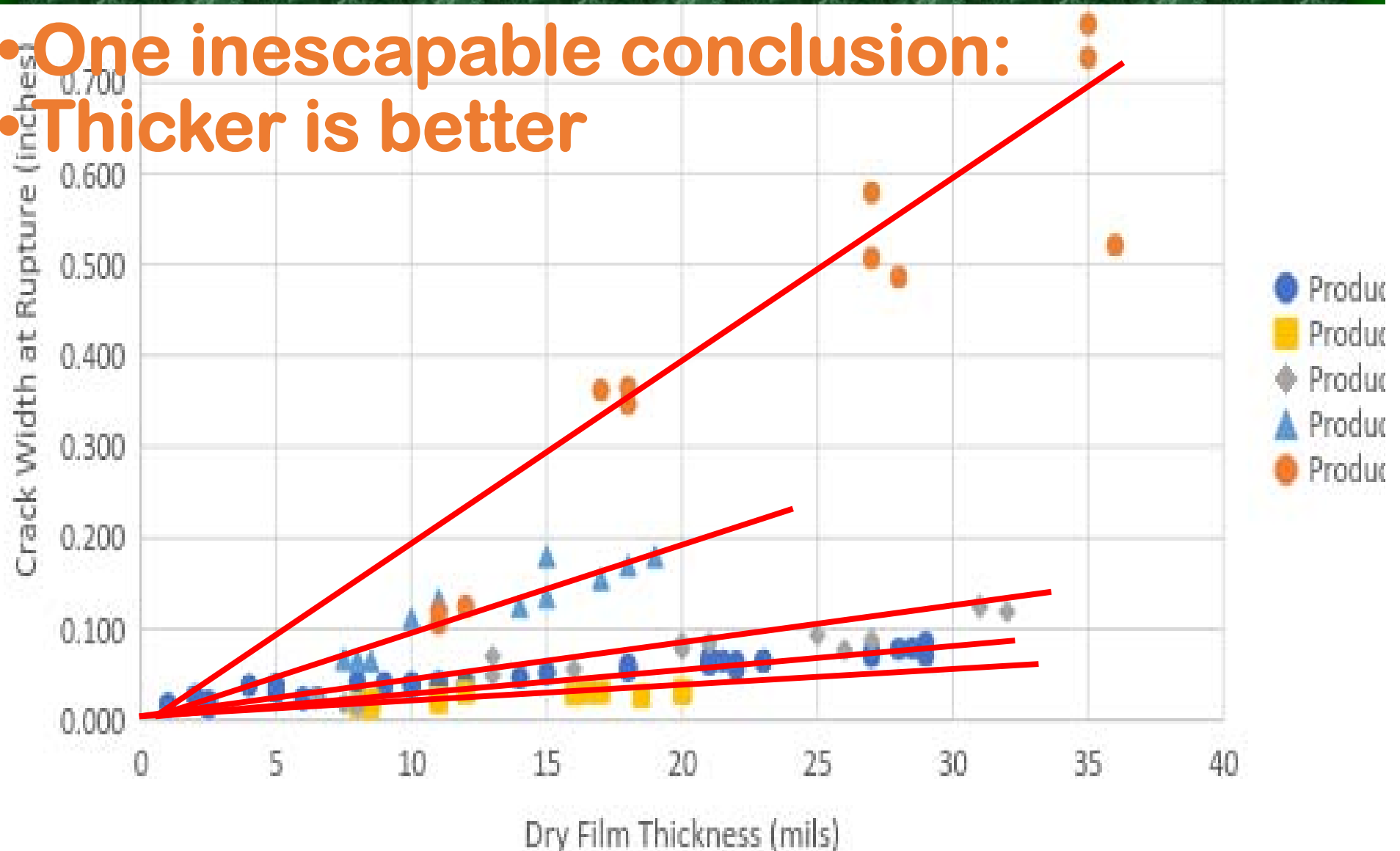


Crack-Bridging Ability



Crack-Bridging Ability

- One inescapable conclusion:
- Thicker is better



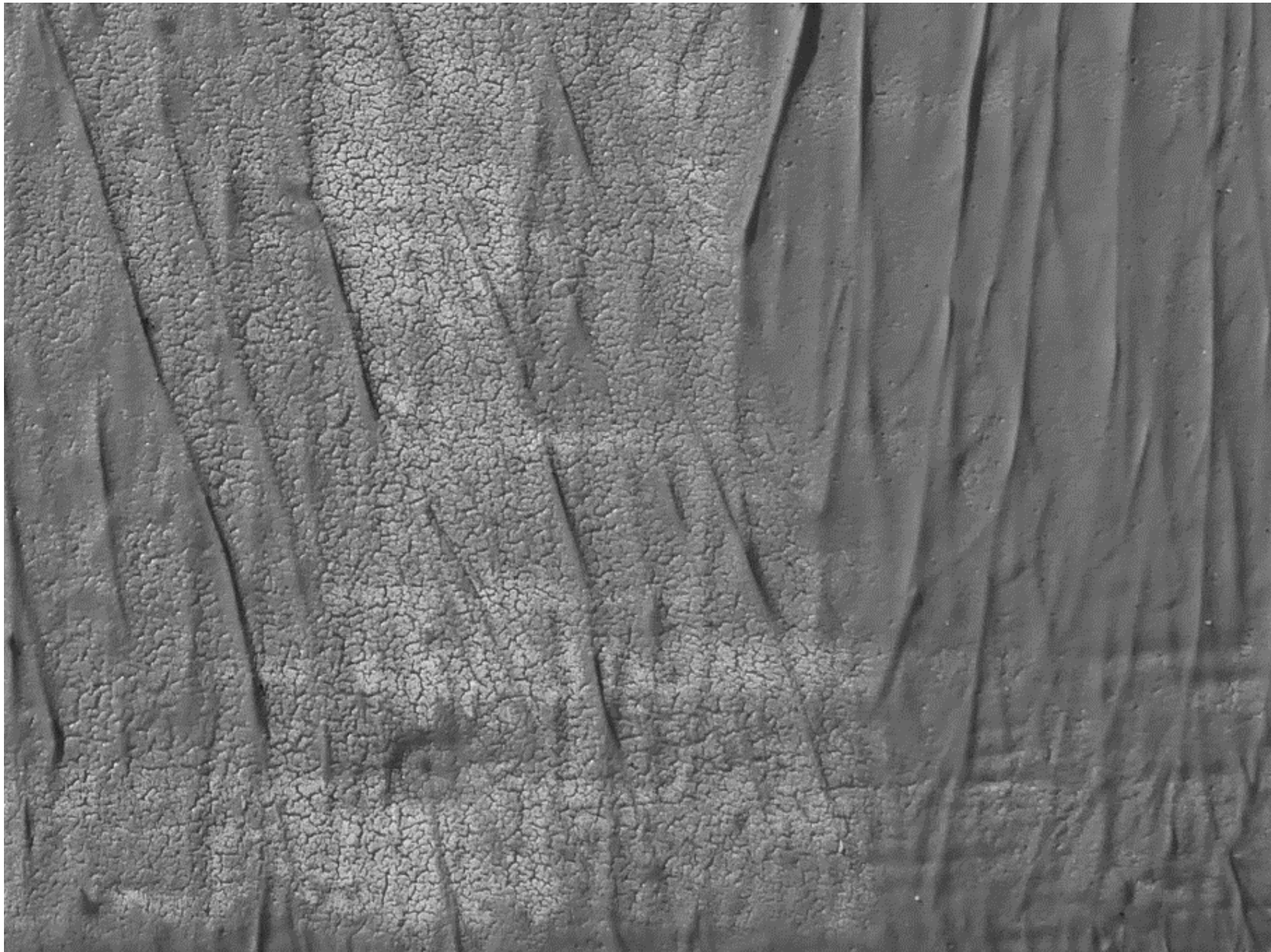




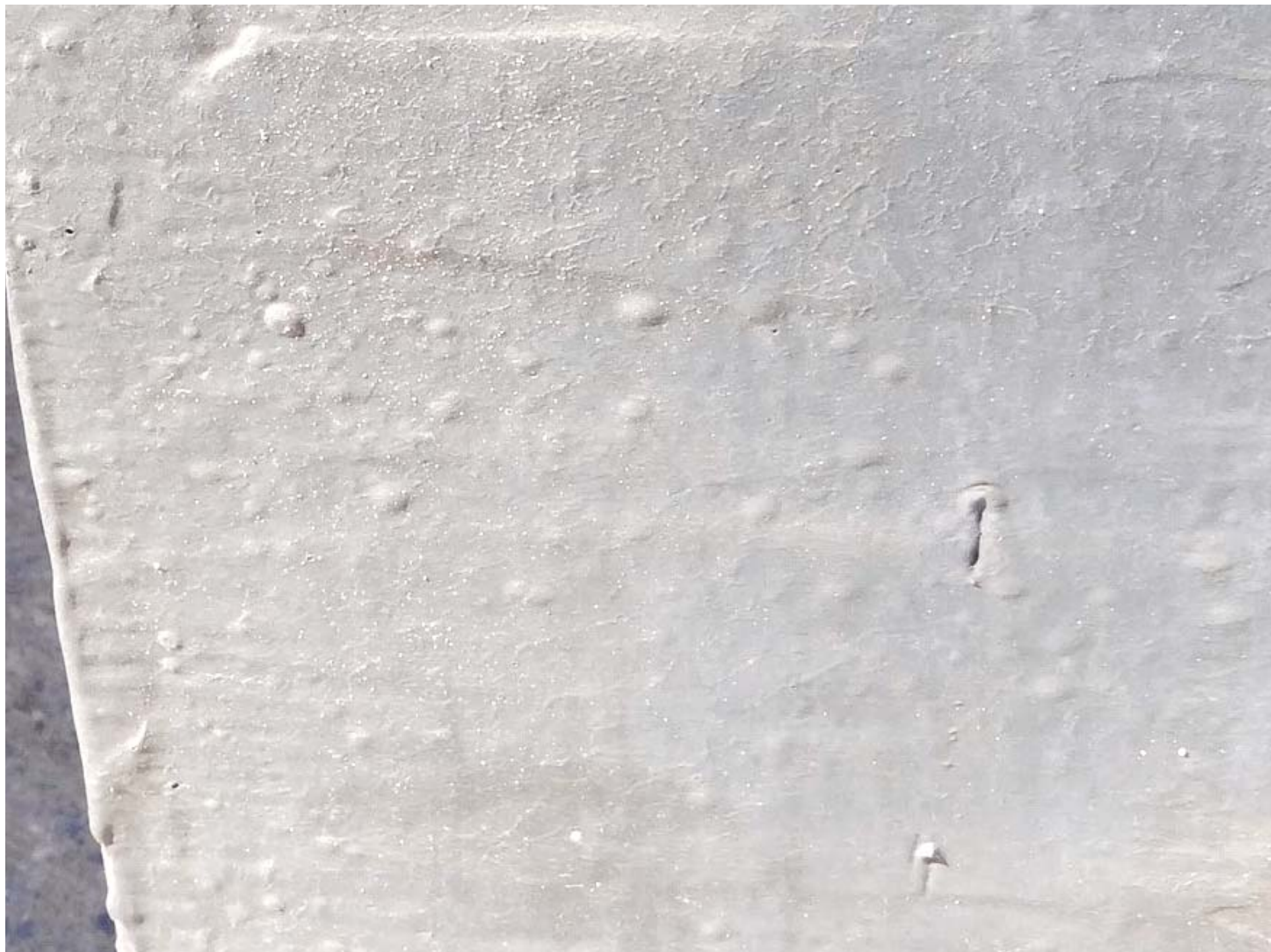
Cladding (siding)

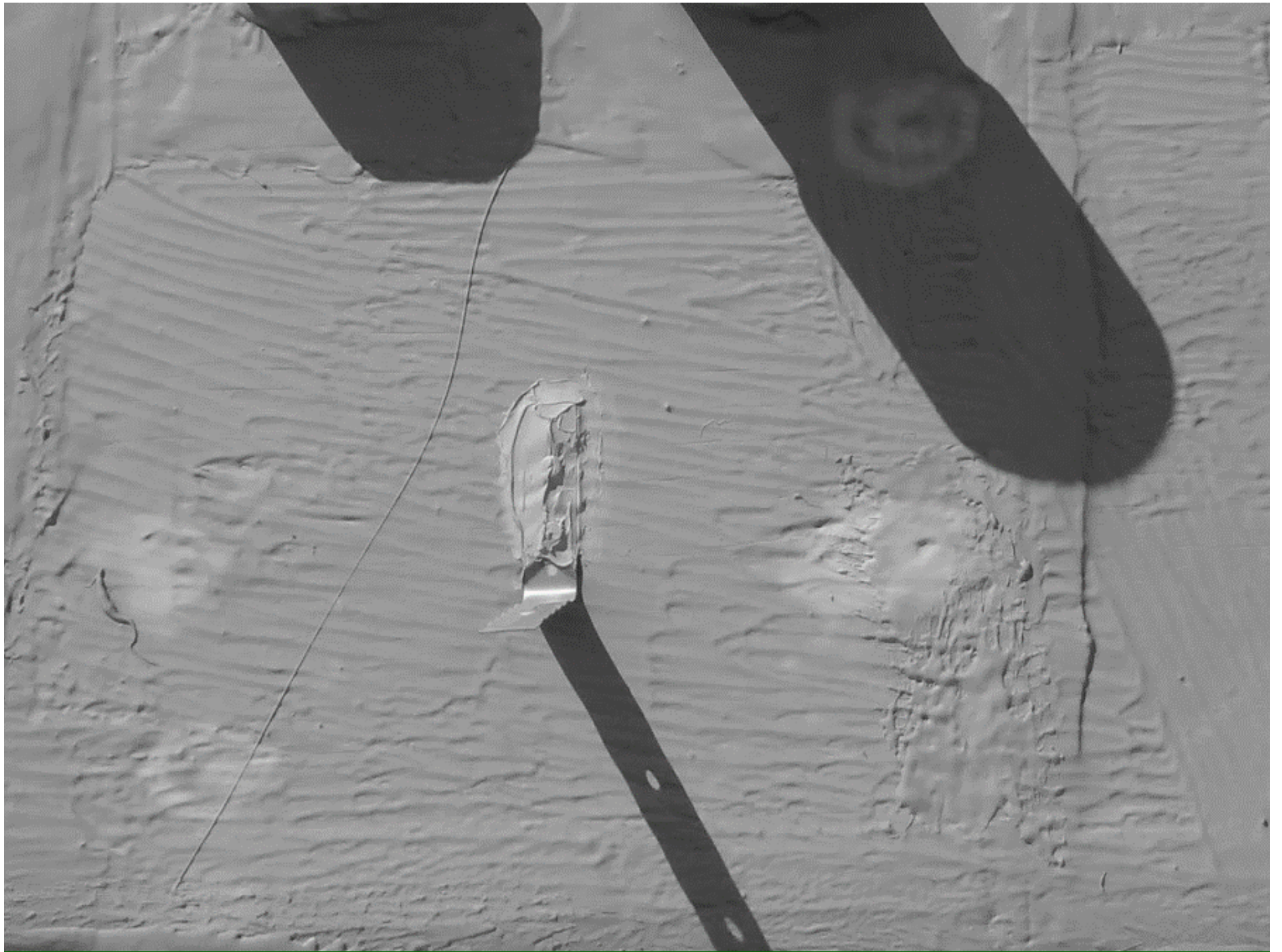
Cladding Tests

- Cladding installed at max. recommended exposure time
- Only 1 published time for all seasons and locations
- Clad only upper half, to see how exposure degrades unclad WRB
- Removable cladding, to observe concealed WRB portion









- How durable is this WRB?
- This is a concealed, permanent component



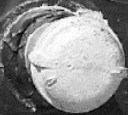
Durability Phase 3: Factors After Cladding

- Continued UV degradation
- Heat resistance
- Water resistance
- Abrasion
- Cutting
- Organic growth (mold)

Cladding Removal

- Cladding removed after 1 year
- Could not remove from 3 panels
- Mechanical damage at 3 others
- WRB washed away at 1 other
- Weathering damage observed

DO NOT TOUCH

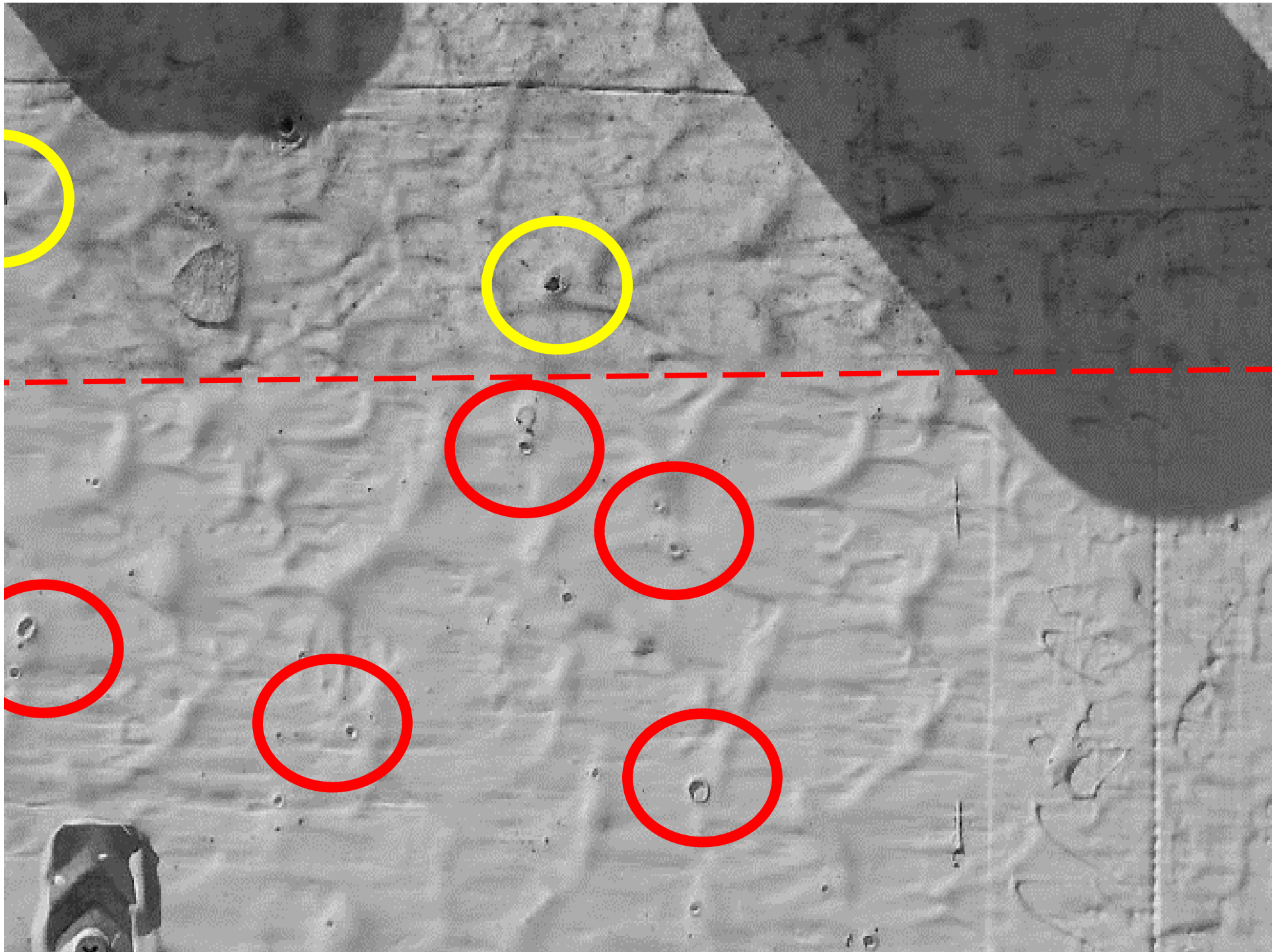


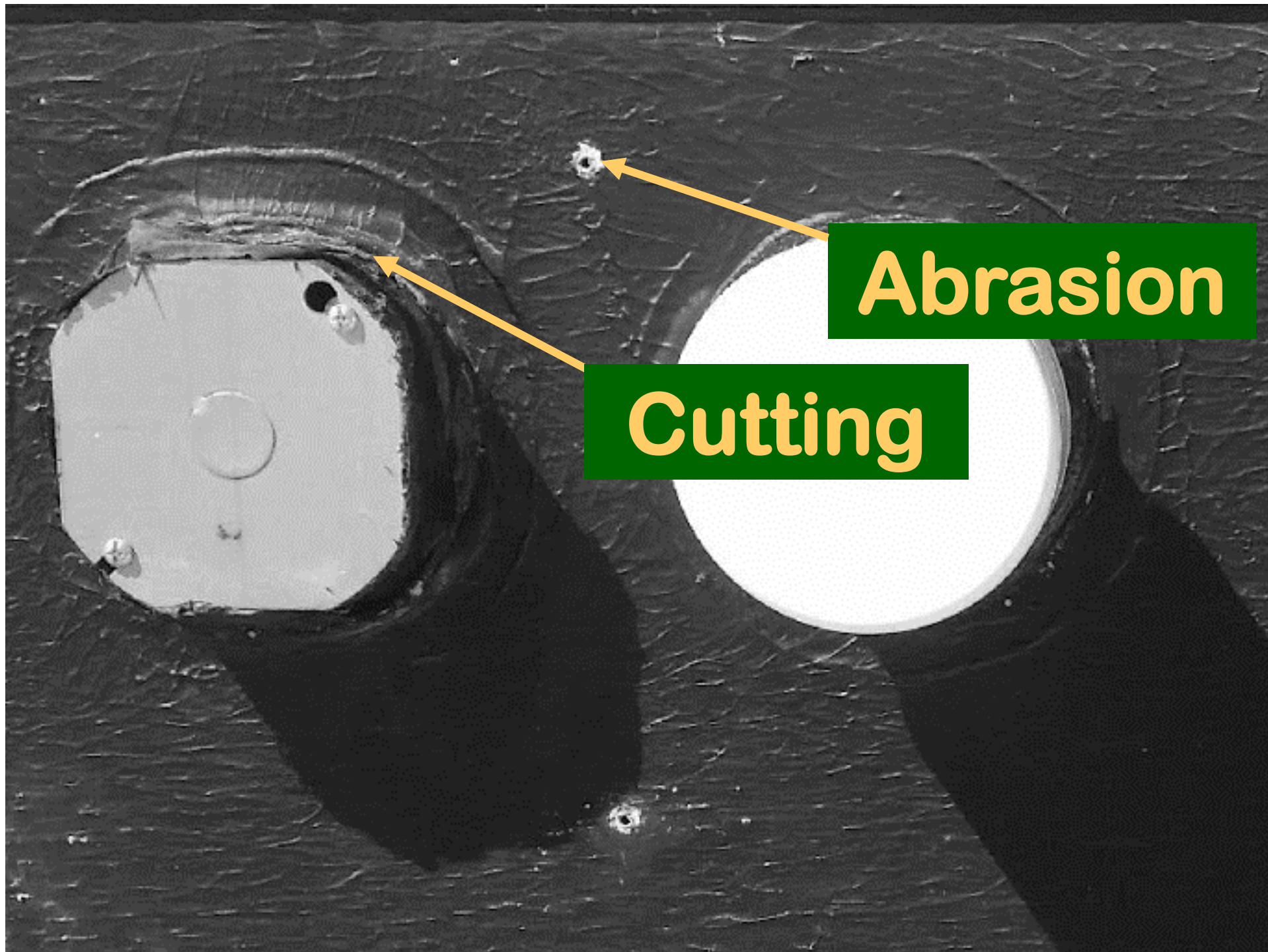


08P100-01

GENOVA
PVC-9015-1003
ABS-9015-1003
MADE IN USA







Abrasion

Cutting



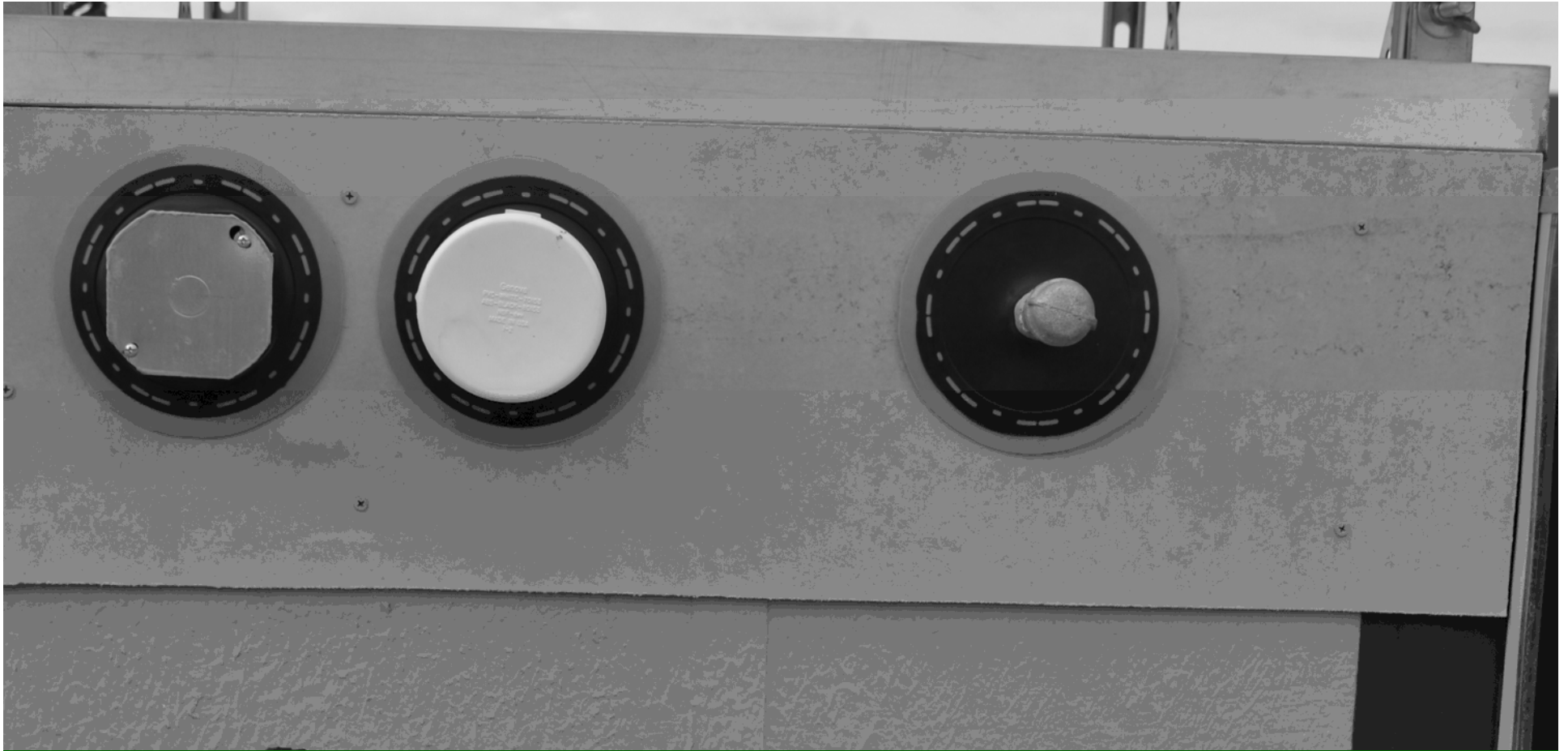
Key Point:

**Real materials are thicker
than CAD lines**



Metal Coping: not water tight





**not remove cladding from 3 par
(fused)**

No. 15 NON-SPEC.

Tapes and Flashings



Peel-and-Stick Go-Wrongs

- Wrinkles and “fishmouths”
- Long-term edge adhesion
- Sag
- Facer curls, especially in heat
- Memory / rebound from rolling
- Shrinkage
- Low tack when cold



Key Point:

**Seal every
edge and seam
of self-adhered
flashing**

Tapes and Flashings: Testing





Tape Adhesion Testing

- Industry standard: tension
- 16 psi desired adhesive strength
 - Based on cohesive strength of expanding urethane foam air seal
- Tension gives highest test values
 - Doesn't represent service condition
 - Misleading value
 - Everything passes



Tape Adhesion Testing

- Could use torsion
- 2nd highest test numbers
 - Doesn't represent service condition



Tape Adhesion Testing

- We use shear
- Lowest test values
- Realistic
- Discriminates (not all pass, fail)





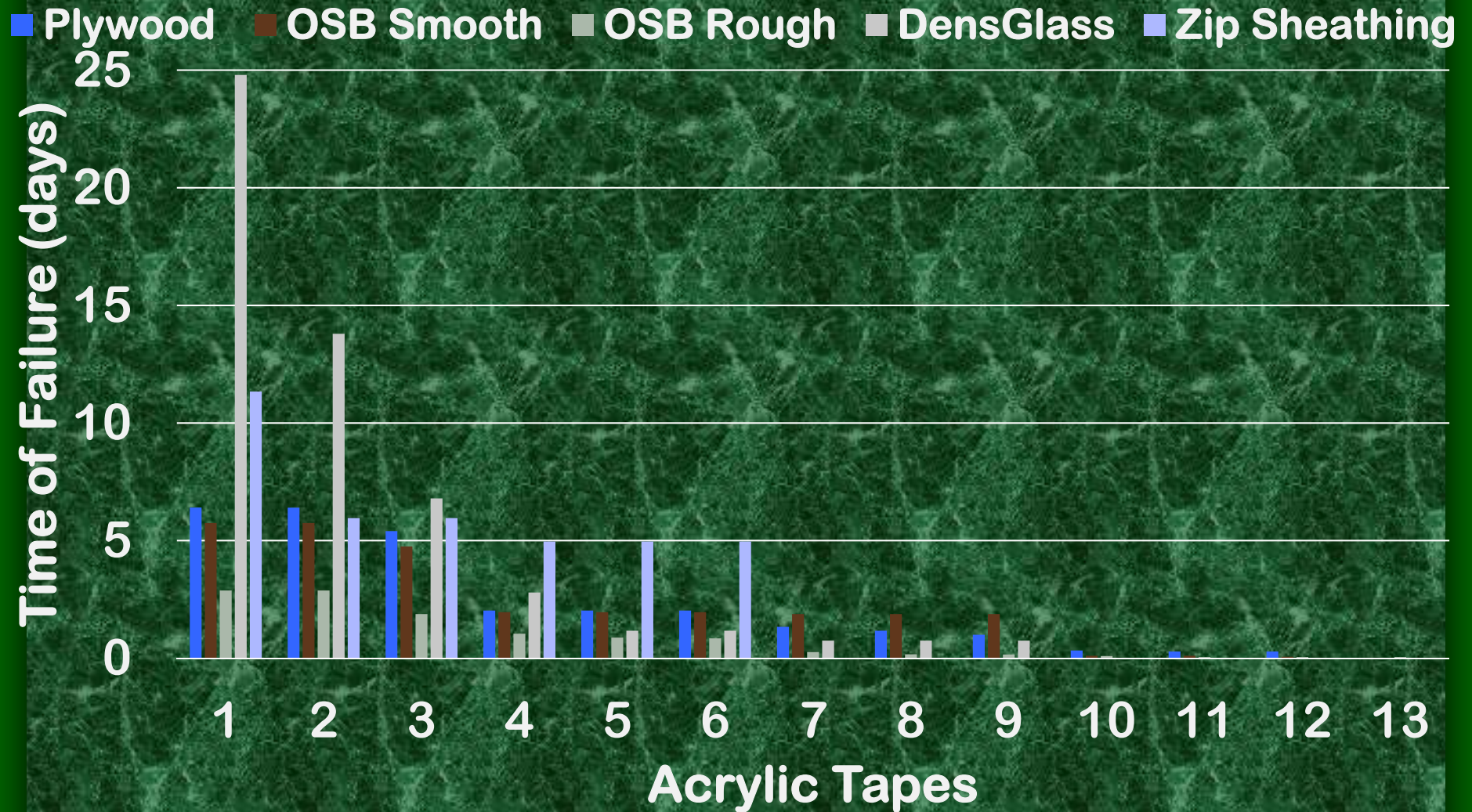
DO NOT TOUCH



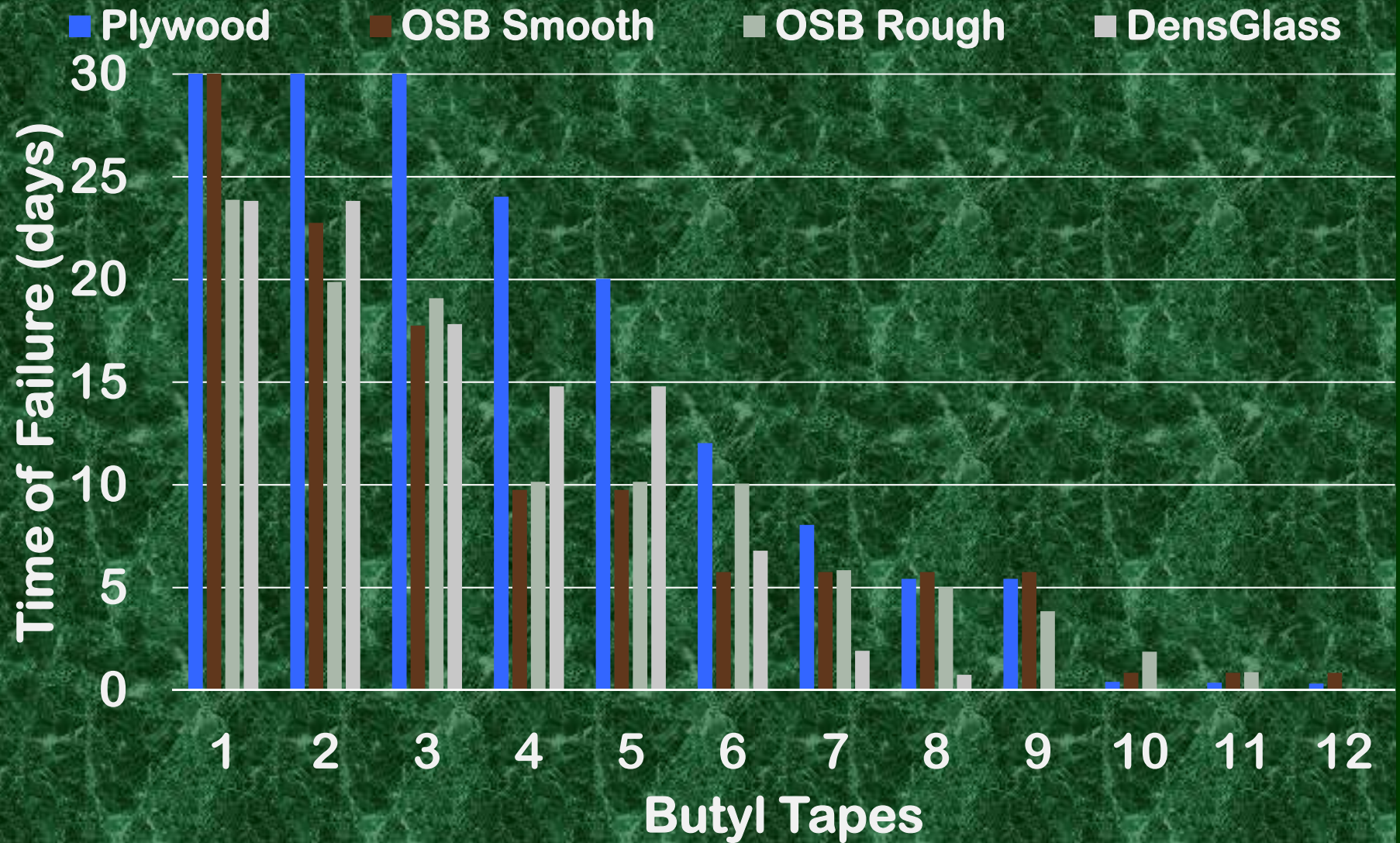
Tape Shear Tests

- Fairly quick test (30 days max.)
- Large number of specimen slots
- So can test many combinations
 - Tapes
 - Substrates
 - Temperature
 - Rollers
 - Primers
- Test minimum 3 replicates each

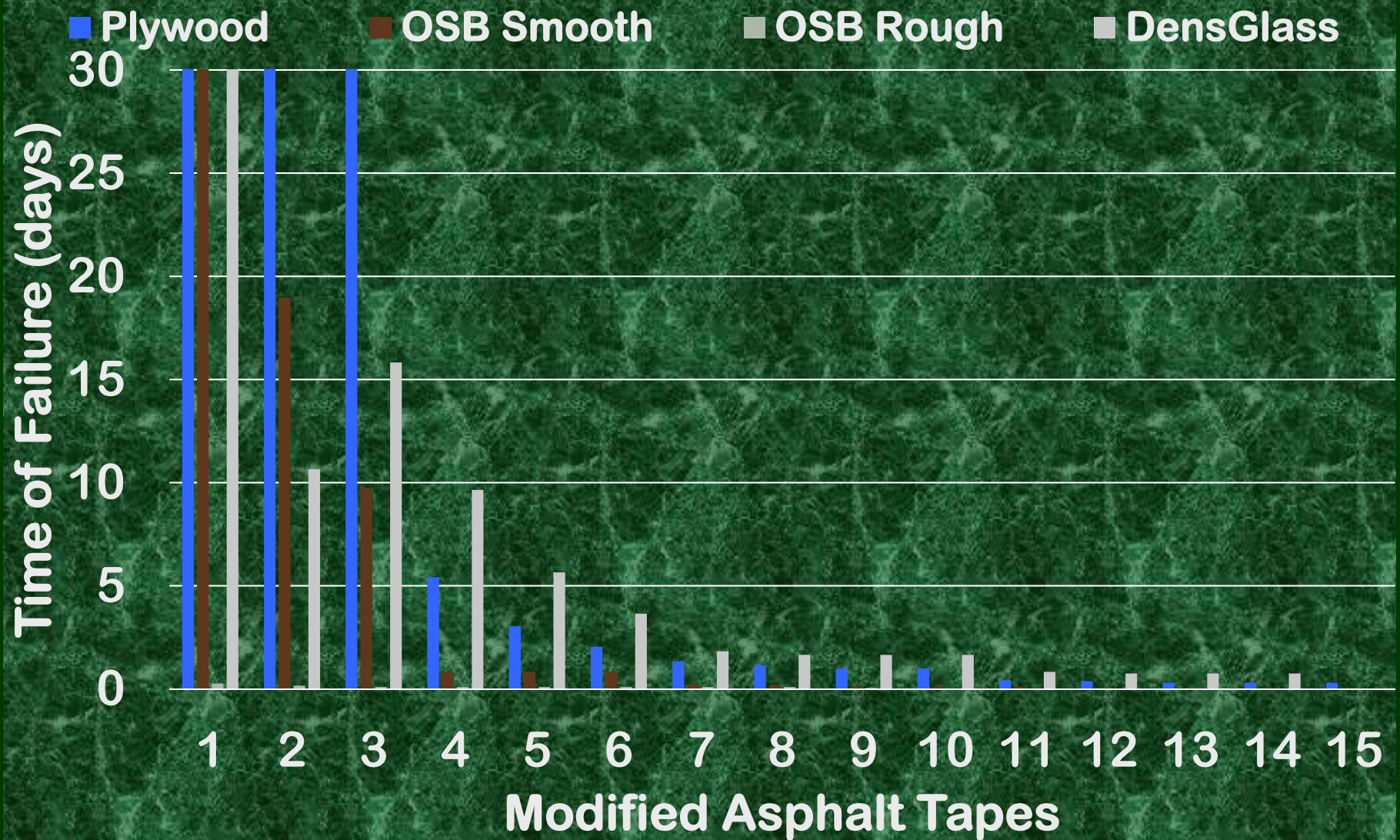
Acrylic Tape Testing



Butyl Tape Testing



Asphalt Tape Testing



Long Specimen Tests

- Shear tests too short for some failure modes
 - Short time
 - Short length
- Also need to test long pieces for long time



6" GRACE PERM-A-BARRIER VPS

6" GRACE PERM-A-BARRIER ALUMINUM

CARLISLE CCN-705HT

CARLISLE CCN-705HT

HENRY BLUESKIN VP 160

POLYGUARD
UV 365

DELTA FLEXX-BAND

ECHO TAPE FL-M8701

ECHO TAPE FL-N8709

ECHO TAPE FL-N8705

ECHO TAPE FL-N8701

WR. MEADOWS AIR SHIELD

BASE W/ FLASH

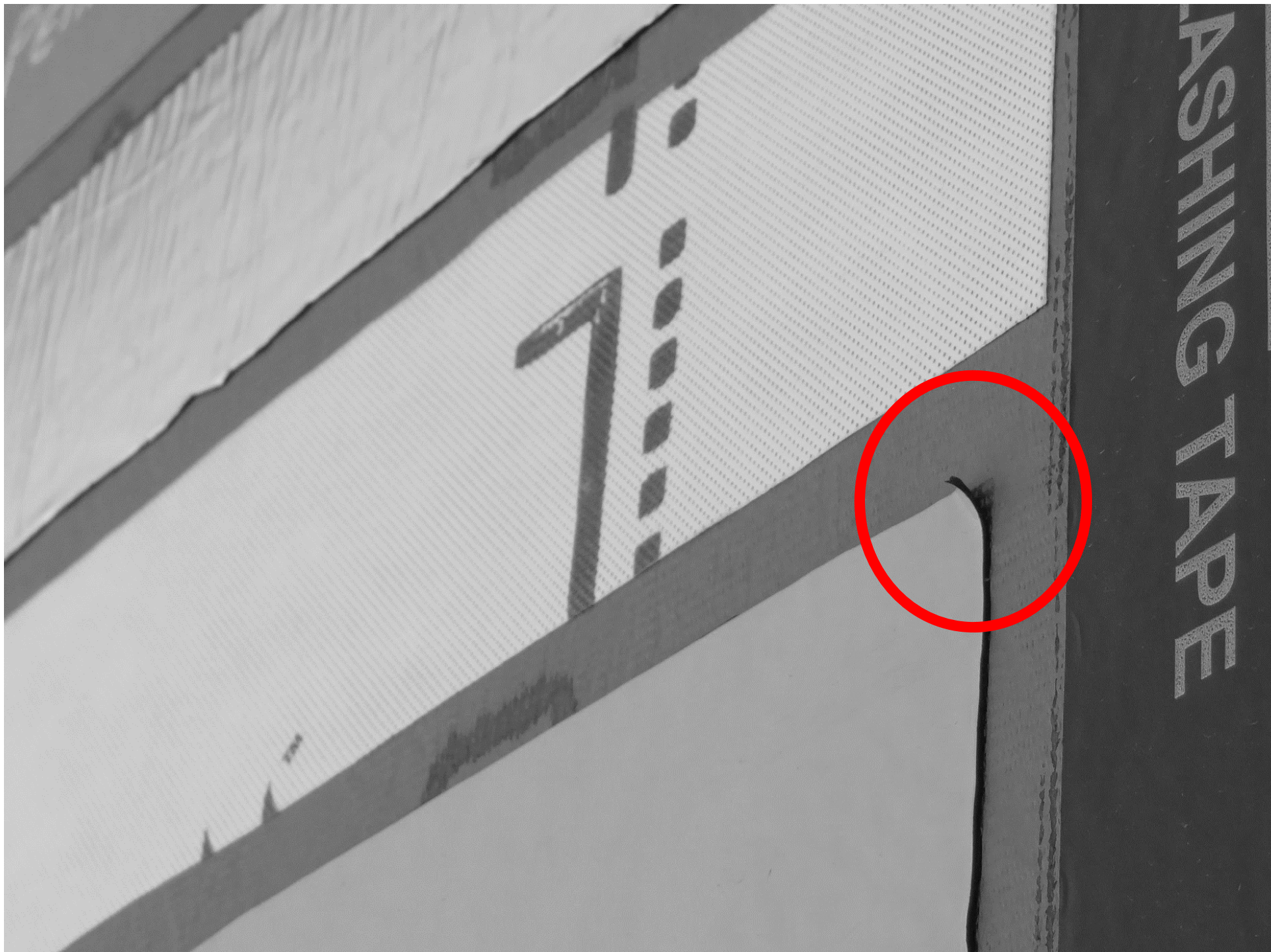
ZIP System

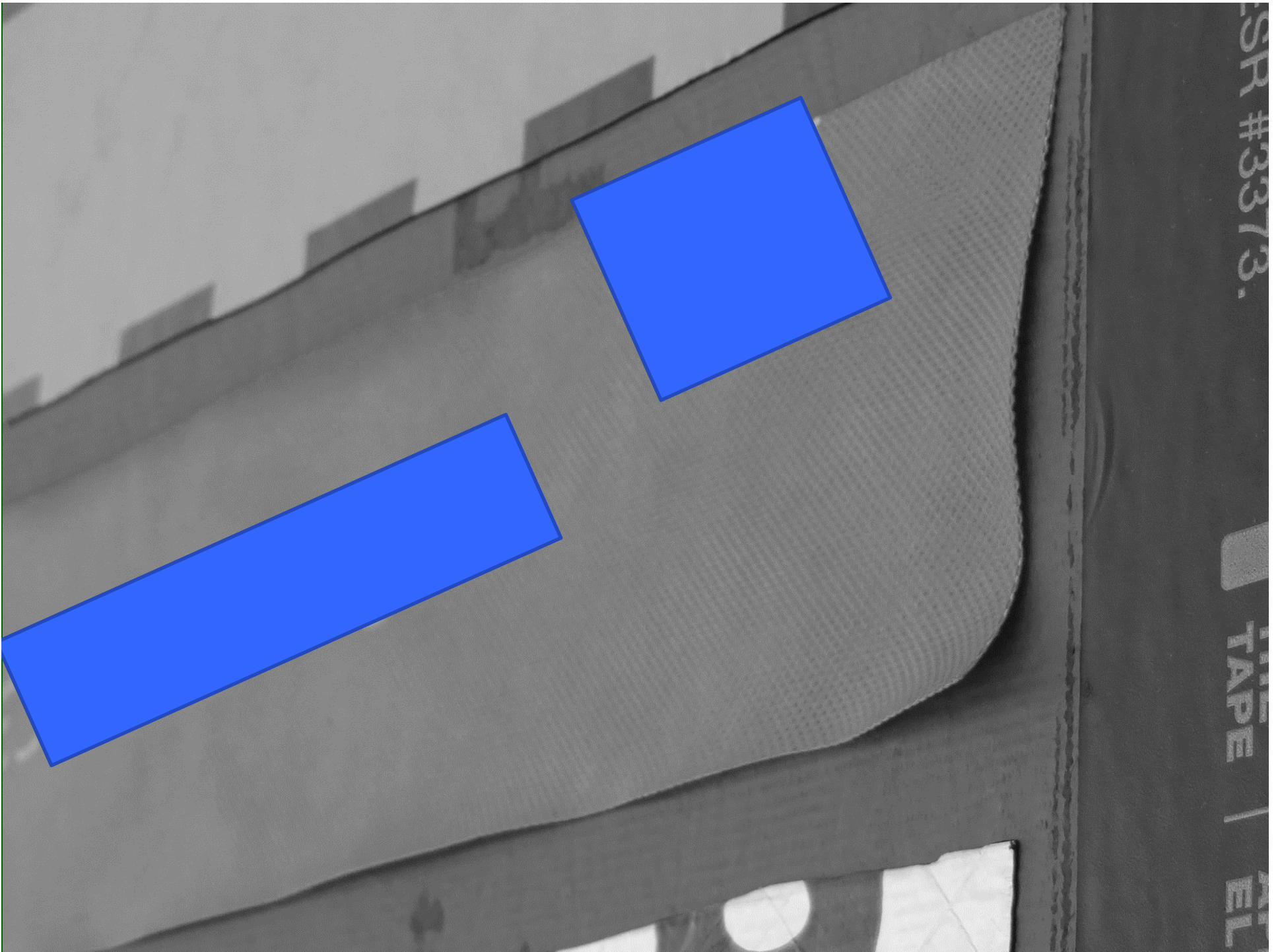
7/16" ROOF AND WALL SHEATHING

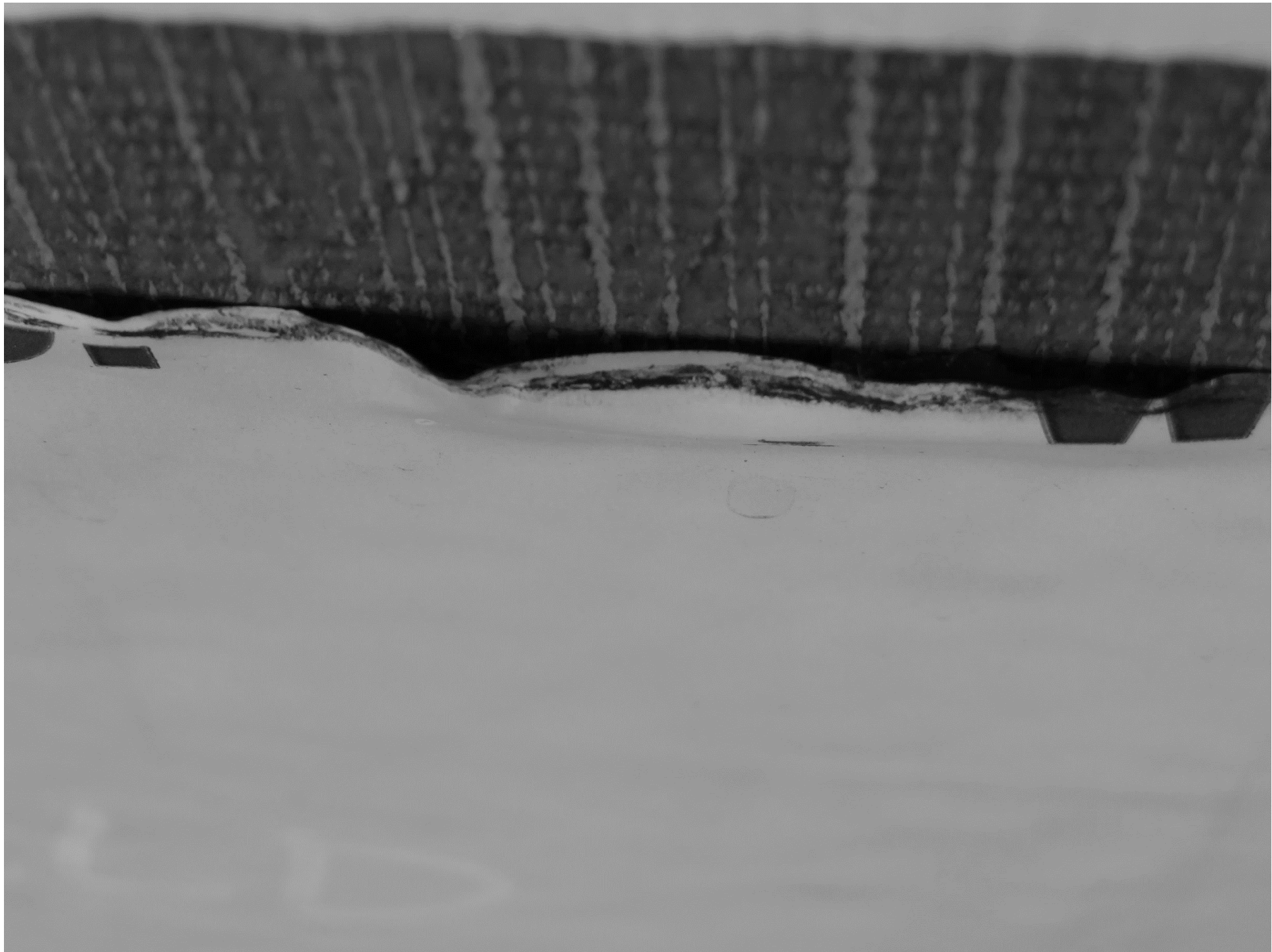
FROM THE CREATORS OF
AdvanTech Flooring

30 LIMITED WARRANTY

ZIP System







WRB Summary

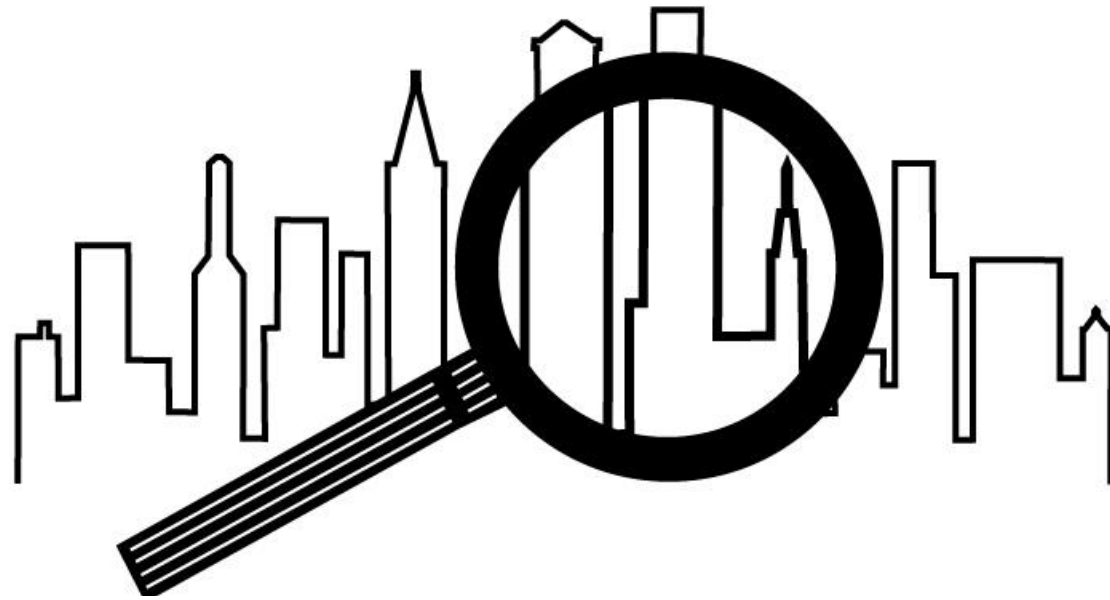
- Installation Issues
 - Instructions missing, wrong, or unrealistic
 - Coverage problems
- Nail Sealability
 - Most products fail test
- Crack Bridging
 - Problem for thin products
- UV Resistance
 - Some premature failure (before cladding)
 - Some continued degradation after cladding
- Water Resistance
 - Some fused
 - Some washed away

Durability vs. Economy

- Robust waterproofing
 - Premium products
 - Meticulous workmanship
- But at a cost
 - More \$ per SF
 - Longer construction schedule
- How much do failures cost?



Thank You Questions?



Building Diagnostics

"The Durability Experts"