

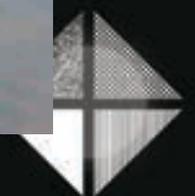
Westford Symposium

2019-08-06 Westford, MA

EIFS Drainage

How the EIFS Industry Got Skewered
by being so Damn Good at Drainage

Everything I know about water intrusion I learned in Kindergarten



Works in winter too



History c.1995

The Dark Ages

North Carolina



No 'source drainage', i.e. flashing

Result

- Class action litigation against the EIFS industry
- *Failure to warn*
- Settled

EIFS Industry Solutions

Late 1990s

- Install over building paper—it's in the code !
- OK for stucco, siding, or brick—referenced in code
- EIFS not in the code — evaluation reports required

Long and winding road

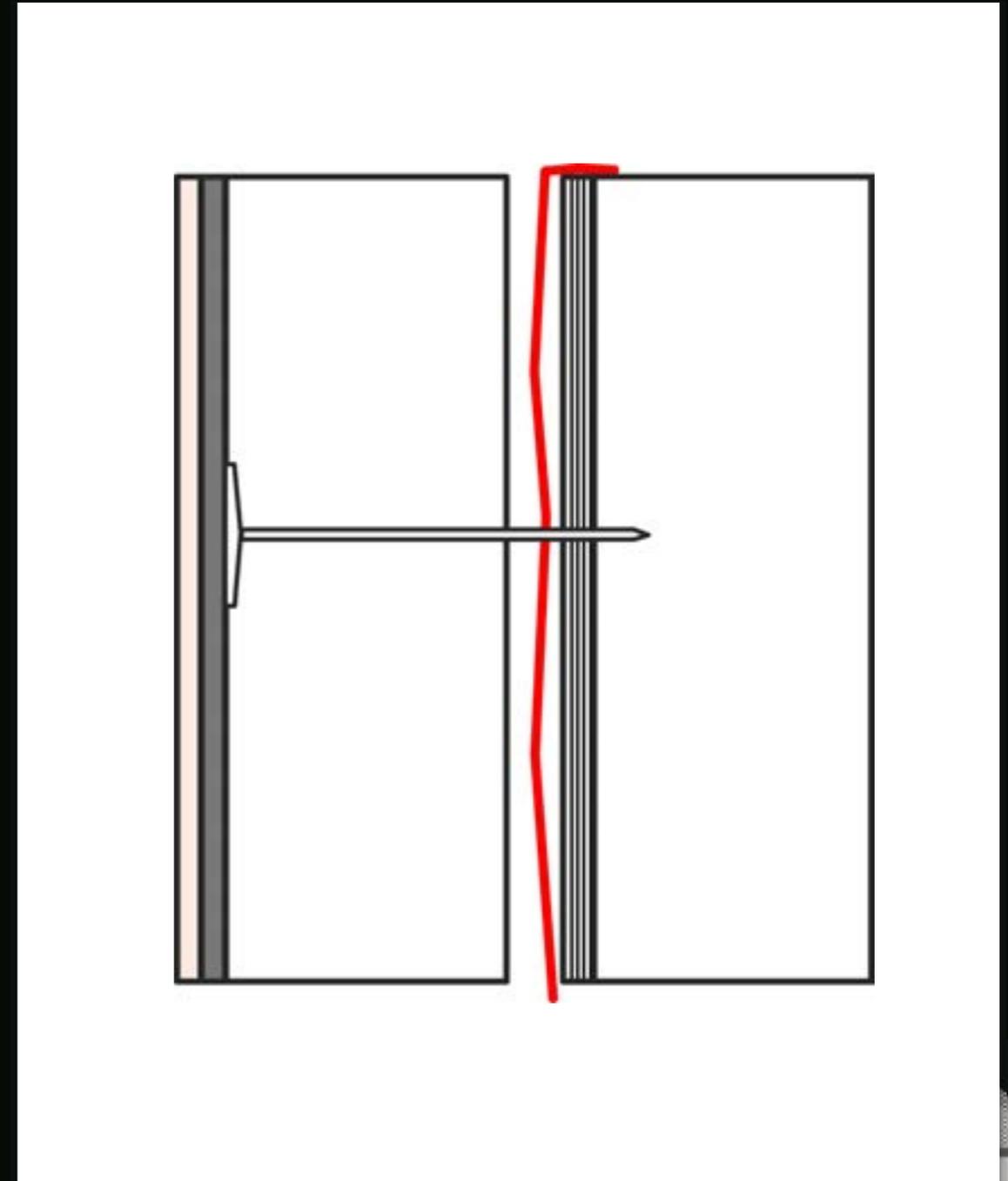
Code Evaluation Services

How Many Evaluation Services ?

- Four model building code evaluation agencies in USA
- One federal agency in Canada
- Plus various state, provincial and municipal agencies
- If you're not in code, they want to talk to you !

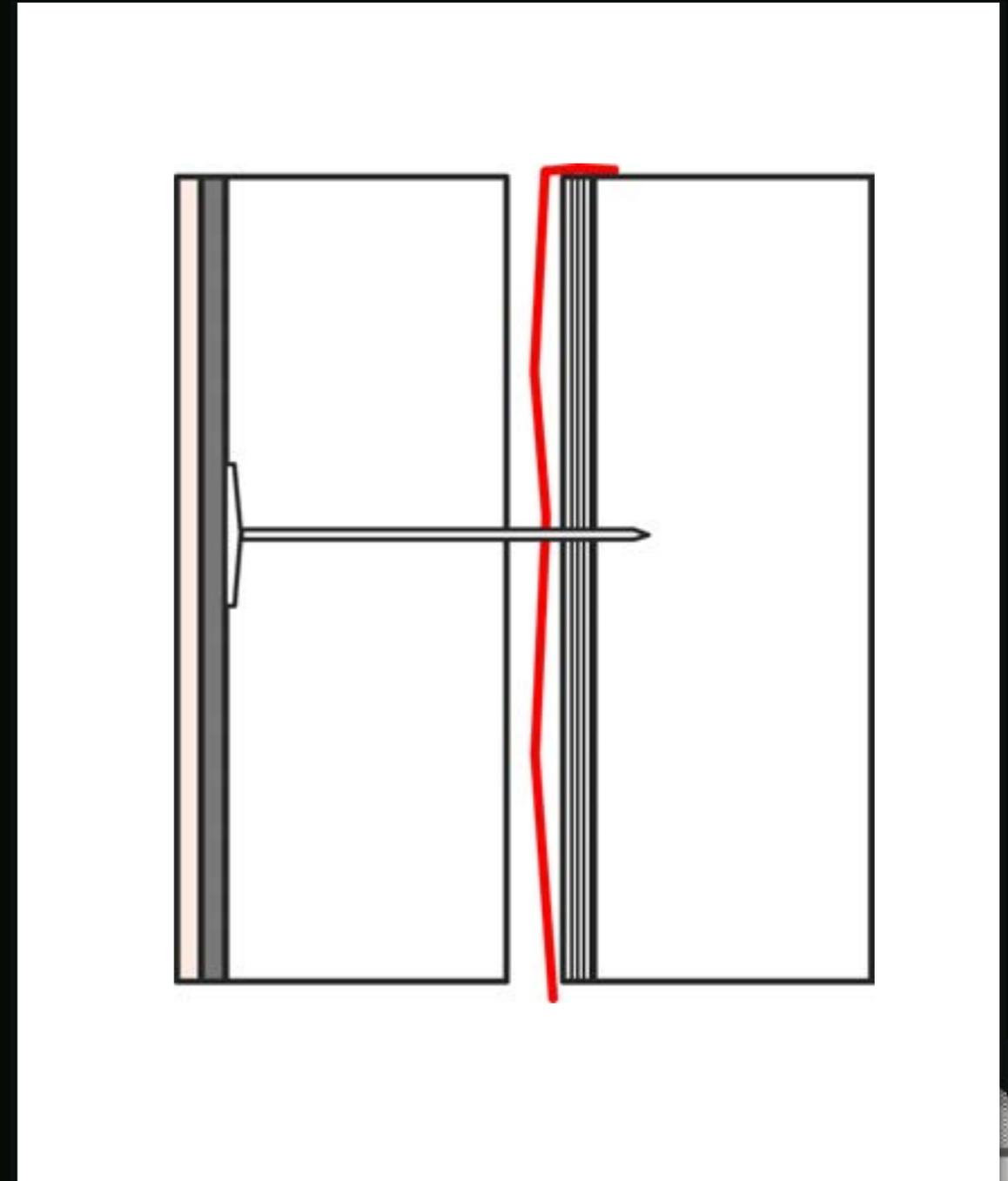
Original Drainage Test

- Demonstration testing for BOCA officials



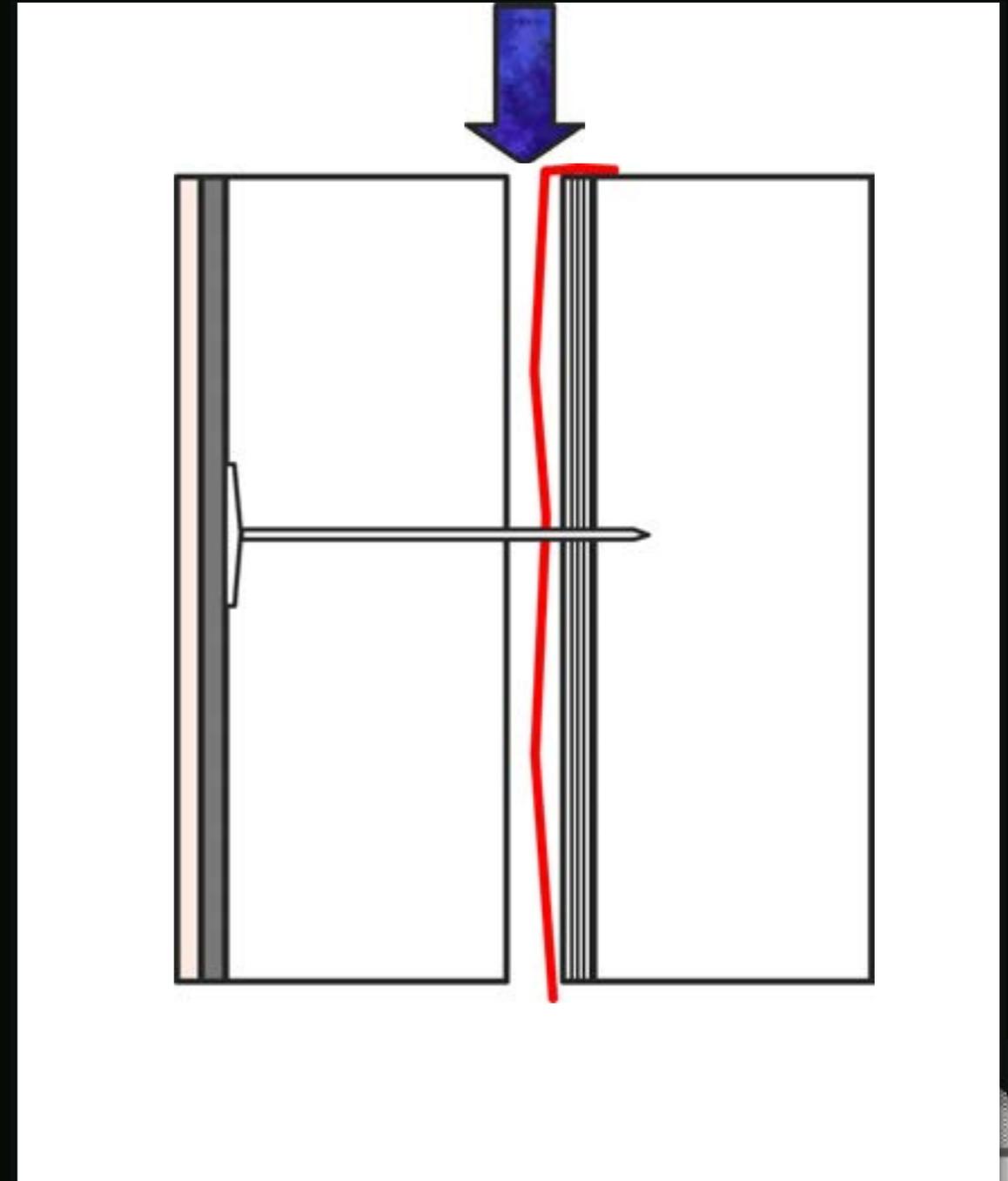
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity



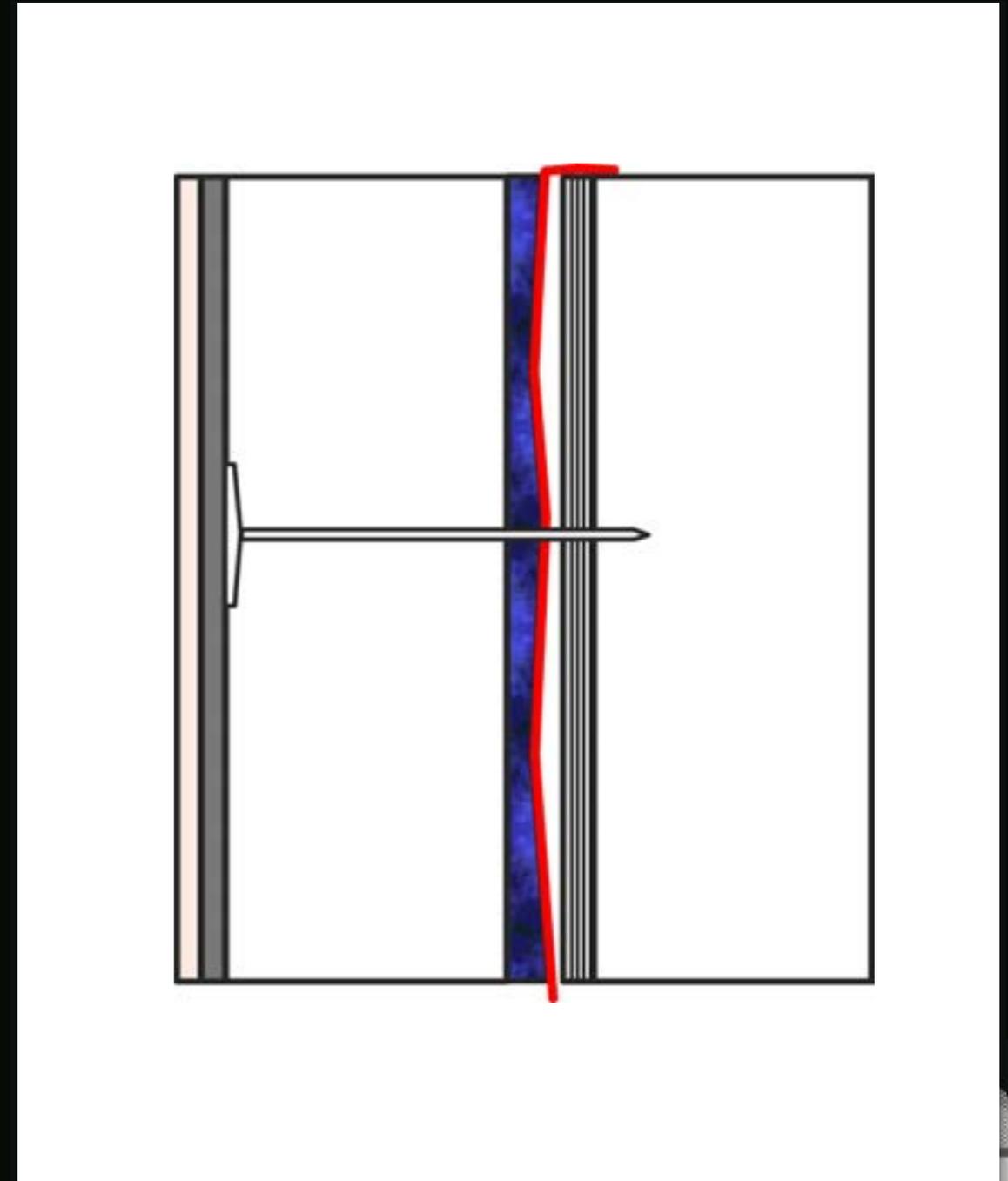
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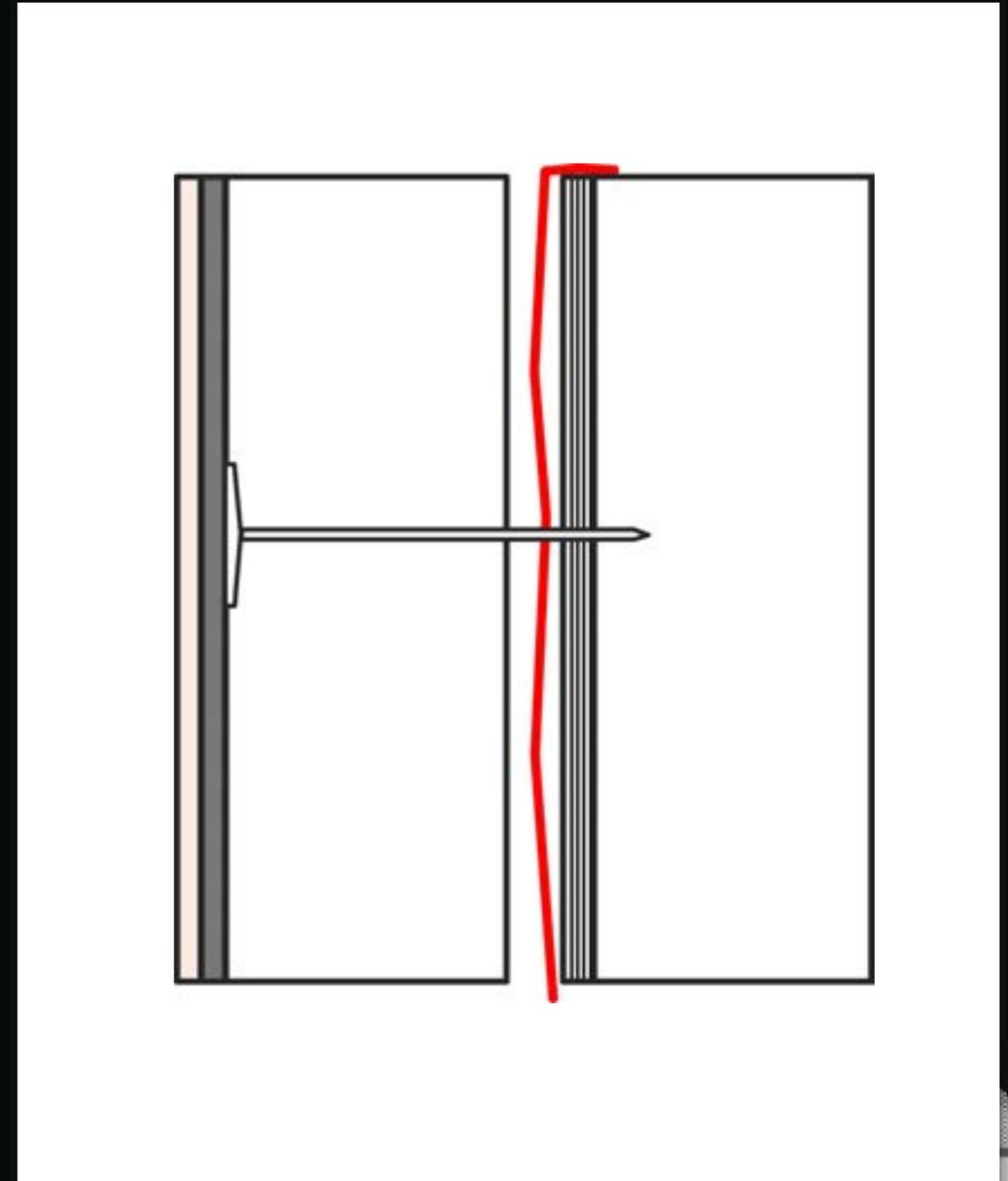
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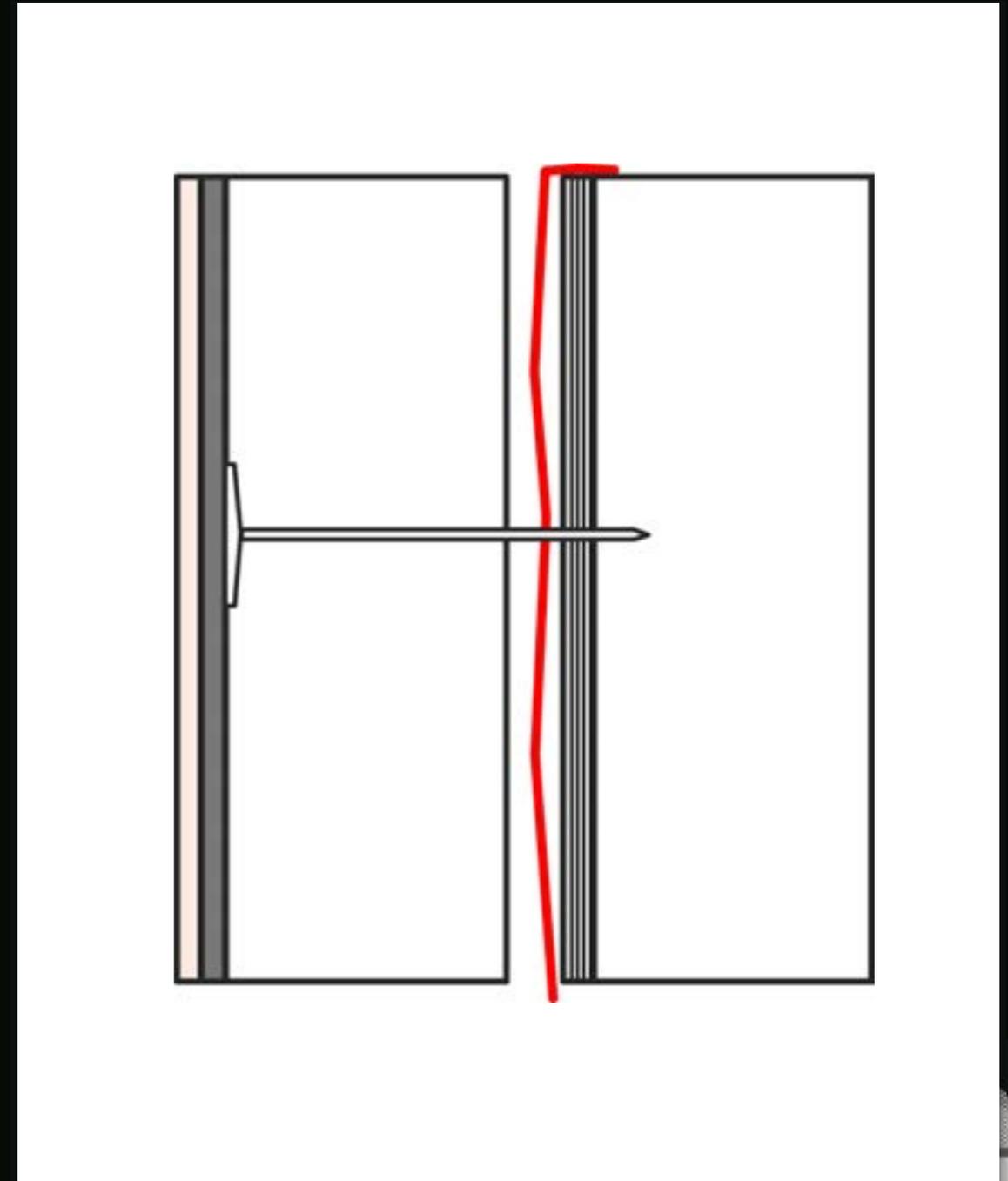
Original Drainage Test

- Demonstration testing for BOCA officials
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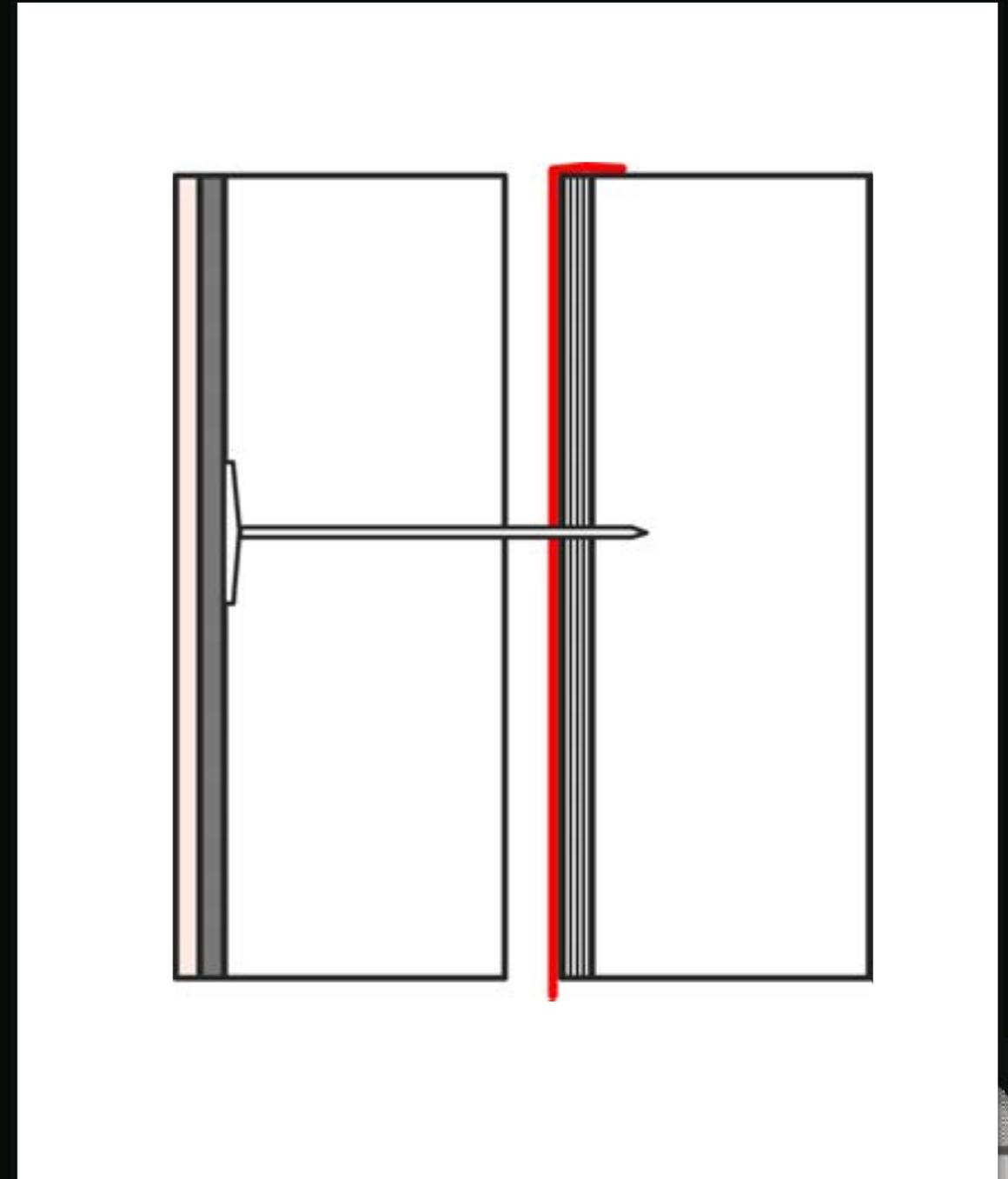
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity
- Pressure difference added



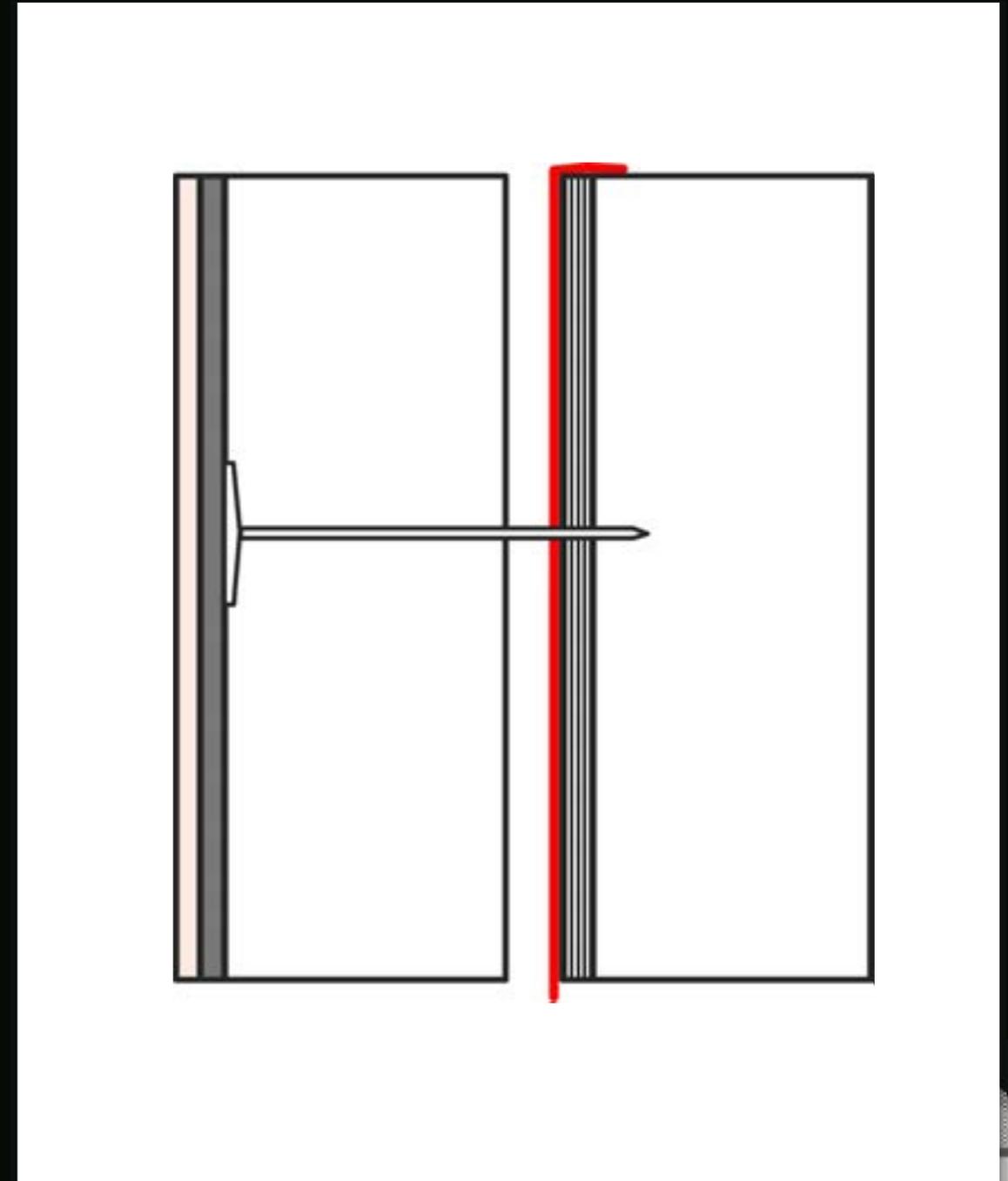
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity
- Pressure difference added



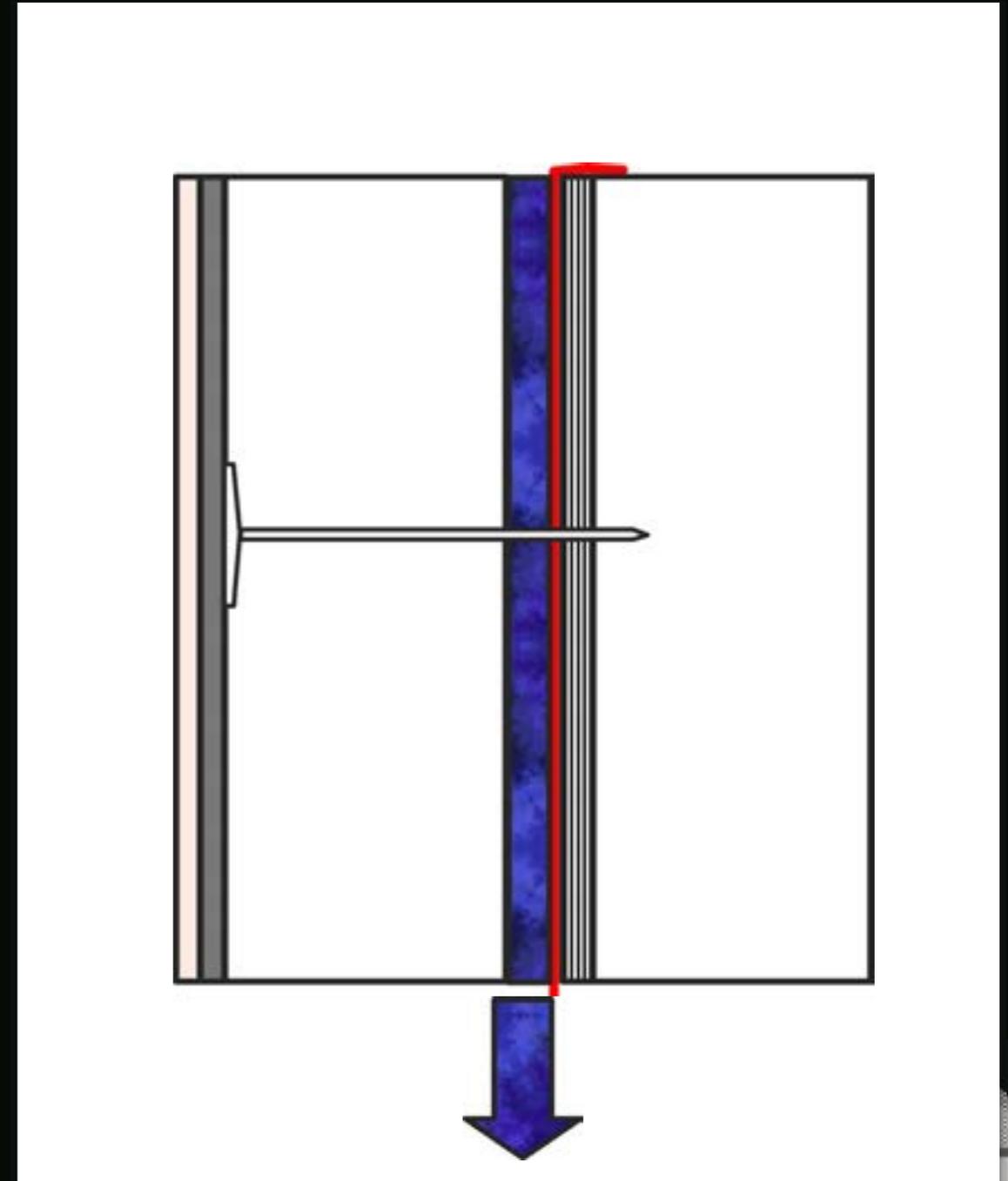
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened



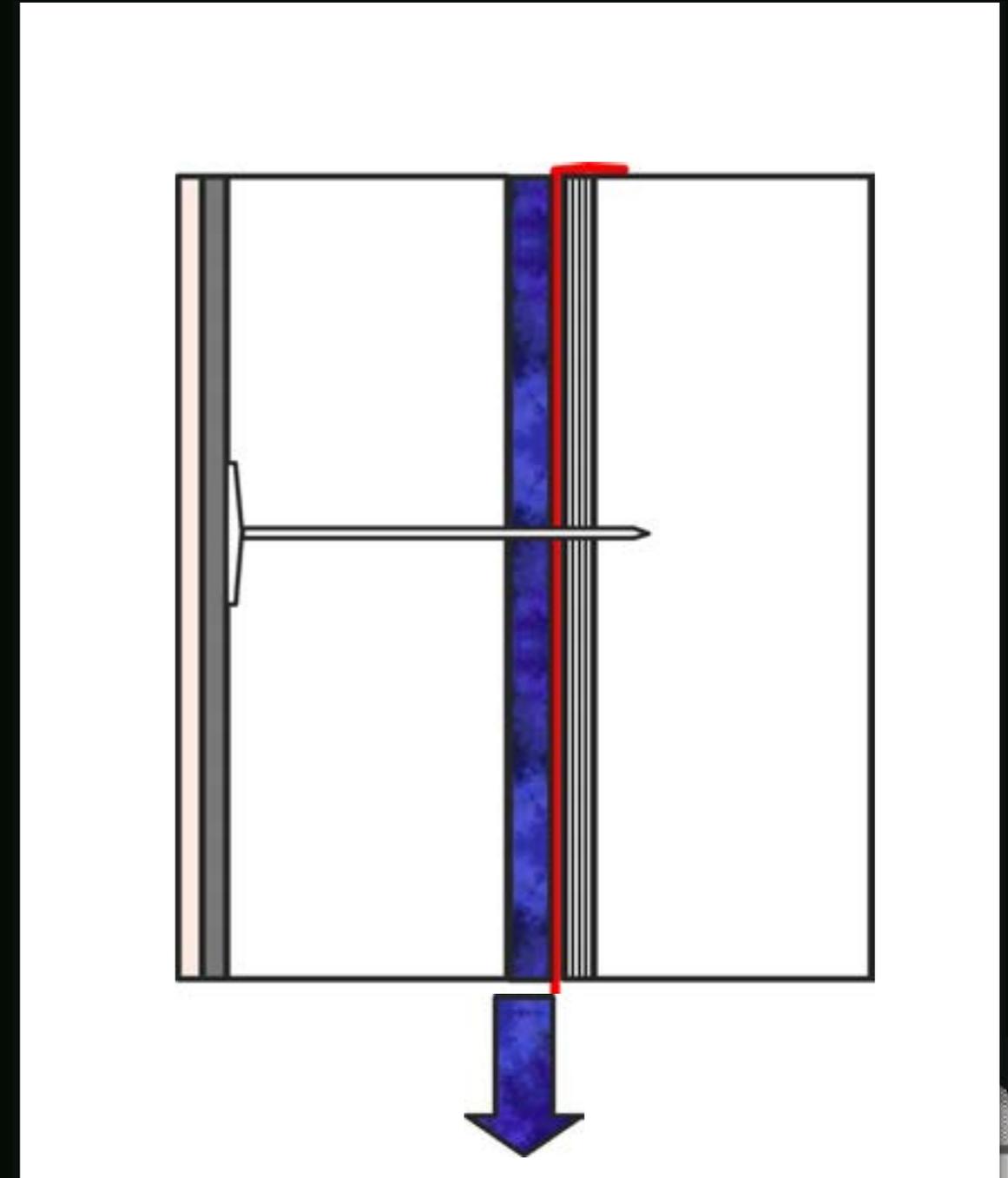
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened



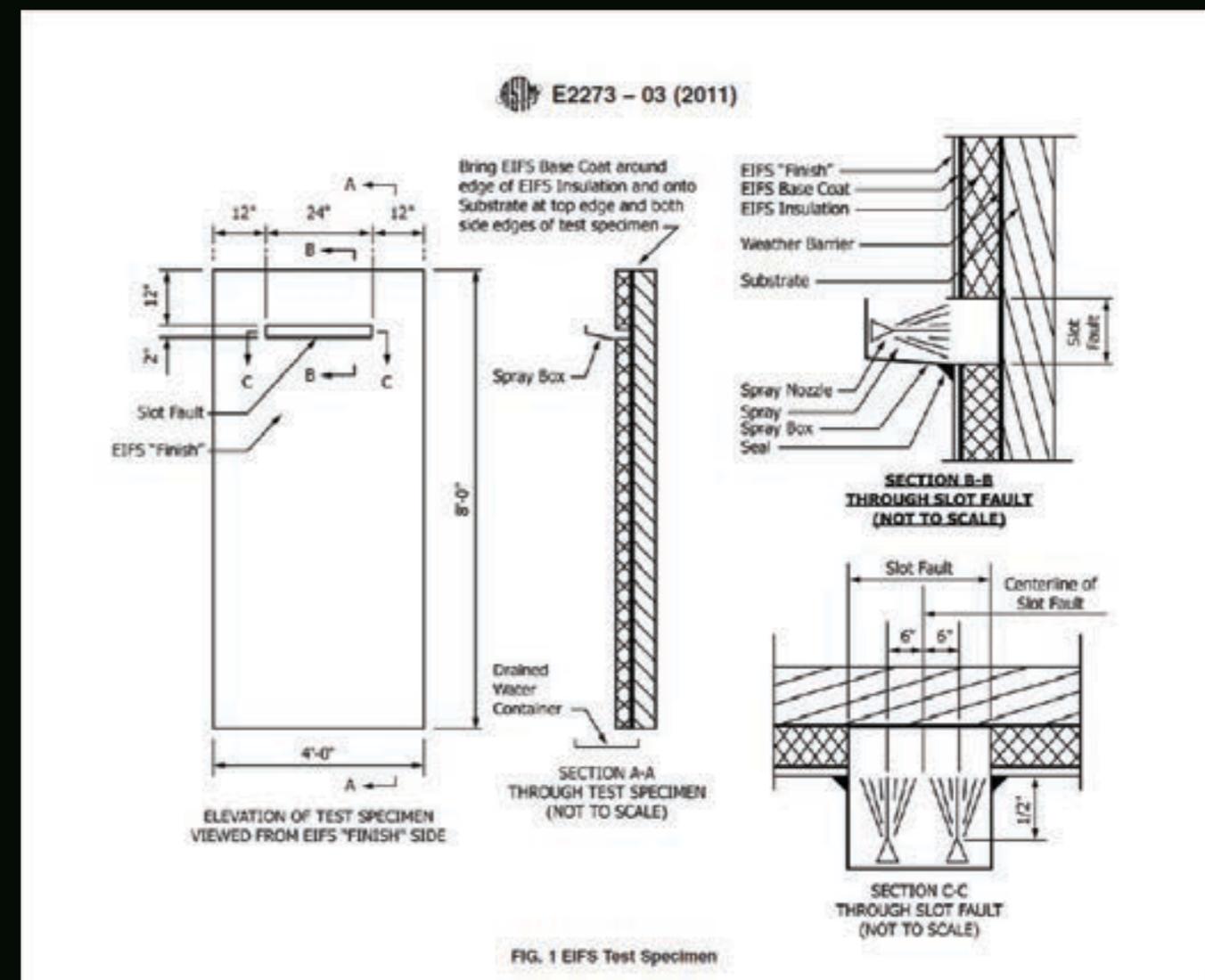
Original Drainage Test

- Demonstration testing for BOCA officials
- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened
- Testing now done without pressure



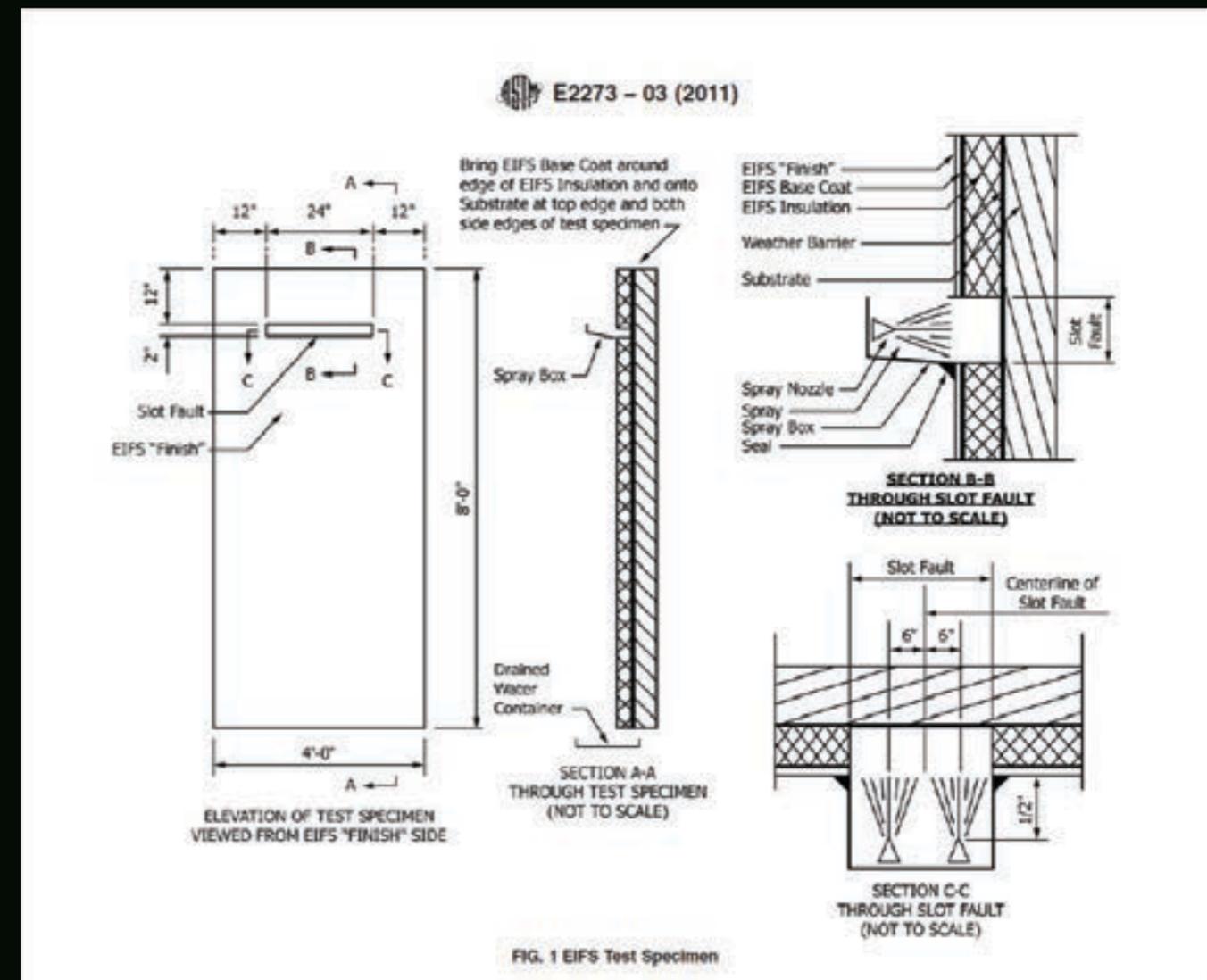
A standard is born

- ASTM E-2273
Drainage for EIFS



A standard is born

- ASTM E-2273
Drainage for EIFS
- 5 gal_{US} / hour sprayed
into 1/3 ft² opening



A standard is born

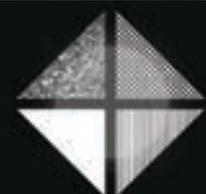
- ASTM E-2273
Drainage for EIFS
- 5 gal_{US} / hour sprayed
into 1/3 ft² opening
- Equals 19”/hour rainfall
- Only for EIFS —
all others ‘meet code’





Isn't water supposed to be deflected
away from the wall cavity ... not through it ?

Kindergarten Building Science



Welcome to Canada



British Columbia



Cladding for the new millennium

Barrett Commission

A government inquiry

“The ignorant provide advice to the deluded
and costly decisions are made.”

M. Chin Pang, Condo Owner
Commission of Inquiry into the Quality of
Condominium Construction in British Columbia

Fallout

- Class action litigation against NBCC*
- National Research Council of Canada gets nervous
- Code committees and NRCC Institutes get ‘fear of god’ lectures

* Spoiler - never sue the government

Moisture in Exterior Wall Systems (MEWS)

NRCC research consortium
c. 2002

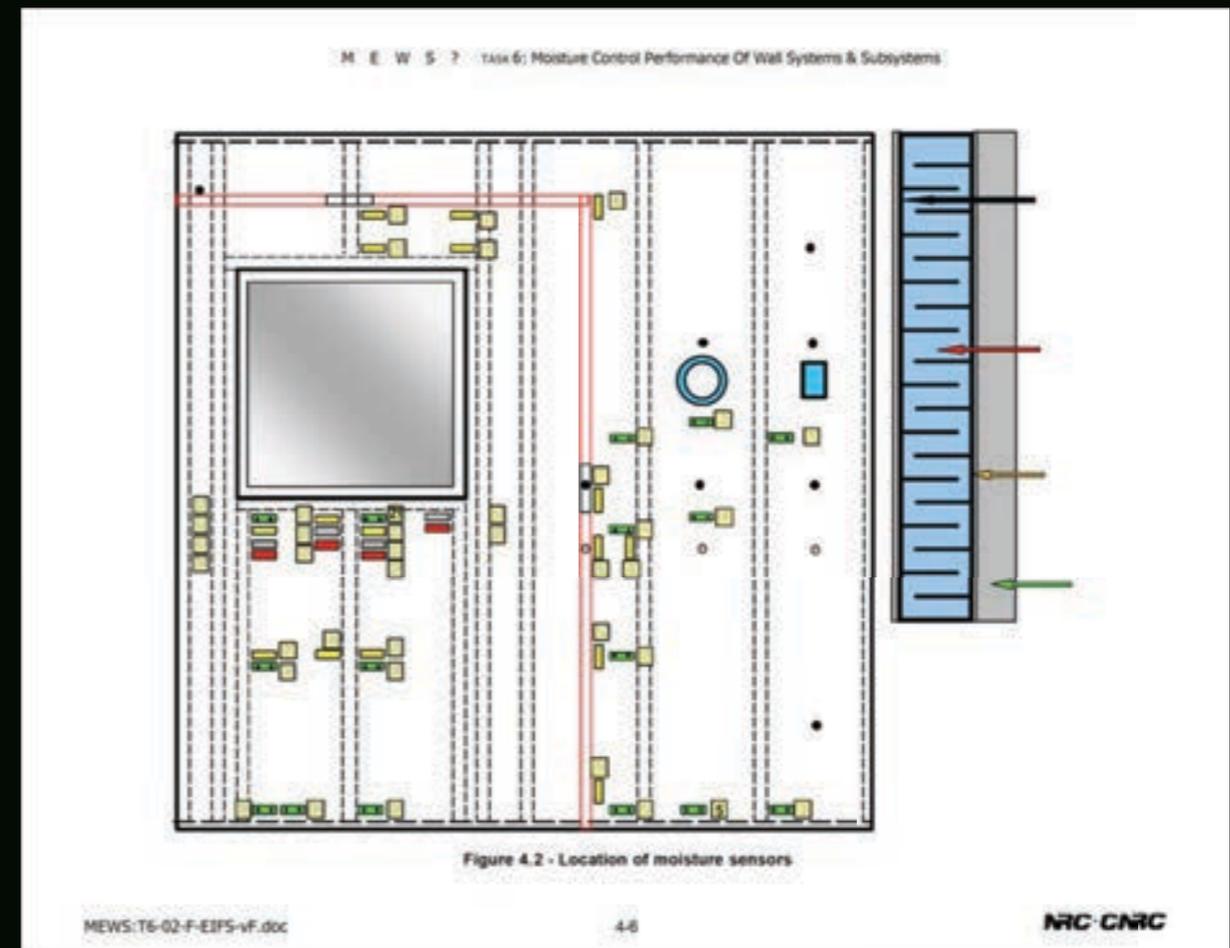


MEWS

- Evaluated weather data across Canada and the USA
- Developed Moisture Index (MI)
— compares rate of wetting vs. drying
- More wetting than drying $MI > 1.0$
- Covers wet coastal areas (Newfoundland & BC)

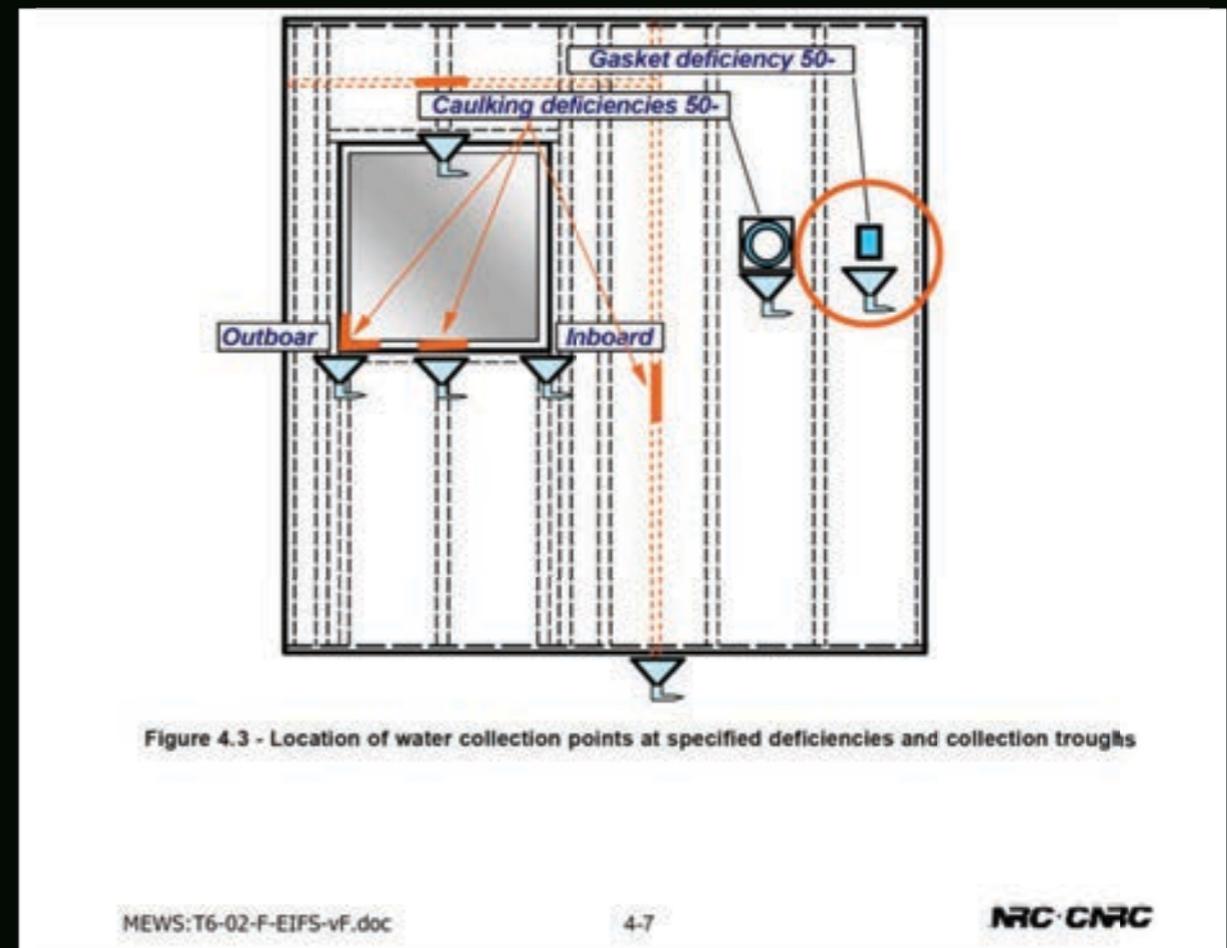
Leakage

- Wall claddings sprayed with water (amount based on worst case weather)



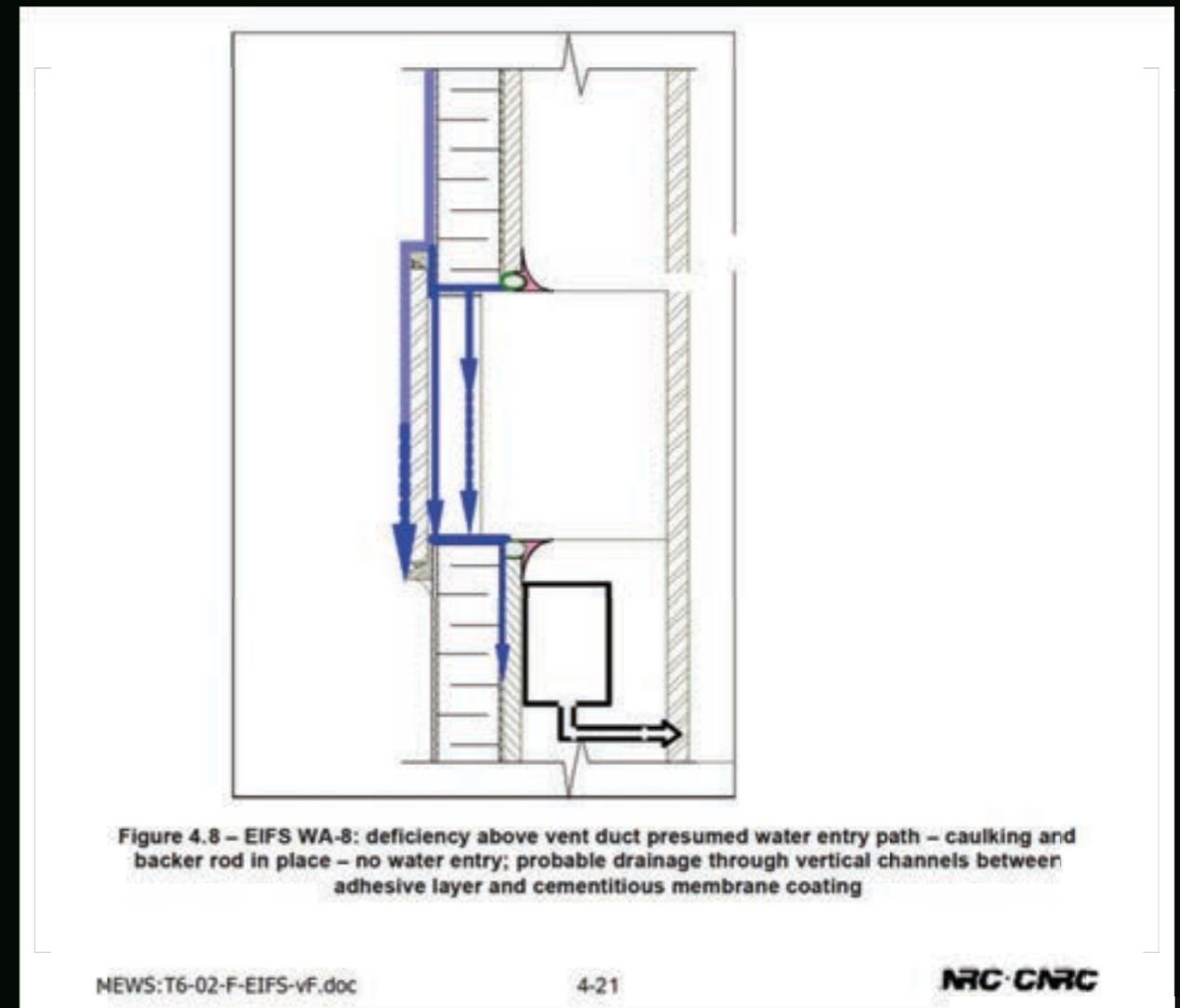
Leakage

- Wall claddings sprayed with water (amount based on worst case weather)
- Walls had normal penetrations with common flaws
- Pressure differences added

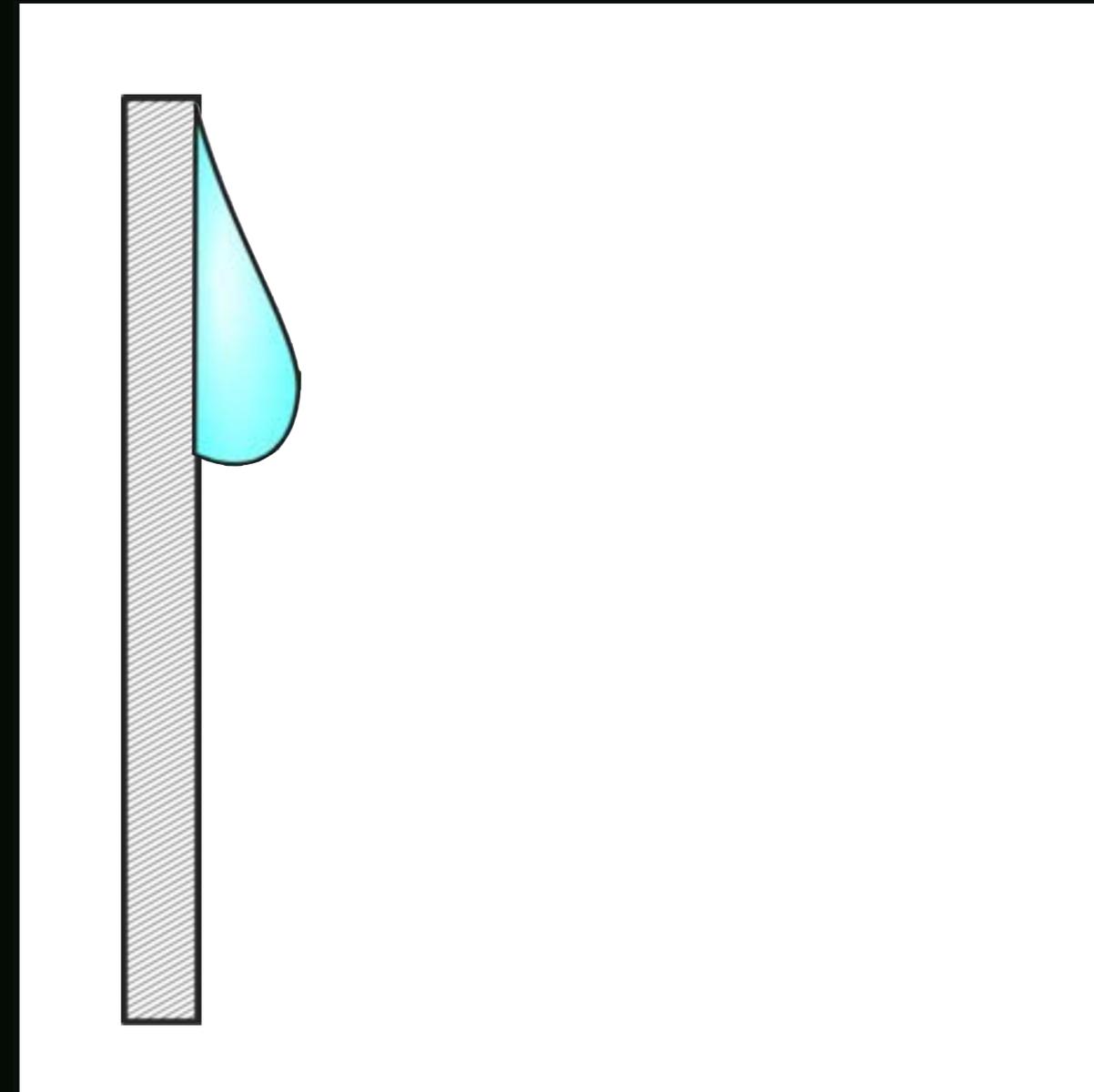


Leakage

- Wall claddings sprayed with water (amount based on worst case weather)
- Walls had normal penetrations with common flaws
- Pressure differences added
- Air leakage added

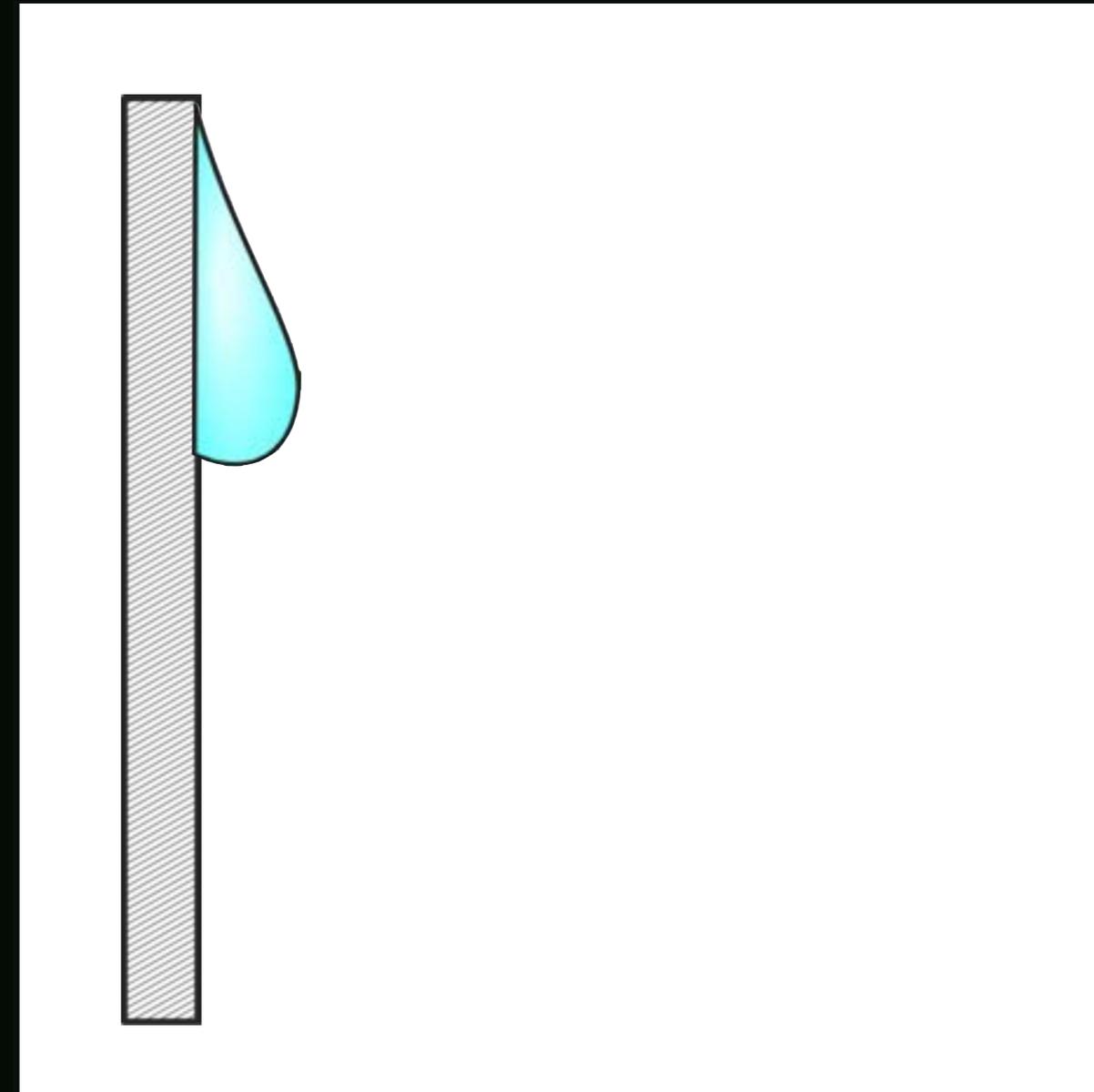


MEWS Fallout



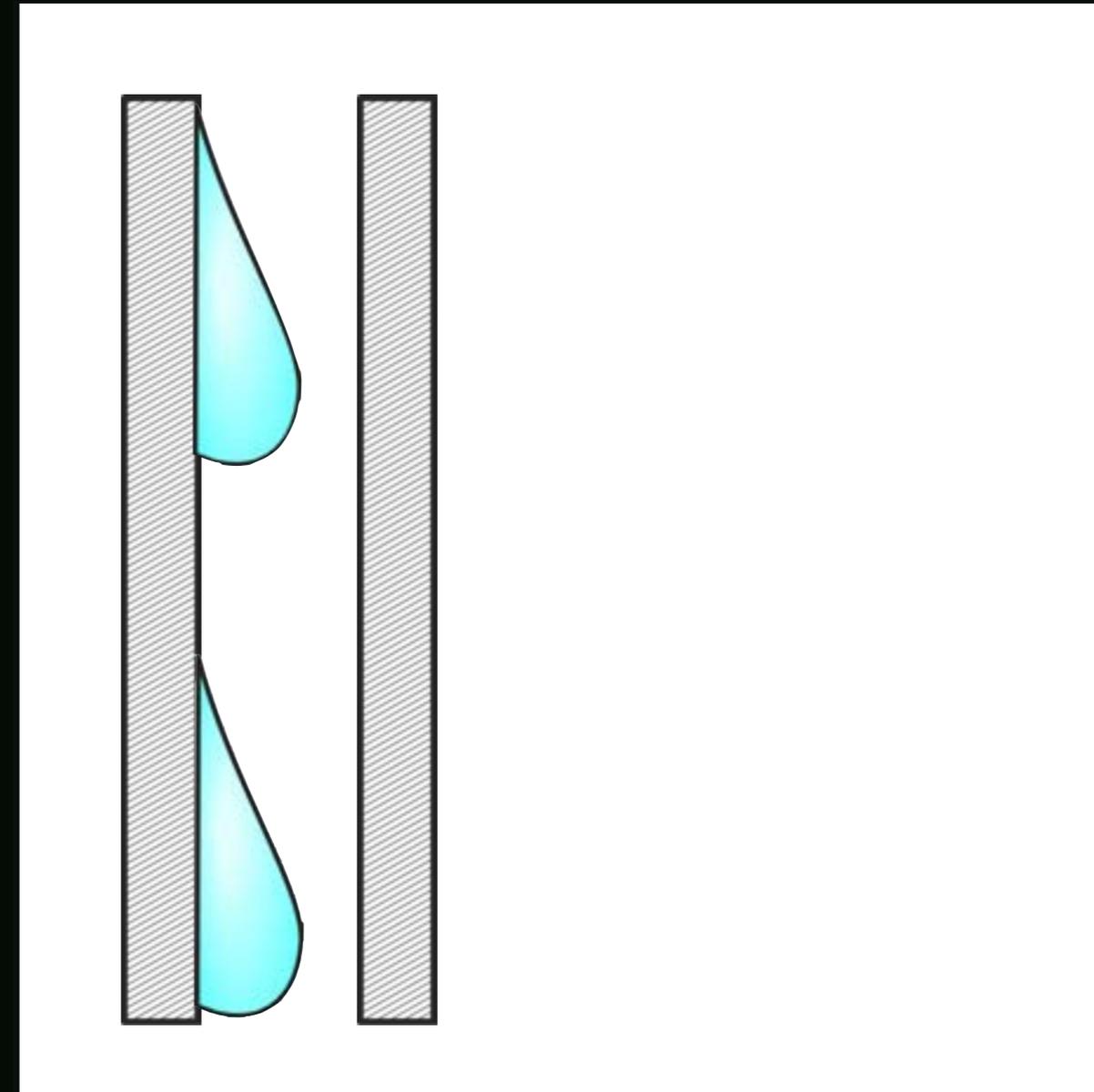
MEWS Fallout

- Moisture Index added to code
- Capillary break required
- Size ?



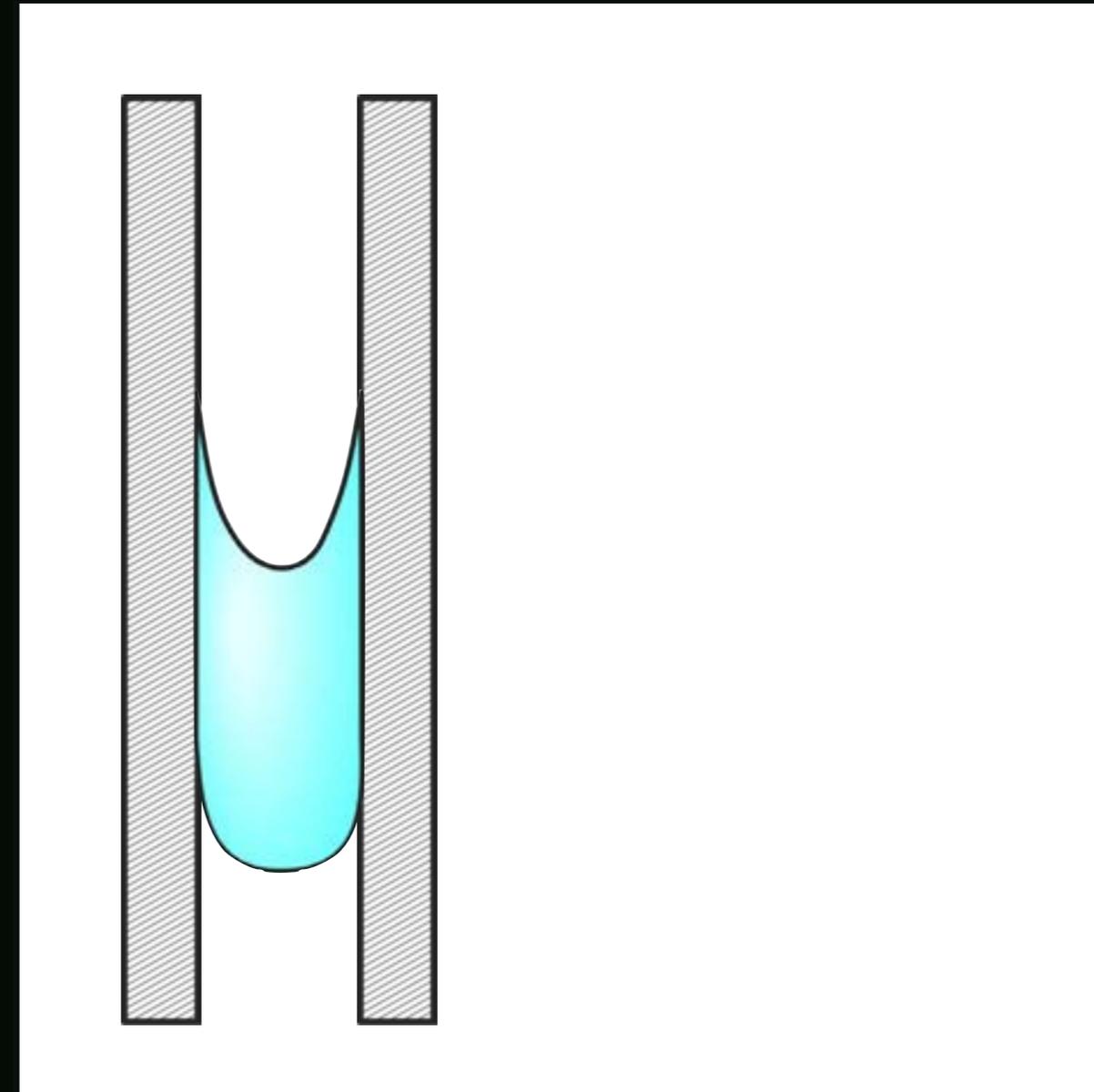
MEWS Fallout

- Moisture Index added to code
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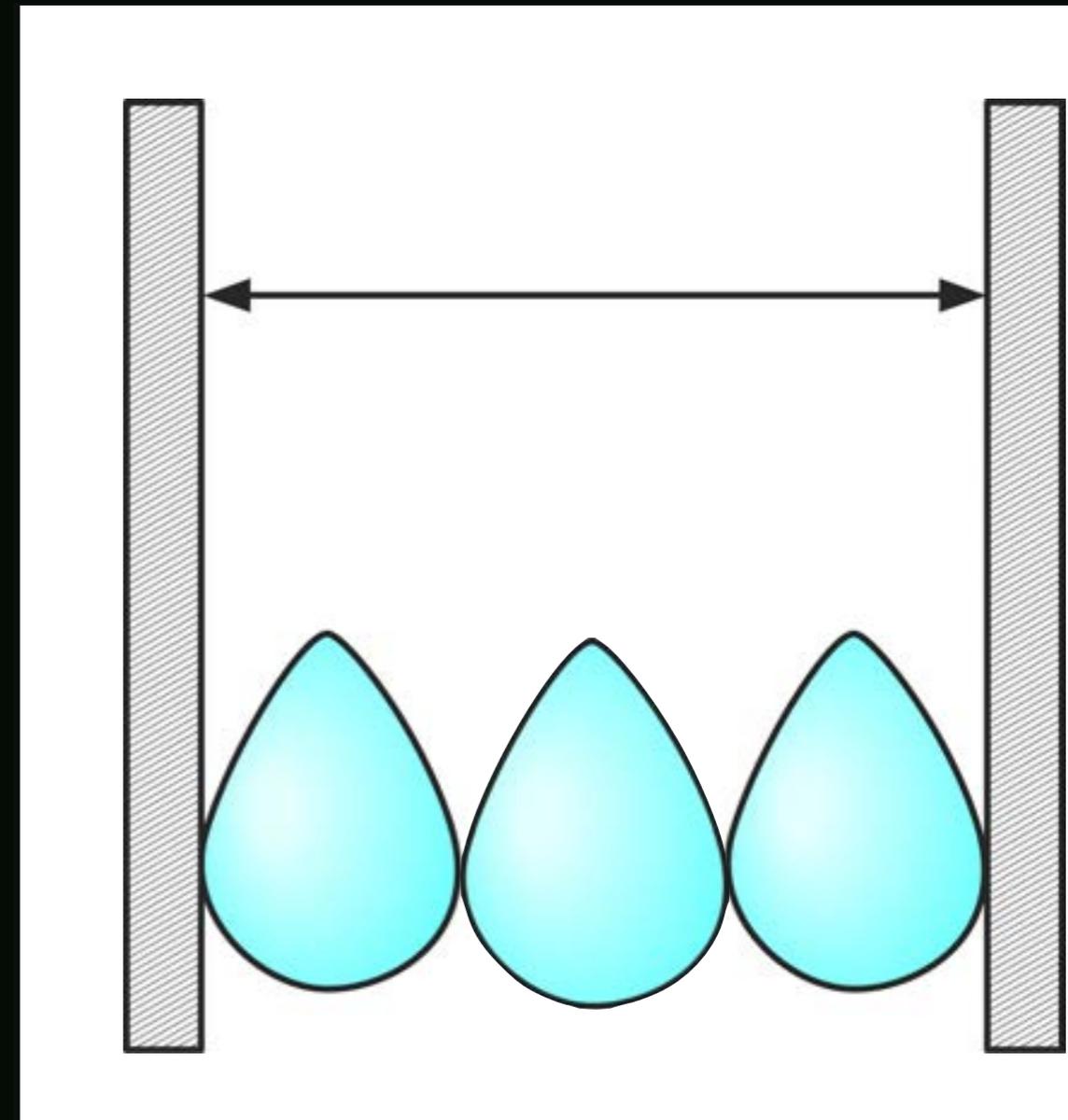
MEWS Fallout

- Moisture Index added to code
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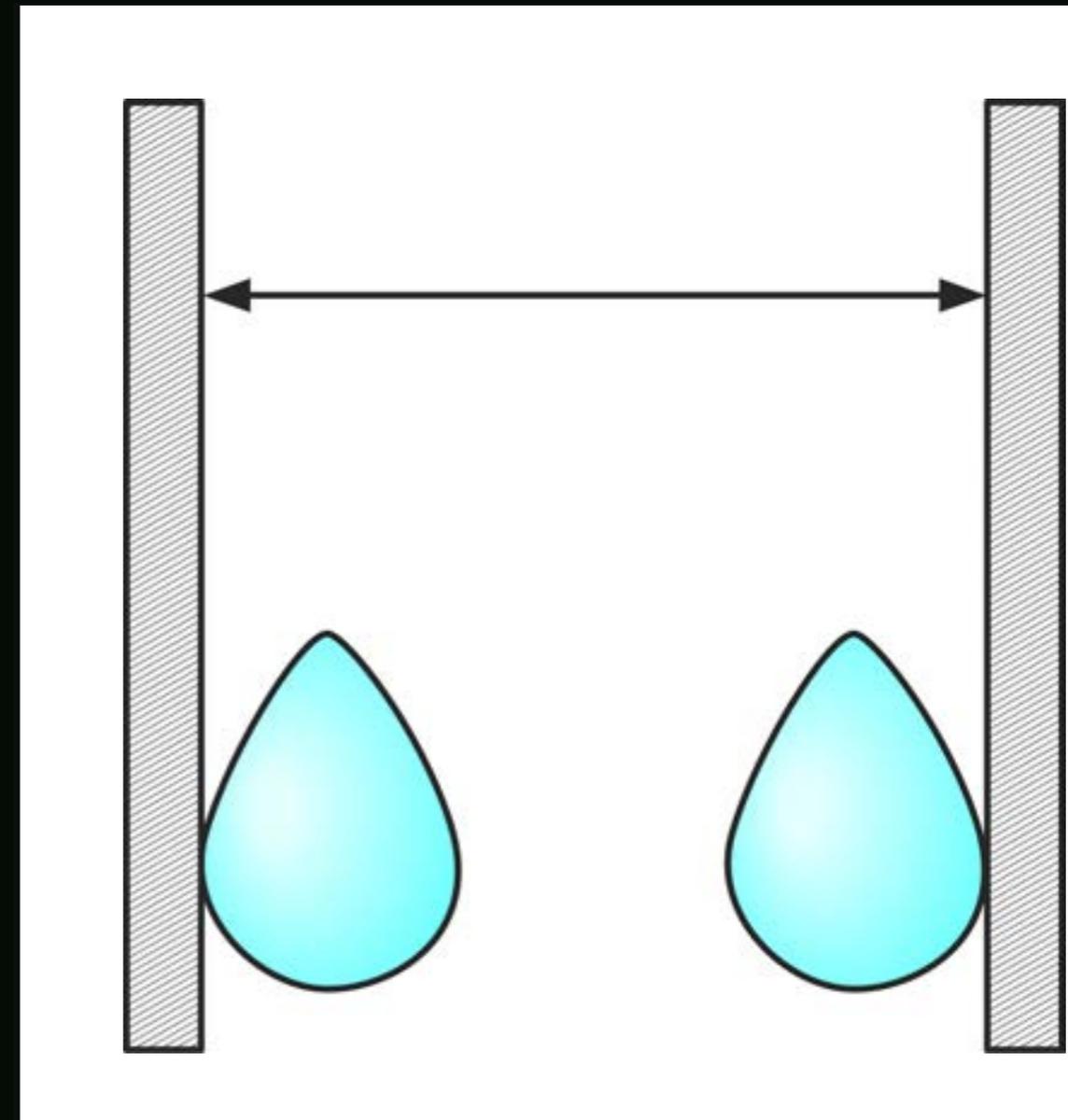
MEWS Fallout

- Moisture Index added to code
- Capillary break required
- Size ?



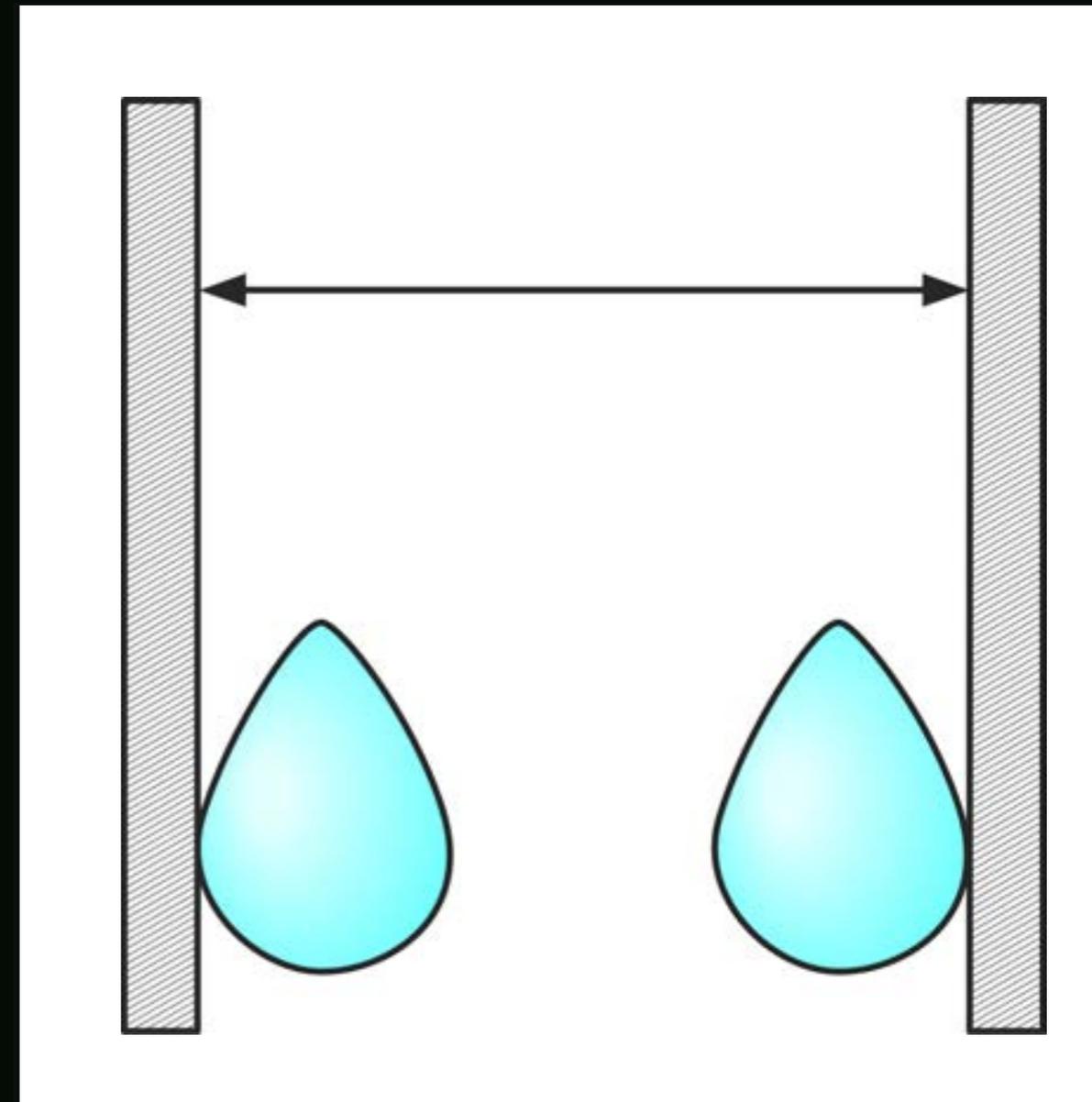
MEWS Fallout

- Moisture Index added to code
- Capillary break required
- Size ?



MEWS Fallout

- Moisture Index added to code
- Capillary break required
- Size ?
- 10 mm - based on width of 3 drops of water.



Canadian Construction Materials Centre

CCMC

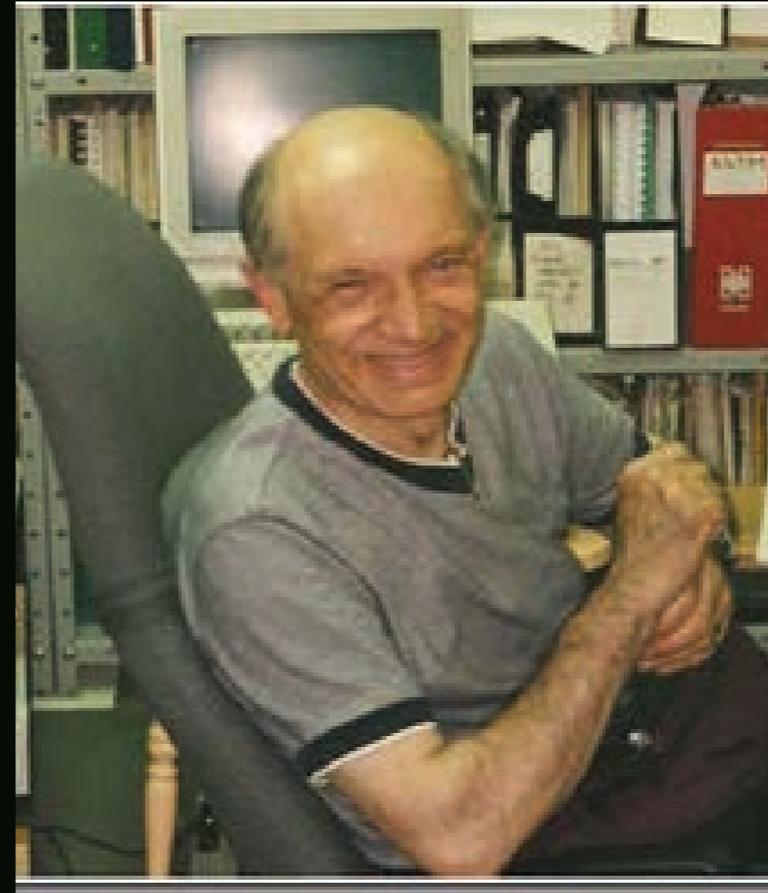
- EIFS must have drainage !
- No problem - ASTM with 90% drainage requirement
- Where does the 10% go ?
- Another consortium research project established !

Forintek



Forintek

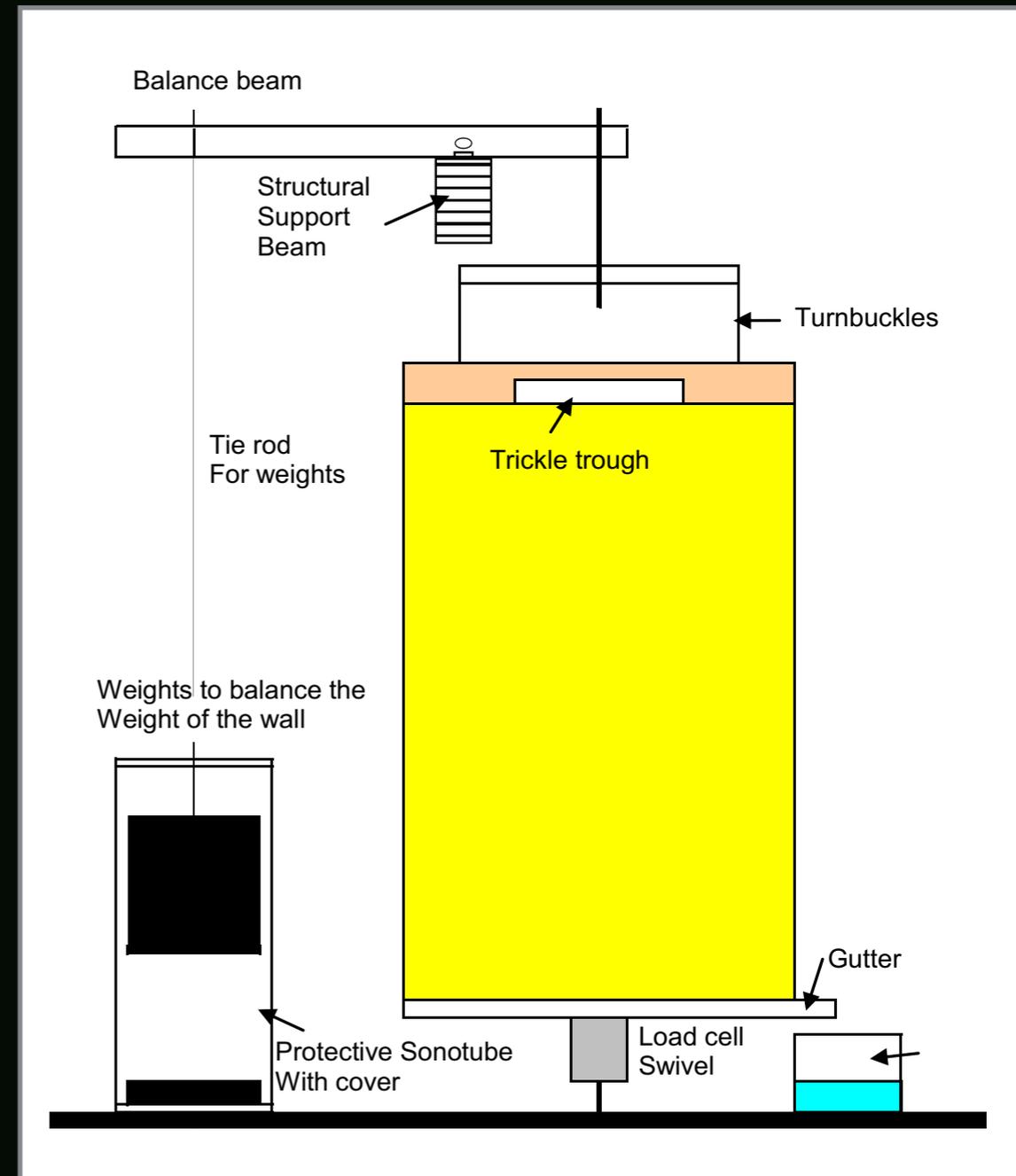
- Enter Drs. Don Onysko and Mark Bomberg
- DMO Associates (Don, Mark and Others)
- Drainage and LA-WRB for CCMC
- Bonus round - drainage for Canada Mortgage and Housing (CMHC)



Drainage Research

Find the 10%

- EIFS panels suspended and counter-balanced
- Leaks are small and chronic, so water dribbled into panels
- Mass of water measured to 1g accuracy



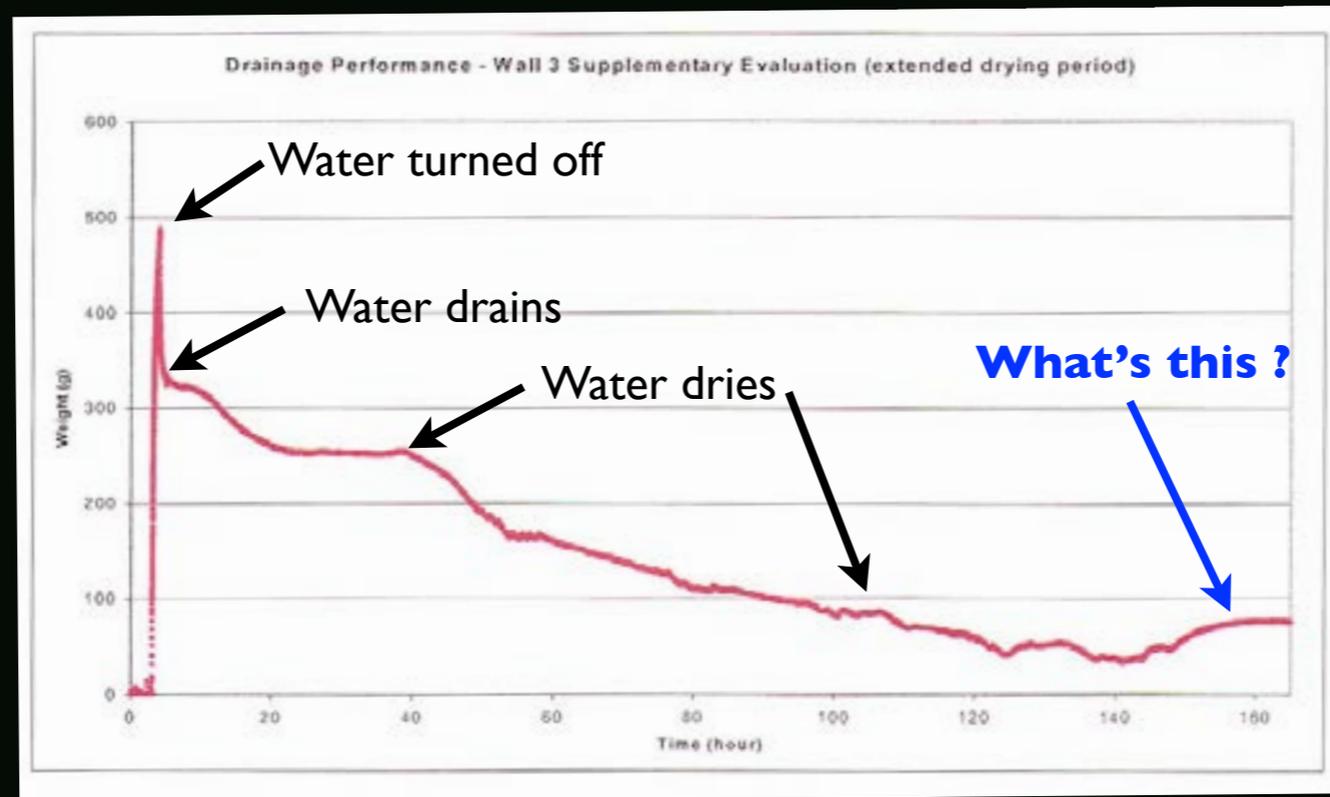
Drainage Research

Find the 10%

- EIFS panels suspended and counter-balanced
- Leaks are small and chronic, so water dribbled into panels
- Mass of water measured to 1g accuracy
- Drained to 99.8% efficiency



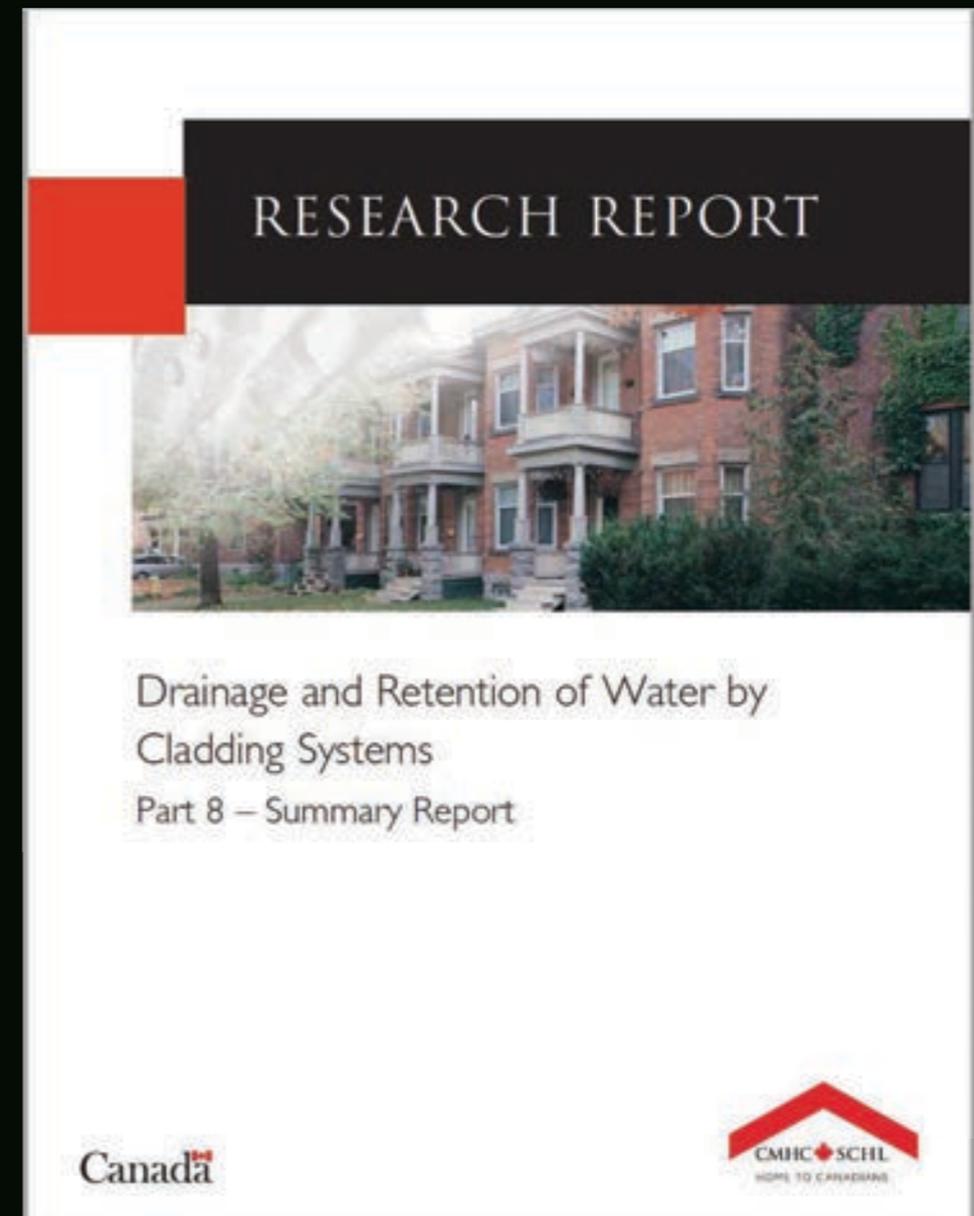
Research at Forintek and CanBEST Labs



St. Jean Baptiste Effect

Canada Mortgage & Housing Corporation (CMHC)

- Compared other claddings to EIFS



Canada Mortgage & Housing Corporation (CMHC)

- Compared other claddings to EIFS
- EIFS tended to drain the best

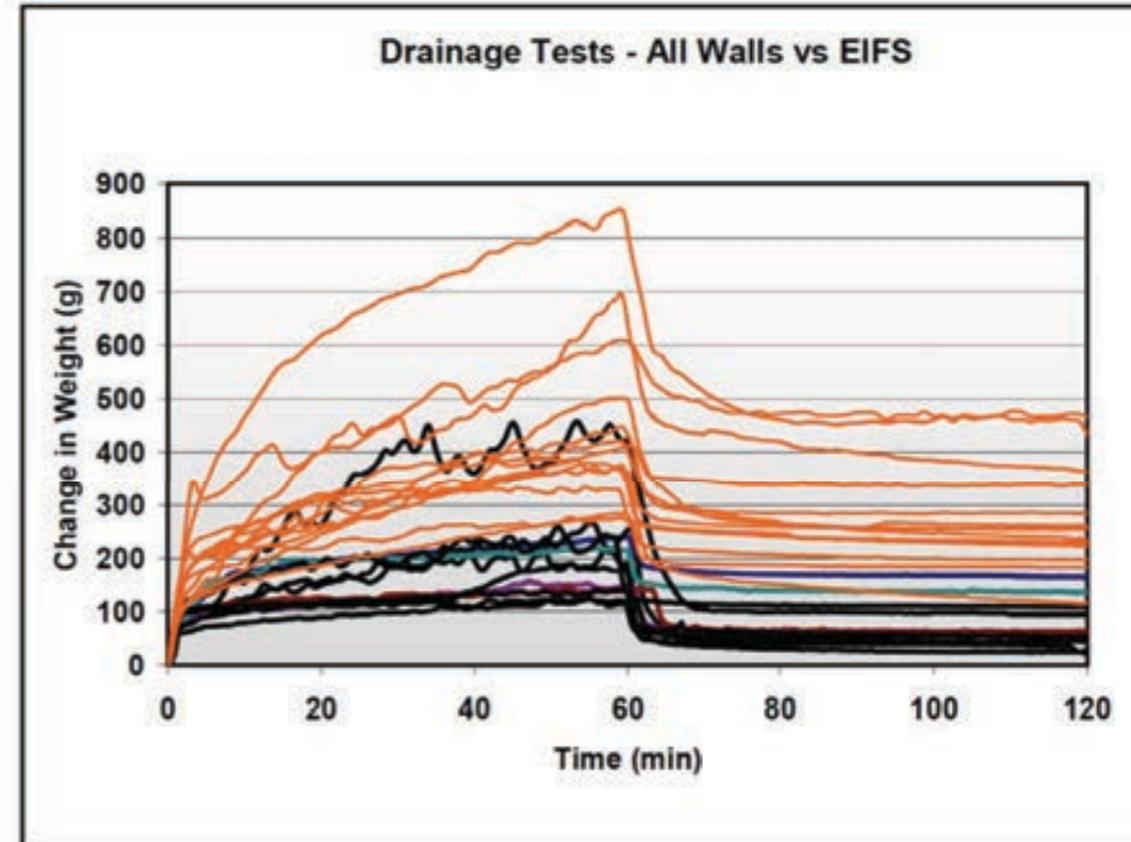


Figure 37 All drainage tests showing EIFS results highlighted.

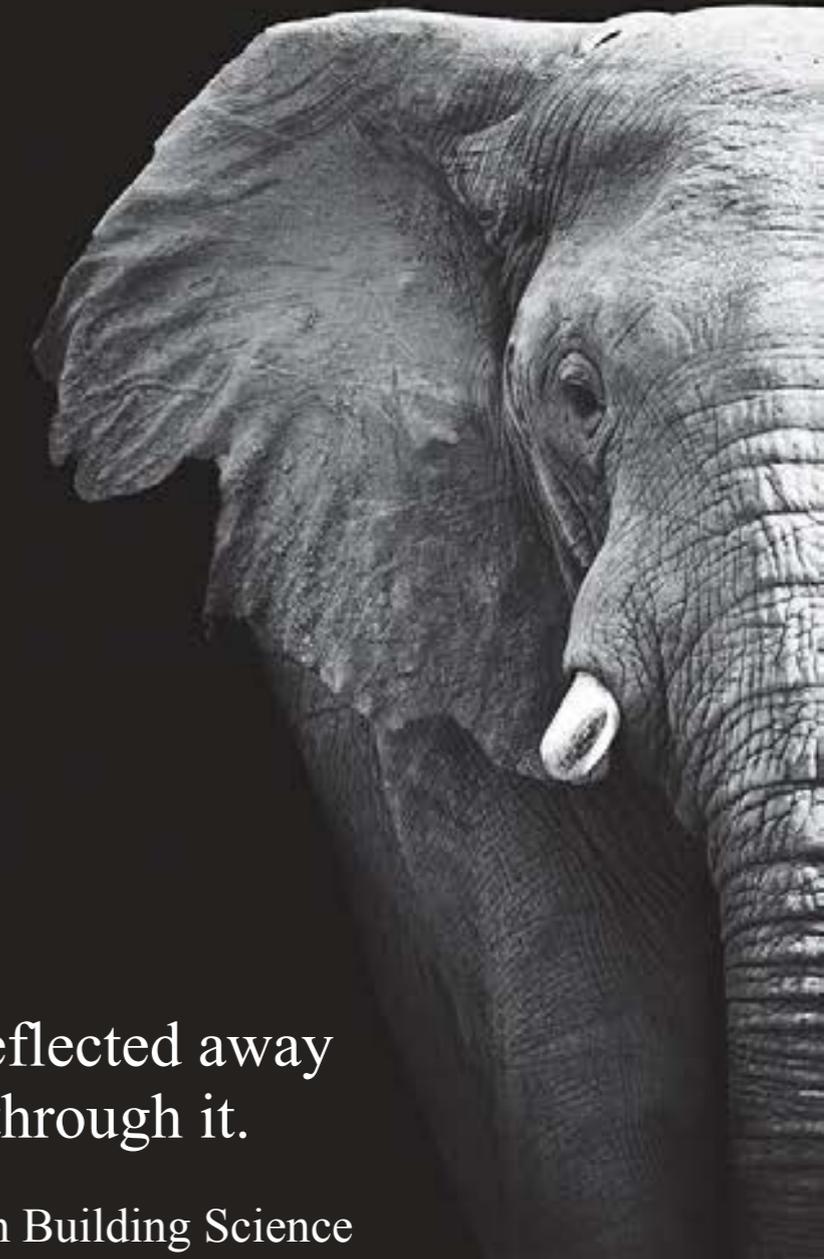


Water is supposed to be deflected away
from the wall cavity, not through it.

Kindergarten Building Science



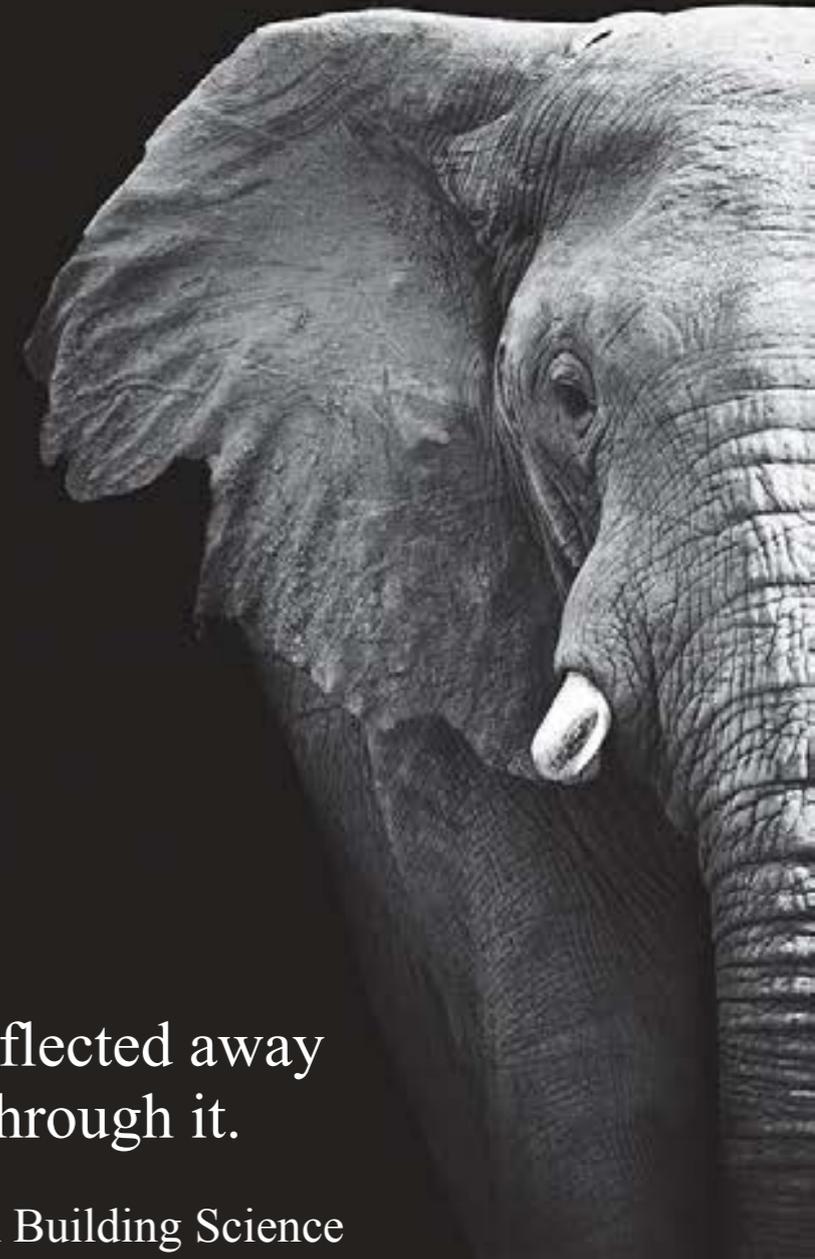
New level of detail



Water is supposed to be deflected away
from the wall cavity, not through it.

Kindergarten Building Science

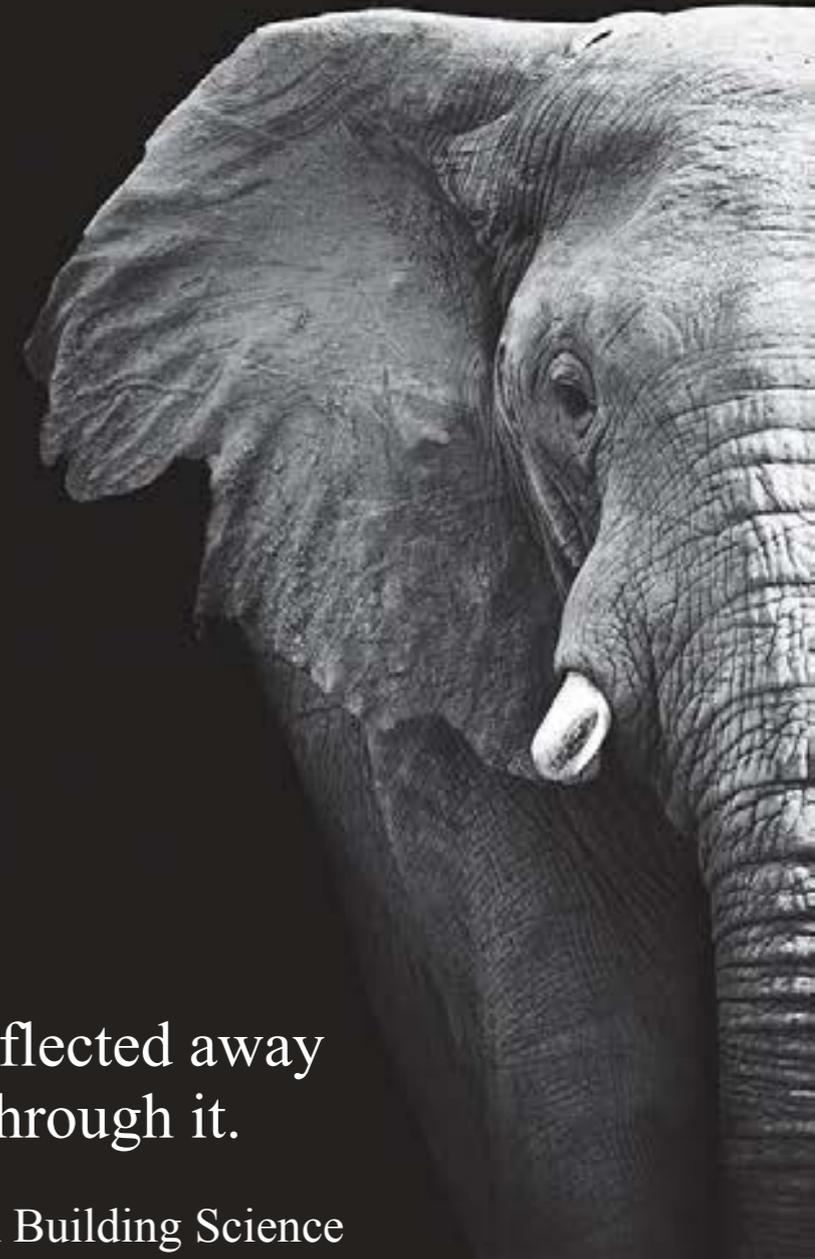
New level of detail



Water is supposed to be deflected away from the wall cavity, not through it.

Kindergarten Building Science

New level of detail



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Kindergarten Building Science

LA-WRB Research



LA-WRB Research

- Jumping elephant test (to induce nail pops)

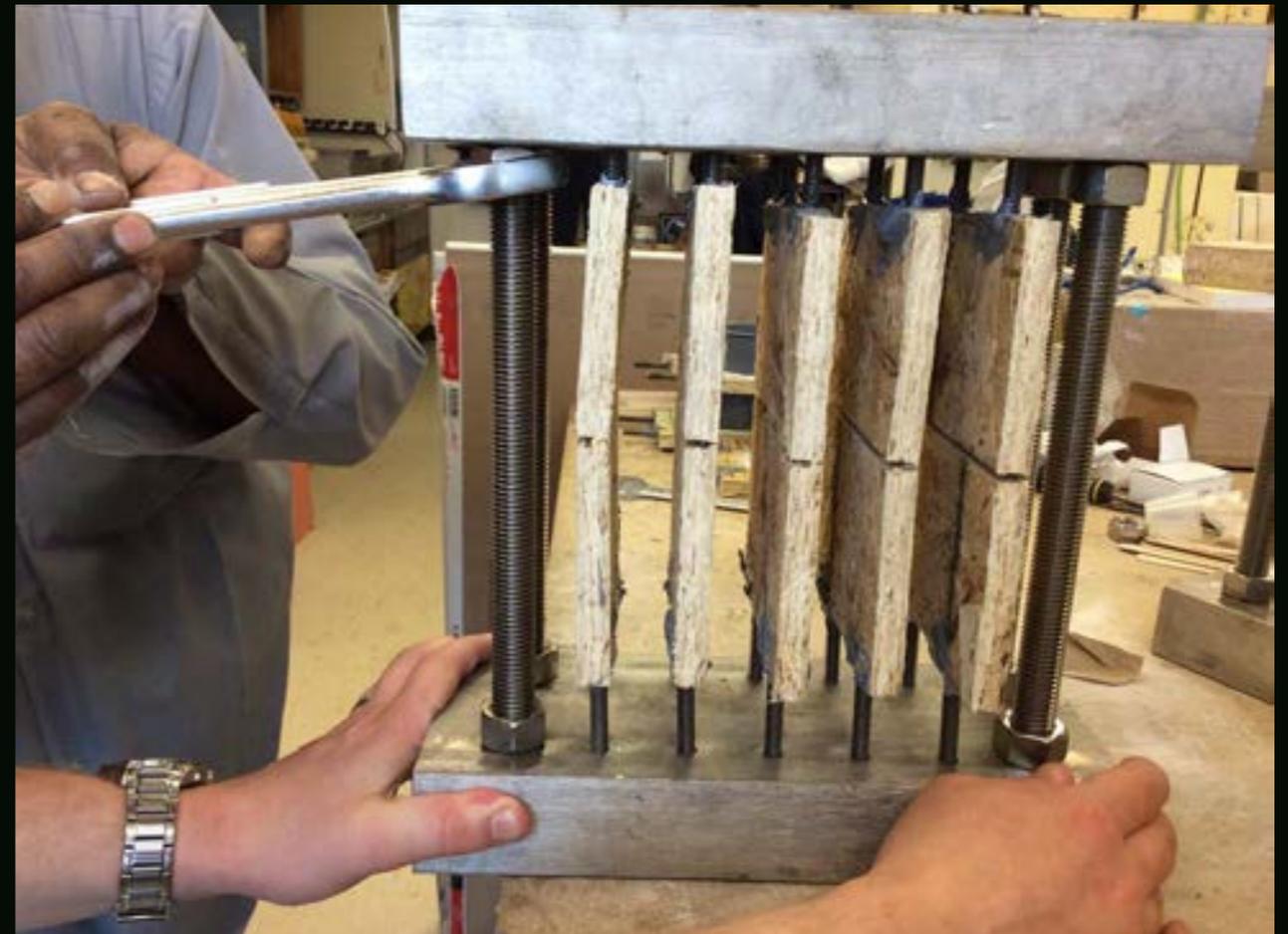


LA-WRB Research

- Jumping elephant test
(to induce nail pops)
- Joint relaxation test

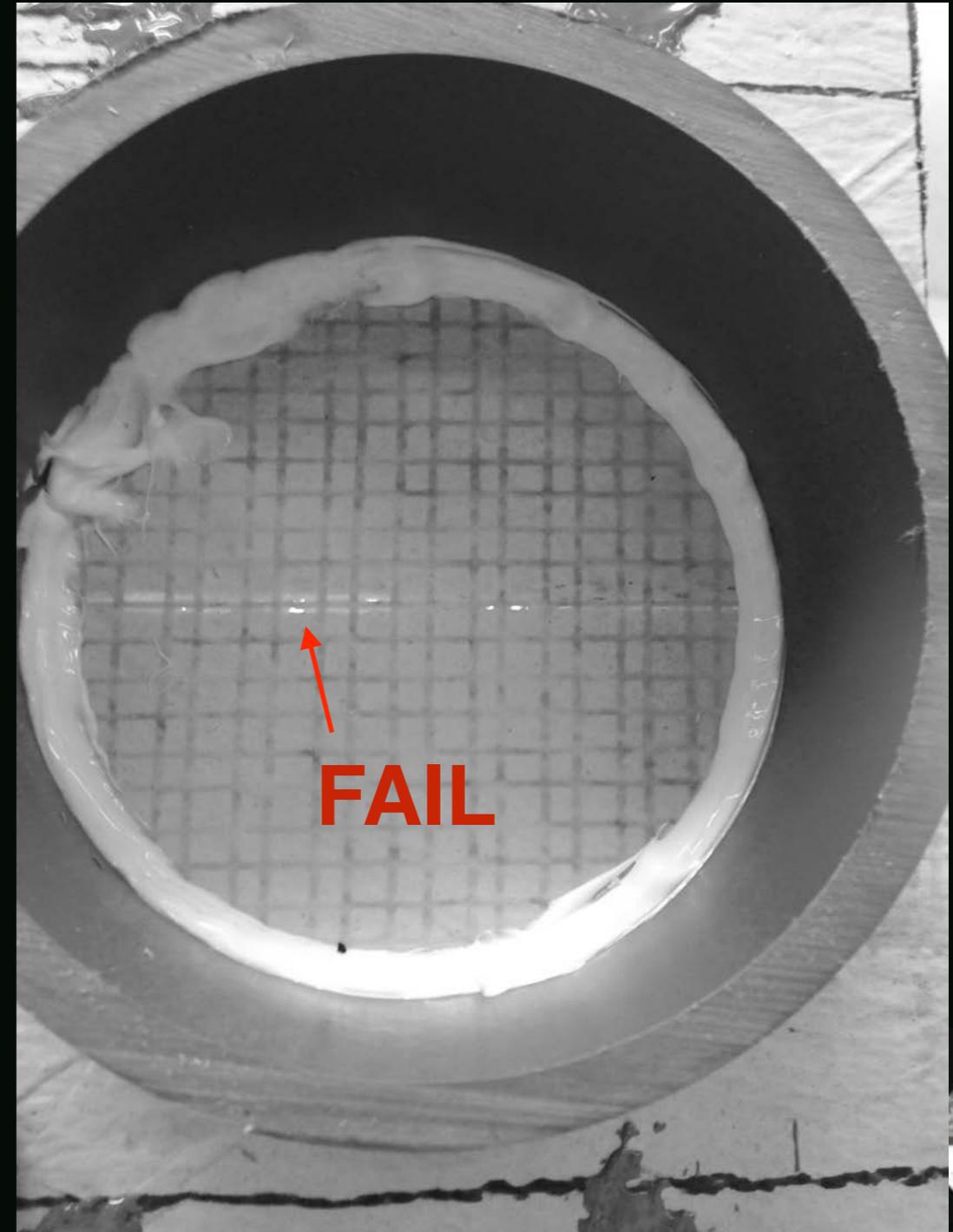
LA-WRB Research

- Jumping elephant test (to induce nail pops)
- Joint relaxation test



LA-WRB Research

- Jumping elephant test (to induce nail pops)
- Joint relaxation test



LA-WRB Research

- Jumping elephant test (to induce nail pops)
- Joint relaxation test



LA-WRB Research

- Jumping elephant test
(to induce nail pops)
- Joint relaxation test
- Joint disruption test
- Bond tests before, during and
after immersion
- CCMC evaluation ??????

CCMC Fallout

A new, very expensive, 5-year NRCC research consortium for Damage Assessment to determine how much water can be retained without damage occurring to the substrate material

CCMC Fallout

A new, very expensive, 5-year NRCC research consortium for Damage Assessment to determine how much water can be retained without damage occurring to the substrate material

OR

CCMC Fallout

OR

Just say 40 grams is the same as zero



The EIFS Industry leads !



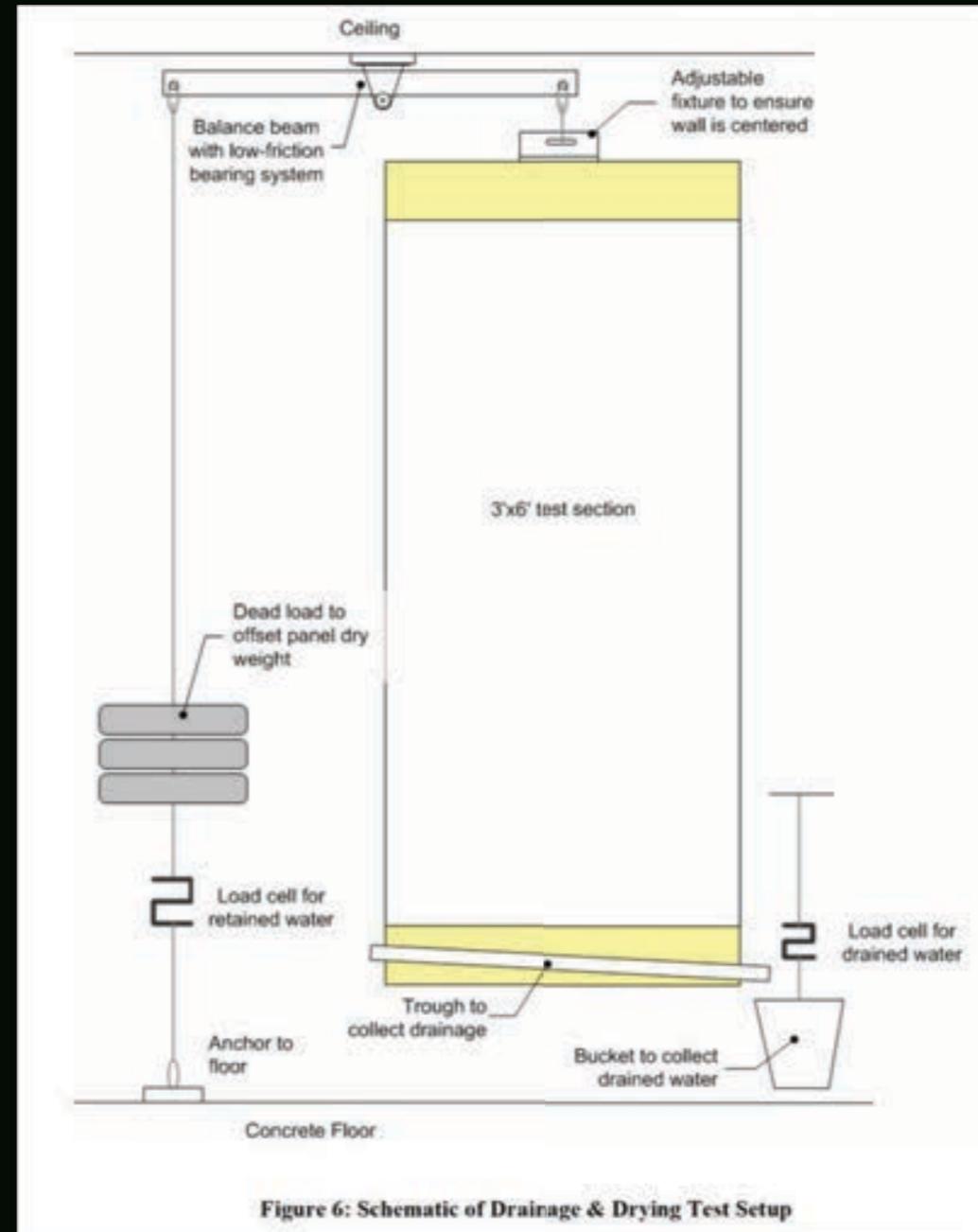
The EIFS Industry leads !



How come no other cladding has to meet the same requirements ?

Drainage at University of Waterloo

Drainage and drying



Drainage and drying

- Air leakage of drainage cavity
- Drainage
- Drying with solar and wind effects
- Supports modelling at ORNL

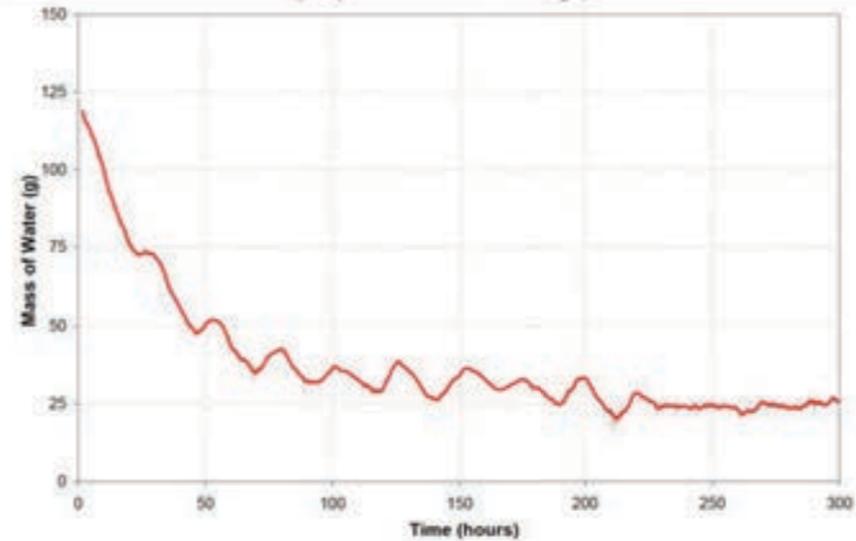


Figure 11: Drying test with small wind pressure (1 Pa)

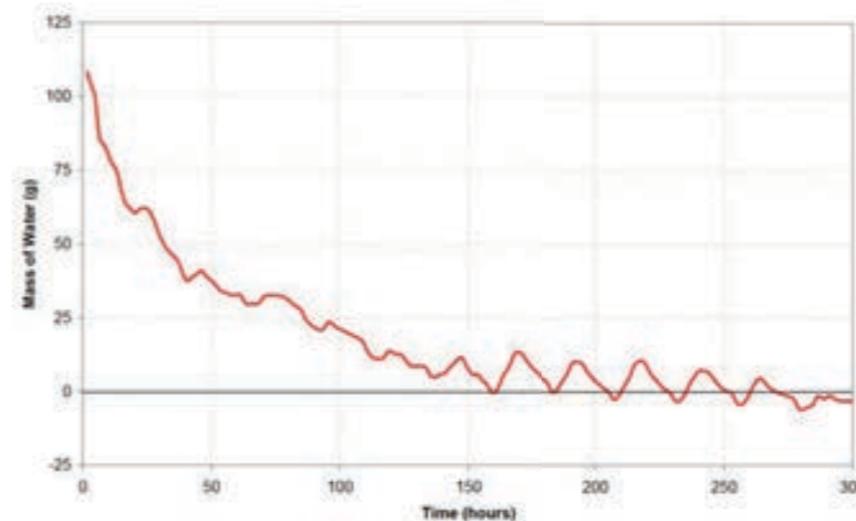


Figure 12: Drying test with low solar exposure 8 hours per day

Drainage and drying

- Air leakage of drainage cavity
- Drainage
- Drying with solar and wind effects
- Supports modelling at ORNL
- Thanks to Jonathan Smegal's master's thesis

Drainage and Drying of Small Gaps in Wall Systems

by

Jonathan Smegal

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Applied Science
in
Civil Engineering

Waterloo, Ontario, Canada, 2006

© Jonathan Smegal, 2006



Back to the USA



Modeling at OakRidge National Laboratory



Advanced Modeling

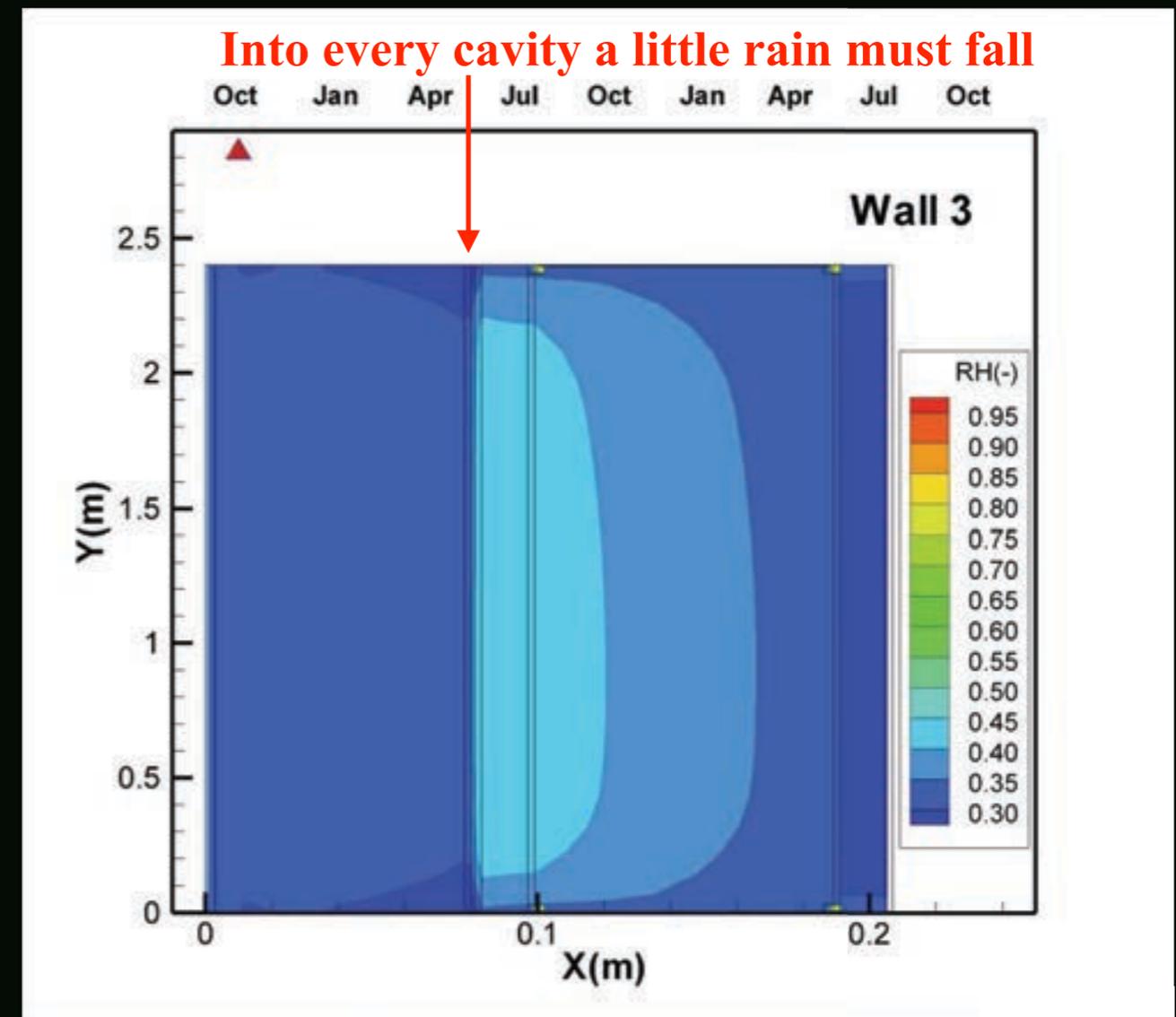
- Famous Greek physicist
- Developed material characteristics
- Model predicts 1% of rainfall enters into cavity
- Showed EIFS works everywhere (including Boston)



Dr. Achilles Karagiozis

Advanced Modeling

- Famous Greek physicist
- Developed material characteristics
- Model predicts 1% of rainfall enters into cavity
- Showed EIFS works everywhere (including Boston)



Field Performance Natural Exposure Test (NET) Facility

Hollywood, South Carolina

Official Opening 2004

- Dignitaries plus ...



Official Opening 2004

- Dignitaries plus ...
- Important scientist to explain how it works



Dr. Andre Desjarlais. ORNL

- Opening day



- Opening day
- After 2 years of monitoring, panels added to opposite side



- Opening day
- After 2 years of monitoring, panels added to opposite side
- It has everything !



- Opening day
- After 2 years of monitoring, panels added to opposite side
- It has everything !
- Including drainage



Monitored leakage

- Gutter size matched to test panel opening



Monitored leakage

- Gutter size matched to test panel opening
- Tip bucket drained onto WRB



Monitored leakage

- Gutter size matched to test panel opening
- Tip bucket drained onto WRB
- EIFS drained

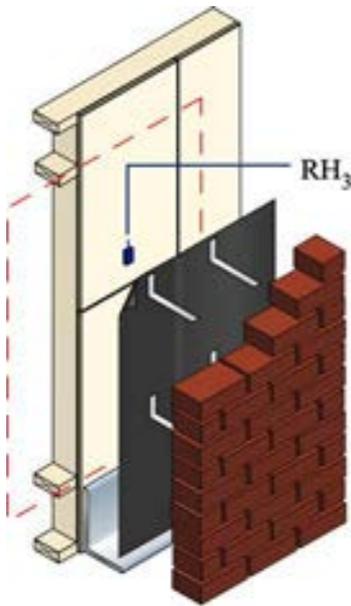


Monitored leakage

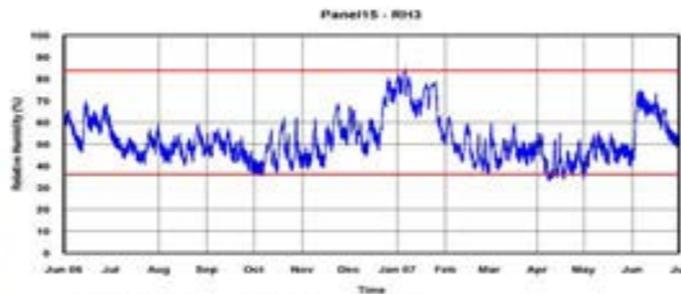
- Gutter size matched to test panel opening
- Tip bucket drained onto WRB
- EIFS drained
- Brick ...



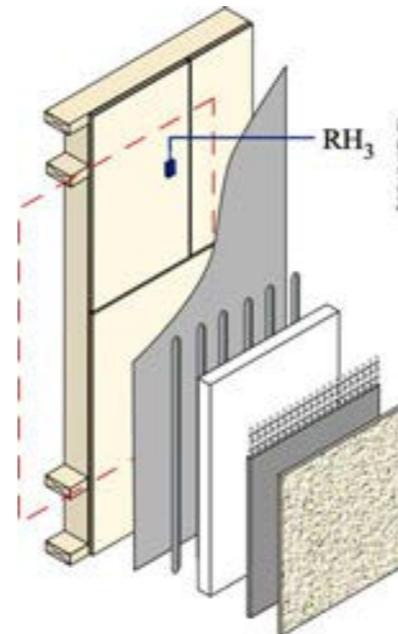
Performance



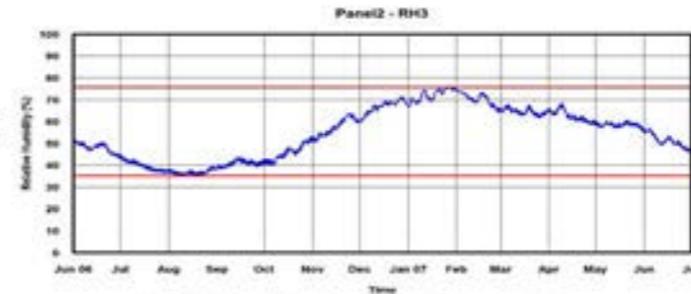
Brick Panel 2 without flaw



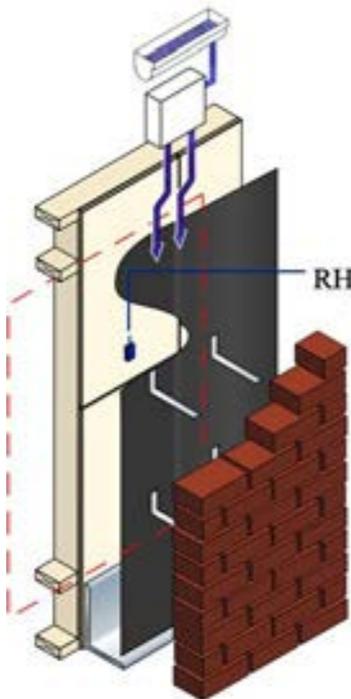
Brick Panel 15 - Sensor RH₃ - no flaw



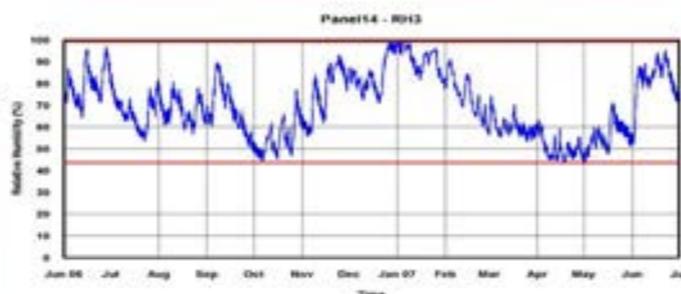
EIFS Panel 2 without flaw



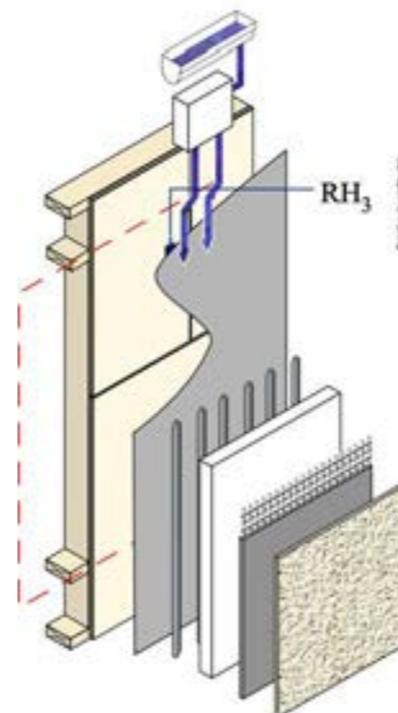
EIFS Panel 2 - Sensor RH₃ - no flaw



Brick Panel 3 with flaw



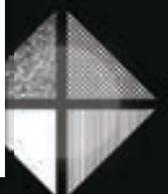
Brick Panel 14 - Sensor RH₃ - flaw



EIFS Panel 3 with flaw



EIFS Panel 3 - Sensor RH₃ - flaw



EIFS has its act together

- Research, testing, and field validation
- Based on field performance, model validated for all climate zones
- EIFS standards placed in model building codes

Back to Canada

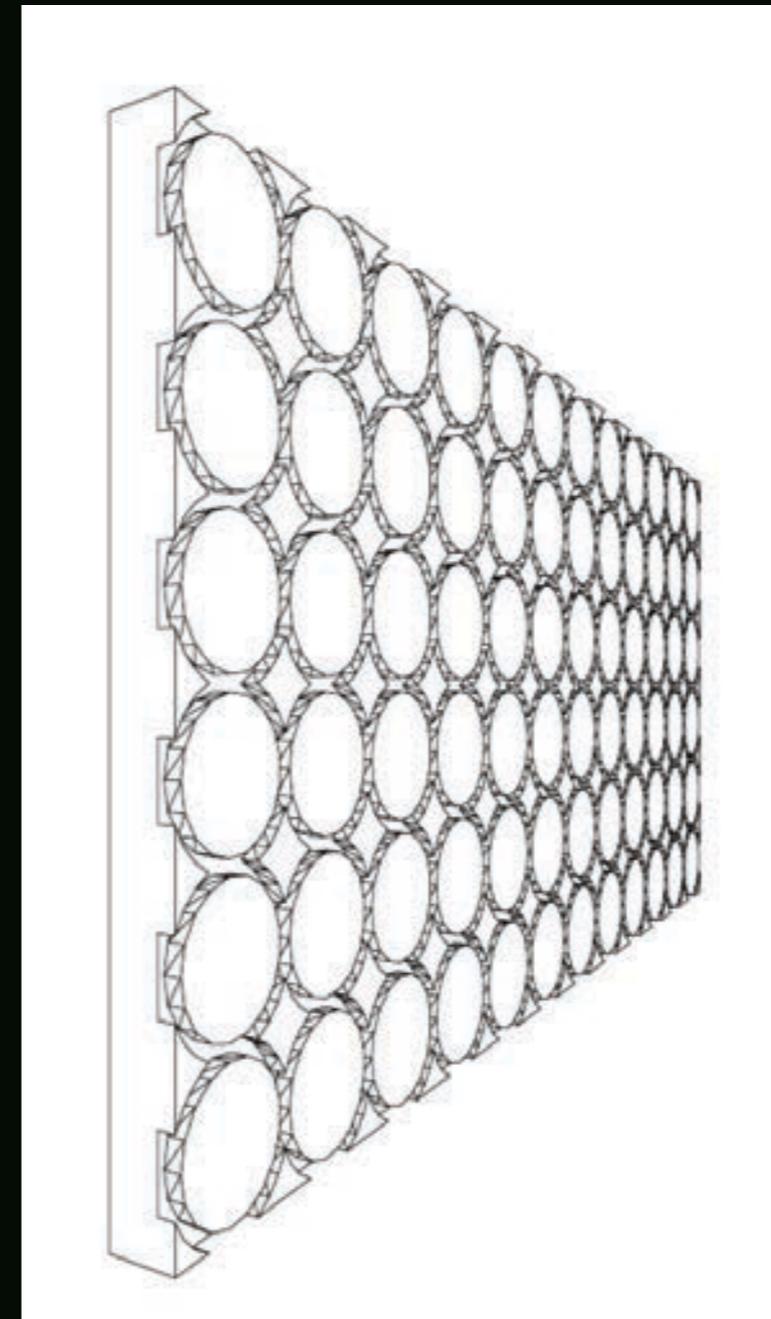
Hello GDDC

Geometrically Defined Drainage Cavity



Patterns cut in insulation

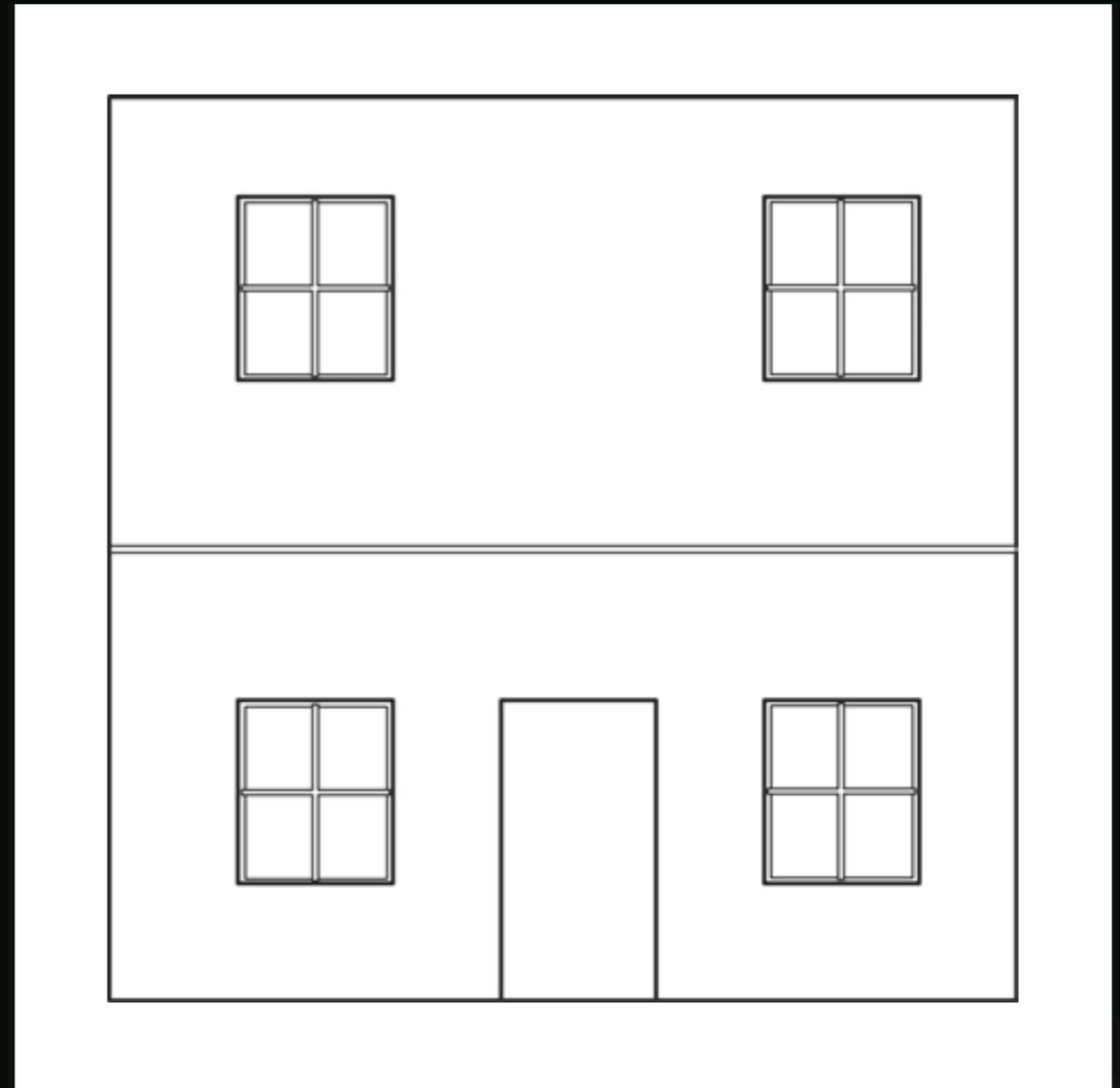
- Only in Canada — a drainage pattern shaped like hockey pucks !



DuRock AlFacing PUCCS

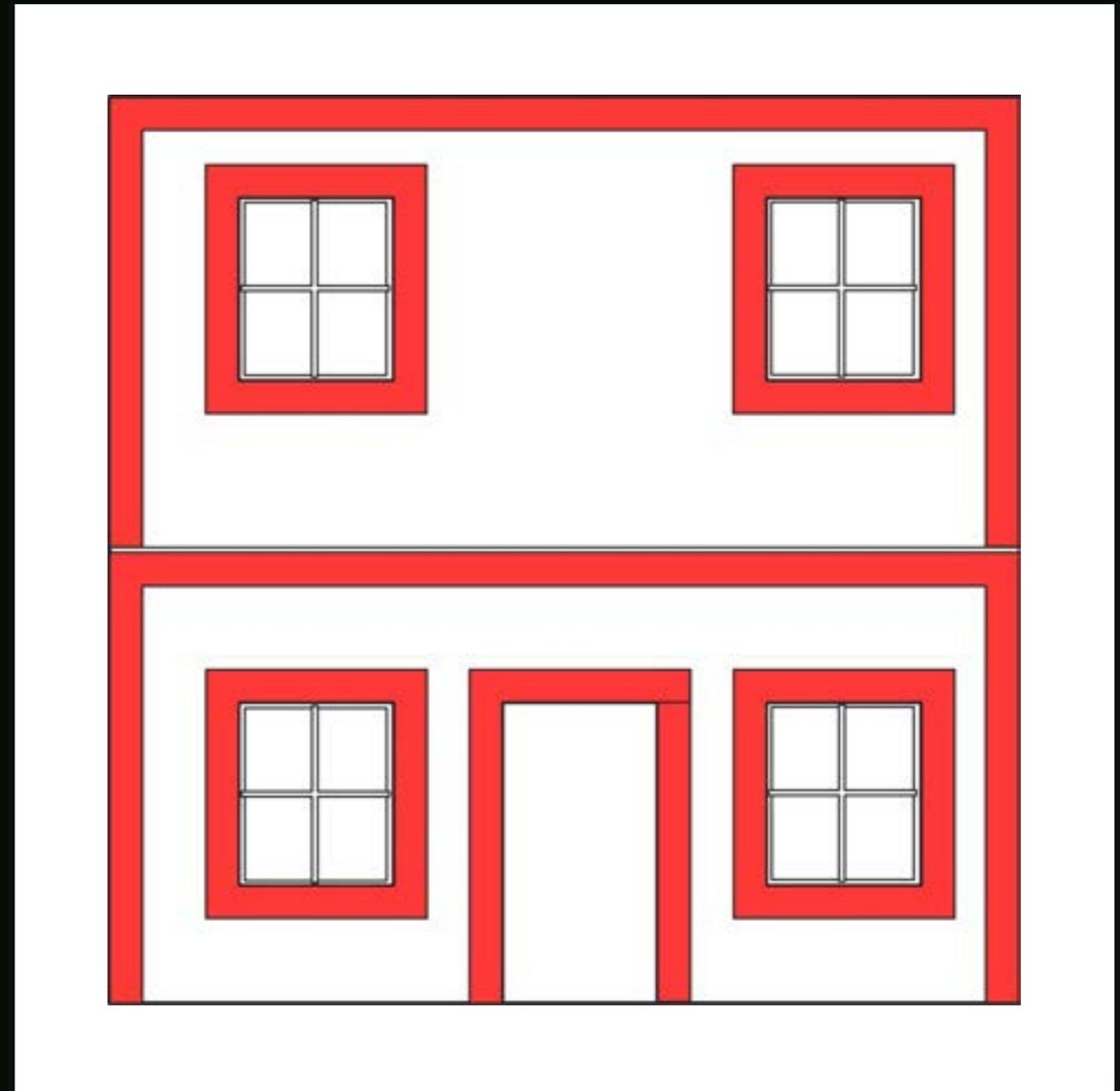
Plot thickens

- GDDC more complicated to install



Plot thickens

- GDDC more complicated to install
- Corners must be closed to prevent wind wash
- Openings sealed to prevent air movement and thermal bridging
- GDDC installed where it is least likely to leak

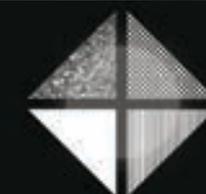


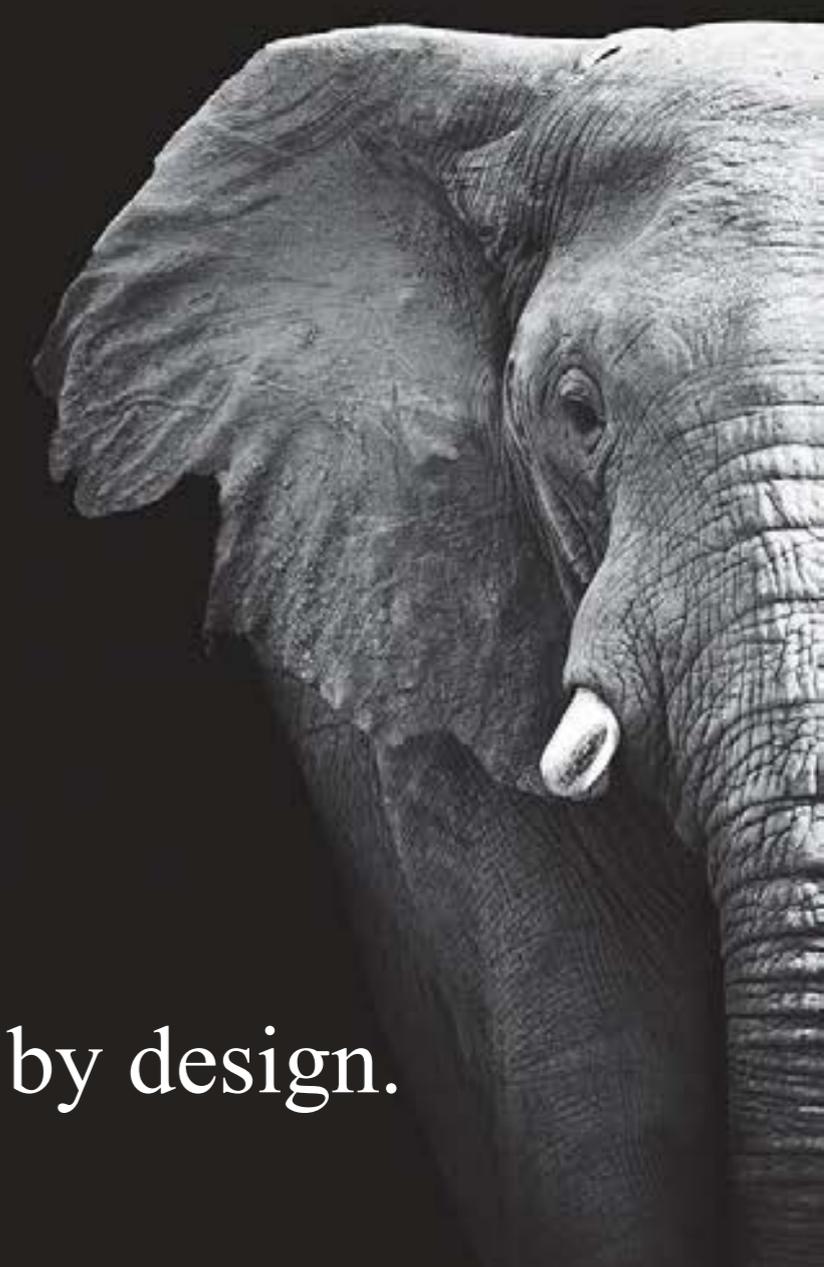


Why is the EIFS industry tying itself into a pretzel ?
Deflect !

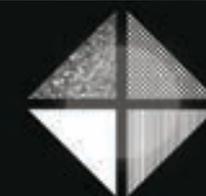


EIFS is not about drainage —



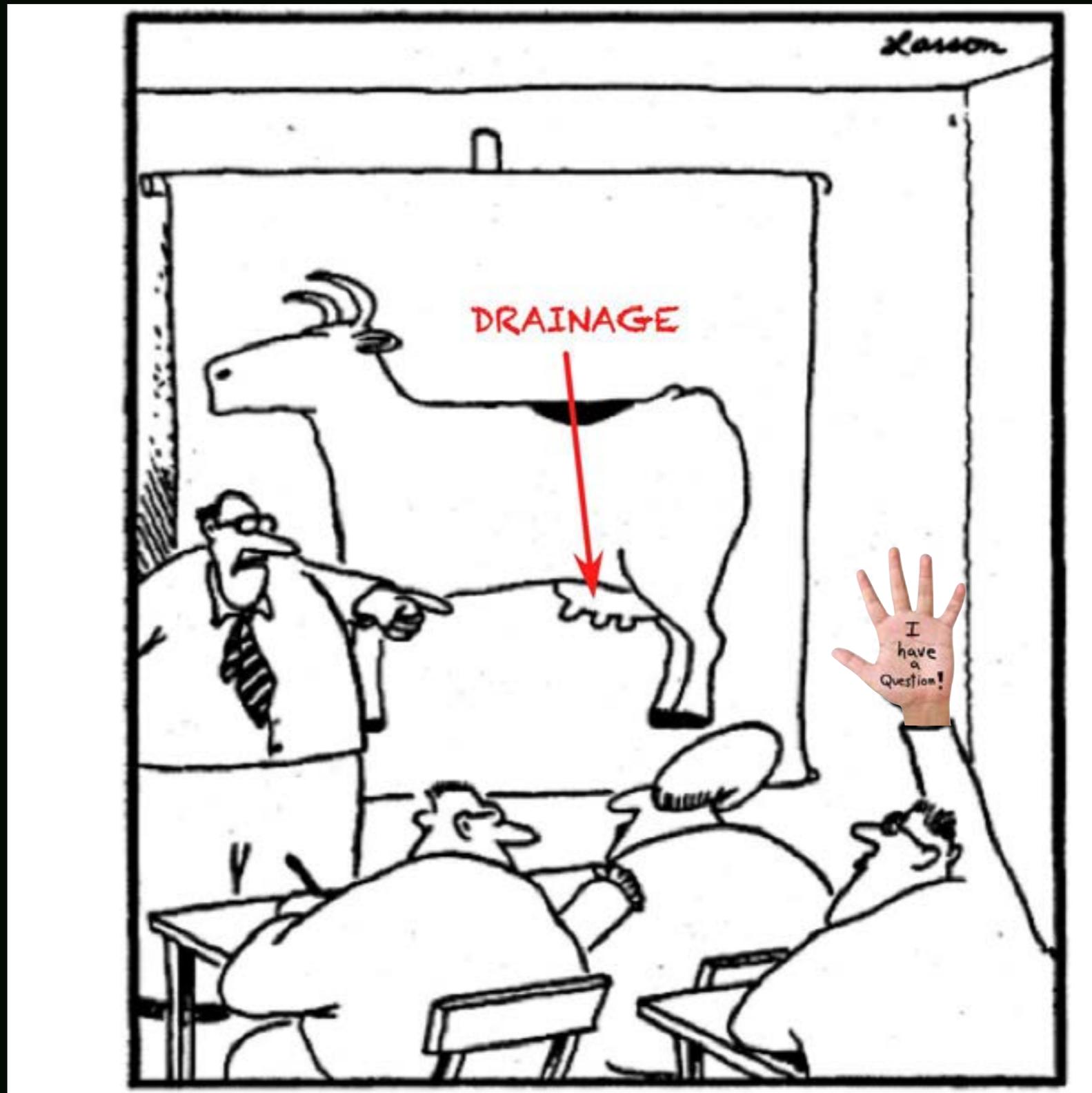


EIFS is not about drainage — EIFS is dry by design.



What's the future hold ?

- ECC comparative life cycle costing study
- Standards development
- Panelization



Yes, I believe there is a question in the back

The End

