

Everything I know about water intrusion I learned in Kindergarten



Introduction

- Thank you ABEC



- Thank you for the support provided to *Doctors Without Borders* !



EIFS Drainage

**How the EIFS industry got skewered
by being so darn good at drainage**

Where we're going

- A journey through US and Canadian evaluations, codes and standards
- Building Science fundamentals
- History of drainage - it's all downhill from here
- Elephant in the room
- Back to the future

History c.1995

The Dark Ages

North Carolina



Flashing not optional — required by code

EIFS Industry Solutions

Late 1990's

- 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

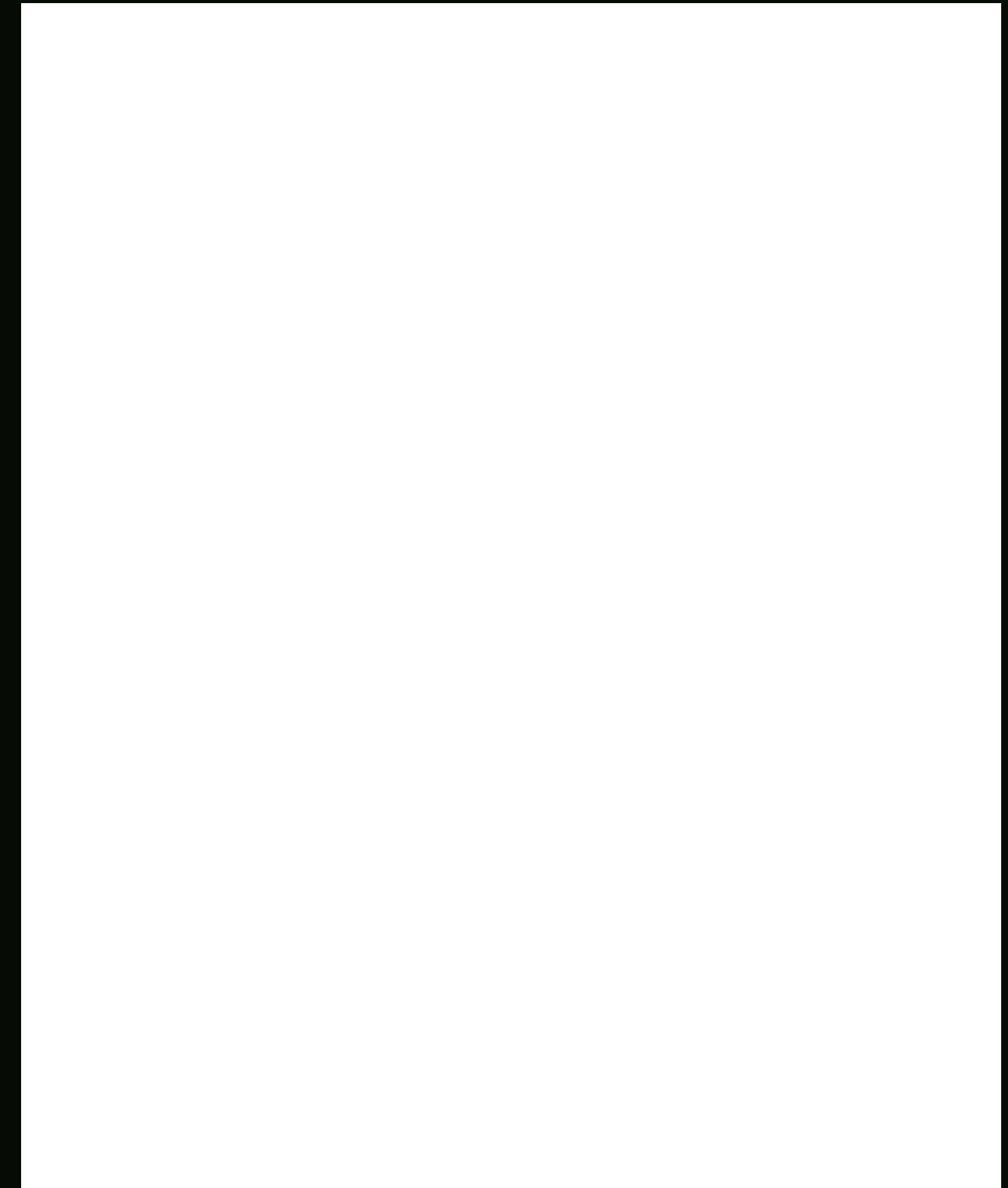
How many evaluation services were there ?

- Four model building code evaluation agencies in USA
- One federal agency in Canada (CCMC)
- Plus various state, provincial and municipal agencies
- If your product was not in code, they'd want to talk to you !

How to Evaluate Drainage ?

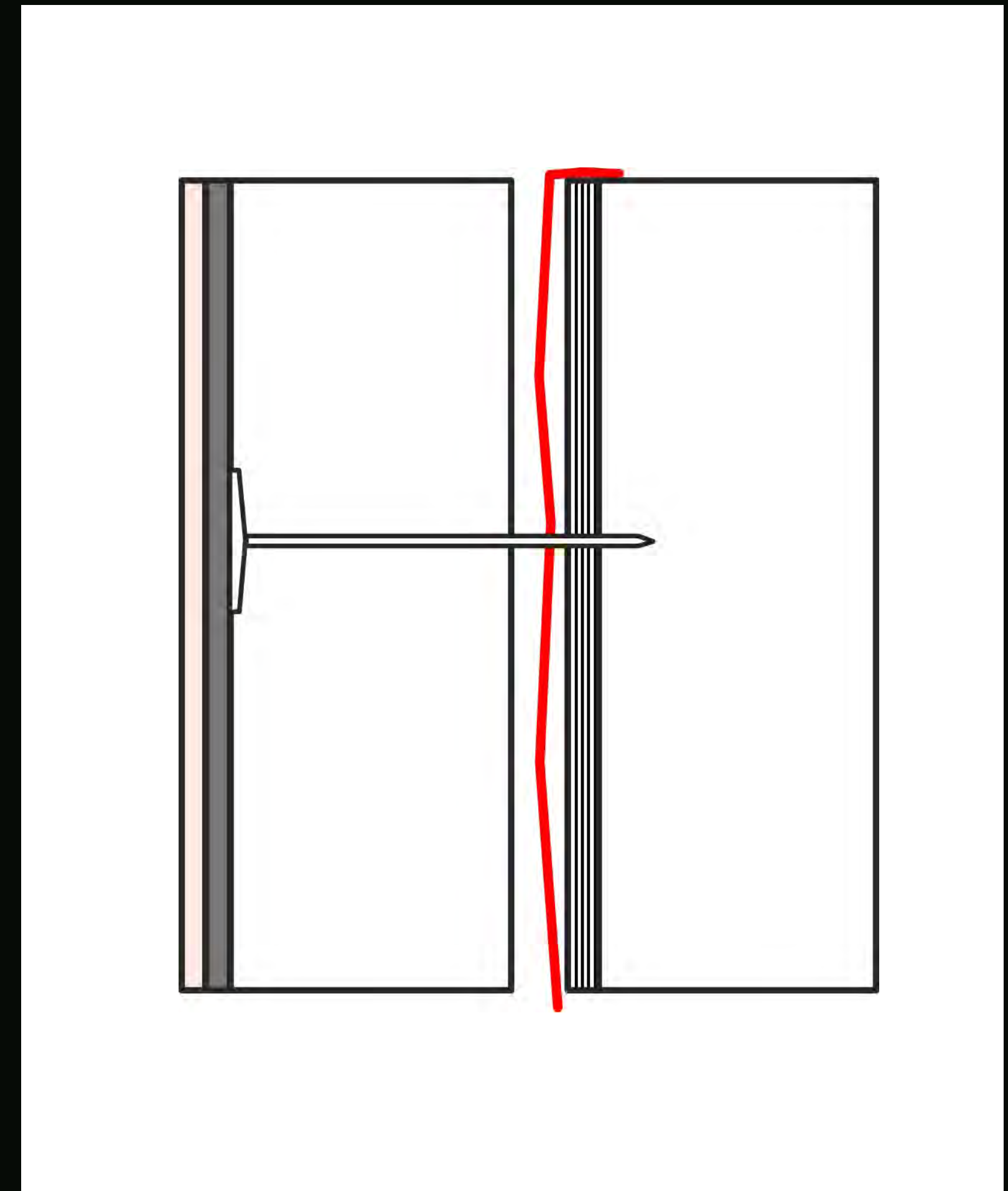
How to Evaluate Drainage ?

Demonstration testing for BOCA officials:



How to Evaluate Drainage ?

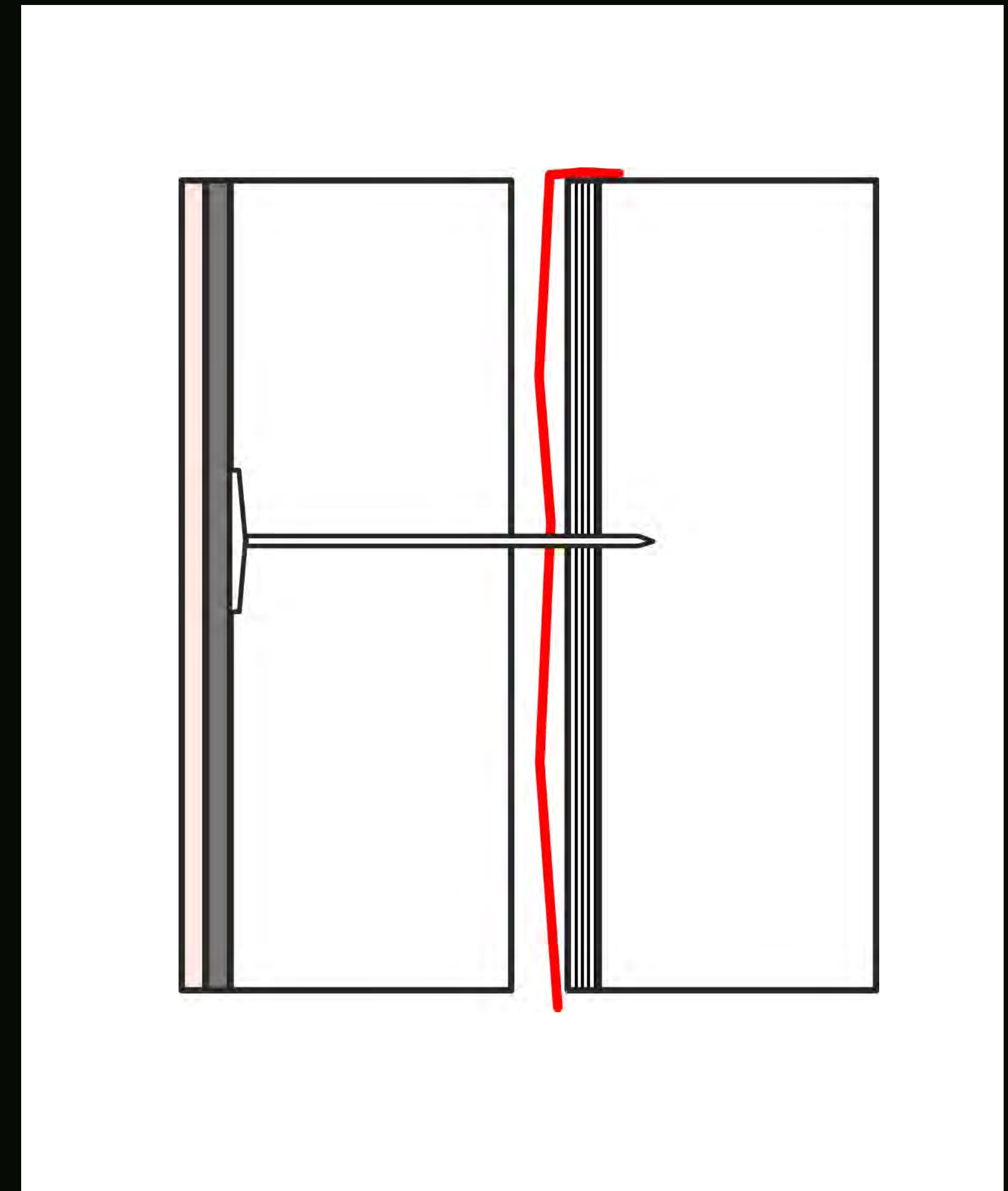
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How to Evaluate Drainage ?

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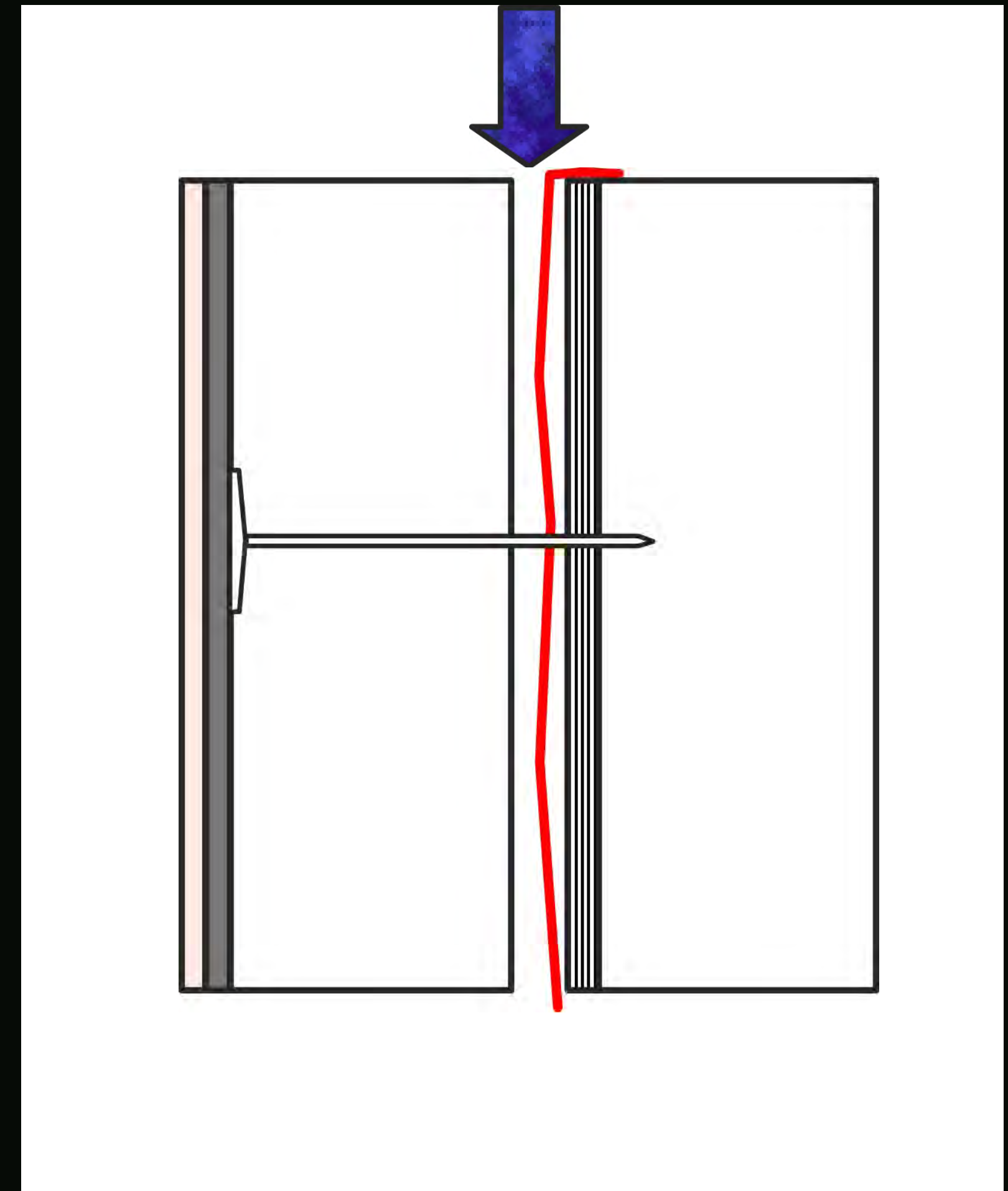
- Water introduced into drainage cavity



How to Evaluate Drainage ?

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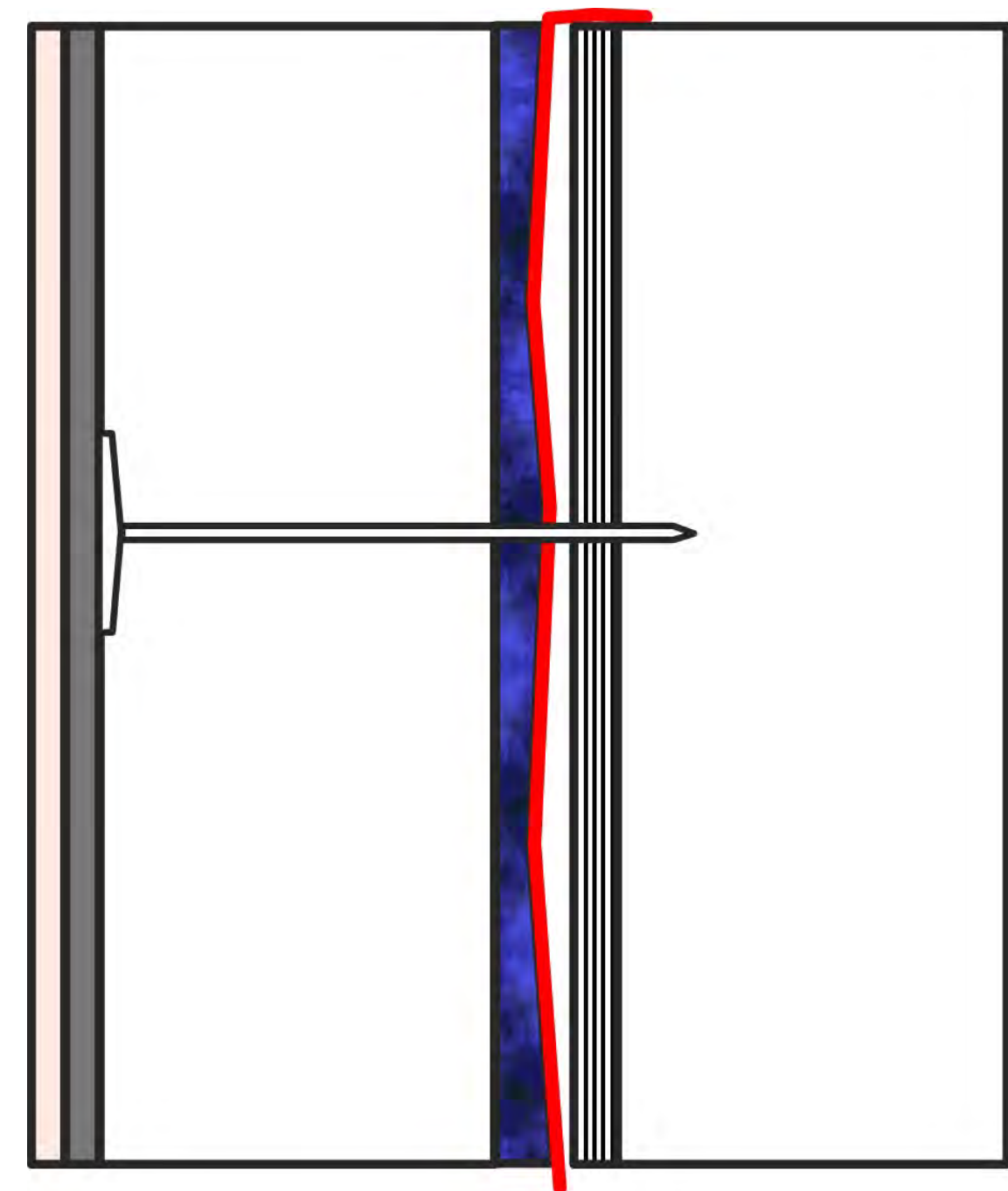
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How to Evaluate Drainage ?

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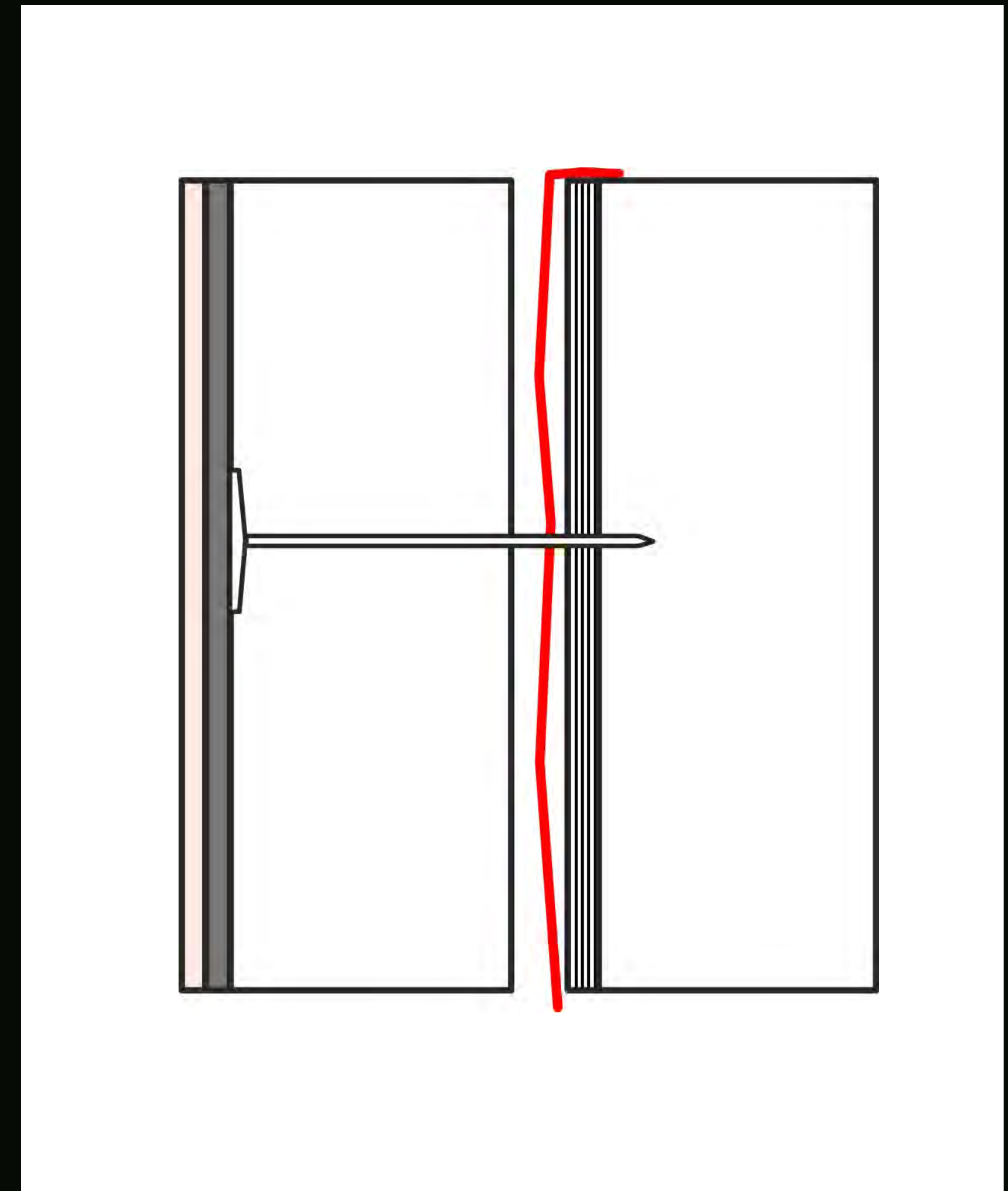
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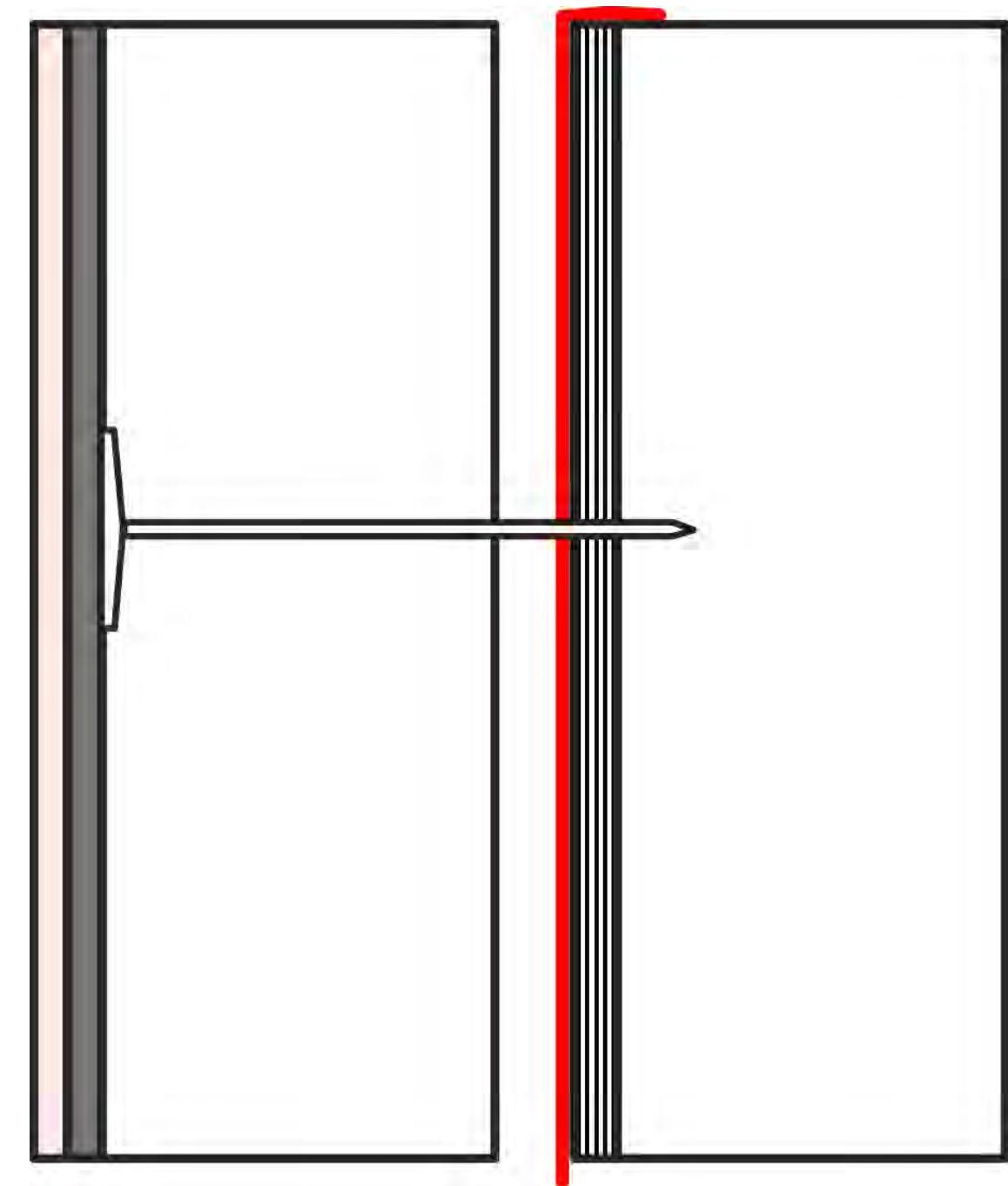
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How to Evaluate Drainage ?

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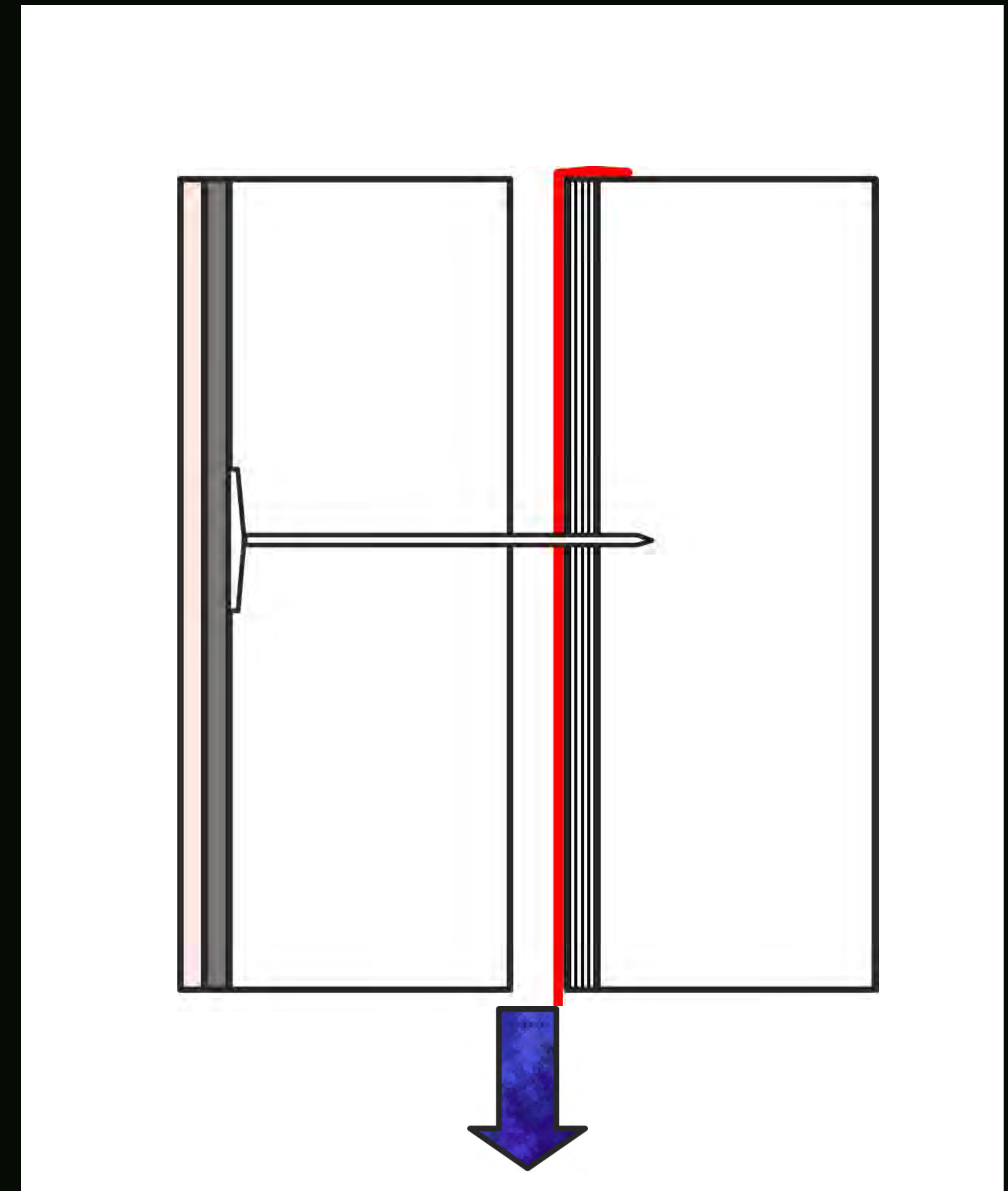
- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened



How to Evaluate Drainage ?

Demonstration testing for BOCA officials:

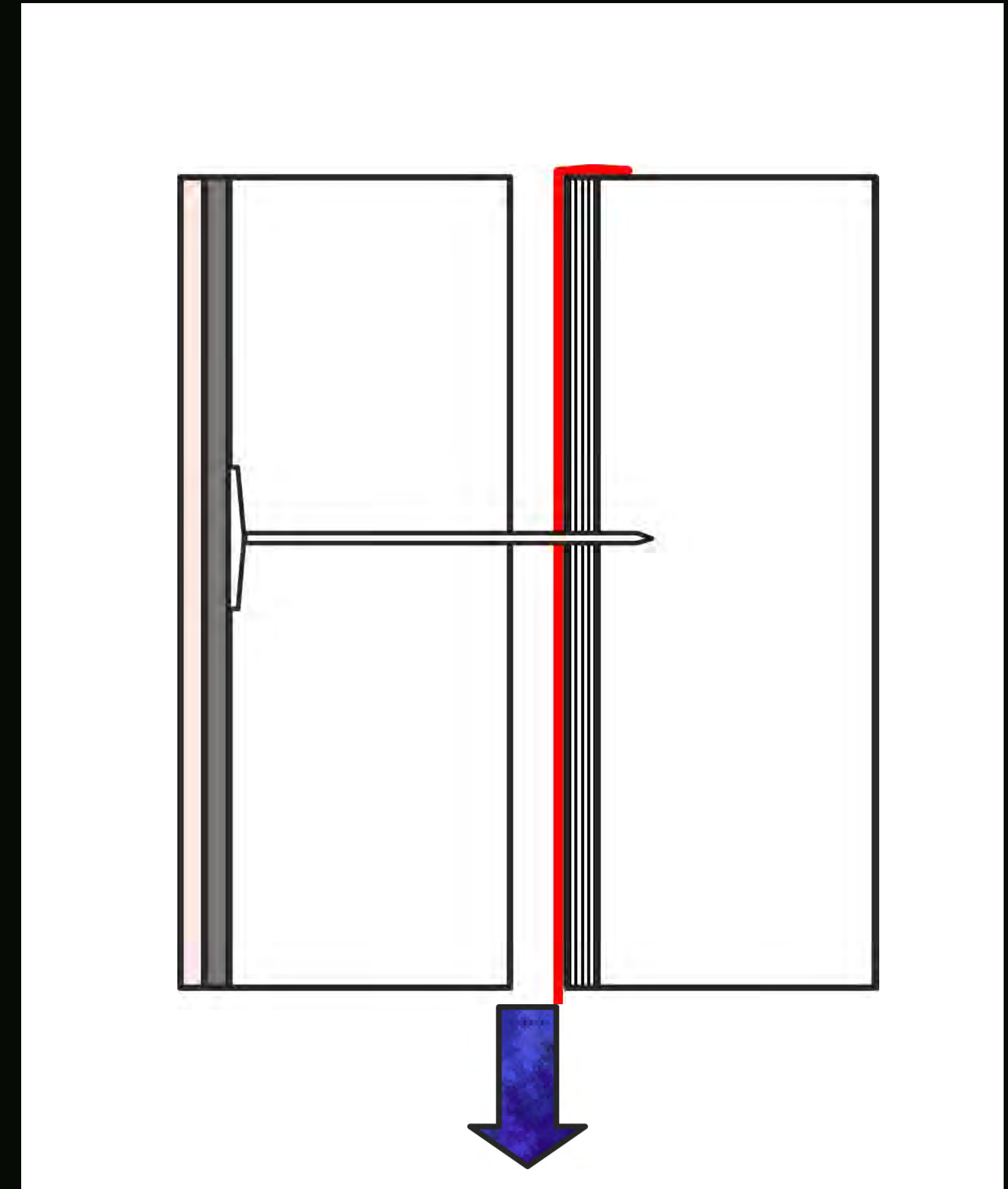
- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened



How to Evaluate Drainage ?

Demonstration testing for BOCA officials:

- Water introduced into drainage cavity
- Pressure difference added
- Cavity opened
- Testing now done without pressure
- **Note: Not acceptable in Canada !**



A standard is born

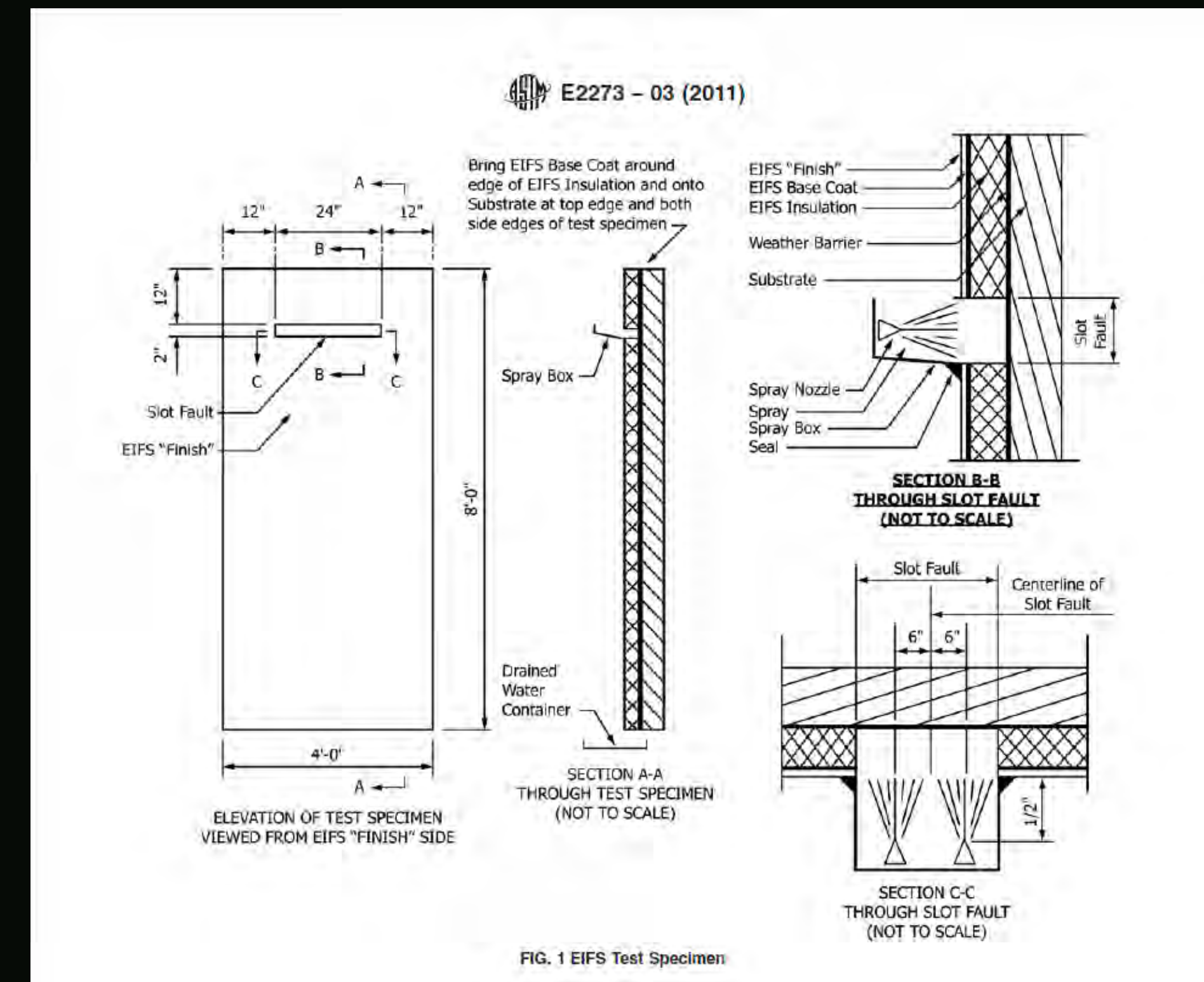
A standard is born

ASTM E-2273 Drainage for EIFS:

A standard is born

ASTM E-2273 Drainage for EIFS:

- 19L/ hour sprayed into 300 cm² opening



A standard is born

ASTM E-2273 Drainage for EIFS:

- 19L/ hour sprayed into 300 cm² opening
- Equals 48 cm/hour rainfall
- Only required for EIFS
- All other claddings “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

B.C. government inquiry

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

Fallout

- Class action litigation against NBCC *
- National Research Council of Canada gets nervous
- Code committees and NRCC institutes get ‘fear of god’ lectures
- Government has to be seen “doing something”

* Spoiler Alert - never sue the government

Moisture in Exterior Wall Systems (MEWS)

NRCC research consortium c. 2002

MEWS

- Weather data across Canada and the USA studied
- Moisture Index (MI) developed
 - compares rate of wetting vs. drying
- If wetting greater than drying $MI > 1.0$
- Covers wet coastal areas (Newfoundland & BC)

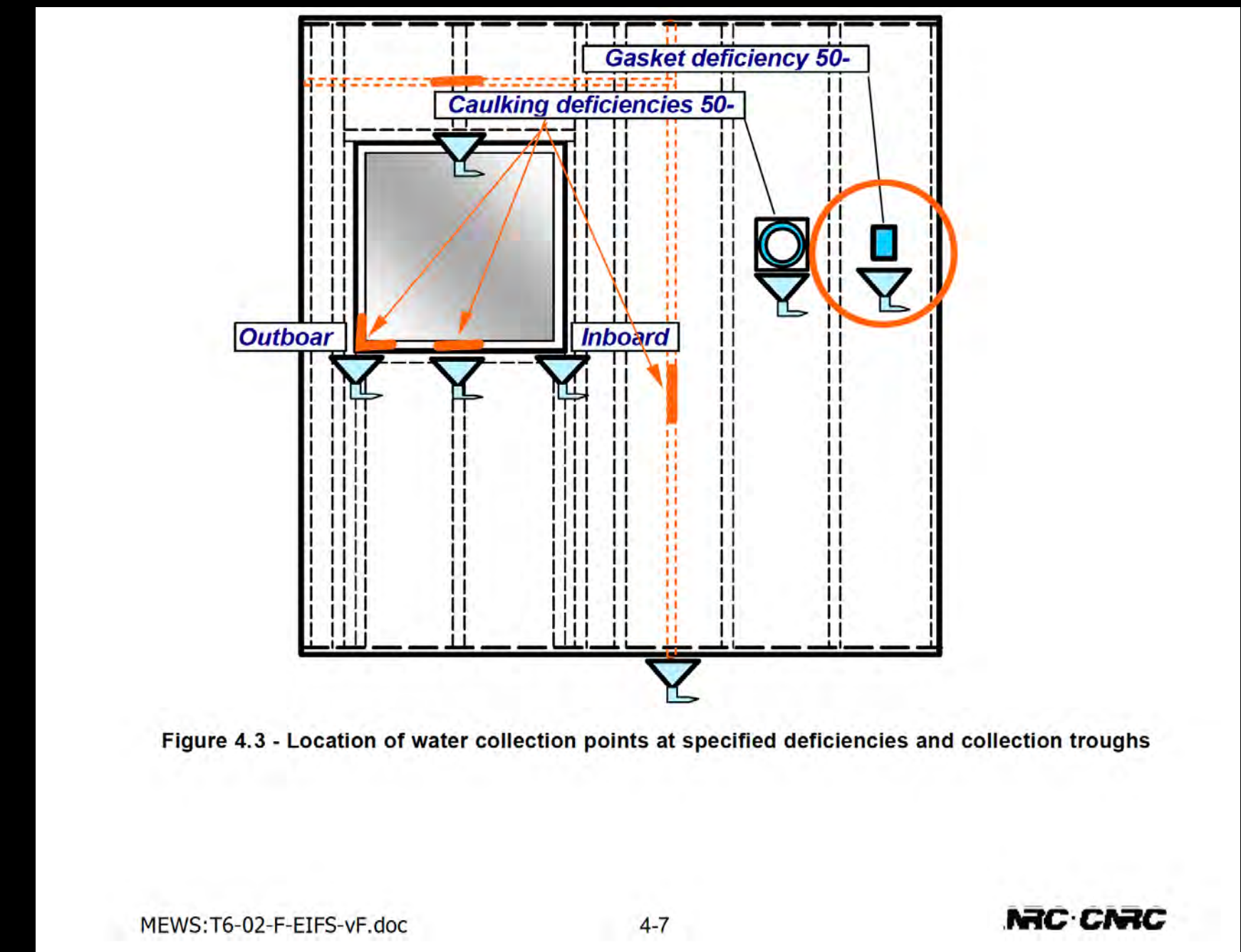
Water Penetration

MEWS Research

Water Penetration

MEWS Research

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



Water Penetration

MEWS Research

- Walls tested with normal penetrations and common flaws
- Wall claddings sprayed with water (amount based on worst case weather)
- Pressure differences added
- Air leakage added
- EIFS with Drainage performed well

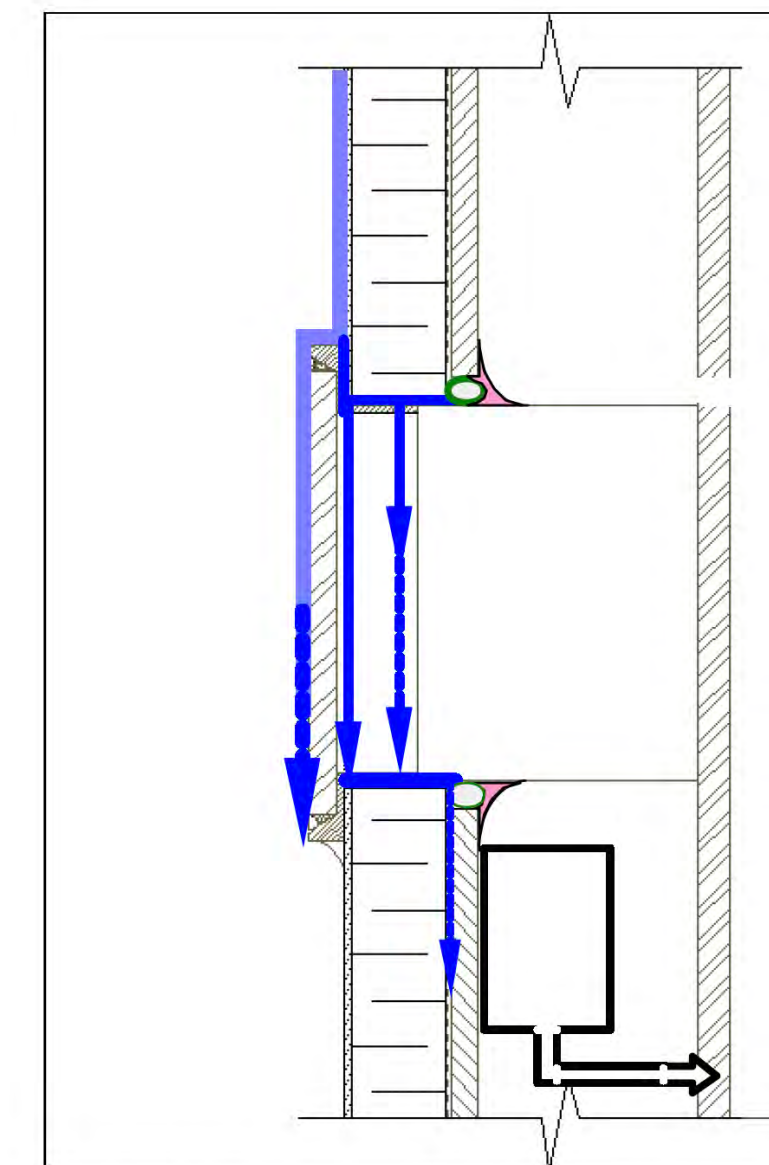


Figure 4.8 – EIFS WA-8: deficiency above vent duct presumed water entry path – caulking and backer rod in place – no water entry; probable drainage through vertical channels between adhesive layer and cementitious membrane coating

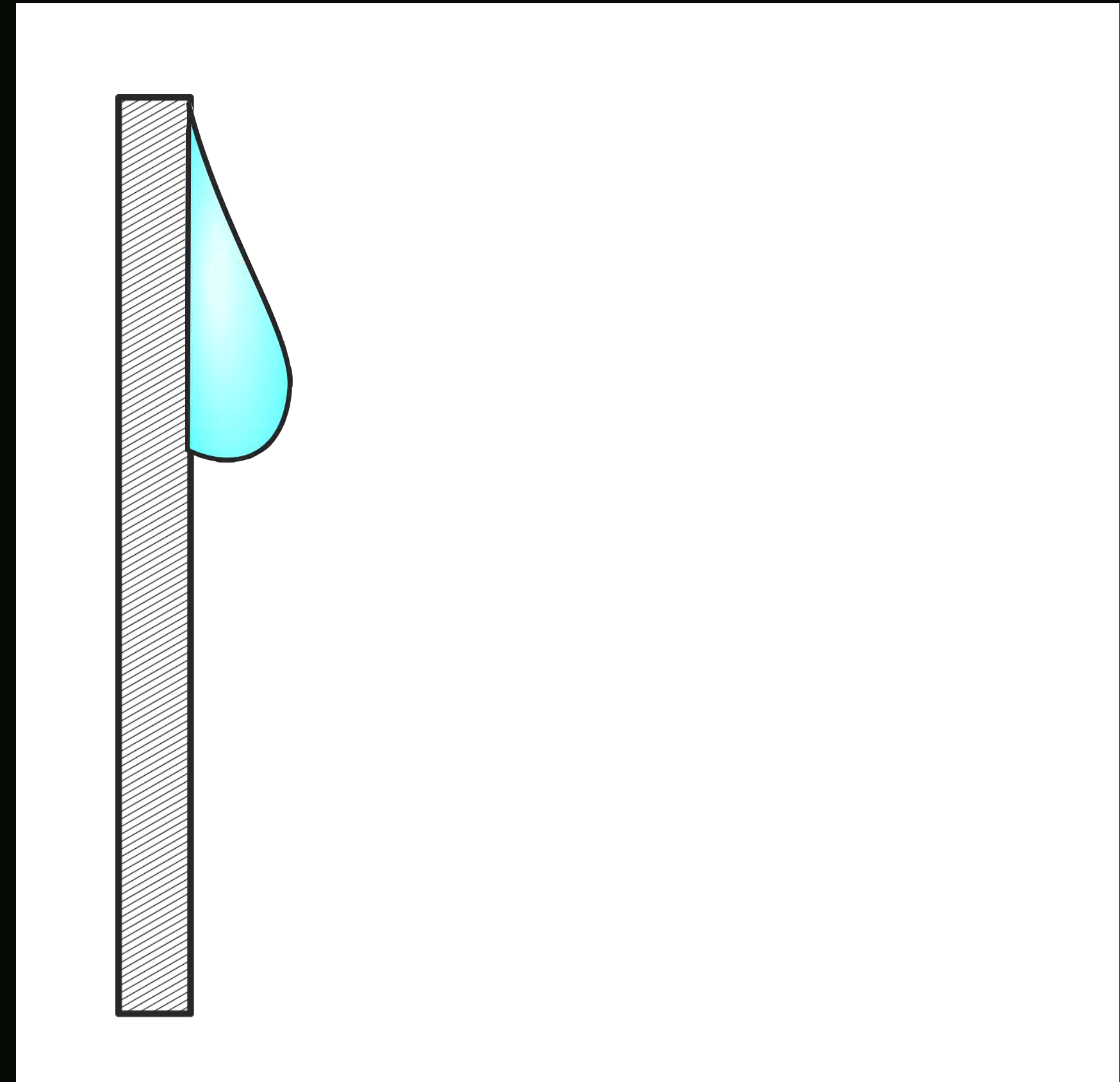
MEWS:T6-02-F-EIFS-vF.doc

4-21

NRC CNRC

MEWS Fallout

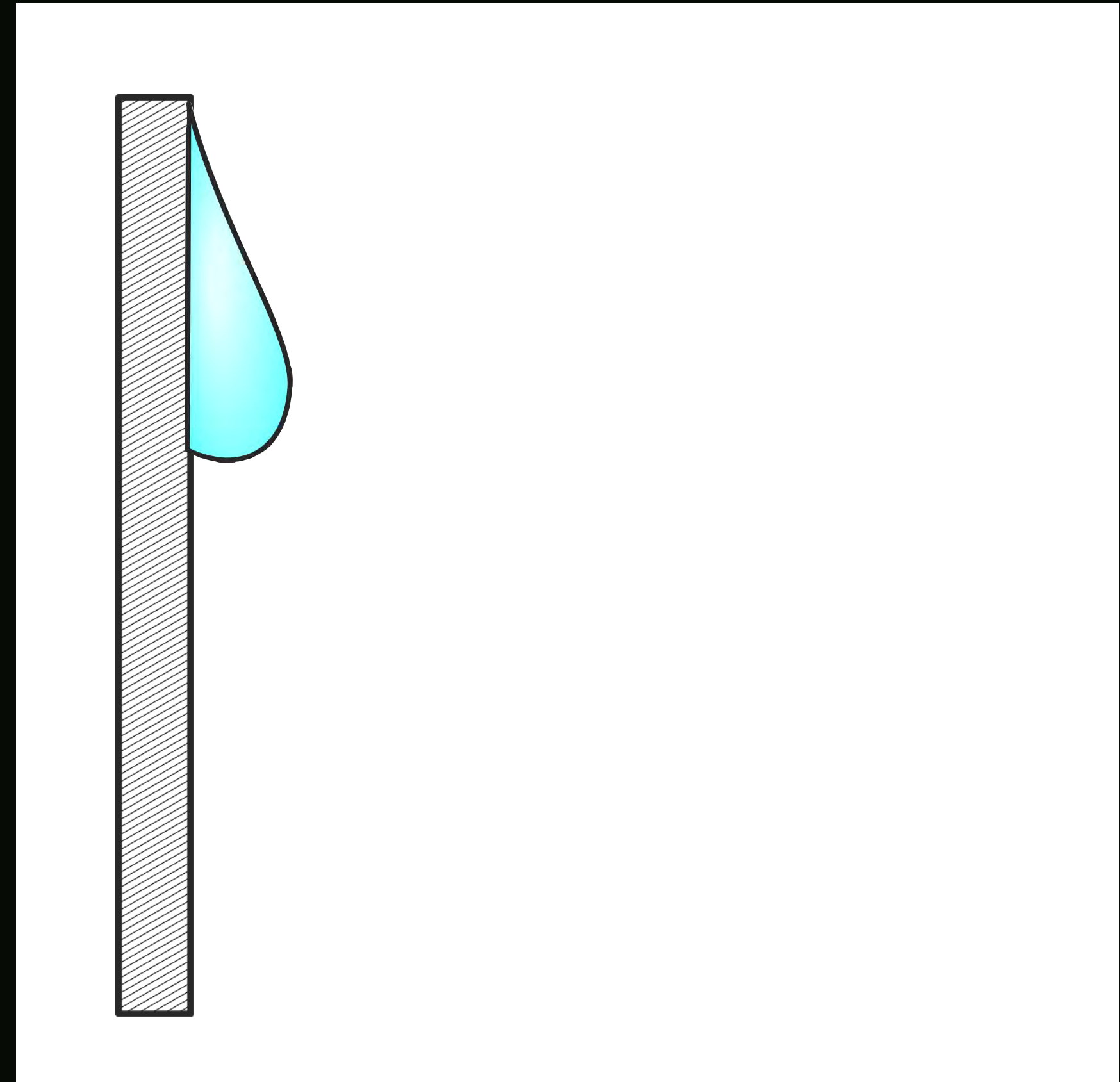
Bureaucrats to the rescue



MEWS Fallout

Bureaucrats to the rescue

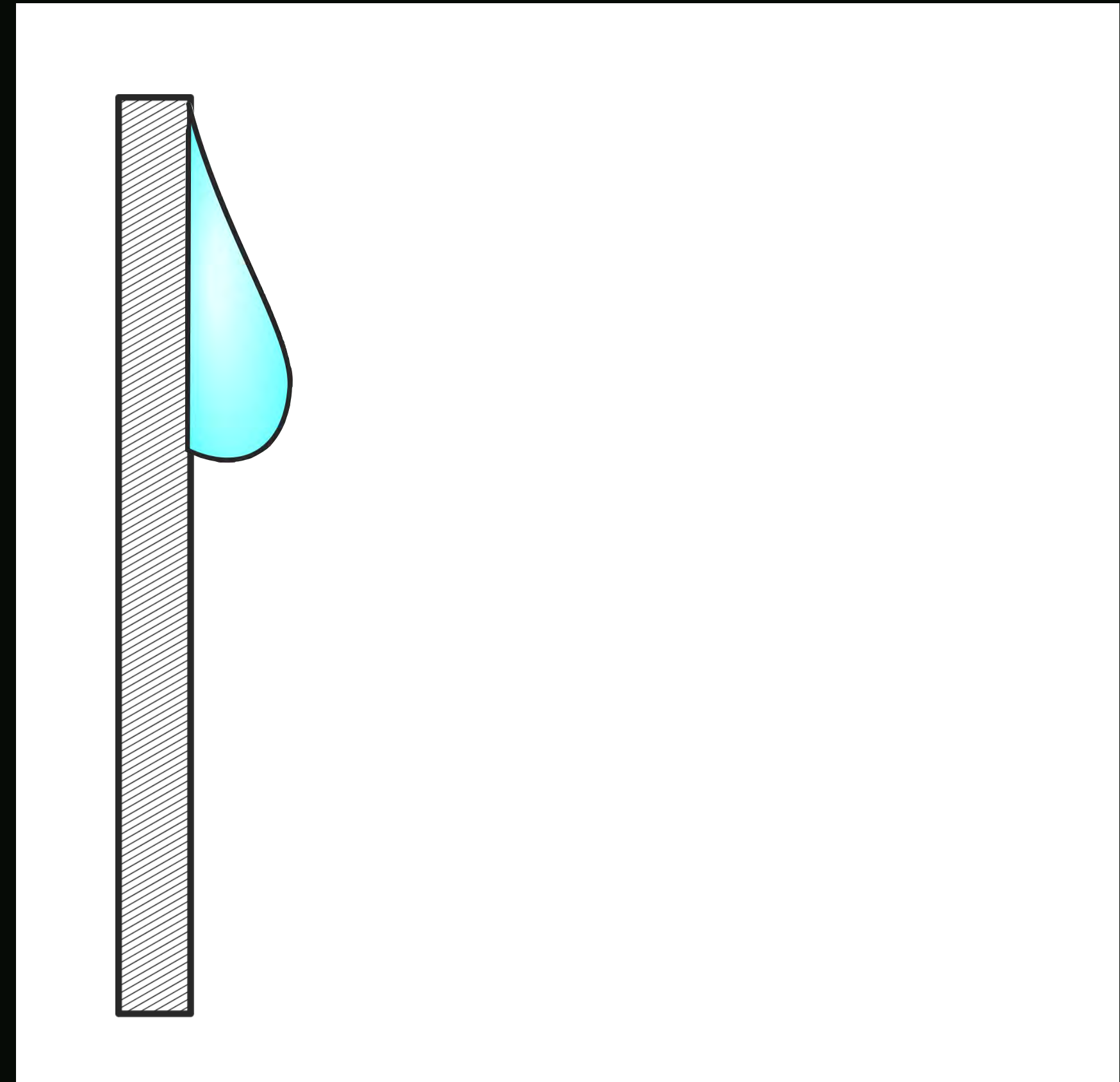
- Moisture Index added to code



MEWS Fallout

Bureaucrats to the rescue

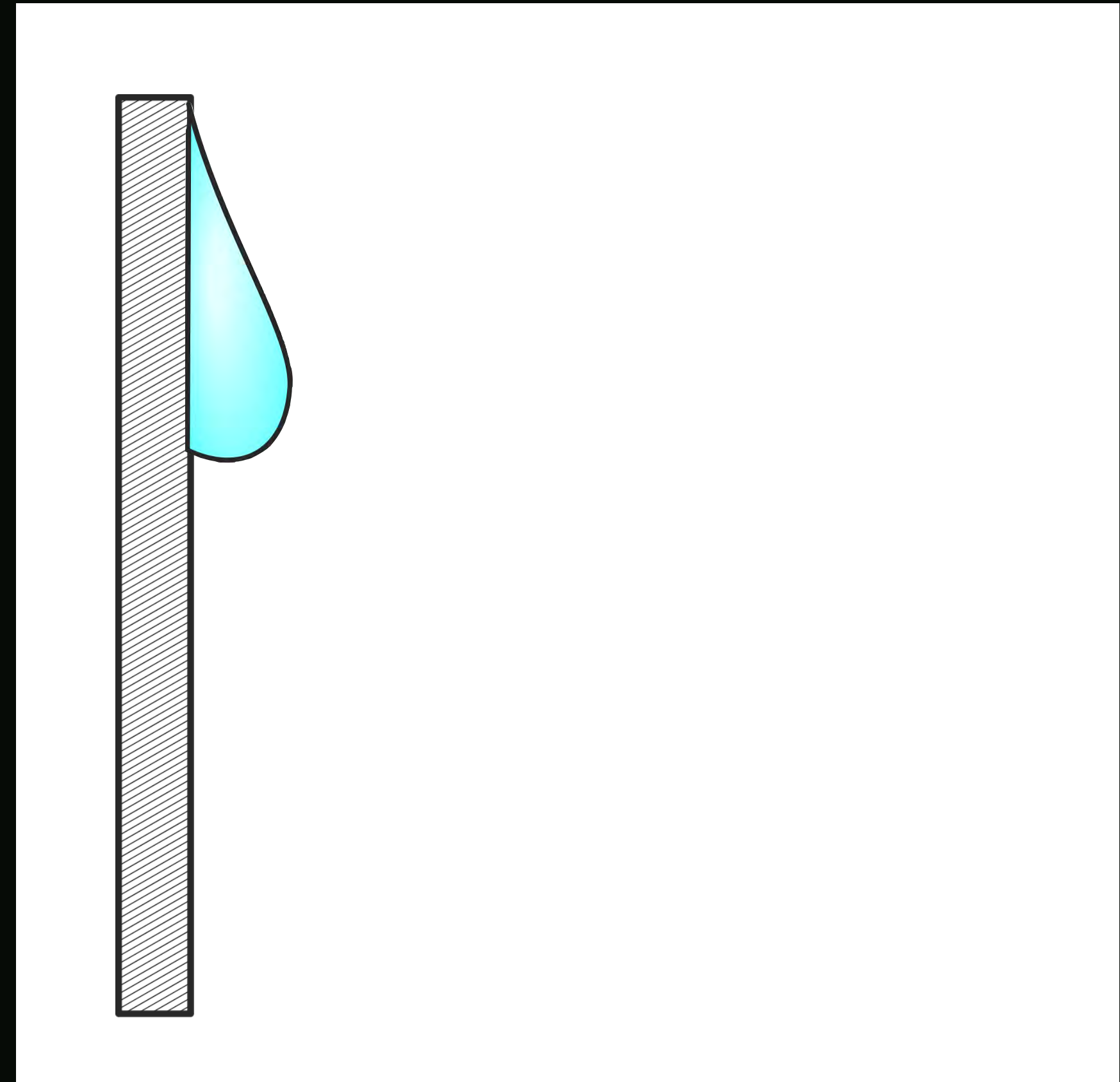
- Moisture Index added to code
- Capillary break required



MEWS Fallout

Bureaucrats to the rescue

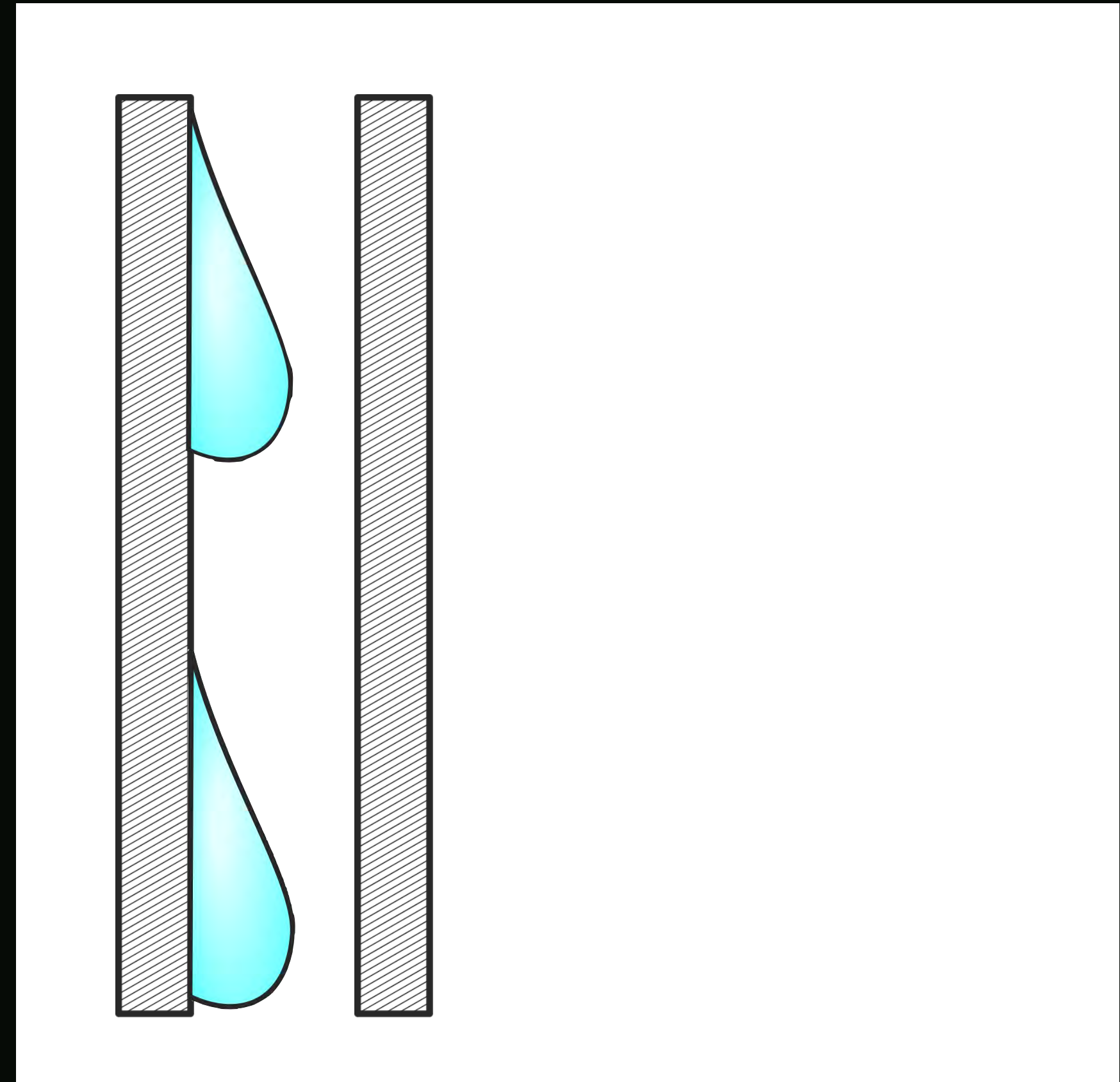
- Moisture Index added to code
- Capillary break required
- Size ?



MEWS Fallout

Bureaucrats to the rescue

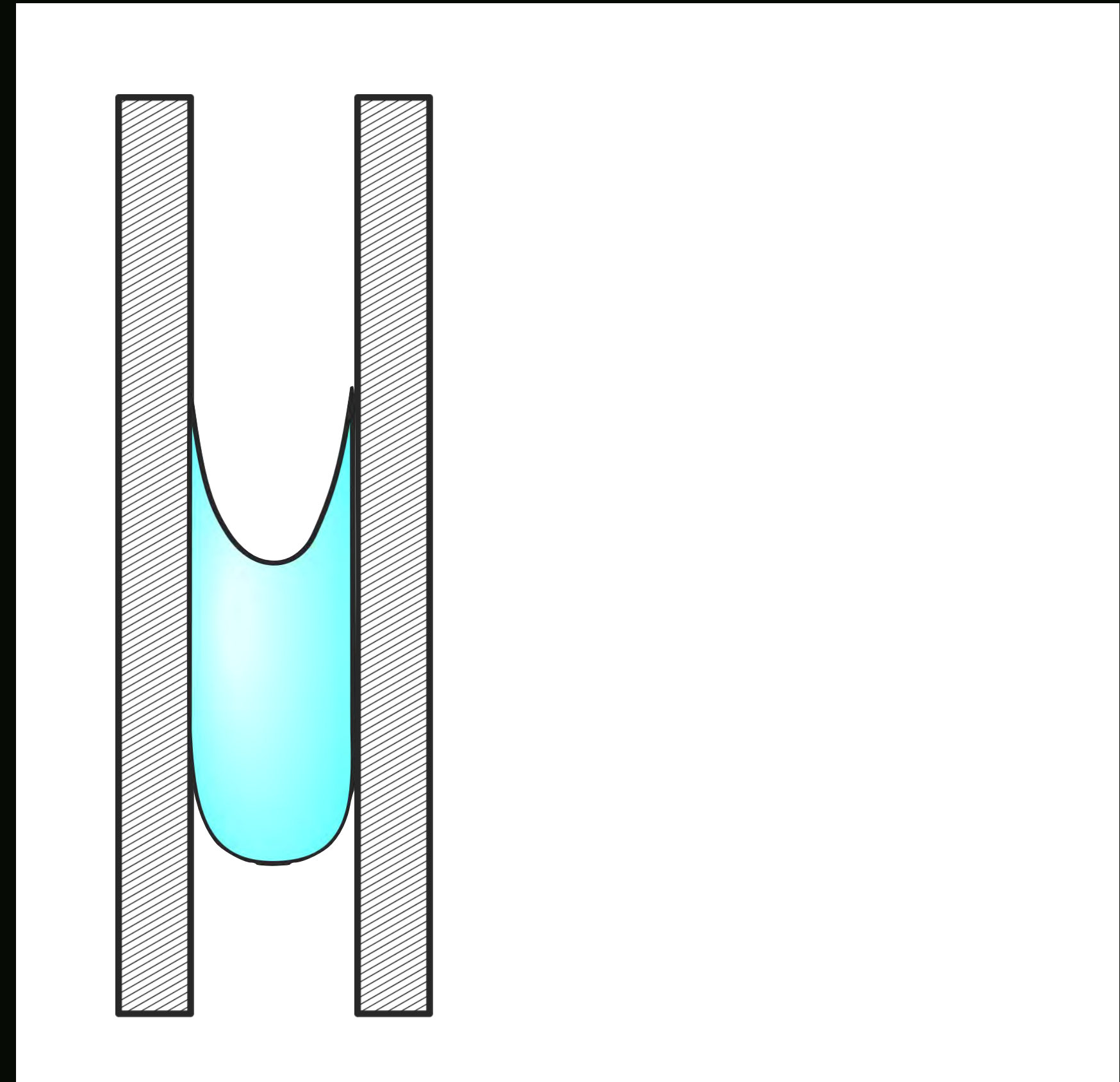
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MEWS Fallout

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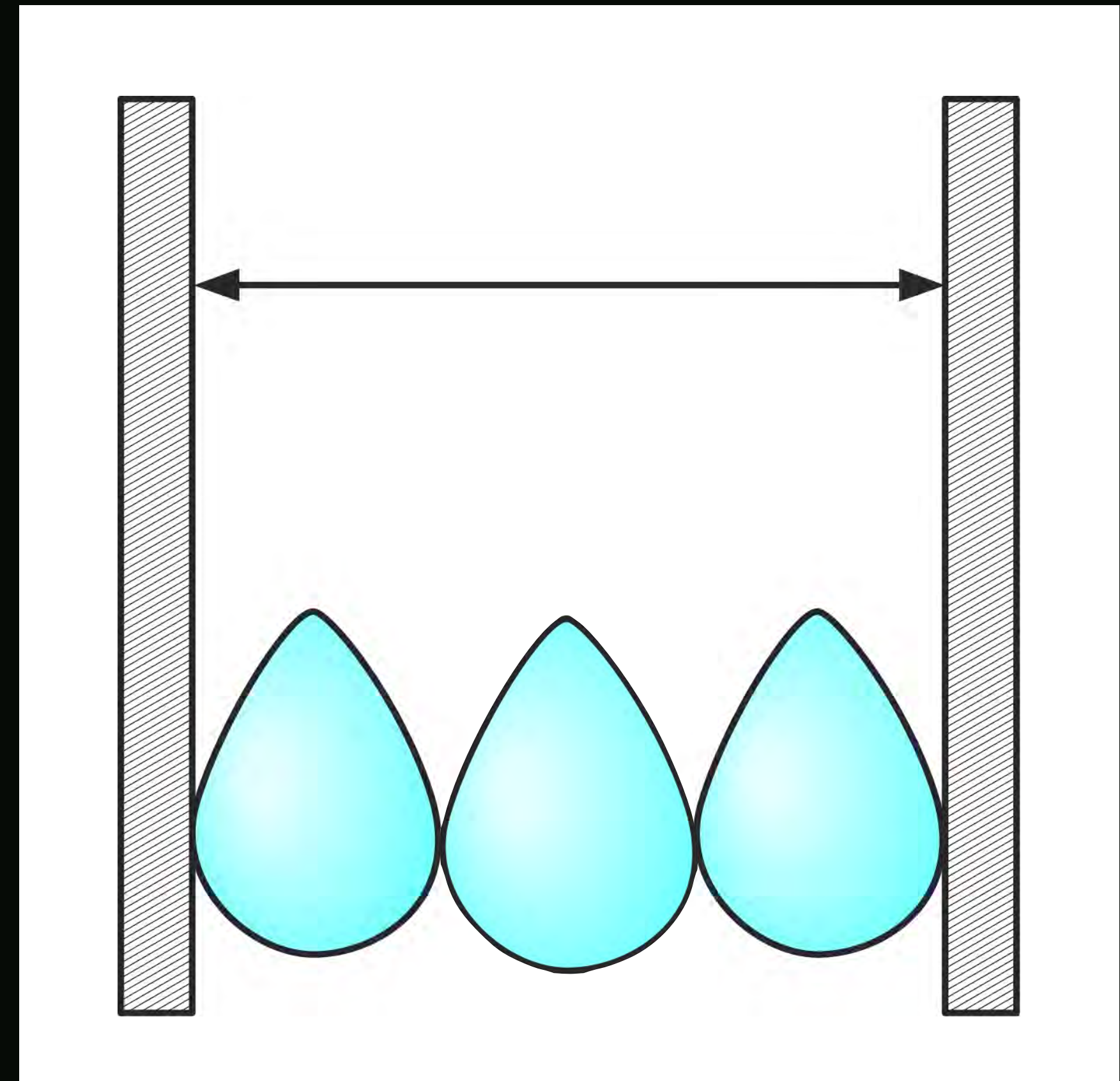
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MEWS Fallout

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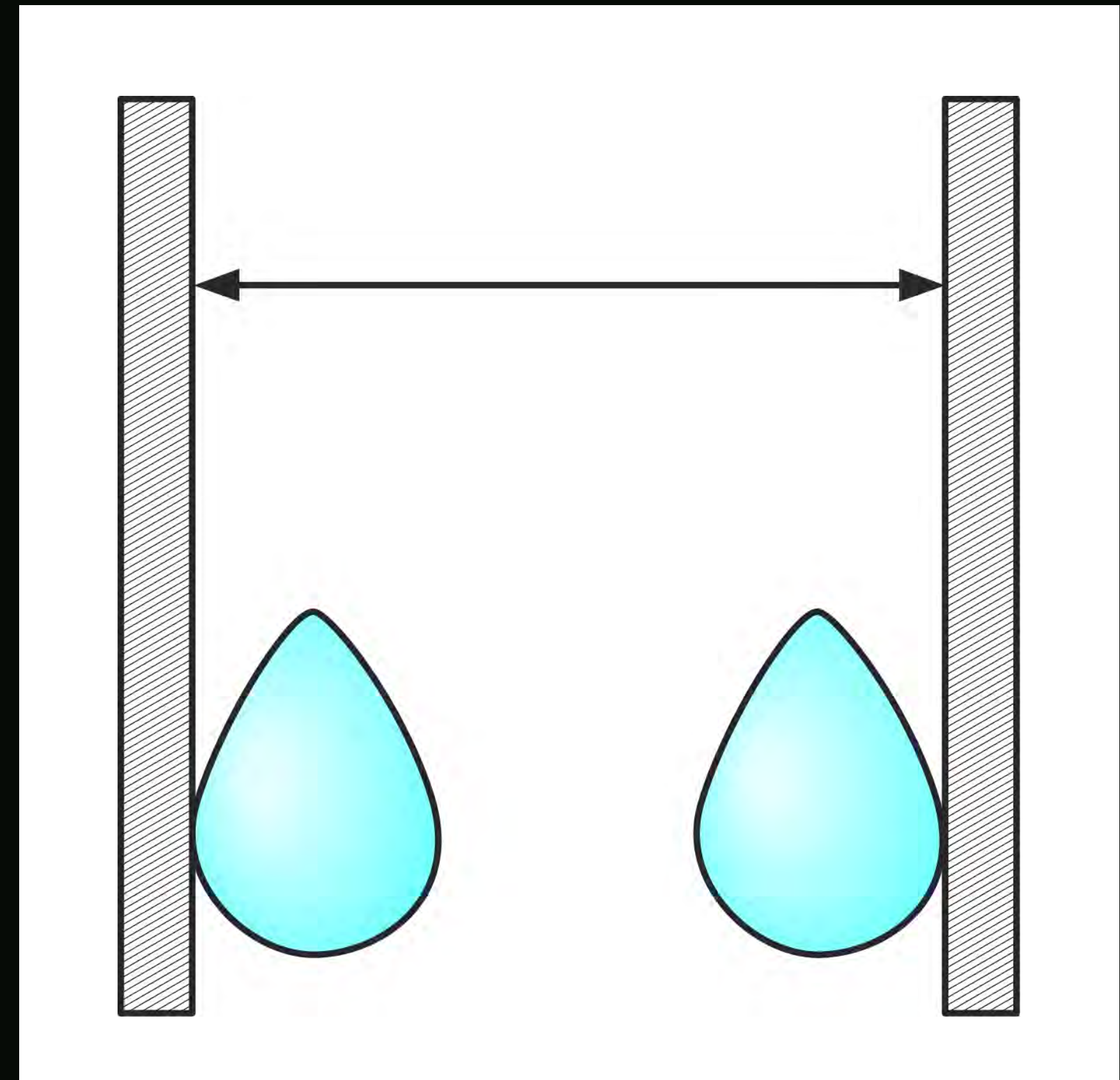


MEWS Fallout

Bureaucrats to the rescue

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

Cue dramatic music - opening chord from Jaws



Canadian Construction Materials Centre (CCMC)

CCMC

- EIFS must have drainage !
- No problem - ASTM with 90% drainage requirement
- Where does the 10% go ?



CCMC

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

Forintek

Find the missing 10%

Forintek

Find the missing 10%

- 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)



Dr. Don Onysko
BECKIE Recipient 2004



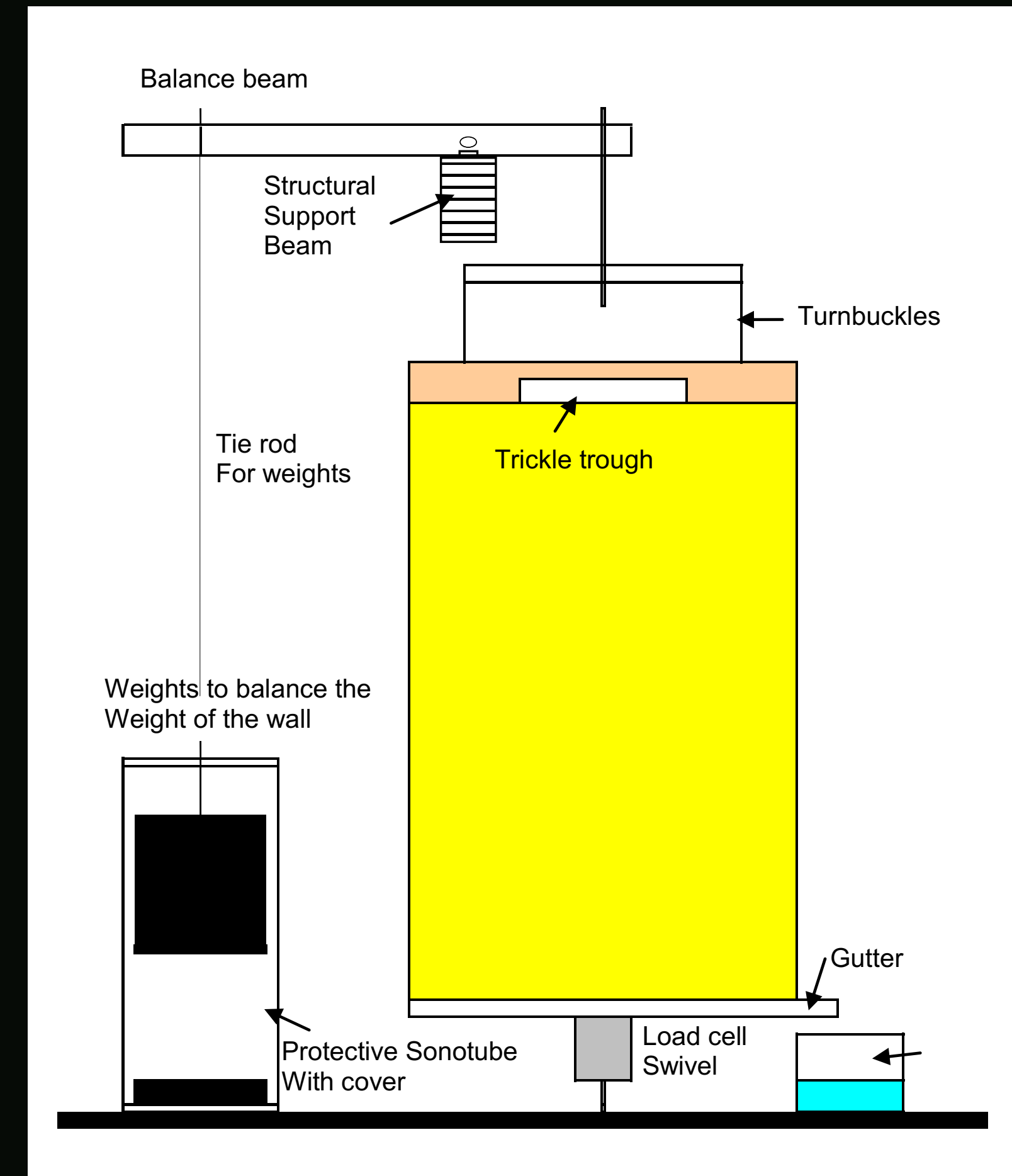
Dr. Mark Bomberg
BECKIE Recipient 1999

Drainage Research

Hangin' in

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

Hangin' in

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



Drainage Research

Hangin' in

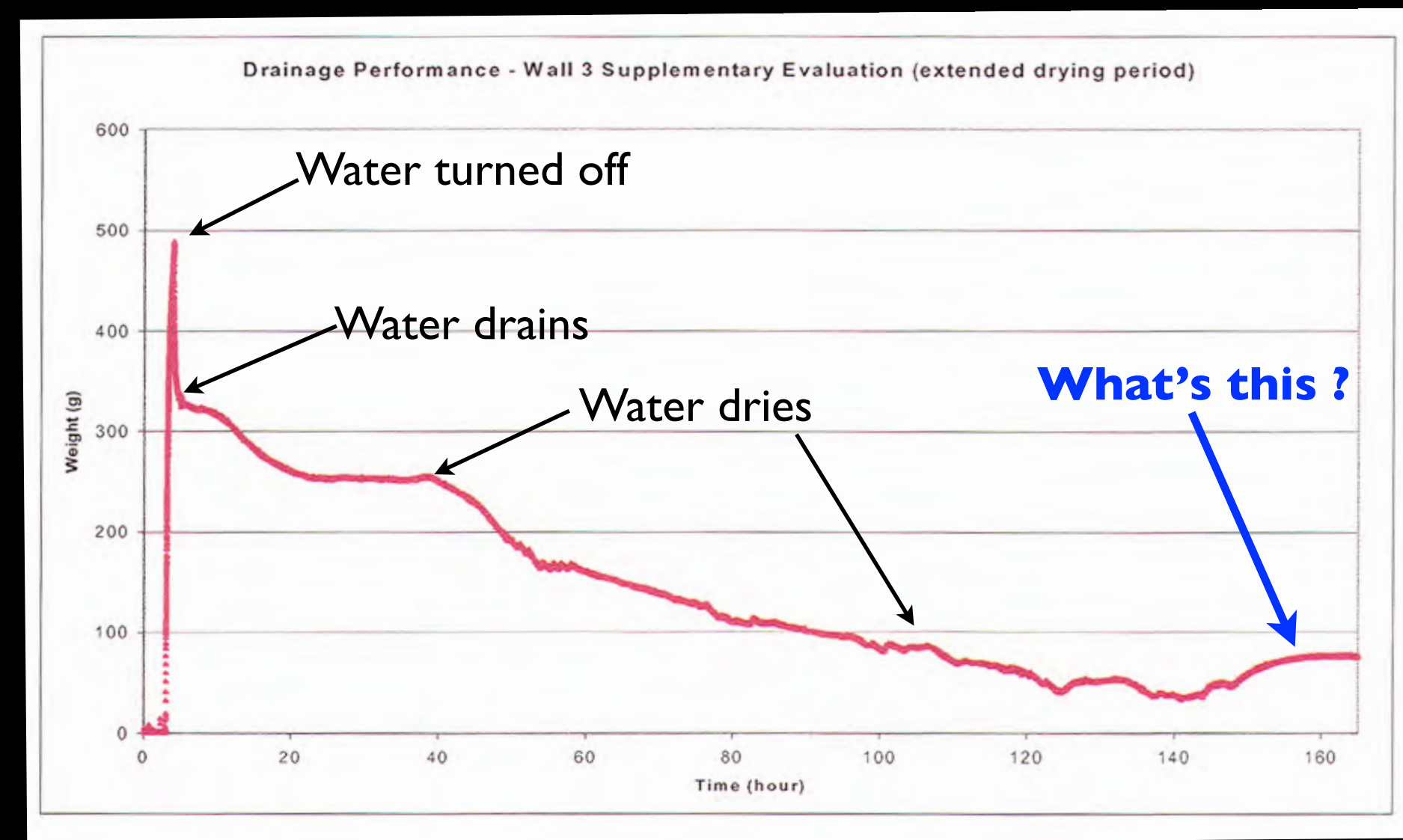
Find the 10%

- 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

Wait for it Where did the 0.2% go ?



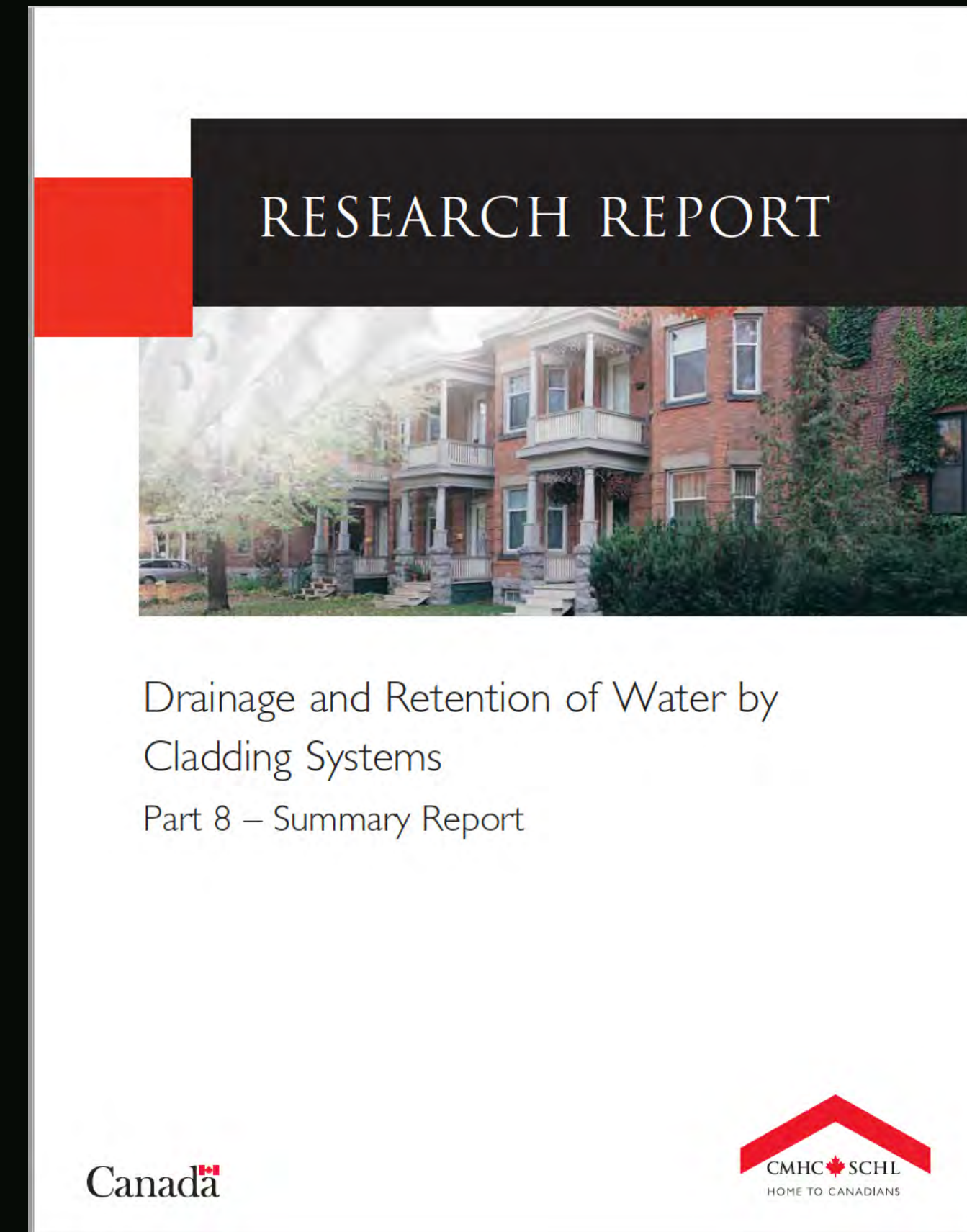
Research at Forintek and CanBEST



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

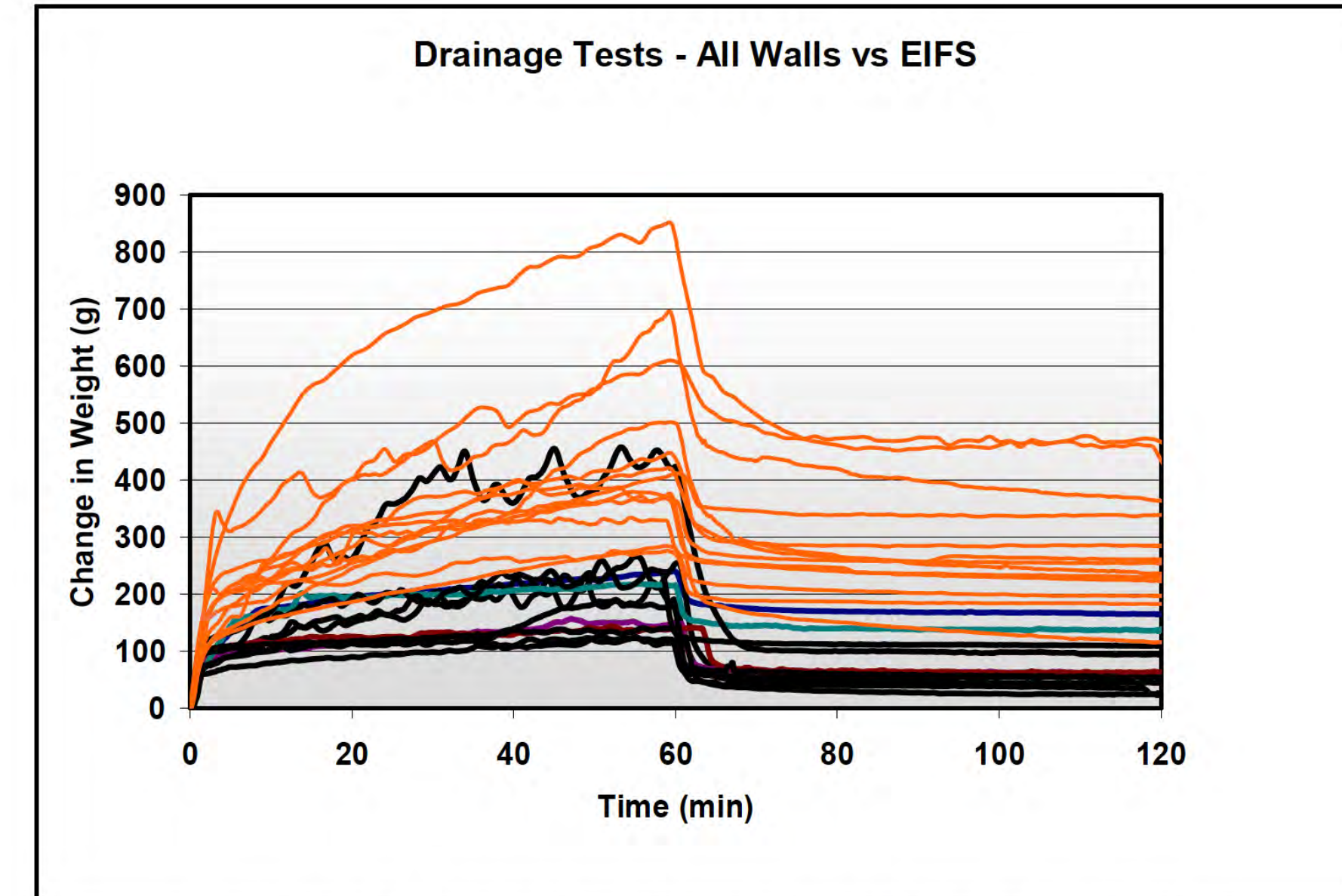
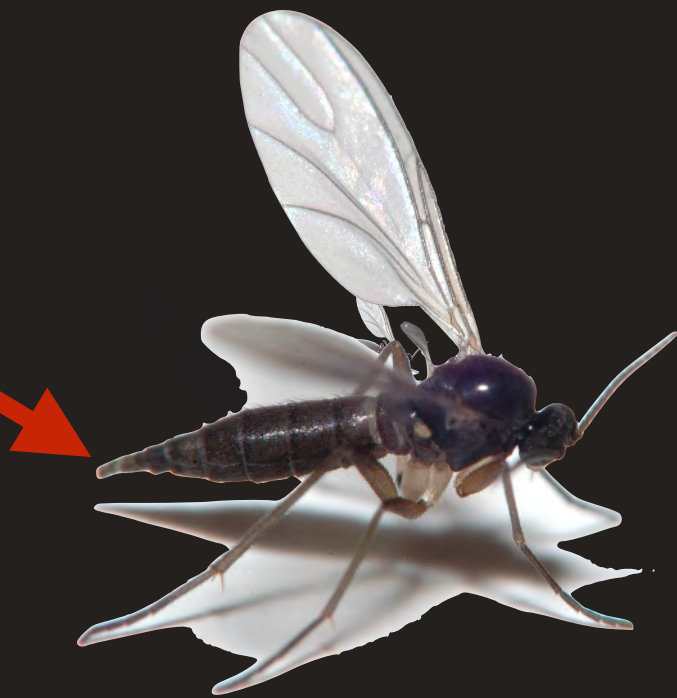


Figure 37 All drainage tests showing EIFS results highlighted.

New level of detail



Isn't water supposed to be deflected
away from the wall cavity ... not through it ?
(Kindergarten Building Science)

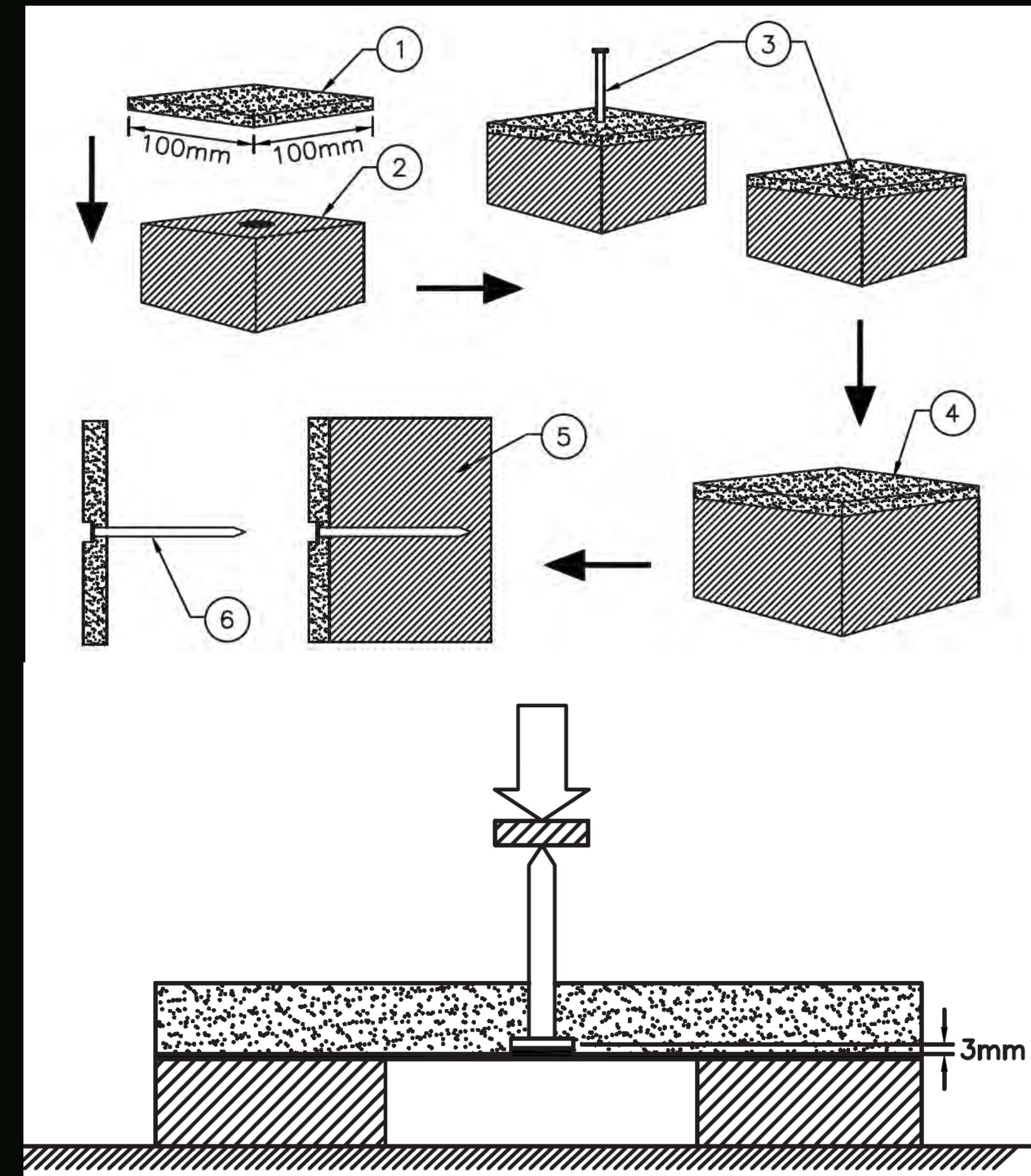
LA-WRB Research

- Jumping elephant test (to induce nail pops)



LA-WRB Research

- Jumping elephant test (to induce nail pops)



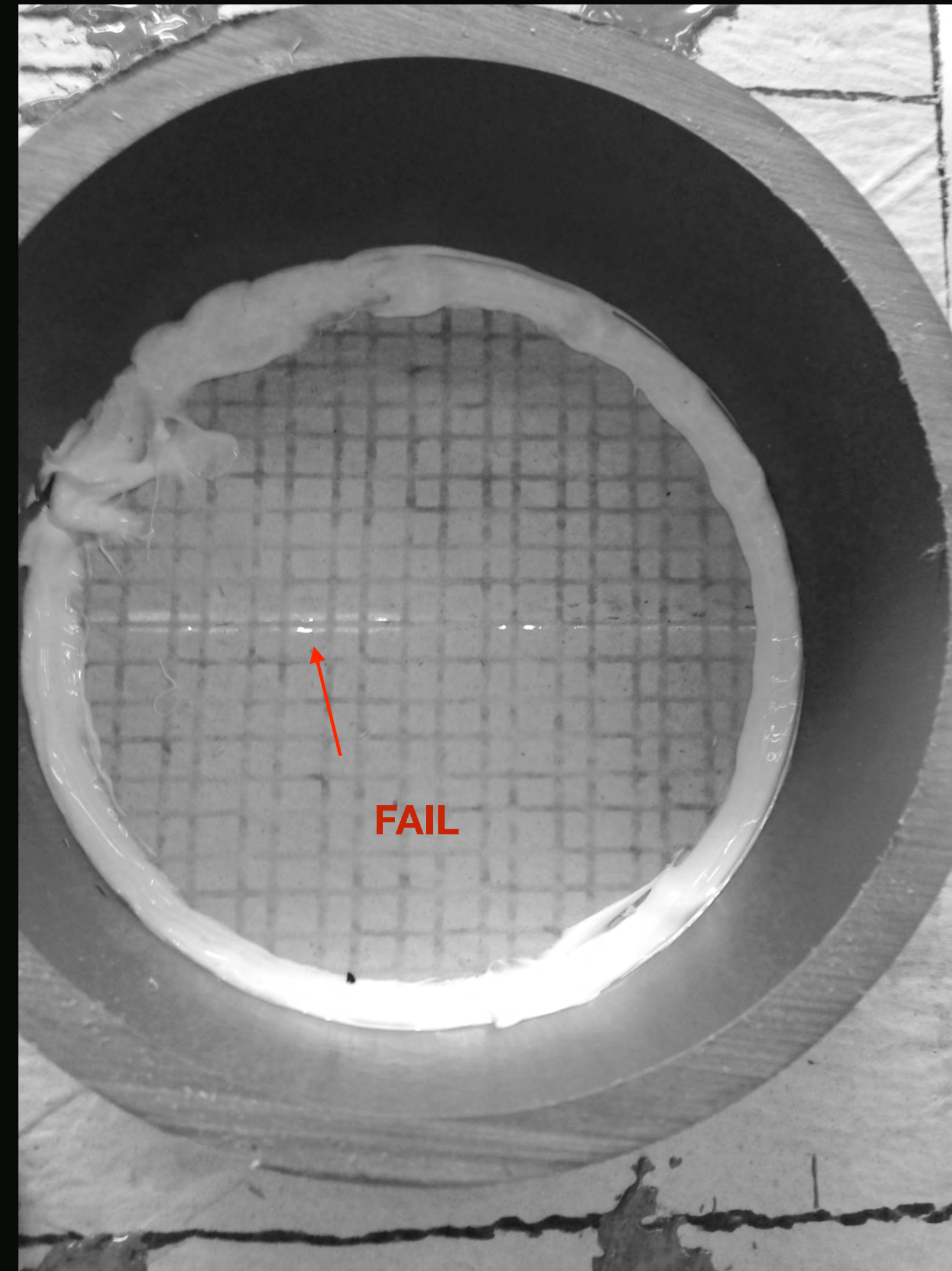
LA-WRB Research

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



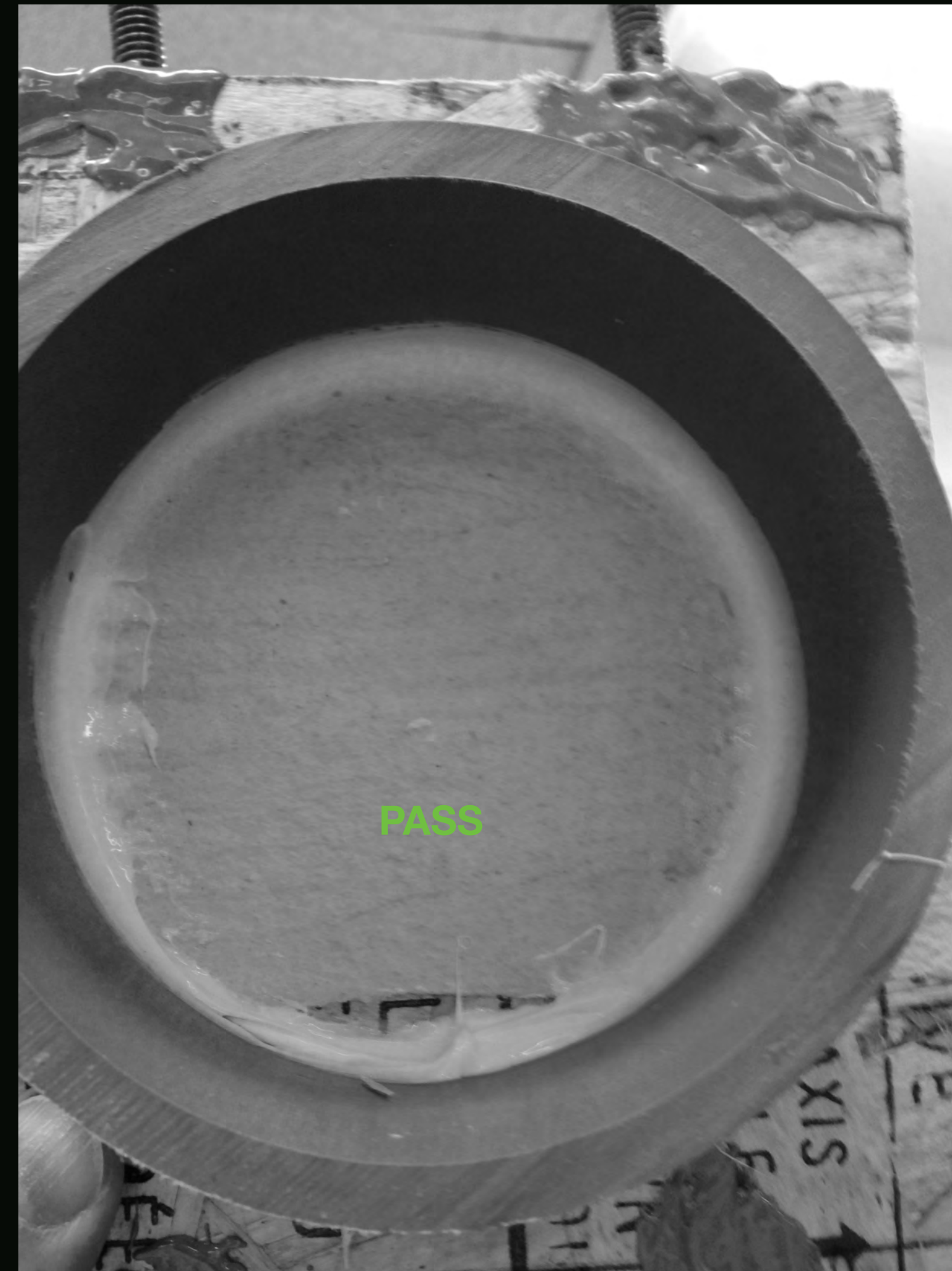
LA-WRB Research

- 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
- 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

OR

Just say 40 grams is the same as zero

The EIFS Industry leads !



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

Drainage at University of Waterloo

Back to the USA



Modelling at Oak Ridge National Laboratory

Advanced Modelling

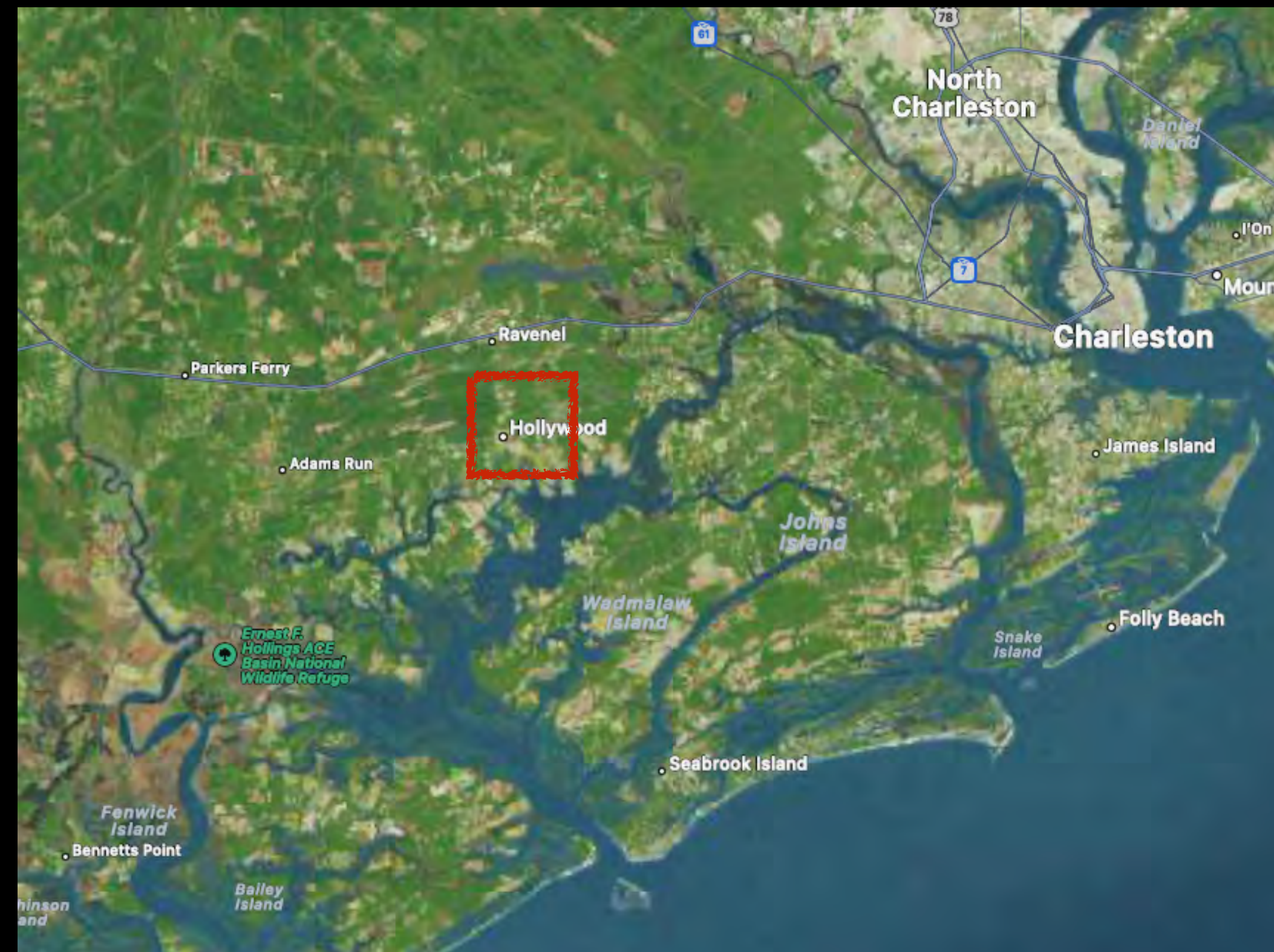
- Developed material characteristic data
- Model predicts 1 % of rainfall enters the cavity
- Showed EIFS works everywhere (including Calgary)

Natural Exposure Test (NET) Facility

Hollywood, South Carolina

Natural Exposure Test (NET) Facility

Hollywood, South Carolina



Natural Exposure Test (NET) Facility

Hollywood, South Carolina



- Opening day



- 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

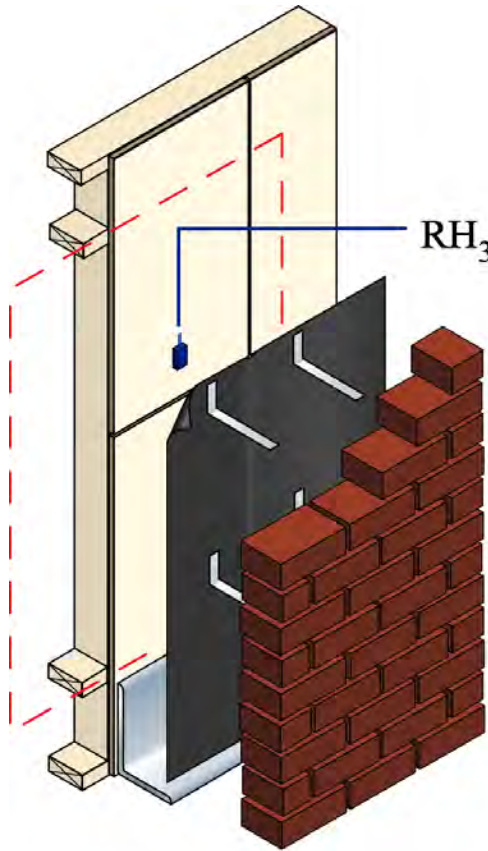


Monitored leakage

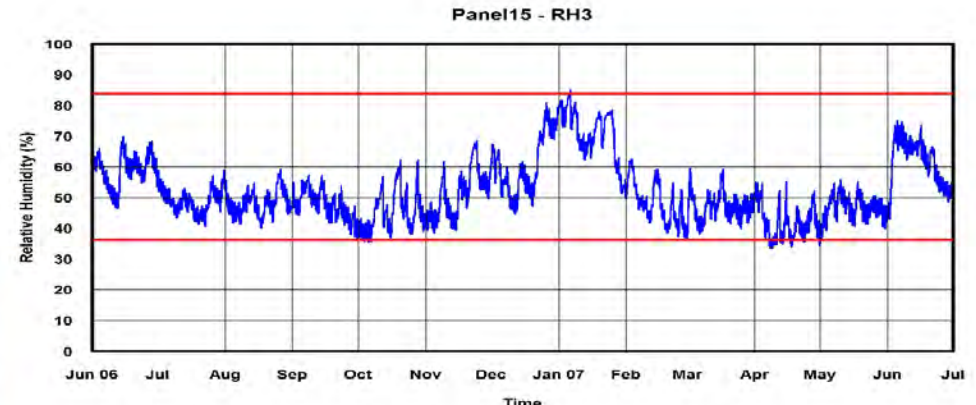
- Gutter size matched to test panel opening
- Tip bucket drained onto WRB
- EIFS drained
- Brick ...



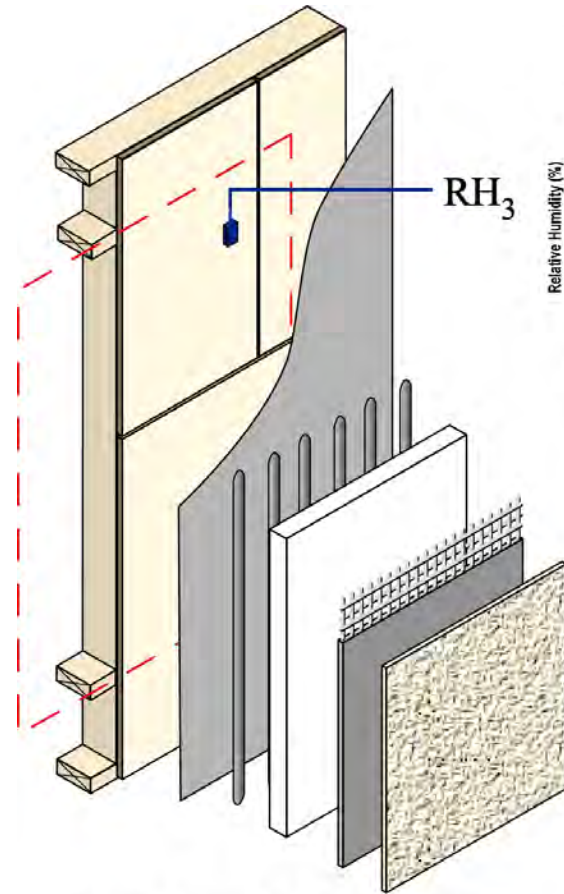
Performance



Brick Panel 2 without flaw



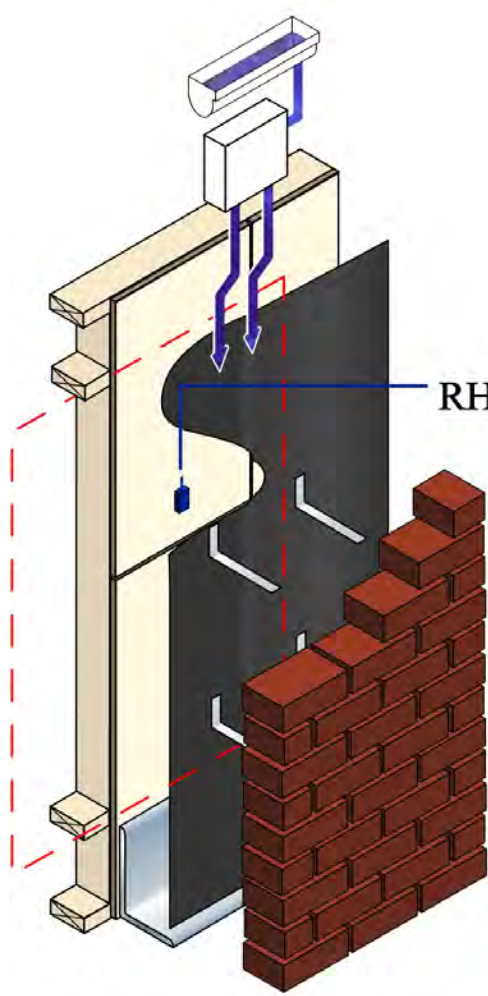
Brick Panel 15 - Sensor RH₃ - no flaw



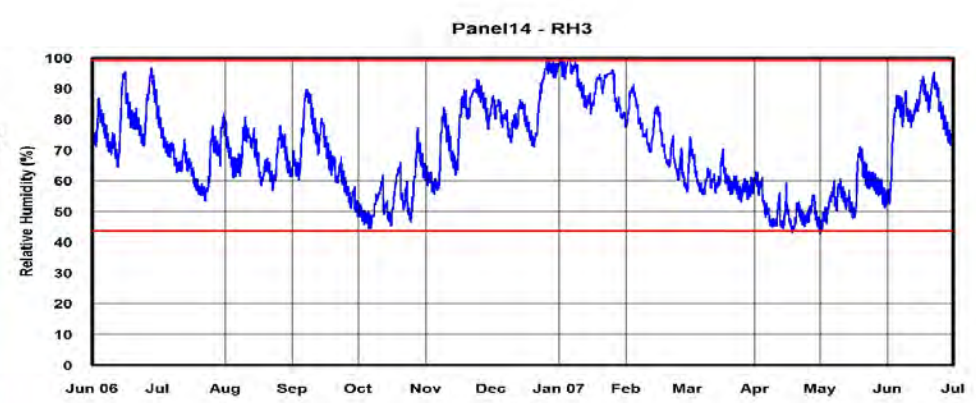
EIFS Panel 2 without flaw



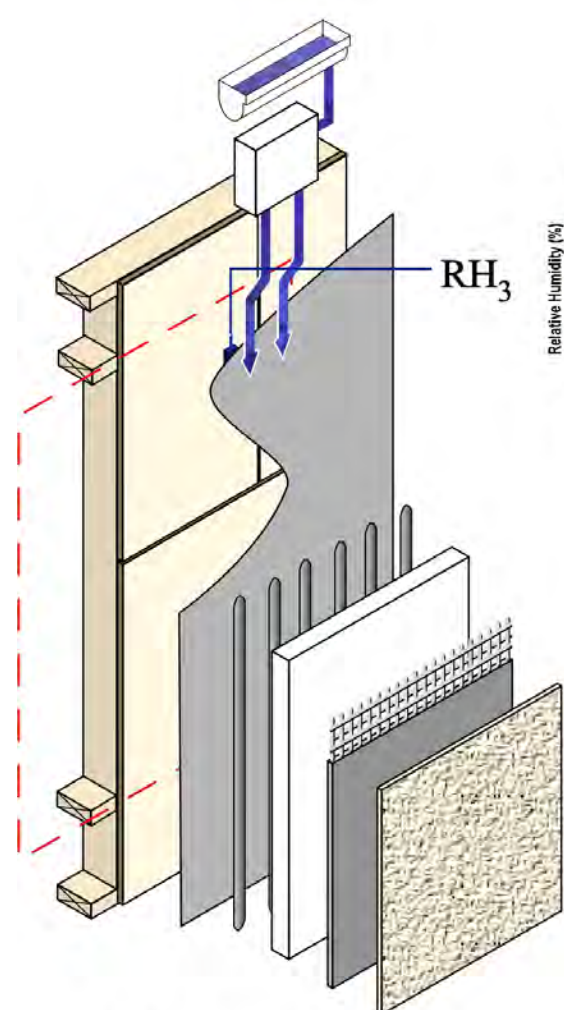
EIFS Panel 2 - Sensor RH₃ - no flaw



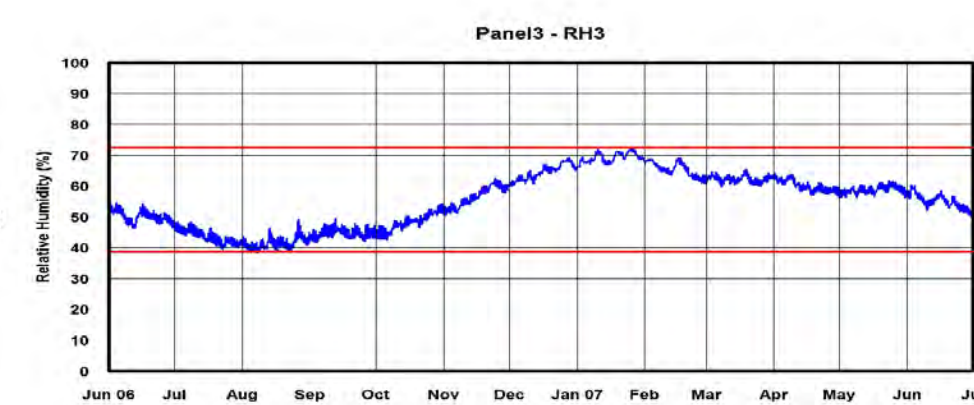
Brick Panel 3 with flaw



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 US model building codes

Back to Canada

Back to Canada



ProDemnity

Insurance company “does” building science

ProDemnity Response to Research

Rejected

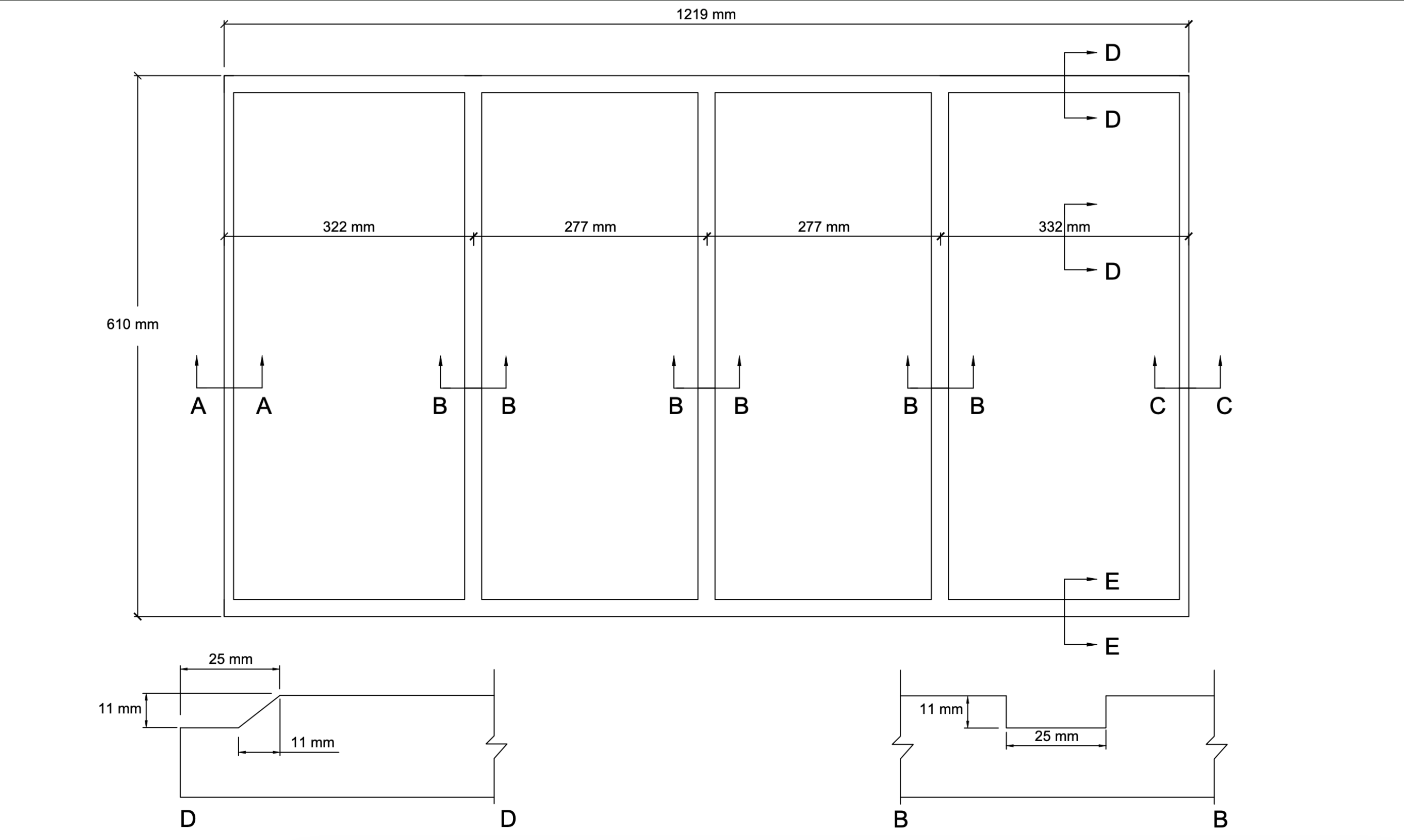
- “We know *intuitively* that 2 mm drainage cavity will not work.”
- Insisted on a 10 mm drainage cavity like the coastal areas
- And - no - we don’t “approve” systems

Hello GDDC

Geometrically Defined Drainage Cavity

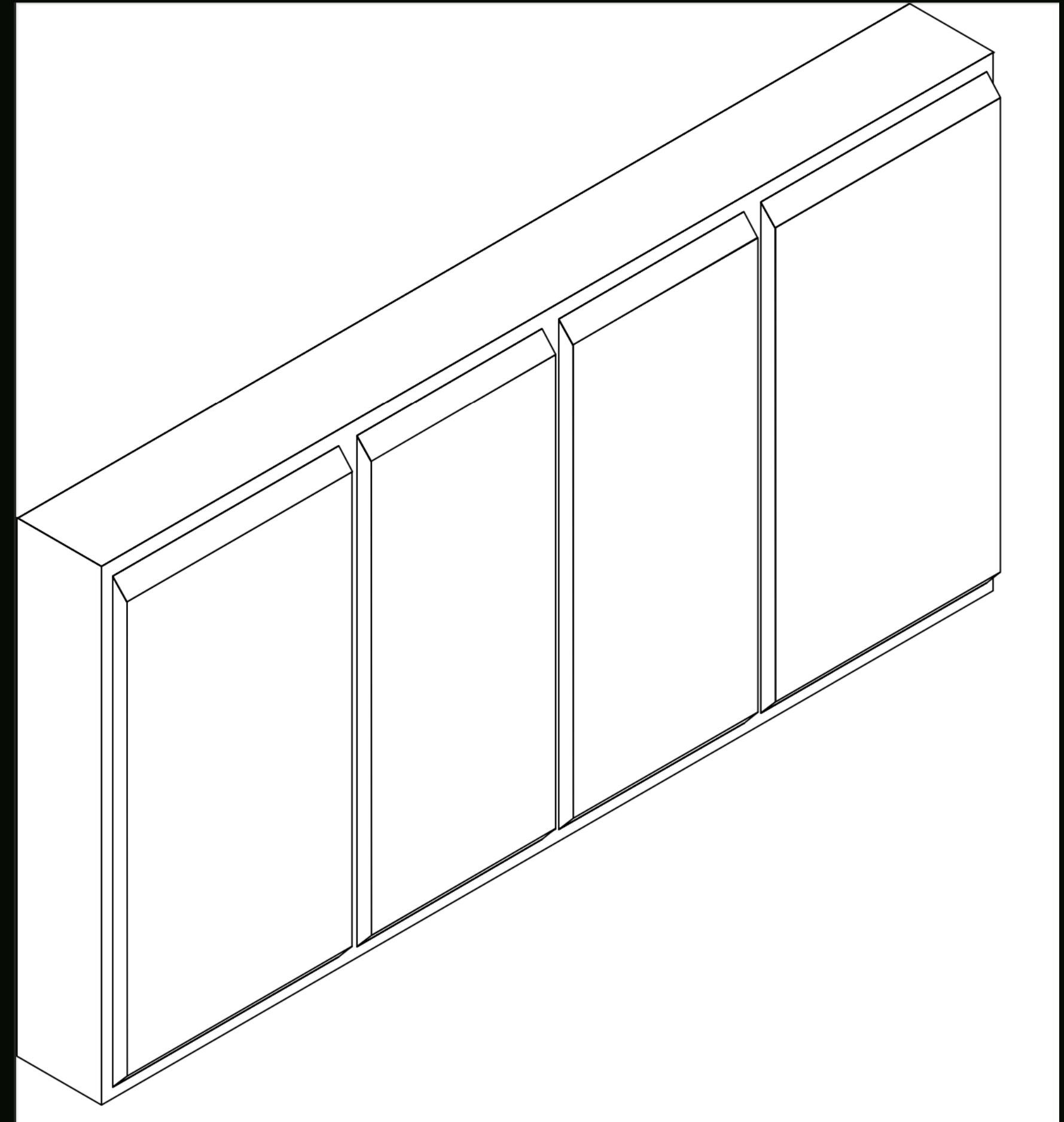
Patterns cut in insulation

- 10 mm drainage



Patterns cut in insulation

- 10 mm drainage
- Still allows adhesive pattern



Why is the EIFS industry tying itself into a pretzel ?



DEFLECT !

EIFS is not about drainage —

EIFS is dry by design.



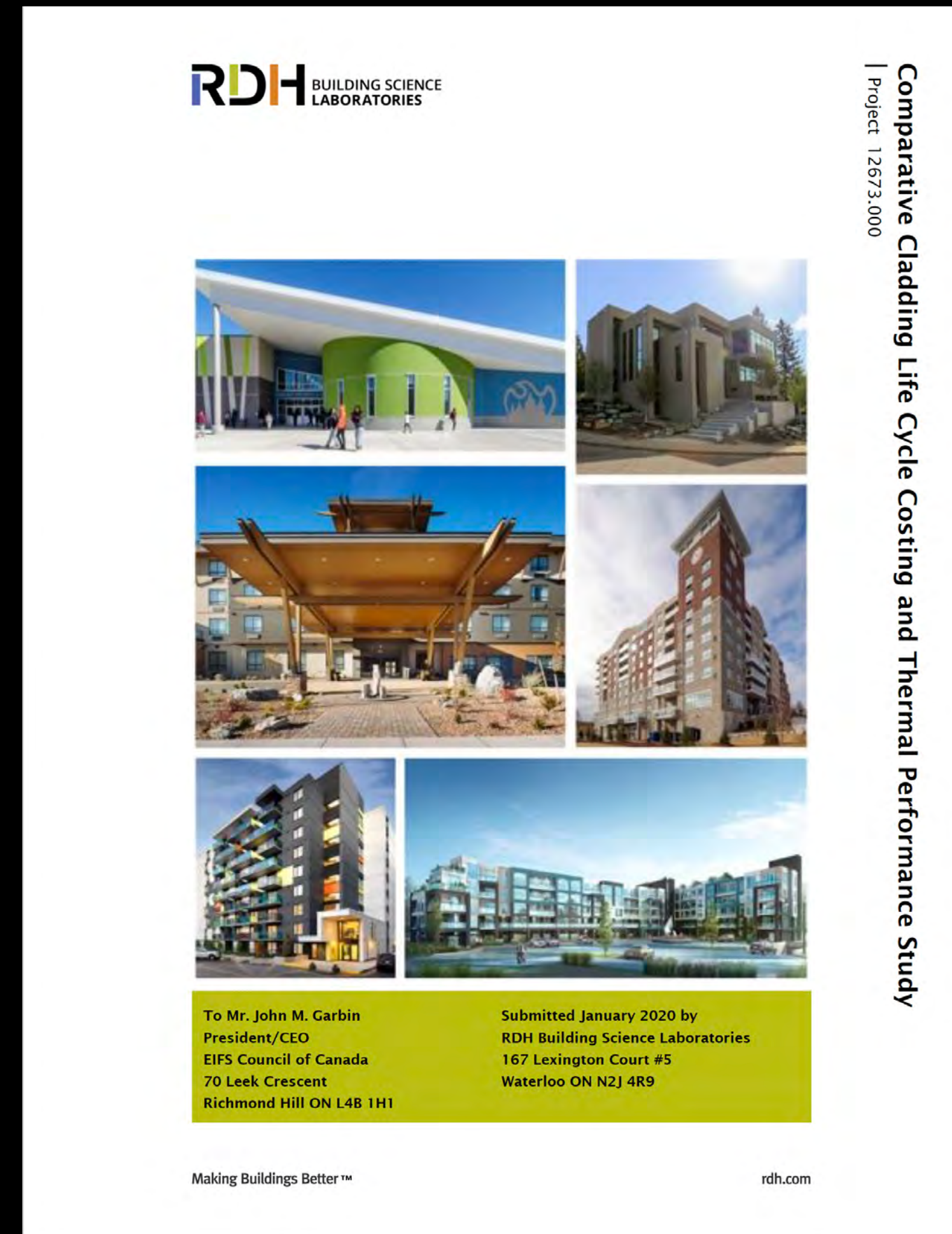
What's next ?

What's next ?

- ECC comparative life cycle costing study

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What's next ?

- ECC comparative life cycle costing study

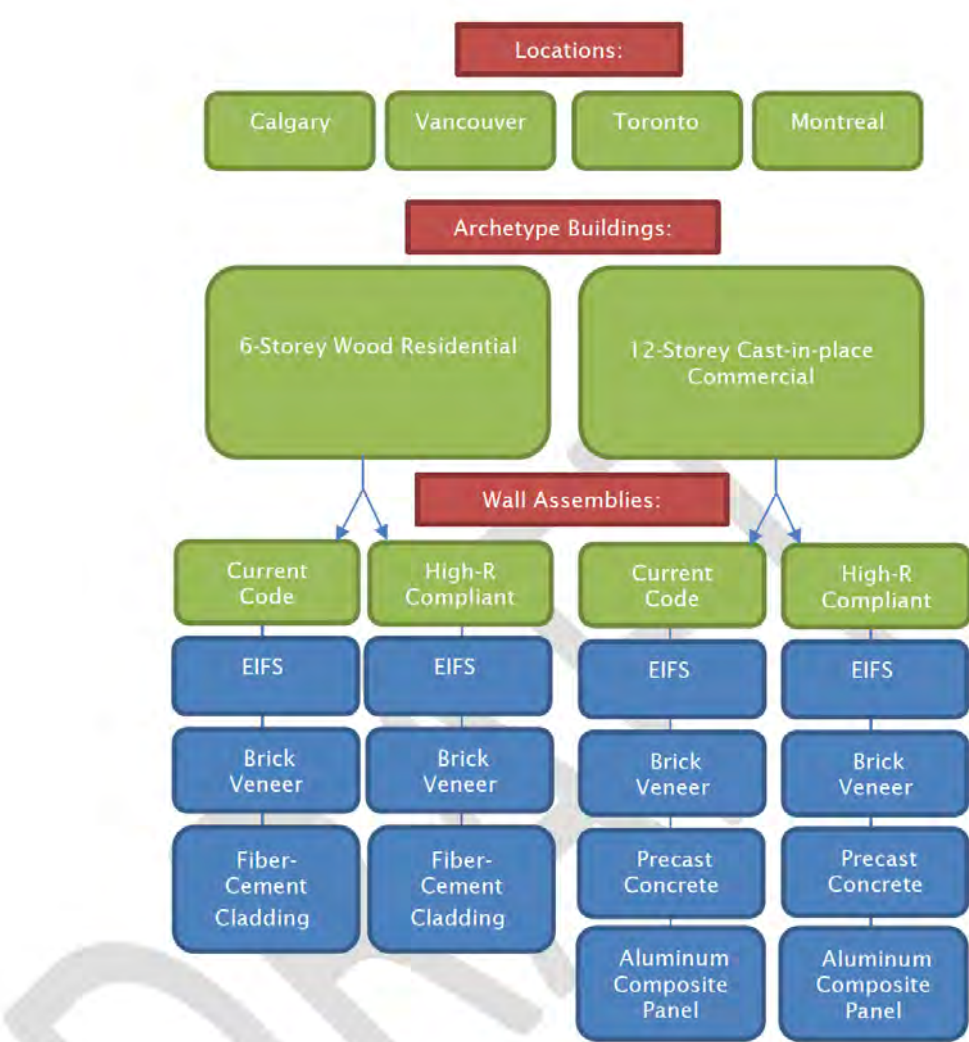


Figure 1-2: Study framework.

The 6-storey size of the residential building captures the popular 4-6 storey wood framed building archetype. The 12-storey commercial building is considered as a cast-in-place concrete structure for simplicity and also due to the popularity of this type of construction. Both building archetypes have 40% glazing. The archetypes also do not have balconies or other complex details (roof terraces, large overhangs, etc.) in order to simplify the study and avoid potential biases due to the limited availability of thermal performance data for these common thermal bridging locations.

TABLE 1-2 CHARACTERISTICS OF BUILDING ARCHETYPES		
Occupancy	Residential	Commercial
Storeys	6	12
Structure	Wood Framed	Cast-in-Place Concrete

What's next ?

- ECC comparative life cycle costing study

TABLE 1-1 SELECTED STUDY BUILDING CITY LOCATIONS		
The application energy code and National Energy Code for Buildings (NECB) climate zone is also provided.		
Climate Zone	Energy Code	NECB Climate Zone
Vancouver	2019 Vancouver Building By-law*	4
Toronto	Toronto Green Standard/SB-10/NECB 2015	5
Montreal	Quebec Construction Code	6
Calgary	NECB 2017	7

* The City of Vancouver recently adopted additional energy code requirements based on the current version of the Vancouver Building By-law (VBBL). NECB requirements were considered in the study to capture typical performance levels for new constructions.

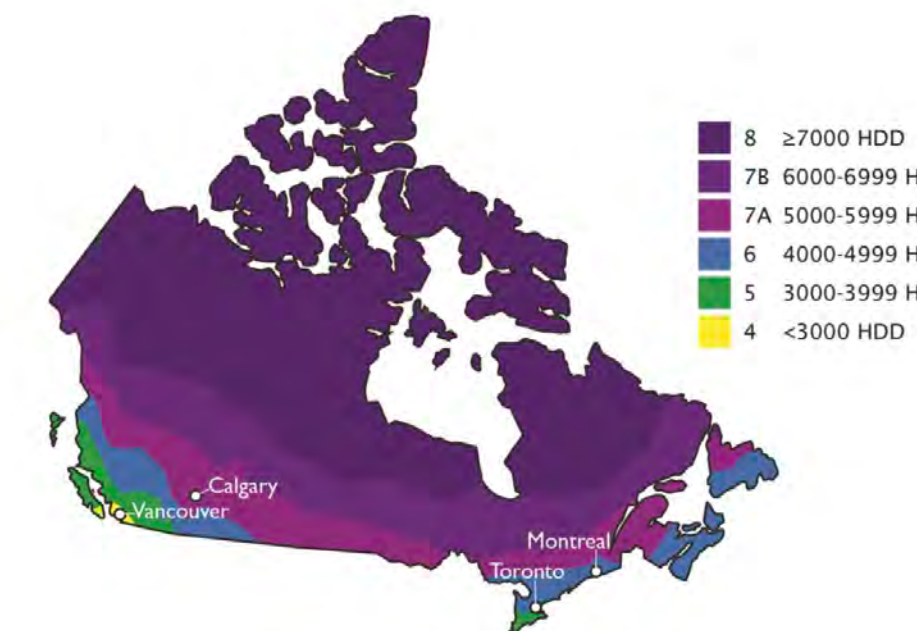
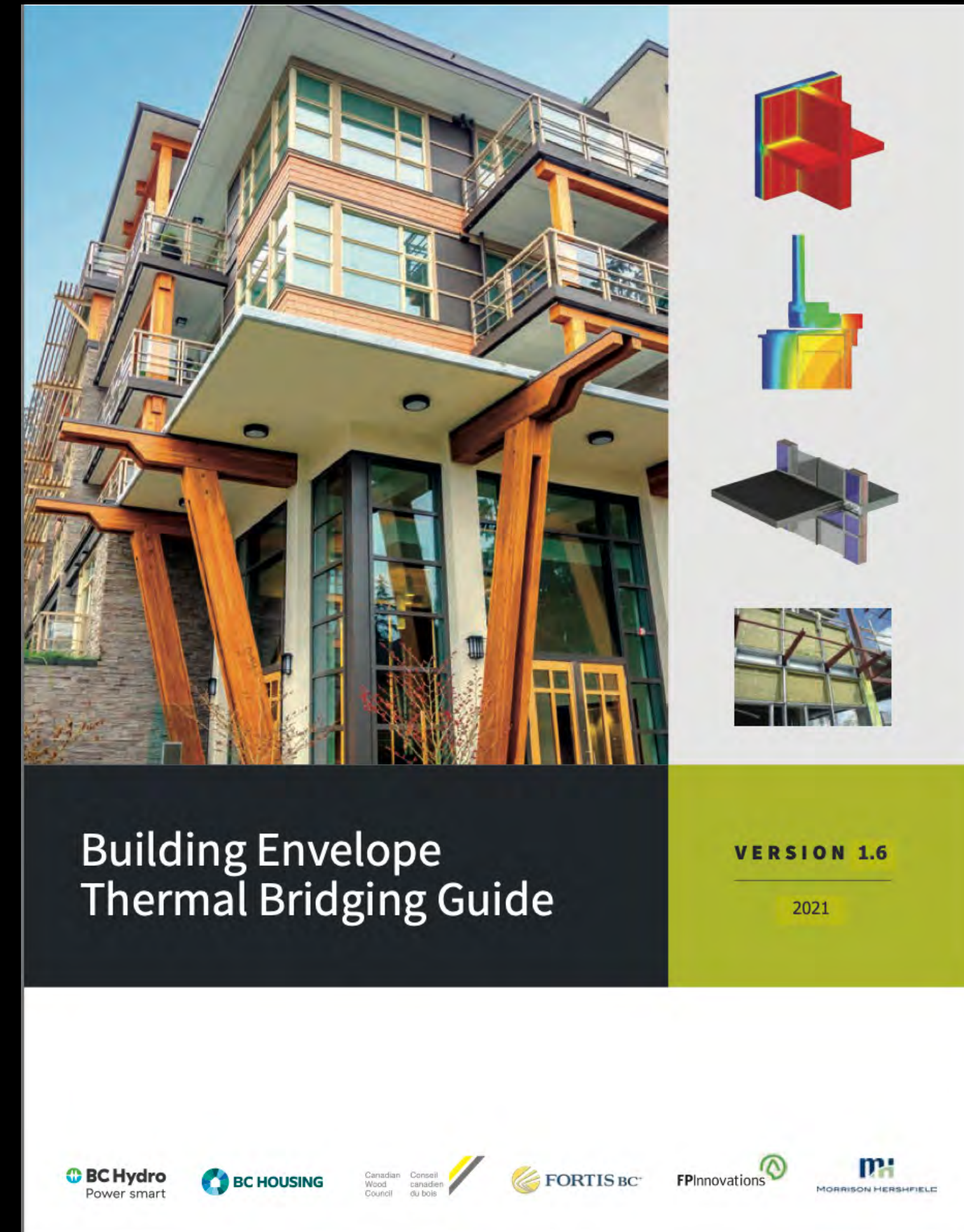


Figure 1-1: Study cities on NECB 2015 Heating Degree Day (HDD) climate zone map.

The study framework is illustrated in Figure 1-2. For each of the study city locations, two building archetypes were considered: a 6-storey residential building and a 12-storey commercial building. A range of building sizes and types were selected to broaden the applicability of conclusions drawn from the study.

What's next ?

- ECC comparative life cycle costing study
- Thermal Bridging Guide



Questions ?