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

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- Water introduced into drainage cavity
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- Water introduced into drainage cavity
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- Cavity opened
Original Drainage Test

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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 ft$^2$ opening
A standard is born

- ASTM E-2273
  Drainage for EIFS

- 5 gal\textsubscript{US} / hour sprayed into 1/3 ft\textsuperscript{2} 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  \(\text{MI} > 1.0\)
- 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

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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

Drainage and Retention of Water by Cladding Systems
Part 8 – Summary Report
Canada Mortgage & Housing Corporation (CMHC)

- Compared other claddings to EIFS
- EIFS tended to drain the best
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
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- 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)
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LA-WRB Research

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LA-WRB Research

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

PASS
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

Figure 6: Schematic of Drainage & Drying Test Setup
Drainage and drying

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

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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

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- Tip bucket drained onto WRB
- EIFS drained
Monitored leakage

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