



What We Don't Know and why it will bite us

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LEARNING OBJECTIVES

- Describe what we don't know
- Relate what we think we know but don't
- List what we do know
- Propose why we should care



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NOW INCLUDING VAPOR AND WATER RESISTIVE BARRIERS

Questions I ask design professionals – answers I get

- Does heat rise?
- What is the number one reason to install an air barrier?
- What is the difference between an air barrier and a vapor barrier?
- If there is a hole in your vapor barrier, does it matter?

Don't forget

People who don't know,
don't know that they don't
know

**It is impossible for anyone to begin
to learn that which he thinks he
already knows.**

Epictetus,
philosopher

So what don't we know

- Well most everything
- We may understand steady state but we don't understand dynamic
- Buildings operate in a dynamic fashion

Thermal insulation

- ASTM C518 & C177
- Steady state at room temperature
- When the temperature is 75°F – guess what – we don't need insulation
- When it is 100°F or -40°F we get different thermal conductivity values
- Fibrous insulation gets a better value and cellular plastics gets a lower values due to condensation of the blowing agent

Thermal insulation

- ASTM C177
- 1.11 It is not practical for a test method of this type to establish details of design and construction and the procedures to cover all contingencies that might offer difficulties to a person without technical knowledge concerning theory of heat flow, temperature measurements and general testing practices.
- The user may also find it necessary, when repairing or modifying the apparatus, to become a designer or builder, or both, on whom the demands for fundamental understanding and careful experimental technique are even greater. Standardization of this test method is not intended to restrict in any way the future development of new or improved apparatus or procedures.

Thermal insulation

- Thermal insulation material specification
- 1.5 The test methods listed in this Standard are used to determine the values for the physical properties. These physical property values are intended for use in specifications, product evaluations and quality control. They are not intended to predict end-use product performance.

Thermal insulation

- How many design professionals use the ASTM C177 or C518 test values as design parameters?
- Do design professionals use different parameters when modeling at different temperatures?
- Do manufacturers published different thermal conductivity values for different temperatures?
- Do they even test at different temperatures?

Thermal insulation

- Roofing industry all up in arms because the installed polyiso does not perform to ASTM C177 or C518 values
- Why are they surprised?
- Who has tested thermal insulation materials in real world conditions with a wide range of temperatures, water vapor transmission, water absorption, freeze thaw?

Water resistive barriers

- No water resistive test method for water resistive barriers
- No sub-assembly testing
- Do we have the right assembly testing? Amount of water delivered? Pressure difference?
- What are the critical material properties for different types of water resistive barriers?

Water resistive barriers

- AATCC 127
- Written for using a machine to create the hydrostatic head
- Physical hydrostatic head of 55 cm not included
- Does a garden hose attached to a funnel that is 55 cm long qualify as a proper test?
- Is 5 hours enough or is 24 hours the proper number (AAMA)
- How do we test materials like fluid applied that need a substrate?

Vapor barriers

- Who cares? Well we need to but maybe not as much as we are doing now?
- ASTM E96 is steady state – what happens in a dynamic fashion? How does that impact the performance of the building? WUFFI? Is wet cup the right method? Should it be dry cup? What happens when both dry cup and wet cup atmospheres happen in a building?
- Accuracy varies based on laboratory

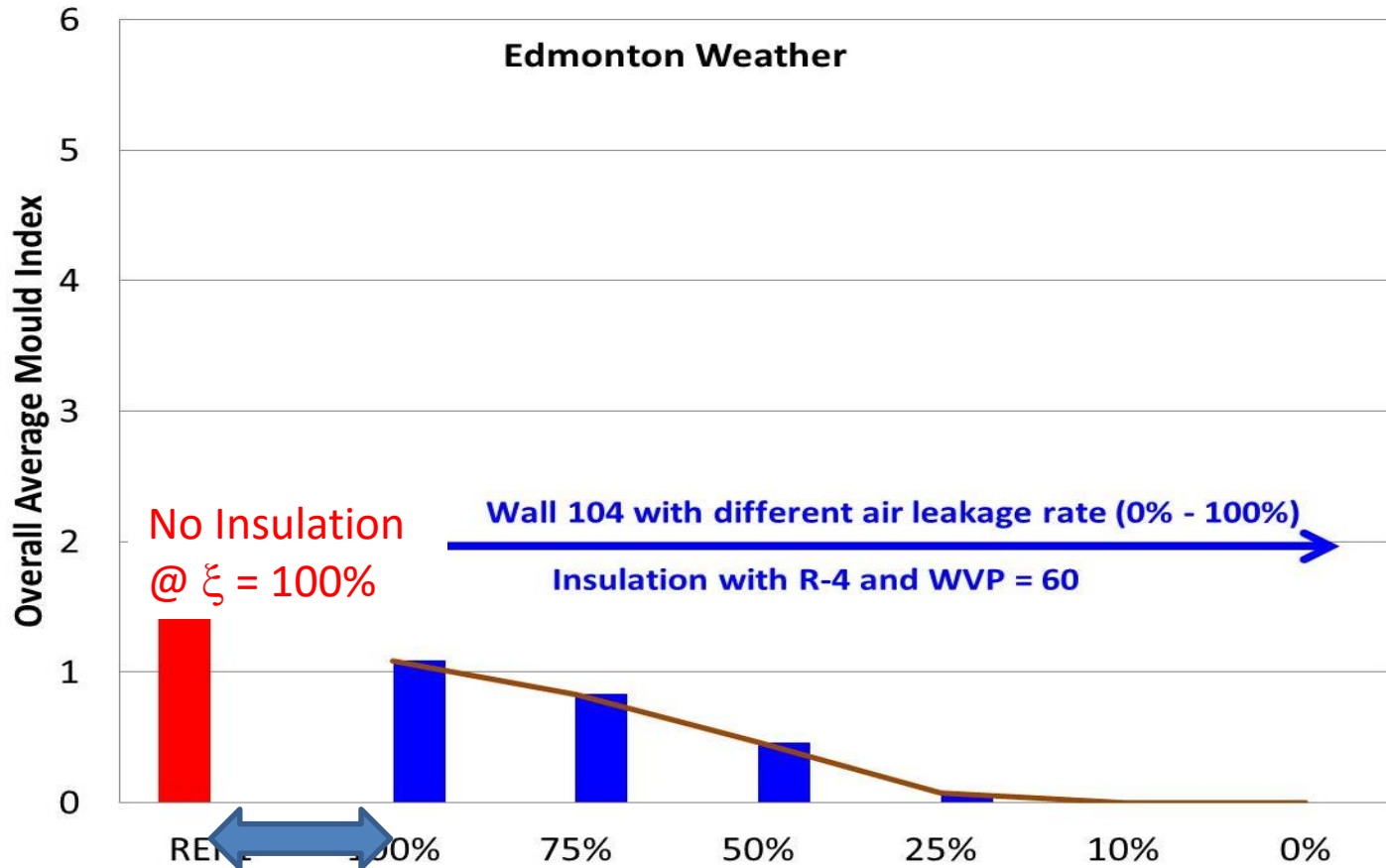
Vapor barriers

- How concerned should we be?
- Is it only a concern in north and south and in the middle we don't care?
- How sure are we that the buildings perform as we predict?
- Is a vapor permeable air barrier better than an air & vapor barrier?
- What happens when we change thickness?
- What happens when we mix vapor permeable and vapor impermeable?

Results (cont.)

Effect of Air Leakage Rate

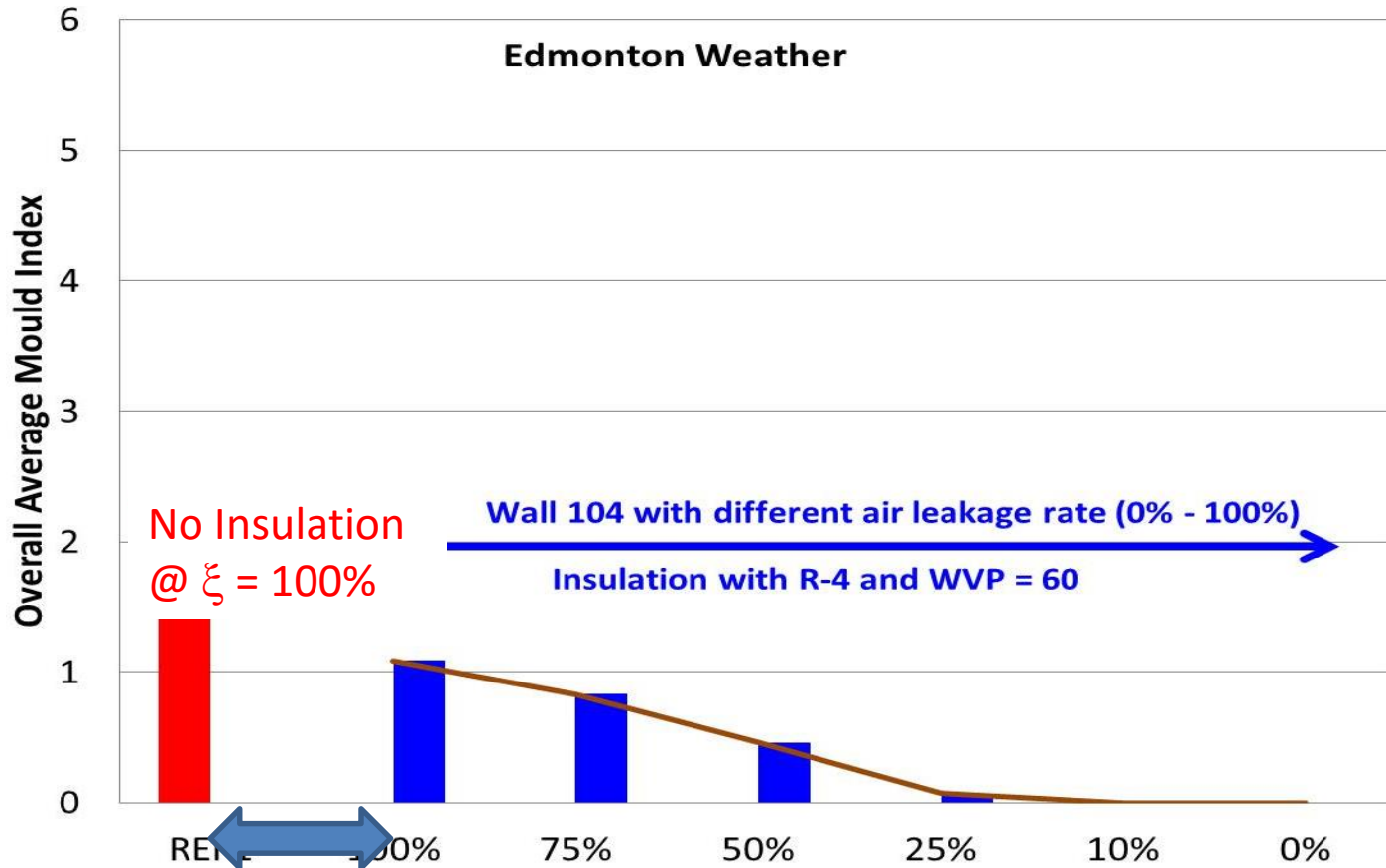
Edmonton: cold, dry, HDD18=5120, MI=0.48



Results (cont.)

Effect of Air Leakage Rate

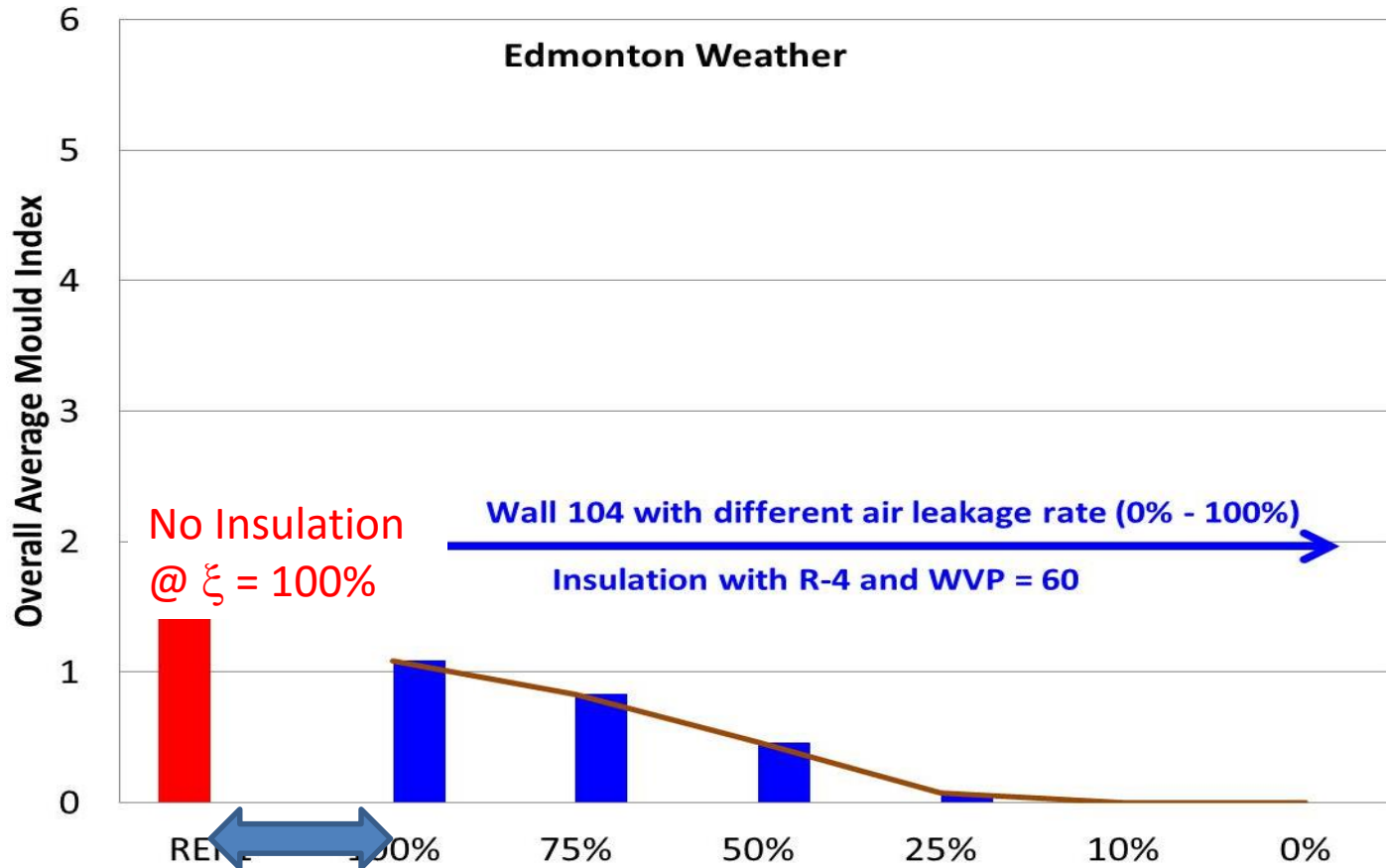
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Results (cont.)

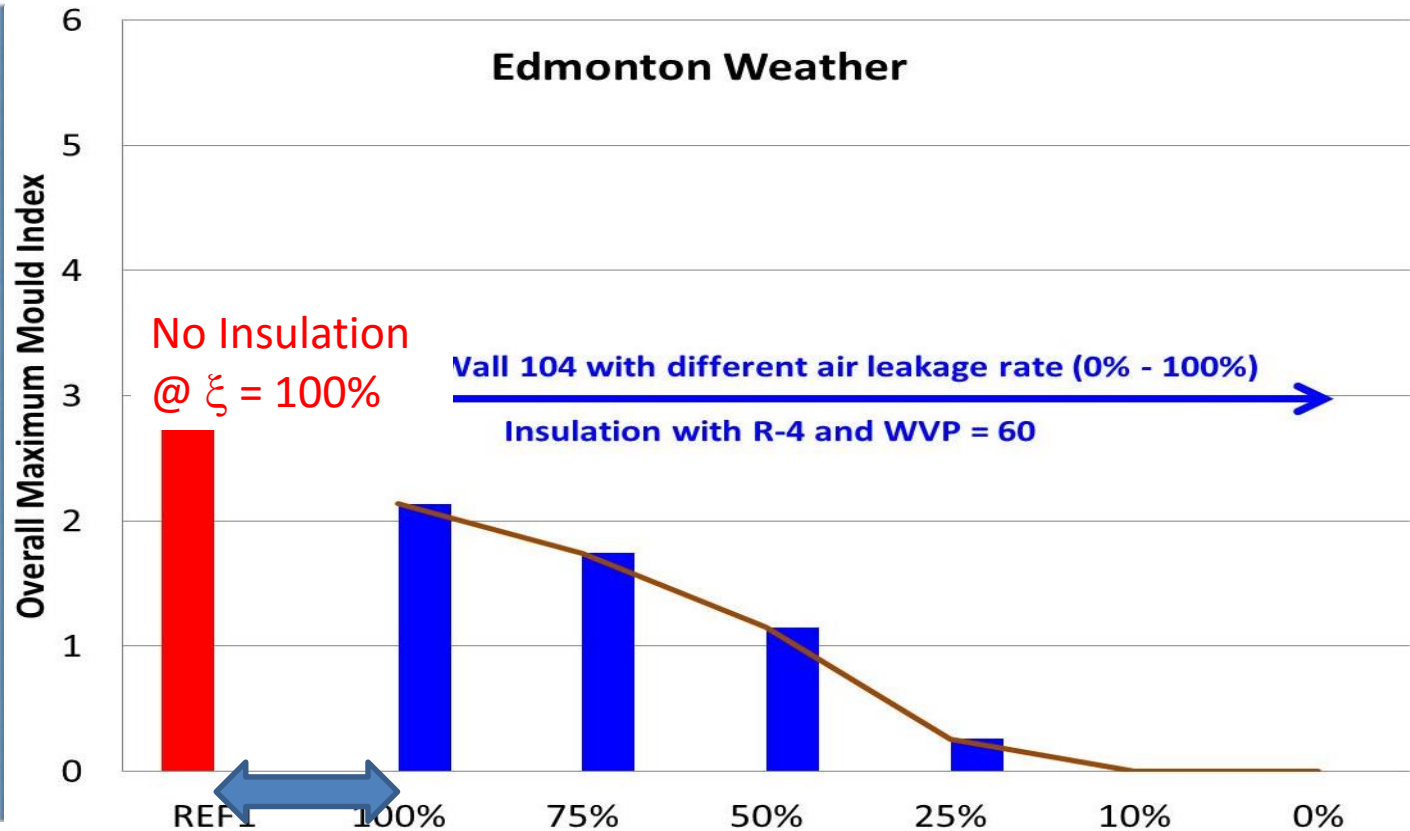
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KEY REQUIREMENTS

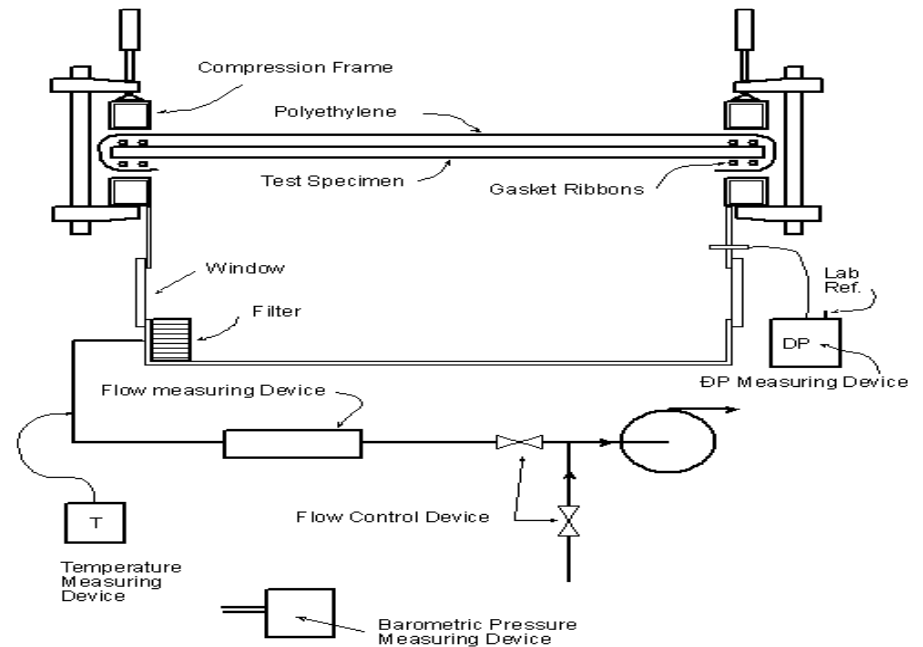
➤ Impermeable material

- ASTM E2178 / CAN/ULC S741 – Standards need updating
- Laboratories – lack accurate equipment – lack experienced testers – lack climate control of the test chamber
- How tight do we need to go? – 0.01 or 0.000001
- How important is a low number for the material vs. assemblies or systems?

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IMPERMEABLE MATERIAL

ASTM E2178 TEST METHOD



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KEY REQUIREMENTS

➤ Impermeable material

The formula: $V = 4005 \times A \times C \times (P)^{1/2}$

Where V: Flow (ft³/min)

A: Area (ft²)

C: Contraction coefficient (0.6)

P: Pressure differential (in of H₂O)

For a flow of 0.02 L/s•m² at a pressure differential of 75 Pa, the equivalent allowed orifice will be around **1.93 mm in diameter** for each square meter of wall. **(0.07598425 inches)**

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KEY REQUIREMENTS

➤ Continuous

- ASTM E2357/CAN ULC S742 – Standards need to be updated
- Loading of specimen – current values address 80% of buildings that are 3 stories or less
- What is required to seal the joints, penetrations or terminations and keep them sealed?

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KEY REQUIREMENTS

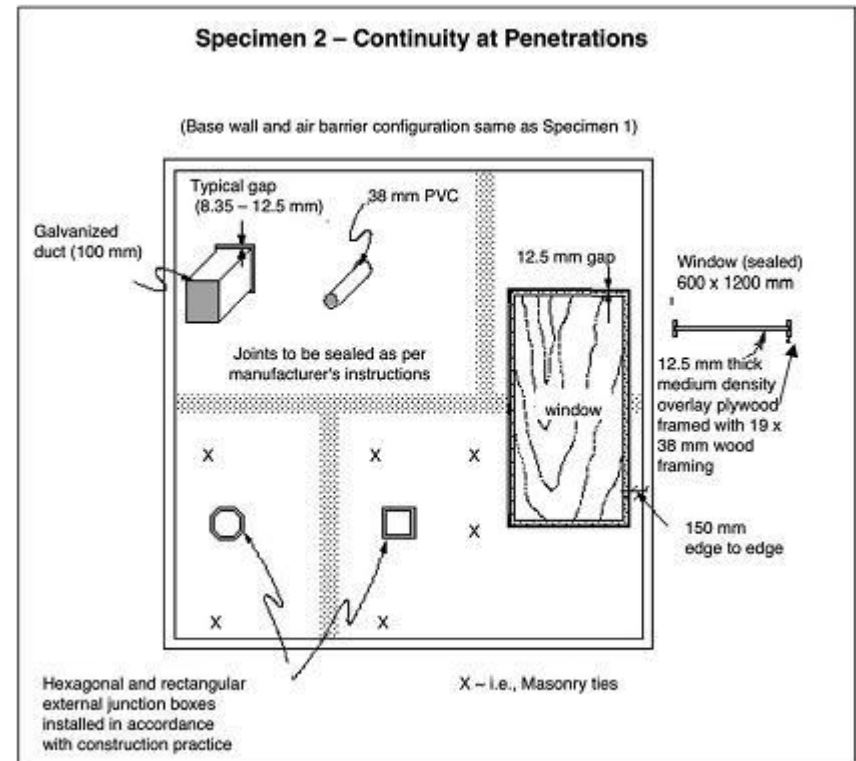
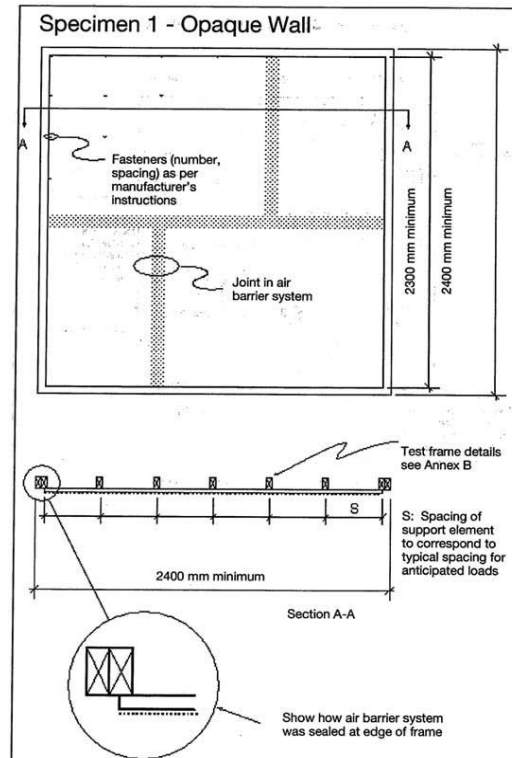
➤ Continuous

- Air carries heat and moisture – but how much?
- What are the actual air leakage in a specific building based on the location and operating parameters?
- What is the impact on the performance of buildings?
Moisture transport – wetting and drying

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CONTINUOUS

➤ ASTM E2357



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CONTINUOUS

➤ ASTM E2357



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CONTINUOUS

- All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight



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KEY REQUIREMENTS

- **Strong: resist positive and negative loads**
 - Flexible vs. non-flexible
 - Adhesion requirement – 16 psi? Based on lowest value achieved when self adhered material was tested in a lab
 - Loads on the material (wind, stack and mechanical) vs. what a properly installed material will achieve
 - ASTM D4541 – Procedure currently not included in standard
 - Should there be different values per substrate per type of material?

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KEY REQUIREMENTS

➤ Durable

- Biggest outstanding question
- For how long?
- How to we do short term testing to predict long term performance?
- How do we define durability?

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KEY REQUIREMENTS

➤ Durable

- C1305 Crack Bridging – temperature / concrete substrate
- D1970 Nail Sealability – measurability / accuracy
- D903 / D3330 – Peel adhesion – which is the proper test

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KEY REQUIREMENTS

- **Relate what we think we know but don't**
 - The 200 GB file is available on request

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KEY REQUIREMENTS

➤ What we know

- To be determined – not available at this time

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KEY REQUIREMENTS

➤ What we know

- No matter what we do with materials – installers can screw it up!!
- Need installation standards not just material standards
- Design standards are needed as that where it starts

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KEY REQUIREMENTS



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KEY REQUIREMENTS

➤ Propose why we should care

- Retrofit and repair contractors are making too much money
- The most green building you can have is the one you did not build new – extend life, retrofit existing
- Affordable housing – re-purposed buildings – retrofitted building
- We should not re-build our buildings and make the same mistakes

Thank you for your time!

Question and Answer Period

This concludes The American Institute of Architects
Continuing Education Systems Course

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