Using Fiber Insulation as a Means of Drying Internally Insulated Walls

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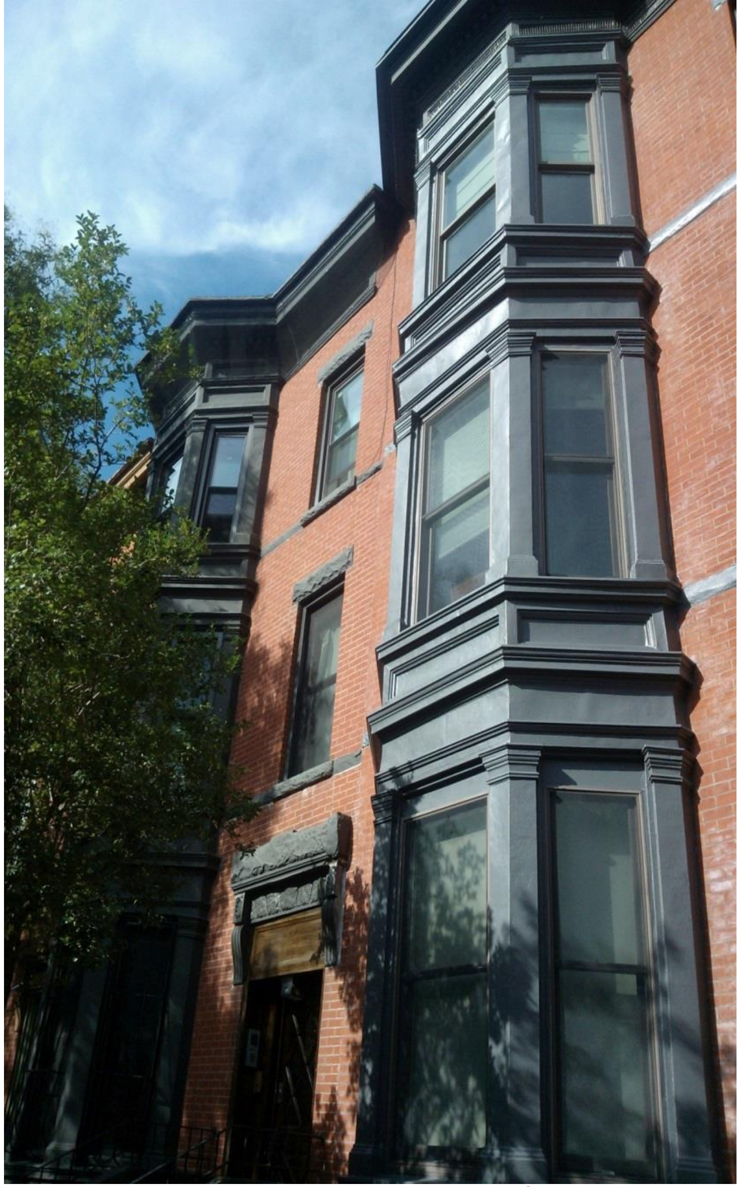
Civil Engineering
UNIVERSITY OF TORONTO



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OVERVIEW

1 Retrofitting Historic Masonry Buildings

2 Methodology

3 Laboratory Testing Results

RESEARCH DRIVING FORCES

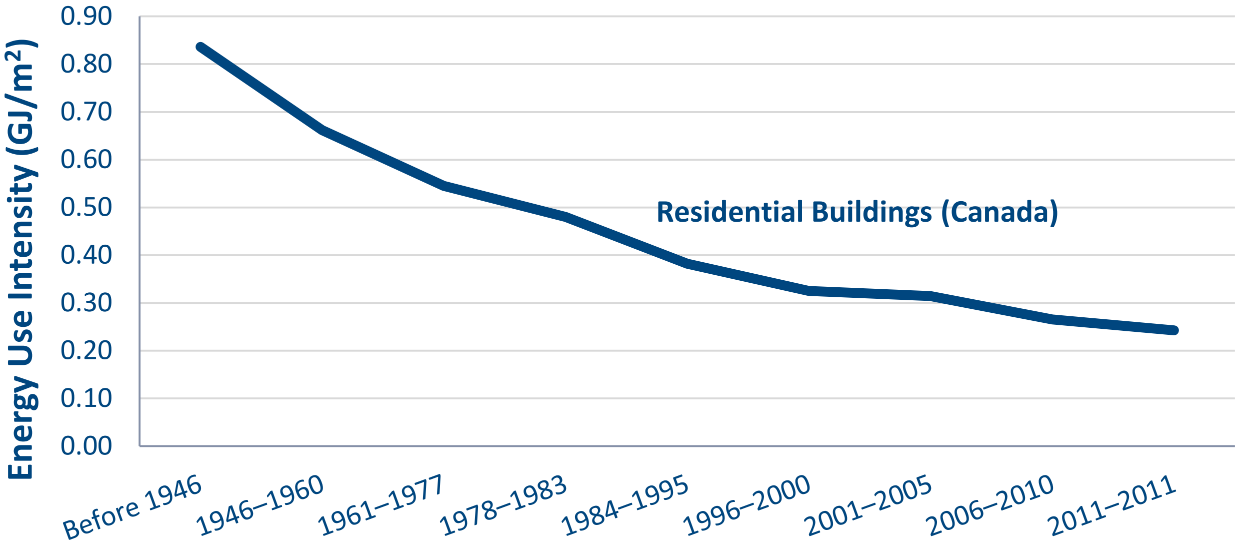
PROBLEM

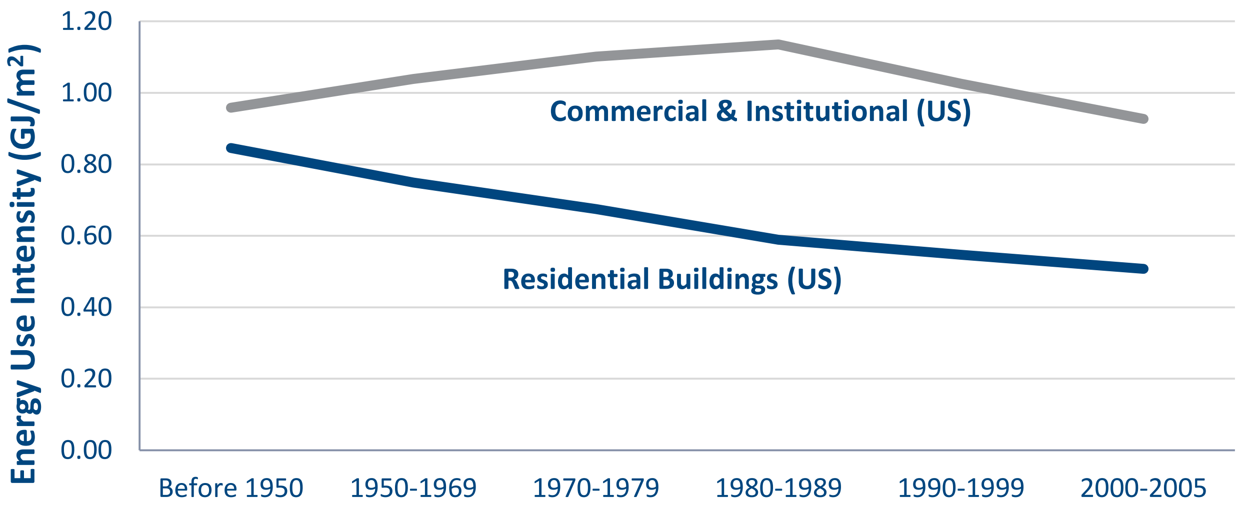
25% of Canada’s GHGs come from buildings

BUT…

We’re not retrofitting them fast enough or deep enough to achieve our targets

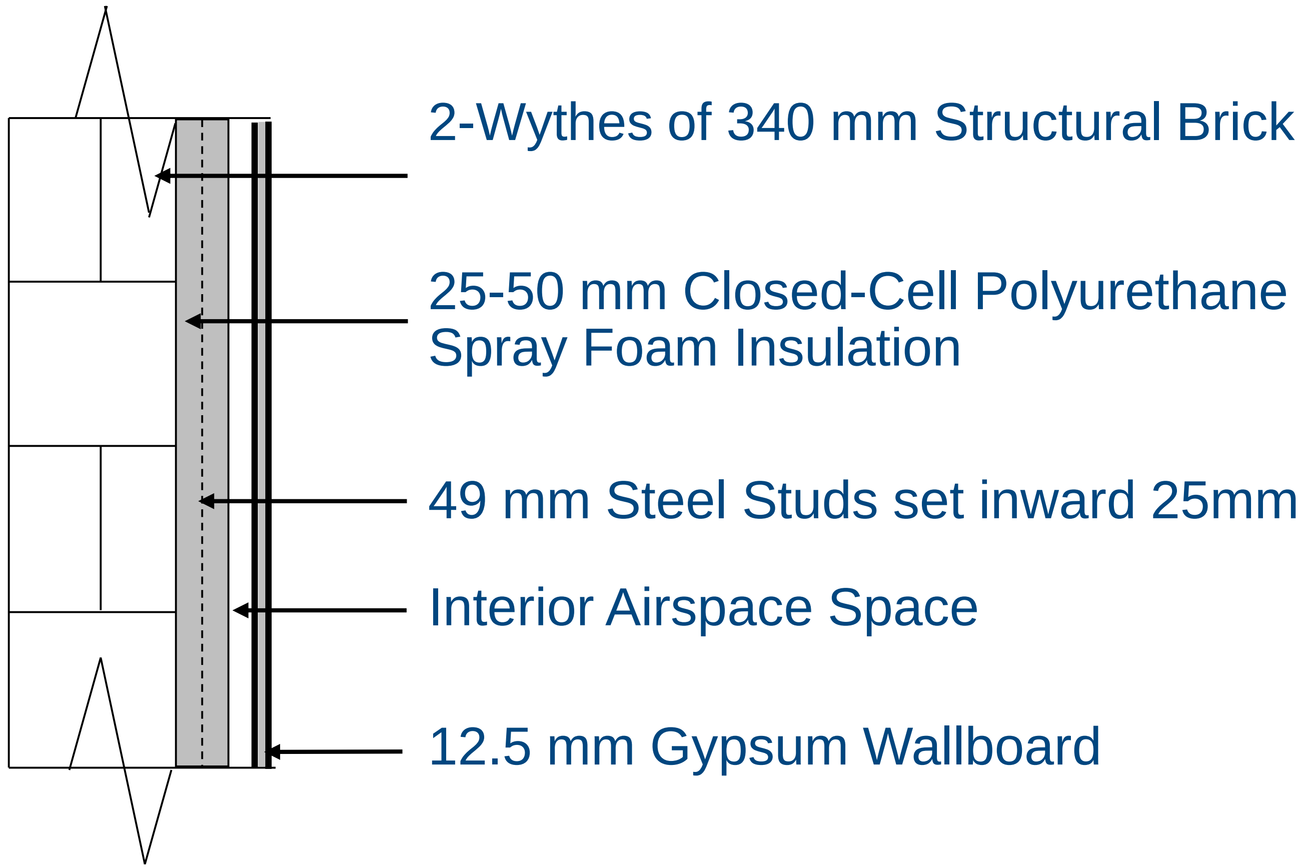
IMPACTS OF OLDER BUILDINGS



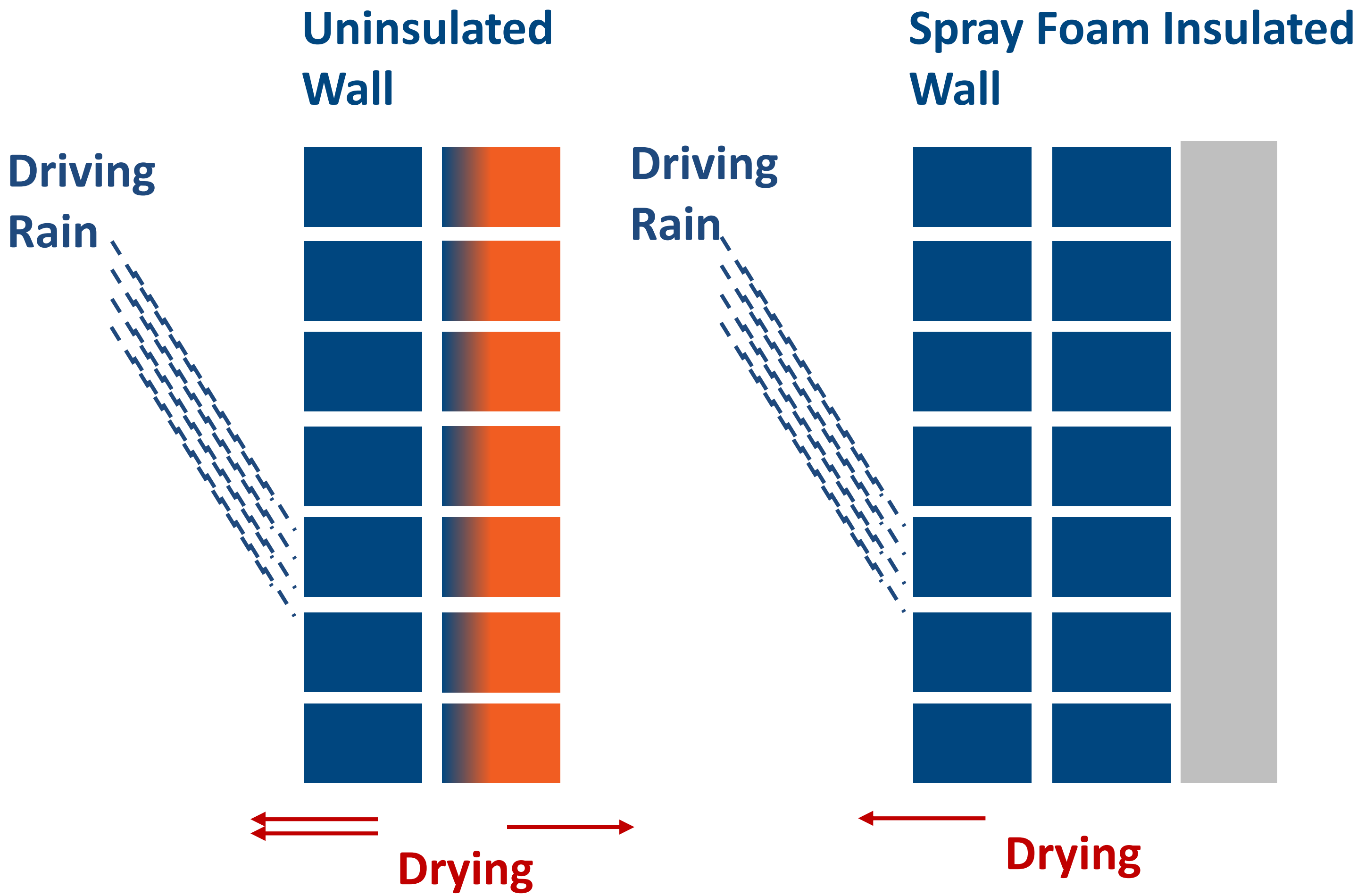


- Low envelope thermal resistance
  - ~0.5 – 0.7 m^2K/W – Walls
  - ~0.2 m^2K/W – Windows
- Uncontrolled air leakage
  - >16 ACH_{50}
  - Ventilation difficult to control
- Varying masonry properties
- Durability issues during retrofits

STANDARD RETROFIT APPROACHES

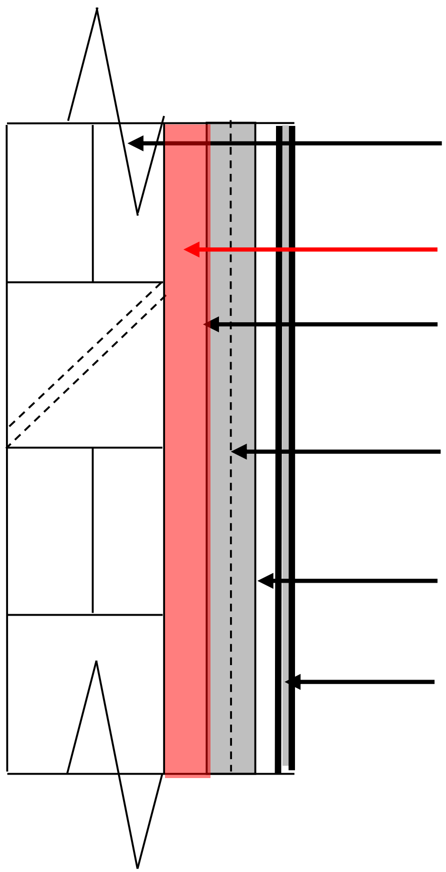


INSULATING SOLID MASONRY WALLS



What happens to the thermal environment when we internally insulate a solid masonry wall?

VENTED MASONRY RETROFIT (VMR)



2-Wythes of 340 mm Structural Brick

20 mm Vented Airspace

25-50 mm Closed-Cell Spray Polyurethane Foam Insulation

49 mm Steel Studs inboard 25 mm

Interior Airspace Space

12.5 mm Gypsum Wallboard

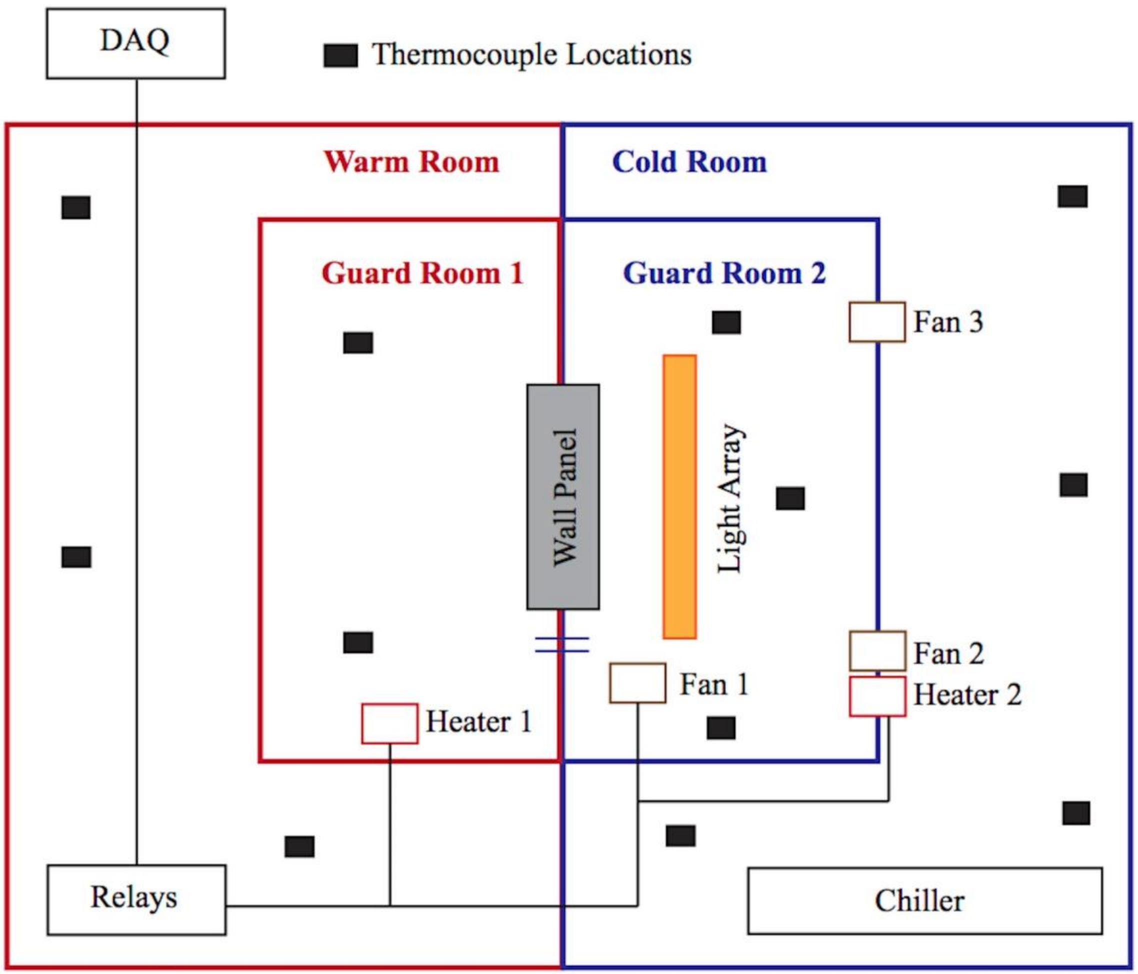
VMR IN PRACTICE

3 Methodology

TESTING OBJECTIVES

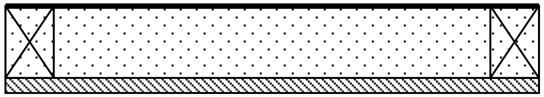
1. Investigate performance of alternative vented airspace using air-permeable, rock wool insulation.
2. Examine influence of vent area ratio, clear airspace, and insulation density.
3. Estimate the amount of moisture removed via ventilation drying.

TESTING APPARATUS



A: Baseline Unvented - No Clear Airspace

Guard Room 1(Inboard)

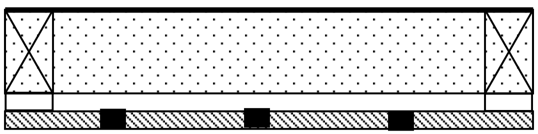


Guard Room 2 (Outboard)

0.15mm (6 mil) Polyethylene (taped joints)
38mm x 140mm (2 in. x 6 in.) spruce studs w. rock wool insulation
Spun bonded polyolefin (SBPO) Air barrier
19mm (3/4 in.) Pine siding

B: Vented - Clear Airspace

Guard Room 1(Inboard)



Guard Room 2 (Outboard)

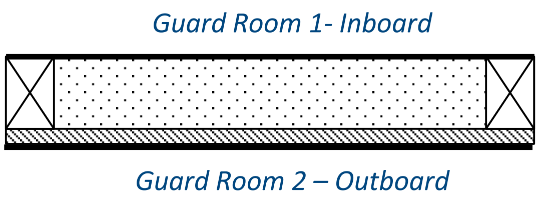
0.15 mm (6 mil) Polyethylene (taped joints)
38mm x 140mm (2in. x 6in.) spruce studs w. rock wool insulation
SBPO Air Barrier
19mm (3/4 in.) Vented airspace
19mm (3/4 in.) Pine siding w. 13mm (1/2 in.) diameter vent holes

CONSTRUCTION

- Shrinkage gaps formed between boards, thereby creating numerous drying pathways.
- Wall A - experienced some natural venting.
- Wall B - venting capacity was not approached.

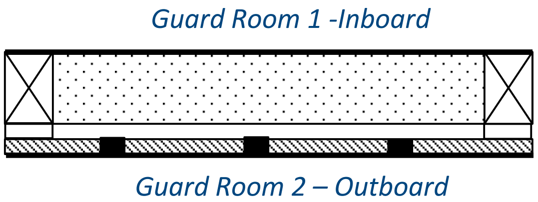
MODIFIED TEST WALLS

C: Non vented & No Clear Airspace



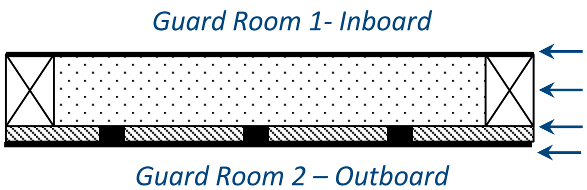
0.15mm (6 mil) Polyethylene (taped joints)
38mm x 140mm (2 in. x 6 in.) Spruce studs w. rock wool insulation
19mm (3/4 in.) Pine siding
0.15mm (6 mil) Polyethylene (taped joints)

D: Vented with Clear Airspace



0.15mm (6 mil) Polyethylene (taped joints)
38mm x 140mm (2 in. x 6 in.) Spruce studs w. rock wool insulation
19mm (3/in.) Vented airspace
19mm (3/4 in.) Pine siding with vent holes
0.15mm (6 mil) Polyethylene (taped joints)

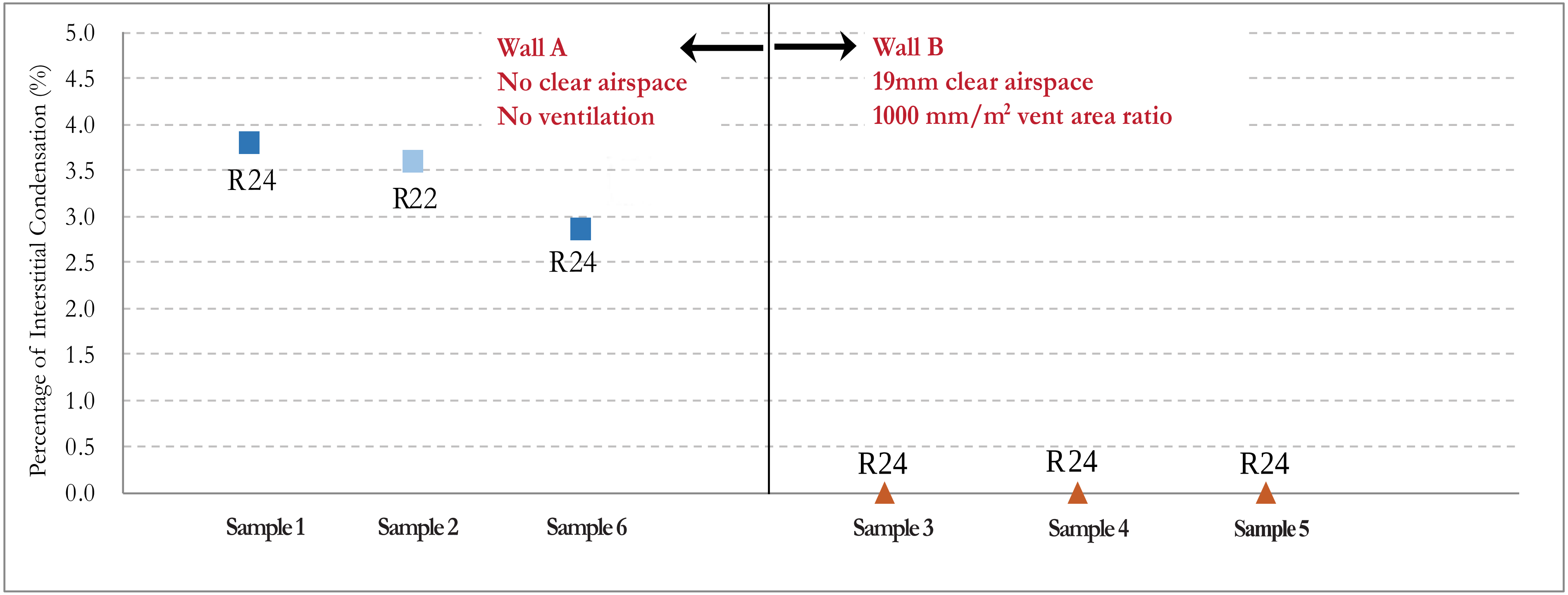
E: Vented & No Clear Airspace



0.15mm (6 mil) Polyethylene (taped joints)
38mm x 140mm (2 in. x 6 in.) Spruce studs w. rock wool insulation
19mm (3/4 in.) Pine siding with vent holes
0.15mm (6 mil) Polyethylene (taped joints)

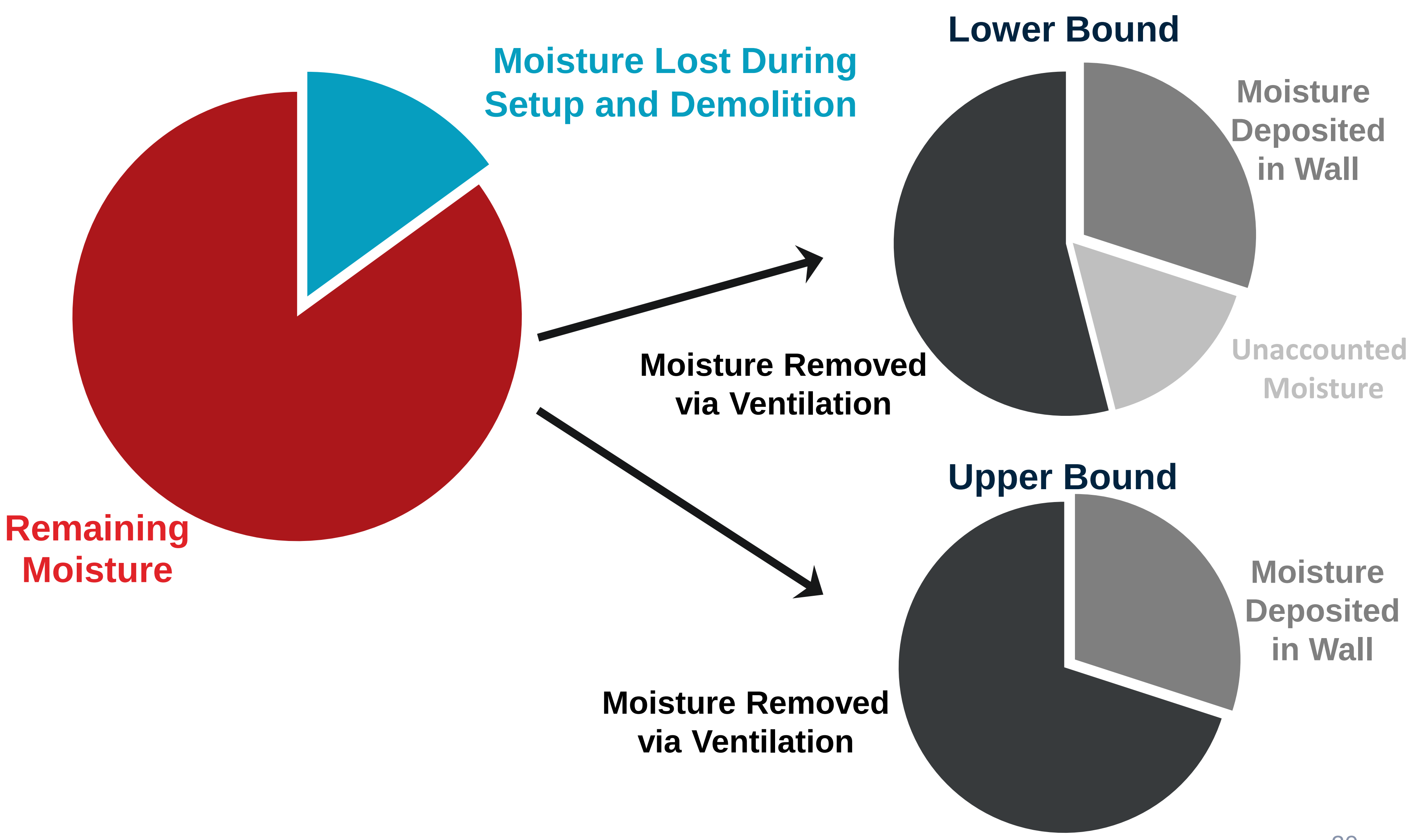
4 Laboratory Testing Results

MOISTURE ANALYSIS – PRELIMINARY TEST WALLS

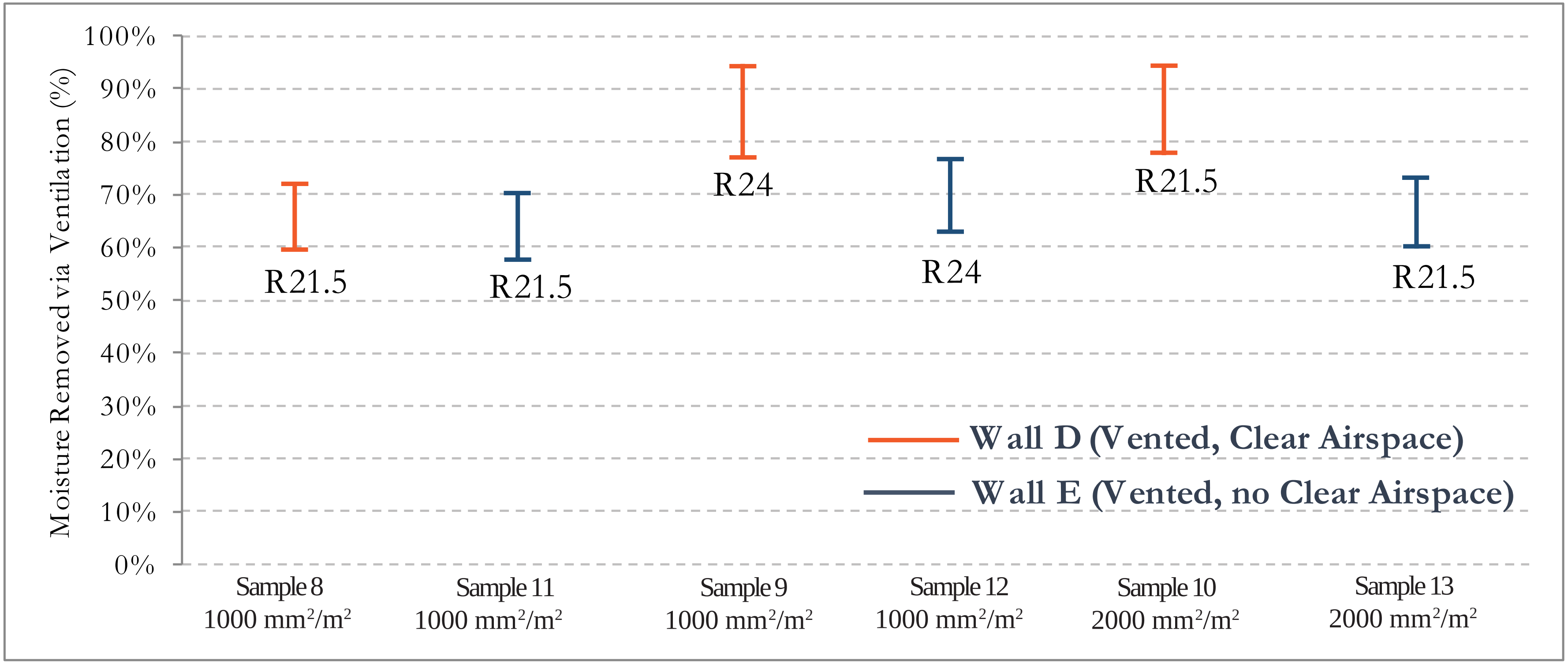


- Gaps formed between shiplap siding – indicating airflow behind siding.
- Majority of moisture was drying via natural ventilation.

MODIFIED TEST WALLS – MOISTURE REMOVED BY VENTILATION

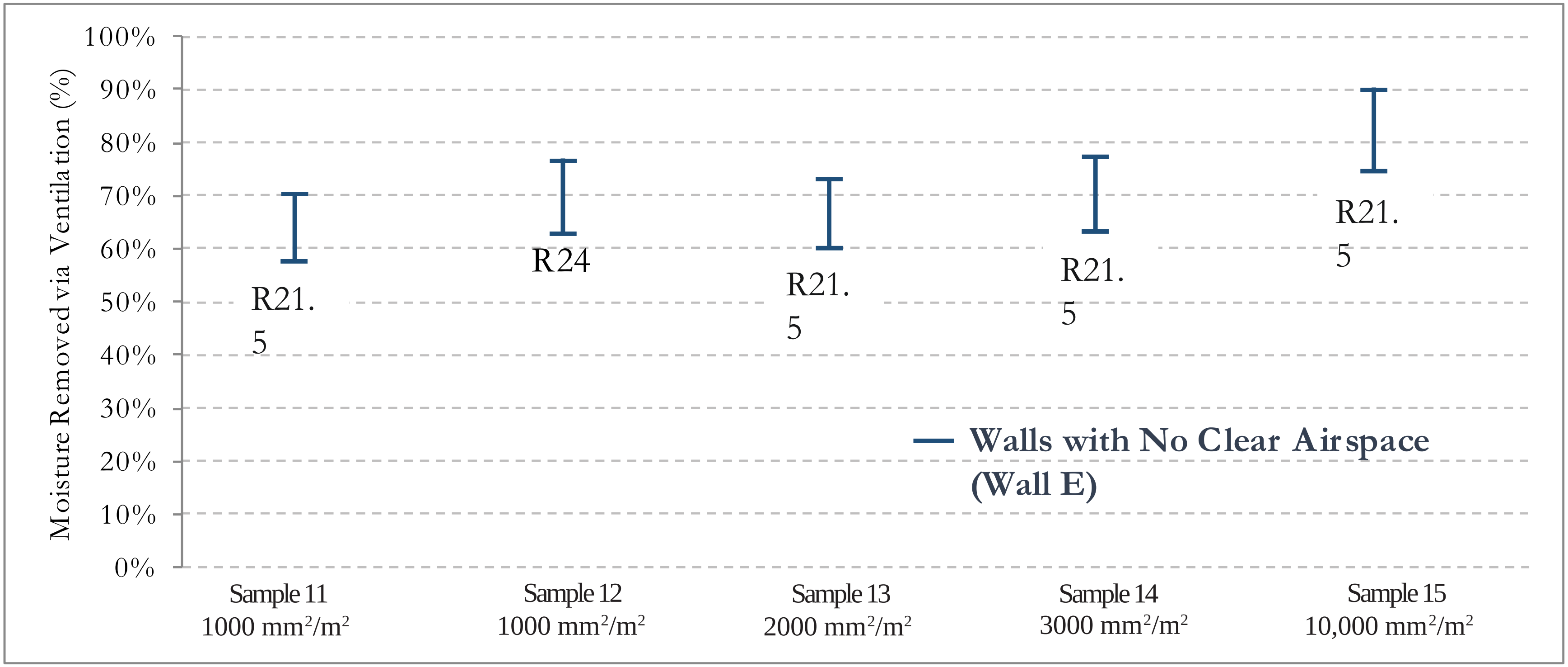


MOISTURE ANALYSIS – MODIFIED TEST WALLS



- Higher vent area ratio – more moisture removed
- Opportunity to use air-permeable insulation in lieu of a clear airspace for ventilation drying of walls

EFFECTS OF VENT AREA RATIOS



- Increasing the vent area ratio influences the amount of moisture removed through ventilation drying.
- Insulation density affects how easily ventilation air flows through the insulation.

KEY FINDINGS

- Moisture can be removed from the walls without a clear airspace with vapor permeable insulation
  - 59% - 95% with clear airspace and vent holes
  - 52% - 90% with vent holes only
- Enough air was able to move through the air-permeable insulation to dry the wall assembly.
- Drying occurs by air movement –solar heating and wind.
- Vent area and insulation density can affect the amount of moisture removed.

- Venting solid masonry as well as masonry veneer
- Venting cathedral ceilings
- Venting flat roofs

STAY CONNECTED!

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