Drainage and Ventilation Gaps

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Building Science Expert Session
Dec 7, 2011

www.BuildingScience.com

Drainage Gaps

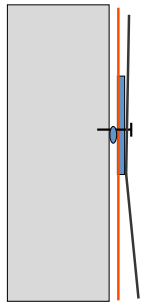
- We have long built gaps
- Questions?
- Both drainage and ventilation use gaps
- What is the proper gap size for:
  - Drainage?
  - Ventilation drying?
- Can we use mesh to make a gap?

Drainage

- Gap avoids hydrostatic pressure
  - drains away
- Reduces time of wetness on housewrap sheathing membrane
- *May* prevent bridging if > 1/8" >3 mm

Leaks

- If obstruction, head builds up and small nail/staple holes leak
- Some housewraps come with pre-manufactured holes



Drainage Gaps

- BEG has been asking: How do they work?
  - Began pressure equalization research 1992
    - CMHC and industry (Owens-Corning, Dow, etc)
  - Began ventilation research 1994
    - CMHC concepts, ASHRAE experimental
  - Began serious drainage research 2000
    - Building Science Corp, industry

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Qualitative Testing (2001)

- Qualitative Drainage Testing BSC
  - Vinyl Siding, Stucco
  - Applied water on and/or behind cladding
  - Inspected the backside
  - No quantities of water measured

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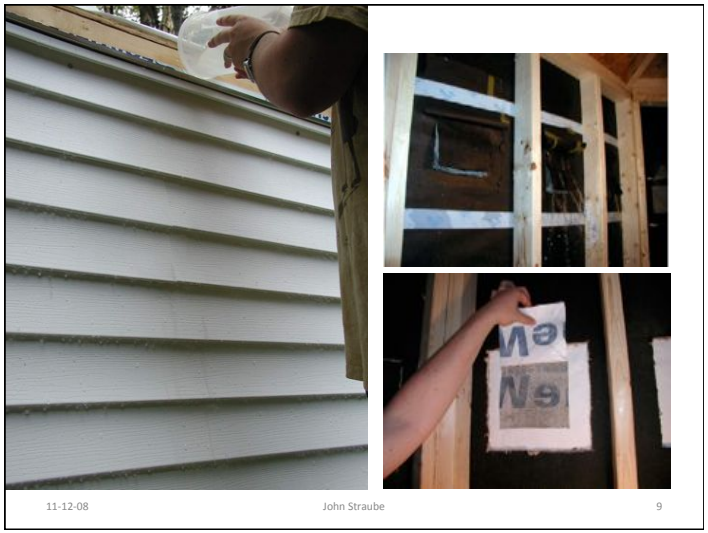
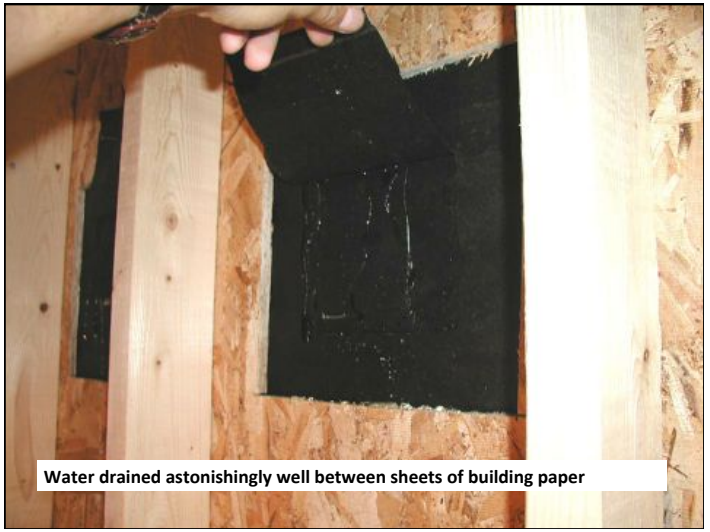



•Drainage gap blocked by stucco adhering to the building paper
•StuccoWrap provides the drainage gap and drainage plane


•Drain water presses through flaws in the building paper
•Drainage then occurs in the drainage gap provided


Water drained astonishingly well between sheets of building paper

- Vinyl drains well with no strapping
- Water leaks out front
- Water leaks out ends

Drainage Test

- Intended to show how easily water drained
- How much was stored?
  - i.e. what needs to be dried out after drainage stops?

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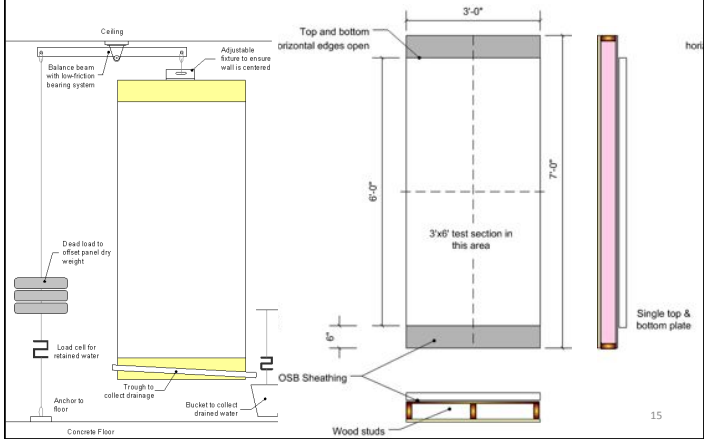
Drying Balance Design



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The wall balance

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Drainage Test Procedure

- Insert water along top of test panel
  - 1 to 1.5 l in about 60 seconds
- Measure water stored and time to start
- Measure retained water
- Repeat
- Measure drying under small "wind" pressures and/or solar heating

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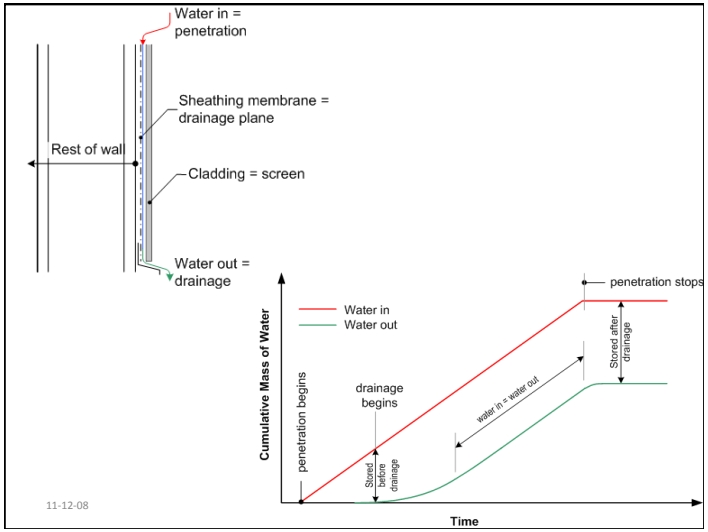
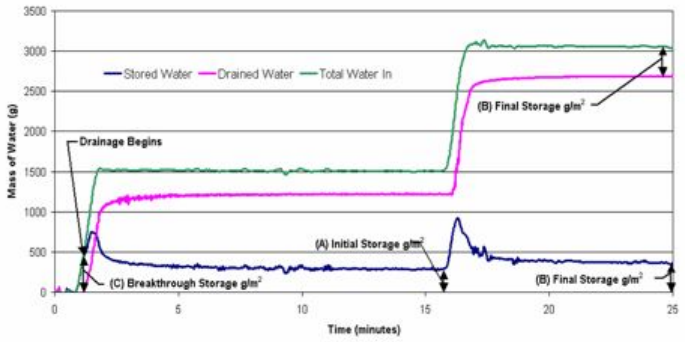
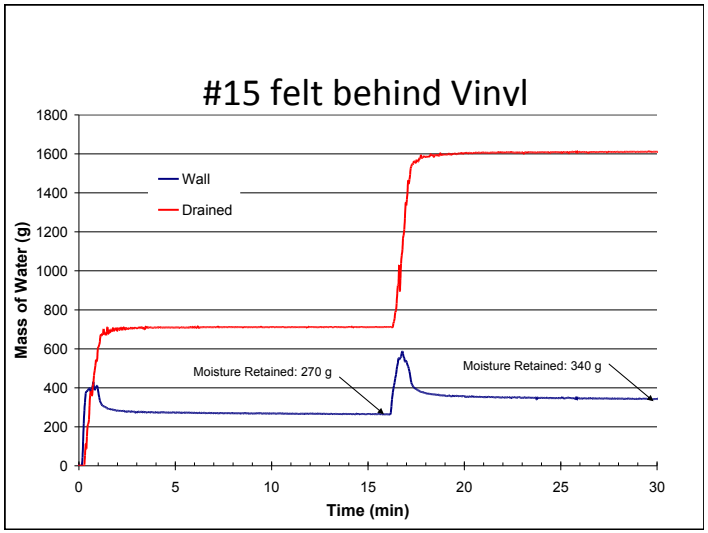
Test Matrix >39 tests

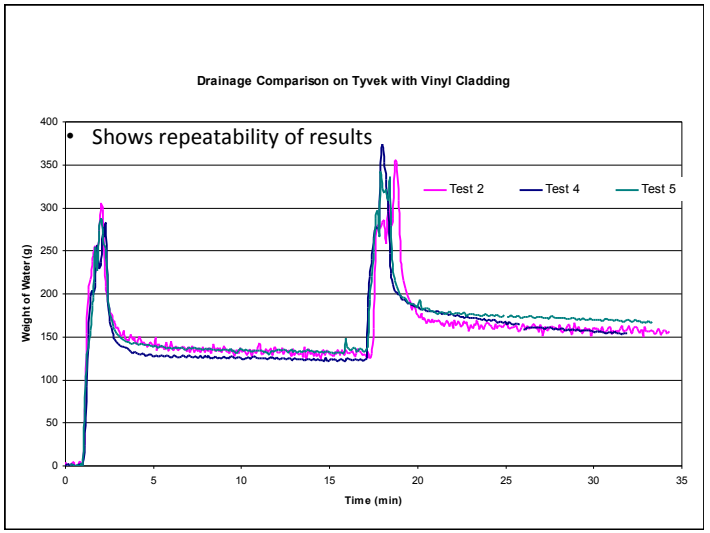
System	Drainage Plane	Cladding	Gap (mm)	Gap
EIFS-1	DensGlas Gold	EPS with ext. finish	>1	formed by adhesive
EIFS-2	trowel applied	EPS with ext. finish	1.5	formed by adhesive
EIFS-3	trowel applied	EPS with ext. finish	<1	1/4" by 1" grooves
EIFS-4	trowel applied	EPS with ext. finish	3	formed by adhesive
EIFS-5	trowel applied	EPS with ext. finish	2	formed by adhesive
EIFS-6	Tyvek	EPS with cement coating		horiz and vert grooves
Stucco-1	2 layers #15 felt	3/4" Cement Stucco	<1	2 layers #15 felt
Stucco-2	2 layers #15 felt	3/4" Cement Stucco	9	19 mm strapping
AGM-1	Air Gap Membrane	Vinyl siding	3	
Felt-1	#15 paper	Vinyl siding		
Towel-1	Air Gap Membrane	fiber cement (paper towels)	3	
Poly-1	polyethylene sheet	none		∞
Plexi-1	plexiglas sheet	plexiglas sheet	approx 1 mm	
Plexi-2	plexiglas sheet	none		∞
FCSheet-1	Tyvek	Fiber cement Sheet		



Typical Drainage Tests Results

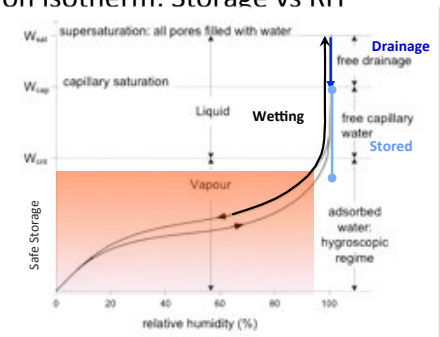






Moisture Storage in Materials

- Sorption Isotherm: Storage vs RH



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Baseline Storage Values

- Surface beading on materials that do not absorb water
  - Sprayed on single polyethylene sheet
    - 35 g/m^2
  - Sprayed on single plexiglas sheet
    - 65 g/m^2
  - Poured between two sheets of plexiglas
    - 23 g/m^2 *less than half that of one sheet!*
    - Surface Characteristics?
    - Small gap prevents beading water?

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Storage Amounts for Claddings

	WRB	Primary Storage (g/m^2)	Secondary Storage (g/m^2)
Cedar Siding	Tyvek	133	223
Vinyl Siding	Tyvek	78	95
Vinyl Siding	Building Paper	90	108
Fibercement	Tyvek	63	88
Fibercement	Building Paper	60	95
LP Smartside	Tyvek	57	75

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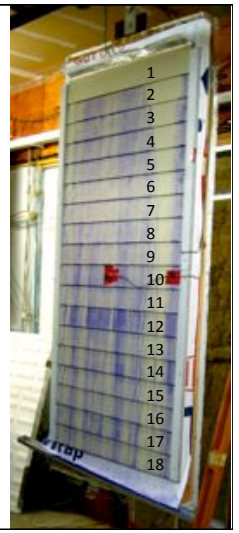
Lap Siding

- Water ran out the front of wall
  - Good design for drainage
  - Difficult to test with developed test method
- Any need for large test samples?



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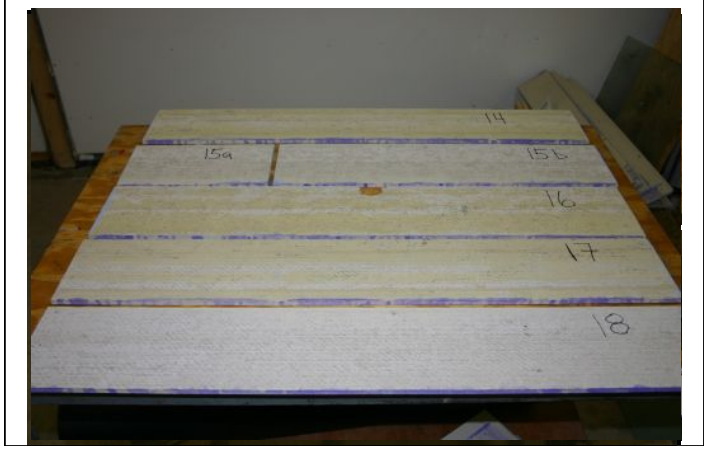
Flow Visualization



Results

- All walls drained very well
  - Gaps of even 1/16" allow excellent drainage
- Lap siding is self draining
  - No strapping/furring needed for drainage
- Drainage stops leaving stored moisture
  - This needs to be removed by ventilation or diffusion
- How big does the gap need to be for drying?

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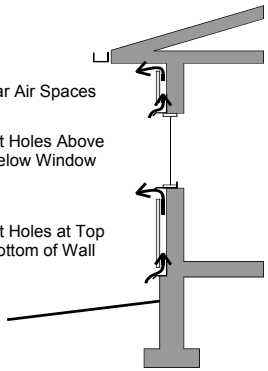
Ventilation Drying

- **Ventilation provides drying to the exterior**
- Can be important for:
  1. **vapor impermeable cladding**
     - metal panels
     - most roofing
  2. **systems which retain rainwater**
- Improves survivability of small rain leaks and condensation



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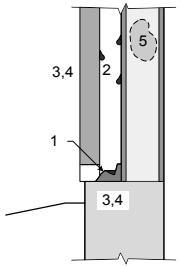
Moisture Storage in Assemblies

1. Trapped / undrained
2. Surface tension
   - Liquid or solid
3. Adsorbed
4. Absorbed
5. Vapour



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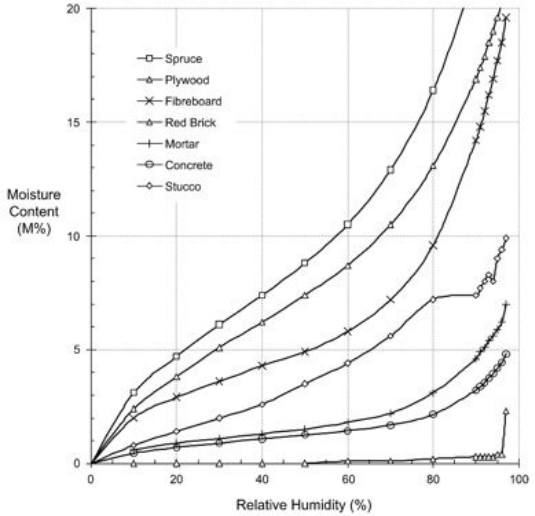

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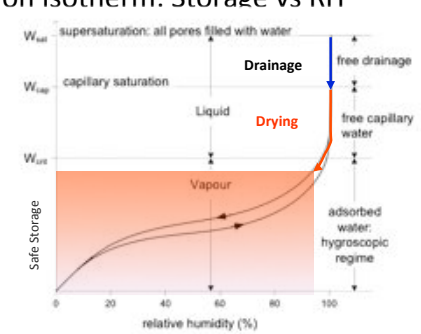
Moisture Storage in Materials

- Sorption Isotherm: Storage vs RH



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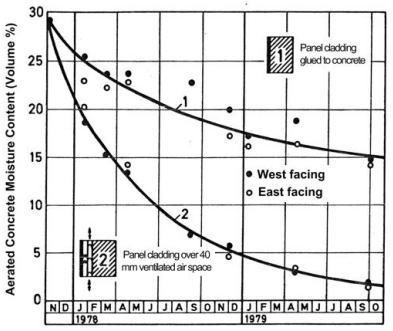
Previous Ventilation Research

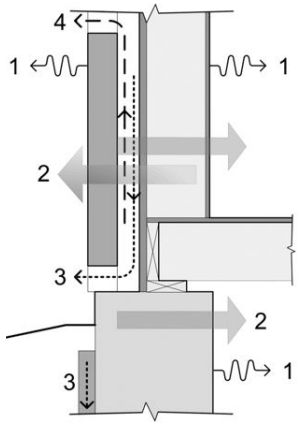
- Fraunhofer Institut
  - Cladding on wet AAC
  - Test hut
  - Ventilation allowed faster drying
- Hansen (2002)
  - Initially dry test hut
  - No effect of ventilation found
  - No wetter/drier



Drying Mechanisms

- Diffusion
- Wicking/Evaporation
- Ventilation

- Sun heats materials
- Wind increases ventilation



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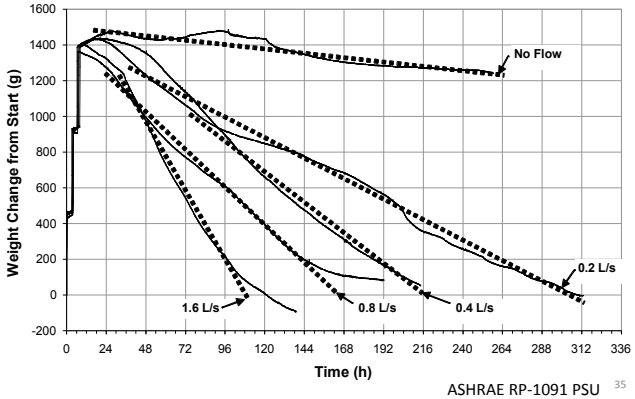
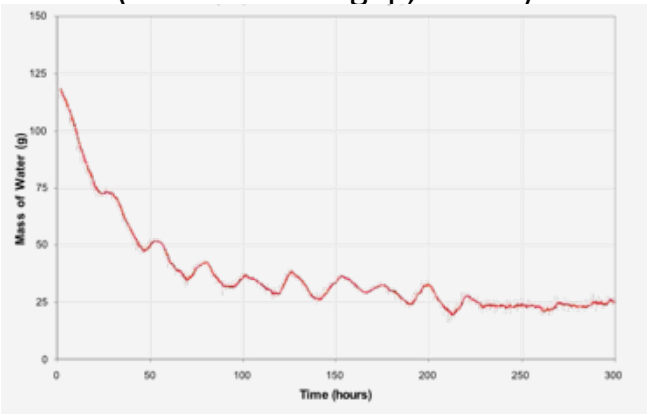
Lab test: Drying vs flow

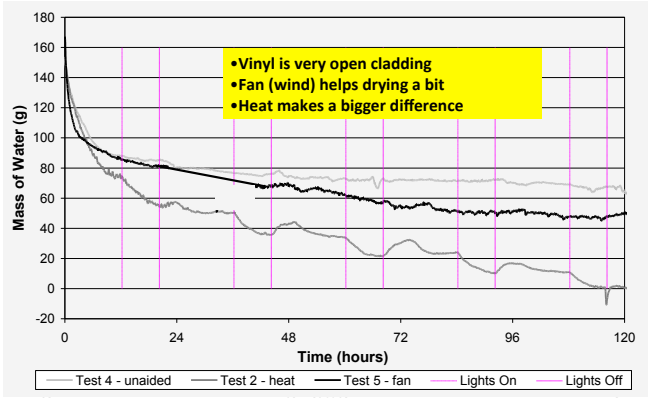


ASHRAE RP-1091 PSU 35

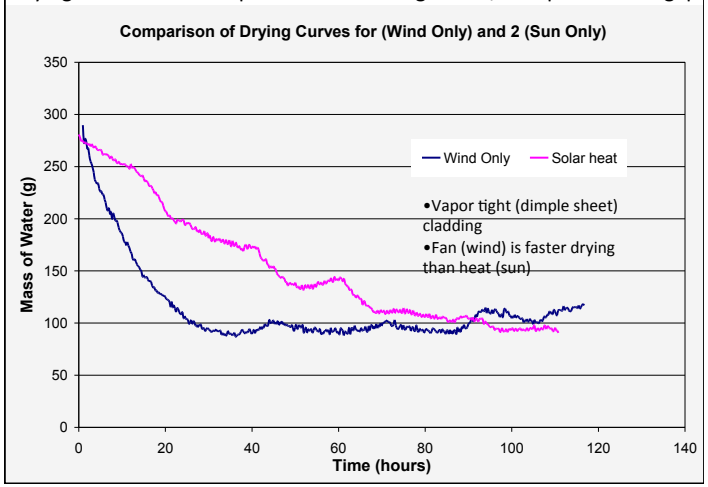
Ventilation Drying (EIFS 2 mm air gap, 1.1 Pa)



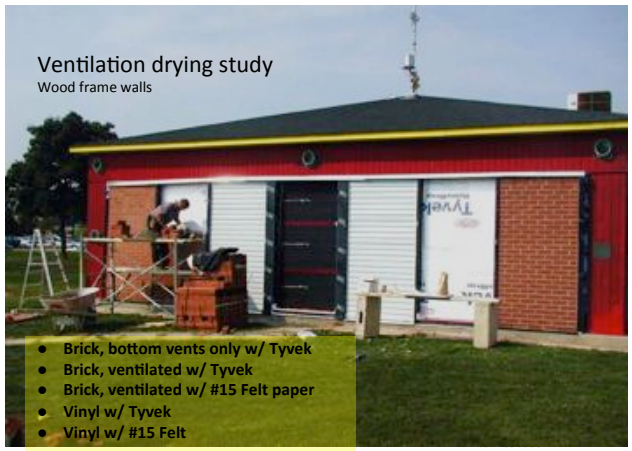
Vinyl over Tyvek Drying



Drying from behind a vapor barrier cladding with 1/8" equivalent air gap



Ventilation Research: ASHRAE 1091



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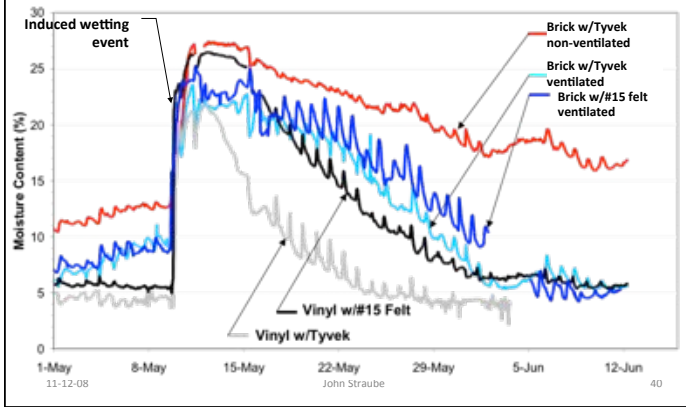
Example Field Results: ASHRAE RP1091



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Ventilation

- Intentional airflow behind cladding bypasses vapor resistance of cladding
- Allows faster drying
- Controls damaging inward diffusion
- Not sure how big of a gap is needed
  - 1/8" - 1"? 3-25 mm?
  - Even smaller may still help

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Summary of Research- We learned:

- We need gaps to provide drainage
- The required size of the drainage gap is very small (in the 1/16"+)
- Larger gaps are useful for ventilation drying (1/4", ¾")
  - We don't always need ventilation drying

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