

Kohta Ueno

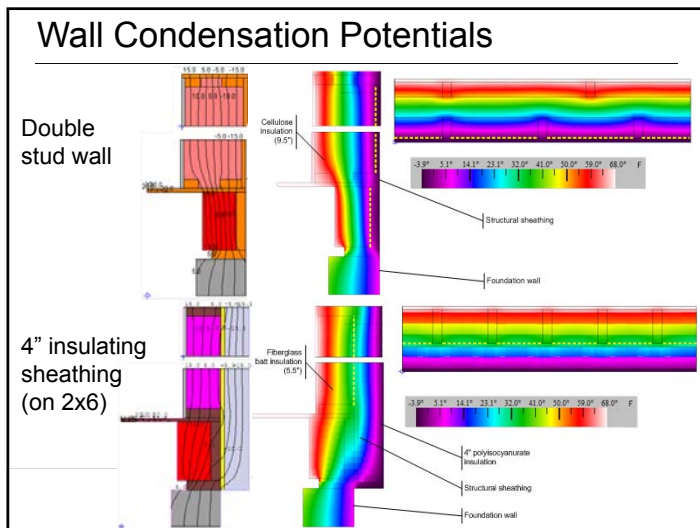
## Double-Stud Wall Field Monitoring

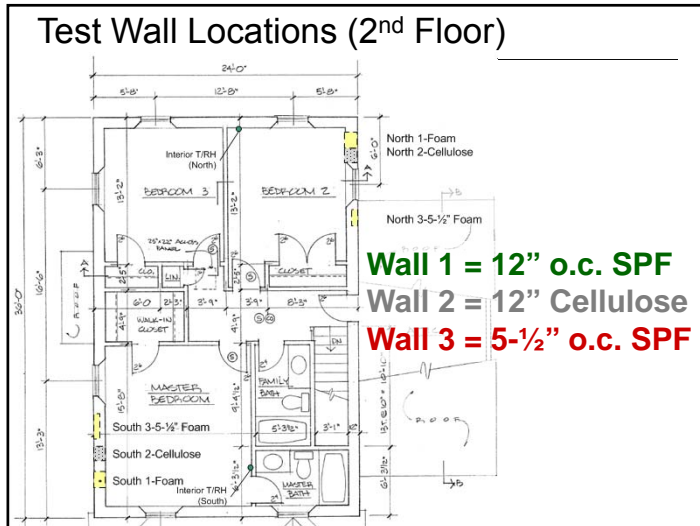
NESEA BuildingEnergy 2014  
March 5, 2014

## Double Stud Wall Monitoring

- Double stud wall advantages:
  - High R values
  - Simplifies exterior detailing (few changes to standard practice)
  - Lower cost vs. other high-R walls?
- Moisture risks due to interstitial condensation?
  - Most common failure, after rain control issues
  - Air barrier imperfections—increase risk
  - Air permeable low-density insulations—increase risk (including convective looping)
  - Air impermeable insulations—decrease risk
  - Reduce risk with “skim” of spray foam at sheathing?

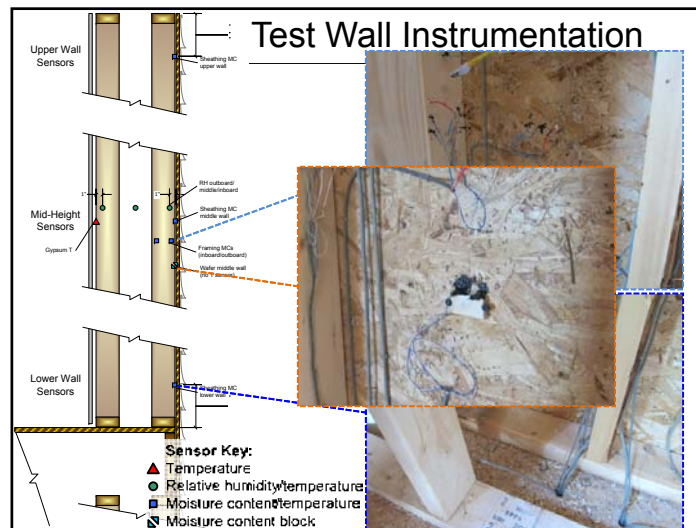
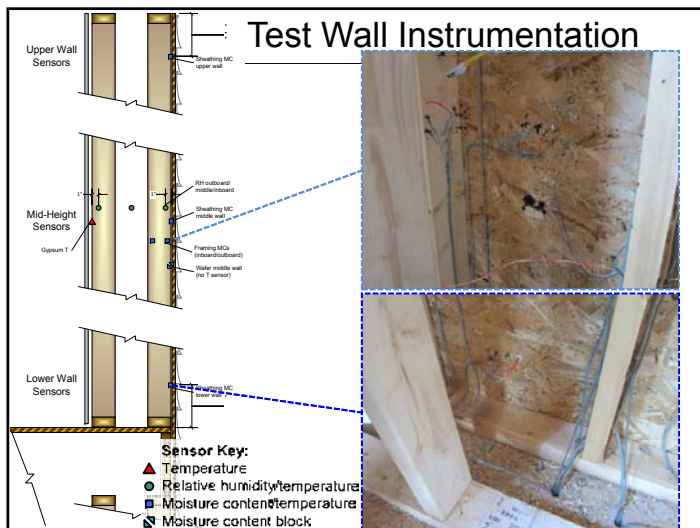
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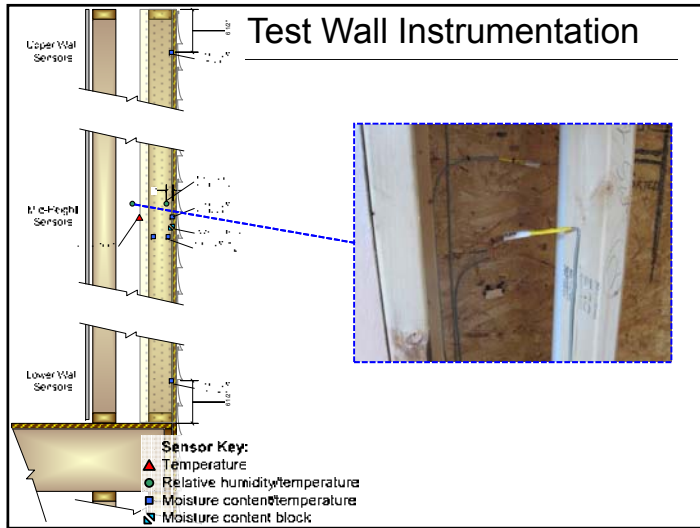




### Wall Construction

- Vinyl siding
- ZIP wall sheathing (OSB)
- Class III vapor control (latex paint)
- IRC R601.3.1—vented cladding over OSB

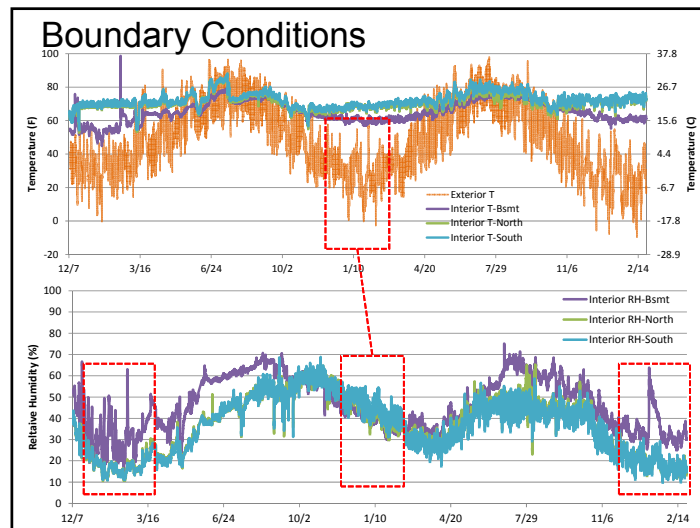
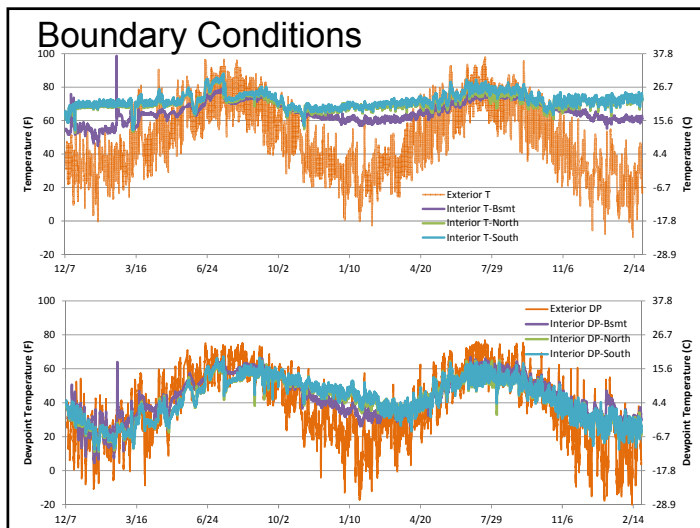




### Results to Date

- Over two years' worth data
- Three winters' worth (partial winters, but different conditions)
- Monitoring continuing

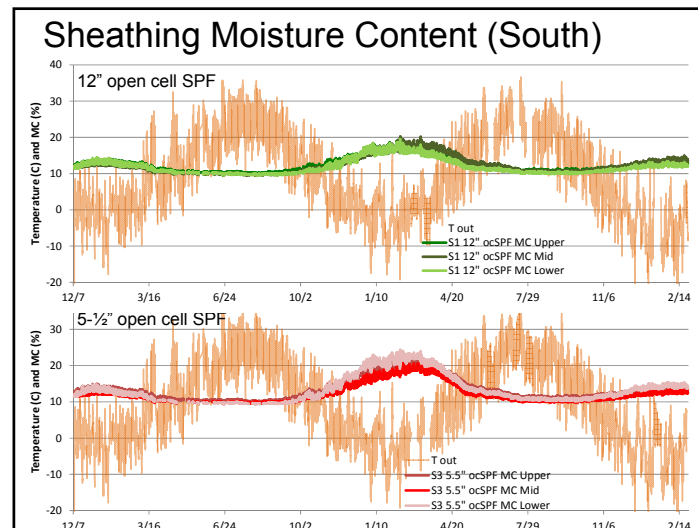
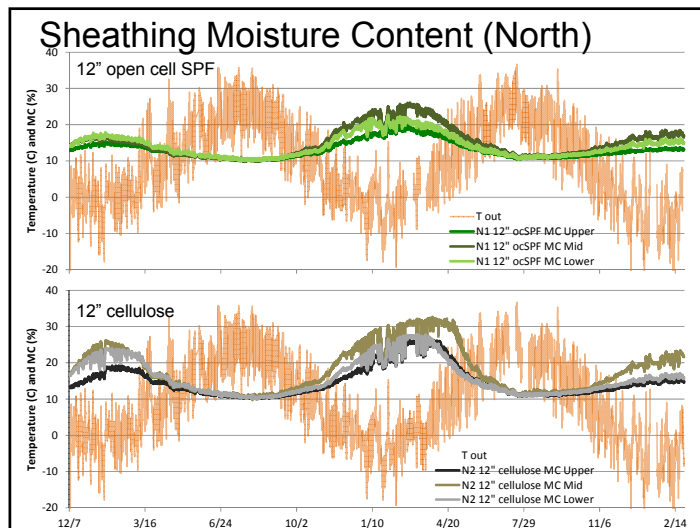
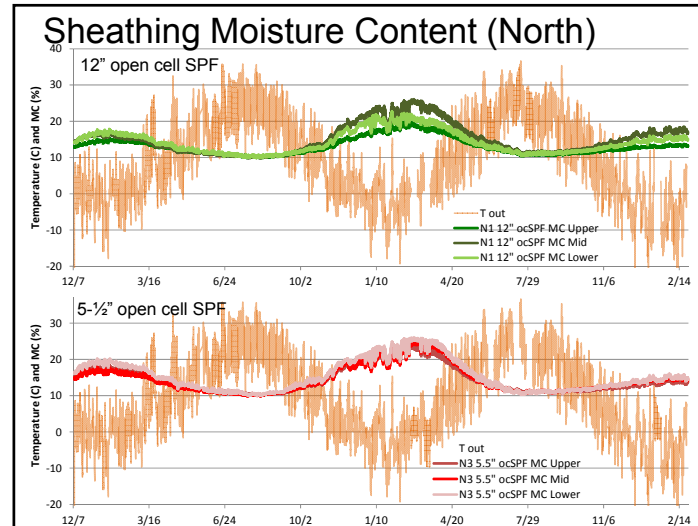
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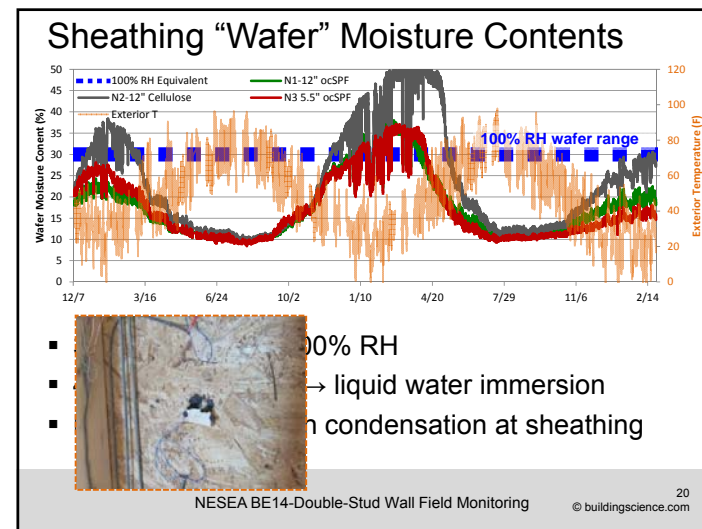
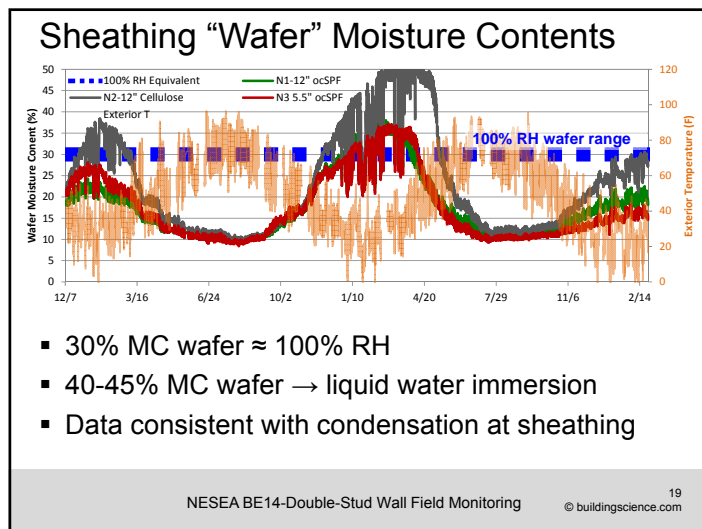
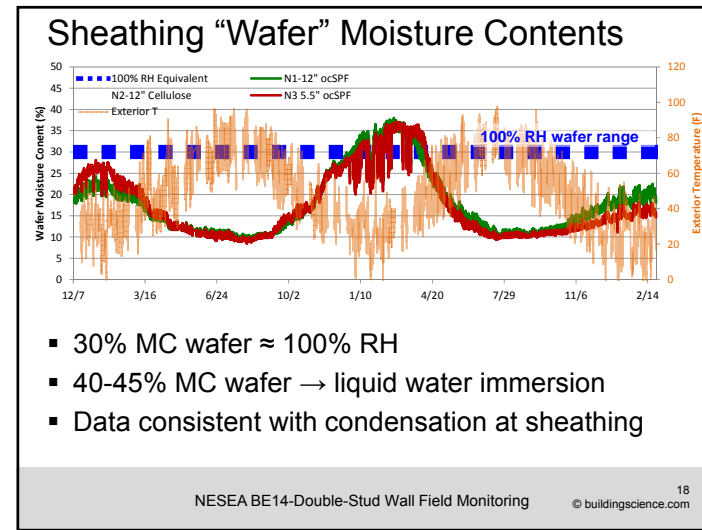
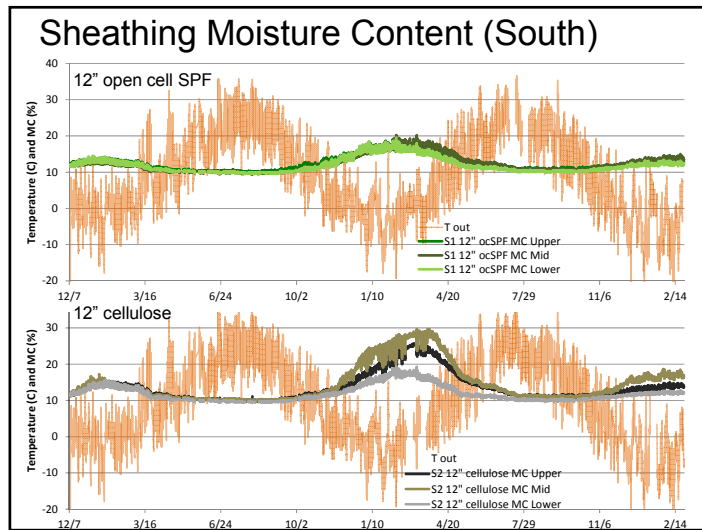
### Boundary Conditions Takeaways

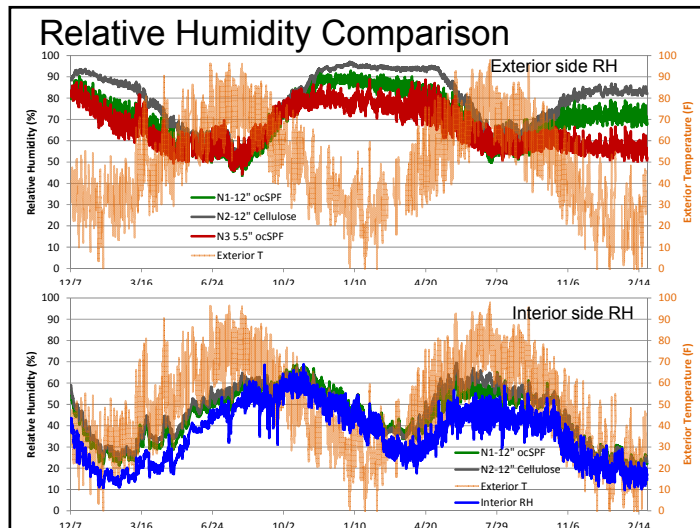
- First Winter (Partial)
  - Unoccupied conditions (no occupant moisture generation)
  - 4400 HDD Base 65 vs. 5600 HDD “normal”
  - Seriously weak-ass winter
- Second Winter
  - Occupied family of four (2 adults, 2 children)
  - Ventilation system not running, ~1 ACH 50 → High RHs
- Third Winter
  - Winter of the “polar vortex”
  - Occupied conditions (same family)
  - Ventilation system running → RHs ~15-30%

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### So What's Going On?

- Air leakage?
- 12" o.c. SPF (LaPolla)—1.8 to 2.5 perms
  - Add 10 perm Class III = 1.5 to 2.0 perms
- 5-1/2" o.c. SPF—4.0 to 5.5 perms
  - Add 10 perm Class III = 2.9 to 3.5 perms
- 12" cellulose—7 to 10 perms (dry/wet cup)
  - Add 10 perm Class III = 4.0 to 5.0 perms
  
- Have not measured paint permeance at this site
- Previous gypsum + latex measurements ~7-11 perm dry cup

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### What's Next?

- Intrusive disassembly of walls (exterior)?
- Vapor retarder paint winter 2014-2015?
  - If experiment continues, and homeowner agrees
  - But lower RHs (with ventilation system) → less challenging conditions
- Are the high sheathing moisture contents actually a problem?
  - Cellulose has borates preservatives; moisture storage

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### Key Takeaways

- Low vs. high relative humidity
- Relative humidity vs. outdoor temperature
- Control the RH in your double stud houses
  - Correctly functioning ventilation system!
- Open cell foam vs. cellulose
- Vapor retarder useful? Necessary?
  - 1 perm vapor retarder paint? "Smart" membranes?
  - Definitely not polyethylene (0.06 perm)
- Sweet spot for vapor control ~3 perms, perhaps?
- Exterior insulation safer for superinsulated walls
  - University of Waterloo work (Trainor/Straube 2014)

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# Questions?

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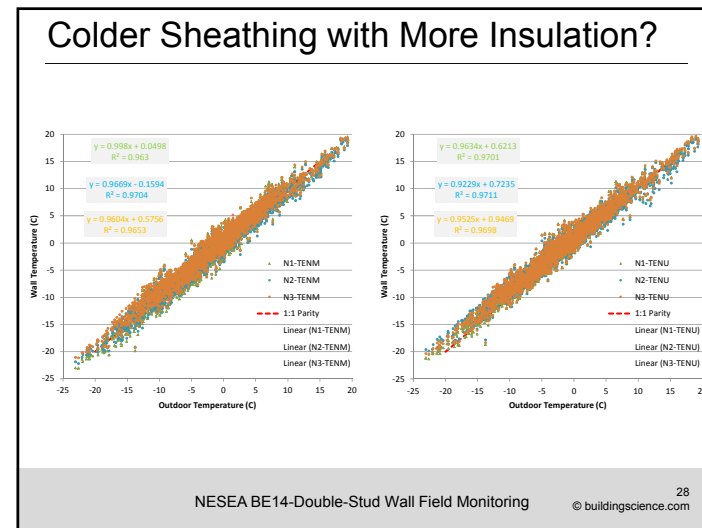
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<http://www.buildingscienceconsulting.com/presentations/recent.aspx?PresentationsYear=2014>

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## Colder Sheathing with More Insulation?

- Outdoor temperature 50 F (10:30 AM)

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### Colder Sheathing with More Insulation?

- Double stud wall sheathing maybe ~2 F or less colder @ ~0 F
- Not big differences: 12" ocSPF coldest; 5.5" ocSPF mostly warmest
- Steady state analysis predicts 0.8 F difference @ 7 F outdoors
- Wintertime energy/Btu's through sheathing possibly more important (drying energy)
- 12" vs. 5.5" cavity insulation different than cavity vs. exterior insulation!