

Building America Roadmap: Moisture Managed High-R Assemblies

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Presentation outline

- Why moisture management is imperative.
- It's complicated.
- So designers need help from an expert (System).
- Moisture loads that impact risk (and what can be done to control their influence).
- Envelope design parameters that impact risk (and how they interact).
- What this Expert System might look like...
- What do you think?

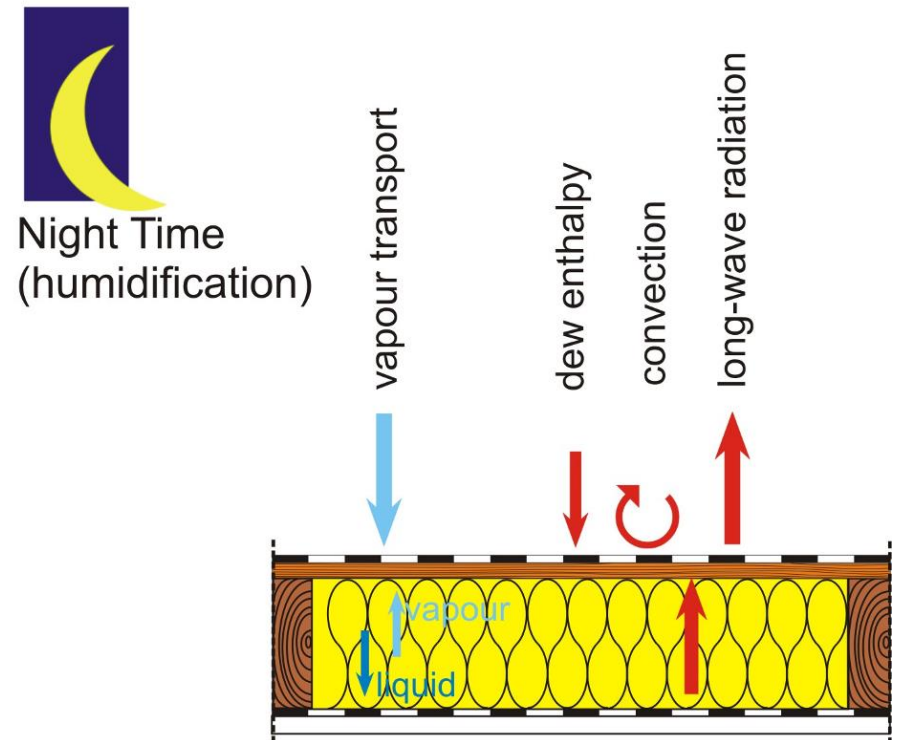
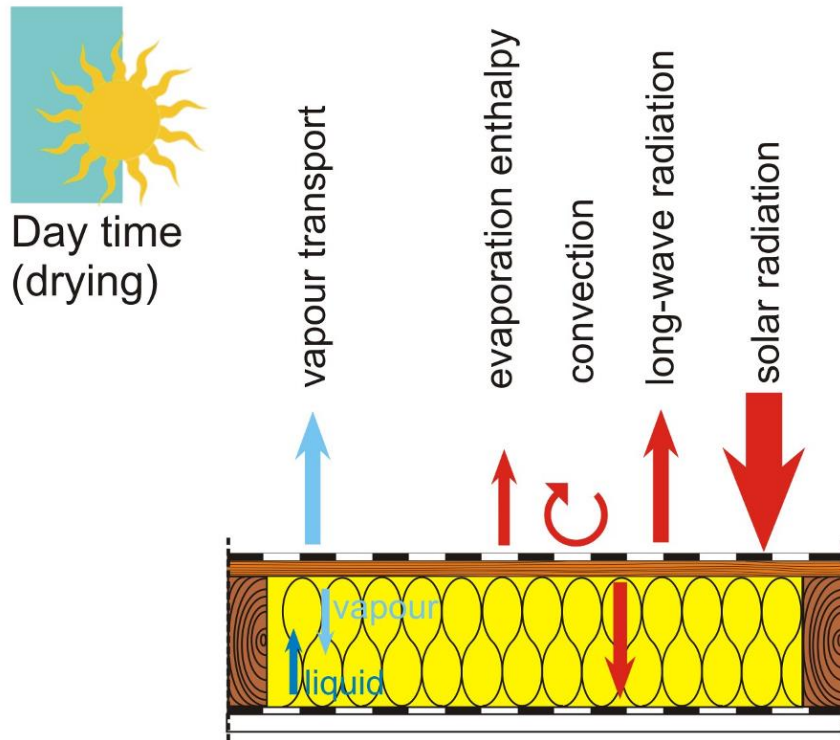
Importance: Moisture problems lead to “city of tarps”



It's complicated!

Transient hygrothermal processes through the building envelope

Example: Flat Roof



High performance moisture-managed envelopes

2015	2016	2017	2018	2019	2020
Moisture Risk Management	Moisture Managed Guidance/Tools & Best Practice Specs for priority High-R Envelope Systems in each climate				
	Lab and Field Moisture Risk Assessment of priority High-R Assemblies & Materials				
	Moisture Risk Assessment & Modeling Standards (e.g., ASHRAE 160)				
High Performance Envelope Solutions	Validate/Demonstrate High Performance Envelope Specs in Real World Test Homes				
	Specs in Voluntary Program Standards (ZERH, Energy Star & HPwES)		Moisture Managed High-R Envelopes addressed in 2021 IECC and IRC		

Critical need

- High performance envelopes may have a greater moisture risk due to a reduced ability to remove unwanted moisture.
- Envelope designs need to be evaluated thoroughly so that builders have confidence in prescribing these assemblies.



High performance moisture-managed envelopes

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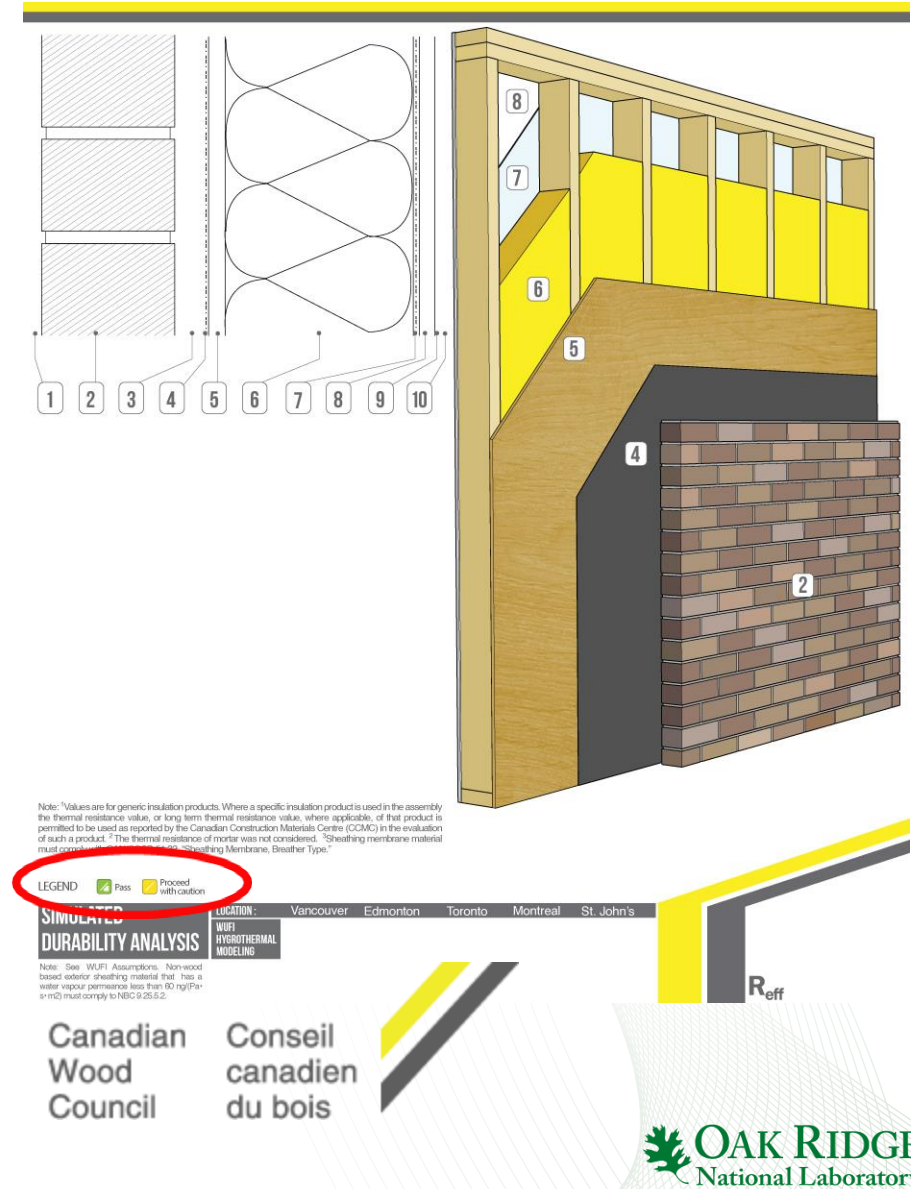
Moisture managed guidance/tools & best practice specs for each climate

- A moisture management analysis is needed so that builders can decide what level of risk they are willing to take as a function of cost level.
- Develop “expert system” that will provide builders confidence in their envelope selections.
- Use “expert system” to produce best practice guidelines.

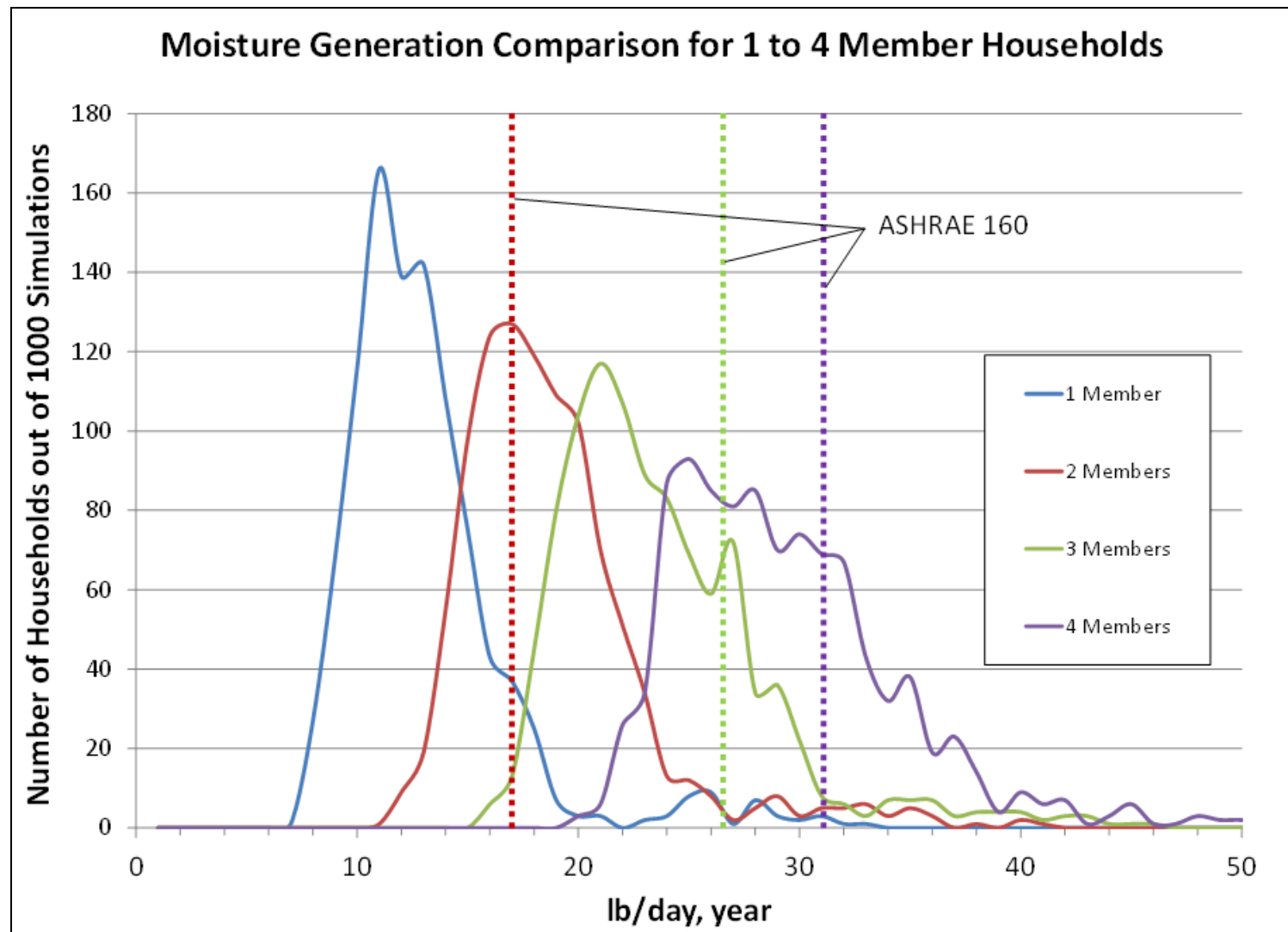


Existing website has neat features

- Only walls in database.
- Offers R-value data on assembly.
- Moisture durability data based on WUFI 1-D modeling.
- Uses a single set of boundary conditions based on ASHRAE Standard 160.
- Offers a “durability analysis”
 - Pass
 - Proceed with caution



Probabilistic distribution of interior moisture sources



Lab and field moisture assessment

- Define parameters that impact moisture durability and their ranges.
- Examine effects of moisture sources, including air leakage, through a combination of simulations and laboratory tests.
- Calibrate hygrothermal simulation tool so it adequately models the effects of air leakage in wall assemblies.
- Validate the calibrated model with laboratory and field tests.
- Vary input parameters to expand the credibility and applicability of the results.

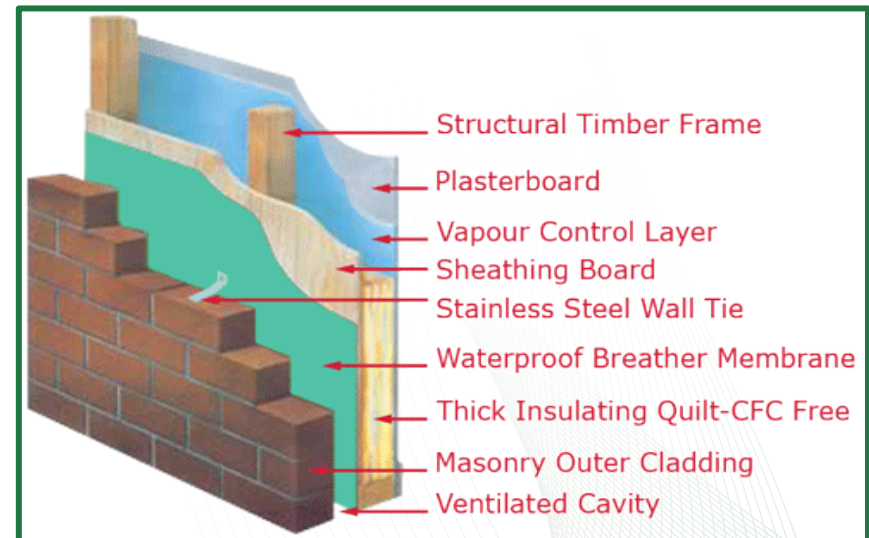
Moisture management parameters

- Moisture Loads
 - Climate
 - Bulk water leakage
 - Internal building moisture loads (people!)
 - Initial construction moisture



Moisture management parameters

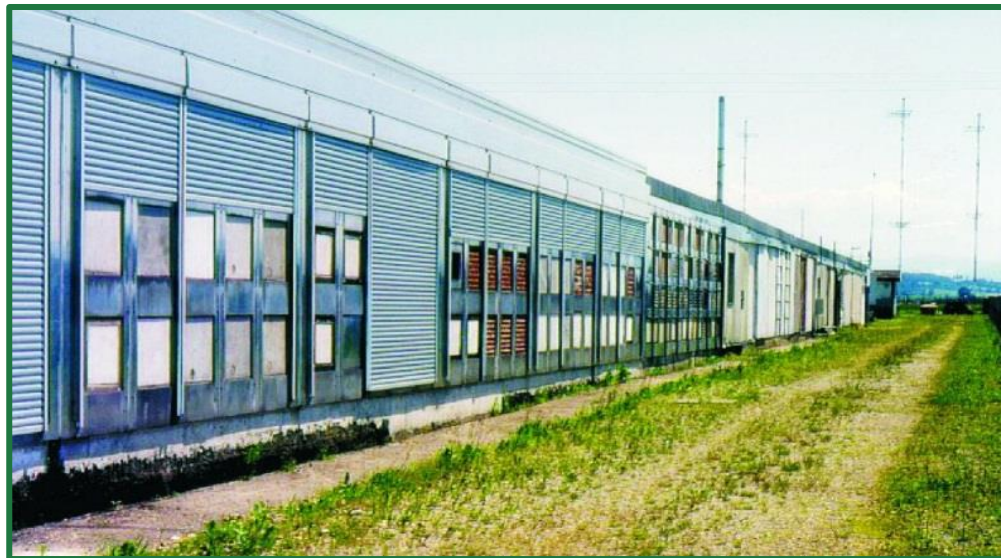
- **Envelope components**
 - Air tightness
 - Interior vapor control
 - Insulation permeance
 - Exterior sheathing permeance
 - WRB permeance
 - Drainage plane
 - Ventilated cavity
 - Cladding type and color
- R-value not listed!



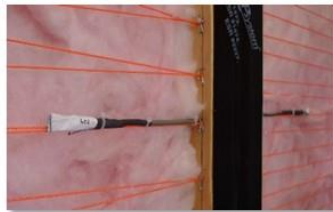
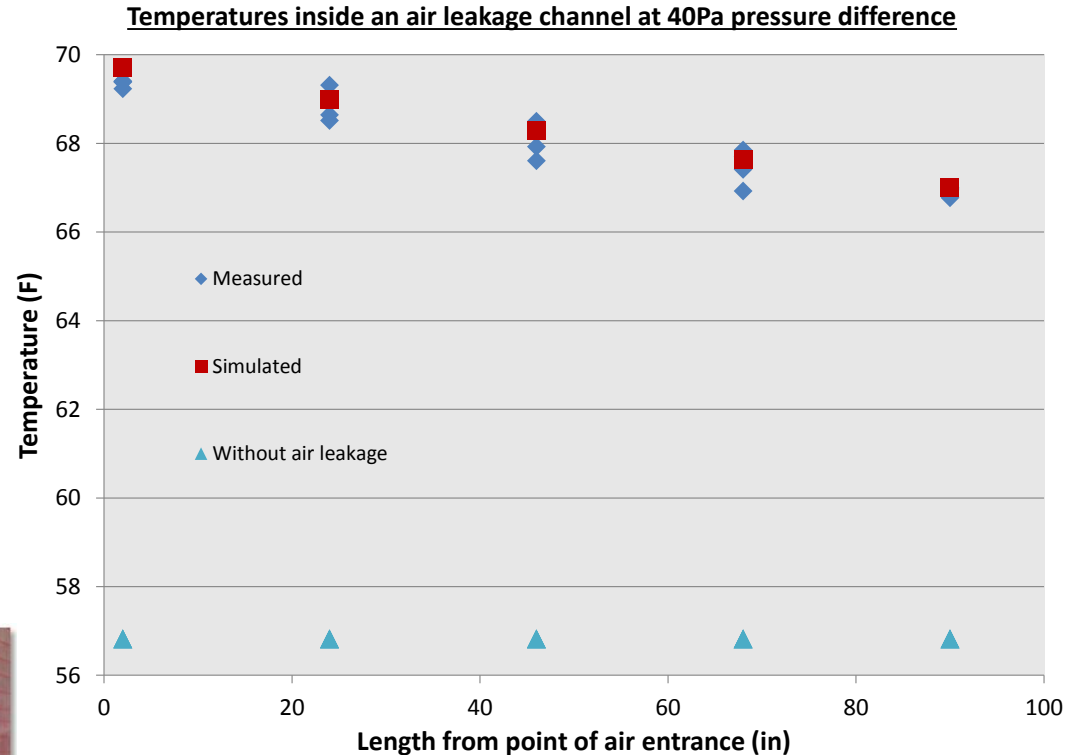
Field data compiled to set baseline for modeling



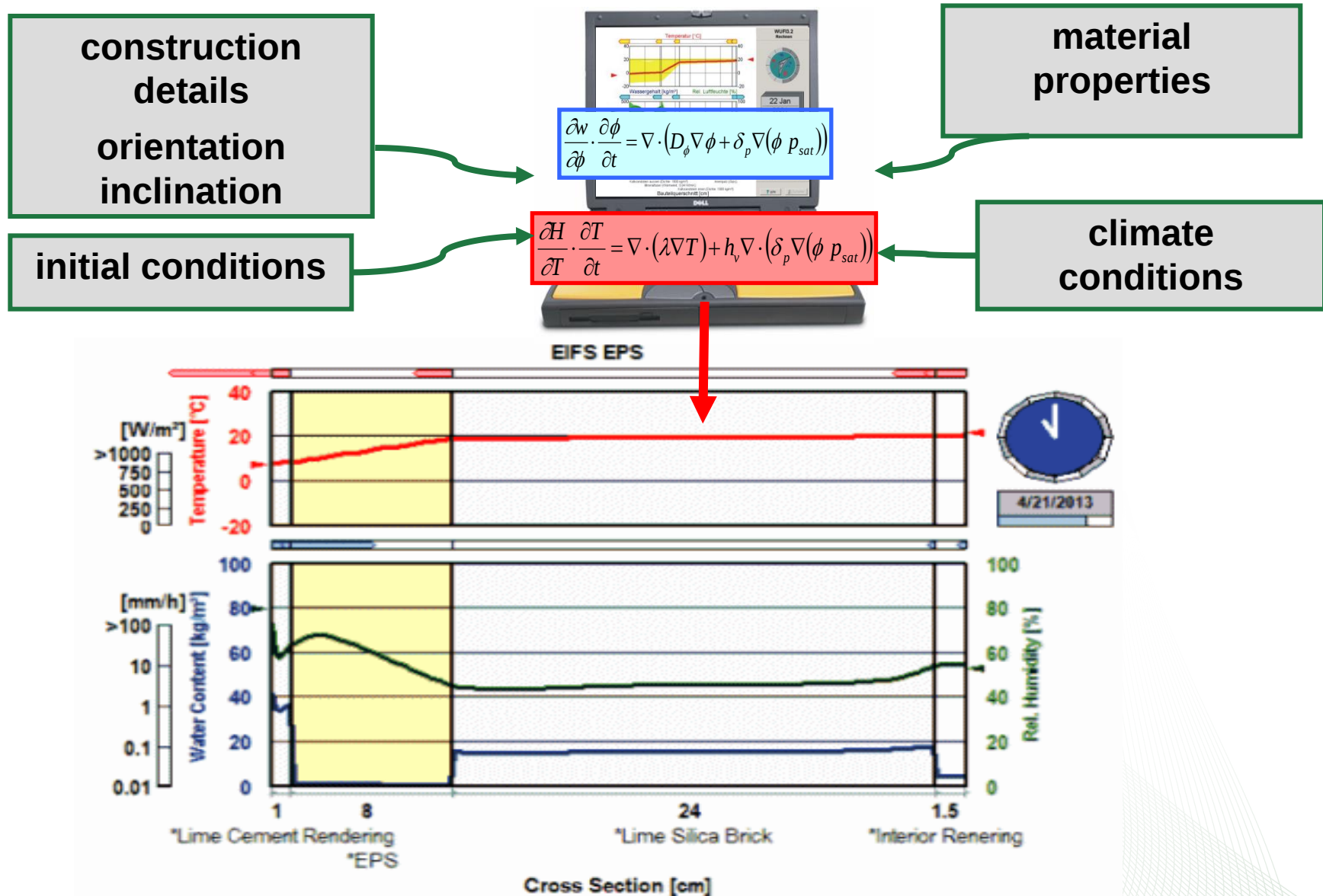
- Measure performance of envelope systems exposed to “real” boundary conditions.
- Data used to validate laboratory measurements and simulations.



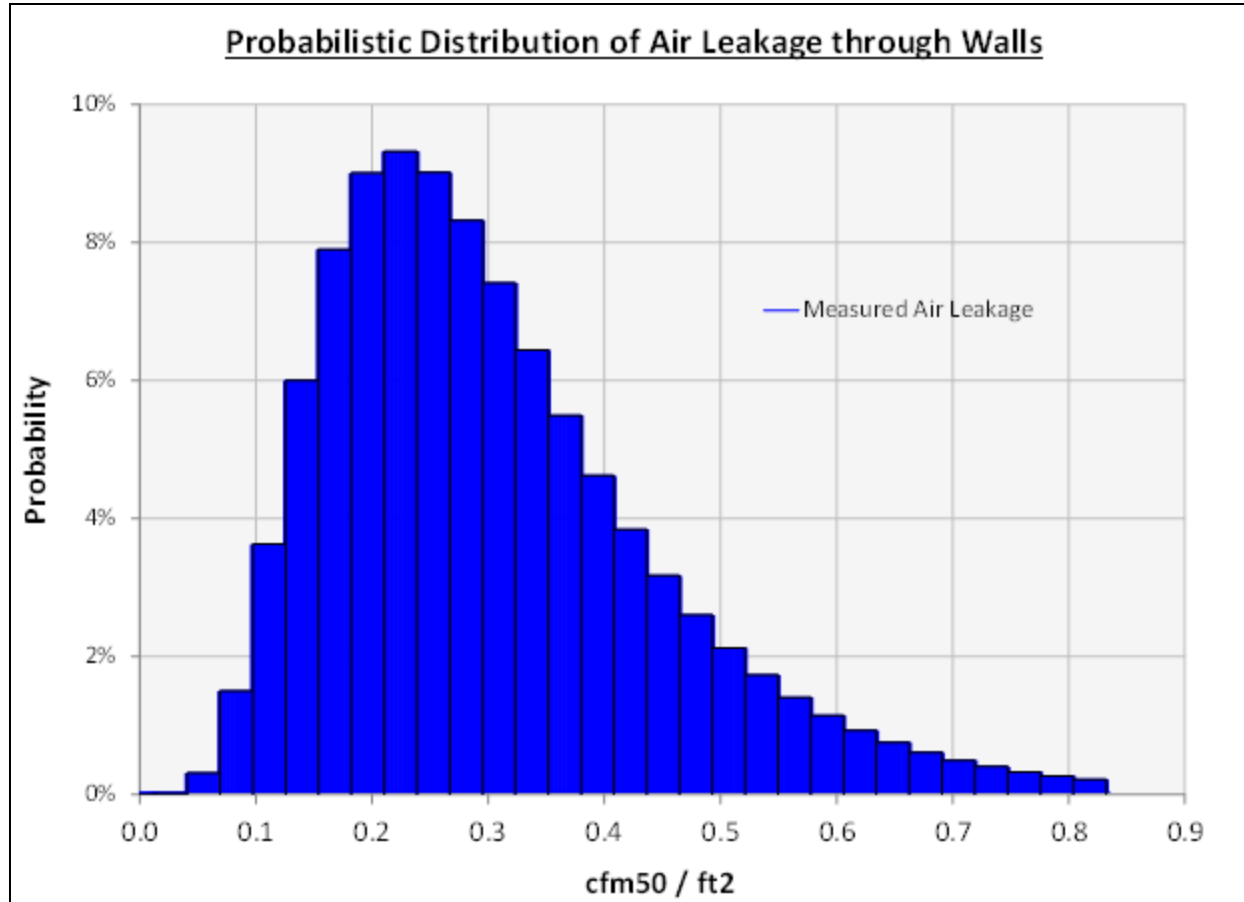
Developing laboratory data for air leakage calibration



Modeling software modified...



...to include varying air leakage impacts



Proposed expert system development

Task #	Task	Completion Date
1	Produce draft website (“borrow” features from the Canadian Wood Council website)	
2	Circulate draft website to users and researchers for input	
3	Develop a plan on how to generate the information that is needed for the website	
4	Develop complete list of wall permutations based on moisture management parameters	
5	Provide estimates of the range of the management parameters (i.e. what is the maximum and minimum amount of rain water leakage we want to consider)	
6	Use building science “common sense” to pare down this list (circulate to experts for input)	
7	Perform additional paring based on simplified analysis (i.e. 1D WUFI simulations)	

Proposed expert system development

Task #	Task	Completion Date
8	Use market potential and cost to rank remaining wall assemblies	
9	Produce prioritized list of systems to be analyzed for risk potential	
10	Perform laboratory experiments	
11	Modify model and perform simulations (EnergyPlus, modified WUFI 1D)	
12	Incorporate initial simulation results into website and circulate for input	
13	Validate simulation results with industry “common sense”	
14	Validate simulation results with BA field data	
15	Finalize website	

Scenario 1: User has wall in mind

Risk
Managed
Insulated
Framed
Cavity
Wall



Framing Options

2 by 4
Framing

2 by 6
Framing

Advanced
Framing

Insulation Options

Fibrous
Insulation
Blown-in

Fibrous
Insulation
Batt

Open-Cell
Spray
Foam

Closed-Cell
Spray
Foam

Flash and
Blow/Batt

Moisture Risk Management Guidance

System is not
advised

Proceed with
caution

Proceed as
designed

Risk Mitigation

Quality
Installation

Operational
Limits

Scenario 2: User wants universal search

I don't know which wall to select



Climate

Hot, humid

Mixed humid

Cold

Marine

Wall Performance

Code level

Above Code

ZERH

Passive House

Suggested Wall Systems

Suggested walls

Walls that must be used with caution

Risk Mitigation for Cautionary Wall

Quality Installation

Operational Limits

Questions?

