Learning to Breathe Again

ICAA

Orlando, FL

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Learning Objectives

- Examine the relationship between heat flow, air flow and moisture flow
- Discuss how the building code addresses each of the above and how recent changes to the code could potentially reduce building durability
- Review the four key mechanisms of moisture flow in buildings in order to explain how things get wet and how things dry
- Describe some of the properties of building materials that play an important role in moisture management
- Explain the concept of safe moisture storage
- Discuss how insulation assemblies can help prevent wetting while promoting drying

AGENDA

1. Review the three basic "physics flows" that drive the movement of heat, air, and moisture through building assemblies

2. The residential building code is challenged to find a balance of these flows amid the increasing demands of "the energy code" (IECC)

3. You must consider a building materials heat, air, and moisture resistance properties in concert or you could get wet

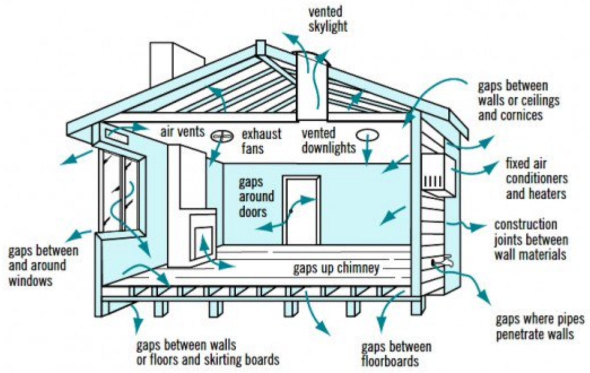
4. Most building materials can accommodate some moisture- how much and how to predict

5. Applied knowledge: how insulation is like beer- both the cause and solution to all our problems?

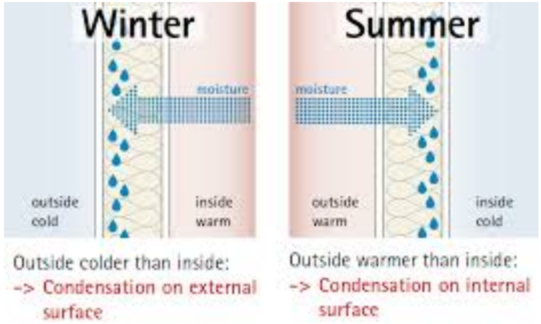
6. Conclusions

Reviewing the three flows:

Heat Flow



Air Flow



Moisture Flow

Reviewing heat flow

Reviewing heat flow

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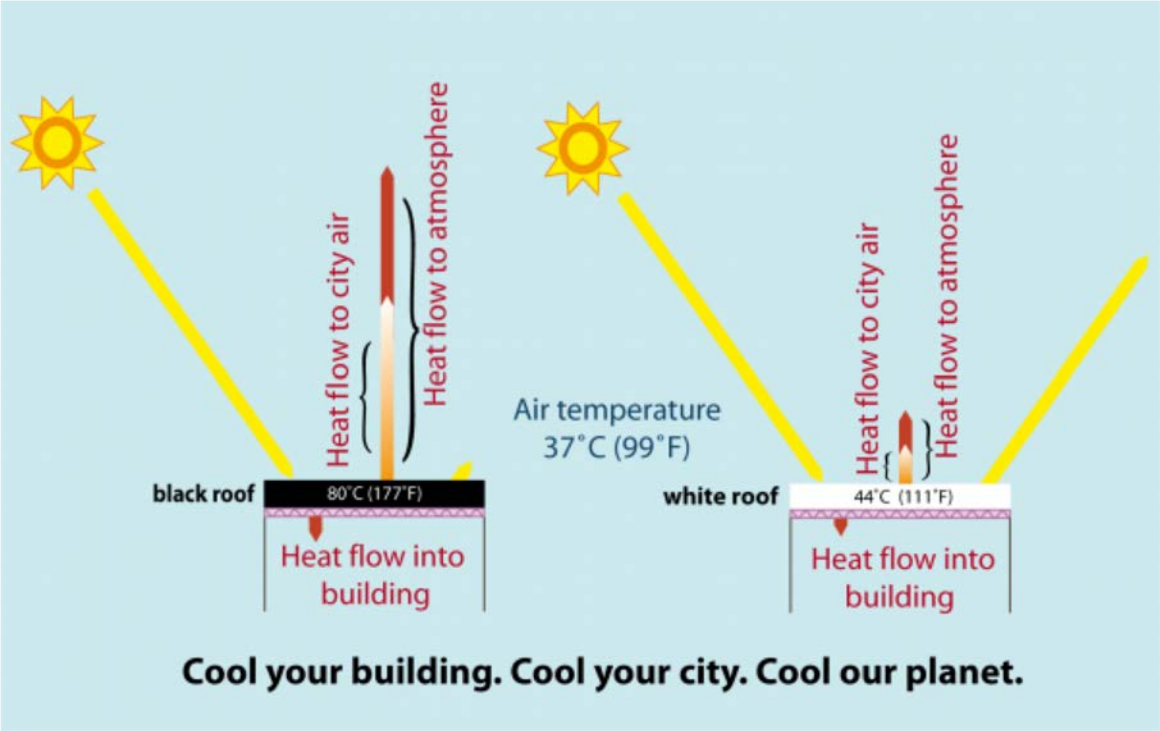
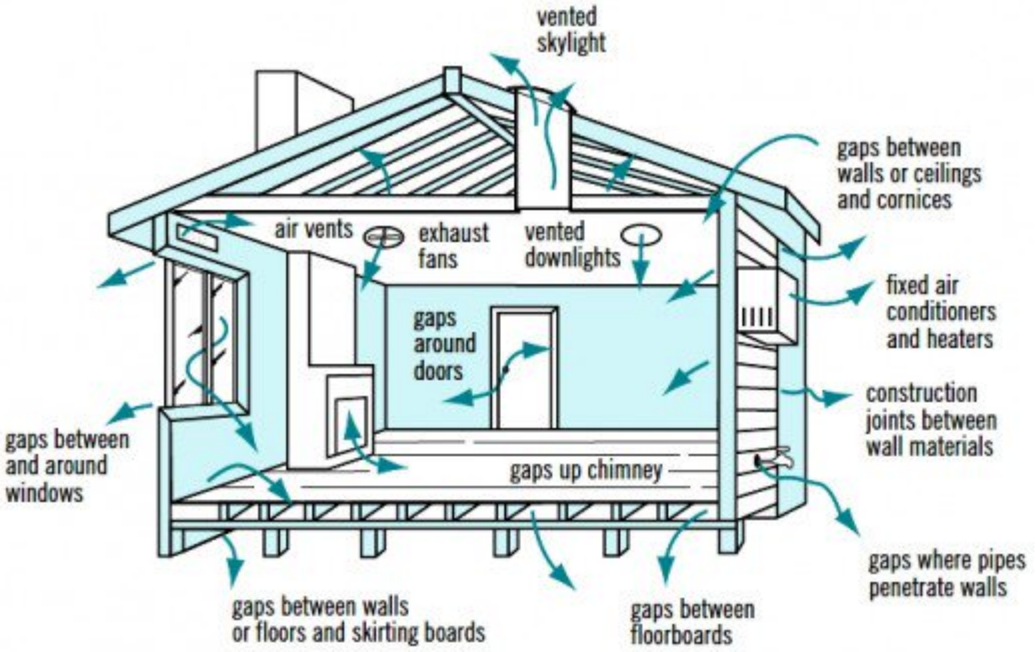


Reviewing heat flow

Reviewing air flow



Reviewing air flow

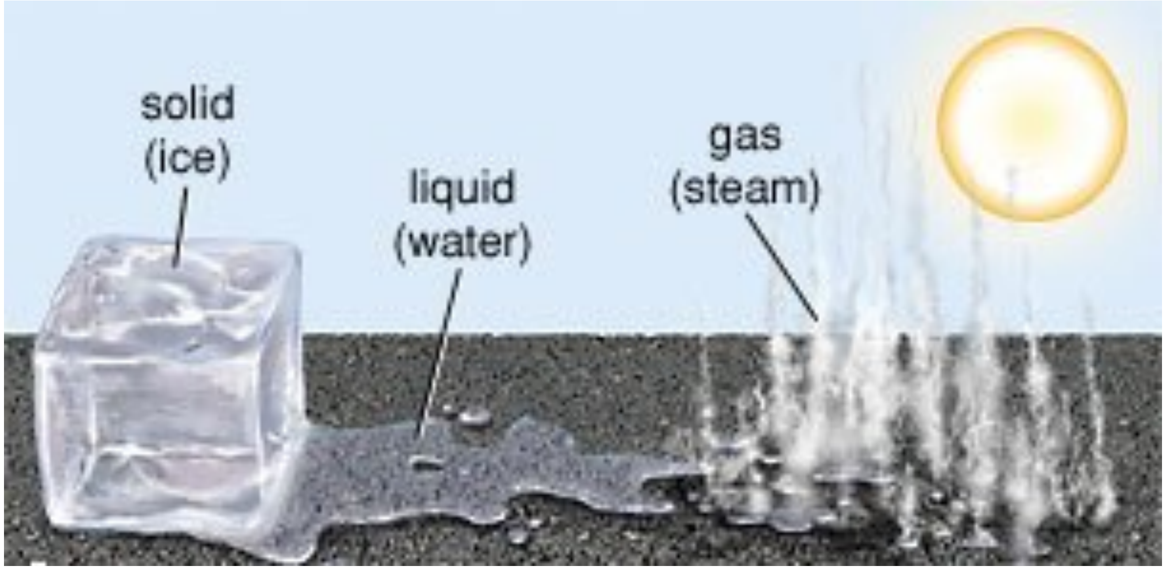
Stack Effect

Flue and Ventilation Effects

Wind Effect

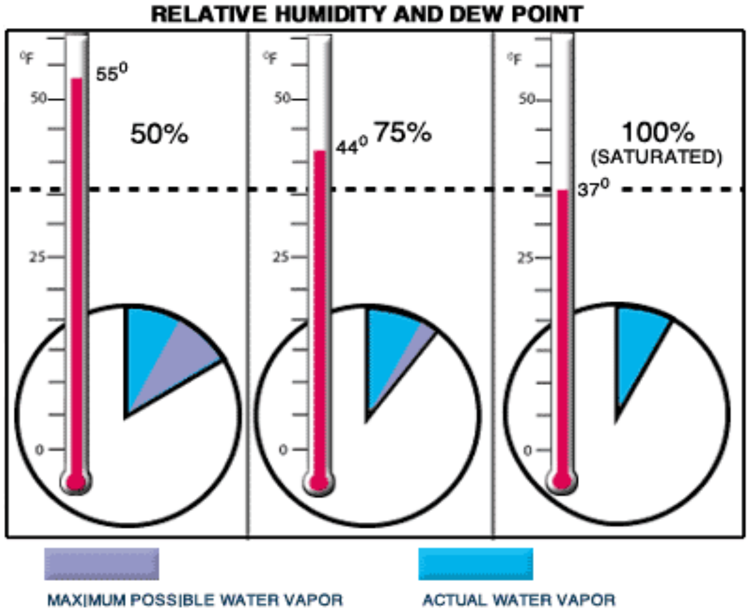
System Effect

Reviewing moisture flow



Reviewing moisture flow

Dew Point: In base terms, it is the temperature at which a given mass of water in the air will form condensation or “dew”. It’s like being at 100%RH and then dropping the temperature 1 degree

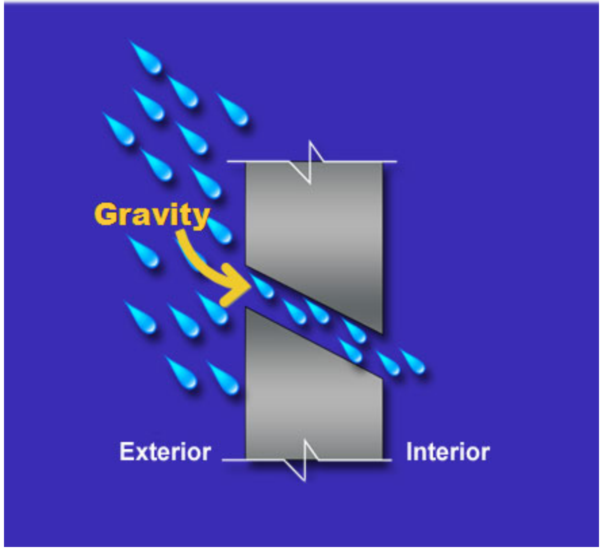


Reviewing moisture flow

Water Flow

- Gravity moves rainwater down the building's exterior surfaces
  - Water will enter downward-sloped openings
  - Storm water runoff can flow against buildings and seep in to basements
- Minimize water flow against the building
- Foundation drainage systems
- Use shingles and flashings to keep rainwater out of joints
  - Overlap the components
  - No reversed laps
  - Drainage holes
  - Protect vertical joints

Illustration of Gravity Flow Through a Wall Opening



Reviewing moisture flow

Airborne Moisture Flow

Air flow carries moisture into buildings

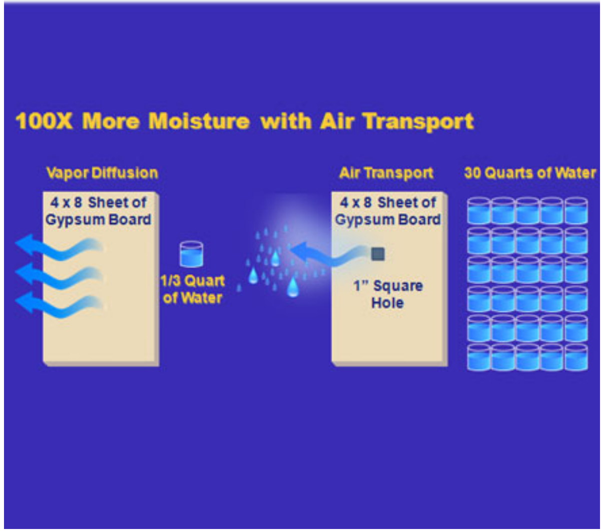
Construction practices can prevent openings

The volume of moisture entering a building by air flow can be 100 times greater than by diffusion

Diffusion through a 4 x 8 sheet of painted gypsum board is about 1/3 quart of water over a heating season in a cold climate

Air flow through a 1-inch hole can add up to 30 quarts!

Airborne Moisture Transport Potential

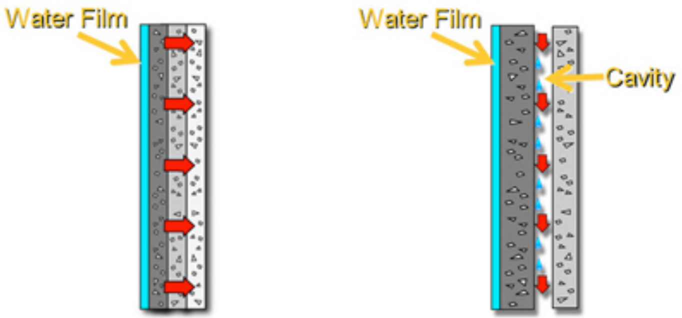


Reviewing moisture flow

Capillary Suction

- Caused by surface tension of water
  - Causes water to be drawn in through tiny pores in building materials
- To prevent capillary flow, create breaks in the components
- Even very narrow spaces work
  - Should drain and vent to the exterior so drying can occur
  - M*oisture tolerant* materials like concrete and masonry help prevent capillary flow

A Capillary Break Protects Building Materials From Absorbing Moisture



Capillary suction, caused by water surface tension, draws water into porous material and tiny cracks

Create capillary breaks to protect building materials from absorbing moisture

Reviewing moisture flow

Diffusion

- The movement of moisture through a substance
- This kind of moisture movement due to difference in vapor pressure
  - Moisture diffuses through a wall to equalize differences in vapor pressure

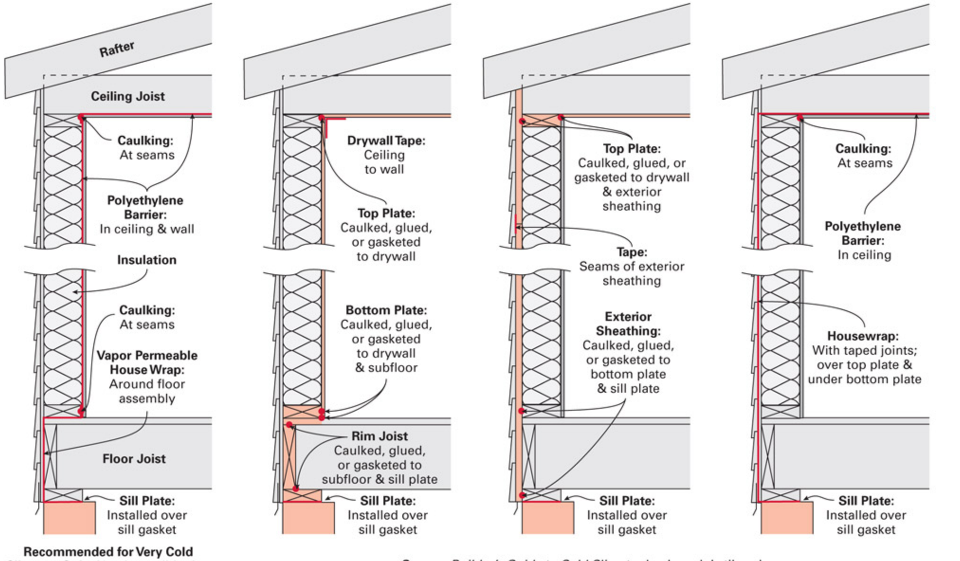
The building code challenge:

Change occurs and consequences are learned then we adjust
Example: Add insulation to attics and now we need ventilation

The building code challenge:

In what ways do air barriers and continuous insulation upset the traditional balance?

Common Approaches to Air Barriers



Source: *Builder's Guide to Cold Climates* by Joseph Lstiburek

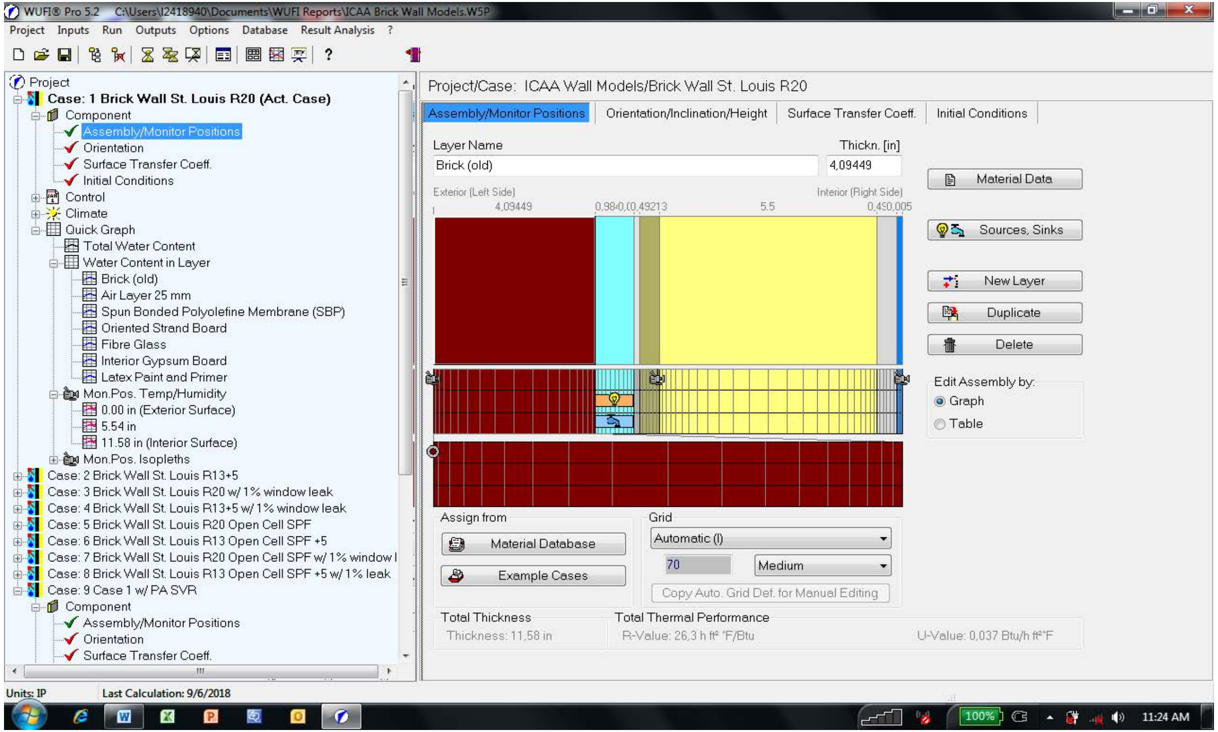
The building code challenge:

Example R20 w/o VR in climate zone 4 (2015 IRC chapter 1405.3 is a sketchy idea)

IECC Residential Requirements							
		IECC	IECC	IECC	IECC	IECC	IECC
		2003	2006	2009	2012	2012	2015
Ceiling	1	19	30	30	30	30	30
	2	26	30	30	38	38	38
	3	30	30	30	38	38	38
	4 exept marine	30	38	38	49	49	49
	Marine 4 and 5	38	38	38	49	49	49
	6	38	49	49	49	49	49
	7 and 8	49	49	49	49	49	49
Wood-Frame Wall	1	11	13	13	13	13	13
	2	11	13	13	13	13	13
	3	13	13	13	20 or 13+5	20 or 13+5	20 or 13+5
	4 exept marine	13	13	13	20 or 13+5	20 or 13+5	20 or 13+5
	Marine 4 and 5	18	19 or 13+5	20 or 13+5	20 or 13+5	20 or 13+5	20 or 13+5
	6	18	19 or 13+5	20 or 13+5	20 or 13+10	20 or 13+10	20 or 13+10
	7 and 8	21	21	21	20+5 or 13+10	20+5 or 13+10	20+5 or 13+10

The building code challenge:

Predicting performance using modeling programs such as WUFI



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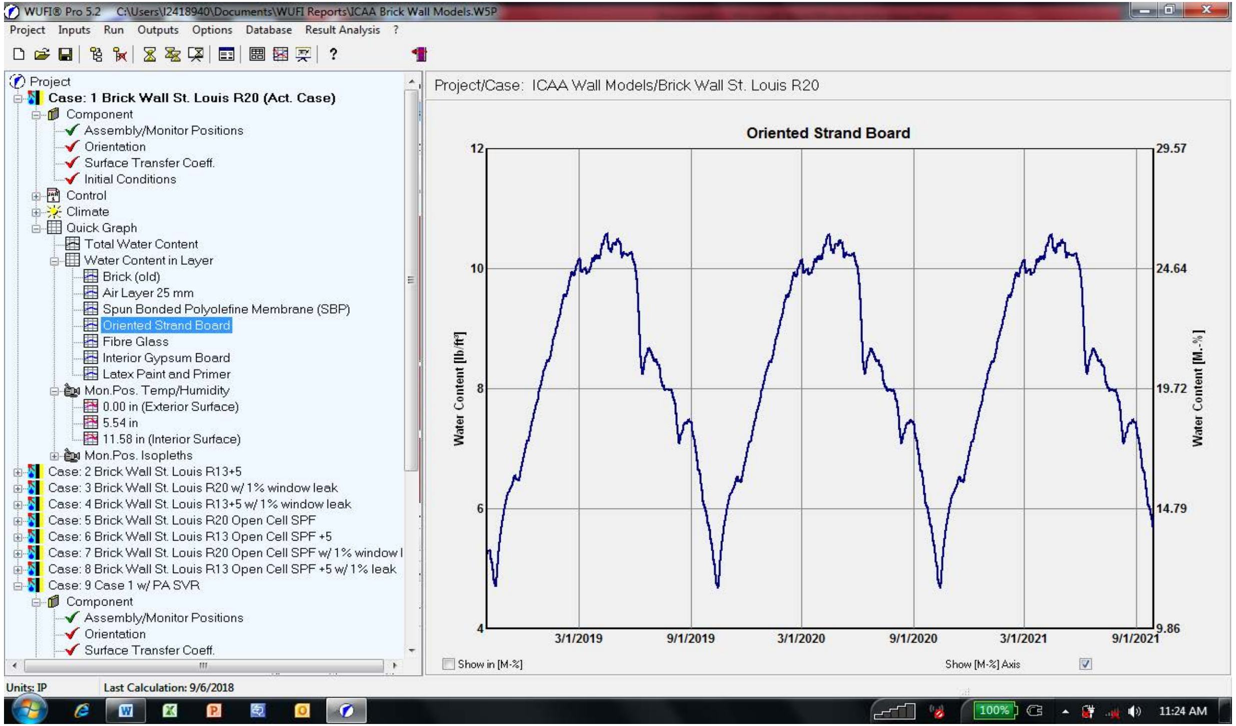

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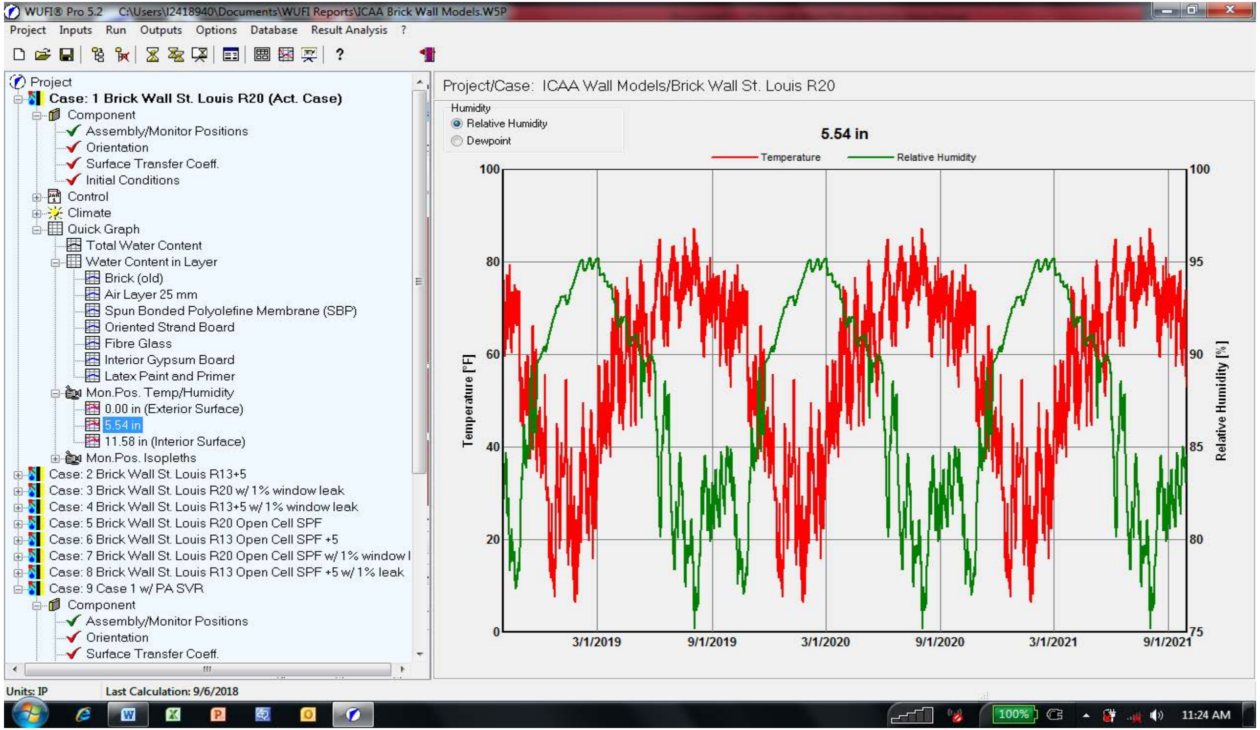

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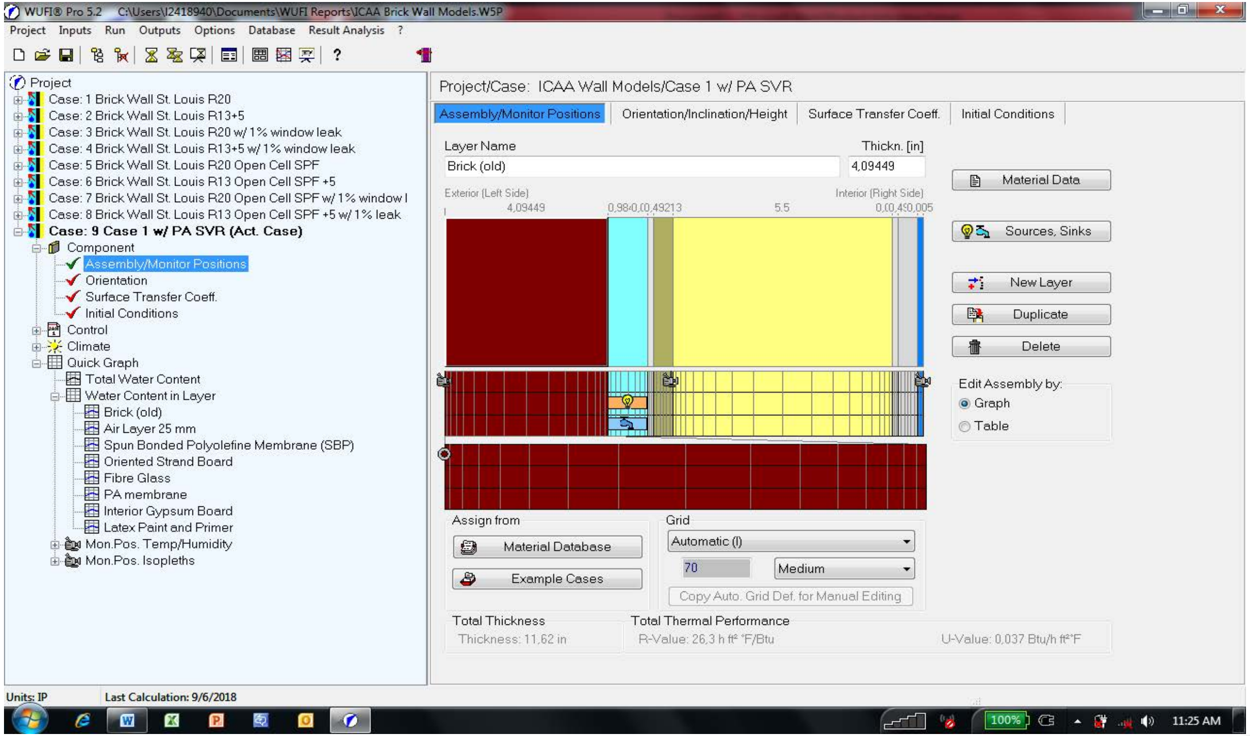

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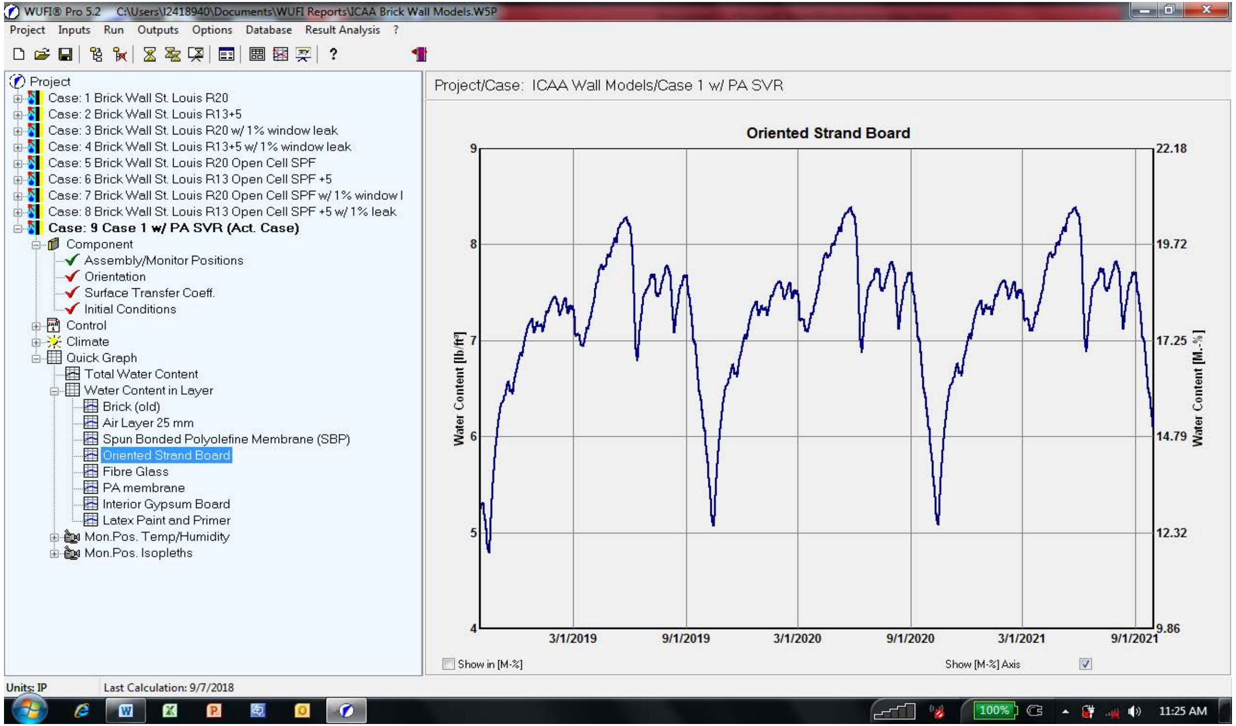

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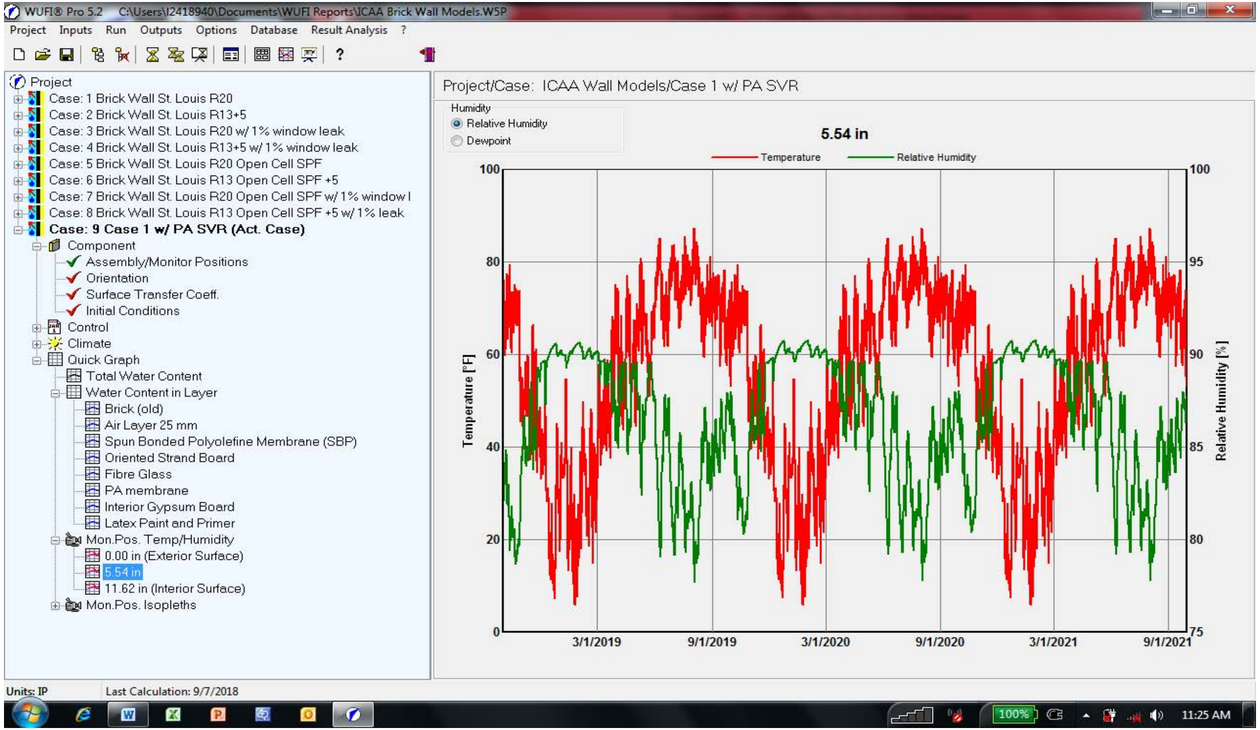
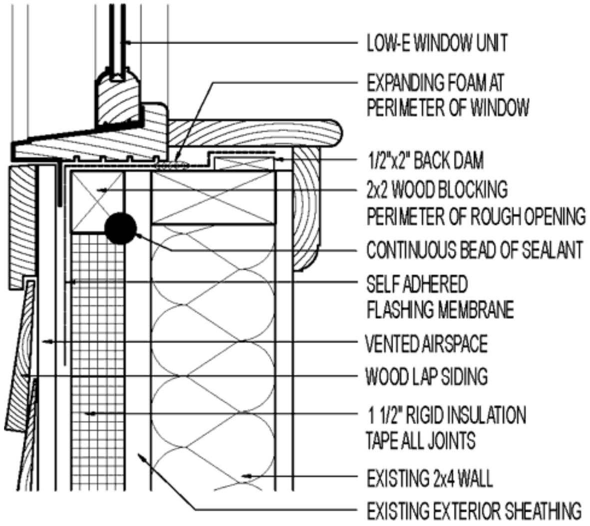
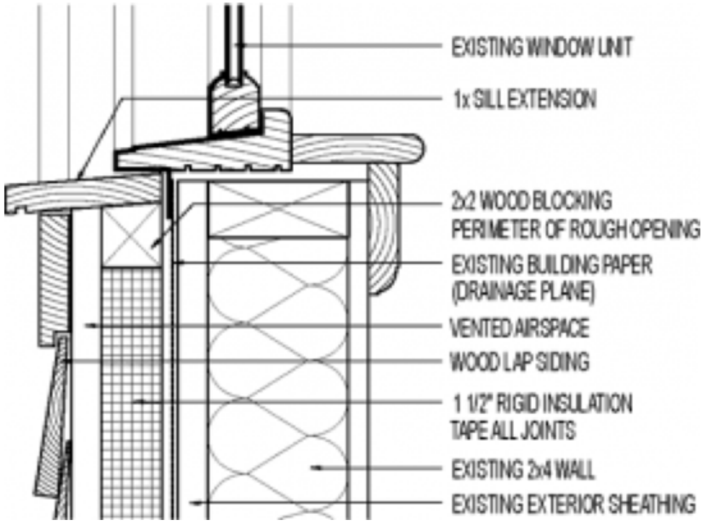


The building code challenge:

So you want to breathe? Why? Do you suspect your going to get wet?



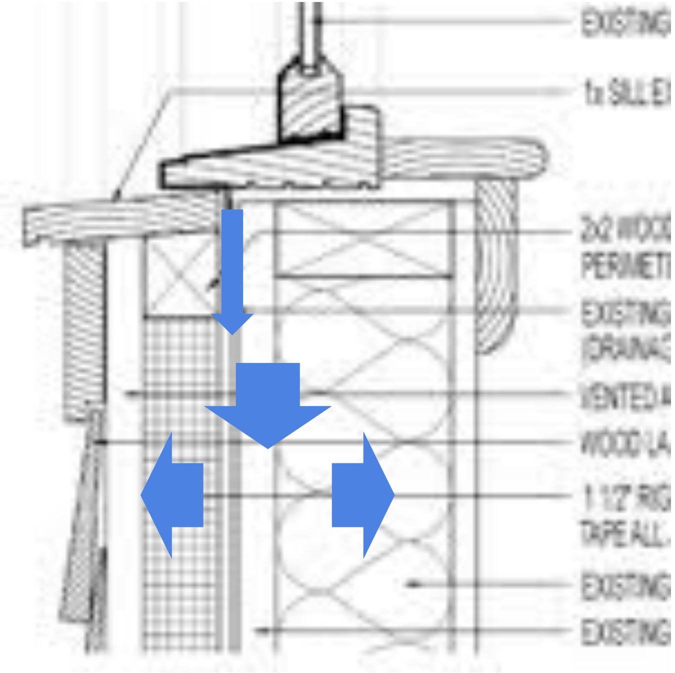


The building code challenge:

So you want to breathe? Why? Do you suspect your going to get wet?

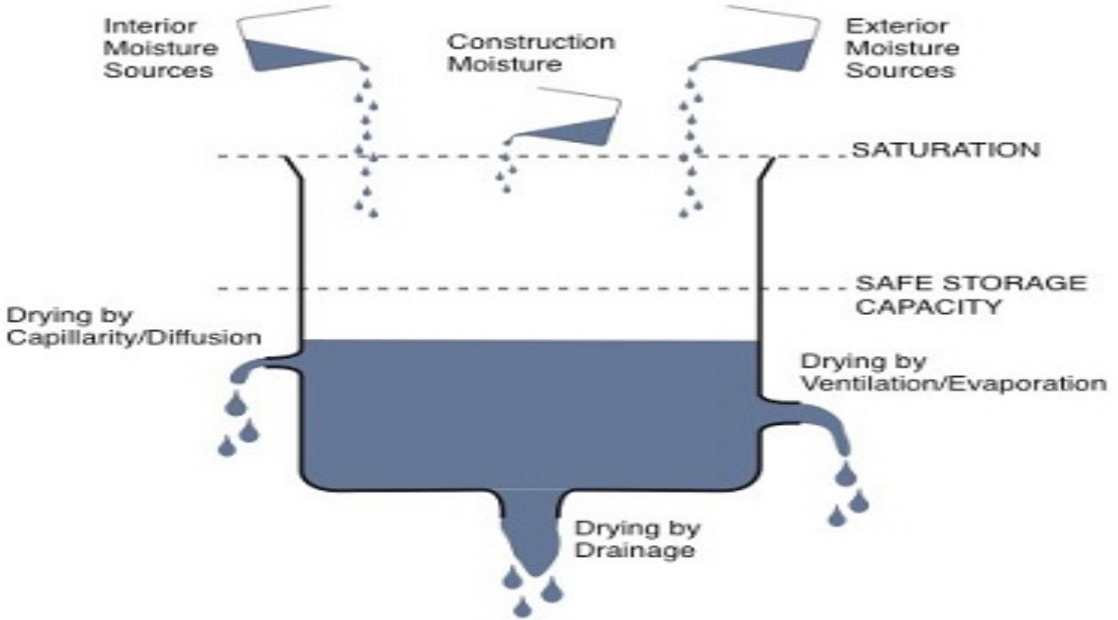
Reverse Shingling of Wrap

The building challenge:



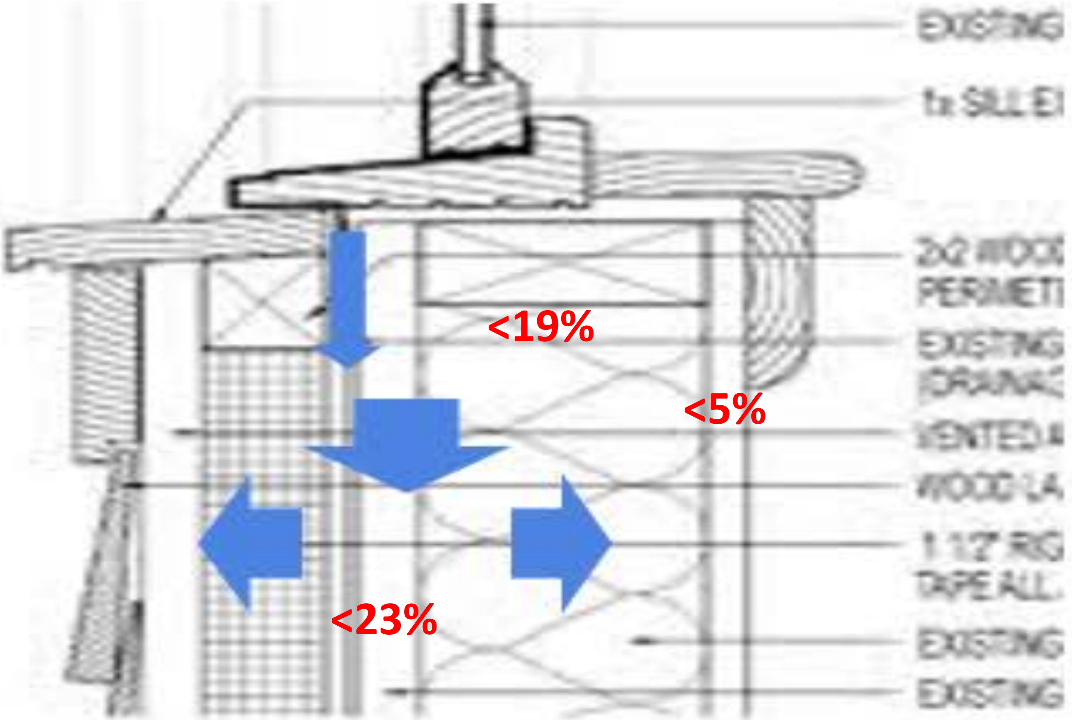
Materiality: why we choose materials for a specific job. Always consider a building materials resistance to heat flow, air flow, and moisture flow simultaneously.

Safe moisture storage:



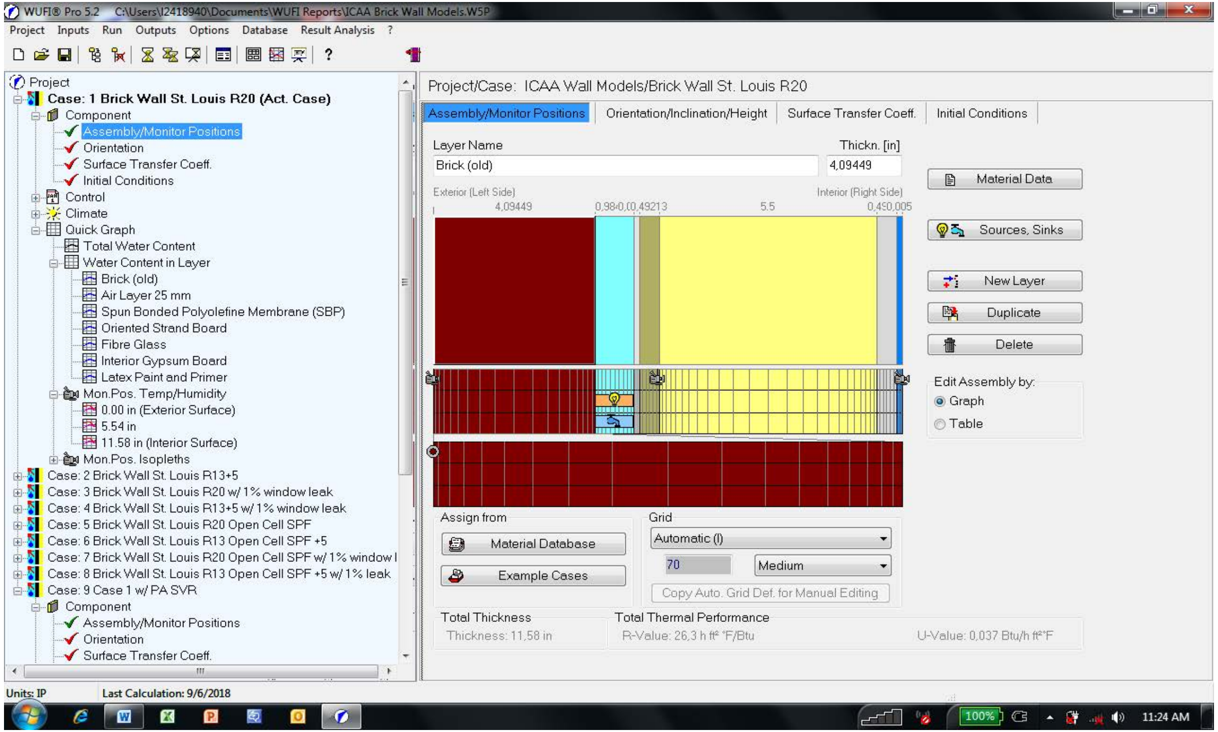
The concept of moisture balance is more easily understood than achieved. By maintaining a balance between wetting and drying, moisture will not accumulate and exceed the safe storage capacity of the material. The extent and duration of wetting, storage and drying must always be considered when assessing the risk of moisture damage. It is also important to reconcile strategies for reducing the amount of wetting potential versus providing greater drying potential and storage.

Safe moisture storage:



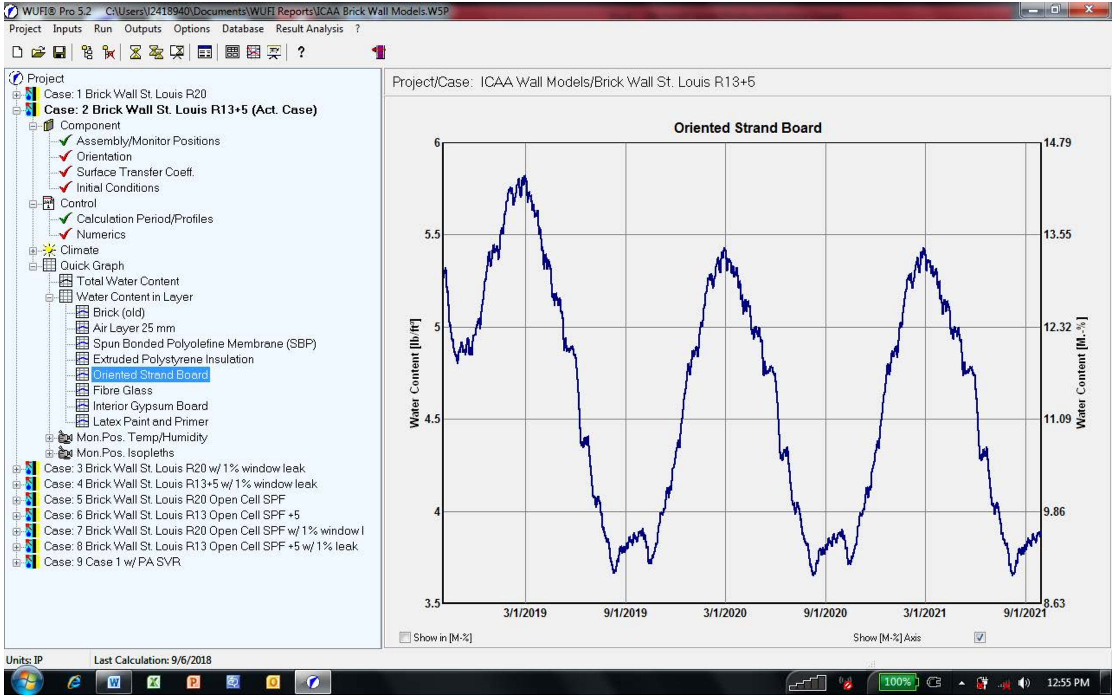
Applied knowledge:

Predicting performance using modeling programs such as WUFI



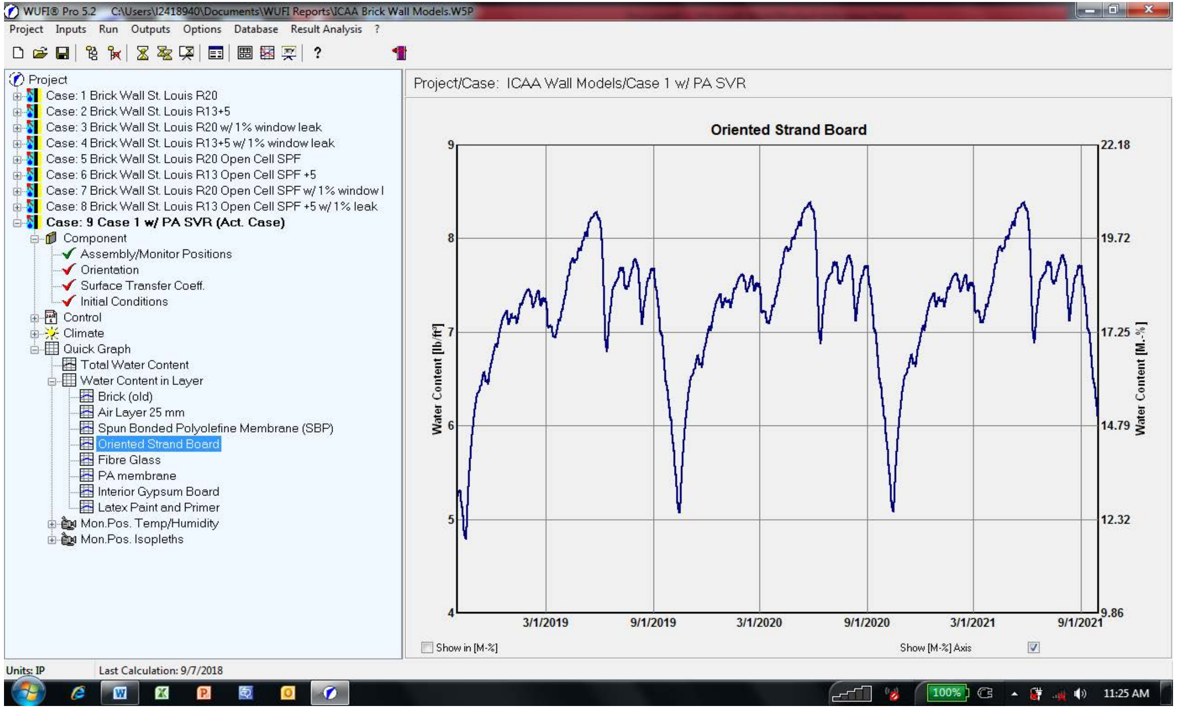
Applied knowledge:

R13 +5 in Zone 4A doesn't need a vapor retarder and is better off without one



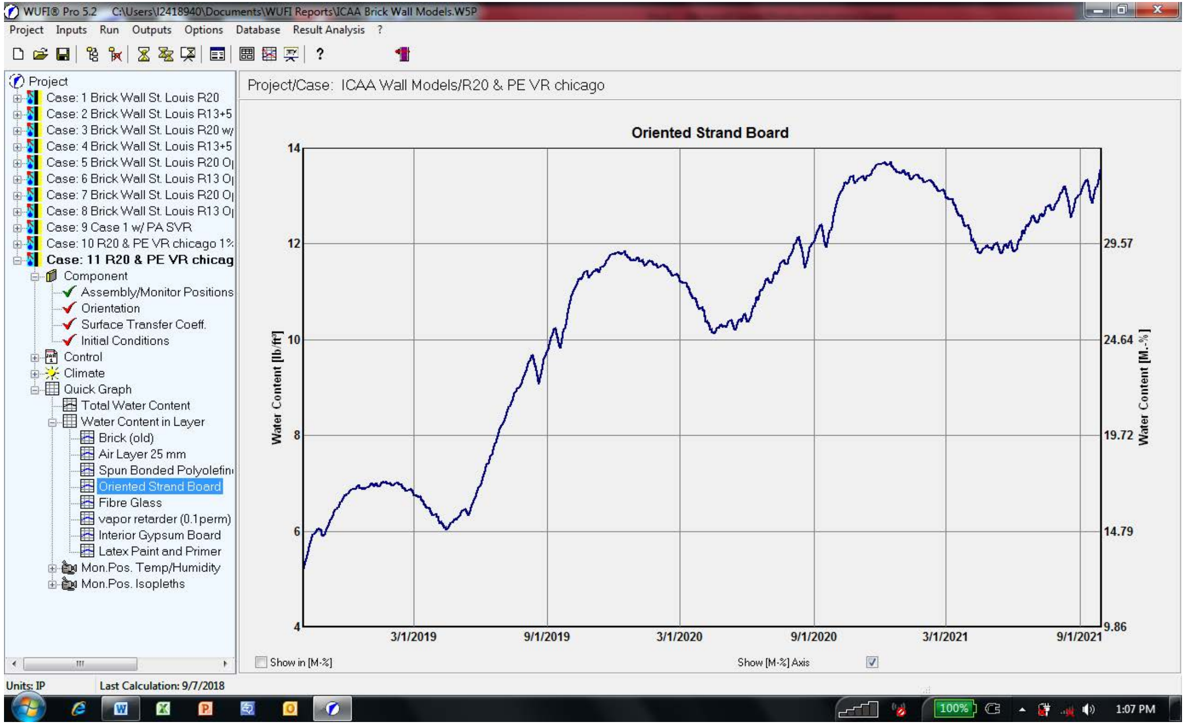
Applied knowledge:

Use smart vapor retarders in zone 4 on R20 walls



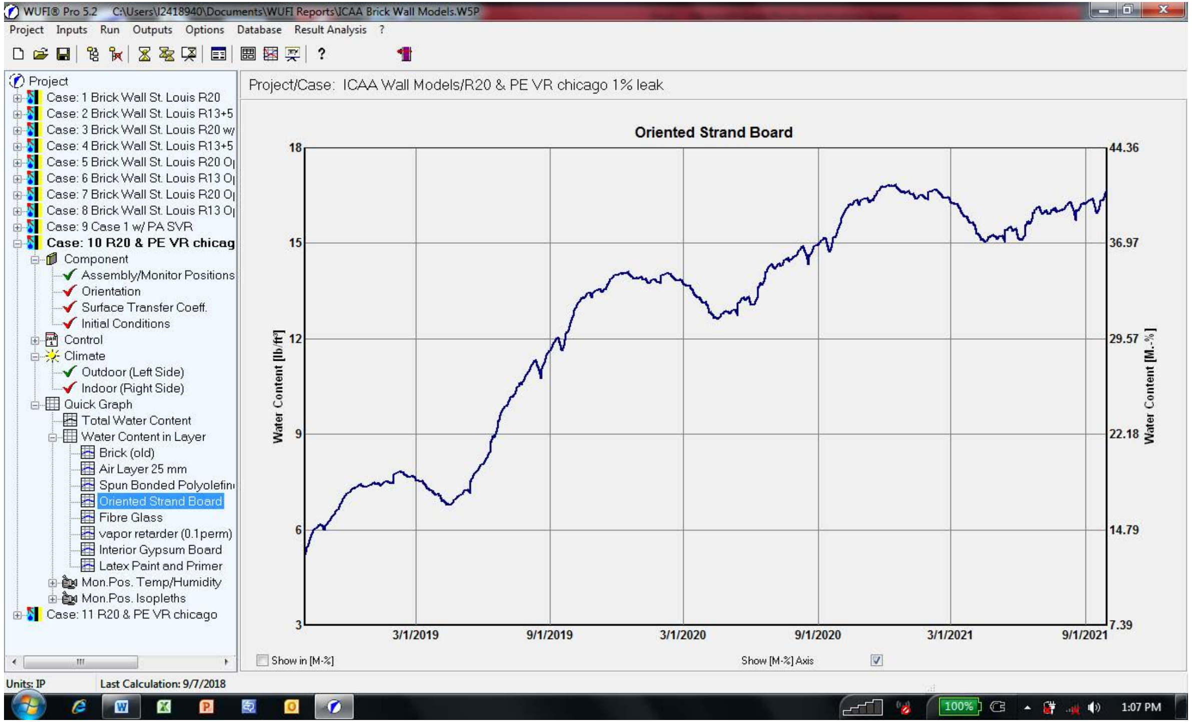
Applied knowledge:

Don't use PE (polyethylene vapor retarders) on R20 in Chicago



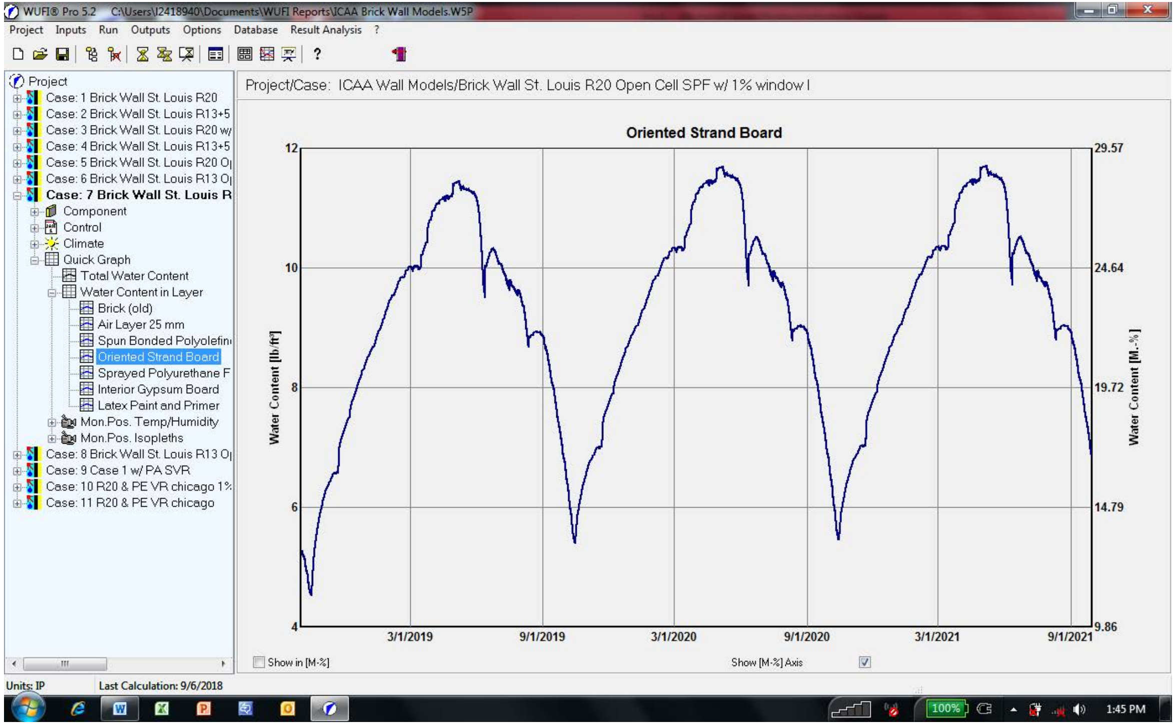
Applied knowledge:

Don't use PE on R20 in Chicago. A window leak is gonna kill the wall.



Applied knowledge:

Be aware that SPF, even open cell doesn't forgive like fiber glass



Applied knowledge:

- ✓ When folks say they want a wall or building to breathe, logically they could only be talking about moisture
- ✓ We’ve been adding layer upon layer to these assemblies for the past 4 decades and none of them were meant to improve “breathing”
- ✓ We need to look at each layer and consider it’s resistance to heat flow, air flow, and moisture flow because they are each going to influence the performance of the whole
- ✓ Continuous insulation materials that don’t “breathe” can pose additional challenges to whole wall durability
- ✓ Fiber glass’ “breathability” and hydrophobicity makes it the ideal insulation to put in framing cavities
- ✓ On thicker framing cavities, use smart vapor retarders (even when the code doesn’t tell you to) in order to prevent wetting and promote drying!

Conclusions

- Examine the relationship between heat flow, air flow and moisture flow
- Discuss how the building code addresses each of the above and how recent changes to the code could potentially reduce building durability
- Review the four key mechanisms of moisture flow in buildings in order to explain how things get wet and how things dry
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Questions

Thank You

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