Building Enclosure Risk in the Codes

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1

Description

The modern building enclosure is quite complex and must account for a combination of code compliance, best practices, constructability, and cost considerations. Often builders are focused on reducing risk of the enclosure not performing as expected and, in some cases, failing. This session will dive into some of the overall concepts related to the risk of building enclosures not meeting expectations. The discussion will identify challenges within the code compliance process and identify strategies to navigate the codes in a manner that mitigates risk to the building and the builder.

8

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Learning Objectives

1. Discuss the type of risk that a builder or design professional may face related to the building enclosure such as moisture considerations, overall inefficiency, and long-term failures.
2. Examine the role of the plan review and inspection process in mitigating building enclosure risk.
3. Identify strategies to ensure proper performance of the building enclosure.
4. Understand the implications of building enclosure failures to builders and design professionals.

9

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What is our Goal?

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What is the Building Enclosure?

- "That part of any building that physically separates the exterior environment from the interior environment(s) is called the building enclosure or building envelope."

  - Dr. John Straube, BSD-018: The Building Enclosure

Source: https://buildingscience.com/documents/digests/bsd-018-the-building-enclosure_revised

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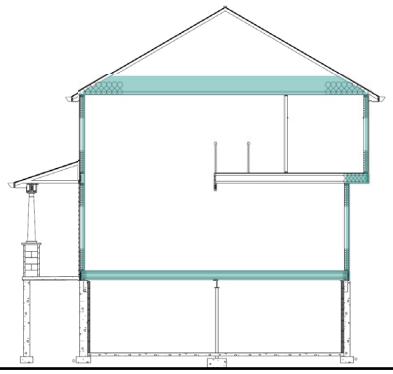

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Building Enclosure Functions

- Support (structural)
- Control (heat, air, moisture, smoke, odor, sound, fire, insects, etc.)
- Aesthetics (exterior and interior finishes)
- Distribution of Services (MEP)

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What Types of Building Enclosure Risks Exist?

- Performance
- Durability

**Not a comprehensive list*

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More Specifically, Risk in the Codes?

- False Equivalency
  - Summary: Assuming minimum code compliance is an adequate substitute for proper design.
- Mistaken Identity
  - Summary: Assuming plan reviewers and inspectors are performing quality control functions.

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Disclaimers

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False Equivalency

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False Equivalency

- Summary: Assuming minimum code compliance is an adequate substitute for proper design.

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UCC Energy Code Summary

Chapter 11

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Residential Provisions

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21

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Climate Zones in PA

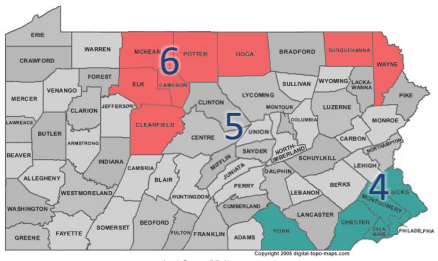

Image Source: digital-topo-maps.com

22

2018 IRC Table N1102.1.2

Table N1102.1.2 (R402.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

Climate Zone	Fenestration *U*-Factor	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[i]	MASS WALL *R*-VALUE	FLOOR *R*-VALUE	BAWSEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	20 or 13 + 5[h]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	20 or 13 + 5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
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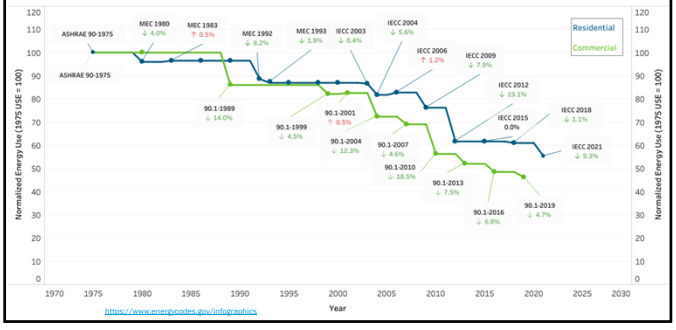
7 and 8	0.30	0.55	NR	49	20 + 5[h] or 13 + 10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

23

Estimated Improvement in Residential & Commercial Energy Codes (1975 - 2021)



24

Hypothesis/Opinion

- *As code minimum and accepted best practice converge, builders/design professionals will view enforceable building codes as design guidance.*
  - *Some code-compliant outcomes may carry tangible amounts of risk.*
- *The larger the gap between code minimum and accepted best practice, the greater the need for design.*

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We Can't Forget About Moisture

- As residential buildings have become more energy efficient, the building enclosure has become more sensitive to moisture-related damage.
  - This is mainly due to the lack of air and heat flow through various building assemblies that provided insurance against moisture damage in the past. Having less heat and ventilation available to provide drying of damp building systems requires greater attention to the design of the assembly up front.

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Example 1: Assembly Drying Potential (Above-Grade)

- **Above-grade wall assembly options:**
  - Exterior vapor retarder/barrier such as foil-faced foam to satisfy continuous exterior insulation requirement
  - Interior vapor retarder/barrier such as kraft paper or poly
  - More specifically, CZ6 prescriptive option of 20+5 and lack of ability to reduce to Class III interior vapor retarder

28

28

Drying Potential

- **Assuming an assembly will get wet, will it be able to dry?**
  - Through proper source control, occupant behavior, and assembly design, all building assemblies *must be designed so that they can* ***dry*** to the *interior, exterior, or both*.

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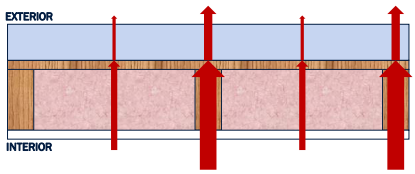
Exterior Continuous Insulation



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Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

31

31

Climate Zone	Rigid Board or Air Impermeable Insulation	Total Cavity Insulation	Total Wall Assembly Insulation	Ratio of Rigid Board Insulation or Air Impermeable R-Value to Total Insulation R-Value
4C	R-2.5	R-13	R-15.5	15%
	R-3.75	R-20	R-23.75	15%
4A, 4B	R-3.5	R-13	R-16.5	20%
	R-5	R-20	R-25	20%
5	R-5	R-13	R-18	30%
	R-7.5	R-20	R-27.5	30%
6	R-7.5	R-13	R-20.5	35%
	R-11.25	R-20	R-31.25	35%
7	R-10	R-13	R-28	45%
	R-15	R-20	R-35	45%
8	R-15	R-13	R-28	50%
	R-20	R-20	R-40	50%

Source: https://buildingscience.com/documents/building-science-insights-newsletters/bsi-100-hybrid-assemblies

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32

2018 IRC Section R702.7.1 Class III Vapor Retarders

- **Class III vapor retarders shall be permitted where any one of the conditions in Table R702.7.1 is met.**
  - *By adding insulated sheathing, drying potential to exterior is reduced – Must maximize interior drying potential*

Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

33

33

2018 IRC Table R702.7.1 Class III Vapor Retarders

Climate Zone	Class III Vapor Retarders Permitted For:
4	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 2.5 over 2 x 4 wall Continuous insulation with R-value ≥ 3.75 over 2 x 6 wall
5	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 5 over 2 x 4 wall Continuous insulation with R-value ≥ 7.5 over 2 x 6 wall
6	Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 7.5 over 2 x 4 wall Continuous insulation with R-value ≥ 11.25 over 2 x 6 wall

Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

34

Example 1: Assembly Drying Potential (Above-Grade)

- **Above-grade wall assembly *recommendations*:**
  - Select materials with an eye toward drying potential
  - Exterior continuous insulation thickness should consider condensation potential
  - View code compliance as only one step in the assembly design process

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Example 2: Assembly Drying Potential (Below-Grade)

- **Below-grade wall assembly options:**
  - Interior vapor retarder/barrier without proper condensation control or air sealing
  - Trapping moisture within the assembly in an effort to prevent moisture from entering the space

36

36

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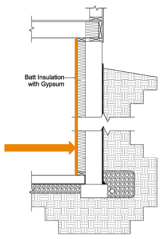
Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

37

37

Avoid Interior Vapor Retarding Layers

- Once interior from the foundation wall, layers should be selected that are generally vapor open
  - Moisture from concrete curing, condensation, diffusion, etc. should be allowed to dry toward the interior



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38

2018 IRC Section R702.7 Vapor Retarders

- Class I or II vapor retarders are required on the interior side of framed walls in Zones 5, 6, 7, 8, and Marine 4
- Exceptions:
  - Basement walls
  - Below grade portion of any wall
  - Construction where moisture or its freezing will not damage materials

Source: International Code Council (ICC). (2017). 2018 International Residential Code, Country Club Hill, Ill.

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39

Drying Potential

- *"If water vapor is allowed to pass through the below-grade wall and insulation, it must be allowed to dry to the inside of the home to avoid condensation in the wall cavity."*

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Source: https://basc.pnnl.gov/resource-guides/no-vapor-retarders-interior-side-air-permeable-foundation-insulation#edit-group-description

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Example 2: Assembly Drying Potential (Below-Grade)

- Below-grade wall assembly *recommendations*:
  - Use moisture tolerant materials in contact with foundation walls
  - Once air-permeable insulation is included, avoid interior vapor retarding layers

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41

Recommendation: Design!

- Approach the building enclosure with a design mentality, not a checklist mentality
- Someone needs to be responsible for the design of building enclosure assemblies
  - And it shouldn't be the code official!
  - They should be paid to own the result

42

42

Mistaken Identity

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Mistaken Identity

- Summary: Assuming plan reviewers and inspectors are performing quality control functions.

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Establishing Expectations

- The primary role of the code official is to provide reasonable assurance of compliance with enforceable codes.
  - They are not there to provide quality control.

46

Example 3: Material Compatibility

- Proprietary materials require adherence to manufacturer installation guidelines
- Challenges can arise:
  - Incompatible materials for the water-resistive barrier (WRB)
  - Lack of required WRB inspection in many municipalities can be a challenge

47

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Example 3: Material Compatibility

- Proprietary materials require adherence to manufacturer installation guidelines
- Recommendations:
  - Verify compatibility
  - Communicate material specifications
    - Subcontractors must understand this!

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Other Examples

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Example 4: The Missing Blower Door Test

- What if you're not asked for your blower door test results?
  - Are you required to meet the airtightness requirements?

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Review: Risk in the Codes?

- False Equivalency
  - Summary: Assuming minimum code compliance is an adequate substitute for proper design.
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52

52

How to Respond

- The multitude of changes in the residential construction industry should prompt some self-reflection and evaluation
  - Don't assume things will go well – small changes can change outcomes (new subs, new materials, etc.)

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Questions?

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54

54