PHRC Webinar Series | Tuesday, October 11 @ 1pm

Durability of Insulated Rim Joists

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Description

Throughout the building enclosure there are various assemblies that are deemed critical to the long-term energy efficiency and durability of a building. When best practices are followed, these critical areas contribute to a sustainable enclosure. When one or more components are incorrectly designed or installed, moisture accumulation, rot, or mold growth may arise. In this webinar we will look at the rim joist portion of the enclosure. Many scenarios come into play such as insulation materials, whether the basement is conditioned and what types of cladding or materials are applied to the exterior of the assembly. We will review these scenarios and work through the risks associated with them.

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Learning Objectives

- Review areas of concern that can lead to degradation due to moisture intrusion.
- Review insulation materials that can achieve the required R-value along with having the potential to be left exposed in unconditioned basements
- Understand the long term deterioration concern of some assemblies. These assemblies can be hidden from sight and can pose a safety and health concern to the occupants
- Review best practices when insulation the rim joist assembly. This will cover many scenarios and will review the best assembly for each.

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Builder Brief

http://www.phrc.psu.edu/assets/docs/Publications/Durability-Evaluation-of-Insulated-Rim-Joists-FINAL.pdf

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Outline

- What is a rim joist?
- What is the required insulation value for a rim joist?
- How to create a durably insulated rim joist

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What is a Rim Joist?

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Rim Joist Definition

- **In the framing of a deck or building, a rim joist is the final joist that caps the end of the row of joists that support a floor or ceiling. A rim joist makes up the end of the box that comprises the floor system.** Wikipedia.com
- **Perimeter joist for wood floor framing system. Usually referred to in conjunction with composite wood floor joists**
- **(band joist) A vertical member that forms the perimeter of a floor system.**

Dictionaryofconstruction.com

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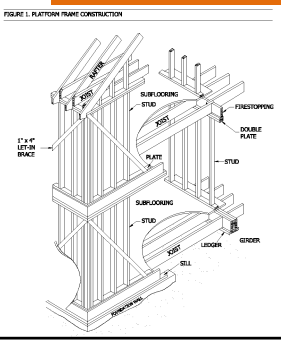
Platform Framing



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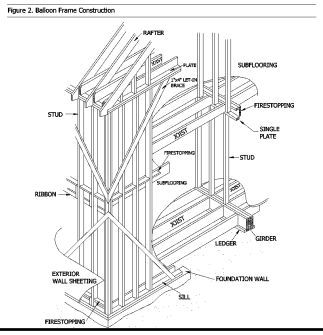
Balloon Framing



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Rim Joist Materials

- **Engineered rim joist**

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Rim Joist Materials

- **Solid sawn rim joist**

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Structural Characteristics of a Rim Joist

- To transfer all vertical loads from above to below at the rim board location
- To provide diaphragm attachment for floor sheathing to the top edge of rim board
- To transfer lateral loads from the diaphragm to the wall plate below

Typical Rim Joist Assembly

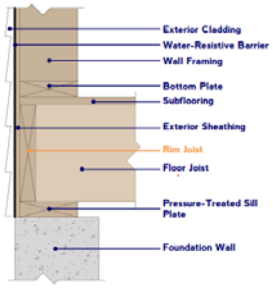

Figure 1: Uninsulated rim joist assembly

Structural Characteristics of a Rim Joist

- To provide lateral support for the floor joists through the attachment to the joists
- To provide closure for ends of floor joists
- To provide attachment base for siding and/or exterior deck ledger

Typical Rim Joist Assembly

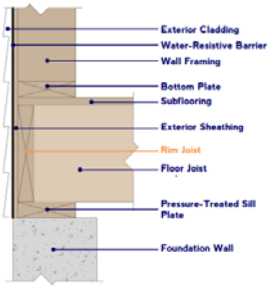

Figure 1: Uninsulated rim joist assembly

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Insulating the Rim Joist

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Why Insulation is Critical at Rim Joists

- Creating a closed building envelope with no gaps leads to energy efficiency in the home.
- Insulating increases long-term durability of the rim joist.
- Uninsulated rim joists are much more likely to rot.

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Rim Joist R-value

- Rim joist insulation values 2009 IRC?

(Portions from)
Table N1102.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

Climate Zone	Ceiling R-Value	Wood Frame Wall R-Value	Floor R-Value	Basement Wall R-Value	Crawlspace Wall R-Value
1	30	13	13	0	0
2	30	13	13	0	0
3	30	13	19	5/13	5/13
4 except Marine	38	13	19	10/13	10/13
5 and Marine 4	38	20 or 13 + 5	30	10/13	10/13
6	49	20 or 13 + 5	30	10/13	10/13
7 and 8	49	21	30	10/13	10/13

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The Breakdown of a Rim Joist

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What can Lead to Degradation?

- Bulk moisture intrusions at penetrations in building envelope.
- Water vapor condensation within walls.

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Thermal Photo of Uninsulated Rim Joist

http://www.rookenergy.com/case-studies-weatherization-work/2015/4/19/home-energy-audit-attic-basement-insulation-portland-maine

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http://www.contractortalk.com/f3/replacing-rotted-rim-joist-entry-door-first-timer-96801/

Combatting Moisture

- **It is important to assume that at some point in its life, the rim joist will come in contact with moisture.**
- **In order to combat, drying must be able to occur through vapor diffusion.**
- **Material selection is most critical in this process.**
- **Chosen insulation type must take into account vapor permeability.**

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Vapor Permeability

- "Breathability"
- A material's ability to allow water vapor to pass through it.
- The higher the vapor permeability, the higher the drying potential.
- Material with the lowest vapor permeability is called the "Throttle."
- Building systems usually dry in the opposite direction of their throttle.

http://www.dupont.com/products-and-services/construction-materials/building-envelope-systems/articles/understanding-vapor-permeability.html

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Insulating the Rim Joist

- There are four options given in this webinar, each with advantages and drawbacks

- Fiberglass Batts
- Interior Foam
- Exterior Foam and Fiberglass Batts
- Interior and Exterior Foam

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Rim Joists with Fiberglass Batt Insulation

- Air with a high relative humidity can come in contact with the cooler rim joist by means of convection because fiberglass batt insulation is air permeable.
- During the winter months, condensation and frost can occur on the inside face of the rim joist material.
- The risk of condensation typically outweighs this drying potential, unless it is implemented with the appropriate conditions.

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Vapor Permeability of Rim Joist Assembly with Batt Insulation

Table 1: Rim joist w/batt assembly materials

Layers (Outside - Inside)	Vapor Permeability (perm)
Water-Resistive Barrier	5.0 - 50
Exterior Sheathing	2.8 - 5.9
Rim Joist	1.4 - 5.0
Fiberglass Batt Insulation	118

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Fiberglass Batt Insulation

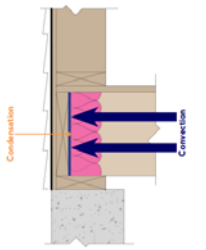

Figure 2: Rim joist assembly w/fiberglass insulation

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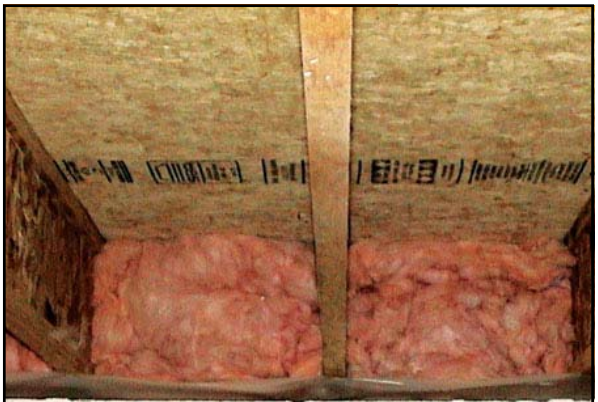

37 http://www.ashireporter.org/HomeInspection/Articles/Moisture-Mysteries/1714?print=true

Rim Joists with Interior Foam Insulation

- This insulating can be achieved through spray polyurethane foam or foam board
- Foam insulation has a much lower air and water vapor permeability than batt insulation.
- Foam also raises the temperature of the interior face of the rim joist.
- These two factors lead to a lower risk of condensation.

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Vapor Permeability of Rim Joist Assembly with Interior Foam Insulation

Table 2: Rim joist w/interior foam assembly materials

Layers (Outside - Inside)	Vapor Permeability (perm)
Water-Resistive Barrier	5.0 - 50
Exterior Sheathing	2.8 - 5.9
Rim Joist	1.4 - 5.0
Closed-Cell Spray Foam Insulation	0.1 - 1.0

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Interior Foam Insulation

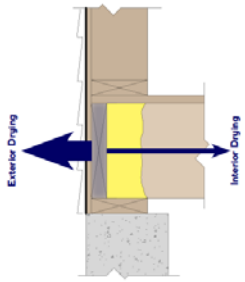

Figure 3: Rim joist w/interior foam insulation

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Rim Joists with Exterior Foam and Interior Fiberglass Batt Insulation

- This assembly can increase the energy efficiency of the enclosure.
- Rigid foam insulation on the exterior keeps the rim joist warmer in the winter, which reduces the risk of condensation.
- Exterior foam must be free of all defects in order to prevent bulk moisture from entering the assembly.

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Vapor Permeability of Rim Joist Assembly with Exterior Foam and Fiberglass Batts

Table 3: Rim joist w/exterior foam assembly materials

Layers (Outside - Inside)	Vapor Permeability (perm)
XPS Rigid Foam Insulation	1.0
Water-Resistive Barrier	5.0 - 50
Exterior Sheathing	2.8 - 5.9
Rim Joist	1.4 - 5.0
Fiberglass Batt Insulation	118

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Exterior Foam and Fiberglass Batt Insulation

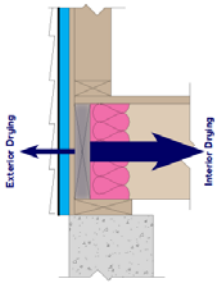

Figure 4: Rim joist w/exterior foam insulation

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Rim Joists with Interior and Exterior Foam

- **This assembly has the potential to reduce thermal bridging when installed correctly.**
- **If exposed to moisture, however, the drying potential is dramatically reduced.**

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Vapor Permeability of Rim Joist Assembly with Exterior and Interior Foam

Table 4: Rim joist w/interior foam assembly materials

Layers (Outside - Inside)	Vapor Permeability (perm)
XPS Rigid Foam Insulation	1.0
Water-Resistive Barrier	5.0 - 50
Exterior Sheathing	2.8 - 5.9
Rim Joist	1.4 - 5.0
Closed-Cell Spray Foam Insulation	0.1 - 1.0

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Interior and Exterior Foam Insulation

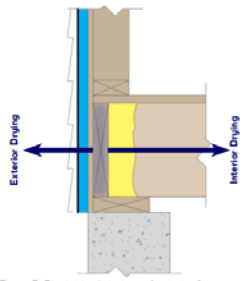

Figure 5: Rim joist w/interior and exterior foam

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Conclusions

- Insulation is beneficial in reducing heat loss during the winter.
- The selection of an insulation product must take into account its interaction with moisture.
- No design will guarantee the success or failure of the system.
- The key to long-term durability is proper assembly design and construction.

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Resources

- International Code Council. (2008). *2009 International Residential Code*, ICC, Country Club Hill, Ill.
- PHRC Builder Brief
  http://www.phrc.psu.edu/assets/docs/Publications/Durability-Evaluation-of-Insulated-Rim-Joists-FINAL.pdf

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