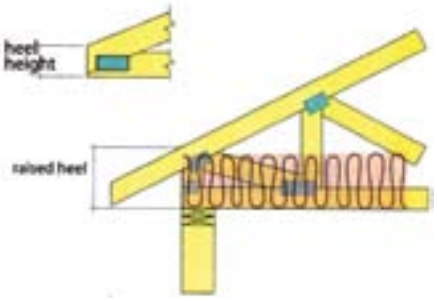
Technical Q & A

IRC Energy Code Requirements & Truss Heel Heights

by SBC Staff

How ceiling assembly R-values in the IRC affect truss heel heights.



The top detail illustrates a standard heel, while the bottom detail illustrates a raised heel, which enables the insulation to extend uncompressed all the way to the wall.

at a glance

- Information about ceiling space energy requirements from the International Energy Conservation Code is replicated in both the IRC and IBC.
- IRC Section N1102.2.2 applies to ceilings without attic spaces while Section N1102.1 applies to those with attic spaces.
- It is assumed that attic spaces do not require raised heels in order to meet given R-values. Instead, the insulation must be deep enough to achieve it wherever the construction technique allows it.

Question

My local jurisdiction recently adopted the 2009 International Residential Code (IRC). I am confused by Section N1102.2.2:

> **N1102.2.2 Ceilings without attic spaces.** Where Section N1102.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section N1102.1 shall be limited to 500 ft^2 (46 m^2) of ceiling area.

Does this mean I need to raise the heel height on trusses to be able to achieve at least an R-30 at the heel to comply?

Answer

No. Section N1102.2.2 applies to construction where there is no attic space. The IRC defines an attic as the unfinished space between the ceiling joists of the top story and the roof rafters. Section N1102.2.2 refers to construction where there is no space between a rafter and a ceiling joist. An example of a ceiling without an attic space is a sloped I-joist roof with the ceiling applied directly to its bottom edge and sheathing applied to the top edge. There is limited space between the ceiling and sheathing to fill with insulation.

When considering trussed construction, we must look to other code sections to understand the heel height requirements. Chapter 11 of the IRC deals with energy efficiency. The information in this section is replicated from Chapter 4 in the International Energy Conservation Code (IECC). (Similar information is also given in the International Building Code.) Table N1102.1 in the 2009 IRC (on page 11) specifies the required R-value that must be achieved in the attic (ceiling) area.

> **N1102.1 Insulation and fenestration criteria.** The building thermal envelope shall meet the requirements of Table N1102.1 based on the climate zone specified in Table N1101.2.

The ceiling R-values in Table N1102.1 are determined by climate zones as defined in Figure N1101.2 in the 2009 IRC (on page 11). Blown cellulose insulation typically provides an R-value of approximately 3.6 per inch.[1] Therefore, in the coldest climates of the United States where R-49 is required (zones 6 and 7), approximately 14" of insulation is required. Similarly, about 11" would be required to achieve R-38.

Table N1102.1 does not define how the required R-value is to be achieved, which has caused some confusion. For instance, does the entire attic space need to achieve the given value? Or is it understood that it may not be possible for some attic areas to achieve it due to the constraints of the framing system (i.e., standard heels on trusses or conventional rafter framing)?

Section N1102.2.1 provides some answers:

> **N1102.2.1 Ceilings with attic spaces.** When Section N1102.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

[1] http://www.cellulose.org/BuildersContractors/KeyPerformanceFeaturesTable.php

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE AND DEPTH	CRAWL SPACE WALL *R*-VALUE
1	1.2	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40[e]	30	13	5	19	0	0	5/13
4 except Marine	0.40	0.60	NR	38	13	5	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	19 or 13 + 5[g]	13	30[f]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	19 or 13 + 5[g]	15	30[f]	10/13	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19	30[f]	10/13	10, 4 ft	10/13

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 insulation shall be permitted to be compressed into a 2 × 6 cavity.
b. The fenestration *U*-factor column excludes skylights. The solar heat gain coefficient (SHGC) column applies to all glazed fenestration.
c. The first *R*-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
d. R-5 shall be added to the required slab edge *R*-values for heated slabs.
e. There are no solar heat gain coefficient (SHGC) requirements in the Marine Zone.
f. Or insulation sufficient to fill the framing cavity, R-19 minimum.
g. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

Table N1102.1. Insulation & Fenestration Requirements by Component[a]

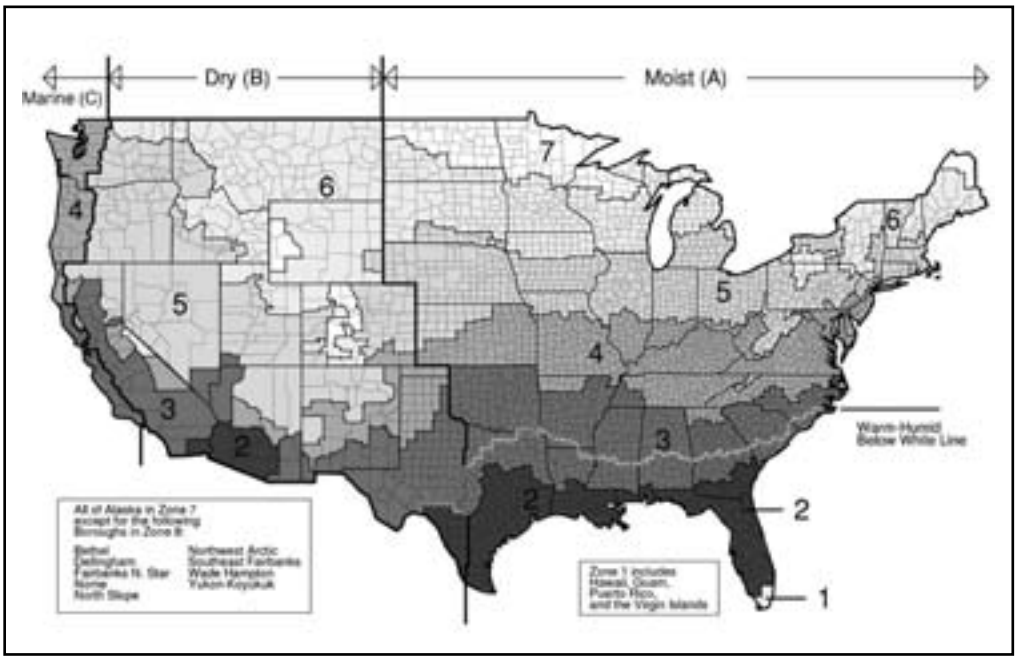


Figure N1101.2. Climate Zones

It is clear from this language that the table values are not intended to cover the entire ceiling area. If they were, the language in Section N1102.2.1 would never apply. Therefore, the R-values listed in Table N1102.1 must be based on a heel height less than that required to achieve the full R-value. Where the Table requires a specific R-value, the insulation must be deep enough to achieve this value wherever the construction technique allows it. The remaining portions of the attic space must be filled with as much insulation as possible while still allowing room for adequate ventilation. Look at it this way: If the intent of the Table N1102.1 requirement was to maintain the full height of uncompressed R-49 across the entire attic space, the R-38 stipulation in Section N1102.2.1 would not be a part of the code.

Sections N1102.2.1 and N1102.2.2 appear to be trade-offs to the ceiling R-value requirement. If you can achieve a higher R-value at the top of the wall plate, then you do not need to supply as high an R-value for the remaining portion of the ceiling area. The bottom line is if the building is designed with standard heel trusses in Climate Zones 6 or 7, R-49 insulation is required wherever the attic space allows it and is then tapered down at the exterior walls (while still allowing for proper ventilation).

In any case, the building designer is responsible to ensure overall compliance with the applicable building and energy codes and specifies the overall building envelop design. Since the design of the overall structure is affected by many of the building's characteristics and many different paths may be taken to achieve the overall required efficiency, the building designer must ensure that the individual elements of the building combine to achieve the desired result. SBC

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