

ROOF AND WALL THERMAL DESIGN

APPLYING THE PRESCRIPTIVE INSULATION STANDARDS OF THE 2015 I-CODES

GUIDE



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/ INTRODUCTION /

THE NEW CODES AND THE CHALLENGE FOR THE BUILDING DESIGNER.

SINCE 1994, THE INTERNATIONAL CODES, OR I-CODES, HAVE SERVED AS MODELS FOR ALMOST ALL STATE AND LOCAL BUILDING CODES IN THE UNITED STATES. THE 2015 EDITION OF THE I-CODES INCLUDE SEVERAL ADVANCES TO INCREASE ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS. FIRST, THE 2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) INCLUDES NEW AND HIGHER STANDARDS FOR SEVERAL COMPONENTS IN THE BUILDING ENVELOPE, MOST NOTABLY FOR ROOFS WITH INSULATION ABOVE DECK. IN ADDITION, THESE ENHANCED STANDARDS ARE FURTHER INCREASED IN THE NEW INTERNATIONAL GREEN CONSTRUCTION CODE (IGCC), WHICH IS INTENDED TO SERVE AS AN OVERLAY CODE, OR “ABOVE THE CODE” STANDARD FOR SUSTAINABLE BUILDINGS.

For many years, the energy provisions of the I-Codes have offered a variety of design paths to achieve code-compliant energy efficiency. These paths include both prescriptive approaches involving specific thermal performance criteria for various commercial building components as well as performance approaches involving total building energy analysis. In addition, the 2015 I-Codes allow the use of ASHRAE 90.1-2013 (Energy Standard for Buildings except Low-Rise Residential Buildings) as an alternative to the IECC and the use of ASHRAE 189.1-2014 (Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings) as an alternative to the energy-related sections of the IGCC. Although the net result of these alternative paths is considered to be beneficial by some energy experts, the variety of options available may be confusing to the non-expert.

This potential for confusion may be especially significant within the prescriptive requirements in the IECC and IgCC in regard to building envelope components. First, a number of prescriptive thermal values for commercial building envelope insulation identified in the 2015 IECC tables differ from their corresponding values in the alternative ASHRAE 90.1-2013 standard. In addition, both the 2015 IgCC and ASHRAE 189.1-2014 have eliminated prescriptive thermal value tables for roofs and walls, replacing them with general instructions regarding how prescriptive thermal values should be increased for application to sustainable buildings.

For the building designer working on large new construction projects, the uncertainty in prescriptive values may not be significant since the majority of new commercial buildings are designed using performance-based tools. However, for the building designer working on smaller buildings or with roof and wall retrofits, this uncertainty may make it very difficult to determine exactly what thermal value is required for building envelope components, especially roof and wall insulation.

/ INTRODUCTION: THE GUIDE /

PURPOSE OF THE GUIDE.

In an effort to provide assistance to the building designer, this guide provides detailed and focused information regarding the prescriptive commercial wall and roof energy requirements of the 2015 I-Codes. Specifically, the guide provides information regarding the prescriptive requirements in the 2015 IECC and 2015 IgCC, presenting this information in simple and straightforward roof and wall R-value tables covering the most common forms of commercial opaque roof and wall construction. In addition, the guide provides R-value tables and other thermal information for the most recent versions of ASHRAE 90.1 and ASHRAE 189.1, which are recognized as alternative prescriptive paths within the IECC and IgCC, respectively.

SPECIAL NOTE

In an effort to provide conciseness and clarity to the discussion and table minimum requirements included in this Guide, the terms 2015 IECC, 2015 International Energy Conservation Code and [2015] I-Codes are frequently used. Please note that all references to the 2015 IECC apply specifically to the Commercial Provisions or 2015 IECC-CE Section and all references to the I-Codes apply to the IECC-CE Section of the 2015 IECC and the 2015 IgCC.

USING THE GUIDE.

In order to identify the appropriate prescriptive thermal value for a roof or wall assembly, the following steps should be used:

1. **Identify the type of roof or wall assembly.** This guide provides information for five of the most common roof and wall assemblies within ASHRAE and the I-Codes:
 - a. Roofs with Insulation Entirely above Deck
 - b. Attics and Other Roofs
 - c. Metal (Steel) Framed Walls
 - d. Wood Framed Walls
 - e. Mass Walls

It should be noted that several types of roofs and walls defined in the I-Codes are not included in this guide. These include Metal Building Roofs and Walls and Below-Grade Walls.

2. **Identify the Climate Zone.** Prescriptive thermal requirements in the I-Codes are provided for seven climate zones in the United States and Canada, as currently identified in ASHRAE 90.1-2013 and the 2015 IECC. In addition, some of these zones are further classified into sub-zones based on differences in humidity and solar intensity. In the case of the charts provided in this guide, the only relevant sub-zone is "Zone 4 Marine," which includes selected counties in northern California, Oregon, and Washington. In this sub-zone, thermal requirements for Attics and Other Roofs and Wood Framed Walls exceed the thermal requirements for non-marine locations in this zone. The Pacific Northwest National Laboratory of the U. S. Department of Energy maintains an interactive web-based county-by-county map of all ASHRAE / IECC climate zones. Simply use the following link and select your state and county to determine your climate zone: <http://energycode.pnl.gov/EnergyCodeReqs/index.jsp>

3. **Check the Building Occupancy.** In most cases, prescriptive thermal requirements in the I-Codes are identical for all types of commercial occupancies. However, prescriptive thermal requirements for walls of commercial buildings containing Group R (residential) occupancies are higher in several climate zones, and such differences are highlighted in footnotes to the tables as applicable.

LIMITATIONS OF THE GUIDE.

- **Prescriptive Design Path.** Because this guide focuses specifically on the prescriptive energy design paths within the I-Codes and ASHRAE standards, the guide does not address the more complex performance paths available to building designers which may allow significant differences and trade-offs in the energy efficiency of specific building components.
- **Conditioned Buildings.** This guide provides prescriptive design information only for conditioned buildings. For semi-heated buildings and semi-heated portions of buildings, please refer directly to the relevant I-Code or ASHRAE document.
- **Other Code Requirements.** Because this guide is intended to provide assistance only in regard to the thermal design of building roofs and walls, no guidance is provided in regard to many other important design requirements within the I-Codes, including but not limited to structural design, fire classification, weather protection and materials. Accordingly, the building designer using this guide should also consult other sources, including the I-Codes themselves, in order to determine and verify overall design compliance.

A SPECIAL NOTE ON IGCC / ASHRAE 189.1 PRESCRIPTIVE R-VALUES.

This guide applies a methodology to the thermal value requirements of the 2015 IgCC and ASHRAE 189.1-2014 that requires a separate calculation to arrive at the roof and wall R-values shown in the guide tables. In the case of roof R-values, the methodology used in this guide starts with the prescriptive U-factor for the type of roofing assembly and climate zone as shown in relevant IECC or ASHRAE 90.1 U-value tables, reduces this value by 5 percent, and then converts this resultant U-value into a corresponding R-value in accordance with instructions contained in ASHRAE 90.1-2013 Normative Appendix A (Rated R-Value of Insulation and Assembly U-Factor, C-Factor and F-Factor Determinations). In the case of wall R-values, the methodology used in this guide is more complicated because two separate R-values may be provided in the relevant IECC and ASHRAE 90.1 tables: one for the insulation installed within the framed wall cavity, and one for the insulation installed continuously on the exterior side of the wall framing. Because addition of insulation within the wall cavity may be difficult (current R-values in the IECC and ASHRAE 90.1 assume the wall cavity is filled with the maximum allowable thickness of typical glass fiber batt insulation.), the 5 percent incremental reduction in assembly U-factor is applied only to the continuous insulation portion of the wall assembly.

A SPECIAL NOTE ON REROOFING OF EXISTING BUILDINGS.

Although the IECC was initially developed to establish energy performance requirements for new construction projects, the code has increasingly been adapted to cover existing buildings as well. This increased focus of the IECC on existing buildings is especially important for commercial roofing, where over 75 percent of all commercial roof projects are installed on existing buildings. First, in recognition of the fact that commercial roofing installations may involve different approaches to assure a water-tight roofing enclosure over an existing building, the IECC now specifically defines three distinct types of roofing activity that may occur on existing buildings:

Roof Recover: The process of installing an additional roof covering over a prepared existing roof covering without removal of the existing roof covering.

Roof Repair: Reconstruction or renewal of any part of an existing roof for maintenance purposes.

Roof Replacement: The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

In the case of roof recover and roof repair, the insulation requirements shown in this guide are not required by the IECC. However, most recent versions of the IECC essentially have required that all roof replacements meet the insulation requirements of the code, and the 2015 IECC has added specific language to assure that roof replacements involving insulation entirely above the deck (see page 8 of this Guide) shall comply with the insulation requirements of the code:

“Roof Replacement. For roof replacements, where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above deck, roof replacement shall include compliance with the requirements of Table C402.1.2 (Opaque Thermal Envelope Assembly Requirements) or Table C402.2 (Opaque Thermal Envelope Requirements).” (2015 IECC Section C402.2.1.1)

/ INTRODUCTION: ABOUT IMT, PIMA, AND THE CENTER /

ABOUT IMT. The Institute for Market Transformation (IMT), founded in 1996, is a Washington, DC-based nonprofit organization promoting energy efficiency, green building, and environmental protection in the United States and abroad. The prevailing focus of IMT's work is energy efficiency in buildings. Its activities include technical and market research, policy and program development, and promotion of best practices and knowledge exchange. All of IMT's work involves many collaborators and targets a broad range of stakeholders in both the public and private sectors.

In particular, IMT aims to strengthen market recognition of the link between buildings' energy efficiency and their financial value. IMT's efforts lead to important new policy outcomes, widespread changes in practice, and, ultimately, lasting market shifts toward greater energy efficiency, with substantial benefits for the economy and the environment.

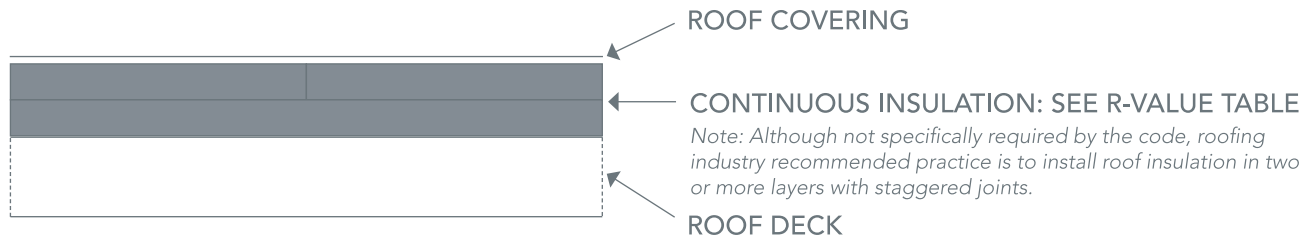
ABOUT PIMA. The Polyisocyanurate Insulation Manufacturers Association (PIMA) is the national trade association that represents polyiso insulation manufacturers and suppliers to the polyiso industry. PIMA advances the use of polyiso insulation and is one of the nation's foremost industry advocates for energy-efficient practices and policies and had been recognized by both the Environmental Protection Agency (EPA) and the Sustainable Building Industries Council for advocacy and products that contribute to this country's efforts to both promote energy efficiency and combat global warming.

ABOUT CEIR. The Center for Environmental Innovation in Roofing (CEIR) serves as a forum for the common causes of the roofing industry and promotes the roofing knowledge base and the development and use of environmentally responsible, high performance roof systems.

DISCLAIMER

This guide is offered for the sole purpose of providing general, non-expert information regarding the prescriptive insulation requirements of the 2015-Codes and ASHRAE building energy standards. The publishers of this guide disclaim any liability under any theory of law for the information contained in this guide, its accuracy, and its suitability for application to roof and wall assemblies for any given building project in any code jurisdiction. The information provided in this guide should not be construed to represent aesthetics or other attributes not specifically addressed, nor should it be construed as an endorsement of the information in this guide or a recommendation for its use. Readers of this guide should consult with local building code authorities before applying information in this guide to any building design or project.

/ ROOFS WITH INSULATION ENTIRELY ABOVE DECK: I-CODE AND ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) / ASHRAE 90.1-2013 ¹	2015 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) / ASHRAE 189.1-2014 ²
1	20.0 ³	26.0
2	25.0	26.0
3	25.0	26.0
4	30.0	32.0
5	30.0	32.0
6	30.0	32.0
7	35.0	37.0
8	35.0	37.0

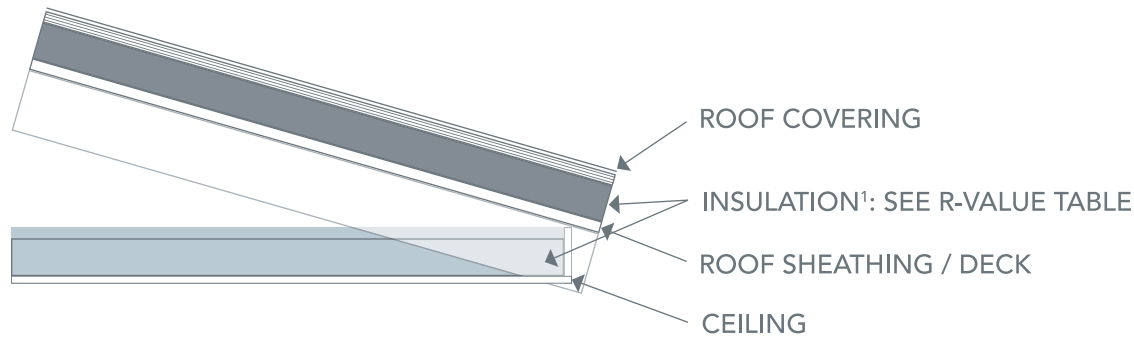
NOTES TO THE TABLE:

1. R-value as shown in 2015 IECC Table C402.1.3 and ASHRAE 90.1-2013 Tables 5.5.1-7 by climate zone for roofs with insulation entirely above deck.
2. Values shown are calculated by reducing the overall roof assembly U-factor in 2012 IECC Table C402.1.2 and ASHRAE Tables 5.5.1-7 for roofs with insulation entirely above deck by 5% per 2015 IGCC Section 605.1.1 / ASHRAE 189.1-2014 Section 7.4.2.1 and converting the assembly U-factor to the corresponding R-value using ASHRAE 90.1 Normative Appendix A. Resultant R-values are rounded to nearest 1.0 R.
3. R-value for Group R occupancies in Zone 1 is 25.0

OTHER DESIGN NOTES:

4. New Construction and Re-Roofing. The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings except for roof recovers. See 2015 IECC Section C503.1 and ASHRAE 90.1-2013 Section 5.1.3 for additional information.
5. Cool Roof Coverings. Roof coverings on low-slope (less than 2 in 12 slope) buildings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See 2015 IECC Section C402.2.1.1 and ASHRAE 90.1-2013 Section 5.5.3.1 for additional information.
6. Roof Air Barrier. As part of the building envelope, roof assemblies shall incorporate a continuous air barrier. See 2015 IECC Section C402.5.1 and ASHRAE 90.1-2013 Section 5.4.3.1 for additional information.

/ ATTICS AND OTHER ROOFS: I-CODE AND ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) / ASHRAE 90.1-2013 ¹	2015 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) / ASHRAE 189.1-2014 ²
1	38.0	41.0
2	38.0	41.0
3	38.0	41.0
4	38.0 ³	41.0 ⁴
5	38.0 ³	41.0 ⁴
6	49.0	52.0
7 & 8 (I-Codes)	49.0	52.0
7 & 8 (ASHRAE)	60.0	64.0

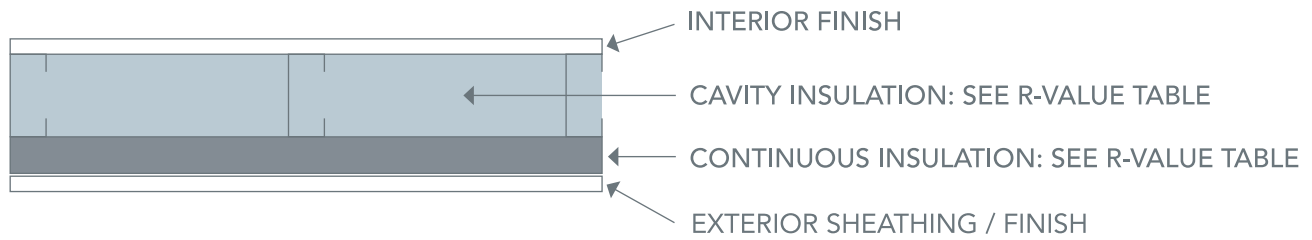
NOTES TO THE TABLE:

1. R-value as shown in 2015 IECC Table C402.1.3 and ASHRAE 90.1-2013 Tables 5.5.1-7 by climate zone for roofs with insulation installed both inside and outside the roof or entirely inside the roof cavity. However, placement of insulation in both the attic space and above the roof deck may require additional investigation of air and moisture drive within the attic space to assure that moisture is not allowed to condense within the attic space.
2. Values shown are calculated by reducing the overall roof assembly U-factor in 2012 IECC Table C402.1.2 and ASHRAE Tables 5.5.1-7 for roofs with insulation installed both inside and outside the roof or entirely inside the roof cavity by 5% per 2015 IgCC Section 605.1.1 / ASHRAE 189.1-2014 Section 7.4.2.1 and converting the assembly U-factor to the corresponding R-value using ASHRAE 90.1 Normative Appendix A. Resultant R-values are rounded to nearest 1.0 R. Please note that resultant R-value will be slightly lower for attic roofs with advanced wood framing and slightly higher for single-rafter roofs and attic roofs with steel joists.
3. R-value for Group R occupancies in Zone 5 and all occupancies in "Marine 4" locations (selected counties in northern California, Oregon, and Washington) is 49.0.
4. R-value for "Marine 4" locations (selected counties in northern California, Oregon, and Washington) is 52.0.

OTHER DESIGN NOTES:

5. New Construction and Re-Roofing. The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings except for roof recovers. See 2015 IECC Section C503.1 and ASHRAE 90.1-2013 Section 5.1.3 for additional information.
6. Cool Roof Coverings. Roof coverings on low-slope (less than 2 in 12 slope) buildings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See 2015 IECC Section C402.2.1.1 and ASHRAE 90.1-2013 Section 5.5.3.1 for additional information.
7. Roof Air Barrier. As part of the building envelope, roof assemblies shall incorporate a continuous air barrier. See 2015 IECC Section C402.5.1 and ASHRAE 90.1-2013 Section 5.4.3.1 for additional information.

/ METAL FRAMED WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²			2015 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³		
	Cavity ¹	+	Continuous	Cavity ¹	+	Continuous
1	13.0	+	5.0	13.0	+	6.0
2	13.0	+	5.0 ⁴	13.0	+	6.0 ⁵
3	13.0	+	7.5	13.0	+	9.0
4	13.0	+	7.5	13.0	+	9.0
5	13.0	+	7.5	13.0	+	9.0
6	13.0	+	7.5	13.0	+	9.0
7	13.0	+	7.5 ⁶	13.0	+	9.0 ⁷
8	13.0	+	7.5 ⁸	13.0	+	9.0 ⁹

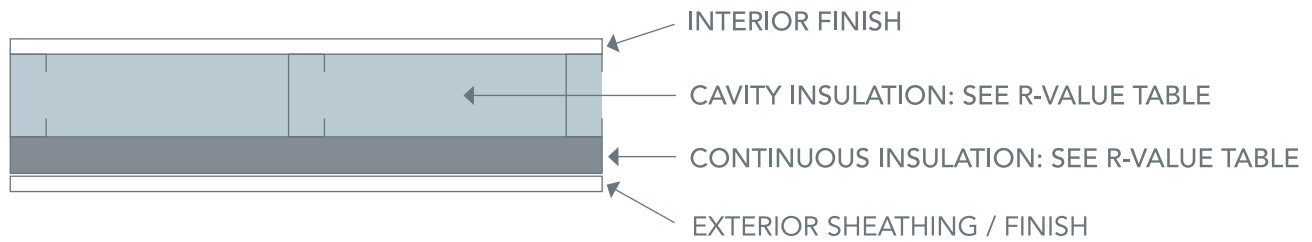
NOTES TO THE TABLE:

- Assumes 3 1/2" (R-13) metal studs spaced 16" on center.
- R-value as shown in 2015 IECC Table C402.1.3 for metal framed walls.
- R-value is derived by reducing the U-value in 2012 IECC Table C402.1.4 for metal framed walls by 5% per 2015 IGCC Section 605.1.1, converting the resultant U-value to the corresponding R-value interpolated using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
- Continuous insulation R-value for Group R occupancies in Zone 2 is 7.5.
- Continuous insulation R-value for Group R occupancies in Zone 2 is 9.0.
- Continuous insulation R-value for Group R occupancies in Zone 7 is 16.0.
- Continuous insulation R-value for Group R occupancies in Zone 7 is 18.0.
- Continuous insulation R-value for Group R occupancies in Zones 8 is 17.5.
- Continuous insulation R-value for Group R occupancies in Zone 8 is 20.0.

OTHER DESIGN NOTES:

- Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See 2015 IECC Section C402.5.1 for additional information.

/ METAL FRAMED WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	ASHRAE 90.1-2013 ²			ASHRAE 189.1-2014 ³		
	CAVITY ¹	+	CONTINUOUS	Cavity ¹	+	Continuous
1	13.0	+	n/a	13.0	+	1.0
2	13.0	+	3.8 ⁴	13.0	+	5.0 ⁵
3	13.0	+	5.0 ⁴	13.0	+	6.0
4	13.0	+	7.5	13.0	+	9.0
5	13.0	+	10.0	13.0	+	11.0
6	13.0	+	12.5	13.0	+	14.0
7	13.0	+	12.5 ⁶	13.0	+	14.0 ⁷
8	13.0	+	18.8	13.0	+	21.0

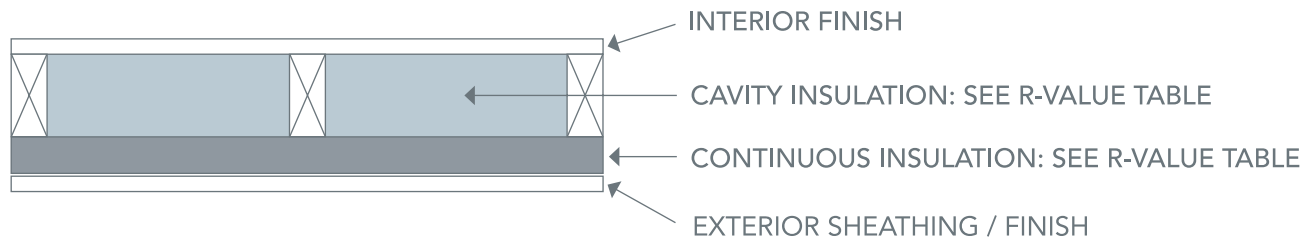
NOTES TO THE TABLE:

- Assumes 3 1/2" (R-13) metal studs spaced 16" on center.
- R-value as shown in ASHRAE 90.1-2013 Tables 5.5.1-7 for metal framed walls.
- R-value is derived by reducing the U-value in ASHRAE 90.1-2013 Tables 5.5.1-7 for metal framed walls by 5% per ASHRAE 189.1-2014 Section 7.4.2.1, converting the resultant U-value to the corresponding R-value using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
- Continuous insulation R-value for Group R occupancies in Zones 2 and 3 is 7.5.
- Continuous insulation R-value for Group R occupancies in Zones 2 and 3 is 9.0.
- Continuous insulation R-value for Group R occupancies in Zone 7 is 15.6.
- Continuous insulation R-value for Group R occupancies in Zone 7 is 17.0.

OTHER DESIGN NOTES:

- Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See ASHRAE 90.1-2013 Section 5.4.3.1 for additional information.

/ WOOD FRAMED WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE ¹	OPAQUE R-VALUE REQUIREMENT					
	2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²			2015 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³		
	Cavity ¹	+	Continuous	Cavity ¹	+	Continuous
1 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
1 (2X6 Walls)	20.0	+	n/a	20.0	+	1.0
2 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
2 (2X6 Walls)	20.0	+	n/a	20.0	+	1.0
3 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
3 (2X6 Walls)	20.0	+	n/a	20.0	+	1.0
4 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
4 (2X6 Walls)	20.0	+	n/a	20.0	+	1.0
5 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
5 (2X6 Walls)	20.0	+	n/a ⁴	20.0	+	1.0
6 (2X4 Walls)	13.0	+	7.5	13.0	+	5.0
6 (2X6 Walls)	20.0	+	3.8	20.0	+	1.0
7 (2X4 Walls)	13.0	+	7.5	13.0	+	5.0
7 (2X6 Walls)	20.0	+	3.8	20.0	+	1.0
8 (2X4 Walls)	13.0	+	15.6	13.0	+	5.0
8 (2X6 Walls)	20.0	+	10.0	20.0	+	1.0

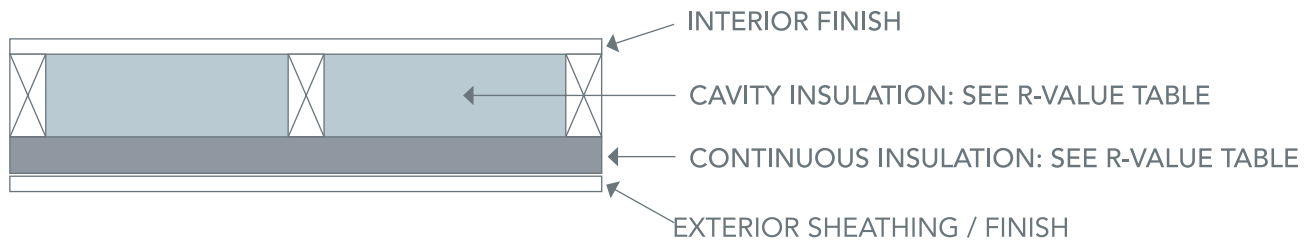
NOTES TO THE TABLE:

- Assumes 3 1/2" (R-13) or 5 1/2" (R-20) wood studs spaced 16" on center.
- R-value as shown in 2015 IECC Table C402.1.3 for wood framed walls.
- R-value derived by reducing the U-value in 2015 IECC Table C402.1.4 for wood framed walls by 5% per 2015 IGCC Section 605.1.1, converting the resultant U-value to the corresponding R-value using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
- Continuous insulation R-value for Group R occupancies in Zone 5 is 3.8.
- Continuous insulation R-value for Group R occupancies in Zone 5 is 5.0.

OTHER DESIGN NOTES:

- Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See 2015 IECC Section C402.5.1.1 for additional information.

/ WOOD FRAMED WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE ¹	OPAQUE R-VALUE REQUIREMENT					
	ASHRAE 90.1-2013 ^{2,4}			ASHRAE 189.1-2014 ³		
	Cavity ¹	+	Continuous	Cavity ¹	+	Continuous
1 (2X4 Walls)	13.0	+	n/a	13.0	+	1.0
1 (2X6 Walls)	n/a	+	n/a	n/a	+	n/a
2 (2X4 Walls)	13.0	+	n/a	13.0	+	1.0
2 (2X6 Walls)	n/a	+	n/a	n/a	+	n/a
3 (2X4 Walls)	13.0	+	n/a ⁴	13.0	+	1.0 ⁵
3 (2X6 Walls)	n/a ⁶	+	n/a ⁶	n/a ⁷	+	n/a ⁷
4 (2X4 Walls)	13.0	+	3.8	13.0	+	5.0
4 (2X6 Walls)	20.0	+	n/a	20.0	+	1.0
5 (2X4 Walls)	13.0	+	7.5	13.0	+	9.0
5 (2X6 Walls)	19.0	+	5.0	19.0	+	6.0
6 (2X4 Walls)	13.0	+	7.5	13.0	+	9.0
6 (2X6 Walls)	19.0	+	5.0	19.0	+	6.0
7 (2X4 Walls)	13.0	+	7.5	13.0	+	9.0
7 (2X6 Walls)	19.0	+	5.0	19.0	+	5.0
8 (2X4 Walls)	13.0	+	18.8	13.0	+	20.0
8 (2X6 Walls)	n/a	+	n/a	20.0	+	n/a

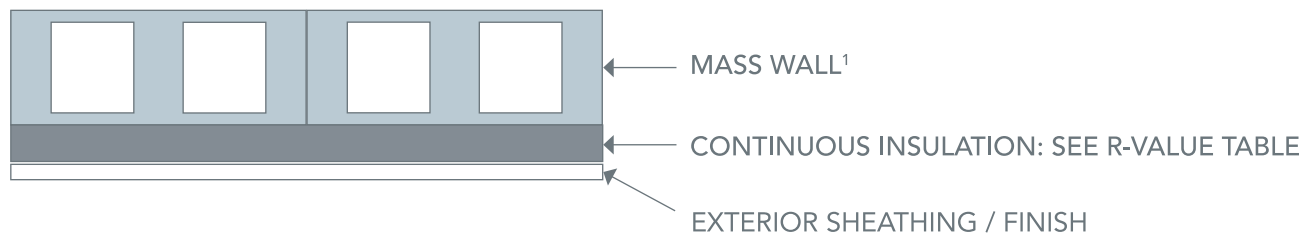
NOTES TO THE TABLE:

- Assumes 3 1/2" (R-13) or 5 1/2" (R-19 or R-20) wood studs spaced 16" on center.
- R-value as shown in ASHRAE 90.1-2013 Tables 5.5.1-7 for wood framed walls.
- R-value is derived by reducing the U-value in ASHRAE 90.1-2013 Tables 5.5.1-7 for wood framed walls by 5% per ASHRAE 189.1-2014 Section 7.4.2.1, converting the resultant U-value to the corresponding R-value using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
- Continuous insulation R-value for Group R occupancies in Zone 3 is 3.8.
- Continuous insulation R-value for Group R occupancies in Zone 3 is 5.0.
- Cavity + continuous insulation R-value for Group R occupancies in Zone 3 is 20.0 + n/a.
- Cavity + continuous insulation R-value for Group R occupancies in Zone 3 is 20.0 + 1.0.

OTHER DESIGN NOTES:

- Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See ASHRAE 90.1-2013 Section 5.4.3.1 for additional information.

/ MASS WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²	2015 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³
	Continuous Insulation	Continuous Insulation
1	5.7	6.0
2	5.7	6.0
3	7.6 ⁴	8.0 ⁵
4	9.5 ⁶	10.0 ⁷
5	11.4 ⁸	12.0 ⁹
6	13.3 ¹⁰	14.0 ¹¹
7	15.2	16.0
8	25.0	26.0

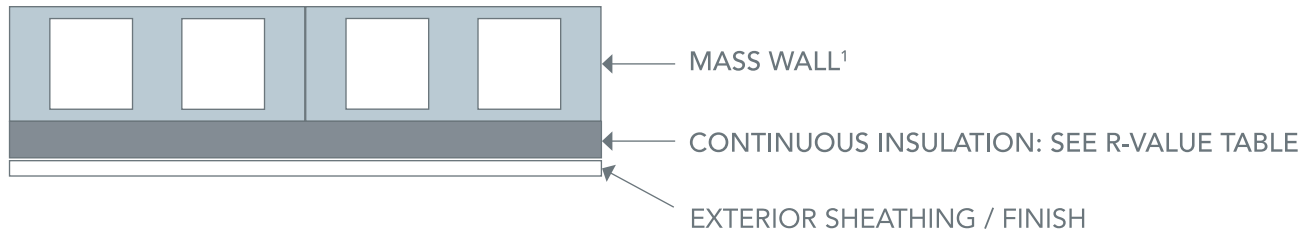
NOTES TO THE TABLE:

1. Mass wall assumed to be 8" medium-weight, solid grouted concrete block and continuous insulation assumed to be uninterrupted by framing. See Table A3.1A Assembly U Factors for Above-Grade Concrete and Masonry Walls, Normative Appendix A, ASHRAE 90.1-2013. Other types of concrete and masonry mass wall assemblies will have different opaque R-value requirements.
2. R-value as shown in 2015 IECC Table C402.1.3 for mass walls.
3. R-value derived by reducing the U-value in 2015 IECC Table C402.1.4 for mass walls by 5% per 2015 IGCC Section 605.1.1, converting the resultant U-value to the corresponding R-value interpolated using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
4. Continuous insulation R-value for Group R occupancies in Zone 3 is 9.5.
5. Continuous insulation R-value for Group R occupancies in Zone 3 is 10.0.
6. Continuous insulation R-value for all occupancies for "Marine 4" locations (selected counties in northern California, Oregon and Washington) as well as all Group R occupancies in Zone 4 is 13.3.
7. Continuous insulation R-value for all occupancies for "Marine 4" locations (selected counties in northern California, Oregon and Washington) as well as all Group R occupancies in Zone 4 is 14.0.
8. Continuous insulation R-value for Group R occupancies in Zone 5 is 13.3.
9. Continuous insulation R-value for Group R occupancies in Zone 5 is 14.0.
10. Continuous insulation R-value for Group R occupancies in Zone 6 is 15.2.
11. Continuous insulation R-value for Group R occupancies in Zone 6 is 16.0.

OTHER DESIGN NOTES:

12. **Wall Air Barrier.** As part of the building envelope, wall assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See 2015 IECC Section C402.4.1.2 for additional information.

/ MASS WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	ASHRAE 90.1-2013 ²	ASHRAE 189.1-2014 ³
	Continuous Insulation	Continuous Insulation
1	n/a ⁴	1.0 ⁵
2	5.7 ⁶	6.0 ⁷
3	7.6 ⁸	8.0 ⁹
4	9.5 ¹⁰	10.0 ¹¹
5	11.4 ¹²	12.0 ¹³
6	13.3 ¹⁴	14.0 ¹⁵
7	15.2	16.0
8	19.0	20.0

NOTES TO THE TABLE:

1. Mass wall assumed to be 8" medium-weight, solid grouted concrete block and continuous insulation assumed to be uninterrupted by framing. See Table A3.1A Assembly U Factors for Above-Grade Concrete and Masonry Walls, Normative Appendix A, ASHRAE 90.1-2010. Other types of concrete and masonry mass wall assemblies may have different opaque R-value requirements.
2. R-value as shown in ASHRAE 90.1-2013 Tables 5.5.1-7 for mass walls.
3. R-value is derived by reducing the U-value in ASHRAE 90.1-2013 Tables 5.5.1-7 for wood framed walls by 5% per ASHRAE 189.1-2014 Section 7.4.2.1, converting the resultant U-value to the corresponding R-value using ASHRAE 90.1 Normative Appendix A, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 1.0 R.
4. Continuous insulation R-value for Group R occupancies in Zone 1 is 5.7.
5. Continuous insulation R-value for Group R occupancies in Zone 1 is 6.0.
6. Continuous insulation R-value for Group R occupancies in Zone 2 is 7.6.
7. Continuous insulation R-value for Group R occupancies in Zone 2 is 8.0.
8. Continuous insulation R-value for Group R occupancies in Zone 3 is 9.5.
9. Continuous insulation R-value for Group R occupancies in Zone 3 is 10.0.
10. Continuous insulation R-value for Group R occupancies in Zone 4 is 11.4.
11. Continuous insulation R-value for Group R occupancies in Zone 4 is 12.0.
12. Continuous insulation R-value for Group R occupancies in Zone 5 is 12.3.
13. Continuous insulation R-value for Group R occupancies in Zone 5 is 13.0.
14. Continuous insulation R-value for Group R occupancies in Zone 6 is 15.2.
15. Continuous insulation R-value for Group R occupancies in Zone 6 is 16.0.

OTHER DESIGN NOTES:

16. **Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See ASHRAE 90.1-2010 Section 5.4.3.1 for additional information.

DISCLAIMER

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