

ROOF AND WALL THERMAL DESIGN GUIDE

APPLYING THE PRESCRIPTIVE INSULATION STANDARDS OF THE 2012 I-CODES



/ TABLE OF CONTENTS /

INTRODUCTION	5
THE GUIDE	6
NORTH AMERICAN CLIMATE ZONES	8
ABOUT THE CENTER AND PIMA	9
ROOFS WITH INSULATION ENTIRELY ABOVE DECK	
I-CODE REQUIREMENTS	11
ASHRAE REQUIREMENTS	12
ATTICS AND OTHER ROOFS	
I-CODE REQUIREMENTS	14
ASHRAE REQUIREMENTS	15
METAL FRAMED WALLS	
I-CODE REQUIREMENTS	17
ASHRAE REQUIREMENTS	18
WOOD FRAMED WALLS	
I-CODE REQUIREMENTS	20
ASHRAE REQUIREMENTS	21
MASS WALLS	
I-CODE REQUIREMENTS	23
ASHRAE REQUIREMENTS	24

/ 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 2012 EDITION OF THE I-CODES INCLUDES SEVERAL LANDMARK ADVANCES TO SIGNIFICANTLY INCREASE ENERGY EFFICIENCY IN BUILDINGS. FIRST, THE 2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) INCLUDES NEW AND HIGHER STANDARDS FOR ALMOST EVERY COMPONENT IN THE BUILDING ENVELOPE, INCLUDING ROOF AND WALL INSULATION. 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 requirements for various building components as well as performance approaches involving total building energy analysis. In addition, the I-Codes allow the use of ASHRAE 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings) as an alternative to the IECC and the use of ASHRAE 189.1 (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 energy experts, the variety of options available may at times be confusing to the non-expert.

This potential for confusion may be especially significant within the prescriptive requirements in the 2012 IECC and 2012 IgCC in regard to building envelope components. Not only do the prescriptive thermal values for roof and wall insulation identified in the 2012 IECC tables differ from the corresponding values in the corresponding ASHRAE 90.1 standard, but the 2012 IgCC completely eliminates thermal value tables and replaces them with general instructions regarding how the thermal values in the IECC should be increased. 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 for the building designer, concerned building envelope organizations including the Polyisocyanurate Insulation Manufacturers Association and the Center for Environmental Innovation in Roofing have developed this guide to the prescriptive wall and roof energy requirements of the 2012 I-Codes. Specifically, the guide provides information regarding the prescriptive thermal value tables in the 2012 IECC (Tables C402.2 and C402.1.2) and the references to these tables in the 2012 IgCC (Section 606.1.1) and translates this information into 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 information regarding the prescriptive thermal value tables in the most recent ASHRAE standards (ASHRAE 90.1-2010 and ASHRAE 189.1-2009) which are recognized as alternative prescriptive paths by the IECC and IgCC, respectively.

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

Note: 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 eight climate zones in the United States and Canada, as currently identified in ASHRAE 90.1-2010 and the 2012 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.

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 PRESCRIPTIVE R-VALUES.

This guide applies a methodology of interpretation to the thermal value requirements of the 2012 IgCC that requires a relatively complex calculation to arrive at the roof and wall R-values shown in the guide tables. The reason for this methodology is contained within the language of the 2012 IgCC pertaining to prescriptive thermal values:

“The building thermal envelope shall exceed the requirements of Tables C402.2 and C402.1.2 of the International Energy Conservation Code by not less than 10 percent. Specifically, for purposes of compliance with this code, each U-factor, C-factor, F-factor and SHGC in the specified tables shall be reduced by 10 percent to determine the prescriptive criteria for this code.” (2012 IgCC Section 605.1.1)

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 Table C402.1.2, reduces this value by 10%, and then converts this resultant U-value into a corresponding R-value in accordance with tables and instructions contained in ASHRAE 90.1-2010 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 are provided in the 2012 IECC 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 (The current R-values in the 2012 IECC for wood framed walls are based on the use of typical batt insulation installed in nominal 2x4 or 2x6 framing.), the 10% incremental reduction in assembly U-factor is applied only to the continuous insulation portion of the wall assembly.

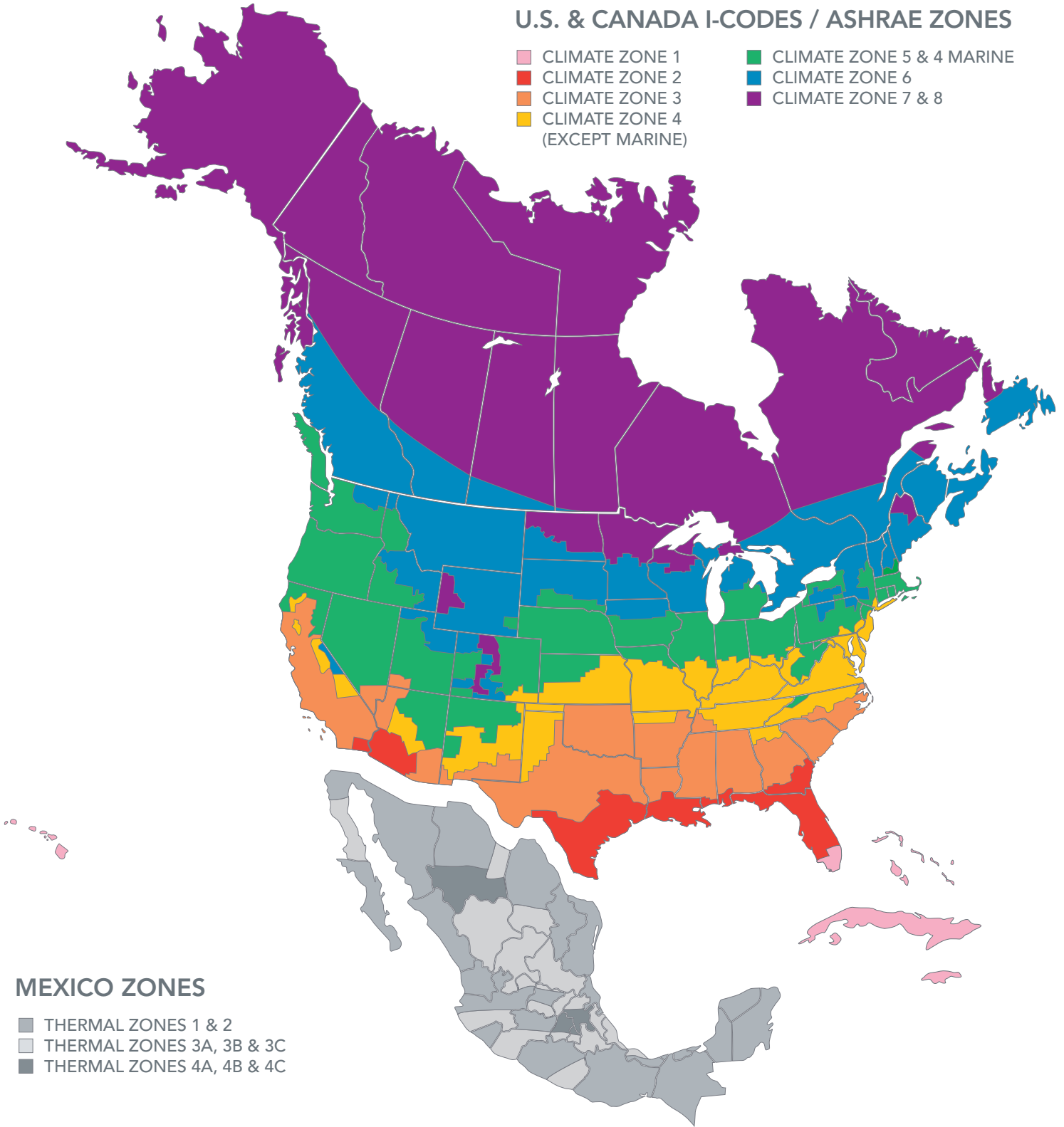
A SPECIAL NOTE ON ASHRAE 90.1 PRESCRIPTIVE R-VALUES.

It should be noted that the current published version of ASHRAE 90.1-2010 does not contain new prescriptive R-value tables for roofs and walls but rather includes the prescriptive R-value tables from the previous version (ASHRAE 90.1-2007). At the time of this publication, ASHRAE has developed new prescriptive R-value tables and the tables have been released for public comment. If and when approved by ASHRAE, the values in the new tables may be higher than the values shown in this edition of the guide.

/ INTRODUCTION: NORTH AMERICAN CLIMATE ZONES /

U.S. & CANADA I-CODES / ASHRAE ZONES

- CLIMATE ZONE 1
- CLIMATE ZONE 2
- CLIMATE ZONE 3
- CLIMATE ZONE 4 (EXCEPT MARINE)
- CLIMATE ZONE 5 & 4 MARINE
- CLIMATE ZONE 6
- CLIMATE ZONE 7 & 8



MEXICO ZONES

- THERMAL ZONES 1 & 2
- THERMAL ZONES 3A, 3B & 3C
- THERMAL ZONES 4A, 4B & 4C

NOTE ON MEXICO ZONES

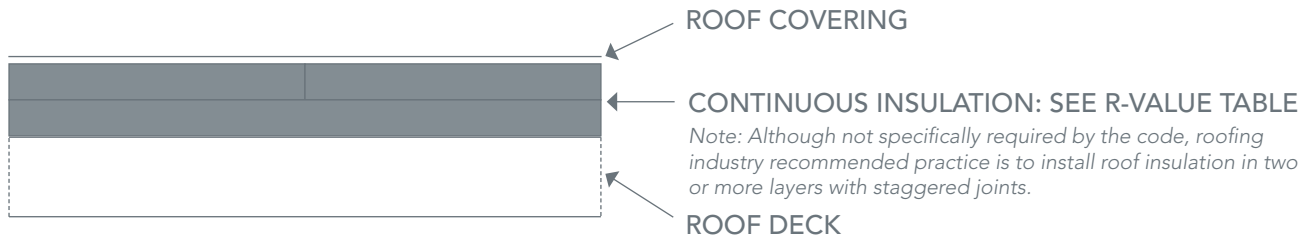
Mexico does not recognize the I-Code/ASHRAE Climate Zones used in the United States and Canada. However, Mexico does recognize multiple thermal zones based on elevation and other climate variances. Information on these climate zones is contained in a document produced by ONNCEE entitled "Building Industry—Insulation—"R" Value for the Housing Envelope by Thermal Zone for Mexican Republic-Specification and Verification." For additional resources, visit www.onnccce.org.mx.

/ INTRODUCTION: ABOUT THE CENTER AND PIMA /

THE CENTER FOR ENVIRONMENTAL INNOVATION IN ROOFING is a not-for-profit 501(c)(6) organization whose mission is to promote the development and use of environmentally responsible, high performance roof systems and technologies. Headquartered in Washington, D.C., the Center serves as a forum to draw together the entire roofing industry to the common cause of raising public awareness of the strategic value of our nation's roofs in reducing energy consumption, mitigating environmental impact and enhancing the quality of the buildings in which we live and work.

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 has been recognized by both the Environmental Protection Agency (EPA) and the Sustainable Building Industries Council for advocacy and products that both contribute to this country's efforts to promote energy efficiency and combat global warming.

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



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ¹	2012 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ²
1	20.0	22.5
2	20.0	22.5
3	20.0	22.5
4	25.0	28.0
5	25.0	28.0
6	30.0	34.0
7	35.0	39.0
8	35.0	39.0

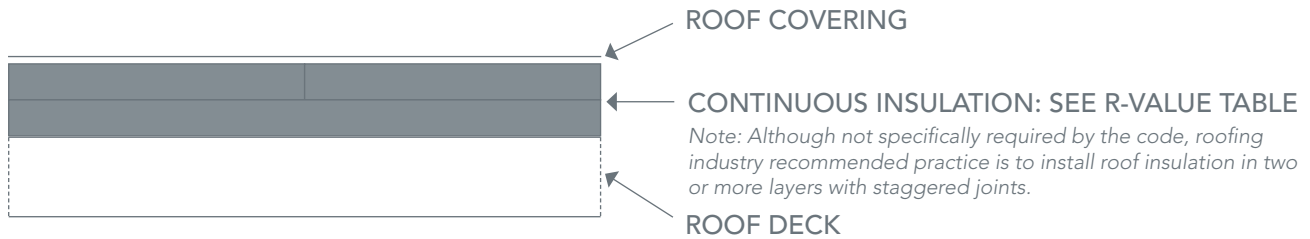
NOTES TO THE TABLE

- R-value as shown in 2012 IECC Table C402.2 by climate zone for “roofs with insulation entirely above deck.”
- For the 2012 IgCC, R-value is determined by reducing the overall roof assembly U-factor in 2012 IECC Table C402.1.2 for “roofs with insulation entirely above deck” by 10% per 2012 IgCC Section 605.1.1 and converting the assembly U-factor to the corresponding insulation R-value shown in Table A.2.2, Assembly U Factors for Roofs with Insulation Entirely Above Deck, Normative Appendix A, ASHRAE 90.1-2010. Resultant R-values rounded to nearest 0.5 R.

OTHER DESIGN NOTES

- New Construction and Re-Roofing.** The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings where “the sheathing or insulation is exposed” during reroofing. See 2012 IECC Chapter C101.4.3, Exception 5.
- Cool Roof Coverings.** Roof coverings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See 2012 IECC Section C402.2.1.1 and 2012 IgCC Section 404.3.1 for additional information.
- Roof Air Barrier.** As part of the building envelope, roof assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See 2012 IECC Section C402.4.1.2 and 2012 IgCC Section 606.1.2 for additional information.

/ ROOFS WITH INSULATION ENTIRELY ABOVE DECK: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	ASHRAE 90.1-2010 ¹	ASHRAE 189.1-2009 ²
1	15.0	20.0
2	20.0	25.0
3	20.0	25.0
4	20.0	25.0
5	20.0	25.0
6	20.0	30.0
7	20.0	35.0
8	20.0	35.0

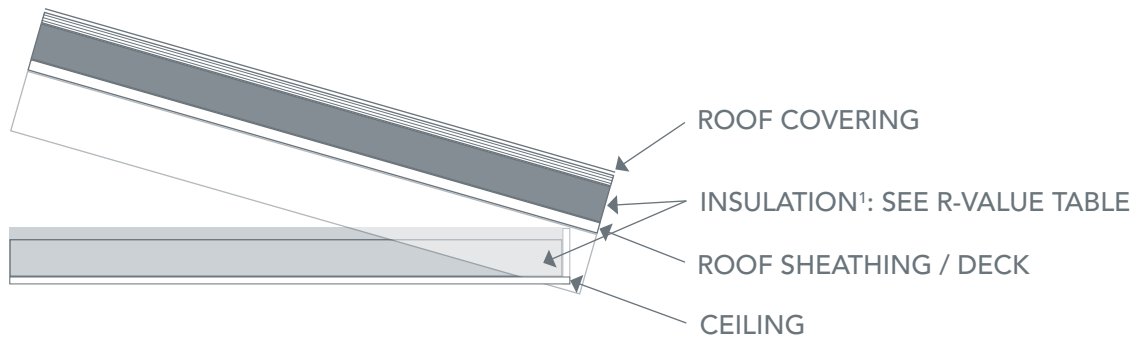
NOTES TO THE TABLE

1. R-value as shown in ASHRAE 90.1-2010 as originally published for roofs with insulation entirely above deck.
2. R-value as shown in ASHRAE 189.1-2009 Appendix A for roofs with insulation entirely above deck.

OTHER DESIGN NOTES

1. **New Construction and Re-Roofing.** The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings where “the sheathing or insulation is exposed” during reroofing. See ASHRAE 90.1-2010 Section 5.1.3, Exception e.
2. **Cool Roof Coverings.** Roof coverings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See ASHRAE 90.1-2010 Section 5.5.3.1.1 for additional information.
3. **Roof Air Barrier.** As part of the building envelope, roof assemblies shall incorporate a continuous air barrier. See ASHRAE 90.1-2010 Section 5.4.3.1 for additional information.

/ ATTICS AND OTHER ROOFS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²	2012 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³
1	38.0	43.5
2	38.0	43.5
3	38.0	43.5
4	38.0	43.5
5	38.0	43.5
6	49.0	54.5
7	49.0	54.5
8	49.0	54.5

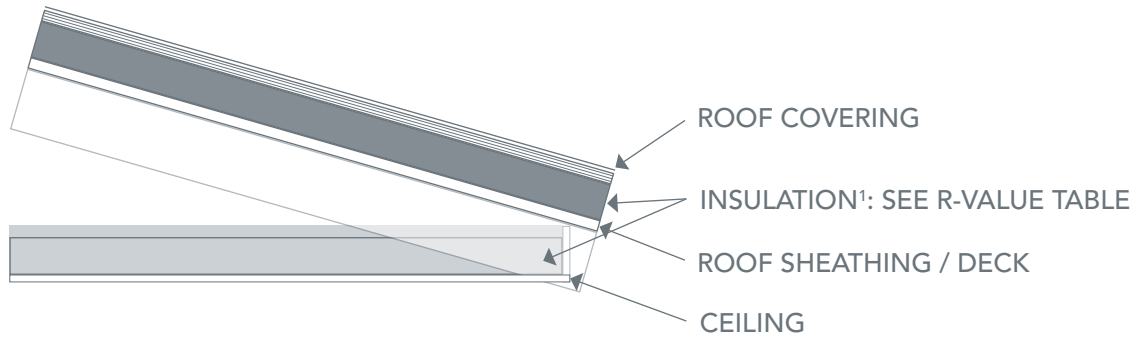
NOTES TO THE TABLE

1. For attics and other roofs, the rated R-value of insulation “is for insulation installed both inside and outside the roof or entirely inside the roof cavity.” (See 2012 IECC Section C402.1.1 and ASHRAE 90.1-2009 Appendix A.) 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 ensure that moisture is not allowed to condense within the attic space.
2. R-value as shown in 2012 IECC Table C402.2.
3. For the 2012 IgCC, R-value is determined by reducing the overall roof assembly U-factor in 2012 IECC Table C402.1.2 for “attic and other roofs” by 10% per 2012 IgCC Section 605.1.1 and converting the assembly U-factor to the corresponding insulation R-value interpolated from Table A.2.4, Assembly U Factors for Attic Roofs with Wood Joists (Standard Framing), Normative Appendix A, ASHRAE 90.1-2010. Resultant R-values rounded to nearest 0.5 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. See ASHRAE 90.1-2010 Normative Appendix A.
4. R-value for “Marine 4” locations (selected counties in northern California, Oregon and Washington) is 49.0.
5. R-value for “Marine 4” locations (selected counties in northern California, Oregon and Washington) is R-54.5.

OTHER DESIGN NOTES

1. **New Construction and Re-Roofing.** The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings where “the sheathing or insulation is exposed” during reroofing. See 2012 IECC Chapter C101.4.3, Exception 5.
2. **Cool Roof Coverings.** Roof coverings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See 2012 IECC Section C402.2.1.1 and 2012 IgCC Section 404.3.1 for additional information.
3. **Roof Air Barrier.** As part of the building envelope, roof assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See 2012 IECC Section C402.4.1.2 for additional information.

/ ATTICS AND OTHER ROOFS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	ASHRAE 90.1-2010 ²	ASHRAE 189.1-2009 ³
1	38.0	38.0
2	38.0	49.0
3	38.0	49.0
4	38.0	49.0
5	38.0	49.0
6	38.0	49.0
7	38.0	60.0
8	49.0	60.0

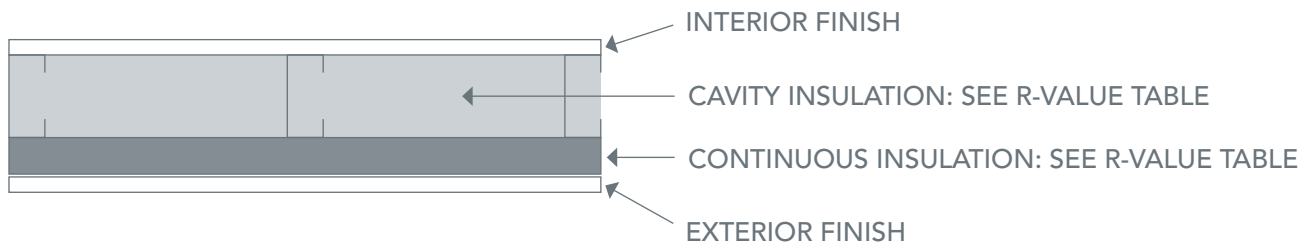
NOTES TO THE TABLE

1. For attics and other roofs, the rated R-value of insulation “is for insulation installed both inside and outside the roof or entirely inside the roof cavity.” (See ASHRAE 90.1-2010 Normative Appendix A.) 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. R-value as shown in ASHRAE 90.1-2010 as originally published for attic and other roofs.
3. R-value as shown in ASHRAE 189.1-2009 Appendix A for attic and other roofs.

OTHER DESIGN NOTES

1. **New Construction and Re-Roofing.** The R-values shown above apply to all new commercial buildings and to the re-roofing of existing buildings where “the sheathing or insulation is exposed” during reroofing. See ASHRAE 90.1-2010 Section 5.1.3, Exception e.
2. **Cool Roof Coverings.** Roof coverings in climate zones 1 through 3 shall meet minimum solar reflectance and emittance requirements. See ASHRAE 90.1-2010 Section 5.5.3.1.1 for additional information.
3. **Roof Air Barrier.** As part of the building envelope, roof assemblies shall incorporate a continuous air barrier. See ASHRAE 90.1-2010 Section 5.4.3.1 for additional information.

/ METAL FRAMED WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²			2012 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³		
	Cavity ¹	+	Continuous ⁴	Cavity ¹	+	Continuous ⁴
1	13.0	+	5.0	13.0	+	6.5
2	13.0	+	5.0	13.0	+	6.5
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	13.0	+	9.0
8	13.0	+	7.5	13.0	+	9.0

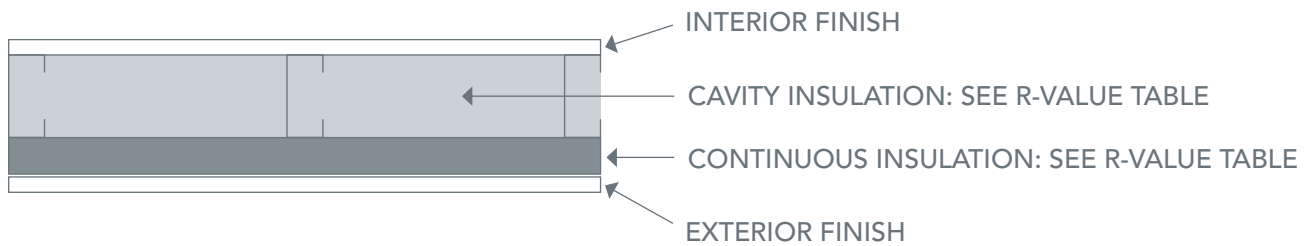
NOTES TO THE TABLE

1. Assumes 3 ½" metal studs spaced 16" on center.
2. R-value as shown in 2012 IECC Table C402.2.
3. For the 2012 IgCC, R-value is derived by reducing the U-value in 2012 IECC Table C402.1.2 for "metal framed walls above grade" by 10% per 2012 IgCC Section 605.1.1, converting the resultant U-value to the corresponding R-value interpolated from Table A.3.3 Assembly U Factors for Steel-Frame Walls, Normative Appendix A, ASHRAE 90.1-2010, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 0.5 R.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases. (See 2012 IECC Tables C402.1.2 and C402.2.)

OTHER DESIGN NOTES

1. **Wall Air Barrier.** As part of the building envelope, wall assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See 2012 IECC Section C402.4.1.2 for additional information.

/ METAL FRAMED WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	ASHRAE 90.1-2010 ²			ASHRAE 189.1-2009 ³		
	Cavity ¹	+	Continuous ⁴	Cavity ¹	+	Continuous ⁴
1	13.0	+	N/A	13.0	+	5.0
2	13.0	+	N/A	13.0	+	5.0
3	13.0	+	N/A	13.0	+	5.0
4	13.0	+	3.8	13.0	+	10.0
5	13.0	+	7.5	13.0	+	10.0
6	13.0	+	7.5	13.0	+	10.0
7	13.0	+	7.5	13.0	+	10.0
8	13.0	+	7.5	13.0	+	10.0

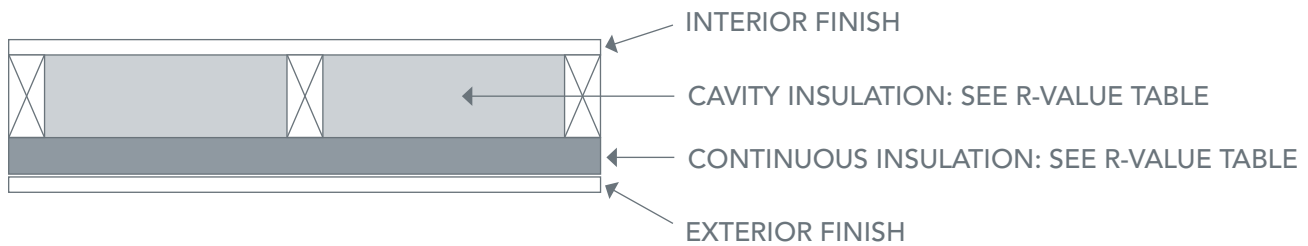
NOTES TO THE TABLE

1. Assumes 3 1/2" metal studs spaced 16" on center.
2. R-value as shown in ASHRAE 90.1-2010 as originally published for steel framed walls.
3. R-value as shown in ASHRAE 189.1-2009 Appendix A for steel framed walls.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases.

OTHER DESIGN NOTES

1. **Wall Air Barrier.** As part of the building envelope, wall assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See Ashrae 90.1-2010 Section 5.4.3.1 for additional information.

/ WOOD FRAMED WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²			2012 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³		
	Cavity ¹	+	Continuous ⁴	Cavity ¹	+	Continuous ⁴
1 (2x4 Walls)	13.0	+	3.8	13.0	+	5.5
1 (2x6 Walls)	20.0	+	N/A	20.0	+	2.0
2 (2x4 Walls)	13.0	+	3.8	13.0	+	5.5
2 (2x6 Walls)	20.0	+	N/A	20.0	+	2.0
3 (2x4 Walls)	13.0	+	3.8	13.0	+	5.5
3 (2x6 Walls)	20.0	+	N/A	20.0	+	2.0
4 (2x4 Walls)	13.0	+	3.8	13.0	+	5.5
4 (2x6 Walls)	20.0	+	N/A	20.0	+	2.0
5 (2x4 Walls)	13.0	+	3.8	13.0	+	5.5
5 (2x6 Walls)	20.0	+	N/A	20.0	+	2.0
6 (2x4 Walls)	13.0	+	7.5	13.0	+	9.5
6 (2x6 Walls)	20.0	+	3.8	20.0	+	5.5
7 (2x4 Walls)	13.0	+	7.5	13.0	+	9.5
7 (2x6 Walls)	20.0	+	3.8	20.0	+	5.5
8 (2x4 Walls)	13.0	+	15.6	13.0	+	19.0
8 (2x6 Walls)	20.0	+	10.0	20.0	+	13.0

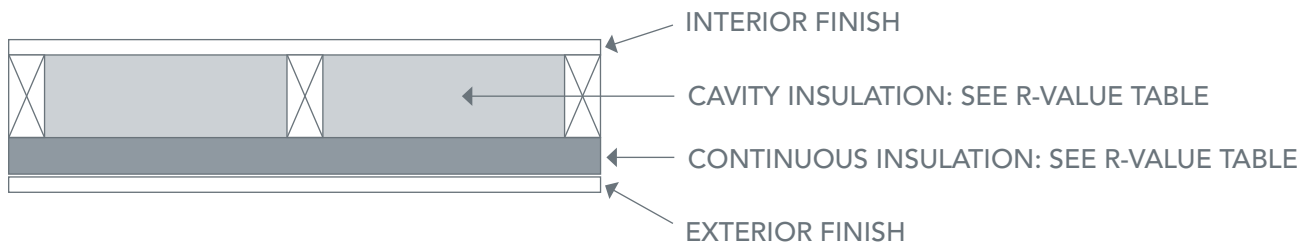
NOTES TO THE TABLE

1. Assumes 3 1/2" (R-13) or 5 1/2" (R-20) wood studs spaced 16" on center.
2. R-value as shown in 2012 IECC Table C402.2.
3. For the 2012 IgCC, R-value is derived by reducing the U-value in 2012 IECC Table C402.1.2 for "wood framed walls above grade" by 10% per 2012 IgCC Section 605.1.1, converting the resultant U-value to the corresponding interpolated R-value per Table A.3.4 Assembly U Factors for Wood-Frame Walls, Normative Appendix A, ASHRAE 90.1-2010, and adding the resultant increase in R-value to the continuous insulation portion of the assembly. Resultant R-values rounded to nearest 0.5 R.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases. (See 2012 IECC Tables C402.1.2 and C402.2).

OTHER DESIGN NOTES

1. **Wall Air Barrier.** As part of the building envelope, wall assemblies shall incorporate a continuous air barrier. See 2012 IECC Section C402.4.1.2 for additional information.

/ WOOD FRAMED WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT					
	ASHRAE 90.1-2010 ^{2,4}			ASHRAE 189.1-2009 ^{3,4}		
	Cavity ¹	+	Continuous	Cavity ¹	+	Continuous
1 (2x4 Walls)	13.0	+	N/A	13.0	+	3.8
1 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
2 (2x4 Walls)	13.0	+	N/A	13.0	+	3.8
2 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
3 (2x4 Walls)	13.0	+	N/A	13.0	+	3.8
3 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
4 (2x4 Walls)	13.0	+	N/A	13.0	+	3.8
4 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
5 (2x4 Walls)	13.0	+	3.8	13.0	+	7.5
5 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
6 (2x4 Walls)	13.0	+	7.5	13.0	+	10.0
6 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
7 (2x4 Walls)	13.0	+	7.5	13.0	+	10.0
7 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A
8 (2x4 Walls)	13.0	+	15.6	13.0	+	10.0
8 (2x6 Walls)	N/A	+	N/A	N/A	+	N/A

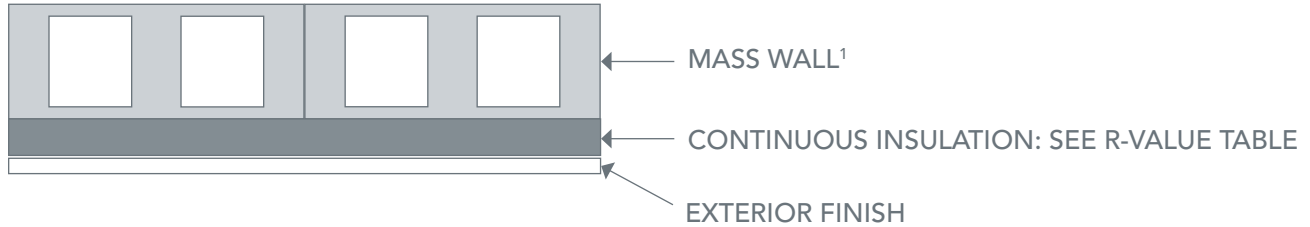
NOTES TO THE TABLE

1. Assumes 3 1/2" (R-13) wood studs spaced 16" on center.
2. R-value as shown in ASHRAE 90.1-2010 as originally published for wood framed walls.
3. R-value as shown in ASHRAE 189.1-2009 Appendix A for wood framed walls.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases.

OTHER DESIGN NOTES

1. **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.

/ MASS WALLS: I-CODE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	2012 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) ²	2012 INTERNATIONAL GREEN CONSTRUCTION CODE (IgCC) ³
	Continuous Insulation ⁴	Continuous Insulation ⁴
1	5.5	6.0
2	5.5	6.0
3	7.5	8.0
4	8.0 ⁵	9.0 ⁶
5	11.5	12.5
6	11.5	12.5
7	15.0	16.0
8	15.0	16.0

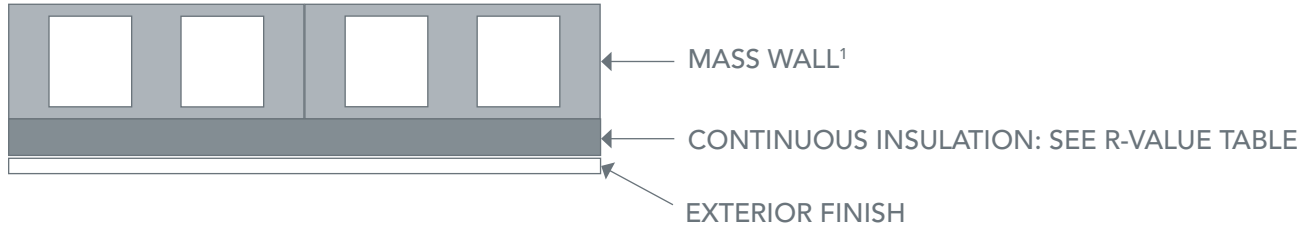
NOTES TO THE TABLE

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 will have different opaque R-value requirements.
2. For the 2012 IECC, continuous insulation R-value is derived by converting the U-value for "mass walls above grade" as shown in 2012 IECC Table C402.1. to the corresponding R-value for "continuous insulation uninterrupted by framing" as shown for ASHRAE 90.1-2010 Table A3.1A (Normative Appendix A) for 8" medium weight solid grouted concrete block walls.
3. For the 2012 IgCC, R-value is derived by reducing the U-value in 2012 IECC Table C402.1.2 for "mass walls above grade" by 10% per 2012 IgCC Section 605.1.1 and converting the resultant U-value to the corresponding interpolated R-value for "continuous insulation uninterrupted by framing" as shown for ASHRAE 90.1-2010 Table A3.1A (Normative Appendix A) for 8" medium weight solid grouted concrete block walls. Resultant R-values rounded to nearest 0.5 R.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases. (See 2012 IECC Tables C402.1.2 and C402.2).
5. R-value for "Marine 4" locations (selected counties in northern California, Oregon and Washington) is 11.5.
6. R-value for "Marine 4" locations (selected counties in northern California, Oregon and Washington) is 12.5.

OTHER DESIGN NOTES

1. **Wall Air Barrier.** As part of the building envelope, wall assemblies in climate zones 4 through 8 shall incorporate a continuous air barrier. See 2012 IECC Section C402.4.1.2 for additional information.

/ MASS WALLS: ASHRAE REQUIREMENTS /



CLIMATE ZONE	OPAQUE R-VALUE REQUIREMENT	
	ASHRAE 90.1-2010 ²	ASHRAE 189.1-2009 ³
	Continuous Insulation ⁴	Continuous Insulation ⁴
1	N/A	5.7
2	5.7	7.6
3	7.6	9.5
4	9.5	11.4
5	11.4	13.3
6	13.3	15.2
7	15.2	20.0
8	15.2	16.0

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 90.1-2010 as originally published for mass walls.
3. R-value as shown in ASHRAE 189.1-2009 Appendix A for mass walls.
4. Nonresidential occupancies only. Continuous insulation R-values for Group R (residential) occupancies are higher in some cases.

OTHER DESIGN NOTES

1. **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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