

TABLE R402.1.2. See below.

❖ Using Table R402.1.2 begins with determining the climate zone for the proposed location from Table R301.1. Once the applicable climate zone for the proposed building has been determined, the *U*-factor and SHGC requirements must be met for the applicable envelope component (e.g., ceilings, walls, floors and fenestration).

Table R402.1.2 gives maximum *U*-factors for building envelope assemblies. Compliance can be demonstrated by calculating the *U*-factor for an entire building envelope assembly, including all insulation materials and building materials that contribute to overall thermal performance of the envelope.

*U*-factors are well suited to a multitude of applications with different building material and insulation material combinations. Unlike the *R*-values in Table R402.1.3, which require consideration of only the insulation components for compliance, *U*-factors consider all the parts of the assembly, including exterior siding, gypsum board and air films. These noninsulation components have been assumed to be present for a "default" wall assembly used in developing the prescriptive *R*-value requirements.

For example, whether wall framing is 16 or 24 inches (406 or 610 mm) on center matters in computing the *U*-factor, but for the prescriptive *R*-values in Table R402.1.3, a default framing condition of 16 inches (406 mm) on center is assumed, and any greater spacing of framing is permissible. Construction types that limit the amount of framing or include thermal breaks as part of their design may benefit from *U*-factor calculations.

An example of a *U*-factor alternative that uses different insulation *R*-values than required by Table R402.1.3 is illustrated by Commentary Figure R402.1.2(1). The example uses a proper *U*-factor calculation method illustrating the different *U*-factor of a wood-framed wall with the same insulation but different framing methods.

Commentary Figure R402.1.2(2) illustrates how staggered framing may be employed to reduce framing material costs and increase insulation levels. The *U*-factor calculation recognizes the value of insulation replacing the framing material and provides a more accurate measure of the insulative properties of this assembly. In the assembly in Commentary Figure R402.1.4(2), the R-13 cavity insulation is removed and a value of 0.91 is assumed for the airspace in the stud cavity. The continuous insulation is increased to 13.1. The framing spacing is increased to 24 inches (610 mm) on center.

The *U*-factor for the assembly must be calculated as follows:

$$U = \frac{0.78}{16.81} + \frac{0.18}{20.28} + \frac{0.04}{20.28} = 0.057$$

Within Climate Zones 0–3, the *U*-factor from the assembly is equal to or less than that specified in Table R402.1.2; therefore, the assembly complies with the *U*-factor requirement of Table R402.1.2 within Climate Zones 0–3.

TABLE R402.1.2  
MAXIMUM ASSEMBLY *U*-FACTORS\* AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR <sup>f</sup>	SKYLIGHT <i>U</i> -FACTOR	GLAZED FENESTRATION SHGC <sup>d,e</sup>	CEILING <i>U</i> -FACTOR	WOOD FRAME WALL <i>U</i> -FACTOR	MASS WALL <i>U</i> -FACTOR <sup>b</sup>	FLOOR <i>U</i> -FACTOR	BASEMENT WALL <i>U</i> -FACTOR	CRAWL SPACE WALL <i>U</i> -FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.026	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

- Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.
- The SHGC column applies to all glazed fenestration.  
**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.
- There are no SHGC requirements in the Marine Zone.
- A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:
  - Above 4,000 feet in elevation above sea level, or
  - In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

**TABLE R402.1.3  
INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT\***

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b,1</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b,2</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE <sup>c</sup>	MASS WALL R-VALUE <sup>e</sup>	FLOOR R-VALUE	BASEMENT <sup>d,g</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>d,h</sup> WALL R-VALUE
0	NR	0.75	0.25	30	13 or 0&10ci	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0&10ci	3/4	13	0	0	0
2	0.40	0.65	0.25	49	13 or 0&10ci	4/6	13	0	0	0
3	.30	0.55	0.25	49	20 or 13&5ci <sup>b</sup> or 0&15ci <sup>b</sup>	8/13	19	5ci or 13f	10ci, 2 ft	5ci or 13f
4 except Marine	.30	0.55	0.40	60	30 or 20&5ci <sup>b</sup> or 13&10ci <sup>b</sup> or 0&20ci <sup>b</sup>	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30 <sup>i</sup>	0.55	0.40	60	30 or 20&5ci <sup>b</sup> or 13&10ci <sup>b</sup> or 0&20ci <sup>b</sup>	13/17	30	15ci or 19 or 13&5ci	10ci, 4 ft	15ci or 19 or 13&5ci
6	0.30 <sup>i</sup>	0.55	NR	60	30 or 20&5ci <sup>b</sup> or 13&10ci <sup>b</sup> or 0&20ci <sup>b</sup>	15/20	30	15ci or 19 or 13&5ci	10ci, 4 ft	15ci or 19 or 13&5ci
7 and 8	0.30 <sup>i</sup>	0.55	NR	60	30 or 20&5ci <sup>b</sup> or 13&10ci <sup>b</sup> or 0&20ci <sup>b</sup>	19/21	38	15ci or 19 or 13&5ci	10ci, 4 ft	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.

ci = continuous insulation.

- a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.  
Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.
- c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 & 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.
- d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.
- g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, "13 & 5" means R-13 cavity insulation plus R-5 continuous insulation.
- h. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.
- i. A maximum U-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:
  1. Above 4,000 feet in elevation, or
  2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

**TABLE C402.1.3  
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD\***

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
<b>Roofs</b>																	
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-25 + R-11 + R-11 LS	R-25 + R-11 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60	R-60	R-60
<b>Walls, above grade</b>																	
Mass <sup>f</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci	R-13 + R-19.5ci	R-13 + R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci	R-13 + R-10ci	R-13 + R-12.5ci	R-13 + R-12.5ci	R-13 + R-12.5ci	R-13 + R-15.6ci	R-13 + R-18.8ci	R-13 + R-18.8ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-18.8ci	R-13 + R-18.8ci
<b>Walls, below grade</b>																	
Below-grade wall <sup>d</sup>	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci	R-15ci
<b>Floors</b>																	
Mass <sup>e</sup>	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci	R-23ci	R-23ci
Joist/framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38	R-38	R-38
<b>Slab-on-grade floors</b>																	
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below	R-20 for 24" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below	R-25 for 48" below
Heated slabs <sup>g</sup>	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous Insulation, NR = No Requirement, LS = Liner System.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA 90.1 Appendix A.

b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft<sup>2</sup> °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. "Mass floors" shall be in accordance with Section C402.2.3.

f. "Mass walls" shall be in accordance with Section C402.2.2.

g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.