

Figure 1. Envelope Features in Low-rise and High-rise Multifamily Buildings

What Are the Envelope Requirements for Multifamily Buildings?

This fact sheet explains the Title 24, Part 6 Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) envelope requirements for multifamily building projects that are classified as New Construction, Additions, or Alterations.

When a multifamily building is newly constructed and conditioned or spaces within an existing multifamily building are newly conditioned, all applicable multifamily envelope requirements must be met. However, when a project is an Alteration, requirements apply only for the altered envelope features.

For building envelope, Energy Code requirements apply to:

- ✦ Roofing product efficiency and installation, attic ventilation, and radiant barrier
- ✦ Exterior or demising roof, wall, floor, and soffit insulation
- ✦ Vapor retarder
- ✦ Solid door efficiency
- ✦ Fenestration efficiency, rating, area allowance, and when daylighting is required
- ✦ Envelope testing measures



Ace Tip

Not all requirements in this fact sheet apply to every project.

To print the section of the fact sheet that applies to your project or to a specific building feature, refer to the Table of Contents and enter the applicable page range.

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For more information, refer to the Fact Sheets:

[Multifamily Buildings: What's New in 2022](#) or [What's Changed in 2022 – Multifamily Buildings](#).

Multifamily Building Types with Envelope Requirements

Building Type	Group	Occupancy Group and Building Type California Building Code §310	Building and Space Type Subject to Energy Code Definitions of §100.1
High-rise and Low-rise Multifamily Buildings	R-2	Residential Group R-2: Buildings with 3 or more dwelling units for permanent residents	A building, other than hotel or motel, of Occupancy Group R-2, R-3, or R-4 with 4 or more habitable stories Examples: Apartment buildings <i>Hotels, motels, and timeshares are excluded.</i>
	R-3	Residential Group R-3: Some multifamily congregate residences with primarily permanent residents	A building, other than hotel or motel, of Occupancy Group R-2, R-3, or R-4 with 4 or more habitable stories Examples: Dormitories <i>Boarding houses or alcohol or drug abuse recovery homes with over 6 guests are excluded.</i>
	R-4	Residential Group R-4: Supervised residential environments for more than 6 ambulatory clients and up to 16 total residents, excluding staff	A building, other than hotel or motel, of Occupancy Group R-2, R-3, or R-4 with 4 or more habitable stories Examples: Assisted living facilities, halfway houses, drug treatment facilities

Table 1. Multifamily Building Types with Envelope Requirements



WHAT'S NEW

The 2022 Energy Code moved all multifamily building requirements together into new subchapters supporting all Mandatory, Prescriptive, and Performance options for New Construction, Additions, and Alterations of multifamily buildings of any number of habitable stories (§§160.0 through 180.2).

How Does this Fact Sheet Apply to Your Project?

Use this fact sheet to determine what 2022 California Energy Code envelope requirements apply for multifamily New Construction, Additions, and Alterations.

There are two basic steps to comply with the Energy Code:

1. Meet all Mandatory requirements by installing required systems, equipment, and devices and ensuring that they perform all functions required by the Energy Code.
2. Select your method of compliance by choosing either the Performance Approach or the Prescriptive Approach.



Mandatory Requirements

All conditioned multifamily buildings must meet a set of Mandatory requirements for minimum envelope efficiencies and construction of assemblies. Examples of building envelope components addressed by Mandatory Measures include minimum insulation levels and infiltration.



Prescriptive Approach

The Prescriptive Approach is considered the most direct path to compliance. It is a set of prescribed performance levels for various building components, where each component must meet the required minimum efficiency. There are different Prescriptive requirements for different Climate Zones and New Construction or Additions versus Alterations. The Performance Approach can be used to gain flexibility with the Prescriptive requirements.



Performance Approach

The Performance Approach builds on the Prescriptive Approach by allowing energy allotments to be traded between building systems for multifamily buildings. There can be proposed energy use trade-offs between features of the building envelope, domestic water-heating, space-heating and cooling equipment. This compliance approach requires using energy analysis software that has been approved by the California Energy Commission (CEC).



Key Terms

Common Use Areas within multifamily residential facilities are private use areas outside of the dwelling units that are shared exclusively by owners, residents, and their guests. The areas may be defined as rooms, spaces, or elements inside or outside of a building.

Demising Partition is a wall, fenestration, floor, or ceiling that separates conditioned space from enclosed unconditioned space. (Example: A wall separating an unconditioned common use corridor from conditioned dwelling units).

Dwelling Unit is a single unit providing complete, independent living facilities for one or more persons, including access, permanent provisions for living, sleeping, eating, cooking, and sanitation.

Exterior Partition is an opaque, translucent, or transparent solid barrier that separates conditioned space from ambient air or space.

High-rise Residential Building is a building, other than a hotel or motel, of Occupancy Group R-2 or R-4 with four or more habitable stories.

Low-rise Residential Building is a building, other than hotel or motel, that is a) Occupancy Group R-2: multifamily with three habitable stories or less, or b) Occupancy Group R-3: single family, or c) Occupancy Group U: utility building located on a residential site.

Metal Building is a complete integrated set of mutually dependent components and assemblies that form a building which consists of a steel-framed superstructure and metal skin. This does not include structural glass or metal panels such as in a curtainwall system.

Mixed-use Occupancy

When a building includes more than one type of occupancy (Example: Occupancy M (retail) and Occupancy R-2 (multifamily)). The requirements depend on the percentages of conditioned floor area for each occupancy type:

- ✦ **Minor Occupancy:** If one of the occupancies is less than 20% of the total conditioned floor area, the smaller occupancy is considered a minor occupancy. Under this scenario, the applicant may choose to treat the entire building as if it is the major occupancy for envelope, HVAC, and water heating compliance. However, all Mandatory requirements and lighting requirements of each occupancy must be met separately except when 90% of the building conditioned and unconditioned floor area is the same occupancy, then all the lighting can be designed to comply with the major occupancy lighting requirements. If none of the occupancies associated with the building are at least 20% of the total conditioned floor area, each occupancy must meet its respective requirements separately.

See our [2022 Nonresidential Envelope Fact Sheet](#) for more information on non-multifamily envelope requirements.

Product Certification and Rating

California Bureau of Household Goods and Services

For the following products to be installed in California, manufacturers must certify to the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS) bhgs.dca.ca.gov that the products meet the standards for insulating materials detailed in Title 24, Part 12, Chapter 12-13, Article 3:

- ✦ Insulation must be certified to meet the applicable conductive thermal performance for the product type ([§110.8\(a\)](#)).
- ✦ Radiant barriers must be certified to have an emittance of 0.05 or less ([§110.8\(j\)](#)).

National Fenestration Rating Council

The National Fenestration Rating Council (NFRC) rates the performance of manufactured and site-built windows, glass doors, opaque doors, and skylights and publishes the directory of NFRC-rated products on its website.

- ✦ Manufactured products: search.nfrc.org/search/searchdefault.aspx
- ✦ Site-Built products: cmast.nfrc.org/

Cool Roof Rating Council

The Cool Roof Rating Council (CRRC) rates the solar reflectance, thermal emittance and solar reflectance index of roofing materials and publishes the directory of CRRC-rated products on its website coolroofs.org/directory/roof.



Does Your Project Trigger the Energy Code?

New Construction, Addition, and Alteration projects are subject to the Energy Code. Repairs are not subject to the Energy Code if the repair does not increase energy use. See Table 2 for a list of typical project scopes, how they are classified, and whether they must comply with the Energy Code.

Is Your Multifamily Project New Construction, Addition, Alteration, or a Repair?		
Project Scope	Project Type	Is the Energy Code triggered?
Newly conditioned building	New Construction	YES
Tenant improvement that is the first conditioned build out of the space	New Construction	YES
First conditioning of a space that is not a tenant improvement	Addition	YES
Adding newly conditioned floor area and volume to a building	Addition	YES
Replacing existing building features associated with conditioned space	Alteration	YES
Recoating, recovering, or replacing roofing but NOT repairing a roof	Alteration	YES
Repairing, but NOT recoating, recovering, or replacing roofing	Repair	No
Replacing glass or sashes within an existing frame of a conditioned space	Repair	No

Addition is any change to a [building](#) that increases conditioned floor area and [conditioned volume](#). See also “[newly conditioned space](#).” **Addition** is also any change that increases the floor area and volume of an unconditioned building of an occupancy group or type regulated by Title 24, Part 6. Addition is also any change that increases the illuminated area of an [outdoor lighting](#) application regulated by Title 24, Part 6.

Alteration is any change to a building’s water-heating system, space-conditioning system, lighting system, electrical power distribution system, or envelope that is not an Addition. Alteration is also any change that is regulated by Title 24, Part 6 to an outdoor lighting system that is not an Addition. Alteration is also any change that is regulated by Title 24, Part 6 to signs located either indoors or outdoors. Alteration is also any change that is regulated by Title 24, Part 6 to a covered process that is not an Addition.

Conditioned Space is an enclosed space within a building that is directly conditioned or indirectly conditioned.

- ✦ **Conditioned Space, Directly** is an enclosed space that is provided with wood heating, mechanical heating that has a capacity exceeding 10 Btu/hr-ft², or mechanical cooling that has a capacity exceeding 5 Btu/hr-ft². Directly conditioned space does not include [process space](#).
- ✦ **Conditioned Space, Indirectly** is an enclosed space that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have [fixed](#) vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.
- ✦ **Newly Conditioned Space** is any space being converted from unconditioned to directly conditioned or indirectly conditioned space. Newly conditioned space must comply with the requirements for an Addition. See [§150.2](#) for single-family occupancies.
- ✦ **Newly Constructed Building** is a building that has never been used or occupied for any purpose.

Repairs must not increase the preexisting energy consumption of the repaired component, system, or equipment.

Table 2. Is Your Multifamily Project New Construction, Addition, Alteration, or a Repair?



Roofs

Why Is Energy Code Compliance Required for Roofs? Roofs have a high potential for heat gains and losses, so increasing insulation levels in these areas can provide significant reductions in heating and cooling loads in buildings. Adding continuous rigid insulation above the roof deck can reduce conductive heat transfer through framing members. Adding rated "Cool Roof" roofing material minimizes the amount of solar energy absorbed by the roof, reducing cooling loads and increasing the efficiency of the roof assembly.

Key Terms

Attic Roof is an enclosed space directly below the roof deck and above the ceiling beams.

Rafter Roof can be either flat or sloped with insulation typically installed between the rafters. With this construction, the insulation is in contact with the ceiling and there is usually a one-inch air gap above the insulation so that moisture can be vented. Whether there is an air space above the insulation depends on local climate conditions and may not be required in some building permit jurisdictions. Filling the entire cavity of framed rafter assemblies with loose-fill mineral fiber, wool, cellulose, or low-density open cell spray polyurethane foam (ocSPF) requires prior approval by the local building official.

Rated Cool Roofing Material, a roofing product with high solar reflectance and thermal emittance, helps reduce cooling loads by lowering roof and attic temperatures on hot, sunny days. Solar reflectance and thermal emittance are properties of the roofing material.

- ✦ **Aged Solar Reflectance** is the solar reflectance of the surface after three years, which typically is lower than the initial reflectance value. The higher the solar reflectance, the better (i.e., the more heat is reflected from the roofing material).
- ✦ **Thermal Emittance** provides a means of quantifying how much of the absorbed heat is rejected for a given material. The higher the thermal emittance value, the better (i.e., the more heat the roofing material emits back to the atmosphere).
- ✦ **Solar Reflectance Index (SRI)** is a measure of the roof's ability to reject solar heat which includes both reflectance and emittance.

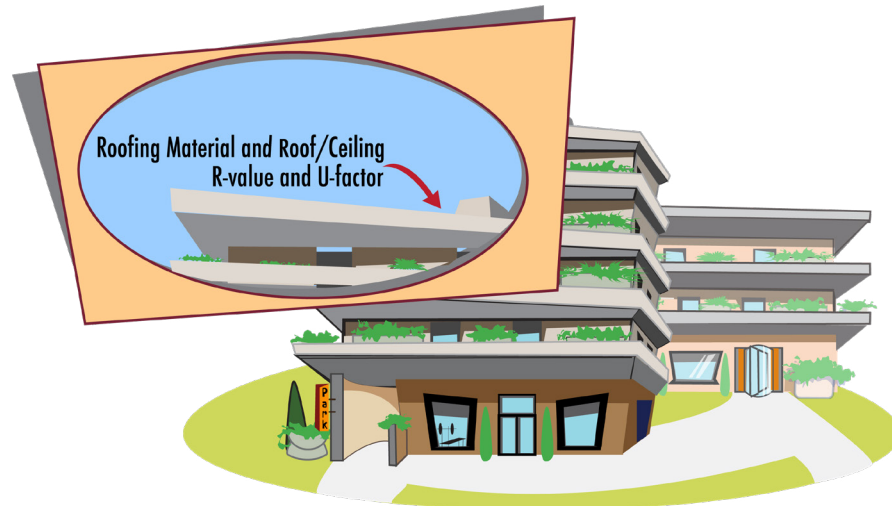


Figure 2. Roofing Material and Roof/Ceiling Insulation for a Multifamily Building

Radiant Barrier is a highly reflective, low emitting material installed at the underside surface of the roof deck and the inside surface of gable ends or other exterior vertical surfaces in attics to reduce solar heat gain.

Roof is the outside cover of a building or structure including the structural supports, decking, and top layer that is exposed to the outside with a slope less than 60° from the horizontal.

Roof, Low Sloped is a roof that has a ratio of rise to run < 2:12 (less than 9.5° from the horizontal).

Roof, Steep Sloped is a roof that has a ratio of rise to run ≥ 2:12 (9.5° or more from the horizontal).

R-value is the measure of the thermal resistance of insulation or any material or building component expressed in ft²-hr-°F/Btu. All insulation must be certified by the Department of Consumer Affairs, Bureau of Household Goods and Services that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Material."

U-factor is the overall coefficient of thermal transmittance of a fenestration, wall, floor, or roof/ceiling component, in Btu/(hr × ft² × °F), including air film resistance at both surfaces.

Wet Insulation Requirements: There are Mandatory requirements in [§110.8](#) that dictate how to determine designed U-factor performance when using the Prescriptive Method to show compliance when wet insulation is used above the roofing membrane or layer to seal the roof from water penetration. Water can penetrate this insulation material and affect the energy performance of the roofing assembly in wet and cool climates. In Climate Zones 1 and 16, the insulating R-value of continuous insulation materials installed above the waterproof membrane of the roof must be multiplied by 0.8, and installers must use the result value in choosing the table column in [Joint Reference Appendix JA4](#) for determining assembly U-factor (when using the Joint Reference Appendix JA4 table to comply). See the footnotes for [Tables 4.2.1 through 4.2.7](#) in the Joint Reference Appendix JA4.



WHAT'S NEW

Attic Roof vs. Rafter Roof

The new Mandatory provisions for multifamily ceiling and roof insulation distinguish between roofs with attic space below and roofs without attic space below (typically called a rafter roof). The Mandatory requirements for multifamily attic roofs are the same as the 2019 Mandatory requirements for low-rise residential attic roofs. The Mandatory requirements for multifamily rafter roofs are the same as the 2019 Mandatory requirements for high-rise residential rafter roofs.

New Construction and Additions

When associated with conditioned spaces, New Construction and Additions must meet Energy Code requirements for roofing materials and roof insulation. They must always meet applicable Mandatory Measures, while also complying with either the Prescriptive or Performance Approach. See Table 3 below for the corresponding Mandatory and Prescriptive Energy Code sections.

Rated Cool Roof Material

To qualify as a Cool Roof under the Energy Code, roofing material must have a Cool Roof Rating Council (CRRC) rating and meet the specified value for reflectance and emittance, or solar reflectance index (SRI) value, specified in the Certificate of Compliance (NRCC or LMCC) form. For the CRRC list of Rated Roof Products, see coolroofs.org/directory/roof.

Mandatory and Prescriptive Multifamily New Construction and Addition Roofing Requirements Associated with Conditioned Spaces				
Project Scope	Roofing Material §§110.8(j), 170.2(a)1A	Roof Insulation §§110.8(a)-(c), 170.2(a)1B	Radiant Barrier §§110.8(j), 170.2(a)1C	Vapor Retarder for Attics Using Air-permeable Insulation §160.1(d)
New Conditioned Building <i>with an attic roof</i>	YES	YES	YES	YES
Addition Including New Conditioned Space <i>that has a rafter roof</i>	YES	YES	No	No, not an attic
Addition <i>that adds a demising rafter roof (such as a newly conditioned space below an enclosed parking garage)</i>	No	YES	No	No, not an attic
Addition <i>that adds unconditioned space with any type of roof</i>	No	No	No	No
Newly Conditioning an Existing Unconditioned Building <i>that has an attic roof (such as converting unconditioned storage rooms to new dwelling units)</i>	YES	YES	YES	YES , if an attic

Table 3. Mandatory and Prescriptive Multifamily New Construction and Addition Roofing Requirements Associated with Conditioned Spaces



Prescriptive Roofing Material Requirements for Multifamily Buildings by Type and Climate Zone: New Construction and Additions

Refer to Table 4 for the Prescriptive roofing material requirements and exceptions for multifamily New Construction and Additions.

Radiant Barrier

A radiant barrier is a highly reflective, low emitting material installed at the underside surface of the roof deck and the inside surface of gable ends or other exterior vertical surfaces in attics to reduce solar heat gain. For Prescriptive compliance, radiant barriers must be installed in vented attics that do not require insulation below the roof deck, or show compliance using the Performance Approach. Radiant barriers must meet the Mandatory requirements of §110.8(j). See Table 5 for which Climate Zones and roof types are required to provide a radiant barrier.

Vapor Retarder - Roofs

Vapor retarders or barriers are a Mandatory requirement per §160.1(d)2 for New Construction and Additions, supporting special coverings over framing and insulation that protect the assembly components from moisture condensation. Water build-up due to condensation can cause the insulation to lose effectiveness, cause structural damage, and generate mold that may contribute to indoor air quality problems.

In Climate Zones 14 and 16, a Class I or Class II vapor retarder must be installed on the conditioned space side of all insulation in all vented attics and unvented attics with air-permeable insulation.

Key Term

Vapor Retarder Class is a measure of the ability of a material or assembly to limit the amount of moisture that passes through the material or assembly meeting §202 of the California Building Code.

Prescriptive Roofing Material Ratings for Multifamily Buildings by Roof Type and Climate Zone: New Construction and Additions

Roof Type		Climate Zones	3-year Aged Solar Reflectance ¹	Thermal Emittance ¹	SRI ¹
Attic Roof ²	Low-sloped	1-12, 14, 16	NR	NR	NR
		13,15	≥ 0.63	≥ 0.75	≥ 75
Attic Roof ²	Steep-sloped	1-9, 16	NR	NR	NR
		10 - 15	≥ 0.20	≥ 0.75	≥ 16
Rafters Roof ³	Low-sloped	1-8,12,16	NR	NR	NR
		9-11, 13-15	≥ 0.63	≥ 0.75	≥ 75
	Steep-sloped	1,16	NR	NR	NR
		2-15	≥ 0.20	≥ 0.75	≥ 16

Low-sloped = rise-to-run ratio of < 2:12 (less than 9.5 degrees); **Steep-sloped** = rise-to-run ratio ≥ 2:12 (9.5 degrees or more); **SRI** = solar reflectance index.

Exceptions:

- ✦ Any area covered by integrated photovoltaic panels or integrated solar thermal panels.
- ✦ Roof constructions with a weight of at least 25 lb/ft² over the roof membrane.

- ¹ For Prescriptive roofing compliance, EITHER meet both the applicable 3-year aged solar reflectance value AND the thermal emittance value, OR meet the applicable solar reflectance index (SRI).
- ² Meeting either Option B or C of [Table 170.2-A](#).
- ³ Meeting Option D of [Table 170.2-A](#)

Table 4. Prescriptive Roofing Material Ratings for Multifamily Buildings by Roof Type and Climate Zone: New Construction and Additions

Radiant Barriers for Roofs and Ceilings

Roof Type	Climate Zone	Radiant Barrier
Attic Roof meeting Prescriptive Attic Requirements of Table 170.2-A - Option B (New Construction, High-rise Additions, Low-rise Additions > 700 ft ²)	2-3, 5-7	Required
	1, 4, 8-16	NR
Attic Roof meeting Prescriptive Attic Requirements of Table 170.2-A - Option C (New Construction, High-rise Additions, Low-rise Additions > 700 ft ²)	2-15	Required
	1, 16	NR
Rafter Roof meeting Prescriptive Attic Requirements of Table 170.2-A - Option D (New Construction and Additions)	1-16	NR
Attic Roof in Low-rise Additions ≤ 700 ft ² when no insulation below roof deck §180.1(a)1Bii	2-15	Required
	1, 16	NR

Table 5. Radiant Barriers for Roofs and Ceilings

Prescriptive Requirements for Roof and Ceiling Insulation

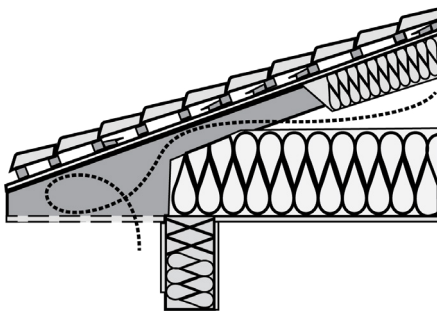
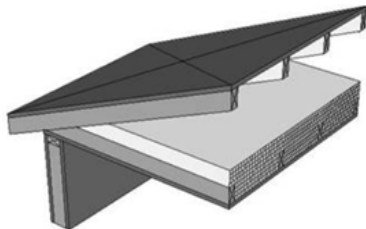
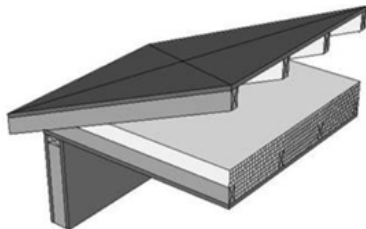
U-factors for common construction assemblies can be determined based on framing type and spacing, cavity insulation, and the type and thickness of any continuous insulation. Determining proposed assembly U-factor can be done by either using the tables under [Joint Reference Appendix JA4.2 Roofs and Ceilings](#) or the by modeling all the layers of the construction assembly using [CEC-certified software](#). Energy Code compliance for New Construction can use an area-weighted average U-factor calculation.

Roofs or ceilings that separate conditioned spaces from unconditioned spaces or ambient air can meet the Prescriptive insulation requirements for multifamily buildings by one of three options as shown in [Table 170.2-A \(Envelope Component Package – Multifamily Standard Building Design\)](#) or show compliance using the Performance Approach. Insulation must be placed in direct contact with the roof or drywall ceiling.

Tables 6 and 8 show the three Prescriptive roof insulation options available for Energy Code compliance:

- ✦ **Option B:** Supports a "high performance attic" which requires insulation at the ceiling for all Climate Zones. Climate Zones 4 and 8 through 16 also require insulation installed below the roof deck between wood framing. In addition, Option B requires a vented attic and an air space between the roofing material and the roof deck, as is common for tile roofs.
- ✦ **Option C:** Supports an attic in which there are insulation requirements at the ceiling, but none at the roof deck. This option depends on the ducts and air handler being located in conditioned space and not in the attic. The duct and air handler locations must be verified by a HERS rater. There are no roofing air-space requirements.
- ✦ **Option D:** Supports a rafter roof (non-attic) with an overall weighted U-factor requirement that considers all layers of the roof assembly, including insulation in the cavity and above the roof deck, as applicable. There are no vented attic or roofing air-space requirements.

Prescriptive Minimum Roof R-value and Maximum U-factor Options for Roof and Ceiling Insulation

Attic Roofs	Climate Zone	Insulation R-value at Attic Floor <i>New Construction and Additions > 700 ft²</i>	Insulation R-value Below Roof Deck ¹ <i>New Construction and Additions > 700 ft²</i>	§180.1(a)1Bi <i>Additions ≤ 700 ft²</i>
	Insulation in contact with the roof deck and an additional layer of ceiling insulation located between attic and conditioned space (Option B in Table 170.2-A) 	1-2	≥ R-38	NR
Ceiling insulation located between attic and conditioned space (Option C in Table 170.2-A) 	3, 5-7	≥ R-30	NR	≥ R-30 (or equivalent U-factor of ≤ 0.031)
	4, 8, 9, 11-15	≥ R-38	≥ R-19	≥ R-38 (or equivalent U-factor of ≤ 0.025)
	10, 16	≥ R-38	≥ R-13	≥ R-38 (or equivalent U-factor of ≤ 0.025)
Ceiling insulation located between attic and conditioned space (Option C in Table 170.2-A) 	1, 11-16	≥ R-38	NR	≥ R-38 (or equivalent U-factor of ≤ 0.025)
	2, 4, 8-10	≥ R-30	NR	≥ R-38 (or equivalent U-factor of ≤ 0.025)
	3, 5-7	≥ R-30	NR	≥ R-30 (or equivalent U-factor of ≤ 0.031)

¹ R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members. Alternatives including insulation above rafters or above roof deck must show compliance using the Performance Approach.

Table 6. Prescriptive Minimum Roof R-value and Maximum U-factor Options for Roof/Ceiling Insulation



Mandatory Requirements for Roof and Ceiling Insulation §160.1(a)

Insulation must be installed in direct contact with a roof or ceiling that is sealed to limit infiltration and exfiltration as specified in §110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling.



✦ Attic Roofs

- ◇ Attic access doors must have insulation that is permanently attached using adhesive or mechanical fasteners. The attic access must be gasketed to prevent air leakage
- ◇ When loose-fill insulation is installed, the minimum installed weight per square foot must meet the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value

✦ Rafter Roofs

- ◇ When insulation is installed at the roof, fixed vents or openings to the outdoors or to unconditioned spaces must not be installed, except for vents that do not penetrate the roof deck and are instead designed for wind resistance for roof membranes
- ◇ When the space between the ceiling and the roof is either directly or indirectly conditioned space, it must not be considered an attic for the purposes of complying with CBC attic ventilation requirements

Wood Framed Assembly: Prescriptive and Performance Approach

Material Layers (exterior layer listed first)	 Prescriptive Joint Reference Appendix 4.2.2-F37	 Performance Layer Manager ¹
Asphalt Roofing	U-factor = 0.034	U-factor = 0.034
Roofing Felt		
R-8 Rigid Insulation		
1/2" Plywood Sheathing		
2x8 Rafters with R-21 Cavity Insulation (with air space)		
5/8" Gypsum Board		

¹ When using the Performance Approach, calculate overall assembly U-factors by modeling the layers of each construction assembly using CEC-approved Energy Code compliance software.

Table 7. Wood Framed Assembly: Prescriptive and Performance Approach

Prescriptive Maximum U-factor Requirements for Rafter Roofs (Non-attic Roofs): Roof and Ceiling Insulation



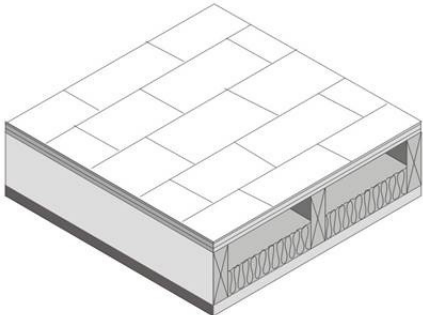
Non-attic Roofs	Climate Zone	Overall Assembly U-factor New Construction and Additions > 700 ft ² §170.2(a)1Biv and §180.1(a)1A	Overall Assembly U-factor Additions ≤ 700 ft ² §160.1(a) and Exception to §180.1(a)1B
 Metal Building (Option D Table 170.2-A)	1-16	≤ 0.041	≤ 0.098
 Wood Framed or any Other Non-Attic Roof Type (Option D Table 170.2-A) <i>See Table 7 at left for more information about graphic.</i>	1,2,4,8-16	≤ 0.028	≤ 0.075
	3, 5-6	≤ 0.034	≤ 0.075
	7	≤ 0.039	≤ 0.075

Table 8. Prescriptive Maximum U-factor Requirements for Rafter Roofs (Non-attic Roofs): Roof and Ceiling Insulation



Alterations

When Do Roof, Attic, or Ceiling Alterations Trigger the Energy Code?

When associated with conditioned spaces, some Alterations must meet Energy Code requirements for roofing materials, roof or attic insulation, and air sealing.

Altering roofing materials by replacing, recovering, or recoating more than half of existing roof area or more than 2,000 ft² of roof, whichever is less, triggers the §180.2(b)1A Prescriptive roofing material requirements shown in Table 10.

For low-sloped roofs, that same level of change to roofing materials also triggers the §180.2(b)1Aiii Prescriptive roof insulation requirements shown in Table 9.

For vented attics, changes to the ceiling that separates the attic from conditioned space trigger the §180.2(b)1Bi Prescriptive insulation and air sealing requirements for most Climate Zones (see Table 9). These triggering ceiling Alterations include replacing existing attic insulation, adding new attic insulation, or replacing the ceiling plane. Installing an entirely new or complete replacement HVAC duct system in an existing vented attic also triggers the same Prescriptive attic insulation and air-sealing requirements.

See Tables 9, 10, and 11 for the Mandatory and Prescriptive Energy Code requirements that apply to different project scopes, as well as for available exceptions to the requirements.

Key Terms

Roof Recoat is not defined in the Energy Code, but typical industry use of “recoat” is when a new layer is applied to the outer surface of the existing roofing material and the existing roofing material is not being replaced and recovered. (See definitions below.)

Roof Recover is the process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

Roof Recover Board is a rigid type board, installed directly below a low-sloped roof membrane, with or without above deck thermal insulation, to: (a) improve a roof system's compressive strength, (b) physically separate the roof membrane from the thermal insulation, or (c) physically separate a new roof covering from an underlying roof membrane as part of a roof overlay project.

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



WHAT'S NEW

Insulation requirements have changed for reroofing!

For more information, see [Table 9](#) on page 11.



Prescriptive Low-sloped and Attic Roof Alterations: Insulation and Air Sealing Requirements §§180.2(b)1A-B

Roof Type	CZ 1	CZ 2	CZ 3	CZ 4	CZs 5-7	CZ 8	CZ 9	CZ 10	CZs 11-15	CZ 16
Low-sloped ^{1,2}	≥ R-14 or U-factor ≤ 0.039	≥ R-14 or U-factor ≤ 0.039	NR	≥ R-14 or U-factor ≤ 0.039	NR	≥ R-14 or U-factor ≤ 0.039	≥ R-14 or U-factor ≤ 0.039	≥ R-14 or U-factor ≤ 0.039	≥ R-14 or U-factor ≤ 0.039	≥ R-14 or U-factor ≤ 0.039
Vented Attic Roofs ^{1,3}	≥ R-49 or U-factor ≤ 0.020 <i>Exception: (E) R-19</i>	≥ R-49 or U-factor ≤ 0.020	≥ R-49 or U-factor ≤ 0.020 <i>Exception: (E) R-19</i>	≥ R-49 or U-factor ≤ 0.020 <i>Exception: (E) R-19</i>	NR	≥ R-49 or U-factor ≤ 0.020	≥ R-49 or U-factor ≤ 0.020 <i>Exception: (E) R-19</i>	≥ R-49 or U-factor ≤ 0.020	≥ R-49 or U-factor ≤ 0.020	≥ R-49 or U-factor ≤ 0.020
Air Sealing ⁴	NR	YES	NR	NR	NR	NR	NR	NR	YES	YES
Can Light Insulation ⁵	YES <i>Exception: (E) R-19</i>	YES <i>Exception: (E) R-19</i>	YES <i>Exception: (E) R-19</i>	YES <i>Exception: (E) R-19</i>	NR	YES <i>Exception: (E) R-19</i>	YES <i>Exception: (E) R-19</i>	YES <i>Exception: (E) R-19</i>	YES	YES

1 Meet either the insulation minimum R-value requirement or the maximum overall weighted average U-factor

2 Low-sloped Exceptions:

- ✦ Roof recovers with new R-10 insulation added above deck
- ✦ When existing mechanical equipment is located on the roof will not be disconnected and lifted, insulation to be the maximum installed thickness that will allow the distance between the height of the roof membrane surface to the top of the base flashing to remain in accordance with the manufacturer's instructions using ≥ R-10 (if R-10 cannot be achieved at a minimum, equipment is to be lifted, and ≥ R-14 will be required)
- ✦ At roof low points, tapered insulation less than R-14 may be used if insulation depth is increased at roof high points so that the average R-value is at least R-14
- ✦ No insulation is required in the area of the roof recoat

3 Vented Attic Roof Exceptions:

- ✦ Dwelling units with at least R-38 existing ceiling insulation in the attic
- ✦ Dwelling units where the Alteration would directly cause the disturbance of asbestos, unless the Alteration is made in conjunction with asbestos abatement
- ✦ Dwelling units with knob and tube wiring located in the vented attic
- ✦ Where the accessible space in the attic is not large enough to accommodate the required R-value, the entire accessible space shall be filled with insulation provided such installation does not violate §806.3 of Title 24, Part 2.5
- ✦ Where the attic space above the altered dwelling unit is shared with other dwelling units and the requirements of [§180.2\(b\)1Bi](#) are not triggered for the other dwelling units

4 [§180.2\(b\)1Bib](#): In Climate Zones 2 and 11-16, air seal all accessible areas of the ceiling plane between attic and conditioned space per [§110.7](#)

Air Sealing Exceptions:

- ✦ Dwelling units with at least R-19 existing ceiling insulation
- ✦ When atmospherically vented space heating or water-heating combustion appliances are located inside the dwelling unit pressure boundary

5 In Climate Zones 1-4 and 8-16, meet recessed downlight insulation requirements per [§180.2\(b\)1Bic](#)

Table 9. Prescriptive Low-sloped and Attic Roof Alterations: Insulation and Air Sealing Requirements [§180.2\(b\)1A-B](#)



Prescriptive Roofing Material Requirements for Multifamily Building Alterations

Altering roofs over conditioned space in multifamily buildings triggers Prescriptive roofing material requirements when it involves replacing, recovering, or recoating more than 50% of existing roof area or more than 2,000 ft² of roof, whichever is less. Table 10 below shows how Prescriptive roofing material requirements vary based on roof slope and Climate Zone. Most roof Alteration projects also require insulation. For insulation requirements, see [Table 9](#) on the previous page.

Prescriptive Roofing Material Requirements for Roofing Alterations ¹				
Roof Style	Climate Zones	3-year Aged Solar Reflectance ²	Thermal Emittance ²	SRI ²
Low-sloped ³	2, 4, 6-15	≥ 0.63	≥ 0.75	≥ 75
Steep-sloped ⁴	4, 8-15	≥ 0.20	≥ 0.75	≥ 16

Low-sloped = rise-to-run ratio of < 2:12 (lower than 9.5 degrees); **steep-sloped** = rise-to-run ratio ≥ 2:12 (9.5 degrees or more).

- 1** Exceptions for any roof type: Roof areas with integrated photovoltaic panels or integrated solar thermal panels; Roof constructions with a weight of ≥ 25 lb/ft²
- 2** For Prescriptive roofing compliance, EITHER meet both the applicable 3-year aged solar reflectance value AND the thermal emittance value, OR meet the applicable solar reflectance index (SRI).
- 3** Low-sloped Exception: The aged solar reflectance requirement can be met by adding insulation at the roof deck specified in [Table 180.2-A](#) (see Table 11).
- 4** Steep-sloped Exceptions:
 - ✦ Buildings with ceiling assemblies with a U-factor ≤ 0.025 or that are insulated with at least R-38 ceiling insulation in an attic; or
 - ✦ Buildings with a radiant barrier in the attic, where the radiant barrier is not installed directly above spaced sheathing; or
 - ✦ Buildings that have no ducts in the attic in Climate Zones 2, 4, 9, 10, 12, 14; or
 - ✦ Buildings with R-2 or greater continuous insulation above or below the roof deck

Table 10. Prescriptive Roofing Material Requirements for Multifamily Building Alterations

Prescriptive Trade-offs Allowed for Low-sloped Roofing Materials in Multifamily Building Alterations

Alterations to multifamily buildings with low-sloped roofs are allowed to comply Prescriptively with roof aged solar reflectance lower than the typical 0.63 minimum requirement if the roof/ceiling insulation is increased by installing the minimum R-values of continuous roof deck insulation shown in Table 11 below. Table 11 is adapted from [Table 180.2-A Roof/Ceiling Insulation Tradeoff for Low-Sloped Aged Solar Reflectance](#).

Prescriptive Low-sloped Roof Alterations: Roof/Ceiling Insulation Trade-offs for Aged Solar Reflectance		
Minimum Aged Solar Reflectance	Minimum Roof Deck Continuous Insulation R-value Climate Zones 6-7	Minimum Roof Deck Continuous Insulation R-value Climate Zones 2, 4, 8-15
0.60	≥ 2	≥ 16
0.55	≥ 4	≥ 18
0.50	≥ 6	≥ 20
0.45	≥ 8	≥ 22
No requirement	≥ 10	≥ 24

Table 11. Prescriptive Low-sloped Roof Alterations: Roof/Ceiling Insulation Trade-offs for Aged Solar Reflectance

Altered Wet Insulation Requirements

Mandatory [§110.8\(h\)](#) requires use of Joint Reference Appendix JA4 to determine the effective R-value of roof insulation installed above the roofing membrane or layer that seals the roof from water penetration. Water can penetrate this insulation material and affect the energy performance of the roofing assembly in wet and cool climates. In Climate Zones 1 and 16, the insulating R-value of continuous insulation materials installed above the waterproof membrane of the roof must be multiplied by 0.8, and installers must use the resulting value in choosing the table column in [Joint Reference Appendix JA4](#) for determining assembly U-factor (when using the Joint Reference Appendix JA4 table to comply). See the footnotes for [Tables 4.2.1 through 4.2.7](#) in the Joint Reference Appendix JA4.



WHAT'S NEW

The trade-off allowances for low-sloped roofs in both high-rise and low-rise multifamily buildings are now shown as R-values of continuous roof deck insulation rather than overall roof and ceiling assembly U-factors.



Walls

Why is compliance required for walls? Walls are important because heat travels through a building's envelope (roofs, walls, windows) and tends to travel from higher temperatures to lower temperatures by conduction, convection, or radiation. The greater the temperature difference, the greater the rate of heat transfer.

When choosing insulation, it is important to consider where the material will be installed in the building envelope assembly and how much insulation is necessary to meet or exceed the Energy Code. Opaque construction assemblies often consist of one or more types of insulation in different locations for cavity insulation and continuous insulation. In many cases, determining the best strategy for insulating depends on the building design and overall project budget.

Another consideration for selecting insulation is its environmental impact. Many of the newer insulation materials are far more "green" than previously available products, including formaldehyde-free and recycled-content insulation.

Key Terms

Below Grade Wall is the portion of a wall, enclosing conditioned space that is below the grade line.

Continuous Insulation (c.i.) is insulation that is continuous across all assemblies that separate conditioned from unconditioned space. It is installed on the exterior or interior or is integral to any opaque surface of the building envelope and has no thermal bridges other than fasteners and necessary service openings.

Fire Protection Rating is the period of time that an "opening protective", such as a fire door, will maintain the ability to confine a fire as determined by tests specified in the California Building Code, Title 24, Part 2, Section 716. Ratings are stated in hours or minutes.

R-value is the measure of the thermal resistance of insulation or any material or building component expressed in $\text{ft}^2\text{-hr-}^\circ\text{F/Btu}$. All insulation must be certified by the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS) that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Material."

U-factor is the overall coefficient of thermal transmittance of a fenestration, wall, floor or roof/ceiling component, in $\text{Btu}/(\text{hr} \times \text{ft}^2 \times ^\circ\text{F})$, including air film resistance at both surfaces.

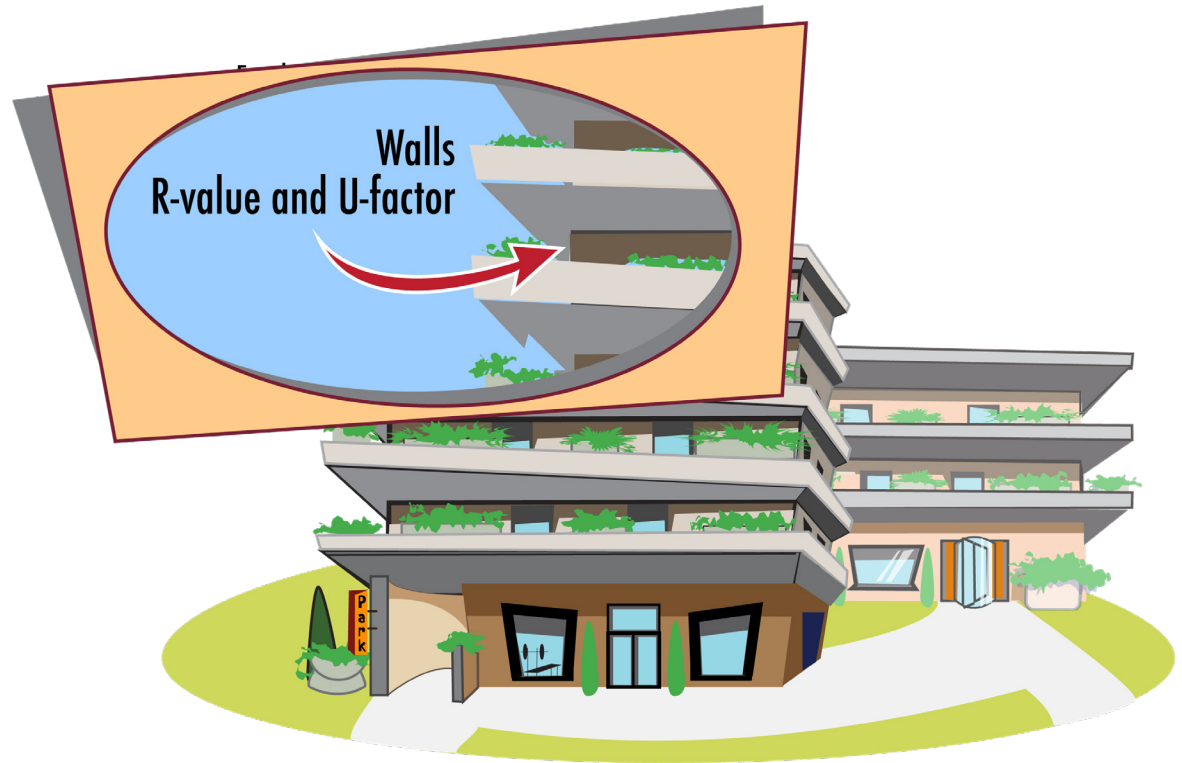


Figure 3. Exterior Walls of a Multifamily Building



New Construction and Additions

When associated with conditioned spaces, New Construction and Additions must meet Energy Code U-factor requirements for exterior walls and demising walls. They must always meet applicable Mandatory Measures, while also complying with either the Prescriptive or Performance Approach. See Table 12 below for the Mandatory and Prescriptive Energy Code sections that apply to exterior, demising, and interior walls for different project scopes.

Mandatory and Prescriptive Multifamily New Construction and Addition Wall Requirements Associated with Conditioned Spaces

Project Scope	Exterior Wall U-factor Requirements <i>When associated with conditioned spaces</i> §§110.8 (a) - (c), 160.1(b), 170.2(a)2	Demising Wall U-factor Requirements <i>When associated with conditioned spaces</i> §§110.8 (a) - (c), 160.1(b)7	Interior Wall Requirements ¹ <i>When associated with conditioned spaces</i>
New Construction: New building	Yes	Yes	N/A
Addition	Yes ²	Yes	N/A
Conditioning an existing building for the first time	Yes	Yes	N/A

¹ Interior walls are the walls that separate conditioned spaces from other enclosed conditioned spaces.

² See also §180.1(a)1 for modifications to §170.2(a)2 wall insulation requirements for Prescriptive Additions.

Table 12. Mandatory and Prescriptive Multifamily New Construction and Addition Wall Requirements Associated with Conditioned Spaces

Wall Insulation Requirements

U-factors for common construction assemblies can be determined based on framing type and spacing, cavity insulation, and the type and thickness of any continuous insulation.

Determining proposed assembly U-factor can be done by either using the tables under [Joint Reference Appendix JA4.3](#) or by modeling all the layers of the construction assembly using CEC-certified software. Compliance for New Construction can use an area-weighted average U-factor calculation.

Exterior walls must have an overall assembly U-factor no greater than the applicable value in [Table 170.2-A \(Envelope Component Package – Multifamily Standard Building Design\)](#) or show compliance using the Performance Approach.

Demising walls must meet the Mandatory maximum U-factor requirements of §160.1(b) requiring wood-framed walls to be no greater than U-0.099 and metal-framed walls to be no greater than U-0.151. Since the demising wall requirements are Mandatory, the Performance Approach does not allow for a greater U-factor allowance.

Vapor Retarder - Walls

Vapor retarders or barriers are a Mandatory requirement per §160.1(d)2 for New Construction and Additions, supporting special coverings over framing and insulation that protect the assembly components from moisture condensation. Water build-up due to condensation can cause the insulation to lose effectiveness, cause structural damage, and generate mold that may contribute to indoor air quality problems.

In Climate Zones 14 and 16, a Class I or Class II vapor retarder must be installed on the conditioned space side of all insulation in all exterior walls with air-permeable insulation.

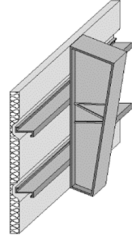
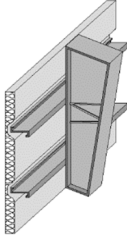
Key Term

Vapor Retarder Class is a measure of the ability of a material or assembly to limit the amount of moisture that passes through the material or assembly meeting Section 202 of the California Building Code.



Wall Insulation Requirements

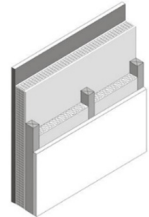
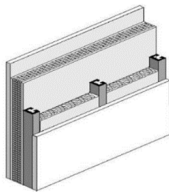
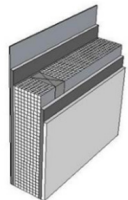
Prescriptive Wall U-factor Requirements for New Construction: Metal Building Walls (Table 170.2-A)

Fire Rating ¹	Climate Zones 1-10	Climate Zones 11-16
Any or No Fire Rating	≤ 0.061 Example from Joint Reference Appendix JA4-Table 4.3.9 : Double Layer of Batt Insulation using R-10 + R-13 	≤ 0.057 Example from Joint Reference Appendix JA4-Table 4.3.9 : Double Layer of Batt Insulation using R-13 + R-13 

1 Fire Rating: Fire Protection Rating is the period of time that an opening protective will maintain the ability to confine a fire as determined by tests specified in the California Building Code, Title 24, Part 2, Section 716. Ratings are stated in hours or minutes.

Table 13. Prescriptive Wall U-factor Requirements for New Construction: Metal Building Walls ([Table 170.2-A](#))

Prescriptive Wall U-factor Requirements for New Construction: Framed (Wood or Metal) and Other (Non-framed and Non-mass) (Table 170.2-A)

Fire Rating ¹	Climate Zones 1-5, 8-10, 12-13	Climate Zones 6-7	Climate Zones 11, 14-16
> 1 Hour Fire Rating	≤ 0.059 Wood-framed Wall Example from Joint Reference Appendix JA4-Table 4.3.1(a) using 5/8" gypsum: ✦ 16" OC ✦ 2 x 6 with R-21 ✦ R-2 CI 	≤ 0.065 Metal-framed Wall Example from Joint Reference Appendix JA4-Table 4.3.3 : ✦ 16" OC ✦ 2 x 6 with R-19 ✦ R-10 CI 	≤ 0.051 SIPS Wall Example from Joint Reference Appendix JA4-Table 4.3.2 : ✦ Single 2x Spline ✦ 6-1/2" using R-22 

OC = On center; **CI** = Continuous insulation with no framing interruption;
SIPS = Structurally Insulated Wall Panels

1 Fire Rating: Fire Protection Rating is the period of time that an opening protective will maintain the ability to confine a fire as determined by tests specified in the California Building Code, Title 24, Part 2, Section 716. Ratings are stated in hours or minutes.

Table 14. Prescriptive Wall U-factor Requirements for New Construction: Framed (Wood or Metal) and Other (Non-framed and Non-mass) ([Table 170.2-A](#))

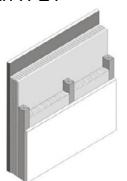
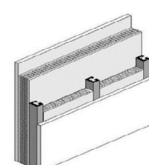


WHAT'S NEW

Prescriptive U-factor requirements for all wall types have changed in most Climate Zones in [Table 170.2-A](#). In addition, fire ratings are now considered when determining maximum U-factor requirements.



Prescriptive Wall U-factor Requirements for New Construction: Framed (Wood or Metal) and Other (Non-framed and Non-mass) (Table 170.2-A)

Fire Rating ¹	Climate Zones 1-5, 8-16	Climate Zones 6-7
≤ 1 hr Fire Rating	≤ 0.051 Wood Framed Wall Example from Joint Reference Appendix JA4-Table 4.3.1(a) using 5/8" gypsum: ✦ 16" OC ✦ 2 x 6 with R-21 ✦ R-4 CI 	≤ 0.065 Metal Framed Wall Example from Joint Reference Appendix JA4-Table 4.3.3 : ✦ 24" OC ✦ 2 x 6 with R-20 ✦ R-10 CI 
	CI = Continuous insulation with no framing interruption; OC = On center	

1 Fire Rating: Fire Protection Rating is the period of time that an opening protective will maintain the ability to confine a fire as determined by tests specified in the California Building Code, Title 24, Part 2, Section 716. Ratings are stated in hours or minutes.

Table 15. Prescriptive Wall U-factor Requirements for New Construction: Framed (Wood or Metal) and Other (Non-framed and Non-mass) ([Table 170.2-A](#))

Prescriptive Wall U-factor Requirements for New Construction: Light Weight Mass (Table 170.2-A)

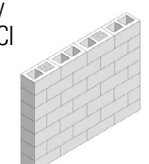
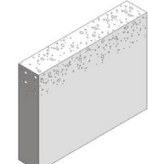
Wall Type	Climate Zones 1-15	Climate Zone 16
Light Mass Walls (Walls with a heat capacity of at least 7.0 Btu/ft ² -°F and less than 15.0 Btu/ft ² -°F)	≤ 0.077 (R-13) 8" CMU Hollow Unit Medium Weight (MW) Wall Example from Joint Reference Appendix JA4-Table 4.3.5-B9 plus JA4 Equation 4-1 to add CI: ✦ Partial grout ✦ Empty ✦ R-12 CI 	≤ 0.059 (R-17) 6" Concrete Wall Example from Joint Reference Appendix JA4-Tables 4.3.6 and 4.3.14 plus JA4 Equation 4-4 : ✦ 2 x 6 wood framed with R-21 
	CI = Continuous insulation with no framing interruption; CMU = Concrete masonry units; MW = Medium weight.	

Table 16. Prescriptive Wall U-factor Requirements for New Construction: Light Weight Mass ([Table 170.2-A](#))

Prescriptive Wall U-factor Requirements for New Construction: Heavy Weight Mass (Table 170.2-A)

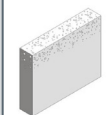
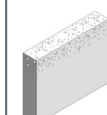
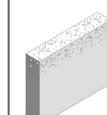
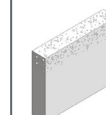
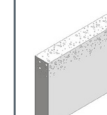
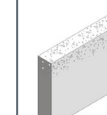
Wall Type	Climate Zones 1, 12	Climate Zones 2-5, 10	Climate Zones 6-9	Climate Zones 11, 14-15	Climate Zone 13	Climate Zone 16
Heavy Mass Walls (Walls with a heat capacity of at least 15.0 Btu/ft ² -°F)	≤ 0.253 8" Concrete Wall Example from Joint Reference Appendix JA4-Table 4.3.6 plus JA4 Equation 4-1 to add CI: ✦ R-8 CI 	≤ 0.650 8" Concrete Wall Example from Joint Reference Appendix JA4-Tables 4.3.6 and 4.3.14 plus JA4 Equation 4-4 : ✦ 3" metal framing, no insulation 	≤ 0.690 8" Concrete Wall Example from Joint Reference Appendix JA4-Tables 4.3.6 and 4.3.14 plus JA4 Equation 4-4 : ✦ 3" metal framing, no insulation 	≤ 0.184 8" Concrete Wall Example from Joint Reference Appendix JA4-Table 4.3.6 plus JA4 Equation 4-1 to add CI: ✦ R-5 CI 	≤ 0.211 8" Concrete Wall Example from Joint Reference Appendix JA4-Tables 4.3.6 and 4.3.14 plus JA4 Equation 4-4 : ✦ 4" metal framing with R-11 	≤ 0.160 8" Concrete Wall Example from Joint Reference Appendix JA4-Tables 4.3.6 and 4.3.14 plus JA4 Equation 4-4 : ✦ 4" metal framing with R-13 

Table 17. Prescriptive Wall U-factor Requirements for New Construction: Heavy Weight Mass ([Table 170.2-A](#))



Extended or Converted Wood-framed Walls §180.1(a)1

The "extended wood-framed" alternative wall option is available for multifamily Additions created by adding newly-constructed conditioned floor area and volume to an existing building. The "converted wood-framed" alternative wall option is available for Additions over 700 ft² created when an existing unconditioned space, such as a parking garage, is converted to conditioned space, such as a new bedroom. The "converted" alternative wall option is only allowed if the existing exterior siding remains.

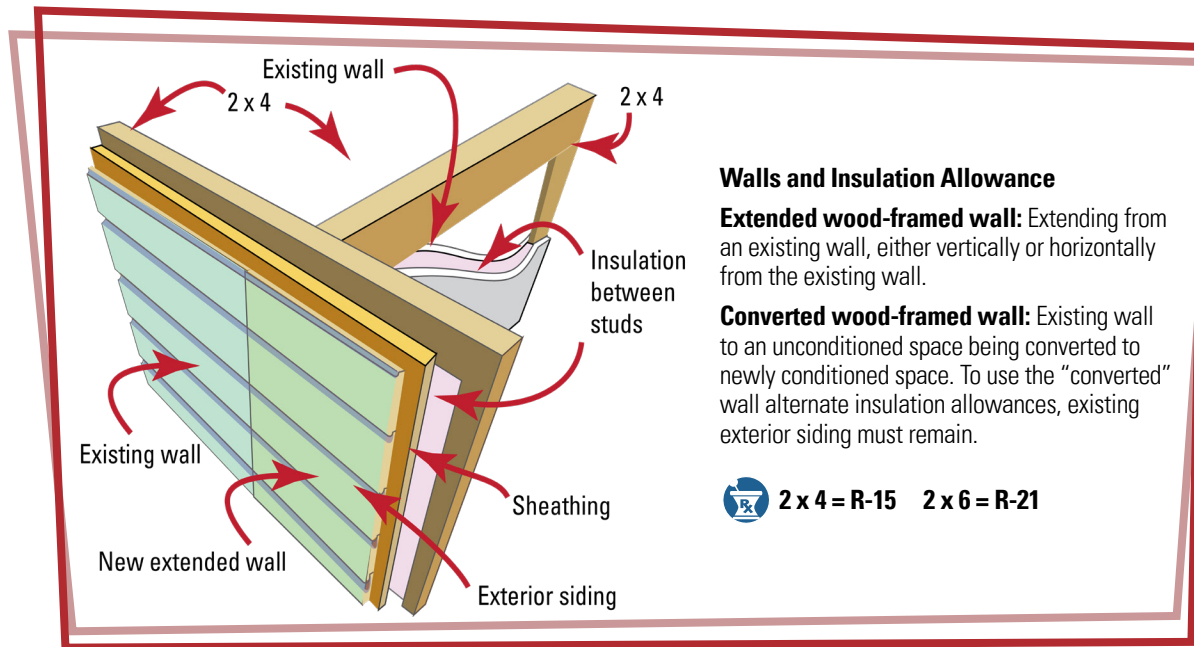


Figure 4. Insulation Allowance for Extended or Converted Wood-framed Walls



Alterations

U-factor requirements for walls are based on whether the work on them is classified as an Alteration, New Construction, or neither. See Table 18 below for which project scopes related to changing walls are classified as Alterations and which as New Construction and then which Energy Code sections determine their U-factor requirements.

Mandatory and Prescriptive Insulation Requirements for Projects Changing Walls			
Project Scope	Exterior Wall Insulation Requirements	Demising Wall Insulation Requirements	Interior Wall Requirements ¹
	<i>When associated with conditioned spaces</i> §§110.8(a)-(c), 160.1(b)	<i>When associated with conditioned spaces</i> §§110.8(a)-(c), 160.1(b)	<i>When associated with conditioned spaces</i>
Altering a wall in an existing space by opening the wall or stripping it down to the studs	Alteration See Table 19	Alteration See Table 19	N/A
Non-altered wall in a space in which other walls are being altered	N/A	N/A	N/A
Rebuilding a wall in the same location	Alteration See Table 19	Alteration See Table 19	N/A
Conditioning an existing space for the first time (newly conditioned)	New Construction See Table 12	New Construction See Table 12	N/A

¹ Interior walls are the walls that separate conditioned spaces from other enclosed conditioned spaces.

Table 18. Mandatory and Prescriptive Insulation Requirements for Projects Changing Walls

Mandatory Requirements for Alterations to Walls

When an exterior wall is altered, insulation also must be provided that meets the requirements in Table 19 below. Note that there are no Prescriptive requirements for wall Alterations.

Mandatory Insulation Requirements for Altered Walls for All Climate Zones §§110.8(a)-(c) and 180.2(a)2	
Wall Type	Minimum Insulation R-value or Equivalent U-factor
Metal Building	≥ R-13 or area-weighted average U-factor ≤ 0.113 <i>Example using Joint Reference Appendix JA-Table 4.3.9: Single layer of R-13 batt insulation</i>
Metal-framed	≥ R-13 or area-weighted average U-factor ≤ 0.217 <i>Example using Joint Reference Appendix JA-Table 4.3.3: 2 x 4 16" OC with R-13 batt insulation</i>
Wood-framed	≥ R-11 or area-weighted average U-factor ≤ 0.110 <i>Example using Joint Reference Appendix JA-Table 4.3.1: 2 x 4 16" OC with R-11 batt insulation</i>
Spandrel Panels or Curtain Wall	≥ R-4 or area-weighted average U-factor ≤ 0.280 <i>Example using Joint Reference Appendix JA-Table 4.3.8: Aluminum frame without thermal break, dual-paned glazing with no low-e coating, and 1" R-4 rigid insulation</i>
Mass (light or heavy)	No Alteration requirements
Any other wall not listed above	≥ R-11 or area-weighted average U-factor ≤ 0.110

CI = Continuous insulation with no framing interruption; OC = On center

Table 19. Mandatory Insulation Requirements for Altered Walls for All Climate Zones §110.8(a)-(c) and §180.2(a)2



WHAT'S NEW

In the 2022 Energy Code, the requirements for wall Alterations in multifamily buildings are based on the 2019 Mandatory requirements for high-rise residential buildings, with minor modifications.



Floors and Soffits

Why is compliance required for floors and soffits? Envelope requirements apply to floors and floor soffits. An exterior floor or soffit is a horizontal exterior partition, or a horizontal demising partition, under conditioned space.

Energy Code compliance is important for floors and soffits because heat travels through a building's exterior and demising surfaces and tends to travel from higher temperatures to lower temperatures by conduction, convection, or radiation. The greater the temperature difference, the greater the rate of heat transfer. Installing Energy Code-compliant floor and soffit insulation helps keep a building warm in the winter and cool in the summer. Adequate insulation also helps reduce the amount of gas and electricity needed to operate space heating and air conditioning equipment.

Opaque construction assemblies often consist of one or more types of insulation in different locations for cavity insulation and continuous insulation. When choosing insulation, it is important to consider where the material will be installed in the construction assembly and how much insulation is necessary to meet or exceed the Energy Code.

In many cases, determining the best strategy for insulating depends on the building design and overall project budget.

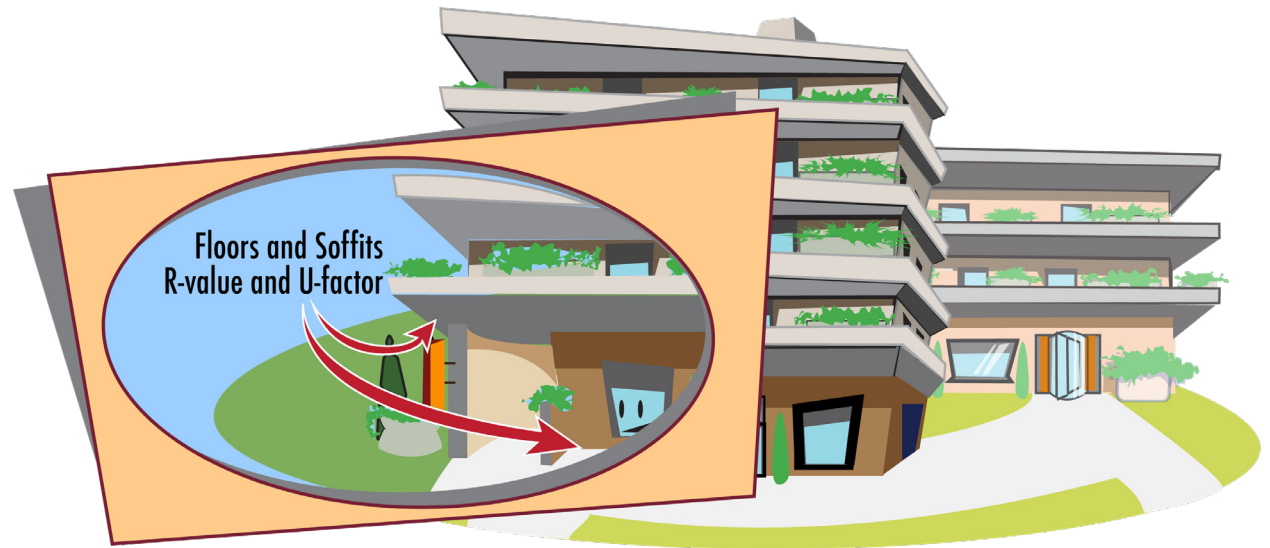


Figure 5. Exterior Floors and Soffits in a Multifamily Building



WHAT'S NEW

The 2022 Prescriptive multifamily insulation requirements for slab-on-grade, wood-framed, and raised mass floors are the same as those for low-rise multifamily buildings in the 2019 Energy Code. However, an "Other" category has been added for any other floor construction type, and it uses values from the 2019 Energy Code for nonresidential buildings.



WHAT'S NEW

Note that in the 2022 Energy Code, the same Prescriptive floor and soffit insulation requirements apply to all multifamily buildings regardless of the number of habitable stories.

Mandatory and Prescriptive Multifamily New Construction and Addition Floor Requirements Associated with Conditioned Spaces

Project Scope	Exterior and Demising Floor Insulation Requirements <i>When associated with conditioned spaces</i> §§110.8(a)-(c), 170.2(a)5	Interior Floor Requirements ¹ <i>When associated with conditioned spaces</i>
New Construction	YES	N/A
Addition	YES	N/A
Conditioning an existing building for the first time	YES	N/A

¹ Interior floors are the floors that separate conditioned spaces from other enclosed conditioned spaces.

Table 20. Mandatory and Prescriptive Multifamily New Construction and Addition Floor Requirements Associated with Conditioned Spaces



Key Terms

R-value is the measure of the thermal resistance of insulation or any material or building component expressed in ft²-hr-°F/Btu. All insulation must be certified by the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS) that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Material."

U-factor is the overall coefficient of thermal transmittance of a fenestration, wall, floor, or roof/ceiling component, in Btu/(hr × ft² × °F), including air film resistance at both surfaces.

New Construction and Additions

When associated with conditioned spaces, New Construction and Additions must meet Energy Code requirements for floors and soffits. See Table 21 for applicable Prescriptive Energy Code sections.

Floor Insulation Requirements

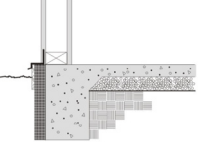
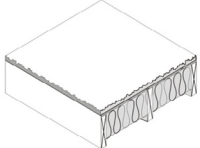
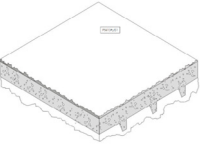
U-factors for common construction assemblies can be determined based on framing type and spacing, cavity insulation, and the type and thickness of any continuous insulation. Determining proposed assembly U-factor can be done by either using the tables under [Joint Reference Appendix JA4.4 Floors and Slabs](#) or by modeling all the layers of the construction assembly using CEC-certified software. Compliance for New Construction can use an area-weighted average U-factor calculation. Area-weighted average calculations are not allowed for Alterations.

Exterior and demising floors must have an overall assembly U-factor no greater than the applicable value in [Table 170.2-A, the multifamily Prescriptive Envelope Component Package](#), or show compliance using the Performance Approach. Note that perimeter slab insulation is required only for low-rise multifamily buildings in Climate Zone 16.

Additionally, heated slab-on-grade floors must meet the Mandatory insulation requirements of [§110.8\(g\) Insulation Requirements for Heated Slab Floors](#).

See Table 21 for the Prescriptive floor and soffit U-factor requirements for multifamily New Construction and Additions.

Prescriptive Floor and Soffit U-factor Requirements for New Construction and Additions (Table 170.2-A)

Floor Type	Climate Zone 1	Climate Zone 2, 11, 14	Climate Zones 3-10	Climate Zones 12	Climate Zone 13	Climate Zone 15	Climate Zone 16
Slab Non-heated ¹ Low-rise Multifamily ²  Joint Reference Appendix JA4-Table 4.4.7	NR	NR	NR	NR	NR	NR	≤ 0.58 (≥ R-7)
Wood-framed  Joint Reference Appendix JA4-Table 4.4.1 or JA4-Table 4.4.2	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)	≤ 0.037 (≥ R-19)
Raised Mass Raised mass floors with a heat capacity ≥ 7.0 Btu/ft²-°F  Joint Reference Appendix JA4-Table 4.4.6	≤ 0.092 (≥ R-8)	≤ 0.092 (≥ R-8)	≤ 0.269 (≥ R-0)	≤ 0.138 (≥ R-4)	≤ 0.092 (≥ R-8)	≤ 0.138 (≥ R-4)	≤ 0.092 (≥ R-8)
Any other type of floor not listed above	≤ 0.048	≤ 0.039	≤ 0.071	≤ 0.071	≤ 0.071	≤ 0.039	≤ 0.039

¹ Heated slabs for any multifamily building type will be required to meet the Mandatory slab edge insulation requirements of [§110.8\(g\) Insulation Requirements for Heated Slab Floors](#)

² High-rise multifamily buildings have no Prescriptive non-heated slab edge requirements

Table 21. Prescriptive Floor and Soffit U-factor Requirements for New Construction and Additions ([Table 170.2-A](#))



Vapor Retarder - Floors

Vapor retarders or barriers are a Mandatory requirement per [§160.1\(d\)](#) for New Construction and Additions, supporting special coverings over framing and insulation that protect the assembly components from moisture condensation. Water build-up due to condensation can cause the insulation to lose effectiveness, cause structural damage, and generate mold that may contribute to indoor air quality problems.

In Climate Zones 1-16, the earth floor of any unvented crawl space must be covered with a Class I or Class II vapor retarder. This requirement also applies to controlled ventilation crawl spaces for buildings complying with the Exception to [§160.1\(c\)](#).

Key Term

Controlled Ventilation Crawlspace (CVC) is a crawl space in a residential building where the side walls of the crawlspace are insulated rather than the floor above the crawlspace. A CVC has automatically controlled crawl space vents. Credit for a CVC is permitted for multifamily buildings that use the Performance Approach to compliance.

Vapor Retarder Class is a measure of the ability of a material or assembly to limit the amount of moisture that passes through the material or assembly meeting Section 202 of the California Building Code.

Alterations

Projects that include floors can trigger Energy Code requirements. See Table 22 for when Energy Code U-factor requirements apply.

WHAT'S NEW

The 2022 Energy Code has added Mandatory floor insulation requirements for Alterations. See [§180.2\(a\)3](#) and Table 23.

Floor Insulation Requirements

When planning an Alteration, see the New Construction and Additions subtopic on [page 20](#) for insulation key terms and ways to determine U-factor for an altered construction assembly.

When an exterior or demising floor is altered, insulation must be provided to meet the Mandatory requirements in Table 23 below.

Alteration Project Scopes that Trigger Floor Requirements in Multifamily Buildings

Project Scope	Exterior and Demising Floor U-factor Requirements §§ 110.8(a)-(c), 180.2(a)3	Interior Floor Requirements ¹
Altering a floor in an existing space by opening the floor, or stripping down to the stud	Alteration See Table 23	N/A
Non-altered floor in a space in which other floors are being altered	N/A	N/A
Rebuilding a floor in the same location	Alteration See Table 23	N/A
Conditioning an existing space for the first time (newly conditioned)	New Construction See Previous Section "New Construction and Additions"	N/A

¹ Interior floors are the floors that separate conditioned spaces from other enclosed conditioned spaces.

Table 22. Alteration Project Scopes that Trigger Floor Requirements in Multifamily Buildings

Mandatory Insulation Required for Exterior or Demising Floors in Multifamily Alterations - All Climate Zones

Floor Type	Altered Floor Requirements R-value	Altered Floor Requirements Area-weighted Average U-factor
Raised Floors	§§110.8(a)-(c), 180.2(a)3	§§110.8(a)-(c), 180.2(a)3
Framed Floors	≥ R-11	≤ 0.071
Mass Floors ¹	≥ R-6	≤ 0.111

¹ Raised mass floors with a heat capacity ≥ 7.0 Btu/ft²-°F

Table 23. Mandatory Insulation Required for Exterior or Demising Floors in Multifamily Alterations

Fenestration

Why is compliance required for fenestration? Choosing the proper windows, glazed doors, and skylights is one of the most important design decisions to ensure compliance with the Energy Code. The use of high-performance fenestration can reduce energy consumption by decreasing the heating, cooling, and lighting loads in multifamily buildings. The size, orientation, shading, and type of fenestration products can dramatically affect overall energy performance.

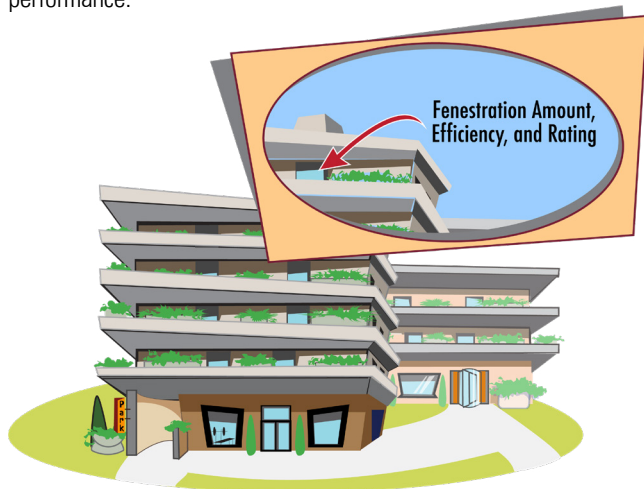


Figure 6. Fenestration in a Multifamily Building

Key Terms

Chromogenic Glazing is a class of switchable glazing which includes active materials (e.g., electrochromic) and passive materials (e.g., photochromic and thermochromic) permanently integrated into the glazing assembly. Their primary function is to switch reversibly from a high transmission state to a low transmission state with associated changes in VT and SHGC.

Clerestory Fenestration is fenestration installed above a roofline greater than or equal to 60° from the horizontal, or any portion of exterior vertical glazing greater than eight feet per floor above the finished floor of a space.

Fenestration Area for windows, glazed doors, and other fenestration products is the total rough opening area which includes the fenestration and fenestration frame components in the exterior walls and roofs.

Fenestration Product is any transparent or translucent material plus any sash, frame, mullions, and dividers in the facade of a building. This includes, but is not limited to, windows, glazed doors, skylights, curtain walls, dynamic glazing, garden windows, glass block, and glazing used in greenhouses.

Field-fabricated Fenestration is fabricated at the building site from elements that are not sold together as a fenestration product (that is, separate glazing, framing, and weatherstripping elements). Field-fabricated does not include site-assembled frame components that were manufactured elsewhere with the intention of being assembled on site, such as knocked-down products, sunspace kits, and curtain walls.

Glazed Door is an exterior door having a glazed area of 25% or greater of the area of the door. Glazed doors must meet fenestration product requirements.

Manufactured Fenestration is a fenestration product constructed of materials that are factory-cut or otherwise factory-formed with the specific intention of being used to fabricate a fenestration product. Knocked down or partially assembled products may be sold as a fenestration product when provided with temporary and permanent labels, as described in §10-111, or as a site-built fenestration product when not provided with temporary and permanent labels, as described in §10-111.

NASF 2017 Performance Class Architectural Window (AW): Product must be certified to meet the North American Fenestration Standard (NAFS) for an Architectural Window (AW) per AAMA/WDMA/CSA 101/1.S.2/A440-2017 (American Architectural Manufacturers Association/Window and Door Manufacturers Association/Canadian Standards Association document titled “North American Fenestration Standard/Specification for windows, doors, and skylights” (2017)).

AW is commonly used in high-rise and mid-rise buildings to meet increased loading requirements and limits on deflection, and in buildings where frequent and extreme use of the fenestration products is expected. This is typically determined by the structural engineer of the project.

Overhang is a contiguous opaque surface, oriented horizontally, and projecting outward horizontally from an exterior vertical surface.

Relative Solar Heat Gain Coefficient (RSHGC) is the ratio of solar heat gain through a fenestration product (corrected for external shading) to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

Shading is the protection from heat gains because of direct solar radiation by permanently attached exterior devices or building elements, interior shading devices, glazing material, or adherent materials.

Shading Coefficient (SC) is the ratio of the solar heat gain through a fenestration product to the solar heat gain through an unshaded 1/8-inch-thick clear double strength glass under the same set of conditions. For multifamily buildings, this must exclude the effects of mullions, frames, sashes, and interior and exterior shading devices.

Skylight is fenestration installed on a roof less than 60° from the horizontal.

Skylight Area is the area of the rough opening for the skylight.

Skylight Type is one of the following three types of skylights: glass mounted on a curb, glass not mounted on a curb, or plastic (assumed to be mounted on a curb).

Solar Heat Gain Coefficient (SHGC) is the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

Tinted Glass is glass colored by incorporation of a mineral admixture resulting in a degree of tinting. Any tinting reduces both visible and radiant transmittance.

U-factor is the overall coefficient of thermal transmittance of a fenestration, wall, floor or roof/ceiling component, in Btu / (hr× ft²× °F), including air film resistance at both surfaces.

Visible Transmittance (VT) is the ratio (expressed as a decimal) of visible light that is transmitted through a glazing fenestration. The higher the VT rating, the more light is allowed through a window or other fenestration product.

Window Film is a fenestration attachment product that consists of a flexible adhesive-backed polymer film which may be applied to the interior or exterior surface of an existing glazing system.



New Construction and Additions

When associated with conditioned spaces, New Construction and Additions must meet Energy Code requirements for fenestration. See Table 24 for the applicable Mandatory and Prescriptive Energy Code sections.

Prescriptive Fenestration Requirements

The Energy Code places Prescriptive limits on window glazing and skylight area and defines minimum efficiency requirements. Newly-constructed projects must meet the following requirements to comply Prescriptively:

- ✦ U-factor and relative solar heat gain coefficient (RSHGC) performance requirements apply to all fenestration with some exceptions. Visible transmittance (VT) applies to curtain wall, storefront, and AW-rated vertical glazing in high-rise multifamily buildings. VT requirements do not apply to any fenestration associated with low-rise multifamily buildings, including both dwelling units and common use areas. Skylights also have Prescriptive haze value requirements. See Tables 25, 26, and 27 on the following pages for specific requirements.
- ✦ The maximum vertical fenestration area must be the smaller of the following:
 - ◊ Maximum 20% window to conditioned floor area
 - ◊ Maximum 40% window to gross exterior wall area
 Demising walls are not part of the gross exterior wall area used to determine Prescriptive maximum vertical fenestration area, and windows and glass doors in demising walls are not included when calculating total proposed vertical fenestration area.
- ✦ Skylight area must not exceed 5% of gross exterior roof area, except for spaces with ceilings over 55 feet high which must not exceed 10% of gross exterior roof area. Skylights over unconditioned spaces, such as some atria, do not count towards the skylight-to-roof ratio [SRR] limit.

If any of these Prescriptive requirements cannot be met, the Performance Approach must be used to demonstrate compliance.

Alternative Compliance for Visible Transmittance Requirement

An alternative method of demonstrating Prescriptive compliance is to show that the visible transmittance (VT) is at least 0.11/WWR, where WWR is the window area to gross wall area ratio for the entire building (see [Equation 170.2-B](#)). This enables buildings with higher WWR to meet the Prescriptive standards with a lower VT value, since the VT requirement is tied to using daylighting potential.

Note that the Prescriptive VT requirement is an area-weighted average. For example, a façade that has high VT windows low along the wall is acceptable, provided that the window area-weighted VT meets the minimum Prescriptive requirement.

Additions > 700 ft² §180.1(a)1Aii

For Additions greater than 700 ft², the maximum fenestration allowance is either 175 ft² or 20% of the conditioned floor area of the Addition only, whichever is greater.

Mandatory and Prescriptive Multifamily New Construction and Addition Fenestration Requirements Associated with Conditioned Spaces

Project Scope ¹	Fenestration U-factor ² Requirements §§110.6, 160.1(e), 170.2(a)3	Fenestration RSHGC ^{2,3} Requirements §§110.6, 170.2(a)3	Fenestration VT Requirements §§110.6, 170.2(a)3	Maximum Fenestration Area Requirements §§170.2(a)3, ⁴ 180.1(a)1Aii ⁵
New Low-rise Multifamily Building	YES	YES	No	YES
New High-rise Multifamily Building	YES	YES	YES	YES
Conditioning a Low-rise Multifamily existing unconditioned space for the first time	YES	YES	No	YES
Conditioning a High-rise Multifamily existing unconditioned space for the first time	YES	YES	YES	YES
Low-rise Multifamily Additions > 700 ft²	YES	YES	No	YES ⁵
High-rise Multifamily Additions > 700 ft²	YES	YES	YES	YES ⁵

RSHGC = relative solar heat gain coefficient; **VT** = visible transmittance.

¹ Applies to new buildings, Additions, and conditioning an existing space for the first time

² Exceptions to §§170.2(a)3Aii and 170.2(a)3Aiiib say that when chromogenic glazing is used:

- ✦ The chromogenic window area cannot be included with other glazing types in the area-weighted efficiency value
- ✦ The lower-rated labeled U-factor and SHGC, or the lower-rated labeled RSHGC, can be used to show compliance if automatic controls are used to regulate solar gain and light transmittance.

³ RSHGC can be reduced with exterior shading such as overhangs using either [Equation 170.2-A](#) or the Performance Approach.

⁴ For vertical glazing, use the smaller of the window-to-wall ratio versus 20% of conditioned floor area. For skylights, use the skylight-to-roof ratio.

⁵ Additions > 700 ft² must meet fenestration area requirements of §180.1(a)1Aii, instead of §170.2(a)3.

Table 24. Mandatory and Prescriptive Multifamily New Construction and Addition Fenestration Requirements Associated with Conditioned Spaces



WHAT'S NEW

The 2022 Energy Code changes the type and amount of unrated site-built fenestration in low-rise and high-rise multifamily buildings that is allowed to show compliance using alternate default U-factor, SHGC, and VT using NAG calculations. See [Table 28](#) for more details.

- ✦ Low-rise multifamily buildings no longer have requirements specific to west-facing fenestration.
- ✦ The fenestration area-weighted average Mandatory U-factor for multifamily buildings is ≤ 0.58 . The Mandatory U-factor can be used only with the Performance Approach. Exceptions are included for up to 0.5% of the conditioned floor area, and for up to 30 ft² of dual-glazed greenhouse or garden windows.

Prescriptive Fenestration Requirements - New Construction and Additions: Curtain Wall and Storefront (Table 170.2-A)

Fenestration Type	Efficiency	CZ 1	CZ 2, 4	CZ 3, 5	CZ 6	CZ 7, 8	CZ 9-13	CZ 14	CZ 15	CZ 16
Curtain Wall (Non-structural system that hangs off, but does not support, the building structure)	Low-rise or High-rise U-factor	≤ 0.38	≤ 0.41	≤ 0.41	≤ 0.41	≤ 0.41	≤ 0.41	≤ 0.41	≤ 0.41	≤ 0.38
	Low-rise RSHGC	NR	≤ 0.26	NR	≤ 0.26	≤ 0.26	≤ 0.26	≤ 0.25	≤ 0.26	NR
or Storefront (Structural system designed to support the building structure)	High-rise RSHGC	≤ 0.35	≤ 0.26	≤ 0.26	≤ 0.26	≤ 0.26	≤ 0.26	≤ 0.25	≤ 0.26	≤ 0.25
	Low-rise VT	NR	NR	NR	NR	NR	NR	NR	NR	NR
	High-rise VT	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46	≥ 0.46

CZ = Climate Zone; **RSHGC** = Relative solar heat gain coefficient; **VT** = Visible transmittance.

Table 25. Prescriptive Fenestration Requirements - New Construction and Additions: Curtain Wall and Storefront (Table 170.2-A)

Prescriptive Fenestration Requirements - New Construction and Additions: NAFS 2017 Performance Class AW (Table 170.2-A)

Fenestration Type	Efficiency	CZ 1	CZ 2, 4	CZ 3, 5	CZ 6	CZ 7, 8	CZ 9-13	CZ 14	CZ 15	CZ 16
AW Rated (Product must be certified to meet the North American Fenestration Standard (NAFS) for an Architectural Window (AW) per AAMA/WDMA/CSA 101/I.S.2/A440-2017)	Low-rise or High-rise U-factor	≤ 0.38	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.38
	Low-rise RSHGC	NR	≤ 0.24	NR	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	NR
	High-rise RSHGC	≤ 0.35	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24
	Low-rise VT	NR	NR	NR	NR	NR	NR	NR	NR	NR
	High-rise VT	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37	≥ 0.37

CZ = Climate Zone; **RSHGC** = Relative solar heat gain coefficient; **VT** = Visible transmittance.

Table 26. Prescriptive Fenestration Requirements - New Construction and Additions: NAFS 2017 Performance Class AW (Table 170.2-A)



Prescriptive Fenestration Requirements - New Construction and Additions: All Other - Including Glass Doors, Windows and Skylights (Table 170.2-A)

Fenestration Type	Efficiency	CZ 1	CZ 2, 4	CZ 3, 5	CZ 6	CZ 7, 8	CZ 9-13	CZ 14	CZ 15	CZ 16
All Other (Any vertical fenestration not listed above such as glass doors ¹ , operable, fixed or punched windows, and skylights ²)	Low-rise or High-rise U-factor	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.34	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.30
	Low-rise RSHGC	NR	≤ 0.23	NR	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	NR
	High-rise RSHGC	≤ 0.35	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23	≤ 0.23
	Low-rise VT	NR	NR	NR	NR	NR	NR	NR	NR	NR
	High-rise VT	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Low-rise or High-rise Skylight Haze Value ³	> 90%	> 90%	> 90%	> 90%	> 90%	> 90%	> 90%	> 90%	> 90%

CZ = Climate Zone; **RSHGC** = Relative solar heat gain coefficient; **VT** = Visible transmittance.

1 For each dwelling unit, ≤ 3 ft² of new glazing area installed in doors is not required to meet the U-factor and RSHGC requirements above

2 For each dwelling unit, ≤ 16 ft² of skylight is allowed a U-factor of ≤ 0.55 and SHGC ≤ 0.30

3 Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of the skylight and light well

Table 27. Prescriptive Fenestration Requirements - New Construction and Additions: All Other - Including Glass Doors, Windows and Skylights (Table 170.2-A)

Daylighting

Both conditioned and unconditioned multifamily New Construction and Addition spaces over 5,000 ft² and with ceiling heights over 15 feet in Climate Zones 2 through 15 may need to meet the Prescriptive daylighting requirements in [§170.2\(b\)](#). See our [2022 Nonresidential Envelope Fact Sheet](#) for more information on these requirements.



Mandatory Methods for Determining Fenestration U-factor and SHGC

There are some differences between high-rise and low-rise multifamily buildings in the options available for determining U-factor, solar heat gain coefficient (SHGC), and visible transmittance (VT) for site-built fenestration for Energy Code compliance. Site-built vertical windows and skylights in all multifamily buildings can use the default U-factor and SHGC values in [Tables 110.6-A and 110.6-B](#) of the Energy Code, or they can be National Fenestration Rating Council (NFRC) rated and certified.

[Nonresidential Reference Appendix NA6](#) default values calculated based on glazing and framing type are also allowed for the following site-built fenestration:

- ✦ Multifamily dwelling unit fenestration meeting area restrictions (the smaller of 20% window-to-floor ratio and 40% window-to-wall ratio)
- ✦ Low-rise multifamily buildings: Less than 250 ft² of new, altered, and replacement vertical windows and skylights
- ✦ High-rise multifamily buildings: Less than 200 ft² of new, altered, and replacement skylights only

Note that the default values for the listed glazing and framing types will not meet Prescriptive requirements, so the Performance Approach must be used in these situations.

Using NFRC Ratings

NFRC has two rating methods. Both methods result in whole product ratings that include all components (e.g., frame, glass, spacer, and gas fill). Both methods require initial simulation and testing typically done by the frame manufacturer. The principal difference is when the insulating glass unit properties are included in the calculations:

1. The NFRC-rated method is commonly used for manufactured products such as punched opening. The NFRC-rated products are calculated at the time of certification by the simulation laboratory and already labeled before the product is shipped to a distributor.
2. The component modeling approach (CMA) is implemented in software named CMAST. The CMA method is convenient when the frames have already been approved and added to the approved CMAST software. If the frame choice and the glass choice are in the CMAST software, CMA certifications can be provided very quickly for specified products at a particular project address. The CMA is used for a specific project with a specific insulating glass unit by an NFRC Accredited Calculation Entity (ACE) at the time the project is needed.

The NFRC issues certificates and provides labels for the products it rates. For an example of an NFRC label, see Figure 7. For an example of a certificate, see Figure 8.

Mandatory Methods for Determining Fenestration U-factor and SHGC for Multifamily New Construction and Additions: U-factor and SHGC Methods Allowed for Different Fenestration Types

Methods for Determining Fenestration U-factor and SHGC	Manufactured Windows	Manufactured Skylights	Site-built Windows	Site-built Skylights	Field-fabricated Windows and Skylights
NFRC-rated Products	Yes	Yes	No	No	No
NFRC Component Modeling Approach (CMA)	No	No	Yes	Yes	No
Default Tables 110.6-A and 110.6-B	Yes	Yes	Yes ¹	Yes	Yes
Nonresidential Reference Appendix NA6	No	No	See Notes ¹ and ² below	See Note ² below	No

- 1 Dwelling units meeting the maximum area restrictions (the smaller of 20% window-to-floor ratio and 40% window-to-wall ratio) using unrated site-built fenestration are allowed to use the NA6 or default values.
- 2 Per [CEC Blueprint Issue 144](#), NA6 allows low-rise multifamily default U-factor, SHGC, and VT calculations for less than 250 ft² of new, altered, and replacement site-built vertical windows and skylights. NA6 default values are not allowed for site-built vertical windows in high-rise multifamily buildings. NA6 allows high-rise multifamily default U-factor, SHGC, and VT calculations for less than 200 ft² of new, altered, and replacement site-built skylights only.

Table 28. Mandatory Methods for Determining Fenestration U-factor and SHGC for Multifamily New Construction and Additions

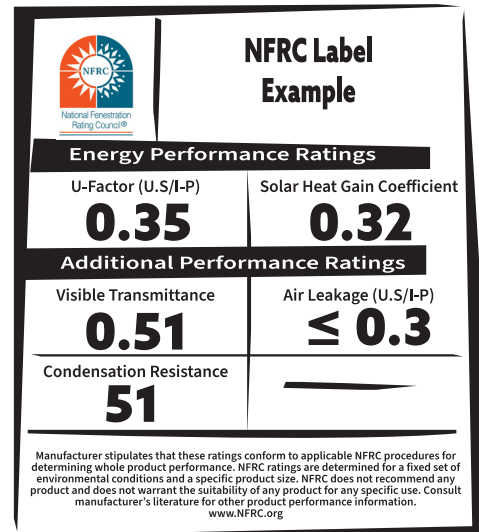


Figure 7. Example of a National Fenestration Rating Council (NFRC) Label



Figure 8. Example of a National Fenestration Rating Council (NFRC) Certificate



Fenestration Alterations

Comparing Prescriptive Requirements for Alterations and Additions

Depending upon the square footage of fenestration that is altered or added, projects trigger different requirements for U-factor, relative solar heat gain coefficient, visible transmittance, and fenestration area. See Table 29 to identify the Energy Code sections and tables that apply to the fenestration in your project.

Prescriptive Fenestration Requirements for Altered Vertical Fenestration

Prescriptive maximum U-factor and RSHGC values from [Table 180.2-B](#), or the area-weighted U-factor and RSHGC from [Table 170.2-A](#) are required for altered vertical fenestration and skylights (replacements) in existing multifamily buildings. Glass replaced in an existing sash and frame, or sashes replaced in an existing frame, are considered repairs as long as the replacement glass is equal to or better than the original glass energy performance.

Window Films

NFRC-certified window films may be used for Alterations in the Performance Approach to lower the effective U-factor and solar heat gain coefficient (SHGC) of the glazing. The [2022 Nonresidential and Multifamily Alternative Calculation Method Reference Manual](#) has a detailed description of the procedures used to calculate SHGC. For Alterations involving the use of window films, see [Nonresidential Reference Appendix NA7.4.2 – Window Films](#) criteria and [§110.6](#) of the Energy Code.

Fenestration Mandatory and Prescriptive Requirements - Alterations

Fenestration Type	Project Scope	Fenestration U-factor Requirements §§110.6-7, 180.2(b)1C	Fenestration RSHGC Requirements §§110.6-7, 180.2(b)1C	Fenestration VT Requirements §§110.6-7, 180.2(b)1C	Maximum Fenestration Area Requirements §§180.2(b)1C, 170.2(a)3
Vertical	Altering ≤ 150 ft ²	YES Per Table 180.2-B	NR	NR	NR
	Altering > 150 ft ²	YES Per Table 180.2-B	YES Per Table 180.2-B	YES Per Table 180.2-B	NR
	Adding ≤ 50 ft ²	NR	NR	NR	NR
	Adding > 50 ft ²	YES Per Table 180.2-B	YES Per Table 180.2-B	YES Per Table 180.2-B	YES Smaller of 20% WFR and 40% WWR
Skylights	Altering Any Skylights	YES Per Table 180.2-B	YES Per Table 180.2-B	YES Per Table 180.2-B	NR
	Adding ≤ 16 ft ² ¹	YES ≤ 0.55	Yes ≤ 0.30	YES Per Table 180.2-B	NR
	Adding > 16 ft ² ¹	YES Per Table 180.2-B	YES Per Table 180.2-B	YES Per Table 180.2-B	YES 5% SRR

SRR = Skylight-to-roof ratio; **WFR** = Window-to-floor ratio; **WWR** = Window-to-wall ratio.

¹ Per dwelling unit

Table 29. Fenestration Mandatory and Prescriptive Prescriptive Requirements - Alterations

WHAT'S NEW

The 2022 Energy Code reduces the allowable added vertical fenestration area exempt from the U-factor, RSHGC, and VT requirements from 75 ft² to 50 ft².



Solid Doors

Why is compliance required for solid doors? Solid doors impact energy use in a building when associated with conditioned space. Energy efficient solid doors that separate a building's conditioned space from the outside can help increase comfort and reduce energy use.



Figure 9. Solid Doors in a Multifamily Building

Key Terms

Door (or Solid Door) is an operable opening in the building envelope, including swinging and roll-up doors, fire doors, pet doors and access hatches with less than 25% glazed area. When that operable opening has 25% or more glazed area, it is a glazed door.

Glazed Door is an exterior door having a glazed area of 25% or greater of the area of the door. Glazed doors must meet fenestration product requirements.

New Construction and Additions

New Construction and Additions must meet the same Energy Code requirements for new and replacement solid doors.

See [Tables 30 and 32](#) on the next page for the applicable Energy Code sections.

Mandatory Requirements for Solid Door U-factor and Air Leakage

[Table 30](#) summarizes the Mandatory methods available to determine solid door U-factors for Energy Code compliance per [§110.6](#) and [Joint Reference Appendix JA4 Table 4.5.1](#). The default solid door U-factors from [Joint Reference Appendix JA4 Table 4.5.1](#) are shown in [Table 31](#) on the next page. [§110.6\(a\)1](#) details Mandatory measures to reduce air leakage for manufactured exterior and demising doors, while [§110.6\(b\)](#) lists caulking and sealing requirements for field-fabricated exterior and demising doors.

Prescriptive Requirements for Dwelling Unit and Common Use Area Solid Entry Doors

The Energy Code places Prescriptive maximum U-factor limits on exterior and demising solid doors used for entry into conditioned multifamily dwelling units and common use areas. [Table 32](#) lists those requirements by space type, door type, and Climate Zone. Swinging doors that are required to have fire protection are not required to meet these requirements. If any of the Prescriptive requirements cannot be met, the Performance Approach must be used to demonstrate compliance.



Mandatory Methods Available to Determine Solid Door U-factors for Compliance per §110.6

Method	Manufactured Solid Door	Field-Fabricated Door
NFRC-rated Products	Yes	No
Default per Joint Reference Appendix JA4 Table 4.5.1¹	Yes	Yes

NFRC = National Fenestration Rating Council.

¹ Non-NFRC-rated doors must use the Performance Approach to show compliance.

Table 30. Mandatory Methods Available to Determine Solid Door U-factors for Compliance per §110.6

Default Solid Door U-factors by Type

Solid Door Type	Maximum U-factor
Uninsulated single-layer metal swinging doors or non-swinging doors, including single-layer uninsulated access hatches and uninsulated smoke vents	≤ 1.45
Uninsulated double-layer metal swinging doors or non-swinging doors, including double-layer uninsulated access hatches and uninsulated smoke vents	≤ 0.70
Insulated metal swinging doors, including fire-rated doors, insulated access hatches, and insulated smoke vents	≤ 0.50
Wood doors with a minimum nominal thickness of 1-3/4 inches (44 mm), including panel doors with a minimum panel thickness of 1-1/8 inches (28 mm), solid core flush doors, and hollow core flush doors	≤ 0.50
Any other wood door	≤ 0.60
Uninsulated single-layer metal roll-up doors, including fire-rated doors	≤ 1.45
Insulated single-layer metal sectional doors with a minimum insulation nominal thickness of 1-3/8 inches expanded polystyrene (R-4 per inch)	≤ 0.179

Table 31. Default Solid Door U-factors by Type (excerpted from [Joint Reference Appendix JA4 Table 4.5.1](#))

Solid Door Prescriptive U-factor Requirements: Exterior and Demising Doors (Table 170.2-A)^{1, 2}

Door Type	CZ 1	CZ 2-15	CZ 16
Dwelling Unit Entry	≤ 0.20	≤ 0.20	≤ 0.20
Common-use Entry: Non-swinging	≤ 0.50	≤ 1.45	≤ 0.50
Common-use Entry: Swinging	≤ 0.70	≤ 0.70	≤ 0.70

CZ = Climate Zone

- ¹ Swinging doors that are required to have fire protection are exempt from these requirements
- ² If any of the Prescriptive requirements cannot be met, the Performance Approach must be used to demonstrate compliance.

Table 32. Solid Door Prescriptive U-factor Requirements: Exterior and Demising Doors ([Table 170.2-A](#))

Solid Door Alterations

When solid exterior or demising doors are added to existing conditioned space in a multifamily building, those doors must meet the same requirements shown in Table 32 for New Construction. Altered solid doors have no Energy Code requirements.



Envelope HERS Measures

Why does compliance require HERS verification of envelope performance and materials? Decades of research have concluded that just specifying an efficient piece of equipment or high levels of insulation is not sufficient for good performance. Correct installation of the assembly or component is essential to its long-term efficiency. However, understanding the correct installation and testing procedures requires more specialized knowledge than commonly included in training of building inspectors, so the CEC created the Home Energy Rating System (HERS) program to maintain an industry of third-party verifiers who are specifically trained in each measure.

Verifications are performed by a HERS Rater, who must be a third-party inspector who is not financially involved in the project or employed by the contractor. HERS Raters are certified to verify compliance on behalf of the building owner and receive special training from the HERS Providers. CEC has approved HERS Providers who train HERS Raters and maintain registries for project documentation. For more information on the HERS Program, see the [Fact Sheet: Low-rise and High-rise Multifamily Buildings: Just the Basics: HERS Verification 2022](#).

Table 33 lists key HERS measures required for the Prescriptive pathway or available for Performance compliance credit for the envelope in multifamily buildings.

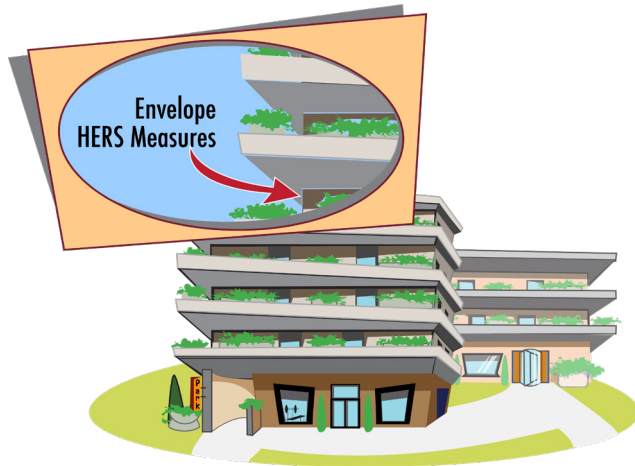


Figure 10. HERS Measures in a Multifamily Building

Envelope HERS Verification Measures for Multifamily: New Construction, Additions, and Alterations			
Verification Measure	Project Scope	Trigger	Description
Quality Insulation Installation	Low-rise New Construction and Additions	<ul style="list-style-type: none"> ✦ New Construction: Prescriptive Compliance Approach (LMCC-NCB-01-E) ✦ Addition: Prescriptive Compliance Approach for Addition > 700 ft² (LMCC-ENV-E) ✦ Or as indicated in the LMCC-PRF-01-E 	The building envelope is inspected for proper air sealing prior to insulation installation. Insulation is verified as meeting required R-value in the Certificate of Compliance, and per HERS protocol of Residential Reference Appendix RA3.5 .
	High-rise New Construction and Additions	NR	NR
	Alterations	NR	NR
Building Envelope Air Leakage Blower Door Testing	Low-rise New Construction and Additions	Using a non-balanced indoor air quality ventilation system in the dwelling units as indicated in LMCC-PRF-01-E	Dwelling unit envelope leakage is ≤ 0.3 cubic feet per minute at 50 Pa (0.2 inch water) per ft ² of dwelling unit envelope surface area per HERS protocol of Residential Reference Appendix RA3.8 .
	High-rise New Construction and Additions	Using a non-balanced indoor air quality ventilation system in the dwelling units as indicated in NRCC-PRF-01-E	Dwelling unit envelope leakage is ≤ 0.3 cubic feet per minute at 50 Pa (0.2 inch water) per ft ² of dwelling unit envelope surface area per HERS protocol of Nonresidential Reference Appendix NA2.3 .
	Alterations	NR	NR
Spray Polyurethane Foam (SPF) R-value	Low-rise New Construction, Additions, and Alterations	As indicated in LMCC-PRF-01-E	A HERS Rater must verify the installation of SPF insulation whenever R-values greater than the default R-value per inch are used for compliance per HERS protocol of Residential Reference Appendix RA3.5.6 : Default Values <ul style="list-style-type: none"> ✦ Open Cell: ≤ R-3.6 per inch ✦ Closed Cell: ≤ R-5.8 per inch
	High-rise New Construction, Additions, and Alterations	Not allowed	Not allowed

Table 33. Envelope HERS Verification Measures for Multifamily: New Construction, Additions, and Alterations



Compliance Forms

Guidance on where to find specific compliance forms can be found on the Energy Code Ace website at energycodeace.com/content/get-forms. There are separate forms for low-rise multifamily (Table 34) and high-rise multifamily (Table 35).

- ✦ Certificates of Compliance define the minimum envelope specifications that are to be supported in the design documents and construction of the permitted project.
 - ◇ If using the Performance Approach, which is only allowed for conditioned areas of a building, CEC-approved software must be used. For more, see www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-1.
 - ◇ Prescriptive non-HERS LMCC and all NRCC-ENV-E forms can be found on the Energy Code Ace website at energycodeace.com/LowriseMultifamilyForms/2022
- and
- ✦ Certificates of Installation must be provided by the installing contractor for each building feature that is subject to the Energy Code. The forms must be made available onsite for the building inspector and provided to the building owner. Certificates of Installation can be completed through the [Virtual Compliance Assistant](#).
- ✦ The installing contractor or general contractor must provide the NRCA form. The NRCA-ENV-02-F form must support that the installed fenestration meets or exceeds the criteria defined by the LMCC or NRCC compliance form. When default or [Nonresidential Reference Appendix NA6](#) applies, the NRCA form must show how those minimum requirements were met. The NRCA form must be made available onsite for the building inspector and provided to the building owner. The CEC provides this form on the Energy Code Ace website at energycodeace.com/NonresidentialForms/2022.
- ✦ The LMCV forms, when required, are completed by a HERS Rater and registered via a HERS Provider.

Compliance Forms Required for Low-rise Multifamily New Construction, Additions, and Envelope Alterations

Low-rise Compliance Methods and Building Envelope Features	Certificates of Compliance	Certificates of Installation	Certificates of Verification and Acceptance
Performance Method	LMCC-PRF-01-E	See below	See below
Prescriptive Method	LMCC-ENV-E	See below	See below
Opaque Envelope	See above	LMCI-ENV-E	See below
Site-Built Fenestration	See above	See above	NRCA-ENV-02-F
QII Air Infiltration Sealing	See above	LMCI-ENV-21-H	LMCV-ENV-21-H
QII Insulation Installation	See above	LMCI-ENV-22-H	LMCV-ENV-21-H

NOTE: Low-rise multifamily projects that require HERS measures must have all compliance forms registered via a HERS Provider (see [Blueprint Issue 145](#) from the CEC for more information). This includes all New Construction projects and Additions that include new dwelling units. Alterations might not have HERS measures; it depends on the scope of work. See our [Fact Sheet: Low-rise and High-rise Multifamily Buildings: Just the Basics: HERS Verification 2022](#) for more information.

Find a HERS Provider at the [CEC Home Energy Rating System Providers](#) website.

Table 34. Compliance Forms Required for Low-rise Multifamily New Construction, Additions, and Envelope Alterations

Compliance Forms Required for High-rise Multifamily New Construction, Additions, and Envelope Alterations

High-rise Compliance Methods and Building Envelope Features	Certificates of Compliance	Certificates of Installation	Certificates of Verification and Acceptance
Performance Method	NRCC-PRF-01-E	See below	See below
Prescriptive Method	NRCC-ENV-E	See below	See below
Opaque Envelope	See above	NRCI-ENV-E	See below
Site-built Fenestration	See above	See above	NRCA-ENV-02-F

Table 35. Compliance Forms Required for High-rise Multifamily New Construction, Additions, and Envelope Alterations

Videos on How to Complete Prescriptive Method Forms

Energy Code Ace offers a [video series](#) on how to use the Virtual Compliance Assistant for both the Prescriptive NRCC and NRCI forms.

Visit The Energy Code Ace [YouTube](#) channel for these videos and more.



For More Information

CALIFORNIA ENERGY COMMISSION

www.energy.ca.gov

Learn more about the California Energy Commission (CEC) and its programs on its website.

[2022 Building Energy Efficiency Standards](#)

Explore the main CEC web portal for the 2022 Energy Code, including information, documents, and historical information.

[2022 Building Energy Efficiency Standards Summary](#)

View or download this visual summary of the Energy Code's purpose, current changes and impact.

Energy Code Hotline

Call: 1-800-772-3300 (Free)

Email: Title24@energy.ca.gov

[Online Resource Center](#)

Use these online resources developed for building and enforcement communities to learn more about the Energy Code.



www.energycodeace.com

Stop by this online "one-stop-shop" for no-cost tools, training and resources designed to help you comply with California's Title 24, Part 6 and Title 20.



Tools

www.energycodeace.com/tools

Explore this suite of interactive tools to understand the compliance process, required forms, installation techniques and energy efficiency regulations in California.

[Reference Ace](#)

Navigate the Title 24, Part 6 Energy Code using an index, keyword search, and hyperlinked text.

[Q&Ace](#)

Search our online knowledge base or submit your question to Energy Code Ace experts.



Training

www.energycodeace.com/training

On-demand, live in-person, and online training alternatives are tailored to a variety of industry professionals and address key measures.



Resources

www.energycodeace.com/resources

Downloadable materials provide practical and concise guidance on how and when to comply with California's building and appliance energy efficiency standards.

Of Special Interest:

Fact Sheets

♦ [Multifamily Buildings: What's Changed in 2022](#)



Check EnergyCodeAce.com for our latest 2022 tools, training, and resources!

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