

Proposed section for multifamily buildings in the 2018 International Energy Conservation Code (IECC), presented to the Department of Energy's Denver Energy Codes Stakeholder Meeting on October 13, 2015. Contact Sean Denniston, Senior Project Manager at New Buildings Institute, by email at sean@newbuildings.org with any questions.

Modify the following Definitions:

Commercial Building. For this code, all buildings that are not included in the definition of "Residential building" or "Multifamily building."

Common Area. For this code, all portions of a *multifamily building* that are not dwelling units.

Multifamily Building. For this code, all Group R-2 buildings.

Residential Building. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group ~~R-2~~, R-3 and R-4 buildings three stories or less in height above grade plane.

Add a new section for multifamily buildings and renumber existing Chapter 5

C501.1 Scope. The provisions in this chapter are applicable to *multifamily buildings* and their building sites.

C501.2 Application. Multifamily buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1, provided the *building* has not less than four stories in height above grade plane.
2. The requirements of Sections C502 through C506.
3. The requirements of Section C507. The building energy cost shall be equal to or less than 85 percent (85%) of the standard reference design building.

C501.2.1 Application to replacement fenestration products. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC in Table C402.4.

Exception: An area-weighted average of the U-factor of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.4 shall be permitted to satisfy the U-factor requirements for each

Home of:

fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 shall not be combined in calculating the area-weighted average U-factor.

C502.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 2 of Section C501.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C502.2 and the thermal requirements of either the R-value-based method of Section C502.1.3; the U-, C- and F-factor-based method of Section C502.1.4; or the component performance alternative of Section C502.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C502.3.
3. Fenestration in building envelope assemblies shall comply with Section C502.4.
4. Air leakage of building envelope assemblies shall comply with Section C502.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C502.4, the building and building thermal envelope shall comply with Section C501.2, Item 1 or 3.

C502.1.1 Low-energy buildings. The following low-energy buildings, or portions thereof separated from the remainder of the building-by-building thermal envelope assemblies complying with this section, shall be exempt from the building thermal envelope provisions of Section C502.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h • ft² (10.7 W/m²) or 1.0 watt per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Greenhouses.

C502.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the building thermal envelope provisions of this code:

1. Are separate buildings with floor area not more than 500 square feet (50 m²).
2. Are intended to house electronic equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m²) and not intended for human occupancy.
3. Have a heating system capacity not greater than (17,000 Btu/hr) (5 kW) and a heating thermostat set point that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof U-factor less than 0.200 in Climate Zones 1 through 5 and less than 0.120 in Climate Zones 6 through 8.
5. Comply with the roof solar reflectance and thermal emittance provisions for Climate Zone 1.

C502.1.3 Insulation component R-value-based method. Building thermal envelope opaque assemblies shall meet the requirements of Sections C502.2 and C502.4 based on the climate zone specified in Chapter 3. For opaque portions of the building thermal envelope intended to comply on an insulation component R-value basis, the R-values for insulation in framing cavities, where required, and for continuous insulation, where required, shall be not less than that specified in the “Group R” column of Table C402.1.3, based on the climate zone specified in Chapter 3. The thermal resistance or R-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope required in accordance with Table C402.1.3 shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below grade wall, whichever is less. Opaque swinging doors shall comply with the “Group R” column of Table C402.1.4 and opaque roll-up or sliding doors shall comply with the “Group R” column of Table C402.1.3.

C502.1.4 Assembly U-factor, C-factor or F-factor-based method. Building thermal envelope opaque assemblies intended to comply on an assembly U-, C-or F-factor basis shall have a U-, C-or F-factor not greater than that specified in the “Group R” column of Table C502.1.4. The C-factor for the below-grade exterior walls of the building envelope, as required in accordance with Table C402.1.4, shall extend to a depth of 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor, whichever is less. Opaque swinging doors shall comply with the “Group R” column of Table C402.1.4 and opaque roll-up or sliding doors shall comply with the “Group R” column of Table C402.1.3.

C502.1.4.1 Thermal resistance of cold-formed steel walls. U-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Section C 402.1.4.1

C502.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Section C402.1.5.

C502.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Section C502.1, insulation shall meet the specific requirements of Sections C502.2.1 through C502.2.7.

C502.2.1 Multiple layers of continuous insulation board. Where two or more layers of continuous insulation board are used in a construction assembly, the continuous insulation boards shall be installed in accordance with Section C303.2. Where the continuous insulation board manufacturer's instructions do not address installation of two or more layers, the edge joints between each layer of continuous insulation boards shall be staggered.

C502.2.2 Roof assembly. The minimum thermal resistance (R-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in the “Group R” column of Table C502.1.3, based on construction

materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted U-factor is equivalent to the same assembly with the R-value specified in the "Group R" column of Table C402.1.3.
2. Where tapered insulation is used with insulation entirely above deck, the R-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the R-value specified in the "Group R" column of Table C502.1.3.
3. Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

C502.2.3 Thermal resistance of above-grade walls. The minimum thermal resistance (R-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in the "Group R" columns of Table C501.3, based on framing type and construction materials used in the wall assembly. The R-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3.

"Mass walls" shall include walls:

1. Weighing not less than 35 psf (170 kg/m²) of wall surface area.
2. Weighing not less than 25 psf(120 kg/m) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m³).
3. Having a heat capacity exceeding 7 Btu/ft² •°F (144 kJ/m² • K).
4. Having a heat capacity exceeding 5 Btu/ft² •°F (103 kJ/m² • K), where the material weight is not more than 120 pcf (1900 kg/m³).

C502.2.4 Floors. The thermal properties (component R-values or assembly U-, C-or F-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in the "Group R" columns of Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly. Floor framing cavity insulation or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

Exceptions:

1. The floor framing cavity insulation or structural slab insulation shall be permitted to be in contact with the top side of sheathing or continuous insulation installed on the bottom side of floor assemblies where combined with insulation that meets or

exceeds the minimum R-value in the "Group R" columns of Table C402.1.4 for "Metal framed" or "Wood framed and other" values for "Walls, Above Grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.

2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the building thermal envelope.

C502.2.5 Slabs-on-grade perimeter insulation. Where the slab on grade is in contact with the ground, the minimum thermal resistance (R-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors designed in accordance with the R-value method of Section C502.1.3 shall be as specified in the "Group R" columns of Table C402.1.3. The insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil.

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

C502.2.6 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

C502.2.7 Insulation of radiant heating systems. Radiant heating system panels, and their associated components that are installed in interior or exterior assemblies shall be insulated with a minimum of R-3.5 (0.62 m²/K • W) on all surfaces not facing the space being heated. Radiant heating system panels that are installed in the building thermal envelope shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the R-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C502.1.4.

Exception: Heated slabs on grade insulated in accordance with Section C502.2.5.

C502.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with Section C402.3.

C502.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C502.4.1 through C502.4.4 and Table C402.4.

C502.4.1 Maximum vertical fenestration area. The vertical fenestration area (not including opaque doors and opaque spandrel panels) shall not be greater than 30 percent of the gross above-grade wall area. The skylight area shall not be greater than 3 percent of the gross roof area.

C502.4.2 Minimum skylight fenestration area. Enclosed *common area* spaces greater than 2,500 square feet (232 m²) in floor area, directly under a roof, with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, or workshop shall comply with Section C402.4.2.

C502.4.3 Maximum U-factor and SHGC. The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Section C402.4.3.

C502.4.3.1 Increased skylight SHGC. In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with daylight responsive controls.

C502.4.3.2 Increased skylight U-factor. Where skylights are installed above daylight zones provided with daylight responsive controls, a maximum U-factor of 0.9 shall be permitted in Climate Zones 1 through 3 and a maximum U-factor of 0.75 shall be permitted in Climate Zones 4 through 8.

C502.4.3.3 Dynamic glazing. Where dynamic glazing is intended to satisfy the SHGC and VT requirements of Table C502.4, the ratio of the higher to lower labeled SHGC shall be greater than or equal to 2.4, and the dynamic glazing shall be automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this section where both the lower and higher labeled SHGC already comply with the requirements of Table C402.4.

C502.4.3.4 Area-weighted U-factor. An area-weighted average shall be permitted to satisfy the U-factor requirements for each fenestration product category listed in Table

C402.4. Individual fenestration products from different fenestration product categories listed in Table C402.4 shall not be combined in calculating area-weighted average U-factor.

C502.4.4 Doors. Opaque doors shall comply with the applicable requirements for doors as specified in the “Group R” columns of Tables C402.1.3 and C402.1.4 and be considered part of the gross area of above-grade walls that are part of the building thermal envelope. Other doors shall comply with the provisions of Section C502.4.3 for vertical fenestration.

C502.5 Air leakage-thermal envelope (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with this section.

C502.5.1 Verification. *Multifamily buildings* with not less than four stories above grade plane shall comply with Section C402.5. All other *multifamily buildings* shall comply with one of the following:

1. The building thermal envelope shall have an air leakage rate of not greater than 0.40 cfm/ft² (0.2 L/s • m²) when tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official when the tested. The *building* shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.
2. The requirements of Sections R402.4.1 through R402.4.4 and Sections C402.5.5 through C402.5.8.

Section C503 Mechanical

C503.1 General. Mechanical systems and equipment serving the building heating, cooling, or ventilation needs shall comply with this section based on the equipment and systems provided.

C503.2 Provisions applicable to all mechanical systems (Mandatory). Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Sections C403.2.1 through C403.2.8, Sections C403.10 through C403.2.13, Section C403.3 and Section C403.4.

Exception: Single-zone systems serving individual *dwelling units* that meet the requirements of Section R403.

C503.3 Ducts. All ducts shall meet the requirements of Section R403.3.

C503.1 High Pressure Ducts. Ducts and plenums designed to operate at static pressures greater than 3 inches water gauge (747 Pa) shall meet the requirements of C403.2.9.1.3.

Section C504
Water Heating

C504.1 General. The equipment, piping, controls and storage for hot water systems shall comply with the requirements of with Sections C404.2 through C404.8 and Section C404.11.

C504.2 Pools and Permanent Spas (Mandatory). The energy consumption of pools and permanent spas shall be in accordance with Sections C404.9.1 through C404.9.3 and APSP-15.

C504.3 Energy consumption of portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

Section C505
ELECTRICAL POWER AND LIGHTING SYSTEMS

C505.1 General. Electrical power and lighting systems shall comply with this section.

C505.2 Equipment. The lighting system controls, maximum lighting power for interior and exterior applications and electrical energy consumption shall comply with Section C405.

Exception: *Dwelling units* that comply with Section R404.1

Section C506
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

C506.1 Requirements. Buildings shall comply with at least one of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. On-site supply of renewable energy in accordance with Section C406.5.
3. High-efficiency service water heating in accordance with Section C406.7.
4. Reduced lighting power in accordance with Section C506.2. ☐
5. Enhanced envelope performance in accordance with Section C506.3. ☐
6. Reduced air infiltration in accordance with Section C506.4 ☐

C506.2 Reduced lighting power density. The total interior lighting power (watts) of the *common areas* shall be determined by using 90 percent of the interior lighting power allowance calculated by the Space-by-Space Method in Section C405.4.2. Additionally, ninety-five percent (95%) of the lamps in permanently installed light fixtures in dwelling units shall be lamps with a minimum efficacy of:

- a) 90 lumens per watt for lamps over 40 watts;☐
- b) 60 lumens per watt for lamps over 15 watts to 40 watts;
- c) 45 lumens per watt for lamps over 5 watts to 15 watts and
- d) 30 lumens per watt for lamps 5 watts or less.

C506.3 Enhanced Envelope Performance. The total UA of the *building thermal envelope* shall be no greater than eighty-five percent (85%) of the total UA of the *building thermal envelope* allowed in accordance with Section C502.1.4.

C506.4 Reduced Air Infiltration. Air infiltration shall be verified by whole building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building envelope shall not exceed 0.25 cfm/ft² (2.0 L/s•m²) under a pressure differential of 0.3 in. water (75 Pa), with the calculated surface area being the sum of the above and below grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner.

Exception. Buildings having over 250,000 ft² (25,000 m²) of conditioned floor area, air leakage testing shall be permitted to conduct testing on representative above grade sections of the building. Tested areas shall total at least 25% of the conditioned floor area and shall be tested in accordance with this section.

Section C507
TOTAL BUILDING PERFORMANCE

C507.1 Scope. This section establishes criteria for compliance using total building performance.

C407.2 Mandatory requirements. Compliance with this section requires that the criteria of Sections C502.5, C503.2, C504 and C505 be met.

C507.1 Requirements. Buildings shall comply with one of the following:

1. Section C407, provided the *building* has not less than four stories above grade plane.
2. Section R405, provided the *building* has not more than three stories above grade plane.
3. Section R406, provided the *building* has not more than three stories above grade plane.