Connecticut Climate Resilient Energy Code for Multifamily Affordable Housing

Version 2.1

Climate Resilient Code Overlay Language for 2022 Connecticut Building Code

Prepared by

New Buildings Institute

on behalf of the Connecticut Climate Resilient Energy Code Project team:

Clean Energy Group, American Microgrid Solutions, the Connecticut Department of Energy & Environmental Protection, the Connecticut Green Bank, the Connecticut Insurance Department, New Buildings Institute, Operation Fuel, and the Yale Center on Climate Change and Health.

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Preface

The Connecticut Climate Resilient Energy (CT-CRE) code is being developed through a Department of Energy (DOE) funded project under the Resilient and Efficient Code Implementation (RECI) program. The CT-CRE code is intended to cover the installation of climate resilient energy systems including solar, battery storage, and efficient heating and cooling to maintain living conditions and power essential services for multifamily affordable housing residents sheltering in place during grid outages. The CT-CRE code development is the product of a years long effort by an integrated project team led by Clean Energy Group in partnership with American Microgrid Solutions, the Connecticut Department of Energy & Environmental Protection, the Connecticut Green Bank, the Connecticut Insurance Department, New Buildings Institute, Operation Fuel, and the Yale Center on Climate Change and Health and has been informed by an Affordable Housing Advisory Group and a Technical Advisor Group consisting of affordable housing and energy sector stakeholders and representatives, and through feedback from listening sessions and interviews conducted with multifamily affordable housing residents in Connecticut.

How to Use this Document

1. *Italicized text* at beginning of each section indicates direction for how to modify, add, or remove language from the existing Connecticut International Residential Code.
2. Underline text markup indicates new text. ~~Crossed out~~ text indicates deleted text.

Contents

Amendments to the 2021 Residential International Energy Conservation Code

Amendments to Chapter 2 Definitions

Add New Definitions as follows:

Emergency Power System: A source of automatic electric power of a required capacity and duration to operate required life safety, fire alarm, detection and ventilation, HVAC, and critical electric power systems in the event of a failure of the primary power. Emergency power systems are required for electrical loads where interruption of the primary power could result in loss of human life or serious injuries.

Geothermal energy: heat extracted from the Earth's interior that is used to produce electricity or mechanical power to provide thermal energy for heating buildings or processes. *Geothermal energy* does not include systems such as heat pumps that use energy independent of geothermal source to raise the temperature of the extracted heat.

Hardscape: *site* paved areas, including roads, driveways, parking lots, walkways, courtyards, and plazas.
Site: a contiguous area of land that is under the ownership or control of one entity.

On-site renewable energy system: photovoltaic, solar thermal, *geothermal energy*, fuel cell, and wind systems used to generate energy and located on any of the following:

a. The building
b. The property upon which the building is located
c. A property that shares a boundary with and is under the same ownership or control as the property on which the building is located
d. A property that is under the same ownership or control as the property on which the building is located and is separated by a public right-of-way from the property on which the building is located

Thermal Bridge. An element or interface of elements that has higher thermal conductivity than the surrounding building thermal envelope, which creates a path of least resistance for heat transfer.

Amendments to Table R402.1.1 Maximum assembly U-factors and fenestration requirements

Replace Table R402.1.2 as follows:

TABLE R402.1.3
MAXIMUM ASSEMBLY U-FACTORS AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Climate Zone	5
FENESTRATION U-FACTOR[b, i]	0.20
SKYLIGHT[b] U-FACTOR	0.30
GLAZED VERTICAL FENESTRATION SHGC[b, e]	0.4
CEILING R-VALUE[g]	0.027
WOOD FRAME WALL R-VALUE[d]	0.035
MASS WALL R-VALUE[f]	0.041
FLOOR R-VALUE[h, j]	0.045
BASEMENT[bc, g] WALL R-VALUE	0.05
SLAB[e] R-VALUE & DEPTH	0.05, 4 ft.
CRAWL SPACE[bc, g] WALL U-FACTOR	0.05

Replacement of Table R402.1.2 Building Envelope Fenestration Maximum U-Factor and SHGC Requirements

Remove and Replace Table R402.1.2 as follows:

~~TABLE R402.1.2~~
~~BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS~~

~~**CLIMATE ZONE**~~	~~**1**~~		~~**2**~~		~~**3**~~		~~**4 EXCEPT MARINE**~~		~~**5 AND MARINE 4**~~		~~**6**~~		~~**7**~~		~~**8**~~	
~~**Vertical fenestration**~~																
~~**U-factor for vertical *curtain walls* and *site-built fenestration products*[a]**~~																
~~Fixed fenestration~~	~~0.50~~		~~0.50~~		~~0.46~~		~~0.38~~		~~0.20~~		~~0.36~~		~~0.29~~		~~0.29~~	
~~Operable fenestration~~	~~0.65~~		~~0.65~~		~~0.60~~		~~0.45~~		~~0.20~~		~~0.43~~		~~0.37~~		~~0.37~~	
~~**U-factor for entrance doors**~~																
~~Entrance doors~~	~~1.10~~		~~0.83~~		~~0.77~~		~~0.77~~		~~0.20~~		~~0.77~~		~~0.77~~		~~0.77~~	
~~**U-factor for all other vertical fenestration**~~																
									~~0.20~~							
~~**SHGC**~~																
~~Orientation[a]~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~	~~SEW~~	~~N~~
~~PF < 0.2~~	~~0.25~~	~~0.33~~	~~0.25~~	~~0.33~~	~~0.25~~	~~0.33~~	~~0.36~~	~~0.48~~	~~0.38~~	~~0.51~~	~~0.40~~	~~0.53~~	~~0.45~~	~~NR~~	~~0.45~~	~~N~~
~~0.2 □ PF < 0.5~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.30~~	~~0.37~~	~~0.43~~	~~0.53~~	~~0.46~~	~~0.56~~	~~0.48~~	~~0.58~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~PF □ 0.5~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.40~~	~~0.58~~	~~0.58~~	~~0.61~~	~~0.61~~	~~0.64~~	~~0.64~~	~~NR~~	~~NR~~	~~NR~~	~~NR~~
~~**Skylights**~~																

~~U-factor~~	~~0.75~~	~~0.65~~	~~0.55~~	~~0.50~~	~~0.30~~	~~0.50~~	~~0.50~~	~~0.50~~
~~SHGC~~	~~0.35~~	~~0.35~~	~~0.35~~	~~0.40~~	~~0.40~~	~~0.40~~	~~NR~~	~~NR~~

~~NR = No Requirement, PF = Projection Factor.~~

~~a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.NR = No Requirement, PF = Projection Factor.~~

TABLE R402.1.2
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	**1**	
Vertical fenestration		
U-factor for vertical *curtain walls* and *site-built fenestration products*[a]		
Fixed fenestration	0.20	
Operable fenestration	0.20	
U-factor for entrance doors		
Entrance doors	0.20	
U-factor for all other vertical fenestration		
SHGC		
Orientation[a]	SEW	N
PF < 0.2	0.25	0.33
0.2 < PF < 0.5	0.30	0.37
PF > 0.5	0.40	0.40
Skylights		
U-factor	0.30	
SHGC	0.35	

NR = No Requirement, PF = Projection Factor.

a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.NR = No Requirement, PF = Projection Factor.

Replacement of Table R402.1.3 Insulation Minimum R-Values and Fenestration Requirements by Component

Remove and Replace Table 402.1.3 as follows:

~~TABLE R402.1.3~~
~~INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]~~

~~**Climate Zone**~~	~~0~~	~~1~~	~~2~~	~~3~~	~~4 except Marine~~	~~5 and Marine 4~~ 5	~~6~~	~~7 and 8~~
~~FENESTRATION U-FACTOR[b, i]~~	~~0.50~~	~~0.50~~	~~0.40~~	~~0.30~~	~~0.30~~	~~0.28~~ 0.25	~~0.28~~	~~0.27~~
~~SKYLIGHT[b] U-FACTOR~~	~~0.60~~	~~0.60~~	~~0.60~~	~~0.53~~	~~0.53~~	~~0.50~~ 0.30	~~0.50~~	~~0.50~~
~~GLAZED VERTICAL~~	~~0.25~~	~~0.25~~	~~0.25~~	~~0.25~~	~~0.40~~	~~NR~~ 0.4	~~NR~~	~~NR~~

FENESTRATION SHGC[b, e]								
CEILING R-VALUE[g]	30	30	38	38	49	49 60 or 36ci	49	49
WOOD FRAME WALL R-VALUE[d]	13 or 0&10ci	13 or 0&10ci	13 or 0&10ci	20 or 13&5ci or 0&15ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci 37 or 20&9ci or 0&28ci	30 or 20&5ci or 13&10ci or 0&20ci	30 or 20&5ci or 13&10ci or 0&20ci
MASS WALL R-VALUE[e]	3/4	3/4	4/6	8/13	8/13	13/17 20ci/24ci	15/20	19/21
FLOOR R-VALUE[h, i]	13 or 7+5ci or 10c	13 or 7+5ci or 10c	13 or 7+5ci or 10c	19 or 13+5ci or 15ci	19 or 13+5ci or 15ci	30 or 19+7.5ci or 20ci 32	30 or 19+7.5ci or 20ci	30 or 19+7.5ci or 20ci
BASEMENT[b, c, g] WALL R-VALUE	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci 30 or 0&20ci or 15&9ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci
SLAB[d] R-VALUE & DEPTH	0	0	0	10ci, 2 ft.	10ci, 3 ft.	10ci, 3 ft. 20ci, 4 ft.	10ci, 4 ft.	10ci, 4 ft.
CRAWL SPACE[b, c, g] WALL U-FACTOR	0	0	0	5ci or 13[f]	10ci or 13	15ci or 19 or 13&5ci 30 or 0&20ci or 15&9ci	15ci or 19 or 13&5ci	15ci or 19 or 13&5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.28.

c. "30 or 0&20ci or 15&9ci" means R-30 cavity insulation on the interior side of the wall; or R-20 continuous insulation (ci) on the interior or exterior surface of the wall; or R-15 cavity insulation on the interior of the wall in addition to R-9 continuous insulation on the interior or exterior surface of the wall. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

d. R-15 R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs. as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.

e. Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

e. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "20&9ci13&5" means R-20R-13 cavity insulation plus R-9R-5 continuous insulation.

f. "20ci/24ci" means R-20 continuous insulation when more than half the insulation is on the exterior of the mass wall, or R-24 continuous insulation when more than half the insulation is on the interior of the mass wall. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

g. A maximum U-factor of 0.30 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation above sea level, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

g. Roofs with insulation entirely above deck shall comply with Section R402.2.1 and the Group R R-values of Table R402.1.2

h. "34 or 20&9ci or 0&22ci 30 or 19+7.5ci or 20ci" means R-34 R30 cavity insulation alone or R-20R19 cavity insulation with R-9R7.5 continuous insulation or R-22R20 continuous insulation alone.

TABLE R402.1.3
INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Climate Zone	5
FENESTRATION U-FACTOR[b, i]	0.20
SKYLIGHT[b] U-FACTOR	0.30
GLAZED VERTICAL FENESTRATION SHGC[b, e]	0.4
CEILING R-VALUE[g]	60 or 36ci
WOOD FRAME WALL R-VALUE[d]	37 or 20&9ci or 0&28ci
MASS WALL R-VALUE[f]	20ci/24ci
FLOOR R-VALUE[h, j]	32 / 22ci
BASEMENT[bc, g] WALL R-VALUE	30 or 0&20ci or 15&9ci
SLAB[e] R-VALUE & DEPTH	20ci, 4 ft.
CRAWL SPACE[bc, g] WALL U-FACTOR	30 or 0&20ci or 15&9ci

For SI: 1 foot = 304.8 mm.

a) R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

b) The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c) "30 or 0&20ci or 15&9ci" means R-30 cavity insulation on the interior side of the wall; or R-20 continuous insulation (ci) on the interior or exterior surface of the wall; or R-15 cavity insulation on the interior of the wall in addition to R-9 continuous insulation on the interior or exterior surface of the wall.

d) The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "20&9ci" means R-20 cavity insulation plus R-9 continuous insulation.

e) R-15 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs. as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.

f) "20ci/24ci" means R-20 continuous insulation when more than half the insulation is on the exterior of the mass wall, or R-24 continuous insulation when more than half the insulation is on the interior of the mass wall. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

g) Roofs with insulation entirely above deck shall comply with Section R402.2.1

h) "34 or 20&9ci or 0&22ci" means R-34cavity insulation alone or R-20 cavity insulation with R-9continuous insulation or R-22 continuous insulation alone.

Amendments to Section R402.4.1.2 Testing

Modify Section as Follows:

R402.4.1.2 Testing. The building or dwelling unit shall be tested for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed ~~5.0 air changes per hour or~~ 0.1 cubic feet per minute (CFM) per square foot [0.169 m3/(h × m2)] of dwelling unit enclosure area. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). ~~Where required by the code official, t~~Testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

~~**Exception**: For heated, attached private garages and heated, detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, 2022 Connecticut State Building Code (w/ Errata #1) Amendments to the 2021 International Energy Conservation Code ED: October 1, 2022 Page - 101 detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.12 and R402.3.5, as applicable.~~

~~During testing:~~

1. ~~Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.~~
2. ~~Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.~~
3. ~~Interior doors, where installed at the time of the test, shall be open.~~
4. ~~Exterior or interior terminations for continuous ventilation systems shall be closed or sealed.~~
5. ~~Heating and cooling systems, where installed at the time of the test, shall be turned off.~~
6. ~~Supply and return registers, where installed at the time of the test, shall be fully open.~~

~~**Exceptions**:~~

1. ~~When testing individual dwelling units, an air leakage rate not exceeding 0.30 cubic feet per minute per square foot [0.008 m3/(s × m2)] of the dwelling unit enclosure area, tested in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pa), shall be an accepted alternative permitted in all climate zones for:~~
    a. ~~Attached dwelling units.~~
    b. ~~Dwelling units that are 1,500 ft2 (139.4 m2) or smaller.~~
2. ~~For buildings with more than seven units, a sampling protocol is allowed by an approved third party. The sampling protocol requires the first seven units to be~~

~~tested without any failures. Upon successful testing of those initial seven units, remaining units can be sampled at a rate of 1 in 7. If any sampled units fail compliance with the maximum allowed air leakage rate, two additional units in the same sample set shall be tested. If additional failures occur, all units in the sample set shall be tested. In addition, all units in the next sample set shall be tested for compliance before sampling of further units can be continued. This exception is not allowed for multi-zone buildings that are treated as single-zone buildings by opening interior doors or by inducing equal pressures in adjacent zones.~~

Addition of new Section R402.4.7 Air barrier performance verification

Add Section as follows

R402.4.7 Air barrier performance verification. The installation of a continuous air barrier shall be verified by the code official, a registered design professional, or an approved agency in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.4.1.1.
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction while the air barrier is still accessible for inspection and repair to verify compliance with the requirements of Section C402.4.1.1.
3. A final commissioning report shall be provided for inspections completed by the *registered design professional* or *approved* agency. The commissioning report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures taken.

Addition of new Section R402.6 Thermal Bridges

Add section as follows:

R402.6 Thermal bridges.

Thermal bridges in *above-grade walls* shall comply with this section or an *approved* design.

Exceptions:

1. Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h x °F (5.19 W/m x K)
2. Blocking, coping, flashing and other similar materials for attachment of roof coverings.
3. *Thermal bridges* accounted for in the *U-factor* for a *building thermal envelope.*

Addition of new Section R402.5.1 Balconies and floor decks

Add section as follows:

R402.6.1 Balconies and floor decks.

Balconies and concrete floor decks shall not penetrate the *building thermal envelope*. Such assemblies shall be separately supported or shall be supported by structural attachments or elements that minimize thermal bridging through the *building thermal envelope*.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where one of the following applies:

1. An area-weighted *U-factor* is used for *above-grade wall* compliance that includes a *U-factor* of 0.8 Btu/h x °F (1.38 W/m x K) for the area of the *above-grade wall* penetrated by the concrete floor deck in accordance with Section R402.1.2.1.5.
2. An *approved* thermal break device with not less than R-10 insulation material is installed in accordance with the manufacturer's instructions.
3. An *approved* design where the *above-grade wall U-factor* used for compliance accounts for all balcony and concrete floor deck *thermal bridges*.

Addition of new Section R402.6.2 Cladding supports

Add section as follows:

R402.6.2 Cladding supports.

Linear elements supporting opaque cladding shall be offset from the structure with attachments that allow the *continuous insulation*, where present, to pass behind the cladding support element except at the point of attachment.

Exceptions:

1. An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the cladding support element *thermal bridge*.
2. Anchoring for *curtain wall* and window wall systems where *curtain wall* and window wall systems comply with Section R402.7.4.

Addition of new Section R402.6.3 Structural beams and columns

Add section as follows:

R402.6.3 Structural beams and columns.

Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of insulation component within the *building thermal envelope*.

Exceptions:

1. Where an *approved* thermal break device is installed in accordance with the manufacturer's instructions.
2. An *approved* design where the *above-grade wall U-factor* used to demonstrate compliance accounts for the beam or column *thermal bridge*.

Addition of new Section Vertical fenestration

Add section as follows:

R402.6.4 Vertical fenestration.

Vertical *fenestration* intersections with *above-grade walls* shall comply with one or more of the following:

1. Where *above-grade walls* include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame *fenestration*, a nonmetal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the *continuous insulation*.
2. Where *above-grade walls* do not include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame *fenestration*, a nonmetal thermal break in the frame shall be positioned within the thickness of the integral or *cavity insulation*.
3. The surface of the rough opening, not covered by the *fenestration* frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (38 mm) thick.
4. For the intersection between vertical *fenestration* and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U-factor* shall account for the *thermal bridges*.

Exceptions:

1. Where an *approved* design for the *above-grade wall U-factor* used for compliance accounts for *thermal bridges* at the intersection with the vertical *fenestration*.
2. Doors

Addition of new Section R402.6.5 Parapets

Add section as follows:

R402.6.5 Parapets.

Parapets shall comply with one or more of the following as applicable:

1. Where *continuous insulation* is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the *continuous insulation* shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-resistance rated wall, and the exterior *continuous insulation* applied to the parapet, shall comply with the fire-resistance ratings of the *International Building Code*.

2. Where *continuous insulation* is installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the *continuous insulation* shall extend up the exterior side of the parapet to not less than the height of the top surface of the *roof assembly*.
3. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent *R-value* insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.
5. Where a thermal break device with not less than R-10 insulation material aligned with the *above-grade wall* and roof insulation is installed in accordance with the manufacturer's instructions.

Exception: An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the parapet *thermal bridge*.

Addition of new Section R402.7 Heat Island Effect Mitigation

Add Section as follows:

R402.6. Heat Island Effect Mitigation.

Addition of new section R402.7.1 Site hardscape

Add the following section R402.6.1:

R402.6.1. Site Hardscape. At least 50% of the *site hardscape* that is not covered by *solar energy systems* shall be provided with one or any combination of the following:

a. Existing trees and vegetation or new biodiverse plantings of native plants and adapted plants, which shall be planted either prior to the final approval by the AHJ or in accordance with a contract established to require planting no later than 12 months after the final approval by the AHJ so as to provide the required shade no later than ten years after the final approval. The effective shade coverage on the hardscape shall be the arithmetic mean of the shade coverage calculated at 10 a.m., noon, and 3 p.m. on the summer solstice.
b. Having materials with a minimum initial solar reflectance index (SRI) of 29. A default SRI value of 35 for new concrete without added color pigment is allowed to be used instead of measurements.
c. Open-graded (uniform-sized) aggregate, permeable pavement, permeable pavers, and porous pavers (open-grid pavers). Permeable pavement and permeable pavers shall have a percolation rate of not less than 2 gal/min • ft2 (100 L/min • m2).

d. Shading through the use of structures, provided that the top surface of the shading structure complies with the provisions of Section R909.
e. Parking under a building, provided that the roof of the building complies with the provisions of Section R909.
f. Buildings or structures that provide shade to the site hardscape. The effective shade coverage on the hardscape shall be the arithmetic mean of the shade coverage calculated at 10 a.m., noon, and 3 p.m. on the summer solstice.

Addition of new Section R402.7.2 Walls

Add the following section R402.6.2:

R402.6.2. Walls. Above-grade building *walls* and retaining walls shall be shaded in accordance with this section. The building is allowed to be rotated up to 45 degrees to the nearest cardinal orientation for purposes of calculations and showing compliance. Compliance with this section shall be achieved through the use of shade-providing plants, man-made structures, existing buildings, hillsides, permanent *building projections*, *on-site renewable energy systems*, or a combination of these, using the following criteria:

a. Shade shall be provided on at least 30% of the west above-grade walls and retaining walls from grade level to a height of 20 ft (6 m) above grade, or the top of the exterior wall, whichever is less. Shade coverage shall be calculated at 3 p.m. for the west walls on the summer solstice.
b. Where shading is provided by vegetation, such vegetation shall be existing trees and vegetation or new biodiverse plantings of native plants and adapted plants. Such planting shall occur prior to the final approval by the AHJ or in accordance with a contract established to require planting no later than 12 months after the final approval by the AHJ so as to provide the required shade no later than ten years after the final approval. Vegetation shall be appropriately sized, selected, planted, and maintained so that it does not interfere with overhead or underground utilities. Trees shall be placed a minimum of 5 ft (1.5 m) from and within 50 ft (15 m) of the building or retaining wall.

Exceptions:

1. The requirements of this section are satisfied if 75% or more of the opaque wall surfaces on the west have a minimum solar reflectance of 0.30 and minimum thermal emittance of 0.75 SRI of 29. Each wall is allowed to be considered separately for this exception.

Addition of new Section R403.1.3 Resilient HVAC controls

Add new Section as follows

R403.1.3 Resilient HVAC controls. Critical HVAC systems and electric circuits served with power from *emergency power systems* according to *International Residential Code* Section E3408.2 shall meet the requirements of R403.1.3.1 through R403.1.3.2

Addition of new Section R403.1.3.1 Resilient heating and cooling controls

Add new Section as follows

R403.1.3.1 Resilient heating and cooling controls. Heating and cooling systems served with power from an *emergency power system* according to *International Residential Code* Section E3408.2 shall have controls capable of automatic temperature setbacks in the event of a failure of the primary power.

Addition of new Section R403.1.3.1.1 Resilient heating and cooling setpoints

Add new Section as follows

R403.1.3.1.1 Resilient heating and cooling setpoints. Automatic thermostat controls for heating and cooling systems served with power from an *emergency power system* according to *International Residential Code* Section E3408.2 shall be capable of achieving temperature setbacks to 60°F for heating and 82°F for cooling.

Addition of new Section R403.1.2 Resilient ventilation controls

Add new Section as follows

R403.1.3.2 Resilient ventilation controls. Ventilation systems served with power from an *emergency power system* according to E3408.2 shall have controls capable of adjusting airflows to 50% of minimum required design airflow in the event of a failure of the primary power.

Addition of new Section R403.14 Resilient HVAC Systems location

Add new Section as follows

R403.14 Resilient HVAC systems location. HVAC systems served with power from an *emergency power system* according to *International Residential Code* Section E3408 shall be located a minimum of 2-feet above the FEMA 500-year base flood elevation.

Modification of Section R403.6.1 Heat or energy recovery ventilation.

Modify section as follow:

R403.6.1 Heat or energy recovery ventilation. *Dwelling units* shall be provided with a heat recovery or energy recovery ventilation system ~~in Climate Zones 7 and 8~~. The system shall

be balanced with a minimum sensible heat recovery efficiency (SRE) of no less than 65% at 32°F (0°C) at a flow greater than or equal to the design airflow. The SRE shall be determined from a listed value or from interpolation of listed values. Construction documents shall include documentation of the SRE.

Addition of new Section R403.13 On-site photovoltaic systems

R403.13 On-Site renewable energy systems. Building projects shall contain on-site renewable energy systems with a rated capacity of not less than 2 W/ft2 (22 W/m2) multiplied by the horizontal projection of the gross roof area over conditioned spaces and semi-heated spaces. The building gross roof area used for calculation excludes the following:

a. Shaded areas that are defined as roof area where direct-beam sunlight is blocked by structures or natural objects for more than 1500 annual hours between 8 a.m. and 4 p.m.

d. Areas designated for helipads.

Exceptions to R403.13:

1. Building projects that have an annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 1.2 kBtu/ft2·day (4.0 kWh/m2 ·day).

2. Renewable energy systems, other than photovoltaic systems, that result in an equal or greater annual energy production.

Addition of new Section R403.14 Electrical energy storage system (ESS)

R403.14 Electrical energy storage system.

Building shall comply with sections C405.14.1.

Addition of new Section R403.14.1 Electric energy storage system (ESS) capacity

R403.14.1 Electric energy storage system (ESS) capacity.

Each building shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

1. ESS-rate energy capacity (kWh) ≥ 5.0 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.

2. ESS-rated power capacity (kW) ≥ 1.25 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.

Where installed, DC-coupled battery systems shall meet the requirements for rated energy capacity alone.

Addition of new Section (IECC) R404.4 Resilient electrical power controls

Add new Section as follows

R404.4 Resilient electrical power controls. Electric circuits and loads beyond those minimally required *International Residential Code* Section E3408.2 that are served with power from an *emergency power system* shall have controls to facilitate automatic load shedding of loads not required by *International Residential Code* Section E3408.2 when *emergency power system* capacity falls below 50%.

Modification to Table R405.2 Requirements For Total Building Performance

Table R405.2 Requirements For Total Building Performance

Section	Title
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
RR402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Section R403.3.2, and R403.3.3 ~~and R403.6~~	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units

R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls

Amendments to the 2021 International Residential Code

Addition of new Section R909 Roof Solar Reflectance

Add Section R909 as follows:

R909 Roof Solar Reflectance

Addition of new Section R909.1 General

R909.1 General

Low-sloped roofs shall comply with one or more of the options in Table R909.2.

Steep-sloped roofs shall comply with one or more of the options in Table R909.3.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table R909.2 and Table R909.3:

1. Portions of the roof that include or are covered by the following:
    1.1. Photovoltaic systems or components.
    1.2. Solar air or water-heating systems or components.
    1.3. Vegetative roofs or landscaped roofs.
    1.4. Above-roof decks or walkways.
    1.5. Skylights.
    1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

Addition of new Table R909.2 Minimum roof reflectance and emittance options for low-sloped roofs

TABLE R909.2 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR LOW-SLOPED ROOFS[a]

Three-year-aged solar reflectance[b] of 0.55 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section R909.2 and a 3-year aged thermal emittance of 0.90.
b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.
c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRCS100.
d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft2 × °F (12 W/m2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. Where an aged solar reflectance required by Section R909.2 is not available, it shall be determined in accordance with Equation 9-x.

$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)]$ (Equation 9-x)

where

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-S100.

Addition of new Table R909.3 Minimum roof reflectance and emittance options for steep-sloped roofs

TABLE R909.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR STEEP-SLOPED ROOFS[a]

Three-year-aged solar reflectance[b] of 0.25 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 20

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section R909.3 and a 3-year aged thermal emittance of 0.90.
b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.
c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRCS100.
d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft2 × °F (12 W/m2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. Where an aged solar reflectance required by Table R909.3 is not available, it shall be determined in accordance with Equation 9-x.

$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)]$ (Equation 9-x)

where

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-S100.

Addition of new Section E3408 Emergency Power Systems

Add Section as follows

Section E3408

Emergency Power Systems

Addition of new Section E3408.1 General

Add new Section as follows

E3408.1 General. *Emergency power systems* shall comply with sections E3408.1 through E3408.4.

Addition of new Section E3408.1.1 Stationary generators

Add new Section as follows

E3408.1.1 Stationary generators. Stationary emergency and standby power generators required by this code shall be listed in accordance with UL 2200.

Addition of new Section E3408.1.2 Energy storage systems

Add new Section as follows

E3408.1.2 Energy storage systems. Energy storage systems required by this code shall be listed in accordance with UL 9540.

Addition of new Section E3408.1.3 Installation

Add new Section as follows

E3408.1.3 Installation. Emergency power systems required by this code shall be installed in accordance with the International Fire Code, NFPA 70, NFPA 110 and NFPA 111.

Addition of new Section E3408.1.4 Load transfer.

Add new Section as follows

E3408.1.4 Load transfer. Emergency power systems shall automatically provide secondary power within 10 seconds after primary power is lost, unless specified otherwise in this code.

Addition of new Section E3408.1.5 Emergency power system sizing

Add new Section as follows

E3408.1.5 Emergency Power System Sizing. *Emergency power systems* demand and load duration shall be sized according to E3408.1.5.2 through E3408.1.5.5.

Addition of new Section E3408.1.5.1 Load Duration

Add new Section as follows

E3408.1.5.1 Load duration. Emergency power systems shall be designed to provide the required power for a minimum duration of 2 hours unless specified otherwise in this code.

Addition of new Section E3408.1.5.2 Critical heating and cooling sizing

Add new Section as follows

E3408.1.5.2 Critical Heating and cooling sizing. Demand and load sizing for heating and cooling systems served by *emergency power systems* according to E3408.2 and calculated at interior design temperatures of 60°F for heating and 82°F for cooling shall satisfy the *emergency power system* sizing requirements of this section.

Addition of new Section E3408.1.5.3 Critical ventilation system sizing

Add new Section as follows

E3408.1.5.3 Critical Ventilation System Sizing. Demand and load sizing for ventilation systems served by *emergency power systems* according to E3408.2 and calculated at 50% of minimum required design airflows shall satisfy the *emergency power system* sizing requirements of this section.

Addition of new Section E3408.1.5.4 Critical electric load sizing

Add new Section as follows

3508.1.5.4 Critical Electric Load Sizing. Demand and load sizing for critical electric circuits served by *emergency power system* according to E3408.2 calculated at 50% shall satisfy the *emergency power system* sizing requirements of this section.

Addition of new Section E3408.2 Emergency power service

Add new Section as follows

E3408.2 Emergency power service. Power from an *emergency power system* shall be provided for critical HVAC and electric power systems in accordance with section E3408.2.1 through E3408.2.4.

Addition of new Section E3408.2.1 Critical heating and cooling systems

Add new Section as follows

E3408.2.1 Critical Heating and Cooling Systems. Power from an *emergency power system* must be provided for heating and cooling systems according to E3408.3.1.1 or E3408.3.1.2.

Addition of new Section E3408.2.1.1 Distributed heating and cooling systems

Add new Section as follows

E3408.2.1.1 Distributed Heating and Cooling Systems. Where dedicated heating and cooling systems are provided to individual *dwelling units*, power from *emergency power*

systems shall be provided to heating and cooling systems serving not less than 50% of the *habitable space* of each *dwelling unit*.

Addition of new Section E3408.2.1.2 Common and community space heating and cooling systems

Add new Section as follows

E3408.2.1.2 Common and Community Space Heating and Cooling Systems: Where a combination of community rooms and common spaces are provided with not less than 20 square feet per occupant, power from an *emergency power system* shall serve the heating and cooling systems of the community rooms and spaces. Occupancy shall be counted as the total number of *dwelling units* plus the total number of bedrooms.

Addition of new Section E3408.2.2 Critical ventilation systems

Add new Section as follows

E3408.2.2 Critical Ventilation Systems. Power from an *emergency power system* shall be provided to ventilation systems serving all *dwelling units* and community rooms and spaces provided with heating and cooling according to E3408.2.1.

Addition of new Section E3408.2.3 Critical electric circuits

Add new Section as follows

E3408.2.3 Critical Electric Circuits. Power from an emergency power system shall be provided to all critical electric circuits according to E3408.2.3.1 through E3408.2.3.2

Addition of new Section E3408.2.3.1 Dwelling unit critical electric circuits

Add new Section as follows

E3408.2.3.1 Dwelling Unit Critical Electric Circuits. Power from emergency power systems shall be provided to at least 1 circuit in each dwelling unit served with heating and cooling according to E3408.2.1.

Addition of new Section E3408.2.3.2 Common and community space critical electric circuits

Add new Section as follows

E3408.2.3.2 Common and Community Space Critical Electric Circuits. Power from emergency power systems shall be provided to all circuits in common spaces served with heating and cooling according to E3408.2.1.

Addition of new Section E3408.2.4 Critical pumps

Add new Section as follows

E3408.2.4 Critical Pumps. Power from an emergency power system shall be provided to any pumping equipment necessary to deliver potable water to all spaces served by heating and cooling systems according to E3408.2.1.

Exception.

1. Requirements of this section are satisfied where residents are provided with access to potable water at a location where containers can be filled. The public access point must be located a minimum of 2 feet above the 500-year FEMA Base Flood Elevation.

Addition of New Section E3408.3 Resilient energy system commissioning

Add new Section as follows

E3408.3 Resilient Energy System Commissioning. *Emergency power systems* commissioning shall be completed according to NEC 2020 Section 708.8 and commissioning report shall be provided to the AHJ.

Addition of New Section E3408.4 Emergency management information

Add new Section as follows

E3408.4 Emergency Management Information. Information on emergency management shall be furnished for equipment and systems that require power from an *emergency power system.*

Addition of New Section E3408.4.1 Building emergency operations procedures

Add new Section as follows

E3408.4.1 Building emergency operations procedures. Procedures for critical HVAC and electric power system operation and management in the event of a loss of primary power shall be developed and provided to the building owner for use by building operations staff.

Addition of New Section E3408.4.2 Resident emergency operations procedures

Add new Section as follows

E3408.4.2 Resident emergency operations and management procedures. An emergency operations and management procedures manual shall be provided to the building owner for use by building residents. The manual shall include recommended procedures for critical HVAC and electric power system operation and management at the dwelling unit level in the event of a loss of primary power. The manual shall additionally provide template language and process for engagement between building operations staff and residents on the establishment of emergency management procedures.

Amendments to the 2021 International Building Code

Amendments to Chapter 2 Definitions

Modify Definition as Follows:

CHI-FACTOR. The heat loss factor for a single *thermal bridge* characterized as a point element of a *building thermal envelope* (Btu/h x °F [W/k].

EMERGENCY POWER SYSTEM: A source of automatic electric power of a required capacity and duration to operate required life safety, fire alarm, detection and Resilient ~~ventilation,~~ HVAC, and electric power systems in the event of a failure of the primary power. Emergency power systems are required for electrical loads where interruption of the primary power could result in loss of human life or serious injuries.

PSI-FACTOR. The heat loss factor for a per unit length of a *thermal bridge* characterized as a linear element of a *building thermal envelope* (Btu/h x ft x °F) [W/(m x K)]

THERMAL BRIDGE. An element or interface of elements that has higher thermal conductivity than the surrounding *building thermal envelope,* which creates a path of least resistance for heat transfer.

Add new Section 2702.1 General

Modify Section as Follows:

2702.1 General. Emergency power systems and standby power systems shall comply with Sections 2702.1.1 through 2702.2.6

Add New Section 2702.1.9 Emergency power system sizing

2702.1.9 Emergency Power System Sizing. Where power from *Emergency power systems* is required to serve systems under 2702.2.20 *Emergency power systems* shall be sized according to 2702.1.9.1 through 2702.1.9.3.

Add New Section 2702.1.9.1 Resilient system load duration

2702.1.9.1 Resilient System Load Duration. Emergency power systems shall be designed to provide the required power for a minimum duration of 2 hours.

Add New Section 2702.1.9.2 Resilient heating and cooling sizing

2702.1.9.2 Resilient heating and cooling sizing. Demand and load sizing for heating and cooling systems served by e*mergency power systems* according to 2702.2.20 and calculated at interior design temperatures of 60° for heating and 82° for cooling shall satisfy the *emergency power system* sizing requirements of this section.

Add New Section 2702.1.9.3 Resilient ventilation system sizing

2702.1.9.3 Resilient Ventilation System Sizing. Demand and load sizing for ventilation systems served by *emergency power systems* according to 2702.2.20 and calculated at 50% of minimum required design airflows shall satisfy the *emergency power system* sizing requirements of this section.

Add New Section 2702.2.20 Resilient HVAC and Electric Power Systems

2702.2.20 Resilient HVAC and Electric Systems. Power from *emergency power systems* shall be provided for Resilient HVAC and electric systems in accordance with Sections 2702.2.20.1 through 2702.2.20. 3 in buildings with Residential Group R-2 occupancy classification.

Add new Section 2702.2.20.1 Resilient heating and cooling systems

2702.2.20.1 Resilient Heating and Cooling Systems: Power from *emergency power systems* must be provided for heating and cooling systems according to 2702.2.20.1.1 or 2702.2.20.1.2

Add New Section 2702.2.20.1.1 Distributed heating and cooling systems

2702.2.20.1.1: Distributed Heating and Cooling Systems: Where dedicated heating and cooling systems are provided to individual *dwelling units*; power from *emergency power systems* shall be provided to heating and cooling systems serving not less than 20 square feet per occupant of the *habitable space* in each *dwelling unit.* Occupancy shall be counted as the total number of dwelling units plus the total number of bedrooms.

Add New Section 2702.2.20.1.2 Common and community space heating and cooling systems

2702.2.20.1.2: Common and Community Space Heating and Cooling Systems: Where a combination of community rooms and common spaces are provided with not less than 20 square feet per occupant, power from *emergency power systems* shall serve the heating and cooling systems of the community rooms and common spaces. Occupancy shall be counted as the total number of *dwelling units* plus the total number of *bedrooms*.

Add New Section 2702.2.20.2 Resilient ventilation systems

2702.2.20.2 Resilient Ventilation Systems: Power from an *emergency power system* shall be provided to ventilation systems serving all *dwelling units* and community rooms and common spaces provided with heating and cooling according to 2702.2.20.1.

Add New Section 2702.2.20.3 Resilient electric circuits

2702.2.20.3 Resilient Electric Circuits: Power from an *emergency power system* shall be provided to Resilient electric circuits according to 2702.2.20.3.1 through 2702.2.20.3.3

Add New Section 2702.2.20.3.1 Dwelling unit resilient electric circuits

2702.2.20.3.1 Dwelling Unit Resilient Electric Circuits. Power from *emergency power systems* shall be provided to at least 1 circuit in each *dwelling unit* served with heating and cooling according to 2702.2.20.1.1.

Add new Section 2702.2.20.3.2 Common and community space resilient electric circuits

2702.2.20.3.2 Common and community Space Resilient Electric Circuits. Power from *emergency power systems* shall be provided to not less than 1 circuit for every 2 *dwelling units* evenly distributed throughout common and community spaces served with heating and cooling according to 2702.2.20.1.1.

Add New Section 2702.2.20.3.3 Resilient Pumps.

2702.2.20.2.3.3 Resilient Pumps. Power from an *emergency power system* shall be provided to any pumping equipment necessary to deliver potable water to all spaces served by heating and cooling systems according to 2702.2.20.1.

Exceptions to 2702.20.2.3.3

1. Requirements of this section are satisfied where residents are provided with access to potable water at a location where containers can be filled. The access point must be located a minimum of 2 feet above the 500-year FEMA Base Flood Elevation.

Add New Section 2702.5 Resilient energy system commissioning

2702.5 Resilient Energy System Commissioning. *Emergency power systems* commissioning shall be completed according to NEC 2020 Section 708.8 and commissioning report shall be provided to the AHJ.

Add New Section 2702.6 Emergency management information

2702.6 Emergency Management Information. Information on emergency management shall be furnished for equipment and systems that require power from an *emergency power system.*

Add New Section 2702.6.1 Building emergency operations procedures

2702.6.1 Building emergency operations procedures. Procedures for resilient HVAC and electric power system operation and management in the event of a loss of primary power shall be developed and provided to the building owner.

Add New Section 2702.6.2 Resident emergency operations and management procedures

2702.6.2 Resident emergency operations and management procedures. An emergency operations and management procedures manual shall be provided to the building owner for use by building residents. The manual shall include recommended procedures for critical HVAC and electric power system operation and management at the dwelling unit level in the event of a loss of primary power. The manual shall additionally provide template language and process for engagement between building operations staff and residents on the establishment of emergency management procedures.

Amendments to the 2021 Commercial International Energy Conservation

Add new Section C401.4 Solar reflectance and thermal emittance

C401.4 Solar Reflectance and Thermal Emittance.

Add new Section C401.4.1 Low-sloped roof solar reflectance and thermal emittance.

C401.4.1 Low-Sloped Roof solar reflectance and thermal emittance. Low-sloped roofs in *Climate Zones* 0 through 5 shall comply with one or more of the options in Table C401.4.1.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C401.4.1:

1. Portions of the roof that include or are covered by the following:
    - 1.1. Photovoltaic systems or components.
    - 1.2. Solar air or water-heating systems or components.
    - 1.3. Vegetative roofs or landscaped roofs.
    - 1.4. Above-roof decks or walkways.
    - 1.5. Skylights.
    - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

Add new Table C401.4.1 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR LOW-SLOPED ROOFS

TABLE C401.4.1 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR LOW-SLOPED ROOFS[a]

Three-year-aged solar reflectance of 0.55[b] and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index of 64[d]

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section C401.4.1 and a 3-year-aged thermal emittance of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRCS100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a

convection coefficient of 2.1 Btu/h × ft2 × °F (12 W/m2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. Where an aged solar reflectance required by Section C401.4.1 is not available, it shall be determined in accordance with Equation 4-x.

$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)]$ (Equation 4-x)

where

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-S100.

Add new Section C401.4.2 Steep-Sloped Roof solar reflectance ant thermal emittance.

C401.4.2 Steep-Sloped Roof solar reflectance and thermal emittance. Steep-sloped roofs in *Climate Zones* 0 through 5 shall comply with one or more of the options in Table C401.4.2.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C401.4.2:

1. Portions of the roof that include or are covered by the following:
    1.1. Photovoltaic systems or components.
    1.2. Solar air or water-heating systems or components.
    1.3. Vegetative roofs or landscaped roofs.
    1.4. Above-roof decks or walkways.
    1.5. Skylights.
    1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

Add new Table C401.4.2 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR STEEP-SLOPED ROOFS

TABLE C401.4.2 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS FOR STEEP-SLOPED ROOFS[a]

Three-year-aged solar reflectance[b] of 0.28 and 3-year aged thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 27

a. The use of area-weighted averages to comply with these requirements shall be permitted. Materials lacking 3-year-aged tested values for either solar reflectance or thermal emittance shall be assigned both a 3-year-aged solar reflectance in accordance with Section C401.4.2 and a 3-year-aged thermal emittance of 0.90.

b. Aged solar reflectance tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 or CRRC-S100.

c. Aged thermal emittance tested in accordance with ASTM C1371 or ASTM E408 or CRRCS100.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E1980 using a convection coefficient of 2.1 Btu/h × ft2 × °F (12 W/m2 × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. Where an aged solar reflectance required by Section C401.4.2 is not available, it shall be determined in accordance with Equation 4-x.

$R_{aged} = [0.2 + 0.7(R_{initial} - 0.2)]$ (Equation 4-x)

where
R_{aged} = The aged solar reflectance.
$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-S100.

Add new Section C401.4.1.3 Wall Solar Reflectance and Thermal Emittance

C401.4.1.3 Wall Solar Reflectance and Thermal Emittance. For Climate Zone 0 through 4, *above-grade east-*, *south-*, and *west-oriented walls* shall comply with subparagraph (a) or (b):

a. A minimum of 75% of the *opaque wall* area shall have a minimum area-weighted initial solar reflectance of 0.30 when tested in accordance with ASTM C1549 with AM1.5GV output, or ASTM E903 with the AM1.5GV output, or determined in accordance with *generally accepted engineering standards*, and a minimum *emittance* or emissivity of 0.75 when tested in accordance with ASTM C835, C1371, E408, or determined in accordance with *generally accepted engineering standards.* For the portion of the *opaque wall* that is glass spandrel area, a minimum solar reflectance of 0.29, determined in accordance with NFRC 300 or ISO 9050, shall be permitted. Area-weighting is permitted only between the *south-*, *east-*, and *west-oriented walls* and only between *walls* of the same *space conditioning category*.

b. A minimum of 30% of the *above-grade wall* area shall be shaded through the use of human-made *structures*, *existing buildings*, hillsides, permanent *building* projections, *on-site renewable energy systems*, or a combination of these. Shade coverage shall be calculated by projecting the shading surface downward on the *wall* at an angle of 45 degrees.

Remove and Replace Table C402.1.3

Remove and Replace new tables as follows:

Table C402.1.3
Opaque Thermal Envelope Assembly Minimum Requirements, R-Value Method[a,b]

Climate Zone	5	
	All Other	Group R
Roofs		
Insulation entirely above roof deck	R-38	R-38
Metal buildings[b]	R-25 + R-11 LS	R-25 + R-11 LS
Attic and other	R-38	R-38
Walls, above grade		
Mass[f]	R-20ci	R-20ci
Metal buildings	R-21 + R14ci, or R-25ci	R-21 + R14ci, or R-25ci
Metal framed	R-21 + R14ci, or R-25ci	R-21 + R14ci, or R-25ci
Wood framed and other	R-21 + R14ci, or R-25ci	R-21 + R14ci, or R-25ci
Walls, below grade		
Below-grade wall[d]	R-10ci	R-10ci
Floors		
Mass[e]	R-25ci	R-25ci
Joist/framing	R-35	R-35
Slab-on-grade floor		

Unheated slabs	R-20 for 24" down at perimeter, R-10 under entire slab	R-20 for 24" down at perimeter, R-10 under entire slab
Heated slabs[g]	R-20 for 24" at perimeter, R-15 under full slab	R-20 for 24" at perimeter, R-15 under full slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m2, 1 pound per cubic foot = 16 kg/m3.
ci = Continuous insulation, NR = No Requirement, LS = Liner System.

a. Assembly descriptions can be found in ASNI/ASHRAE/IESNA 90.1 Appendix A
b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4
c. Placeholder
d. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
e. "Mass floors" shall be in accordance with Section C402.2.3.
f. "Mass walls" shall be in accordance with Section C402.2.2.
g. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab

Remove and Replace Table C402.1.4

Table C402.1.4
Opaque Thermal Envelope Assembly Maximum Requirements, U-Factor Method[a,b]

Climate Zone	5	
	All Other	Group R
Roofs		
Insulation entirely above roof deck	U-0.026	U-0.026
Metal buildings[b]	U-0.026	U-0.026
Attic and other	U-0.026	U-0.026
Walls, Above grade		
Mass[f]	U-0.05	U-0.05
Metal buildings	U-0.041	U-0.041
Metal framed	U-0.041	U-0.041
Wood framed and other	U-0.041	U-0.041
Walls, below grade		
Below-grade wall[d]	C-0.092	C-0.092
Floors		
Mass[e]	U-0.04	U-0.04
Joist/framing	U-0.04	U-0.04
Slab-on-grade floor		
Unheated slabs		
Heated slabs[g]		

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m2, 1 pound per cubic foot = 16 kg/m3.
ci = Continuous insulation, NR = No Requirement, LS = Liner System.

a. Where assembly U-factors, C-factors and F-factors are established in ASNI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding systems on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Where U-factors have been established by testing in accordance with AASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The R-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

c. Where heated slabs are below grade, below grade walls shall comply with the U-factor requirements for above-grade mass walls

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

e. These C-, F-, and U-factors are based on assemblies that are not required to contain insulation.

f. The first value is for perimeter insulation and the second value is for full, under-slab insulation

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

h. Swinging door U-factors shall be determined in accordance with NFRC-100

i. Garage doors having a single row of fenestration shall have an assembly U-factor less than or equal to 0.44 in Climate Zone 5.

Modification to Section C402.5 Air Leakage

C402.5 Air leakage – thermal envelope.

A building thermal envelope shall comply with Section C402.5.1 through Section C402.5.11.1, ~~or~~ and the building thermal envelope shall be tested in accordance with Section C402.5.2 ~~or~~ and C402.5.2. ~~Where compliance is based on such testing, the building shall also comply with Section C402.5.7, C402.5.8 and C402.5.9.~~

Modification to Section C402.5.3 Building thermal envelope testing

C402.5.3 Building thermal envelope testing. The building thermal envelope shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.20 cfm/ft2 (1.0.0 L/s x m2) ~~0.40 cfm/ft2 (2.0 L/s × m2)~~ of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof.
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

~~Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft2 (2.0 L/s × m2) but does not exceed 0.60 cfm/ft2 (3.0 L/s × m2), a diagnostic evaluation using smoke tracer or infrared imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with the requirements of this section~~

Add new Section C402.6 Thermal bridges in above-grade walls

C402.7 Thermal bridges in above-grade walls.

Thermal bridges in *above-grade walls* shall comply with this section or an *approved* design.

Exceptions:

4. Any *thermal bridge* with a material thermal conductivity not greater than 3.0 Btu/h x °F (5.19 W/m x K)
5. Blocking, coping, flashing and other similar materials for attachment of roof coverings.
6. *Thermal bridges* accounted for in the *U-factor* for a *building thermal envelope.*

Add new Section C402.6.1 Balconies and floor decks

C402.7.1 Balconies and floor decks.

Balconies and concrete floor decks shall not penetrate the *building thermal envelope*. Such assemblies shall be separately supported or shall be supported by structural attachments or elements that minimize thermal bridging through the *building thermal envelope*.

Exceptions: Balconies and concrete floor decks shall be permitted to penetrate the *building thermal envelope* where one of the following applies:

4. An area-weighted *U-factor* is used for *above-grade wall* compliance that includes a *U-factor* of 0.8 Btu/h x °F (1.38 W/m x K) for the area of the *above-grade wall* penetrated by the concrete floor deck in accordance with Section R402.1.2.1.5.
5. An *approved* thermal break device with not less than R-10 insulation material is installed in accordance with the manufacturer's instructions.
6. An *approved* design where the *above-grade wall U-factor* used for compliance accounts for all balcony and concrete floor deck *thermal bridges*.

Add new Section C402.6.2 Cladding supports

C402.6.2 Cladding Supports.

Linear elements supporting opaque cladding shall be offset from the structure with attachments that allow the *continuous insulation*, where present, to pass behind the cladding support element except at the point of attachment.

Exceptions:

3. An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the cladding support element *thermal bridge.*

4. Anchoring for *curtain wall* and window wall systems where *curtain wall* and window wall systems comply with Section R402.7.4.

Add new Section C402.6.3 Structural beams and columns

C402.6.3 Structural beams and columns.
Structural steel and concrete beams and columns that project through the *building thermal envelope* shall be covered with not less than R-5 insulation for not less than 2 feet (610 mm) beyond the interior or exterior surface of insulation component within the *building thermal envelope*.

Exceptions:

3. Where an *approved* thermal break device is installed in accordance with the manufacturer's instructions.
4. An *approved* design where the *above-grade wall U-factor* used to demonstrate compliance accounts for the beam or column *thermal bridge*.

Add new Section C402.6.4 Vertical fenestration

C402.6.4 Vertical fenestration.
Vertical *fenestration* intersections with *above-grade walls* shall comply with one or more of the following:

5. Where *above-grade walls* include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame *fenestration*, a nonmetal thermal break in the frame shall be positioned within 2 inches (610 mm) of the interior or exterior surface of the *continuous insulation*.
6. Where *above-grade walls* do not include *continuous insulation*, the plane of the exterior glazing layer or, for metal frame *fenestration*, a nonmetal thermal break in the frame shall be positioned within the thickness of the integral or *cavity insulation*.
7. The surface of the rough opening, not covered by the *fenestration* frame, shall be insulated with insulation of not less than R-3 material or covered with a wood buck that is not less than 1.5 inches (38 mm) thick.
8. For the intersection between vertical *fenestration* and opaque spandrel in a shared framing system, manufacturer's data for the spandrel *U-factor* shall account for the *thermal bridges*.

Exceptions:

3. Where an *approved* design for the *above-grade wall U-factor* used for compliance accounts for *thermal bridges* at the intersection with the vertical *fenestration*.
4. Doors

Add new Section C402.6.5 Parapets

C402.6.5 Parapets.
Parapets shall comply with one or more of the following as applicable:

1. Where *continuous insulation* is installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the *continuous insulation* shall extend up both sides of the parapet not less than 2 feet (610 mm) above the roof covering or to the top of the parapet, whichever is less. Parapets that are an integral part of a fire-

resistance rated wall, and the exterior *continuous insulation* applied to the parapet, shall comply with the fire-resistance ratings of the *International Building Code*.

2. Where *continuous insulation* is installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the *continuous insulation* shall extend up the exterior side of the parapet to not less than the height of the top surface of the *roof assembly*.
3. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof is insulated with insulation entirely above deck, the wall cavity or integral insulation shall extend into the parapet up to the exterior face of the roof insulation or equivalent *R-value* insulation shall be installed not less than 2 feet (610 mm) horizontally inward on the underside of the roof deck.
4. Where *continuous insulation* is not installed on the exterior side of the *above-grade wall* and the roof insulation is below the roof deck, the wall and roof insulation components shall be adjacent to each other at the roof-ceiling-wall intersection.
5. Where a thermal break device with not less than R-10 insulation material aligned with the *above-grade wall* and roof insulation is installed in accordance with the manufacturer's instructions.

Exception: An *approved* design where the *above-grade wall U-factor* used for compliance accounts for the parapet *thermal bridge*.

Modification to Section C403.7.4.1 Nontransient dwelling units.

C403.7.4.1 Nontransient dwelling units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an enthalpy recovery ratio of not less than ~~50~~ 65 percent at cooling design condition and not less than ~~60~~ 65 percent at heating design condition.

Addition of New Section C403.14 Resilient HVAC controls

C403.14 Resilient HVAC Controls. *Resilient HVAC systems served with power from an emergency power system according to International Building Code Section 2702.2.20 shall meet the requirements of C403.14.1 through C403.14.2.*

Addition of New Section C403.14.1 Resilient heating and cooling controls

C403.14.1 Resilient Heating and Cooling Controls. Heating and cooling systems served with power from an *emergency power system* according to *International Building Code* Section 2702.2.20 shall have controls capable of automatic temperature setbacks in the event of a failure of the primary power.

Addition of New Section C402.14.1.2 Resilient heating and cooling setpoints

C402.14.1.2 Resilient Heating and Cooling Setpoints. Automatic thermostat controls for heating and cooling systems served with power from an *emergency power system* shall be capable of achieving temperature setbacks to 60°F for heating and 82°F for cooling.

Addition of New Section C403.14.2 Resilient ventilation controls

C403.14.2 Resilient Ventilation Controls. Ventilation systems served with power from an *emergency power system* according to 2702.2.20 shall have controls capable of adjusting airflows to 50% of minimum required design airflow in the event of a failure of the primary power.

Addition of New Section C403.14.3 Resilient equipment flood elevation

C403.14.3 Resilient Equipment Flood Elevation. Resilient mechanical systems shall be located a minimum of 2 feet above the 500-year FEMA floodplain Base Flood Elevation.

Addition of New Section C405.12.6 Resilient electric power controls.

C405.12.6 Resilient electrical power controls. Electric circuits and loads beyond those minimally required *International Building Code* Section E2702.2.20 that are served with power from an *emergency power system* shall have controls to facilitate automatic load shedding of loads not required by *International Residential Code* Section E2702.2.20 when *emergency power system* capacity falls below 50%.

Addition of New Section C405.13 On-site renewable energy.

C403.13 On-Site renewable energy systems. Building projects shall contain on-site renewable energy systems with a rated capacity of not less than 2 W/ft2 (22 W/m2) multiplied by the horizontal projection of the gross roof area over conditioned spaces and semi-heated spaces. The building gross roof area used for calculation excludes the following:

b. Shaded areas that are defined as roof area where direct-beam sunlight is blocked by structures or natural objects for more than 1500 annual hours between 8 a.m. and 4 p.m.

e. Areas designated for helipads.

Exceptions to R403.13:

2. Building projects that have an annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 1.2 kBtu/ft2·day (4.0 kWh/m2 ·day).

3. Renewable energy systems, other than photovoltaic systems, that result in an equal or greater annual energy production.

Addition of new Section C405.14 Electric energy storage system (ESS)

C405.14 Electrical energy storage system.

Building shall comply with sections C405.14.1.

Addition of new Section C405.14.1 Electric energy storage system (ESS) capacity

C405.14.1 Electric energy storage system (ESS) capacity.

Each building shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

3. ESS-rate energy capacity (kWh) ≥ 5.0 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.
4. ESS-rated power capacity (kW) ≥ 1.25 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.

Where installed, DC-coupled battery systems shall meet the requirements for rated energy capacity alone.

Modification of Section C407.2 Requirements for total building performance.

Table C407.2 Requirement For Total Building Performance

Section	Title
	Air leakage – thermal envelope
C402.5	
	Mechanical
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4 except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7~~, except C403.7.4.1~~	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope

C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commissioning