STANDARD

ANSI/ASHRAE/IES Addendum r to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on May 31, 2024; and by the Illuminating Engineering Society on May 8, 2024.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum r modifies and clarifies core terminology within ANSI/ASHRAE/IES Standard 90.1, creating a distinction between the generic use of the word "floor" and the proposed revision of the defined term, "floor." Floor, which is an element of the building's thermal envelope, will become the term "envelope floor," which better describes the intended application of the term. This change is needed, because the common term "floor" in Standard 90.1 is often italicized incorrectly, which can result in misapplication of the standard.

Numerous sections are proposed to be modified within Standard 90.1, clarifying the intent of when a floor is just a floor or when it is instead an element of the thermal envelope.

***Note:** In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.*

Addendum r to Standard 90.1-2022

Modify Section 3.2 as follows (IP and SI).

[. . .]

addition: an extension or increase in ~~*floor*~~ floor area or height of a *building* outside of the *existing building envelope* or the *equipment* or *systems* to a *site*.

[. . .]

class of construction: for the *building envelope*, a subcategory of *roof*, *above-grade wall*, *below-grade wall*, *envelope floor*, *slab-on-grade floor*, *opaque door*, *vertical fenestration*, or *skylight*. (See *roof*, *wall*, *envelope floor*, *slab-on-grade floor*, *door*, and *fenestration*.)

[. . .]

computer room: a room whose primary function is to house *equipment* for the processing and storage of electronic data and that has a design electronic data *equipment* power density exceeding 20 W/ft^2 of conditioned ~~*floor*~~ floor area.

[. . .]

daylight area: the ~~*floor*~~ floor area substantially illuminated by daylight.

daylight area under roof monitors: the *daylight area under roof monitors* is the combined *daylight area* under each *roof monitor* within each *space*. The *daylight area* under each *roof monitor* is the product of

a. the width of the *vertical fenestration* above the ceiling level plus, on each side, the smallest of
   1. 2 ft,
   2. the distance to any 5 ft or higher vertical obstruction, or
   3. the distance to the edge of any *primary sidelighted area*

and

b. the smaller of the following horizontal distances inward from the bottom edge of the *vertical fenestration* (see Figure 3.2-1):
   1. The monitor sill height (MSH) (the vertical distance from the ~~*floor*~~ floor to the bottom edge of the monitor glazing)
   2. The distance to the nearest face of any *opaque* vertical obstruction, where any part of the obstruction is farther away than the difference between the height of the obstruction and the monitor sill height (MSH – OH)

daylight area under skylights in multistory spaces: the *daylight area under skylights in multistory spaces* shall include ~~*floor*~~ floor areas directly beneath the *skylight* and portions of the uppermost ~~*floor*~~ floor adjacent to the multistory *space* that meet the criteria for a *daylight area under skylights*, where CH is the ceiling height of the uppermost ~~*floor*~~ floor (see Figure 3.2-3).

primary sidelighted area: the total *primary sidelighted area* is the combined *primary sidelighted area* within each *space*. Each *primary sidelighted area* is directly adjacent to *vertical fenestration* in an exterior *wall* below the ceiling (see Figure 3.2-4).

a. The *primary sidelighted area* width is the width of the *vertical fenestration* plus, on each side, the smaller of
   1. one half of the *vertical fenestration* head height (where head height is the distance from the ~~*floor*~~ floor to the top of the glazing) or
   2. the distance to any 5 ft or higher *opaque* vertical obstruction.

b. The *primary sidelighted area* depth is the horizontal distance perpendicular to the *vertical fenestration*, which is the smaller of
   1. one *vertical fenestration* head height or
   2. the distance to any 5 ft or higher *opaque* vertical obstruction.

[. . .]

envelope floor: that lower portion of the *building envelope*, including *opaque* area and *fenestration*, that has conditioned or *semiheated space* above and is horizontal or tilted at an angle of less than 60 degrees from horizontal and not in contact with the ground ~~but excluding *slab-on-grade floors*~~. For the purposes of determining *building envelope* requirements, the classifications are defined as follows:

mass floor: an *envelope floor* with a *heat capacity* that exceeds (a) 7 Btu/ft^2·°F or (b) 5 Btu/ft^2·°F, provided that the ~~*floor*~~ floor has a material unit mass not greater than 120 lb/ft^3.

steel-joist floor: an *envelope floor* that (a) is not a *mass floor* and (b) has *steel joist* members supported by structural members.

wood-framed and other floors: all other *envelope floor* types, including wood-joist *floors*. (See *building envelope*, *fenestration*, *opaque*, *and slab-on-grade floor*).

[. . .]

floor area, gross: the sum of the ~~*floor*~~ floor areas of the *spaces* within the *building*, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 ft or greater. It is measured from the exterior faces of *walls* or from the centerline of *walls* separating *buildings*, but excluding covered walkways, open roofed-over areas, porches and similar *spaces*, pipe trenches, exterior terraces or steps, chimneys, *roof* overhangs, and similar features.

gross conditioned floor area: the *gross floor area* of *conditioned spaces*.

gross lighted floor area: the *gross floor area* of lighted *spaces*. (See *building envelope*, *envelope floor*, *slab-on-grade floor*, *and space*.)

[. . .]

heat capacity (HC): the amount of heat necessary to raise the temperature of a given mass 1°F. Numerically, the *HC* per unit area of surface (Btu/ft^2·°F) is the sum of the products of the mass per unit area of each individual material in the *roof*, *wall*, or *envelope floor* surface multiplied by its individual specific heat.

[. . .]

mass floor: see *envelope floor*.

[. . .]

residential associated HVAC zone: any *HVAC zone* that primarily includes *nonresidential spaces* designed to serve occupants of *residential spaces*, including but not limited to corridors, stairwells, elevator lobbies, and common restrooms, on a ~~*floor*~~ floor where over 75% of the *gross conditioned floor area* are *residential spaces*. This definition does not apply to *HVAC zones* within hospitals.

[. . .]

slab-on-grade floor: that portion of a ~~slab *floor*~~ floor ~~of the *building envelope*~~ that is ground supported and ~~in contact with the ground and that is either~~ above *grade* or ~~is~~ less than or equal to 24 in. below the final elevation of the nearest exterior *grade*.

[. . .]

space: an *enclosed space* within a *building*. The classifications of *spaces* are as follows for the purpose of determining *building envelope* requirements:

conditioned space: a *cooled space*, *heated space*, or *indirectly conditioned space* defined as follows:

a. ***cooled space:*** an *enclosed space* within a *building* that is cooled by a cooling *system* whose sensible output

capacity is ≥3.4 Btu/h·ft^2 of ~~*floor*~~ floor area.

b. ***heated space:*** an *enclosed space* within a *building* that is heated by a heating *system* whose output capacity relative to the ~~*floor*~~ floor area is greater than or equal to the criteria in Table 3.2.

[. . .]

semiheated space: an *enclosed space* within a *building* that is heated by a heating *system* whose output capacity is greater than or equal to 3.4 Btu/h·ft^2 of ~~*floor*~~ floor area but is not a *conditioned space*.

[. . .]

story: portion of a *building* that is between one finished ~~*floor*~~ floor level and the next higher finished ~~*floor*~~ floor level or the *roof*, provided, however, that a basement or cellar shall not be considered a story.

[. . .]

thermal bridge: an element that has higher thermal conductivity than the surrounding materials, which creates a path of least resistance for heat transfer. For the purposes of determining *building envelope* requirements, the classifications for *thermal bridges* are defined as follows:

[. . .]

linear thermal bridge: a length-based element associated with horizontal, vertical, or diagonal elements that penetrates the insulation in the *building envelope* and with length measured along the exterior surface of the *building envelope*. Examples of *linear thermal bridges* include edges of ~~*floor*~~ floors, balconies, columns and beams in the plane of an assembly, parapets, *roof-wall-* ~~*floor*~~ floor intersections, *fenestration* interfaces, shelf angles, and similar conditions not otherwise defined as a *clear field thermal bridge* or *point thermal bridge*.

point thermal bridge: a discrete element that penetrates the insulation in the *building envelope*. Examples of *point thermal bridges* include a beam penetrating a *wall,* a column penetrating a *roof* or *envelope floor*, and an anchor or connection used to attach an element to the *building* and not otherwise defined as a *clear field thermal bridge* or *linear thermal bridge*. The cross-sectional area of the *point thermal bridge* is measured at the outer surface of the outermost layer of insulation that is penetrated by the element.

[. . .]

wall: that portion of the *building envelope*, including *opaque* area and *fenestration*, that is vertical or tilted at an angle of 60 degrees from horizontal or greater. This includes ~~above~~ *above-grade walls,* ~~and~~ *below-grade walls*, between ~~*floor*~~ floor spandrels, peripheral edges of ~~*floor*~~ floors, and foundation *walls*. For the purposes of determining *building envelope* requirements, the classifications are defined as follows:

[. . .]

wall area, gross: the area of the *wall* measured on the exterior ~~face~~ from the top of the lowest ~~*floor*~~ floor to the bottom of the *roof*. For this definition, the exterior of a *below-grade wall* is that portion of the *wall* assembly in contact with the ground.

[. . .]

wood-framed and other floors: see *envelope floor*.

[. . .]

Modify Section 4.2.4.3 as follows (IP and SI).

4.2.4.3 Continuous-Air-Barrier Inspections. Where a *continuous air barrier* is installed as a component of an *opaque roof*, *above-grade walls* and *below-grade walls*, or *envelope floors*, it shall be inspected for compliance in accordance with Section 5.8.3.1. Integration with adjoining *fenestration* and other *continuous air barrier* elements shall be in accordance with Section 5.4.3.1.

Modify Section 5.1.4 as follows (IP and SI).

5.1.4 Alterations to Building Envelopes. *Alterations* to the *building envelope* shall comply with the requirements of Section 5.2 for insulation, *air leakage*, and *fenestration* applicable to those specific portions of the *building* that are being altered.

Exceptions to 5.1.4: The following *alterations* need not comply with these requirements, provided such *alterations* will not increase the *energy* use of the *building*:

1. Installation of storm windows or glazing panels over existing glazing, provided the storm window or glazing panel contains a low-emissivity coating. However, a low-emissivity coating is not required where the existing glazing already has a low-emissivity coating. Installation is permitted to be either on the inside or outside of the existing glazing.

2. Replacement of glazing in existing sash and frame, provided the *U-factor* and *SHGC* will be equal to or lower than before the glass replacement.
3. *Alterations* to *roof*, *wall*, or *envelope floor* cavities that are insulated to full depth with insulation having a minimum nominal value of R-3.0/in.
4. *Alterations* to *walls* and *envelope floors*, where the existing *structure* is without framing cavities and no new framing cavities are created.

[. . .]

Modify Section 5.4.3.2 as follows (IP and SI).

5.4.3.2 Continuous Air Barrier Design and Installation. The *continuous air barrier* shall be designed and installed in the following manner:

a. Components designed to provide the *continuous air barrier*, and the component's position within each of the *building envelope* assemblies, shall be clearly identified on *construction documents*.
b. The joints, interconnections, and penetrations of the *continuous air barrier* components shall be detailed in the *construction documents*.
c. The *continuous air barrier* shall extend over all surfaces of the *building envelope* and be identified in the *construction documents* to be continuous across the components of the below-*grade* areas, *walls*, *fenestration*, *doors*, and *roofs*.
d. The *continuous air barrier* shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical *ventilation* and allow for anticipated movements.
e. The following areas of the *continuous air barrier* in the *building envelope* shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize *air leakage*:
    1. Joints around *fenestration* and *door* frames
    2. Junctions between *walls* and *envelope floors*; between *walls* at *building* corners; between *walls* and *roofs*, including parapets and copings; and *walls* at foundations
    3. Penetrations through the *continuous air barrier* in *building envelope roofs*, *walls*, and *envelope floors*

[. . .]

Modify Section 5.4.3.4.2 as follows (IP and SI).

5.4.3.4.2 Vestibule Size. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than 7 ft when in the closed position. The floor ~~*floor*~~ area of each vestibule shall not exceed the greater of 50 ft^2 or 2% of the *gross conditioned floor area* for that level of the *building*.

Modify Section 5.5, Table 5.5-0, as follows (IP and SI).

Table 5.5-0 Building Envelope Requirements for Climate Zone 0 (A,B)

Opaque Elements	Assembly Maximum	Insulation Value	Assembly Maximum	Insulation Min. R-Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below-Grade			
Below-grade wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
			Envelope Floors			
Mass	U-0.322	NR	U-0.322	NR	U-0.322	NR
Steel joist	U-0.350	NR	U-0.350	NR	U-0.350	NR
Wood-framed and other	U-0.282	NR	U-0.282	NR	U-0.282	NR
			Slab-on-Grade Floors			
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR

Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.

[. . .]

Modify Section 5.5, Table 5.5-1, as follows (IP and SI).

Table 5.5-1 Building Envelope Requirements for Climate Zone 1 (A,B)

Opaque Elements	Assembly Maximum	Insulation R-Value	Assembly Maximum	Insulation Min. Min. R-Value	Assembly Maximum	Insulation Min. R-Value
[. . .]						
Wall, below Grade						
Below-grade wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Envelope Floors						
Mass	U-0.322	NR	U-0.322	NR	U-0.322	NR
Steel joist	U-0.350	NR	U-0.350	NR	U-0.350	NR
Wood-framed and other	U-0.282	NR	U-0.282	NR	U-0.282	NR
Slab-on-Grade Floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.
[. . .]						

Modify Section 5.5, Table 5.5-2, as follows (IP and SI).

Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A,B)

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
[. . .]						
Wall, below Grade						
Below-grade wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Envelope Floors						
Mass	U-0.107	R-6.3 *c.i.*	U-0.087	R-8.3 *c.i.*	U-0.322	NR
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.069	R-13
Wood-framed and other	U-0.033	R-30	U-0.033	R-30	U-0.066	R-13
Slab-on-Grade Floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-0.900	R-10 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.
[. . .]						

Modify Section 5.5, Table 5.5-3, as follows (IP and SI).

Table 5.5-3 Building Envelope Requirements for Climate Zone 3 (A,B,C)

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below Grade			
Below-grade wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
			Envelope Floors			
Mass	U-0.074	R-10 *c.i.*	U-0.074	R-10 *c.i.*	U-0.137	R-4.2 *c.i.*
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19
Wood-framed and other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19
			Slab-on-Grade Floors			
Unheated	F-0.730	NR	F-0.540	R-10 for 24 in.	F-0.730	NR
Heated	F-0.860	R-15 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.
			[. . .]			

Modify Section 5.5, Table 5.5-4, as follows (IP and SI).

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below Grade			
Below-grade wall	C-0.119	R-7.5 *c.i.*	C-0.092	R-10 *c.i.*	C-1.140	NR
			Envelope Floors			
Mass	U-0.057	R-14.6 *c.i.*	U-0.051	R-16.7 *c.i.*	U-0.107	R-6.3 *c.i.*
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19
Wood-framed and other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19
			Slab-on-Grade Floors			
Unheated	F-0.520	R-15 for 24 in.	F-0.520	R-15 for 24 in.	F-0.730	NR
Heated	F-0.843	R-20 for 24 in.	F-0.688	R-20 for 48 in.	F-0.900	R-10 for 24 in.
			[. . .]			

Modify Section 5.5, Table 5.5-5, as follows (IP and SI).

Table 5.5-5 Building Envelope Requirements for Climate Zone 5 (A,B,C)

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			

			Wall, below Grade			
Below-grade wall	C-0.119	R-7.5 *c.i.*	C-0.092	R-10 *c.i.*	C-1.140	NR
			Envelope Floors			
Mass	U-0.057	R-14.6 *c.i.*	U-0.051	R-16.7 *c.i.*	U-0.107	R-6.3 *c.i.*
Steel joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19
Wood-framed and other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19
			Slab-on-Grade Floors			
Unheated	F-0.520	R-15 for 24 in	F-0.510	R-20 for 24 in.	F-0.730	NR
Heated	F-0.688	R-20 for 48 in.	F-0.688	R-20 for 48 in.	F-0.900	R-10 for 24 in.
			[. . .]			

Modify Section 5.5, Table 5.5-6, as follows (IP and SI).

Table 5.5-6 Building Envelope Requirements for Climate Zone 6 (A,B)

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below Grade			
Below-grade wall	C-0.092	R-10 *c.i.*	C-0.063	R-15 *c.i.*	C-0.119	R-7.5 c.i
			Envelope Floors			
Mass	U-0.051	R-16.7 *c.i.*	U-0.051	R-16.7 *c.i.*	U-0.087	R-8.3 *c.i.*
Steel joist	U-0.032	R-38	U-0.032	R-38	U-0.052	R-19
Wood-framed and other	U-0.027	R-38	U-0.027	R-38	U-0.051	R-19
			Slab-on-Grade Floors			
Unheated	F-0.510	R-20 for 24 in.	F-0.434	R-20 for 48 in	F-0.730	NR
Heated	F-0.688	R-20 for 48 in.	F-0.671	R-25 for 48 in.	F-0.860	R-15 for 24 in.
			[. . .]			

Modify Section 5.5, Table 5.5-7, as follows (IP and SI).

Table 5.5-7 Building Envelope Requirements for Climate Zone 7

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below Grade			
Below-grade wall	C-0.063	R-15 *c.i.*	C-0.063	R-15 *c.i.*	C-0.119	R-7.5 *c.i.*
			Envelope Floors			
Mass	U-0.042	R-20.9 *c.i.*	U-0.042	R-20.9 *c.i.*	U-0.074	R-10.4 *c.i.*
Steel joist	U-0.032	R-38	U-0.032	R-38	U-0.052	R-19
Wood-framed and other	U-0.027	R-38	U-0.027	R-38	U-0.051	R-19

			Slab-on-Grade Floors			
Unheated	F-0.510	R-20 for 24 in.	F-0.434	R-20 for 48 in.	F-0.730	NR
Heated	F-0.671	R-25 for 48 in.	F-0.671	R-25 for 48 in.	F-0.860	R-15 for 24 in.

[. . .]

Modify Section 5.5, Table 5.5-8, as follows (IP and SI).

Table 5.5-8 Building Envelope Requirements for Climate Zone 8

Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
			[. . .]			
			Wall, below Grade			
Below-grade wall	C-0.063	R-15 *c.i.*	C-0.063	R-15 *c.i.*	C-0.119	R-7.5 *c.i.*
			Envelope Floors			
Mass	U-0.038	R-23 *c.i.*	U-0.038	R-23 *c.i.*	U-0.064	R-12.5 *c.i.*
Steel joist	U-0.032	R-38	U-0.032	R-38	U-0.052	R-19
Wood-framed and other	U-0.027	R-38	U-0.027	R-38	U-0.033	R-30
			Slab-on-Grade Floors			
Unheated	F-0.434	R-20 for 48 in.	F-0.424	R-25 for 48 in.	F-0.540	R-10 for 24 in.
Heated	F-0.671	R-25 for 48 in.	F-0.373	R-20 full slab	F-0.860	R-15 for 24 in.
			[. . .]			

Modify Section 5.5.3.4.1 as follows (IP and SI).

5.5.3.4.1 Floor Insulation. All *envelope floors* shall comply with the insulation values specified in Tables 5.5-0 through 5.5-8.

Modify Section 5.5.3.4.2 as follows (IP and SI).

5.5.3.4.2 Insulated Metal Panels. The *U-factor* of *envelope floor* assemblies that include *insulated metal panels* shall not be greater than the *U-factors* of Tables 5.5-0 through 5.5-8 for the applicable *class of construction*. *U-factors* of *insulated metal panels* shall be determined in accordance with Section A9.4.7.

Modify Section 5.5.4.2.2 as follows (IP and SI)

5.5.4.2.2 Maximum Skylight Fenestration Area. The total *skylight* area shall not be greater than that specified in Tables 5.5-0 through 5.5-8.

Exception to 5.5.4.2.2: The total *skylight* area is permitted to be increased to no greater than 6% of the *gross roof area*, provided the *skylights* meet all of the criteria in Section 5.5.4.4.2, Exception 1 and the total *daylight area under skylights* is a minimum of half the ~~*floor*~~ floor area of the *space*.

Modify Section 5.5.4.2.3 as follows (IP and SI).

5.5.4.2.3 Minimum Skylight Fenestration Area. In any *enclosed space* in a *building* that is

a. 2500 ft^2 and greater;
b. directly under a *roof* with ceiling heights greater than 15 ft; and

c. one of the following *space* types: office, lobby, atrium, concourse, corridor, storage (including nonrefrigerated warehouse), gymnasium, fitness/exercise area, playing area, gymnasium seating area, convention exhibit/event *space*, courtroom, automotive service, fire station engine room, manufacturing corridor/ transition and bay areas, retail, library reading and stack areas, distribution/sorting area, transportation baggage and seating areas, or workshop, the total *daylight area under skylights* shall be a minimum of half the ~~*floor*~~ floor area and either

[. . .]

Exceptions to 5.5.4.2.3:

1. *Enclosed spaces* in Climate Zones 6 through 8.
2. *Enclosed spaces* where it is documented that existing *structures* or natural objects block direct- beam sunlight on at least half of the *roof* over the *enclosed space* for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.
3. *Enclosed spaces* where the *daylight area under roof monitors* is greater than 50% of the *enclosed space* ~~*floor*~~ floor area.

[. . .]

Modify Section 5.5.4.6 as follows (IP and SI).

5.5.4.6 Visible Transmittance/SHGC Ratio. Where *automatic* daylighting controls are required in accordance with Section 9.4.1.1(e) or (f), *fenestration* shall have a ratio of *VT* divided by *SHGC* not less than that specified in Tables 5.5-0 through 5.5-8 for the appropriate *fenestration area*.

Exceptions to 5.5.4.6:

1. A *light-to-solar-gain ratio* (*LSG*) of not less than 1.25 is allowed to be used as an alternative to *VT*/ *SHGC*. When using this option, the center-of-glass *VT* and the center-of-glass *SHGC* shall be determined in accordance with NFRC 300 and NFRC 301, determined by an independent laboratory or included in a database published by a government agency, and certified by the *manufacturer*.
2. *Fenestration* not covered in the scope of the NFRC 200.
3. *Enclosed spaces* where the *daylight area under roof monitors* is greater than 50% of the *enclosed space* ~~*floor*~~ floor area.

[. . .]

Modify Section 5.5.5.2 as follows (IP and SI).

5.5.5.2 Walls and Intermediate Floor Intersections. At ~~*floor*~~ floor and *exterior wall* intersections, the *exterior wall* insulation shall comply with Sections 5.5.5.2.1 and 5.5.5.2.2 as applicable to the type of ~~*floor*~~ floor intersection, *exterior wall* assembly, and location of the *exterior wall* insulation.

5.5.5.2.1 Intermediate ~~*floor*~~ floor edges that do not serve as balconies or ~~*floor*~~ floor overhangs shall comply with the following as applicable:

a. Where a *wall* has *exterior continuous insulation*, such insulation shall extend continuously past the ~~*floor*~~ floor edge.
b. Where a *wall* has cavity insulation that represents more than 50% of the total wall insulation *R-value*, the cavity insulation shall extend to the underside of the ~~*floor*~~ floor deck and shall be permitted to be interrupted by ~~*floor*~~ floor framing members and *wall* top and bottom plates or tracks. (***Informative Note:*** See Informative Appendix K, Figures K-4[a] and K-4[b].)
c. Where a *mass wall* has integral insulation that represents more than 50% of the total wall insulation *R- value*, the intermediate ~~*floor*~~ floor intersection shall comply with one of the following:
   1. The full thickness of integral insulation shall extend past the ~~*floor*~~ floor edge.
   2. Where the intermediate ~~*floor*~~ floor deck extends through the integral insulation, insulation having a *rated R-value of insulation* not less than R-5 shall be maintained to the full depth of the ~~*floor*~~ floor edge on the exterior side of the ~~*floor*~~ floor edge.

   See Informative Appendix K, Figures K-4(c) and K-4(d).
d. Where a *mass wall* has interior insulation that represents more than 50% of the total wall insulation *R- value*, the interior insulation shall extend to the underside of the ~~*floor*~~ floor deck, shall be permitted to be interrupted by framing members, and shall comply with one of the following:
   1. Additional interior insulation having a *rated R-value of insulation* not less than R-5 shall cover

the full depth of the ~~*floor*~~ floor edge. Such insulation shall be permitted to be interrupted by ~~*floor*~~ floor framing members. Fire safing applied to the full depth of the ~~*floor*~~ floor edge meets this requirement.

2. Additional insulation having a *rated R-value of insulation* not less than R-5 shall cover the full depth of the ~~*floor*~~ floor edge on the exterior side of the wall.
3. The *wall* insulation values in Tables 5.5-0 through 5.5-8 shall be adjusted in accordance with Table 5.5.5.2.1.

Informative Note: See Informative Appendix K, Figures K-4(e) and K-4(f).

e. Where *mass walls* have not less than 50% of the *rated R-value of insulation* on the exterior side of the *wall* and the remainder on the interior side, the insulation on the interior side of the *wall* shall be permit ted to be interrupted by an intermediate ~~*floor*~~ floor. (***Informative Note:*** See Informative Appendix K, Figure K-4[g].)

[. . .]

Table 5.5.5.2.2 ~~Mass~~ Floor Balcony or Floor Overhang Allowances

Climate Zone	Maximum Percent of Building Perimeter
4	35%
5	30%
6	20%
7	10%
8	0%

5.5.5.2.2 The total length of ~~*mass floor*~~ floor assembly projections serving as balconies or ~~*floor*~~ floor overhangs that penetrate the *building envelope* shall not exceed the percentages of the total *building* perimeter depicted in Table 5.5.5.2.2. For this calculation, total *building* perimeter is the sum of the perimeters of each above-*grade* floor ~~*grade floor*~~ where it intersects the *exterior building envelope*.

Exceptions to 5.5.5.2.2:

1. ~~*Mass floor*~~ Floor assembly projections located directly above and providing protection to a pedestrian walkway at street-level.
2. ~~*Mass floor*~~ Floor assembly projections thermally broken with a continuous thermal spacer block not less than R-12. The thermal spacer block shall be permitted to be interrupted by structural connections.

Modify Section 5.5.5.3 as follows (IP and SI).

5.5.5.3 Exterior Cladding Support. Shelf angles that support masonry exterior cladding shall be offset from the ~~*floor*~~ floor edge or primary structural frame using point connections to accommodate the full depth of any exterior *continuous insulation* between the support and ~~*floor*~~ floor or structure, exclusive of the point connections. The cross-sectional area of point connections shall not exceed 1.5 in.^{2}/lin ft for carbon steel connections or 2.3 in.^{2}/lin ft for stainless steel. Other cladding supports that penetrate the exterior *continuous insulation* shall be subject to the provisions of Section 5.5.5.5 and be mounted away from the backup construction using point connections to accommodate the full depth of any exterior *continuous insulation* exclusive of the point connections.

Exception to 5.5.5.3: Girts in *metal building walls* as described in Normative Appendix A.

(***Informative Note:*** See Informative Appendix K, Figure K-5.)

Modify Section 5.7.2 as follows (IP and SI).

5.7.2 Permit Application Documentation. Application documents shall include, at a minimum, the type and *rated R-value of insulation* for each product; *opaque door* schedule showing the *U-factor* for each *opaque door* product as determined in accordance with Section 5.8.2; *fenestration* schedule showing the *manufacturer*, model number, *orientation*, area, *U-factor*, *SHGC*, and *VT* for each *fenestration* product, as determined in accordance with Section

5.8.2; *air leakage* details in accordance with Section 5.4.3; and *point* and *linear thermal bridge* details in the *proposed building* shall be represented on the compliance documents in accordance with Section 5.5.5. In addition:

a. **Labeling of space conditioning categories.** For *buildings* that contain *spaces* that will be only *semiheated space* or *unconditioned space*, and compliance is sought using the *semiheated space building envelope* criteria, such *spaces* shall be clearly indicated on the ~~*floor*~~ floor plans.
b. **Labeling of daylight areas.** Daylighting documentation shall identify *daylight areas* on ~~*floor*~~ floor plans, including the *primary sidelighted areas*, *secondary sidelighted areas*, *daylight area under skylights*, and *daylight area under roof monitor*.

[. . .]

Modify Section 5.8.1.5 as follows (IP and SI).

5.8.1.5 Substantial Contact. Insulation shall be installed in a permanent manner in *substantial contact* with the inside surface in accordance with the *manufacturer*'s recommendations for the framing system used. Flexible batt insulation installed in *envelope floor* cavities shall be supported in a permanent manner by supports no greater than 24 in. on center.

[. . .]

Modify Section 5.8.1.6 as follows (IP and SI).

5.8.1.6 Recessed Equipment. Lighting *fixtures*; heating, ventilating, and air-conditioning *equipment*, including *wall* heaters, ducts, and *plenums*; and other *equipment* shall not be recessed in such a manner as to affect the insulation thickness unless

a. the total combined area affected (including necessary clearances) is less than 1% of the *opaque* area of the assembly,
b. the entire *roof*, *wall*, or *envelope floor* is covered with insulation to the full depth required, or

[. . .]

Modify Section 6.4.3.3.3 as follows (IP and SI).

6.4.3.3.3 Optimum Start Controls. Individual heating and cooling *systems* with *setback controls* and *DDC* shall have *optimum start controls*. The control algorithm shall, as a minimum, be a function of the difference between *space* temperature and occupied *set point*, the outdoor temperature, and the amount of time prior to scheduled occupancy. Mass radiant ~~*floor*~~ floor slab *systems* shall incorporate ~~*floor*~~ floor temperature into the optimum start algorithm.

[. . .]

Modify Section 6.4.4.1.5 as follows (IP and SI).

6.4.4.1.5 Radiant Floor Heating. The bottom surfaces of ~~*floor*~~ floor structures incorporating radiant heating shall be insulated with a minimum of R-3.5. Adjacent *building envelope* insulation counts toward this requirement.

[. . .]

Modify Section 6.4.5 as follows (IP and SI).

6.4.5 Walk-In Coolers and Walk-In Freezers. Site-assembled or *site*-constructed *walk-in coolers* and *walk-in freezers* shall conform to the following requirements:

a. Shall be equipped with *automatic door* closers that firmly close walk-in *doors* that have been closed to within 1 in. of full closure.
   Exception to 6.4.5(a): *Doors* wider than 3 ft 9 in. or taller than 7 ft.
b. Doorways shall have strip *doors* (curtains), spring-hinged *doors*, or other method of minimizing infiltration when *doors* are open.
c. *Walk-in coolers* shall contain *wall*, ceiling, and *door* insulation of at least R-25 and at least R-32 for *walk-in freezers*.
   Exception to 6.4.5(c): Glazed portions of *doors* or structural members.
d. *Walk-in freezers* shall contain floor ~~*floor*~~ insulation of at least R-28.

[. . .]

Modify Section 6.5.8.2 as follows (IP and SI).

6.5.8.2 Heating Enclosed Spaces. *Radiant heating systems* that are used as primary or supplemental *heating for enclosed spaces* must be in conformance with the governing provisions of the standard, including but not limited to the following:

a. Radiant hydronic ceiling or floor ~~*floor*~~ panels (used for heating or cooling)

[. . .]

Modify Table 6.8.2 as follows (IP and SI).

Table 6.8.2 Minimum to Duct Insulation R-Value[a]

[. . .]

a. Insulation *R-values*, measured in h·ft^2·°F/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where portions of the *building envelope* are used as a *plenum* enclosure, *building envelope* insulation shall be as required by the most restrictive condition of Section 6.4.4.1 or Section 5, depending on whether the *plenum* is located in the *roof*, *wall*, or *envelope floor*. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a *mean temperature* of 75°F at the installed thickness.
b. Includes attics above insulated ceilings, parking garages and crawl *spaces*.
c. Includes return air *plenums* with or without exposed *roofs* above.
d. Return ducts in this duct location do not require insulation.

Modify Section 8.4.2 as follows (IP and SI).

8.4.2 Automatic Receptacle Control. The following shall be *automatically* controlled:

[. . .]

This control shall function on

a. a scheduled basis using a time-of-day operated *control device* that turns receptacles off at specific programmed times—an independent program schedule shall be provided for controlled areas of no more than 5000 ft^2 and not more than one floor ~~*floor*~~ (the occupant shall be able to manually override the *control device* for up to two hours);

[. . .]

Modify Section 8.7.3.1 as follows (IP and SI).

8.7.3.1 Record Documents. *Construction documents* shall require that within 90 days after the date of *system* acceptance, *record documents* shall be provided to the *property* owner, including

a. a *single-line diagram* of the *property* electrical *distribution system*,
b. floor ~~*floor*~~ plans indicating location and area served for all distribution, and
c. *site* plans indicating location and area served for all distribution.

Modify Section 9.3. as follows (IP and SI).

9.3 Simplified Building Method Compliance Path. The Simplified Building Method contains the requirements for interior lighting in Section 9.3.1 and exterior lighting in Section 9.3.2 and shall be allowed to be used where at least 80% of the ~~*floor*~~ floor area supports either office *buildings*, retail *buildings*, or school *buildings*. The Simplified Building Method shall be used for new *buildings* or tenants improvements of less than 25,000 ft^2. Interior and exterior wattage allowances shall be calculated and complied with separately.

Modify Section 9.4.1.1 as follows (IP and SI).

9.4.1.1 Interior Lighting Controls. For each *space* in the *building*, all of the lighting control functions indicated in Tables 9.5.2.1-1 and 9.5.2.1-2, for the appropriate *space* type in the first column, and as described below, shall be implemented. All control functions indicated as "REQ" are mandatory and shall be implemented. If a *space* type has control functions indicated as "ADD1," then at least one of those functions shall be implemented. If a *space* type has control functions indicated as "ADD2," then at least one of those functions shall be implemented. For *space* types not listed, select a reasonably equivalent type.

[. . .]

e. Automatic daylight responsive controls for sidelighting: In any *space* where the combined input power of all *general lighting* completely or partially within the *primary sidelighted areas* is 75 W or greater, the *general lighting* in the *primary sidelighted areas* shall be controlled by photocontrols.

In any *space* where the combined input power of all *general lighting* completely or partially within the *primary sidelighted area* and *secondary sidelighted area* is 150 W or greater, the *general lighting* in the

primary sidelighted area and *secondary sidelighted area* shall be controlled by photocontrols. *General lighting* in the *secondary sidelighted area* shall be controlled independently of the *general lighting* in the *primary sidelighted area*.

The control *system* shall have the following characteristics:

1. The calibration adjustment control shall be located no higher than 11 ft above the finished floor ~~*floor*~~. Calibration shall not require the physical presence of a person at the sensor while it is processing.

[. . .]

f. Automatic daylight responsive controls for *toplighting*: In any *space* where the combined input power for all *general lighting* completely or partially within *daylight area under skylights* and *daylight area under roof monitors* is 75 W or greater, *general lighting* in the *daylight area* shall be controlled by photocontrols. The control *system* shall have the following characteristics:

1. The calibration adjustment control shall be located no higher than 11 ft above the finished floor ~~*floor*~~. Calibration shall not require the physical presence of a person at the sensor while it is processing.

[. . .]

i. Scheduled shutoff: All lighting in the space, including lighting connected to emergency circuits, shall be automatically shut off during periods when the space is scheduled to be unoccupied using either (1) a time-of-day operated control device that automatically turns the lighting off at specific programmed times or (2) a signal from another automatic control device or alarm/security system. The control device or system shall provide independent control sequences that (1) control the lighting for an area of no more than 25,000 ft^2, (2) include no more than one floor ~~*floor*~~, and (3) shall be programmed to account for weekends and holidays. Any manual control installed to provide override of the scheduled shutoff control shall not turn the lighting on for more than two hours per activation during scheduled off periods and shall not control more than 5000 ft^2.

Modify Section 9.5.2.1 as follows (IP and SI).

9.5.2.1 Space-by-Space Method of Calculating Interior Lighting Power Allowance. Use the following steps to determine the *interior lighting power allowance* by the Space-by-Space Method:

a. For each *space* enclosed by partitions that are 80% of the ceiling height or taller, determine the appropriate *space* type and the corresponding *LPD* allowance from Tables 9.5.2.1-1 and 9.5.2.1-2. If a *space* has multiple functions, where more than one *space* type is applicable, that *space* shall be broken up into smaller subspaces, each using its own *space* type from Tables 9.5.2.1-1 and 9.5.2.1-2. Any of these sub- spaces that are smaller in floor ~~*floor*~~ area than 20% of the original *space* and less than 1000 ft^2 need not be broken out. Include the floor ~~*floor*~~ area of balconies and other projections in this calculation.

[. . .]

Modify Table 9.5.2.1-2 as follows (IP and SI).

Table 9.5.2.1-2 Maximum Lighting Power Density Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

Building-Specific Space Types[a]	LPD, W/ft^2	RCR	Local Control 9.4.1.1(a)	Manual ON 9.4.1.1(b)	Partial Auto ON 9.4.1.1(c)	Multilevel Lighting Control 9.4.1.1(d)	Daylight Response Sidelight 9.4.1.1(e) [b]	Daylight Response Toplight 9.4.1.1(f) [b]	Auto Reduction (Full OFF complies) 9.4.1.1(g)	Auto Full OFF 9.4.1.1(h)	Scheduled Shutoff 9.4.1.1(i)
[. . .]											
Manufacturing Facility											
Detailed manufacturing area	0.75	4	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
Extra-high bay area (>50 ft floor ~~*floor*~~ -to-ceiling height)	1.36	8	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
High bay area (25 to 50 ft floor ~~*floor*~~ -to-ceiling height)	1.24	6	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
Low bay area (<25 ft floor ~~*floor*~~ -to-ceiling height)	0.85	3	REQ	ADD1	ADD1		REQ	REQ		ADD2	ADD2
[. . .]											

a. Where both a common *space* type and a *building* specific *space* type are listed, the *building* specific *space* type shall apply (see Table 9.5.2.1-1 for common *space* types).
b. *Automatic* daylight responsive controls are mandatory only if the *space* meets the requirements of the specified sections.

Modify Table 9.5.2.2 as follows (IP and SI).

Table 9.5.2.2 Additional Lighting Power

Section	Description	Additional Lighting Power	Required Controls
[. . .]			

Notes:

Retail Area 1 = the floor ~~*floor*~~ area for all products not listed in Retail Areas 2, 3, or 4

Retail Area 2 = the floor ~~*floor*~~ area used for the sale of vehicles, sporting goods, and small electronics

Retail Area 3 = the floor ~~*floor*~~ area used for the sale of furniture, clothing, cosmetics, and artwork

Retail Area 4 = the floor ~~*floor*~~ area used for the sale of jewelry, crystal, and china

Modify Section 10.4.5 as follows (IP and SI).

10.4.5 Air Curtains. Air curtain unit performance shall be tested in accordance with ANSI/AMCA 220 or ISO 27327-1 and shall have a jet speed of not less than 6.6 ft/s at 6.0 in. above the floor ~~*floor*~~. Automatic controls shall be provided that will operate the air curtain unit with the opening and closing of the *door* and comply with Section 6.4.3.9. To ensure proper operation, each air curtain unit shall be commissioned in accordance with the *manufacturer*'s instructions, including airstream split location and direction.

Modify Section 10.5.1.1 as follows (IP and SI).

10.5.1.1 On-Site Renewable Energy. The *building site* shall have *equipment* for *on-site renewable energy* with a rated capacity of not less than 0.50 W/ft^2 or 1.7 Btu/ft^2 multiplied by the sum of the *gross conditioned floor area* for all floors up to the three largest floors.

Exceptions to 10.5.1.1:

1. Any *building* located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2·day.
2. Any *building* where more than 80% of the *roof* area is covered by any combination of *equipment* other than for *on-site renewable energy systems*, planters, vegetated *space*, *skylights*, or occupied *roof* deck.
3. Any *building* where more than 50% of *roof* area is shaded from direct-beam sunlight by natural objects or by *structures* that are not part of the *building* for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
4. New *construction* or *additions* in which the sum of the *gross conditioned floor area* of the three largest floors ~~*floors*~~ of the new construction or *addition* is less than 10,000 ft^2.

[. . .]

Modify Section 12.5.3 as follows (IP and SI).

12.5.3 Modeling Building Envelope Air Leakage. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 in. of water) shall be converted to appropriate units for the *simulation program* using one of the following formulas:

a. For methods describing *air leakage* as a function of floor ~~*floor*~~ area,

$$I_{FLR} = 0.112 \times I_{75Pa} \times S/A_{FLR}$$

[. . .]

where

I_{75Pa} = *air leakage* rate of the *building envelope* in cfm/ft^2 at a fixed *building* pressure differential of 75 Pa (0.30 in. of water)

Q = volume of air in cfm flowing through the *building envelope* when subjected to a pressure differential of 75 Pa (0.30 in. of water), in accordance with ASTM E779, ASTM E1827, or ASTM E3158

S = total area of the *building envelope* in ft^2, including the lowest floor ~~*floor*~~, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

[. . .]

Modify Section 12.7.2 as follows (IP and SI).

12.7.2 Permit Application Documentation. Compliance shall be documented and submitted to the *building official*. The information submitted shall include the following:

a. The *energy cost budget* for the *budget building design* and the *design energy cost* for the *proposed design*.
b. The *simulation program* used and the version of the *simulation program*.
c. An overview of the project that includes the number of *stories* (above and below *grade*), the typical floor ~~*floor*~~ size, the uses in the *building* (e.g., office, cafeteria, retail, parking, etc.), the gross area of each use, and whether each use is *conditioned*.
d. A list of the *energy*-related features that are included in the design and on which compliance with the provisions of Section 12 is based. This list shall document all *energy* features that differ between the models used in the *energy cost budget* and the *design energy cost* calculations.
e. A list showing compliance for the *proposed design* with all the requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 (mandatory provisions).
f. *Building* elevations and floor ~~*floor*~~ plans.

[. . .]

Modify Table 12.5.1 as follows (IP and SI).

Table 12.5.1 Modeling Requirements for Calculating Design Energy Cost and Energy Cost Budget

Proposed Design (Column A) Design Energy Cost (DEC)	Budget Building Design (Column B) Energy Cost Budget (ECB)
[. . .]	
5. Building Envelope	
[. . .]	The *budget building design* shall have identical *conditioned floor area* and identical exterior dimensions and *orientations* as the *proposed design*, except as follows: a. *Opaque* assemblies, such as *roof*, *envelope floors*, *doors*, and *walls*, shall be modeled as having the same *heat capacity* as the *proposed design* but with the minimum *U-factor* required in Section 5.5 for new *buildings* or additions and Section 5.1.4 for *alterations*. [. . .]
[. . .]	[. . .]
8. Thermal Blocks—HVAC Zones not Designed	
[. . .] b. Separate *thermal blocks* shall be assumed for *spaces* adjacent to glazed *exterior walls* or glazed *semiexterior walls*; a separate zone shall be provided for each *orientation*, except that *orientations* that differ by less than 45 degrees may be considered to be the same *orientation*. Each zone shall include all ~~*floor*~~ floor area that is 15 ft or less from a glazed perimeter *wall*, except that ~~*floor*~~ floor area within 15 ft of glazed perimeter *walls* having more than one *orientation* shall be divided proportionately between zones. c. Separate *thermal blocks* shall be assumed for *spaces* having ~~*floors*~~ floors that are in contact with the ground or exposed to ambient conditions from zones that do not share these features. [. . .]	[. . .]
9. Thermal Blocks—Multifamily Residential Buildings	
Residential spaces shall be modeled using at least one *HVAC zone* per *dwelling unit* except for those units with the same *orientations*, which may be combined into one *thermal block*. Corner units and units with *roof* or *envelope floor* or *slab-on-grade floor* loads shall only be combined with units sharing these features.	[. . .]

Modify Section A5.2.1 as follows (IP and SI).

A5.2.1 General. For the purpose of Section A1.2, the base assembly is *continuous insulation* over or under a solid concrete *mass floor*. The *U-factors* include R-0.92 for interior air film, heat flow down; R-1.23 for carpet and rubber pad; R-0.50 for 8 in. concrete; and R-0.46 for semiexterior air film. Added insulation is continuous and uninterrupted by framing. Framing factor is zero.

Modify Section A5.2.2.3 as follows (IP and SI).

A5.2.2.3 For waffle-slab *mass floors*, the ~~*floor*~~ floor shall be insulated either on the interior above the slab or on all exposed surfaces of the waffle.

Modify Section A5.2.2.4 as follows (IP and SI).

A5.2.2.4 For *mass floors* with beams that extend below the ~~*floor*~~ floor slab, the ~~*floor*~~ floor shall be insulated either on the interior above the slab or on the exposed ~~*floor*~~ floor and all exposed surfaces of the beams that extend 24 in. and less below the exposed *mass floor*.

Modify Section A5.2.3.1 as follows (IP and SI).

A5.2.3.1 The *U-factors* for *mass* ~~*walls*~~ *floors* shall be taken from Table A5.2.3.1.

Modify Section A5.3.1 as follows (IP and SI).

A5.3.1 General. For the purpose of Section A1.2, the base assembly is a *steel-joist floor* where the insulation is either placed between the *steel joists* or is sprayed on the underside of the ~~*floor*~~ floor and the joists. In both cases, the steel provides a thermal bypass to the insulation. The *U-factors* include R-0.92 for interior air film, heat flow down; R-1.23 for carpet and pad; R-0.25 for 4 in. concrete; R-0 for metal deck; and R-0.46 for semiexterior air film. The performance of the insulation/framing layer is calculated using the values in Table A9.2-1.

Modify Section A5.3.2.2 as follows (IP and SI).

A5.3.2.2 It is acceptable for this insulation to also be *continuous insulation* uninterrupted by framing. All *continuous insulation* shall be installed either on the interior above the *steel-joist floor* structure or below a framing cavity completely filled with insulation.

Modify Section A5.4.1 as follows (IP and SI).

A5.4.1 General. For the purpose of Section A1.2, the base assembly is a *wood-framed and other floor* attached directly to the top of the wood joist with insulation located directly below the *floor* and ventilated air space below the insulation. The heat flow path through the joist is calculated to be the same depth as the insulation. The *U-factors* include R-0.92 for interior air film, heat flow down; R-1.23 for carpet and pad; R-0.94 for 0.75 in. wood sub- floor; and R-0.46 for semiexterior air film. The weighting factors are 91% insulated cavity and 9% framing.

Modify Section A5.4.2.1 as follows (IP and SI).

A5.4.2.1 It is acceptable for this insulation to also be *continuous insulation* uninterrupted by framing. All *continuous insulation* shall be installed either on the interior above the *wood-framed and other floor* structure or below a framing cavity completely filled with insulation.

Modify Section A5.4.3.1 as follows (IP and SI).

A5.4.3.1 The *U-factors* for *wood-framed and other floors* shall be taken from Table A5.4.3.1.

Modify Section A6.1 as follows (IP and SI).

A6.1 General. For the purpose of Section A1.2, the base assembly is a *slab-on-grade floor* of 6 in. concrete poured directly on to the earth, the bottom of the slab is at *grade* line, and soil conductivity is 0.75 Btu/h·ft·°F. In contrast to the *U-factor* for *envelope floors*, the *F-factor* for *slab-on-grade floors* is expressed per linear foot of *building* perimeter. *F-factors* are provided for unheated slabs and for heated slabs. *Unheated slab-on-grade floors* do not have heating elements, and *heated slab-on-grade floors* do have heating elements within or beneath the slab. *F-factors* are provided for five insulation configurations:

Modify Section A9.2 as follows (IP and SI).

A9.2 Required Procedures. Two- or three-dimensional finite difference and finite volume computer models shall be an acceptable alternative method to calculating the thermal performance values for all assemblies and constructions listed below. The following procedures shall also be permitted to determine all alternative *U-factors*, *F-factors*, and *C-factors*:

[. . .]

d. Floors

1. *Mass floors*: Testing or parallel path calculation method if concrete is solid and uniform or isothermal planes calculation method if concrete has hollow sections.
2. *Steel-joist floors*: Testing or modified zone calculation method.
3. *Wood-joist floors*: Testing or parallel path calculation method or isothermal planes calculation method.
4. Other *envelope floors*: Testing or two-dimensional calculation method.

[. . .]

Modify Section C1.1 as follows (IP and SI).

C1.1 At the Building Level. The ~~*floor*~~ floor area, broken down by *space conditioning categories* and *building* area type, shall be specified. Each *building* area type shall be chosen from Table 9.5.1.

Modify Section C1.2.6 as follows (IP and SI).

C1.2.6 For Uninsulated Assemblies. All uninsulated assemblies (e.g., projecting balconies, perimeter edges of intermediate ~~*floor*~~ floor slabs, concrete ~~*floor*~~ beams of *envelope floors* over parking garages, *roof* parapet) shall be separately modeled.

Modify Section C3.5.2 as follows (IP and SI).

C3.5.2 Model Geometry and Thermal Zones. The *building* model shall be divided into thermal zones described as follows:

a. Determine the ratio (R_c) of the *gross conditioned floor area* ~~*floor area*~~ to the *gross wall area* for each unique combination of *space conditioning category* and *building* area type. The index "c" refers to a combination of *space conditioning category* and *building* area type as defined for each surface.
b. Create a perimeter zone for each unique combination of *building* area type, *above-grade-wall orientation*, and *space conditioning category*. If there is more than one *above-grade-wall* assembly for a *building* area type and *orientation*, each *above-grade-wall* assembly shall be placed end-to-end in the order it is defined. The area of each perimeter zone shall be the *gross wall area* of the zone times R_c or 1.25, whichever is smaller.
c. For each unique combination of *space conditioning category* and *building* area type with R_c greater than 1.25, interior zones shall be created and used in the trade-off procedure. The area of the interior zone shall be the total area for the unique combination of *space conditioning category* and *building* area type less the area of the perimeter zones for that combination of *space conditioning category* and *building* area type.
d. Create a below-*grade* zone for each unique combination of *space conditioning category* and *building* area type associated with *below-grade walls*. If there is more than one *below-grade-wall* assembly for a *building* area type, each below-*grade-wall* assembly shall be placed end-to-end in the order it is defined. The area of each below-*grade* zone shall be the *gross wall area* of the zone times R_c or 1.25, whichever is smaller.
e. The *wall* height and the height of each thermal zone shall be 15 ft.
f. *Roof* area and *envelope floor* area associated with each *building* area type shall be prorated among all zones of the corresponding *building* area type in proportion to the zone area of each zone. *Roof* area and ~~*floor*~~ floor area in each zone shall be centered in the horizontal plane of the zone with the same aspect ratio as the horizontal plane of the zone.

[. . .]

Modify Section C3.5.5.3 as follows (IP and SI).

C3.5.5.3 Air Leakage. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 in. of water) shall be 0.35 cfm/ft^2 of *building envelope* area when *air leakage* compliance is based on whole-*building* pressurization testing and shall be 0.45 cfm/ft^2 of *building envelope* area when *air leakage* compliance is based on verification. The *air leakage* of the *building envelope* shall be converted to the appropriate units to describe the *air leakage* as a function of the area of *walls* that separate *conditioned spaces* and *semiheated spaces* from the exterior as follows:

$$I_{AGW} = 0.112 \times I_{75Pa} \times S/A_{AGW}$$

where

I_{75Pa} = *air leakage* rate of the *building envelope* (cfm/ft^2) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water)

S = total area of the *building envelope* (ft^2) including the lowest floor ~~*floor*~~, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

[. . .]

Modify Section G1.3.2 as follows (IP and SI).

G1.3.2 Application Documentation. The following documentation shall be submitted to the *rating authority:*

a. The *simulation program* used, the version of the *simulation program*, and the results of the *energy* analysis, including the calculated values for baseline *building* unregulated *energy* cost (BBUEC), baseline *building* regulated *energy* cost (BBREC), *building* performance factor (BPF), *baseline building performance*, the *proposed building performance*, Performance Cost Index (PCI), and Performance Cost Index Target (PCI$_t$).
b. An overview of the project that includes the number of *stories* (above and below *grade*), the typical ~~*floor*~~ floor size, the uses in the *building* (e.g., office, cafeteria, retail, parking, etc.), the gross area of each use, and whether each use is *conditioned space*.
c. A list of the *energy*-related features that are included in the design and on which the performance rating is based. This list shall document all *energy* features that differ between the models used in the *baseline building performance* and *proposed building performance* calculations.
d. A list showing compliance for the *proposed design* with all the requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 (mandatory provisions).
e. A list identifying those aspects of the *proposed design* that are less stringent than the requirements of Sections 5.5, 6.5, 7.5, and 9.5 (prescriptive provisions).
f. A list identifying those aspects of the *proposed design* that are more stringent than the requirements of Sections 5 through 10.
g. A table with a summary by end use of the *proposed building performance* and *baseline building performance*, with each end use separated into regulated and unregulated components.
h. A *site* plan showing all adjacent *buildings* and topography that may shade the proposed *building* (with estimated height or number of *stories*).
i. *Building* elevations and ~~*floor*~~ floor plans.
j. A diagram showing the *thermal blocks* used in the computer simulation.

[. . .]

Modify Section G3.2.1.1 as follows (IP and SI).

G3.2.1.1 Baseline HVAC System Types based on Building Area Types. *HVAC system* types in the *baseline building design* shall be determined as follows:

a. Determine the combined area of the *gross conditioned floor area* and *semiheated floor area* of each of the following *building* area types in the *proposed design:*
    1. **Residential.** *HVAC zones* that include *dwelling units*, guest rooms, living quarters, private living *spaces*, and sleeping quarters, and *residential associated HVAC zones* shall be classified as *residential*. Other *space* types, including patient rooms in hospitals, shall not be classified as *residential.*
    2. **Public Assembly.** Houses of worship, auditoriums, movie theaters, performance theaters, concert

halls, arenas, enclosed stadiums, ice rinks, gymnasiums, convention centers, exhibition centers, and natatorium *buildings* shall be classified as public assembly. *HVAC zones* that include these area types in other *buildings* shall also be classified as public assembly.

3. **Heated-Only Storage.** Nonrefrigerated warehouse *buildings* and heated parking garages that are not mechanically cooled, shall be classified as heated-only storage.
4. **Retail.** Grocery stores, retail stores, and supermarket *buildings* with two ~~*floors*~~ floors or fewer shall be classified as retail.

[. . .]

Modify Table G3.1 as follows (IP and SI).

Table G3.1 Modeling Requirements for Calculating Proposed Building Performance and Baseline Building Performance

Proposed Building Performance	Baseline Building Performance
1. Design Model	
a. The simulation model of the *proposed design* shall be consistent with the design documents, including proper accounting of *fenestration* and *opaque building envelope* types and areas; interior lighting power and controls; *HVAC system* types, sizes, and controls; and *service water-heating systems* and controls. [. . .]	The *baseline building design* shall be modeled with the same number of ~~*floors*~~ floors and identical *gross conditioned floor area* as the *proposed design*. [. . .]
[. . .]	[. . .]
5. Building Envelope	
[. . .]	Equivalent dimensions shall be assumed for each *building envelope* component type as in the *proposed design*; i.e., the total gross area of *walls* shall be the same in the *proposed design* and *baseline building design*. The same shall be true for the areas of *roofs*, *envelope floors*, and *doors*, and the exposed perimeters of concrete slabs on *grade* shall also be the same in the *proposed design* and *baseline building design*. ... The following additional requirements shall apply to the modeling of the *baseline building design*: **d. Opaque Assemblies.** *Opaque* assemblies used for new *buildings*, *existing buildings*, or additions shall conform with assemblies detailed in Normative Appendix A and shall match the appropriate assembly maximum *U-factors* in Tables G3.4-1 through G3.4-8: • *Roofs* with insulation entirely above deck (A2.2). • *Above-grade walls—steel-framed* (A3.3). • *Below-grade walls*—concrete block (A4). • *Envelope floors—steel-joist* (A5.3). • *Slab-on-grade floors* shall match the *F-factor* for unheated slabs from the same tables (A6). • *Opaque door* types shall be of the same type of *construction* as the *proposed design* and conform to the *U-factor* requirements from the same tables (A7). [. . .]
[. . .]	[. . .]

8. Thermal Blocks—HVAC Zones Not Designed	
Where the *HVAC zones* and *systems* have not yet been designed, *thermal blocks* shall be defined based on similar internal load densities, occupancy, lighting, thermal and *space* temperature schedules, and in combination with the following guidelines: a. Separate *thermal blocks* shall be assumed for interior and perimeter *spaces*. Interior *spaces* shall be those located greater than 15 ft from an *exterior wall* or *semiexterior wall*. Perimeter *spaces* shall be those located within 15 ft of an *exterior wall* or *semiexterior wall*. A separate thermal zone does not need to be modeled for areas adjacent to *semiexterior walls* that separate *semiheated space* from *conditioned space*. b. Separate *thermal blocks* shall be assumed for *spaces* adjacent to glazed *exterior walls* or glazed *semiexterior walls*; a separate zone shall be provided for each *orientation*, except that *orientations* that differ by less than 45 degrees may be considered to be the same *orientation*. Each zone shall include all floor area that is 15 ft or less from a glazed perimeter *wall*, except that floor area within 15 ft of glazed perimeter *walls* having more than one *orientation* shall be divided proportionately between zones. c. Separate *thermal blocks* shall be assumed for *spaces* having ~~*floors*~~ floors that are in contact with the ground or exposed to ambient conditions from zones that do not share these features. d. Separate *thermal blocks* shall be assumed for *spaces* having exterior ceiling or *roof* assemblies from zones that do not share these features.	[. . .]
9. Thermal Blocks—Multifamily Residential Buildings	
Residential spaces shall be modeled using at least one *thermal block* per *dwelling unit*, except that those units facing the same *orientations* may be combined into one *thermal block*. Corner units and units with ~~*roof*~~ roof or ~~*floor*~~ floor loads shall only be combined with units sharing these features.	[. . .]
[. . .]	[. . .]
14. Exterior Conditions	
a. **Shading by Adjacent Structures and Terrain.** The effect that *structures* and significant vegetation or topographical features have on the amount of solar radiation being received by a *structure* shall be adequately reflected in the computer analysis. All elements whose effective height is greater than their distance from a proposed *building* and whose width facing the proposed *building* is greater than one-third that of the proposed *building* shall be accounted for in the analysis. b. **Ground Temperatures for Below-Grade Wall and Basement Floor Heat-Loss Calculations.** It is acceptable to use either an annual average ground temperature or monthly average ground temperatures for calculation of heat loss through *below-grade walls* and basement floors ~~*floors*~~. [. . .]	[. . .]
[. . .]	[. . .]

Modify Section G3.2.1.3 as follows (IP and SI).

G3.2.1.3 For baseline *HVAC systems* 1, 2, 3, 4, 9, 10, 11, 12, and 13, each *HVAC zone* or *thermal block* shall be modeled with its own *HVAC system*. For Systems 5, 6, 7, and 8, each ~~*floor*~~ floor shall be

modeled with a separate *HVAC system*. ~~*Floors*~~ Floors with identical *HVAC zones* or *thermal blocks* can be grouped for modeling purposes.

[. . .]

Modify Section G3.2.1.7 as follows (IP and SI).

G3.2.1.7 Modeling Building Envelope Air Leakage. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 in. of water) shall be converted to appropriate units for the *simulation program* using one of the following formulas:

[. . .]

where

I_{75Pa} = *air leakage* rate of the *building envelope* (cfm/ft^2) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water)

Q = volume of air in cfm flowing through the *building envelope* when subjected to a pressure differential of 75 Pa (0.30 in. of water), in accordance with ASTM E 779, ASTM E1827, or ASTM E3158

S = total area of the *building envelope* (ft^2), including the lowest floor ~~*floor*~~, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

[. . .]

Modify Table G3.4-1 as follows (IP and SI).

Table G3.4-1 Performance Rating Method Building Envelope Requirements for Climate Zones 0 and 1 (A,B)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Envelope Floors			
Steel-joist	U-0.350	U-0.350	U-0.350
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-2 as follows (IP and SI).

Table G3.4-2 Performance Rating Method Building Envelope Requirements for Climate Zone 2 (A,B)*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Envelope Floors			

Steel-joist	U-0.052	U-0.052	U-0.350
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-3 as follows (IP and SI).

Table G3.4-3 Performance Rating Method Building Envelope Requirements for Climate Zone 3 (A,B,C)*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Envelope Floors			
Steel-joist	U-0.052	U-0.052	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-4 as follows (IP and SI).

Table G3.4-4 Performance Rating Method Building Envelope Requirements for Climate Zone 4 (A,B,C)*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Envelope Floors			
Steel-joist	U-0.052	U-0.038	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-5 as follows (IP and SI).

Table G3.4-5 Performance Rating Method Building Envelope Requirements for Climate Zone 5 (A,B,C)*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Envelope Floors			
Steel-joist	U-0.052	U-0.038	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-6 as follows (IP and SI).

Table G3.4-6 Performance Rating Method Building Envelope Requirements for Climate Zone 6 (A,B)*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-1.140	C-0.119	C-1.140
Envelope Floors			
Steel-joist	U-0.038	U-0.038	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
[. . .]			

Modify Table G3.4-7 as follows (IP and SI).

Table G3.4-7 Performance Rating Method Building Envelope Requirements for Climate Zone 7*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-0.119	C-0.119	C-1.140
Envelope Floors			
Steel-joist	U-0.038	U-0.038	U-0.052
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.540	F-0.730
[. . .]			

Modify Table G3.4-8 as follows (IP and SI).

Table G3.4-8 Performance Rating Method Building Envelope Requirements for Climate Zone 8*

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
[. . .]			
Wall, Below-Grade			
Below-grade wall	C-0.119	C-0.119	C-1.140
Envelope Floors			
Steel-joist	U-0.038	U-0.032	U-0.052
Slab-on-Grade Floors			
Unheated	F-0.540	F-0.520	F-0.730
[. . .]			

Modify Section L1.1.1.1 as follows (IP and SI).

L1.1.1.1 Allowable Building Use Types. *HVAC systems* that serve the following *building* use types are allowed to use the Mechanical System Performance Rating Method:

a. Large office (*gross conditioned floor area* >150,000 ft^2 or >5 *stories*)
b. Medium office (*gross conditioned floor area* 5000 to 150,000 ft^2 and ≤5 *stories*)
c. Small office (*gross conditioned floor area* ≤5000 ft^2 and ≤5 *stories*)
d. Retail
e. Multifamily (including dormitory)
f. Hotel (including motel)
g. School (including education and university)
h. Other *building* use types that are <1000 ft^2 and <10% of the *building* <u>gross conditioned floor area</u> ~~conditioned floor area~~ unless specifically excluded by Section L1.1.1.2(a)

[. . .]

Modify Section L1.1.1.2 as follows (IP and SI).

L1.1.1.2 Excluded HVAC Systems. The following *HVAC systems* are excluded from using the Mechanical System Performance Rating Method:

a. *HVAC systems* serving one of the following excluded *building* areas:

1. Data centers and *computer rooms* with *equipment* power density exceeding 20 W/ft^2 of *gross conditioned floor area* ~~conditioned floor area~~ and exceeding 10 *kW* of *equipment* load
2. Laboratories with fume hoods

[. . .]

Modify Section L2.2.2 as follows (IP and SI).

L2.2.2 Building Envelope Components. *Building envelope* thermal properties used in the *proposed design* shall be based on the actual *proposed design* using documented user-defined values and shall comply with all of the following:

a. Where different *roof* thermal properties are present in a single block, an area-weighted *U-factor* shall be used.
b. Where different *wall* constructions exist on the facade of a block, an area-weighted *U-factor* shall be used.
c. Where different *below-grade wall* constructions exist in a block, an area-weighted *C- factor* shall be used.
d. Where different *envelope floor* constructions exist in the block, an area-weighted *U-factor* shall be used.
e. Where different *slab-on-grade floor* constructions exist in a block, an area-weighted *F-factor* shall be used.

[. . .]

Modify Table L2.2.3 as follows (IP and SI).

Table L2.2.3 Proposed Building HVAC System Parameters

Category	Parameter	Fixed or User Defined	Required	Applicable Systems [a]
		[. . .]		
Demand Control Ventilation	*DCV* application ON/OFF	User defined	Percentage of block floor area under occupied standby controls, ON/OFF only (see Section 6.5.3.8) with no variable control	3, 4, 9, 10, 11, 12
	DCV application CO_2	User defined	Percentage of block ~~*floor*~~ floor area under variable *DCV* control (CO_2); may include both variable and ON/OFF control	3, 4, 9, 10, 11, 12
		[. . .]		

Modify Section L4.1.4 as follows (IP and SI).

L4.1.4 Building Envelope Components. *Building envelope* thermal properties used in the *proposed design* shall be modeled based on the actual *proposed design* using inputs described in Section L2.2.2 and shall comply with all of the following:

a. *Roofs* shall be modeled with insulation above a steel *roof* deck. *Roof* solar absorptance shall be modeled at 0.70 and thermal *emittance* at 0.90.
b. *Above-grade walls* shall be modeled as steel-frame construction.
c. Above-*grade* ~~exterior~~ *envelope floors* shall be modeled as steel-frame construction.
d. The area, *U-factor*, and *SHGC* of vertical *fenestration* shall be modeled for each facade based on the actual *proposed design*. The *simulation program* shall model a combined single window centered on each facade based on the area and sill height input by the user.
e. The *skylight* area shall be modeled for each *roof* based on the actual *proposed design*. *Skylights* shall be combined into a single *skylight* centered on the *roof* of each zone based on the area input by the user.

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