CHAPTER 4

RESIDENTIAL ENERGY EFFICIENCY

SECTION ECC 401
GENERAL

401.1 Scope.

This chapter applies to residential buildings.

401.2 Compliance.

Projects shall comply with Sections 401, 402.2.12, 402.4, 402.5, 402.6, 403 and 404.1 (referred to as the mandatory provisions) and either:

1. Sections 402.1 through 402.3 (prescriptive); or
2. Section 405 (performance).
3. When compliance is demonstrated by computer software, as provided in Section 101.5.1.
4. When a sunroom complies with Section 402.2.11.

401.3 Certificate.

A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall not cover or obstruct visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominant R-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawl space wall and/or floor) and ducts outside conditioned spaces; U-factors for fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace, and/or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace," or "baseboard electric heater" as appropriate. An efficiency shall not be listed for gas-fired unvented room heaters, electric furnaces, or electric baseboard heaters.

SECTION ECC 402
BUILDING THERMAL ENVELOPE

402.1 General (Prescriptive).

402.1.1 Insulation and fenestration criteria.

The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.

402.1.2 R-value computation.

Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films.

402.1.3 U-factor alternative.

An assembly with a U-factor equal to or less than that specified in Table 402.1.3 shall be permitted as an alternative to the R-value in Table 402.1.1.

TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[f]	MASS WALL *R*-VALUE[g]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
4	0.35	0.60	38	13	5/10[g]	19	10/13[c]	10, 2ft[d]	10/13[c]
5	0.35	0.60	38	20 or 13+5[f]	13/17[g]	30[e]	10/13[c]	10, 2ft[d]	10/13[c]
6	0.35	0.60	49	20 or 13+5[f]	15/19[g]	30[e]	15/19[c]	10, 4ft[d]	10/13[c]

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 × 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.
b. The fenestration *U*-factor column excludes skylights.
c. The first value shown represents minimum "R" value of continuous insulated sheathing on the interior or the exterior of the wall, the second value shown represents minimum "R" value of cavity insulation at the interior of the basement wall. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
d. R-5 shall be added to the required slab edge *R*-values for heated slabs.
e. Or insulation sufficient to fill the framing cavity, R-19 minimum.
f. "13 + 5" means R-13 cavity insulation plus R-5 insulated sheathing. When structural sheathing is utilized per requirements of the *Residential Code of New York State*, Section R602.10 Wall Bracing (or per requirements of the *Building Code of New York State*, Section 2309.8.3 Bracing), insulating sheathing with a minimum value R-2 shall be added over the required structural sheathing. All other areas must be sheathed with insulating sheathing of R-5 as indicated by the table. If 100 percent continuous structural panel sheathing is used on a 2 × 4 wall, then R-5 continuous insulated sheathing must also be applied over the structural sheathing.
g. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

TABLE 402.1.3
EQUIVALENT U-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
4	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.10 in Zone 4, and the same as the frame wall *U*-factor in Zones 5 through 6.

402.1.4 Total UA alternative.

If the total building thermal envelope UA (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table 402.1.3 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table 402.1.1. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials.

402.1.5 Siding attachment over foam sheathing.

In areas where the basic wind speed is less than 100 mph (45 m/s), siding shall be attached over foam sheathing in accordance with Section 402.1.5.1, Section 402.1.5.2, or an approved design. In all other areas, siding attachments shall be in accordance with approved design. In no case shall the siding material be used in a manner that exceeds its application limits.

Exception: Where the siding manufacturer has provided installation instructions for application over foam sheathing, those requirements shall apply.

402.1.5.1 Direct siding attachment.

Siding installed directly over foam sheathing without separation by an air space shall comply with Table 402.1.5.1 in regard to minimum fastening requirements and maximum foam sheathing thickness limitations to support siding dead load. The siding fastener and siding installation shall otherwise comply with the *Residential Code of New York State*, Section 703.4 and Table R703.4, and in no case shall result in a less stringent fastening requirement than required by the *Residential Code of New York State*, Section R703.4 or the manufacturer's installation instructions for the specific siding material used.

Exception: For exterior insulation and finish systems, refer to the *Residential Code of New York State*, Section 703.9.

TABLE 402.1.5.1
SIDING MINIMUM FASTENING REQUIREMENTS FOR DIRECT SIDING ATTACHMENT OVER FOAM PLASTIC SHEATHING TO SUPPORT SIDING WEIGHT[1]

SIDING FASTENER THROUGH FOAM SHEATHING INTO:	SIDING FASTENER TYPE AND MINIMUM SIZE[2]	SIDING FASTENER VERTICAL SPACING (INCHES)	MAXIMUM FOAM SHEATHING THICKNESS (INCHES)					
			16″oc Fastener Horizontal Spacing			24″oc Fastener Horizontal Spacing		
			Siding Weight:			Siding Weight:		
			3 psf	11 psf	25 psf	3 psf	11 psf	25 psf
Wood Framing (minimum1-¼ inch penetration)	0.113″ diameter nail	6	4	3	1	4	2	0.75
		8	4	2	0.75	4	1.5	DR
		12	4	1.5	DR	3	0.75	DR
	0.120″ diameter nail	6	4	3	1.5	4	2	0.75
		8	4	2	1	4	1.5	0.5
		12	4	1.5	0.5	3	1	DR
	0.131″ diameter nail	6	4	4	1.5	4	3	1
		8	4	3	1	4	2	0.75
		12	4	2	0.75	4	1	DR
Steel Framing (minimum penetration of steel thickness + 3 threads)	#8 screw into 33 mil steel or thicker	6	3	3	1.5	3	2	DR
		8	3	2	0.5	3	1.5	DR
		12	3	1.5	DR	3	0.75	DR
	#10 screw into 33 mil steel	6	4	3	2	4	3	0.5
		8	4	3	1	4	2	DR
		12	4	2	DR	3	1	DR
	#10 screw into 43 mil steel or thicker	6	4	4	3	4	4	2
		8	4	4	2	4	3	1.5
		12	4	3	1.5	4	3	DR

For SI: 1 inch = 25.4 mm; 1 pound per square foot (psf) = 0.0479 kPa.
DR = design required

1. Tabulated requirements are based on wood framing of Spruce-Pine-Fir or any wood species with a specific gravity of 0.42 or greater in accordance with AFPA/NDS and minimum 33 ksi steel for 33 mil and 43 mil steel and 50 ksi steel for 54 mil steel or thicker.
2. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Self-drilling tapping screw fasteners for connection of siding to steel framing shall comply with the requirements of AISI S230. Specified fasteners in accordance with *Residential Code of New York State*, Section R703.4, or the siding manufacturer's approved installation instructions shall meet all other requirements in ASTM F1667, AISI S230 or be otherwise approved for the intended application.

402.1.5.2 Offset siding attachment.

When an airspace separates the siding from direct contact with the foam plastic sheathing, the siding shall be attached in accordance with the *Residential Code of New York State*, Section R703.4 and Table R703.4, to minimum 1 × 3 wood or minimum 33 mil steel hat channel furring placed over the foam sheathing. Furring shall be attached through the foam sheathing to wall framing in accordance with the *Residential Code of New York State*, Table R703.3.2.2, in regard to minimum fastening requirements and maximum foam sheathing thickness limitations to support siding dead load. The components and cladding design wind pressure determined in accordance with the *Residential Code of New York State*, Table R301.2(2), shall not exceed the allowable design wind pressure value in accordance with the *Residential Code of New York State*, Table R703.3.2.2. For 25 (1.2 kPa) psf siding weight in accordance with the *Residential Code of New York State*, Table R703.3.2.2, the Seismic Design Category shall not exceed D_0 for 16 inch o.c. furring or C for 24 inch o.c. furring. When placed horizontally, wood furring shall be preservative treated wood or naturally durable wood and fasteners shall be corrosion resistant in accordance with the *Residential Code of New York State*, Section R317. Steel hat channel furring shall have a minimum G60 galvanized coating.

Exception: Furring shall not be required over foam plastic sheathing located behind anchored stone and masonry veneer installed in accordance with the *Residential Code of New York State*, Section R703.7. Veneer ties shall be installed in accordance with the *Residential Code of New York State*, Section R703.7.4.1.

TABLE 402.1.5.2
FURRING MINIMUM FASTENING REQUIREMENTS FOR APPLICATION OVER FOAM PLASTIC SHEATHING TO SUPPORT SIDING WEIGHT[1,2]

FURRING MATERIAL	FRAMING MEMBER	FASTENER TYPE AND MINIMUM SIZE	MINIMUM PENETRATION INTO WALL FRAMING (inches)	FASTENER SPACING IN FURRING (inches)	MAXIMUM THICKNESS OF FOAM SHEATHING (inches)						ALLOWABLE DESIGN WIND PRESSURE (PSF)	
					16″OC FURRING[4] SIDING WEIGHT:			24″OC FURRING[4] SIDING WEIGHT:				
					3 psf	11 psf	25 psf	3 psf	11 psf	25 psf	16″oc Furring	24″oc Furring
Minimum 1 × Wood Furring[3]	Minimum 2 × Wood Stud	Nail (0.120″ shank; 0.271″ head)	1-¼	8	4	4	1.5	4	2	1	42.6	28.4
				12	4	2	1	4	1.5	0.5	28.4	18.9
				16	4	2	0.5	4	1	DR	21.3	14.2
		Nail (0.131″ shank; 0.281″ head)	1-¼	8	4	4	2	4	3	1	46.5	31.0
				12	4	3	1	4	2	0.75	31.0	20.7
				16	4	2	0.75	4	1.5	DR	23.3	15.5
		#8 wood screw[5]	1	12	4	4	1.5	4	3	1	98.9	66.0
				16	4	3	1	4	2	0.5	74.2	49.5
				24	4	2	0.5	4	1	DR	35.1	23.4
		1/4″ lag screw[5]	1-½	12	4	4	3	4	4	1.5	140.4	93.6
				16	4	4	2	4	3	1	79.0	52.7
				24	4	3	1	4	2	0.5	35.1	23.4
Minimum 33mil Steel Hat Channel or Minimum 1 × Wood Furring[3]	33 mil Steel Stud	#8 screw (0.285″ head)	Steel thickness +3 threads	12	3	1.5	DR	3	0.5	DR	52.9	35.3
				16	3	1	DR	2	DR	DR	39.7	26.5
				24	2	DR	DR	2	DR	DR	26.5	17.6
		#10 screw (0.333″ head)	Steel thickness +3 threads	12	4	2	DR	4	1	DR	62.9	41.9
				16	4	1.5	DR	3	DR	DR	47.1	31.4
				24	3	DR	DR	2	DR	DR	31.4	21.0
	43 mil or thicker Steel Stud	#8 screw (0.285″ head)	Steel thickness +3 threads	12	3	1.5	DR	3	0.5	DR	69.0	46.0
				16	3	1	DR	2	DR	DR	51.8	34.5
				24	2	DR	DR	2	DR	DR	34.5	23.0
		#10 screw (0.333″ head)	Steel thickness +3 threads	12	4	3	1.5	4	3	DR	81.9	54.6
				16	4	3	0.5	4	2	DR	61.5	41.0
				24	4	2	DR	4	0.5	DR	35.1	23.4

For SI: 1 inch = 25.4 mm; 1 pound per square foot (psf) = 0.0479 kPa. DR = design required.

1. Table values are based on: (1) minimum ¾-inch (19.1 mm) thick wood furring and wood studs of Spruce-Pine-Fir or any softwood species with a specific gravity of 0.42 or greater per AFPA/NDS, (2) minimum 33 mil steel hat channel furring of 33 ksi steel, and (3) steel framing of indicated nominal steel thickness and minimum 33 ksi steel for 33 mil and 43 mil steel and 50 ksi steel for 54 mil steel or thicker. Steel hat channel shall have a minimum 7/8-inch (22.2 mm) depth.
2. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Self-drilling tapping screw fasteners for connection of siding to steel framing shall comply with the requirements of AISI S230. Specified fasteners in accordance with Section R703.4 or the siding manufacturer's approved installation instructions shall meet all other requirements in ASTM F1667 or AISI S230 or be otherwise approved for the intended application.
3. Where the required siding fastener penetration into wood material exceeds ¾ inch (19.1 mm) and is not more than 1-½ inches (38.1 mm), a minimum 2 × wood furring shall be used unless approved deformed shank siding nails or siding screws are used to provide equivalent withdrawal strength allowing connection to 1× wood furring.
4. Furring shall be spaced a maximum of 24 inches o.c. in a vertical or horizontal orientation. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing. In a horizontal orientation, furring strips shall be fastened at each stud intersection with a number of fasteners equivalent to the required fastener spacing. In no case shall fasteners be spaced more than 24 inches (0.6 m) apart.
5. Lag screws shall be installed with a standard cut washer. Lag screws and wood screws shall be pre-drilled in accordance with AFPA/NDS. Approved self-drilling screws of equal or greater shear and withdrawal strength shall be permitted without pre-drilling.

402.2 Specific insulation requirements (Prescriptive).

402.2.1 Ceilings with attic spaces.

When Section 402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Similarly, R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.

402.2.1.1 Unvented attic assemblies.

Unvented attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) shall be permitted in one- and two-family dwellings and multiple single-family dwellings (townhouses) as defined by the *Residential Code of New York State* if all the following conditions are met:

1. The unvented attic space is completely contained within the building thermal envelope.
2. No interior vapor retarders (Class I or II) are installed on the ceiling side (attic floor) of the unvented attic assembly.

3. Where wood shingles or shakes are used, a minimum 1/4 inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.

4. In Climate Zones 5 and 6 any air-impermeable (e.g., spray foam) insulation shall be a Class III vapor retarder, or shall have a vapor retarder coating, or covering in direct contact with the underside of the insulation.

5. Either Item 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.

   5.1. Air-impermeable (e.g., spray foam) insulation only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.

   5.2. Air-permeable (e.g., fiberglass or cellulose) insulation only. In addition to the air-permeable insulation installed directly below the structural sheathing, rigid board sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R402.2.1.1 for condensation control.

   5.3. Air-impermeable and air-permeable insulation. The air-impermeable (e.g., spray foam) insulation shall be applied in direct contact with the underside of the structural roof sheathing as specified in Table R402.2.1.1 for condensation control. The air-permeable (e.g., fiberglass or cellulose) insulation shall be installed directly under the air-impermeable (e.g., spray foam) insulation.

TABLE 402.2.1.1
INSULATION FOR CONDENSATION CONTROL

CLIMATE ZONE	MINIMUM RIGID BOARD OR AIR-IMPERMEABLE INSULATION R-VALUE[a]
4	R-15
5	R-20
6	R-25

a. Contributes to, but does not supersede Section N1102.1.1 requirements.

402.2.2 Existing ceiling/roof assemblies without attic spaces (includes cathedral ceilings).

Where Section 402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the U-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.

402.2.3 Access hatches and doors (Mandatory).

Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

402.2.4 Mass walls.

Mass walls for the purposes of this Chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs.

402.2.5 Steel-frame ceilings, walls and floors.

Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table 402.2.5, or shall meet the U-factor requirements of Table 402.1.3. The calculation of the U-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

TABLE 402.2.5
STEEL-FRAME CEILING, WALL AND
FLOOR INSULATION (R-VALUE)

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT *R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel Framed Wall	
R-13	R-13 + 5 or R-15 + 4 or R-21 + 3 or R-0 + 10
R-20	R-13 + 10 or R-19 + 9 or R-25 + 8
Steel Joist Floor	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-19	R-19 + 6 in 2 × 6 R-19 + 12 in 2 × 8 or 2 × 10

For SI: 1 inch = 25.4 mm.
a. Cavity insulation *R*-value is listed first, followed by continuous insulation *R*-value.
b. Insulation exceeding the height of the framing shall cover the framing.

402.2.6 Floors.

Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

402.2.7 Basement walls.

Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections 402.1.1 and 402.2.6.

402.2.8 Slab-on-grade floors.

Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table 402.1.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table 402.1.1 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the code enforcement official as having a very heavy termite infestation.

402.2.9 Crawl space walls.

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

402.2.10 Masonry veneer.

Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

402.2.11 Thermally isolated sunroom insulation (Prescriptive).

For sunroom additions not exceeding 500 square feet (46 m^2) in area, the minimum ceiling insulation R-values shall be R-19 in Zone 4 and R-24 in Zones 5 and 6. The minimum wall R-value shall be R-13 in all zones. New wall(s), windows and doors separating such sunroom addition from conditioned space shall meet the building thermal envelope requirements of Table 402.1.1.

402.2.12 Tenant separation walls.(Mandatory).

Fire separations between dwelling units in two-family dwellings and multiple single-family dwellings (townhouses) shall be insulated to no less than R-10 and the walls shall be air sealed in accordance with Section 402.4.1 of this chapter.

402.3 Fenestration (Prescriptive).

402.3.1 U-factor.

An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

402.3.2 Glazed fenestration exemption.

Up to 15 square feet (1.4 m^2) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor requirements in Section 402.1.1. This exemption shall not apply to the U-factor alternative approach in Section 402.1.3 and the Total UA alternative in Section 402.1.4.

402.3.3 Opaque door exemption.

One side-hinged opaque door assembly up to 24 square feet (2.22 m^2) in area is exempted from the U-factor requirement in Section 402.1.1. This exemption shall not apply to the U-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.

402.3.4 Thermally isolated sunroom U-factor (Prescriptive).

For Zones 4 through 6, the maximum fenestration U-factor shall be 0.50 and the maximum skylight U-factor shall be 0.75. New windows and doors separating the sunroom from conditioned space shall meet the building thermal envelope requirements.

402.3.5 Replacement fenestration.

Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor in Table 402.1.1, where required by Section 101.4.3.

402.4 Air leakage (Mandatory).

402.4.1 Building thermal envelope.

The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joist junctions.
12. Sill plates and headers. Foam plastic (spray foam insulation) shall be permitted to be spray applied to a sill plate, header, and rim joists without the thermal barrier as specified in the *Residential Code of New York State*, Section 314.4 subject to all of the following:

    a. The maximum thickness of the foam plastic shall be 3¼ inches (83 mm).

    b. The density of the foam plastic shall be in the range of 0.5 to 2.0 pounds per cubic foot (8 to 32 kg/m^3).

c. The foam plastic shall have a flame spread index of 25 or less and an accompanying smoke developed index of 450 or less when tested in accordance with ASTM E 84.

13. Other sources of infiltration

402.4.2 Air sealing and insulation (Mandatory).

Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section 402.4.2.1 or 402.4.2.2:

402.4.2.1 Testing option.

Building envelope tightness and insulation installation shall be considered acceptable when tested air leakage is less than seven air changes per hour (ACH) when tested with a blower door at a pressure of 1.0 psf (50 Pa) as verified using instruments and procedures specified in ASHRAE/ASTM E779. The test shall be conducted by a qualified person, who shall demonstrate competence to the satisfaction of the code enforcement official for the conduct of such tests. For the purpose of this section, ACH50 shall mean air changes per hour of infiltration into a house as measured with a blower door at 50 pascals of pressure, in accordance with ASHRAE/ASTM E779. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed, including exhaust, intake, makeup air, backdraft and flue dampers;
3. Interior doors shall be open;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off;
6. HVAC ducts shall not be sealed; and
7. Supply and return registers shall not be sealed.

Test results shall be provided to the code enforcement official and shall include:

a. Name and place of business of the tester;

b. Address of the building which was tested;

c. Conditioned floor area of dwelling, calculated in accordance with ANSI Z65-1996, except that conditioned floor area shall include areas where the ceiling height is less than 5 feet (1524 mm);

d. Measurement of ACH50; and

e. Certification of accuracy of test results and signature of tester.

402.4.2.2 Visual inspection option.

Building envelope tightness and insulation installation shall be considered acceptable when the items listed in Table 402.4.2, applicable to the method of construction, are field verified. Where required by the code enforcement official, an approved party independent from the installer of the insulation shall inspect the air barrier and insulation.

TABLE 402.4.2
AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier.
	Breaks or joints in the air barrier are filled or repaired.
	Air-permeable insulation is not used as a sealing material.
	Air-permeable insulation is inside of an air barrier.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed.
	Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated.
	Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking.
	Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls.
	Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes.
	Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

402.4.3 Recessed lighting.

Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

402.4.4 Fenestration air leakage.

Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m^2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m^2), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

402.5 Vapor retarders (Mandatory).

Class I or II vapor retarders are required on the interior side of frame walls in Zones 5 and 6 for all above grade framed walls, and floors and ceilings where the framed cavity is not ventilated to allow moisture to escape.

Exceptions:

1. Basement walls.
2. Below-grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

402.5.1 Class III vapor retarders.

Class III vapor retarders shall be permitted where the conditions in Table 402.5.1 are met.

TABLE 402.5.1
CLASS III VAPOR RETARDERS[1]

ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR:
5	cladding over OSB cladding over Plywood cladding over Fiberboard cladding over Gypsum d sheathing with *R*-value > 5 over 2 × 4 wall d sheathing with *R*-value > 7.5 over 2 × 6 wall
6	cladding over Fiberboard cladding over Gypsum d sheathing with *R*-value > 7.5 over 2 × 4 wall d sheathing with *R*-value > 11.25 over 2 × 6 wall

1. Spray foam with a minimum density of 2 lbs/ft (2.98 kg/m) applied to the interior cavity side of OSB, plywood, fiberboard, insulating sheathing or gypsum is deemed to meet the insulating sheathing requirement where the spray foam *R*-value meets or exceeds the specified insulating sheathing *R*-value.

402.5.2 Vapor retarder class.

The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly. The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, unperforated aluminum foil.

Class II: Kraft-faced fiberglass batt, or low perm paint (0.1 < perm < = 1.0).

Class III: Latex or enamel paint.

402.5.3 Minimum clear air spaces and vented openings for vented cladding.
For the purposes of this section, vented cladding shall include the following minimum clear air spaces or vented siding:

1. Stucco with a 3/8-inch (9.52 mm) clear airspace with 3/8-inch (9.52 mm) continuous slot vent openings at the top and bottom of each wall.
2. Brick with a 2-inch (51 mm) clear airspace behind the brick with vents at both the top and bottom of the brick. The vents shall be 3/8 inch × 2.5-inch (9.52 mm × 63 mm) openings every third brick at both the bottom and top.
3. Stone or masonry veneer with a 2-inch (51 mm) clear airspace behind the stone with vents at the top and bottom. The vents shall have at least 1 square inch of vent area for every 24 inches (610 mm) of wall.
4. Panel siding with 3/8-inch (9.52 mm) clear airspace with 3/8-inch (9.52 mm) continuous slot vent openings at both the top and bottom of each wall.
5. Wood, wood based, or fiber cement siding with either a 1/4-inch (6.35 mm) clear airspace; or alternatively a 1/4-inch (6.35 mm) gap between the horizontal siding laps.
6. Vinyl lap siding applied directly to a weather resistive barrier.
7. Manufactured stone veneer with a 3/8-inch (9.52 mm) clear airspace with 3/8-inch (9.52 mm) continuous slot vent openings at both the top and bottom of each wall.

8. Other approved clear air spaces and vented openings.

402.6 Maximum fenestration U-factor. (Mandatory).

The area weighted average maximum fenestration U-factor permitted using trade offs from Section 402.1.4 or Section 405 shall be 0.48 in Zones 4 and 5 and 0.40 in Zone 6 for vertical fenestration, and 0.75 in Zones 4 through 6 for skylights.

SECTION 403
SYSTEMS (Mandatory)

403.1 Controls.

At least one thermostat shall be provided for each separate heating and cooling system.

403.1.1 Programmable thermostat.

Each dwelling unit shall have at least one thermostat capable of automatically adjusting the space temperature set point of the largest heating or cooling zone and capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

403.1.2 Heat pump supplementary heat.

Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

403.2 Ducts.

403.2.1 Insulation.

Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

403.2.2 Sealing.

All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.1 of the *Residential Code of New York State*, or, in New York City, the *New York City Construction Codes*. Duct tightness shall be verified by either of the following:

1. Post construction test: Leakage to outdoors shall be less than or equal to 8 cfm (226.5 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area or a total leakage less than or equal to 12 cfm (12 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 6 cfm (169.9 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area.

Exception: Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

The building duct and plenum system shall meet the requirements above as verified using instruments and procedures specified in ANSI/ASHRAE 152 and ASTM E1554 Test Method A. Tests at other test pressures are permitted to be used if they are converted to equivalent leakage at 25 pascals (Pa) of pressure, and such equivalence is demonstrated to the satisfaction of the code enforcement official. The test shall be conducted by a qualified person, who shall demonstrate competence to the satisfaction of the code enforcement official for the conduct of such tests. For the purpose of this section CFM_{25} shall mean the leakage from all ducts and plenums in cubic feet per minute measured at 25 pascals of pressure in accordance with ANSI/ASHRAE 152 or ASTM E1554. Test results shall be provided to the code enforcement official and shall include:

1. Name and place of business of the tester;
2. Address of the building which was tested;
3. Conditioned floor area of dwelling, calculated in accordance with ANSI Z65, except that conditioned floor area shall include areas where the ceiling height is less than 5 feet (1524 mm);

4. Measurement of CFM_{25}; and

5. Certification of accuracy of test results and signature of tester.

403.2.3 Building cavities.

Building framing cavities shall not be used as supply ducts.

403.3 Mechanical system piping insulation.

Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

403.4 Circulating hot water systems.

All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

403.5 Mechanical ventilation.

Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

403.6 Equipment sizing.

Heating and cooling equipment shall be sized in accordance with ACCA Manual J or similar section of the *Residential Code of New York State*.

403.7 Systems serving multiple dwelling units.

Systems serving buildings containing three or more dwelling units shall comply with Sections 503 and 504 in lieu of Section 403.

403.8 Snow melt system controls.

Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C), and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4°C).

403.9 Pools.

Pools shall be provided with energy-conserving measures in accordance with Sections 403.10.1 through 403.10.3.

403.9.1 Pool heaters.

All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

403.9.2 Time switches.

Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.

2. Where pumps are required to operate solar- and waste-heat-recovery pool-heating systems.

403.9.3 Pool covers.

Heated pools shall be equipped with a vapor-retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

Exception: Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

SECTION ECC 404
ELECTRICAL POWER AND LIGHTING SYSTEMS

404.1 Lighting equipment (Mandatory).

A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.

404.2 Electrical energy consumption.

In all buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each unit by separately metering or monitoring individual dwelling units.

SECTION ECC 405
SIMULATED PERFORMANCE ALTERNATIVE (Performance)

405.1 Scope.

This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, and service water heating energy only.

405.2 Mandatory requirements.

Compliance with this section requires that the mandatory provisions identified in Section 401.2 be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

405.3 Performance-based compliance.

Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code enforcement official, such as the Department of Energy, Energy Information Administration's State Energy Price and Expenditure Report. Code enforcement officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

405.4 Documentation.

405.4.1 Compliance software tools.

Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code enforcement official.

405.4.2 Compliance report.

Compliance software tools shall generate a report that documents that the proposed design complies with Section 405.3. The compliance documentation shall include the following information:

1. Address or other identification of the residence;
2. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table 405.5.2(1). The inspection checklist shall show results for both the standard reference design and the proposed design, and shall document all inputs entered by the user necessary to reproduce the results;
3. Name of individual completing the compliance report; and
4. Name and version of the compliance software tool.

Exception: Multiple orientations. When an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four cardinal (north, east, south and west) orientations.

405.4.3 Additional documentation.

The code enforcement official shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the standard reference design.
2. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table 405.5.2(1).
3. Documentation of the actual values used in the software calculations for the proposed design.

405.5 Calculation procedure.

405.5.1 General.

Except as specified by this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

405.5.2 Residence specifications.

The standard reference design and proposed design shall be configured and analyzed as specified by Table 405.5.2(1). Table 405.5.2(1) shall include by reference all notes contained in Table 402.1.1.

TABLE 405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame. Gross area: same as proposed *U*-factor: from Table 402.1.3 Solar absorptance = 0.75 Remittance = 0.90	As proposed As proposed As proposed As proposed As proposed
Basement and crawl space walls	Type: same as proposed Gross area: same as proposed *U*-factor: from Table 402.1.3, with insulation layer on interior side of walls.	As proposed As proposed As proposed
Above-grade floors	Type: wood frame Gross area: same as proposed *U*-factor: from Table 402.1.3	As proposed As proposed As proposed
Ceilings	Type: wood frame Gross area: same as proposed *U*-factor: from Table 402.1.3	As proposed As proposed As proposed
Roofs	Type: composition shingle on wood sheathing Gross area: same as proposed Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed foundation wall area above and below grade and soil characteristics: same as proposed.	As proposed As proposed
Doors	Area: 40 ft^2 Orientation: North *U*-factor: same as fenestration from Table 402.1.3.	As proposed As proposed As proposed
Glazing[a]	Total area[b]= (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area. (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area. Orientation: equally distributed to four cardinal compass orientations (N, E, S & W). *U*-factor: from Table 402.1.3 SHGC: From Table 402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85[c] External shading: none	As proposed As proposed As proposed As proposed Same as standard reference design As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

TABLE 405.5.2(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Specific leakage area (SLA)[d] = 0.00036 assuming no energy recovery.	For residences that are not tested, the same as the standard reference design. For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] combined with the mechanical ventilation rate, *f* which shall not be less than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: *CFA* = conditioned floor area N_{br} = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = $0.03942 \times CFA + 29.565 \times (N_{br} + 1)$ where: *CFA* = conditioned floor area N_{br} = number of bedrooms	As proposed
Internal gains	IGain = $17{,}900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[g, f] but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air. For masonry basement walls, as proposed, but with insulation required by Table 402.1.3 located on the interior side of the walls For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed As proposed As proposed
Heating systems[g, h]	As proposed Capacity: sized in accordance with Section M1401.3 of the *Residential Code of New York State*	As proposed
Cooling systems[g, i]	As proposed	As proposed

	Capacity: sized in accordance with Section M1401.3 of the *Residential Code of New York State*	
Service water heating[g, i, j, k]	As proposed Use: same as proposed design	As proposed gal/day = 30 + (10 × N_{br})
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. Duct insulation: From Section 403.2.1. For tested duct systems, the leakage rate shall be the applicable maximum rate from Section 403.2.2.	As tested or as specified in Table 405.5.2(2) if not tested
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature set point = 72°F	Same as standard reference

For SI: 1 square foot = 0.93 m^2; 1 British thermal unit = 1055 J; 1 pound per square foot = 4.88 kg/m^2; 1 gallon (U.S.) = 3.785 L; °C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight-transmitting opening is less than 50 percent of the door area, the glazing area is the sunlight-transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.

b. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:

$AF = A_s \times FA \times F$

where:

AF = Total glazing area.

A_s = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

c. For fenestrations facing within 15 degrees (0.26 rad) of true south that are directly coupled to thermal storage mass, the winter interior shade fraction shall be permitted to be increased to 0.95 in the proposed design.

d. Where leakage area (*L*) is defined in accordance with Section 5.1 of ASHRAE 119 and where:

SLA = *L*/*CFA*

where *L* and *CFA* are in the same units.

e. Tested envelope leakage shall be determined and documented by an independent party approved by the *code enforcement official*. Hourly calculations as specified in the ASHRAE *Handbook of Fundamentals*, Sherman-Grimsrud model or the equivalent shall be used to determine the energy loads resulting from infiltration.

f. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with “Combining Residential Infiltration and Mechanical Ventilation” of ASHRAE *Handbook of Fundamentals*, and the “Whole-house Ventilation” provisions of ASHRAE *Handbook of Fundamentals*, for intermittent mechanical ventilation.

g. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

h. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

i. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.

j. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

k. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

TABLE 405.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION:	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	—	0.95
Untested distribution systems entirely located in conditioned space[c]	0.88	1
"Ductless" systems[d]	1	—

For SI: 1 cubic foot per minute = 0.47 L/s; 1 square foot = 0.093m^2; 1 pound per square inch = 6895 Pa; 1 inch water gauge = 1250 Pa.

a. Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air handler enclosure.

405.6 Calculation software tools.

405.6.1 Minimum capabilities.

Calculation procedures used to comply with this section shall be software tools approved by the Department of State capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

1. Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure shall not allow the user to directly modify the building component characteristics of the standard reference design.
2. Calculation of whole-building (as a single zone) sizing for the heating and cooling equipment in the standard reference design residence in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed code enforcement official inspection checklist listing each of the proposed design component characteristics from Table 405.5.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (e.g., R-value, U-factor, SHGC, AFUE, SEER, EF, etc.).

405.6.2 Specific approval.

Performance analysis tools meeting the applicable sections of Section 405 shall be permitted to be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The code enforcement official shall be permitted to approve tools for a specified application or limited scope.

405.6.3 Input values.

When calculations require input values not specified by Sections 402, 403, 404 and 405, those input values shall be taken from an approved source.