

AMENDED AND RESTATED
CONTRACT ZONING AGREEMENT
BY AND BETWEEN THE TOWN OF CUMBERLAND
AND
VILLAGE GREEN CUMBERLAND, LLC

RELATING TO PHASE 1 and PHASE 4 OF THE
VILLAGE GREEN REVITALIZATION MASTER PLAN

~~(The former "Doane" Parcel Consisting of Approximately 40.7 Acres)~~

This Amended and Restated Contract Zoning Agreement is entered into this ~~___¹¹th~~ day of ~~April, 2011~~, 2016 by and between the **Town of Cumberland**, a Municipal Corporation (the "**Town**"), and **Village Green Cumberland, LLC**, a Maine Limited Liability Company with a business address of PO Box 3572, Portland, ME 04104-3571, its nominee or assigns (the "**Developer**"), pursuant to the Conditional and Contract rezoning provisions set forth in 30-A M.R.S.A. Section 4352 (the "**Act**") and Section ~~606-315-79~~ of the Cumberland Zoning Ordinance Code, as amended (the "**Zoning Ordinance Code**").

WHEREAS, the Town and Developer entered into a Contract Zoning Agreement dated April 11, 2011, which is recorded at the Cumberland County Registry of Deeds in Book 28735, Page 158 (the "Original Agreement"); and

WHEREAS, the Town conveyed to the Developer the property subject to the Original Agreement, a 40.7 +/- acre parcel of unimproved real estate located between Drowne Road and Wyman Way, identified on the Town of Cumberland Tax Assessor map as Map U10, Lot 7B (the "Original Property"), by virtue of a Deed dated January 18, 2012, recorded in the Cumberland County Registry of Deeds in Book 29285, Page 284; and

WHEREAS, the Developer has begun developing the Original Property into a 59 lot residential subdivision, subject to the terms and conditions set forth in the Original Agreement and a subdivision plan as approved by the Cumberland Planning Board on January 17, 2012, recorded in the Cumberland County Registry of Deeds in Plan Book 212, Page 18; and

WHEREAS, the Developer intends to expand the residential subdivision of the Original Property, subject to the terms and conditions set forth herein, to include additional residential lots on a 5.72 +/- parcel of real estate adjoining the Original Property, identified on the Town of Cumberland Tax Assessor map as Map U10, Lot 1B (the "Phase 4 Property"), which property is currently owned by George and Constance Russell by virtue of a Deed dated August 20, 2001, recorded in the Cumberland County Registry of Deeds in Book 16675, Page 235; and

WHEREAS, the Town and the Developer desire to amend and restate the Original Agreement in its entirety;

NOW THEREFORE, the Original Agreement is hereby amended and restated in its entirety, as follows, it being understood that this Amended and Restated Contract Zoning Agreement supersedes and replaces the Original Agreement, which shall be of no further force and effect:

WHEREAS, the property subject to this Amended and Restated Contract Zoning Agreement consists of two separate parcels, the Original Property, a 40.7 +/- acre parcel of ~~unimproved~~ real estate located between Drowne Road and Wyman Way, identified on the Town's Tax Assessor map as MAP U10, Lot 7B, and the Phase 4 Property, a 5.72 +/- acre parcel of real estate located adjacent to the northern boundary of the Original Property, identified on the Town's Tax Assessor map as Map U10, Lot 1B, both properties consisting of 46.41 +/- acres total as more particularly shown on Exhibit A attached hereto (together hereinafter referred to as the "Property"), which property is currently owned by the Town by virtue of a certain Deed dated September 13, 2000, recorded in the Cumberland County Registry of Deeds in Book 15732, Page 22; and

WHEREAS, the Original Property is located in the Village Mixed-Use Zone (V-MUZ) Zoning District (the "V-MUZ Zoning District") located in ~~s~~Section 204-13315-18 of the Zoning Ordinance Cumberland Code; and

WHEREAS, the Phase 4 Property is located in the Rural Residential 1 (RR1) Zoning District (the "RR1 Zoning District") located in Section 315-6 of the Cumberland Code; and

~~WHEREAS, the Developer has entered into a Purchase and Sale Agreement—Land Only, dated 3/14/2011, as amended (the "Purchase and Sale Agreement"), pursuant to which the Developer has agreed to purchase the Property from the Owner;~~

WHEREAS, the Town desires to sell the property to generate tax revenue and stimulate further economic development in the town center as recommended by the 2009 Comprehensive Plan.

~~WHEREAS, the Developer intends to develop the Property into a 59 lot residential subdivision, subject to the terms and conditions set forth herein, as further described in the Exhibit B attached hereto (the "Project");~~

WHEREAS, the Developer has submitted an application for subdivision approval to the Cumberland Planning Board, in accordance with the subdivision plan attached hereto as Exhibit E; and

WHEREAS, in order for the Project to be financially feasible for the construction and sale of residential dwelling units while meeting all applicable codes, certain Amendments with respect to dimensional, design and certain other performance standards of the Cumberland Zoning Ordinance are required, ~~and;~~ and

WHEREAS, the Developer has the ability to acquire additional land to the underlying contract zone and the Town would be benefitted thereby, and;

WHEREAS, ~~the Town and Developer desire to enter into this Contract Zoning Agreement relating to the Property, subject to the terms and conditions set forth herein. on~~ the Cumberland Town Council approved the execution of this Amended and Restated Contract Zoning Agreement, subject to later compliance with the Subdivision and Site Plan Standards as set forth in Chapter 250 and Chapter 229, respectively, of the Cumberland Code, provided such provisions are not in conflict with the Act;

NOW THEREFORE, pursuant to the provisions of 30-A.M.R.S.A. § 4352(8) and Section ~~606-315-79~~ of the ~~Cumberland Zoning Ordinance Code~~, as amended, the Cumberland Town Council hereby finds that this Amended and Restated Contract Zoning Agreement:

- A) is consistent with the Comprehensive Plan duly adopted by the Town of Cumberland on November 9, 2009; and
- B) establishes a contract zone area consistent with the existing and permitted uses in the original zone of the area involved; and
- C) only includes conditions and restrictions which relate to the physical development and future operation of the proposed development; and
- D) imposes those conditions and restrictions which are necessary and appropriate for the protection of the public health, safety and general welfare of the Town.

In furtherance of these common goals, the parties agree as follows:

I. **Establishment of the Contract Zone:**

The Town hereby agrees that the Property as described herein shall be a contract zone (the “**Contract Zone**”) pursuant to the provisions of 30-A.M.R.S.A. § 4352(8) and Section ~~606-315-79~~ of the Cumberland ~~Zoning Ordinance Code~~. This Agreement shall create an overlay zone. Except as expressly modified or otherwise stated herein, the Property shall be subject to the requirements of the ~~underlying~~-V-MUZ ~~Zoning~~-District, as the same may be amended from time to time, together with all applicable lot requirements and general requirements, not modified herein.

II. **Permitted Uses Within the Contract Zone:**

The development permitted within the Contract Zone established herein shall be as follows:

A. All uses currently authorized either as permitted uses or special exceptions in the V-MUZ ~~Zoning~~-District, or as specifically authorized herein.

B. Up to ~~six~~ four additional residential dwelling units may be constructed on the Phase 4 Property, not including the existing residential dwelling unit that currently exists on the

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Phase 4 Property and is currently occupied by the property owners George and Constance Russell.

III. **Restrictions and Certain Design Standards Within ~~The~~ Contract Zone:**

All restrictions as currently set forth in Section ~~606-315-79~~ of the Cumberland ~~Zoning Ordinance Code~~, except as modified herein and as appears on Exhibit C, attached hereto and made a part hereof.

IV. **Performance Standards Within the Contract Zone:**

The following performance standards shall apply to the Contract Zone (Phase ~~I-1 and Phase 4~~ of the VGRMP) as follows:

- A. The Recreation Facilities and Open Space Impact Fee Ordinance of the Town of Cumberland shall be waived in accordance with Article ~~1-10~~Section 137-10, Waiver of Impact Fee subject to the following provisions:
- 137-6 Payment of Fees shall be modified as follows: the Developer shall submit to the Town a list of specific public improvements with corresponding values for said improvements to be provided by each Phase of the approved Village Green Revitalization Master Plan (VGRMP). The public improvements shall include construction of a roadway from the existing terminus of Wyman Way, crossing the Property and connecting with Drowne Road. All public improvements provided in lieu of the impact fee for each Phase of the approved VGRMP shall be completed prior to the final release of bonds or letter of credit(s) required to secure all public improvements for each Development Phase. Performance guarantees, including Letters of Credit and bonds, shall include the value of the in lieu payments attributed to Public Improvements, even where the Public Improvements are to be located upon future Phases which may or may not be constructed.
 - The public improvements provided for each Phase of the approved VGRMP will, at a minimum, equal the value of the impact fee(s) otherwise due as provided in 137-11 Calculation of Fees.
 - All public improvements to be located within the adjacent “Civic Lot” (Map U10-A, Lot 13) provided by the Developer as part of this Agreement shall be in accordance with a Site Plan approved in advance by the Town.

VI. **Further Assurances:** In order to effectively and properly implement this Agreement, the parties agree to negotiate in good faith the terms and conditions of such further instruments and agreements as may be reasonably necessary from time to time to give effect to this Agreement.

VII. **Maine Agreement:** This contract is a Maine Agreement, entered into in the State of Maine and shall be governed by and enforced in accordance with the laws of the State of Maine.

VIII. **Binding Covenants:** The above stated restrictions, provisions, and conditions are an essential part of this contract and shall run with the subject premises, shall bind the interest therein, and any party in possession or occupancy of said property or any part thereof, and shall inure to the benefit of and be enforceable by the Town, by and through its duly authorized representatives. This Agreement may not be amended except by mutual written agreement by the parties.

IX. **Severability:** In the event any one or more clauses of this Agreement shall be held to be void or unenforceable for any reason by any court of competent jurisdiction, such clause or clauses shall be deemed to be severable and of no force or effect in such jurisdiction, and the remainder of this Agreement shall be deemed to be valid and in full force and effect, and the terms of this Agreement shall be equitably adjusted if possible so as to compensate the appropriate party for any consideration lost because of the elimination of such clause or clauses.

X. **Enforcement:** The Town shall also have the ability to enforce any breach of this Agreement or any other violation of the Zoning Ordinance through the provisions of 30-A M.R.S.A § 4452.

IN WITNESS WHEREOF, the parties have hereunto caused this Agreement to be executed as of the day and year first above written.

WITNESS:

Town of Cumberland

By: _____
William R. Shane
Its Town Manager

WITNESS:

Village Green Cumberland, LLC

By: _____
David H. Bateman
Its Manager

State of Maine
County of Cumberland, ss.
28 _____, 2015~~2016~~

~~—~~ July

Personally appeared the above-named William R. Shane, Town Manager of the Town of Cumberland and acknowledged the foregoing instrument to be his free act and deed and the free act and deed of the Town of Cumberland and subscribed and swore to the same.

Notary Public/Attorney-at-Law
Print Name: ~~Kenneth M. Cole III,~~

Esq. _____

State of Maine
County of Cumberland, ss.
_____, July 28, 2015~~2016~~

Personally appeared the above-named David H. Bateman, Manager of Village Green Cumberland, LLC and acknowledged the foregoing to be his free act and deed in his said capacity, and the free act and deed of Village Green Cumberland, LLC.

Notary Public/Attorney-at-Law
Print Name: ~~Kenneth M. Cole III,~~

Esq. _____

EXHIBITS

- Exhibit A** Survey of the Property
- Exhibit B** Approved Village Green Revitalization Master Plan (VGRMP) Phase 1
and Phase 4
- Exhibit C** Summary of Zoning Amendments
- Exhibit D** Plan of Open Space/Recreational Easement(s)
- Exhibit E** Proposed Subdivision Plan
- Exhibit F** Energy Conservation Standards
- Exhibit F-1** Street Lighting

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EXHIBIT A

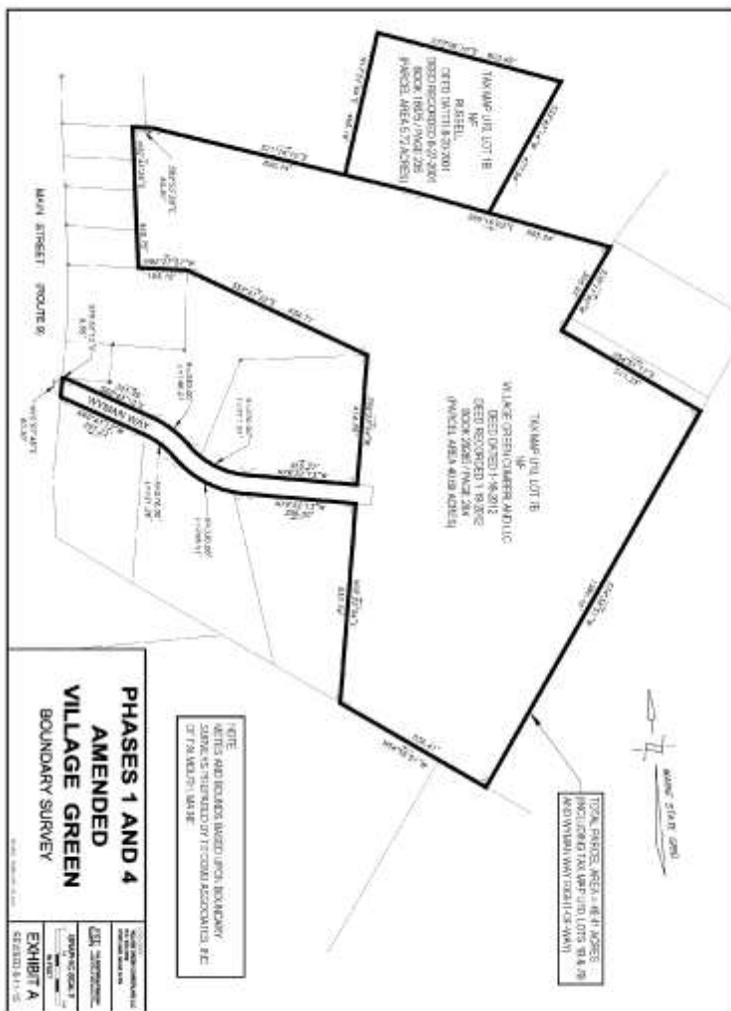


EXHIBIT C
Summary of Zoning Amendments

A) The following minimum lot frontages shall be required on a Private Drive within the Contract Zone (Phase I and Phase 4 of the Village Green Revitalization Master Plan, VGRMP) as follows:

Use	Min. Lot Frontage
Detached Single Family Residential Structure	15'
Attached Single Family Residential Structure	15'
Duplex Residential Structure	50'

Maximum Number of Residential Units Accessed from Private Drive = 6

B) The following minimum setbacks within the V-MUZ-District shall be modified for all structures within the Contract Zone (Phase I and Phase 4 of the VGRMP) as follows:

Structure Type	Front	Side
Detached Single Family Residential Structure and Garage	15' *	
Attached Single Family Residential Structure and Garage	15' *	10' **
Duplex Residential Structure and Garage	15' *	
Driveways	0'	8' **

* Setback between face of garage and sidewalk shall be minimum distance of 20'

** Side setback reduced to 0' along common sideline between attached residential structures and garages

C) All public roads within the Contract Zone (Phase I and Phase 4 of the VGRMP), including the full extent of Wyman Way connecting to Main Street, shall be designed in accordance with the residential sub-collector roadway standards as contained in Section 8.2 Article VI and Table 2 of Chapter 250, of the Subdivision Ordinance of Land, of the Cumberland Code, as modified by Section 204.13.5.4315-18, of the V-MUZ District, of the Cumberland Code, and as further modified below:

Standard	Public Road
Grass Esplanade	6' * (one side)
Paved Sidewalk	6' (one side)
Min. Tangent Length Between Curves of Reverse Alignment	0'
Min. Distance Between Street Intersections on Same Side	100'
Min. Distance Between Street Intersections on	200'

Opposite Side	
Min. Pavement Radii at Intersections	25'
Min. K Factor, Crest Vertical Curve	15
Min. K Factor, Sag Vertical Curve	20
MPH Design Speed	25
Min. Property Line Radius at Intersection	15'
Dead End Turn Around	Cul-de-Sac Per 8.2.D.3
Right-of-Way Width	50'
Minimum Centerline Radius	100'
Minimum Angle of Street Intersection	71 degrees
Minimum Pavement Radii at Intersection	25'
Aggregate Subbase Course: Sand	0"

* Reduce esplanade width to 0' along portion of Wyman Way extending between Parcel 1 (Tax Map U10, Lot 7B) – Former Doane Parcel and Main Street (Route 9).

D) All private roads within the Contract Zone (Phase 1 and Phase 4 of the VGRMP) shall be designed in accordance with the private roadway standards as contained in Article VI and Table 2 of Chapter 250, Section 8.2 of the Subdivision of Land Ordinance, of the Cumberland Code, as modified by Section ~~204.13.5.4315-18,~~ of the V-MUZ District, of the Cumberland Code, and as further modified below:

Standard	Private Road
Grass Esplanade	4' (one side)
Paved Sidewalk	5' (one side)
Min. Tangent Length Between Curves of Reverse Alignment	0'
Min. Distance Between Street Intersections on Same Side	100'
Dead End Turn Around	Tee Turn Around 25' Length

E) The following roadway standards shall apply to private drives within the Contract Zone (Phase 1 and Phase 4 of the VGRMP):

Standard	Private Drive
Right-of-Way Width	30'
Roadway Pavement Width	18'
Grass Esplanade	N/A
Paved Sidewalk	N/A
Max. Dead End Road Length	250' <u>675'</u>
Min. Roadway Centerline Grade (1.0% preferred)	1.0%
Max. Roadway Centerline Grade	10%
Min. Centerline Radius	100'

(100' Preferred)	
Min. Tangent Length Between Curves of Reverse Alignment	0'
Min. Angle of Street Intersections (90° Preferred)	75°
Min. Distance Between Street Intersections on Same Side	100'
Min. Distance Between Street Intersections on Opposite Side	100'
Min. Pavement Radii at Intersections	10'
Min. Pavement Crown	1/4" per foot
Min. Slope of Gravel Shoulder	1/2" per foot
Min. K Factor, Crest Vertical Curve	15
Min. K Factor, Sag Vertical Curve	20
MPH Design Speed	25
Max. Grade within 75' of Intersection	3%
Min. Property Line Radius at Intersection	0'
Dead End Turn Around	N/A

F) The following design standards shall apply to the Contract Zone (Phase I and Phase 4 of the VGRMP) as follows:

1. The portion of public roadway along the existing Wyman Way right-of-way shall conform to the existing right-of-way dimensions and geometry, which shall include the ability of the roadway not to be centered within the existing right-of-way.
2. The drainage system for public and private roadways shall consist of closed drainage to the extent practicable; however, shallow under-drained swales may be used alongside roadways where no sidewalk is proposed. Where sidewalks are proposed, they shall be constructed with curb and access to the closed drain system through catch basin inlets, for example.
3. Parking and garage doors facing towards the public right-of-way are permissible provided the garages are architecturally designed to not be the principal element of the structure. Parking and garage doors facing towards private roads and private drives are permissible.
4. No minimum wooded buffer strip is required to be maintained along existing public streets as referenced in Section 7.9 of the Subdivision Ordinance.
5. Curbing at roadways to be either bituminous or slip form concrete.
6. A minimum 50' buffer shall be maintained along the exterior of the VGRMP parcel (excluding Wyman Way right-of-way) and abutting

residential development. The 50' buffer shall not be required to adjacent land owned by the Town.

EXHIBIT D

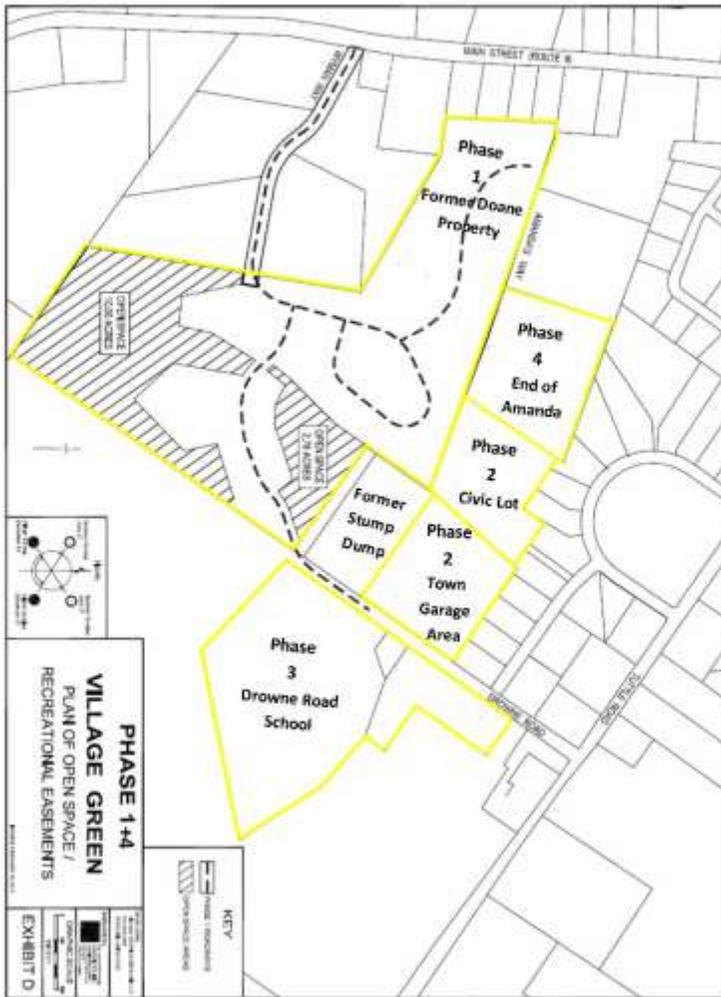


EXHIBIT EF

CHAPTER 4

RESIDENTIAL ENERGY EFFICIENCY

**SECTION 401
GENERAL**

401.1 Scope. This chapter applies to residential buildings.

401.2 Compliance. Projects shall comply with Sections 401, 402.4, 402.5, and 403.1, 403.2.2, 403.2.3, and 403.3 through 403.9 (referred to as the mandatory provisions) and either:

1. Sections 402.1 through 402.3, 403.2.1 and 404.1 (prescriptive); or
2. Section 405 (performance).

401.3 Certificate. A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall not cover or obstruct the 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, crawlspace wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration and the solar heat gain coefficient (SHGC) of 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 efficien-

cies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace, 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 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.

**TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT***

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,*}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65 ^f	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50 ^f	0.65	0.30	30	13	5/8	19	5/13 ^g	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 ^h	13/17	30 ^h	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5 ^h	15/19	30 ^h	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38 ^h	15/19	10, 4 ft	10/13

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 x 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. The SHGC column applies to all glazed fenestration.
- c. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "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. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
- g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- h. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
- i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
- j. For impact rated fenestration complying with Section R301.2.1.2 of the *International Residential Code* or Section 1608.1.2 of the *International Building Code*, the maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

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 ^c
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	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
7 and 8	0.35	0.60	0.026	0.057	0.057	0.028	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 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall *U*-factor in Marine Zone 4 and Zones 5 through 8.

c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure 301.J and Table 301.1.

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.

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. The SHGC requirements shall be met in addition to UA compliance.

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. 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.

402.2.2 Ceilings without attic spaces. 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 Sec-

tion 402.1.1 shall be limited to 500 square feet (46 m²) 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. 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 that 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 in Table 402.1.3. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

Exception: In Climate Zones 1 and 2, the continuous insulation requirements in Table 402.2.5 shall be permitted to be reduced to R-3 for steel frame wall assemblies with studs spaced at 24 inches (610 mm) on center.

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-19	R-13 + 9 or R-19 + 8 or R-25 + 7
R-21	R-13 + 10 or R-19 + 9 or R-25 + 8
	Steel Joist Floor
R-13	R-19 in 2 × 6 R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6 R-19 + 12 in 2 × 8 or 2 × 10

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 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 horizon-

tally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code*. 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. The minimum ceiling insulation R-values shall be R-19 in Zones 1 through 4 and R-24 in Zones 5 through 8. The minimum wall R-value shall be R-13 in all zones. New wall(s) separating a sunroom from *conditioned space* shall meet the *building thermal envelope* requirements.

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 SHGC. An area-weighted average of fenestration products more than 50 percent glazed shall be permitted to satisfy the SHGC requirements.

402.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor and SHGC 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.

402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) 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.

402.3.5 Thermally isolated sunroom U-factor. For Zones 4 through 8, 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.

402.3.6 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 and SHGC in Table 402.1.1.

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.

RESIDENTIAL ENERGY EFFICIENCY

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 junction.
12. Other sources of infiltration.

402.4.2 Air sealing and insulation. 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 50 pascals (1 psf). 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.

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 official*, an *approved* party independent from the installer of the insulation shall inspect the air barrier and insulation.

402.4.3 Fireplaces. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

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/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), 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.

Exceptions: Site-built windows, skylights and doors.

402.4.5 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.

402.5 Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration U-factor permitted using trade-offs from Section 402.1.4 or 405 shall be 0.48 in Zones 4 and 5 and 0.40 in Zones 6 through 8 for vertical fenestration, and 0.75 in Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using trade-offs from Section 405 in Zones 1 through 3 shall be 0.50.

SECTION 403 SYSTEMS

403.1 Controls (Mandatory). At least one thermostat shall be provided for each separate heating and cooling system.

403.1.1 Programmable thermostat. Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be 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 (Mandatory). 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 (Prescriptive). 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 (Mandatory). All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed.

RESIDENTIAL ENERGY EFFICIENCY

Joints and seams shall comply with Section M1601.4.1 of the *International Residential Code*.

Duct tightness shall be verified by either of the following:

1. Postconstruction test: Leakage to outdoors shall be less than or equal to 8 cfm (226.5 L/min) per 100 ft² (9.29 m²) of conditioned floor area or a total leakage less than or equal to 12 cfm (12 L/min) per 100 ft² (9.29 m²) 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 ft² (9.29 m²) 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 ft² (9.29 m²) of conditioned floor area.

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

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.

403.2.3 Building cavities (Mandatory). Building framing cavities shall not be used as supply ducts.

403.3 Mechanical system piping insulation (Mandatory). 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 (Mandatory). 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 (Mandatory). Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

403.6 Equipment sizing (Mandatory). Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code*.

403.7 Systems serving multiple dwelling units (Mandatory). Systems serving multiple dwelling units shall comply with Sections 503 and 504 in lieu of Section 403.

403.8 Snow melt system controls (Mandatory). 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, and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F.

403.9 Pools (Mandatory). Pools shall be provided with energy-conserving measures in accordance with Sections 403.9.1 through 403.9.3.

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 404 ELECTRICAL POWER AND LIGHTING SYSTEMS

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

SECTION 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 official*, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*. *Code 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 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 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.

405.6 Calculation software tools.

405.6.1 Minimum capabilities. Calculation procedures used to comply with this section shall be software tools 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 Section M1401.3 of the *International Residential Code*.
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 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, HSPF, 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 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.

RESIDENTIAL ENERGY EFFICIENCY

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) ^a = 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 ^f 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 ^f combined with the mechanical ventilation rate, <i>I</i> which shall not be less than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: <i>CFA</i> = conditioned floor area <i>N_{br}</i> = 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: <i>CFA</i> = conditioned floor area <i>N_{br}</i> = number of bedrooms	As proposed
Internal gains	$I_{Gain} = 17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (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 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.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table 402.1.3 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems ^h	As proposed Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed
Cooling systems ^{h,j}	As proposed Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed
Service H ₂ O heating ^{h,k,l}	As proposed Use: same as proposed design	As proposed gal/day = $30 + (10 \times N_{br})$
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 setpoint = 72°F	Same as standard reference

(continued)

RESIDENTIAL ENERGY EFFICIENCY

TABLE 405.5.2(1)—continued

- For SI: 1 square foot = 0.93 m²; 1 British thermal unit = 1055 J; 1 pound per square foot = 4.88 kg/m²; 1 gallon (U.S.) = 3.785 L; °C = (°F-32)/1.8; 1 degree = 0.79 rad.
- 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.
 - 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.
 - 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.
 - Where leakage area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:

$$SLA = LCFA$$
 where L and CFA are in the same units.
 - Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2001 ASHRAE *Handbook of Fundamentals*, Chapter 26, page 26.21, Equation 40 (Sherman-Grimsrud model) or the equivalent shall be used to determine the energy loads resulting from infiltration.
 - The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
 - 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.
 - 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.
 - 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.
 - 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.
 - 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 = 0.093 m²; 1 pound per square inch = 6895 Pa; 1 inch water gauge = 1250 Pa.
- Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
 - 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.
 - 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.
 - Ductless systems shall be allowed to have forced airflow across a ceiling but shall not have any ducted airflow external to the manufacturer's air handler enclosure.

EXHIBIT FE-1

Street lighting in Phase 1 shall utilize current energy-saving lighting equipment and technologies for street lighting, including LED cut-offs on all Town roads, private roads and common parking areas.