3. Defining the Proposed and Standard Designs

The space conditioning energy budget for the low-rise residential Standards is a custom budget, that is, the energy that would be used by a building similar to the *Proposed Design*, but that is modified to just meet the requirements of the prescriptive standards. The building that is modeled to create the custom budget is the *Standard Design*. This section of the *ACM Approval Manual* describes how the *Proposed* Design and *Standard Designs* are defined.

For the The *Proposed Design*, the is modeled based upon user inputs that are subject to a variety of restrictions as well as a variety of fixed and restricted assumptions regarding dwelling design and operation. The user enters information to describe the thermal characteristics of the proposed building envelope including its surface areas, air leakage, shading structures and attachments, thermal mass elements, heating and cooling equipment and distribution systems, and water heating equipment and distribution systems. These inputs are subject to a variety of restrictions which are defined in this section. Modeling assumptions and algorithms for making energy calculations are described in Chapter 4.

The process of generating the *Standard Design* and calculating the custom budget mustshall be performed automatically by the program, based on the allowed and default inputs for the *Proposed Design* as well as the fixed and restricted inputs and assumptions for both designs. The process of custom budget generation se operations shall not be accessible to program users for modification when the program is used for compliance purposes or when compliance forms can be are generated by the program. The *Standard Design* generator mustshall automatically take user input about the *Proposed Design* and create input data for the *Standard Design*, using all the applicable fixed and restricted inputs and assumptions described in this Chapter and in Chapter 4. All assumptions and algorithms used to model the *Proposed Design* mustshall also be used in a consistent manner in the *Standard Design* building.

The basis of the *Standard Design* is prescriptive Package D, which is contained in Section 151(f) of the Standards. The Package D prescriptive requirements are not repeated here. However, the following sections present the details on how the *Standard Design* is to be developed. Defining the *Standard Design* building involves two steps.

- First, the geometry of the proposed building is modified from the description entered for the *Proposed Design*.
- Second, building features and performance characteristics are modified to meet the minimum requirements of compliance with package Package D of the Standards.

The following sections present the details on how the *Standard Design* is to be developed.

3.2Basis of the Standard Design - Package D

The basis of the *Standard Design* is package D. The requirements of package D are contained in Section 151(f) of Title 24, Part 6 of the State Building Standards. These prescriptive requirements are not repeated here.

3.33.1 Building Physical Configuration

Proposed Design. The building configuration is defined by the user through entries for heavy and light floor areas, wall areas, roof and ceiling areas, fenestration areas, and door areas. Each , which are entered along with performance characteristics such as U-factors, SHGC, thermal mass, etc. Information about the othe orientation of these building elements. rientation and tilt is required for walls, fenestration and other elements. The user entries for all of these building elements mustshall be consistent with the actual building design and configuration. If the ACM actually models the specific geometry of the building by using a coordinate system or graphic entry technique, the building geometry data entered mustshall be as consistent as reasonably possible with the actual building design necessary to achieve thermal modeling accuracy.

Standard Design. The *Standard Design* building has the same floor area, volume, and configuration as the *Proposed Design*, except that wall and window area are distributed equally between the four main compass points, North, East, South, and West. The details are described below.

~~3.3.1~~3.1.1 Conditioned Floor Area

Proposed Design. The ACM ~~must~~shall require the user to enter the total conditioned floor area of the *Proposed Design* as well as the conditioned slab floor area. The conditioned slab floor area is the area of a slab floor with a minimum slab thickness of 3.5 inches or a minimum heat capacity of 7.0 Btu/ºF-ft^2~~ft^2-°F~~ and conditioned space above and unconditioned space or the ground/gravel below. The non-slab conditioned floor area is the total conditioned floor area minus the conditioned slab floor area. Stairwell floor area shall be included in conditioned floor area as the horizontal area of the stairs and landings between two floors of each story of the house. The conditioned slab floor area may be either on-grade or a raised slab.

Standard Design. The total conditioned floor area and the conditioned slab floor area of the *Standard Design* building is the same as the *Proposed Design*.

~~***Proposed Design & Standard Design***~~***Note.*** ACMs ~~must~~shall keep track of the conditioned floor area and ~~must~~shall at least be able to keep separate track of the total conditioned floor area and conditioned slab floor area. These areas are used to determine the default thermal mass for the *Proposed Design* and the thermal mass for the *Standard Design*. ~~Stairwell floor area is the horizontal area of the stairs and landings between two floors of each story of the house. The conditioned slab floor area may be either on-grade or a raised slab.~~

~~3.3.2~~3.1.2 Conditioned Volume

Proposed Design. The volume of the *Proposed Design* is the conditioned volume of air enclosed by the building envelope. The volume ~~must~~shall be consistent with the air volume of the actual design and may be determined from the total conditioned floor area and the average ceiling height or from a direct user entry for volume.

Standard Design. The volume of the *Standard Design* building is the same as the *Proposed Design*.

3.2 Opaque Envelope Elements

3.2.1 Insulation Installation Quality

Proposed Design. The ACM user may specify either *Standard* or *Improved* insulation installation quality for the *Proposed Design*. The presence of *Improved* insulation installation quality shall be reported in the *Field Verification and Diagnostic Testing* listings on the CF-1R. *Improved* insulation installation quality shall be certified by the installer and field verified.

Standard Design. The *Standard Design* shall be modeled with *Standard* insulation installation quality.

Note. Chapter 4 has the modeling rules for Standard and Improved insulation installation quality.

~~3.3.3~~3.2.2 Ceilings/Roofs

Proposed Design. The ACM shall allow a user to enter one or more ceiling/roof areas for the *Proposed Design* ~~from an approved list of roof/ceiling construction types. Some of these construction types may be user-defined but the ACM must determine the output names for user-defined construction types for all building envelope constructions. The ACM shall not allow the user to specify output names for construction types or envelope elements.~~ The roof/ceiling areas, construction assemblies, orientations, and tilts modeled ~~must~~shall be consistent with the corresponding areas, construction assemblies, and tilts in the actual building design and ~~must~~shall ~~total~~ equal the overall roof/ceiling area with conditioned space on the inside and unconditioned space on the other side. ~~Except as indicated in the next sentence, the U-value of the modeled assembly must be the same as the U-value of the actual assembly.~~ U-factors shall be selected from ACM Joint Appendix IV. If new ~~C~~ceiling and wall construction assemblies ~~that~~ do not meet the mandatory minimum ~~U-value~~U-factor required by Title 24, the building shall not pass compliance ~~shall not be allowed~~. If the *Proposed Design* has *Improved* insulation installation quality, then all ceiling/roof assemblies in the *Proposed Design* are modeled accordingly (see Section 3.2.1 and Chapter 4).

Standard Design. The ceiling/roof areas of the *Standard Design* building are equal to the ceiling/roof areas of the *Proposed Design*. The *Standard Design* roof and ceiling surfaces are assumed to be horizontal (no tilts) and have a ~~U-value~~U-factor specific to the package D requirements. The U-factors in Table R3-1 shall be used in the *Standard Design* for the appropriate R-value criteria in Package D. The *Standard Design* generator ~~must~~shall consider all exterior surfaces in the *Proposed Design* with a tilt less than 60 degrees as roof elements. Surfaces that tilt 60 degrees or more are treated as walls. The *Standard Design* is modeled with *Standard* insulation installation quality U-factors by correcting the U-factors in Table R3-1 with the standard insulation installation quality adjustment factors for ceilings/roofs from Section 4.2.3.

Table R3-1 – Ceiling/Roof U-factors for the Standard Design

Building Component	R-value Requirement	U-factor	ACM Joint Appendix IV Reference
Roof			
	R-30	0.032	Table IV.1-A7
	R-38	0.026	Table IV.1-A8

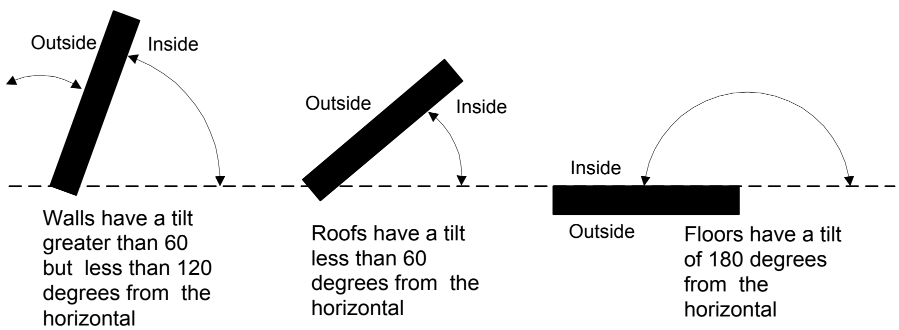

Figure R3-1 – Surface Definitions

~~*3.3.4*~~*Radiant Barriers*

Proposed Design. The ACM ~~must~~shall allow the user to input a radiant barrier. The presence of a radiant barrier ~~must~~shall be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R ~~and C-2R~~.

Standard Design. The *Standard Design* shall have a radiant barrier in accordance with Package D requirements. When required by Package D, radiant barriers are required on all ceiling/roof surfaces. See Section 4.2.1 for radiant barrier eligibility criteria.

~~*3.3.5*~~*Cool Roofs*

Proposed Design. The ACM ~~must~~shall allow the user to input a cool roof. The presence of a cool roof ~~must~~shall be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R ~~and C-2R~~.

Standard Design. The *Standard Design* shall be modeled without a cool roof.

~~3.3.6~~3.2.3 Wall~~s~~s

Proposed Design. The ACM shall allow a user to enter one or more wall areas for the *Proposed Design* ~~from an approved list of wall construction types~~. ~~Some of these construction types may be user-defined but the ACM must determine the name for user-defined construction types for all building envelope constructions. The ACM shall not allow the user to specify names for construction types or envelope elements.~~ The wall areas modeled mustshall be consistent with the corresponding wall areas in the actual building design and the total wall area mustshall be equal to the gross wall area with conditioned space on the inside and unconditioned space or exterior conditions on the other side. U-factors for *Proposed Design* wall constructions shall be selected from ACM Joint Appendix IV. If the *Proposed Design* has *Improved* insulation installation quality, then walls are modeled accordingly (see Chapter 4). Walls include all opaque surfaces with a slope greater than 60º but less than 120º from the horizontal (see Figure R3-1).

Standard Design. The gross wall area in the *Standard Design* run is equal to the gross wall area of the *Proposed Design*, including knee walls in the ceiling construction of the *Proposed Design*. The gross wall area in the *Standard Design* is equally divided between the four main compass points, North, East, South, and West. Window and door areas are subtracted from the gross wall area to determine the net wall area in each orientation. All surfaces included in the *Proposed Design* run input file with a tilt from the horizontal of 60 degrees or more and less than 120 degrees are treated as walls. Surfaces that have a tilt of less than 60 degrees are considered to be roof surfaces.The *Standard Design* has *Standard* insulation installation quality. U-factors for the *Standard Design* walls shall be those from Table R3-2 for the appropriate Package D R-value criteria multiplied by the standard insulation installation quality factor for walls from Section 4.2.3.

Table R3-2 – Wall U-factors for the Standard Design

Building Component	Package D R-value Criteria	Standard Design U-factor	ACM Joint Appendix IV Reference
Wall	R-13	0.1020.1020.074	Table IV.9-A3
	R-19	0.074 0.0740.065	Table IV.9-A5
	R-21	0.0690.0690.061	Table IV.9-A6

3.3.73.2.4 Basement Walls and Floors

Proposed Design. Portions of basement walls above grade must shall be modeled as conventional walls above grade. For below-grade basement walls, tThe user mustshall be requested to eenter the area of basement walls below grade as the area of below grade wall at each of three3 depths: fromor Zero zero to 2 feet below grade (shallow), greater than 2 feet to 6 feet below grade (medium), and greater than 6 feet below grade (deep). The ACM shall allow users to enter as many wall types as necessary to model the proposed construction*Proposed Design*. The ACM must use the same method for determining tThe U-valueU-factor, C-factor, and mass characteristics of below-grade walls shall be calculated using methods consistent with ACM Joint Appendix IV. for below grade walls as used for above grade walls. The default thermal performance characteristics value for the *Proposed Design* below-grade wall constructions shall be the same as the *Standard Design*.

Standard Design. The *Standard Design* shall have the same basement wall areas as the *Proposed Design* and at the same depths. The *Standard Design* basement wall shall be assumed to be a wall with a Heat Capacity of 15.7 Btu/(ft^2-^{o}F), a thickness of 8 inches, and an uniform R-value of 1.5.

3.3.83.2.5 Raised Floors

Proposed Design. In addition to the total conditioned floor area and total conditioned slab floor area (see 3.1.1), ACMACM s must allow the users shall to enter floor areas for the standard raised floor construction types listed in Table R3-3Table R3-2 and at least three user-defined construction types. The ACM mustshall require user input to be able to distinguish floor areas and constructions that are over crawl spaces. The U-factor for ACM and its documentation must inform the user that the floor constructions and areas mustshall be consistent with the actual building design. U-factors shall be those from ACM Joint Appendix IV. .

The effect of a conventional crawl space is approximated with a thermal resistance of R-6; however, for controlled ventilation crawl spaces (an optional capability), the crawl space is modeled as a separate thermal zone and R-6 is not assumed. The R-6 value for a conventional crawlspace shall be automatically calculated by the ACM and shall not be allowed as a user input.

Standard Design. The floor areas of the *Standard Design* are equal to the areas of the *Proposed Design*. The exposed raised floor U-valueU-factor used in for the *Standard Design* is taken from Table R3-3 and depends independent of the proposed construction assembly. It does vary, however, depending on whether or not the floor assembly in the *Proposed Design* is located over a crawl space. For this reason, tThe ACM mustshall keep track of which raised floor surfaces are over crawl spaces and which are not.

Proposed Design & Standard Design. The effect of a crawl space is approximated with a thermal resistance of R-6 and this is accounted for in the *Standard Design* U-value in Table R3-2. Raised floors in the *Proposed Design* that are not located over a crawl space shall not include the R-6 thermal resistance used for floors over a crawl space.

Notes. The effect of a conventional crawl space is modeled with a thermal resistance of R-6; however, for controlled ventilation crawl spaces (an optional capability), the crawl space is modeled as a separate thermal zone and R-6 is not assumed. The R-6 value for a conventional crawlspace shall be automatically calculated by the ACM and shall not be allowed as a user input. The U-factors in Table R3-3 account for the additional R-6.

Table R3-3 – Floor U-factors for the Standard Design

Floor Type	Package D Criteria	U-factor	ACM Joint Appendix IV Reference
Raised Floor (crawl space)	R-19	0.037	IV18-A4Table IV.20-A4
Raised Floor (no crawl space)	R-19	0.048	IV19-A4Table IV.21-A4

3.3.93.2.6 Slab-on-Grade Perimeter

Proposed Design. The ACM mustshall allow users to enter at least two different slab perimeter constructions and their corresponding lengths. Typically, ACMs have no practical limit on the number of slab perimeter constructions that may be entered. The default condition for the *Proposed Design* is ACMs must assume that 80% of any slab edge length entered is adjacent to rug-covered (R-2 for carpet and pad) slab and 20% is adjacent to exposed slab on the conditioned side. F-factors for slab loss shall be taken from Joint Appendix IV, Table IV.26R3-4 or be calculated using methods consistent with ACM Joint Appendix IV and accurately represent the conditions in the actual building. and determine an overall F2 factor for the total length or specify that the user enter or choose such a weighted F2 factor. The ACM mustshall be able to determine the amount of slab edge adjacent to unconditioned spaces separately from the slab edge adjacent to the outside so that the ACM can determine the appropriate *Standard Design*. In the *Proposed Design*, the F2 factor(s) may account for slab perimeter insulation for both slab edges exposed to the outside and slab edges adjacent to unconditioned spaces such as garages. In climate zone 16, Sslab edges adjacent to garages and unconditioned spaces may be considered to be insulated with R-7 insulation and have an FF-2 factor of 0.51.

Standard Design. The total slab perimeter length in the *Standard Design* is the same as in the *Proposed Design*. For the *Standard Design,* the slab edge heat loss F-factor, F2, is 0.76 for all climate zones except Climate Zone 16 where the FF-factor2 is 0.51. See Package D. For the *Standard Design* for heated slabs, the slab edge heat loss F-factors shall be those specified in Column B of Joint Appendix IV, Table IV.27 for the installed depth or horizontal distance of the proposed design for all climate zones except climate zone 16 where the F-factor shall be those specified in Column D. For the *Standard Design* unconditioned spaces such as the garage are assumed to be detached., hence the slab perimeter between conditioned spaces and unconditioned spaces such as garages is assumed to meet the Alternative Component Package D requirements in Section 151 of the building efficiency standards and is assumed to be exposed to the outside conditions. See Section 4.7.1 for details.

Table R3-4 – Slab Edge F-factors for the Standard Design

Slab Edge Condition	Package D Criteria	F-factor	ACM Joint Appendix IV Reference
No Insulation	None	0.73	Table IV.265-A1
R-7 Insulation	R-7	0.56	Table IV.265-C7

3.3 Fenestration and Doors

3.3.103.3.1 Doors

Proposed Design. ACMs mustshall allow users to enter at least two different door construction types, their U-factors, areas, and orientations. These door types must include the standard door type specified in Table R3-2 plus at least one user-defined door type with an ACM specified name or designator. Door U-factors shall accurately represent the doors installed in the building and be calculated in a manner consistent with ACM Joint Appendix IV.

For the user-defined door type, the ACM must at least allow the user to enter the area, the orientation, and the U-value or R-value of the door.

Standard Design. The *Standard Design* has 40 square feet of door area for each dwelling unit. All doors are assumed to face north and have a U-factor of 0.330.50 from Joint Appendix IV reference IV28-A3. This means that tThe net opaque wall area facing north is reduced by 40 ft²ft² for each dwelling unit for the *Standard Design* run.

3.3.113.3.2 Fenestration Types and Areas

Proposed Design. ACMs mustshall allow users to select enter fenestration or window types, specify the U-factor, SHGC, area, orientation, and tilt. Performance data (U-factors and SHGC) shall be NFRC values or taken from from the CEC default tables. in the standards or from several user-defined fenestration types where the user must enter the *Number of Fenestration Assemblies*, the *U-value* and *Solar Heat Gain Coefficient (SHGC)* for any user-defined window type. For each user-defined fenestration type the ACM must require the user to enter the Fenestration Area, tilt and orientation.

Standard Design. Fenestration area in the Standard Design is determined by the package D specification for the appropriate climate zone. If package D for the climate zone permits 20% of the conditioned floor area in glass, then the Standard Design has a fenestration area equal to 5% of the conditioned floor area facing in the direction of each major compass point. If package D for the climate zone permits 16% of the conditioned floor area in glass, then the Standard Design has a fenestration area equal to 4% of the conditioned floor area facing in the direction of each major compass point. If the *Proposed Design* fenestration area is less than 20%, the *Standard Design* fenestration area is set equal to the *Proposed Design* fenestration area. Otherwise, the *Standard Design* fenestration area is set equal to 20% of the conditioned floor area. The *Standard Design* fenestration area is distributed equally between the four main compass points—North, East, South and West. There is no skylight area in tThe *Standard Design* runhas no skylights. The net wall area on each orientation is reduced by the fenestration area (and door area) on each facade. The U-factor and SHGC performance factors for the *Standard Design* are taken from the Package D specification.

3.3.123.3.3 Overhangs and Sidefins

Proposed Design. ACMs mustshall allow users to enter a set of basic generic parameters for a description of an overhang and sidefinfor each individual fenestration or window area entry. The basic parameters mustshall include *Fenestration Height, Fenestration Width, Overhang/Sidefin Length, and Overhang/Sidefin Height.* ACM user entries for overhangs may also include *Fenestration Width, Overhang Left Extension* and *Overhang Right Extension.* ACM user entries for sidefins may also include *Fin Left Extension* and *Fin Right Extension* for both left and right fins. (See Sections 2.2.9 and 2.2.10.)

Standard Design. The *Standard Design* does not have overhangs.

3.2 Envelope Heat Loss Factors

Heat loss factors include U-values for ceilings/roofs, walls, floors, windows and doors. For the slab edges of slabs-on-grade the heat loss factor is expressed as an F2 factor

Proposed Design. Except for user-defined walls, ACMs must automatically assign heat loss factors based on the user's selection of one of the standard building elements from the approved lists of standard building elements.

ACM vendors should note that user entered U-values are developed with an outside air film resistance of 0.17 based on a 15 mph wind speed. The vendors may internally adjust the U-value in the simulation for average wind conditions (3 mph wind) by assuming an outside air film resistance of 0.38 or they may strip off the fixed outside air film R-value of 0.17 and calculate an hourly R-value for the outside air film coefficient based on the wind speed and surface roughness.

Standard Design. Heat loss factors in the *Standard Design* are determined by the Package D specification. They are independent of the construction assembly in the proposed building. The heat loss factors used in the *Standard Design* are given in the table below. The *Standard Design* U-values for roof/ceilings and walls depends only on the package specification and is independent of the actual construction assembly proposed. The standard design U-values include an external air film with an R-value of 0.17 based on a 15 mile per hour wind speed. The adjustment to this air film for the standard design shall be the same as that used for the proposed design.

For slab edges, the heat loss factor (F2 factor) is one of two fixed values in the *Standard Design* run. For climate zones with no slab edge insulation requirement and slab edges adjacent to unconditioned spaces F2 is 0.76 and for slab edges required to be insulated it is 0.51. For the climate zone package(s) that require slab edge insulation (Climate Zone 16), the slab edge for the *Standard Design* has insulation on the total perimeter length and has an F2 factor of 0.51.

The door U-value is fixed at 0.330 Btu/(hr-ft^2-°F) in the *Standard Design* run.

Design. Design.

Table R3-2 - Basecase Heat Loss Factors

Building Component	Package Specification or Mandatory Minimum	U-value
Roof	R-19	0.051
	R-30	0.034
	R-38	0.028
Wall	R-13	0.088
	R-19	0.065
	R-21	0.059
Raised Concrete Floor	R-0	
	R-4	
	R-8	
Raised Floor (crawl space)	R-19	0.037
Raised Floor (no crawl space)	R-19	0.049
Fenestration	U = 0.75	0.75
	U = 0.65	0.65
	U = 0.60	0.60
Doors	na.	0.330
		F2 Factor[1]
Slab Edge	None	0.76
	R-7	0.51

[1] The F2 Factor is determined based on the required assumption that 80% of the slab edge is adjacent to rug-covered slab and 20% is adjacent to exposed slab.

3.33.3.4 Solar Heat Gain Coefficients

Proposed Design. ACMs mustshall require the user to enter the fenestration Solar Heat Gain Coefficient for each window, skylight, or other fenestration system type with a separate area. This requirement may be met by having the user select from a standard default list of fenestration systems and sizes or by direct entry for user-definedusing NFRC-certified values for windows, doors with glass or skylights. In addition, for each window, skylight and fenestration element the ACM mustshall require allow the user to select an exterior shading treatment from the lists given in Table R3-7. The ACM will then determine the overall SHGC for the complete fenestration system based on the fenestration SHGC and the SHGCs assigned to the Commission-approved exterior shading devices and assigned interior shading devices from and Table R3-7Table R3-4.

Standard Design. The *Standard Design* fenestration Solar Heat Gain Coefficients (SHGCs) are determined by the appropriate Package D specifications for the applicable climate zone. Note that the frame type and the presence or absence of muntins or dividers is irrelevant for the *Standard Design* as the Package D values for $SHGC_{fen}$ and the U-factor include the effects of fenestration features such as framing, dividers, and muntins.

3.43.3.5 Interior Shading Devices and their Solar Heat Gain Coefficients

Internally, ACMs shall use two values to calculate solar heat gain through windows: $SHGC_{open}$ and $SHGC_{closed}$. $SHGC_{open}$ $SHGC_{open}$ is the total solar heat gain coefficient of the fenestration and its exterior shading device when the operable interior shading device is open. $SHGC_{closed}$ $SHGC_{closed}$ is the total solar heat gain coefficient when the interior shading device is closed. $SHGC_{open}$ $SHGC_{open}$ is the setting that applies when the air conditioner is not operating, which typically is most of the 24-hour period, while $SHGC_{closed}$ $SHGC_{closed}$ applies only for periods when the air conditioner operates. The *Standard Design* values for these SHGCs are shown in Table R3-6 below. $SHGC_{open}$ $SHGC_{open}$ and $SHGC_{closed}$ $SHGC_{closed}$ are not user specified inputs. See Chapter 4 for more details.

The ACM mustshall require the user to directly or indirectly specify $SHGC_{fen}$ and frame type. The ACM mustshall assign an interior shading device as listed in and require the user to specify exterior shading device as listed in Table R3-7Table R3-4. The ACMs mustshall calculate the overall SHGC for the fenestration with shading devices as shown in Chapter 4.

For both the *Proposed Design* and the *Standard Design,* all windows are assumed to have draperies and skylights are assumed to have no interior shading. The ACM Compliance Supplement must also explicitly indicate that the ACM automatically gives credit for draperies for all windows and that credit is allowed only for one exterior shading device.

Table R3-5 – Allowed Interior Shading Devices and Recommended Descriptors

Recommended Descriptor	Interior Shading Attachment Reference	Solar Heat Gain Coefficient
Standard	Draperies or No Special Interior Shading - Default Interior Shade	0.68 (see Note 1)
None (see Note 2)	No Interior Shading - Only for Skylights (Fenestration tilt <60 degrees)	1.00

Note (general): No other interior shading devices or attachments are allowed credit for compliance with the building efficiency standards.

Note 1: Standard shading shall be assumed for all fenestration with a tilt of 60 degrees or greater from horizontal.

Note 2: *None* is the default interior shading device in the standard and proposed design for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights), i.e. *None* is not an interior shading option for ordinary vertical windows

Table R3-6 – Standard Design *Shading Conditions*

	Package Specification	
Characteristic	$SHGC_{fen}$ = NR	$SHGC_{fen}$ = 0.37
$SHGC_{fen}$	0.67	0.37
$SHGC_{open}$	0.649	0.358
$SHGC_{closed}$	0.614	0.339
Glazing	Double Clear	Double Low Solar Low E
Interior Shade	Drapes (*Standard*)	Drapes (*Standard*)
$SHGC_{int}$	0.68	0.68
Exterior Shade	Bugscreen (*Standard*)	BugScreen (*Standard*)
$SHGC_{ext}$	0.76	0.76

3.3.6 Exterior Shading Devices

Proposed Design. The ACM mustshall require the user to either accept the default exterior shading device or select from a specific Commission-approved list of exterior shading devices for each fenestration element. The interior shading device is *Standard* (0.68 SHGC) for windows and *None* (1.0 SHGC) for skylights. The default choice for exterior shading device is *Standard,* which is assigned an average SHGC of 0.76. The ACM Compliance Supplement shall explicitly indicate that credit is allowed only for one exterior shading device. See Table R3-7 for other choices.

Standard Design. The *Standard Design* shall assume the default exterior shading, which is the standard bug screen. ACM uses the default values for interior and exterior shading devices for the *Standard Design* based on *Standard* for windows and *None* for skylights from Table R3-3 and Table R3-4.

Table R3-3 - Allowed Interior Shading Devices and Recommended Descriptors

Recommended Descriptor	Interior Shading Attachment Reference	Solar Heat Gain Coefficient
Standard	Draperies or No Special Interior Shading - Default Interior Shade	0.68 1
None 2	No Interior Shading - Only for Skylights (Fenestration tilt <60 degrees)	1.00

Note (general): No other interior shading devices or attachments are allowed credit for compliance with the building efficiency standards.

Note 1: Standard shading shall be assumed for all fenestration with a tilt of 60 degrees or greater from horizontal.

Note 2: *None* is the default interior shading device in the standard and proposed design for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights), i.e. *None* is not an interior shading option for ordinary vertical windows.

Table R3-7 – Allowed Exterior Shading Devices and Recommended Descriptors

Table R3-4 - Allowed Exterior Shading Devices and Recommended Descriptors

Recommended Descriptor	Exterior Shading Device Reference	Solar Heat Gain Coefficient
Standard	Bug Screen or No Shading - Default Bugscreens are modeled	0.76
WvnScrn	Woven SunScreen (SC<0.35)	0.30
LvrScrn	Louvered Sunscreen	0.27
LSASnScrn	LSA Sunscreen	0.13
RlDwnAwng	Roll-down Awning	0.13
RlDwnBlnds	Roll -down Blinds or Slats	0.13
None (see Note 1)	For skylights only - No exterior shading	1.00

Note 1: None is the default for fenestration tilted less than 60 degrees from horizontal (skylights) and is only allowed for fenestration tilted less than 60 degrees from horizontal (skylights)., i.e. None is not an exterior shading option for ordinary vertical windows.

Table R3-5 - Standard Design *Shading Conditions*

	Package Specification	
Characteristic	$SHGC_{fen}$ = NR	$SHGC_{fen}$ = 0.40
$SHGC_{fen}$	0.70	0.40
$SHGC_{open}$	0.68	0.39
$SHGC_{closed}$	0.63	0.37
Glazing	Double Clear	Double Clear
$SHGC_{fen+int}$	0.647	0.378
Interior Shade	Drapes (*Standard*)	Drapes (*Standard*)
$SHGC_{int}$	0.68	0.68
Exterior Shade	Bugscreen (*Standard*)	BugScreen (*Standard*)
$SHGC_{ext}$	0.76	0.76

3.53.4 Thermal Mass

The performance approach is based on pPrescriptive Package D, the basis of the *Standard Design*, of the efficiency standards, which has no thermal mass requirements. Package D and the performance approach assume that both the *Proposed Design* and *Standard Design* building have a minimum mass as a function of the conditioned area of slab floor and non-slab floor.

Proposed Design. The ACM may require the user to identify whether or not the *Proposed Design* will be modeled with the same thermal mass as the Standard design unless the Proposed Design is a high mass building as defined below. that exceeds the specified mass threshold. Unless the *Proposed Design* has thermal mass that exceeds a thermal mass minimum threshold, the ACM shall model thermal mass for *the Proposed Design* the same as the *Standard Design*.

Standard Design. The conditioned slab floor in ACM shall model the *Standard Design* is assumed to be as 20% percent of the *Proposed Design*'s conditioned slab floor area as exposed slab and , 80% slab of the conditioned slab covered by carpet or casework. The non-slab floor in the *Standard Design* is assumed to be floor area as rug-covered slab, and 5% of the *Proposed Design*'s nonslab floor area as exposed 2 with two inch thick concrete with the remainder low-mass wood construction. No other mass elements are modeled in the *Standard Design*. The *Standard Design* mass is modeled with the following characteristics.

- The conditioned slab floor area (slab area) shall have be modeled as 20 percent exposed thermal mass having a thickness of 3.5 inches,; a volumetric heat capacity of 28 Btu/ft³-°F,; a conductivity of 0.98 Btu-in/hr-ft²-°F. The exposed portion shall have , and a surface conductance of 1.3 Btu/hr-ft²-°F (no thermal resistance on the surface) and the covered portion. The remaining 80% of the conditioned slab floor area shall be modeled as covered thermal mass with the same characteristics as the exposed mass, but with the addition of shall have a surface R-value conductance of 2.0 Btu/hr-ft²-°F, typical of a carpet and pad.
- The "exposed" portion of the cConditioned non-slab floor area shall have a thickness of 2.0 inches; a volumetric heat capacity of 28 Btu/ft³-°°F; a conductivity of 0.98 Btu-in/hr-ft²-°°F; and a surface conductance of 1.3 Btu/hr-ft²-°F (no added thermal resistance on the surface). These thermal mass properties apply to the "exposed" portion of non-slab floors for both the *Proposed Design* and *Standard Design*. The covered portion of non-slab floors is assumed to have no thermal mass. be modeled with 5% of the nonslab floor area as exposed thermal mass. This thermal mass is modeled in both the *Proposed Design* and *Standard Design* with a thickness of 2.0 inches, a volumetric heat capacity of 28 Btu/ft³-°F, a conductivity of 0.98 Btu-in/hr-ft²-°F, a surface conductance of 1.3 Btu/hr-ft²-°F (no added thermal resistance on the surface).

3.3.1High Mass Threshold

Proposed DesignDefinition of High Mass Building. The ACM may only allow the user to model aAdditional thermal mass in the proposed design may only be modeled when the equivalent thermal mass for the *Proposed Design* is a high mass building. A high mass building has mass equivalent to 30% of the conditioned slab floor area being exposed slab and 70% slab covered by carpet or casework, and 15% of the conditioned non-slab floor area being exposed with two inch thick concrete with the remainder low-mass wood construction. ACMs may let users reaches a specific mass threshold. The ACM may require that a user indicate a high mass design before entering the user is allowed to enter additional mass elements for the proposed design, or ACMs can let users enter mass elements, but only consider them in the proposed design if the building qualifies as a high mass building. and mass characteristics other than what is assumed for the *Standard Design*. The high mass threshold is determined by an amount of mass equivalent to 30% of the conditioned slab floor area as exposed slab, 70% of the conditioned slab floor area as rug-covered slab and 15% of the conditioned nonslab floor area as 2 inch thick exposed concrete with the same specifications as those given in the Thermal Mass section above. Thermal mass equivalency is determined through the concept of o determine the threshold, this mass is converted to a standard Interior Mass Capacity using the Unit Interior Mass Capacity (UIMC) method described in Appendix IACM RB-2005.

The thermal mass of the *Proposed Design,* other than the default mass modeled for the *Standard Design* mass is only modeled and displayed on compliance output if the *Proposed Design* qualifies as a design has more equivalent thermal mass than the high mass thresholdbuilding. The ACM may require that the user specify that the design is a high mass design before the entry of mass elements not related to the slab floor and nonslab floor defaults. For example, a *Proposed Design* with all of the conditioned floor area as slab-on-grade construction designed with 25% exposed slab is still modeled with 20% exposed slab because the designed thermal mass does not exceed the threshold. If the same house is designed with 30% of the conditioned floor area as exposed slab and 70% rug-covered slab then the permit applicant may model that amount of thermal mass in the *Proposed Design*. In addition, a *Proposed Design* may model and take credit for other forms of thermal mass such as masonry fireplaces or extra-thick sheetrock using the UIMC method to determine if the threshold mass is reached. Additional mass elements are not modeled in the *Standard Design*.

Standard Design. The *Standard Design* thermal mass is the same as described in Section 3.6.

3.83.5 Infiltration/Ventilation

The intentional or unintentional replacement of conditioned indoor air by unconditioned outdoor air creates heat gains or heat losses for a conditioned building. This exchange of indoor and outdoor air occurs for all buildings to a greater or lesser extent. Mechanical ventilation gives a certain degree of control of the rate of this exchange and depending on the balancing of the ventilation may create building pressurization.

Proposed Design. As a default, ACMs shall not require the user to enter any values related to infiltration or mechanical ventilation for air quality and shall set the infiltration level to be the same as the standard design. Specific data on infiltration may be entered ACMs shall allow a user to specify if they the building will be using diagnostically testeding during building construction or if they wish to take infiltration reduction credit for aa qualifying n air-retarding wrap is specified.

Air Retarding Wrap. or reduced duct leakage. An air retarding wrap can qualify for a default reduction in Specific Leakage Area (SLA) of 0.50 without confirmation by diagnostic testing. The air retarding wrap mustshall be tested and labeled by the manufacturer to comply with ASTM E1677-95, *Standard Specification for an Air Retarder (AR) Material or system for Low-Rise Framed Building Walls* and have a minimum perm rating of 10. The air-retarding wrap mustshall be installed per the manufacturer's specifications that mustshall be provided to comply with ASTM E1677-95 (2000). The air retarding wrap specifications listed above shall also be reported in the *Special Features and Modeling Assumptions* listings when an air retarder is modeled by the ACM.

Reduced Infiltration due to Duct Sealing. The default infiltration (no diagnostic testing and measurement of infiltration) credit for reduced duct leakage is also an SLA reduction of 0.50. The ACM shall automatically apply this credit when the *Proposed Design* has sealed and tested ducts. The use of this SLA reduction credit for Low-leakage HVAC ducts shall be listed in the *Special Features and Modeling Assumptions* listings of the CF-1R.

Diagnostic Testing for Reduced Infiltration. Neither of the above se credits may shall be taken if the user chooses a diagnostic testing target for reduced infiltration. When the user chooses diagnostic testing for reduced infiltration, the diagnostic testing shall be performed using fan pressurization of the building in accordance with ASTM E 779-031987 (Reapproved 1992), *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization* and the equipment used for this test shall meet the instrumentation specifications found in ACM RF. The specifications for diagnostic testing and the target values specified above shall be reported in the *Field Verification and Diagnostic Testing* listings on the CF-1R.

Either of these prescriptive infiltration reduction credits are special features and must be listed in the *Special Features and Modeling Assumptions* listings of the CF-1R and C-2R. The air retarder specifications listed above must also be reported in the *Special Features and Modeling Assumptions* listings when an air retarder is modeled by the ACM. If the user specifies they will be using diagnostic testing during construction, for either reduced infiltration or reduced infiltration with mechanical ventilation, the ACM mustshall require the user to choose an input menu to enter a target value for measured $CFM50_H$ or the SLA corresponding to the target $CFM50_H$, and, if mechanical ventilation is to be used, the wattage and cfm of the ventilation supply and exhaust fans. Note that when the *Proposed Design* target value for reduced infiltration falls below a value corresponding to an SLA of 3.0, mechanical ventilation is required and this requirement mustshall be reported as described in Chapter 2. Whenever mechanical ventilation is modeled (required or not), the volumetric capacity modeled mustshall be at least 0.047 cfm/ft^2 of conditioned floor area. This minimum capacity is needed to provide adequate ventilation for indoor air quality. If the user attempts to model total mechanical volumetric capacity (balanced + unbalanced) less than 0.047 cfm/ft^2, then the ACM mustshall indicate an input error and automatically block compliance output.

Tested infiltration below a value corresponding to an SLA of 1.5 is not allowed unless mechanical *supply* ventilation is installed adequate to maintain the residence at a pressure greater than -5 pascals relative to the outside average air pressure with other continuous ventilation fans operating. When the user chooses diagnostic testing, the diagnostic testing shall be performed using fan pressurization of the building in accordance with ASTM E 779-1987 (Reapproved 1992), *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization* and the equipment used for this test must meet the instrumentation specifications found in Section 4.1 of Appendix F. The specifications for diagnostic testing and the target values specified above must be reported in the *HERS Required Verification* listings on the CF-1R and C-2R as described in Chapter 2.

Standard Design. The *Standard Design* does not use mechanical ventilation and assumes infiltration corresponding to a Specific Leakage Area (SLA) of 4.9 for ducted HVAC systems and an SLA of 3.8 for non-ducted HVAC systems. See Chapter 4

Refer to Sections 4.17 and 4.17.1 for more detailed information.

3.5.1 Free Ventilation Area

Proposed Design: Free ventilation area for the proposed design is calculated by the ACM based on the types and areas of windows specified in the *Proposed Design*. The free ventilation area is modeled as 20% of the fenestration area for hinged type windows such as casements, awnings, hoppers, patio doors and French doors that are capable of a maximum ventilation area of approximately 80% of the rough frame opening. If the ACM user increases the ventilation area for hinged type windows, the ACM shall also consider the possible effect of fixed glazing in the building which has no free ventilation area (window opening type *Fixed*). The ACM user may account for additional free ventilation area by entering the total area for sliding windows, the total area for hinged windows, and the total area of fixed windows. The ACM shall verify that the total area entered for these three types is the same as the total area of windows calculated elsewhere or the ACM may determine the area of fixed windows by subtracting the slider window area and the hinged window area from the total window area if it is less than the total window and skylight area. If the total window and skylight area is less than the area specified for sliding windows and hinged windows the ACM shall reduce the area of hinged windows by the difference. The total ventilation area is calculated from the areas of the three possible fenestration opening types, as shown below:

Equation R3-1 $$Vent_{Area} = (Area_{Slider} \times 0.1) + (Area_{Hinged} \times 0.2) + (Area_{Fixed} \times 0.0)$$

The ACM's ability to accept a customized ventilation area is an optional capability. When this optional capability is used, the fact that the user entered a customized free ventilation area and the total areas of each of these three fenestration opening types shall be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R. Note that the maximum free ventilation area that may be modeled by any ACM for compliance purposes is 20% of the total area of windows and skylights assuming that all windows and skylights are hinged.

Free ventilation area is the adjusted area taking into account bug screens, window framing and dividers, and other factors.

Standard Design: The *Standard Design* value for free ventilation area is 10% of the fenestration area (rough frame opening). This value assumes that all windows are opening type *Slider*. The approved ACM compliance manual shall note that fenestration-opening type *Slider* also may be selected by the user or automatically used by the ACM as a default or "*Standard*" opening type.

3.5.2 Ventilation Height Difference

Proposed Design: The default assumption for the *Proposed Design* is 2 ft for one story buildings and 8 ft for two or more stories. Greater height differences may be used with special ventilation features such as high, operable clerestory windows. In this case, the height difference entered by the user is the height between the average center height of the lower operable windows and the average center height of the upper operable windows. Such features shall be fully documented on the building plans and noted in the *Special Features and Modeling Assumptions* listings of the CF-1R.

Standard Design: The *Standard Design* modeling assumptions for the elevation difference between the inlet and the outlet is two feet for one story buildings and eight feet for two or more stories.

~~3.7~~3.6 Heating and Cooling System

3.6.1 System Type

Proposed Design. ACMs ~~must~~shall require the user to enter simple heating and cooling seasonal efficiencies that ~~are used to~~ characterize basic package single zone HVAC systems used to heat and/or cool the modeled building. ACMs ~~must~~shall be able to distinguish what fuel is being used to heat the building and what fuel is used to cool the dwelling. This may be based on direct user input or indirectly determined from the user's selection of HVAC equipment types. ACMs ~~must~~shall require the user to enter the type of distribution system that is used in the proposed design.

For building using more than one system type, equipment type or fuel type, and the types do not serve the same floor area, the user shall either zone the building or enter the floor area served by each type. The ACM shall weight the load to each type by zone or floor area.

For floor areas served by more than one heating system, equipment, or fuel type, the user of the program shall specify which system, equipment, and fuel type satisfies the heating loads.

For floor areas served by more than one cooling system, equipment, or fuel type, the user of the program shall specify which system, equipment, and fuel type satisfies the cooling loads.

Standard Design. The standard heating and cooling system for central HVAC systems is a single zone system with ducts in the attic. The standard heating and cooling system for non-central HVAC systems is an unducted system.

For buildings using more than one system, equipment, or fuel type where each conditions a different floor area within the building, the *Standard Design* shall use the weighted allocation of loads to each system, equipment, or fuel type as used for the *Proposed Design.*

For floor areas in the proposed design served by more than one system, equipment, or fuel type, loads for those floor areas shall be assumed to be satisfied in the *Standard Design* as specified in Section 3.6.3 and 3.6.4 for each system, equipment, and fuel type the user specifies in the proposed design.

3.6.2 No Cooling

Proposed Design: When the *Proposed Design* has no air conditioning system, the *Proposed Design* is required to model a split system air conditioner meeting Package D requirements. If the heating system is ducted, the location and R-value of those ducts shall be used for the cooling system. If the heating system has no ducts the cooling system ducts shall be modeled as located in the attic, insulated to Package D levels. Since the Standard Design has these same features, there is no penalty or credit related to the lack of ducts.

Standard Design: The *Standard Design* has a split system air conditioning system meeting the Package D requirements and with air distribution ducts located in the attic. The *Proposed Design* is assumed to have the same features so there is no penalty or credit.

~~3.7.1~~3.6.3 Heating Equipment

Proposed Design. ACMs ~~must~~shall be able to model the basic types of heating equipment and the efficiency metrics listed in the Appliance Efficiency Regulations ~~for Gas Fired Wall Furnaces, Floor Furnaces and Room Heaters~~, except for combined hydronic space and water heating systems, which is an optional modeling capability. ACMs ~~must~~shall require the user to enter the basic information to model the energy use of these pieces of equipment. At ~~the~~ a minimum this includes some type of seasonal efficiency for heating and information on whether or not the HVAC system has ducts and the performance characteristics of those ducts. ~~When using a~~ With gas heating systems, the ACM ~~must~~shall require the user to identify if the gas heating system is ducted or non-ducted. The gas heating system type shall also be identified: ~~and if it is a~~ central gas furnace; or gas heat pump system, or a non-central gas furnace system. If the system is a non-ducted non-central gas furnace system, the ACM mustshall require the user to select the type and size of the equipment from Table 3-5 the Appliance Efficiency Regulations for Gas Fired Wall Furnaces, Floor Furnaces and Room Heaters, where the system size, as a default, may be determined as 34 Btu/hour per square foot of conditioned floor area. For central ducted systems the ACM Proposed Design shall use Equation 3.2 for gas furnaces, 3.4h for gas heat pumps, and 3.3 for electric heat pumps and electric resistance furnaces.

Table R3-8 – Non-Ducted Non-Central Heating Equipment Default Efficiencies

Gas Fired Wall Furnaces, Floor Furnaces and Room Heaters

Location	**Type**	**Size**	**Seasonal Efficiency**
Wall	Fan Type	up to 42,000 Btu/hour	73%
		over 42,000 Btu/hour	74%
	Gravity Type	up to 10,000 Btu/hour	59%
		over 10,000 Btu/hour up to 12,000 Btu/hour	60%
		over 12,000 Btu/hour up to 15,000 Btu/hour	61%
		over 15,000 Btu/hour up to 19,000 Btu/hour	62%
		over 19,000 Btu/hour up to 27,000 Btu/hour	63%
		over 27,000 Btu/hour up to 46,000 Btu/hour	64%
		over 46,000 Btu/hour	65%
Floor	Gravity Type	up to 37,000 Btu/hour	56%
		over 37,000 Btu/hour	57%
Room	Gravity Type	up to 18,000 Btu/hour	57%
		over 18,000 Btu/hour up to 20,000 Btu/hour	58%
		over 20,000 Btu/hour up to 27,000 Btu/hour	63%
		over 27,000 Btu/hour up to 46,000 Btu/hour	64%
		over 46,000 Btu/hour	65%

Standard Design. When electricity is used for heating, the heating equipment for the *Standard Design* shall be an electric split system heat pump with a Heating Seasonal Performance Factor (HSPF) of 6.8, meeting the Appliance Efficiency Regulations requirements for split systems. However, except when the *Proposed Designs* uses a single package heat pump only, the *Standard Design* shall have a heat pump with assume an HSPF of 6.6 meeting the Appliance Efficiency Regulations requirements for single package equipment. When a *Proposed Design* uses both a single package split system heat pump and another type of heat pump electric heat, the *Standard Design* HSPF shall be a conditioned floor area weighted average of the minimum single package sHSPF for the floor area conditioned by single package equipment and the minimum split system HSPF for the remaining floor area of the heating equipment. When electricity is not used for heating, the equipment used in the *Standard Design* building shall be either a gas furnace with an Annual Fuel Utilization Efficiency (AFUE) meeting the Appliance Efficiency Regulations minimum efficiency of 0.78 for central systems, or shall be a gas furnace of the type specified in the proposed design at the efficiency level shown in Table 3-5 the Appliance Efficiency Regulations for Gas Fired Wall Furnaces, Floor Furnaces and Room Heatersnon-central systems. When a *Proposed Design* uses both a nonelectric central system and another type of nonelectric system, the *Standard Design* efficiency shall be a conditioned floor area weighted average of the efficiencies of the heating equipment.

Note: Minimum efficiencies for heat pumps change effective January 23, 2006 (see Table C-2 of the Appliance Efficiency Regulations). The *Standard Design* shall use those new efficiencies after that date. If the *Proposed Design* has both electric and fossil-fuel-fired heating equipment types, the standard system shall be based on the floor area weighted Source Seasonal Efficiency (SSE). In calculating the weighted average SSE, the efficiencies of all heating equipment and distribution systems are converted to source seasonal efficiencies (SSE), as shown in Equations 3.2 and 3.3.

3.2.1 Seasonal air distribution efficiencies ($\eta_{dist,\ seasonal}$) for the *Proposed Design* and the *Standard Design* shall be calculated using the procedures and algorithms in Appendix F, and Equation 3.1. The seasonal distribution efficiencies for the *Standard Design* shall be calculated using the defaults specified in Appendix F. The seasonal distribution system efficiency shall be calculated using the seasonal delivery effectiveness ($DE_{seasonal}$), the equipment efficiency factor (F_{equip}), and the thermal recovery factor (F_{recov})

3.2.2

3.2.3 $$\eta_{dist,seasonal} = 0.98 \times DE_{seasonal} \times F_{equip} \times F_{recov}$$

3.2.4 Equation 3.1

3.2.5 $$SSE_{\text{gas with fan}} = \left(\frac{1 + (0.005 \times 3.413)}{\frac{1}{AFUE} + (0.005 \times 10.239)} \right) \times \eta_{dist,seasonal}$$ Equation 3.2

3.2.6 $$SSE_{electric} = \left(\frac{HSPF}{10.239} \right) \times \eta_{dist,\ seasonal}$$ Equation 3.3

3.2.7 $$SSE_{\text{GasHeatPump,Heating}} = \frac{\eta_{dist,seasonal}}{\left[\frac{1}{COP_{heatinggas}} + \frac{3}{COP_{heatingelectric}} \right]}$$ Equation 3.4h

3.2.8

3.7.23.6.4 Cooling Equipment

Proposed Design. ACMs mustshall be able to model the basic types of cooling equipment and the efficiency metrics listed in **Error! Reference source not found.**Table R 2-3. ACMs mustshall require the user to enter the basic information to model the energy use of these pieces of equipment. At the minimum this includes some type of seasonal distribution system efficiency for cooling, identification of whether the cooling system is ducted or non-ducted and whether it is central or non-central and the type of equipment as identified in the Appliance Efficiency Regulations. If the cooling system is non-ducted, non-central, the ACM mustshall require the user to select the type and size of the equipment from the Appliance Efficiency Regulations for Room Air Conditioners, Room Air Conditioning Heat Pumps, Package Terminal Air Conditioners and Package Terminal Heat Pumpsthose shown in Table 3-6Table R3-9. The efficiencies of all electric cooling equipment and distribution systems are converted to source seasonal energy efficiency ratios (SSEER), as shown in Equations 3.2c and 3.3c. The efficiencies of all gas cooling equipment and distribution systems are converted to source seasonal efficiency as shown in Equations 3.4c. Packaged air conditioning systems (PkgAirCond, LrgPkgAirCond, PkgHeatPump or LrgPkgHeatPump) shall be noted in the Special Features and Modeling Assumptions listings.

Table R3-9– Non-Ducted Non-Central Cooling Equipment Default Efficiencies

Room Air Conditioner Type			
Reverse Cycle	Side Louvers	Cooling Capacity	Energy Efficiency Ratio
Without	With	Less than 6,000 Btu	8.0
		6,000 to 7,999 Btu	8.5
		8,000 to 13,999 Btu	9.0
		14,000 to 19,999 Btu	8.8
		20,000 and more Btu	8.2
	Without	Less than 6,000 Btu	8.0
		6,000 to 7,999 Btu	8.5
		8,000 to 13,999 Btu	8.5
		14,000 to 19,999 Btu	8.5
		20,000 and more Btu	8.2
With	With	All	8.5
	Without	All	8.0

Standard Design. If a packaged ducted central air conditioner (*PkgAirCond* or *LrgPkgAirCond*) or ducted central packaged heat pump (*PkgHeatPump* or *LrgPkgHeatPump*) is used for the *Proposed Design*, the cooling system used in the *Standard Design* building shall be a single package air conditioner (*PkgAirCond* or *LrgPkgAirCond*) with an SEER (seasonal energy efficiency ratio) of 9.7. Otherwise, tThe cooling system for the *Standard Design* building with a central system shall be of the same type identified in the Appliance Efficiency Regulations and selected for the proposed designa split system central air conditioner *(SplitAirCond)* with an SEER of 10.0meeting the Appliance Efficiency Regulations minimum requirements. For non-ducted non-central cooling equipment, the efficiencies shall be from the Appliance Efficiency Regulations for Room Air Conditioners, Room Air Conditioning Heat Pumps, Package Terminal Air Conditioners and Package Terminal Heat Pumps as shown in Table R3-9 for the type and size in the *Proposed Design* where the size may be a user input or shall default to 24 Btu per hour per square foot of conditioned floor area. In the case of *NoCooling* for the *Proposed Design*, the cooling system for the *Standard Design* building shall be a split system air conditioner (*SplitAirCond*) with an SEER of 10.0. When a *Proposed Design* uses both a split system air conditioner and another type of air conditioner, the *Standard Design* SEER shall be a conditioned floor area weighted average of the equivalent SEERs of the cooling equipment.

Note: Minimum efficiencies for air conditioners and heat pumps change effective January 23, 2006 (see Table C-2 of the Appliance Efficiency Regulations). The *Standard Design* shall use those new efficiencies after that date. The efficiencies of all electric cooling equipment and distribution systems are converted to source seasonal energy efficiency ratios (SSEER), as shown in Equations 3.2c and 3.3c. The efficiencies for gas cooling equipment and distribution systems are converted to source seasonal efficiency ($SSE_{GasHeatpumCooling}$) as shown in Equation 3.4c

Seasonal air distribution efficiencies ($\eta_{dist, seasonal}$) for the *Proposed Design* and the *Standard Design* shall be calculated using the procedures and algorithms in Appendix F. The seasonal distribution efficiencies for the *Standard Design* shall be calculated using the defaults specified in Appendix F. The seasonal distribution system efficiency shall be calculated using the seasonal delivery effectiveness ($DE_{seasonal}$), the equipment efficiency factor (F_{equip}), and the thermal recovery factor (F_{recov})

Source seasonal energy efficiency ratios for the *Standard Design* shall be calculated as shown in Equations 3.1c, 3.2c and 3.3c.

$$\eta_{dist,seasonal} = 0.98 \times DE_{seasonal} \times F_{equip} \times F_{recov} \qquad \text{Equation 3.1c}$$

$$SSEER_{central,ducted} = SEER_{temperature} \times F_{install} \times F_{TXV} \times \eta_{dist,seasonal} \qquad \text{Equation 3.2c}$$

$$SSEER_{other} = SEER \times \eta_{dist,seasonal} \qquad \text{Equation 3.3c}$$

$$SSE_{\text{GasHeatPump,Cooling}} = \frac{F_{install} \times F_{TXV} \times \eta_{dist,seasonal}}{\left[\frac{1}{COP_{coolinggas}} + \frac{3}{COP_{coolingelectric}} \right]} \quad \text{Equation 3.4c}$$

The temperature adjusted SEER ($SEER_{temperature}$) adjusts the performance of the cooling equipment at typical outdoor air temperatures by climate zone depending on the SEER rating. For *SplitAirCond, PkgAirCond, SplitHeatPump, PkgHeatPump*, $SEER_{temperature}$ shall be interpolated from Table 3.6c. Extrapolation shall not be used with this table. Equipment with a SEER below 8 shall use the value for 8. Equipment with a SEER above 18 shall use the value for 18. For all other central ducted equipment, $SEER_{temperature}$ shall be equal to the EER rating.

3.2.9Table 3.6c -- Temperature adjusted SEER ($SEER_{temperature}$) by Climate Zone

				3.2.103.2.11SEER							
3.2.12CZ	3.2.138	3.2.149	3.2.1510	3.2.1611	3.2.1712	3.2.1813	3.2.1914	3.2.2015	3.2.2116	3.2.2217	3.2.2318
3.2.241	3.2.258.0	3.2.269.0	3.2.2710.	3.2.2811.	3.2.2912.	3.2.3013.	3.2.3114.	3.2.3215.	3.2.3316.	3.2.3417.	3.2.3518.
3.2.362	3.2.377.7	3.2.388.7	3.2.399.7	3.2.4010.	3.2.4111.	3.2.4212.	3.2.4312.	3.2.4413.	3.2.4514.	3.2.4615.	3.2.4715.
3.2.483	3.2.497.8	3.2.508.7	3.2.519.7	3.2.5210.	3.2.5311.	3.2.5412.	3.2.5513.	3.2.5613.	3.2.5714.	3.2.5815.	3.2.5916.
3.2.604	3.2.617.8	3.2.628.7	3.2.639.7	3.2.6410.	3.2.6511.	3.2.6612.	3.2.6713.	3.2.6813.	3.2.6914.	3.2.7015.	3.2.7116.
3.2.725	3.2.737.9	3.2.748.9	3.2.759.9	3.2.7610.	3.2.7711.	3.2.7812.	3.2.7913.	3.2.8014.	3.2.8115.	3.2.8216.	3.2.8317.
3.2.846	3.2.857.9	3.2.868.9	3.2.879.9	3.2.8810.	3.2.8911.	3.2.9012.	3.2.9113.	3.2.9214.	3.2.9315.	3.2.9416.	3.2.9517.
3.2.967	3.2.977.9	3.2.988.9	3.2.999.9	3.2.10010	3.2.10111	3.2.10212	3.2.10313	3.2.10414	3.2.10515	3.2.10616	3.2.10717
3.2.1088	3.2.1097.	3.2.1108.	3.2.1119.	3.2.11210	3.2.11311	3.2.11412	3.2.11512	3.2.11613	3.2.11713	3.2.11814	3.2.11915
3.2.1209	3.2.1217.	3.2.1228.	3.2.1239.	3.2.12410	3.2.12511	3.2.12611	3.2.12712	3.2.12812	3.2.12912	3.2.13013	3.2.13113
3.2.13210	3.2.1337.	3.2.1348.	3.2.1359.	3.2.13610	3.2.13710	3.2.13811	3.2.13911	3.2.14011	3.2.14112	3.2.14212	3.2.14312
3.2.14411	3.2.1457.	3.2.1468.	3.2.1479.	3.2.14810	3.2.14910	3.2.15010	3.2.15111	3.2.15211	3.2.15311	3.2.15411	3.2.15512
3.2.15612	3.2.1577.	3.2.1588.	3.2.1599.	3.2.16010	3.2.16110	3.2.16211	3.2.16311	3.2.16411	3.2.16512	3.2.16612	3.2.16712
3.2.16813	3.2.1697.	3.2.1708.	3.2.1719.	3.2.17210	3.2.17310	3.2.17410	3.2.17511	3.2.17611	3.2.17711	3.2.17811	3.2.17911
3.2.18014	3.2.1817.	3.2.1828.	3.2.1838.	3.2.1849.	3.2.18510	3.2.18610	3.2.18710	3.2.18810	3.2.18910	3.2.19010	3.2.19110
3.2.19215	3.2.1937.	3.2.1948.	3.2.1958.	3.2.1969.	3.2.19710	3.2.19810	3.2.19910	3.2.20010	3.2.20110	3.2.20210	3.2.20310
3.2.20416	3.2.2057.	3.2.2068.	3.2.2079.	3.2.20810	3.2.20911	3.2.21012	3.2.21112	3.2.21213	3.2.21314	3.2.21415	3.2.21515

3.2.216

The installation factor ($F_{install}$), which adjusts for typical installation practice where refrigerant charge and airflow are not at design values, shall be 0.852.

3.2.217 The refrigerant charge and airflow factor (F_{TXV}), which adjusts the system performance to account for the presence of a TXV, shall be 1.0 for systems without a TXV. For systems with a TXV, the refrigerant charge and airflow factor shall be 1.07 for duct systems designed according to ACCA Manual D and 1.11 for all other duct systems.

3.7.33.6.5 Refrigerant Charge or TXVand Airflow

Proposed Design. The ACM mustshall allow the user to enter a central ducted cooling system indicate if split system air conditioners or heat pumps have diagnostically tested refrigerant charge and airflow or a field verified thermostatic expansion valve (TXV)option requires either measuring charge and airflow using procedures set forth in Appendix K (for split system equipment only) or requires the presence of a thermostatic expansion valve (TXV). This applies only to split system air conditioners and heat pumps. It does not apply to package air conditioners and heat pumps. These features require field verification or diagnostic testing by the HERS rater and mustshall be reported in the *Special Features and Modeling Assumptions* and *Field Verification and Diagnostic Testing* HERS Required Verification listings on the CF-1R and C-2R.

Standard Design. Standard Design. If a split system ducted central air conditioner or heat pump (*SplitAirCond* or *SplitHeatPump*) is used for the *Proposed Design* then the cooling system used in the *Standard Design* building shall be modeled with ehave either diagnostically tested refrigerant charge or a field verified and airflow measurement or be equipped with a thermostatic expansion valve TXV if required by Package D.

Adjustments to the source seasonal energy efficiency ratio due to refrigerant charge and airflow measurement or thermostatic expansion valves are described in section 3.8.2.

3.7.43.6.6 Air Distribution Ducts and HVAC Seasonal Distribution System Efficiency for Ducted Systems

Proposed Design. ACMs shall be able to model the basic types of HVAC distributions systems and locations listed in Table R2-3. As a default, for ducted systems HVAC ducts and the air handler are located in the attic. As a default, HVAC ducts for ducted systems are assumed to exist and are located in the attic. Likewise, as a default, the air handler is assumed to be located in the attic. Proposed HVAC systems with a duct layout and design on the plans may locate the ducts in the crawlspace or a basement if the layout and design specify that all of the supply registers are located in the floor or within two feet of the floor, and show the appropriate locations for the ducts. Otherwise, the default location is the attic as shown in Table R4-11. When all of the supply registers are located in the floor or all of the supply registers are located in the ceiling, the ACM can use Table 4.1 of Appendix F to allocate the duct surface areas. If all supply registers are in at the floor, but the building has both a crawlspace and a basement, the duct location may be taken as a floor area weighted average of the duct efficiencies of a crawlspace and a basement. entries in Table 4.1 of Appendix F. If any story of a building has supply registers in both the floor and more than two feet above the floor, the duct location for that story must be modeled as 100% ducts in the attic. If the modeled duct location for a given story is not in the attic, the ACM mustshall specify that all supply registers for that story of the building (or the whole building) are located in the floor or within two feet of the floor, and this shall be noted in the *Special Features and Modeling Assumptions* listings for special verification by the local enforcement agencyof the CF-1R.

Proposed HVAC systems with a complete ACCA Manual Dduct design, including the duct layout and design on the plans, may allocate duct surface area in more detail in the ACM model but the distribution of duct surface areas by location mustshall appear on the *Field Verification and Diagnostic Testing HERS Required Verification* list of the CF-1R.for verification by a HERS rater.

In a similar fashion, the supply duct surface area (and the location of the ducts) of an ACCA Manual D designed duct system may be modeled explicitly in the ACM and receive energy efficiency credit. When a non-default supply duct surface area is modeled, the supply duct surface area is subject to verification by a HERS rater and must be listed on the *HERS Required Verification* listings. The HERS rater mustshall also verify the existence of the ACCA Manual D duct design and layout and the general consistency of the actual HVAC distribution system with the design. The HERS rater mustshall also measure and verify adequate the fan flow, see Section 3.6.9. and confirm that it is consistent with the ACCA Manual D design specifications.

The ACM shall allow users to specify if they will be using diagnostic testing of HVAC distribution efficiency of a fully-ducted system by a HERS rater during the construction of the building to confirm the modeling of improved HVAC distribution efficiency measures such as duct leakage. The default shall be that no diagnostic testing will be done. Duct efficiency credits may not be taken and diagnostic testing may not be done on any HVAC system that uses nonducted building cavities such as plenums or a platform returns, to convey conditioned air unless they are defined or constructed with sealed sheet metal or duct board.. Building cavities, including support platforms, may contain ducts. If the user does not select diagnostic testing, the ACM shall require users to input at least two (2) basic parameters to determine HVAC distribution efficiency: the total conditioned floor area of the building as specified above and the R-value of the duct insulation which may be defaulted to R4. the minimum duct insulation requirements2. Additional data may be required to determine seasonal distribution system efficiency. The default input parameters are presented in Appendix FChapter 4. If the user specifies diagnostic testing to be performed during construction, the ACM shall request prompt the user to enter the data described in Section 4.19Section 4.8.2, *Duct Seasonal Distribution System Efficiency* and shall report all required measurements and the features used to achieve higher HVAC distribution efficiencies in the *Field HERS Required Verification and Diagnostic Testing* listings on the CF-1R. When the user chooses diagnostic testing, the diagnostic testing shall be performed as described in Appendix ACM RCF-2005. Diagnostic testing must be reported in the *HERS Required Verification* listings on the CF-1R and C-2R as described in Chapter 2.

Standard Design. The standard heating and cooling system for central systems is assumed to havemodeled with non-designed air distribution ducts located in an attic space, with the duct leakage factor for sealed and tested new duct systems (see Table R4-13) 6% total tested duct leakage, non-ACCA Manual D designed duct system, and a radiant barrier in climate zones where required by Package D. The *Standard Design* duct insulation is determined by the Package D specifications for the applicable climate zone. R-4.2 duct insulation is assumed for the *Standard Design* building. The *Standard Design* building is assumed to have the same number of stories as the *Proposed Design* for purposes of determining the duct efficiency. HVAC distribution system efficiencies mustshall be calculated using the algorithms and equations in Appendix F Chapter 4 of this manual for both the *Proposed Design* and the *Standard Design*. The *Standard Design* calculation mustshall use the default values of that procedure. For non-central HVAC systems, the *Standard Design* shall have no ducts.

3.6.7 Fan Energy

Proposed Design. The ACM shall allow the user to specify whether or not the proposed design will take credit for reduced fan Watts, see Chapter 4. The credit for reduced fan Watts shall be reported in the *Special Features and Modeling Assumptions* listings on the CF-1R.

Standard Design. The *Standard Design* shall have the default fan watts.

3.6.8 Maximum Cooling Capacity Credit

Proposed Design. The ACM shall allow the user to specify that the maximum cooling capacity determined using ACM RF-2005 will be met. Compliance credit may be taken if the installed cooling capacity is less than or equal to the maximum cooling capacity, and the system will have verified adequate airflow, sealed and tested ducts and proper refrigerant charge (or alternatively a TXV). The ACM shall not allow compliance credit to be taken for cooling capacity less than the maximum cooling capacity if any of these other features are not also specified for compliance. If this alternative is not used, the *Proposed Design* shall make no adjustment to the duct efficiency of the *Standard Design* for this feature. If compliance credit is taken for this alternative, it must be reported in the *Field Verification and Diagnostic Testing* listings of the CF-1R along with the other measures that are required to take the credit.

Standard Design. When this alternative is selected, the *Standard Design* shall model the Maximum Allowable Cooling Capacity as calculated using the procedure in ACM RM-2005, otherwise the *Standard Design* shall match the *Proposed Design*.

3.6.9 Adequate Airflow

Proposed Design. The default for the Proposed Design assumes inadequate airflow (see Section 4.7.4). However, compliance credit may be taken if adequate airflow is diagnostically tested using the procedures of Appendix RE. Adequate airflow shall be reported in the *Field Verification and Diagnostic Testing* listings of the CF-1R.

Standard Design. The standard design shall assume inadequate airflow as specified in section 4.7.4.

3.7 Water Heating

Proposed Design. ACMs shall be able to model the basic types of water heaters listed in Table R2-7, the water heating distribution system choices (within the dwelling unit) listed in Table R3-89 (and R2-5), and the multiple dwelling unit recirculating system control choices listed in R3-910 (and R2-6). ACM users shall specify the following information about each water heating system:

- The number of dwelling units served by the water heating system (needed only when the system serves multiple dwelling units).
- The number of water heaters that are a part of the system
- The performance characteristics of each water heater:
  - For gas water heaters with an input rating of 75,000 Btu/h or less and for electric water heaters with an input rating of 12 kW or less, the energy factor (EF) is entered.
  - For small instantaneous gas or oil water heaters as defined in the Appliance Efficiency Standards, the Energy Factor (EF) is entered.
  - For large instantaneous gas or oil water heaters as defined in the Appliance Efficiency Standards, the thermal efficiency (TE), pilot light energy (Pilot), standby loss (SBE or SBL), tank surface area (TSA), and R-value of exterior insulation wrap (REI) is entered.
  - For large storage water heaters, the hourly jacket loss, thermal efficiency (TE), and type (indirect or direct) and pilot light energy (Pilot) are entered. If not available from the manufacturer, jacket loss may be calculated from the tank surface area (TSA), the R-value of exterior insulating wrap (REI) and the standby loss expressed either as a fraction of the heat content of the stored water (SBL) or in Btu/hr (SBE). Tank surface area may also be calculated based on the tank capacity in gallons. See ACM RN for details.
- Information about any solar or wood stove supplementary heating that is provided. See ACM RGN for details.
- The type of distribution system used within the dwelling unit. This is a selection from Table R3-8. For recirculating systems that serve multiple dwelling units, the brake horsepower of the circulation pump (hp), the efficiency of the pump, the efficiency of the motor, and the type of control (choose from Table R3-9).
- If multiple water heating systems serve a single dwelling unit, then the ACM shall keep track of the conditioned floor area served by each water heating system.

- For water heating systems serving multiple dwelling units, the ACM shall keep track of the dwelling units served by each system.

For systems serving multiple dwelling units, the characteristics of an average or typical dwelling unit, e.g. conditioned floor area and number of stories (within the dwelling unit), may be used in making calculations.

Table R3-8 – Water Heater Distribution System Choices (Within the Dwelling Unit)

Distribution System Measure	Code
Pipe Insulation (kitchen lines ≥ 3/4 inches) – Standard Case	STD
Pipe Insulation (all lines)	PIA
Standard pipes with no insulation	SNI
Point of Use	POU
Parallel Piping	PP
Recirculation (no control)	RNC
Recirculation + timer control	RTm
Recirculation + temperature control	RTmp
Recirculation + timer/temperature	RTmTmp
Recirculation + demand control	RDmd

Table R3-9 – Multiple Dwelling Unit Recirculating System Control Choices

Distribution System Measure	Code
No Control	NoCtrl
Timer Control	STD ~~Timer~~
~~Temperature Control~~	~~Temp~~
~~Timer and Temperature Control~~	~~Timer/Temp~~
~~Demand Recirculation~~	~~Demand~~

Standard Design. For multiple dwelling unit systems, the *Standard Design* shall have the same number of water heating systems as the *Proposed Design*. For single dwelling unit systems, the *Standard Design* shall have one water heating system, regardless of the number of systems in the *Proposed Design*. Each *Standard Design* water heating system shall have the characteristics specified in Table R3-10.

Table R3-10 – Specification of Standard Design Water Heater

Does the water heating system serve a single dwelling unit?	**Yes**	Standard design is a 50 gallon gas or LPG storage type water heater. If natural gas is available at the site, the standard design is a gas water heater, otherwise it is LPG. EF is equal to 0.575, which is the NAECA minimum for the 50 gallon basecase water heater. EF = 0.67 – 0.0019 V, where V is the volume in gallons. A standard distribution system with no circulation system. Actual efficiency depends on the size of the dwelling unit and the number of stories.				
	No	Does the proposed water heating system have a storage tank?	**Yes**	Is the input rating of each water heater in the proposed design less than or equal to 75,000 Btu/h or if electric, less than or equal to 12 kW.	**Yes**	Standard design is one or more NAECA gas or LPG water heater. If natural gas is available at the site, the standard design is a gas water heater, otherwise it is LPG. If the total storage volume of the proposed design is less than 100 gallons, then the standard design is single water heater with a storage volume equal to the total storage volume of the proposed design. If the total storage volume of the proposed design is larger than 100 gallons, then the standard design shall have multiple 100 gallon water heaters. The number of water heaters is equal to the total storage capacity of the proposed design divided by 100 and rounded up. The EF of each 100 gallon water heater shall be 0.48, which is the NAECA minimum. If the standard design is less than 100 gallons, then the EF = 0.67 – 0.0019 V. See specification of distribution system in the note below.
					No	Standard design is composed of the same number of large storage gas or LPG water heaters as in the proposed design with a storage volumes the same as the storage volumes of the proposed design. If natural gas is available at the site, the standard design is a gas water heater, otherwise it is LPG. The thermal efficiency is 0.80 and stand-by losses are as specified in Table 113A. See specification of distribution system in the note below.
			No	Standard design is the same number of natural gas or LPG instantaneous water heaters as in the proposed design with input ratings equal to those in the proposed design. If natural gas is available at the site, the standard design is a gas water heater, otherwise it is LPG. Thermal efficiency of the instantaneous water heaters shall be equal to the requirements in Section 111~~of Table 113A~~. See specification of distribution system in the note below.		

The *Standard Design* distribution system for systems serving multiple dwelling units is described in more detail below:

1. When the distribution system is a recirculating system, the standard design shall be a recirculating system with timer controls, e.g. the coefficients in Table ~~RN4~~RG-5 for "Timer Controls" shall be used in the calculation of energy use for the standard design, otherwise the standard design shall be a non-recirculating system.
2. Pipe length and location in the standard design shall be the same as the proposed design. There are three possible locations defined in ACM RG-2005.
3. The pipes in the recirculation system shall be insulated in accordance with Section 150(j).
4. The pumping head and motor size for the standard design shall be equal to the pumping head and motor size in the proposed design.
5. The motor efficiency of the recirculation pump in the standard design shall be equal to the requirements in the CEC appliance efficiency standards, e.g. NEMA high efficiency motors.
6. The distribution losses within the dwelling units shall be calculated based on one story and the average dwelling unit size for all the dwelling units served by the water heating system (see ~~RN3.2~~RG-3.2).

~~3.9~~3.8 Additions and Alterations

There are three compliance approaches for additions to and alterations of existing buildings:

- Whole Building Approach
- Addition Alone Approach
- Existing + Addition + Alteration Approach

Each of these approaches and their accompanying rules are described in the following sections. The existing + addition + alteration approach is the most flexible.

3.8.1 Whole Building Approach

The entire proposed building, including all additions and/or alterations, is modeled the same as a newly constructed building. The building complies if the Proposed Design uses equal or less energy than the Standard Design.

Except in cases where the existing building is being completely remodeled, this is usually a difficult standard to meet as the existing building usually does not meet current standards and must be substantively upgraded.

Proposed Design. Entire building (including additions, alterations and existing building) modeled the same as new construction as described throughout the ACM manual.

Standard Design. Entire building modeled the same as new construction as described throughout the ACM manual.

3.8.2 Addition Alone Approach

The proposed addition alone is modeled the same as a newly constructed building except that the internal gains are prorated to the size of the dwelling, and any surfaces such as walls or ceilings that are between the existing building and the addition are modeled as adiabatic and not included in the calculations. Water heating is not modeled when using this approach. The addition complies if the Proposed Design uses equal or less space heating and space cooling TDV energy than the Standard Design.

The Addition Alone Approach shall not be used when alterations to the existing building are proposed or when there are proposed modifications to existing water heating or when additional water heaters are being added. Instead, the Existing + Addition + Alteration approach shall be used for these cases. Note that modifications to any surfaces between the existing building and the addition are part of the addition and are not considered alterations.

This approach works best when the energy features in the addition are similar to those in the prescriptive packages.

~~Additions are treated as separate new buildings except for the determination of internal heat gains, which are specified in Section 4.5 for the purpose of determining a *Standard Design* for the addition. The modeling of additions or alterations must be reported in the *Special Features and Modeling Assumptions* listings, which must state that the building vintage and the input assumptions corresponding to this vintage must be verified prior to alteration to receive credit.~~

~~When an existing HVAC system is extended to serve an addition, the default assumptions for duct and HVAC distribution efficiency must be used for both the *Proposed Design* and the *Standard Design*. However, when a new, high efficiency HVAC distribution system is used to serve the addition or the addition and the existing building, that system may be modeled to receive energy credit subject to diagnostic testing and verification of proper installation by a HERS rater.~~

Proposed Design. The user ~~must~~shall ~~enter an~~ indicat~~ion~~e that an addition alone is being modeled and enter the conditioned floor area of the addition. The number of dwelling units shall be set to the fractional dwelling unit as specified in Section 4.1.4~~below.~~ ~~for the *Proposed Design*~~. Any surfaces that are between the existing building and the addition are not modeled or treated as an adiabatic surfaces. All other features of the addition shall be modeled as for a newly constructed building. When an ACM has the capability of running an existing building plus an addition in a single pass, the addition and the existing building must be entered independently and reported independently. Special output must be created to clearly indicate existing building components separately from new components. Likewise altered existing components must have separate accounting and reporting. Existing building components must be reported exclusively in lowercase type and new or altered components exclusively in UPPERCASE type for single pass Addition with Existing Building runs or Alteration runs. ACMs that require two or more passes to model these situations do not require these restrictions on type case for existing and new (or altered) component reporting but these ACMs must clearly indicate which run corresponds to existing conditions and which run corresponds to the new or altered conditions and the *Special Features and Modeling Assumptions* listings for both runs must report that two output files, two CF-1Rs and two C-2Rs are required to be checked.

An existing building plus an addition may be modeled by means of two separate compliance runs:

The user or the ACM models the *Existing Building* and the *Addition plus the Altered Existing Building.* There will be two sets of energy use figures for each of these energy simulation runs, the predicted energy use of the modeled building (EU) and the predicted energy budget calculated based on the rules specified in this manual (EB).

Let

EU_e = the energy use of the existing building (*Proposed Design*).

EB_e = the energy budget for the existing building (*Standard Design*).

EU_{e+a} = the energy use of the altered existing building with the addition.

EB_{e+a} = the energy budget of the altered existing building with the addition.

and

A_e = the conditioned floor area of the existing building.

A_{e+a} = the conditioned floor area of the altered existing building with the addition.

Equation 3.3 $$F = \frac{A_e}{(A_{e+a})}$$

The altered existing building with the addition complies with the Standards when Equation 3.2 is satisfied:

Equation 3.4 $$EU_{e+a} \le EB_{e+a} + F \times (EU_e - EB_e)$$

When no water heating is proposed for the addition, the ACM must report that no water heating energy is being calculated and the energy budgets cannot reflect the use of water heating energy. When a new water heater is replacing the existing water heater for the whole dwelling, the ACM must use the existing plus addition approach to compliance with the water heater modeled with the existing building. When the specifications of the existing water heater are unknown, the water heating budget is determined as if the dwelling were all new construction.

When an existing HVAC system is extended to serve the addition, the Proposed Design shall assume the same efficiency for the HVAC equipment as the Standard Design.

When a dual-glazed greenhouse window or a dual-glazed skylight is installed in an addition, the Proposed Design U-factor shall be the lower of the Standard Design U-factor or the NFRC rated U-factor for the greenhouse window or skylight

If the addition increases the number of water heaters in the dwelling then the addition *Standard Design* must be modeled with a non-circulating, gas-fired water heater with a volume which is the lessor of the *Proposed Design* volume or 50 gallons and an Energy Factor of 0.60. If the building does not have gas service, the ACM may allow the *Standard Design* water heater to be a non-circulating electric water heater with an Energy Factor of 0.98.

Standard Design. For additions, tThe addition alone is modeled the same as newly constructed building as described throughout the ACM manual. *Standard Design* shall have a total glazing area equal to that allowed by Package D and the conditioned floor area of the addition just as for new buildings. For the *Standard Design* the glazing orientation, U-value, and SHGC of the fenestration shall be modeled in the same manner as a new building.

When additions are modeled with an existing building, the ACM must require the user to determine and enter the vintage of the existing building. The ACM shall then use the default assumptions specified in 313 or modeling the existing structure. If the ACM allows the user to enter higher U-values, higher F2 values, higher SHGCs, lower efficiencies, or lower energy factors than the vintage defaults from 313 for the existing building's *Proposed Design*, the ACM must report such values as special features on the *Special Features and Modeling Assumptions* listings.

3.8.3 Existing + Addition + Alteration Approach

The proposed building, including all additions and/or alterations, is modeled with tags that describe each energy feature as part of the existing building or the addition or the alteration. The ACM uses the tags to create an existing + addition + alteration (abbreviated e+ad+al) standard design in accordance with the rules in this section that takes into account whether altered components meet or exceed the prescriptive alteration levels. The energy use of the e+ad+al Proposed Design shall use equal or less energy than the e+ad+al Standard Design.

Valid tags include:

- Existing - building features that currently exist and will not be altered
- Altered – building features that are being altered from existing conditions but are not part of an addition
- Added.- building features that are being added as part of an addition
- Deleted – existing building features that are being deleted as part of an addition or alteration

This section describes the case where the information about the e+ad+al is contained in a single input file using tags as needed for each zone, opaque surface, fenestration surface, mass surface, etc. Alternate input approaches that provide the information necessary to calculate and provide compliance documentation consistent with the descriptions in this section are allowed with approval from the Commission.

Proposed Design. The user shall indicate that an e+ad+al is being modeled and shall enter the appropriate tags for surfaces or systems. Features that are being altered will need to be paired by the ACM with the existing feature it replaces. The ACM shall clearly indicate each of the tags on the compliance documentation. To generate the proposed design, the ACM shall run the calculations using the surfaces and systems that represent the building when the additions and/or alterations are complete. This includes building features that are tagged as existing, altered and added. Features that are being deleted are not included in the proposed design.

When modeling an existing building, the ACM shall allow the use of the default assumptions specified in Table R3-11 for modeling the existing structure according to the vintage of the existing building. If the user enters higher U-factors, higher F-factors, higher SHGCs, lower efficiencies, or lower energy factors than the vintage defaults from Table R3-11 for the existing building's *Proposed Design*, the ACM shall report such values as special features in the *Special Features and Modeling Assumptions* listings.

Standard Design. Establishing the standard design for e+ad+al approach requires use of the tags entered by the user and, in some circumstances if there are alterations that involve fenestration, a simulation to determine if prescriptive shading requirements are met or exceeded. The resulting e+ad+al Standard Design is very different from the Standard Design for newly constructed buildings because it accounts for the energy use of the existing building and for altered features, and is dependent on whether altered features meet the prescriptive alteration requirements. The Standard Design is determined using the following rules:

- Existing features are included in the standard design
- Deleted features are included in the standard design
- Added features are assigned standard design values in the same manner as for an addition alone, as described above
- Altered features are modeled in the standard design as follows:

  General Approach. Each altered feature is compared to the prescriptive requirements in Section 152(b)1. Fenestration shading and area have additional modeling requirements described below:

  - If the altered feature meets or exceeds the prescriptive alteration requirements the Standard Design is the unaltered existing feature (note that the prescriptive alteration requirements are the mandatory requirements for all altered components plus additional prescriptive requirements for altered fenestration, HVAC equipment (refrigerant charge measurement or TXV), and ducts);
  - Otherwise, the Standard Design is the prescriptive alteration requirement (i.e., the mandatory requirement for altered components other than altered fenestration, HVAC equipment and ducts, which have additional prescriptive requirements beyond the mandatory requirements)

  Fenestration Shading. Determining whether the prescriptive alteration requirement for fenestration shading is met may require an annual TDV energy simulation as follows:

  - For climate zones with an SHGC requirement, where the annual TDV energy for the combination of the proposed altered fenestration and the shading of that altered fenestration by existing overhangs or sidefins is less than or equal to the annual TDV energy due to the prescriptive alteration fenestration shading requirement with no shading from overhangs or sidefins, the Standard Design is the unaltered existing feature (existing fenestration products plus existing shading). Otherwise, the Standard Design is the prescriptive alteration requirement.
  - For climate zones without an SHGC requirement, the Standard Design is the unaltered existing feature (existing fenestration products plus existing shading).

  Fenestration Area. The Standard Design surfaces and areas for the existing plus alteration (fenestration area in an addition is not included in this section) is determined as follows:

  - If no fenestration area is being added, then the fenestration surfaces in the Standard Design are the existing fenestration surfaces.
  - If fenestration area is being added and the existing fenestration area is less than or equal to 20% of the existing floor area and the combination of the existing ~~minus deleted~~ plus added fenestration is less than or equal to 20% of the existing floor area, then the fenestration surfaces in the Standard Design are the existing fenestration surfaces ~~minus the deleted fenestration surfaces~~ plus the added fenestration surfaces.
  - If fenestration area is being added and the existing fenestration area is less than or equal to 20% of the existing floor area and the combination of the existing ~~minus deleted~~ plus added fenestration is greater than 20% of the existing floor area, then the fenestration area in the Standard Design is 20% of the existing floor area. The fenestration surfaces in the Standard Design are the existing fenestration surfaces ~~minus the deleted fenestration surfaces~~ plus the added fenestration surfaces with the ~~combination of the deleted surface areas and~~ added surface areas scaled so that the total area of existing ~~minus deleted~~ plus added fenestration surfaces equals 20% of the existing floor area. For example, if the existing floor area is 2,000 square feet, the existing fenestration is 300 ~~400~~ square feet, ~~no fenestration area is being deleted~~ and the added fenestration is 200 square feet, the scaling factor applied to each added fenestration surface would be:

Equation R3-2

$$ScalingFactor = \frac{(AddedFenArea - DeletedFenArea + ExistingFenArea) - 0.20 \times ExistingCFA}{DeletedFenArea + AddedFenArea}$$

$$= \frac{(200 + 400) - 0.20 \times 2000}{200} = 0.50$$

$$ScalingFactor = \frac{(0.20xExistingCFA) - (ExistingFenArea)}{AddedFenArea}$$

$$= \frac{(0.20 \times 2000) - 300}{200} = 0.50$$

Thus, the square footage of each of the new fenestration surfaces would be scaled by a factor of 0.50 to determine the Standard Design.

- Otherwise, if fenestration area is being added and the existing fenestration area is greater than 20% of the existing floor area, then the fenestration surfaces in the Standard Design are the existing fenestration surfaces.

The resulting Standard Design inputs are run as a single simulation and the results are compared to the Proposed Design. The energy use of the e+ad+al Proposed Design shall use equal or less energy than the e+ad+al Standard Design.

Conceptually, the e+ad+al approach can be described as follows where the right hand side term is calculated in a single simulation:

Equation R3-3 $$EU_{e+ad+al} \leq EU_e + EB_{ad} + EB_{al}$$

Where

$EU_{e+ad+al}$ = the Proposed Design energy use of the existing building with all additions and alterations completed

EU_e = the energy use for the unaltered portion of the existing building

EB_{ad} = the Standard Design energy use for the addition alone

EB_{al} = the Standard Design energy use of the altered features (= energy use of the unaltered existing feature when the prescriptive alteration requirements, including mandatory requirements, are met or energy use of the prescriptive alteration requirements when the prescriptive alteration requirements are not met).

3.8.4 Duct Sealing in Additions and Alterations

Section 152(a)1 establishes prescriptive requirements for duct sealing in additions and Sections 152(b)1.D. and 152(b)1.E. establish prescriptive requirements for duct sealing and duct insulation for installation of new and replacement duct systems and duct sealing for installation of new and replacement space conditioning equipment. Table R4-13 provides Duct Leakage Factors for modeling of sealed and tested new duct systems, sealed and tested existing duct systems, and untested duct systems built prior to and after June 1, 2001. Appendix C~~F~~ provides procedures for duct leakage testing and Table C~~F~~-2 provides duct leakage tests and leakage criteria for sealed and tested new duct systems and sealed and tested existing duct systems. These requirements, factors, procedures, tests and criteria apply to performance compliance for duct sealing in Additions and Alterations.

Condition	*Proposed Design*	*Standard Design*
Additions Served by Entirely New Duct Systems	The Proposed Design shall be either sealed and tested new duct systems or untested duct systems.	The Standard Design shall be sealed and tested new duct systems.

Condition	Proposed Design	Standard Design
Additions Served by Extensions of Existing Duct Systems	The Proposed Design shall be either 1) sealed and tested new duct systems, if the total combined existing plus new duct system meets the leakage requirements for tested and sealed new duct systems; 2) sealed and tested existing duct systems, if the total combined existing plus new duct system meets the leakage requirements for tested and sealed existing duct systems; 3) untested duct systems in homes built after June 1, 2001; or 4) untested duct systems in homes built prior to June 1, 2001.	The Standard Design shall be sealed and tested existing duct systems.
Alterations with Prescriptive Duct Sealing Requirements when Entirely New Duct Systems are Installed	The Proposed Design shall be either 1) sealed and tested new duct systems; 2) untested duct systems built after June 1, 2001; or 3) untested duct systems in homes built prior to June 1, 2001.	The Prescriptive Alteration Requirement is sealed and tested new duct systems. Determine the Standard Design by the Standard Design rules in sSection 3.8.33.1.3.
Alterations with Prescriptive Duct Sealing Requirements when Existing Duct Systems are extended or replaced or when new or replacement air conditioners are installed	The Proposed Design shall be either 1) sealed and tested new duct systems, if the total combined existing plus new duct system meets the leakage requirements for tested and sealed new duct systems; 2) sealed and tested existing duct systems, if the total combined existing plus new duct system meets the leakage requirements for tested and sealed existing duct systems; 3) untested duct systems built after June 1, 2001; or 3) untested duct systems in homes built prior to June 1, 2001.	Prescriptive Alteration Requirement is sealed and tested existing duct systems. Determine the Standard Design by the Standard Design rules in sSection 3.8.33.1.3.
Alterations for which Prescriptive Duct Sealing Requirements do not apply	The Proposed Design shall be either 1) sealed and tested new duct systems, if the new duct system or the total combined existing plus new duct system meets the leakage requirements for tested and sealed new duct systems; 2) sealed and tested existing duct systems, if the total combined existing plus new duct system meets the leakage requirements for tested and sealed existing duct systems; 3) untested duct systems built after June 1, 2001; or 3) untested duct systems in homes built prior to June 1, 2001.	The Standard Design shall be either 1) untested duct systems built after June 1, 2001; or 3) untested duct systems in homes built prior to June 1, 2001.

Table R3-11 – Default Assumptions for Existing Buildings

Table R3-7 - Default Assumptions for Existing Buildings

	Default Assumptions for Year Built (Vintage)							
Conservation Measure	**Before 1978**	**1978 to 1983**	**1984 to 1991**	**1992 to 1998**	**1999 - 2000+**	**2001-2003**	**2004-2005**	**2006 and Later**
INSULATION U-VALUEU-FACTOR								
Roof	0.0769	0.0479	0.0479	0.0479	0.0479	0.0479	0.0479	0.0479
Wall	0.386356	0.096110	0.096110	0.088102	0.088102	0.088102	0.088102	0.088102
Raised Floor -–CrawlSp	0.09799	0.09799	0.09799	0.0460.037	0.0460.037	0.046	0.046	0.046
Raised Floor-No CrawlSp	0.2398	0.2398	0.2398	0.0640.097	0.0640.097	0.064	0.064	0.064
Slab Edge F2-factor =	0.763	0.763	0.763	0.763	0.763	0.763	0.763	0.763
Ducts	R-2.1	R-2.1	R-2.1	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
LEAKAGE								
Building (SLA)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Ducts Leakage Factor (See Table 4-13)	28%0.86	28%0.86	28%0.86	28%0.86	28%0.86	0.89	0.89	0.89
FENESTRATION								
U-valueU-factor	Use Table Table 1-D116-A - Title 24, Part 6, Section 116 for all Vintages							
SHGC	Use Table 1-E 116-B - Title 24, Part 6, Section 116 for all Vintages							
Shading Dev.	Use Table R3-4 Table R3-7 for all Vintages							
SPACE HEATING EFFICIENCY								
Gas Furnace (Central) AFUE	0.75	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Gas Heater (Room) AFUE	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Heat Pump HSPF	5.6	5.6	6.6	6.6	6.8	6.8	6.8	7.4
Electric Resistance HSPF	3.413	3.413	3.413	3.413	3.413	3.413	3.413	3.413
SPACE COOLING EFFICIENCY.								
All Types, SEER	8.0	8.0	8.9	9.7	9.7	9.7	9.7	12.0
WATER HEATING								
Energy Factor	0.525	0.525	0.525	0.525	0.58	0.58	0.575	0.575
Rated Input, MBH	28.0	28.0	28.0	28.0	28.028.0	28.0	28.0	28.0