8. Performance Method

8.1 Overview

This chapter explains the performance method of complying with the Standards. The method works by calculating the Time Dependent Valuation (TDV) energy use of the proposed design and comparing it to the TDV energy use of the standard design (the budget). The standard design is a building with the same size as the proposed design, but incorporating all features of Prescriptive Package A. The energy budget includes water heating, space heating, and space cooling. Lighting is not included in the performance calculations. If the proposed design uses equal or less TDV energy than the standard design, then the building complies.

Computer programs used for compliance are certified by the Energy Commission as being capable of calculating space conditioning and water heating energy use in accordance with a detailed set of rules. The computer programs simulate or model the thermal behavior of buildings by calculating hourly heat flows into and out of the various thermal zones of the building. The computer programs certified by the Energy Commission must demonstrate their accuracy in analyzing annual space conditioning and water heating energy use of different building conservation features, levels and techniques.

This method provides maximum flexibility because the building designer may trade-off the energy performance of different building components and design features to achieve compliance. Making a building more efficient will result in lower utility bills and usually improved comfort. The performance approach provides the ability to test different options and choose the best strategy to reduce your overall energy budget. With today's wide choice of high efficiency materials, equipment and controls there are many opportunities to make a building more energy efficient. Improving the building envelop provides several opportunities for improving efficiency, in particular with measures related to window placement, location, and efficiency. In space conditioning there is not only equipment with very high efficiency for space heating and cooling but also many innovative system types that eliminate the need for ducts, combine space and water heating together, or use advanced designs that can dramatically improve the buildings overall performance. Improved water heating system efficiency includes a wide range equipment that can significantly increase efficiency, and improvements to the distribution system can drastically reduce energy losses.

The performance method is the most popular compliance method under the Standards, with more than 95 percent of building permit applications for newly constructed buildings being submitted in this manner. The method is especially popular with production homebuilders because they can optimize performance and achieve compliance at the lowest possible cost.

This chapter provides only a general overview of the performance method. Each computer program that is certified by the Energy Commission is required

to have a compliance supplement that provides more detailed information regarding the use of the software for compliance purposes. The requirements for the compliance supplement along with other requirements for approved computer programs are documented in the 2013 Residential ACM Approval Manual.

8.2 What's New for 2013

In 2013, the most significant change is that all certified residential compliance software programs will use the same modeling and rules processing "Compliance Manager" software within their compliance programs. Compliance software vendors are no longer allowed to separately implement the ACM rules or use the energy modeling algorithms of their choice.. This new Compliance Manager includes many advancement is modeling capabilities including the modeling of solar gains, thermal mass and airflows.

8.3 The Performance Compliance Process

Any certified computer program may be used to comply with the Standards using the performance method. The following steps are a general outline of the typical computer program procedure:

1. Collect all necessary data on each component. For the building envelope the area of each fenestration, wall, door, roof, ceiling and floor needs to be available. For each component the applicable energy characteristics needs to be defined including U-factor, solar heat gain coefficients or shading coefficient, solar reflectance, and thermal mass values. For space conditioning system the equipment efficiency, and the type and location of distribution system as well as the amount of insulation is needed. For water heating the volume and efficiency is needed. Other information may be needed such as standby loss, pilot energy, or the presence of additional storage to totally define equipment efficiency. For the hot water distribution system the design of the distribution system must be known to take into account the style of distribution of the presence of a recirculation system. Other efficiency measures and options exist that can be used to improve building efficiency. To review the complete list of options refer to your compliance software users guide.
2. Start by entering the basic data such as square footage, number of stories, occupancy type, climate zone, etc. Follow this by enter the building envelope data by defining each opaque surface with its orientation, area and thermal performance properties. Add the fenestrations, overhangs and fins that are associated to each opaque surface. Enter the data on the equipment and distribution systems for the space conditioning and water heating systems. Input values and assumptions must correctly correspond to the information on the final approved plan set and no inputs can have values that do not conform to the required mandatory measures.

3. Launch a computer run to automatically calculate the TDV energy of the standard design and the proposed design.

The building complies if the total TDV energy use of the proposed design is the same as or less than the standard design TDV energy budget.

When creating a computer input file, use the space provided for the project title information to concisely and uniquely describe the building being modeled. User-designated names should be clear and internally consistent with other orientations and/or buildings being analyzed. Title names and explanatory comments should assist individuals involved in both the compliance and enforcement process.

8.3.2 Defining the Standard Design

Each approved computer program must automatically calculate the TDV energy use of the standard design. The standard design is created based upon data entered for the proposed design using all the correct fixed and restricted inputs.

The computer program defines the standard design by modifying the geometry of the proposed design and inserting the building features of prescriptive Package A. This process is built into each approved computer program and the user cannot access it. Key details on how the standard design is created and calculated by the computer programs, including the listing of fixed and restricted input assumptions are documented in the 2013 Residential ACM Manual.

The standard design assumes the same total conditioned floor area, conditioned slab floor area, and volume as the proposed design, and the same gross exterior wall area as the proposed design, except that the wall area in each of the four cardinal orientations is equal. The standard design uses the same roof/ceiling area, raised floor area, slab-on-grade area and perimeter as the proposed design, assuming the standard insulation R-values required in the prescriptive packages.

Total fenestration area in the standard design is equal to the proposed design if the fenestration area in the proposed design is less than or equal to 20 percent of the floor area, otherwise, the fenestration area of the standard design is equal to 20 percent of the floor area. Fenestration area in the standard design is evenly distributed between the four cardinal orientations. SHGC and U-factors are those listed in Package A, and no fixed shading devices such as overhangs are assumed for the standard design.

The standard design includes minimum efficiency heating and cooling equipment, as well as the minimum duct R-value with ducts in a vented attic if the proposed design has an attic. Ducts are assumed to be sealed as required by Package A. The standard design also has correct refrigerant charge as required by Package A.

For water heating systems that serve individual dwelling units, the standard design is a 50 gallon gas storage water heater with an Energy Factor equal to the federal minimum standard.. The standard design has a trunk and branch distribution system, that includes the assumption that all mandatory measures are met (i.e., the first 5 ft of hot and cold water piping from heating source)

and that all piping ¾ of an inch or larger is insulated and the entire length of piping to kitchen fixtures are insulated as specified in §150.0(j)2A or §150.0(j)2B.

For water heating systems that serve multiple dwelling units either a central distribution system may be used or individual water heaters may be installed in each unit. The standard design system type is based on what the proposed design uses.

Standard Reports

For consistency and ease of enforcement, the manner in which building features are reported by Compliance Software programs is standardized. Energy Commission-approved Compliance Software programs must automatically produce compliance reports in this standard format. The principal report is the Certificate of Compliance (CF-1R).

The CF-1R has two highly visible sections, one for special features and modeling assumptions, and a second for features requiring field verification and/or diagnostic testing by approved HERS raters. These two sections serve as a punch list for special consideration during compliance verification by the local enforcement agency and the HERS rater. Items listed in the Special Features and Modeling Assumptions section indicate that unusual features or assumptions are used for compliance, and they call for special care by the local enforcement agency. Items listed in the HERS Required Verification section are for features that rely on diagnostic testing and independent verification by approved HERS providers/raters to ensure proper field installation. Diagnostic testing and verification by HERS providers/raters is in addition to local enforcement agency inspections.

lists some of the measures that are to be listed on the

8.3.3 Professional Judgment

Some modeling techniques and compliance assumptions applied to the proposed design are fixed or restricted. There is little or no freedom to choose input values for compliance modeling purposes. However, other aspects of computer modeling remain for which some professional judgment is necessary. In those instances, exercise proper judgment in evaluating whether a given assumption is appropriate.

The enforcement agencies have full discretion to reject a particular input, especially if the user has not substantiated the value with supporting documentation.

Two questions may be asked in order to resolve whether professional judgment has been applied correctly in any particular case:

1. Is a simplified assumption appropriate for a specific case? If simplification reduces the predicted energy use of the proposed building when compared to a more explicit and detailed modeling assumption, the simplification is not acceptable (i.e., the simplification must reflect higher energy use than a more detailed modeling assumption).

2. Is the approach or assumption used in modeling the proposed design consistent with the approach or assumption used in generating the energy budget?

One must always model the proposed design using the same assumption and/or technique used by the program in calculating the energy budget unless drawings and specifications indicate specific differences that warrant conservation credits or penalties.

Any unusual modeling approach, assumption or input value should be documented with published data and should conform to standard engineering practice.

For assistance in evaluating the appropriateness of particular input assumptions, call the Energy Hotline or call the vendor of the Compliance Software program.

8.4 Mixed Occupancy Buildings

- *§100.0(e)*

Some residential buildings have areas of other occupancies, such as retail or office, in the same building. An example of this might be a three-story building with two floors of apartments above ground floor shops and offices. The first thing to consider when analyzing the energy compliance of a mixed occupancy building is the type and area of each occupancy type.

Depending on the area of the different occupancies, you may be able to demonstrate energy compliance as if the whole building is residential for the heating cooling and water heating requirements. This is allowed if the residential occupancy accounts for greater than 80 percent of the conditioned floor area of the building (or permitted space). Lighting compliance must be based on the requirements for the actual occupancy type.

Note: Mandatory measures apply separately to each occupancy type regardless of the compliance approach used. For example, if complying under the mixed occupancy exception, both residential documentation (MF-1R form) and nonresidential documentation for mandatory measures must be submitted with other compliance documentation.

If the building design does not fit the criteria described above for a dominant occupancy, then the low-rise residential occupancy type must be shown to comply on its own. The remaining occupancy types must be shown to comply separately either by independent compliance for each occupancy or (for the nonresidential performance approach) by combining nonresidential occupancies in accordance with the rules of the Nonresidential ACM Manual. This may be done by using any of the approved prescriptive or performance methods available for each occupancy type. As a result, documentation for each occupancy type must also be considered separately, and a Certificate of Compliance must be submitted for each occupancy type. Note that mixed high-rise and low-rise residential occupancies will not occur in the same building because the designation applies to the building.

8.5 Multifamily Buildings

- *§101(b)*

Envelope and HVAC equipment requirements for multifamily apartment buildings with four or more habitable stories (and hotels or motels of any number of stories) are covered by the Nonresidential Standards. These are explained in the Nonresidential Compliance Manual. Multifamily buildings with one to three habitable stories are considered low-rise residential buildings and are discussed in this manual.

Compliance for a low-rise multifamily building may be demonstrated either for the building as a whole or on a unit-by-unit basis. Floors and walls between dwelling units are considered to have no heat transfer, and may be ignored in performance calculations.

8.5.1 Whole-building Compliance Approach

The simplest approach to compliance for a multifamily building is to treat the building as a whole, using any of the compliance paths described in earlier chapters. In practice, this process is similar to analyzing a single family dwelling, except for some differences in water-heating budgets and internal gains, as described in the *2013Residential ACM Manual*.

Multifamily buildings that utilize efficiency measures that require HERS field verification must submit separate compliance documentation for each individual dwelling unit in the building as specified by Reference Residential Appendix Section RA2.3. This requirement does not prevent use of the whole-building compliance approach for submittal of the Certificate of Compliance to the Enforcement Agency, however when the whole-building compliance approach has utilized a measure that requires HERS field verification, a separate copy of the whole-building Certificate of Compliance must be submitted to the HERS provider for every dwelling unit in order to satisfy the requirements of the HERS provider data registry documentation procedures. In practice, the Certificate of Compliance information may not need to be submitted to the HERS provider more than one time, but a relationship must be established in the HERS provider data registry between the whole-building Certificate of Compliance and the corresponding dwelling-specific Installation Certificates, and the dwelling-specific Certificates of Field Verification and Diagnostic Testing. Thus, for the whole-building compliance approach in a multifamily building that has utilized a compliance option that requires HERS verification, the required energy compliance documentation for each dwelling unit should consist of a whole-building Certificate of Compliance (CF-1R), a dwelling-specific Installation Certificate (CF-2R), and a dwelling-specific Certificate of Field Verification and Diagnostic Testing (CF-3R).

When the whole-building compliance approach is utilized for a multifamily building, some of the energy efficiency measures that require HERS field verification cannot be used for compliance credit in the performance calculations. These HERS measures are excluded from the whole-building compliance approach because they require dwelling-specific data input to the Compliance Software, and dwelling-specific data output from the Compliance Software that must be shown on the Certificate of Compliance, therefore they

cannot be properly documented using a single whole-building Certificate of Compliance.

When the Standards require registration of the compliance documents, the information for the Certificate of Compliance (CF-1R), Installation Certificate (CF-6R), and Certificate of Field Verification and Diagnostic Testing (CF-4R) must be submitted electronically to the HERS provider data registry. Refer to Reference Residential Appendix RA2 for additional information on these document registration procedures.

8.5.2 Unit-By-Unit Compliance Approach – Fixed Orientation Alternative

The unit-by-unit compliance approach for multifamily buildings requires that each dwelling unit must demonstrate compliance separately. The fixed orientation alternative requires that each unique dwelling unit in the building, as determined by orientation and floor level, must be separately modeled using an approved computer program. In this approach, surfaces that provide separation between dwelling units may be ignored since they are assumed to have no heat loss or heat gain associated with them. Surfaces that provide separation between dwelling units and central/interior corridor areas must be modeled for heat transfer if the corridor area is not directly conditioned (see Reference Joint Appendix JA1 for definition). If the corridor area is conditioned, the corridor area may be modeled separately.

Different orientations and locations of each unit type within the building must be considered separately. That is, a one-bedroom apartment on the ground floor of a three-story building is different from the same plan on a middle floor or the top floor, even if all apartments have the same orientation and are otherwise identical. Likewise, end units must be modeled separately from the middle units; and opposite end units must both be modeled. With this approach every unit of the building must comply with the Standards, so this approach is more stringent than modeling the building as a whole (see Figure 8-1).

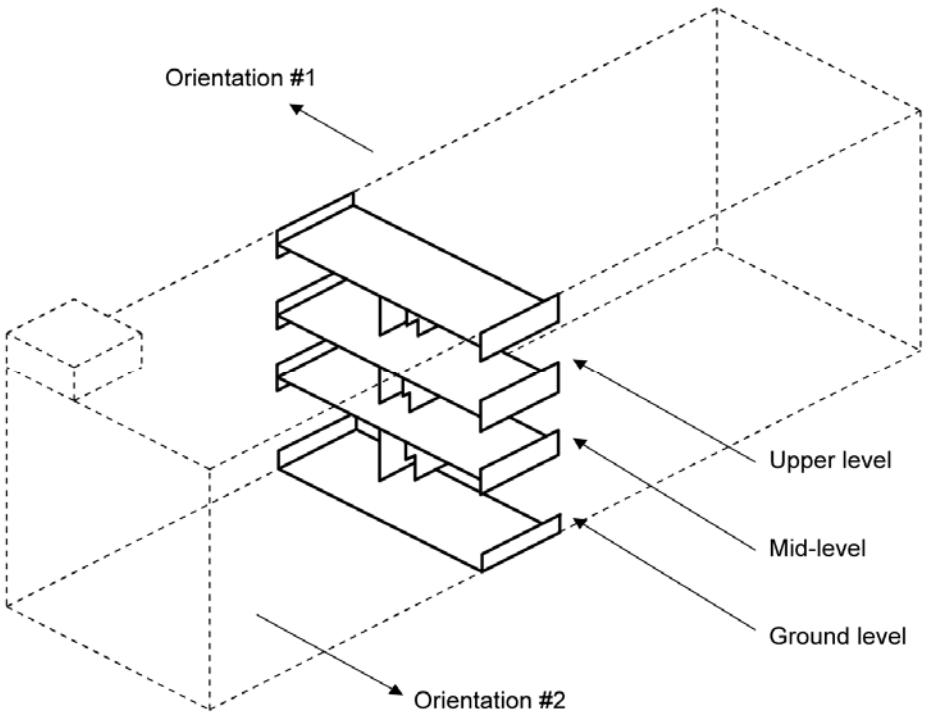

Figure 8-1 – Multifamily Building Compliance Option

Demonstrate Compliance for Each Generic Unit Type in Each of its Characteristic Locations

Example 8-1

Question

When preparing compliance calculations for a three-story apartment complex, I have the option of showing compliance for each dwelling unit or for the entire building. If I use the individual dwelling unit approach, do I need to provide calculations for every dwelling unit?

Answer

Each dwelling unit must comply with the Standards when using this approach. When dwelling units have identical conditions, the calculations can be combined. This means you will show separate compliance for all unique conditions, such as:

- Front-facing North
- Front-facing West
- Front/side walls facing East and North
- Front/side walls facing East and South
- Middle units and both end units
- Exterior roof, no exterior floor
- Exterior floor, no exterior roof

Surfaces separating two conditioned spaces (such as common walls) have little heat transfer and can be disregarded in the compliance calculations.

8.5.3 Unit-By-Unit Compliance Approach – Multiple Orientation Alternative

Another option for showing unit-by-unit compliance for a multifamily building is similar to a method that may be utilized for single family master plans in subdivisions (described in Section 8.6).

The computer method may be used to demonstrate that a dwelling unit plan in a multifamily building complies regardless of how it is oriented. To assure compliance in any orientation, the annual energy consumption must be calculated in each of the four cardinal orientations: true north, true east, true south and true west. With this option, a dwelling unit plan must be modeled using the identical combination of energy features and levels in each orientation, and must comply with the energy budget in each case. If a multifamily dwelling floor plan is utilized as both reversed and original/standard floor plan types, either the reversed plan or the original/standard plan may be used to demonstrate compliance, but compliance must be shown in all four cardinal orientations using only one of the plan types.

Each unique dwelling unit plan must be modeled using the worst-case condition for the energy features that the plan may contain within the multifamily building (e.g. highest glazing percentage, least overhangs, largest wall surface area, and with exterior walls instead of party walls if applicable). See Reference Residential Appendix RA 2.6.1 for information that describes how to determine when a dwelling is considered to be a unique model. Each unique dwelling plan must also be modeled separately for each unique floor level (see Figure 8-1).

8.6 Subdivisions and Master Plans

Subdivisions often require a special approach to energy compliance, since they generally include one or a few basic building or unit plans repeated in a variety of orientations. The basic floor plans, as *drawn*, may also be used in a mirror image or *reversed* configuration.

There are two compliance options for subdivisions. They are:

1. Model each individual building, or building condition, separately according to its actual orientation.
2. Model all four cardinal orientations for each building or plan type with identical conservation features for no orientation restrictions.

8.6.2 Individual Building Approach

The most straightforward compliance option for subdivisions is to analyze each individual building in the project separately using any compliance method. This may be practical for subdivisions with only custom buildings, or with only one or two specific orientations for each building plan. This approach requires that each unit comply separately, with separate documentation submitted for each unit plan in the orientation in which it will be constructed.

8.6.3 Multiple Orientation Alternative: No Orientation Restrictions

- *§151(c)*

The computer method may be used to demonstrate that a single family dwelling plan complies regardless of how it is oriented within the same climate zone. To assure compliance in any orientation, the annual energy consumption must be calculated in each of the four cardinal orientations: true north, true east, true south and true west. With this option, the buildings must have the identical combination of conservation measures and levels in each orientation and comply with the energy budget in each case.

If a building floor plan is reversed, either the original plans or the reversed plans may be shown to comply in all four cardinal orientations.

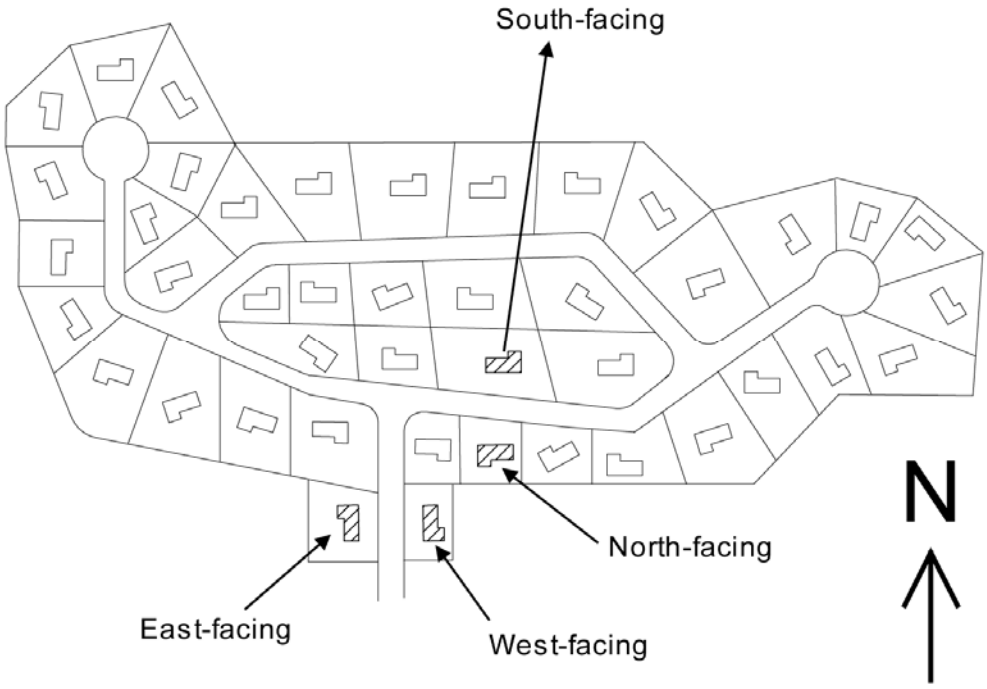

Figure7-2– Subdivisions and Master Plans Compliance Option

Demonstrate Compliance for Each Cardinal Orientation for Each Basic Model Type

For compliance, submit Certificate of Compliance documentation of the energy budgets for each of the four orientations to the enforcement agency. Only one
CF-1R form that documents compliance for all four orientations is required to be submitted to the enforcement agency for each unique plan.

Master plans that utilize the multiple orientation alternative, that utilize a compliance approach that requires HERS field verification, must submit a separate copy of the multiple orientation master plan Certificate of Compliance to the HERS provider for every dwelling unit in the subdivision in order to satisfy the requirements of the HERS provider data registry documentation procedures. In practice, the Certificate of Compliance information for each multiple orientation master plan may not need to be submitted to the HERS provider data registry more than one time, but a relationship must be

established in the HERS provider data registry between the applicable multiple orientation master plan Certificate of Compliance and the corresponding dwelling-specific Installation Certificates (CF-6R), and the dwelling-specific Certificates of Field Verification and Diagnostic Testing (CF-4R). Thus, for the multiple orientation compliance approach in a master plan subdivision that has utilized a compliance option that requires HERS verification, the required energy compliance documentation for each dwelling unit should consist of a multiple orientation master plan Certificate of Compliance (CF-1R), a dwelling-specific Installation Certificate (CF-6R), and a dwelling-specific Certificate of Field Verification and Diagnostic Testing (CF-4R).

8.7 HVAC Issues

8.7.1 No Cooling Installed

When a building does not have a proposed cooling system, there is no compliance credit. The air conditioning system is modeled to be equivalent to Package A. A hypothetical cooling duct system is modeled as equivalent to Package A (e.g., Attic, R-6) or as matching the heating system ducts. Modeling no ducts is not an appropriate assumption.

8.7.2 Equipment without SEER or HSPF

For equipment without a tested SEER, the EER is used in place of the SEER. Another option is to use the EER of the equipment and use it for both the SEER and EER entry. If this approach is used, the EER must be verified by a HERS rater.

Equipment without an HSPF rating is assumed to have 3.41 HSPF (electric resistance), 3.55 (electric radiant), or an HSPF calculated from a COP as

HSPF = (3.2 x COP) – 2.4.

8.7.3 Multiple HVAC Systems

Buildings with multiple HVAC systems can be treated in a couple of different ways. not meeting the zonal control criteria (see Section 4.4.2) may model each zone separately without taking credit for zonal control.

- For buildings using more than one system type, equipment type or fuel type, where the types do not serve the same floor area, model either the building zone or enter the floor area served by each type. Note that if both zones are associated with attic space then a portion of the attic must be modeled with each zone.
- Floor areas served by more than one heating or cooling system, equipment, or fuel type must simulate the building using the system with the most TDV energy consumption for compliance. For additions with electric resistance heat and another heating system (except for

wood heating) the electric resistance shall be deemed to be the most TDV energy consuming system. Supplemental heating units may be installed in a space served directly or indirectly by a primary heating system provided that the thermal capacity of the supplement unit does not exceed two kilowatts or 7,000 Btu/h and is controlled by a time-limiting device not exceeding 30 minutes.

For floor areas served by more than one cooling system, equipment, or fuel type, indicate which system, equipment, and fuel type satisfies the cooling loads.

When there is more than one system meeting the heating or cooling load for the same space, all systems must still meet all the mandatory requirements of the standards.

For example, a building using an appliance rated gas fireplace in combination with a central gas furnace. The central furnace would be used as the primary system and the fireplace would be treated as the supplemental system. The controls for the fireplace would not need to meet the setback thermostat requirements of §112(c) due to the exception.

For rooms such as the bedroom or bathroom, spot heating with a supplemental system may be desirable. An exemption to Tables 150.1-AC, D & E of the Standards is provided for installing either a two kW electric resistance or 7,000 Btu gas heaters, with a 30-minute timer control for such instances. Therefore, this type of supplemental space heating need not meet the setback thermostat requirement.

8.7.4 Existing + Addition + Alteration Approach

The performance approach may be used to show compliance for alterations in existing buildings, new additions, and Existing + Addition + Alteration. This topic is discussed in Chapter 9, Section ? Existing + Addition + Alteration Approach of this manual.