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Performance Approach

Overview

This chapter summarizes the building performance approach to be used for compliance. It includes a discussion of the alternative calculation methods, the procedures involved in determining the energy budget of the Standard Design and the energy use of the proposed design building, and how to plan check performance compliance documentation. The basic procedure is to show that the long-term system costs (LSC) and source energy use of the proposed design are less than or equal to the LSC and source energy budget of the standard design. The standard design is a building with the same geometry as the proposed design, but the envelope, lighting, and mechanical features are defined by the mandatory and prescriptive requirements of the Energy Code. The standard design features are defined in detail in the Nonresidential and Multifamily Alternative Calculation Method (ACM) Reference Manual.

The performance method is the most detailed and flexible compliance path. The energy performance of a proposed building can be calculated according to actual building geometry and site placement. Credit for certain energy features, such as a high-efficiency mechanical system, cannot be taken in the prescriptive approach but can be evaluated with an approved compliance software program using the performance approach.

Performance Method Description

The ACM Approval Manual describes the application and approval process for submitted compliance software. The Nonresidential and Multifamily ACM (NRMFACM) Reference Manual is approved by the California Energy Commission (Energy Commission) and includes explanations of the instructions that all compliance software programs must use to model the energy performance of the proposed design building and the standard design building. The reference manual also includes an explanation of the reference method and certification tests used by the Energy Commission to approve compliance software tools. Since the NRMFACM Reference Manual is approved by the Energy Commission (just like the residential and nonresidential compliance manuals), it can be updated from time to time to allow for corrections and enhancements during the 2025 Energy Code cycle.

Performance Concepts

Please refer to Chapter 12.2.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Minimum Capabilities

Please refer to Chapter 12.2.2 of the *2022 Nonresidential and Multifamily Compliance Manual*.

California Energy Commission Approval

Alternative Calculation Methods (Compliance Software)

Please refer to Chapter 12.2.3.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Input and Output Requirements

Please refer to Chapter 12.2.3.2 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Building Performance Metrics

Beginning with the 2005 Energy Code, the metric or "currency" for assessing building performance has been time-dependent valued (TDV) energy. TDV energy replaced annual source energy that had been the compliance metric since the Energy Commission first adopted the Energy Code in 1978. Starting with the 2025 code cycle, compliance will be based on both LSC and hourly source energy. For a proposed building to comply, both its LSC and source energy use must be less than or equal to the standard design energy budgets. More details on how proposed design energy use and the standard design energy budgets are calculated and how compliance is determined can be found in the NRMFACM Reference Manual and the CBECC or third-party compliance software user's manuals.

Long-Term System Cost (LSC)

While TDV focuses on short-term variations in energy value, LSC provides a long-term perspective, considering the lifespan of a building. This can be especially useful in assessing the true value of investments in energy efficiency or renewable energy systems.

Since when people use energy is as important as how much we use, these calculations are done for each hour throughout a typical year. They are also created for each of the 16 climate zones in California.

Source Energy

Please refer to Chapter 12.2.3.4 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Professional Judgment

Certain modeling techniques and compliance assumptions applied to the proposed design are fixed or restricted. That is, there is little or no freedom to choose input values for energy compliance modeling. However, there are other aspects of energy modeling where some professional judgment may be necessary. In those instances, the compliance software user must decide whether a given input is appropriate and will be matched by the actual installation.

Enforcement agencies have discretion to question a particular input if the permit applicant cannot substantiate the value with supporting documentation, cannot demonstrate that appropriate judgment has been applied, or cannot demonstrate that the actual installation matches the input.

Simplified modeling approaches can be used if the predicted energy use of the proposed building is not affected or if the proposed energy use increases, reducing the compliance margin when compared to a more explicit and detailed modeling assumption. That is, simplification must reflect the same or higher energy use than a more detailed model and reflect the same or lower compliance margin when comparing the standard and proposed LSC and source energy.

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

Example 12-1

Question:

Three different-sized windows in the same wall of a new one-story office building are designed without exterior shading, and they have the exact same NFRC-rated U-factors and SHGC values. Is it acceptable professional judgment to simplify the computer model by adding the areas of the three windows together and inputting them as a single fenestration area?

Answer:

Yes. For a simplified, two-dimensional, geometry model, the compliance software will produce about the same energy results whether the windows are modeled individually or together as one area because the orientation, fenestration U-factors, and SHGC values of the windows are identical.

However, if overhangs and side-fins are modeled, the correct geometry of fixed shades must be modeled for each window.

For detailed, three-dimensional, geometry models, the location of windows on walls affects the daylighting energy calculation, and this effect must be considered before making the simplification in the example.

For reference, to help determine if you're using a detailed or simplified approach, a wall in a simplified model will be entered as an area, orientation (i.e., North, South, East, West), height, and width. In a detailed model a wall is entered as a series of points (i.e., x, y, z coordinates) to place the wall in three-dimensional space relative to other surfaces in the building.

Analysis Procedure

Reference: Section 140.1

This section summarizes the analysis procedures used to demonstrate building compliance when using approved compliance software programs. Software users and those checking for enforcement should consult the most current version of the compliance software user's manual, on-line help and associated compliance supplements, or a combination for specific instructions on the operation of the compliance software. Although there are numerous requirements for each software input, the data entered into each software version may be organized differently from one vendor to the next. As a result, it is not possible in this summary to present all variables in the correct order or hierarchy for any one software version. The aim is to identify the procedures used to calculate the standard and proposed design LSC and source energy budgets.

General Procedure

Please refer to Chapter 12.4.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Computer Input Files

Please refer to Chapter 12.4.1.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Basic Data Entry

Elements Used in Compliance Software

Please refer to Chapter 12.4.2.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Calculating Building Energy Use

The LSC and source energy proposed design energy use and standard design energy budgets are separated into compliance totals, which are the basis for building compliance with the performance method, and total building energy use, which adds receptacle, process and other nonregulated energy usage.

The compliance total energy can be summarized into several components:

- The space-conditioning energy use
- The service water heating energy use
- The mechanical ventilation energy use
- The lighting energy use
- The photovoltaic system energy impact
- The battery energy storage system energy impact
- The demand flexibility energy impact

Nonregulated energy such as process, receptacle, other lighting, and process motors is treated as compliance neutral. The standard design will always match the proposed energy usage for these categories.

The proposed building energy use is defined by Section 140.1(b) and includes the envelope, space conditioning and ventilation, indoor lighting, and water-heating systems assigned to the building. The key component of calculating the LSC energy and source energy use of the proposed building is that if a feature of the building is not included in the building permit application, the energy use of that feature is equal to that of the standard design energy budget defined in Section 140.1(a). That means that if a permit is submitted for a building shell (envelope only), and the performance approach is used to demonstrate compliance, trade-offs cannot be made between the envelope and the mechanical or lighting system.

The standard design budget is defined by replacing all of the energy features of the proposed building with the prescriptive requirements in Section 140.3 of the Energy Code. Details of the standard design features are documented in the NRMFACM Reference Manual.

Space-Conditioning Energy Budget

Please refer to Chapter 12.4.3.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Lighting Energy Budget

The indoor lighting energy budget consists of the lighting power used by a building based on one of the following criteria:

- When no lighting plans or specifications are submitted for permit and the occupancy of the space is not known, the standard lighting power density is 0.40 W/ft².
- When no lighting plans or specifications are submitted for permit and the occupancy of the space is known, the standard lighting power is equal to the corresponding watt per ft² value derived in the Area Category Method of Section 140.6(c)2.
- When lighting plans and specifications are submitted for permit, the standard lighting power is equal to the corresponding total allowed lighting power (in watts) that was used in calculating the proposed lighting level that can be based on the Area Category Method in Section 140.6(c)2. The standard design building uses the lesser of allowed watts or actual lighting power to be installed in the building. The proposed design building uses the actual lighting power to be installed as detailed on the lighting plans. This value must be equal to or less than the allowed watts.

For all occupancies except hotel guest rooms and multifamily dwelling units, the proposed lighting power is input into the software. For hotel guest rooms or multifamily dwelling units, the compliance software will automatically set the proposed lighting power and the standard design lighting power at the same value as specified in the NRMFACM Reference Manual.

Water-Heating Energy

Please refer to Chapter 12.4.3.3 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Application Scenarios

Please refer to Chapter 12.5 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Whole-Building Compliance

Please refer to Chapter 12.5.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Compliance by Permit Stage

Please refer to Chapter 12.5.2 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Modeling Future Construction by Permit Stage

Please refer to Chapter 12.5.2.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Modeling Existing Construction by Permit Stage

Please refer to Chapter 12.5.2.2 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Additions Performance Compliance

An addition that consists of new conditioned floor area and added volume will either need to comply as an addition alone or as an existing plus addition plus alteration. For the addition-alone path, the same requirements for a newly constructed building will apply to the addition.

All systems serving the addition will require compliance to be demonstrated, and either the prescriptive or performance approach can be used for each stage of the construction of the addition. Existing plus addition plus alteration requires modeling of the existing, altered, and new components but gives the opportunity for compliance tradeoffs between the new and altered components in the addition and existing building.

When existing space conditioning or water heating is extended from the existing building to serve the addition, the existing components of these systems should be modeled as existing, and the new components of these systems must be modeled as new (e.g., new ducts extended to the addition) so that the software can determine the correct standard design based on Section 141.0(a).

Addition Only

Additions that show compliance with the performance approach independent of the existing building must meet the requirements for newly constructed buildings. Section 141.0(a) states that the envelope and indoor lighting of the addition, and any newly installed space conditioning, electrical power distribution system, or water-heating system, must meet mandatory measures and the applicable energy budget:

- If the permit is done in stages, the rules for each permit stage apply to the performance run of the addition.
- If the whole addition (envelope, lighting, and mechanical) is included in the permit application, the rules for whole buildings apply.

Existing Plus Addition Plus Alteration

Additions may also show compliance by either:

- Demonstrating that efficiency improvements to the envelope component of the existing building, as well as certain indoor lighting and mechanical improvements, offset addition performance that would otherwise not meet the energy budgets for the addition alone. (See Section 141.0(a)2Bii.
- Showing that the existing building combined with the addition meet the requirements of Section 141.0(b) for newly constructed buildings.

For additions, the most flexible compliance method is to consider the entire existing building along with the addition (Existing + Addition + Alteration).[1] The combination of additions and alterations to the existing building may be shown to comply by demonstrating that the proposed design energy use is equal to or less than the standard design energy budget based on the alterations meeting the requirements of Section 141.0(b)3 and additions meeting the requirements of Section 141.0(a)2. Furthermore, Section 141.0(a)2 states that the envelope and indoor lighting in the conditioned space of the addition, and any newly installed space conditioning, electrical power distribution system or service water heating system, must meet the mandatory measures.

1This method may also be used whenever an alteration is made to existing buildings, whether or not there is an addition to the building at the same time.

This approach allows the applicant to improve the energy efficiency of the existing building so that the entire building meets the energy budget that would apply if the existing building were unchanged, and the addition complied on its own. Changes to features in the existing building are considered alterations.

For a full description of when and how altered components in the existing building are counted in the performance calculation, as well as basic energy modeling rules for alterations, see the Alterations Performance Compliance below.

Example 12-2

Question:

Three thousand square feet (3,000 ft²) of conditioned space is being added to an existing office building. Twenty-five percent of the lighting fixtures in the existing office space are being replaced with more efficient fixtures. Can credit be taken for the improved lights in the existing building to comply through the existing-plus-addition performance approach?

Answer:

Since 10 percent or more of the lighting fixtures are replaced, all prescriptive lighting alteration requirements must be met. Credit can be taken only for lighting efficiency improvements, resulting in a lower lighting power than is required to meet Section 140.6.

Alterations Performance Compliance

Please refer to Chapter 12.5.4 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Alterations of the Permitted Space

Altered spaces can show compliance with the performance approach independent of the remainder of the existing building but must still meet the requirements for the altered components of the building as specified in Section 141.0(b)2. These require that envelope and lighting alterations, as well as any new or replacement space-conditioning or service water-heating system serving the alteration, meet the mandatory measures. The permitted space alone may comply with the energy budget determined using approved compliance software.

If the permit is done in stages, the rules for each permit stage apply to the alteration performance run.

Alterations in Existing Buildings Without an Addition

Alterations may also show compliance by demonstrating that the energy use of the proposed design — including all energy efficiency improvements to the existing building — is equal to or less than the standard design energy budget that is based on the alterations meeting the requirements of Section 141.0(b)2 and Table 141.0-E of the Energy Code. Section 141.0(b)1 also requires that envelope, lighting, space-conditioning, and service water-heating system alterations meet the applicable mandatory measures.

This approach allows the applicant to improve the energy efficiency of the existing building so that it meets the energy budget that would apply to the entire building if the existing building other than the portion being altered was unchanged. Changes to features in the existing building are considered alterations.

Altered components that do not meet or exceed the requirements of Section 141.0(b)2 are considered when the complying through the performance pathway. A credit is assigned to an alteration (improvement) that exceeds the requirements in Section 141(b)2 as summarized in Table 141.0-E of the Energy Code and further detailed in the NRMFACM Reference Manual. The compliance software sets the standard design for the altered component, as listed in Table 141.0-E of the Energy Code.

This compliance approach includes the entire building, which means the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all conditioned and unconditioned space within the structure. The inclusion of the characteristics of unconditioned spaces has an effect on the overall performance budget of the building due to the loads of the unconditioned spaces adjacent to the conditioned spaces, which can be beneficial or detrimental to the overall compliance margin.

When using this compliance approach, it is important to take into account all the changes in the features of the building that are:

- Existing (that remain unchanged).
- Altered (improved or replaced).
- New (all new).

Surfaces that are being completely removed from the existing building — roofs/ceilings, exterior walls and floors, and all glazing removed with those removed surfaces — are not modeled.

To show compliance with this approach, you need to follow the instructions in the compliance software user's manual. Documentation of the existing building's glazing areas is required to be submitted with the permit application if this method is used for replacement fenestration credit.

Example 12-3

Question:

Alterations to an existing office building in Climate Zone 12 include replacing all single clear metal frame-operable windows with new NFRC-rated windows (U-factor =0.45, SHGC=0.31.) What standard design values will the compliance software use for the replacement fenestration area?

Answer:

The standard design will use the values in Table 141.0-A (U=0.47, SHGC=0.31 and VT=0.32) of the Energy Code regardless of whether the replacement windows' values exceed those Table 141.0-A values.

Alterations in Existing Building With an Addition

Please refer to Chapter 12.5.4.3 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Alternate Performance Compliance Approach

Please refer to Chapter 12.5.4.4 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Enforcement and Compliance

Please refer to Chapter 12.6 of the *2022 Nonresidential and Multifamily Compliance Manual*.

Performance Inspection

Please refer to Chapter 12.6.1 of the *2022 Nonresidential and Multifamily Compliance Manual*.