Calculation of Design Energy Cost and the Energy Cost Budget (§ 11.3)

The *design energy cost* is calculated by the simulation program based on the proposed design of the building in its final form, that is, the design submitted for building permit approval. For most new buildings, this is a straightforward exercise in modeling the building as it was designed, using good engineering judgment and the capabilities of the simulation program. All the building features shown in the design documents, including building size and shape, building envelope components and assemblies, lighting, water heating, and mechanical system equipment and controls, must be accounted for. The rules for calculating the design energy cost in § 11.3 deal primarily with special circumstances and exceptions.

The *energy cost budget* establishes the energy efficiency target for the building. It is the estimated annual energy cost for the budget building design. The energy cost budget is compared to the design energy cost, which may not exceed the budget. The design energy cost and the energy cost budget are calculated as separate runs by an approved simulation program using the rules spelled out in the Standard.

The most important thing for a designer to understand about the ECB method is how the two simulation runs differ from each other; it is these differences that determine the trade-offs between measures and determine whether the proposed design complies with the Standard. Many, if not most, of the inputs to the two simulation runs are identical. These identical building features and operational characteristics are "energy neutral," i.e., they produce no energy credits or debits that could affect the overall building energy performance. The features that are different may result in savings or increases in energy cost, and so these differences are the ones that determine compliance.

The following sections describe how the budget building design is derived for each of the major systems. For new buildings, the basic concept is that the budget design is the same as the proposed design, except that each of the components is assumed to just meet the applicable prescriptive requirements of the Standard. For existing building spaces, new system components are assumed to meet the prescriptive requirements, while unchanged components are modeled at their existing levels of energy performance. There are special cases that are covered with special rules, but the basic concept is just that simple.

Design Model (Table 11.3.1-1)

The proposed design and the corresponding budget building shall be consistent with information contained on the plans and specifications.

Some buildings, such as retail malls and speculative office buildings, typically are built in phases. For example, the core mechanical system may be installed with the base building, while the ductwork and terminal units are installed later as part of tenant improvements. A similar situation can occur with the lighting system or with the building's other energy-related features.

This situation was discussed in general terms above (see When the ECB Method May Be Used). For the purpose of calculating the design energy cost, the rule is simple: future energy features that are not yet designed or documented in the construction documents are assumed to minimally comply with the applicable Mandatory Provisions and prescriptive requirements of the Standard, as specified in Sections 5 through 10. In cases where the space use classification is not known, the default assumption is to classify it as office space using the Building Area Method.

The ECB method, and indeed the rest of the Standard, is based on the assumption that nonresidential buildings are heated and cooled. Even if not installed initially, it is common for buildings lacking a heating or cooling system to have one retrofitted by future occupants. Accordingly, there is a special rule for calculating the design energy cost when a building's HVAC system is heating-only or cooling-only: the building must be modeled as if it had both heating and cooling. The missing system is modeled as the default heating or cooling system that just meets the Prescriptive Requirements of the Standard. The same system is modeled for both runs. (Specific details of these default systems are discussed in the following section on HVAC systems; also see Table G3.1-10 and § 11.3.2j in the Standard.) This requirement only applies to conditioned spaces in the building: semiheated spaces would only have a heating system; unconditioned spaces would have neither heating nor cooling systems.

Alterations and Additions (Table 11.3.1-2)

The basic rules for alterations and additions were discussed at the beginning of this chapter. There are some further rules that apply to cases where it is undesirable either to treat the addition as a stand-alone building or to fully model the entire existing building. It is often necessary with additions or alterations to model at least part of the existing building.

For instance, if the existing building's HVAC system is being extended to serve the new construction, then that system needs to be fully modeled in order to account for its energy performance. If, however, this system only serves a portion of the existing building and only part of that building is influenced by the new work, then it is unnecessary to model the entire existing building.

The rules for excluding parts of the existing building are as follows.

1. If there is any new work covered by the Standard that is in a part of the existing building that will be excluded from the proposed design modeling, then those parts must comply with the Standard's applicable prescriptive requirements.
2. The excluded parts of the existing building must be served by HVAC systems that are completely independent of the systems or building components being modeled for the design energy cost.
3. There should not be any significant energy flows between the excluded parts of the building and the modeled parts. In other words, the design space temperature, HVAC system operating setpoints, and operating and occupancy schedules on both sides of the boundary between the included and excluded parts must be the same. If the excluded portion of the building was a refrigerated warehouse and the included portion was an office, this condition would not be met, because there would be significant energy flows between them.
4. If the included and excluded parts of the building share the same utility meter, and if there is a declining block or similar utility rate used for the analysis, then the energy cost analysis must be based on the full energy use block for the building plus addition. This may be done either by modeling both the existing portion of the building plus the addition served by the utility meter, or by making an appropriate adjustment in the energy cost calculation to account for the difference.

Choosing Space Use Classifications (Table 11.3.1-3)

A key task in modeling the proposed design is assigning space use classifications to different areas of the building. These classifications are used to assign lighting power budget assumptions and to differentiate areas within the building that may have different operating schedules and characteristics (thermostat settings, ventilation rates, etc.).

The choice of space use classifications is taken from one of the two lighting tables in the Standard: either Table 9.5.1 (the building area method) or Table 9.6.1 (the space-by-space method). The designer may choose either classification scheme but may not mix the schemes by using one for part of the building and the other for the rest of the building. "Building," in this context, refers to the space encompassed by a single building permit application, which may be less than the complete building (e.g., a permit for tenant improvements on one floor of a multi-story building).

The designer's choice of space use classification determines how the budget building design lighting power densities will be calculated. The reasons for choosing one method over the other are discussed more fully in Chapter 9 of this Manual.

If the building area method is used for a mixed-use facility, the building may be subdivided into the different areas that correspond to the building types listed in Table 9.5.1. The secondary support areas associated with each of these major building types would be included in each building type. For example, if a building included both office and retail areas, the corridors and restrooms associated with the office occupancy would be included in the office area, and the storage and dressing room areas associated with the sales floor would be included in the retail area.

Schedules (Table 11.3.1-4)

The operating and occupancy schedules for the building and its systems have a large impact on the overall energy cost. The Standard allows designers, with the approval of the authority having jurisdiction, to select reasonable or typical schedules for the building. In selecting the schedules, it is prudent to consider the likely long-term operation of the building. For example, if a new school will initially operate on a traditional schedule, but the school district has a policy of shifting its schools over to year-round operation, then it would be prudent to apply a year-round schedule in the ECB method modeling. The selected schedules should likewise not intentionally misrepresent the operation of the building. If a grocery store chain keeps its stores open 24 hours a day, it would be inappropriate to use a 12-hour-a-day operating schedule in the modeling.

The designers are required to specify weekday, Saturday, Sunday, and holiday schedules for each of the following (§ 11.2.1.1b):

- Occupancy;
- Lighting power;
- Miscellaneous equipment power (plug loads);
- Thermostat setpoints;
- HVAC system operation, including system availability, fans, off-hour operation, etc;
- Any other significant loads or equipment that could affect trade-off calculations.