CHAPTER

3 [CE] GENERAL REQUIREMENTS

General Comments

Chapter 3 [CE] specifies the climate zones that establish exterior design conditions and provides general requirements for interior design conditions, as well as materials, systems and equipment. In general, the climate zone provisions are determined simply by referring to the map (Figure C301.1). Table C301.1 or Section C301.3. In addition, Section C302 provides the interior design conditions that are used for heating and cooling load calculations. Section C303 provides requirements for fenestration, identification of insulation and other basic general requirements for insulation materials.

Purpose

Climate has a major impact on the energy use of most buildings. The code establishes many requirements, such as wall and roof insulation *R*-values, window and door thermal transmittance requirements (*U*-factors) and provisions, that affect the mechanical systems based on the climate where the building is located. This chapter contains the information that will be used to properly assign the building location into the correct climate zone, which will then be used as the basis for establishing or eliminating requirements.

Materials and systems used to provide insulation and fenestration values, including *U*-factor and solar heat gain coefficient (SHGC) ratings, must be based on data used by appropriate tests. This establishes a level playing field for product manufacturers.

Discussion and Development of the Climate Zone Map

The 2024 IECC maintains the existing climate zones from the 2021 IECC. The 2021 IECC included a significant update to the climate zones based on ANSI/ASHRAE Standard 169—2013, *Climatic Data for Building Design Standards*. This is a continued evolution of climate zone development initially based on a paper titled "Climate Classification for Building Energy Codes and Standards." Written by Robert S. Briggs, Robert G. Lucas and Z. Todd Taylor of the US Department of Energy's Pacific Northwest National Laboratory, this paper was the basis of climate zones in the code since 2006. Updates to the climate zones are incorporated into the code as necessary.

Climate zones were developed based on the following criteria:

1. Offer consistent climate materials for all compliance methods and code sections (including both commercial and residential).
2. Enable the code to be self-contained with respect to climate data.
3. Be technically sound.
4. Map to political boundaries.
5. Provide a long-term climate classification solution.
6. Be generic and neutral (in other words, not overly tailored to current code requirements).
7. Be useful in beyond-code and future-code contexts.
8. Offer a more concise set of climate zones and presentation formats.
9. Provide a basis for use outside of the United States.

The climate zones on which ASHRAE 169 is based were developed in an open process involving several standards committees of ASHRAE, the US Department of Energy (DOE) staff and other interested parties. Given the interest of the International Code Council® (ICC)® and ASHRAE in producing documents that are capable of being used internationally, an effort was made to develop a system of climate zones that could work outside of the United States. The climate definitions were developed using SI (The International System of Units, abbreviated SI from the French Le Systéme International d'Unités). By using the SI units and climate indices, which are widely available internationally, the climate zones and the development of building energy-efficiency provisions can be applied anywhere in the world. The boundaries between the various climate zones in Table C301.3(2) occur in multiples of 900-degree days Fahrenheit, which converts to 500-degree days Celsius. Degree days are a measure of how much (in degrees) outside air temperature is below or above a certain level, accumulated over a period of days. Distinguishing the climate zones with these numbers results in a clean and understandable division between the climate zones in either system of temperature measurement.

The revised climate zones retain the bands of 1,000 Heating Degree Days (HDD) 18°C (1800 HDD65°F) that facilitate the use of both SI and inch-pound (I-P) units. ASHRAE 169 expands the number of climate zones from eight to nine. The existing

Climate Zone 1 is subdivided into two overarching zones: “extremely hot” and “very hot.” The “extremely hot” climate zone encompasses a huge swath of highly populated equatorial areas outside North America and represents the hottest areas of the world. The humid portion of the extremely hot climate zone includes over 250 weather sites within over 60 countries. The dry portion of the extremely hot climate zone includes more than 75 weather sites within 20 countries.

In terms of the climate data, the updated version of Standard 169 reflects a general warming of most, but not all, climate sites. Consequently, most of the climate sites remain in the same thermal climate zone as defined previously (with the notable exception of those locations in the thermal Climate Zone 0). However, there are over 300 counties in the United States that are assigned to climate zones. The reassignment of climate zones within the US will result in a lessening of energy-efficiency requirements, until the revised climate zone assignments are accompanied by revisions to the energy-efficiency provisions. The change to climate zone assignments affects two-thirds of the states, in virtually all of the climate zones, but most of the changes are to counties in moderate Climate Zones 4 and 5.

SECTION C301—CLIMATE ZONES

C301.1 General. *Climate zones* from Figure C301.1 or Table C301.1 shall be used for determining the applicable requirements from Chapter 4. Locations not indicated in Table C301.1 shall be assigned a *climate zone* in accordance with Section C301.3.

C Climate involves temperature, moisture, wind and sun, and includes both daily and seasonal patterns of variation of the parameters. To account for these variations, the code establishes climate zones that serve as the basis for the code provisions.

This section serves as the starting point for determining many code requirements, especially under the prescriptive compliance path. Table C301.1 lists and notes the climate zone for each county and territory in the United States. Additionally, the US climate zones are shown in the map in Figure C301.1. Whether the map or the county list is used, the climate classification for each area will be the same.

When following the Prescriptive Compliance path (see commentary, Section C401.2.1) code requirements are based on climate zone, the code user would simply look at the listing in Table C301.1 and select the proper climate zone based on the location of the building.

However, where the Simulated Building Performance path is the selected compliance option, additional climatic data may be needed for modeling purposes. Recall the Simulated Building Performance Compliance path allows users to perform an energy analysis and demonstrate compliance based on equivalence with the referenced design. To perform these analyses, users must select appropriate weather data for their given project’s location. It is recommended that US locations use TMY3 weather data files, which can be found at https://energyplus.net/weather/.

FIGURE C301.1—CLIMATE ZONES

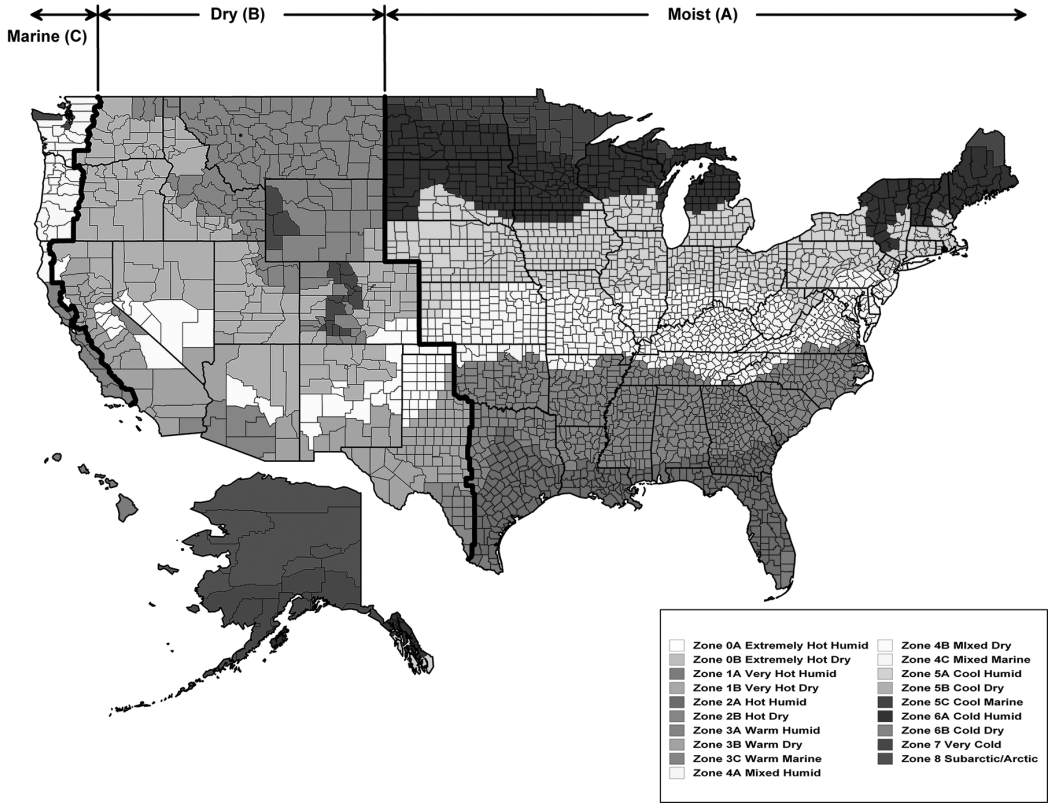


TABLE C301.1—CLIMATE ZONES, MOISTURE REGIMES AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY[a]

US STATES
ALABAMA
3A Autauga*
2A Baldwin*
3A Barbour*
3A Bibb
3A Blount
3A Bullock*
3A Butler*
3A Calhoun
3A Chambers
3A Cherokee
3A Chilton
3A Choctaw*
3A Clarke*
3A Clay
3A Cleburne
2A Coffee*
3A Colbert
3A Conecuh*
3A Coosa
2A Covington*
3A Crenshaw*
3A Cullman
2A Dale*
3A Dallas*
3A DeKalb
3A Elmore*
2A Escambia*
3A Etowah
3A Fayette
3A Franklin
2A Geneva*
3A Greene
3A Hale
2A Henry*
2A Houston*
3A Jackson
3A Jefferson
3A Lamar
3A Lauderdale
3A Lawrence
3A Lee
3A Limestone
3A Lowndes*
3A Macon*
3A Madison
3A Marengo*
3A Marion
3A Marshall
2A Mobile*
3A Monroe*
3A Montgomery*
3A Morgan
3A Perry*
3A Pickens
3A Pike*
3A Randolph
3A Russell*
3A Shelby
3A St. Clair
3A Sumter
3A Talladega
3A Tallapoosa
3A Tuscaloosa
3A Walker
3A Washington*
3A Wilcox*
3A Winston
ALASKA
7 Aleutians East
7 Aleutians West
7 Anchorage
7 Bethel
7 Bristol Bay
8 Denali
7 Dillingham
8 Fairbanks North Star
6A Haines
6A Juneau
7 Kenai Peninsula
5C Ketchikan Gateway
6A Kodiak Island
7 Lake and Peninsula
7 Matanuska-Susitna
8 Nome
8 North Slope
8 Northwest Arctic
5C Prince of Wales Outer Ketchikan
5C Sitka
6A Skagway-Hoonah-Angoon
8 Southeast Fairbanks

TABLE C301.1—CLIMATE ZONES, MOISTURE REGIMES AND WARM HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY[a]—continued

US STATES—continued
ALASKA *(continued)*
7 Valdez-Cordova
8 Wade Hampton
6A Wrangell-Petersburg
7 Yakutat
8 Yukon-Koyukuk
ARIZONA
5B Apache
3B Cochise
5B Coconino
4B Gila
3B Graham
3B Greenlee
2B La Paz
2B Maricopa
3B Mohave
5B Navajo
2B Pima
2B Pinal
3B Santa Cruz
4B Yavapai
2B Yuma
ARKANSAS
3A Arkansas
3A Ashley
4A Baxter
4A Benton
4A Boone
3A Bradley
3A Calhoun
4A Carroll
3A Chicot
3A Clark
3A Clay
3A Cleburne
3A Cleveland
3A Columbia*
3A Conway
3A Craighead
3A Crawford
3A Crittenden
3A Cross
3A Dallas
3A Desha
3A Drew
3A Faulkner
3A Franklin
4A Fulton
3A Garland
3A Grant
3A Greene
3A Hempstead*
3A Hot Spring
3A Howard
3A Independence
4A Izard
3A Jackson
3A Jefferson
3A Johnson
3A Lafayette*
3A Lawrence
3A Lee
3A Lincoln
3A Little River*
3A Logan
3A Lonoke
4A Madison
4A Marion
3A Miller*
3A Mississippi
3A Monroe
3A Montgomery
3A Nevada
4A Newton
3A Ouachita
3A Perry
3A Phillips
3A Pike
3A Poinsett
3A Polk
3A Pope
3A Prairie
3A Pulaski
3A Randolph
3A Saline
3A Scott
4A Searcy
3A Sebastian
3A Sevier*
3A Sharp
3A St. Francis

CHAPTER

4 [CE] COMMERCIAL ENERGY EFFICIENCY

General Comments

Energy fuels our lives–businesses, households, and society in general. Yet, energy use and associated greenhouse gas emissions can pose significant challenges to communities, homeowners and renters, and business owners. For example:

- Americans currently spend more than $200 billion annually on energy bills.
- Globally, buildings and building construction sectors combined are responsible for over one-third of global final energy consumption and nearly 40 percent of total direct and indirect CO_2 emissions.

However, there are solutions. Building energy codes contribute to the health, safety and welfare of communities and citizens, reducing energy bills, improving occupant and community health, enhancing resilience and reducing greenhouse gas emissions.

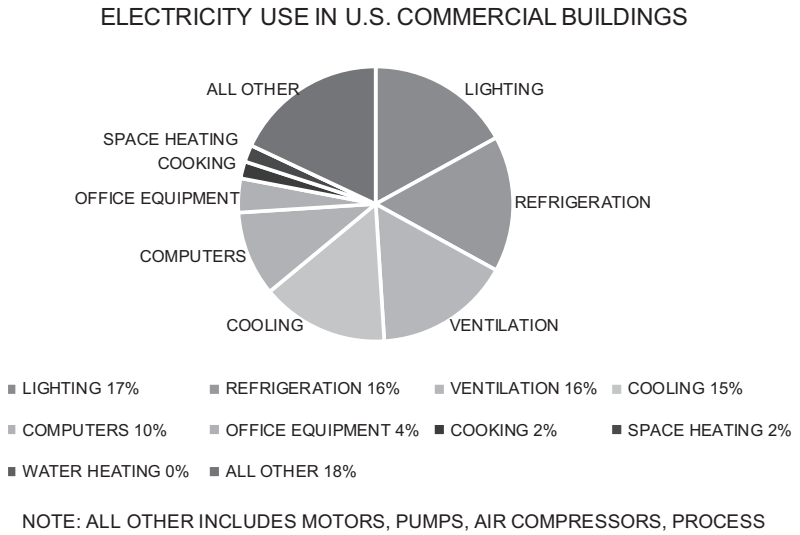
When we look at how buildings use energy, the targets for reduction are clear. Commentary Figure 4C(1) illustrates commercial building energy use in the United States.

Although the distribution of energy use varies by climate, building occupancy type and occupancy use, this chart illustrates clear targets for reduction. Chapter 4 includes the requirements of the code that address the design of all building systems that individually and collectively affect building energy use, including:

- Wall, roof and floor insulation.
- Windows and skylights.
- Cooling equipment (air conditioners, chillers and cooling towers).
- Heating equipment (boilers, furnaces and heat pumps).
- Pumps, piping and liquid circulation systems.
- Heat rejection equipment (fan cooling towers, air-cooled condensers).
- Service water heating (kitchens, lavatories and pools).
- Electrical power and lighting systems (lighting types, densities, zones, and controls).
- Energy-using equipment (walk-in coolers and freezers, electric transformers and motors, elevators and escalators).

Chapter 4 presents the paths and options for compliance with the energy-efficiency provisions. A performance alternative is also provided to allow for energy code compliance other than by the prescriptive method, and compliance with ASHRAE 90.1 is an alternative. This chapter contains the energy-efficiency-related requirements for the design and construction of commercial buildings regulated under the code. The applicable portions of the building must comply with the provisions in this chapter for energy efficiency.

Commentary Figure 4C(1)—Commercial Sector Building Energy Use



Chapter 4 [CE] presents the paths and options for compliance for most types of commercial buildings. See Commentary Figure 4C(2). The definitions of "Residential" and "Commercial" buildings result in buildings of residential use that are greater than three stories in height above grade to be classified as commercial buildings and are, therefore, regulated under this half of the code [see Commentary Figure 4C(1)]. Commercial buildings will include Group R-1 occupancies (hotels and motels) of any height. Institutional occupancies such as hospitals and nursing homes are also considered to be commercial buildings.

In accordance with Sections C402.1.1 and C402.1.2, the thermal envelope requirements of the code do not apply to:

- Very low energy use buildings (less than 3.4 Btu per hour per square foot or 1 watt per square foot of floor area).
- Buildings or portions of buildings that are neither heated nor cooled.
- Low Energy Greenhouses.
- Small equipment buildings.
- Some or all provisions of the code are modified or not applicable for the following buildings or actions (see Chapter 5 [CE]):
- Continued use of existing buildings.
- Historic buildings.
- Additions, alterations, renovations or repairs.

Section C401 provides general requirements for commercial buildings and specifies the three alternative compliance options.

Section C402 provides building thermal envelope standards for commercial buildings, including limitations on air infiltration (leakage).

Section C403 contains the mechanical system requirements for energy-efficient heating, ventilation and air-conditioning (HVAC) systems.

Section C404 provides regulations regarding the heating of service water as well as heat recovering of drain water.

Section C405 addresses lighting systems, including controls and the total allowed power for both interior and exterior systems. This section also provides energy efficiency standards for other electrical systems, receptacle controls and metering requirements.

Section C406 requires that all commercial building designs include 10 points of efficiency savings from Section C406. The section provides 11 methods by which additional energy can be saved using a newly revised points system based on energy savings associated with each climate zone.

Section C407 provides the requirements for buildings designed under the simulated building performance approach.

Section C408 provides commissioning requirements applicable to most buildings regardless of the compliance path selected by the designer.

Section C409 provides the requirements for Total System Performance Ratio (TSPR). TSPR is a compliance option for Section C403.

Note the use of italics throughout Chapter 4. These are intended to draw attention to the associated definitions in Chapter 2.

Note the IECC covers commercial buildings and building sites and associated systems and equipment as they are defined in Chapter 2 [CE] as buildings that are not residential.

Purpose

This chapter covers "commercial" buildings as they are defined in Chapter 2 [CE], which includes all buildings that are not residential; e.g., IECC commercial buildings are IECC nonresidential buildings. A review of the definition is important because some buildings that are classified as "residential" by the *International Building Code*® (IBC®), such as hotels, motels and other transient occupancies are not included in the IECC definition of "Residential" and would, therefore, need to comply with the commercial provisions of this chapter. In addition, Group R-2, R-3 and R-4 buildings greater than three stories are also governed by the commercial provisions.

This chapter describes the specific requirements for the portions of the building and building systems that impact energy use in commercial construction and promotes the effective use and conservation of energy that is in line with the intent of the code expressed in Section R101.3. The provisions in the chapter promote energy efficiency in the building envelope, the heating and cooling system, the service water-heating system and the lighting of the building. Compliance with this chapter will provide a minimum level of energy efficiency for new construction.

Commentary Figure 4C(2)—Examples of Building Types Covered by Chapter 4

Airports	Indoor sporting facilities
Apartment buildings and condominiums (more than three stories)	Industrial work buildings
Assembly and conference areas	Laboratories
Banks	Libraries
Barber shops and beauty parlors	Museums and galleries
Bowling alleys	Nursing homes
Churches, synagogues and chapels	Offices
Commercial or industrial warehouses	Police and fire houses
Convention centers	Restaurants
Dormitories (more than three stories)	Retail, grocery and wholesale stores
Exhibit halls	Schools
Gymnasiums	Shopping malls
Health clubs	Shops
High-rise residential	Sporting arenas
Hospitals	Theaters and auditoriums
Hotels and motels	Warehouses and storage facilities

Note: This table includes only examples of building types covered by the code. It is not intended to be an exhaustive list. Other building types may be covered, even though they are not listed.

SECTION C401—GENERAL

C401.1 Scope. The provisions in this chapter are applicable to *commercial buildings* and their *building sites*.

C This chapter applies to commercial buildings, including Group R occupancies, that contain residential uses but are outside of the code's definition of "Residential building." Chapter 4 [CE] does not apply to low-rise residential buildings such as single-family homes, duplexes and other Group R-2, R-3 and R-4 occupancies three stories or less in height.

The code does not limit or regulate the energy use intended primarily for manufacturing or for commercial or industrial processing. Although the energy for manufacturing and processing is excluded, the envelope, mechanical systems, service water heating and electrical power and lighting systems of these buildings are regulated.

C401.2 Application. *Commercial buildings* shall comply with Section C401.2.1 or C401.2.2.

C This section specifies the compliance options using the IECC for Prescriptive or Simulated Building Performance, or using ASHRAE/IES Standard 90.1. Naming the compliance options (prescriptive, performance) formalizes the way in which the paths are typically identified. A code user may evaluate all three options and use the one that fits the project best; however, a user cannot pick and choose from multiple options. Once a compliance option is selected, the building must fully comply with that option.

Most of the requirements of this chapter are based on the climate zone where the project is being built. The climate zone map and list of United States counties can be found in Section C301.1. Climate Zones 1 through 7 apply to various parts of the continental United States and are defined by county lines. Climate Zones 7 and 8 apply to various parts of Alaska. Hawaii is classified as Climate Zone 1. Climate Zone 0 is applied to very hot climates outside of the US, ranging from Caribbean Islands to Saudi Arabia. The climate zones have been divided into marine, dry and moist to address levels of humidity. For more details and background on the development of the climate zones, see the commentary to Section C301.1.

C401.2.1 International Energy Conservation Code. *Commercial buildings* shall comply with one of the following:

1. Prescriptive Compliance. The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. *Dwelling units* and *sleeping units* in Group R-2 buildings shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. *Simulated Building Performance*. The *Simulated Building Performance* option requires compliance with Section C407.

Exception: *Additions*, *alterations*, *repairs* and changes of occupancy to existing buildings complying with Chapter 5.

C Chapter 4 [CE] applies to a wide variety of buildings across nine climate zones with the goal of consistently achieving energy-efficient building performance. The IECC includes two compliance options—prescriptive and simulated building performance. Prescriptive compliance requirements are found in Sections C402 through C406, plus the commissioning requirements of C408.

Where prescriptive compliance is selected, Section C402 insulation requirements can be met in one of three ways: component *R*-value compliance per Section C402.1.3, assembly *U*-factor compliance per Section C402.1.4 or component performance per Section C402.1.5.

Simulated Building Performance requirements are identified in C407. Table C407.2 lists the sections that detail requirements for Simulated Building Performance (see commentary, Section C407.2).

C401.2.2 ASHRAE 90.1. *Commercial buildings* shall comply with the requirements of ANSI/ASHRAE/IES 90.1.

C ASHRAE 90.1 in its entirety, is an alternative compliance path to the IECC. It also provides a prescriptive compliance path and performance-based design paths.

C401.3 Building thermal envelope certificate. A permanent *building thermal envelope* certificate shall be completed by an *approved* party. Such certificate shall be posted on a wall in the space where the space conditioning equipment is located, a utility room or other *approved* location. If located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. A copy of the certificate shall also be included in the construction files for the project. The certificate shall include the following:

1. *R*-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, *basement walls*, *crawl space walls* and floors and *ducts* outside *conditioned spaces*.
2. *U-factors* and *solar heat gain coefficients* (SHGC) of *fenestrations*.
3. Results from any *building thermal envelope air leakage* testing performed on the *building*.

Where there is more than one value for any component of the *building thermal envelope*, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10 percent or more of the total component area.

C This section requires a permanent certificate to commercial buildings that will record basic information related to the building thermal envelope. This is like the requirement for residential buildings in Section R401.3, which has been in the IECC since at least the 2006 edition and has been successfully integrated into software programs such as REScheck.

Under Section C408, a significant percentage of commercial buildings will undergo system commissioning, which will include documentation of mechanical and lighting systems. However, there is no similar requirement or documentation for the building's thermal envelope components. Due to the broad range of commercial buildings, the certificate requirement covers only the basic elements of the thermal envelope.

The information contained in this certificate will be readily available at construction, but as the building ages and ownership is transferred, some of this critical information could be lost. As future owners or lessors undertake load calculations for HVAC sizing or other measures that require a working knowledge of the building's thermal envelope characteristics, this information will be important. Recording the information in a permanent manner in an approved location at the building, as well as including documentation in the construction files for the project will provide valuable information to future building owners.

SECTION C402—BUILDING THERMAL ENVELOPE REQUIREMENTS

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of Section C402.1.2, C402.1.3 or C402.1.4. Where the total area of through penetrations of mechanical equipment is greater than 1 percent of the opaque *above-grade wall* area, the *building thermal envelope* shall comply with Section C402.1.2.1.8.
2. Wall solar reflectance and thermal *emittance* shall comply with Section C402.3.
3. Roof solar reflectance and thermal *emittance* shall comply with Section C402.4.
4. *Fenestration* in the *building thermal envelope* shall comply with Section C402.5. Where *buildings* have a vertical *fenestration* area or skylight area greater than that allowed in Section C402.5, the *building* and *building thermal envelope* shall comply with Item 2 of Section C401.2.1, C401.2.2 or C402.1.4.
5. *Air leakage* of *building thermal envelope* shall comply with Section C402.6.
6. *Thermal bridges* in *above-grade walls* shall comply with Section C402.7.
7. *Walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall comply with Section C403.12.

C The building envelope is important to building energy efficiency; it is a key term and resounding theme used throughout the energy requirements. When it is cold outside, heat loss and air leakages through the building envelope add to the heating load. On hot days, solar gains through windows, heat gain through opaque assemblies and infiltration of hot or humid air contribute to the air-conditioning (cooling) load. The building envelope requirements of Section C402 are intended to reduce heat gains and losses through the building envelope. The building envelope is defined in C202 as "the basement