STANDARD

**ANSI/ASHRAE/IES Standard 90.1-2013**
(Supersedes ANSI/ASHRAE/IES Standard 90.1-2010)
Includes ANSI/ASHRAE/IES Addenda listed in Appendix F

# Energy Standard for Buildings Except Low-Rise Residential Buildings

## (I-P Edition)

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IES Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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### Energy Standard for Buildings Except Low-Rise Residential Buildings (I-P Edition)


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**NOTE**

**Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.**

**(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)**

## FOREWORD

*The original Standard 90.1 was published in 1975, and revised editions were published in 1980, 1989, and 1999 using the ANSI and ASHRAE periodic maintenance procedures. Based upon these procedures, the entire standard was publicly reviewed and published in its entirety each time. As energy prices and technology began changing more rapidly, the ASHRAE Board of Directors voted in 1999 to place the standard on continuous maintenance, permitting the standard to be updated several times each year through the publication of approved addenda to the standard. As of the 2001 edition, the standard is now published in its entirety in the fall of every third year. This schedule allows the standard to be submitted and proposed by the deadline for inclusion or reference in model building and energy codes. All approved addenda and errata are included in the new edition issued every three years. This procedure allows users to have some certainty of the timing of publication of new editions.*

*The 2013 edition of the standard includes numerous energy-saving measures resulting from continuous maintenance proposals from the public and from volunteers on the committee. The Project Committee welcomes suggestions for improvement, and users are encouraged to use the continuous maintenance proposal (CMP) form included in the back of this standard to submit recommended changes. The committee takes formal action on every CMP received.*

*More than 110 addenda were processed by the committee and approved by the ASHRAE and IES Boards of Directors and are included in this edition. This edition also corrects all known typographical errors in the 2010 standard. Appendix F gives brief descriptions and publication dates of the addenda to Standard 90.1-2010 that are incorporated into this new edition.*

*The most significant changes included are as follows:*

a. ***Building Envelope.*** *Opaque elements and fenestration requirements have been revised to increase stringency while maintaining a reasonable level of cost-effectiveness. Opaque and fenestration assemblies in Tables 5.5-1 through 5.5-8 are revised in most climates. These changes include*
   1. *criteria requiring double-glazed fenestration in many climates;*
   2. *minimum VT/SHGC ratio to enable good daylighting with minimum solar gain, while not restricting triple and quadruple glazing; and*
   3. *simplification of the skylighting criteria.*

b. ***Lighting.*** *These changes include improvements to daylighting and daylighting controls, space-by-space lighting power density limits, thresholds for toplighting, and revised controls requirements and format.*

c. ***Mechanical.*** *Equipment efficiencies were revised upward for heat pumps, packaged terminal air conditioners (PTAC), single-package vertical heat pumps and air conditioners (SPVHP and SPVAC), and evaporative condensers. Also, fan efficiency requirements were introduced for the first time. Additional provisions that have been included address commercial refrigeration equipment, improved controls on heat rejection and boiler equipment, requirements for expanded use of energy recovery, small motor efficiencies, and fan power control and credits. Control revision requirements were added to the standard, such as DDC controls in many applications. Finally, the 2013 edition completes the work that was begun on equipment efficiencies for chillers in the 2010 edition.*

d. ***Energy Cost Budget (ECB) and Modeling.*** *Improvements were made to the ECB and Appendix G provisions in the standard to clarify the use of the prescriptive provisions when performing building-energy-use modeling. In addition, these sections were revised to enhance capturing daylighting when performing the modeling calculations.*

*Another important change for the 2013 edition is the first alternate compliance path in Section 6. Section 6.6 was added to the 2010 edition to provide a location for alternate methods of compliance with the standard. The first such alternate path has been developed for computer room systems and was formulated with the assistance of the data center technical committee (TC9.9). This path uses the PUE (Power Usage Effectiveness) metric that was established by that industry. This alternate efficiency path format provides a framework that could be considered for other energy-using facets of buildings not easily covered in the prescriptive provisions of the standard. Also new to the standard are requirements for operating escalators and moving walkways at minimum speed, per ASME A17.1, when not conveying passengers.*

*Standard 90.1 is a fluid document. As technology evolves, the project committee is continually considering new changes and proposing addenda for public review. When addenda are approved, notices will be published on the ASHRAE and IES websites. Users are encouraged to sign up for the free ASHRAE and IES Internet listserv for this standard to receive notice of all public reviews and approved and published addenda and errata.*

*The Chair and Vice-Chairs extend grateful thanks to the committee volunteers, public review commenters, and all involved throughout the open, consensus-building process.*

## 1. PURPOSE

To establish the minimum energy efficiency requirements of buildings other than low-rise residential buildings for

a. design, construction, and a plan for operation and maintenance; and
b. utilization of on-site, renewable energy resources.

## 2. SCOPE

**2.1** This standard provides

a. minimum energy-efficient requirements for the design and construction, and a plan for operation and maintenance of
   1. new buildings and their systems,
   2. new portions of buildings and their systems,
   3. new systems and equipment in existing buildings, and
   4. new equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes

   and
b. criteria for determining compliance with these requirements.

**2.2** The provisions of this standard do not apply to

a. single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular) or
b. buildings that use neither electricity nor fossil fuel.

**2.3** Where specifically noted in this standard, certain other buildings or elements of buildings shall be exempt.

**2.4** This standard shall not be used to circumvent any safety, health, or environmental requirements.

## 3. DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

**3.1 General.** Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard. Terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based upon American standard English language usage as documented in an unabridged dictionary accepted by the adopting authority.

**3.2 Definitions**

***above-grade wall:*** see *wall.*

***access hatch:*** see *door.*

***addition:*** an extension or increase in floor area or height of a building outside of the existing building envelope.

***adopting authority:*** the agency or agent that adopts this standard.

***air economizer:*** see *economizer, air.*

***air system balancing:*** see *balancing, air system*.

***alteration:*** a replacement or addition to a building or its systems and equipment; routine maintenance, repair, and service, or a change in the building's use classification or category shall not constitute an alteration.

***annual fuel utilization efficiency (AFUE):*** an efficiency descriptor of the ratio of annual output energy to annual input energy as developed in accordance with the requirements of U.S. Department of Energy (DOE) 10 CFR Part 430.

***astronomical time switch:*** a device that turns the lighting on at a time relative to sunset and off at a time relative to sunrise, accounting for geographic location and day of year.

***attic and other roofs:*** see *roof.*

***authority having jurisdiction:*** the agency or agent responsible for enforcing this standard.

***automatic:*** self-acting, operating by its own mechanism when actuated by some nonmanual influence, such as a change in current strength, pressure, temperature, or mechanical configuration.

***automatic control device:*** a device capable of automatically turning loads off and on without manual intervention.

***balancing, air system:*** adjusting airflow rates through air distribution system devices, such as fans and diffusers, by manually adjusting the position of dampers, splitter vanes, extractors, etc., or by using automatic control devices, such as constant-air-volume or variable-air-volume (VAV) boxes.

***balancing, hydronic system:*** adjusting water flow rates through hydronic distribution system devices, such as pumps and coils, by manually adjusting the position valves or by using automatic control devices, such as automatic flow control valves.

***ballast:*** a device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under the proper circuit conditions of voltage, current, wave form, electrode heat, etc.

> ***electronic ballast:*** a ballast constructed using electronic circuitry.
>
> ***hybrid ballast:*** a ballast constructed using a combination of magnetic core and insulated wire winding and electronic circuitry.
>
> ***magnetic ballast:*** a ballast constructed with magnetic core and a winding of insulated wire.

***baseline building design:*** a computer representation of a hypothetical design based on the proposed building project. This representation is used as the basis for calculating the baseline building performance for rating above-standard design.

***baseline building performance:*** the annual energy cost for a building design intended for use as a baseline for rating above-standard design.

***below-grade wall:*** see *wall*.

***boiler:*** a self-contained, low-pressure appliance for supplying steam or hot water.

> ***modulating boiler:*** a boiler that is capable of more than a single firing rate in response to a varying temperature or heating load.
>
> ***packaged boiler:*** a boiler that is shipped complete with heating equipment, mechanical draft equipment, and automatic controls, and that is usually shipped in one or more sections. A packaged boiler includes factory-built boilers manufactured as a unit or system, disassembled for shipment, and reassembled at the site.

***branch circuit:*** the circuit conductors between the final overcurrent device protecting the circuit and the outlet(s); the final wiring run to the load.

***bubble point:*** the refrigerant liquid saturation temperature at a specified pressure.

***budget building design:*** a computer representation of a hypothetical design based on the actual proposed building design. This representation is used as the basis for calculating the energy cost budget.

***building:*** a structure wholly or partially enclosed within exterior walls, or within exterior and party walls, and a roof, affording shelter to persons, animals, or property.

***building entrance:*** any doorway, set of doors, revolving door, vestibule, or other form of portal that is ordinarily used to gain access to the building or to exit from the building by its users and occupants. This does not include doors solely used to directly enter mechanical, electrical, and other building utility service equipment rooms.

***building envelope:*** the exterior plus the semi-exterior portions of a building. For the purposes of determining building envelope requirements, the classifications are defined as follows:

> ***exterior building envelope:*** the elements of a building that separate conditioned spaces from the exterior.
>
> ***semi-exterior building envelope:*** the elements of a building that separate conditioned space from unconditioned space or that enclose semiheated spaces through which thermal energy may be transferred to or from the exterior, to or from unconditioned spaces, or to or from conditioned spaces.

***building envelope trade-off schedules and loads*:** the schedules and internal loads[1], by building area type, to be used in the building envelope trade-off option simulations described in Appendix C.

***building exit:*** any doorway, set of doors, or other form of portal that is ordinarily used only for emergency egress or convenience exit.

***building grounds lighting:*** lighting provided through a building's electrical service for parking lot, site, roadway, pedestrian pathway, loading dock, or security applications.

***building material:*** any element of the building envelope, other than air films and insulation, through which heat flows and that is included in the component U-factor calculations.

***building official:*** the officer or other designated representative authorized to act on behalf of the authority having jurisdiction.

***C-factor:*** see *thermal conductance.*

***circuit breaker:*** a device designed to open and close a circuit by nonautomatic means and to open the circuit automatically at a predetermined overcurrent without damage to itself when properly applied within its rating.

1. Schedules and internal loads, by building area type, are located at http://sspc901.ashraepcs.org/content.html.

***class of construction:*** for the building envelope, a subcategory of roof, above-grade wall, below-grade wall, floor, slab-on-grade floor, opaque door, vertical fenestration, or skylight. (See *roof*, *wall*, *floor*, *slab-on-grade floor*, *door*, and *fenestration*.)

***code official:*** see *building official*.

***coefficient of performance (COP)—cooling:*** the ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

***coefficient of performance (COP), heat pump—heating:*** the ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions.

***computer room:*** a room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density exceeding 20 W/ft$^2$ of conditioned floor area.

***computer room energy:*** annual energy use of the data center, including all IT equipment energy, plus energy that supports the IT equipment and computer room space, calculated in accordance with industry-accepted standards defined as Total Annual Energy (see Informative Appendix E).

***condensing unit:*** a factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant. It consists of one or more refrigerant compressors, refrigerant condensers (air cooled, evaporatively cooled, and/or water-cooled), condenser fans and motors (where used), and factory-supplied accessories.

***conditioned floor area, gross:*** see *floor area, gross.*

***conditioned space:*** see *space*.

***conductance:*** see *thermal conductance*.

***construction:*** the fabrication and erection of a new building or any addition to or alteration of an existing building.

***construction documents:*** drawings and specifications used to construct a building, building systems, or portions thereof.

***continuous air barrier:*** the combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope.

***continuous daylight dimming:*** method of automatic lighting control using daylight photosensors, where the lights are dimmed continuously, or using at least four preset levels with at least a five-second fade between levels, where the control turns the lights off when sufficient daylight is available.

***continuous insulation (c.i.):*** insulation that is uncompressed and continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

***control:*** to regulate the operation of equipment.

***control device:*** a specialized device used to regulate the operation of equipment.

***cooldown:*** reduction of space temperature down to occupied setpoint after a period of shutdown or setup.

***cooled space:*** see *space*, *conditioned space*.

***cooling degree-day, base (CDD):*** see *degree-day.*

***cooling design temperature:*** the outdoor dry-bulb temperature equal to the temperature that is exceeded by 1% of the number of hours during a typical weather year.

***cooling design wet-bulb temperature:*** the mean coincident outdoor wet-bulb temperature utilized in conjunction with the cooling design dry-bulb temperature, often used for the sizing of cooling systems.

***critical circuit:*** the hydronic circuit that determines the minimum differential pressure that the pump must produce to satisfy the zone loads (e.g., the circuit with the most-open valve). The critical circuit is the one with the highest pressure drop required to satisfy its load. At part-load conditions, the critical circuit can change based on zone loads.

***daylight area:***

***daylight area under roof monitors:*** the daylight area under roof monitors is the combined daylight area under each roof monitor within each space. The daylight area under each roof monitor is the product of

a. the width of the vertical fenestration above the ceiling level plus, on each side, the smallest of
   1. 2 ft,
   2. the distance to any 5 ft or higher vertical obstruction, or
   3. the distance to the edge of any primary sidelighted area

and

b. the smaller of the following horizontal distances inward from the bottom edge of the vertical fenestration (see Figure 3.2-1):
   1. The monitor sill height (MSH) (the vertical distance from the floor to the bottom edge of the monitor glazing)
   2. The distance to the nearest face of any opaque vertical obstruction, where any part of the obstruction is farther away than the difference between the height of the obstruction and the monitor sill height (MSH – OH).

***daylight area under skylights:*** the daylight area under skylights is the combined daylight area under each skylight within a space. The daylight area under each skylight is bounded by the opening beneath the skylight and horizontally in each direction (see Figure 3.2-2), the smaller of

a. 70% of the ceiling height (0.7 × CH), or
b. the distance to the nearest face of any opaque vertical obstruction, where any part of the obstruction is farther away than 70% of the distance between the top of the obstruction and the ceiling (0.7 × [CH – OH], where CH = the height of the ceiling at the lowest edge of the skylight and OH = the height to the top of the obstruction).

***primary sidelighted area:*** the total primary sidelighted area is the combined primary sidelighted area within each space. Each primary sidelighted area is directly adjacent to vertical fenestration below the ceiling (see Figure 3.2-3).

a. The primary sidelighted area width is the width of the vertical fenestration plus, on each side, the smaller of
   1. one half of the vertical fenestration head height (where head height is the distance from the floor to the top of the glazing) or
   2. the distance to any 5 ft or higher opaque vertical obstruction.
b. The primary sidelighted area depth is the horizontal distance perpendicular to the vertical fenestration which is the smaller of
   1. one vertical fenestration head height or
   2. the distance to any 5 ft or higher opaque vertical obstruction.

***secondary sidelighted area:*** the total secondary sidelighted area is the combined secondary sidelighted area within a space. Each secondary sidelighted area is directly adjacent to a primary sidelighted area (see Figure 3.2-4):

a. The secondary sidelighted area width is the width of the vertical fenestration plus, on each side, the smaller of
   1. one half of the vertical fenestration head height or
   2. the distance to any 5 ft or higher opaque vertical obstruction.
b. The secondary sidelighted area depth is the horizontal distance perpendicular to the vertical fenestration, which begins at the edge of the primary sidelighted area depth and ends at the smaller of
   1. one vertical fenestration head height or
   2. the distance to any 5 ft or higher opaque vertical obstruction.

If the adjacent primary sidelighted area ends at a 5 ftor higher opaque vertical obstruction, there is no secondary sidelighted area beyond such obstruction.

***daylighted area:*** the floor area substantially illuminated by daylight.

***dead band:*** the range of values within which a sensed variable can vary without initiating a change in the controlled process.

***decorative lighting:*** see *lighting*, *decorative*.

***dedicated replacement air:*** see *makeup air.*

***degree-day:*** the difference in temperature between the outdoor mean temperature over a twenty-four-hour period and a given base temperature. For the purposes of determining building envelope requirements, the classifications are defined as follows:

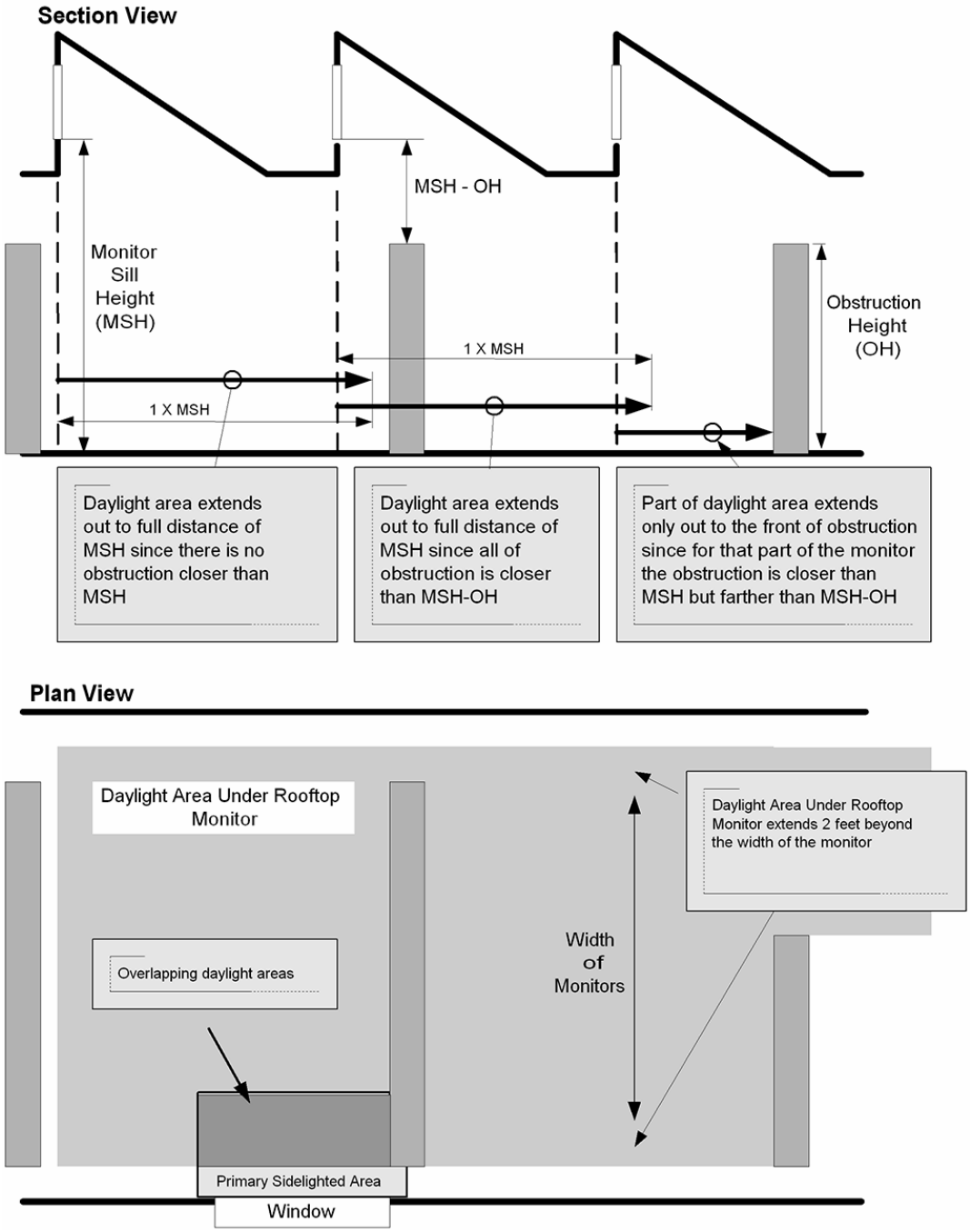


**Figure 3.2-1. Computing the daylight area under roof monitors.**

***cooling degree-day base 50°F (CDD50):*** for any one day, when the mean temperature is more than 50°F, there are as many degree-days as degrees Fahrenheit temperature difference between the mean temperature for the day and 50°F. Annual cooling degree-days (CDDs) are the sum of the degree-days over a calendar year.

***heating degree-day base 65°F (HDD65):*** for any one day, when the mean temperature is less than 65°F, there are as many degree-days as degrees Fahrenheit temperature difference between the mean temperature for the day and 65°F. Annual heating degree-days (HDDs) are the sum of the degree-days over a calendar year.

***demand:*** the highest amount of power (average Btu/h over an interval) recorded for a building or facility in a selected time frame.

***demand control ventilation (DCV):*** a ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

***design capacity:*** output capacity of a system or piece of equipment at design conditions.

***design conditions:*** specified environmental conditions, such as temperature and light intensity, required to be produced

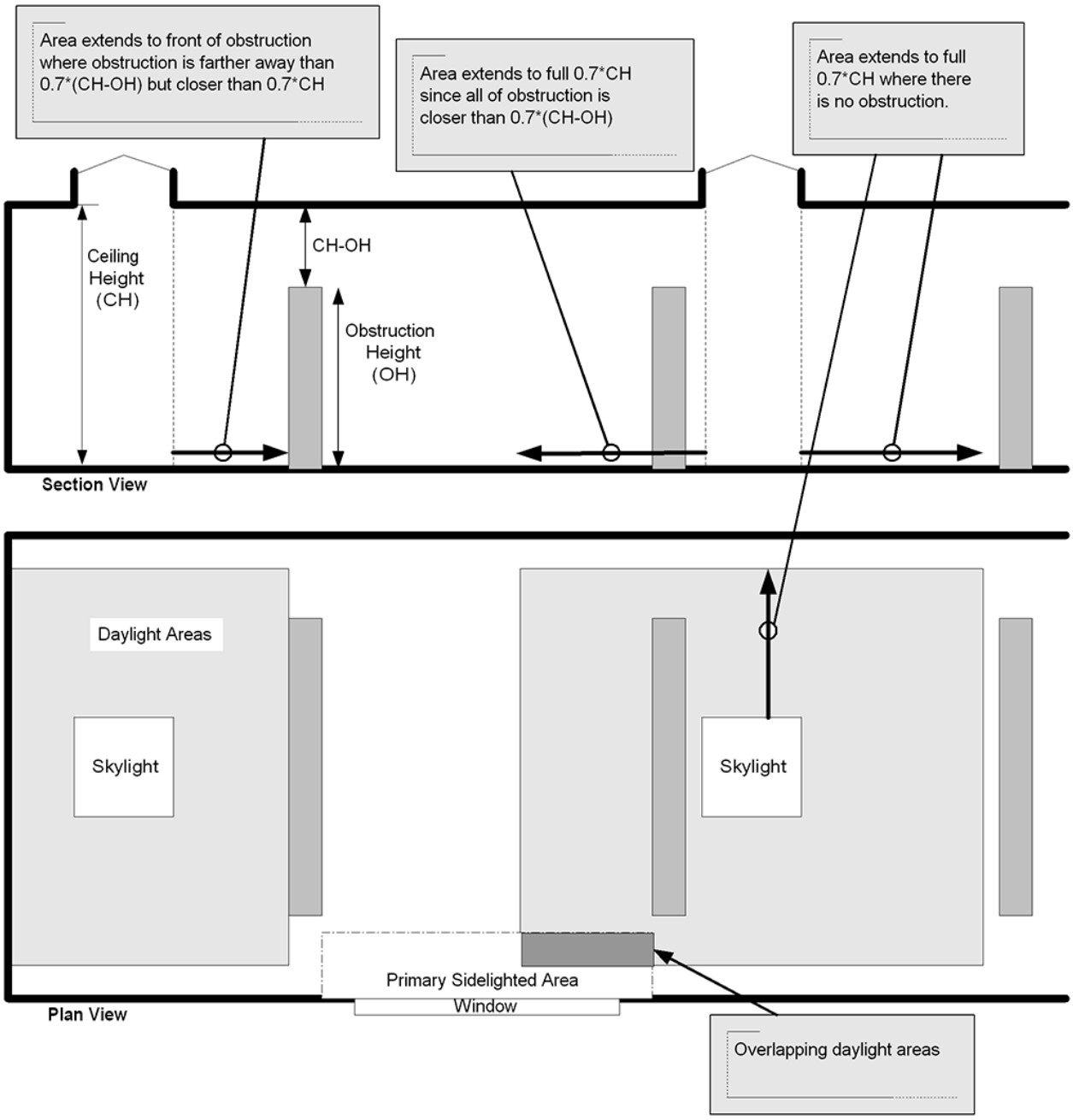


**Figure 3.2-2. Computing the daylight area under skylights.**

and maintained by a system and under which the system must operate.

***design energy cost:*** the annual energy cost calculated for a proposed design.

***design professional:*** an architect or engineer licensed to practice in accordance with applicable state licensing laws.

***direct digital control (DDC):*** a type of control where controlled and monitored analog or binary data (e.g., temperature, contact closures) are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control physical devices.

***disconnect:*** a device or group of devices or other means by which the conductors of a circuit can be disconnected from their source of supply.

***distribution system:*** conveying means, such as ducts, pipes, and wires, to bring substances or energy from a source to the point of use. The distribution system includes such auxiliary equipment as fans, pumps, and transformers.

***door (access hatch):*** all operable opening areas (that are not fenestration) in the building envelope, including swinging and roll-up doors, fire doors, and access hatches. Doors that are more than one-half glass are considered fenestration (see *fenestration*). For the purposes of determining building envelope requirements, the classifications are defined as follows:

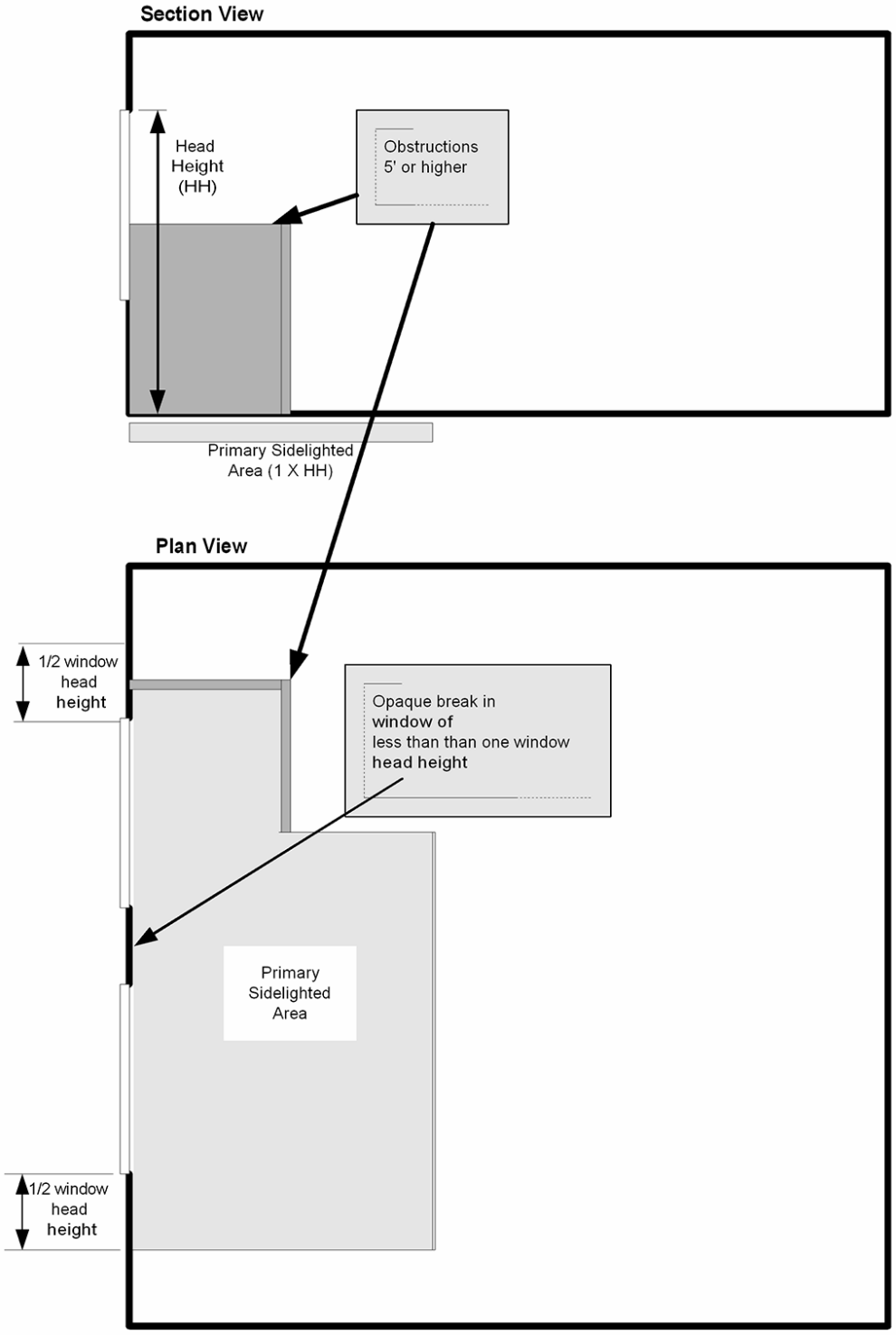


**Figure 3.2-3. Computing the primary sidelighted area.**

***metal coiling door:*** an upward-acting, nonswinging door assembly consisting of interlocking horizontal slats or sheets that, upon opening the door, roll up around a horizontal barrel above the door opening.

***nonswinging door:*** roll-up, metal coiling, sliding, and all other doors that are not swinging doors.

***swinging door:*** all operable opaque panels with hinges on one side and opaque revolving doors.

***door area:*** total area of the door measured using the rough opening and including the door slab and the frame. (See *fenestration area*.)

***ductwork:*** a system of ducts for distribution and extraction of air.

***dwelling unit:*** a single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

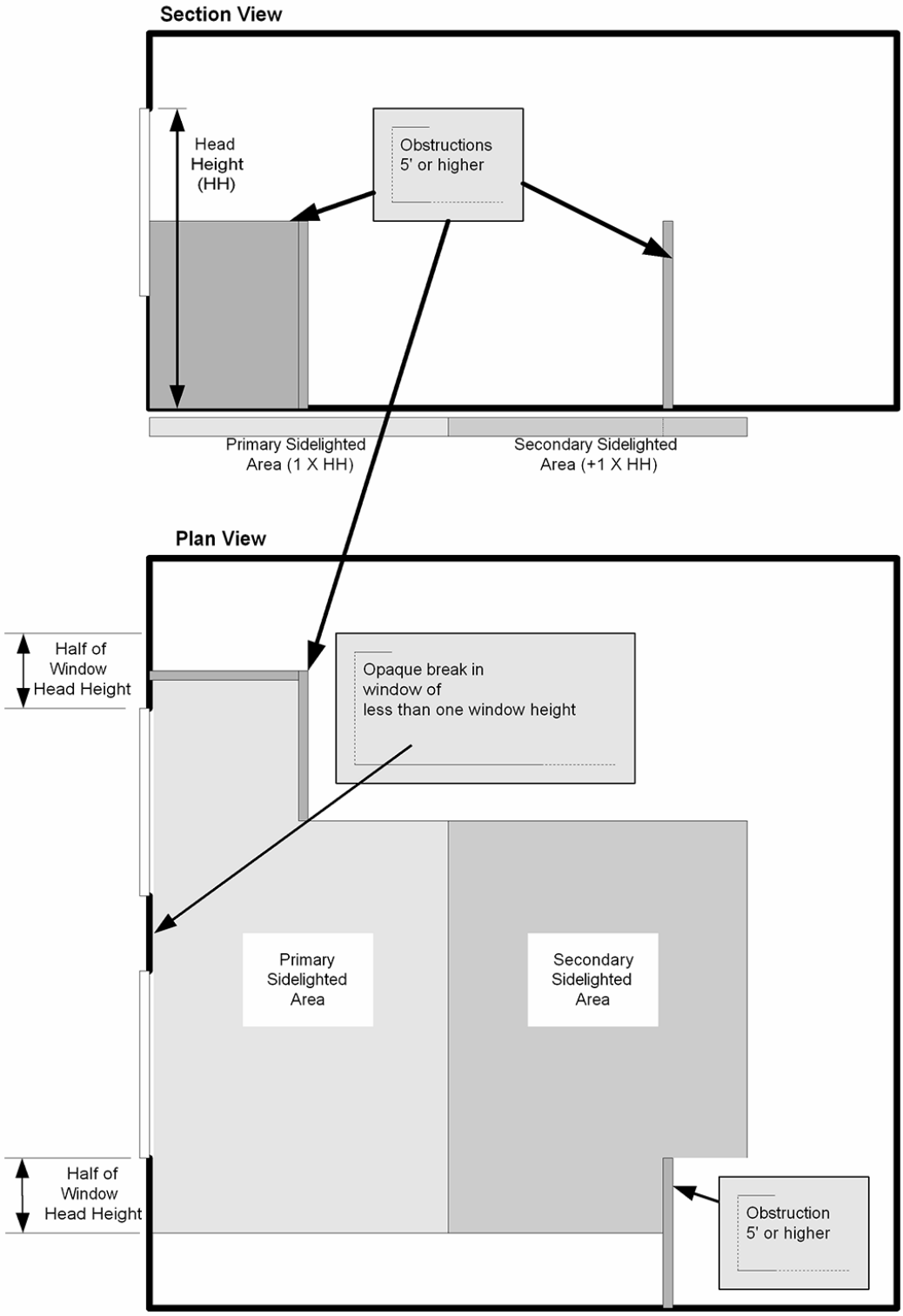


**Figure 3.2-4. Computing the secondary sidelighted area.**

***dynamic glazing:*** any glazing system/glazing infill that has the fully reversible ability to change its performance properties, including U-factor, solar heat gain coefficient, or visible transmittance. This includes, but is not limited to, shading systems between the glazing layers and chromogenic glazing.

***economizer, air:*** a duct and damper arrangement and automatic control system that together allow a cooling system to supply outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

***economizer, water:*** a system by which the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

***effective panel surface:*** see *thermally effective panel surface*.

***efficacy (of a lamp):*** the ratio of the total luminous output of a lamp to the total power input to the lamp, typically expressed in lm/W.

***efficiency:*** performance at specified rating conditions.

***electric resistance:*** see *resistance, electric*.

***emittance:*** the ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions.

***enclosed space:*** a volume substantially surrounded by solid surfaces, such as walls, floors, roofs, and openable devices, such as doors and operable windows.

***energy:*** the capacity for doing work. It takes a number of forms that may be transformed from one into another such as thermal (heat), mechanical (work), electrical, and chemical (Btu).

***energy cost budget:*** the annual energy cost for the budget building design intended for use in determining minimum compliance with this standard.

***energy efficiency ratio (EER):*** the ratio of net cooling capacity (Btu/h) to total rate of electric input in watts under designated operating conditions. (See *coefficient of performance [COP]—cooling*.)

***energy factor (EF):*** a measure of water heater overall efficiency.

***entrance door:*** see *fenestration*.

***envelope performance factor:*** the trade-off value for the building envelope performance compliance option calculated using the procedures specified in Section 5. For the purposes of determining building envelope requirements, the classifications are defined as follows:

> ***base envelope performance factor:*** the building envelope performance factor for the base design.
>
> ***proposed envelope performance factor:*** the building envelope performance factor for the proposed design.

***equipment:*** devices for comfort conditioning, electric power, lighting, transportation, or service water heating, including but not limited to furnaces, boilers, air conditioners, heat pumps, chillers, water heaters, lamps, luminaires, ballasts, elevators, escalators, or other devices or installations.

***essential facility:*** those portions of a building serving one of the following functions:

a. Hospitals and other health care facilities having surgery or emergency treatment facilities
b. Fire, rescue, and police stations and emergency vehicle garages
c. Designated earthquake, hurricane, or other emergency shelters
d. Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response
e. Power-generating stations and other public utility facilities required as emergency backup facilities for other essential facilities
f. Structures containing highly toxic materials where the quantity of the material exceeds the maximum allowable quantities
g. Aviation control towers, air traffic control centers, and emergency aircraft hangars
h. Buildings and other structures having critical national defense functions

***evaporation design wet-bulb temperature:*** the outdoor wet-bulb temperature utilized in conjunction with the mean coincident dry-bulb temperature, often used for the sizing of evaporative systems such as cooling towers.

***existing building:*** a building or portion thereof that was previously occupied or approved for occupancy by the authority having jurisdiction.

***existing equipment:*** equipment previously installed in an existing building.

***existing system:*** a system or systems previously installed in an existing building.

***exterior building envelope:*** see *building envelope*.

***exterior lighting power allowance:*** see *lighting power allowance, exterior.*

***eye adaptation:*** the process by which the retina becomes accustomed to more or less light than it was exposed to during an immediately preceding period. It results in a change in the sensitivity to light.

***F-factor:*** the perimeter heat loss factor for slab-on-grade floors (Btu/h·ft·°F).

***façade area:*** area of the façade, including overhanging soffits, cornices, and protruding columns, measured in elevation in a vertical plane parallel to the plane of the face of the building. Nonhorizontal roof surfaces shall be included in the calculation of vertical façade area by measuring the area in a plane parallel to the surface.

***fan brake horsepower (bhp):*** the horsepower delivered to the fan's shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

***fan efficiency grade (FEG):*** the fan efficiency without consideration of drives, as defined in AMCA 205.

***fan system brake horsepower (bhp):*** the sum of the fan brake horsepower of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

***fan system design conditions:*** operating conditions that can be expected to occur during normal system operation that result in the highest supply airflow rate to conditioned spaces served by the system.

***fan system motor nameplate horsepower (hp):*** the sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

***feeder conductors:*** the wires that connect the service equipment to the branch circuit breaker panels.

***fenestration:*** all areas (including the frames) in the building envelope that let in light, including windows, plastic panels, clerestories, roof monitors, skylights, doors that are more than one-half glass, and glass block walls. (See *building envelope* and *door*.)

***field-fabricated fenestration:*** fenestration whose frame is made at the construction site of materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior glazed door. Field-fabricated fenestration does not include site-built fenestration designed to be glazed or assembled in the field using specific factory-cut or otherwise factory-formed framing and glazing units, such as storefront systems, curtain walls, and atrium roof systems.

***skylight:*** a fenestration surface having a slope of less than 60 degrees from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

***vertical fenestration:*** all fenestration other than skylights. Trombe wall assemblies, where glazing is installed within 12 in. of a mass wall, are considered walls, not fenestration.

***fenestration area:*** total area of the fenestration measured using the rough opening and including the glazing, sash, and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area. (See *door area*.)

***fixed:*** see *vertical fenestration*.

***fixture:*** the component of a luminaire that houses the lamp or lamps or positions the lamp, shields it from view, and distributes the light. The fixture also provides for connection to the power supply, which may require the use of a ballast.

***floor:*** that lower portion of the building envelope, including opaque area and fenestration, that has conditioned or semiheated space above and is horizontal or tilted at an angle of less than 60 degrees from horizontal but excluding slab-on-grade floors. For the purposes of determining building envelope requirements, the classifications are defined as follows:

***mass floor:*** a floor with a heat capacity that exceeds (1) 7 Btu/ft$^2$·°F or (2) 5 Btu/ft$^2$·°F, provided that the floor has a material unit mass not greater than 120 lb/ft$^3$.

***steel-joist floor:*** a floor that (1) is not a mass floor and (2) has steel joist members supported by structural members.

***wood-framed and other floors:*** all other floor types, including wood-joist floors.

(See *building envelope*, *fenestration*, *opaque*, and *slab-on-grade floor*).

***floor area, gross:*** the sum of the floor areas of the spaces within the building, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 ft or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

***gross building envelope floor area:*** the gross floor area of the building envelope, but excluding slab-on-grade floors.

***gross conditioned floor area:*** the gross floor area of conditioned spaces.

***gross lighted floor area:*** the gross floor area of lighted spaces.

***gross semiheated floor area:*** the gross floor area of semiheated spaces.

(See *building envelope*, *floor*, *slab-on-grade floor*, and *space*.)

***flue damper:*** a device in the flue outlet or in the inlet of or upstream of the draft control device of an individual, automatically operated, fossil-fuel-fired appliance that is designed to automatically open the flue outlet during appliance operation and to automatically close the flue outlet when the appliance is in a standby condition.

***fuel:*** a material that may be used to produce heat or generate power by combustion.

***fossil fuel:*** fuel derived from a hydrocarbon deposit such as petroleum, coal, or natural gas derived from living matter of a previous geologic time.

***general lighting:*** see *lighting*, *general*.

***general purpose electric motor (subtype I):*** a general purpose electric motor that

a. is a single-speed induction motor;
b. is rated for continuous duty (MG1) operation or for duty type SI (IEC);
c. contains a squirrel-cage (MG1) or cage (IEC) rotor;
d. has foot-mounting that may include foot-mounting with flanges or detachable feet;
e. is built in accordance with NEMA T-frame dimensions or their IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents;
f. has performance in accordance with NEMA Design A (MG1) or B (MG1) characteristics, or equivalent designs, such as IEC Design N (IEC);
g. operates on polyphase alternating current 60 Hz sinusoidal power and
    1. is rated at 230 or 460 V (or both), including motors rated at multiple voltages that include 230 or 460 V (or both) or
    2. can be operated on 230 or 460 V (or both); and
h. includes, but is not limited to, explosion-proof construction.

***general purpose electric motor (subtype II):*** any general purpose electric motor that incorporates the design elements of a general purpose electric motor (subtype I) and that is configured in one or more of the following ways:

a. Is built in accordance with NEMA U-frame dimensions, as described in NEMA MG-1-1967, or in accordance with the IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents
b. Has performance in accordance with NEMA Design C characteristics, as described in MG1, or an equivalent IEC design(s) such as IEC Design H
c. Is a close-coupled pump motor
d. Is a footless motor
e. Is a vertical, solid-shaft normal thrust motor (as tested in a horizontal configuration) built and designed in a manner consistent with MG1
f. Is an 8-pole motor (900 rpm)
g. Is a polyphase motor with voltage rating of not more than 600 V, is not rated at 230 or 460 V (or both), and cannot be operated on 230 or 460 V (or both)

***generally accepted engineering standard:*** a specification, rule, guide, or procedure in the field of engineering, or related thereto, recognized and accepted as authoritative.

***grade:*** the finished ground level adjoining a building at all exterior walls.

***gross floor area:*** see *floor area, gross.*

***gross lighted area (GLA):*** see *floor area, gross*.

***gross roof area:*** see *roof area, gross*.

***gross wall area:*** see *wall area, gross*.

***growth media:*** an engineered formulation of inorganic and organic materials including but not limited to heat-expanded clays, slates, shales, aggregate, sand, perlite, vermiculite, and organic material including but not limited to compost worm castings, coir, peat, and other organic material.

***heat capacity (HC):*** the amount of heat necessary to raise the temperature of a given mass 1°F. Numerically, the HC per unit area of surface (Btu/ft$^2$·°F) is the sum of the products of the mass per unit area of each individual material in the roof, wall, or floor surface multiplied by its individual specific heat.

***heat trace:*** a heating system where the externally applied heat source follows (traces) the object to be heated (e.g., water piping).

***heated space:*** see *space*.

***heating degree-day, base:*** see *degree-day.*

***heating design temperature:*** the outdoor dry-bulb temperature equal to the temperature that is exceeded at least 99.6% of the number of hours during a typical weather year.

***heating seasonal performance factor (HSPF):*** the total heating output of a heat pump during its normal annual usage period for heating (Btu) divided by the total electric energy input during the same period.

***high-frequency electronic ballast:*** ballasts that operate at a frequency greater than 20 kHz.

***historic:*** a building or space that has been specifically designated as historically significant by the adopting authority, or is listed in The National Register of Historic Places or has been determined to be eligible for such listing by the U.S. Secretary of the Interior.

***hot-water supply boiler:*** a boiler used to heat water for purposes other than space heating.

***humidistat:*** an automatic control device used to maintain humidity at a fixed or adjustable setpoint.

***HVAC system:*** the equipment, distribution systems, and terminals that provide, either collectively or individually, the processes of heating, ventilating, or air conditioning to a building or portion of a building.

***HVAC zone:*** a space or group of spaces within a building with heating and cooling requirements that are sufficiently similar so that desired conditions (e.g., temperature) can be maintained throughout using a single sensor (e.g., thermostat or temperature sensor).

***hydronic system balancing:*** see *balancing, hydronic system*.

***indirectly conditioned space:*** see *space.*

***ineffective panel surface:*** see *thermally ineffective panel surface*.

***infiltration:*** the uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building caused by pressure differences across these elements due to factors such as wind, inside and outside temperature differences (stack effect), and imbalance between supply and exhaust air systems.

***installed exterior lighting power:*** the power in watts of all site, landscape, and building lighting systems for exterior luminaires.

***installed interior lighting power:*** the power in watts of all general, task, and furniture lighting systems for interior luminaires.

***integrated energy efficiency ratio (IEER):*** a single-number figure of merit expressing cooling part-load EER efficiency for commercial unitary air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

***integrated part-load value (IPLV):*** a single-number figure of merit based on part-load EER, COP, or kW/kW expressing part-load efficiency for air-conditioning and heat-pump equipment on the basis of weighted operation at various load capacities for the equipment.

***interior lighting power allowance:*** see *lighting power allowance*.

***isolation devices:*** devices that isolate HVAC zones so that they can be operated independently of one another. Isolation devices include, but are not limited to, separate systems, isolation dampers, and controls providing shutoff at terminal boxes.

***IT equipment energy:*** annual energy used for computer storage and network equipment along with supplemental equipment represented by the uninterruptible power supply (UPS) output calculated in accordance with industry-accepted standards (see Informative Appendix E).

***joist, steel:*** any structural steel member of a building or structure made of hot-rolled or cold-rolled solid or open-web sections.

***kilovolt-ampere (kVA):*** where the term *kilovolt-ampere* is used in this standard, it is the product of the line current (amperes) times the nominal system voltage (kilovolts) times 1.732 for three-phase currents. For single-phase applications, kVA is the product of the line current (amperes) times the nominal system voltage (kilovolts).

***kilowatt (kW):*** the basic unit of electric power, equal to 1000 W.

***labeled:*** equipment or materials to which a symbol or other identifying mark has been attached by the manufacturer indicating compliance with specified standards or performance in a specified manner.

***lamp:*** a generic term for a man-made light source often called a bulb or tube.

> ***compact fluorescent lamp:*** a fluorescent lamp of a small compact shape, with a single base that provides the entire mechanical support function.
>
> ***fluorescent lamp:*** a low-pressure electric discharge lamp in which a phosphor coating transforms some of the ultraviolet energy generated by the discharge into light.
>
> ***general service lamp:*** a class of incandescent lamps that provide light in virtually all directions. General service lamps are typically characterized by bulb shapes such as "A," standard; "S," straight side; "F," flame; "G," globe; and "PS," pear straight.
>
> ***high-intensity discharge (HID) lamp:*** an electric discharge lamp in which light is produced when an electric arc is discharged through a vaporized metal such as mercury or sodium. Some HID lamps may also have a phosphor coating that contributes to the light produced or enhances the light color.
>
> ***incandescent lamp:*** a lamp in which light is produced by a filament heated to incandescence by an electric current.
>
> ***reflector lamp:*** a class of incandescent lamps that have an internal reflector to direct the light. Reflector lamps are typically characterized by reflective characteristics such as "R," reflector; "ER," ellipsoidal reflector; "PAR," parabolic aluminized reflector; "MR," mirrorized reflector; and others.

***light-to-solar gain ratio (LSG):*** the ratio of the center-of-glass visible transmittance to the center-of-glass solar heat gain coefficient.

***lighting, decorative:*** lighting that is purely ornamental and installed for aesthetic effect. Decorative lighting shall not include general lighting.

***lighting, general:*** lighting that provides a substantially uniform level of illumination throughout an area. General lighting shall not include decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.

***lighting power allowance, exterior:*** the maximum lighting power in watts allowed for the exterior of a building.

***lighting power allowance, interior:*** the maximum lighting power in watts allowed for the interior of a building.

***lighting power density (LPD):*** the maximum lighting power per unit area of a building classification of space function.

***lighting system:*** a group of luminaires circuited or controlled to perform a specific function.

***liner system (Ls):*** a continuous vapor barrier liner installed below the purlins and uninterrupted by framing members.

***low-rise residential buildings:*** single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular).

***luminaire:*** a complete lighting unit consisting of a lamp or lamps together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

***makeup air (dedicated replacement air):*** outdoor air deliberately brought into the building from the outside and supplied to the vicinity of an exhaust hood to replace air, vapor, and contaminants being exhausted. Makeup air is generally filtered and fan-forced, and it may be heated or cooled depending on the requirements of the application. Makeup air may be delivered through outlets integral to the exhaust hood or through outlets in the same room.

***manual (nonautomatic):*** requiring personal intervention for control. Nonautomatic does not necessarily imply a manual controller, only that personal intervention is necessary. (See *automatic*.)

***manufacturer:*** the company engaged in the original production and assembly of products or equipment or a company that purchases such products and equipment manufactured in accordance with company specifications.

***mass floor:*** see *floor.*

***mass wall:*** see *wall*.

***mean temperature:*** one-half the sum of the minimum daily temperature and maximum daily temperature.

***mechanical cooling:*** reducing the temperature of a gas or liquid by using vapor compression, absorption, desiccant dehumidification combined with evaporative cooling, or another energy-driven thermodynamic cycle. Indirect or direct evaporative cooling alone is not considered mechanical cooling.

***mechanical heating:*** raising the temperature of a gas or liquid by use of fossil fuel burners, electric resistance heaters, heat pumps, or other systems that require energy to operate.

***metal building:*** a complete integrated set of mutually dependent components and assemblies that form a building, which consists of a steel-framed superstructure and metal skin.

> ***metal building roof:*** see *roof.*
>
> ***metal building wall:*** see *wall*.

***metering:*** instruments that measure electric voltage, current, power, etc.

***motor power, rated:*** the rated output power from the motor.

***multilevel occupancy sensor:*** an occupancy sensor having an automatic OFF function that turns off all the lights, and either an automatic or a manually controlled ON function capable of activating between 30% and 70% of the lighting power. After that event occurs, the device shall be capable of all of the following actions when manually called to do so by the occupant:

a. Activating alternate sets of lights
b. Activating 100% of the lighting power
c. Deactivating all lights

***multiscene control:*** a lighting control device or system that allows for two or more predefined lighting settings, in addition to all off, for two or more groups of luminaires to suit multiple activities in the space, and allows the automatic recall of those settings.

***nameplate horsepower (hp):*** the nominal motor horsepower rating stamped on the motor nameplate.

***nameplate rating:*** the design load operating conditions of a device as shown by the manufacturer on the nameplate or otherwise marked on the device.

***nonautomatic:*** see *manual*.

***nonrecirculating system:*** a domestic or service hot-water distribution system that is not a recirculating system.

***nonrenewable energy:*** energy derived from a fossil fuel source.

***nonresidential:*** all occupancies other than residential. (See *residential*.)

***nonstandard part-load value (NPLV):*** a single-number part-load efficiency figure of merit calculated and referenced to conditions other than IPLV conditions, for units that are not designed to operate at AHRI standard rating conditions.

***nonswinging door:*** see *door.*

***nonweatherized space constrained single-package vertical unit:*** a single-package vertical air conditioner (SPVAC) or single-package vertical heat pump (SPVHP) that meets all of the following requirements:

a. Is for indoor use only
b. Has rated cooling capacities no greater than 36,000 Btu/h
c. Is a single-package unit requiring opening in an exterior wall with overall exterior dimensions that requires or uses an existing sleeve that meets one of the following criteria:
    1. Has a width of less than 32 in. and height of less than 45 in.
    2. Fits inside an existing 1310 $in.^2$ opening
d. Is commonly installed in site-built commercial buildings
e. Is of a similar cooling capacity and, if a heat pump, similar heating capacity
f. Draws outdoor air for heat exchange directly through an existing opening, used for both inlet and outlet, in the exterior wall
g. Is restricted to applications where an existing air conditioner, heat pump, or gas/electric unit, installed in an existing exterior wall opening, is to be replaced
h. Bears a permanent "Replacement" marking, conspicuously placed, and clearly indicating that its application is limited to installations where an existing air conditioner or heat pump is to be replaced

***north-oriented:*** facing within 45 degrees of true north in the northern hemisphere (however, facing within 45 degrees of true south in the southern hemisphere).

***occupant sensor:*** a device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

***on-site renewable energy:*** energy generated from renewable sources produced at the building site.

***opaque:*** all areas in the building envelope, except fenestration and building service openings such as vents and grilles. (See *building envelope* and *fenestration*.)

***operable:*** see *vertical fenestration*.

***optimum start controls:*** controls that are designed to automatically adjust the start time of an HVAC system each day with the intention of bringing the space to desired occupied temperature levels immediately before scheduled occupancy.

***orientation:*** the direction an envelope element faces, i.e., the direction of a vector perpendicular to and pointing away from the surface outside of the element.

***outdoor (outside) air:*** air that is outside the building envelope or is taken from outside the building that has not been previously circulated through the building.

***overcurrent:*** any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

***packaged terminal air conditioner (PTAC):*** a factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies, or sections. It may include heating capability by hot water, steam, or electricity and is intended for mounting through the wall to serve a single room or zone.

***packaged terminal heat pump (PTHP):*** a PTAC capable of using the refrigerating system in a reverse cycle or heat pump mode to provide heat.

***party wall:*** a fire wall on an interior lot line used or adapted for joint service between two buildings.

***performance rating method:*** a calculation procedure that generates an index of merit for the performance of building designs that substantially exceeds the energy efficiency levels required by this standard.

***permanently installed:*** equipment that is fixed in place and is not portable or movable.

***photosensor:*** a device that detects the presence of visible light, infrared (IR) transmission, and/or ultraviolet (UV) energy.

***piping:*** the pipes or tubes interconnecting the various parts of a fluid distribution system, including all elements that are in series with the fluid flow, such as pumps, valves, strainers, and air separators, but not including elements that are not in

series with the fluid flow, such as expansion tanks, fill lines, chemical feeders, and drains.

***plenum:*** a compartment or chamber to which one or more ducts are connected, that forms a part of the air distribution system, and that is not used for occupancy or storage. A plenum often is formed in part or in total by portions of the building.

***pool:*** any structure, basin, or tank containing an artificial body of water for swimming, diving, or recreational bathing. The term includes, but is not limited to, swimming pool, whirlpool, spa, and hot tub.

***power roof/wall ventilators (PRV):*** a fan consisting of a centrifugal or axial impeller with an integral driver in a weather-resistant housing and with a base designed to fit, usually by means of a curb, over a wall or roof opening.

***power usage effectiveness (PUE):*** computer room energy divided by IT equipment energy calculated in accordance with industry-accepted standards (see Informative Appendix E).

> ***power usage effectiveness—category 0 ($PUE_0$):*** peak electric demand (kW) for the entire computer room, including IT equipment and supporting infrastructure, divided by peak electric demand (kW) of the IT equipment.
>
> ***power usage effectiveness—category 1 ($PUE_1$):*** annual energy consumption (kWh) for the entire computer room, including IT equipment and supporting infrastructure, divided by annual energy consumption (kWh) of the IT equipment.

***process energy:*** energy consumed in support of a manufacturing, industrial, or commercial process other than conditioning spaces and maintaining comfort and amenities for the occupants of a building.

***process load:*** the load on a building resulting from the consumption or release of process energy.

***projection factor (PF):*** the ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.

***proposed building performance:*** the annual energy cost calculated for a proposed design.

***proposed design:*** a computer representation of the actual proposed building design, or portion thereof, used as the basis for calculating the design energy cost.

***public facility restroom:*** a restroom used by the transient public.

***pump system power:*** the sum of the nominal power demand (nameplate horsepower) of motors of all pumps that are required to operate at design conditions to supply fluid from the heating or cooling source to all heat transfer devices (e.g., coils, heat exchanger) and return it to the source.

***purchased energy*****:** energy or power purchased for consumption and delivered to the building site.

***purchased energy rates:*** costs for units of energy or power purchased at the building site. These costs may include energy costs as well as costs for power demand as determined by the adopting authority.

***R-value:*** see *thermal resistance*.

***radiant heating system:*** a heating system that transfers heat to objects and surfaces within the heated space primarily (greater than 50%) by infrared radiation.

***rated motor power:*** see *motor power, rated.*

***rated R-value of insulation:*** the thermal resistance of the insulation alone as specified by the manufacturer in units of $h \cdot ft^2 \cdot °F/Btu$ at a mean temperature of 75°F. Rated R-value refers to the thermal resistance of the added insulation in framing cavities or insulated sheathing only and does not include the thermal resistance of other building materials or air films. (See *thermal resistance*.)

***rating authority:*** the organization or agency that adopts or sanctions use of this rating methodology.

***readily accessible:*** capable of being reached quickly for operation, renewal, or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. In public facilities, accessibility may be limited to certified personnel through locking covers or by placing equipment in locked rooms.

***recirculating system:*** a domestic or service hot-water distribution system that includes a closed circulation circuit designed to maintain usage temperatures in hot-water pipes near terminal devices (e.g., lavatory faucets, shower heads) in order to reduce the time required to obtain hot water when the terminal device valve is opened. The motive force for circulation is either natural (due to water density variations with temperature) or mechanical (recirculation pump).

***recooling:*** lowering the temperature of air that has been previously heated by a mechanical heating system.

***record drawings:*** drawings that record the conditions of the project as constructed. These include any refinements of the construction or bid documents.

***reflectance:*** the ratio of the light reflected by a surface to the light incident upon it.

***refrigeration system, low-temperature:*** systems for maintaining food products in their frozen state in refrigeration applications.

***refrigeration systems, medium-temperature:*** systems for maintaining food products above their frozen state in refrigeration applications.

***refrigerant dew point:*** the refrigerant vapor saturation temperature at a specified pressure.

***reheating:*** raising the temperature of air that has been previously cooled either by mechanical refrigeration or an economizer system.

***repair:*** the reconstruction or renewal of any part of an existing building for the purpose of its maintenance.

***replacement air:*** outdoor air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: makeup air, supply air, transfer air, and infiltration. However, the ultimate source of all replacement air is outdoor air. When replacement air exceeds exhaust, the result is exfiltration.

***reset:*** automatic adjustment of the controller setpoint to a higher or lower value.

***residential:*** spaces in buildings used primarily for living and sleeping. Residential spaces include, but are not limited to, dwelling units, hotel/motel guest rooms, dormitories, nursing homes, patient rooms in hospitals, lodging houses, fraternity/sorority houses, hostels, prisons, and fire stations.

***resistance, electric:*** the property of an electric circuit or of any object used as part of an electric circuit that determines for a given circuit the rate at which electric energy is converted into heat or radiant energy and that has a value such that the product of the resistance and the square of the current gives the rate of conversion of energy.

***roof:*** the upper portion of the building envelope, including opaque areas and fenestration, that is horizontal or tilted at an angle of less than 60 degrees from horizontal. For the purposes of determining building envelope requirements, the classifications are defined as follows:

***attic and other roofs:*** all other roofs, including roofs with insulation entirely below (inside of) the roof structure (i.e., attics, cathedral ceilings, and single-rafter ceilings), roofs with insulation both above and below the roof structure, and roofs without insulation but excluding metal building roofs.

***metal building roof:*** a roof that

a. is constructed with a metal, structural, weathering surface;
b. has no ventilated cavity; and
c. has the insulation entirely below deck (i.e., does not include composite concrete and metal deck construction nor a roof framing system that is separated from the superstructure by a wood substrate) and whose structure consists of one or more of the following configurations:
    1. Metal roofing in direct contact with the steel framing members
    2. Metal roofing separated from the steel framing members by insulation
    3. Insulated metal roofing panels installed as described in subitems (a) or (b)

***roof with insulation entirely above deck:*** a roof with all insulation

a. installed above (outside of) the roof structure and
b. continuous (i.e., uninterrupted by framing members).

***single-rafter roof:*** a subcategory of attic roofs where the roof above and the ceiling below are both attached to the same wood rafter and where insulation is located in the space between these wood rafters.

***roof area, gross:*** the area of the roof measured from the exterior faces of walls or from the centerline of party walls. (See *roof* and *wall*.)

***roof covering:*** the topmost component of the roof assembly intended for weather resistance, fire classification, or appearance.

***roof recovering:*** the process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

***roof monitor:*** that part of a building that projects above the plane of the roof and whose walls contain vertical fenestration for lighting the interior.

***room air conditioner:*** an encased assembly designed as a unit to be mounted in a window or through a wall or as a console. It is designed primarily to provide direct delivery of conditioned air to an enclosed space, room, or zone. It includes a prime source of refrigeration for cooling and dehumidification and a means for circulating and cleaning air. It may also include a means for ventilating and heating.

***room cavity ratio (RCR):*** a factor that characterizes room configuration as a ratio between the walls and ceiling and is based upon room dimensions.

***saturated condensing temperature:*** the saturation temperature corresponding to the measured refrigerant pressure at the condenser inlet for single component and azeotropic refrigerants, and the arithmetic average of the dew-point and bubble-point temperatures corresponding to the refrigerant pressure at the condenser entrance for zeotropic refrigerants.

***seal class A:*** a ductwork sealing category that requires sealing all transverse joints, longitudinal seams, and duct wall penetrations. Duct wall penetrations are openings made by pipes, holes, conduit, tie rods, or wires. Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow.

***seasonal coefficient of performance—cooling ($SCOP_C$):*** the total cooling output of an air conditioner during its normal annual usage period for cooling divided by the total electric energy input during the same period in consistent units (analogous to SEER but in I-P or other consistent units).

***seasonal coefficient of performance—heating ($SCOP_H$):*** the total heating output of a heat pump during its normal annual usage period for heating divided by the total electric energy input during the same period in consistent units (analogous to HSPF but in I-P or other consistent units).

***seasonal energy efficiency ratio (SEER):*** the total cooling output of an air conditioner during its normal annual usage period for cooling (Btu) divided by the total electric energy input during the same period (Btu).

***sectional garage door:*** an upward-acting, nonswinging door assembly made of two or more horizontal panels hinged together vertically.

***semi-exterior building envelope:*** see *building envelope.*

***semiheated floor area:*** see *floor area, gross*.

***semiheated space:*** see *space*.

***sensible cooling panel:*** a panel designed for sensible cooling of an indoor space through heat transfer to the thermally effective panel surfaces from the occupants and/or indoor space by thermal radiation and natural convection.

***sensible heating panel:*** a panel designed for sensible heating of an indoor space through heat transfer from the thermally effective panel surfaces to the occupants and/or indoor space by thermal radiation and natural convection.

***sensible recovery effectiveness:*** change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and return air dry-bulb temperatures, expressed as a percentage.

***service:*** the equipment for delivering energy from the supply or distribution system to the premises served.

***service agency:*** an agency capable of providing calibration, testing, or manufacture of equipment, instrumentation, metering, or control apparatus, such as a contractor, laboratory, or manufacturer.

***service equipment:*** the necessary equipment, usually consisting of a circuit breaker or switch and fuses and accessories, located near the point of entrance of supply conductors to a building or other structure (or an otherwise defined area) and intended to constitute the main control and means of cutoff of the supply. Service equipment may consist of circuit breakers or fused switches provided to disconnect all under-grounded conductors in a building or other structure from the service-entrance conductors.

***service water heating:*** heating water for domestic or commercial purposes other than space heating and process requirements.

***setback:*** reduction of heating (by reducing the setpoint) or cooling (by increasing the setpoint) during hours when a building is unoccupied or during periods when lesser demand is acceptable.

***setpoint:*** point at which the desired temperature (°F) of the heated or cooled space is set.

***SHGC:*** see *solar heat gain coefficient*.

***shading coefficient (SC):*** the ratio of solar heat gain at normal incidence through glazing to that occurring through 1/8 in.-thick clear, double-strength glass. SC does not include interior, exterior, or integral shading devices.

***simulation program:*** a computer program that is capable of simulating the energy performance of building systems.

***single-line diagram:*** a simplified schematic drawing that shows the connection between two or more items. Common multiple connections are shown as one line.

***single-package vertical air conditioner (SPVAC):*** a type of air-cooled small or large commercial package air-conditioning and heating equipment; factory assembled as a single package having its major components arranged vertically, which is an encased combination of cooling and optional heating components; is intended for exterior mounting on, adjacent interior to, or through an outside wall and is powered by single or three-phase current. It may contain separate indoor grille(s), outdoor louvers, various ventilation options, or indoor free air discharge, ductwork, wall plenum, or sleeve. Heating components may include electrical resistance, steam, hot water, gas, or no heat, but may not include reverse-cycle refrigeration as a heating means.

***single-package vertical heat pump (SPVHP):*** an SPVAC that utilizes reverse-cycle refrigeration as its primary heat source, with secondary supplemental heating by means of electrical resistance, steam, hot water, or gas.

***single-rafter roof:*** see *roof*.

***single-zone system:*** an HVAC system serving a single HVAC zone.

***site-recovered energy:*** waste energy recovered at the building site that is used to offset consumption of purchased fuel or electrical energy supplies.

***site-solar energy:*** thermal, chemical, or electrical energy derived from direct conversion of incident solar radiation at the building site and used to offset consumption of purchased fuel or electrical energy supplies. For the purposes of applying this standard, site-solar energy shall not include passive heat gain through fenestration systems.

***skylight:*** a fenestration surface having a slope of less than 60 degrees from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

***skylight effective aperture:*** the overall amount of visible transmittance of the roof via skylights. Skylight effective aperture is calculated according to the following formula:

$$\text{Skylight effective aperture} = \frac{0.85 \times \text{skylight area} \times \text{skylight VT} \times \text{WF}}{\text{daylight area under skylight}}$$

where

skylight area = total fenestration area of skylights

skylight VT = area weighted average visible transmittance of skylights as determined in accordance with Section 5.8.2.6.

WF = area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 ft, or 0.7 if light well depth is 2 ft or greater. Light well depth is measured vertically from the underside of the lowest point on the skylight glazing to the ceiling plane under the skylight.

***skylight well:*** the shaft from the skylight to the ceiling.

***slab-on-grade floor:*** that portion of a slab floor of the building envelope that is in contact with the ground and that is either above grade or is less than or equal to 24 in. below the final elevation of the nearest exterior grade.

***heated slab-on-grade floor:*** a slab-on-grade floor with a heating source either within or below it.

***unheated slab-on-grade floor:*** a slab-on-grade floor that is not a heated slab-on-grade floor.

***small electric motor:*** a NEMA general purpose, alternating current, single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1-1987, including IEC metric equivalent motors; constructed in the NEMA 42, 48, and 56 frame sizes or IEC metric equivalent.

***solar energy source:*** source of thermal, chemical, or electrical energy derived from direct conversion of incident solar radiation at the building site.

***solar heat gain coefficient (SHGC):*** the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space. (See *fenestration area*.)

***space:*** an enclosed space within a building. The classifications of spaces are as follows for the purpose of determining building envelope requirements:

***conditioned space:*** a cooled space, heated space, or indirectly conditioned space defined as follows:

a. ***cooled space:*** an enclosed space within a building that is cooled by a cooling system whose sensible output capacity exceeds 5 Btu/h·ft$^2$ of floor area.
b. ***heated space:*** an enclosed space within a building that is heated by a heating system whose output capacity relative to the floor area is greater than or equal to the criteria in Table 3.2.
c. ***indirectly conditioned space:*** an enclosed space within a building that is not a heated space or a cooled space, which is heated or cooled indirectly by being connected to adjacent space(s) provided:
    1. the product of the U-factor(s) and surface area(s) of the space adjacent to connected space(s) exceeds the combined sum of the product of the U-factor(s) and surface area(s) of the space adjoining the outdoors, unconditioned spaces, and to or from semiheated spaces (e.g., corridors) or
    2. that air from heated or cooled spaces is intentionally transferred (naturally or mechanically) into the space at a rate exceeding 3 ach (e.g., atria).

***semiheated space:*** an enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h·ft$^2$ of floor area but is not a conditioned space.

***unconditioned space:*** an enclosed space within a building that is not a conditioned space or a semiheated space. Crawlspaces, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

***space-conditioning category:***

a. nonresidential conditioned space (See *nonresidential*.)
b. residential conditioned space (See *residential*.)
c. nonresidential and residential semiheated space (See *space*.)

***steel-framed wall:*** see *wall*.

**TABLE 3.2 Heated Space Criteria**

| Heating Output, Btu/h·ft$^2$ | Climate Zone |
|---|---|
| 5 | 1 and 2 |
| 10 | 3 |
| 15 | 4 and 5 |
| 20 | 6 and 7 |
| 25 | 8 |

***steel-joist floor:*** see *floor*.

***story:*** portion of a building that is between one finished floor level and the next higher finished floor level or the roof, provided, however, that a basement or cellar shall not be considered a story.

***substantial contact:*** a condition where adjacent building materials are placed so that proximal surfaces are contiguous, being installed and supported so they eliminate voids between materials without compressing or degrading the thermal performance of either product.

***swinging door:*** see *door*.

***system(s):*** a combination of equipment and auxiliary devices (e.g., controls, accessories, interconnecting means, and terminal elements) by which energy is transformed so it performs a specific function, such as HVAC, service water heating, or lighting.

***task lighting:*** lighting directed to a specific surface or area that provides illumination for visual tasks.

***temperature control throttling range:*** the number of degrees that room temperature must change in order to go from full heating to no heating or from full cooling to no cooling.

***terminal:*** a device by which energy from a system is finally delivered, e.g., registers, diffusers, lighting fixtures, faucets, etc.

***thermal block:*** a collection of one or more HVAC zones grouped together for simulation purposes. Spaces need not be contiguous to be combined within a single thermal block.

***thermal conductance (C-factor):*** time rate of steady-state heat flow through unit area of a material or construction, induced by a unit temperature difference between the body surfaces (Btu/h·ft$^2$·°F). Note that the C-factor does not include soil or air films.

***thermal resistance (R-value):*** the reciprocal of the time rate of heat flow through a unit area induced by a unit temperature difference between two defined surfaces of material or construction under steady-state conditions (h·ft$^2$·°F/Btu).

***thermal transmittance (U-factor):*** heat transmission in unit time through unit area of a material or construction and the boundary air films, induced by unit temperature difference between the environments on each side (Btu/h·ft$^2$·°F).

***thermally effective panel surface:*** any exterior surface of a panel that is intended to transfer heat between the panel and the occupants and/or the indoor space.

***thermally ineffective panel surface:*** any exterior surface of a panel, which is not intended to transfer heat between the panel and the occupants and/or the indoor space.

***thermostat:*** an automatic control device used to maintain temperature at a fixed or adjustable setpoint.

***thermostatic control:*** an automatic control device or system used to maintain temperature at a fixed or adjustable setpoint.

***tinted:*** (as applied to fenestration) bronze, green, blue, or gray coloring that is integral with the glazing material. Tinting does not include surface-applied films such as reflective coatings, applied either in the field or during the manufacturing process.

***transfer air:*** air transferred from one room to another through openings in the room envelope, whether it is transferred intentionally or not. The driving force for transfer air is generally a small pressure differential between the rooms, although one or more fans may be used.

***transformer:*** a piece of electrical equipment used to convert electric power from one voltage to another voltage.

> ***dry-type transformer:*** a transformer in which the core and coils are in a gaseous or dry compound.
>
> ***liquid-immersed transformer:*** a transformer in which the core and coils are immersed in an insulating liquid.

***toplighting:*** lighting building interiors with daylight admitted through fenestration, such as skylights and roof monitors, located on the roof.

***U-factor:*** see *thermal transmittance.*

***unconditioned space:*** see *space*.

***unenclosed space:*** a space that is not an enclosed space.

***unitary cooling equipment:*** one or more factory-made assemblies that normally include an evaporator or cooling coil and a compressor and condenser combination. Units that perform a heating function are also included.

***unitary heat pump:*** one or more factory-made assemblies that normally include an indoor conditioning coil, compressor(s), and an outdoor refrigerant-to-air coil or refrigerant-to-water heat exchanger. These units provide both heating and cooling functions.

***unmet load hour:*** an hour in which one or more zones is outside of the thermostat setpoint plus or minus one half of the temperature control throttling range. Any hour with one or more zones with an unmet cooling load or unmet heating load is defined as an unmet load hour.

***variable-air-volume (VAV) system:*** HVAC system that controls the dry-bulb temperature within a space by varying the volumetric flow of heated or cooled supply air to the space.

***variable-refrigerant-flow (VRF) system:*** an engineered direct expansion (DX) multisplit system incorporating at least one variable capacity compressor distributing refrigerant through a piping network to multiple indoor fan-coil units, each capable of individual zone temperature control, through integral zone temperature control devices and common communications network. Variable refrigerant flow utilizes three or more steps of control on common, interconnecting piping.

***vegetative roof system:*** vegetation, growth media, drainage system, and waterproofing over a roof deck.

***vent damper:*** a device intended for installation in the venting system of an individual, automatically operated, fossil-fuel-fired appliance in the outlet or downstream of the appliance draft control device, which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby or shutdown condition.

***ventilation:*** the process of supplying or removing air by natural or mechanical means to or from any space. Such air is not required to have been conditioned.

***ventilation system motor nameplate horsepower (hp):*** the sum of the motor nameplate horsepower of all fans that are required to operate as part of the system.

***vertical fenestration:*** all fenestration other than skylights. Trombe wall assemblies, where glazing is installed within 12 in. of a mass wall, are considered walls, not fenestration. For the purposes of determining building envelope requirements, the vertical fenestration classifications are defined as follows:

> ***metal framing:*** products with metal framing with or without thermal break.
>
> ***metal framing, entrance door:*** any doorway, set of doors, turnstile, vestibule, or other form of portal that is ordinarily used to gain access by its users and occupants to the building or to individual tenant spaces accessed from the exterior. (See *building entrance* and *door.*)
>
> ***metal framing, fixed:*** all types of vertical fenestration, other than entrance door and operable, including, but not limited to, curtain walls, window walls, fixed windows, picture windows, glass block walls, nonopenable clerestory windows, and nonopenable sidelights and transoms.
>
> ***metal framing, operable:*** all vertical fenestration that opens, except entrance doors, including, but not limited to, casement windows, projecting windows, pivoting windows, horizontal sliding windows, vertical sliding windows, openable clerestory windows, openable sidelights and transoms, sliding glass doors, and doors that are not entrance doors.
>
> ***nonmetal framing:*** all products with framing materials other than metal with or without metal reinforcing or cladding.

***visible transmittance (VT):*** the ratio of visible radiation entering the space through the fenestration product to the incident visible radiation, determined as the spectral transmittance of the total fenestration system, weighted by the photopic response of the eye and integrated into a single dimensionless value.

***voltage drop:*** a decrease in voltage caused by losses in the lines connecting the power source to the load.

***VT:*** see *visible transmittance*.

***walk-in cooler:*** an enclosed storage space of <3000 $ft^2$ that can be walked into and that is designed to maintain a space temperature of >32°F and ≤55°F.

***walk-in freezer:*** an enclosed storage space of <3000 $ft^2$ that can be walked into that is designed to maintain a space temperature of ≤32°F.

***wall:*** that portion of the building envelope, including opaque area and fenestration, that is vertical or tilted at an angle of 60 degrees from horizontal or greater. This includes above- and below-grade walls, between floor spandrels, peripheral edges of floors, and foundation walls. For the purposes of determining building envelope requirements, the classifications are defined as follows:

***above-grade wall:*** a wall that is not a below-grade wall.

***below-grade wall:*** that portion of a wall in the building envelope that is entirely below the finish grade and in contact with the ground.

***mass wall:*** a wall with a heat capacity exceeding (1) 7 Btu/$ft^2$·°F or (2) 5 Btu/$ft^2$·°F, provided that the wall has a material unit weight not greater than 120 lb/$ft^3$.

***metal building wall:*** a wall whose structure consists of metal spanning members supported by steel structural members (i.e., does not include spandrel glass or metal panels in curtain wall systems).

***steel-framed wall:*** a wall with a cavity (insulated or otherwise) whose exterior surfaces are separated by steel framing members (i.e., typical steel stud walls and curtain wall systems).

***wood-framed and other walls:*** all other wall types, including wood stud walls.

***wall area, gross:*** the area of the wall measured on the exterior face from the top of the floor to the bottom of the roof.

***warm-up:*** increase in space temperature to occupied setpoint after a period of shutdown or setback.

***water economizer:*** see *economizer, water.*

***water heater:*** vessel in which water is heated and is withdrawn for use external to the system.

***wood-framed and other walls:*** see *wall.*

***wood-framed and other floors:*** see *floor.*

### 3.3 Abbreviations and Acronyms

| | |
|---|---|
| **ac** | alternating current |
| **ach** | air changes per hour |
| **AFUE** | annual fuel utilization efficiency |
| **AHAM** | Association of Home Appliance Manufacturers |
| **ANSI** | American National Standards Institute |
| **AHRI** | Air-Conditioning, Heating and Refrigeration Institute |
| **ASHRAE** | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| **ASTM** | ASTM International |
| **bhp** | brake horsepower |
| **BSR** | Board of Standards Review |
| **Btu** | British thermal unit |
| **Btu/h** | British thermal unit per hour |
| **Btu/$ft^2$·°F** | British thermal unit per square foot per degree Fahrenheit |
| **Btu/h·$ft^2$** | British thermal unit per hour per square foot |
| **Btu/h·ft·°F** | British thermal unit per hour per linear foot per degree Fahrenheit |
| **Btu/h·$ft^2$·°F** | British thermal unit per hour per square foot per degree Fahrenheit |
| **CDD** | cooling degree-day |
| **CDD50** | cooling degree-days base 50°F |
| **cfm** | cubic feet per minute |
| **c.i.** | continuous insulation |
| **COP** | coefficient of performance |
| **CTI** | Cooling Technology Institute |
| **DCV** | demand control ventilation |
| **DDC** | direct digital control |
| **DOE** | U.S. Department of Energy |
| $E_c$ | combustion efficiency |
| **EER** | energy efficiency ratio |
| **EF** | energy factor |
| **ENVSTD** | Envelope System Performance Compliance Program |
| $E_t$ | thermal efficiency |
| **F** | Fahrenheit |
| **FC** | filled cavity |
| **ft** | foot |
| **gr** | grains of moisture per pound of dry air |
| **h** | hour |
| **HC** | heat capacity |
| **HDD** | heating degree-day |
| **HDD65** | heating degree-days base 65°F |
| **h·$ft^2$·°F/Btu** | hour per square foot per degree Fahrenheit per British thermal unit |
| **HID** | high-intensity discharge |
| **hp** | horsepower |
| **HSPF** | heating seasonal performance factor |
| **HVAC** | heating, ventilating, and air conditioning |