§1602 DEFINITIONS

§1602.1 Definitions. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

ALLOWABLE STRESS DESIGN. A method of proportioning structural members, such that elastically computed stresses produced in the members by nominal loads do not exceed specified allowable stresses (also called working stress design).

BALCONY, EXTERIOR. An exterior floor projecting from and supported by a structure without additional independent supports.

BASE SHEAR. Total design lateral force or shear at the base.

BOUNDARY MEMBERS. Portions along wall and diaphragm edges strengthened by longitudinal and transverse reinforcement and/or structural steel members.

CANTILEVERED COLUMN SYSTEM. A structural system relying on column elements that cantilever from a fixed base and have minimal rotational resistance capacity at the top with lateral forces applied essentially at the top and are used for lateral resistance.

COLLECTOR ELEMENTS. Members that serve to transfer forces between floor diaphragms and members of the lateral-force-resisting system.

CONFINED REGION. The portion of a reinforced concrete component in which the concrete is confined by closely spaced special transverse reinforcement restraining the concrete in directions perpendicular to the applied stress.

COUPLING BEAM. A beam that is used to connect adjacent concrete wall piers to make them act together as a unit to resist lateral loads.

DEAD LOADS. The weight of materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding, and other similarly
incorporated architectural and structural items, and fixed service equipment, including the weight of cranes.

DECK. An exterior floor supported on at least two opposing sides by an adjacent structure, and/or posts, piers or other independent supports.

DEFORMABILITY. The ratio of the ultimate deformation to the limit deformation.

High deformability element. An element whose deformability is not less than 3.5 when subjected to four fully reversed cycles at the limit deformation.

Limited deformability element. An element that is neither a low deformability or a high deformability element.

Low deformability element. An element whose deformability is 1.5 or less.

DEFORMATION

Limit deformation. Two times the initial deformation that occurs at a load equal to 40 percent of the maximum strength.

Ultimate deformation. The deformation at which failure occurs and which shall be deemed to occur if the sustainable load reduces to 80 percent or less of the maximum strength.

DESIGN STRENGTH. The product of the nominal strength and a resistance factor (or strength reduction factor).

DIAPHRAGM, FLEXIBLE. A diaphragm is flexible for the purpose of distribution of story shear and torsional moment when the lateral deformation of the diaphragm is more than two times the average story drift of the associated story, determined by comparing the computed maximum in-plane deflection of the diaphragm itself under lateral load with the story drift of adjoining vertical-resisting elements under equivalent tributary lateral load.
DIAPHRAGM, RIGID. A diaphragm that does not conform to the definition of flexible diaphragm.

DURATION OF LOAD. The period of continuous application of a given load, or the aggregate of periods of intermittent applications of the same load.

ELEMENT

Ductile element. An element capable of sustaining large cyclic deformations beyond the attainment of its nominal strength without any significant loss of strength.

Limited ductile element. An element that is capable of sustaining moderate cyclic deformations beyond the attainment of nominal strength without significant loss of strength.

Nonductile element. An element having a mode of failure that results in an abrupt loss of resistance when the element is deformed beyond the deformation corresponding to the development of its nominal strength. Nonductile elements cannot reliably sustain significant deformation beyond that attained at their nominal strength.

EQUIPMENT SUPPORT. Those structural members or assemblies of members or manufactured elements, including braces, frames, lugs, snuggers, hangers or saddles, that transmit gravity load and operating load between the equipment and the structure.

ESSENTIAL FACILITIES. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

FACTORED LOAD. The product of a nominal load and a load factor.

FLEXIBLE EQUIPMENT CONNECTIONS. Those connections between equipment components that permit rotational and/or translational movement without degradation of performance.

FRAME
Braced frame. An essentially vertical truss, or its equivalent, of the concentric or eccentric type that is provided in a building frame system or dual frame system to resist shear.

Concentrically braced frame (CBF). A braced frame in which the members are subjected primarily to axial forces.

Eccentrically braced frame (EBF). A diagonally braced frame in which at least one end of each brace frames into a beam a short distance from a beam-column or from another diagonal brace.

Ordinary concentrically braced frame (OCBF). A steel concentrically braced frame in which members and connections are designed in accordance with the provisions of AISC Seismic without modification.

Special concentrically braced frame (SCBF). A steel or composite steel and concrete concentrically braced frame in which members and connections are designed for ductile behavior.

FRAME, MOMENT

Intermediate moment frame (IMF). A moment frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members.

Ordinary moment frame (OMF). A moment frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members.

Special moment frame (SMF). A moment frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members.

FRAME SYSTEM

Building frame system. A structural system with an essentially complete space frame system providing support for vertical loads. Seismic force resistance is provided by shear walls or braced frames.
Dual frame system. A structural system with an essentially complete space frame system providing support for vertical loads. Seismic force resistance is provided by a moment-resisting frame and shear walls or braced frames.

Space frame system. A structural system composed of interconnected members, other than bearing walls, that is capable of supporting vertical loads and that also may provide resistance to seismic forces.

GUARD. See §1002.1.

IMPACT LOAD. The load resulting from moving machinery, elevators, craneways, vehicles, and other similar forces and kinetic loads, pressure and possible surcharge from fixed or moving loads.

JOINT. A portion of a column bounded by the highest and lowest surfaces of the other members framing into it.

LIMIT STATE. A condition beyond which a structure or member becomes unfit for service and is judged to be no longer useful for its intended function (serviceability limit state) or to be unsafe (strength limit state).

LIVE LOADS. Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load or dead load.

LIVE LOADS (ROOF). Those loads produced (1) during maintenance by workers, equipment and materials; and (2) during the life of the structure by movable objects such as planters and by people.

LOAD AND RESISTANCE FACTOR DESIGN (LRFD). A method of proportioning structural members and their connections using load and resistance factors such that no applicable limit state is reached when the structure is subjected to appropriate load combinations. The term "LRFD" is used in the design of steel and wood structures.
LOAD FACTOR. A factor that accounts for deviations of the actual load from the nominal load, for uncertainties in the analysis that transforms the load into a load effect, and for the probability that more than one extreme load will occur simultaneously.

LOADS. Forces or other actions that result from the weight of building materials, occupants and their possessions, environmental effects, differential movement, and restrained dimensional changes. Permanent loads are those loads in which variations over time are rare or of small magnitude. Other loads are variable loads (see also "Nominal loads").

LOADS EFFECTS. Forces and deformations produced in structural members by the applied loads.

NOMINAL LOADS. The magnitudes of the loads specified in this chapter (dead, live, soil, wind, snow, rain, flood and earthquake).

NOTATIONS

\[ D = \text{Dead load}. \]

\[ E = \text{Combined effect of horizontal and vertical earthquake induced forces as defined in §1616.4.1 and §1617.1.1}. \]

\[ E_m = \text{Maximum seismic load effect of horizontal and vertical seismic forces as set forth in §1616.4.1 and §1617.1.1}. \]

\[ F = \text{Load due to fluids}. \]

\[ F_a = \text{Flood load}. \]

\[ H = \text{Load due to lateral pressure of soil and water in soil}. \]

\[ L = \text{Live load, except roof live load, including any permitted live load reduction}. \]

\[ L_r = \text{Roof live load including any permitted live load reduction}. \]

\[ P = \text{Ponding load}. \]
R = Rain load.

S = Snow load.

T = Self-straining force arising from contraction or expansion resulting from temperature change, shrinkage, moisture change, creep in component materials, movement due to differential settlement, or combinations thereof.

W = Load due to wind pressure.

OTHER STRUCTURES. Structures, other than buildings, for which loads are specified in this chapter.

P-DELTA EFFECT. The second order effect on shears, axial forces and moments of frame members induced by axial loads on a laterally displaced building frame.

PANEL (PART OF A STRUCTURE). The section of a floor, wall or roof comprised between the supporting frame of two adjacent rows of columns and girders or column bands of floor or roof construction.

RESISTANCE FACTOR. A factor that accounts for deviations of the actual strength from the nominal strength and the manner and consequences of failure (also called strength reduction factor).

SHALLOW ANCHORS. Shallow anchors are those with embedment length-to-diameter ratios of less than 8.

SHEAR PANEL. A floor, roof or wall component sheathed to act as a shear wall or diaphragm.

SHEAR WALL. A wall designed to resist lateral forces parallel to the plane of the wall.

SPECIAL TRANSVERSE REINFORCEMENT. Reinforcement composed of spirals, closed stirrups, or hoops and supplementary cross-ties provided to
restrain the concrete and qualify the portion of the component, where used, as a confined region.

STRENGTH, NOMINAL. The capacity of a structure or member to resist the effects of loads, as determined by computations using specified material strengths and dimensions and formulas derived from accepted principles of structural mechanics or by field tests or laboratory tests of scaled models, allowing for modeling effects and differences between laboratory and field conditions.

STRENGTH, REQUIRED. Strength of a member, cross section or connection required to resist factored loads or related internal moments and forces in such combinations as stipulated by these provisions.

STRENGTH DESIGN. A method of proportioning structural members such that the computed forces produced in the members by factored loads do not exceed the member design strength (also called load and resistance factor design.) The term "strength design" is used in the design of concrete and masonry structural elements.

WALL, LOAD BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

2. Any masonry or concrete wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

WALL, NONLOAD BEARING. Any wall that is not a load-bearing wall.

§1603
CONSTRUCTION DOCUMENTS

§1603.1 General. Construction documents shall show the size, section and relative locations of structural members with floor levels, column centers and offsets fully dimensioned. The design loads and other information pertinent to the structural design required by §1603.1.1 through §1603.1.8 shall be clearly indicated on the construction documents for parts of the building or structure.
EXCEPTION: Construction documents for buildings constructed in accordance with the conventional light-frame construction provisions of §2308 shall indicate the following structural design information:

1. Floor and roof live loads.

2. Ground snow load, $P_g$.

3. Basic wind speed (3-second gust), miles per hour (km/hr) and wind exposure.

4. Seismic Design Category and Site Class.

§1603.1.1 Floor live load. The uniformly distributed, concentrated and impact floor live load used in the design shall be indicated for floor areas. Live load reduction of the uniformly distributed floor live loads, if used in the design, shall be indicated.

§1603.1.2 Roof live load. The roof live load used in the design shall be indicated for roof areas (§1607.11).

§1603.1.3 Roof snow load. The ground snow load, $P_g$, shall be indicated. In areas where the ground snow load, $P_g$, exceeds 10 pounds per square foot (0.479 kN/m^2), the following additional information shall also be provided, regardless of whether snow loads govern the design of the roof:

   1. Flat-roof snow load, $P_f$.

   2. Snow exposure factor, $C_e$.

   3. Snow load importance factor, $I_o$.

   4. Thermal factor, $C_t$.

§1603.1.4 Wind load. The following information related to wind loads shall be shown, regardless of whether wind loads govern the lateral design of the building:
1. Basic wind speed (3-second gust), miles per hour (km/hr).

2. Wind importance factor, I, and building category.

3. Wind exposure, if more than one wind exposure is utilized, the wind exposure and applicable wind direction shall be indicated.

4. The applicable internal pressure coefficient.

5. Components and cladding. The design wind pressures in terms of pounds per square foot (kN/m^2) to be used for the design of exterior component and cladding materials not specifically designed by the registered design professional.

§1603.1.5 Earthquake design data. The following information related to seismic loads shall be shown, regardless of whether seismic loads govern the lateral design of the building:

1. Seismic use group.


3. Site class.

4. Basic seismic-force-resisting system.

5. Design base shear.

6. Analysis procedure.

§1603.1.6 Flood load. For buildings located in flood hazard areas as established in §1612.3, the following information, referenced to the datum on the community’s flood insurance rate map (FIRM), shall be shown, regardless of whether flood loads govern the design of the building:

1. In flood hazard areas not subject to high-velocity wave action, the elevation of proposed lowest floor, including basement.
2. In flood hazard areas not subject to high-velocity wave action, the elevation to which any nonresidential building will be dry floodproofed.

3. In flood hazard areas subject to high-velocity wave action, the proposed elevation of the lowest horizontal structural member of the lowest floor, including basement.

§1603.1.7 Special loads. Special loads that are applicable to the design of the building, structure or portions thereof shall be indicated along with the specified section of this code that addresses the special loading condition.

§1603.1.8 System and components requiring special inspections for seismic resistance. Construction documents or specifications shall be prepared for those systems and components requiring special inspection for seismic resistance as specified in §1707.1 by the registered design professional responsible for their design and shall be submitted for approval in accordance with §106.1. Reference to seismic standards in lieu of detailed drawings is acceptable.

§1603.2 Restrictions on loading. It shall be unlawful to place, or cause or permit to be placed, on any floor or roof of a building, structure, or portion thereof, a load greater than is permitted by these requirements.

§1603.3 Live loads posted. Where the live loads for which each floor or portion thereof of a commercial or industrial building is or has been designed to exceed 50 pounds per square foot (2.40 kN/m^2), such design live loads shall be conspicuously posted by the owner in that part of each story in which they apply, using durable signs. It shall be unlawful to remove or deface such notices.

§1603.4 Occupancy permits for changed loads. Construction documents for other than residential buildings filed with the building official with applications for permits shall show on each drawing the live loads per square foot (m^2) of area covered for which the building is designed. Occupancy permits for buildings hereafter erected shall not be issued until the floor load signs, required by §1603.3, have been installed.

§1604
GENERAL DESIGN REQUIREMENTS
§1604.1 General. Building, structures, and parts thereof shall be designed and constructed in accordance with strength design, load and resistance factor design, allowable stress design, empirical design, or conventional construction methods, as permitted by the applicable material chapters.

§1604.2 Strength. Buildings and other structures, and parts thereof, shall be designed and constructed to support safely the factored loads in load combinations defined in this code without exceeding the appropriate strength limit states for the materials of construction. Alternatively, buildings and other structures, and parts thereof, shall be designed and constructed to support safely the nominal loads in load combinations defined in this code without exceeding the appropriate specified allowable streses for the materials of construction.

Loads and forces for occupancies or uses not covered in this chapter shall be subject to the approval of the building official.

§1604.3 Serviceability. Structural systems and members thereof shall be designed to have adequate stiffness to limit deflections and lateral drift. See §1617.3 for drift limits applicable to earthquake loading.

### TABLE 1604.3
DEFLECTION LIMITS{a,b,c}

<table>
<thead>
<tr>
<th>Roof members: {e}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting plaster ceiling</td>
</tr>
<tr>
<td>Supporting nonplaster ceiling</td>
</tr>
<tr>
<td>Not supporting ceiling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Floor members</th>
</tr>
</thead>
<tbody>
<tr>
<td>- l/360</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exterior walls and interior partitions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>With brittle finishes</td>
</tr>
<tr>
<td>With flexible finishes</td>
</tr>
</tbody>
</table>
Farm buildings - - l/180
Green houses - - l/120

For SI: 1 foot = 304.8 mm.

{a} For structural roofing and siding made of formed metal sheets, the total load deflection shall not exceed l/60. For secondary roof structural members supporting formed metal roofing, the live load deflection shall not exceed l/150. For secondary wall members supporting formed metal siding, the design wind load deflection shall not exceed l/90. For roofs this exception only applies when the metal sheets have no roof covering.

{b} Interior partitions not exceeding 6 feet in height and flexible, folding and portable partitions are not governed by the provisions of this section. The deflection criteria for interior partitions is based on the horizontal load defined in §1607.13.

{c} See §2403 for glass supports.

{d} For wood structural members having a moisture content of less than 16 percent at time of installation and used under dry conditions, the deflection resulting from L + 0.5D is permitted to be substituted for the deflection resulting from L + D.

{e} The above deflections do not ensure against ponding. Roofs that do not have sufficient slope or camber to assure adequate drainage shall be investigated for ponding. See §1611 for rain and ponding requirements and §1503.4 for roof drainage requirements.

{f} The wind load is permitted to be taken as 0.7 times the "component and cladding" loads for the purpose of determining deflection limits herein.

{g} For steel structural members the dead load shall be taken as zero.

§1604.3.1 Deflections. The deflections of structural members shall not exceed the more restrictive of the limitations of §1604.3.2 through §1604.3.5 or that permitted by Table 1604.3.
§1604.3.2 Reinforced concrete. The deflection of reinforced concrete structural members shall not exceed that permitted by ACI 318.

§1604.3.3 Steel. The deflection of steel structural members shall not exceed that permitted by AISC LRFD, AISC HSS, AISC ASD, AISI, ASCE 3, ASCE 8-SSD-LRFD/ASD, and the standard specifications of SJI Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders as applicable.

§1604.3.4 Masonry. The deflection of masonry structural members shall not exceed that permitted by ACI 530/ASCE 5/TMS 402.

§1604.3.5 Aluminum. The deflection of aluminum structural members shall not exceed that permitted by AA-94.

§1604.3.6 Limits. Deflection of structural members over span, l, shall not exceed that permitted by Table 1604.3.

§1604.4 Analysis. Load effects on structural members and their connections shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility, and both short-and long-term material properties.

Members that tend to accumulate residual deformations under repeated service loads shall have included in their analysis the added eccentricities expected to occur during their service life.

Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring loads from their point of origin to the load-resisting elements.

The total lateral force shall be distributed to the various vertical elements of the lateral-force-resisting system in proportion to their rigidities considering the rigidity of the horizontal bracing system or diaphragm. Rigid elements that are assumed not to be a part of the lateral-force-resisting system shall be permitted to be incorporated into buildings provided that their effect on the action of the system is considered and provided for in design. Provisions shall be made for the increased forces induced on resisting elements of the structural system.
resulting from torsion due to eccentricity between the center of application of
the lateral forces and the center of rigidity of the lateral-force-resisting system.

Every structure shall be designed to resist the overturning effects caused by the
lateral forces specified in this chapter. See §1613 for earthquake, §1609.1.3 for
wind, and §1610 for lateral soil loads.

§1604.5 Importance factors. The value for snow load, wind load and seismic
load importance factors shall be determined in accordance with Table 1604.5.

TABLE 1604.5
CLASSIFICATION OF BUILDINGS AND OTHER STRUCTURES FOR
IMPORTANCE FACTORS

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SEISMIC</th>
<th>SNOW</th>
<th>WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>FACTOR I</td>
<td>FACTOR I</td>
<td>FACTOR I</td>
</tr>
<tr>
<td>a</td>
<td>NATURE OF OCCUPANCY</td>
<td>e</td>
<td>s</td>
</tr>
<tr>
<td>Buildings and other structures</td>
<td>1.00</td>
<td>1.0</td>
<td>1.00</td>
</tr>
<tr>
<td>I except those listed in Categories II, III and IV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to:

- Buildings and other structures where more than 300 people congregate in one area
- Buildings and other structures with elementary school, secondary school or day-care facilities with capacity greater than 250
- Buildings and other structures with a capacity greater than 500 for
II  • Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities

• Jails and detention facilities

• Any other occupancy with an occupant load greater than 5,000

• Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Category III

• Buildings and other structures not included in Category III containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released

Buildings and other structures designated as essential facilities including, but not limited to:

• Hospitals and other health care facilities having surgery or emergency treatment facilities

• Fire, rescue and police stations and emergency vehicle garages

• Designated earthquake, hurricane or other emergency
shelters

• Designated emergency preparedness, communication, and operation centers

III and other facilities required for emergency response

• Power-generating stations and other public utility facilities required as emergency back-up facilities for Category III structures

• Structures containing highly toxic materials as defined by §307 where the quantity of the material exceeds the exempt amounts of Table 307.7(2)

• Aviation control towers, air traffic control centers and emergency aircraft hangars

• Buildings and other structures having critical national defense functions

• Water treatment facilities required to maintain water pressure for fire suppression

Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to:

IV • Agricultural facilities 1.00 0.8 0.87

• Certain temporary facilities
• Minor storage facilities

{a} "Category" is equivalent to "Seismic Use Group" for the purposes of §1616.2.

{b} In hurricane-prone regions with V>100 miles per hour, I_w shall be 0.77.

§1604.6 In-situ load tests. The building official is authorized to require an engineering analysis or a load test, or both, of any construction whenever there is reason to question the safety of the construction for the intended occupancy. Engineering analysis and load tests shall be conducted in accordance with §1710.

§1604.7 Preconstruction load tests. Materials and methods of construction that are not capable of being designed by approved engineering analysis or that do not comply with the applicable material design standards listed in Chapter 35, or alternative test procedures in accordance with §1704, shall be load tested in accordance with §1709.

§1604.8 Anchorage.

§1604.8.1 General. Anchorage of the roof to walls and columns, and of walls and columns to foundations, shall be provided to resist the uplift and sliding forces that result from the application of the prescribed loads.

§1604.8.2 Concrete and masonry walls. Concrete and masonry walls shall be anchored to floors, roofs and other structural elements that provide lateral support for the wall. Such anchorage shall provide a positive direct connection capable of resisting the horizontal forces specified in this chapter but not less than a minimum horizontal force of 200 pounds per linear foot (2.92 kN/m) of wall, substituted for "E." Walls shall be designed to resist bending between anchors where the anchor spacing exceeds 4 feet (1219 mm). Required anchors in masonry walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See §1609.6.5 and §1620 for wind and earthquake design requirements.

§1604.8.3 Decks. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both
vertical and lateral loads as applicable. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal. Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting. For decks with cantilevered framing members, connections to exterior walls or other framing members shall be designed and constructed to resist uplift resulting from the full live load specified in Table 1607.1 acting on the cantilevered portion of the deck.

§1605
LOAD COMBINATIONS

§1605.1 General. Buildings and other structures and portions thereof shall be designed to resist the load combinations specified in §1605.2 or §1605.3 and Chapter 18 through Chapter 23, and the special seismic load combinations of §1605.4 where required by §1620.1.7 or §1620.3.5. Applicable loads shall be considered, including both earthquake and wind, in accordance with the specified load combinations. Effects from one or more transient loads not acting shall be investigated.

§1605.2 Load combinations using strength design or load and resistance factor design.

§1605.2.1 Basic load combinations. Where strength design or load and resistance factor design is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

\[
\text{FORMULA 16}_1 \\
1.4D
\]

\[
\text{FORMULA 16}_2 \\
1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)
\]

\[
\text{FORMULA 16}_3 \\
1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1L \text{ or } 0.8W)
\]

\[
\text{FORMULA 16}_4 \\
1.2D + 1.6W + f_1L + 0.5(L_r \text{ or } S \text{ or } R)
\]
FORMULA 16_5
1.2D + 1.0E + f_1L + f_2S

FORMULA 16_6
0.9D + (1.0E or 1.6W)

where:

f_1 = 1.0 for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m^2), and for parking garage live load.

= 0.5 for other live loads.

f_2 = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure.

= 0.2 for other roof configurations.

EXCEPTIONS:

1. For concrete structures where load combinations do not include seismic forces, the factored load combinations of ACI 318 §9.2 shall be used. For concrete structures designed using the design wind forces of ASCE 7, W shall be divided by the directionality factor K_d. For concrete structures designed using §1609.6, W shall be divided by a directionality factor of 0.85.

2. Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

§1605.2.2 Other loads. Where F, H, P or T are to be considered in design, each applicable load shall be added to the above combinations in accordance with §2.3.2 of ASCE 7. Where F_a is to be considered in design, the load combinations of §2.3.3 of ASCE 7 shall be used.

§1605.3 Load combinations using allowable stress design.

§1605.3.1 Basic load combinations. Where allowable stress design (working stress design), as permitted by this code, is used, structures and portions
thereof shall resist the most critical effects resulting from the following combinations of loads:

FORMULA 16_7  
D

FORMULA 16_8  
D + L

FORMULA 16_9  
D + L + (L_r or S or R)

FORMULA 16_10  
D + (W or 0.7E) + L + (L_r or S or R)

FORMULA 16_11  
0.6D + W

FORMULA 16_12  
0.6D + 0.7E

EXCEPTIONS:

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.

2. Flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

§1605.3.1.1 Load reduction. It is permitted to multiply the combined effect of two or more transient loads by 0.75 and add to the effect of dead load. The combined load used in design shall not be less than the sum of the effects of dead load and any one of the transient loads. The 0.7 factor on E does not apply for this provision.

Increases in allowable stresses specified in the appropriate materials section of this code or referenced standard shall not be used with the load
combinations of §1605.3.1 except that a duration of load increase shall be permitted in accordance with Chapter 23.

§1605.3.1.2 Other loads. Where F, H, P or T are to be considered in design, the load combinations of §2.4.1 of ASCE 7 shall be used. Where \( F_a \) is to be considered in design, the load combinations of §2.4.2 of ASCE 7 shall be used.

§1605.3.2 Alternate basic load combinations. In lieu of the basic load combinations specified in §1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternate basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced, where permitted by the material section of this code or referenced standard. Where wind loads are calculated in accordance with §1609.6 or ASCE 7, the coefficient \( w \) in the following formulas shall be taken as 1.3. For other wind loads \( w \) shall be taken as 1.0.

\[
\text{FORMULA 16_13} \\
D + L + (Lr \text{ or } S \text{ or } R)
\]

\[
\text{FORMULA 16_14} \\
D + L + (wW)
\]

\[
\text{FORMULA 16_15} \\
D + L + wW + S/2
\]

\[
\text{FORMULA 16_16} \\
D + L + S + wW/2
\]

\[
\text{FORMULA 16_17} \\
D + L + S + E/1.4
\]

\[
\text{FORMULA 16_18} \\
0.9D + E/1.4
\]

EXCEPTIONS:
1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.

2. Flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

§1605.3.2.1 Other loads. Where F, H, P or T are to be considered in design, 1.0 times each applicable load shall be added to the combinations specified in §1605.3.2.

§1605.4 Special seismic load combinations. For both allowable stress design and strength design methods, where specifically required by §1613 through §1622 or by Chapter 18 through Chapter 23, elements and components shall be designed to resist the forces due to Formula 16_16 - Formula 16_19 when the effects of the seismic ground motion are additive to gravity forces and Formula 16_16 - Formula 16_20 when the effects of the seismic ground motion counteract gravity forces.

FORMULA 16_19
1.2D + f_1L + E_m

FORMULA 16_20
0.9D + E_m

where:

E_m = The maximum effect of horizontal and vertical forces as set forth in §1617.1.2.

f_1 = 1.0 for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m^2), and for parking garage live load.

f1 = 0.5 for other live loads.

§1605.5 Heliports and helistops. Heliport and helistop landing or touchdown areas shall be designed for the following loads, combined in accordance with §1605:
1. Dead load, D, plus the gross weight of the helicopter, D_h, plus snow load, S.

2. Dead load, D, plus two single concentrated impact loads, L, approximately 8 feet (2438 mm) apart applied anywhere on the touchdown pad (representing each of the helicopter's two main landing gear, whether skid type or wheeled type), having a magnitude of 0.75 times the gross weight of the helicopter. Both loads acting together total 1.5 times the gross weight of the helicopter.

3. Dead load, D, plus a uniform live load, L, of 100 pounds per square foot (4.79 kN/m^2).

§1605
LOAD COMBINATIONS

§1605.1 General. Buildings and other structures and portions thereof shall be designed to resist the load combinations specified in §1605.2 or §1605.3 and Chapter 18 through Chapter 23, and the special seismic load combinations of §1605.4 where required by §1620.1.7 or §1620.3.5. Applicable loads shall be considered, including both earthquake and wind, in accordance with the specified load combinations. Effects from one or more transient loads not acting shall be investigated.

§1605.2 Load combinations using strength design or load and resistance factor design.

§1605.2.1 Basic load combinations. Where strength design or load and resistance factor design is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

FORMULA 16_1
1.4D

FORMULA 16_2
1.2D + 1.6L + 0.5(L_r or S or R)

FORMULA 16_3
\[1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1L \text{ or } 0.8W)\]

**FORMULA 16_4**

\[1.2D + 1.6W + f_1L + 0.5(L_r \text{ or } S \text{ or } R)\]

**FORMULA 16_5**

\[1.2D + 1.0E + f_1L + f_2S\]

**FORMULA 16_6**

\[0.9D + (1.0E \text{ or } 1.6W)\]

where:

\[f_1 = 1.0\] for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m^2), and for parking garage live load.

\[= 0.5\] for other live loads.

\[f_2 = 0.7\] for roof configurations (such as saw tooth) that do not shed snow off the structure.

\[= 0.2\] for other roof configurations.

**EXCEPTIONS:**

1. For concrete structures where load combinations do not include seismic forces, the factored load combinations of ACI 318 §9.2 shall be used. For concrete structures designed using the design wind forces of ASCE 7, W shall be divided by the directionality factor \(K_d\). For concrete structures designed using §1609.6, W shall be divided by a directionality factor of 0.85.

2. Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

§1605.2.2 Other loads. Where \(F, H, P\) or \(T\) are to be considered in design, each applicable load shall be added to the above combinations in accordance with §2.3.2 of ASCE 7. Where \(F_a\) is to be considered in design, the load combinations of §2.3.3 of ASCE 7 shall be used.
§1605.3 Load combinations using allowable stress design.

§1605.3.1 Basic load combinations. Where allowable stress design (working stress design), as permitted by this code, is used, structures and portions thereof shall resist the most critical effects resulting from the following combinations of loads:

\[ \text{FORMULA 16}_7 \]
\[ D \]

\[ \text{FORMULA 16}_8 \]
\[ D + L \]

\[ \text{FORMULA 16}_9 \]
\[ D + L + (L_r \text{ or } S \text{ or } R) \]

\[ \text{FORMULA 16}_10 \]
\[ D + (W \text{ or } 0.7E) + L + (L_r \text{ or } S \text{ or } R) \]

\[ \text{FORMULA 16}_11 \]
\[ 0.6D + W \]

\[ \text{FORMULA 16}_12 \]
\[ 0.6D + 0.7E \]

EXCEPTIONS:

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.

2. Flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

§1605.3.1.1 Load reduction. It is permitted to multiply the combined effect of two or more transient loads by 0.75 and add to the effect of dead load. The combined load used in design shall not be less than the sum of
the effects of dead load and any one of the transient loads. The 0.7 factor on E does not apply for this provision.

Increases in allowable stresses specified in the appropriate materials section of this code or referenced standard shall not be used with the load combinations of §1605.3.1 except that a duration of load increase shall be permitted in accordance with Chapter 23.

§1605.3.1.2 Other loads. Where F, H, P or T are to be considered in design, the load combinations of §2.4.1 of ASCE 7 shall be used. Where F_a is to be considered in design, the load combinations of §2.4.2 of ASCE 7 shall be used.

§1605.3.2 Alternate basic load combinations. In lieu of the basic load combinations specified in §1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternate basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced, where permitted by the material section of this code or referenced standard. Where wind loads are calculated in accordance with §1609.6 or ASCE 7, the coefficient w in the following formulas shall be taken as 1.3. For other wind loads w shall be taken as 1.0.

**FORMULA 16_13**

\[ D + L + (Lr \text{ or } S \text{ or } R) \]

**FORMULA 16_14**

\[ D + L + (wW) \]

**FORMULA 16_15**

\[ D + L + wW + S/2 \]

**FORMULA 16_16**

\[ D + L + S + wW/2 \]

**FORMULA 16_17**

\[ D + L + S + E/1.4 \]

**FORMULA 16_18**
0.9D + E/1.4

EXCEPTIONS:

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.

2. Flat roof snow loads of 30 pounds per square foot (1.44 kN/m^2) or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 pounds per square foot (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

§1605.3.2.1 Other loads. Where F, H, P or T are to be considered in design, 1.0 times each applicable load shall be added to the combinations specified in §1605.3.2.

§1605.4 Special seismic load combinations. For both allowable stress design and strength design methods, where specifically required by §1613 through §1622 or by Chapter 18 through Chapter 23, elements and components shall be designed to resist the forces due to Formulas 16_16 - 16_19 when the effects of the seismic ground motion are additive to gravity forces and Formulas 16_16 - 16_20 when the effects of the seismic ground motion counteract gravity forces.

FORMULA 16_19
1.2D + f_1L + E_m

FORMULA 16_20
0.9D + E_m

where:

E_m = The maximum effect of horizontal and vertical forces as set forth in §1617.1.2.

f_1 = 1.0 for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m^2), and for parking garage live load.

f1 = 0.5 for other live loads.
§1605.5 Heliports and helistops. Heliport and helistop landing or touchdown areas shall be designed for the following loads, combined in accordance with §1605:

1. Dead load, \( D \), plus the gross weight of the helicopter, \( D_h \), plus snow load, \( S \).

2. Dead load, \( D \), plus two single concentrated impact loads, \( L \), approximately 8 feet (2438 mm) apart applied anywhere on the touchdown pad (representing each of the helicopter's two main landing gear, whether skid type or wheeled type), having a magnitude of 0.75 times the gross weight of the helicopter. Both loads acting together total 1.5 times the gross weight of the helicopter.

3. Dead load, \( D \), plus a uniform live load, \( L \), of 100 pounds per square foot (4.79 kN/m\(^2\)).

§1606
DEAD LOADS

§1606.1 Weights of materials and construction. In determining dead loads for purposes of design, the actual weights of materials and construction shall be used. In the absence of definite information, values used shall be subject to the approval of the building official.

§1606.2 Weights of fixed service equipment. In determining dead loads for purposes of design, the weight of fixed service equipment, such as plumbing stacks and risers, electrical feeders, heating, ventilating and air conditioning systems and fire sprinkler systems, shall be included.

§1607
LIVE LOADS

§1607.1 General. Live loads are those loads defined in §1602.1.

TABLE 1607.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND MINIMUM CONCENTRATED LIVE LOADS{g}
<table>
<thead>
<tr>
<th>UNIFORM OCCUPANCY OR USE</th>
<th>CONCENTRATED (psf)</th>
<th>(lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Apartments (see residential)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Access floor systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office use</td>
<td>50</td>
<td>2,000</td>
</tr>
<tr>
<td>Computer use</td>
<td>100</td>
<td>2,000</td>
</tr>
<tr>
<td>3. Armories and drill rooms</td>
<td>150</td>
<td>-</td>
</tr>
<tr>
<td>4. Assembly areas and theaters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed seats (fastened to floor)</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>Lobbies</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Movable seats</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Stages and platforms</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Follow spot, projection and control rooms</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Catwalks</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>5. Balconies (exterior)</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>On one-and two-family residences only, and not exceeding 100 ft.(^2)</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>6. Decks</td>
<td>Same as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>occupancy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>served{h}</td>
<td></td>
</tr>
<tr>
<td>7. Bowling alleys</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>8. Cornices</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>9. Corridors, except as otherwise indicated</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>10. Dance halls and ballrooms</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>11. Dining rooms and restaurants</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>12. Dwellings (see residential)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
13. Elevator machine room grating  
   (on area of 4 in.^2)  -  300

14. Finish light floor plate construction  
   (on area of 1 in.^2)  -  200

15. Fire escapes  
   On single-family dwellings only  40

16. Garages (passenger cars only)  50  Note a
   Trucks and buses  See §1607.6

17. Grandstands (see stadium and arena bleachers)  -  -

18. Gymnasiums, main floors and balconies  100  -

19. Handrails, guards and grab bars  See §1607.7

20. Hospitals
   Operating rooms, laboratories  60  1,000
   Private rooms  40  1,000
   Wards  40  1,000
   Corridors above first floor  80  1,000

21. Hotels (see residential)  -  -

22. Libraries
   Reading rooms  60  1,000
   Stack rooms  150[b]  1,000
   Corridors above first floor  80  1,000

23. Manufacturing
   Light  125  2,000
   Heavy  250  3,000

24. Marquees and canopies  75  -
25. Office buildings
   File and computer rooms shall be designed for heavier loads based on anticipated occupancy
   Lobbies and first floor corridors 100 2,000
   Offices 50 2,000
   Corridors above first floor 80 2,000

26. Penal Institutions
   Cell blocks 40 -
   Corridors 100

27. Residential
   Group R-3 as applicable in §101.2
   Uninhabitable attics without storage 10
   Uninhabitable attics with storage 20
   Habitable attics and sleeping areas 30
   All other areas except balconies 40
   Hotels and multifamily dwellings
     Private rooms 40
     Public rooms and corridors serving them 100

28. Reviewing stands, grandstands and bleachers 100\{c\} -

29. Roofs
   See §1607.11

30. Schools
   Classrooms 40 1,000
   Corridors above first floor 80 1,000
   First floor corridors 100 1,000

31. Scuttles, skylight ribs, and accessible ceilings
    - 200

32. Sidewalks, vehicular driveways and yards, subject to trucking
    250\{d\} 8,000\{e\}

33. Skating rinks
    100 -
34. Stadiums and arenas
   Bleachers 100{c}
   Fixed seats (fastened to floor) 60{c}

35. Stairs and exits 100  Note f
   One-and two-family dwellings 40
   All other 100

36. Storage warehouses (shall be designed for
   heavier loads if required for
   anticipated storage)
   Light 125
   Heavy 250

37. Stores
   Retail
   First floor 100 1,000
   Upper floors 75 1,000
   Wholesale, all floors 125 1,000

38. Vehicle barriers  See §1607.7

39. Walkways and elevated platforms 60 -
   (other than exitways)

40. Yards and terraces, pedestrians 100 -

For SI: 1 square inch = 645.16 mm^2,
          1 pound per square foot = 0.0479 kN/m^2,
          1 pound = 0.004448 kN.

NOTES TO TABLE 1607.1

{a} Floors in garages or portions of building used for the storage of motor
   vehicles shall be designed for the uniformly distributed live loads of Table
   1607.1 or the following concentrated load: (1) for passenger cars
   accommodating not more than nine passengers, 2,000 pounds acting on an area
   of 20 square inches; (2) mechanical parking structures without slab or deck,
   passenger car only, 1,500 pounds per wheel.
{b} The weight of books and shelving shall be computed using an assumed density of 65 pounds per foot squared and converted to a uniformly distributed load; this load shall be used if it exceeds 150 pounds per square foot.

{c} In addition to the vertical live loads, horizontal swaying forces parallel and normal to the length of seats shall be included in the design according to the requirements of NFPA 102.

{d} Other uniform loads in accordance with an approved method which contains provisions for truck loadings shall also be considered where appropriate.

{e} The concentrated wheel load shall be applied on an area of 20 square inches.

{f} Minimum concentrated load on stair treads (on area of 4 square inches) is 300 pounds.

{g} Where snow loads occur that are in excess of the design conditions, the structure shall be designed to support the loads due to the increased loads caused by drift buildup or a greater snow design determined by the building official. See §1608. For special-purpose roofs, see §1607.11.2.2.

{h} See §1604.8.3 for decks attached to exterior walls.

§1607.2 Loads not specified. For occupancies or uses not designated in Table 1607.1, the live load shall be determined in accordance with a method approved by the building official.

§1607.3 Uniform live loads. The live loads used in the design of buildings and other structures shall be the maximum loads expected by the intended use or occupancy but shall in no case be less than the minimum uniformly distributed unit loads required by Table 1607.1.

§1607.4 Concentrated loads. Floors and other similar surfaces shall be designed to support the uniformly distributed live loads prescribed in §1607.2 or the concentrated load, in pounds (kilonewtons), given in Table 1607.1, whichever produces the greater load effects. Unless otherwise specified, the indicated concentration shall be assumed to be uniformly distributed over an area 2.5 feet
square [6.25 ft^2 (0.58 m^2)] and shall be located so as to produce the maximum load effects in the structural members.

§1607.5 Partition loads. In office buildings and in other buildings where partition locations are subject to change, provision for partition weight shall be made, whether or not partitions are shown on the construction documents, unless the specified live load exceeds 80 pounds per square foot (3.83 kN/m^2). Such partition load shall not be less than a uniformly distributed live load of 20 pounds per square foot (0.96 kN/m^2).

§1607.6 Truck and bus garages. Minimum live loads for garages having trucks or buses shall be as specified in Table 1607.6, but shall not be less than 50 pounds per square foot (2.40 kN/m^2), unless other loads are specifically justified and approved by the building official. Actual loads shall be used where they are greater than the loads specified in the table.

| TABLE 1607.6 |
| UNIFORM AND CONCENTRATED LOADS |

<table>
<thead>
<tr>
<th>CONCENTRATED LOAD</th>
<th>(pounds){b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIFORM LOAD</td>
<td>(pounds/linear foot of lane)</td>
</tr>
<tr>
<td>LOADING CLASS{a}</td>
<td>640</td>
</tr>
<tr>
<td>H20-44 and HS20-44</td>
<td>480</td>
</tr>
</tbody>
</table>

For SI: 1 pound per linear foot = 0.01459 kN/m, 1 pound = 0.004448 kN, 1 ton = 8.90 kN.

{a} An H loading class designates a two-axle truck with a semi-trailer. An HS loading class designates a tractor truck with a semi-trailer. The numbers following the letter classification indicate the gross weight in tons of the standard truck and the year the loadings were instituted.
{b} See §1607.6.1 for the loading of multiple spans.

§1607.6.1 Truck and bus garage live load application. The concentrated load and uniform load shall be uniformly distributed over a 10-foot (3048 mm) width on a line normal to the centerline of the lane placed within a 12-foot-wide (3658 mm) lane. The loads shall be placed within their individual lanes so as to produce the maximum stress in each structural member. Single spans shall be designed for the uniform load in Table 1607.6 and one simultaneous concentrated load positioned to produce the maximum effect. Multiple spans shall be designed for the uniform load in Table 1607.6 on the spans and two simultaneous concentrated loads in two spans positioned to produce the maximum negative moment effect. Multiple span design loads, for other effects, shall be the same as for single spans.

§1607.7 Loads on handrails, guards, grab bars and vehicle barriers. Handrails, guards, grab bars as designed in ICC A117.1, and vehicle barriers shall be designed and constructed to the structural loading conditions set forth in this section.

§1607.7.1 Handrails and guards. Handrail assemblies and guards shall be designed to resist a load of 50 pounds per linear foot (pound per foot) (0.73 kN/m) applied in any direction at the top and to transfer this load through the supports to the structure.

EXCEPTIONS:

1. For one-and two-family dwellings, only the single, concentrated load required by §1607.7.1.1 shall be applied.

2. In Groups I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load no greater than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

§1607.7.1.1 Concentrated load. Handrail assemblies and guards shall be able to resist a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point along the top, and have attachment devices and supporting structure to transfer this loading to appropriate structural elements of the building. This load need not be assumed to act concurrently with the loads specified in the preceding paragraph.
§1607.7.1.2 Components. Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds (0.22 kN) on an area not to exceed 1 square foot (305 mm^2) including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of either preceding paragraph.

§1607.7.1.3 Stress increase. Where handrails and guards are designed in accordance with the provisions for allowable stress design (working stress design) exclusively for the loads specified in §1607.7.1, the allowable stress for the members and their attachments are permitted to be increased by one-third.

§1607.7.2 Grab bars, shower seats and dressing room bench seats. Grab bars, shower seats and dressing room bench seat systems shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point.

§1607.7.3 Vehicle barriers. Vehicle barrier systems for passenger cars shall be designed to resist a single load of 6,000 pounds (26.70 kN) applied horizontally in any direction to the barrier system and shall have anchorage or attachment capable of transmitting this load to the structure. For design of the system, the load shall be assumed to act at a minimum height of 1 foot, 6 inches (457 mm) above the floor or ramp surface on an area not to exceed 1 square foot (305 mm^2), and is not required to be assumed to act concurrently with any handrail or guard loadings specified in the preceding paragraphs of §1607.7.1. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provision for traffic railings.

§1607.8 Impact loads. The live loads specified in §1607.2 include allowance for impact conditions. Provision shall be made in the structural design for uses and loads that involve unusual vibration and impact forces.

§1607.8.1 Elevators. Elevator loads shall be increased by 100 percent for impact and the structural supports shall be designed within the limits of deflection prescribed by ASME A17.1.
§1607.8.2 Machinery. For the purpose of design, the weight of machinery and moving loads shall be increased as follows to allow for impact: (1) elevator machinery, 100 percent; (2) light machinery, shaft-or motor-driven, 20 percent; (3) reciprocating machinery or power-driven units, 50 percent; (4) hangers for floors or balconies, 33 percent. Percentages shall be increased where specified by the manufacturer.

§1607.9 Reduction in live loads. The minimum uniformly distributed live loads, L_o, in Table 1607.1 are permitted to be reduced according to the following provisions.

§1607.9.1 General. Subject to the limitations of §1607.9.1.1 through §1607.9.1.4, members for which a value of K_LLA_T is 400 square feet (37.16 m^2) or more are permitted to be designed for a reduced live load in accordance with the following equation:

EQUATION 16-1

where:

L = Reduced design live load per square foot (meter) of area supported by the member.

L_o = Unreduced design live load per square foot (meter) of area supported by the member (see Table 1607.1).

K_LL = Live load element factor (see Table 1607.9.1).

A_T = Tributary area, in square feet (square meters).

L shall not be less than 0.50L_o for members supporting one floor and L shall not be less than 0.40L_o for members supporting two or more floors.

TABLE 1607.9.1
LIVE LOAD ELEMENT FACTOR, K_LL

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>K_LL</th>
</tr>
</thead>
</table>


Interior columns                                      4
Exterior columns without cantilever slabs             4

Edge columns with cantilever slabs                   3
Corner columns with cantilever slabs                 2
Edge beams without cantilever slabs                  2
Interior beams                                        2

All other members not identified above including:
  Edge beams with cantilever slabs
  Cantilever beams                                    1
  Two-way slabs
  Members without provisions for continuous
    shear transfer normal to their span

§1607.9.1.1 Heavy live loads. Live loads that exceed 100 pounds per foot
  squared (4.79 kN/m^2) shall not be reduced except the live loads for
  members supporting two or more floors are permitted to be reduced by a
  maximum of 20 percent, but the live load shall not be less than L as
  calculated in §1607.9.1.

§1607.9.1.2 Passenger car garages. The live loads shall not be reduced in
  passenger car garages except the live loads for members supporting two
  or more floors are permitted to be reduced by a maximum of 20 percent,
  but the live load shall not be less than L as calculated in §1607.9.1.

§1607.9.1.3 Special occupancies. Live loads of 100 pounds per foot
  squared (4.79 kN/m^2) or less shall not be reduced in public assembly
  occupancies.

§1607.9.1.4 Special structural elements. Live loads shall not be reduced
  for one-way slabs except as permitted in §1607.9.1.1. Live loads of 100
  pound per foot squared (4.79 kN/m^2) or less shall not be reduced for
  roof members except as specified in §1607.11.2.
§1607.9.2 Alternate floor live load reduction. As an alternative to §1607.9, floor live loads are permitted to be reduced in accordance with the following provisions. Such reductions shall apply to slab systems, beams, girders, columns, piers, walls and foundations.

1. A reduction shall not be permitted in Group A occupancies.

2. A reduction shall not be permitted when the live load exceeds 100 pounds per square foot (4.79 kN/m^2) except that the design live load for columns may be reduced by 20 percent.

3. For live loads not exceeding 100 pounds per square foot (4.79 kN/m^2), the design live load for any structural member supporting 150 square feet (13.94 m^2) or more is permitted to be reduced in accordance with the following equation:

**EQUATION 16-2**

\[
\text{Such reduction shall not exceed 40 percent for horizontal members, 60 percent for vertical members, nor}\ R \ \text{as determined by the following equation:}
\]

**EQUATION 16-3**

where:

\[
\begin{align*}
A &= \text{Area of floor or roof supported by the member, square feet (m}^2) .\\
D &= \text{Dead load per square foot (m}^2) \text{ of area supported.}\\
L_0 &= \text{Unreduced live load per square foot (m}^2) \text{ of area supported.}\\
R &= \text{Reduction in percent.}\\
r &= \text{Rate of reduction equal to 0.08 percent for floors.}
\end{align*}
\]
§1607.10 Distribution of floor loads. Where uniform floor live loads are involved in the design of structural members arranged so as to create continuity, the minimum applied loads shall be the full dead loads on all spans in combination with the reduced floor live load or the full live loads on adjacent spans and on alternate spans.

§1607.11 Roof loads. The structural supports of roofs and marquees shall be designed to resist wind and, where applicable, snow and earthquake loads, in addition to the dead load of construction and the appropriate live loads as prescribed in this section, or as set forth in Table 1607.1. The live loads acting on a sloping surface shall be assumed to act vertically on the horizontal projection of that surface.

§1607.11.1 Distribution of roof loads. Where uniform roof live loads are involved in the design of structural members arranged so as to create continuity, the minimum applied loads shall be the full dead loads on all spans in combination with full roof live loads on adjacent spans and on alternate spans. See §1608.5 for partial snow loading.

§1607.11.2 Minimum roof live loads. Minimum roof loads shall be determined for the specific conditions in accordance with §1607.11.2.1 through §1607.11.2.5.

§1607.11.2.1 Flat, pitched and curved roofs. Ordinary flat, pitched and curved roofs shall be designed for the live loads specified in the following formula or other controlling combinations of loads in §1605, whichever produces the greater load. In structures, where special scaffolding is used as a work surface for workers and materials during maintenance and repair operations, a lower roof load than specified in the following formula shall not be used unless approved by the building official. Greenhouses shall be designed for a minimum roof live load of 10 pounds per square foot (0.479 kN/m^2).

EQUATION 16-4

The reduction factors R_1 and R_2 shall be determined as follows:
EQUATION 16-5

EQUATION 16-6

EQUATION 16-7

where:

At = Tributary area (span length multiplied by effective width) in square feet (m^2) supported by any structural member, and

F = for a sloped roof, the number of inches of rise per foot (for SI: F = 0.125 slope, with slope expressed in percentage points), and

F = for an arch or dome, rise-to-span ratio multiplied by 32, and

EQUATION 16-8

EQUATION 16-9

EQUATION 16-10

§1607.11.2.2 Special-purpose roofs. Roofs used for promenade purposes shall be designed for a minimum live load of 60 pounds per square foot (2.87 kN/m^2). Roofs used for roof gardens or assembly purposes shall be designed for a minimum live load of 100 pounds per square foot (4.79 kN/
m^2). Roofs used for other special purposes shall be designed for appropriate loads, as directed or approved by the building official.

§1607.11.2.3 Landscaped roofs. Where roofs are to be landscaped, the uniform design live load in the landscaped area shall be 20 pounds per square foot (0.958 kN/m^2). The weight of the landscaping materials shall be considered as dead load and shall be computed on the basis of saturation of the soil.

§1607.11.2.4 Awnings and canopies. Awnings and canopies shall be designed for a uniform live load of 5 pounds per square foot (0.240 kN/m^2) as well as for snow loads and wind loads as specified in §1608 and §1609.

§1607.11.2.5 Overhanging eaves. In other than occupancies in Group R-3 as applicable in §101.2, and except where the overhang framing is a continuation of the roof framing, overhanging eaves, cornices and other roof projections shall be designed for a minimum uniformly distributed live load of 60 pounds per square foot (2.87 kN/m^2).

§1607.12 Crane loads. The crane live load shall be the rated capacity of the crane. Design loads for the runway beams, including connections and support brackets, of moving bridge cranes and monorail cranes shall include the maximum wheel loads of the crane and the vertical impact, lateral, and longitudinal forces induced by the moving crane.

§1607.12.1 Maximum wheel load. The maximum wheel loads shall be the wheel loads produced by the weight of the bridge, as applicable, plus the sum of the rated capacity and the weight of the trolley with the trolley positioned on its runway at the location where the resulting load effect is maximum.

§1607.12.2 Vertical impact force. The maximum wheel loads of the crane shall be increased by the percentages shown below to determine the induced vertical impact or vibration force:

Monorail cranes (powered) ...................... 25 percent
Cab-operated or remotely operated bridge cranes (powered) ....................... 25 percent

Pendant-operated bridge cranes (powered) ........................................ 10 percent

Bridge cranes or monorail cranes with hand-geared bridge, trolley and hoist .......... 0 percent

§1607.12.3 Lateral force. The lateral force on crane runway beams with electrically powered trolleys shall be calculated as 20 percent of the sum of the rated capacity of the crane and the weight of the hoist and trolley. The lateral force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction perpendicular to the beam, and shall be distributed according to the lateral stiffness of the runway beam and supporting structure.

§1607.12.4 Longitudinal force. The longitudinal force on crane runway beams, except for bridge cranes with hand-geared bridges, shall be calculated as 10 percent of the maximum wheel loads of the crane. The longitudinal force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction parallel to the beam.

§1607.13 Interior walls and partitions. Interior walls and partitions that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength to resist the loads to which they are subjected but not less than a horizontal load of 5 pounds per square foot (0.240 kN/m^2).

§1608
SNOW LOADS

§1608.1 General. Design snow loads shall be determined in accordance with §7 of ASCE 7, but the design roof load shall not be less than that determined by §1607.

§1608.2 Ground snow loads. The ground snow loads to be used in determining the design snow loads for roofs are given in Figure 1608.2 for the contiguous United States and Table 1608.2 for Alaska. Site-specific case studies shall be made in areas designated CS in Figure 1608.2. Ground snow loads for sites at elevations above the limits indicated in Figure 1608.2 and for all sites within the
CS areas shall be approved. Ground snow load determination for such sites shall be based on an extreme value statistical analysis of data available in the vicinity of the site using a value with a 2-percent annual probability of being exceeded (50-year mean recurrence interval). Snow loads are zero for Hawaii, except in mountainous regions as approved by the building official.

### TABLE 1608.2
GROUND SNOW LOADS, \( p_g \), FOR ALASKAN Locations

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>POUNDS PER SQUARE FOOT</th>
<th>LOCATION</th>
<th>POUNDS PER SQUARE FOOT</th>
<th>LOCATION</th>
<th>POUNDS PER SQUARE FOOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adak</td>
<td>30</td>
<td>Galena</td>
<td>60</td>
<td>Petersburg</td>
<td>150</td>
</tr>
<tr>
<td>Anchorage</td>
<td>50</td>
<td>Gulkana</td>
<td>70</td>
<td>St. Paul Islands</td>
<td>40</td>
</tr>
<tr>
<td>Angoon</td>
<td>70</td>
<td>Homer</td>
<td>40</td>
<td>Seward</td>
<td>50</td>
</tr>
<tr>
<td>Barrow</td>
<td>25</td>
<td>Juneau</td>
<td>60</td>
<td>Shemya</td>
<td>25</td>
</tr>
<tr>
<td>Barter Island</td>
<td>35</td>
<td>Kenai</td>
<td>70</td>
<td>Sitka</td>
<td>50</td>
</tr>
<tr>
<td>Bethel</td>
<td>40</td>
<td>Kodiak</td>
<td>30</td>
<td>Talkeetna</td>
<td>120</td>
</tr>
<tr>
<td>Big Delta</td>
<td>50</td>
<td>Kotzebue</td>
<td>60</td>
<td>Unalakleet</td>
<td>50</td>
</tr>
<tr>
<td>Cold Bay</td>
<td>25</td>
<td>McGrath</td>
<td>70</td>
<td>Valdez</td>
<td>160</td>
</tr>
<tr>
<td>Cordova</td>
<td>100</td>
<td>Nenana</td>
<td>80</td>
<td>Whittier</td>
<td>300</td>
</tr>
<tr>
<td>Fairbanks</td>
<td>60</td>
<td>Nome</td>
<td>70</td>
<td>Wrangell</td>
<td>60</td>
</tr>
<tr>
<td>Fort Yukon</td>
<td>60</td>
<td>Palmer</td>
<td>50</td>
<td>Yakutat</td>
<td>150</td>
</tr>
</tbody>
</table>

For SI: 1 pound per square foot = 0.0479 kN/m^2.
GROUND SNOW LOADS, $P_g$, FOR THE UNITED STATES (psf)

§1608.3 Flat roof snow loads. The flat roof snow load, $p_f$, on a roof with a slope equal to or less than 5 degrees (0.09 rad) (1 inch per foot = 4.76 degrees) shall be calculated in accordance with §7.3 of ASCE 7.

§1608.3.1 Exposure factor. The value for the snow exposure factor, $C_e$, used in the calculation of $p_f$ shall be determined from Table 1608.3.1.

TABLE 1608.3.1
SNOW EXPOSURE FACTOR, $C_e$

<table>
<thead>
<tr>
<th>EXPOSURE OF ROOF{$a,b$}</th>
<th>TERRAIN CATEGORY{$a$}</th>
<th>Fully exposed{$c$}</th>
<th>Partially exposed</th>
<th>Sheltered</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (see §1609.4)</td>
<td>N/A</td>
<td>1.1</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>B (see §1609.4)</td>
<td>0.9</td>
<td>1.0</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>C (see §1609.4)</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>D (see §1609.4)</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

Above the treeline in windswept mountainous areas

<table>
<thead>
<tr>
<th>Fully exposed{$c$}</th>
<th>Partially exposed</th>
<th>Sheltered</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>0.8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

In Alaska, in areas where trees do not exist within a 2-mile radius of the site

<table>
<thead>
<tr>
<th>Fully exposed{$c$}</th>
<th>Partially exposed</th>
<th>Sheltered</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>0.8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

For SI: 1 mile = 1609 344 m.
{a} The terrain category and roof exposure condition chosen shall be representative of the anticipated conditions during the life of the structure. An exposure factor shall be determined for each roof of a structure.

{b} Definitions of roof exposure are as follows:

1. Fully exposed shall mean roofs exposed on all sides with no shelter afforded by terrain, higher structures or trees. Roofs that contain several large pieces of mechanical equipment, parapets which extend above the height of the balanced snow load, $h_b$, or other obstructions are not in this category.

2. Partially exposed shall include all roofs except those designated as "fully exposed" or "sheltered."

3. Sheltered roofs shall mean those roofs located tight in among conifers that qualify as "obstructions."

{c} Obstructions within a distance of 10 $h_o$ provide "shelter," where $h_o$ is the height of the obstruction above the roof level. If the only obstructions are a few deciduous trees that are leafless in winter, the "fully exposed" category shall be used except for terrain category "A." Note that these are heights above the roof. Heights used to establish the terrain category in §1609.4 are heights above the ground.

§1608.3.2 Thermal factor. The value for the thermal factor, $C_t$, used in the calculation of $p_f$ shall be determined from Table 1608.3.2.

<table>
<thead>
<tr>
<th>THERMAL CONDITION</th>
<th>$C_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All structures except as indicated below</td>
<td>1.0</td>
</tr>
<tr>
<td>Structures kept just above freezing and others with cold, ventilated roofs in which the thermal resistance (R-value) between the ventilated space and the heated space exceeds 25 ft$^2$•hr•ºF/Btu</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Unheated structures

Continuously heated greenhouses\{b\} with a roof having a thermal resistance (R-value) less than 2.0 ft\(^2\)•hr•ºF/Btu

For SI: \(ºC = [(ºF)-32]/1.8\), 1 British thermal unit per hour = 0.2931W.

\{a\} The thermal condition shall be representative of the anticipated conditions during winters for the life of the structure.

\{b\} A continuously heated greenhouse shall mean a greenhouse with a constantly maintained interior temperature of 50ºF or more during winter months. Such greenhouse shall also have a maintenance attendant on duty at all times or a temperature alarm system to provide warning in the event of a heating system failure.

§1608.3.3 Snow load importance factor. The value for the snow load importance factor, \(I_S\), used in the calculation of \(p_f\) shall be determined in accordance with Table 1604.5. Greenhouses that are occupied for growing plants on production or research basis, without public access, shall be included in Importance Category IV.

§1608.3.4 Rain-on-snow surcharge load. Roofs with a slope less than 1/2 inch per foot (2.38 degrees) shall be designed for a rain-on-snow surcharge load determined in accordance with §7.10 of ASCE 7.

§1608.3.5 Ponding instability. For roofs with a slope less than 1/4 inch per foot (1.19 degrees), the design calculations shall include verification of the prevention of ponding instability in accordance with §7.11 of ASCE 7.

§1608.4 Sloped roof snow loads. The snow load, \(p_s\), on a roof with a slope greater than 5 degrees (0.09 rad) (1 inch per foot = 4.76 degrees) shall be calculated in accordance with §7.4 of ASCE 7.

§1608.5 Partial loading. The effect of not having the balanced snow load over the entire loaded roof area shall be analyzed in accordance with §7.5 of ASCE 7.
§1608.6 Unbalanced snow loads. Unbalanced roof snow loads shall be determined in accordance with §7.6 of ASCE 7. Winds from all directions shall be accounted for when establishing unbalanced snow loads.

§1608.7 Drifts on lower roofs. In areas where the ground snow load, \( p_g \), as determined by §1608.2, is equal to or greater than 5 pounds per square foot (0.240 kN/m\(^2\)), roofs shall be designed to sustain localized loads from snow drifts in accordance with §7.7 of ASCE 7.

§1608.8 Roof projections. Drift loads due to mechanical equipment, penthouses, parapets and other projections above the roof shall be determined in accordance with §7.8 of ASCE 7.

§1608.9 Sliding snow. The extra load caused by snow sliding off a sloped roof onto a lower roof shall be determined in accordance with §7.9 of ASCE 7.

§1610

SOIL LATERAL LOAD

§1610.1 General. Basement and retaining walls shall be designed to resist lateral soil loads. Soil loads specified in Table 1610.1 shall be used as the minimum design lateral soil loads unless specified otherwise in a soil investigation report approved by the building official. Design lateral pressure from surcharge loads shall be added to the lateral earth pressure load. Design lateral pressure shall be increased if soils with expansion potential are present at the site.

| TABLE 1610.1
SOIL LATERAL LOAD

| DESIGN LATERAL SOIL LOAD{a} (pound per square foot)
| UNIFIED SOIL DESCRIPTION OF BACKFILL MATERIAL{e} CLASSIFICATION of depth)
Well-graded, clean gravels; gravel-sand mixes       GW            30{c}
Poorly graded clean gravels; gravel-sand mixes       GP            30{c}
Silty gravels, poorly graded gravel-sand mixes       GM            40{c}
Clayey gravels, poorly graded gravel-and-clay mixes   GC            45{c}
Well-graded, clean sands; gravelly sand mixes         SW            30{c}
Poorly graded clean sands; sand-gravel mixes          SP            30{c}
Silty sands, poorly graded sand-silt mixes            SM            45{c}
Sand-silt clay mix with plastic fines                 SM-SC         45{d}
Clayey sands, poorly graded sand-clay mixes           SC            60{d}
Inorganic silts and clayey silts                     ML            45{d}
Mixture of inorganic silt and clay                    ML-CL         60{d}
Inorganic clays of low to medium plasticity          CL            60{d}
Organic silts and silt clays, low plasticity         OL             {b}
Inorganic clayey silts, elastic silts                MH             {b}
Inorganic clays of high plasticity                   CH             {b}
Organic clays and silty clays                        OH             {b}

For SI: 1 pound per square foot per foot of depth = 0.157 kPa/m,
1 foot = 304.8 mm.

{a} Design lateral soil loads are given for moist conditions for the specified soils
at their optimum densities. Actual field conditions shall govern. Submerged or
saturated soil pressures shall include the weight of the buoyant soil plus the hydrostatic loads.

{b} Unsuitable as backfill material.

{c} For relatively rigid walls, as when braced by floors, the design lateral soil load shall be increased for sand and gravel type soils to 60 pounds per square foot per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered as being relatively rigid walls.

{d} For relatively rigid walls, as when braced by floors, the design lateral load shall be increased for silt and clay type soils to 100 pounds per square foot per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered as being relatively rigid walls.

{e} The definition and classification of soil materials shall be in accordance with ASTM D 2487.

§1610.2 Retaining walls. Retaining walls shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Retaining walls shall be designed for a safety factor of 1.5 against lateral sliding and overturning.

§1611 RAIN LOADS

§1611.1 Design rain loads. Each portion of a roof shall be designed to sustain the load of rainwater that will accumulate on it if the primary drainage system for that portion is blocked plus the uniform load caused by water that rises above the inlet of the secondary drainage system at its design flow.

EQUATION 16-15

where:
\(d_h\) = Additional depth of water on the undeflected roof above the inlet of secondary drainage system at its design flow (i.e., the hydraulic head), in inches (mm).

\(d_s\) = Depth of water on the undeflected roof up to the inlet of secondary drainage system when the primary drainage system is blocked (i.e., the static head), in inches (mm).

\(R\) = Rain load on the undeflected roof, in pounds per square foot (kN/m^2). When the phrase "undeflected roof" is used, deflections from loads (including dead loads) shall not be considered when determining the amount of rain on the roof.

§1611.2 Ponding instability. Ponding refers to the retention of water due solely to the deflection of relatively flat roofs. Roofs with a slope less than one-fourth unit vertical in 12 units horizontal (2-percent slope) shall be investigated by structural analysis to ensure that they possess adequate stiffness to preclude progressive deflection (i.e., instability) as rain falls on them or meltwater is created from snow on them. The larger of snow load or rain load shall be used in this analysis. The primary drainage system within an area subjected to ponding shall be considered to be blocked in this analysis.

§1611.3 Controlled drainage. Roofs equipped with hardware to control the rate of drainage shall be equipped with a secondary drainage system at a higher elevation that limits accumulation of water on the roof above that elevation. Such roofs shall be designed to sustain the load of rainwater that will accumulate on them to the elevation of the secondary drainage system plus the uniform load caused by water that rises above the inlet of the secondary drainage system at its design flow determined from §1611.1. Such roofs shall also be checked for ponding instability in accordance with §1611.2.

§1612
FLOOD LOADS

§1612.1 General. Within flood hazard areas as established in §1612.3, all new construction of buildings, structures and portions of buildings and structures,
including substantial improvements and restoration of substantial damage to buildings and structures, shall be designed and constructed to resist the effects of flood hazards and flood loads.

§1612.2 Definitions. The following words and terms shall, for the purposes of this section, have the meanings shown herein.

BASEMENT. The portion of a building having its floor subgrade (below ground level) on all sides.

BASE FLOOD. The flood having a 1 percent chance of being equaled or exceeded in any given year.

BASE FLOOD ELEVATION. The elevation of the base flood, including wave height, relative to the National Geodetic Vertical Datum (NGVD), North American Vertical Datum (NAVD) or other datum specified on the flood insurance rate map (FIRM).

DESIGN FLOOD. The flood associated with the greater of the following two areas:

1. Area with a floodplain subject to a 1 percent or greater chance of flooding in any year; or

2. Area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

DESIGN FLOOD ELEVATION. The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map.

DRY FLOODPROOFING. A combination of design modifications that result in a building or structure, including the attendant utility and sanitary facilities, being watertight with walls substantially impermeable to the passage of water and with structural components having the capacity to resist loads as identified in ASCE 7.

EXISTING CONSTRUCTION. Any buildings and structures for which the "start of construction" commenced before the effective date of the
community's first floodplain management code, ordinance or standard. "Existing construction" may also be referred to as "existing structures."

EXISTING STRUCTURES. See "Existing construction."

FLOOD or FLOODING. A general and temporary condition of partial or complete inundation of normally dry land from:

1. The overflow of inland or tidal waters.

2. The unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD DAMAGE RESISTANT MATERIALS. Any construction material capable of withstanding direct and prolonged contact with floodwaters without sustaining any damage that requires more than cosmetic repair.

FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a floodplain subject to a 1 percent or greater chance of flooding in any year.

2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

FLOOD HAZARD AREA SUBJECT TO HIGH VELOCITY WAVE ACTION. Area within the flood hazard area that is subject to high velocity wave action, and shown on a Flood Insurance Rate Map or other flood hazard map as Zone V, VO, or V1-30.

FLOOD INSURANCE RATE MAP (FIRM). An official map of a community on which the Federal Emergency Management Agency has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

FLOOD INSURANCE STUDY. The official report provided by the Federal Emergency Management Agency containing the Flood Insurance Rate Map, the Flood Boundary and Floodway Map (FBFM), the water surface elevation of the base flood and supporting technical data.
FLOODWAY. The channel of the river, creek, or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

LOWEST FLOOR. The floor of the lowest enclosed area, including basement, but excluding any unfinished or flood-resistant enclosure, usable solely for vehicle parking, building access, or limited storage provided that such enclosure is not built so as to render the structure in violation of this section.

SPECIAL FLOOD HAZARD AREA. The land area subject to flood hazards and shown on a Flood Insurance Rate Map or other flood hazard map as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE, or V1-30.

START OF CONSTRUCTION. The date of permit issuance for new construction and substantial improvements to existing structures, provided the actual start of construction, repair, reconstruction, rehabilitation, addition placement, or other improvement is within 180 days after the date of issuance. The actual start of construction means the first placement of permanent construction of a building (including a manufactured home) on a site, such as the pouring of a slab or footings, installation of pilings or construction of columns.

Permanent construction does not include land preparation (such as clearing, excavation, grading, or filling), or the installation of streets or walkways, or excavation for a basement, footings, piers or foundations, or the erection of temporary forms, or the installation of accessory buildings such as garages or sheds not occupied as dwelling units or not part of the main building. For a substantial improvement, the actual "start of construction" means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.
SUBSTANTIAL IMPROVEMENT. Any repair reconstruction, rehabilitation, addition, or improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the building official and that are the minimum necessary to assure safe living conditions.

2. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

§1612.3 Establishment of flood hazard areas. To establish flood hazard areas, the governing body shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in an engineering report entitled "The Flood Insurance Study for [INSERT NAME OF JURISDICTION]," dated [INSERT DATE OF ISSUANCE], as amended or revised with the accompanying Flood Insurance Rate Map (FIRM) and Flood Boundary and Floodway Map (FBFM) and related supporting data along with any revisions thereto. The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

§1612.4 Design and construction. The design and construction of buildings and structures located in flood hazard areas, including flood hazard areas subject to high velocity wave action, shall be designed and constructed in accordance with ASCE 24.

§1612.5 Flood hazard certificates. The following certifications shall be submitted to the building official:

1. For construction in flood hazard areas not subject to high-velocity wave action:
1.1. As part of the lowest floor elevation inspection required in §106.3.3, certification of the elevation of the lowest floor, including basement.

1.2. For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in §2.6.1.1, ASCE 24, certification by a registered design professional that the design will provide for equalization of hydrostatic flood forces in accordance with §2.6.1.2, ASCE 24.

1.3. For dry floodproofed nonresidential buildings, certification by a registered design professional that the dry floodproofing is designed in accordance with ASCE 24.

2. For construction in flood hazard areas subject to high-velocity wave action:

2.1. As part of the lowest floor elevation inspection required in §106.3.3, a certification of the elevation of the lowest horizontal structural member.

2.2. A certificate prepared by a registered design professional that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.

2.3. For breakaway walls designed to resist a nominal load of less than 10 pounds per square foot (0.48 kN/m^2) or more than 20 pounds per square foot (0.96 kN/m^2), a certificate prepared by a registered design professional that the breakaway wall is designed in accordance with ASCE 24.