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*Governor*

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**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

**DENNIS J. LANGFORD**
*Commissioner*

# ***FORMAL INTERPRETATIONS NO. 00-24***

DOCUMENT: Section 315.1, 1995 CABO/ One and Two Family Dwelling Code (CABO/OTFDC) **and** Section 1014.7 Exception 1, 1997 Kentucky Building Code (KBC)

SUBJECT: Handrail requirements for stairs with three- (3) or more risers.

***Question:*** Does a stair leading to a porch of a single family dwelling require a handrail if the stair has two steps (also two risers) and a third riser to the porch or landing.

***Answer:*** **Yes**

***Commentary:*** The requirement for handrails is based on the number of risers and not the number of steps. The term "riser" is not defined by the KBC so one must take its ordinarily accepted meaning. Webster's New World Dictionary defines *"riser" as any of the vertical pieces between the steps in a stairway*. The KBC includes treads, risers and landings (or porches) in the definition of a stairway. Any stair or flight of steps that requires one to take more than two vertical steps upward or downward requires a handrail on at least one side.

May 25, 2000
Date Board Approved

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FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-01

DOCUMENT: The 1995 *CABO/One & Two Family Dwelling Code* **and** the 1997 *Kentucky Building Code*

SUBJECT: Section 314.6, *CABO/One & Two Family Dwelling Code*
Section 310.6, 1997 *Kentucky Building Code*
(Circular stairs within single family dwelling units)

**Question 1.** Is the minimum tread depth of a circular stair measured 12" from the narrower end of the tread?

**Answer:** *Yes*

**Question 2.** Can a circular stair within a single family dwelling unit be constructed to meet winder stair requirements?

**Answer:** *Yes*

***Commentary:*** The proponent of the change to the 1995 CABO Code to allow circular stairs within single family dwelling units inadvertently omitted the language to measure the tread depth 12" from the narrower end of the tread as all three model codes currently require. Circular stairs constructed to meet winder stair requirements would not have to meet the minimum radius requirements for a circular stair and thus could accomplish a tighter turn.

***Note:*** *The maximum riser height and the minimum tread depth for all regular, winder and circular stairs within single family dwelling units would be 8 1/4" and 9" respectively because of the special Kentucky exception in the 1997 KBC. See Sections 310.6 and 1014.6, Exception 8, of the 1997 KBC.*

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Board of Housing, Buildings and Construction

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FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-02

DOCUMENT: 1997 Kentucky Building Code

SUBJECT: Section 1010.4, emergency escape and rescue windows

**Question:** Will a window opening comply with the requirements for emergency escape if its minimum net clear opening width dimension is 20 inches and its minimum net clear opening height dimension is 24 inches?

**Answer:** No.

***Commentary:*** To comply with the opening requirements, the window must also have a minimum net clear opening of 5.7 square feet, unless the window is a grade floor window in which case the minimum net clear opening is 5.0 square feet. The window opening size indicated in the question above only has a minimum net clear opening of 3.3 square feet. If the minimum allowable width of 20 inches is used then the height of the window opening shall be at least 41 inches.

If the minimum allowable window height of 24 inches is used, then the width of the window opening shall be at least 34 inches.

There have been studies made that indicate that the minimum opening sizes listed in the code text are necessary in order for a fireman to maneuver through the window opening with full dress firefighting gear including breathing apparatus and possibly a victim.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-03

DOCUMENT: 1997 Kentucky Building Code

SUBJECT: Table 705.2, fire resistance rating of exterior walls

**Question:** Do the fire separation requirements of Table 705.2 apply to exterior building walls that run perpendicular to the property line?

**Answer:** No.

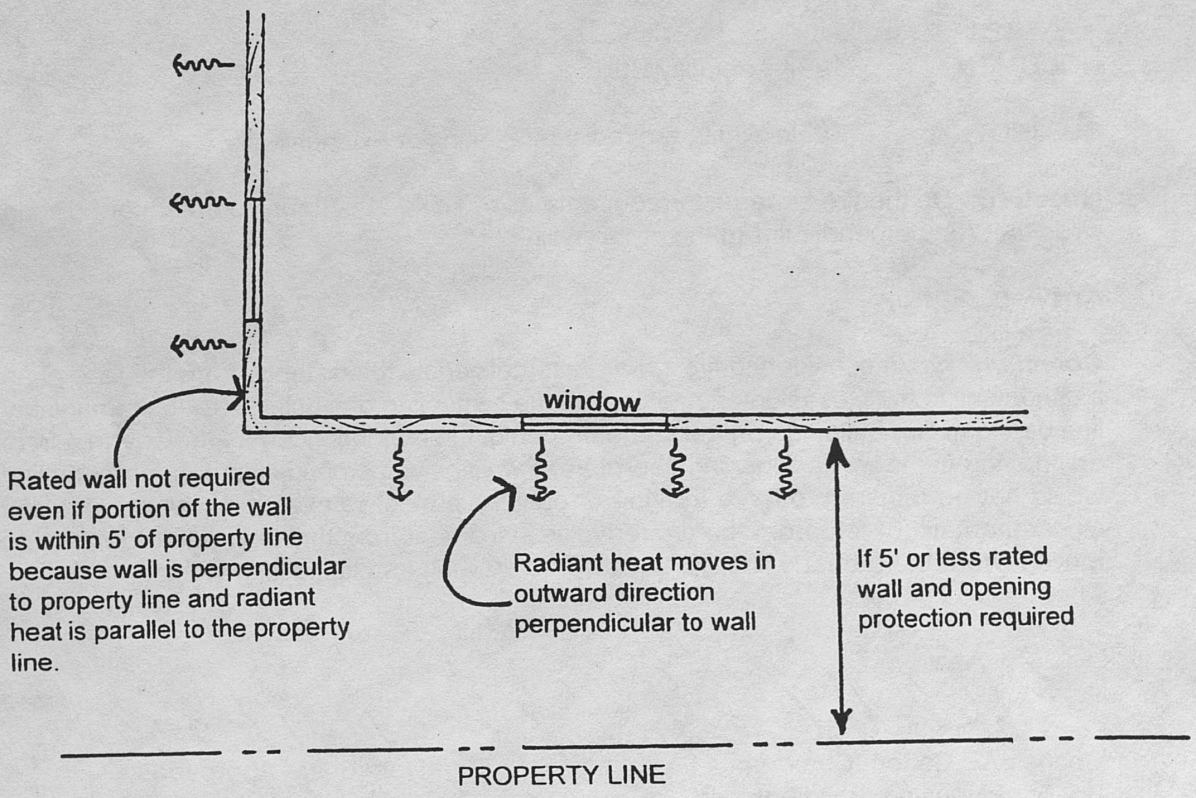
***Commentary:*** In considering fire separation (defined as the distance from the face of an exterior wall to the closest interior lot line, to the center line of a public street, or imaginary line between two buildings on the same property), the major concern is radiant heat from an opening in the wall or opening, therefore, a wall that is perpendicular to a property line would not be required to have a rating or opening protective even if a wall was located closer than six (6) feet from the property line since heat from that wall would not tend to move toward the property line. (See attached drawing for clarification.)

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window
Rated wall not required even if portion of the wall is within 5' of property line because wall is perpendicular to property line and radiant heat is parallel to the property line.
Radiant heat moves in outward direction perpendicular to wall
If 5' or less rated wall and opening protection required
PROPERTY LINE

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FAX (502) 564-6799

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# FORMAL INTERPRETATION NO. 99-04

DOCUMENT: 1997 KENTUCKY BUILDING CODE

SUBJECT: Sections 105.1 and 105.2, state or local jurisdiction

**QUESTION:** In regard to Sections 105.1 and 105.2 of the 1997 Kentucky Building Code, what guidelines are used to determine the authority having jurisdiction over alterations or additions to existing buildings?

**ANSWER:** If an existing structure is of the size and/or occupancy which, if newly constructed, would fall under State jurisdiction, then any alterations and/or additions to that building would fall under State jurisdiction regardless of whether or not an addition is separated from the existing structure by a firewall.

If an addition to an existing structure increases the size of the total structure to the point where the total structure would fall under State jurisdiction if it were new construction, then the addition would fall under State jurisdiction regardless of whether or not a firewall separates the addition from the existing structure.

Whenever a change of occupancy to a more restrictive use group occurs and if this building would fall under state jurisdiction as a new building, then the project would fall under state jurisdiction.

Fire walls are not taken into account when determining whether or not a project is under state or local jurisdiction, Section 104.5.

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FAX (502) 564-6799

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# FORMAL INTERPRETATION NO. 99-05

DOCUMENT: 1997 LIFE SAFETY CODE and 1997 Kentucky Building Code

SUBJECT: Door swing

**QUESTION:** When a pair of doors are installed, such as in a horizontal exit or a smoke partition, is there a requirement as to which leaf swings in what direction?

**ANSWER:** Yes. Though the code does not specify which leaf is to swing in the direction of egress travel, it is understood that normal traffic flow indicates the door leaf to an individuals right ( as the door is faced) is to swing in the direction of egress travel. Therefore, this office will require that the right leaf (as the door is faced) shall swing in the direction of egress travel.

EXCEPTION 1. Existing installations may remain unchanged.

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FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-06

DOCUMENT: 1997 Kentucky Building Code, 1995 CABO/ One and Two Family Dwelling Code (Section 303.3) **and** 1993 BOCA/ National Mechanical Code (Section M-1603.0 & 1604.0)

SUBJECT: Bathroom exhaust termination

***Question:*** Can a bathroom exhaust terminate in a ventilated crawl space, attic space or to an eave soffit vent?

***Answer:*** **No**

***Commentary:*** All three of the above referenced codes require mechanically ventilated bathrooms to be exhausted directly to the outdoors. While the air within ventilated attics and crawl spaces is not tempered air and in most cases is the same temperature as the outdoor air, it is not considered to be outdoors because those spaces are still within the exterior building envelope. In order for a vent to be considered as discharging to the outdoors the vent duct must penetrate the outermost exterior membrane of the building. Bathroom exhaust ducts that are run horizontally in the ceiling space and then turned down to a soffit vent leave an opportunity for some moisture to escape into the attic space.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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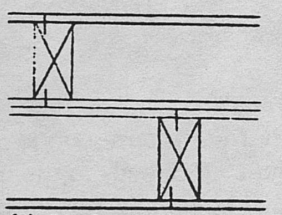
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*Commissioner*

# FORMAL INTERPRETATION NO. 99-07

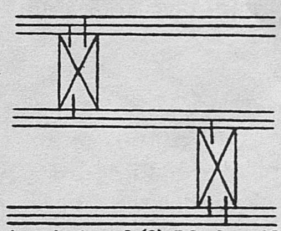
**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

SUBJECT: Fire walls/party walls, Section 707.1

**QUESTION**: Do two (2) 1-hour rated partitions or two (2) 2-hour rated partitions tilted together but left independent of each other, as shown below, comprise a fire wall per Section 707.1 of the Kentucky Building Code?



(2) U.L. Des. U317 Partitions



A variation of (2) U.L. Des. U305 or U314 Partitions

**ANSWER:** No.

***COMMENTARY:*** Section 707.1 of the Kentucky Building Code requires that fire walls be constructed of masonry or concrete materials. The two designs shown are comprised of combustible materials in that 2 X 4 wood studs are used. It is also noted that UL Design No. U317 has a 45-minute assembly rating, not 1-hour.

This interpretation does not apply to townhouses designed in accordance with the CABO One & Two Family Dwelling Code.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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(502) 564-8044
FAX (502) 564-6799

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# FORMAL INTERPRETATION NO. 99-08

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** Suppression of Furnace Rooms and rooms containing non-fuel fired equipment, Table 302.1.1

***FURNACE ROOMS:***

It is the intent of Table 302.1.1 to require suppression in all rooms housing furnaces and similar fuel-fired equipment (boilers, water heaters, etc.). The definition of a furnace room is a room containing fuel-fired equipment and, therefore, non-fuel fired equipment (electric, steam, etc.) are not considered furnace rooms and would not require suppression under this Section.

***ROOMS CONTAINING NON-FUEL FIRED MECHANICAL EQUIPMENT:***

Rooms with non-fuel fired equipment would be considered as storage rooms and would require suppression and/or separation when located in a use group requiring storage rooms to be suppressed.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-09

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** 1-2. Dwelling Unit Separation Walls
3. Draft stopping

**QUESTION #1:** Is it the intent of the KBC to require the dwelling unit separation walls enclosing upper floor dwelling units to be continuous to the underside of the roof deck above?

**ANSWER:** No.

***COMMENTARY:*** Section 711.4 requires dwelling unit separation walls to extend from the top of the fire rated floor/ceiling assembly below to the fire resistance rated floor/ceiling or roof/ceiling assembly above.

In the case of a sloped roof truss system, tested design assemblies may not exist, therefore, we will allow the separation walls to terminate at the underside of any ceiling membrane having a finish rating of not less than sixty (60) minutes.
NOTE: A minimum of two layers of 5/8 inch Type X Gypsum Board is required for a sixty (60) minute finish rating. Installation of the ceiling shall be in accordance with the design assembly from UL, GA, FM, or other nationally recognized fire resistance design manual.

**QUESTION #2:** If the answer to Question #1 is no, are there any approved alternatives when the roof/ceiling assembly is not a fire rated assembly?

**ANSWER:** Yes.

***COMMENTARY:*** The dwelling unit separation walls may be continuous to the underside of the roof deck.

**QUESTION #3:** When the fire rated dwelling separation walls terminate at the fire rated assembly, as specified in Section 711.4, is draft stopping required in concealed spaces?

**ANSWER:** Yes, In accordance with Section 721.7.2.1, Exception 6.

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***COMMENTARY:*** For floor/ceiling assemblies where suspended ceilings are used or the assembly uses open web floor trusses, buildings of Use Group R-1 and R-2 shall be provided with draft stopping in line with tenant separation walls when the walls do not extend to the floor sheathing above. (Section 721.7.1.1)

For buildings of Use Group R-3, the floor/ceiling space shall be divided into approximately equal areas not greater then 500 square feet and installed parallel to the main framing members. (Section 721.7.1.2)

The attic spaces for buildings of Use Group R, the draft stopping shall be above and in line with the tenant separation walls that do not extend to the roof sheathing above. (Section 721.7.2.1)

NOTE: When dwelling unit separation walls are constructed to the underside of a fire resistance rated roof/ceiling assembly or to a ceiling with sixty (60) minute finish rating, the Department will accept attic draft stopping complying with Section 721.7.2.2 ( i.e., horizontal draft stopped areas not exceeding 3,000 square feet).

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Board of Housing, Buildings and
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1047 U.S. HIGHWAY 127S, BAY 1
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(502) 564-8044
FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-10

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE
STATE PLUMBING CODE

**SUBJECT:** Accessible Toilet Rooms in Mercantile Occupancies

**QUESTION #1:** Can a store have restrooms in it's storage area as long as the access to that area is clearly identified with signs?

**ANSWER:** No.

***COMMENTARY:*** The Kentucky State Plumbing Code requires mercantile use buildings or tenants having sales areas exceeding 5,000 square feet to have public toilets that are accessible to the public directly from the sales area without going into or through a secure area such as a stock room or other such space. This will also require that these toilets be accessible to the physically disabled. Therefore, these toilets must be located directly adjacent to the public areas and/or accessed through a public corridor, vestibule or the like.

Access through a stock area or other area not considered for general public access is no longer considered accessible under the provisions of the 1997 Kentucky Building Code.

Buildings or tenants under 5,000 square feet that exceed a total occupant load of 100 persons as calculated under Section 1008 of the Kentucky Building Code are not required to have public toilets. However, the employee toilets must still be accessible to the physically disabled. 815 KAR 20:191, Section 13(2)(b)

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Board of Housing, Buildings and Construction

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1047 U.S. HIGHWAY 127S, BAY 1
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(502) 564-8044
FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-11

**DOCUMENT:** 1997 LIFE SAFETY CODE

**SUBJECT:** Sprinkler protection throughout

**QUESTION:** Section 12-3.5.1 of the 1997 Life Safety Code requires all health care facilities to be protected throughout by an approved sprinkler system. Is it the intent of the Code to sprinkle wardrobes, cabinets, lockers or similar components (no matter how they are labeled) when found in patient sleeping rooms, staff lounge/locker rooms etc?

**ANSWER:** Yes.

***COMMENTARY:*** All areas used for storage, which are enclosed or recessed in building construction (such as wall pockets, alcoves), shall be sprinkled. However, there is an exception for storage spaces that do not exceed 2 feet in depth and a total of 6 square feet in area.

In applying this section, any enclosed storage space, whether part of the building construction or a fabricated unit installed within the building construction, is subject to suppression if the top and sides are not exposed into the room, thereby, protected by the suppression protection in that room.

In applying the exception, if the space is subdivided by permanent construction into areas not more than two (2) feet deep and six (6) square feet in total area, the space need not be sprinkled. This includes multiple units with permanent interior subdivided areas or side by side units not exceeding the sizes listed above.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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1047 U.S. HIGHWAY 127S, BAY 1
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(502) 564-8044
FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-12

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** Combustible elements in non-combustible construction, Section 603.4.1

**QUESTION:** Does wood blocking, nailers and furring strips (normally within walls) that are installed in Types 1 and 2 construction have to be fire retardant treated?

**ANSWER:** No.

***COMMENTARY:*** Wood blocking can be "wood strips or sections", normally of a small size; and, installed horizontally between steel studs to provide anchorage for the attachment of fixtures such as grab bars, handrails, sinks, urinals, frame support for openings and similar wall mounted items. This blocking is normally used to obtain more stability and strength than is usually found in steel stud construction.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and
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FAX (502) 564-6799

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# FORMAL INTERPRETATION NO. 99-13

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** Roof trusses in protected construction, Table 602

**QUESTION:** Type 5A construction requires the roof/ceiling assembly to have a minimum one hour fire resistance rating. When the roof structure consists of an open web truss system, the rating is achieved by attaching two (2) layers of 5/8 inch firecode drywall to the bottom chord of the truss. Can attic access openings be located in the ceiling membrane when the 2 layers of drywall are used to get the required fire rating?

**ANSWER:** Yes.

***COMMENTARY:*** The opening may be framed in wood. There shall be two (2) layers of drywall of the same rating and thickness as the ceiling placed in the opening. The two (2) layers shall be securely attached to each other to ensure both pieces remain in place. Any method that will ensure a good bond between the two (2) pieces will be acceptable. This assembly shall fit snugly into the access opening. This shall apply when the double layer drywall/truss design is used for the fire rating.

When the fire rated assembly requires one (1) layer of drywall as part of the fire rating, the opening may be framed in wood and a single layer of drywall the same rating and thickness as the ceiling may be inserted into the opening. The drywall panel shall be securely attached to a piece of ½ inch plywood that is the same dimension as the drywall panel for added security and weight . This assembly shall fit snugly into the access opening.

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FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-14

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** Lay-in ceiling panel, Table 602; Sections 704.1, 713.1.1 and 716.2

**QUESTION:** Can a rated ceiling membrane (i.e., U.L. listed acoustical lay-in ceiling panel) suffice as a fire rated assembly?

**ANSWER:** No.

***COMMENTARY:*** When using a fire resistant assembly design as listed by a nationally recognized testing laboratory, the design must be followed completely. Approved fire resistant designs list every construction component including materials, nails, nailing schedule, wire, and light fixtures. If the construction details are not as specified in the approved design assembly, then the construction can not be considered as achieving the rating required. In some cases the building official may accept equivalent materials or methods.

To our knowledge, only one ceiling membrane will provide a one hour rating regardless of the composition of the assembly. That ceiling membrane is two (2) layers of Type X 5/8 inch gypsum board applied to the underside of structural members spaced a maximum of 2 feet on center. This ceiling has a finish rating of at least 60 minutes which is documented by Factory Mutual test data. Therefore, it will qualify for a one-hour fire resistant rating.

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-15

**DOCUMENT:** 1997 KENTUCKY BUILDING CODE

**SUBJECT:** Electrical outlet boxes

**QUESTION:** Is it the intent of Section 714.1.6.1 of the 1997 Kentucky Building Code to require all electrical outlet boxes, that are located in a wall, to be separated by a horizontal distance of 24 inches minimum?

**ANSWER:** No.

***COMMENTARY:*** Where solid wood studs are used, the 24 inch requirement is unnecessary, provided each outlet is separated by one intervening stud cavity. When metal studs are used, then the 24 inch dimension is required because of the perforations in the metal studs. The 24 inch horizontal distance does not apply to electrical outlets in solid concrete or masonry wall construction.

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Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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(502) 564-8044
FAX (502) 564-6799

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*Commissioner*

# FORMAL INTERPRETATION NO. 99-16

**DOCUMENT:** BOCA NATIONAL MECHANICAL CODE, Section M-504.5.1.93

**SUBJECT:** Range Hood Exhaust Systems

There has been some confusion over whether or not a UL #710 listing for commercial range hoods meet all requirements of the Kentucky Building Code. The answer is, not completely.

The U.L. listing does not address the fire extinguishing system, the exhaust duct from the hood to the exterior, the capture velocity to contain cooking vapors and residue within the hood under normal operating conditions nor the proper source of make-up air. All of these items must be reviewed for compliance with the Kentucky building codes in order to obtain approval from this office or the authority having jurisdiction for a range hood.

Plans are required to be submitted to and approved by this office or the authority having jurisdiction. Final approval is dependent upon the range hood performance in containing cooking vapors and residue within the hood under normal operating conditions. A test shall be conducted to show that containment is achieved. Observation of the removal of large quantities of smoke from beneath the hood with all appliances at operating temperatures and all air moving devices, such as the HVAC system operating, is one acceptable test method. Our field inspectors, or the authority having jurisdiction, shall be present during the test.

All required make-up air shall pass between the cooking surface and the face of the hood. In this case, make-up air is the same as or greater than the exhaust volumes stipulated by Section M-504.5.1 of the 1993 BOCA National Mechanical Code. Air introduced inside the hood and above the face opening shall not be counted as make-up air. Exhaust air volumes below those required by Section M-504.5.1 of the 1993 BOCA National Mechanical Code may be allowed if documentation is provided to show that containment of the contaminants will be accomplished. However, in no case shall exhaust volumes be less than 50 CFM/ft$^2$ of the face area (open perimeter x height of hood above cooking surface x 50 ft./min.) for wall mounted and island type hoods.

Attached is a procedure for calculating exhaust volumes required for a specific cooking appliance arrangement.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

1/21/99
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| Equipment | Heated Surface Dimensions (In.) | Area $A_{HS}$ | Updraft Velocity Factor | Contaminated Air |
|---|---|---|---|---|
| (A) Oven | 30x36 | 7.5 | 50 | 375 |
| (B) Fryer | 18x24* | 3 | 85 | 255 |
| (C) Charbroiler | 32x34* | 7.6 | 150 | 1133 |
| (D) Range | 42x34* | 9.9 | 50 | 496 |

Total area of cooking equip. 28.0
Exhaust required by cooking equip. 2259

* Heated surface dimensions are smaller than top surface for these pieces of equipment

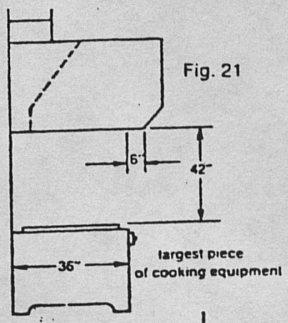


Fig. 21

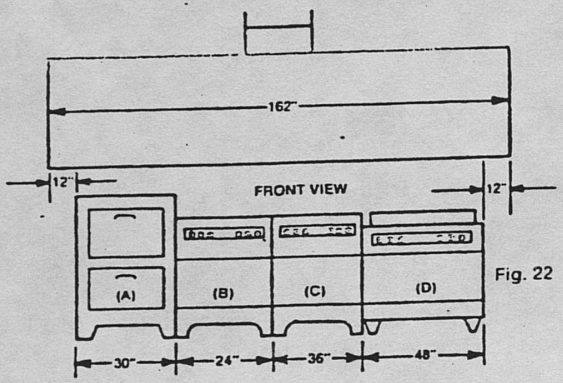


Fig. 22

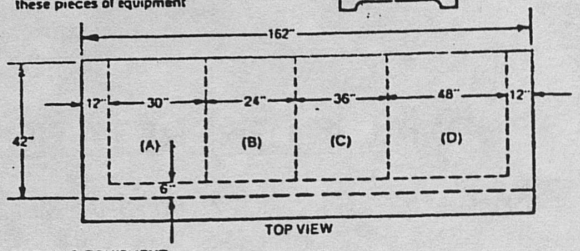


Fig. 23

COOKING EQUIPMENT
(A) CONVENTIONAL OVEN
(B) FRYER
(C) CHARBROILER
(D) RANGE

From the table, the required exhaust for the cooking equipment is 2259 cubic feet per minute. To determine the quantity of air required for the minimal capture velocity, the total cooking surface area (28 square feet) must be subtracted from the face area of the hood. The difference then multiplied by 50.

$$\text{Total face area of hood} = \frac{42'' \times 162''}{144} = 47.25 \text{ Ft.}^2$$

Face area (47.25 Ft.²)—$A_{HS}$ (28 Ft.²) = 19.25 Ft.² outside updrafts.

Minimum capture airflow = 19.25 Ft.² x 50 Ft./Min. = 963 CFM.

The quantity of exhaust air ($Q_E$) required for the wall canopy hood, as shown in Figures 21, 22 and 23, is 3222 cubic feet per minute [2259 + 963].

If physical side curtains were used, as shown in Figures 24 and 25, the exhaust airflow would be adjusted as follows. The amount of contaminated air generated remains the same (2259 CFM) since there was no change in cooking equipment. The reduction in hood face area eliminates the airflow required to establish a minimal capture velocity in these areas.

$$\text{Hood face area} = \frac{42'' \times 138''}{144} = 40.25 \text{ Ft.}^2$$

Hood face area (40.25 Ft.²)—$A_{HS}$ (28 Ft.²) = 12.25 Ft.² outside updrafts.

12.25 Ft.² x 50 Ft./Min. = 613 CFM.

For this hood and side curtain combination, the required exhaust would be 2872 CFM (2259 + 613). Side curtains reduce the effects of crossdrafts and the airflow requirements as shown in this example.

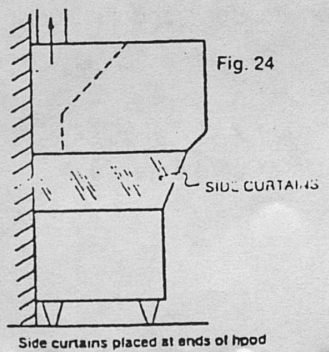


Fig. 24
Side curtains placed at ends of hood

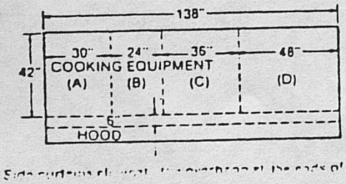


Fig. 25

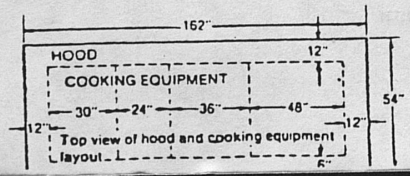


Fig. 27

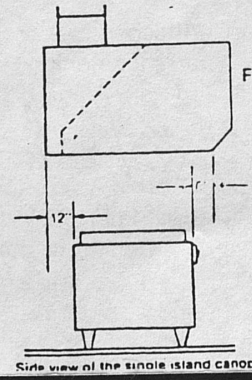


Fig. 26
Side view of the single island canopy

## Determining Hood Exhaust Airflow Requirements

The amount of air which must be removed from the kitchen hood is dependent upon the following two quantities: 1. The quantity of exhaust airflow which will remove all the contaminated air being generated by the cooking equipment and entering the hood. 2. The quantity of air required to establish a minimal capture velocity under the hood in areas outside the updrafts.

The generation of contaminated air from each piece of cooking equipment is mainly a function of its size, temperature, and design. For convenience, the following table has been established for various types of equipment.

| Equipment and Description | Updraft Velocity Factor |
|---|---|
| Steam kettles, ranges, conventional ovens—non-grease producing equipment | 50 |
| Fryers/Griddles—Grease producing equipment | 85 |
| Charbroilers—High heat and grease producing equipment | 150 |

To calculate the amount of air which must be removed for a given piece of cooking equipment, the cooking surface area ($A_{HS}$) must be determined in square feet. In the case of gas equipment, flues must be treated as heated surfaces and with an updraft velocity factor of 150 feet per minute. The quantity of contaminated air entering the hood can be calculated by multiplying the area of the cooking surface by the appropriate updraft velocity factor. For example, a charbroiler with a two by three foot cooking surface requires 900 cubic feet of air exhausted per minute. A gas charbroiler with a two by three foot cooking surface and a two by thirty-six inch gas flue would require 975 cubic feet of exhaust. The following equation can be utilized in determining the quantity of contaminated air generated by a given piece of cooking equipment.

$$Q_C = A_{HS} \times UD_f \quad \text{(EQ. 1)}$$

$Q_C$ = Contaminated airflow (cubic feet per minute)

$A_{HS}$ = Area of heated surface (square feet)

$UD_f$ = Updraft velocity factor (feet per minute)

---

Examples:

A. $Q_C$ = [2 ft. x 3 ft.] x 150 ft./min. = 900 cubic feet per minute.

B. $Q_C$ = [2 ft. x 3 ft.] x 150 ft./min. = 900 cooking surface.

$$= \frac{2 \times 36}{144} \text{ ft.}^2 \times 150 \text{ ft./min.} = 75 \text{ gas flue}$$

$Q_C$ total exhaust = 975 cubic feet per minute

---

The following method is utilized to determine the quantity of air required to establish a minimal capture velocity in the regions outside the updrafts. A velocity of 50 feet per minute has been established as the value required to contain contaminated air in the hood and reduce the effects of crossdrafts. By taking the difference between the total face area of the hood and the total area of the cooking equipment, the area outside the updrafts can be determined. This difference multiplied by 50 will yield the quantity of air which must be removed to establish a minimal capture velocity in these regions.

The following section depicts a typical example and the method utilized to determine kitchen hood exhaust requirements. The kitchen hood and cooking equipment layout are as shown in Figures 21, 22 and 23. The necessary dimensions for each piece of cooking equipment are tabulated below. The amount of contaminated air generated by each piece of equipment is determined by multiplying the surface area by the appropriate updraft velocity factor. These values are tabulated in the far right column.

The placement of the cooking equipment used in the previous examples under an island hood would result in the following. The hood size and layout is as depicted in Figures 26 and 27. In this application, an additional 12 inch overhang is required behind the equipment to prevent spillage. Again, since the cooking equipment did not change, the amount of exhaust required remains 2259 CFM. The change occurs in the quantity of air required to establish a minimal capture velocity across the face of the hood outside the updraft region.

$$\text{Hood face area} = \frac{162'' \times 54''}{144} = 60.75 \text{ Ft.}^2$$

Hood face area (60.75 Ft.²)—$A_{HS}$ (28 Ft.²) = 32.75 Ft.² outside updrafts.

32.75 Ft.² x 50 Ft./Min. = 1638 CFM.

The total exhaust required for this island hood is 3897 CFM (2259 + 1638).

These examples depict the method utilized for determining the exhaust airflow requirements of several hood designs for a given application. The exhaust flow rates are for removal of contaminated air entering the hood and may need to be adjusted due to codes, to reduce kitchen heat gains, or other factors as discussed in this text. This approach does offer a viable method by which the exhaust airflow rate can be calculated based on the type of cooking equipment under the hood.

COMMONWEALTH OF KENTUCKY
**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
**DIVISION OF BUILDING CODES ENFORCEMENT**
1047 U. S. Highway 127 S, Suite 1
FRANKFORT, KENTUCKY 40601-4337
TEL. (502) 564-8090
FAX (502) 564-6799

BRERETON C. JONES
GOVERNOR

JACK M. RHODY, P.E.
DIRECTOR

# FORMAL INTERPRETATION

NUMBER: 95-1

DOCUMENT: Basic Mechanical Code M-504.5.1.93 (Replaces M-312.0/81/83159, dated 5-8-83)

DATE: June 26, 1995

There has been some confusion over whether or not a U. L. #710 listing for commercial range hoods meet all requirements of the Kentucky Building Codes. The answer is not completely. The U. L. listing does not address the fire extinguishing system, the exhaust duct from the hood to the exterior, the capture velocity to contain cooking vapors and residue within the hood under normal operating conditions nor the proper source of make-up air. All of these items must be reviewed for compliance with the Kentucky Building Codes in order to obtain approval from this office or the authority having jurisdiction for a range hood.

Plans are required to be submitted to and approved by this office or the authority having jurisdiction prior to installation.

Final approval is dependent upon the range hoods performance in containing cooking vapors and residue within the hood under normal operating conditions. A test, to show that containment is achieved, shall be conducted. Observation of the removal of large quantities of smoke from beneath the hood with all appliances at operating temperatures and all air moving devices, such as the HVAC system operating, is testing method. Our field inspectors, or the authority having jurisdiction, shall be present during the test.

All required make-up air shall pass between the cooking surface and the face of the hood. In this case, make-up air is the same as or greater than the exhaust volumes stipulated by Section M-504.5.1 of the 1993 BOCA National Mechanical Code. Air introduced inside the hood and above the face opening shall not be counted as make-up air. Exhaust air volumes below those required by Section M-504.5.1 of the 1993 BOCA National Mechanical Code may be allowed if documentation is provided to show that containment of contaminants will be accomplished. However, in no case shall exhaust volumes be less than 50 CFM/ft $^2$ of the face area (open perimeter x height of hood above cooking surface x 50 ft./min.) for wall mounted and island type hoods.

FORMAL INTERPRETATION
Number: M-504.5.1/93
DOCUMENT: Basic Mechanical Code

I have enclosed a procedure for calculating exhaust volumes required for a specific cooking appliance arrangement.

Jack M. Rhody

JACK M. RHODY
CHIEF BUILDING CODES OFFICIAL/DIRECTOR

*17 Edition of "Industrial Ventilation a Manual of Recommended Practices", American Conference of Governmental Industrial Hygienists - Page 5-110.

PAUL E. PATTON
*Governor*

COMMONWEALTH OF KENTUCKY
**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-17

**DOCUMENT:** KENTUCKY FIRE PREVENTION CODE (Standards of Safety)
STATE PLUMBING CODE
KENTUCKY BUILDING CODE

**SUBJECT:** Conflict of Codes

**CONDITIONS:** A facility has been constructed in accordance with the Kentucky Building Code in effect at the time and a lawful Certificate of Occupancy has been issued. There have been no changes in use or modifications made to the facility since the occupancy certificate was issued.

**QUESTION:** Can other officials, such as a local or state fire official, require that additional provisions, not in the Kentucky Building Code, be complied with as part of a fire safety maintenance inspection?

**ANSWER:** No.

***COMMENTARY***: It is the intent of the uniform state building codes to eliminate such occurrences. KRS 198B.060(1) states in part that local governments "shall neither adopt nor enforce any other ordinance regulating buildings which conflict with the uniform state building codes."

In addition, 815 KAR 10:050, Kentucky Fire Prevention Code, states that if a conflict exists between a provision of the Standards of Safety or the codes adopted by reference therein and the Kentucky Building Code, the Kentucky Building Code shall prevail.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

1/21/99
Date Board Approved

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**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-18

DOCUMENT: 1997 KBC, Section 920.3.2 and
1995 CABO/ One and Two Family Dwelling Code, Section 316.

SUBJECT: Smoke detectors in dwelling units.

***Question:*** Are smoke detectors required at the top and bottom of stairs within dwellings even though each level already has a required detector?

***Answer:*** **No**

***Commentary:*** The intent of both codes is to require a smoke detector in the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms; and
3. In each story within a dwelling unit, including basements.

**Example 1:** A typical 3-bedroom, 1-story home with a basement and which all bedrooms are located at one end of the home would require a total of five(5) smoke detectors. One in each of the three bedrooms; one in the hallway leading to the bedrooms and one in the basement. If the basement is divided into room spaces (no bedrooms) then the preferred location of the basement detector would be at the bottom of the stairs.

**Example 2:** A 3-bedroom, 2-story home with a basement and which all bedrooms are located on the 2nd floor would require a total of six(6) smoke detectors. One in each bedroom; one in the 2nd floor hallway at the top of the stairs; one on the 1st floor (preferably at base of stairs); and one in the basement (also preferred at base of stairs).

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-19

DOCUMENT: 1997 Kentucky Building Code, Section 407.0 **and**
1995 CABO/ One and Two Family Dwelling Code, Section 309.

SUBJECT: Dwelling/garage separation wall

***Question:*** Should the wall required between dwelling units and attached garages be treated the same as a fire partition or fire separation wall?

***Answer:*** **No**

***Commentary:*** The intent of both codes is to require a single layer of ½ inch gypsum board on the garage side of the wall between the garage and dwelling unit. The dwelling unit side of the wall can be of any approved finish materials. This requirement prohibits having an unfinished attached garage.

An old saying in code enforcement of "one side does not an assembly make" applies in this case. If one were required to build a 1-hour wood stud wall one would not be allowed to place both layers of gypsum board on the same side of the studs. Therefore, one layer of ½ inch gypsum board does not create a fire rated wall assembly.

Penetrations of the wall for pipes or electrical wiring should be sealed tight but the requirements of Section 714.1.6.1 (Electrical outlet boxes) for example should not be applied to this wall because it is not intended to be a fire rated wall assembly.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

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*Governor*

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**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-20

DOCUMENT: 1997 KBC, Section 407.0 and
1995 CABO/ One and Two Family Dwelling Code, Section 309

SUBJECT: Dwelling/ garage separation wall

***Question:*** Does the wall between the dwelling unit and attached garage have to extend through a common attic space to the underside of the roof deck?

***Answer:*** **No**

***Commentary:*** The intent of both codes is to achieve a complete separation of the dwelling unit and the garage with a minimum of ½ inch gypsum board applied to the garage side. The wall between the dwelling unit and garage, with the ½ inch gypsum board applied to the garage side, may extend through the common attic space to the underside of the roof deck or the ½ inch gypsum board may be extended horizontally as the garage ceiling. In that case, penetrations of the garage ceiling such as for an attic access opening would have to be protected with a tight fitting panel of ½ inch gypsum board.

***Note:*** If there were habitable room spaces above the garage then Section 407.3 of the 1997 KBC would require the floor/ceiling assembly to have a 1-hour fireresistance rating. The CABO code only requires the ½ gypsum board between the dwelling and garage no matter whether there are habitable room spaces above the garage.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

1/21/99

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FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
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CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-21

DOCUMENT: 1997 Kentucky Building Code, 1995 CABO/ One and Two Family Dwelling Code (Section 1801, **and** 1993 BOCA/ National Mechanical Code (Section M-312.1)

SUBJECT: Residential clothes dryer exhaust.

***Question:*** Can the moisture vent of a residential clothes dryer terminate in a vented crawl space or attic space?

***Answer:*** **No**

***Commentary:*** All three of the above referenced codes require this type of appliance to vent moisture to the outdoors. While the air within attics and crawl spaces that are properly ventilated is not tempered air it is not considered to be outdoors because those spaces are still within the exterior building envelope. In order for a vent to be considered as discharging to the outdoors the vent duct must penetrate the outer most exterior membrane of the building. When such vents discharge into the crawl space or attics it is only a matter of time before other problems are created from the extremely moist air.

Charles A. Cotton
Charles A. Cotton, Chairman
Board of Housing, Buildings and Construction

1/21/99
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**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
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FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# ***FORMAL INTERPRETATION NO. 99-22***

**DOCUMENT:** The 1997 Kentucky Building Code **and**
The 1995 CABO/One and Two Family Dwelling Code

**SUBJECT:** Radon Abatement

**BACKGROUND:** Since the beginning of the first Kentucky Building Code (KBC) on February 15, 1980, it has never been the intent of the Code to apply to the construction of single family dwellings unless a local government passed an ordinance to extend the Code to cover those structures. It was only until recently that legislation became effective on July 15, 1998, to require all single family dwellings permitted after that date to be constructed in compliance with the KBC no matter whether a local government had an inspection program or an ordinance to extend the Code to cover single family dwellings.

Once code applicability has been established all seven editions of the KBC have indicated that a single family dwelling should be designed and built in accordance with the KBC for a Use Group R-3 structure or with the requirements of the CABO/One and Two Family Dwelling Code (CABO) referenced by the KBC. This means that a single family dwelling constructed under either code is considered a "equally good or better method of construction" and in compliance with the intent of the KBC.

If a single family dwelling has been determined to be in substantial compliance with the 1995 CABO Code with the exception of the radon control requirements located in Appendix F of that Code, then the dwelling should also be considered to be in substantial compliance with the 1997 KBC as the KBC does not have radon control requirements. While there may be other minor differences in the requirements of each Code, Section 310.6 of the KBC has already established either Code as being an acceptable standard and there should be no reason to re-inspect a single family dwelling for compliance with the KBC when it had previously been permitted, inspected and determined to be in compliance with the CABO Code with the exception of the radon construction requirements. Such requirement would be unreasonable.

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During the July 16, 1998, Board of Housing meeting, the Board approved an amendment to the KBC that would require the radon control methods to apply no matter which Code was chosen by the builder at the time of plans submission. Later on, during the October, 1998, Board meeting, the July amendment was put on hold until further discussion could be held. Finally, on January 21, 1999, the Board approved a code change that in effect allows each local government of the 30 Kentucky counties located in Radon Zone 1 to enforce the radon control requirements by passing a local ordinance. The radon control requirements found in Appendix F of the 1995 One and Two Family Dwelling Code would not be applicable unless made so by local ordinance.

**BOARD INTERPRETATION**

Until such time that the Board's January 21,1999 code change proposal to the KBC becomes effective, single family dwellings may have permits issued, plans reviewed and inspections made using the 1997 Kentucky Building Code or the 1995 CABO/One and Two Family Dwelling Code and with or without radon control methods. Substantial compliance with the 1995 CABO/One and Two Family Dwelling Code, except for radon control methods, is deemed equivalent to the KBC.

Charles A. Cotton, Chairman
Board of Housing, Buildings and
Construction

1/21/99
Date Board Approved

PAUL E. PATTON
*Governor*

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**DEPARTMENT OF HOUSING,**
**BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

# FORMAL INTERPRETATION NO. 99-23

**Document**: 1997 Kentucky Building Code(KBC) & 1995 CABO/ One and Two Family Dwelling Code (CABO/ OTFDC)

**Subject:** Emergency escape windows

***Question:*** Can the net clear window opening required by Section 1010.4 of the 1997 KBC or Section 310.2.1 of the 1995 CABO/ OTFDC be achieved by removing both sashes or does the minimum net clear opening have to be achieved through the normal operation of raising or opening the window to the fullest?

***Answer:*** **No and Yes**

***Commentary:*** Section 1010.4 of the 1997 KBC indicates the minimum net clear opening for an emergency escape window shall be obtained through the normal operation of the window. Removing the sash(s) does not qualify as normal operation of the window. The CABO and KBC have identical requirements for window opening sizes, however the CABO does not have the statement regarding "normal operation of the window". The KBC may be utilized in this situation since it is the adopted code and the CABO is the referenced standard.

Charles A. Cotton

Charles A. Cotton, Chairman
Board of Housing, Buildings
And Construction

1/21/99
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KENTUCKY CODE REPORT

A Bulletin on Building and Fire Code Enforcement
Vol. No. 1
November, 1997

# 1997 KENTUCKY BUILDING CODE UPDATE

## CUMULATIVE SUPPLEMENT

Please keep this in the front of your Code book for quick reference and mark each amended Section with an asterisk in your KBC.

The following amendments have been approved by the Board of Housing, Buildings and Construction and are currently in the legislative approval process. The anticipated effective date of these changes is mid December, 1997. When finalized, these amendments to the 1997 Edition of the Kentucky Building Code will update the Code through 1997.

*TABLE OF CONTENTS*


| | | | |
|---|---|---|---|
| Chapter 1 | Page 1 | Chapter 9 | Page 5 |
| Chapter 3 | Page 4 | Chapter 18 | Page 5 |
| Chapter 4 | Page 4 | Chapter 31 | Page 5 |
| Chapter 7 | Page 5 | | |


## Chapter 1

A new Section 111.3.1 has been created to read:

> **111.3.1 Limitation on changes.** No inspector shall be authorized to require changes on-site which are contrary to the approved construction documents. If an inspector finds a code discrepancy in an on-site inspection, the inspector shall refer the matter to the official having construction document review responsibility who shall require corrections if the code so requires.

The fees in Section 112 have been amended as follows:

**SECTION 112.0 FEES**

**112.1 General**: A permit to begin work for new construction, *alteration,* removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid.

**112.2 Special fees:** Payment of fees for construction, alteration or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs and* display structures, marquees or other *appurtenant structures, or* fees of inspections or certificates of occupancy or other privileges or requirements established by law.

PAUL E. PATTON
*Governor*

COMMONWEALTH OF KENTUCKY
**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

DENNIS J. LANGFORD
*Commissioner*

July, 2000

# NOTICE

## 1997 KENTUCKY BUILDING CODE AMENDMENTS

Please find enclosed the July 2000 Kentucky Code Report update. The Report is a cumulative supplement to the 1997 Kentucky Building Code and contains all changes to the Code since its adoption on December 13, 1997. Important features to be noted are:

- All plan review fees have been increased effective September 15, 2000 by ½ cent per square foot.
- Formal Interpretations approved by the Board of Housing are included and are binding statewide
- A sample ordinance for enforcement of the Code on single family dwellings and for electrical inspections is included
- A number of NFPA pamphlets have been upgraded to the latest edition (see list on pages 15 and 16 of the Report)
- The 2000 International Mechanical Code will be mandatory and effective January 1, 2001

Also, please be aware that the 2000 International Building Code has been published. At the present time, Department staff is reviewing each chapter in order to make a recommendation to the Board regarding adoption for next year.

For your use and information, the following key personnel within the Department are identified, with appropriate telephone numbers.

Commissioner's Office 502/564-8044
Dennis J. Langford, Commissioner
Skip Zimmerman, Deputy Commissioner
Ken Meredith, Deputy Commissioner
Judith Walden, General Counsel

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Division of Plumbing 502/564-3580
Tommy Barnes, Director

Division of Heating, Ventilation and Air Conditioning Contractors 502/564-1436
Nelson Henderson, Director

Division of Building Codes Enforcement 502/564-8090
Jack Rhody, Director

Division of Fire Prevention 502/564-3626
Dave Manley, Director and State Fire Marshal

Sections within Division of Fire Prevention:

- Boiler Inspection
- Electrical Inspection
- Elevator Inspection
- Fire Protection Systems
- Hazardous Materials 502/564-4010
- Manufactured Housing 502/564-4018
- Code Book Ordering 502/564-7811

# KENTUCKY CODE REPORT

A Bulletin on Building and Fire Code Enforcement
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# 1997 KENTUCKY BUILDING CODE UPDATE

## CUMULATIVE SUPPLEMENT (Contains all amendments since 12/13/97)

**Please keep this Supplement in the front of your Code book for quick reference and mark each amended Section with an asterisk in your KBC.**

The Board of Housing, Buildings and Construction and the Legislative Regulation Review Subcommittee have approved the following amendments. The effective date is indicated for each amendment. Please note that new amendments between the January Supplement and this edition have been underlined.

*TABLE OF CONTENTS*


| | | | |
|---|---|---|---|
| *Chapter 1* | Page 1 | *Chapter 10* | Page 12 |
| *Chapter 2* | Page 6 | *Chapter 16* | Page 14 |
| *Chapter 3* | Page 6 | *Chapter 18* | Page 14 |
| *Chapter 4* | Page 7 | *Chapter 28* | Page 14 |
| *Chapter 7* | Page 10 | *Chapter 31* | Page 15 |
| *Chapter 9* | Page 11 | *Chapter 35* | Page 15 |
| | | *Appendix C* | Page 16 |


## Chapter 1

1. Sections 101.3 through 101.3.3 and the Exceptions thereunder have been amended, deleted or renumbered to read as follows:

**101.3 Single-family dwellings**: All single-family dwellings shall conform to the construction standards of this code for R-3 structures.

**Exceptions:**

1. Manufactured homes.
2. Farm dwellings.
3. Single family dwellings constructed in accordance with Section 310.6 and the CABO One and Two Family Dwelling Code, including the National Electrical Code, the CABO Model Energy Code and the State Plumbing Code referenced in Chapter 35 of this code. **Effective 8/16/98**

**101.3.1 Enforcement by local government:** The electrical system shall be inspected and approved by a certified electrical inspector pursuant to KRS 227.489 and 815 KAR 35:015. The plumbing system shall be inspected and approved pursuant to KRS Chapter 318 and the Kentucky State Plumbing Code (815 KAR 20:010-060). Other permits and inspections of single family dwellings shall be performed only if required by local ordinance. **Effective 8/16/98**

**101.3.2 Other codes applicable:** NFPA 70 shall apply to all manufactured/mobile homes exterior service hook-ups and the State Plumbing Code shall apply to the exterior water and sewer lines of non-farm manufactured/mobile homes. **Effective 2/24/99**

2. Section 103.1, item #3, has been amended to read:

   3. The removal or change of any required *means of egress* or emergency escape windows; or.... **Effective 8/16/98**

3. Section 105.2.2 was amended to delete frozen food locker plants and reads:

   **105.2.2** Buildings classified as educational, institutional, high hazard or *industrialized building systems,* regardless of occupancy size or occupancy classification. **Effective 8/16/98**

4. Section 107.3 was amended to delete language regarding application made by someone other than owner in fee and reads:

   **107.3 By whom application is made:** Application for a local building permit shall be made by the owner or lessee of the building or structure, or the builder or other agent of either, or by the licensed engineer or architect employed in connection with the proposed work. The full names and addresses of the owner, lessee, applicant and of the responsible officers, if the owner or lessee is a corporate body, shall be stated in the application. **Effective 8/16/98**

5. A new Section 111.3.1 has been created to read:

   **111.3.1 Limitation on changes.** No inspector shall be authorized to require changes on-site which are contrary to the approved construction documents. If an inspector finds a code discrepancy in an on-site inspection, the inspector shall refer the matter to the official having construction document review responsibility who shall require corrections if the code so requires. **Effective 12/13/97**

6. The fees in Section 112 have been amended as follows:

**SECTION 112.0 FEES**

**112.1 General**: A permit to begin work for new construction, *alteration,* removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid. **Effective 12/13/97**

**112.2 Special fees:** Payment of fees for construction, alteration or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs and* display structures, marquees or other *appurtenant structures, or* fees of inspections or certificates of occupancy or other privileges or requirements established by law. **Effective 12/13/97**

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable. **Effective 12/13/97**

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3.1.
*Please note:* *Table 112.3.1 was approved by the Board on May 25, 2000, and the new fees will become effective on **September 15, 2000**.

**112.3.1.1 Fast track elective:** For permit applicants seeking early site and foundation approval prior to full review of complete set of construction documents, the fee shall be that as calculated from Table 112.3.1 plus 50 percent of the full fee. The additional 50 percent fee shall not be less than $200 and not more than $3,000. The entire fee shall be paid at the time of the initial plans submission. **Effective 8/16/98**

***Table 112.3.1**
**DEPARTMENT OF HOUSING FEE SCHEDULE**

| Occupancy type | Cost per sq ft thru 9/14/00 | Cost per sq ft effective 9/15/00 |
|---|---|---|
| Residential | 5 cents | 5.5 cents |
| Assembly | 6 cents | 6.5 cents |
| Day care centers | 5 cents | 5.5 cents |
| Educational | 5 cents | 5.5 cents |
| Business | 5 cents | 5.5 cents |
| Mercantile | 5 cents | 5.5 cents |
| Industrial factories | 3.75 cents | 4.25 cents |
| Warehouses | 3 cents | 3.5 cents |
| Institutional | 6 cents | 6.5 cents |
| Frozen food plants | 4 cents | 4.5 cents |
| High hazard | 5 cents | 5.5 cents |
| All other nonresidential | 4 cents | 4.5 cents |

**112.3.2 Submission of plans and fees**: All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar. **Effective 12/13/97**

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky, State Treasurer. **Effective 12/13/97**

**112.3.4 Construction approval:** Approval for construction shall not be issued by the Department until all required fees have been paid. **Effective 12/13/97**

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table 112.3.1 by the measurement of the square footage of the addition, as determined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.7 Change in use:** Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the alterations or repairs by 0.0025; or calculated by multiplying the total area being altered; or repaired by the cost per square foot of each occupancy type as listed in Table 112.3.1, whichever is less. The total square footage shall be determined by the outside dimensions of the area being altered or repaired. The minimum fee for

review of plans under this section shall be $100. **Effective 8/16/99**

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the specialized plan reviews listed. **Effective 12/13/97**

Table 112.3.9
AUTOMATIC SPRINKLER REVIEW FEE TABLE

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $100 |
| 201-300 | $125 |
| 301-400 | $160 |
| 401-750 | $200 |
| Over 750 | $200 plus 19 cents per Sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $100; over 20,000 square feet shall be $100 plus $19 for each additional 10,000 square feet in excess of 20,000 square feet. **Effective 12/13/97**

**112.3.11 Standpipe plan review fee:** $100 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule). **Effective 12/13/97**

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $100, over 200 pounds of agent shall be $100 plus 2 cents per pound in excess of 200 pounds. **Effective 12/13/97**

**112.3.13 Clean agent suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds. The fee for gaseous systems shall be 5 cents per cubic foot and not less than $100. **Effective 8/16/99**

**112.3.14 Foam suppression system review fee:** 50 cents per gallon of foam concentrate where the system is not part of an automatic sprinkler system. Foam suppression system plans that are submitted as part of an automatic sprinkler system shall be reviewed under the automatic sprinkler review fee schedule. The fee for review of plans under this section shall not be less than $100 or more than $1,500. **Effective 8/16/99**

**112.3.15 Commercial range hood review fee:** $100 per hood. **Effective 12/13/97**

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $100; over 30 pounds of agent shall be $100 plus 25 cents per pound in excess of 30 pounds. **Effective 12/13/97**

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components. **Effective 12/13/97**

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18. **Effective 12/13/97**

Table 112.3.18
BOILER AND UNFIRED PRESSURE VESSEL FEES

| Heating surface (square feet) | Fee | Heating surface (square feet) | Fee |
|---|---|---|---|
| 100 and under | $ 30 | 4,001 to 10,000 | $ 80 |
| 101 to 1,000 | $ 40 | 10,001 and over | $110 |
| 1,001 to 4,000 | $ 60 | Unfired pressure vessels | $ 30 |

**112.4 Local jurisdiction**: Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed. **Effective 12/13/97**

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law. **Effective 12/13/97**

7. Section 113.3 was amended to read as follows:

**113.3 Final Inspection:** Upon completion of the building, the owner or agent of the facility shall request a final inspection. The code official shall set a time for the inspection and notify the owner or agent. If substantial compliance with the approved *construction documents* and permit has been achieved, a certificate of occupancy shall be issued, as described in Section 118.0 of this code. If compliance has not been achieved, violations of the approved *construction documents* and permit shall be noted and immediately communicated to the owner, agency or other person holding the permit and the fire code official. It shall be the owner's responsibility and the responsibility of the person or company responsible for the construction work to fulfill any compliance deficiencies noted. **Effective 8/16/99**

8. Section 116.2 was amended to read as follows:

**116.2 Notice of Violation:** The code official shall serve a notice of violation or order on the property owner and any other person responsible for the design, erection, construction, *alteration*, extension, repair, removal, demolition or occupancy of a building or structure in violation of the provisions of this code, or in violation of a detailed statement or a plan approved thereunder, or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation. **Effective 8/16/99**

9. Section 119.1 and 119.2 was amended to reflect the Cabinet name change and will read as follows:

SECTION 119.0 CABINET FOR FAMILIES AND CHILDREN
**and** CABINET FOR HEALTH
SERVICES REGULATED BUILDINGS

**119.1 Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities:** Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services and inspected under contract with the Cabinet for Families and Children or the Cabinet for Health Services by the Department of Housing, Buildings and Construction shall comply with the institutional use group requirements specified in Chapter 4, including specific references to other sections of this code, and the applicable provisions of NFPA 101 listed in Chapter 35. **Effective 8/16/99**

**119.2 Day care centers:** Day care centers, except those governed by Section 422.0 and other similar care facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services which comply with the provisions of NFPA #101 listed in Chapter 35 as approved by the State Fire Marshal shall be deemed to satisfy the life safety requirements of this code. **Effective 8/16/99**

## Chapter 2

10. Chapter 2, Definitions, was amended to add the following definition:

    **Townhouse:** A single-family dwelling unit constructed in a row of attached units separated by property lines and with open space on at least two sides. **Effective 2/24/99**

## Chapter 3

11. Section 305.1 was amended to read as follows:

    **305.1 General:** All structures, or parts thereof, other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes, including, among others, schools, academies, colleges and universities, shall be classified as Use Group E. **Effective 12/13/97**

12. Section 307.5 was amended by deleting the reference to "Class I" under Organic peroxides. **Effective 12/13/97**

13. Section 307.8, Exception number 3, was amended to read as follows: (No change to other Exceptions)

    **3.** Buildings and structures occupied for the storage of 10,000 or more vehicle tires, weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1. **Effective 12/13/97**

14. Section 310.6 was amended to include townhouses in Use Group R-4 and further reorganized. Over the years, Kentucky's exceptions or alternatives to the CABO Code have increased and reorganization was necessary for clarity and ease of interpretation and enforcement. The reorganized section reads as follows:

    **310.6 Use Group R-4 structures:** This use group shall include all *townhouses* and detached *one- and two- family dwellings* not more than three stories in height, and their *accessory structures* as indicated in the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. All of these structures shall be designed and built in accordance with the requirements of this code for a Use Group R-3 structure, or with the requirements of the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. The choice of the construction code shall be made by the permit applicant at the time of plans submission. **Effective 2/24/99**

    **310.6.1 CABO code alternatives:** When the permit applicant chooses the *CABO/ One & Two Family Dwelling Code* as the review code of record in Sections 310.6.1.1 through 310.6.1.6 shall be applicable and shall supersede any conflicting provision of the *CABO/ One & Two Family Dwelling Code*. **Effective 2/24/99**

    **310.6.1.1** A minimum stair tread depth of 9 inches (229 mm) and maximum riser height of 8 1/4 inches (210 mm). **Effective 2/24/99**

    **310.6.1.2** A minimum ceiling height complying with Section 1204. **Effective 2/24/99**

    **310.6.1.3** A minimum door height complying with Exception No. 6 of Section 1017.3. **Effective 2/24/99**

    **310.6.1.4** The plumbing system shall comply with the requirements of the *State Plumbing Code* (see 815 KAR Chapter 20). **Effective 2/24/99**

**310.6.1.5** The stair handrails may conform with Exception No. 5 of Section 1014.7 and Exception No. 2 of Section 1022.2. **Effective 2/24/99**

**310.6.1.6** Handrail grip size and profiles complying with Appendix C, Figure 1022.2.4 (A) through (E) are deemed to comply with Section 325.2 of the 1995 CABO/One and Two Family Dwelling Code. (Approved by the Board 5/25/00)

**310.7 Radon protection**: Radon control measures shall not be mandatory unless specifically required by local ordinance. **Effective 2/24/99**

**310.8 Energy conservation:** Each one or two family dwelling and each townhouse shall be provided with energy conservation measures complying with the CABO Model Energy Code listed in Chapter 35 or the Kentucky Prescriptive Method for Insulating Homes Pamphlet dated January, 2000. (Approved by the Board 2/21/00)

## Chapter 4

15. Amend Section 410.1 by including the following new definitions as follows:

**410.1.1 Definitions:**
**State jails:** Any Use Group I-3 facility under the direct supervision and operation of the Commonwealth of Kentucky. State jails shall comply with Sections 410.2 through 410.8 of this code.
**Local jails:** Any Use Group I-3 facility under the supervision of a county, regional jail authority, city or urban county government. Local jails shall comply with the special requirements of Section 410.9, Local jails, in addition to the requirements of Sections 410.2 through 410.8 of this code. **Effective 8/16/99**

**410.1.1.1 Local jails terminology:** For the purpose of applying the special requirements of Section 410.9 for *local jails*, the following definitions shall be applicable: **Effective 5/20/00**

**Inmate living area:** Those areas where inmates are normally confined and where their movement is restricted by penal doors, including cells, dayrooms, dormitories, detoxification cells, isolation cells and temporary holding cells.
**Penal door:** A door required by the Kentucky Jail Standards to enclose *inmate living area* or restrict inmate movement through other areas of a local jail.

16. A new Section 410.9. Local Jails, has been created to read:

**410.9 Local Jails:** Local jails shall comply with the requirements of this section and where conflicts exist with other requirements of this code, this section shall take precedence. Local jails shall be further defined and classified as one of the following: **Effective 8/16/98**

**Jail:** Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 3:010 by and under the supervision of any county, regional jail authority, city or urban county government.
**Restricted custody center:** Restricted custody center means a facility or area separate from the jail used for the housing of sentenced inmates who have been approved for educational, work or program participation release and pretrial inmates who have been approved by the court for educational, work or program participation release and operated under 501 KAR 7:010.
**Life Safety Jail:** Life Safety Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 13:010 by and under the supervision of any county government which does not house state prisoners as defined by KRS 532.100.

**410.9.1 Emergency smoke control/evacuation:** All areas of *Jails* and *Life Safety Jails* where an inmate may be confined, shall be provided with an emergency smoke control/ evacuation system meeting the requirements of this section. The system shall be activated by smoke detectors and shall be connected to an emergency power supply. The system shall be engineered as an independent system or may be engineered to work in conjunction with the building HVAC system. **Effective 5/20/00**

**410.9.1.1 Design:** All floors which house inmates shall be designed to have a minimum of two smoke compartments of approximately equal size and separated by a smoke barrier wall constructed in accordance with Section 712.0 of this code. The smoke control system shall be capable of maintaining a negative pressure in the contaminated smoke compartment. The smoke control system shall be capable of 6 air changes per hour. The plan review of the system; the operation of the system and the final operational test shall be subject to approval by the Department of Corrections. **Effective 5/20/00**

**410.9.2 Automatic sprinkler system:** All areas of *Jails* and *Life Safety Jails* where inmates will not be confined, including but not limited to corridors, storage areas, laundry rooms, mechanical rooms, closets and office areas shall be equipped with an *automatic sprinkler system* installed in accordance with Section 906.2.1. Facilities that are equipped with an automatic sprinkler system as required by this section and a emergency smoke control/evacuation system as required by Section 410.9.1 are entitled to all height or area increases and other reductions of code requirements normally allowed for fully sprinkled buildings. **Effective 5/20/00**

**410.9.3 Mixed use buildings:** Where a *Jail or Life Safety Jail* is attached to; located above or below another occupancy or is otherwise a part of a building not of the I-3 occupancy, the building shall comply with Section 313.1.2 or Section 313.1 of this code. The *Jail or Life Safety Jail* shall be separated from all other occupancies with fireresistant construction of not less than 2-hours. **Effective 5/20/00**

**410.9.4 Doors and glazing:** The Department of Corrections shall approve penal doors in *Jails and Life Safety Jails*. Glass-clad polycarbonate glazing shall be an acceptable alternate to wired glazing. All door openings that do not require a penal door and hardware shall be protected by opening protectives as required by other sections of this code. **Effective 5/20/00**

**410.9.5 Restricted Custody Centers**: All *restricted custody centers* attached to or separate from a *jail* shall be considered as **Occupancy Condition I** and shall have free egress or automatic time delayed emergency release doors with a maximum time delay of 30 seconds. **Effective 5/20/00**

**410.9.5.1 Automatic sprinkler system:** All restricted custody centers attached to or separated from a *jail* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. **Effective 5/20/00**

**410.9.6 Existing facilities:** All existing *Jails, Life Safety Jails* and *Restricted Custody Centers* which are in operation and have prior approval from the Department of Corrections shall be exempt from these requirements until such time the facilities are renovated. **Effective 5/20/00**

17. Various Sections of Section 421, Swimming Pools, have been amended as follows:

**Section 421.2 Definitions:**

The definition of "**Above-ground/in-ground pool**" has been deleted in its entirety. **Effective 12/13/97**

The following definitions have been amended to read as follows:

**Barrier:** A fence, a wall, a building wall, or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool. **Effective 12/13/97**

**Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes swimming pools constructed below grade on site, but not those assembled above grade on site. **Effective 12/13/97**

**Public swimming pool:** Any swimming pool constructed below grade on site which is not a private swimming pool. **Effective 12/13/97**

18. A new subsection, 421.8.1 Protection of heating equipment, has been created to read:

**421.8.1 Protection of heating equipment:** Gas appliances located in rooms or spaces where corrosive or flammable chemicals are present shall be protected in accordance with Sections 5.1.6 and 6.22.1 of NFPA 54 listed in Chapter 35. **Effective 2/24/99**

19. Sections 421.9.1 and 421.9.3 have been amended to read as follows:

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground. **Effective 12/13/97**

**Exemptions:** The following shall be exempt from the provisions of this section.
1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

**421.9.3 Alternative devices:** A natural barrier approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection afforded by the enclosure, gate and latch described herein. **Effective 12/13/97**

20. A new Section 421.9.4 has been created and shall read:

**421.9.4 Private swimming pool enclosures.**
1. An indoor private pool enclosure may consist of the walls of the house including any entrance and exit doors, screens or glass separations designed for the purpose of preventing uninvited persons from entering the pool.
2. An outdoor private pool enclosure may surround the pool area only or it may surround a larger area if the barrier prevents uninvited persons from entering the pool. **Effective 12/13/97**

21. Section 422.1 was amended to create a new exception to read as follows:

**422.1 Scope:** The provisions of this section shall apply to buildings or structures or portions thereof, required to be licensed as a day care center, which are classified in Chapter 3 under Use Group E, except as specifically modified by Sections 422.1 through 422.12, day care centers shall meet all applicable provisions of this code.

**Exception:** After school programs that may also be licensed day care centers and are located in schools, shall not be made to comply with the requirements of this section where all clients of the day care and after school program are also students of that school. **Effective 8/16/99**

22. Table 422.2 was amended as follows: **Effective 8/16/98**

TABLE 422.2
LOCATION/CONSTRUCTION TYPE LIMITATIONS

| Location of day care | Sprinklered building | Construction type permitted |
|---|---|---|
| Story of exit discharge | No | Any type |
| 1 story above LED | Yes | Any type |
| | No | 1A, 1B, 2A |
| 2 or 3 stories above LED | Yes | Any type other than 3B, 4 & 5B |
| >3 stories above LED But not high rise | Yes | 1A, 1B, 2A or 2B |
| High Rise | Yes | 1A, 1B or 2A |

23. Section 422.9, number 3, was amended to read as follows: (no change to text of Exceptions 1 & 2 of the Subsection)

**3.** In all rooms within the center that are classified as a *habitable space* or an *occupiable space* in accordance with Section 1202.0 of this code. **Effective 12/13/97**
**Exception:** Kitchens.

24. Section 423.1, number 3, was amended to read as follows:

**3.** Interconnected smoke detectors shall be provided in accordance with Section 920.3.2, 920.4 and 920.5. **Effective 12/13/97**

## Chapter 7

25. Section 707.1 has been amended and an exception created to read as follows:

**707.1 General.** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials that provide the required strength and fire resistance rating specified in Table 602 for the type of construction, but not less than the fire resistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16. **Effective 12/13/97**

**Exception:** Fire walls and party walls utilized in Use Group R-3 shall be permitted to be constructed of any noncombustible materials that provide the required strength and fireresistance rating specified in Table 602, and has sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. **Effective 8/16/99**

26. **721.7.1.1 Use Groups R-1 and R-2:** In occupancies in Use Groups R-1 and R-2, *draftstopping* shall be installed in line with tenant, guestroom and *dwelling unit* separation walls where the walls do not extend to the underside of the floor sheathing above. **Effective 8/16/99** (no change to exception)

27. **721.7.2.1 Use Group R:** In occupancies in Use Group R, in attics, mansards, overhangs or other concealed roof spaces, draftstopping shall be installed above, and in line with, tenant, guestroom and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

**Exceptions:**

1. Where *corridor walls* provide a tenant, guestroom or *dwelling unit* separation, draftstopping shall only be required above one of the *corridor* walls.
2. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant, guestroom and *dwelling unit* separation walls if the joists form a *draftstop.*
3. No change in current text.
4. No change in current text.
5. No change in current text.

6. When tenant, guestroom or *dwelling unit* separation walls are constructed to the underside of a fireresistance rated roof/ceiling assembly or to a ceiling with a 60-minute finish rating, the *attic draftstopping* complying with Section 720.7.2.2 [i.e., horizontal draftstopped areas not exceeding 3,000 square feet (279 $m^2$)] shall be deemed equivalent. **Effective 8/16/99**

## Chapter 9

28. Exception #2 of Section 904.1 was amended to read:

2. In telecommunications equipment buildings, or portions thereof, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies. **Effective 8/16/98**

29. The Exception of Section 906.2 was amended to read:

**Exception:** Where water as an extinguishing agent is not compatible with the fire hazard (see Section 905.1) or is prohibited by a law, statute or ordinance, or when the property owner chooses use of an alternative system because of the nature of the property to be protected in lieu of an automatic sprinkler system, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard. **Effective 8/16/98**

30. Section 906.5 , Exception 2 was amended to read:

2. Audible or visual alarm devices shall not be required on the exterior of the building for fire sprinkler system supervised by method 1 of Section 924.1. **Effective 12/13/97**

31. Section 918.4.1 was amended to include exceptions allowing modular or portable educational buildings a less expensive alternative in providing fire alarms. The Section reads as follows:

**918.4.1 Use Group A-4 or E:** A fire alarm system shall be installed and maintained in all occupancies in Use Group A-4 or E. A fire alarm system shall not be required for sanctuary and nave areas of churches and similar religious buildings.

**Exceptions:**

1. Church buildings which do not exceed 10,000 square feet (930 $m^2$) and in which single-station smoke detectors are installed as follows:
    1. Smoke detectors may be single station and wired in series so as to sound an alarm in the sanctuary.
    2. Smoke detectors shall be installed in fellowship halls and more hazardous areas such as furnace rooms, mechanical rooms and storage rooms, but shall not be required in Sunday school classrooms.
    3. Detector spacing shall be 30 feet (9144 mm) on center in corridors and 900 square feet (84 $m^2$) per detector in open spaces, or in accordance with the manufacturer's specifications.
2. Modular or portable educational buildings or clusters of such buildings in which the main building fire alarm is extended to the buildings or in which single-station smoke detectors are installed under the following conditions:
    1. Individual buildings or cluster of buildings with a total aggregate floor area of not more than 7200 square feet (672 $m^2$).
    2. Each modular or portable building is separated from all other school buildings on the campus by a minimum horizontal distance of 10 feet (3048 mm).
    3. Smoke detectors are installed in each classroom and wired in series so as to sound

an alarm in each classroom of the building or cluster of buildings. The smoke detector spacing shall be in accordance with item #3 of Exception No. 1 (above). **Effective 8/16/99**

32. Section 919.5 was amended to read as follows:

**919.5 Sprinklered buildings exception:** Buildings equipped throughout with an automatic sprinkler in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 918.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use groups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3. **Effective 12/13/97**

33. Section 924.1 was amended to delete the reference to "supervisory service" and clarify that the front desk clerk or security guard (supervisory service) does not mean a "constant attended location." The Section reads as follows:

**924.1 Fire suppression systems:** All *automatic fire suppression systems* required for occupancies in Use Group A, B, E. H, I, M or R shall be supervised by method 1. All *automatic fire suppression systems* in other use groups shall be supervised by one of the following methods:

1. Central-station system, proprietary system or remote-station system in accordance with NFPA 72 listed in Chapter 35; or
2. Locking open all valves on connections to *water supplies*, sectional control valves and other valves in supply pipes to fire protection devices. **Effective 8/16/99** (No change to Exceptions)

## Chapter 10

34 . Amend Table 1010.3 to increase the number of dwelling units that share a single exit by the construction of a 2-hour fire separation wall. Table 1010.3 and the Notes shall read as follows:

**Table 1010.3**
**BUILDINGS WITH ONE EXIT**

| Use Group | Maximum number of stories above grade | Maximum per floor occupants, travel distance[e] dwelling units |
|---|---|---|
| A, B, E, F, M | 1 Story | 50 occupants and 75 feet travel |
| H-2, H-3 | 1 Story | 3 occupants and 25 feet travel |
| H-4, I, R | 1 Story | 10 occupants and 75 feet travel |
| S[a] | 1 Story | 30 occupants and 100 feet travel |
| B[b], F, M, S[a], U | 2 Stories | 30 occupants and 75 feet travel |
| R-2 | 2 Stories[c] | 4 dwelling units[d] |

**Note a.** For the required number of exits for open parking structures, see Section 1010.5.
**Note b.** For the required number of exits for air traffic control towers, see Section 414.0.
**Note c.** Buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1 or 906.2.2 with an occupancy in Use Group R-2 shall have a maximum height of three stories above grade.
**Note d.** The number of dwelling units that share a single exit may exceed 4 per floor where each 4 dwelling units sharing a single exit are separated from other groups of 4 dwelling units sharing a single exit by not less than a 2-hour fire separation wall constructed in accordance with Section 709.0 of this code. A 2-hour fire wall is not required unless it is needed to reduce building areas to within the limits of Table 503 for the type of construction.

**Note e.** 1 foot = 304.8 mm.

35. Exception #4 of Section 1010.4 has been created to read: (no change to Exceptions 1-3)

    4. Replacement of emergency escape and rescue windows which meet or exceed the provisions of the applicable code at the time the facility was originally constructed. **Effective 8/16/98**

36. Section 1012.5.1 was amended to specify the minimum length of gaps or breaks in aisle handrails. The Section reads as follows:

    **1012.5.1 Discontinuous rails:** Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not less than three rows and not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the handrail shall have rounded terminations or bends. **Effective 8/16/99**

37. Section 1014.6 was amended to create an additional exception to the tread and riser height requirements for swimming pools, spas and baptisteries to read as follows:

    **1014.6 Treads and risers:** Maximum riser height shall be 7 inches (178 mm) and minimum riser height shall be 4 inches (102 mm). The riser height shall be measured vertically between the leading edges of the adjacent treads. Minimum tread depth shall be 11 inches (279 mm), measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge.

    **Exceptions:**

    1. through 9.- No change in current text.
    10. Stairways providing access to or from swimming pools, spas or baptisteries with the tread surface entirely below water shall have treads and risers complying with Section 421.5.5 of this code. **Effective 8/16/99**

38. Section 1022.2.3 was amended to include an additional exception to the requirement of handrails ends or where handrails are not continuous. The Section reads as follows:

    **1022.2.3 Handrail ends:** At locations where handrails are not continuous between stairway flights, including the top and bottom of a stairway, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. The handrail ends shall be returned to a wall or post.

    Where handrails are not continuous between ramp segments, including the top and bottom of a ramp, the handrails shall extend at least 12 inches (305 mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The handrail ends shall be returned to a wall or post.

    **Exceptions:**

    1. Within a dwelling unit, the horizontal extension beyond the top riser of the stairway flight or top of the ramp segment, and the extension beyond the bottom riser of the stairway flight or bottom of the ramp segment is not required.
    2. Within a dwelling unit, the use of a volute, turnout or starting easing is allowed on the lowest tread.
    3. Within aisle stairs, the horizontal extension is not required beyond the bottom or top riser, provided the handrail begins at the first riser and is continuous, except where gaps or breaks are permitted in Section 1012.5.1, to the top row of seats. **Effective 8/16/99**

39. Exception #1 of Section 1022.2.4 has been amended to read: (no change to Exception 2)

    1. Any other shape with a perimeter dimension of at least 4 inches (100 mm), but not greater than

6 1/4 inches (158 mm) with the largest cross-sectional dimension not exceeding 2 1/4 inches (57 mm). The figures shown in Appendix C, Figure 1022.2.4, are approved for use under this Section/subsection. **Effective 8/16/98**

## Chapter 16

40. Kentucky Building Code/1997, Chapter 16, Structural Loads. It has been discovered that Section 1601.2, Certificate of Compliance, from the 1994 Kentucky Building Code was not printed in the current edition. This section should be included in the 1997 KBC and reads as follows:

**1601.2 Certificate of compliance:** Design compliance with the provisions of this Chapter and Chapter 18 shall be satisfied when certification of an architect or engineer registered in Kentucky to that effect is placed on drawings submitted to the code official, unless the code official shall notify the designer that a specific code violation exists.

## Chapter 18

41. Section 1806.1 was amended to read as follows:

**1806.1 Frost Protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30$m^2$) in area or 10 feet (3048 mm) in height shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the load within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall not be founded on frozen soils unless such frozen condition is of a permanent character. **Effective 12/13/97**

## Chapter 28

42. Create a new subsection in Chapter 28 to read:

**2801.2.3 Gas-fired appliances:** Gas utilization equipment, including piping, vent/chimney connectors, vent systems and combustion/dilution air shall comply with NFPA 54 listed in Chapter 35. **Effective 2/24/99**

43. Delete section 2801.6, Gas-fired appliances, in its entirety. **Effective 2/24/99**

44. Section 2810.0, Range Hoods, has been created to read:

**SECTION 2810.0 RANGE HOODS**

**2810.1 Range hoods:** Range hoods in kitchen exhaust systems shall comply with the requirements of the mechanical code listed in Chapter 35. The bottom edge of the hood shall be located at a height of not more than 4 feet (1219 mm) above the cooking surface.

**Exception:** In churches and in other occupancies where the range is merely a convenience for occasional use and where there is minimal or nonexistent grease-laden vapors, a commercial exhaust system shall not be required. **Effective 2/24/99**

45. Section 2811, Oxygen Systems, was created to recover a code requirement from the 1994 edition that was inadvertently omitted in the 1997 KBC. The Section reads as follows:

SECTION 2811.0 OXYGEN SYSTEMS

**2811.1 General:** Non-medical oxygen systems shall be designed and installed in accordance with NFPA 50 and NFPA 51 listed in Chapter 35.

## Chapter 31

46. Section 3102.0, Signs, has been deleted in its entirety. **Effective 12/13/97**

## Chapter 35

47. (a) Under "Codes", page 330, amend the reference to the *Kentucky Fire Prevention Code* to cite the 1999 Edition. Also, delete the reference to "Building Officials and Code Administrators" at the top and the asterisk at the bottom should indicate that "all publications are available from the Department of Housing, Buildings and Construction. **Effective 2/24/99**

*Note:* Please be advised that effective May 26, 1999, NFPA 1, Fire Prevention Code, 1997 Edition, became effective as the 1999 Kentucky Standards of Safety and replaced the 1996 Kentucky Fire Prevention Code. NFPA 101, Life Safety Code, 1997 Edition, was incorporated by reference. The 1999 Kentucky Standards of Safety were promulgated in administrative regulation 815 KAR 10:060.

Both NFPA 1 and NFPA 101 are adopted for application to both new and existing conditions to the extent that they do not conflict with the building codes or fire codes under which the facility was constructed, maintained and used.

A copy of administrative regulation 815 KAR 10:060 should accompany NFPA 1 as the regulation contains some minor changes to the Code. Copies of NFPA 1 and 815 KAR 10:060 are available from the Department. NFPA 101 can also be obtained from the National Fire Protection Association, 1 Batterymarch Park, P O Box 9101, Quincy, MA 02269-9101. If you purchase NFPA 1 from the National Fire Protection Association, please contact this Department for a copy of administrative regulation 815 KAR 10:060.

(b) Under Codes, page 330, add a reference to the International Mechanical Code, 2000 Edition to the reference to the BOCA National Mechanical Code, 93 Edition and indicate that the 2000 International Mechanical Code will be mandatory and effective January 1, 2001. (Approved by Board 5/25/00)

48. (a) Update NFPA 70 to 1999 Edition. **Effective 2/24/99**

(b) Update edition dates of the following NFPA standards: (Approved by Board 5/25/00)

| | |
|---|---|
| 10-98 | Portable Fire Extinguishers |
| 11-98 | Low Expansion Foam |
| 11A-99 | Medium and High Expansion Foam |
| 12-98 | Carbon Dioxide Extinguishing Systems |
| 12A-97 | Halon 1301 Fire Extinguishing Systems |
| 13-99 | Installation of Sprinkler Systems |
| 13D-99 | Installation of Sprinkler Systems in 1 & 2 Family Dwellings and Manufactured Homes |
| 13R- 99 | Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height |
| 14 – 00 | Standpipe and Hose Systems |
| 15 – 99 | Water Spray Fixed Systems for Fire Protection |
| 16 – 99 | Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems |
| 17 – 98 | Dry Chemical Extinguishing Systems |
| 17A – 98 | Wet Chemical Extinguishing Systems |
| 24 | Installation of Private Fire Service Mains (Note: This standard is now incorporated in NFPA 13-99 & NFPA14-99) |
| 30B – 98 | Manufacture and Storage of Aerosol Products |

| | |
|---|---|
| 32 – 00 | Dry-cleaning Plants |
| 40 – 97 | Storage and Handling of Cellulose Nitrate Motion Picture Film |
| 51 – 97 | Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes |
| 54 - 99 | National Fuel Gas Code |
| 58 –98 | Storage and Handling of Liquefied Petroleum Gases |
| 61 - 99 | Prevention of Fires and Dust Explosions in Agricultural Food Products Facilities (Note: NFPA 65 has been incorporated into NFPA 651) |
| 69 –97 | Explosion Prevention Systems |
| 70 – 99 | National Electrical Code |
| 72 – 99 | National Fire Alarm Code |
| 79 -97 | Electrical Standard for Industrial Machinery |
| 80 – 99 | Fire Doors and Windows |
| 82 – 00 | Incinerators and Waste and Linen Handling Systems and Equipment |
| 90A – 99 | Installation of Air Conditioning and Ventilation Systems |
| 90B – 99 | Installation of Warm Air Heating and Air Conditioning Systems |
| 99 – 99 | Health Care Facilities |
| 120 – 99 | Coal Preparation Plants |
| 230-99 | Rack Storage of Materials |

(Note: NFPA 231C has been incorporated into NFPA 13-99 and replaced by NFPA 230-99)

| | |
|---|---|
| 651 – 98 | Manufacture of Aluminum Powder |
| 654 – 97 | Prevention of Fire and Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries |
| 664 – 98 | Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities |
| 701 – 99 | Methods of Fire Tests for Flame-Resistant Textiles and Films |
| 704 – 96 | Identification of the Fire Hazards of Materials |
| 8503 – 97 | Pulverized Fuel Systems |

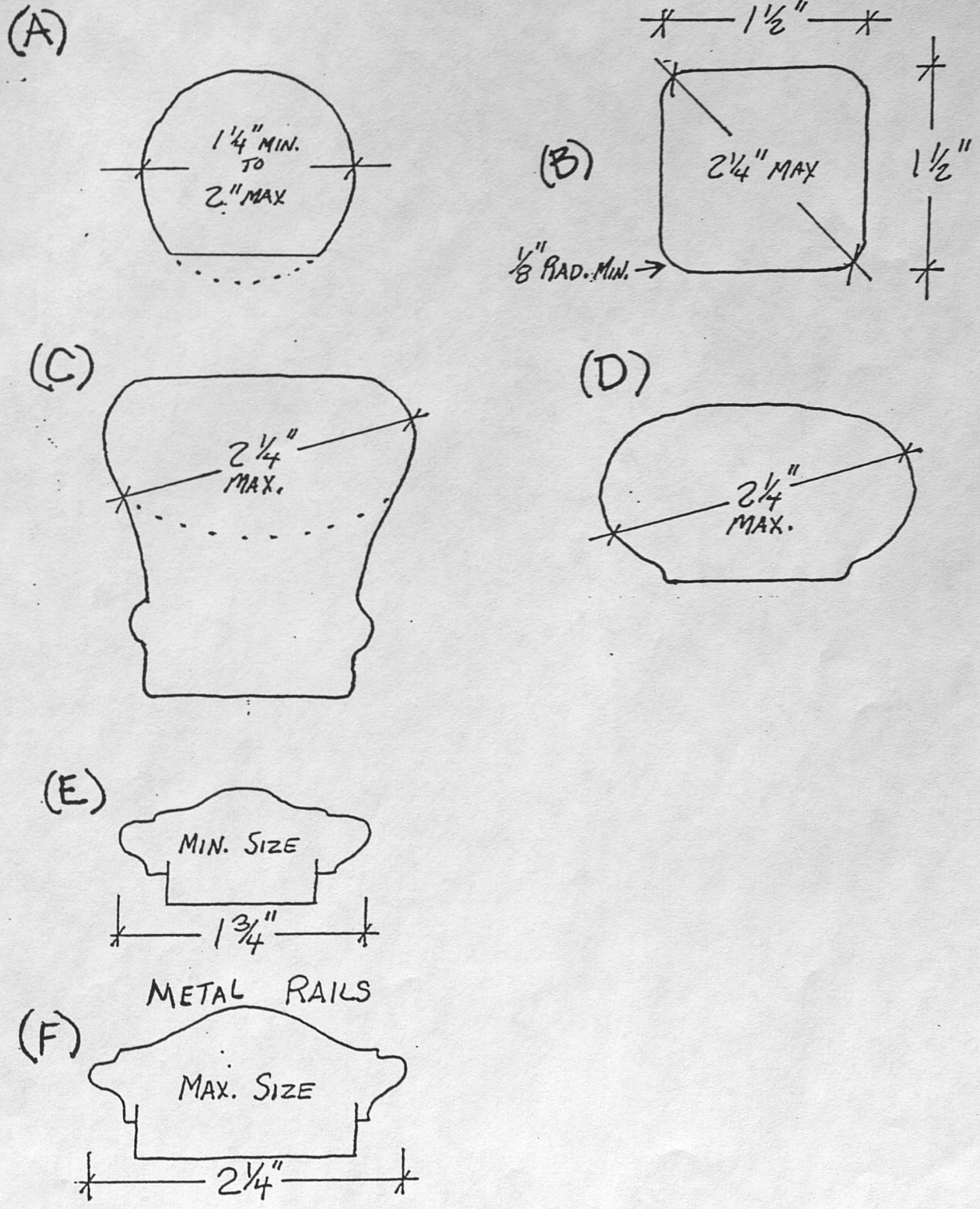
49. Update NFPA 101 to 1997 Edition. **Effective 2/24/99**

## Appendix C

50. Illustration of acceptable handrail profiles in conjunction with Section 1022.2.4. (Attached) **Effective 8/16/98**

## APPENDIX C

# HANDRAIL PROFILES
# FIGURE 1022.2.4



# ADOPTION INFORMATION

*The Kentucky Building Code/1997* applies to all buildings to be constructed, altered or remodeled with the exception of farms and manufactured houses.

The following sample adoption ordinance addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

SAMPLE ORDINANCE FOR ADOPTION OF THE 1997 KENTUCKY BUILDING CODE
(CITY/COUNTY) ORDINANCE

Ordinance Number _____

AN ORDINANCE RELATING TO THE ADOPTION OF THE KENTUCKY BUILDING CODE AS PROMULGATED IN 815 KAR 7:105 BY THE BOARD OF HOUSING, BUILDINGS AND CONSTRUCTION OF THE COMMONWEALTH OF KENTUCKY

Be it ordained by the *(Governing Board)* of the *(Name of Jurisdiction)* as follows:

WHEREAS, KRS 198B.060(1), requires that all buildings constructed in____ *(City/County)*_____ shall be built in compliance with the uniform state building code as adopted by the Board of Housing, Buildings and Construction; and

WHEREAS, KRS 198B.060(1) authorizes any city, county or urban county government to require, by ordinance, permits, inspections and certificates of occupancy for single family dwellings; and

WHEREAS, KRS 198B.060(11) requires the local government to employ or conract for or with electrical insepction services; and

WHEREAS, KRS 198B.060(18) authorizes each local government to establish a schedule of fees which are designed to cover the cost of the service performed but not to exceed it;

Now, therefore, BE IT ORDAINED by the Fiscal County and/or legislative body of _____(City/County) _____, COMMONWEALTH OF KENTUCKY:

**SECTION 1. ADOPTION OF THE KENTUCKY BUILDING CODE.**

THAT, the KENTUCKY BUILDING CODE, including the CABO One and Two Family Dwelling Code, as promulgated in 815 KAR 7:105 by the Board of Housing, Buildings and Construction, Commonwealth of Kentucky, is hereby adopted in full as an Ordinance of _____*(City/County)* _____of the Commonwealth of Kentucky as if set out at length herein;

THAT, a copy of said Kentucky Building Code, together with a copy of the CABO One and Two Family Dwelling Code and all other regulations or NFPA pamphlets adopted or referred to thereunder, is on file in the Office of the _____ County Clerk, and the Clerk shall at all times keep a copy of said building code for reference;

THAT, an attested copy of this Ordinance shall be transmitted to the Department of Housing, Buildings and Construction of the Commonwealth of Kentucky.

**SECTION 2. DESIGNATED ENFORCEMENT OFFICER.**

THAT, _____ *(Officer)*_____, shall be designated as the local enforcement agent/agency for said Kentucky Building Code. All building code inspections shall be performed by persons certified by the Kentucky Department of Housing, Buildings and Construction. All electrical inspections shall be performed by a certified electrical inspector specifically approved by this jurisdiction.

**SECTION 3. BUILDING INSPECTION PROGRAM.**

THAT, pursuant to KRS 198B.060(8), a building inspection program is hereby established in _____*(City-County)*_____.

**SECTION 4. PERMITS AND FEES.**

THAT, the fees for permits and inspections shall be as provided for in the attached schedule.

**SECTION 5. INCONSISTENT ORDINANCES REPEALED.**

THAT, all ordinances or parts of ordinances in conflict herewith are, to the extent of such conflict, hereby repealed.

**SECTION 6. EFFECTIVE DATE.**

THAT, this resolution shall take effect and be in full force when passed, published and recorded according to law.

_____
*COUNTY JUDGE/EXECUTIVE OR MAYOR*

ATTEST:

_____
*CITY/COUNTY CLERK*

_____
*DATE PASSED*

PAUL E. PATTON
*Governor*

COMMONWEALTH OF KENTUCKY
**DEPARTMENT OF HOUSING,**
**BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S. BAY 1
FRANKFORT, KENTUCKY 40601-4322
(502) 564-8044
FAX (502) 564-6799

*Commissioner*

January, 2000

## NOTICE

## 1997 KENTUCKY BUILDING CODE AMENDMENTS

Please find enclosed a cumulative list of amendments which have been made to the 1997 Kentucky Building Code, Seventh Edition, and includes those reported in the Kentucky Code Report, Volumes 1, 2 and 3.

You may wish to make copies and keep in front of each code book you have purchased.

As additional changes are made and approved, they will be sent to you.

Judith G. Walden, Editor

Judith G. Walden, Editor

Enclosure: Vol 4, Kentucky Code Report

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# KENTUCKY CODE REPORT

A Bulletin on Building and Fire Code Enforcement
Vol. No. 4
January, 2000


# 1997 KENTUCKY BUILDING CODE UPDATE

## CUMULATIVE SUPPLEMENT (Contains all amendments since 12/13/97)

**Please keep this Supplement in the front of your Code book for quick reference and mark each amended Section with an asterisk in your KBC.**

The Board of Housing, Buildings and Construction and the Legislative Regulation Review Subcommittee have approved the following amendments. The effective date is indicated for each amendment. Please note that new amendments between the March Supplement and this edition have been underlined.

*TABLE OF CONTENTS*


| | | | |
|---|---|---|---|
| *Chapter 1* | Page 1 | *Chapter 10* | Page 11 |
| *Chapter 2* | Page 5 | *Chapter 18* | Page 12 |
| *Chapter 3* | Page 6 | *Chapter 28* | Page 12 |
| *Chapter 4* | Page 6 | *Chapter 31* | Page 12 |
| *Chapter 7* | Page 9 | *Chapter 35* | Page 12 |
| *Chapter 9* | Page 10 | *Appendix C* | Page 13 |


## Chapter 1

1. Sections 101.3 through 101.3.3 and the Exceptions thereunder have been amended, deleted or renumbered to read as follows:

**101.3 Single-family dwellings**: All single-family dwellings shall conform to the construction standards of this code for R-3 structures.

**Exceptions:**

1. Manufactured homes.
2. Farm dwellings.
3. Single family dwellings constructed in accordance with Section 310.6 and the CABO One and Two Family Dwelling Code, including the National Electrical Code, the CABO Model Energy Code and the State Plumbing Code referenced in Chapter 35 of this code. **Effective 8/16/98**

**101.3.1 Enforcement by local government:** The electrical system shall be inspected and approved by a certified electrical inspector pursuant to KRS 227.489 and 815 KAR 35:015. The plumbing system shall be inspected and approved pursuant to KRS Chapter 318 and the Kentucky State Plumbing Code (815 KAR 20:010-060). Other permits and inspections of single family dwellings shall be performed only if required by local ordinance. **Effective 8/16/98**

**101.3.2 Other codes applicable:** NFPA 70 shall apply to all manufactured/mobile homes exterior service hook-ups and the State Plumbing Code shall apply to the exterior water and sewer lines of non-farm manufactured/mobile homes. **Effective 2/24/99**

2. Section 103.1, item #3, has been amended to read:

   3. The removal or change of any required *means of egress* or emergency escape windows; or **Effective 8/16/98**

3. Section 105.2.2 was amended to delete frozen food locker plants and reads:

   **105.2.2** Buildings classified as educational, institutional, high hazard or *industrialized building systems,* regardless of occupancy size or occupancy classification. **Effective 8/16/98**

4. Section 107.3 was amended to delete language regarding application made by someone other than owner in fee and reads:

   **107.3 By whom application is made:** Application for a local building permit shall be made by the owner or lessee of the building or structure, or the builder or other agent of either, or by the licensed engineer or architect employed in connection with the proposed work. The full names and addresses of the owner, lessee, applicant and of the responsible officers, if the owner or lessee is a corporate body, shall be stated in the application. (Language regarding application made by someone other than owner in fee was deleted) **Effective 8/16/98**

5. A new Section 111.3.1 has been created to read:

   **111.3.1 Limitation on changes.** No inspector shall be authorized to require changes on-site which are contrary to the approved construction documents. If an inspector finds a code discrepancy in an on-site inspection, the inspector shall refer the matter to the official having construction document review responsibility who shall require corrections if the code so requires. **Effective 12/13/97**

6. The fees in Section 112 have been amended as follows:
   *Please note:* Subsection 112.3.1.1 & Table 112.3.1 were further amended by the Board on January 15, 1998, and effective as indicated.

**SECTION 112.0 FEES**

**112.1 General**: A permit to begin work for new construction, *alteration,* removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid. **Effective 12/13/97**

**112.2 Special fees:** Payment of fees for construction, alteration or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs and* display structures, marquees or other *appurtenant structures, or* fees of inspections or certificates of occupancy or other privileges or requirements established by law. **Effective 12/13/97**

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable. **Effective 12/13/97**

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3.1. **Effective 12/13/97**

**112.3.1.1 Fast track elective:** For permit applicants seeking early site and foundation approval prior to full review of complete set of construction documents, the fee shall be that as calculated from Table 112.3.1 plus 50 percent of the full fee. The additional 50 percent fee shall not be less than $200 and not more than $3,000. The entire fee shall be paid at the time of the initial plans submission. **Effective 8/16/98**

Table 112.3.1
DEPARTMENT OF HOUSING FEE SCHEDULE

| Occupancy type | Cost per square foot |
|---|---|
| Residential | 5 cents |
| Assembly | 6 cents |
| Day care centers | 5 cents |
| Educational | 5 cents |
| Business | 5 cents |
| Mercantile | 5 cents |
| Industrial factories | 3: cents |
| Warehouses | 3 cents |
| Institutional | 6 cents |
| Frozen food plants | 4 cents |
| High hazard | 5 cents |
| All other nonresidential | 4 cents |

**112.3.2 Submission of plans and fees**: All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar. **Effective 12/13/97**

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky, State Treasurer. **Effective 12/13/97**

**112.3.4 Construction approval:** Approval for construction shall not be issued by the Department until all required fees have been paid. **Effective 12/13/97**

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table 112.3.1 by the measurement of the square footage of the addition, as determined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.7 Change in use:** Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $100. **Effective 12/13/97**

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the alterations or repairs by 0.0025; or calculated by multiplying the total area being altered; or repaired by the cost per square foot of each occupancy type as listed in Table 112.3.1, whichever is less. The total square footage shall be determined by the outside dimensions of the area being altered or repaired. The minimum fee for review of plans under this section shall be $100. **Effective 8/16/99**

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the

specialized plan reviews listed. **Effective 12/13/97**

Table 112.3.9
AUTOMATIC SPRINKLER REVIEW FEE TABLE

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $100 |
| 201-300 | $125 |
| 301-400 | $160 |
| 401-750 | $200 |
| Over 750 | $200 plus 19 cents per Sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $100; over 20,000 square feet shall be $100 plus $19 for each additional 10,000 square feet in excess of 20,000 square feet. **Effective 12/13/97**

**112.3.11 Standpipe plan review fee:** $100 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule). **Effective 12/13/97**

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $100, over 200 pounds of agent shall be $100 plus 2 cents per pound in excess of 200 pounds. **Effective 12/13/97**

**112.3.13 Clean agent suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds. The fee for gaseous systems shall be 5 cents per cubic foot and not less than $100. **Effective 8/16/99**

**112.3.14 Foam suppression system review fee:** 50 cents per gallon of foam concentrate where the system is not part of an automatic sprinkler system. Foam suppression system plans that are submitted as part of an automatic sprinkler system shall be reviewed under the automatic sprinkler review fee schedule. The fee for review of plans under this section shall not be less than $100 or more than $1,500. **Effective 8/16/99**

**112.3.15 Commercial range hood review fee:** $100 per hood. **Effective 12/13/97**

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $100; over 30 pounds of agent shall be $100 plus 25 cents per pound in excess of 30 pounds. **Effective 12/13/97**

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components. **Effective 12/13/97**

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18. **Effective 12/13/97**

Table 112.3.18
BOILER AND UNFIRED PRESSURE VESSEL FEES

| Heating surface (square feet) | Fee | Heating surface (square feet) | Fee |
|---|---|---|---|
| 100 and under | $ 30 | 4,001 to 10,000 | $ 80 |
| 101 to 1,000 | $ 40 | 10,001 and over | $110 |
| 1,001 to 4,000 | $ 60 | Unfired pressure vessels | $ 30 |

**112.4 Local jurisdiction**: Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed. **Effective 12/13/97**

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law. **Effective 12/13/97**

7. Section 113.3 was amended to read as follows:

**113.3 Final Inspection:** Upon completion of the building, the owner or agent of the facility shall request a final inspection. The code official shall set a time for the inspection and notify the owner or agent. If substantial compliance with the approved *construction documents* and permit has been achieved, a certificate of occupancy shall be issued, as described in Section 118.0 of this code. If compliance has not been achieved, violations of the approved *construction documents* and permit shall be noted and immediately communicated to the owner, agency or other person holding the permit and the fire code official. It shall be the owner's responsibility and the responsibility of the person or company responsible for the construction work to fulfill any compliance deficiencies noted. **Effective 8/16/99**

8. Section 116.2 was amended to read as follows:

**116.2 Notice of Violation:** The code official shall serve a notice of violation or order on the property owner and any other person responsible for the design, erection, construction, *alteration*, extension, repair, removal, demolition or occupancy of a building or structure in violation of the provisions of this code, or in violation of a detailed statement or a plan approved thereunder, or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation. **Effective 8/16/99**

9. Section 119.1 and 119.2 was amended to reflect the Cabinet name change and will read as follows:

SECTION 119.0 CABINET FOR FAMILIES AND CHILDREN **and** CABINET FOR HEALTH SERVICES REGULATED BUILDINGS

**119.1 Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities:** Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services and inspected under contract with the Cabinet for Families and Children or the Cabinet for Health Services by the Department of Housing, Buildings and Construction shall comply with the institutional use group requirements specified in Chapter 4, including specific references to other sections of this code, and the applicable provisions of NFPA 101 listed in Chapter 35. **Effective 8/16/99**

**119.2 Day care centers:** Day care centers, except those governed by Section 422.0 and other similar care facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services which comply with the provisions of NFPA #101 listed in Chapter 35 as approved by the State Fire Marshal shall be deemed to satisfy the life safety requirements of this code. **Effective 8/16/99**

## Chapter 2

10. Chapter 2, Definitions, was amended to add the following definition:

**Townhouse:** A single-family dwelling unit constructed in a row of attached units separated by property lines and with open space on at least two sides. **Effective 2/24/99**

## Chapter 3

11. Section 305.1 was amended to read as follows:

**305.1 General:** All structures, or parts thereof, other than those occupied for business training or vocational

training, which accommodate more than five persons for educational purposes, including, among others, schools, academies, colleges and universities, shall be classified as Use Group E. **Effective 12/13/97**

12. Section 307.5 was amended by deleting the reference to "Class I" under Organic peroxides. **Effective 12/13/97**

13. Section 307.8, Exception number 3, was amended to read as follows: (No change to other Exceptions)

    **3.** Buildings and structures occupied for the storage of 10,000 or more vehicle tires, weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1. **Effective 12/13/97**

14. Section 310.6 was amended to include townhouses in Use Group R-4 and further reorganized. Over the years, Kentucky's exceptions or alternatives to the CABO Code have increased and reorganization was necessary for clarity and ease of interpretation and enforcement. The reorganized section reads as follows:

    **310.6 Use Group R-4 structures:** This use group shall include all *townhouses* and detached *one- and two-family dwellings* not more than three stories in height, and their *accessory structures* as indicated in the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. All of these structures shall be designed and built in accordance with the requirements of this code for a Use Group R-3 structure, or with the requirements of the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. The choice of the construction code shall be made by the permit applicant at the time of plans submission. **Effective 2/24/99**

    **310.6.1 CABO code alternatives:** When the permit applicant chooses the *CABO/ One & Two Family Dwelling Code* as the review code of record in Sections 310.6.1.1 through 310.6.1.6 shall be applicable and shall supersede any conflicting provision of the *CABO/ One & Two Family Dwelling Code*. **Effective 2/24/99**

    **310.6.1.1** A minimum stair tread depth of 9 inches (229 mm) and maximum riser height of 8 1/4 inches (210 mm). **Effective 2/24/99**

    **310.6.1.2** A minimum ceiling height complying with Section 1204. **Effective 2/24/99**

    **310.6.1.3** A minimum door height complying with Exception No. 6 of Section 1017.3. **Effective 2/24/99**

    **310.6.1.4** The plumbing system shall comply with the requirements of the *State Plumbing Code* (see 815 KAR Chapter 20). **Effective 2/24/99**

    **310.6.1.5** The stair handrails may conform with Exception No. 5 of Section 1014.7 and Exception No. 2 of Section 1022.2. **Effective 2/24/99**

    **310.7 Radon protection**: Radon control measures shall not be mandatory unless specifically required by local ordinance. **Effective 2/24/99**

    **310.8 Energy conservation:** *(This amendment is to clarify that energy conservation measures are mandatory for all one and two family dwellings and each townhouse. The exact language is pending Board approval)*

## Chapter 4

15. Amend Section 410.1 by including the following new definitions as follows:

    **410.1.1 Definitions:**
    **State jails:** Any Use Group I-3 facility under the direct supervision and operation of the Commonwealth of Kentucky. State jails shall comply with Sections 410.2 through 410.8 of this code.
    **Local jails:** Any Use Group I-3 facility under the supervision of a county, regional jail authority, city or urban county government. Local jails shall comply with the special requirements of Section 410.9, Local jails, in addition to the requirements of Sections 410.2 through 410.8 of this code. **(Effective 8/16/99)**

**410.1.1.1 Local jails terminology:** For the purpose of applying the special requirements of Section 410.9 for *local jails*, the following definitions shall be applicable: (Approved by the Board 10/ 21/99)

**Inmate living area:** Those areas where inmates are normally confined and where their movement is restricted by penal doors, including cells, dayrooms, dormitories, detoxification cells, isolation cells and temporary holding cells.
**Penal door:** A door required by the Kentucky Jail Standards to enclose *inmate living area* or restrict inmate movement through other areas of a local jail.

16. A new Section 410.9. Local Jails, has been created to read:
(Se*ction 410.9 was created by the Board and became effective 8/16/98. On 10/21/99, the Board approved additional amendments to some areas of the Section, resulting in some sections being renumbered. The areas amended on 10/21/99 are underlined.*

**410.9 Local Jails:** Local jails shall comply with the requirements of this section and where conflicts exist with other requirements of this code, this section shall take precedence. Local jails shall be further defined and classified as one of the following: **Effective 8/16/98**

**Jail:** Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 3:010 by and under the supervision of any county, regional jail authority, city or urban county government.
**Restricted custody center:** Restricted custody center means a facility or area separate from the jail used for the housing of sentenced inmates who have been approved for educational, work or program participation release and pretrial inmates who have been approved by the court for educational, work or program participation release and operated under 501 KAR 7:010.
**Life Safety Jail:** Life Safety Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 13:010 by and under the supervision of any county government which does not house state prisoners as defined by KRS 532.100.

**410.9.1 Emergency smoke control/evacuation:** All areas of *Jails* and *Life Safety Jails* where an inmate may be confined, shall be provided with an emergency smoke control/ evacuation system meeting the requirements of this section. The system shall be activated by smoke detectors and shall be connected to an emergency power supply. The system shall be engineered as an independent system or may be engineered to work in conjunction with the building HVAC system. (Approved by Board 10/21/99)

**410.9.1.1 Design:** All floors which house inmates shall be designed to have a minimum of two smoke compartments of approximately equal size and separated by a smoke barrier wall constructed in accordance with Section 712.0 of this code. The smoke control system shall be capable of maintaining a negative pressure in the contaminated smoke compartment. The smoke control system shall be capable of 6 air changes per hour. The plan review of the system; the operation of the system and the final operational test shall be subject to approval by the Department of Corrections. (Approved by Board 10/21/99)

**410.9.2 Automatic sprinkler system:** All areas of *Jails* and *Life Safety Jails* where inmates will not be confined, including but not limited to corridors, storage areas, laundry rooms, mechanical rooms, closets and office areas shall be equipped with an *automatic sprinkler system* installed in accordance with Section 906.2.1. Facilities that are equipped with an automatic sprinkler system as required by this section and a emergency smoke control/evacuation system as required by Section 410.9.1 are entitled to all height or area increases and other reductions of code requirements normally allowed for fully sprinkled buildings. (Approved by the Board 10/21/99)

**410.9.3 Mixed use buildings:** Where a *Jail or Life Safety Jail* is attached to; located above or below another occupancy or is otherwise a part of a building not of the I-3 occupancy, the building shall comply with Section 313.1.2 or Section 313.1 of this code. The *Jail or Life Safety Jail* shall be separated from all other

occupancies with fireresistant construction of not less than 2-hours. (Approved by the Board 10/21/99)

**410.9.4 Doors and glazing:** The Department of Corrections shall approve penal doors in *Jails and Life Safety Jails*. Glass-clad polycarbonate glazing shall be an acceptable alternate to wired glazing. All door openings that do not require a penal door and hardware shall be protected by opening protectives as required by other sections of this code. (Approved by the Board 10/21/99)

**410.9.5 Restricted Custody Centers**: All *restricted custody centers* attached to or separate from a *jail* shall be considered as **Occupancy Condition I** and shall have free egress or automatic time delayed emergency release doors with a maximum time delay of 30 seconds. (Approved by the Board 10/21/99)

**410.9.5.1 Automatic sprinkler system:** All restricted custody centers attached to or separated from a *jail* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. (Approved by the Board 10/21/99)

**410.9.6 Existing facilities:** All existing *Jails, Life Safety Jails* and *Restricted Custody Centers* which are in operation and have prior approval from the Department of Corrections shall be exempt from these requirements until such time the facilities are renovated. (Approved by the Board 10/21/99)

17. Various Sections of Section 421, Swimming Pools, have been amended as follows:

**Section 421.2 Definitions:**

The definition of "**Above-ground/in-ground pool"** has been deleted in its entirety. **Effective 12/13/97**

The following definitions have been amended to read as follows:

**Barrier:** A fence, a wall, a building wall, or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool. **Effective 12/13/97**

**Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is
used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes swimming pools constructed below grade on site, but not those assembled above grade on site. **Effective 12/13/97**

**Public swimming pool:** Any swimming pool constructed below grade on site which is not a private swimming pool. **Effective 12/13/97**

18. A new subsection, 421.8.1 Protection of heating equipment, has been created to read:

**421.8.1 Protection of heating equipment:** Gas appliances located in rooms or spaces where corrosive or flammable chemicals are present shall be protected in accordance with Sections 5.1.6 and 6.22.1 of NFPA 54 listed in Chapter 35. **Effective 2/24/99**

19. Sections 421.9.1 and 421.9.3 have been amended to read as follows:

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground. **Effective 12/13/97**

**Exemptions:** The following shall be exempt from the provisions of this section.
1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

**421.9.3 Alternative devices:** A natural barrier approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection afforded by the enclosure, gate and latch described herein. **Effective 12/13/97**

20. A new Section 421.9.4 has been created and shall read:

**421.9.4 Private swimming pool enclosures.**

1. An indoor private pool enclosure may consist of the walls of the house including any entrance and exit doors, screens or glass separations designed for the purpose of preventing uninvited persons from entering the pool.
2. An outdoor private pool enclosure may surround the pool area only or it may surround a larger area if the barrier prevents uninvited persons from entering the pool. **Effective 12/13/97**

21. Section 422.1 was amended to create a new exception to read as follows:

**422.1 Scope:** The provisions of this section shall apply to buildings or structures or portions thereof, required to be licensed as a day care center, which are classified in Chapter 3 under Use Group E, except as specifically modified by Sections 422.1 through 422.12, day care centers shall meet all applicable provisions of this code.

**Exception:** After school programs that may also be licensed day care centers and are located in schools, shall not be made to comply with the requirements of this section where all clients of the day care and after school program are also students of that school. **Effective 8/16/99**

22. Table 422.2 was amended as follows: **Effective 8/16/98**

TABLE 422.2
LOCATION/CONSTRUCTION TYPE LIMITATIONS

| Location of day care | Sprinklered building | Construction type permitted |
|---|---|---|
| 1 story below LED | Yes | Any type other than 3B & 5B |
| Story of exit discharge | No | Any type |
| 1 story above LED | Yes | Any type |
| | No | 1A, 1B, 2A |
| 2 or 3 stories above LED | Yes | Any type other than 3B, 4 & 5B |
| >3 stories above LED But not high rise | Yes | 1A, 1B, 2A or 2B |
| High Rise | Yes | 1A, 1B or 2A |

23. Section 422.9, number 3, was amended to read as follows: (no change to text of Exceptions 1 & 2 of the Subsection)

**3.** In all rooms within the center that are classified as a *habitable space* or an *occupiable space* in accordance with Section 1202.0 of this code. **Effective 12/13/97**
**Exception:** Kitchens.

24. Section 423.1, number 3, was amended to read as follows:

**3.** Interconnected smoke detectors shall be provided in accordance with Section 920.3.2, 920.4 and 920.5. **Effective 12/13/97**

## Chapter 7

25. Section 707.1 has been amended and an exception created to read as follows:

**707.1 General.** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials that provide the required strength and fire resistance rating specified in Table 602 for the

type of construction, but not less than the fire resistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16. **Effective 12/13/97**

**Exception:** Fire walls and party walls utilized in Use Group R-3 shall be permitted to be constructed of any noncombustible materials that provide the required strength and fireresistance rating specified in Table 602, and has sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. **Effective 8/16/99**

26. **721.7.1.1 Use Groups R-1 and R-2:** In occupancies in Use Groups R-1 and R-2, *draftstopping* shall be installed in line with tenant, guestroom and *dwelling unit* separation walls where the walls do not extend to the underside of the floor sheathing above. **Effective 8/16/99** (no change to exception)

27. **721.7.2.1 Use Group R:** In occupancies in Use Group R, in attics, mansards, overhangs or other concealed roof spaces, draftstopping shall be installed above, and in line with, tenant, guestroom and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

**Exceptions:**

1. Where *corridor walls* provide a tenant, guestroom or *dwelling unit* separation, draftstopping shall only be required above one of the *corridor* walls.
2. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant, guestroom and *dwelling unit* separation walls if the joists form a *draftstop.*
3. No change in current text.
4. No change in current text.
5. No change in current text.
6. When tenant, guestroom or *dwelling unit* separation walls are constructed to the underside of a fireresistance rated roof/ceiling assembly or to a ceiling with a 60-minute finish rating, the *attic draftstopping* complying with Section 720.7.2.2 [i.e., horizontal draftstopped areas not exceeding 3,000 square feet (279 $m^2$)] shall be deemed equivalent. **Effective 8/16/99**

## Chapter 9

28. Exception #2 of Section 904.1 was amended to read:

2. In telecommunications equipment buildings, or portions thereof, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies. **Effective 8/16/98**

29. The Exception of Section 906.2 was amended to read:

**Exception:** Where water as an extinguishing agent is not compatible with the fire hazard (see Section 905.1) or is prohibited by a law, statute or ordinance, or when the property owner chooses use of an alternative system because of the nature of the property to be protected in lieu of an automatic sprinkler system, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard. **Effective 8/16/98**

30. Section 906.5 , Exception 2 was amended to read:

2. Audible or visual alarm devices shall not be required on the exterior of the building for fire sprinkler system supervised by method 1 of Section 924.1. **Effective 12/13/97**

31. Section 918.4.1 was amended to include exceptions allowing modular or portable educational buildings a less expensive alternative in providing fire alarms. The Section reads as follows:

**918.4.1 Use Group A-4 or E:** A fire alarm system shall be installed and maintained in all occupancies in Use Group A-4 or E. A fire alarm system shall not be required for sanctuary and nave areas of churches and similar religious buildings.

**Exceptions:**

1. Church buildings which do not exceed 10,000 square feet (930 $m^2$) and in which single-station smoke detectors are installed as follows:
   1. Smoke detectors may be single station and wired in series so as to sound an alarm in the sanctuary.
   2. Smoke detectors shall be installed in fellowship halls and more hazardous areas such as furnace rooms, mechanical rooms and storage rooms, but shall not be required in Sunday school classrooms.
   3. Detector spacing shall be 30 feet (9144 mm) on center in corridors and 900 square feet (84 $m^2$) per detector in open spaces, or in accordance with the manufacturer's specifications.
2. Modular or portable educational buildings or clusters of such buildings in which the main building fire alarm is extended to the buildings or in which single-station smoke detectors are installed under the following conditions:
   1. Individual buildings or cluster of buildings with a total aggregate floor area of not more than 7200 square feet (672 $m^2$).
   2. Each modular or portable building is separated from all other school buildings on the campus by a minimum horizontal distance of 10 feet (3048 mm).
   3. Smoke detectors are installed in each classroom and wired in series so as to sound an alarm in each classroom of the building or cluster of buildings. The smoke detector spacing shall be in accordance with item #3 of Exception No. 1 (above). **Effective 8/16/99**

32. Section 919.5 was amended to read as follows:

**919.5 Sprinklered buildings exception:** Buildings equipped throughout with an automatic sprinkler in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 918.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use groups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3. **Effective 12/13/97**

33. Section 924.1 was amended to delete the reference to "supervisory service" and clarify that the front desk clerk or security guard (supervisory service) does not mean a "constant attended location." The Section reads as follows:

**924.1 Fire suppression systems:** All *automatic fire suppression systems* required for occupancies in Use Group A, B, E. H, I, M or R shall be supervised by method 1. All *automatic fire suppression systems* in other use groups shall be supervised by one of the following methods:

1. Central-station system, proprietary system or remote-station system in accordance with NFPA 72 listed in Chapter 35; or
2. Locking open all valves on connections to *water supplies*, sectional control valves and other valves in supply pipes to fire protection devices. **Effective 8/16/99** (No change to Exceptions)

## Chapter 10

34. Exception #4 of Section 1010.4 has been created to read: (no change to Exceptions 1-3)

4. Replacement of emergency escape and rescue windows which meet or exceed the provisions of the applicable code at the time the facility was originally constructed. **Effective 8/16/98**

35. Section 1012.5.1 was amended to specify the minimum length of gaps or breaks in aisle handrails. The Section reads as follows:

**1012.5.1 Discontinuous rails:** Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not less than three rows and not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the handrail shall have rounded terminations or bends. **Effective 8/16/99**

36. Section 1014.6 was amended to create an additional exception to the tread and riser height requirements for swimming pools, spas and baptisteries to read as follows:

**1014.6 Treads and risers:** Maximum riser height shall be 7 inches (178 mm) and minimum riser height shall be 4 inches (102 mm). The riser height shall be measured vertically between the leading edges of the adjacent treads. Minimum tread depth shall be 11 inches (279 mm), measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge.

**Exceptions:**

1. through 9.- No change in current text.
10. Stairways providing access to or from swimming pools, spas or baptisteries with the tread surface entirely below water shall have treads and risers complying with Section 421.5.5 of this code. **Effective 8/16/99**

37. Section 1022.2.3 was amended to include an additional exception to the requirement of handrails ends or where handrails are not continuous. The Section reads as follows:

**1022.2.3 Handrail ends:** At locations where handrails are not continuous between stairway flights, including the top and bottom of a stairway, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. The handrail ends shall be returned to a wall or post.

Where handrails are not continuous between ramp segments, including the top and bottom of a ramp, the handrails shall extend at least 12 inches (305 mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The handrail ends shall be returned to a wall or post.

**Exceptions:**

1. Within a dwelling unit, the horizontal extension beyond the top riser of the stairway flight or top of the ramp segment, and the extension beyond the bottom riser of the stairway flight or bottom of the ramp segment is not required.
2. Within a dwelling unit, the use of a volute, turnout or starting easing is allowed on the lowest tread.
3. Within aisle stairs, the horizontal extension is not required beyond the bottom or top riser, provided the handrail begins at the first riser and is continuous, except where gaps or breaks are permitted in Section 1012.5.1, to the top row of seats. **Effective 8/16/99**

38. Exception #1 of Section 1022.2.4 has been amended to read: (no change to Exception 2)

1. Any other shape with a perimeter dimension of at least 4 inches (100 mm), but not greater than 6 1/4 inches (158 mm) with the largest cross-sectional dimension not exceeding 2 1/4 inches (57 mm). The figures shown in Appendix C, Figure 1022.2.4, are approved for use under this Section/subsection. **Effective 8/16/98**

## Chapter 18

39. Section 1806.1 was amended to read as follows:

**1806.1 Frost Protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30$m^2$) in area or 10 feet (3048 mm) in height shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the load within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall not be founded on frozen soils

unless such frozen condition is of a permanent character. **Effective 12/13/97**

## Chapter 28

40. Create a new subsection in Chapter 28 to read:

**2801.2.3 Gas-fired appliances:** Gas utilization equipment, including piping, vent/chimney connectors, vent systems and combustion/dilution air shall comply with NFPA 54 listed in Chapter 35. **Effective 2/24/99**

41. Delete section 2801.6, Gas-fired appliances, in its entirety. **Effective 2/24/99**

42. Section 2810.0, Range Hoods, has been created to read:

**SECTION 2810.0 RANGE HOODS**

**2810.1 Range hoods:** Range hoods in kitchen exhaust systems shall comply with the requirements of the mechanical code listed in Chapter 35. The bottom edge of the hood shall be located at a height of not more than 4 feet (1219 mm) above the cooking surface.

**Exception:** In churches and in other occupancies where the range is merely a convenience for occasional use and where there is minimal or nonexistent grease-laden vapors, a commercial exhaust system shall not be required. **Effective 2/24/99**

## Chapter 31

43. Section 3102.0, Signs, has been deleted in its entirety. **Effective 12/13/97**

## Chapter 35

44. Under "Codes", page 330, amend the reference to the *Kentucky Fire Prevention Code* to cite the 1999 Edition and the administrative regulation reference is now 815 KAR 10:060. Also, delete the reference to "Building Officials and Code Administrators" at the top and the asterisk at the bottom should indicate that "all publications are available from the Department of Housing, Buildings and Construction. **Effective 2/24/99**

45. Amend NFPA 70 by updating to 1999 Edition. **Effective 2/24/99**

46. Amend NFPA 101 by updating to 1997 Edition. **Effective 2/24/99**

## Appendix C

47. Illustration of acceptable handrail profiles in conjunction with Section 1022.2.4. (Attached) **Effective 8/16/98**

PAUL E. PATTON
*Governor*

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HOUSING,
BUILDINGS AND CONSTRUCTION
1047 U.S. HIGHWAY 127S, SUITE 1
FRANKFORT, KENTUCKY 40601-4337
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

March, 1999

# NOTICE

## 1997 KENTUCKY BUILDING CODE AMENDMENTS

Please find enclosed a cumulative list of amendments which have been made to the 1997 Kentucky Building Code, Seventh Edition, and includes those reported in Kentucky Code Report, Volumes 1 and 2.

You may wish to make copies and keep in front of each code book you have purchased.

As additional changes are made and approved, they will be sent to you.

Judith G. Walden

Judith G. Walden, Editor

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# KENTUCKY CODE REPORT

A Bulletin on Building and Fire Code Enforcement
Vol. No. 3
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# 1997 KENTUCKY BUILDING CODE UPDATE

## CUMULATIVE SUPPLEMENT

**Please keep this Supplement in the front of your Code book for quick reference and mark each amended Section with an asterisk in your KBC.**

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The following amendments have been approved by the Board of Housing, Buildings and Construction and the legislative Regulation Review Subcommittee. The effective date for all amendments is as indicated. Amendments which have been approved by the Board and are currently in the legislative approval process are listed on Pages 13-15. When effective, these amendments will be listed within the body of the Code Report. Please note that some of these changes have been underlined for emphasis.

*TABLE OF CONTENTS*


| | | | |
|---|---|---|---|
| *Chapter 1* | *Page 1* | *Chapter 18* | *Page 11* |
| *Chapter 2* | *Page 5* | *Chapter 28* | *Page 11* |
| *Chapter 3* | *Page 5* | *Chapter 31* | *Page 12* |
| *Chapter 4* | *Page 6* | *Appendix A* | *Page 12* |
| *Chapter 7* | *Page 10* | *Proposed Amendments* | *Page 13* |
| *Chapter 9* | *Page 10* | | |
| *Chapter 10* | *Page 11* | | |

| Chapter 1 | Effective |
|---|---|
| 1. Sections 101.3 through 101.3.3 and the Exceptions thereunder have been amended, deleted or renumbered to read as follows:<br><br>**101.3 Single-family dwellings**: All single-family dwellings shall conform to the construction standards of this code for R-3 structures. | 8/16/98 |
| **Exceptions:**<br>1. Manufactured homes.<br>2. Farm dwellings.<br>3. Single family dwellings constructed in accordance with Section 310.6 and the CABO One and Two Family Dwelling Code, including the National Electrical Code, the CABO Model Energy Code and the State Plumbing Code referenced in Chapter 35 of this code. | |
| **101.3.1 Enforcement by local government:** The electrical system shall be inspected and approved by a certified electrical inspector pursuant to KRS 227.489 and 815 KAR 35:010. The plumbing system shall be inspected and approved pursuant to KRS Chapter 318 and the Kentucky State Plumbing Code (815 KAR 20:010-060). Other permits and inspections of single family dwellings shall be performed only if required by local ordinance. | 8/16/98 |
| **101.3.2 Other codes applicable:** NFPA 70 shall apply to all manufactured/mobile homes exterior service hook-ups and the State Plumbing Code shall apply to the exterior water and sewer lines of nonfarm manufactured/mobile homes. | 2/24/99 |
| 2. Section 103.1, item #3, has been amended to read:<br><br>3. The removal or change of any required *means of egress* or emergency escape windows; or | 8/16/98 |
| 3. A new Section 111.3.1 has been created to read:<br><br>**111.3.1 Limitation on changes.** No inspector shall be authorized to require changes on-site which are contrary to the approved construction documents. If an inspector finds a code discrepancy in an on-site inspection, the inspector shall refer the matter to the official having construction document review responsibility who shall require corrections if the code so requires. | 12/13/97 |
| 4. The fees in Section 112 have been amended as follows:<br>*Please note:* Subsection 112.3.1.1 & Table 112.3.1 were further amended by the Board on January 15, 1998, and effective as indicated.<br><br>**SECTION 112.0 FEES** | 12/13/97 |
| **112.1 General**: A permit to begin work for new construction, *alteration,* removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building | 12/13/97 |

Effective

department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid. 12/13/97

**112.2 Special fees:** Payment of fees for construction, alteration or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs and* display structures, marquees or other *appurtenant structures, or* fees of inspections or certificates of occupancy or other privileges or requirements established by law.

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable.

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3.1. 12/13/97

**112.3.1.1 Fast track elective:** For permit applicants seeking early site and foundation approval prior to full review of complete set of construction documents, the fee shall be that as calculated from Table 112.3.1 plus 50 percent of the full fee. The additional 50 percent fee shall not be less than $200 and not more than $3,000. The entire fee shall be paid at the time of the initial plans submission. 8/16/98

Table 112.3.1
DEPARTMENT OF HOUSING FEE SCHEDULE

8/16/98

| Occupancy type | Cost per square foot |
|---|---|
| Residential | 5 cents |
| Assembly | 6 cents |
| Day care centers | 5 cents |
| Educational | 5 cents |
| Business | 5 cents |
| Mercantile | 5 cents |
| Industrial factories | 3¾ cents |
| Warehouses | 3 cents |
| Institutional | 6 cents |
| Frozen food plants | 4 cents |
| High hazard | 5 cents |
| All other nonresidential | 4 cents |

**112.3.2 Submission of plans and fees**: All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar. 12/13/97

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky, State Treasurer. 12/13/97

**112.3.4 Construction approval:** Approval for construction shall not be issued 12/13/97

by the Department until all required fees have been paid.

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $100.

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table 112.3.1 by the measurement of the square footage of the addition, as deter mined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $100.

**112.3.7 Change in use:** Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $100. 12/13/97

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the repairs by 0.0025. Minimum fee for review of plans under this section shall be $100. 12/13/97

See Page 13

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the specialized plan reviews listed. 12/13/97

Table 112.3.9
AUTOMATIC SPRINKLER REVIEW FEE TABLE

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $100 |
| 201-300 | $125 |
| 301-400 | $160 |
| 401-750 | $200 |
| Over 750 | $200 plus 19 cents per sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $100; over 20,000 square feet shall be $100 plus $19 for each additional 10,000 square feet in excess of 20,000 square feet. 12/13/97

**112.3.11 Standpipe plan review fee:** $100 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule). 12/13/97

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $100, over 200 pounds of agent shall be $100 plus 2 cents per pound in excess of 200 pounds. 12/13/97

Effective

**112.3.13 Halon suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds. — 12/13/97 Se Page 13

**112.3.14 Foam suppression system review fee:** $1.25 per gallon of foam concentrate. The fee for review of plans under this section shall not be less than $100 or more than $1,900. — 12/13/97 See Page 13

**112.3.15 Commercial range hood review fee:** $100 per hood. — 12/13/97

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $100; over 30 pounds of agent shall be $100 plus 25 cents per pound in excess of 30 pounds. — 12/13/97

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components. — 12/13/97

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18. — 12/13/97

Table 112.3.18
BOILER AND UNFIRED PRESSURE VESSEL FEES

| Heating surface (square feet) | Fee |
|---|---|
| 100 and under | $ 30 |
| 101 to 1,000 | $ 40 |
| 1,001 to 4,000 | $ 60 |
| 4,001 to 10,000 | $ 80 |
| 10,001 and over | $110 |
| Unfired pressure vessels | $ 30 |

**112.4 Local jurisdiction**: Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed. — 12/13/97

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law. — 12/13/97

## Chapter 2

5. Chapter 2, Definitions, was amended to add the following definition: — 2/24/99

**Townhouse:** A single-family dwelling unit constructrd in a row of attached units separated by property lines and with open space on at least two sides.

## Chapter 3

Effective

6. Section 305.1 was amended to read as follows: — 12/13/97

**305.1 General:** All structures, or parts thereof, other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes, including, among others, schools, academies, colleges and universities, shall be classified as Use Group E.

7. Section 307.5 was amended by deleting the reference to "Class I" under Organic peroxides. — 12/13/97

8. Section 307.8, Exception number 3 was amended to read as follows: — 12/13/97

**3.** Buildings and structures occupied for the storage of 10,000 or more vehicle tires, weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

9. Section 310.6 was amended to include townhouses in Use Group R-4 and further reorganized. Over the years, Kentucky's exceptions or alternatives to the CABO Code have increased and reorganization was necessary for clarity and ease of interpretation and enforcement. The reorganized section reads as follows: — 2/24/99

**310.6 Use Group R-4 structures:** This use group shall include all *townhouses* and detached *one- and two- family dwellings* not more than three stories in height, and their *accessory structures* as indicated in the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. All of these structures shall be designed and built in accordance with the requirements of this code for a Use Group R-3 structure, or with the requirements of the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. The choice of the construction code shall be made by the permit applicant at the time of plans submission.

**310.6.1 CABO code alternatives:** When the permit applicant chooses the *CABO/ One & Two Family Dwelling Code* as the review code of record, Sections 310.6.1.1 through 310.6.1.6 shall be applicable and shall supersede any conflicting provision of the *CABO/ One & Two Family Dwelling Code*.

**310.6.1.1** A minimum stair tread depth of 9 inches (229 mm) and maximum riser height of 8 1/4 inches (210 mm).

**310.6.1.2** A minimum ceiling height complying with Section 1204.

**310.6.1.3** A minimum door height complying with Exception No. 6 of Section 1017.3.

**310.6.1.4** The plumbing system shall comply with the requirements of the *State Plumbing Code* (see 815 KAR Chapter 20).

**310.6.1.5** The stair handrails may conform with Exception No. 5 of Section

| | Effective |
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| 1014.7 and Exception No. 2 of Section 1022.2. | |
| **310.7 Radon protection**: Radon control measures shall not be mandatory unless specifically required by local ordinance. | 2/24/99 |

## Chapter 4

10. A new Section 410.9. Local Jails, has been created to read:

| | |
|---|---|
| **410.9 Local Jails:** Any local jail that is under the supervision of a county, regional jail authority, city or urban county government shall comply with the requirements of this section and where conflicts exist with other requirements of this code, this section shall take precedent. | 8/16/98 |
| **Jail:** Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 3:010 by and under the supervision of any county, regional jail authority, city or urban county government. | 8/16/98 |
| **Restricted custody center:** Restricted custody center means a facility or area separate from the jail used for the housing of sentenced inmates who have been approved for educational, work or program participation release and pretrial inmates who have been approved by the court for educational, work or program participation release and operated under 501 KAR 7:010. | 8/16/98 |
| **Life Safety Jail:** Life Safety Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 13:010 by and under the supervision of any county government which does not house state prisoners as defined by KRS 532.100. | 8/16/98 |
| **410.9.2 Emergency smoke evacuation:** All areas of *Jails* and *Life Safety Jails* where an inmate may be confined, shall be provided with an emergencysmoke control/ evacuation system meeting the requirements of this section. The system shall be activated by smoke detectors and shall be connected to an emergency power supply. The system shall be engineered as an independent system or may be engineered to work in conjunction with the building HVAC system. | 8/16/98 |
| **410.9.2.1 Design:** All floors which house inmates shall be designed to have a minimum of two smoke compartments. The smoke control system shall be capable of maintaining a negative pressure in the contaminated smoke compartment. The smoke control system shall be capable of 6 air changes per hour. The system operation shall be subject to a final operational test by the Department of Corrections. | 8/16/98 |
| **410.9.3 Automatic sprinkler system:** All areas of *Jails* and *Life Safety Jails* where inmates will not be confined, including but not limited to corridors, storage areas, laundry rooms, mechanical rooms, closets and office areas shall be equipped with an *automatic sprinkler system* installed in accordance | 8/16/98 |

| | | Effective |
|---|---|---|
| | with Section 906.2.1. Facilities that are not equipped throughout with an automatic sprinkler system are not entitled to height or area increases, reduction of corridor ratings or other reductions of code requirements normally allowed for fully sprinkled buildings. | |
| | **410.9.4 Doors and glazing:** Penal doors in *Jails* and *Life Safety Jails* shall be approved by the Department of Corrections. Glass-clad polycarbonate glazing shall be an acceptable alternate to wired glazing. All door openings that do not require a penal door and hardware shall be protected by opening protectives as required by other sections of this code. | 8/16/98 |
| | **410.9.5 Restricted Custody Centers**: All *restricted custody centers* attached to or separate from a *jail* shall be considered as **Occupancy Condition I** and shall have free egress or automatic time delayed emergency release doors with a maximum time delay of 30 seconds. | 8/16/98 |
| | **410.9.5.1 Automatic sprinkler system:** All restricted custody centers attached to or separated from a *jail* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. | 8/16/98 |
| | **410.9.6 Existing facilities:** All existing *Jails, Life Safety Jails* and *Restricted Custody Centers* which are in operation and have prior approval from the Department of Corrections shall be exempt from these requirements until such time the facilities are renovated. | 8/16/98 |
| 11. | Various Sections of Section 421, Swimming Pools, have been amended as follows: | 12/13/97 |
| | **Section 421.2 Definitions:** | |
| | The definition of "**Above-ground/on-ground pool**" has been deleted in its entirety. | 12/13/97 |
| | The following definitions have been amended to read as follows: | |
| | **Barrier:** A fence, a wall, a building wall, or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool. | 12/13/97 |
| | **Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes swimming pools constructed below grade on site, but not those assembled above grade on site. | 12/13/97 |
| | **Public swimming pool:** Any swimming pool constructed below grade on site which is not a private swimming pool. | 12/13/97 |
| 12. | A new subsection, 421.8.1 Protection of heating equipment, has been created | 2/24/99 |

**Effective**

to read:

**421.8.1 Protection of heating equipment:** Gas appliances located in rooms or spaces where corrosive or flammable chemicals are present shall be protected in accordance with Sections 5.1.6 and 6.22.1 of NFPA 54 listed in Chapter 35. — 2/24/99

13. Sections 421.9.1 and 421.9.3 have been amended to read as follows: — 12/13/97

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground.

**Exemptions:** The following shall be exempt from the provisions of this section.
1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

**421.9.3 Alternative devices:** A natural barrier approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection afforded by the enclosure, gate and latch described herein.

14. A new Section 421.9.4 has been created and shall read: — 12/13/97

**421.9.4 Private swimming pool enclosures.**
1. An indoor private pool enclosure may consist of the walls of the house including any entrance and exit doors, screens or glass separations designed for the purpose of preventing uninvited persons from entering the pool.
2. An outdoor private pool enclosure may surround the pool area only or it may surround a larger area if the barrier prevents uninvited persons from entering the pool.

15. Table 422.2 was amended as follows: — 8/16/98

TABLE 422.2
LOCATION/CONSTRUCTION TYPE LIMITATIONS

| Location of day care | Sprinklered building | Construction type permitted |
|---|---|---|
| 1 story below LED | Yes | Any type other than 3B & 5B |
| Story of exit discharge | No | Any type |
| 1 story above LED | Yes | Any type |
| | No | 1A, 1B, 2A |
| 2 or 3 stories above LED | Yes | Any type other than 3B, 4 & 5B |
| >3 stories above LED But not high rise | Yes | 1A, 1B, 2A or 2B |
| High Rise | Yes | 1A, 1B or 2A |

**Effective**

16. Section 422.9, number 3, was amended to read as follows: 12/13/97

**3.** In all rooms within the center that are classified as a *habitable space* or an *occupiable space* in accordance with Section 1202.0 of this code. **Exception:** Kitchens.

17. Section 423.1, number 3, was amended to read as follows: 12/13/97

**3.** Interconnected smoke detectors shall be provided in accordance with Section 920.3.2, 920.4 and 920.5.

## Chapter 7

18. Section 707.1 has been amended to read as follows: 12/13/97 See Page 13

**707.1 General.** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials that provide the required strength and fire resistance rating specified in Table 602 for the type of construction, but not less than the fire resistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16.

## Chapter 9

19. Exception #2 of Section 904.1 was amended to read: 8/16/98

2. In telecommunications equipment buildings, or portions thereof, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies.

20. The Exception of Section 906.2 was amended to read: 8/16/98

**Exception:** Where water as an extinguishing agent is not compatible with the fire hazard (see Section 905.1) or is prohibited by a law, statute or ordinance, or when the property owner chooses use of an alternative system because of the nature of the property to be protected in lieu of an automatic sprinkler system, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard.

**Effective**

21. Section 906.5 , Exception 2 was amended to read: 12/13/97

    2. Audible or visual alarm devices shall not be required on the exterior of the building for fire sprinkler system supervised by method 1 of Section 924.1.

22. Section 919.5 was amended to read as follows: 12/13/97

    **919.5 Sprinklered buildings exception:** Buildings equipped throughout with an automatic sprinkler in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 918.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use roups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3.

## Chapter 10

23. Exception #4 of Section 1010.4 has been created to read: 8/16/98

    4. Replacement of emergency escape and rescue windows which meet or exceed the provisions of the applicable code at the time the facility was originally constructed.

24. Exception #1 of Section 1022.2.4 has been amended to read: 8/16/98

    1. Any other shape with a perimeter dimension of at least 4 inches (100 mm), but not greater than 6 1/4 inches (158 mm) with the largest cross-sectional dimension not exceeding 2 1/4 inches (57 mm). The figures shown in Appendix A, Figure 1022.2.4, are approved for use under this Section/subsection.

## Chapter 18

25. Section 1806.1 was amended to read as follows: 12/13/97

    **1806.1 Frost Protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30$m^2$) in area or 10 feet (3048 mm) in height shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the load within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall not be founded on frozen soils unless such frozen condition is of a permanent character.

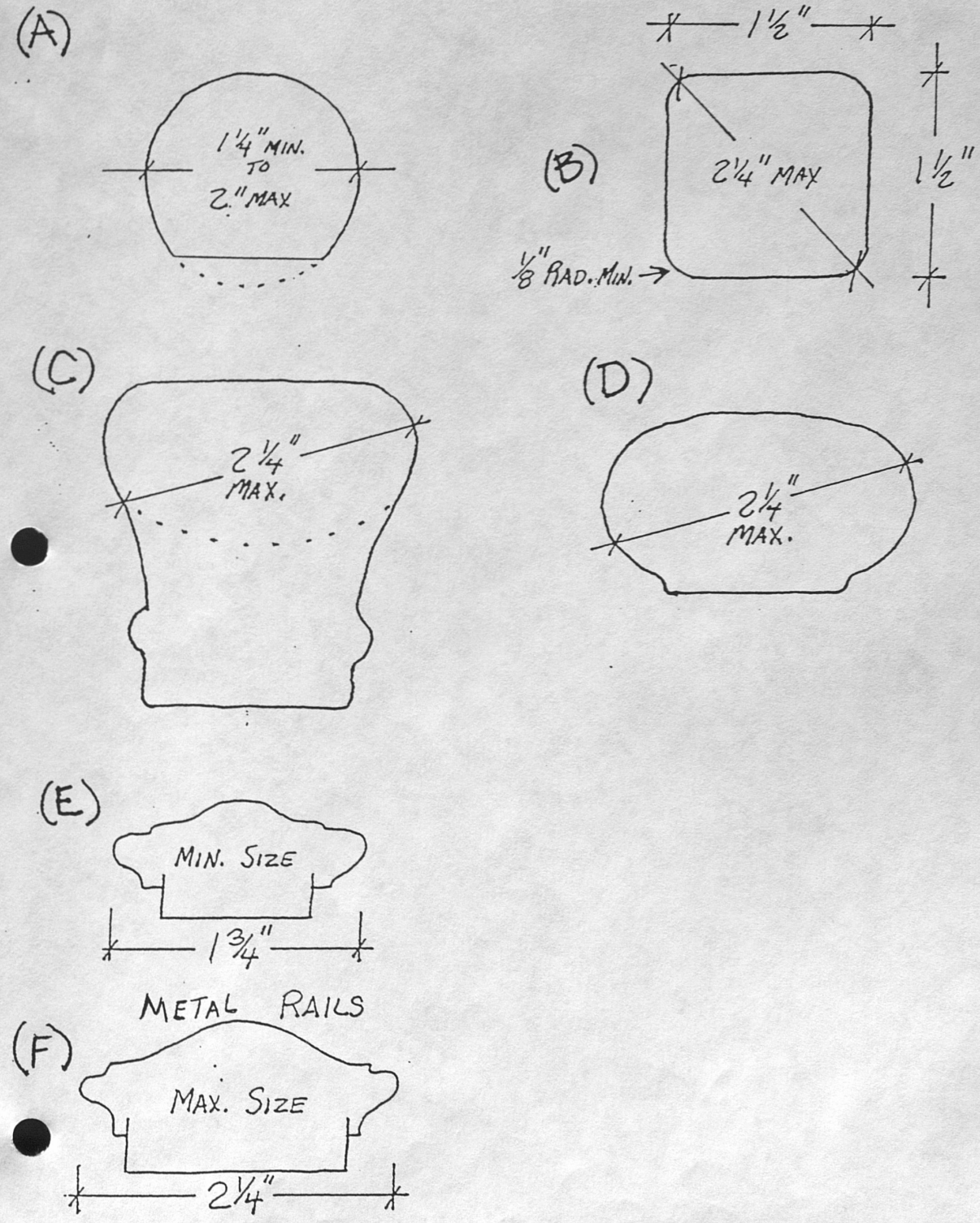
## Chapter 28

26. Create a new subsection in Chapter 28 to read:

| | | Effective |
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| | **2801.2.3 Gas-fired appliances:** Gas utilization equipment, including piping, vent/chimney connectors, vent systems and comjbustion/dilution air shall comply with NFPA 54 listed in Chapter 35. | 2/24/99 |
| 27. | Delete section 2801.6, Gas-fired appliances, in its entirety. | 2/24/99 |
| 28. | Section 2810.0, Range Hoods, has been created to read: | 8/16/98 |
| | SECTION 2810.0 RANGE HOODS | |
| | **2810.1 Range hoods:** Range hoods in kitchen exhaust systems shall comply with the requirements of the mechanical code listed in Chapter 35. The bottom edge of the hood shall be located at a height of not more than 4 feet (1219 mm) above the cooking surface. | |
| | **Exception:** In churches and in other occupancies where the range is merely a convenience for occasional use and where there is minimal or nonexistent grease-laden vapors, a commercial exhaust system shall not be required. | |
| **Chapter 31** | | |
| 29. | Section 3102.0, Signs, has been deleted in its entirety. | 12/13/97 |
| **Appendix A** | | |
| 30. | Illustration of acceptable handrail profiles in conjunction with Section 1022.2.4. (Attached) | 8/16/98 |
| 31. | Amend NFPA 101 by updating to 1997 Edition. | 2/24/99 |
| 32. | Amend NFPA 70 by updating to 1999 Edition. | 2/24/99 |

## APPENDIX A

## HANDRAIL PROFILES
## FIGURE 1022.2.4



Amendments approved by the Board of Housing and currently in the legislative approval process:

1. **105.2.2** Buildings classified as educational, institutional, high hazard or *industrialized building systems,* regardless of occupancy size or occupancy classification. (Frozen food locker plants were deleted)

2. **107.3 By whom application is made:** Application for a local building permit shall be made by the owner or lessee of the building or structure, or the builder or other agent of either, or by the licensed engineer or architect employed in connection with the proposed work. The full names and addresses of the owner, lessee, applicant and of the responsible officers, if the owner or lessee is a corporate body, shall be stated in the application. (Language regarding application made by someone other than owner in fee deleted)

3. **112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the alterations or repairs by 0.0025; or calculated by multiplying the total area being altered; or repaired by the cost per square foot of each occupancy type as listed in Table 112.3.1, whichever is less. The total square footage shall be determined by the outside dimensions of the area being altered or repaired. The minimum fee for review of plans under this section shall be $100.

4. **112.3.13 Clean agent suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds. The fee for gaseous systems shall be 5 cents per cubic foot and not less than $100.

5. **112.3.14 Foam suppression system review fee:** 50 cents per gallon of foam concentrate where the system is not part of an automatic sprinkler system. Foam suppression system plans that are submitted as part of an automatic sprinkler system shall be reviewed under the automatic sprinkler review fee schedule. The fee for review of plans under this section shall not be less than $100 or more than $1,500.

6. Name of Cabinet changed:

SECTION 119.0 CABINET FOR FAMILIES AND CHILDREN **and** CABINET FOR HEALTH SERVICES REGULATED BUILDINGS

**119.1 Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities:** Hospitals, nursing homes and other institutional (Use Groups I-1 & I-2) facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services and inspected under contract with the Cabinet for Families and Children or the Cabinet for Health Services by the Department of Housing, Buildings and Construction shall comply with the institutional use group requirements specified in Chapter 4, including specific references to other sections of this code, and the applicable provisions of NFPA 101 listed in Chapter 35.

**119.2 Day care centers:** Day care centers, except those governed by Section 422.0 and other similar care facilities licensed by the Cabinet for Families and Children or the Cabinet for Health Services which comply with the provisions of NFPA #101 listed in Chapter 35 as approved by the State Fire Marshal shall be deemed to satisfy the life safety requirements of this code.

7. **422.1 Scope:** The provisions of this section shall apply to buildings or structures or portions thereof, required to be licensed as a day care center, which are classified in Chapter 3 under Use Group E, except as specifically modified by Sections 422.1 through 422.12, day care centers shall meet all applicable provisions of this code.
   **Exception:** After school programs that may also be licensed day care centers and are located in schools, shall not be made to comply with the requirements of this section where all clients of the day care and after school program are also students of that school.

8. **707.1 General:** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials

that provide the required strength and fireresistance rating specified in Table 602 for the type of construction, but not less than the fireresistance rating for the use group specified in Table 707.I. Strength and stability shall comply with the provisions of Chapters 14 and 16.

**Exception:** Fire walls and party walls utilized in Use Group R-3 shall be permitted to be constructed of any noncombustible materials that provide the required strength and fireresistance rating specified in Table 602, and has sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.

9. **721.7.1.1 Use Groups R-1 and R-2:** In occupancies in Use Groups R-1 and R-2, *draftstopping* shall be installed in line with tenant, guestroom and *dwelling unit* separation walls where the walls do not extend to the underside of the floor sheathing above.

10. **721.7.2.1 Use Group R:** In occupancies in Use Group R, in attics, mansards, overhangs or other concealed roof spaces, draftstopping shall be installed above, and in line with, tenant, guestroom and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

**Exceptions:**

1. Where *corridor walls* provide a tenant, guestroom or *dwelling unit* separation, draftstopping shall only be required above one of the *corridor* walls.
2. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant, guestroom and *dwelling unit* separation walls if the joists form a *draftstop.*
3. No change in current text.
4. No change in current text.
5. No change in current text.
6. When tenant, guestroom or *dwelling unit* separation walls are constructed to the underside of a fireresistance rated roof/ceiling assembly or to a ceiling with a 60-minute finish rating, the *attic draftstopping* complying with Section 720.7.2.2 [i.e., horizontal draftstopped areas not exceeding 3,000 square feet (279 $m^2$)] shall be deemed equivalent.

11. **918.4.1 Use Group A-4 or E:** A fire alarm system shall be installed and maintained in all occupancies in Use Group A-4 or E. A fire alarm system shall not be required for sanctuary and nave areas of churches and similar religious buildings.

**Exceptions:**

1. Church buildings which do not exceed 10,000 square feet (930 $m^2$) and in which single-station smoke detectors are installed as follows:
    1. Smoke detectors may be single station and wired in series so as to sound an alarm in the sanctuary.
    2. Smoke detectors shall be installed in fellowship halls and more hazardous areas such as furnace rooms, mechanical rooms and storage rooms, but shall not be required in Sunday school classrooms.
    3. Detector spacing shall be 30 feet (9144 mm) on center in corridors and 900 square feet (84 $m^2$) per detector in open spaces, or in accordance with the manufacturer's specifications.
2. Modular or portable educational buildings or clusters of such buildings in which the main building fire alarm is extended to the buildings or in which single-station smoke detectors are installed under the following conditions:
    1. Individual buildings or cluster of buildings with a total aggregate floor area of not more than 7200 square feet (672 $m^2$).
    2. Each modular or portable building is separated from all other school buildings on the campus by a minimum horizontal distance of 10 feet (3048 mm).
    3. Smoke detectors are installed in each classroom and wired in series so as to sound an alarm in each classroom of the building or cluster of buildings. The smoke detector spacing shall be in accordance with item #3 of Exception No. 1 (above).

12. **1012.5.1 Discontinuous rails:** Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not less than three rows and not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the handrail shall have rounded terminations or bends.

13. **1014.6 Treads and risers:** Maximum riser height shall be 7 inches (178 mm) and minimum riser height shall be 4 inches (102 mm). The riser height shall be measured vertically between the leading edges of the adjacent treads. Minimum tread depth shall be 11 inches (279 mm), measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge.

**Exceptions:**

1. through 9.- No change in current text.
10. Stairways providing access to or from swimming pools, spas or baptisteries with the tread surface entirely below water shall have treads and risers complying with Section 421.5.5 of this code.

14. **1022.2.3 Handrail ends:** At locations where handrails are not continuous between stairway flights, including the top and bottom of a stairway, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. The handrail ends shall be returned to a wall or post.

Where handrails are not continuous between ramp segments, including the top and bottom of a ramp, the handrails shall extend at least 12 inches (305 mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The handrail ends shall be returned to a wall or post.

**Exceptions:**

1. Within a dwelling unit, the horizontal extension beyond the top riser of the stairway flight or top of the ramp segment, and the extension beyond the bottom riser of the stairway flight or bottom of the ramp segment is not required.
2. Within a dwelling unit, the use of a volute, turnout or starting easing is allowed on the lowest tread .
3. Within aisle stairs, the horizontal extension is not required beyond the bottom or top riser, provided the handrail begins at the first riser and is continuous, except where gaps or breaks are permitted in Section 1012.5.1, to the top row of seats.

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable.

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3. 1.

**112.3.1.1 Fast track:** Full fee plus 10 percent with each phase. Minimum: $100/Maximum: $1,000.

Table 112.3.1
DEPARTMENT OF HOUSING FEE SCHEDULE

| Occupancy type | Cost per square foot |
|---|---|
| Residential[a] | 5 cents |
| Assembly occupancies | |
| Nightclub/restaurants | 6 cents |
| All other assembly | 6 cents |
| Day care centers | 5 cents |
| Educational | 5 cents |
| Business | 5 cents |
| Mercantile | 5 cents |
| Industrial factories | 3¾ cents |
| Warehouses | 3 cents |
| Institutional | 6 cents |
| Frozen food plants | 4 cents |
| High hazard | 5 cents |
| All other nonresidential | 4 cents |

**Note a.** Excluding single-family dwellings and duplexes.

**112.3.2 Submission of plans and fees**: All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar.

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky, State Treasurer.

**112.3.4 Construction approval:** Approval for construction shall not be issued by the Department until all required fees have been paid.

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $100.

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table 112.3.1 by the measurement of the square footage of the addition, as determined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $100.

**112.3.7 Change in use**: Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $100.

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the repairs by 0.0025. Minimum fee for review of plans under this section shall be $100.

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the specialized plan reviews listed.

Table 112.3.9
AUTOMATIC SPRINKLER REVIEW FEE TABLE

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $100 |
| 201-300 | $125 |
| 301-400 | $160 |
| 401-750 | $200 |
| Over 750 | $200 plus 19 cents per sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $100; over 20,000 square feet shall be $100 plus $19 for each additional 10,000 square feet in excess of 20,000 square feet.

**112.3.11 Standpipe plan review fee:** $100 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule).

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $100 , over 200 pounds of agent shall be $100 plus 2 cents per pound in excess of 200 pounds.

**112.3.13 Halon suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds.

**112.3.14 Foam suppression system review fee:** $1.25 per gallon of foam concentrate. The fee for review of plans under this section shall not be less than $100 or more than $1,900.

**112.3.15 Commercial range hood review fee:** $100 per hood.

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $100; over 30 pounds of agent shall be $100 plus 25 cents per pound in excess of 30 pounds.

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components.

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18.

Table 112.3.18
BOILER AND UNFIRED PRESSURE VESSEL FEES

| Heating surface (square feet) | Fee |
|---|---|
| 100 and under | $30 |
| 101 to 1,000 | $40 |
| 1,001 to 4,000 | $60 |
| 4,001 to 10,000 | $80 |
| 10,001 and over | $110 |
| Unfired pressure vessels | $30 |

**112.4 Local jurisdiction**: Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed.

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law.

## CHAPTER 3

Section 305.1 was amended to read as follows:

**305.1 General:** All structures, or parts thereof, other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes, including, among others, schools, academies, colleges and universities, shall be classified as Use Group E.

Section 307.5 was amended by deleting the reference to "Class I" under Organic peroxides.

Section 307.8, Exception number 3 was amended to read as follows:

3. Buildings and structures occupied for the storage of 10,000 or more vehicle tires, weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

## CHAPTER 4

Various Sections of Section 421, Swimming Pools, have been amended as follows:

**Section 421.2 Definitions:**

The definition of "**Above-ground/on-ground pool**" has been deleted in its entirety.

The following definitions have been amended to read as follows:

**Barrier:** A fence, a wall, a building wall, or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool.

**Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes swimming pools constructed below grade on site, but not those assembled above grade on site.

**Public swimming pool:** Any swimming pool constructed below grade on site which is not a private swimming pool.

Sections 421.9.1 and 421.9.3 have been amended to read as follows:

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground.

**Exemptions:** The following shall be exempt from the provisions of this section.

1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

**421.9.3 Alternative devices:** A natural barrier approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection afforded by the enclosure, gate and latch described herein.

A new Section 421.9.4 has been created and shall read:

**421.9.4 Private swimming pool enclosures.**

1. An indoor private pool enclosure may consist of the walls of the house including any entrance and exit doors, screens or glass separations designed for the purpose of preventing uninvited persons from entering the pool.
2. An outdoor private pool enclosure may surround the pool area only or it may surround a larger area if the barrier prevents uninvited persons from entering the pool.

Section 422.9, number 3, was amended to read as follows:

3. In all rooms within the center that are classified as a *habitable space* or an *occupiable space* in accordance with Section 1202.0 of this code.
   **Exception:** Kitchens.

Section 423.1, number 3, was amended to read as follows:

3. Interconnected smoke detectors shall be provided in accordance with Section 920.3.2, 920.4 and 920.5.

## CHAPTER 7

Section 707.1 has been amended to read as follows:

**707.1 General.** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials that provide the required strength and fire resistance rating specified in Table 602 for the type of construction, but not less than the fire resistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16.

## CHAPTER 9

Section 906.5 , Exception 2 was amended to read as follows:

2. Audible or visual alarm devices shall not be required on the exterior of the building for fire sprinkler system supervised by method 1 of Section 924.1.

Section 919.5 was amended to read as follows:

**919.5 Sprinklered buildings exception:** Buildings equipped throughout with an automatic sprinkler in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 918.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use roups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3.

## CHAPTER 18

Section 1806.1 was amended to read as follows:

**1806.1 Frost Protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30$m^2$) in area or 10 feet (3048 mm) in height shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the load within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall not be founded on frozen soils unless such frozen condition is of a permanent character.

## CHAPTER 31

Section 3102.0, Signs, has been deleted in its entirety.

PAUL E. PATTON
*Governor*

COMMONWEALTH OF KENTUCKY
**DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION**
1047 U.S. HIGHWAY 127S, SUITE 1
FRANKFORT, KENTUCKY 40601-4337
(502) 564-8044
FAX (502) 564-6799

CHARLES A. COTTON
*Commissioner*

September, 1998

# NOTICE

## 1997 KENTUCKY BUILDING CODE AMENDMENTS

Please find enclosed a cumulative list of amendments which have been made to the 1997 Kentucky Building Code and includes those reported in Volume 1, November, 1997 Code Report.

You may wish to make copies and keep in the front of each code book you have purchased.

As additional changes are made and approved, they will be sent to you.

Judith G. Walden

Judith G. Walden, Editor

Encl/Vol 2, Sept, 1998 Kentucky Code Report

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# KENTUCKY CODE REPORT

A Bulletin on Building and Fire Code Enforcement
Vol. No. 2
September, 1998

# 1997 KENTUCKY BUILDING CODE UPDATE

## CUMULATIVE SUPPLEMENT

Please keep this Supplement in the front of your Code book for quick reference and mark each amended Section with an asterisk in your KBC.

The following amendments have been approved by the Board of Housing, Buildings and Construction and the legislative Regulation Review Subcommittee. The effective date for all amendments is as indicated. Amendments which have been approved by the Board and are currently in the legislative approval process are indicated with an asterisk and will be reprinted as approved in the next edition. The anticipated effective date of these latest amendments is mid-November, 1998. Please note that some of these changes have been underlined for emphasis.

*TABLE OF CONTENTS*


| | | | |
|---|---|---|---|
| *Chapter 1* | Page 1 | *Chapter 10* | Page 10 |
| *Chapter 2* | Page 5 | *Chapter 18* | Page 11 |
| *Chapter 3* | Page 5 | *Chapter 28* | Page 11 |
| *Chapter 4* | Page 6 | *Chapter 31* | Page 11 |
| *Chapter 7* | Page 9 | *Appendix A* | Page 11 |
| *Chapter 9* | Page 10 | | |


**Chapter 1** — **Effective**

1. Sections 101.3 through 101.3.3 and the Exceptions thereunder have been amended, deleted or renumbered to read as follows: — 8-6-98

**101.3 Single-family dwellings**: All single-family dwellings shall conform to the construction standards of this code for R-3 structures.

**Exceptions:**

1. Manufactured homes.
2. Farm dwellings.
3. Single family dwellings constructed in accordance with Section 310.6 and the CABO One and Two Family Dwelling Code, including the National Electrical Code, the CABO Model Energy Code and the State Plumbing Code referenced in Chapter 35 of this code.

* new amendment

**Effective**

**101.3.1 Enforcement by local government:** The electrical system shall be inspected and approved by a certified electrical inspector pursuant to KRS 227.489 and 815 KAR 35:010. The plumbing system shall be inspected and approved pursuant to KRS Chapter 318 and the Kentucky State Plumbing Code (815 KAR 20:010-060). Other permits and inspections of single family dwellings shall be performed only if required by local ordinance.

**101.3.2 Other codes applicable:** NFPA 70 shall apply to all manufactured/mobile homes exterior service hook-ups and the State Plumbing Code shall apply to the exterior water and sewer lines of nonfarm manufactured/mobile homes.

2. Section 103.1, item #3, has been amended to read: 8/6/98

   3. The removal or change of any required *means of egress* or <u>emergency escape windows</u>; or

3. A new Section 111.3.1 has been created to read: 12/13/97

**111.3.1 Limitation on changes.** No inspector shall be authorized to require changes on-site which are contrary to the approved construction documents. If an inspector finds a code discrepancy in an on-site inspection, the inspector shall refer the matter to the official having construction document review responsibility who shall require corrections if the code so requires.

4. The fees in Section 112 have been amended as follows: 12/13/97
   *Please note:* Subsection 112.3.1.1 & Table 112.3.1 were further amended by the Board on January 15, 1998, and effective as indicated.

**SECTION 112.0 FEES**

**112.1 General**: A permit to begin work for new construction, *alteration,* removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid.

**112.2 Special fees:** Payment of fees for construction, alteration or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs and* display structures, marquees or other *appurtenant structures, or* fees of inspections or certificates of occupancy or other privileges or requirements established by law.

*** new amendment**

Effective

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable.

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3. 1.

**112.3.1.1 Fast track elective:** For permit applicants seeking early site and foundation approval prior to full review of complete set of construction documents, the fee shall be that as calculated from Table 112.3.1 plus 50 percent of the full fee. The additional 50 percent fee shall not be less than $200 and not more than $3,000. The entire fee shall be paid at the time of the initial plans submission. 8/6/98

Table 112.3.1
DEPARTMENT OF HOUSING FEE SCHEDULE

8/6/98

| Occupancy type | Cost per square foot |
|---|---|
| Residential | 5 cents |
| Assembly | 6 cents |
| Day care centers | 5 cents |
| Educational | 5 cents |
| Business | 5 cents |
| Mercantile | 5 cents |
| Industrial factories | 3¾ cents |
| Warehouses | 3 cents |
| Institutional | 6 cents |
| Frozen food plants | 4 cents |
| High hazard | 5 cents |
| All other nonresidential | 4 cents |

**112.3.2 Submission of plans and fees**: All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar.

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky, State Treasurer.

**112.3.4 Construction approval:** Approval for construction shall not be issued by the Department until all required fees have been paid.

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $100.

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table

**Effective**

112.3.1 by the measurement of the square footage of the addition, as determined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $100.

**112.3.7 Change in use:** Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $100.

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the repairs by 0.0025. Minimum fee for review of plans under this section shall be $100.

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the specialized plan reviews listed.

Table 112.3.9
AUTOMATIC SPRINKLER REVIEW FEE TABLE

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $100 |
| 201-300 | $125 |
| 301-400 | $160 |
| 401-750 | $200 |
| Over 750 | $200 plus 19 cents per sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $100; over 20,000 square feet shall be $100 plus $19 for each additional 10,000 square feet in excess of 20,000 square feet.

**112.3.11 Standpipe plan review fee:** $100 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule).

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $100, over 200 pounds of agent shall be $100 plus 2 cents per pound in excess of 200 pounds.

**112.3.13 Halon suppression system review fee:** Up to 35 pounds of agent shall be $100, over 35 pounds shall be $100 plus 6 cents per pound in excess of 35 pounds.

**112.3.14 Foam suppression system review fee:** $1.25 per gallon of foam concentrate. The fee for review of plans under this section shall not be less than $100 or more than $1,900.

**112.3.15 Commercial range hood review fee:** $100 per hood.

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $100; over 30 pounds of agent shall be $100

* new amendment

Effective

plus 25 cents per pound in excess of 30 pounds.

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components.

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18.

Table 112.3.18
BOILER AND UNFIRED PRESSURE VESSEL FEES

| Heating surface (square feet) | Fee |
|---|---|
| 100 and under | $ 30 |
| 101 to 1,000 | $ 40 |
| 1,001 to 4,000 | $ 60 |
| 4,001 to 10,000 | $ 80 |
| 10,001 and over | $110 |
| Unfired pressure vessels | $ 30 |

**112.4 Local jurisdiction**: Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed.

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law.

## Chapter 2

5. Chapter 2, Definitions, was amended to add the following definition: *

**Townhouse:** A single-family dwelling unit constructrd in a row of attached units separated by property lines and with open space on at least two sides.

## Chapter 3

6. Section 305.1 was amended to read as follows: 12/13/97

**305.1 General:** All structures, or parts thereof, other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes, including, among others, schools, academies, colleges and universities, shall be classified as Use Group E.

7. Section 307.5 was amended by deleting the reference to "Class I" under Organic peroxides. 12/13/97

* new amendment

**Effective**

8. Section 307.8, Exception number 3 was amended to read as follows: 12/13/97

   **3.** Buildings and structures occupied for the storage of 10,000 or more vehicle tires, weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

9. Section 310.6 was amended to include townhouses in Use Group R-4 and further reorganized. Over the years, Kentucky's exceptions or alternatives to the CABO Code have increased and reorganization was necessary for clarity and ease of interpretation and enforcement. The reorganized section reads as follows: *

   **310.6 Use Group R-4 structures:** This use group shall include all *townhouses* and detached *one- and two- family dwellings* not more than three stories in height, and their *accessory structures* as indicated in the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. All of these structures shall be designed and built in accordance with the requirements of this code for a Use Group R-3 structure, or with the requirements of the CABO/ *One & Two Family Dwelling Code* listed in Chapter 35. The choice of the construction code shall be made by the permit applicant at the time of plans submission.

   **310.6.1 CABO code alternatives:** When the permit applicant chooses the *CABO/ One & Two Family Dwelling Code* as the review code of record in Sections 310.6.1.1 through 310.6.1.6 shall be applicable and shall supersede any conflicting provision of the *CABO/ One & Two Family Dwelling Code*.

   **310.6.1.1** A minimum stair tread depth of 9 inches (229 mm) and maximum riser height of 8 1/4 inches (210 mm).

   **310.6.1.2** A minimum ceiling height complying with Section 1204.

   **310.6.1.3** A minimum door height complying with Exception No. 6 of Section 1017.3.

   **310.6.1.4** The plumbing system shall comply with the requirements of the *State Plumbing Code* (see 815 KAR Chapter 20).

   **310.6.1.5** The stair handrails may conform with Exception No. 5 of Section 1014.7 and Exception No. 2 of Section 1022.2.

   **310.7 Single family dwellings and radon protection**: Radon control measures shall be installed as described in Appendix F of the *CABO/ One & Two Family Dwelling Code*.

## Chapter 4

10. A new Section 410.9. Local Jails, has been created to read: 8/6/98

    **410.9 Local Jails:** Any local jail that is under the supervision of a county, regional jail authority, city or urban county government shall comply with the

* new amendment

requirements of this section and where conflicts exist with other requirements of this code, this section shall take precedent.

**Jail:** Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 3:010 by and under the supervision of any county, regional jail authority, city or urban county government.

**Restricted custody center:** Restricted custody center means a facility or area separate from the jail used for the housing of sentenced inmates who have been approved for educational, work or program participation release and pretrial inmates who have been approved by the court for educational, work or program participation release and operated under 501 KAR 7:010.

**Life Safety Jail:** Life Safety Jail means county jails and correctional or detention facilities, including correctional facilities defined in KRS 67B.020 which are operated under 501 KAR 13:010 by and under the supervision of any county government which does not house state prisoners as defined by KRS 532.100.

**410.9.2 Emergency smoke evacuation:** All areas of *Jails* and *Life Safety Jails* where an inmate may be confined, shall be provided with an emergencysmoke control/ evacuation system meeting the requirements of this section. The system shall be activated by smoke detectors and shall be connected to an emergency power supply. The system shall be engineered as an independent system or may be engineered to work in conjunction with the building HVAC system.

**410.9.2.1 Design:** All floors which house inmates shall be designed to have a minimum of two smoke compartments. The smoke control system shall be capable of maintaining a negative pressure in the contaminated smoke compartment. The smoke control system shall be capable of 6 air changes per hour. The system operation shall be subject to a final operational test by the Department of Corrections.

**410.9.3 Automatic sprinkler system:** All areas of *Jails* and *Life Safety Jails* where inmates will not be confined, including but not limited to corridors, storage areas, laundry rooms, mechanical rooms, closets and office areas shall be equipped with an *automatic sprinkler system* installed in accordance with Section 906.2.1. Facilities that are not equipped throughout with an automatic sprinkler system are not entitled to height or area increases, reduction of corridor ratings or other reductions of code requirements normally allowed for fully sprinkled buildings.

**410.9.4 Doors and glazing:** Penal doors in *Jails* and *Life Safety Jails* shall be approved by the Department of Corrections. Glass-clad polycarbonate glazing shall be an acceptable alternate to wired glazing. All door openings that do not require a penal door and hardware shall be protected by opening protectives as required by other sections of this code.

**410.9.5 Restricted Custody Centers**: All *restricted custody centers* attached to or separate from a *jail* shall be considered as **Occupancy Condition I** and shall have free egress or automatic time delayed emergency release doors with a maximum time delay of 30 seconds.

*** new amendment**

**410.9.5.1 Automatic sprinkler system:** All restricted custody centers attached to or separated from a *jail* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**410.9.6 Existing facilities:** All existing *Jails, Life Safety Jails* and *Restricted Custody Centers* which are in operation and have prior approval from the Department of Corrections shall be exempt from these requirements until such time the facilities are renovated.

**Effective**

11. Various Sections of Section 421, Swimming Pools, have been amended as follows: 12/13/97

**Section 421.2 Definitions:**

The definition of "**Above-ground/on-ground pool**" has been deleted in its entirety.

The following definitions have been amended to read as follows:

**Barrier:** A fence, a wall, a building wall, or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool.

**Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes swimming pools constructed below grade on site, but not those assembled above grade on site.

**Public swimming pool:** Any swimming pool constructed below grade on site which is not a private swimming pool.

12. A new subsection, 421.8.1 Protection of heating equipment, has been created to read: *

**421.8.1 Protection of heating equipment:** Gas appliances located in rooms or spaces where corrosive or flammable chemicals are present shall be protected in accordance with Sections 5.1.6 and 6.22.1 of NFPA 54 listed in Chapter 35.

13. Sections 421.9.1 and 421.9.3 have been amended to read as follows: 12/13/97

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground.

**Exemptions:** The following shall be exempt from the provisions of this section.
1. A spa or hot tub with an approved safety cover.
2. Fixtures which are drained after each use.

**421.9.3 Alternative devices:** A natural barrier approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection

* new amendment

afforded by the enclosure, gate and latch described herein.

14. A new Section 421.9.4 has been created and shall read: 12/13/97

**421.9.4 Private swimming pool enclosures.**

1. An indoor private pool enclosure may consist of the walls of the house including any entrance and exit doors, screens or glass separations designed for the purpose of preventing uninvited persons from entering the pool.
2. An outdoor private pool enclosure may surround the pool area only or it may surround a larger area if the barrier prevents uninvited persons from entering the pool.

15. Table 422.2 was amended as follows: 8/6/98

TABLE 422.2
LOCATION/CONSTRUCTION TYPE LIMITATIONS

| Location of day care | Sprinklered building | Construction type permitted |
|---|---|---|
| 1 story below LED | Yes | Any type other than 3B & 5B |
| Story of exit discharge | No | Any type |
| 1 story above LED | Yes | Any type |
| | No | 1A, 1B, 2A |
| 2 or 3 stories above LED | Yes | Any type other than 3B, 4 & 5B |
| >3 stories above LED But not high rise | Yes | 1A, 1B, 2A or 2B |
| High Rise | Yes | 1A, 1B or 2A |

16. Section 422.9, number 3, was amended to read as follows: 12/13/97

**3.** In all rooms within the center that are classified as a *habitable space* or an *occupiable space* in accordance with Section 1202.0 of this code. **Exception:** Kitchens.

17. Section 423.1, number 3, was amended to read as follows: 12/13/97

**3.** Interconnected smoke detectors shall be provided in accordance with Section 920.3.2, 920.4 and 920.5.

## Chapter 7

18. Section 707.1 has been amended to read as follows: 12/13/97

**707.1 General.** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of approved masonry or concrete materials that provide the required strength and fire resistance rating specified in Table 602 for the type of construction, but not less than the fire resistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16.

Effective

## Chapter 9

19. Exception #2 of Section 904.1 was amended to read: 8/6/98

2. In telecommunications equipment buildings, or portions thereof, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies.

20. The Exception of Section 906.2 was amended to read: 8/6/98

**Exception:** Where water as an extinguishing agent is not compatible with the fire hazard (see Section 905.1) or is prohibited by a law, statute or ordinance, or when the property owner chooses use of an alternative system because of the nature of the property to be protected in lieu of an automatic sprinkler system, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard.

21. Section 906.5 , Exception 2 was amended to read: 12/13/97

2. Audible or visual alarm devices shall not be required on the exterior of the building for fire sprinkler system supervised by method 1 of Section 924.1.

22. Section 919.5 was amended to read as follows: 12/13/97

**919.5 Sprinklered buildings exception:** Buildings equipped throughout with an automatic sprinkler in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 918.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use roups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3.

## Chapter 10

23. Exception #4 of Section 1010.4 has been created to read: 8/6/98

4. Replacement of emergency escape and rescue windows which meet or exceed the provisions of the applicable code at the time the facility was originally constructed.

24. Exception #1 of Section 1022.2.4 has been amended to read: 8/6/98

1. Any other shape with a perimeter dimension of at least 4 inches (100 mm), but not greater than 6 1/4 inches (158 mm) with the largest cross-sectional dimension not exceeding 2 1/4 inches (57 mm). The figures shown in

Appendix A, Figure 1022.2.4, are approved for use under this Section/subsection.

**Effective**

## Chapter 18

25. Section 1806.1 was amended to read as follows: 12/13/97

**1806.1 Frost Protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30m$^2$) in area or 10 feet (3048 mm) in height shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the load within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall not be founded on frozen soils unless such frozen condition is of a permanent character.

## Chapter 28

26. Create a new subsection in Chapter 28 to read: *

**2801.2.3 Gas-fired appliances:** Gas utilization equipment, including piping, vent/chimney connectors, vent systems and combustion/dilution air shall comply with NFPA 54 listed in Chapter 35.

27. Delete section 2801.6, Gas-fired appliances, in its entirety. *

28. Section 2810.0, Range Hoods, has been created to read: 8/6/98

SECTION 2810.0 RANGE HOODS

**2810.1 Range hoods:** Range hoods in kitchen exhaust systems shall comply with the requirements of the mechanical code listed in Chapter 35. The bottom edge of the hood shall be located at a height of not more than 4 feet (1219 mm) above the cooking surface.

**Exception:** In churches and in other occupancies where the range is merely a convenience for occasional use and where there is minimal or nonexistent grease-laden vapors, a commercial exhaust system shall not be required.

## Chapter 31

29. Section 3102.0, Signs, has been deleted in its entirety. 12/13/97

## Appendix A

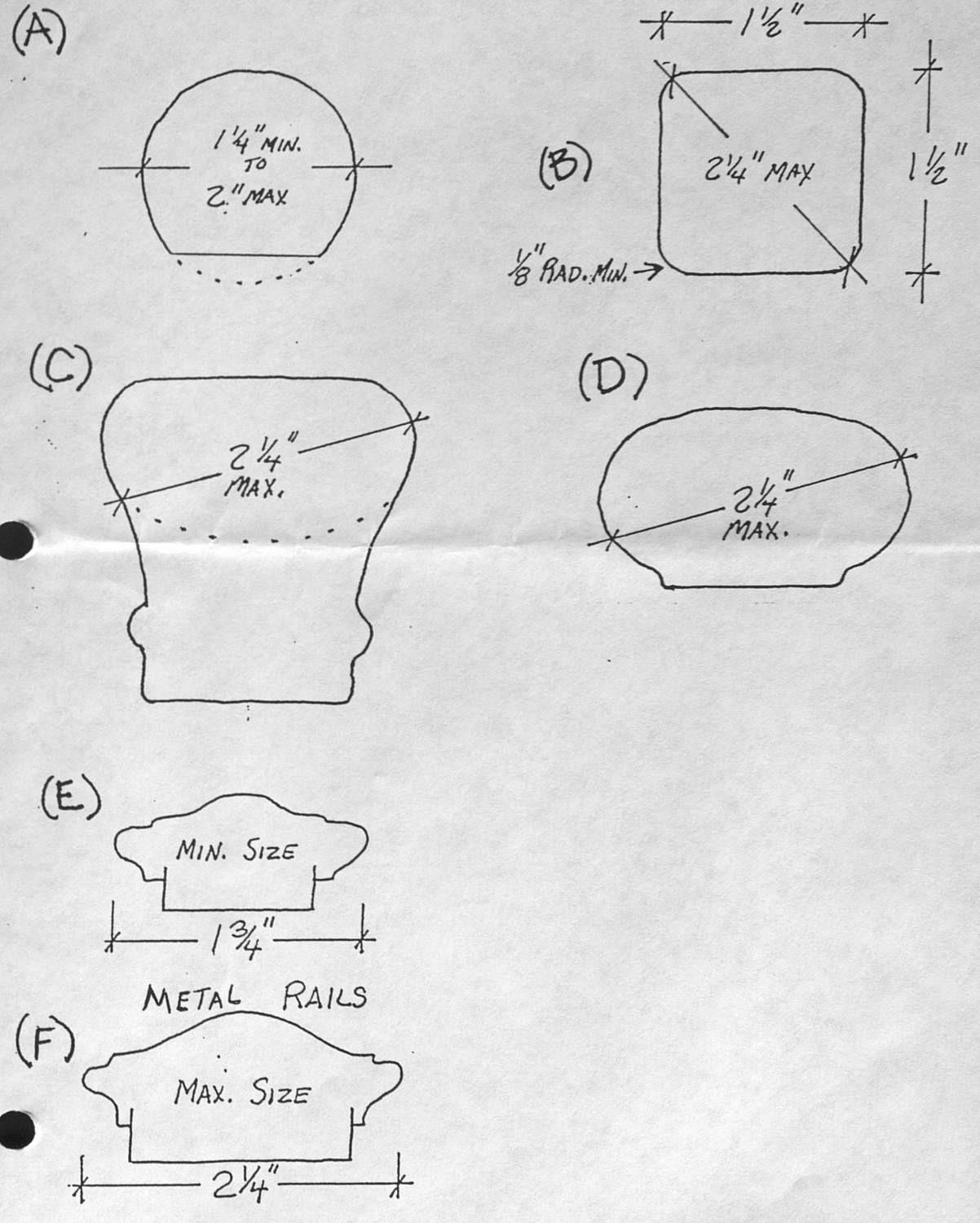
30. Illustration of acceptable handrail profiles in conjunction with Section 1022.2.4. (Attached) 8/6/98

31. Amend NFPA 101 by updating to 1997 Edition. *

* new amendment

## APPENDIX A

## HANDRAIL PROFILES
## FIGURE 1022.2.4



# The Kentucky Building Code

Seventh Edition
1997

**Judith G. Walden**
*Editor, Kentucky Edition*

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**As Adopted By:**

**KENTUCKY BOARD OF HOUSING, BUILDINGS AND CONSTRUCTION**

**Department of Housing, Buildings and Construction**
**Administered by: Charles A. Cotton, Commissioner**

**The 127 Building — 1047 U.S. 127 South**
**Frankfort, Kentucky 40601**
**Telephone (502) 564-8044 or 8090**
**FAX (502) 564-6799**

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# PREFACE

The *Kentucky Building Code*, now in its 17th year, is essentially the *BOCA National Building Code* published by Building Officials and Code Administrators International, Inc. (BOCA), with specific Kentucky amendments. It provides minimum standards to insure the public safety, health and welfare insofar as they are affected by building construction and to secure safety to life and property from all hazards incident to the occupancy of buildings, structures or premises. The code states regulations in terms of measured performance rather than in rigid specification of materials whenever possible and, in this way, makes possible the acceptance of new materials and methods of construction which can be evaluated by national standards, without the necessity of adopting cumbersome amendments for each variable condition.

By presenting the purposes to be accomplished rather than the method to be followed, the *Kentucky Building Code* allows the code user the widest possible freedom and does not hamper development. The code adopts nationally recognized standards as the criteria for evaluation of minimum safe practice, or for determining the performance of materials or systems of construction. The application of these standards is stated in the text of the code requirements, and the standards are listed and identified in Chapter 35, making it practical and convenient to update any standard as it is revised or reissued by the sponsoring agency.

This edition presents the code as originally issued, with changes approved through 1996, and with certain editorial changes made to maintain the sequence of the code and to update the references to standards.

Changes as described above do not just happen. The *BOCA National Building Code* is dedicated to the thousands of code enforcement officials from throughout the United States and Canada; to the engineers, architects, technicians, builders, contractors, material producers, trade associations and others who voluntarily collaborated in its preparation; and to the members of the code changes committees and their constituent committees, who participated in the important work of keeping the code abreast of new developments in construction technology. These individuals have given unstintingly of their time and their talents to produce and maintain this performance-type code, which has been widely recognized, highly respected, and adopted by countless communities.

The *Kentucky Building Code* may be amended by proposals to the Kentucky Board of Housing, Buildings and Construction by code enforcement officials, industry and design professionals, and other interested persons and organizations. Changes are discussed in an open meeting of the board. Changes approved are printed in the *Kentucky Administrative Register* and forwarded to all those in possession of the *Kentucky Building Code* for inclusion therein.

The *Kentucky Building Code* is a "mini/maxi" code, meaning that it is a statewide uniform mandatory building code and no local government shall adopt or enforce any other building code.

# NOTE TO KENTUCKY BUILDING CODE USERS

The 1997 edition of the *Kentucky Building Code* contains, for the benefit and convenience of code users, vertical lines in the outside margins of some pages.

As in previous editions, vertical lines in the margin indicate approved changes to the text of code requirements. Editorial changes are not so marked. For example, lines shown in the margins indicate technical content changes to BOCA since its 1993 edition. Double vertical lines indicate that the section has been amended for Kentucky buildings. These features are designed to streamline the review process for jurisdictions wishing to adopt current, up-to-date provisions.

Several features are again as reflected in the 1996 editions of the *BOCA National Codes*.

Definitions of terms are located within the chapter or section that represents the predominant subject matter associated with each term. Definitions related predominantly to Chapter 1 and those that have broad applicability throughout the code remain in full in Chapter 2. All defined terms are listed alphabetically in Chapter 2 followed by either the text of the definition or a reference to the section number that contains the text of the definition. Selected defined terms are italicized where they appear in the code in the same manner as in previous editions.

An indenting feature is used in tandem with the codes' decimal-based section numbering system to indicate the hierarchy of each subsection.

The values stated in the U.S. customary units of measurement are to be regarded as code requirements. The metric equivalents of U.S. customary units may be approximate.

# ADOPTION INFORMATION

The *Kentucky Building Code/1997* applies to all buildings to be constructed, altered or remodeled with the exception of farms, manufactured houses and single-family dwellings which are not trade-name or brand-name homes.

The *Kentucky Building Code* may be extended by local government ordinance to apply to single-family dwellings. Jurisdictions wishing to adopt enforceable minimum construction safety requirements for single-family dwellings should insure that certain factual information is included in the adopting ordinance at the time adoption is being considered by the appropriate governmental body. The following sample adoption ordinance addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

## SAMPLE ORDINANCE FOR ADOPTION OF THE 1997 KENTUCKY BUILDING CODE (CITY/COUNTY) ORDINANCE

Ordinance Number _____

AN ORDINANCE RELATING TO THE ADOPTION OF THE KENTUCKY BUILDING CODE AS PROMULGATED IN 815 KAR 7:105 BY THE BOARD OF HOUSING, BUILDINGS AND CONSTRUCTION OF THE COMMONWEALTH OF KENTUCKY

Be it ordained by the (*Governing Body*) of the (*Name of Jurisdiction*) as follows:

WHEREAS, KRS 198B.060(1), requires that all buildings constructed in _____ (*City/County*) _____ shall be built in compliance with the uniform state building code as adopted by the Board of Housing, Buildings and Construction; and

WHEREAS, KRS 198B.010(5) authorizes any city, county or urban county government to extend, by ordinance, the application of the Kentucky Building Code to single-family dwellings; and

WHEREAS, KRS 198B.060(18) authorizes each local government to establish a schedule of fees which are designed to cover the cost of the service performed but not to exceed it;

Now, therefore, BE IT ORDAINED by the Fiscal County and/or legislative body of _____ (*City/County*) _____, COMMONWEALTH OF KENTUCKY;

**SECTION 1. ADOPTION OF THE KENTUCKY BUILDING CODE.**

THAT, the KENTUCKY BUILDING CODE as promulgated in 815 KAR 7:105 by the Board of Housing, Buildings and Construction, Commonwealth of Kentucky, is hereby adopted in full as an Ordinance of _____ (*City/County*) _____ of the Commonwealth of Kentucky as if set out at length herein;

THAT, a copy of said Kentucky Building Code, together with a copy of all other regulations or NFPA pamphlets adopted or referred to thereunder, is on file in the Office of the _____ County Clerk, and the Clerk shall at all times keep a copy of said building code for reference;

THAT, an attested copy of this Ordinance shall be transmitted to the Department of Housing, Buildings and Construction of the Commonwealth of Kentucky.

**SECTION 2. DESIGNATED ENFORCEMENT OFFICER.**

THAT, _____ (*Officer*) _____, shall be designated as the local enforcement agent/agency for said Kentucky Building Code. All Inspections shall be performed by persons certified by the Kentucky Department of Housing, Building and Construction.

**SECTION 3. EXTENDED APPLICATION.**

THAT, the application of the Kentucky Building Code is hereby extended to all single-family dwellings to be constructed in _____ (*City/County*) _____.

**SECTION 4. PERMITS AND FEES.**

THAT, the fees for permits and inspections shall be as provided for in the attached schedule.

**SECTION 5. INCONSISTENT ORDINANCES REPEALED.**

THAT, all ordinances or parts of ordinances in conflict herewith are, to the extent of such conflict, hereby repealed.

**SECTION 6. EFFECTIVE DATE.**

THAT, this resolution shall take effect and be in full force when passed, published and recorded according to law.

_____

*COUNTY JUDGE/EXECUTIVE OR MAYOR*

ATTEST:

_____

*CITY/COUNTY CLERK*

_____

*DATE PASSED*

# A GUIDE TO USE OF THE KENTUCKY BUILDING CODE

The following step-by-step approach is recommended for use in determining the code's application to particular buildings and occupancies.

1. **Construction documents:** Determine compliance with the requirements for construction documents in Sections 107.0, 114.0, 703.0, 903.0, 1003.0, 1203.0, 1503.0, 1603.0, 1703.0, 1804.0, 2103.0, 2702.0, 2802.0, 2902.0, 3003.0, 3102.4 and 3302.0.
2. **Use group:** Determine the appropriate use group classification of the building. See Section 302.0 for a listing of all use groups and Sections 303.0 through 312.0 for a description of each use group.
3. **Height and area:** Determine the type of construction required based on the building use group and the height and area limitations of Chapter 5. See Sections 503.0 through 507.0, as well as Table 503 for general limitations and exceptions.
4. **Type of construction:** Determine compliance with the required type of construction of the building by the building materials used and the fireresistance rating of the building elements. See Section 602.0 and Table 602 for a listing of all of the types of construction, and Sections 603.0 through 606.0 for a description of each type of construction.
5. **Siting:** Determine the location of the building on the site, including separation distances from lot lines and other buildings. See Section 705.0 for exterior wall and wall opening requirements based on proximity to lot lines and adjacent buildings.
6. **Fire performance:** Determine compliance with detailed requirements for fireresistance (Chapter 7) and fire protection systems (Chapter 9).
7. **Interior environment and design:** Determine compliance with special use and occupancy requirements (Chapter 4), means of egress requirements (Chapter 10), accessibility requirements (Chapter 11) and interior environment requirements (Chapter 12).
8. **Exterior envelope:** Determine compliance with exterior envelope requirements (Chapters 14 and 15) as well as energy conservation (Chapter 13).
9. **Structural performance:** Determine compliance with structural requirements (Chapters 16 and 18) and building material requirements (Chapters 17 and 19 through 26).
10. **Building service system:** Determine compliance with various building service system requirements (Chapters 27 through 30).

# EFFECTIVE DATES

On February 15, 1980, the *Kentucky Building Code* became mandatorily effective for the construction of all buildings in Kentucky in excess of three stories; or in excess of 20,000 square feet; or intended for assembly, educational, institutional, or high-hazard occupancy; or business or industrial occupancy in excess of 100 persons; or for use as a frozen-food locker plant.

The *Kentucky Building Code* became mandatorily effective for other buildings on a county-wide basis on the following schedule:

### February 15, 1980

Boyd, Campbell, Daviess, Fayette, Franklin, Jefferson, Kenton, McCracken and Warren.

### August 15, 1981

Allen, Anderson, Barren, Bath, Bell, Boone, Bourbon, Boyle, Bracken, Breathitt, Bullitt, Caldwell, Calloway, Carroll, Carter, Christian, Clark, Clay, Crittenden, Estill, Fleming, Floyd, Fulton, Gallatin, Graves, Grayson, Greenup, Hardin, Harlan, Harrison, Henderson, Henry, Hopkins, Jessamine, Johnson, Knox, Larue, Laurel, Letcher, Lewis, Logan, Madison, Magoffin, Marshall, Marion, Mason, Mercer, Montgomery, Muhlenberg, Nelson, Nicholas, Oldham, Pendleton, Perry, Pike, Powell, Pulaski, Robertson, Rowan, Scott, Shelby, Simpson, Taylor, Todd, Union, Washington, Wayne, Webster, Whitley and Woodford.

### August 15, 1982

Adair, Ballard, Breckinridge, Butler, Carlisle, Casey, Clinton, Cumberland, Edmonson, Elliott, Garrard, Grant, Green, Hancock, Hart, Hickman, Jackson, Knott, Lawrence, Lee, Leslie, Lincoln, Livingston, Lyon, McCreary, McLean, Martin, Menifee, Meade, Metcalfe, Monroe, Morgan, Ohio, Owen, Owsley, Rockcastle, Russell, Spencer, Trigg, Trimble and Wolfe.

### New Editions

The second edition of the *Kentucky Building Code* became effective February 3, 1982. The effective date of the third edition was July 9, 1985, although it did not become mandatory until December 1, 1985. The effective date of the fourth edition was September 10, 1987, although it did not became mandatory until January 1, 1988. The effective date of the fifth edition was October 14, 1990, although it did not become mandatory until January 1, 1991. The effective date of the 6th edition was January 1, 1994, although it did not become mandatory until July 1, 1994. The effective date of this 7th edition is February 6, 1997, although it does not become mandatory until July 1, 1997.

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Frankfort, Kentucky

*David L. Armstrong*
Frankfort, Kentucky

*James S. Barger*
Frankfort, Kentucky

*Lonnie Bellamy*
Bowling Green, Kentucky

*Steven Beshear*
Frankfort, Kentucky

*James S. Bird*
Versailles, Kentucky

*Robert G. Blanton*
Winchester, Kentucky

*Frances M. Bowles*
Madisonville, Kentucky

*Ethan Buell*
Lexington, Kentucky

*Guy Carter*
Frankfort, Kentucky

*Ben Chandler*
Frankfort, Kentucky

*Floyd Van Cook*
Danville, Kentucky

*Charles A. Cotton*
Frankfort, Kentucky

*Frederic J. Cowan*
Frankfort, Kentucky

*James A. Deopker*
Ft. Thomas, Kentucky

*Frank H. Dries, Jr.*
Lexington, Kentucky

*Barry Edwards*
Glasgow, Kentucky

*Dee English*
Owensboro, Kentucky

*Harry A. Eskridge*
Louisville, Kentucky

*Donald L. Fuller*
Paducah, Kentucky

*Ricky L. George*
Louisville, Kentucky

*H. Carleton Godsey*
Louisville, Kentucky

*Joe Goodlette*
Hazard, Kentucky

*Chris Gorman*
Frankfort, Kentucky

*Jan L. Gould*
Frankfort, Kentucky

*John R. Groves, Jr.*
Lexington, Kentucky

*Mary Beth Hall*
Lexington, Kentucky

*Jerry Hammond*
Frankfort, Kentucky

*Frank Hartz, Sr.*
Owensboro, Kentucky

*Joe M. Hawkins*
Lexington, Kentucky

*Bruce Henderson*
Louisville, Kentucky

*Carlos Hernandez*
Frankfort, Kentucky

*Katheryn D. Higgins*
Louisville, Kentucky

*John D. Hinkle*
Georgetown, Kentucky

*B.H. Holcomb*
Lexington, Kentucky

*Robert Kee*
Argillite, Kentucky

*William R. Lane, Sr.*
Lexington, Kentucky

*Rice Leach*
Frankfort, Kentucky

*F. Lynn Luallen*
Frankfort, Kentucky

*Thomas K. Lyons*
Glasgow, Kentucky

*William F. Marcum*
Paducah, Kentucky

*John W. Martin*
Erlanger, Kentucky

*John G. Martinez*
Frankfort, Kentucky

*Howard B. Maxfield*
Taylor Mill, Kentucky

*Gary F. McComas*
Lexington, Kentucky

*Earl McDaniel*
Lexington, Kentucky

*Leo McMillen*
Elizabethtown, Kentucky

*Delbert J. Melcher*
Louisville, Kentucky

*Lester Mimms*
Earlington, Kentucky

*Otto G. Mock*
Louisville, Kentucky

*Timothy E. Morris*
Lexington, Kentucky

*Charles Murphy*
Lexington, Kentucky

*Edward Nairn*
Prestonburg, Kentucky

*Frank J. O'Neil*
Louisville, Kentucky

*Gene F. Paulin, Jr.*
Fairdale, Kentucky

*Mark Peacock*
Richmond, Kentucky

*Richard S. Prater*
Lexington, Kentucky

*Anna Dale Pyles*
Maysville, Kentucky

*James Ruth*
Covington, Kentucky

*Charles E. Schmidt*
Louisville, Kentucky

*C. Vincent Schmidt*
Louisville, Kentucky

*John W. Scott*
Lexington, Kentucky

*Robert Slaton*
Frankfort, Kentucky

*Pat Smith*
Elizabethtown, Kentucky

*Carl F. Smoak*
Frankfort, Kentucky

*David Sowders*
Bowling Green, Kentucky

*Robert Stephens*
Frankfort, Kentucky

*Jay Teegarden*
Alexandria, Kentucky

*Donna Terry*
Princeton, Kentucky

*Elmus Ussery*
Louisville, Kentucky

*Art VanHouten III*
Frankfort, Kentucky

*Thomas W. Waldron, Jr.*
Hopkinsville, Kentucky

*Donald Q. Wallace*
Lexington, Kentucky

*F.E. Warren, Jr.*
Frankfort, Kentucky

*Gerald Williams*
Lexington, Kentucky

*Edward A. Wilmot*
Berea, Kentucky

# CHAPTER 1

# ADMINISTRATION

## SECTION 101.0 SCOPE

**101.1 Title:** This chapter shall supersede all other conflicting administration provisions which may be referenced by this code and these regulations shall be known as the *Kentucky Building Code*, hereafter referred to as "this code."

**101.2 Scope:** The provisions of this code shall apply, as specified in this code, to the following:

**101.2.1 New construction:** The construction, use and occupancy of buildings and structures;

**101.2.2 Existing buildings:** *Alterations* and *additions* to buildings and structures; and

**101.2.3 Appurtenances:** Appurtenances to buildings and structures; whether hereafter erected or, where expressly stated in this code, existing; and whether on land, over water, or on water, permanently moored to land, and substantially a land structure.

**101.3 Single-family dwellings:** All single-family dwellings shall comply with this section.

**101.3.1** All single-family dwellings (R-4) shall comply fully with the requirements of NFPA 70 listed in Chapter 35.

**101.3.2** Modular homes and other trade-name or brand-name homes shall comply with all requirements of this code.

**Exceptions**

1. Manufactured homes.
2. Farm dwellings.
3. Site-built homes which are not trade-name or brand-name homes, unless local ordinance requires compliance, in which case Section 310.6 allows the builder to elect to build in accordance with this code or the CABO *One and Two Family Dwelling Code* listed in Chapter 35.

**101.3.3 Other codes applicable:** NFPA 70 shall apply to all manufactured/mobile homes exterior service hook-ups and the State Plumbing Code shall apply to the exterior water and sewer lines of nonfarm manufactured/mobile homes.

**101.4 Farm structures:** If a building, other than a dwelling, is to be located on a farm, it is exempt from the requirements of this code if all of the following criteria are met:

1. The building use is incident to the operation of the farm (e.g., storage building, etc.); and
2. The building is located outside the boundary of a municipality; and
3. The building is not to be used in the business of retail trade; and
4. The building is not to be used as a regular place of work for 10 or more people; and
5. The building is not to be used in the storage or processing of timber products.

**101.5 Intent:** The code's intent shall be to secure public safety, health and welfare affected by building construction quality, through structural strength, adequate *means of egress*, light and *ventilation*, electrical systems, plumbing, energy, boiler safety, accessibility for persons with physical disabilities, life safety from hazards of fire and explosion and other disasters and, in general, to secure safety to life and property from all hazards incident to the removal, design, erection, repair or occupancy of buildings. It shall also be the intent of this code to avoid duplicative plan review and inspection of new construction and to maintain one set of administrative regulations with the requirements relating to the construction of buildings in the state to enable builders, *owners* and code officials to be adequately informed.

**101.6 Other regulations:** Other local or state law shall be consulted to determine the existence of other powers given to the code official, such as those related to demolition or authority over unsafe structures unless a *change of occupancy* as required by Chapter 34 is made or proposed. Otherwise, this code shall not be cited as authority for upgrading existing structures which are not under construction.

**101.7 Fire safety authority:** The State Fire Marshal and the local fire code official shall continue to be the authority having jurisdiction for enforcement of the *Kentucky Standards of Safety* (Fire Prevention Code) in existing buildings not regulated by this code, and for continued fire safety maintenance in buildings constructed and approved under this code.

**101.8 Accessibility:** Facilities and buildings required by KRS 198B.270 to be accessible to persons with physical disabilities shall comply with Chapter 11 of this code.

**101.9 Accepted engineering practice:** In the absence of provisions not specifically contained in this code or final decisions of the appeals board, the specifications and standards listed in Chapter 35 shall be deemed to represent accepted engineering practice with respect to materials, equipment, system or method of construction as specified and shall be acceptable.

## SECTION 102.0 APPLICABILITY

**102.1 General:** The provisions of this code shall apply to all matters affecting or relating to buildings and structures as set forth in Sections 101.2 and 101.3. The construction, *alteration*, *addition* and *change of occupancy* of buildings shall comply with applicable provisions of this code.

**102.2 Existing structures:** The legal use and occupancy of any structure existing on the date of adoption of this code or for which it has been approved, may be continued without change, except as is specifically covered in this code and deemed necessary by the code official for the general safety and welfare of the occupants and the public, or as may be required by the State Fire Marshal under the *Kentucky Standards of Safety* (Fire Prevention Code), or an existing structures code adopted by and enforced under authority of a local ordinance. Application of the code to existing buildings shall apply as required by Section 3401.1 when *alterations*, *additions* or *changes of occupancy* as set forth in Chapter 34 of this code are proposed or occur.

**102.2.1 Moved structures:** Buildings and structures moved into or within the Commonwealth shall comply with the provisions of this code for new buildings and structures and shall not be used or occupied until the certificate of occupancy has been issued by the code official.

**102.3 Alternative regulations:** A structural, fire or sanitary safety building requirement necessary for the safety of the occupants and which is not specifically covered by this code, shall be determined by other administrative regulations of the department or other applicable law.

**102.4 Referenced standards:** The standards referenced in this code and listed in Chapter 35 shall be considered part of the requirements of this code to the prescribed extent of each reference. If differences occur between provisions of this code and referenced standards, the provisions of this code shall apply, and newer editions of referenced standards may be used to meet the intent of the code in lieu of the adopted edition.

**102.5 Violation:** A person who violates a provision of this administrative regulation or any other provision of this code shall be subject to the penalties in Section 116.0 of this code.

## SECTION 103.0 ORDINARY REPAIRS AND MAINTENANCE

**103.1 Repairs:** Ordinary repairs to structures may be made without application or notice to the code official. Ordinary repairs shall not include:

1. Additions to or alterations of electrical wiring or HVAC or sprinkler systems;
2. The removal or cutting of any structural beam or bearing support;
3. The removal or change of any required *means of egress*; or
4. Rearrangement of parts of a structure affecting the *exit* requirements.

**103.2 Maintenance:** All buildings and structures, both existing and new, shall be maintained in a safe and sanitary condition. Service equipment, *means of egress*, devices and safeguards required by this code or a previous code in a building or structure, shall be maintained in good working order.

**103.3 Owner responsibility:** The *owner* or the *owner's* designated agent shall be responsible for the safe and sanitary maintenance of the building or structure and its *means of egress* facilities at all times.

**103.4 Housekeeping inspections:** Periodic inspections of existing uses and occupancies shall be made by legally authorized fire code, health and other designated lawful officials to insure maintenance of equipment and good housekeeping conditions.

**103.5 Nonstructural repairs:** Nonstructural *alterations* or repairs which do not adversely affect a structural member having a required fireresistance rating may be made with the same materials of which the structure was constructed.

## SECTION 104.0 DEPARTMENT OF BUILDING INSPECTION

**104.1 Building code official:** Each local government shall employ or otherwise provide for a certified Level I code official, certified electrical inspector and other code enforcement personnel necessary to enforce this code within its jurisdiction. The department shall be responsible for the enforcement of this code as it pertains to the buildings assigned to it by law.

**104.2 Appointment:** Local code officials shall be appointed by the chief appointing authority for the respective jurisdiction and shall meet the qualifications for the position which may be established by the appointing authority, in addition to the requirements for certification of Kentucky code inspectors set forth in 815 KAR 7:070.

**104.3 Organization:** The code official shall appoint such number of officers, technical assistants, inspectors and other employees as shall be necessary for the administration of this code and as authorized by the appointing authority.

**104.4 Retention of records:** The code official shall keep official records of applications received, permits and certificates issued, fees collected, reports of inspections and notices and orders issued. These records shall be retained in accordance with state retention regulations promulgated by the Kentucky Department of Libraries and Archives pursuant to KRS 171.450.

**104.5 Building size includes fire wall:** To determine plan review jurisdiction and the necessity for design professionals, the calculation of the total square footage and occupant load for any project shall include areas on both sides of *fire walls*.

**104.6 Relief from personal responsibility:** The code official, officer or employee charged with the enforcement of this code, while acting for the jurisdiction, shall not thereby be rendered liable personally, and is hereby relieved from all personal liability for any damage accruing to persons or property as a result of any act required or permitted in the discharge of official duties. Any suit instituted against an officer or employee because of an act performed by that officer or employee in the lawful discharge of duties and under the provisions of this code shall be defended by the legal representative of the jurisdiction until the final termination of the proceedings. The code official or any subordinate shall not be liable for costs in any action, suit or proceeding that is instituted in pursuance of the provisions of this code; and any officer of the department of building inspection, acting in good faith and without malice, shall be free from liability for acts performed under any of its provisions or by reason of any

act or omission in the performance of official duties in connection therewith.

**104.7 Official records:** Official records shall be kept of all business and activities of the various local building departments or state building departments specified in this code, and all of these records shall be open to the public for inspection at all appropriate times under the terms and conditions of KRS Chapter 61.

## SECTION 105.0 DUTIES AND POWERS OF THE CODE OFFICIAL

**105.1 Local jurisdiction:** The local code official shall be responsible for the examination and approval of plans and specifications and the inspections necessary to determine compliance for buildings as listed in this section and the determination of jurisdiction shall be based upon occupant load calculations in accordance with Section 1008.0 of this code.

**105.1.1 In storage, residential or utility occupancies:** The local code official shall be responsible for the examination and approval of plans and specifications and the inspections necessary to determine compliance for all buildings classified as storage, residential, miscellaneous or utility occupancies as long as the buildings do not exceed three stories in *height* or 20,000 square feet (1860 $m^2$) of floor area.

**105.1.2 In assembly, business or mercantile occupancies:** The local code official shall be responsible for the examination and approval of plans and specifications and the inspections necessary to determine compliance for all buildings classified as assembly, business or mercantile occupancies having a capacity which does not exceed 100 persons.

**105.1.3 In churches:** The local code official shall be responsible for the examination and approval of plans and specifications and the inspections necessary to determine compliance for all church buildings having a capacity of 400 or less persons and all church buildings having 6,000 square feet (558 $m^2$) or less of total floor area.

**105.1.4 In factory or industrial occupancies:** The local code official shall be responsible for the examination and approval of plans and specifications and the inspections necessary to determine compliance for all buildings classified as factory or industrial occupancies having a capacity which does not exceed 100 persons.

**105.1.5 State buildings exempt:** Buildings owned by the Commonwealth shall not be subject to local plan review, inspection or approval, regardless of size, occupant load or occupancy classification.

**105.2 State jurisdiction:** It shall be the responsibility of the Department to review *construction documents*, issue permits, make inspections and to determine compliance with this code for the buildings listed in Sections 105.2.1 through 105.2.6.

**105.2.1** Buildings classified as assembly occupancies having a capacity in excess of 100 persons, except church buildings having a capacity of 400 or less persons and church buildings having 6,000 square feet (558 $m^2$) or less of total floor area.

**105.2.2** Buildings classified as educational, institutional, high hazard, frozen food locker plants or industrialized building systems, regardless of occupancy size or occupancy classification.

**105.2.3** Buildings classified as business and mercantile occupancies having a capacity in excess of 100 persons.

**105.2.4** Buildings classified as industrial and factory occupancies having a capacity in excess of 100 persons.

**105.2.5** All other buildings containing in excess of three stories or 20,000 square feet (1860 $m^2$) of floor area.

**105.2.6** All buildings owned by the Commonwealth regardless of occupancy classification or size.

**105.3 Notices and orders:** The code official shall issue all necessary notices or orders to ensure compliance with this code.

**105.4 Preemptive authority:** The board may withdraw or preempt authority for plan review and inspection for code compliance under this code from a local building department if it finds, upon petition of the department, that the local inspection agency is not adequately performing any portion of its program, allowing the department to preempt that portion of a local program.

**105.5 Identification:** The code official and authorized representatives shall carry proper identification of their respective office for the purpose of inspecting buildings and premises and the performance of duties under this code.

**105.6 Rule-making authority:** By means of the board's appeals procedures, the board may issue interpretations which shall be binding upon the appellee and the code official, and the code official shall implement the provisions of this code to secure its intent as determined by the board.

**105.7 Additional responsibility:** A local government may petition the department for additional plan review responsibility in accordance with KRS 198B.060(5) and (6).

**105.8 Required inspections:** The code official having jurisdiction shall make all of the required inspections, or the official may accept reports of inspection by authoritative and recognized services or individuals. Inspection reports shall be in *writing* and certified by a responsible officer of an authoritative service or by the responsible individual.

## SECTION 106.0 APPROVAL

**106.1 Approved materials and equipment:** All materials, equipment and devices approved by the code official shall be constructed and installed in accordance with such approval.

**106.2 Modifications:** When there are practical difficulties involved in carrying out structural or mechanical provisions of this code, the code official shall have the right to vary or modify such provisions upon application of the owner or the owner's representative, provided that the spirit and intent of the law is observed and that the public health, safety and welfare is assured.

**106.2.1 Records:** The application for modification and the final decision of the code official shall be in *writing* and shall be officially recorded with the application for the permit in the permanent records of the department of building inspection.

**106.3 Used materials and equipment:** Used materials, equipment and devices shall not be reused unless they have been reconditioned, tested and placed in good and proper working condition and approved by the code official.

**106.4 Alternative materials and equipment:** The provisions of this code are not intended to prevent the installation of any material or to prohibit any method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material or method of construction shall be approved when the code official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fireresistance, durability and safety.

**106.5 Supporting data:** Code officials may accept supporting data from the following sources to assist them in their determinations:

1. Duly authenticated research reports from BOCA; or
2. From other approved authenticated sources for materials or assemblies proposed for use which are not specifically provided for in this code.

## SECTION 107.0 APPLICATION FOR PERMIT

**107.1 Permit application:** An application shall be submitted to the code official for the following activities and these activities shall not commence without a permit being issued in accordance with Section 108.0:

1. Construct or alter a building.
2. Construct an *addition*.
3. Move a building.
4. Make a change of occupancy classification.
5. Install or alter any equipment that is regulated by this code.
6. Move a lot line which affects an existing structure.

**107.1.1 Repairs:** Application or notice to the code official is not required for ordinary repairs. Such repairs shall not include the cutting away of any wall, partition or portion thereof, the removal or cutting of any structural beam or loadbearing support, or the removal or change of any required *means of egress*, or rearrangement of parts of a structure affecting the egress requirements; nor shall ordinary repairs include *addition* to, *alteration* of, replacement or relocation of any *standpipe*, water supply, sewer, drainage, drain leader, gas, soil, waste, vent or similar piping, electric wiring or mechanical or other work affecting public health or general safety.

**107.2 Form of application:** The application for a permit shall be submitted to the code official, in *writing*, and shall be accompanied by the required fee, as prescribed in Section 112.0.

**107.3 By whom application is made:** Application for a permit shall be made by the owner or lessee of the building or structure, or the agent of either, or by the licensed engineer or architect employed in connection with the proposed work. If the application is made by a person other than the owner in fee, it shall be accompanied by a verified *written* statement by the person making the application that the proposed work is authorized by the owner in fee and that the applicant is authorized to make application. The full names and addresses of the owner, lessee, applicant and of the responsible officers, if the owner or lessee is a corporate body, shall be stated in the application.

**107.4 Description of work.** The application shall contain:

1. A general description of the proposed work;
2. The location of the proposed work;
3. The use and occupancy of all parts of the building or structure and of all portions of the site or lot not covered by the building or structure;
4. Provision for *special inspections* required by Section 1705.0; and
5. Any additional information required by the code official.

**107.5 Construction documents:** The application for permit shall be accompanied by *construction documents* drawn to scale with sufficient clarity and detail dimensions to show the nature and character of the work to be performed. Except for additional sets of plumbing documents as may be required by the Kentucky Division of Plumbing, only one complete set of the *construction documents* shall be required for buildings subject to the jurisdiction of the state under Section 105.2. Additional sets of documents may be required by local governments for buildings subject to local jurisdiction under Section 105.1. The code official shall cooperate with the fire code official by allowing the fire code official to review all *construction documents*. Any recommendations made by the fire code official relating to fire safety in construction of a building shall be considered by the code official, and the decision shall be reported to the fire code official. If quality of materials is essential for conformity to this code, specific information shall be given to establish the quality of the materials. This code shall not be cited or the term "legal" or its equivalent shall not be used as a substitute for specific information requested. The code official may waive the requirement.

**107.6 Site survey and site plan required:** A copy of the site survey bearing the signature and seal of a Kentucky Registered Land Surveyor shall be submitted for all new buildings or *additions*; except that the code official may, in the official's discretion, accept other proof of location.

**107.6.1 Site plan:** A site plan shall be filed showing, to scale, the size and location of the new construction and all existing structures on the site, the distances from *lot lines*, the established street grades and the proposed finished grades. The site plan shall be drawn in accordance with the accurate boundary line survey.

**107.6.2 Change in site plan:** A lot shall not be changed, increased or diminished in *area* from that shown on the official plot site plan unless a revised plan showing the changes, accompanied by the necessary affidavit of owner or applicant, shall have been filed and approved.

**Exception:** The revised plan shall not be required if the change is caused by reason of an official street opening, street widening or other public improvement.

**107.7 Engineering details:** The code official may require adequate details of structural, mechanical and electrical work, including computations, stress diagrams and other essential technical data to be filed, including how the required structural and fireresistance rating integrity shall be maintained, and where

penetrations will be made for electrical, mechanical, plumbing and communication conduits, pipes, and systems. All engineering plans and computations shall bear the signature of the responsible design professional.

**107.8 Amendments to application:** Subject to the limitations of Section 107.9, amendments to a plan, application or other records accompanying the same shall be filed at any time before completion of the work for which the permit is sought or issued. Such amendments shall be deemed part of the original application and shall be filed therewith.

**107.9 Time limitation of application:** An application for permit for any proposed work shall be considered abandoned six months after the filing date if a permit has not been issued. The code official shall grant one or more extensions of time for additional periods not exceeding 90 days each if there is reasonable cause. Once an application for permit is abandoned, an applicant may reapply for a permit at any time by submitting the required application for permit, construction documents and fee.

## SECTION 108.0 PERMITS

**108.1 Action on application:** The code official shall examine or cause to be examined all applications for permits and amendments thereto within a reasonable time after filing. If the application or the *construction documents* do not conform to the requirements of all pertinent laws, the code official shall reject such application in *writing*, stating the reasons therefor. If the code official is satisfied that the proposed work conforms to the requirements of this code and all laws and ordinances applicable thereto, the code official shall issue a permit therefor as soon as practical, but not later than 30 days.

**108.2 Suspension of permit:** Any permit issued shall become invalid if the authorized work is not commenced within six months after issuance of the permit, or if the authorized work is suspended or abandoned for a period of six months after the time of commencing the work. After the building official has notified a permit holder that the permit is invalid, work may not resume until a new permit has been obtained by resubmitting the required application for permit, construction documents and fee.

**108.3 Previous approvals:** This code shall not require changes in the *construction documents*, construction or designated use group of a building for which a lawful permit has been issued or otherwise lawfully authorized by approved *construction documents*, if substantial construction on the project has commenced within six months from the date the permit was issued.

**108.4 Signature to permit:** The code official's signature shall be attached to every permit; or the code official shall authorize a subordinate to affix such signature thereto.

**108.5 Approved construction documents:** The code official shall stamp or endorse in *writing* both sets of *construction documents* "Approved," and one set of the approved *construction documents* shall be retained by the code official and the other set shall be kept at the building site, open to inspection of the code official or an authorized representative at all reasonable times.

**108.6 Revocation of permit:** The code official shall revoke a permit or approval issued under the provisions of this code in case of any false statement or misrepresentation of fact in the application or on the plans on which the permit or approval was based.

**108.7 Approval of part:** The code official is authorized to issue a permit for the construction of foundations or any other part of a building or structure before the *construction documents* for the whole building or structure have been submitted, provided that adequate information and detailed statements have been filed complying with all of the pertinent requirements of this code. The holder of such permit for the foundation or other parts of a building or structure shall proceed at the holder's own risk with the building operation and without assurance that a permit for the entire structure will be granted.

**108.8 Posting of permit:** A true copy of the building permit shall be kept on the site of operations, open to public inspection during the entire time of prosecution of the work and until the completion of the same.

**108.9 Notification of changes:** The code official shall be notified prior to any construction which does not comply with the building code requirements of the previously approved *construction documents*.

**108.10 Local permit limitation:** Local permits shall not be issued for the construction of buildings subject to state plan review jurisdiction under Section 105.2 until the Department has approved construction to begin.

## SECTION 109.0 TEMPORARY STRUCTURES

**109.1 General:** Pursuant to a variance granted by the board of appeals under the provisions of Sections 121.0 and 122.0, the code official shall issue a permit for temporary construction as approved by the board of appeals. Such permits shall be limited as to time of service, but such temporary construction shall not be permitted for more than one year.

**109.2 Special approval:** All temporary construction shall conform to the structural strength, fire safety, *means of egress*, light, *ventilation* and sanitary requirements of this code as necessary to insure the public health, safety and general welfare.

**109.3 Termination of approval:** The code official is hereby authorized to terminate such special approval and to order the demolition of any such construction at the official's discretion, or as directed by a decision of the board of appeals.

## SECTION 110.0 PROOF OF INSURANCE

**110.1 Compliance with law:** The issuance of a building permit shall be contingent upon presentation of proof to the effect that all contractors and subcontractors employed or that will be employed in the construction, *alteration* or repair under the permit are in compliance with Kentucky law relating to worker's compensation and unemployment insurance.

**110.2 General applicability:** Compliance with this section shall be achieved by presenting certificates or other forms approved by law to the code official issuing the permit.

**110.3 Deleted.**

## SECTION 111.0 CONDITIONS OF PERMIT

**111.1 Payment of fees:** A permit shall not be issued until the fees have been paid as prescribed by Section 112.0 of this code.

**111.2 Compliance with code:** The permit shall be a license to proceed with the work and shall not be construed as authority to violate, cancel or set aside any of the provisions of this code, except as specifically stipulated by modification or legally granted variation as described in the application or permit.

**111.3 Compliance with permit:** All work shall conform to the approved application and the approved *construction documents* for which the permit has been issued and any approved amendments to the approved application or the approved *construction documents*.

**111.4 Compliance with site plan and zoning:** All new work shall be located strictly in accordance with the approved plot plan and any local ordinances governing the location of the building.

## SECTION 112.0 FEES

**112.1 General:** A permit to begin work for new construction, *alteration*, removal or other building operations shall not be issued until the fees prescribed by law shall have been paid to the department, if applicable, and to the local building department. If an amendment to a permit necessitates an additional fee because of an increase in the estimated cost of the work involved, the permit shall not be approved until the additional fee has been paid.

**112.2 Special fees:** Payment of fees for construction, *alteration* or removal, and for all work done in connection with or concurrently with the work contemplated by a building permit shall not relieve the applicant or holder of the permit from the payment of other fees that may be prescribed by law or ordinance for water taps, sewer connections, electrical permits, erection of *signs* and display structures, marquees or other *appurtenant structures*, or fees of inspections or certificates of occupancy or other privileges or requirements established by law.

**112.3 State jurisdiction:** The fees for plan examination and inspection functions required by the Department of Housing, Buildings and Construction shall be as prescribed in Sections 112.3.1 through 112.3.18, as applicable.

**112.3.1 Fee schedule:** The fees shall be paid in accordance with Table 112.3.1.

**Table 112.3.1**
**DEPARTMENT OF HOUSING FEE SCHEDULE**

| Occupancy type | Cost per square foot |
|---|---|
| Residential[a] | 4 cents |
| Assembly occupancies | |
| Nightclub/restaurants | 5 cents |
| All other assembly | 5 cents |
| Day care centers | 4 cents |
| Educational | 4 cents |
| Business | 4 cents |
| Mercantile | 4 cents |
| Industrial factories | 3 cents |
| Warehouses | 2.5 cents |
| Institutional | 5 cents |
| Frozen food plants | 4 cents |
| High hazard | 4 cents |
| All other nonresidential | 4 cents |

**Note a.** Excluding single-family dwellings and duplexes.

**112.3.2 Submission of plans and fees:** All plans and specifications required to be submitted to the Department by this code shall be accompanied by the applicable fee as set forth herein, rounded to the nearest dollar.

**112.3.3 Method of payment:** All fees required herein shall be in check form payable to the Kentucky State Treasurer.

**112.3.4 Construction approval:** Approval for construction shall not be issued by the Department until all required fees have been paid.

**112.3.5 New construction:** Departmental plan review fees for new buildings shall be calculated by multiplying the total building area under construction by the cost per square foot of each occupancy type as listed in Table 112.3.1. Total square footage shall be determined by the outside dimensions of the building. Minimum fee for review of plans under this section shall be $75.

**112.3.6 Additions to existing buildings:** Plan review fees for additions to existing buildings, which shall not require the entire building to conform to the Kentucky Building Code, shall be calculated in accordance with Table 112.3.1 by the measurement of the square footage of the addition, as determined by the outside dimensions of the addition. Minimum fee for review of plans under this section shall be $75.

**112.3.7 Change in use:** Plan review fees for existing buildings in which the use group or occupancy type is changed shall be calculated in accordance with Table 112.3.1 by using the total square footage of the entire building or structure under the new occupancy type as determined by the outside dimensions. Minimum fee for review of plans under this section shall be $75.

**112.3.8 Alterations and repairs:** Plan review fees for alterations and repairs not otherwise covered by this fee schedule shall be calculated by multiplying the cost for the repairs by 0.002. Minimum fee for review of plans under this section shall be $75.

**112.3.9 Specialized fees:** In addition to the above fees, the fees in Table 112.3.9 shall be applied for the specialized plan reviews listed.

**Table 112.3.9**
**AUTOMATIC SPRINKLER REVIEW FEE TABLE**

| Sprinkler heads | Fee |
|---|---|
| 4-200 | $ 75 |
| 201-300 | $100 |
| 301-400 | $125 |
| 401-750 | $150 |
| Over 750 | $150 plus 15 cents per sprinkler over 750 |

**112.3.10 Fire detection system review fee:** Zero to 20,000 square feet shall be $75; over 20,000 square feet shall be $75 plus $15 for each additional 10,000 square feet in excess of 20,000 square feet.

**112.3.11 Standpipe plan review fee:** $50 (combination standpipe and riser plans shall be reviewed under the automatic sprinkler review fee schedule).

**112.3.12 Carbon dioxide suppression system review fee:** One to 200 pounds of agent shall be $75; over 200 pounds of agent shall be $75 plus 2 cents per pound in excess of 200 pounds.

**112.3.13 Halon suppression system review fee:** Up to 35 pounds of agent shall be $75; over 35 pounds shall be $75 plus 5 cents per pound in excess of 35 pounds.

**112.3.14 Foam suppression system review fee:** $1 per gallon of foam concentrate. The fee for review of plans under this section shall not be less than $75 or more than $1,500.

**112.3.15 Commercial range hood review fee:** $75 per hood.

**112.3.16 Dry chemical systems review fee (except range hoods):** One to 30 pounds of agent shall be $75; over 30 pounds of agent shall be $75 plus 20 cents per pound in excess of 30 pounds.

**112.3.17 Flammable, combustible liquids or gases and hazardous materials plan review fee:** $50 per tank, plus $25 for each additional tank and $50 per piping system including valves, fill pipes, vents, leak detection, spill and overfill detection, cathodic protection or associated components.

**112.3.18 Boiler and unfired pressure vessel fees:** Plan review fees of boiler and unfired pressure vessel installations pursuant to Kentucky Administrative Regulation 815 KAR 15:027 shall be in accordance with Table 112.3.18.

**Table 112.3.18**
**BOILER AND UNFIRED PRESSURE VESSEL FEES**

| Heating surface (square feet) | Fee |
|---|---|
| 100 and under | $ 20 |
| 101 to 1,000 | $ 30 |
| 1,001 to 4,000 | $ 50 |
| 4,001 to 10,000 | $ 70 |
| 10,001 and over | $100 |
| Unfired pressure vessels | $ 20 |

**112.4 Local jurisdiction:** Each local government shall adopt its own schedule of reasonable fees for building permits and the performance of functions under this code. The fees shall be designed to cover fully the cost of the service performed but shall not exceed the cost of the service performed.

**112.5 Accounting:** The code official shall keep an accurate account of all fees collected; and such collected fees shall be deposited monthly in the jurisdiction treasury, or otherwise disposed of as required by law.

## SECTION 113.0 INSPECTION

**113.1 Preliminary inspection:** Before issuing a permit, the appropriate code official shall examine or cause to be examined all buildings, structures and sites on which construction has began or for which an application has been filed for a permit to construct, enlarge, alter, repair, remove, or change the use as required by Chapter 34. Construction shall not begin until a local code official has issued a permit for construction and an official representing the department has issued a letter releasing the *construction documents* for construction (if the Department has plan review responsibility).

**113.2 Required inspections:** After issuing a building or construction permit, the code official shall conduct periodic inspections during the critical construction phase and upon completion of the work for which a permit has been issued. A record of all examinations, inspections and violations of this code shall be maintained in accordance with the Kentucky Records and Retention Plan. The owner shall provide for *special inspections* in accordance with Section 1705.0.

**113.2.1 Plant inspection:** Where required by the provisions of this code, materials or assemblies shall be inspected at the point of manufacture or fabrication in accordance with Section 1703.3.

**113.2.2 Off-site construction:** In-plant inspections in production and manufacturing facilities for industrialized building systems as well as on-site inspection shall be conducted by the department or its authorized agent. The local code official shall be responsible for inspection of these systems for *zoning*, water supply and sewage disposal, and other applicable local ordinance purposes.

**113.2.3 Trade-name dwelling inspections:** Inspections for code compliance of trade-name or brand-name homes shall be the responsibility of the local code official.

**113.2.4 On-site construction:** On-site construction related to modular home installations may be permitted and inspected by the local code official having jurisdiction.

**113.3 Final inspection:** Upon completion of the building, the owner or agent of the facility shall request a final inspection. The code official shall set a time for the inspection and notify the owner or agent. If substantial compliance with the approved *construction documents* and permit has been achieved, a certificate of occupancy shall be issued, as described in Section 118.0 of this code. If compliance has not been achieved, violations of the approved *construction documents* and permit shall be noted and immediately communicated to the owner, agent or other person holding the permit and the fire code official. It shall be the owner's responsibility to fulfill any compliance deficiencies noted.

**113.4 Right of entry:** The code official shall have the authority to enter at any reasonable time any structure or premises for which a permit has been issued but has not received a certificate of occupancy in accordance with Section 118.0.

For all other structures or premises, when the code official has reasonable cause to believe that a code violation exists, the code official is authorized to enter the structure or premises at reasonable times to inspect, subject to constitutional restrictions on unreasonable searches and seizures. Prior to entering into a space not otherwise open to the general public, the code official shall make a reasonable effort to locate the owner or other person having charge or control of the structure or premises, present proper identification and request entry. If requested entry is refused or not obtained, the code official is authorized to pursue recourse as provided by law.

**113.5 Coordination of inspections:** Whenever in the enforcement of this code or another code or ordinance, the responsibility of more than one code official of the jurisdiction is involved, it shall be the duty of the code officials involved to coordinate their inspections and administrative orders as fully as practicable so that the owners and occupants of the structure shall not be subjected to visits by numerous inspectors or multiple or conflicting orders. Whenever an inspector from any agency or department observes an apparent or actual violation of some

provision of some law, ordinance or code not within the inspector's authority to enforce, the inspector shall report the findings to the code official having jurisdiction.

**113.6 Fire code official inspections:** The code official shall cooperate with the fire code official by allowing the fire code official to inspect all buildings during construction. Recommendations made by the fire code official relating to fire safety in construction of a building shall be considered by the code official, and if a certificate of occupancy is issued contrary to the *written* recommendations, the code official shall give *written* notification of the decision to the fire code official at once.

## SECTION 114.0 PROFESSIONAL SERVICES (Architects, Engineers, Licensed Contractors)

**114.1 General:** All design for new construction, *alteration*, repair, expansion, *addition* or modification work involving the practice of professional architecture or engineering, as defined by KRS Chapters 322 and 323, shall be prepared by Kentucky-licensed professional architects or engineers and all *construction documents* required for a building permit application for the work shall bear the required signature and seals of the design professionals, as required by law.

**Exception:** Seals of design professionals shall not be required for tenant space alterations unless the space itself is of a size that would require the seal if it were a new building.

**114.2 Special inspections:** *Special inspections* shall be made as required by and in accordance with Section 1705.0.

**114.2.1 Seismic design:** *Special inspections* shall be a requirement for buildings subject to seismic design under Section 1705.0.

**114.2.2 Fees and costs:** Fees and costs related to the performance of *special inspections* by professional services shall be borne by the owner.

**114.2.3 Code assurances:** If construction on a building began prior to approval by the code official or the construction does not conform to the approved *construction documents* or the standards required by the code, the code official may require *special inspections* and reports if necessary to ensure safety.

**114.3 Licensed HVAC contractors:** All work involving HVAC as defined and required by KRS Chapter 198B shall be provided by a licensed Journeyman HVAC Mechanic working under the supervision of a licensed Master HVAC Contractor. The code official may require proof of licensure when making inspections.

## SECTION 115.0 WORKMANSHIP

**115.1 General:** All work shall be conducted, installed and completed in a workmanlike and acceptable manner so as to secure the results intended by this code.

## SECTION 116.0 VIOLATIONS

**116.1 Unlawful acts:** It shall be unlawful for any person, firm or corporation to erect, construct, *alter*, extend, repair, remove, demolish or occupy any building or structure or equipment regulated by this code, or cause same to be done, in conflict with or in violation of any of the provisions of this code.

**116.2 Notice of violation:** The code official shall serve a notice of violation or order on the person responsible for the erection, construction, *alteration*, extension, repair, removal, demolition or occupancy of a building or structure in violation of the provisions of this code, or in violation of a detailed statement or a plan approved thereunder, or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

**116.3 Prosecution of violation:** If the notice of violation is not complied with promptly, the code official shall request the legal counsel of the jurisdiction to institute the appropriate proceeding at law or in equity to restrain, correct or abate such violation or to require the removal or termination of the unlawful occupancy of the building or structure in violation of the provisions of this code or of the order or direction made pursuant thereto.

**116.4 Violation penalties:** A person who violates a provision of this code or fails to comply with the requirements of this code, or a person who erects, constructs, alters or repairs a building or structure in violation of an approved *construction document* or proper direction of the code official or of a permit or certificate issued under the provisions of this code, shall be subject to the penalties provided by KRS 198B.990 and other applicable law.

**116.5 Abatement of violation:** The department or any local agency enforcing the uniform state building code may obtain injunctive relief from any court of competent jurisdiction to enjoin the offering for sale, delivery, use, occupancy or construction of any building on which construction was begun after the effective date of said code, upon an affidavit of the department or the local government agency specifying the manner in which the construction, or, if a building existed prior to the effective date of said code, the reconstruction, *alteration*, repair or conversion does not conform to the requirements of this code.

**116.6 Hindering an inspection:** A person shall not hinder an inspector enforcing the provisions of this code in the performance of the inspector's lawful duties under this chapter.

## SECTION 117.0 STOP WORK ORDER

**117.1 Notice to owner:** Upon notice from the code official that work on any building or structure is being prosecuted contrary to the provisions of this code or in an unsafe and dangerous manner, such work shall be immediately stopped. The stop work order shall be in *writing* and shall be given to the owner of the property involved, or to the owner's agent, or to the person doing the work; and shall state the conditions under which work will be permitted to resume.

**117.2 Unlawful continuance:** A person who shall continue work in or about the structure after having been served with a stop-work order, except the work that person is directed to perform to remove a violation or unsafe condition, shall be liable to a fine of not less than $10 nor more than $1,000. Each day constitutes a separate offense, as required by KRS 198B.990.

## SECTION 118.0 CERTIFICATE OF OCCUPANCY

**118.1 General:** A certificate of occupancy, indicating completion of the work for which a permit was issued, shall be obtained prior to any occupancy of a structure except as provided for in Section 118.2.

**118.2 Temporary occupancy:** Upon the request of the holder of a permit, a temporary certificate of occupancy shall be issued

before the completion of the entire work covered by the permit provided that such portion or portions shall be occupied safely prior to full completion of the structure without endangering life or public welfare. Any occupancy permitted to continue during the work shall be discontinued within 30 days after completion of the work unless a certificate of occupancy is issued by the code official.

**118.3 Deleted.**

**118.4 Certificate information:** If a building or structure is entitled to a certificate, the code official shall issue a certificate of occupancy within ten days after *written* application. The certificate shall certify compliance with the provisions of this code and the purpose for which any portion of the building or structure may be used. The certificate of occupancy shall specify the following information:

1. The edition of the code under which the permit was issued;
2. The use group, in accordance with the provisions of Chapter 3;
3. The type of construction, as defined in Chapter 6; and
4. Special stipulations, restrictions or conditions, if any.

**118.5 Approval of service equipment:** If the installation, extension, *alteration* or repair of an elevator, moving *stairway*, mechanical equipment, refrigeration, air-conditioning or *ventilating* apparatus, plumbing, gas piping, electrical wiring, heating system or other equipment is controlled by the provisions of this code, this equipment shall not be used until a certificate of approval has been issued by the code official or other agency having jurisdiction.

## SECTION 119.0 CHR REGULATED BUILDINGS

**119.1 Hospitals, nursing homes and other institutional (I-2) facilities:** Hospitals, nursing homes and other institutional (I-2) facilities licensed by the Cabinet for Human Resources and inspected under contract with the Cabinet for Human Resources by the Department of Housing, Buildings and Construction shall comply with the institutional use group requirements specified in Chapter 4, including specific references to other sections of this code, and the applicable provisions of NFPA 101 listed in Chapter 35.

**119.2 Day care centers:** Day care centers, except those governed by Section 422.0 and other similar care facilities licensed by the Cabinet for Human Resources which comply with the provisions of NFPA Pamphlet #101 (Life Safety Code) listed in Chapter 35 as approved by the State Fire Marshal shall be deemed to satisfy the life safety requirements of this code.

**119.3 Deleted.**

**119.4 Deleted.**

**119.5 Deleted.**

**119.6 Deleted.**

## SECTION 120.0 EMERGENCY MEASURES

**120.1 Vacating structures:** If, in the opinion of the code official, during construction on a building for which a permit is required, there is actual and immediate danger of failure or collapse of a building or structure, or a portion of a building or structure, which would endanger life; or if a building or structure, or a portion of a building or structure, has fallen and life is endangered by occupation of the building or structure, the code official shall be authorized and empowered to order and require the inmates and occupants to vacate the building or structure. The code official shall cause to be posted at each entrance to the building a notice reading as follows: "This Structure is Unsafe and its Use or Occupancy has been Prohibited by the Code Official." It shall be unlawful for any person to enter the building or structure except for the purpose of making the required repairs or of demolishing the building or structure.

**120.2 Temporary safeguards:** If, in the opinion of the code official, there is actual and immediate danger of collapse or failure of a building or structure (over which the code official has jurisdiction) which would endanger life, pursuant to KRS Chapter 198B and this code, the code official shall cause the necessary work or *special inspection* to be performed to render the building or structure or any portion of the building or structure temporarily safe, whether or not the legal procedures described herein have been instituted.

**120.3 Closing streets:** When necessary for the public safety, the code official shall temporarily close structures and close, or order the authority having jurisdiction to close, sidewalks, streets, *public ways* and places adjacent to unsafe structures, and prohibit the same from being used.

**120.4 Deleted.**

**120.5 Deleted.**

**120.6 Deleted.**

**120.6.1 Deleted.**

**120.6.2 Deleted.**

## SECTION 121.0 LOCAL BOARD OF APPEAL

**121.1 Local appeals board:** Local appeals boards may be appointed to hear appeals from the decisions of the local code official in accordance with the provisions of Sections 121.1.1 through 121.5.

**121.1.1 Appointment:** The mayor or county judge executive of a local government which is enforcing the *Kentucky Building Code* may, upon approval of the local legislative body, appoint a local appeals board, consisting of at least five technically qualified persons with professional experience related to the building industry, three of which shall not be employees of the local government, to hear appeals from the decisions of the local code official regarding building code requirements.

**121.1.2 Cooperative agreements:** Local governments which are enforcing the *Kentucky Building Code* may cooperate with each other and provide a local appeals board and shall adhere to the provisions of KRS Chapter 65 when entering into a cooperative agreement.

**121.1.3 Disqualification of member:** Local code officials or employees of a local inspection department shall not sit on a local appeals board if the board is hearing an appeal to a decision rendered by the local department. A member of a local appeals board shall not hear an appeal in a case in which the member has a financial interest.

**121.1.4 Right to appeal:** Any party to a decision by the local code official may appeal that decision to the local appeals board. Upon receipt of an appeal from a qualified party, the local appeals board shall convene a hearing to consider the appeal within 15 days of receipt.

**121.2 Notice of meeting:** All parties to the appeal shall be notified of the time and place of the hearing by letter sent by certified mail not later than ten days prior to the date of the hearing.

**121.2.1 Deleted.**

**121.2.2 Deleted.**

**121.2.3 Deleted.**

**121.2.4 Deleted.**

**121.2.5 Deleted.**

**121.2.6 Deleted.**

**121.3 Board decision:** The local appeals board shall render a decision within five working days after the hearing. The board may uphold, amend or reverse the decision of the local code official, and there shall be no appeal from the decision of the local appeals board other than by appeal to the Board of Housing, Buildings and Construction.

**121.4 Open hearing:** All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

**121.4.1 Procedure:** The board shall adopt and make available to the public through the secretary procedures under which a hearing will be conducted. The procedures shall not require compliance with strict rules of evidence but shall mandate that only relevant information be received.

**121.5 Deleted.**

**121.6 Board decision:** The board shall modify or reverse the decision of the code official by a concurring vote of three members.

**121.6.1 Deleted.**

**121.6.2 Deleted.**

**121.7 Deleted.**

## SECTION 122.0 STATE BOARD OF APPEALS

**122.1 General:** All appeals from the decisions of code officials shall be conducted in accordance with the appeals provisions of KRS 198B.070. Where a local appeals board exists, a party must first appeal to the local board when aggrieved by a decision of the local code official. The board shall further hear appeals directly from a party aggrieved by the decision of an agent of the department.

**122.2 Appeal by fire code official:** Decisions rendered by the code official with respect to enforcement of the *Kentucky Building Code* on any building may be appealed by the local fire code official of the jurisdiction if the fire code official is aggrieved by that decision.

**122.3 Method of appeal:** Application for appeal by a property owner may be made when it is claimed in *writing* that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply, or an equally good or better form of construction can be used, or that the code official has refused to grant a modification to the provisions of this code covering the manner of construction or material to be used in the erection, *alteration* or repair of a building or structure.

**122.4 Application procedure:** Appeals to the board shall be in *writing* and shall be addressed to the Commissioner of Housing, Buildings and Construction, The 127 Building, 1047 U.S. 127 South, Suite #1, Frankfort, KY 40601; Attention: Appeals Board. The appeal shall include citations of those provisions of the *Kentucky Building Code* which are at issue, an explanation of why the decision of the state code official or local code official relative to those provisions is being contested and a copy of the decision rendered by the local appeals board, if any.

**122.5 Investigation of appeal:** The commissioner shall immediately notify the board or the five-member committee authorized by the board when an appeal is received. The commissioner or a designated employee of the department shall then investigate the evidence pertaining to the appeal and, based upon the results of the investigation, make written recommendations to the board or committee on the disposition of the case in question, within 30 days.

**122.6 Employee deferral:** Employees of the department shall not investigate or make recommendations on an appeal to his or her own decision, but shall defer in this case to employees who are not party to the decision which led to the appeal.

**122.7 Investigative authority:** In conducting an investigation, the commissioner or the designated representatives, acting for the department, shall have the authority to administer oaths and affirmations, issue subpoenas authorized by law, rule upon offers of proof and receive relevant evidence, take or cause depositions to be taken, regulate the course of any hearings they may schedule, and hold conferences for the settlement or simplification of the issue by consent of the parties.

**122.8 Administrative hearing:** Pursuant to KRS Chapter 13B, if the issue has not been settled by agreement of the parties within limitations set by Section 122.5, the Board shall schedule an administrative hearing on the matter. Final orders of the Board are appealable to the Circuit Court in the county in which the property is located.

## SECTION 123.0 POSTING STRUCTURES

**123.1 Posting:** All *signs* required by this code to be posted shall be furnished by the owner and shall be of a permanent design. The *signs* shall not be removed or defaced and, if lost, removed or defaced, shall be immediately replaced.

## SECTION 124.0 EFFECTIVE DATES

**124.1 General:** Until July 1, 1997, the department shall accept plans in compliance with the requirements of either the 1994 or 1997 edition of the *Kentucky Building Code*. Effective July 1, 1997, all plans shall be designed to conform to this code.

# CHAPTER 2

# DEFINITIONS

## SECTION 201.0 GENERAL

**201.1 Scope:** Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code, have the meanings shown in this chapter.

**201.2 Interchangeability:** Words used in the present tense include the future; words used in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

**201.3 Terms defined in other codes:** Where terms are not defined in this code and are defined in the plumbing, fire prevention or mechanical codes listed in Chapter 35, such terms shall have the meanings ascribed to them as in those codes.

**201.4 Terms not defined:** Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.

## SECTION 202.0 GENERAL DEFINITIONS

**Acceleration**

**Effective peak acceleration:** See Section 1610.2.

**Effective peak velocity-related acceleration:** See Section 1610.2.

**Accepted engineering practice:** That which conforms to accepted principles, tests or standards of nationally recognized technical or scientific authorities.

**Accessible:** See Section 1102.0.

**Accessible route:** See Section 1102.0.

***Accessory structure:*** A building, the occupancy of which is incidental to that of the main building, that is located on the same *lot* as the main building.

* **ADAAG:** See Section 1102.0.

***Addition:*** An increase in building *area*, aggregate floor *area*, *height* or number of stories of a structure (see Section 3403.0).

**Admixture:** See Section 1902.0.

***Aerosol:*** See Section 307.2.

***Aerosol container:*** See Section 307.2.

**Agricultural building:** A building or structure, other than one exempt from the code as a building or structure incident to the operation of a farm under Section 101.4, utilized to store farm implements, hay, feed, grain or other agricultural or horticultural products or to house poultry, livestock or other farm animals. Such structure shall not include *habitable* or *occupiable spaces*, spaces in which agricultural products are processed, treated or packaged, nor shall an agricultural building be a place of occupancy by the general public (see Section 312.0).

***Aisle accessway:*** See Section 1002.0.

***Alarm verification:*** See Section 902.0.

***Alteration:*** Any construction or renovation to an existing structure other than repair or addition.

***Alternating tread stairway:*** See Section 1002.0.

**Anchor:** See Section 2102.0.

**Anchor store:** See Section 402.2.

**Annular space:** See Section 702.0.

**Approved:** Approved by the code official or other authority having jurisdiction.

***Approved agency:*** See Section 1702.0.

**Approved material, equipment and methods:** Material, equipment and methods evaluated and approved (see Section 106.0).

***Approved rules:*** The legally adopted rules of the code official (see Section 105.0).

***Appurtenant structure:*** A device or structure attached to the exterior or erected on the roof of a building designed to support service equipment or used in connection therewith, or for advertising or display purposes, or other similar occupancies.

**Architectural terra cotta:** See Section 2102.0.

***Area, building:*** See Section 502.0.

**Area, gross cross-sectional:** See Section 2102.0.

***Areaway (form of construction):*** See Section 3203.2.

**Atrium:** See Section 404.1.

***Attic:*** See Section 1202.0.

**Automatic:** See Section 902.0.

***Automatic fire suppression system:*** See Section 902.0.

**Automotive service station:** See Section 309.1.

**Awning:** See Section 3105.2.

**Balcony (exterior):** See Section 1602.0.

***Barricade:*** See Section 307.2.

**Base:** See Section 1610.2.

**Base shear:** See Section 1610.2.

***Basement:*** See Section 502.0.

**Bay (part of a structure):** See Section 1610.2.

**Bay window:** See Section 1406.5.

**Bed-and-breakfast establishment:** See Section 310.2.

**Bed joint:** See Section 2102.0.

***Bleachers:*** See Section 1002.0.

**Blocked diaphragm:** See Section 2306.2.

**Board of Housing or board:** Kentucky Board of Housing, Buildings and Construction.

**BOCA:** Building Officials and Code Administrators International, Inc.

***Boiling point:*** See Section 307.2.

**Brick**
**Calcium silicate brick (sand lime brick):** See Section 2102.0.
**Clay or shale:** See Section 2102.0.
**Concrete brick:** See Section 2102.0.
**Hollow brick:** See Section 2102.0.

**Building:** Any combination of materials, whether portable or fixed, which comprises a structure or nonmine underground area affording facilities or shelter for any human occupancy, whether infrequent or regular. The word "building" shall be construed whenever used herein as if followed by the words "or part or parts thereof, and all equipment therein," unless the context clearly requires a different meaning. "Building" shall also mean swimming pools constructed below grade on site, but not swimming pools assembled above grade on site. "Building" shall not mean a mobile home, or a farm dwelling or other farm buildings and structures incident to the operation and maintenance of the farm, if such farm structures are located outside the boundary of a municipality and are not used in the business of retail trade or used as a place of regular employment for ten (10) or more people or structures used in the storage or processing of timber products. This chapter shall not apply to any single-family dwelling except those sold or constructed under a trade or brand name. For application of this code, each portion of a building which is completely separated from other portions by *fire walls* complying with Section 707.0 shall be considered as a separate building.

**Building, existing:** Any structure occupied prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued.

**Building line:** The line established by law, beyond which a building shall not extend, except as specifically provided by law.

**Building service equipment:** The mechanical, electrical and elevator equipment including piping, wiring, fixtures and other accessories, which provides sanitation, lighting, heating, *ventilation*, fire protection and transportation facilities essential for the habitable occupancy of the building or structure for its designated occupancy.

**Building site:** The area occupied by a building or structure, including the yards and *courts* required for light and *ventilation*, and such areas that are prescribed for access to the street.

**Buttress:** See Section 2102.0.

**Canopy:** See Section 3105.2.

**Carbon dioxide extinguishing system:** See Section 909.1.

**Catchment area:** See Section 1012.2.

**Cementitious material:** See Section 1902.0.

**Chapter:** A chapter of the *BOCA National Building Code/1996*, 13th edition, Chapters 1 through 35, published by Building Officials and Code Administrators International, Inc., 4051 West Flossmoor Road, Country Club Hills, Illinois 60478-5795.

**Chimney:** See Section 2102.0.

**Chimney types**
**High-heat appliance type:** See Section 2102.0.
**Low-heat appliance type:** See Section 2102.0.
**Masonry type:** See Section 2102.0.
**Medium-heat appliance type:** See Section 2102.0.

**Clean agent:** See Section 902.0.

**Closed system:** See Section 307.2.

**Code official or official:** An inspector certified by the Department in accordance with 815 KAR 7:070 and designated by the Department or by a local government as an enforcement official for the *Kentucky Building Code* pursuant to KRS Chapter 198B.

**Collar joint:** See Section 2102.0.

***Combustible dusts:*** See Section 307.2.

***Combustible fibers:*** See Section 307.2.

***Combustible liquids:*** See Section 307.2.

**Combustible material:** A material which cannot be classified as noncombustible in accordance with Section 704.4.1.1.

**Commissioner:** The commissioner of housing, buildings and construction.

***Common path of travel:*** See Section 1002.0.

**Components and cladding:** See Section 1609.2.

***Compressed gas:*** See Section 307.2.

**Concrete:**
**Plain concrete:** See Section 1902.0.
**Reinforced concrete:** See Section 1902.0.

**Connector:** See Section 2102.0.

***Construction documents:*** All of the written, graphic and pictorial documents prepared or assembled for describing the

design, location and physical characteristics of the elements of the project necessary for obtaining a building permit. The construction drawings shall be drawn to an appropriate scale.

**Construction equipment:** See Section 3312.1.

**Construction, type of:** See Section 602.0.
**Type 1:** See Section 603.0.
**Type 2:** See Section 603.0.
**Type 3:** See Section 604.0.
**Type 4:** See Section 605.0.
**Type 5:** See Section 606.0.

***Control area:*** See Section 307.2.

***Corridor:*** See Section 1002.0.

***Corrosive:*** See Section 307.2.

***Court:*** See Section 1202.0.
***Inner:*** See Section 1202.0.
***Outer:*** See Section 1202.0.

**Court height:** See Section 1202.0.

**Court width:** See Section 1202.0.

***Cryogenic liquids (flammable or oxidizing):*** See Section 307.2.

**Curb level:** See Section 3203.2.
**Building or wall height:** See Section 3203.2.

***Damper, fire:*** See Section 702.0.

**Deck:** See Section 1602.0.

***Deflagration:*** See Section 307.2.

***Deluge system:*** See Section 902.0.

**Department:** The department of housing, buildings and construction.

**Design earthquake:** See Section 1610.2.

**Designated seismic systems:** See Section 1610.2.

**Detached storage building:** See Section 307.2.

**Detector, heat:** See Section 902.0.

**Detector, smoke:** See Section 902.0.

***Detonation:*** See Section 307.2.

**Diaphragm:** See Sections 1610.2, 2102.0 and 2306.2.

**Dimensions**
**Actual dimensions:** See Section 2102.0.
**Nominal dimensions:** See Section 2102.0.

**Dish antenna:** See Section 3109.3.

**Dispensing:** See Section 307.2.

**Door assembly, fire:** See Section 702.0.

***Door, fire:*** See Section 702.0.

***Draftstopping:*** See Section 702.0.

**Dry-chemical extinguishing system:** See Section 910.1.

***Dumbwaiter:*** See Section 3002.0.

**Dwellings**
***Boarding house:*** See Section 310.2.
***Dormitory:*** See Section 310.2.
***Dwelling unit:*** See Section 310.2.
***Multiple-family dwelling:*** See Section 310.2.
***Multiple single-family dwelling:*** See Section 310.2.
***One-family dwelling:*** See Section 310.2.
***Two-family dwelling:*** See Section 310.2.

***Dwelling unit:*** **Deleted.**

**Effective height:** See Section 2102.0.

**Elevator:** See Section 3002.0.
***Freight elevator:*** See Section 3002.0.
***Hand elevator:*** See Section 3002.0.
***Hydraulic elevator:*** See Section 3002.0.
***Passenger elevator:*** See Section 3002.0.
***Power elevator:*** See Section 3002.0.
***Sidewalk elevator:*** See Section 3002.0.

***Elevator repairs:*** See Section 3002.0.

***Emergency control station:*** See Section 416.2.

**Emergency electrical system:** See Section 2706.1.

**Equipment, existing:** Any equipment regulated by this code which was legally installed prior to the effective date of this code, or for which a permit to install has been issued.

***Escalator:*** See Section 3002.0.

***Exit:*** See Section 1002.0.

***Exit access:*** See Section 1002.0.

***Exit discharge:*** See Section 1002.0.

***Exit discharge, level of:*** See Section 1002.0.

***Exit, horizontal:*** See Section 1002.0.

***Explosive:*** See Section 307.2. *

***Exterior wall finish:*** See Section 1402.0.

***Fabric awning:*** See Section 1607.2.

***Fabric canopy:*** See Section 1607.2.

***Fabricated item:*** See Section 1702.0.

***Fabrication area:*** See Section 416.2.

**Facility:** See Section 1102.0.

**Farm:** Property located outside the corporate limits of a municipality on at least 10 acres and having a bona fide agricultural or horticultural use as defined by KRS 132.010(9) and (10) and qualified by and registered with the property valuation administrator in that county.

**Fire alarm box, manual:** See Section 902.0.

**Fire alarm system:** See Section 902.0.

***Fire area:*** See Section 702.0.

**Fire code official:** The State Fire Marshal, fire chief or other enforcement officer designated by the appointing authority of the jurisdiction for the enforcement of the provisions of KRS 227.300 and the *Kentucky Standards of Fire Safety* (Fire Prevention Code) as set forth in Title 815, Chapter 10, of the Kentucky Administrative Regulations.

*Fire command station:* See Section 902.0.

*Fire detector, automatic:* See Section 902.0.

**Fire hazard:** The potential degree of fire severity based on the occupancy of a structure, classified as high, moderate or low.
**High:** All occupancies which involve the storage, sale, manufacture or processing of highly combustible, volatile flammable or explosive products which are capable of burning with extreme rapidity and produce explosions or large volumes of smoke, poisonous fumes or gases in the event of fire.
**Moderate:** All occupancies which involve the storage, sale, manufacture or processing of materials which are capable of burning with moderate rapidity and a considerable volume of smoke, but which do not produce either poisonous fumes or explosions, in the event of fire.
**Low:** All occupancies which involve the storage, sale or manufacture of materials that do not ordinarily burn rapidly, or produce excessive smoke, poisonous fumes or explosions in the event of fire.

*Fire partition:* See Section 702.0.

**Fire protection:** The provision of construction safeguards and *exit* facilities; and the installation of fire alarm, fire-detecting and fire-extinguishing service equipment to reduce the fire risk, including the risk involved in the spread of fire by exterior exposure to and from adjoining buildings and structures.

*Fire protection rating:* See Section 702.0.

*Fire protection system:* See Section 902.0.

*Fire separation assembly:* See Section 702.0.

*Fire separation distance:* See Section 702.0.

*Fire window:* See Section 702.0.

*Fireblocking:* See Section 702.0.

**Fireplace throat:** See Section 2102.0.

**Fireresistance:** See Section 702.0.

**Fireresistance rating:** See Section 702.0.

*Fireresistive joint system:* See Section 702.0.

**Flame spread:** See Section 802.0.

**Flame spread rating:** See Section 802.0.

**Flameresistance:** See Section 802.0.

*Flammable:* See Section 307.2.

*Flammable compressed gas:* See Section 307.2.

*Flammable liquids:* See Section 307.2.

*Flammable solid:* See Section 307.2.

*Flash point:* See Section 307.2.

*Floor area, gross:* See Section 1002.0.

*Floor area, net:* See Section 1002.0.

*Floor finish:* See Section 802.0.

**Foam-extinguishing systems:** See Section 911.1.

**Foyer:** See Section 1006.2.4.

**Frame**
**Braced:** See Section 1610.2.
**Concentrically braced frame (CBF):** See Section 1610.2.
**Eccentrically braced frame (EBF):** See Section 1610.2.
**Diagonal brace:** See Section 1610.2.
**Lateral support members:** See Section 1610.2.
**Link beam:** See Section 1610.2.
**Link beam end web stiffeners:** See Section 1610.2.
**Link beam intermediate web stiffener:** See Section 1610.2.
**Link beam rotation angle:** See Section 1610.2.
**Intermediate moment frame:** See Section 1610.2.
**Ordinary moment frame:** See Section 1610.2.
**Space frame:** See Section 1610.2.
**Special moment frame:** See Section 1610.2.

**Frame system**
**Building:** See Section 1610.2.
**Dual:** See Section 1610.2.
**Moment resisting:** See Section 1610.2.

*Garage, private:* See Section 407.2.

*Garage, public:* See Section 408.2.
**Group 1:** See Section 408.2
**Group 2:** See Section 408.2

*Grade hallway, grade lobby, grade passageway:* See Section 1002.0.

*Grade plane:* See Section 502.0.

*Grandstand:* See Section 1002.0.

**Greenhouse**
**Continuously heated:** See Section 1608.2.
**Production:** See Section 1608.2.
**Retail:** See Section 1608.2.

**Gross leasable area:** See Section 402.2.

**Guard system:** See Section 1002.1.

*Habitable space:* See Section 1202.0.

**Halogenated extinguishing system:** See Section 912.1.

**Handling:** See Section 307.2.

**Handrail:** See Section 1002.1.

*Hazardous materials:* See Section 307.2.

*Hazardous production material (HPM):* See Section 416.2.

**Head joint:** See Section 2102.0.

**Header (Bonder):** See Section 2102.0.

*Health hazard:* See Section 307.2.

*Height*
*Building:* See Section 502.0.
**Court:** See Section 1202.0.
**Story:** See Section 502.0.
**Walls:** See Section 2102.0.

**Hereafter:** After the time that this code becomes effective.

**Heretofore:** Before the time that this code became effective.

**High-temperature energy source:** See Section 1610.2.

***Highly toxic:*** See Section 307.2.

***Hoist***
***Material:*** See Section 3002.0.
***Personnel:*** See Section 3002.0.

***Hoisting and conveying equipment, special:*** See Section 3002.0.
***Automotive lift:*** See Section 3002.0.
***Conveyors:*** See Section 3002.0.
***Freight lift:*** See Section 3002.0.
***Manlifts:*** See Section 3002.0.

***Hoisting and elevating equipment, miscellaneous:*** See Section 3002.0.

***Incompatible materials:*** See Section 307.2.

**Industrialized building system or building system:** As defined in KRS 198B.010(18) and shall apply to buildings of any size or use, all or any component parts of which are of closed construction made from precast concrete panels or precut wood sections fabricated to individual specifications in an off-site manufacturing facility and assembled in accordance with the manufacturer's instructions.

***Inspection certificate:*** See Section 1702.0.

***Inspection, special:*** See Section 1702.0.

**Inverted pendulum-type structures:** See Section 1610.2.

***Irritant:*** See Section 307.2.

***Joint:*** See Section 702.0.

**Jurisdiction:** The governmental unit which has adopted this code under due legislative authority.
**KAR:** Kentucky Administrative Regulations.
**KBC:** *Kentucky Building Code* as established in this chapter.
***Kentucky Standards of Safety:*** The Kentucky Administrative Regulations established by the Commissioner of the Department of Housing, Buildings and Construction pursuant to KRS 227.300 to serve as the fire prevention code for existing buildings as well as a supplement to this code, where applicable.
**KRS:** Kentucky Revised Statutes.

***Label:*** See Section 1702.0.

**Light-framed wall with shear panels:** See Section 1610.2.

***Load:*** See Section 1602.0.
***Dead load:*** See Section 1602.0.
***Duration of load:*** See Section 1602.0.
***Earthquake load:*** See Section 1602.0.
***Impact load:*** See Section 1602.0.
* ***Lateral soil load:*** See Section 1602.0.
***Live load:*** See Section 1602.0.
***Wind load:*** See Section 1602.0.

**Loadbearing wall system:** See Section 1610.2.

**Lot:** A portion or parcel of land considered as a unit.

**Lot, corner:** A *lot* with two adjacent sides abutting upon streets or other public spaces.

**Lot, interior:** A *lot* which faces on one street or with opposite sides on two streets.

***Lot line:*** A line dividing one *lot* from another, or from a street or any public place.

***Lot line, interior:*** Any lot line other than one adjoining a street or public space.

***Lot line, street:*** The lot line dividing a *lot* from a street or other *public way*.

**Main windforce-resisting system:** See Section 1609.2.

**Mall:** See Section 402.2.

**Mall building, covered:** See Section 402.2.

**Mansard:** See Section 1502.0.

**Manufactured home:** A factory-built structure on a permanent chassis designed to be used as a dwelling and which is regulated by the federal government and the State Fire Marshal. These homes are required to carry a "HUD" seal applied by the manufacturer.

***Manufacturer's designation:*** See Section 1702.0.

***Mark:*** See Section 1702.0.

**Marquee:** See Section 3203.11.

**Masonry:** See Section 2102.0.
**Ashlar facing masonry:** See Section 2102.0.
**Ashlar masonry:** See Section 2102.0.
**Solid masonry:** See Section 2102.0.

**Masonry unit**
**Clay:** See Section 2102.0.
**Concrete:** See Section 2102.0.
**Hollow:** See Section 2102.0.
**Solid:** See Section 2102.0.

**Mean roof height (*h*):** See Section 1609.2.

***Means of egress:*** See Section 1002.0.

**Member**
**Primary:** See Section 1902.0.
**Secondary:** See Section 1902.0.

***Membrane:*** See Section 3103.2.

**Membrane structures**
**Air-inflated structure:** See Section 3103.2.
**Air-supported structure:** See Section 3103.2.
**Double skin:** See Section 3103.2.
**Single skin:** See Section 3103.2.
**Cable-restrained, air-supported structure:** See Section 3103.2.
**Membrane-covered cable structure:** See Section 3103.2.
**Membrane-covered frame structure:** See Section 3103.2.
**Noncombustible membrane structure:** See Section 3103.2.
**Tent:** See Section 3103.2.

***Mezzanine:*** See Section 502.0.

**Mobile unit:** See Section 420.1.

**Modular home:** An industrialized building system designed to be used as a residence which is not a manufactured or mobile home.

**Mortar:** See Section 2102.0.

**Mortar, surface-bonding:** See Section 2102.0.

***Moving walk:*** See Section 3002.0.

**Nominal dimension**
**Lumber:** See Section 2302.0.

**Noncombustible:** This is a general, relative term. Its precise meaning is defined in this code for specific applications.

**Noncombustible building material:** See Section 704.4.

**Occupancy:** The purpose for which a building or portion thereof is used.

***Occupancy, change of:*** A change in the purpose or level of activity within a structure that involves a change in application of the requirements of this code.

**Occupant load:** See Section 1002.0.

***Occupiable space:*** See Section 1202.0.

**Occupied:** As applied to a building, shall be construed as though followed by the words "or intended, arranged or designed to be occupied."

**Open parking structures:** See Section 406.1.

***Open system:*** See Section 307.2.

**Ordinary repair:** Any nonstructural reconstruction or renewal of any part of an existing building for the purpose of its maintenance or decoration, and shall include, but not be limited to, the replacement or installation of nonstructural components of the building such as roofing, siding, windows, storm windows, insulation, drywall or lath and plaster, or any other replacement, in kind, that does not alter the structural integrity or alter the occupancy or use of the building, or affect, by rearrangement, exitways and means of egress; but shall not include additions to, or alterations of, or relocation of any standpipe, water supply, sewer, drainage, gas, soil, waste, vent or similar piping, electric wiring or mechanical equipment including furnaces and hot water heaters or other work affecting public health or safety.

***Organic peroxide:*** See Section 307.2.

***Oriel window:*** See Section 3203.2.

**Other health-hazard material:** See Section 307.2.

***Owner:*** Any person, agent, firm or corporation having a legal or equitable interest in the property.

***Oxidizer:*** See Section 307.2.

**P-delta effect:** See Section 1610.2.

**Panel (part of a structure):** See Section 1602.0.

***Particleboard:*** See Section 2302.0.

***Penthouse:*** See Section 1502.0.

**Permit:** An official document or *certificate* issued by the authority having jurisdiction which authorizes performance of a specified activity (see Section 108.0).

**Person:** Includes a corporation, firm, partnership, association, organization and any other group acting as a unit as well as individuals. It shall also include an executor, administrator, trustee, receiver or other representative appointed according to law. Whenever the word "person" is used in any section of this code prescribing a penalty or fine, as to partnerships or associations, the word shall include the partners or members thereof, and as to corporations, shall include the officer, agents or members thereof who are responsible for any violation of such section.

***Physical hazard:*** See Section 307.2.

**Physically disabled person:** See Section 1102.0.

*Plastic*
**Light-diffusing system:** See Section 2602.0.
**Plastic glazing:** See Section 2602.0.
**Plastic roof panels:** See Section 2602.0.
**Plastic wall panels:** See Section 2602.0.
**Reinforced plastic, glass fiber:** See Section 2602.0.
**Thermoplastic material:** See Section 2602.0.
**Thermosetting material:** See Section 2602.0.

***Platform*:** See Section 412.2.

**Plenum:** See Section 2805.1.

**Pools, swimming, hot tubs and spas**
**Above-ground/on-ground pool:** See Section 421.2.
**Barrier:** See Section 421.2.
**Hot tub:** See Section 421.2.
**In-ground pool:** See Section 421.2.
**Power safety cover:** See Section 421.2.
**Private swimming pool:** See Section 421.2.
**Private swimming pool, indoor:** See Section 421.2.
**Private swimming pool, outdoor:** See Section 421.2.
**Public swimming pool:** See Section 421.2.
**Spa:** See Section 421.2.

**Preaction system:** See Section 902.0.

**Premises:** A lot, plot or parcel of land, including any structure thereon.

***Preservative treatment (treated material):*** See Section 2302.0.

**Proscenium wall:** See Section 412.2.

***Protected construction:*** See Section 702.0.

***Public way:*** See Section 1002.0.

***Pyrophoric:*** See Section 307.2.

***Radioactive material:*** See Section 307.2.

***Registered design professional:*** An architect or engineer, registered or licensed to practice professional architecture or engineering, as defined by the statutory requirements of the professional registration laws of the state in which the project is to be constructed.

**Repair:** The reconstruction or renewal of any part of an existing structure for the purpose of its maintenance (see Section 107.1.1).

**Required:** Shall be construed to be mandatory by provisions of this code.

**Resilient stable-mounting system:** See Section 1610.2.

**Restraining device:** See Section 1610.2.
**Elastic:** See Section 1610.2.
**Fixed:** See Section 1610.2.
**Seismic activated:** See Section 1610.2.

**Roof:** See Section 1502.0.

**Roof covering:** See Section 1502.0.

**Roof structure:** See Section 1502.0.

**Rubble masonry:** See Section 2102.0.
**Coursed rubble:** See Section 2102.0.
**Random rubble:** See Section 2102.0.
**Rough or ordinary rubble:** See Section 2102.0.

**Running bond:** See Section 2102.0.

**Sallyport:** See Section 410.3.6.

**Seismic-resisting system:** See Section 1610.2.

**Self-closing:** See Section 702.0.

***Sensitizer:*** See Section 307.2.

***Service passage, HPM:*** See Section 416.2.

***Shaft:*** See Section 702.0.

**Shall:** The term, where used in this code, shall be construed as mandatory.

**Shear wall:** See Section 1610.2.

***Sign:*** See Section 3102.2.
**Closed sign:** See Section 3102.2.
**Ground sign:** See Section 3102.2.
**Marquee sign:** See Section 3102.2.
**Open sign:** See Section 3102.2.
**Portable sign:** See Section 3102.2.
**Projecting sign:** See Section 3102.2.
**Roof sign:** See Section 3102.2.
**Temporary sign:** See Section 3102.2.
**Wall sign:** See Section 3102.2.

**Single-family dwelling:** A single unit providing complete independent living facilities for one or more persons including permanent provisions for living, sleeping, eating, cooking and sanitation, and which shall not be connected to any other unit or building.

***Single membrane penetration:*** See Section 702.0.

**Site:** See Section 1102.0.

**Slidescape:** See Section 1002.0.

**Smoke barrier:** See Section 702.0.

***Smoke compartment:*** See Section 702.0.

**Smoke detector, multiple station:** See Section 902.0.

**Smoke detector, single station:** See Section 902.0.

***Smokeproof enclosure:*** See Section 1002.0.

**Smoke-protected assembly seating:** See Section 1013.2.

**Special amusement building:** See Section 413.2.

***Splice:*** See Section 702.0.

***Sprinkler:*** See Section 902.0.

***Sprinkler system, automatic:*** See Section 902.0.

***Sprinkler system, limited area:*** See Section 902.0.

**Stack bond:** See Section 2102.0.

***Stage:*** See Section 412.2.

***Stairway:*** See Section 1002.0.

**Standby power system:** See Section 2707.1.

***Standpipe system:*** See Section 902.0.

**Steel construction, cold-formed:** See Section 2202.0.

**Steel joist:** See Section 2202.0.

**Steel member, structural:** See Section 2202.0.

**Stone masonry:** See Section 2102.0.
**Ashlar stone masonry:** See Section 2102.0.
**Rubble stone masonry:** See Section 2102.0.

***Storage room, HPM, separate inside:*** See Section 416.2.
***HPM cutoff room:*** See Section 416.2.
***HPM inside room:*** See Section 416.2.

**Story:** See Section 502.0.

***Story above grade:*** See Section 502.0.

**Story drift ratio:** See Section 1610.2.

**Story shear:** See Section 1610.2.

**Street:** A public thoroughfare (such as a street, avenue or boulevard) which has been dedicated for public use.

**Structure:** That which is built or constructed or a portion thereof.

**Structure, existing:** A structure erected prior to the date of adoption of the appropriate code or one for which a legal building permit has been issued.

**Supervisory device:** See Section 902.0.

**Technically infeasible:** See Section 1102.0.

**Through penetration:** See Section 702.0.

***Through-penetration firestop system:*** See Section 702.0.

**Tie, wall:** See Section 2102.0.

**Tile:** See Section 2102.0.

**Tile, structural clay:** See Section 2102.0.

***Tires, bulk storage of:*** See Section 307.2.

***Toxic:*** See Section 307.2.

**Trade-name or brand-name home:** A single-structure home made of precut or prefabricated panels, sections or individual pieces which are sold or prefabricated under a name that

identifies both the manufacturer and a particular type of structure that the manufacturer makes, and which are assembled on a permanent foundation by conventional homebuilding and electrical and plumbing installation techniques.

***Unstable (reactive) material:*** See Section 307.2.

**Use group:** The classification of an occupancy in accordance with Section 302.1.

***Vapor retarder:*** See Section 1202.0.

***Ventilation:*** See Section 1202.0.

**Vertical opening:** See Section 702.0.

**Voice/alarm signaling system:** See Section 902.0.

**Wall**
**Apron wall:** See Section 1402.0.
**Cavity wall:** See Section 2102.0.
**Composite wall:** See Section 2102.0.
**Dry-stacked, surface-bonded walls:** See Section 2102.0.
**Faced wall:** See Section 2102.0.
***Fire separation wall:*** See Section 702.0.
***Fire wall:*** See Section 702.0.
**Foundation wall:** See Section 1812.2.
**Loadbearing wall:** See Section 1602.0.
**Masonry bonded hollow wall:** See Section 2102.0.
**Nonloadbearing wall:** See Section 1602.0.
**Parapet wall:** See Section 2102.0.
**Party wall:** See Section 702.0.
**Retaining wall:** See Section 1812.2.
**Skeleton or panel wall:** See Section 1402.0.
**Spandrel wall:** See Section 1402.0.
**Veneered wall:** See Section 1402.0.

***Water-reactive material:*** See Section 307.2.

**Water-spray fixed system:** See Section 908.1.

***Water supply, automatic:*** See Section 902.0.

**Wet-chemical range hood extinguishing system:** See Section 914.1.

**Wind tributary area (*A*):** See Section 1609.2.

**Winder:** See Section 1002.0.

**Windowless building (I-3):** See Section 410.8.

**Wood shear panel:** See Section 2306.2.

**Wood structural panels:** See Section 2302.0.

***Writing (written):*** The term shall be construed to include handwriting, typewriting, printing, photo offset or any other form of reproduction in legible symbols or characters.

**Wythe:** See Section 2102.0.

**Yard:** See Section 1202.0.

***Zoning:*** The reservation of certain specified areas within a community or city for buildings and structures, or use of land for certain purposes with other limitations such as height, *lot* coverage and other stipulated requirements.

# CHAPTER 3

# USE OR OCCUPANCY

## SECTION 301.0 GENERAL

**301.1 Scope:** The provisions of this chapter shall control the classification of all buildings and structures as to use group.

**301.2 Application of other laws:** The provisions of this chapter shall not be deemed to nullify any provisions of the *zoning* law or any other statute of the jurisdiction pertaining to the location or occupancy of buildings, except as is specifically required by the provisions of this code.

## SECTION 302.0 CLASSIFICATION

**302.1 General:** All structures shall be classified with respect to occupancy in one or more of the use groups listed below. Where a structure is proposed for a purpose which is not specifically provided for in this code, such structure shall be classified in the use group which the occupancy most nearly resembles.

1. Assembly (see Section 303.0): Use Groups A-1, A-2, A-3, A-4 and A-5
2. Business (see Section 304.0): Use Group B
3. Educational (see Section 305.0): Use Group E
4. Factory and Industrial (see Section 306.0): Use Groups F-1 and F-2
5. High Hazard (see Section 307.0): Use Groups H-1, H-2, H-3 and H-4
6. Institutional (see Section 308.0): Use Groups I-1, I-2 and I-3
7. Mercantile (see Section 309.0): Use Group M
8. Residential (see Section 310.0): Use Groups R-1, R-2, R-3 and R-4
9. Storage (see Section 311.0): Use Groups S-1 and S-2
10. Utility and Miscellaneous (see Section 312.0): Use Group U

**302.1.1 Specific occupancy areas:** Specific occupancy areas which are incidental to the main use group shall be separated and protected in accordance with Table 302.1.1 and shall be classified in accordance with the main use group of the portion of the building in which the specific occupancy area is located. Where the building, or portion thereof, containing the specific occupancy area is required to be protected with an *automatic fire suppression system*, the separation alternative of Table 302.1.1 shall not apply.

**Exception:** Specific occupancy areas within and serving a *dwelling unit* are not required to comply with this section.

**Table 302.1.1**
**SPECIFIC OCCUPANCY AREAS**

| Room or area[b] | Separation[a]/protection |
|---|---|
| All use groups: | |
| Paint shops in occupancies other than Use Group F employing hazardous materials in quantities less than those which cause classification as Use Group H | 2 hours; or 1 hour and automatic fire suppression system |
| Waste and soiled linen collection rooms and chute termination rooms | 1 hour and automatic fire suppression system |
| Waste and soiled linen chute access rooms | 1 hour; or automatic fire suppression system with smoke partitions |
| Boiler and furnace rooms | 1 hour; or automatic fire suppression system with smoke partitions |
| Incinerator rooms | 2 hours and automatic fire suppression system |
| Use Groups A, B, E, I-1, R-1, R-2: | |
| Storage rooms more than 50 square feet in area but not more than 100 square feet in area | 1 hour; or automatic fire suppression system with smoke partitions |
| Storage rooms more than 100 square feet in area | Automatic fire suppression system with smoke partitions |
| Physical plant maintenance shop and workshop | 2 hours; or 1 hour and automatic fire suppression system |
| Use Groups I-2, I-3: | |
| Boiler and furnace rooms | 1 hour and automatic fire suppression system |
| Handicraft shops, kitchens, and employee locker rooms | 1 hour; or automatic fire suppression system with smoke partitions |
| Laundries greater than 100 square feet in area | 1 hour and automatic fire suppression system |
| Storage rooms more than 50 square feet in area but not more than 100 square feet in area | Automatic fire suppression system with smoke partitions |
| Storage rooms more than 100 square feet in area | 1 hour and automatic fire suppression system |
| Physical plant maintenance shop and workshop | 1 hour and automatic fire suppression system |
| Use Group I-2: | |
| Gift/retail shops and laboratories employing hazardous quantities less than those which cause classification as Use Group H | 1 hour; or automatic fire suppression system with smoke partitions |
| Use Group I-3 padded cells | 1 hour and automatic fire suppression system |

**Note a.** For requirements for fireresistance rated separations and smoke partitions, see Section 302.1.1.1.
**Note b.** 1 square foot = 0.093 $m^2$.

**302.1.1.1 Separation:** Where Table 302.1.1 requires a fireresistance rated separation, the specific occupancy area shall be separated from the remainder of the building with *fire separation assemblies* (see Section 709.0). Where Table 302.1.1 requires smoke partitions, the smoke partitions shall be constructed of materials consistent with the type of construction and shall be capable of resisting the passage of smoke. The smoke partitions shall extend from the floor to the underside of the fireresistance rated floor/ceiling or roof/ceiling assembly or to the underside of the floor or roof deck above. All doors shall be self-closing or automatic-closing upon detection of smoke. Doors shall not have air transfer openings and shall not be undercut in excess of the clearance permitted in accordance with NFPA 80 listed in Chapter 35.

**302.1.2 Accessory areas:** Except for accessory areas of Use Group H in accordance with Section 302.1.2.1 and specific occupancy areas indicated in Section 302.1.1, a *fire separation assembly* shall not be required between the main use group and accessory areas where the aggregate area devoted to all accessory occupancies does not occupy more than 10 percent of any *fire area*; the aggregate area devoted to all accessory uses within a story does not exceed 10 percent of the area of the story; and the aggregate area devoted to an accessory occupancy is not more than 10 percent of the allowable area permitted by Section 503.0 based on the accessory use group. The required type of construction and the *automatic fire suppression* requirements in Section 904.0 shall be based on the main use group of the *fire area*.

**302.1.2.1 High-hazard uses:** In buildings that are three stories or less in *height* and equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, an occupancy in Use Group F or S is permitted to have accessory areas of Use Group H-2, H-3 or H-4, provided that such areas do not occupy more than 10 percent of any *fire area*, nor more than 10 percent of the allowable area permitted by Section 503.0 based on the use group of the accessory area. A *fire separation assembly* shall not be required between the F or S use group and the accessory H use group. The maximum quantity of *hazardous materials* within the accessory H use group shall not exceed twice the permitted exempt amount specified in Table 307.8(1) or Table 307.8(2). The required type of construction shall be based on the main use group of the *fire area*.

**302.2 Mixed use:** All buildings and structures that include more than one use group shall be further designated as a mixed use and shall comply with Section 313.0. Specific occupancy areas and accessory areas complying with Sections 302.1.1 and 302.1.2, respectively, shall be classified in accordance with the main use group.

## SECTION 303.0 ASSEMBLY USE GROUPS

**303.1 General:** All structures which are designed or occupied for the gathering together of persons for purposes such as civic, social or religious functions, recreation, food or drink consumption or awaiting transportation, shall be classified as Use Group A-1, A-2, A-3, A-4 or A-5. A room or space used for assembly purposes by less than 50 persons and which is accessory to another use group shall be included as a part of that main use group. The term "Use Group A" shall include Use Groups A-1, A-2, A-3, A-4 and A-5.

**303.2 Use Group A-1, theaters:** This use group shall include all theaters and all other buildings and structures intended for the production and viewing of performing arts or motion pictures; and which are usually provided with fixed seats — including theaters, motion picture theaters and television and radio studios admitting an audience. *Stages* and *platforms* shall comply with Section 412.0.

**303.3 Use Group A-2 structures:** This use group shall include all buildings and places of public assembly, without theatrical *stage* accessories, designed for occupancy as dance halls, nightclubs and for similar purposes, including all rooms, lobbies and other spaces connected thereto with a common *means of egress* and entrance.

**303.4 Use Group A-3 structures:** This use group shall include all buildings with or without an auditorium in which persons assemble for amusement, entertainment or recreation purposes, as well as incidental motion picture, dramatic or theatrical presentations, lectures or other similar purposes without theatrical *stage* other than a raised *platform*; and which are principally occupied without permanent seating facilities, including art galleries, exhibition halls, museums, lecture halls, libraries, restaurants other than nightclubs, and recreation centers; and buildings designed for similar assembly purposes, including passenger terminals.

**303.5 Use Group A-4 structures:** This use group shall include all buildings and structures which are occupied exclusively for the purpose of worship or other religious services.

**303.5.1 Incidental uses:** Gymnasiums, Sunday school spaces, multipurpose rooms, libraries and fellowship halls located within or attached to a Use Group A-4 occupancy shall be classified as Use Group A-4 for purposes of determining *height* and *area* limitations of Table 503.

**303.6 Use Group A-5, outdoor assembly:** This use group shall include structures utilized for outdoor assembly which are intended for participation in or reviewing activities, including *grandstands* (Section 1013.0), *bleachers* (Section 1013.0), coliseums, stadiums, amusement park structures (Section 413.0) and fair or carnival structures. Such structures shall comply with all pertinent provisions of this code.

## SECTION 304.0 BUSINESS USE GROUP

**304.1 General:** All buildings and structures which are occupied for the transaction of business, for the rendering of professional services, or for other services that involve stocks of goods, wares or merchandise in limited quantities which are incidental to office occupancies or sample purposes, shall be classified as Use Group B.

**304.2 List of business occupancies:** The occupancies listed in Table 304.2 are indicative of and shall be classified as Use Group B.

**Table 304.2**
**BUSINESS OCCUPANCIES**

| | |
|---|---|
| Airport traffic control towers | Fire stations |
| Animal hospitals, kennels, pounds | Florists and nurseries |
| Automobile and other motor vehicle showrooms | Laboratories; testing and research |
| Banks | Laundries; pickup and delivery stations and self-service |
| Barber shops | Police stations |
| Beauty shops | Post offices |
| Car wash | Print shops |
| Civic administration | Professional services; attorney, dentist, physician, engineer, etc. |
| Clinic, outpatient | Radio and television stations |
| Dry cleaning; pickup and delivery stations and self-service | Telecommunication equipment building |
| Electronic data processing | |

## SECTION 305.0 EDUCATIONAL USE GROUP

**305.1 General:** All structures other than those occupied for business training or vocational training, which accommodate more than five persons for educational purposes through the 12th grade, shall be classified as Use Group E.

**Exception:** A room or space occupied for educational purposes by less than 50 persons, 5 years of age or more, and which is accessory to another use group shall be classified as a part of the main use group.

**305.1.1 Day care facilities:** Any licensed facility which is not classified as Use Group I-1 or I-2 and which provides care for 13 or more children or other persons for less than 24 hours per day shall be classified as Use Group E. Licensed facilities providing for care of less than 13 persons shall be inspected by the State Fire Marshal in accordance with NFPA 101 listed in Chapter 35.

**305.2 Business or vocational training:** Structures occupied for business training or vocational training shall be classified in the same use group as the business or vocation taught.

**305.3 Incidental uses:** Gymnasiums, vocational shops, multipurpose rooms, libraries and cafeterias located within or attached to an educational occupancy shall be considered educational for purposes of determining *height* and *area* limitations of Table 503.

## SECTION 306.0 FACTORY AND INDUSTRIAL USE GROUPS

**306.1 General:** All structures in which occupants are engaged in work or labor in the fabricating, assembling or processing of products or materials, shall be classified as Use Group F-1 or F-2. This includes, among others, factories, assembling plants, industrial laboratories and all other industrial and manufacturing occupancies. The term "Use Group F" shall include Use Groups F-1 and F-2.

**306.2 Use Group F-1 structures:** Factory and industrial occupancies which are not otherwise classified as low-hazard Use Group F-2, shall be classified as a moderate-hazard factory and industrial occupancy, Use Group F-1. The manufacturing processes listed in Table 306.2 are indicative of and shall be classified as Use Group F-1.

**306.3 Use Group F-2 structures:** Factory and industrial occupancies which involve the fabrication or manufacturing of noncombustible materials that, during finishing, packing or processing, do not contribute to a significant fire hazard, shall be classified as Use Group F-2. The manufacturing processes listed in Table 306.3 are indicative of and shall be classified as Use Group F-2.

**Table 306.2**
**MODERATE-HAZARD FACTORY AND INDUSTRIAL OCCUPANCIES**

| | |
|---|---|
| Aircraft | Film, photographic |
| Appliances | Food processing |
| Athletic equipment | Furniture |
| Automobiles and other motor vehicles | Hemp and jute products |
| Bakeries | Laundries |
| Beverages, alcoholic | Leather and tanneries, excluding enameling or japanning |
| Bicycles | Machinery |
| Boat building | Millwork and woodworking, wood distillation |
| Boiler works | Motion picture and television filming |
| Brooms or brushes | Musical instruments |
| Business machines | Optical goods |
| Cameras and photo equipment | Paper mills or products |
| Canneries, including food products | Plastic products |
| Clothing | Printing or publishing |
| Condensed and powdered milk manufacture | Recreational vehicles |
| Construction and agricultural machinery | Refuse incinerators |
| Disinfectants | Shoes |
| Dry cleaning using other than flammable liquids in cleaning or dyeing operations or other than classified in Section 307.0 | Soaps and detergents |
| Electric light plants and power houses | Sugar refineries |
| Electrolytic-reducing works | Textile mills, including canvas, cotton cloth, bagging, burlap, carpets and rags |
| Electronics | Tobacco |
| Engines, including rebuilding | Trailers |
| | Upholstery and manufacturing shops |

**Table 306.3**
**LOW-HAZARD FACTORY AND INDUSTRIAL OCCUPANCIES**

| | |
|---|---|
| Beverages, nonalcoholic | Gypsum |
| Brick and masonry | Ice |
| Ceramic products | Metal fabrication and assembly |
| Foundries | Water-pumping plants |
| Glass products | |

## SECTION 307.0 HIGH-HAZARD USE GROUPS

**307.1 General:** All structures which are occupied for the manufacturing, processing, generation, storage or other use of *hazardous materials* in excess of the exempt quantities specified in Section 307.8 shall be classified as Use Group H-1, H-2, H-3 or H-4 in accordance with the hazards presented by each material as described in Sections 307.3 through 307.6. The term "Use Group H" shall include Use Groups H-1, H-2, H-3 and H-4.

**307.1.1 Information required:** Separate floor plans shall be submitted for buildings and structures with an occupancy in Use Group H, identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure. A report identifying all *hazardous materials* including, but not limited to, materials representing hazards that are classified in Use Group H to be stored or utilized, shall be submitted and the methods of protection from such hazards shall be indicated on the *construction documents*.

**307.1.2 Referenced codes:** The fire code official shall have exclusive jurisdiction for code enforcement of the storage, handling, processing and transportation of *flammable* and *combustible liquids* and other *hazardous materials* pursuant to 815 KAR 10:050 (*Kentucky Fire Prevention Code*); and fees for the installation and alteration of tanks and piping systems shall be paid in accordance with Section 112.3.1.

**307.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Aerosol:*** A product that is dispensed from an *aerosol container* by a propellant.

***Aerosol container:*** Metal cans, glass or *plastic* bottles designed to dispense an *aerosol*. Metal cans shall be limited to a maximum size of 33.8 fluid ounces (1000 ml). Glass or *plastic* bottles shall be limited to a maximum size of 4 fluid ounces (118 ml).

***Barricade:*** A structure that consists of a combination of walls, floor and roof, which is designed to withstand the rapid release of energy in an explosion and which is fully confined, partially vented or fully vented; or other effective method of shielding from *explosive* materials by a natural or artificial barrier.

***Boiling point:*** The temperature at which the vapor pressure of a liquid equals the atmospheric pressure of 14.7 pounds per square inch (psia) or 760 mm of mercury. Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for the purposes of this classification, the 10 percent of a distillation performed in accordance with ASTM D86 listed in Chapter 35 shall be used as the boiling point of the liquid.

***Closed system:*** The use of a solid or liquid *hazardous material* in a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of *compressed gases*. Examples of closed systems for solids and liquids include product conveyed through a piping system into a closed vessel, system or piece of equipment.

***Combustible dusts:*** Dusts and any similar solid material sufficiently comminuted for suspension in still air which, when so suspended, is capable of self-sustained combustion.

***Combustible fibers:*** Includes readily ignitable and free-burning fibers such as cotton, sisal, henequen, jute, hemp, tow, cocoa fiber, oakum, baled waste, baled wastepaper, kapok, hay, straw, excelsior, Spanish moss and other like material.

***Combustible liquids:*** Any liquids having a *flash point* at or above 100 degrees F. (38 degrees C.) shall be known as Class II or III liquids. Combustible liquids shall be divided into the following classifications:

**Class II:** Liquids having *flash points* at or above 100 degrees F. (38 degrees C.) and below 140 degrees F. (60 degrees C.).

**Class IIIA:** Liquids having *flash points* at or above 140 degrees F. (60 degrees C.) and below 200 degrees F. (93 degrees C.).

**Class IIIB:** Liquids having *flash points* at or above 200 degrees F. (93 degrees C.).

***Compressed gas:*** A gas or mixture of gases as contained having an absolute pressure exceeding 40 psi at 70 degrees F. (276 kPa at 21 degrees C.) or, regardless of the pressure at 70 degrees F. (21 degrees C.), having an absolute pressure exceeding 140 psi at 130 degrees F. (965 kPa at 54 degrees C.); or any liquid material having a vapor pressure exceeding 40 psi absolute at 100 degrees F. (276 kPa at 38 degrees C.) as determined by ASTM D323 listed in Chapter 35.

***Control area:*** Spaces within a building which are enclosed and bounded by exterior walls, *fire walls*, *fire separation assemblies* and roofs, or a combination thereof, where quantities of *hazardous materials* not exceeding the exempt amounts are stored, dispensed, used or handled.

***Corrosive:*** A chemical that causes visible destruction of, or irreversible *alterations* in, living tissue at the point of contact. A chemical shall be considered a corrosive if, when tested on the intact skin of albino rabbits by the test method described by DOTn 49 CFR; 173 listed in Chapter 35, such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours. This term shall not refer to action on inanimate surfaces.

***Cryogenic liquids (flammable or oxidizing):*** Any liquid that has a *boiling point* below -200 degrees F. (-129 degrees C.).

***Deflagration:*** An exothermic reaction, such as the extremely rapid oxidation of a *flammable* dust or vapor in air, in which the reaction progresses through the unburned material at a rate less than the velocity of sound. A deflagration can have an explosive effect.

**Detached storage building:** A separate single-story building, without a *basement* or crawl space, used for the storage of *hazardous materials* and located an approved distance from all structures.

***Detonation:*** An exothermic reaction characterized by the presence of a shock wave in the material which establishes and maintains the reaction. The reaction zone progresses through the material at a rate greater than the velocity of sound. The principal heating mechanism is one of shock compression. *Detonations* have an explosive effect.

**Dispensing:** The pouring or transferring of any material from a container, tank or similar vessel, whereby vapors, dusts, fumes, mists or gases are liberated to the atmosphere.

***Explosive:*** Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord and igniters.

The term "explosive" includes any material determined to be within the scope of USC Title 18; Chapter 40 listed in Chapter 35 and also includes any material classified as an explosive by the Hazardous Material Regulations of DOTn 49 CFR listed in Chapter 35.

***Flammable:*** Capable of being readily ignited from common sources of heat or at a temperature of 600 degrees F. (316 degrees C.) or less.

***Flammable compressed gas:*** Either a mixture of 13 percent or less (by volume) with air forms a *flammable* mixture, or the *flammable* range with air is wider than 12 percent, regardless

of the lower limitation. These limitations shall be determined at atmospheric temperature and pressure.

***Flammable liquids:*** Any liquid that has a *flash point* below 100 degrees F. (38 degrees C.), and has a vapor pressure not exceeding 40 psia (276 kPa) at 100 degrees F. (38 degrees C.). Flammable liquids shall be known as Class I liquids and shall be divided into the following classifications:

**Class IA:** Liquids having a *flash point* below 73 degrees F. (23 degrees C.) and having a *boiling point* below 100 degrees F. (38 degrees C.).

**Class IB:** Liquids having a *flash point* below 73 degrees F. (23 degrees C.) and having a *boiling point* at or above 100 degrees F. (38 degrees C.).

**Class IC:** Liquids having a *flash point* at or above 73 degrees F. (23 degrees C.) and below 100 degrees F. (38 degrees C.).

***Flammable solid:*** A solid, other than a blasting agent or *explosive*, that is capable of causing fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which has an ignition temperature below 212 degrees F. (100 degrees C.) or which burns so vigorously and persistently when ignited as to create a serious hazard. A chemical shall be considered a flammable solid as determined in accordance with the test method of CPSC 16 CFR; 1500.44 listed in Chapter 35, if it ignites and burns with a self-sustained flame at a rate greater than 0.1 inch (3 mm) per second along its major axis.

***Flash point:*** The minimum temperature in degrees Fahrenheit at which a *flammable liquid* will give off sufficient vapors to form an ignitable mixture with air near the surface or in the container, but will not sustain combustion. The flash point of a liquid shall be determined by appropriate test procedure and apparatus as specified in ASTM D56 and ASTM D93 listed in Chapter 35.

**Handling:** The deliberate transport by any means to a point of storage or use.

***Hazardous materials:*** Those chemicals or substances which are *physical hazards* or *health hazards* as defined and classified in this section and the fire prevention code listed in Chapter 35, whether the materials are in usable or waste condition.

***Health hazard:*** A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term "health hazard" includes chemicals which are *toxic* or *highly toxic*, *irritants*, *corrosives*, *sensitizers*, or *radioactive*.

***Highly toxic:*** A chemical falling within any of the following categories is considered highly toxic.

1. A chemical that has a median lethal dose ($LD_{50}$) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose ($LD_{50}$) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration ($LC_{50}$) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

***Incompatible materials:*** Materials which, when mixed, have the potential to react in a manner that generates heat, fumes, gases or by-products which are hazardous to life or property.

***Irritant:*** A chemical which is not *corrosive*, but which causes a reversible inflammatory effect on living tissue by chemical action at the point of contact. A chemical shall be considered an irritant if, when tested on the intact skin of albino rabbits by the test method of CPSC 16 CFR; 1500.41 listed in Chapter 35 for 4 hours exposure, it results in an empirical score of 5 or more. A chemical is an eye irritant if so determined by the procedure in CPSC 16 CFR; 1500.42 listed in Chapter 35.

***Open system:*** The use of a solid or liquid *hazardous material* in a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations. Examples of open systems for solids and liquids include dispensing from or into open beakers or containers, dip tank and plating tank operations.

***Organic peroxide:*** An organic compound that contains the bivalent double-bonded oxygen structure and which is considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical.

**Unclassified detonable:** Organic peroxides which are capable of *detonation*. These peroxides present an extremely high explosion hazard through rapid explosive decomposition.

**Class I:** Class I organic peroxides are capable of *deflagration*, but not *detonation*. These peroxides present a high explosion hazard through rapid decomposition.

**Class II:** Class II organic peroxides burn very rapidly and present a severe reactivity hazard.

**Class III:** Class III organic peroxides burn rapidly and present a moderate reactivity hazard.

**Other health-hazard material:** A *hazardous material* that affects target organs of the body, which includes, but is not limited to, those materials which cause liver damage, kidney damage or damage to the nervous system; act on the blood to decrease hemoglobin function; deprive the body tissue of oxygen; or affect reproductive capabilities, including mutations (chromosomal damage) or teratogens (effects on fetuses).

***Oxidizer:*** A material that is capable, generally by yielding oxygen, of causing or enhancing the combustion of other materials.

**Class 4:** An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. Additionally, the oxidizer will enhance the burning rate and is capable of causing spontaneous ignition of combustibles.

**Class 3:** An oxidizer that will cause a severe increase in the burning rate of combustible materials with which the oxidizer comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat.

**Class 2:** An oxidizer that will cause a moderate increase in the burning rate or that is capable of causing spontaneous ignition of combustible materials with which the oxidizer comes in contact.

**Class 1:** An oxidizer whose primary hazard is a slight increase in the burning rate but which does not cause spontaneous ignition when the oxidizer comes in contact with combustible materials.

***Physical hazard:*** A chemical for which there is evidence in the referenced standards listed in Chapter 35 that it is a *combustible liquid*, *compressed gas*, *cryogenic*, *explosive*, *flammable* gas, *flammable liquid*, *flammable solid*, *organic peroxide*, *oxidizer*, *pyrophoric* or *unstable (reactive)* or *water-reactive material*.

***Pyrophoric:*** A material that will spontaneously ignite in air at or below a temperature of 130 degrees F. (54 degrees C.).

***Radioactive material:*** Any material or combination of material that spontaneously emits ionizing radiation.

***Sensitizer:*** A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

***Tires, bulk storage of:*** Storage of 10,000 or more average-sized passenger vehicle tires weighing approximately 25 pounds (111 N) each (see Section 307.5).

***Toxic:*** A chemical that is within any of the following categories shall be considered toxic:

1. A chemical that has a median lethal dose ($LD_{50}$) of more than 50 milligrams per kilogram, but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose ($LD_{50}$) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
3. A chemical that has a median lethal concentration ($LC_{50}$) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

***Unstable (reactive) material:*** A material which, in the pure state or as commercially produced, will vigorously polymerize, decompose or condense, become self-reactive, or otherwise undergo a violent chemical change under conditions of shock, pressure or temperature.

**Class 4:** Materials that in themselves are readily capable of *detonation* or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes, among others, materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.

**Class 3:** Materials that in themselves are capable of *detonation* or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. This class includes, among others, materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

**Class 2:** Materials that readily undergo violent chemical change at elevated temperatures and pressures. This class includes, among others, materials that exhibit an exotherm at temperatures less than or equal to 150 degrees C. when tested by differential scanning calorimetry.

**Class 1:** Materials that in themselves are normally stable, but which can become unstable at elevated temperatures and pressures. This class includes, among others, materials that change or decompose on exposure to air, light or moisture, and materials that exhibit an exotherm at temperatures greater than 150 degrees C., but less than or equal to 300 degrees C., when tested by differential scanning calorimetry.

***Water-reactive material:*** A material which has the potential to become spontaneously *flammable* or to give off *flammable, highly toxic* or *toxic* gases or other gases with a $LC_{50}$ value of 5,000 ppm or less at a rate greater than 1 liter per kilogram of material per hour when tested in accordance with the method described in Section 4 of Appendix E to DOTn 49 CFR; 173 listed in Chapter 35. Class 1 water-reactive materials are not subject to regulation in this code. Water-reactive materials are classified into three groups as follows:

**Class 3:** A material which reacts vigorously with water at ambient temperatures and generally demonstrates a tendency for gas produced to ignite spontaneously or which reacts readily with water at ambient temperatures such that the rate of evolution of *flammable* or *toxic* gas is equal to or greater than 10 liters per kilogram of material over any 1 minute. In accordance with DOTn 49 CFR; 172 listed in Chapter 35, the classification for these materials is 4.3, Packing Group I.

**Class 2:** A material which reacts readily with water at ambient temperatures such that the maximum rate of evolution of *flammable* or *toxic* gas is equal to or greater than 20 liters over kilogram of material per hour, and which does not meet the criteria for Class 3 water-reactive materials. In accordance with DOTn 49 CFR; 172 listed in Chapter 35, the classification for these materials is 4.3, Packing Group II.

**Class 1:** A material which reacts slowly with water at ambient temperatures such that the maximum rate of evolution of *flammable* or *toxic* gas is greater than 1 liter per kilogram of material per hour, and which does not meet the criteria for Class 2 or 3 water-reactive materials. In accordance with DOTn 49 CFR; 172 listed in Chapter 35, the classification for these materials is 4.3, Packing Group III.

**307.3 Use Group H-1 structures:** All buildings and structures which contain materials that present a *detonation* hazard, shall be classified as Use Group H-1. Such materials shall include but not be limited to:

*Explosives*
*Organic peroxides*, unclassified detonable
*Oxidizers*, Class 4
*Unstable (reactive) materials*, Class 3 detonable, and Class 4
Detonable *pyrophoric* materials

**307.4 Use Group H-2 structures:** All buildings and structures which contain materials that present a *deflagration* hazard or a hazard from accelerated burning, shall be classified as Use Group H-2. Such materials shall include but not be limited to:

*Combustible dusts*
*Combustible liquids*, Class II and Class IIIA
*Cryogenic liquids, flammable or oxidizing*
*Flammable* gases
*Flammable liquids*
*Organic peroxides*, Class I
*Oxidizers*, Class 3
Oxidizing gases
*Pyrophoric* liquids, solids and gases, nondetonable
*Unstable (reactive) materials*, Class 3, nondetonable

**307.5 Use Group H-3 structures:** All buildings and structures which contain materials that readily support combustion or present a *physical hazard*, shall be classified as Use Group H-3. Such materials shall include but not be limited to:

*Aerosols*, Level 2 and Level 3
*Combustible fibers*
*Combustible liquids*, Class IIIB
*Flammable solids*
*Organic peroxides*, Class I, Class II and Class III
*Oxidizers*, Class 1 and Class 2
*Tires, bulk storage of*
*Unstable (reactive) materials*, Class 2
*Water-reactive materials*, Class 2 and Class 3

**307.6 Use Group H-4 structures:** All buildings and structures which contain materials that are *health hazards*, shall be classified as Use Group H-4. Such materials shall include but not be limited to:

*Corrosives*
*Highly toxic* materials
*Irritants*
*Radioactive materials*
*Sensitizers*
*Toxic* materials

**307.7 Multiple hazards:** All buildings and structures containing a material or materials representing hazards that are classified in one or more of Use Groups H-1, H-2, H-3 and H-4, shall conform to the code requirements for each of the use groups so classified.

**307.8 Exceptions:** The following shall not be classified in Use Group H, but shall be classified in the use group which they most nearly resemble. *Hazardous materials* in any quantity shall conform to the requirements of this code, including Section 417.0, and the fire prevention code listed in Chapter 35.

1. All buildings and structures which contain not more than the exempt quantities of *hazardous materials* as shown in Tables 307.8(1) and 307.8(2) provided that such buildings are maintained in accordance with the fire prevention code listed in Chapter 35.
2. Buildings utilizing *control areas* in accordance with Section 417.2 which contain not more than the exempt quantities of *hazardous materials* as shown in Tables 307.8(1) and 307.8(2).
3. Buildings and structures occupied for the storage of 10,000 or less vehicle tires weighing approximately 25 pounds (111 N) each, provided that such buildings are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.
4. Buildings and structures occupied for the application of *flammable* finishes, provided that such buildings or areas conform to the requirements of Section 419.0 and NFPA 33, NFPA 34 and the fire prevention code listed in Chapter 35.
5. Rooms containing *flammable liquids* in tightly closed containers of 1-gallon capacity (3.8 L) or less for private utilization on the premises and in quantities not exceeding 2 gallons per square foot (82 L/m$^2$) of room area.
6. Wholesale and retail sales and storage of *flammable* and *combustible liquids* in mercantile occupancies conforming to NFPA 30 and the fire prevention code listed in Chapter 35.
7. *Closed systems* housing *flammable* or *combustible liquids* or gases utilized for the operation of machinery or equipment.
8. Cleaning establishments which utilize *combustible liquid* solvents having a *flash point* of 140 degrees F. (60 degrees C.) or higher in *closed systems* employing equipment listed by an *approved testing agency*, provided that this occupancy is separated from all other areas of the building by 1-hour fireresistance rated *fire separation assemblies*.
9. Cleaning establishments which utilize a liquid solvent having a *flash point* at or above 200 degrees F. (93 degrees C.).
10. Liquor stores and distributors without bulk storage.
11. Refrigeration systems.
12. The storage or utilization of materials for agricultural purposes on the premises.
13. Stationary batteries utilized for facility emergency power, uninterrupted power supply or telecommunication facilities provided that the batteries are provided with safety venting caps and *ventilation* is provided in accordance with the mechanical code listed in Chapter 35.
14. *Corrosives*, *irritants* and *sensitizers* shall not include personal or household products in their original packaging used in retail display or commonly used building materials.
15. Buildings and structures occupied for *aerosol* manufacturing or storage shall be classified as Use Group F-1 or S-1, provided that such buildings conform to the requirements of NFPA 30B and the fire prevention code listed in Chapter 35.
16. Display and storage of nonflammable solid and nonflammable or noncombustible liquid *hazardous materials* in mercantile occupancies in accordance with Section 417.2.1.
17. The storage of Level 2 and Level 3 *aerosol* products in occupancies in Use Groups A, B, E, F, M, I and R provided such occupancies conform to the fire prevention code listed in Chapter 35.

**Table 307.8(1)**
**EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A PHYSICAL HAZARD**
**MAXIMUM QUANTITIES PER CONTROL AREA[a, l]**

| Material | Class | Use Group | Storage[b] | | | Closed systems[b] | | | Open systems[b] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Solid pounds (cubic feet) | Liquid gallons (pounds) | Gas cubic feet | Solid pounds (cubic feet) | Liquid gallons (pounds) | Gas cubic feet | Solid pounds (cubic feet) | Liquid gallons (pounds) |
| Combustible liquid[c,k] | II<br>IIIA<br>IIIB | H-2<br>H-2<br>H-3 | Not applicable | 120[d,e]<br>330[d,e]<br>13,200[e,f] | Not applicable | Not applicable | 120[d]<br>330[d]<br>13,200[f] | Not applicable | Not applicable | 30[d]<br>80[d]<br>3,300[f] |
| Combustible dust pounds per 1,000 cubic feet | | H-2 | 1[g] | Not applicable | Not applicable | 1[g] | Not applicable | Not applicable | 1[g] | Not applicable |
| Combustible fiber | Loose<br>Baled | H-3 | (100)<br>(1,000) | Not applicable | Not applicable | (100)<br>(1,000) | Not applicable | Not applicable | (20)<br>(200) | Not applicable |
| Cryogenics, flammable or oxidizing | | H-2 | Not applicable | 45[d] | Not applicable | Not applicable | 45[d] | Not applicable | Not applicable | 10[d] |
| Explosives | | H-1 | 1[e,h,i] | (1)[e,h,i] | Not applicable | 1/4[h] | (1/4)[h] | Not applicable | 1/4[h] | (1/4)[h] |
| Flammable gas | Gaseous<br>Liquefied | H-2 | Not applicable | Not applicable 30[d,e] | 1,000[d,e]<br>Not applicable | Not applicable | Not applicable 30[d,e] | 750[d,e]<br>Not applicable | Not applicable | Not applicable |
| Flammable liquid[c] | IA<br>IB<br>IC | H-2 | Not applicable | 30[d,e]<br>60[d,e]<br>90[d,e] | Not applicable | Not applicable | 30[d]<br>60[d]<br>90[d] | Not applicable | Not applicable | 10[d]<br>15[d]<br>20[d] |
| Combination (IA, IB, IC) | | H-2 | Not applicable | 120[d,e,j] | Not applicable | Not applicable | 120[d,j] | Not applicable | Not applicable | 30[d,j] |
| Flammable solid | | H-3 | 125[d,e] | Not applicable | Not applicable | 25[d] | Not applicable | Not applicable | 25[d] | Not applicable |
| Organic peroxide | UD<br>I<br>II<br>III | H-1<br>H-2<br>H-3<br>H-3 | 1[e,h]<br>5[d,e]<br>50[d,e]<br>125[d,e] | (1)[e,h]<br>(5)[d,e]<br>(50)[d,e]<br>(125)[d,e] | Not applicable | 1/4[h]<br>1[d]<br>50[d]<br>125[d] | (1/4)[h]<br>(1)[d]<br>(50)[d]<br>(125)[d] | Not applicable | 1/4[h]<br>1[d]<br>10[d]<br>25[d] | (1/4)[h]<br>(1)[d]<br>(10)[d]<br>(25)[d] |
| Oxidizer | 4<br>3<br>2<br>1 | H-1<br>H-2<br>H-3<br>H-3 | 1[e,h]<br>10[d,e]<br>250[d,e]<br>4,000[d,e] | (1)[e,h]<br>(10)[d,e]<br>(250)[d,e]<br>(4,000)[d,e] | Not applicable | 1/4[h]<br>2[d]<br>250[d]<br>4,000[d] | (1/4)[h]<br>(2)[d]<br>(250)[d]<br>(4,000)[d] | Not applicable | 1/4[h]<br>2[d]<br>50[d]<br>1,000[d] | (1/4)[h]<br>(2)[d]<br>(50)[d]<br>(1,000)[d] |
| Oxidizer — gas | Gaseous<br>Liquefied | H-2 | Not applicable | Not applicable 15[d,e] | 1,500[d,e]<br>Not applicable | Not applicable | Not applicable 15[d,e] | 1,500[d,e]<br>Not applicable | Not applicable | Not applicable |
| Pyrophoric | | H-2 | 4[e,h] | (4)[e,h] | 50[e,h] | 1[h] | (1)[h] | 10[e,h] | 0 | 0 |
| Unstable (reactive) | 4<br>3<br>2 | H-1<br>H-1 or H-2<br>H-3 | 1[e,h]<br>5[d,e]<br>50[d,e] | (1)[e,h]<br>(5)[d,e]<br>(50)[d,e] | 10[d,h]<br>50[d,e]<br>250[d,e] | 1/4[h]<br>1[d]<br>50[d] | (1/4)[h]<br>(1)[d]<br>(50)[d] | 2[e,h]<br>10[d,e]<br>250[d,e] | 1/4[h]<br>1[d]<br>10[d] | (1/4)[h]<br>(1)[d]<br>(10)[d] |
| Water reactive | 3<br>2 | H-3<br>H-3 | 5[d,e]<br>50[d,e] | (5)[d,e]<br>(50)[d,e] | Not applicable | 5[d]<br>50[d] | (5)[d]<br>(50)[d] | Not applicable | 1[d]<br>10[d] | (1)[d]<br>(10)[d] |

**Note a.** For use of control areas, see Section 417.2.

**Note b.** The aggregate quantity in utilization and storage shall not exceed the quantity listed for storage.

**Note c.** The quantities of alcoholic beverages in retail sales occupancies shall not be limited, provided the liquids are packaged in individual containers not exceeding 1 gallon. In retail sales and storage occupancies, the quantities of medicines, foodstuffs and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1 gallon.

**Note d.** Maximum quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

**Note e.** Quantities shall be increased 100 percent when stored in approved cabinets, gas cabinets, fume hoods, exhausted enclosures, or safety cans as specified in the fire prevention code listed in Chapter 35. Where Note d also applies, the increase for both notes shall be applied accumulatively.

**Note f.** The permitted quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

**Note g.** A dust explosion potential is considered to exist where 1 pound or more of combustible dust per 1,000 cubic feet of volume is normally in suspension or could be put into suspension in all or a portion of an enclosure or inside pieces of equipment. This also includes combustible dust which accumulates on horizontal surfaces inside buildings or equipment and which could be put into suspension by an accident, sudden force or small explosion.

**Note h.** Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

**Note i.** One pound of black sporting powder and 20 pounds of smokeless powder are permitted in sprinklered or unsprinklered buildings. The maximum quantities of black sporting and smokeless powder shall be the amounts specified in NFPA 495 where such powder is stored in accordance with NFPA 495 listed in Chapter 35.

**Note j.** Containing not more than the exempt amounts of Class I-A, Class I-B or Class I-C flammable liquids.

**Note k.** Inside a building, the maximum capacity of a combustible liquid storage system that is connected to a fuel-oil piping system shall be 660 gallons provided such system conforms to the fire prevention code listed in Chapter 35.

**Note l.** Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = 0.028 $m^3$; 1 pound = 0.454 kg; 1 gallon = 3.785 L.

**Table 307.8(2)**
**EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A HEALTH HAZARD**
**MAXIMUM QUANTITIES PER CONTROL AREA [a, b, i]**

| Material | Storage[c] | | | Closed systems[c] | | | Open systems[c] | |
|---|---|---|---|---|---|---|---|---|
| | Solid pounds[d,e] | Liquid gallons (pounds)[d,e] | Gas cubic feet | Solid pounds[d] | Liquid gallons (pounds)[d] | Gas cubic feet | Solid pounds[d] | Liquid gallons (pounds)[d] |
| Corrosive | 5,000 | 500 | 810[d,e,h] | 5,000 | 500 | 810[d,e,h] | 1,000 | 100 |
| Highly toxic | 1 | (1) | 20[f] | 1 | (1) | 20[f] | 1/4 | (1/4) |
| Irritant | Not limited | Not limited | 810[d,e] | Not limited | Not limited | 810[d,e] | Not limited | Not limited |
| Radioactive[g] | 25 rem - unsealed source<br>100 rem - sealed source | | | 100 rem - sealed source | | | 25 rem - sealed source | |
| Sensitizer | Not limited | Not limited | 810[d,e] | Not limited | Not limited | 810[d,e] | Not limited | Not limited |
| Toxic | 500 | (500) | 810[d,e] | 500 | (500) | 810[d,e] | 125 | (125) |
| Other health hazards | Not limited | Not limited | 810[d,e] | Not limited | Not limited | 810[d,e] | Not limited | Not limited |

**Note a.** For use of control areas, see Section 417.2.

**Note b.** In retail sales occupancies, the quantities of medicines, foodstuffs and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1 gallon.

**Note c.** The aggregate quantity in utilization and storage shall not exceed the quantity listed for storage.

**Note d.** Maximum quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

**Note e.** Maximum quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets, fume hoods, exhausted enclosures, or safety cans as specified in the fire prevention code listed in Chapter 35. Where Note d also applies, the increase for both notes shall be applied accumulatively.

**Note f.** Permitted only when stored in approved exhausted gas cabinets, exhausted enclosures or fume hoods.

**Note g.** Maximum dosage permitted in any single exposure.

**Note h.** A single cylinder containing 150 pounds or less of anhydrous ammonia in a single control area in a nonsprinklered building shall be considered an exempt quantity. Two cylinders, each containing 150 pounds or less in a single control area shall be considered an exempt quantity provided the building is equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.

**Note i.** Quantities in parenthesis indicate quantity units in parenthesis at the head of each column. 1 cubic foot = 0.028 $m^3$; 1 pound = 0.454 kg; 1 gallon = 3.785 L.

## SECTION 308.0 INSTITUTIONAL USE GROUPS

**308.1 General:** All structures in which people suffering from physical limitations because of health or age are harbored for medical or other care or treatment, or in which people are detained for penal or correction purposes, or in which the liberty of the inmates is restricted, shall be classified as Use Group I-1, I-2 or I-3. The term "Use Group I" shall include Use Groups I-1, I-2 and I-3.

**308.2 Use Group I-1:** This use group shall include buildings and structures which house six or more individuals who, because of age, mental disability or other reasons, must live in a supervised environment but who are physically capable of responding to an emergency situation without personal assistance. Where accommodating persons of the above description, the following types of facilities shall be classified as I-1 facilities: board and care facilities, half-way houses, group homes, social rehabilitation facilities, alcohol and drug centers and convalescent facilities. A facility such as the above with five or less occupants shall be classified as a residential use group.

**308.3 Use Group I-2:** This use group shall include buildings and structures used for medical, surgical, psychiatric, nursing or custodial care on a 24-hour basis of six or more persons who are not capable of self-preservation. Where accommodating persons of the above description, the following types of facilities shall be classified as I-2 facilities: hospitals, nursing homes (both intermediate care facilities and skilled nursing facilities), mental hospitals and detoxification facilities. A facility such as the above with five or less occupants shall be classified as a residential use group.

**308.3.1 Deleted.**

**308.4 Use Group I-3:** This use group shall include buildings and structures which are inhabited by six or more persons who are under some restraint or security. An I-3 facility is occupied by persons who are generally incapable of self-preservation due to security measures not under the occupants' control. Where accommodating persons of the above description, the following types of facilities shall be classified as I-3 facilities: prisons, jails, reformatories, detention centers, correctional centers and prerelease centers. Buildings of Use Group I-3 shall be classified as one of the occupancy conditions indicated in Sections 308.4.1 through 308.4.5 (see Section 410.0).

**308.4.1 Occupancy Condition I:** This occupancy condition shall include all buildings in which free movement is allowed from sleeping areas, and other spaces where access or occupancy is permitted, to the exterior via *means of egress* without restraint. An Occupancy Condition I facility shall be classified as Use Group R.

**308.4.2 Occupancy Condition II:** This occupancy condition shall include all buildings in which free movement is allowed from sleeping areas and any other occupied *smoke compartment* to one or more other *smoke compartments*. Egress to the exterior is impeded by locked *exits*.

**308.4.3 Occupancy Condition III:** This occupancy condition shall include all buildings in which free movement is allowed within individual *smoke compartments*, such as within a residential unit comprised of individual sleeping rooms and group activity spaces, where egress is impeded by remote-controlled release of *means of egress* from such *smoke compartment* to another *smoke compartment*.

**308.4.4 Occupancy Condition IV:** This occupancy condition shall include all buildings in which free movement is re-

stricted from an occupied space. Remote-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

**308.4.5 Occupancy Condition V:** This occupancy condition shall include all buildings in which free movement is restricted from an occupied space. Staff-controlled release is provided to permit movement from all sleeping rooms, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

## SECTION 309.0 MERCANTILE USE GROUP

**309.1 General:** All buildings and structures which are occupied for display and sales purposes involving stocks of goods, wares or merchandise incidental to such purposes and open to the public, shall be classified as Use Group M. This includes, among others, retail stores, automotive service stations, shops, salesrooms and markets. An automotive service station is that portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or approved containers, including any building used for the sale of automotive accessories, or for minor automotive repair work. Minor repairs include the exchange of parts, oil changes, engine tune-ups and similar routine maintenance work. Retail sales of *hazardous materials* shall comply with Section 307.8.

## SECTION 310.0 RESIDENTIAL USE GROUPS

**310.1 General:** All structures in which sleeping accommodations are provided, excluding those that are classified as institutional occupancies, shall be classified as Use Group R-1, R-2, R-3 or R-4. The term "Use Group R" shall include Use Groups R-1, R-2 and R-3.

**310.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Dwellings**

**Bed-and-breakfast establishment:** A building occupied as a *one-family dwelling unit*, but which also has additional guestrooms or suites which are used, rented or hired out to be occupied or which are occupied for sleeping purposes by persons not members of the single-family unit. The building shall be known as either a bed-and-breakfast inn or a bed-and-breakfast home.

***Boarding house:*** A building arranged or used for lodging for compensation, with or without meals, and not occupied as a single-family unit.

***Dormitory:*** A space in a building where group sleeping accommodations are provided in one room, or in a series of closely associated rooms, for persons not members of the same family group.

***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.

***Multiple-family dwelling:*** A building or portion thereof containing more than two *dwelling units* and not meeting the requirements for a *multiple single-family dwelling*.

***Multiple single-family dwelling:*** A building or portion thereof containing more than two *dwelling units* (see Section 310.5).

***One-family dwelling:*** A building containing one *dwelling unit* with not more than five lodgers or boarders.

***Two-family dwelling:*** A building containing two *dwelling units* with not more than five lodgers or boarders per family.

**310.3 Use Group R-1 structures:** This use group shall include all hotels, motels, *boarding houses* and similar buildings arranged for shelter and sleeping accommodations for more than five occupants who are primarily transient in nature, occupying the facilities for a period of less than 30 days.

**310.3.1 Bed-and-breakfast inn:** A bed-and-breakfast establishment having six or more guestrooms or suites shall comply with the requirements of this code applicable to Use Group R-1.

**310.4 Use Group R-2 structures:** This use group shall include all *multiple-family dwellings* having two or more *dwelling units*, sharing a common means of egress and shall also include all *boarding houses* and similar buildings arranged for shelter and sleeping accommodations in which the occupants are primarily not transient in nature.

**310.4.1 Dormitories:** A *dormitory* facility which accommodates more than five persons more than $2^1/_2$ years of age shall be classified as Use Group R-2.

**310.5 Use Group R-3 structures:** This use group shall include all buildings arranged for occupancy as *one-* or *two-family dwelling units*, including not more than five lodgers or boarders per family and *multiple-family dwellings* where each unit has an independent *means of egress*.

**310.5.1 Bed and breakfast home:** A bed-and-breakfast establishment having five or less guestrooms or suites shall comply with the requirements of this code applicable to Use Group R-3 and with Section 423.1.

**310.6 Use Group R-4 structures:** This use group shall include all detached *one- or two-family dwellings* not more than three stories in *height*, and their *accessory structures* as indicated in the CABO *One and Two Family Dwelling Code* listed in Chapter 35. All of these structures shall be designed and built in accordance with the requirements of this code for a Use Group R-3 structure, or with the requirements of the CABO *One and Two Family Dwelling Code* listed in Chapter 35, except that the minimum tread depth of 9 inches (229 mm) and maximum riser height of $8^1/_4$ inches (210 mm) set forth in Exception No. 8 of Section 1014.6 and that the requirements of the State Plumbing Code (see Chapter 29) shall supersede those conflicting requirements of the CABO *One and Two Family Dwelling Code*. Choice of the construction code shall be made by the permit applicant at the time of plans submission. Whichever code is chosen by the permit applicant at the time of plans submission, Exception No. 5 of Section 1014.7 and Exception No. 2 of Section 1022.2 may be used to determine whether or not a stair handrail in a dwelling unit is continuous, under this code and the CABO *One and Two Family Dwelling Code* listed in Chapter 35.

## SECTION 311.0 STORAGE USE GROUPS

**311.1 General:** All structures which are primarily used for the storage of goods, wares or merchandise shall be classified as Use Group S-1 or S-2. This includes, among others, warehouses, storehouses and freight depots. The quantity of *hazardous mate-*

*rials* in storage shall comply with Section 307.8. The term "Use Group S" shall include Use Groups S-1 and S-2.

**311.2 Moderate-hazard storage, Use Group S-1:** Buildings occupied for the storage of moderate-hazard contents which are likely to burn with moderate rapidity, but which do not produce either poisonous gases, fumes or *explosives* including, among others, the materials listed in Table 311.2, shall be classified as Use Group S-1. A motor vehicle repair garage is that portion of a property wherein major repairs, such as engine overhauls, painting or body work, are performed on motorized vehicles.

**Table 311.2**
**MODERATE-HAZARD STORAGE OCCUPANCIES**

| | |
|---|---|
| Barns[a] | Linoleum |
| Bags, cloth, burlap and paper | Livestock shelters[a] |
| Bamboo and rattan | Lumber yards |
| Baskets | Motor vehicle repair garages |
| Belting, canvas and leather | Petroleum warehouses for storage of lubricating oils with a flash point of 200 degrees F. (93.33 degrees C.) or higher |
| Books and paper in rolls or packs | Photo engraving |
| Boots and shoes | Public garages (Group 1) and stables |
| Buttons, including cloth covered, pearl or bone | Silk |
| Cardboard and cardboard boxes | Soap |
| Clothing, woolen wearing apparel | Sugar |
| Cordage | Tobacco, cigars, cigarettes and snuff |
| Furniture | Upholstering and mattress manufacturing |
| Furs | Wax candles |
| Grain silos[a] | |
| Glue, mucilage, paste and size | |
| Horn and combs, other than celluloid | |
| Leather, enameling or japanning | |

**Note a.** For the use group classification where such structures are accessory to a residential occupancy, see Section 312.1.

**311.3 Low-hazard storage, Use Group S-2:** Low-hazard storage occupancies shall include buildings occupied for the storage of noncombustible materials, and of low-hazard wares that do not ordinarily burn rapidly such as products on wood pallets or in paper cartons without significant amounts of combustible wrappings, but with a negligible amount of *plastic* trim such as knobs, handles or film wrapping. Such occupancies shall be classified as Use Group S-2 including, among others, the materials listed in Table 311.3.

**Table 311.3**
**LOW-HAZARD STORAGE OCCUPANCIES**

| | |
|---|---|
| Asbestos | Gypsum board |
| Beer or wine up to 12% alcohol in metal, glass or ceramic containers | Inert pigments |
| Cement in bags | Ivory |
| Chalk and crayons | Meats |
| Dairy products in nonwaxed coated paper containers | Metal cabinets |
| Dry cell batteries | Metal desks with plastic tops and trim |
| Electrical coils | Metal parts |
| Electrical motors | Metals |
| Food products | Mirrors |
| Foods in noncombustible containers | New empty cans |
| Fresh fruits and vegetables in nonplastic trays or containers | Oil-filled and other types of distribution transformers |
| Frozen foods | Open parking structures |
| Glass | Porcelain and pottery |
| Glass bottles, empty or filled with noncombustible liquids | Public garages (Group 2) |
| | Stoves |
| | Talc and soapstones |
| | Washers and dryers |

## SECTION 312.0 UTILITY AND MISCELLANEOUS USE GROUP

**312.1 General:** Buildings and structures of an accessory character and miscellaneous structures not classified in any specific use group shall be constructed, equipped and maintained to conform to the requirements of this code commensurate with the fire and life hazard incidental to their occupancy. Use Group U shall include structures that are accessory to a residential occupancy including, but not limited to, those listed in Table 312.1.

**Table 312.1**
**UTILITY AND MISCELLANEOUS OCCUPANCIES**

| | |
|---|---|
| Agricultural buildings | Livestock shelters |
| Barns | Detached private garages |
| Carports | Greenhouses |
| Grain silos | Sheds having a building area less than 2,500 square feet[a] |
| Stables | |

**Note a.** 1 square foot = 0.093 $m^2$.

## SECTION 313.0 MIXED USE GROUPS

**313.1 Two or more use groups:** Where a building is occupied by two or more occupancies not included in the same use group, the building or portion thereof shall comply with Section 313.1.1, 313.1.2 or 313.1.3 or with combinations of these sections, except that occupancies in Use Group H shall be separated from occupancies of Use Groups A, E, I, M, R and nonaccessory areas of Use Group B in accordance with Section 313.1.2 or 313.1.3. Buildings that include an open parking structure located beneath an A, B, I, M or R Use Group shall comply with Sections 313.1.1, 313.1.2, 313.1.3 or 313.2.

**Exception:** *Fire areas* of Use Group H-1 shall be in separate and detached buildings and structures in accordance with Section 707.1.1.

**313.1.1 Nonseparated use groups:** Each portion of the building shall be individually classified as to use. The required type of construction for the building shall be determined by applying the *height* and *area* limitations for each of the applicable use groups to the entire building. The most restrictive type of construction, so determined, shall apply. The other requirements of this code shall apply to each portion of the building based on the use group of that occupancy, except that the most restrictive applicable provisions of Section 403.0 and Chapter 9 shall apply to these nonseparated use groups. A *fire separation assembly* is not required between use groups, except as required by other sections of this code.

**313.1.2 Separated use groups:** Each portion of the building shall be individually classified in a use group and shall be completely separated from adjacent *fire areas* by *fire separation assemblies* (see Section 709.0) and floor/ceiling assemblies (see Section 713.0) having a fireresistance rating determined in accordance with Table 313.1.2, for the use groups being separated. Each *fire area* shall comply with the code based on the use group of that space. Each *fire area* shall comply with the *height* limitations of Section 503.0 based on the use of that space and the type of construction classification. In each story, the *building area* shall be such that the sum of the ratios of the floor area of each use group divided by the allowable *area* from Section 503.0 for each use group shall not exceed one.

**Exception:** Where the building is equipped throughout with an *automatic sprinkler system* in accordance with

Section 906.2.1, the required fireresistance rating of *fire separation assemblies* separating areas of other than Use Group H, shall be reduced from those indicated in Table 313.1.2 by 1 hour but to not less than 1 hour and to not less than that required by Table 602 for floor construction.

**313.1.3 Separate buildings:** Each use group shall be considered a separate building where each such use group is completely separated from adjacent use groups by *fire walls* having a fireresistance rating corresponding to that required by Table 602. Each building shall then comply with the provisions of this code applicable to the use group of that building.

**313.2 Open parking structures beneath other use groups:** Open parking structures constructed under Use Groups A, I, B, M and R shall not exceed the *height* and *area* limitations permitted under Section 406.0. The *height* and *area* of the portion of the building above the open parking structure shall not exceed the limitations in Section 503.0 for the upper use group. The *height*, in both feet and stories, of the portion of the building above the open parking structure shall be measured from *grade plane* and shall include both the open parking structure and the portion of the building above the parking structure.

*Fire separation assemblies* between the parking occupancy and the upper occupancy shall correspond to the required fireresistance rating prescribed in Table 313.1.2 for the uses involved. The type of construction shall apply to each occupancy individually, except that all structural members — including main bracing within the open parking structure which is necessary to support the upper occupancy — shall be protected with the more restrictive fireresistive assemblies of the occupancies involved as shown in Table 602. *Exit* facilities for the upper occupancy shall conform to Chapter 10 and shall be separated from the parking area by *fire separation walls* having at least a 2-hour fireresistance rating as required by Table 602 and self-closing *doors* complying with Section 717.0. *Means of egress* from the open parking facility shall comply with Section 1010.5.

**313.3 Use Group R:** In buildings of Type 2C, 3B or 5B construction with an occupancy in Use Group R, the first floor shall not be occupied for use groups other than Use Group R, unless the floor/ceiling assembly and the enclosure walls are protected to afford a 1-hour fireresistance rating and the *exits* from the residential floors are separately enclosed in accordance with the requirements of Chapter 10.

**313.4 Use Groups A-4 and E:** Sections 305.1 and 305.3 shall supersede requirements for certain occupancies in Use Groups A-4 and E.

**Table 313.1.2**
**FIRERESISTANCE RATING REQUIREMENTS FOR FIRE SEPARATION ASSEMBLIES BETWEEN FIRE AREAS[a]**

**NP — Not Permitted**
**NA — Not Applicable**

| Use Group | | A-1 | A-2 | A-3 | A-4 | A-5 | B | E | F-1 | F-2 | H-1 | H-2 | H-3 | H-4 | I-1 | I-2 | I-3 | M | R-1 | R-2 | R-3 | S-1 | S-2 | U[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USE GROUP | A-1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | A-2 | | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | A-3 | | | 2 | 2 | 2 | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | A-4 | | | | 2 | 2 | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | A-5 | | | | | NA | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | B | | | | | | 2 | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | E | | | | | | | 2 | 3 | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | F-1 | | | | | | | | 3 | 3 | NP | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | F-2 | | | | | | | | | 2 | NP | 4 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | H-1 | | | | | | | | | | NP | NP | NP | NP | NP | NP | NP | NP | NP | NP | NP | NP | NP | NP |
| | H-2 | | | | | | | | | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | H-3 | | | | | | | | | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | H-4 | | | | | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | I-1 | | | | | | | | | | | | | | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | I-2 | | | | | | | | | | | | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | I-3 | | | | | | | | | | | | | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | M | | | | | | | | | | | | | | | | | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| | R-1 | | | | | | | | | | | | | | | | | | 2 | 2 | 2 | 3 | 2 | 3 |
| | R-2 | | | | | | | | | | | | | | | | | | | 2 | 2 | 3 | 2 | 3 |
| | R-3 | | | | | | | | | | | | | | | | | | | | 2 | 3 | 2 | 3 |
| | S-1 | | | | | | | | | | | | | | | | | | | | | 3 | 3 | 3 |
| | S-2 | | | | | | | | | | | | | | | | | | | | | | 2 | 3 |
| | U | | | | | | | | | | | | | | | | | | | | | | | 3 |

**Note a.** Fireresistance ratings are expressed in hours.
**Note b.** For requirements for private garages, see Section 407.0.

# CHAPTER 4

# SPECIAL USE AND OCCUPANCY

## SECTION 401.0 GENERAL

**401.1 Scope:** In addition to the general requirements of this code governing the location, construction and equipment of all buildings and structures, and the fireresistance ratings, *height* and *area* limitations of Tables 503 and 602, the provisions of this chapter shall control all buildings and structures designed for special occupancies as herein provided.

## SECTION 402.0 COVERED MALL BUILDINGS

**402.1 Scope:** The provisions of this section shall apply to buildings or structures defined herein as covered mall buildings not exceeding three floor levels in height at any one point. Except as specifically required by this section, covered mall buildings shall meet all applicable provisions of this code.

**Exceptions:** Where approved by the code official, the following occupancies are not required to comply with the provisions of this section.

1. Foyers and lobbies in occupancies in Use Group B, R-1 or R-2.
2. Buildings which comply totally with all other applicable provisions of this code.

**402.2 Definitions:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Anchor store:** An exterior perimeter department store or major merchandising or magnet center having direct access to a mall and having its required *exits* independent of the mall.

**Gross leasable area:** The total floor area designed exclusively for tenant occupancy. The area of tenant occupancy is measured from the center lines of joint partitions to the outside of the tenant walls.

**Mall:** A roofed-over common pedestrian area serving more than one tenant located within a covered mall building.

**Mall building, covered:** A building enclosing a number of tenants and occupancies such as retail stores, drinking and dining establishments, entertainment and amusement facilities, passenger transportation terminals, offices and other similar occupancies wherein two or more tenants have a main entrance into one or more malls. Anchor stores shall not be considered as part of the covered mall building.

**402.3 Lease plan:** The permit holder shall provide both the building and fire departments with a lease plan showing the locations of each occupancy and its *means of egress* after the certificate of occupancy has been issued. Such plans shall be kept current. Modifications or changes in occupancy shall not be made from that shown on the lease plan without prior approval.

**402.4 Tenant separations:** Each tenant space shall be separated from other tenant spaces by a *fire partition* having a fireresistance rating of not less than 1 hour. The *fire partition* shall comply with Section 711.0 except that the *fire partition* is not required to extend beyond the underside of a ceiling that is not part of a fireresistance rated assembly. A wall is not required in *attic* or ceiling spaces above tenant separation walls, nor is a tenant separation wall required between any tenant space and a mall, except for occupancy separations required elsewhere in this code.

**402.4.1 Anchor store openings:** Openings between an anchor store and the pedestrian area of a mall are not required to be protected.

**402.5 Egress:** Each individual occupancy within the covered mall building shall be provided with a *means of egress* in accordance with other provisions of this code. Measurements shall be made to the entrance to the mall.

**402.5.1 Travel distance:** The maximum length of *exit access* travel from any point within the mall to an approved *exit* along the natural and unobstructed path of travel shall not exceed 200 feet (60960 mm).

**402.5.2 Anchor store exits:** Anchor stores shall provide the required number of *exits* and the minimum width for the required *exit* capacity directly to the exterior. The occupant load of anchor stores opening into the mall shall not be included in determining *exit* requirements for the mall.

**402.5.3 Dead ends:** The dead end of a mall shall not exceed twice the width of the mall.

**402.5.4 Design occupant load:** In determining required *exit* facilities of the mall, the number of occupants for whom *exit* facilities are to be provided shall be based on gross leasable area of the covered mall building (excluding anchor stores) and the occupant load factor as determined by the following formula:

$$OLF = (0.00007)\ (GLA) + 25$$

where:
*OLF* = The occupant load factor (square feet per person).
*GLA* = The gross leasable area (square feet).

The occupant load factor (OLF) is not required to be less than 30 and shall not exceed 50.

**402.5.5 Exit access width:** The minimum width of *exit access* passageways and *corridors* from a mall shall be 66 inches (1676 mm).

**402.5.6 Exit distribution:** The required *exits* and *exit* widths shall be distributed equally throughout the mall.

**402.5.7 Storage prohibited:** Storage is prohibited in *exit corridors* that are used for service to tenants. Such *corridors* shall be posted with conspicuous signs so stating.

**402.5.8 Passenger transportation terminals:** A covered mall building whose primary purpose is a passenger transportation terminal shall comply with the *means of egress* requirements for Use Group A-3.

**402.5.9 Service areas fronting on exit passageways and corridors:** Mechanical rooms, electrical rooms, building service areas and service elevators are permitted to open directly into *exit* passageways and *exit corridors* provided that the required fireresistance rating of the *exit* enclosure is maintained.

**402.6 Mall width:** The minimum width of the mall shall be 20 feet (6096 mm). There shall be a minimum of 10 feet (3048 mm) clear *exit* width to a height of 8 feet (2438 mm) between any projection of a tenant space bordering the mall and the nearest kiosk, vending machine, bench, display opening or other obstruction to *means of egress* travel. The mall width shall be sufficient to accommodate the occupant load emptying into the immediately adjacent mall as determined by Section 402.5.4 for all occupancies except Use Groups A and E which shall be determined by Section 1008.0.

**402.7 Structural elements:** Covered mall buildings shall be of Type 1, 2 or 4 construction. Covered mall buildings three stories or less in *height* are exempt from the *area* limitations of Table 503.

**402.7.1 Structural elements, anchor stores:** An anchor store three stories or less in *height* shall be of Type 1, 2 or 4 construction and is exempt from the *area* limitations of Table 503, provided that a smoke control system is installed in the anchor store. For anchor stores where a smoke control system is required by Section 404.4, the smoke control system shall comply with Section 922.0. For other anchor stores, the smoke control system shall be designed to differentiate between floor levels in a multilevel anchor store, and shall be capable of producing at least six air changes per hour of exhaust on the fire floor. The smoke control system shall be activated by smoke detectors installed in the return air portion of every heating and cooling system ahead of any fresh air intake, by operation of the *automatic sprinkler system*, or by manual controls provided in an approved location. Acceptance testing of the anchor store smoke control system shall be performed in accordance with Section 922.6.

**402.8 Roof coverings:** Roof coverings for covered mall buildings shall be of Class A, B or C as required by Section 1506.0.

**402.9 Use Groups A-1 and A-2:** Use Group A-1 and A-2 occupancies shall not have more than one-half of their required *means of egress* opening directly to the mall (see Section 1006.2.2).

**402.10 Sprinkler system:** The mall and all buildings connected thereto shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. The system shall be installed in such a manner that when any portion of the system serving tenant spaces is shut down, the portion of the system serving the mall will remain operational.

**402.11 Standpipes:** There shall be a *standpipe* hose connection located within the mall at each entrance to an *exit* passageway, *exit corridor* or enclosed *stairway* and at all exterior entrances to the mall. The hose connection shall be supplied from the *automatic sprinkler system* of the mall or from a separate *standpipe system*. The *water supply* shall be capable of delivering 250 gallons per minute (gpm) (946 L/min). *

**402.12 Fire department access to equipment controls:** *Fire protection system* and HVAC system controls shall be identified, and the fire department shall have access thereto.

**402.13 Plastic panels and plastic signs:** Within every story or level and from side wall to side wall of each tenant space, approved *plastic* panels and signs shall be limited as specified in Sections 402.13.1 through 402.13.4. Approved light-transmitting *plastic* interior wall *signs* in areas other than covered mall buildings shall comply with Section 2609.0.

**402.13.1 Area:** The panels and signs shall not exceed 20 percent of the wall area facing the mall.

**402.13.2 Height and width:** The panels and signs shall not exceed a height of 36 inches (914 mm); except if the panel or sign is vertical, the height shall not exceed 96 inches (2438 mm) and the width shall not exceed 36 inches (914 mm).

**402.13.3 Location:** The panels and signs shall be located a minimum distance of 18 inches (457 mm) from adjacent tenants.

**402.13.4 Encasement:** All edges and the backs shall be fully encased in metal.

**402.14 Kiosks:** Kiosks and similar structures (temporary or permanent) shall meet the requirements of Sections 402.14.1 through 402.14.4.

**402.14.1 Construction:** Combustible kiosks or other structures shall not be located within the mall unless constructed of fireretardant-treated wood throughout conforming to Section 2310.0.

**402.14.2 Fire suppression:** Kiosks and similar structures that are covered and are located within the mall shall be protected by an *automatic sprinkler system* installed in accordance with Chapter 9.

**402.14.3 Horizontal separation:** The minimum horizontal separation between kiosks and other structures within the mall shall be 20 feet (6096 mm).

**402.14.4 Maximum area:** Kiosks or similar structures shall have a maximum area of 300 square feet (27.90 $m^2$).

**402.15 Parking structures:** An attached *garage* for the storage of passenger vehicles that have a capacity of not more than nine

persons, or an open parking structure, shall be considered as a separate building where it is separated from the covered mall building by a *fire separation assembly* having a fireresistance rating of not less than 2 hours or shall be considered as part of the covered mall building.

## SECTION 403.0 HIGH-RISE BUILDINGS

**403.1 Applicability:** The provisions of this section shall apply to all buildings having occupied floors located more than 75 feet (22860 mm) above the lowest level of fire department vehicle access.

**Exception:** The provisions of this section shall not apply to the following buildings and structures:

1. Airport traffic control towers conforming to the requirements of Section 414.0.
2. Open parking structures (see Section 406.0).
3. Buildings with an occupancy in Use Group A-5 (see Section 303.6).
4. Low-hazard special occupancies where approved by the code official (see Section 503.1.1).
5. Buildings with an occupancy in Use Group H-1, H-2 or H-3 (see Section 418.0).

**403.2 Sprinkler system:** All buildings and structures shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**Exception:** An *automatic sprinkler system* shall not be required in spaces or areas of:

1. Open parking structures complying with Section 406.0.
2. Telecommunications equipment buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies.

**403.3 Alternative sprinkler system:** Alternatively, to qualify for the fireresistance rating reduction for certain building elements listed in Section 403.3.3, the *automatic sprinkler system* shall comply with Section 906.2.1 and the optional fire protection features listed in Sections 403.3.1 and 403.3.2.

**403.3.1 Control valves and water-flow devices:** *Sprinkler* control valves equipped with supervisory initiating devices and water-flow initiating devices shall be provided for each floor.

**403.3.2 Secondary water supply:** In addition to the main *water supply*, for buildings located where the effective peak velocity-related acceleration ($A_v$) is equal to or greater than 0.20 in accordance with Section 1610.1, a secondary on-site *water supply* equal to the hydraulically calculated *sprinkler* design demand plus 100 gallons per minute (378 L/min) shall be provided. This *water supply* shall have a duration of 30 minutes.

**403.3.3 Automatic sprinkler system alternative:** Where a complete *automatic sprinkler system* with the additional system features listed in Sections 403.3.1 and 403.3.2 is installed throughout, modifications to this code are permitted as described in Sections 403.3.3.1 and 403.3.3.2.

**403.3.3.1 Type of construction:** Other than in buildings with an occupancy in Use Groups F-1, M and S-1, the minimum type of construction required by this code shall be modified as indicated in Table 403.3.3.1.

**Exception:** The Type 1A to 1B modification shall be permitted for buildings with an occupancy in Use Groups F-1, M and S-1.

**Table 403.3.3.1**
**TYPE OF CONSTRUCTION MODIFICATIONS PERMITTED FOR HIGH-RISE BUILDINGS**

| Type of construction set forth in Table 602 | Modified type of construction permitted hereunder |
|---|---|
| 1A | 1B |
| 1B | 2A[a] |
| 2A | 2B |

**Note a.** The minimum fireresistance rating for floor construction shall be 2 hours.

**403.3.3.2 Shaft enclosures:** The required fireresistance rating of the *fire separation assemblies* enclosing vertical *shafts*, other than *stairway* enclosures and elevator hoistway enclosures, shall be reduced to 1 hour where automatic *sprinklers* are installed within the *shafts* at the top and at alternate floor levels.

**403.4 Automatic fire detection:** A smoke detector suitable for the intended application shall be installed in each of the following rooms: mechanical equipment; electrical; transformer; telephone equipment; elevator machine; or similar room. The actuation of any detector shall sound an alarm at a constantly attended location.

**403.5 Voice/alarm signaling systems:** A voice/alarm signaling system shall be provided in accordance with Section 918.9 and activated in accordance with Section 918.7.1.

**403.6 Fire department communication system:** A two-way fire department communication system shall be provided for fire department use. The communication system shall operate between the *fire command station* and every elevator, elevator lobby and enclosed *exit stairway*. Acceptable types of fire department communications shall include:

1. Telephone or fire department radio in lieu of a dedicated system, where approved by the fire department; and
2. Intercom or two-way public address system complying with NFPA 72 listed in Chapter 35.

**403.7 Fire command station:** A *fire command station* for fire department operations shall be provided in a location approved by the fire department. The *fire command station* shall contain: the voice/alarm signaling system controls; the fire department communication system controls; the automatic fire detection and alarm system annunciator panels; an annunciator that visually indicates the floor location of elevators and whether they are operational; status indicators and controls for air-handling systems; controls for unlocking all *stairway* doors simultaneously;

*sprinkler* valve and water-flow detector display panels; emergency and standby power; status indicators; and a telephone for fire department use with controlled access to the public telephone system.

**403.8 Elevators:** Elevator operation and installation shall be in accordance with Chapter 30. Elevator service shall be provided for fire department emergency access to all floors. Said elevator cab shall be of such size to accommodate an ambulance cot that is 24 inches (610 mm) by 76 inches (1930 mm) in the horizontal open position.

**403.9 Standby power, light and emergency systems:** Standby power, light and emergency systems shall comply with the requirements of Sections 403.9.1 through 403.9.3.

**403.9.1 Standby power:** A standby power system conforming to the requirements of Section 2707.0 shall be provided. If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2-hour fireresistance rated *fire separation assemblies*. System supervision with manual start and transfer features shall be provided at the *fire command station*.

**403.9.1.1 Fuel supply:** An on-premises fuel supply, sufficient for not less than 2-hour full-demand operation of the system, shall be provided.

**Exception:** Where the system is supplied with pipeline natural gas and is approved.

**403.9.1.2 Capacity:** The standby system shall have a capacity and rating that supplies all equipment required to be operational at the same time. The generating capacity is not required to be sized to operate all of the connected electrical equipment simultaneously.

**403.9.1.3 Connected facilities:** All power and lighting facilities for the *fire command station* and elevators specified in Sections 403.7 and 403.8, as applicable, and electrically powered fire pumps required to maintain pressure, shall be transferable to the standby source. Standby power shall be provided for at least one elevator to serve all floors and be transferable to any elevator.

**403.9.2 Separate circuits and fixtures:** Separate lighting circuits and fixtures shall be required to provide sufficient light with an intensity of not less than 1 footcandle (10.76 lux) measured at floor level in all *means of egress corridors*, *stairways*, *smokeproof enclosures*, elevator cars and lobbies, and other areas which are clearly a part of the escape route.

**403.9.2.1 Other circuits:** All circuits supplying lighting for the *fire command station* and mechanical equipment rooms shall be transferable to the standby source.

**403.9.3 Emergency systems:** *Exit* signs, *exit* illumination as required by Section 1024.0, and elevator car lighting are classified as emergency systems and shall operate within 10 seconds of failure of the normal power supply and shall be capable of being transferred to the standby source.

**Exception:** *Exit* sign, *exit* and *means of egress* illumination are permitted to be powered by a standby source in buildings of Use Groups F and S.

**403.10 Stairway door operation:** All *stairway* doors which are to be locked from the *stairway* side shall be capable of being unlocked simultaneously without unlatching upon a signal from the *fire command station*.

**403.10.1 Stairway communication system:** A telephone or other two-way communication system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each required *stairway* where the doors to the *stairway* are locked.

## SECTION 404.0 ATRIUMS

**404.1 General:** The term "atrium" shall mean an occupied space that includes a floor opening or series of floor openings, which connects two or more stories. An atrium shall comply with this section where a *shaft* enclosure is required by Section 713.3. Atriums shall be permitted in all occupancies, other than Use Group H, where provided with the protection herein required.

**404.2 Automatic sprinkler system:** The atrium and all stories and floor areas connected to the atrium shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. The *automatic sprinkler system* shall be supervised in accordance with Section 924.1, method 1.

**Exception:** An *automatic sprinkler system* shall not be required in areas separated from the atrium by *fire separation assemblies* in accordance with Section 709.0.

**404.3 Atrium occupancy:** The floor of the atrium shall not be occupied for other than low fire-hazard occupancies and only approved materials and decorations shall be located in the atrium space.

**Exception:** The occupancy of the atrium floor area for any approved purpose shall not be restricted where the hazard is protected with an *automatic sprinkler system* installed in accordance with Section 906.2.1.

**404.3.1 Exit discharge:** *Exit discharge* in accordance with Section 1020.0 is permitted within the atrium.

**404.4 Smoke control:** A smoke control system complying with Section 922.0 shall be installed in all atriums that connect more than two stories.

**404.5 Enclosure of atriums:** Atrium spaces shall be separated from adjacent spaces by a 1-hour *fire partition* as required for *corridors*.

**Exceptions**

1. In residential occupancies, protected openings are not required where the floor area of each guestroom or *dwelling unit* does not exceed 1,000 square feet (93 $m^2$) and each room or unit has an approved *means of egress* not entering the atrium.
2. Adjacent spaces shall be separated from the atrium by *fire windows* or wall systems consisting of tempered, wired, laminated glass or nonfireresistance rated glass-block wall subject to the following criteria:
   2.1. The glass shall be protected by a specially designed *automatic sprinkler system*. The *sprinkler system* shall completely wet the entire surface of the glass wall when actuated. Where

there are walking surfaces on both sides of the glass, both sides of the glass shall be so protected;

2.2. The tempered, wired (not meeting Section 719.1) or laminated glass shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (*loading*) the glass before the *sprinkler system* operates;

2.3. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic *sprinklers* and the glass; and

2.4. Doors in such walls shall be of glass or other approved material that will resist the passage of smoke. Glass utilized in doors shall be installed and protected in accordance with Items 2.1 and 2.3 of this exception. If installed in a frame, glass utilized in doors shall be protected in accordance with Item 2.2 of this exception. Doors shall be self-closing or automatic-closing upon smoke-detection and be positive latching.

3. The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium; however, these spaces shall be included in the atrium volume for the design of the smoke control system (see Section 922.0).
4. The *area* limitations specified for fireresistance rated glass block and approved *fire windows* shall be unlimited where protected by an *automatic sprinkler system* that shall completely wet the entire surface of the glass when actuated. Where there are walking surfaces on both sides of the glass, both sides of the glass shall be protected.

**404.6 Alarm system:** A fire alarm system shall be installed in all occupancies with an atrium that connects more than two stories. The system shall be activated in accordance with Section 918.7.1. Such occupancies in Use Group A, E or M shall be provided with a voice/alarm signaling system complying with the requirements of Section 918.9.

**404.7 Travel distance:** In other than the lowest level of the atrium, where the required *means of egress* is through the atrium space, the portion of *exit access* travel distance within the atrium space shall not exceed 150 feet (45720 mm).

## SECTION 405.0 UNDERGROUND STRUCTURES

**405.1 Applicability:** The provisions of this section apply to all structures having a floor level used for human occupancy more than 30 feet (9144 mm) below, or more than one story below, the lowest *level of exit discharge* serving that floor level.

**Exception:** The provisions of this section shall not apply to the following structures:

1. Occupancies in Use Group R-3 equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0.
2. *Public garages* equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0.
3. Fixed guideway transit systems.
4. Occupancies in Use Group A-5.
5. Structures wherein the lowest story is the only story that qualifies the structure as an underground structure and which have an area not exceeding 1,500 square feet (140 $m^2$) and an occupant load less than 10.

**405.2 Construction:** The underground portion of the structure shall be of Type 1 construction.

**405.3 Automatic sprinkler system:** The highest *level of exit discharge* serving the underground portions of the structure and all levels below shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0.

**405.4 Compartmentation:** In structures that have a floor level more than 60 feet (18288 mm) below the lowest *level of exit discharge*, the highest *level of exit discharge* serving the underground portions of the structure and all levels below shall each be divided into a minimum of two compartments of approximately equal size by a smoke barrier in accordance with Section 712.0.

**Exception:** Two compartments are not required in the lowest story where such story has an area of less than 1,500 square feet (140 $m^2$) and an occupant load of less than 10.

**405.4.1 Smoke barrier penetrations:** Penetrations of the smoke barrier shall be limited to plumbing and *automatic sprinkler system* piping and electrical raceways. The air supply, return and exhaust system provided in one compartment shall be independent of such systems provided in other compartments.

**405.4.2 Elevators:** Where elevators are provided, each compartment shall have direct access to an elevator. Where an elevator serves more than one compartment, an elevator lobby shall be provided and shall be separated from both compartments by a *fire separation assembly* having not less than a 1-hour fireresistance rating.

**405.4.3 Egress:** Each compartment shall contain not less than one *exit* and shall also have an *exit access* doorway into the adjoining compartment.

**405.5 Smoke exhaust system:** Where compartmentation is required by Section 405.4, each compartment shall have an independent automatically activated smoke exhaust system capable of manual operation. The system shall have an air supply and smoke exhaust capability which will provide a minimum of six air changes per hour.

**405.5.1 Automatic fire detection:** A smoke detector complying with Section 919.8 and suitable for the intended use shall be installed in each of the following rooms: mechanical equipment; electrical; transformer; telephone equipment; elevator machine; or similar room. The actuation of any detector shall sound an alarm at a constantly attended location.

**405.5.2 Activation:** The smoke exhaust system shall be activated in the compartment of origin by actuation of the following, independently of each other:

1. *Automatic sprinkler system*;
2. Smoke detectors required by Section 405.5.1; and
3. Manual controls provided for fire department use.

**405.6 Fire alarm system:** Where the lowest level of a structure is more than 60 feet (18288 mm) below the lowest *level of exit discharge*, the structure shall be equipped throughout with a fire alarm system in accordance with Section 918.0, including a voice/alarm signaling system installed in accordance with Section 918.9 and activated in accordance with Section 918.7.1.

**405.7 Public address:** Where a fire alarm system is not required by Sections 405.6 or 918.4, a public address system shall be provided which shall be capable of transmitting voice communications to the highest *level of exit discharge* serving the underground portions of the structure and all levels below.

**405.8 Standby power:** A standby power system of sufficient capacity and rating and conforming to the requirements of Section 2707.0 shall be provided.

**405.8.1 Fuel supply:** If the standby system is a generator set inside a structure, the system shall be located in a separate room enclosed with 2-hour fireresistance rated *fire separation assemblies*. System supervision with manual start and transfer features shall be provided at the central station.

**405.8.2 Capacity:** The standby system shall supply the following required systems:

1. Smoke exhaust system.
2. *Smokeproof enclosure*.
3. Fire pumps.
4. One elevator to serve all floors with the capability of transferring power to any elevator.
5. Emergency electrical system.

**405.9 Emergency power:** An emergency electrical system of sufficient capacity and rating and conforming to the requirements of Section 2706.0 shall be provided. The emergency system shall supply the following required systems:

1. Voice communication system.
2. Fire alarm system.
3. Fire detection systems.
4. Elevator car lighting.
5. *Means of egress* lighting and *exit* sign illumination.

## SECTION 406.0 OPEN PARKING STRUCTURES

**406.1 General:** Open parking structures are those structures used for the parking or storage of passenger motor vehicles designed to carry not more than nine persons, wherein provision for the repair of such vehicles is not made and where the exterior walls of the structure have openings on not less than two sides. Open parking structures are not required to conform to Section 408.0 for *public garages*.

**406.1.1 Openings:** The exterior walls of the open parking structure shall have uniformly distributed openings on not less than two sides totaling not less than 40 percent of the building perimeter. The aggregate area of such openings in exterior walls in each level shall not be less than 20 percent of the total perimeter wall area of each level. Interior wall lines and column lines shall be at least 20 percent open with openings distributed to provide *ventilation*.

**Exception:** Openings are not required to be distributed over 40 percent of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building.

**406.1.2 Separation:** Exterior walls containing openings shall have a *fire separation distance* of greater than 10 feet (3048 mm).

**406.2 Construction requirements:** Passenger vehicle structures shall be constructed of approved noncombustible materials throughout, including structural framing, floors, roofs and walls. Any enclosed room or space on the premises shall comply with the applicable requirements of this code.

**406.3 Fuel dispensing:** Areas where fuel is dispensed shall conform to the requirements of Section 408.4.

**406.4 Heights and areas:** *Heights* and *areas* of open parking structures shall not exceed the limitations specified in Table 406.4, except as provided for in Section 406.4.1. The *heights* and *areas* are subject to the increases indicated in Sections 504.0 and 506.0. The above *height* limitations permit parking on the roof.

**Table 406.4**
**HEIGHT AND AREA LIMITATIONS FOR OPEN PARKING STRUCTURES**

| Type of construction | Height[a] | Area (square feet)[a] |
|---|---|---|
| 1A and 1B | Unlimited | Unlimited |
| 2A | 12 Stories — 120 feet | Unlimited |
| 2B | 10 Stories — 100 feet | 50,000 |
| 2C | 8 Stories — 85 feet | 50,000 |

**Note a.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**406.4.1 Unlimited area:** Structures with all sides open shall be unlimited in *area* provided that the *height* does not exceed 75 feet (22860 mm). For a side to be considered open, the total area of openings along the side shall not be less than 50 percent of the exterior area of the side at each parking level and such openings shall be equally distributed along the length of each level. All portions of each parking level shall be within 200 feet (60960 mm) horizontally from an exterior wall opening on any permanent open space.

**406.5 Guards:** All open-sided floor areas shall be provided with a guard in accordance with Section 1021.0, except that in those structures wherein vehicles are hoisted to the desired level and placed in the parking space entirely by approved mechanical means, the guard is not required on the side of the parking levels adjacent to the space occupied by the hoisting and placing equipment.

**406.6 Wheel guards:** Wheel guards made of approved noncombustible material shall be placed wherever required.

## SECTION 407.0 PRIVATE GARAGES

**407.1 General:** *Private garages* shall comply with the requirements of this section. All *private garages* not falling within the purview of Sections 407.3 through 407.9 and which are attached to or located beneath a building shall comply with the requirements of Section 313.0 for *public garages*.

**407.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Garage, private:*** A garage for four or less passenger motor vehicles, four or less single motor airplanes, or one commercial motor vehicle, without provision for repairing or servicing such vehicles for profit.

**407.3 Beneath rooms:** *Private garages* located beneath habitable rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be separated from adjacent interior spaces by *fire partitions* and floor/ceiling assemblies which are constructed with not less than a 1-hour fireresistance rating. Wood structural members of the minimum dimensions specified in Section 2304.0 for Type 4 construction shall be acceptable without any further protection where a 1-hour fireresistance rating is required.

**407.4 Attached to rooms:** *Private garages* attached side-by-side to rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be completely separated from the interior spaces and the *attic* area by means of $^1/_2$-inch gypsum board or the equivalent applied to the garage side.

**407.5 Door sills:** The sills of all door openings between *private garages* and adjacent interior spaces shall be raised not less than 4 inches (102 mm) above the garage floor.

**407.6 Opening protectives:** The door opening protectives shall comply with one of the following.

1. $1^3/_4$-inch solid core wood door.
2. $1^3/_4$-inch solid or honeycomb core steel door.

**407.7 Fireblocking of concealed spaces:** Where a *garage* is connected to an occupancy in Use Group R-3 by a concealed space, such as a breezeway, that is of Type 5B construction and 10 feet (3048 mm) or greater in length, the junction of the *garage* and the concealed space shall be *fireblocked* to comply with Section 721.0.

**407.8 Means of egress:** Where living quarters are located above a *private garage*, the required *means of egress* facilities shall be separated from the garage area with 1-hour fireresistance rated construction.

**407.9 Floor surface:** The *floor finish* of attached garages shall be of concrete or other approved noncombustible material.

## SECTION 408.0 PUBLIC GARAGES

**408.1 General:** *Public garages* shall comply with the applicable requirements of this section. Those portions of *public garages* where paint spraying is done shall comply with the requirements of Section 419.0.

**408.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Garage, public:*** A building or structure for the storage or parking of more than four passenger motor vehicles, motor-powered boats or private or commercial airplanes, or more than one commercial motor vehicle. Public garages shall be classified in one of the following groups according to their specific occupancies:

***Group 1:*** A public garage occupied for the storage, parking, repairing or the painting of, or the dispensing of fuel to, motor vehicles.

***Group 2:*** A public garage occupied exclusively for passenger vehicles that will accommodate not more than nine passengers.

**408.3 Construction:** All *Group 1 public garages* hereafter erected shall be classified as Use Group S-1 and all *Group 2 public garages* shall be classified as Use Group S-2; both shall conform to the *height* and *area* limitations of Table 503 except as specifically provided for herein.

**408.3.1 Sprinkler system:** All *public garages* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1:

1. Where any *fire area* exceeds 12,000 square feet (1116 $m^2$);
2. Where the total area of all *fire areas* on all floors exceeds 24,000 square feet (2232 $m^2$);
3. Where any *fire area* is more than three *stories above grade*; or
4. Where located beneath other use groups.

For the purposes of this section, a roof occupied for the parking or storage of motor vehicles shall not constitute a story.

**408.3.2 Roof storage of motor vehicles:** Where the roof of a building is occupied for the parking or storage of motor vehicles, such roof shall be provided with a parapet wall or a guard constructed in accordance with Section 1021.0, and with a wheel guard not less than 6 inches (152 mm) in height that is located so as to prevent any vehicle from striking the parapet wall or guard.

**408.3.3 Floor construction:** The *floor finish* of *public garages*, including airplane hangers, shall be of concrete or other approved nonabsorbent, noncombustible material.

**408.4 Fuel-dispensing areas:** Fuel-dispensing areas shall be located on the level nearest grade. *Public garages* with fuel-dispensing areas shall be completely separated from any other use group by *fire separation assemblies* having a minimum fireresistance rating of 2 hours. The floors of the fuel-dispensing areas shall be graded to a floor drainage system such that any fuel spill or leak is contained within the area. The drainage system shall conform to the requirements of the plumbing code listed in Chapter 35. The fuel-dispensing area shall be equipped with an *automatic sprinkler system* in accordance with Chapter 9.

**408.4.1 Fuel-dispensing systems:** All fuel-dispensing and fuel storage systems shall conform to the requirements of the mechanical code listed in Chapter 35.

**408.5 Ventilation:** All *public garages* shall be *ventilated* in accordance with the mechanical code listed in Chapter 35. Fuel-dispensing areas shall be mechanically *ventilated.*

**408.6 Special hazards:** Any process conducted in conjunction with *public garages* which involves volatile *flammable* solvents shall be segregated or located in a detached building or structure, except as provided for in Section 418.0 for the storage and handling of gasoline and other volatile *flammables*. The quantity of *flammable liquids* stored or handled in *public garages* — except in underground storage tanks, in special enclosures where permitted in accordance with NFPA 30A and the fire prevention

code listed in Chapter 35, and in the tanks of motor vehicles — shall not be more than 5 gallons (18.9 L) in approved safety cans.

## SECTION 409.0 USE GROUP I-2

**409.1 General:** All occupancies in Use Group I-2 shall apply with the provisions of NFPA 101 listed in Chapter 35. In addition, the following sections of this code shall comply: Table 503 (Area Limitations Only), Sections 412.0, 506.0, 507.0, Chapter 6, 705.0, 706.0, 707.0, 708.0, 713.1.2, 710.4, 710.5, 713.0, 714.0, 715.0, 719.0, 720.0, 721.0, 722.0, 806.0, 807.0, 903.2.2, 1005.7, 1014.12.1, 1017.2.1, 1017.6, 1027.0, Chapter 11, 1211.2, Chapter 13, Chapter 14, 1511.0, and Chapters 16 through 34.

**409.2 Deleted.**

**409.2.1 Deleted.**

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**409.5.1 Deleted.**

## SECTION 410.0 USE GROUP I-3

**410.1 General:** All occupancies in Use Group I-3 shall comply with the provisions of this section and all other applicable provisions of this code (see Section 308.4).

**410.2 Mixed use groups:** Portions of buildings with an occupancy in Use Group I-3 which are classified as a different use group shall meet the applicable requirements of this code for such use groups. Where security operations necessitate the locking of required *means of egress*, provisions shall be made for the release of occupants at all times.

**410.3 Means of egress:** Except as modified or as provided for in this section, the provisions of Chapter 10 shall apply.

**410.3.1 Door width:** Doors to resident sleeping rooms shall have a clear width of not less than 28 inches (711 mm).

**410.3.2 Sliding doors:** Where doors in a *means of egress* are of the horizontal-sliding type, the force to slide the door to its fully open position shall not exceed 50 pounds (222 N) with a perpendicular force against the door of 50 pounds (222 N).

**410.3.3 Horizontal exits:** *Horizontal exits* shall be permitted to comprise 100 percent of the *exits* required provided that access to an *exit*, other than a *horizontal exit*, is available in another fire compartment without requiring return through the compartment of origin. At least 6 square feet (0.56 $m^2$) of available space per occupant shall be provided on each side of the *horizontal exit* for the total number of occupants in the compartment served by that *exit*.

**410.3.4 Spiral stairs and alternating tread stairways:** Spiral stairs that conform to the requirements of Section 1014.6.4 and *alternating tread stairways* that conform to the requirements of Section 1014.6.6 are permitted for access to and between staff locations.

**410.3.5 Exit discharge:** *Exits* are permitted to discharge into a fenced or walled courtyard. Enclosed yards or *courts* shall be of a size to accommodate all occupants, a minimum of 50 feet (15240 mm) from the building with a net area of 15 square feet (1.4 $m^2$) per person.

**410.3.6 Sallyports:** A sallyport shall be permitted in a *means of egress* where there are provisions for continuous and unobstructed passage through the sallyport during an emergency exiting condition. A sallyport is a security vestibule with two or more doors where the intended purpose is to prevent continuous and unobstructed passage by allowing the release of only one door at a time.

**410.3.7 Exit stairways:** One of the required *exit stairways* in each building shall be permitted to have glazing installed in doors and interior walls at each landing level providing access to the *stairway*, provided that all of the following conditions are met:

1. The *stairway* shall not serve more than four floor levels.
2. Stair doors shall not be less than $^3/_4$-hour *fire doors* complying with Section 717.0.
3. The total area of glazing at each floor level shall not exceed 5,000 square inches (3.23 $m^2$) and individual panels of glazing shall not exceed 1,296 square inches (0.84 $m^2$).
4. The glazing shall be protected on both sides by an *automatic sprinkler system*. The *sprinkler* system shall be designed to wet completely the entire surface of any glazing affected by fire when actuated.
5. The glazing shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the *sprinkler* system operates.
6. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic *sprinklers* and the glazing.

**410.4 Locks:** *Egress* doors are permitted to be locked in accordance with the applicable use condition. Doors from an area of refuge to the exterior are permitted to be locked with a key lock in lieu of locking methods described in Section 410.4.1. The keys to unlock the exterior doors shall be available at all times and the locks shall be operable from both sides of the door.

**410.4.1 Remote release:** All remote release of locks on doors in a *means of egress* shall be provided with reliable means of operation, remote from the resident living areas, to release locks on all required doors. In Occupancy Conditions III or IV, the arrangement, accessibility and security of the release mechanism(s) required for *egress* shall be such that with the

minimum available staff at any time, the lock mechanisms are capable of being released within 2 minutes.

**Exception:** Provisions for remote locking and unlocking of occupied rooms in Occupancy Condition IV are not required provided that not more than ten locks are necessary to be unlocked in order to move all occupants from one *smoke compartment* to an area of refuge within 3 minutes. The opening of all necessary locks shall be accomplished with not more than two separate keys.

**410.4.2 Power-operated doors and locks:** All power-operated sliding doors or power-operated locks for swinging doors shall be operable by a manual release mechanism at the door, and either emergency power or a remote mechanical operating release shall be provided.

**410.4.3 Redundant operation:** Remote release, mechanically operated sliding doors or remote release, mechanically operated locks shall be provided with a mechanically operated release mechanism at each door, or shall be provided with a redundant remote release control.

**410.4.4 Relock capability:** Doors remotely unlocked under emergency conditions shall not automatically relock when closed unless specific action is taken at the remote location to enable doors to relock.

**410.4.5 Emergency power:** Emergency power in accordance with Section 2706.0 shall be provided for all electrically power-operated sliding doors and power-operated locks.

**Exception:** Facilities with ten locks or less complying with the exception to Section 410.4.1.

**410.5 Vertical openings:** Vertical openings shall be enclosed in accordance with Section 713.3.

**Exception:** A floor opening between floor levels of residential housing areas is permitted without enclosure protection between the levels, provided that all of the following conditions are met:

1. The entire normally occupied areas so interconnected are open and unobstructed so as to enable observation of the areas by supervisory personnel.
2. *Means of egress* capacity is sufficient to provide simultaneous egress for all occupants from all interconnected levels and areas.
3. The height difference between the highest and lowest finished floor levels shall not exceed 23 feet (7010 mm). Each story, considered separately, has at least one-half of its individual required *means of egress* capacity provided by *exits* leading directly out of that story without traversing another story within the interconnected area.

**410.6 Smoke barrier:** All occupancies in Use Group I-3 shall have smoke barriers complying with Section 712.0 to divide every story occupied by residents for sleeping, or any other story having an occupant load of 50 or more persons, into at least two *smoke compartments*.

**Exception:** Spaces having direct *exit* to one of the following, provided that the locking arrangement of the doors involved complies with the requirements for doors at the compartment barrier for the use condition involved:

1. A *public way*;
2. A building separated from the resident housing area by a 2-hour fireresistance rated assembly or 50 feet (15240 mm) of open space; or
3. A secured yard or *court* having a holding space 50 feet from the housing area that provides 6 square feet (0.56 $m^2$) or more of refuge area per occupant including residents, staff and visitors.

**410.6.1 Smoke compartments:** The maximum number of residents in any *smoke compartment* shall be 200. The travel distance to a door in a smoke barrier from any room door required as *exit access* shall not exceed 150 feet (45720 mm). The travel distance to a door in a smoke barrier from any point in a room shall not exceed 200 feet (60960 mm).

**410.6.2 Refuge area:** At least 6 net square feet (0.56 $m^2$) per occupant shall be provided on each side of each smoke barrier for the total number of occupants in adjoining *smoke compartments*. This space shall be readily available whenever the occupants are moved across the smoke barrier in a fire emergency.

**410.6.3 Independent egress:** A *means of egress* shall be provided from each *smoke compartment* created by smoke barriers without having to return through the *smoke compartment* from which *means of egress* originates.

**410.7 Subdivision of resident housing areas:** Sleeping areas and any contiguous day room, group activity space or other common spaces where residents are housed shall be separated from all other spaces in accordance with Sections 410.7.1 through 410.7.4.

**410.7.1 Occupancy Conditions III and IV:** Each sleeping area in Occupancy Conditions III and IV shall be separated from the adjacent common spaces by a smoke-tight partition where the travel distance from the sleeping area through the common space to the *exit access corridor* exceeds 50 feet (15240 mm).

**410.7.2 Occupancy Condition V:** Each sleeping area in Occupancy Condition V shall be separated from adjacent sleeping areas, corridors and common spaces by a smoke-tight partition. Additionally, common spaces shall be separated from the *exit access corridor* by a smoke-tight partition.

**410.7.3 Openings in room face:** The aggregate area of all openings in a solid sleeping room face in Occupancy Conditions II, III, IV and V shall not exceed 120 square inches (77419 $mm^2$). The aggregate area shall include all openings including door undercuts, food passes and grilles. All openings shall be not more than 36 inches (914 mm) above the floor. In Occupancy Condition V, the openings shall be closable from the room side.

**410.7.4 Smoke-tight doors:** Doors in openings in partitions required to be smoke tight by Section 410.7 shall be substantial doors, of construction that will resist the passage of smoke. Latches and door closers are not required on cell doors.

**410.8 Windowless buildings:** For the purposes of this section, a windowless building or portion of a building is one with nonopenable windows, windows not readily breakable or without windows. Windowless buildings shall be provided with vent openings, smoke *shafts* or an engineered smoke control system to provide *ventilation* (mechanical or natural) for each windowless *smoke compartment*.

## SECTION 411.0 MOTION PICTURE PROJECTION ROOMS, SCREENING ROOMS AND SOUND STAGES

**411.1 General:** The provisions of this section shall apply to rooms in which ribbon-type cellulose acetate or other safety film is utilized in conjunction with electric arc, xenon or other light-source projection equipment which develops hazardous gases, dust or radiation. Where cellulose nitrate film is utilized or stored, such rooms shall comply with NFPA 40 listed in Chapter 35.

Every motion picture machine projecting film as mentioned within the scope of this section shall be enclosed in a projection room. Appurtenant electrical equipment, such as rheostats, transformers and generators, shall be within the projection room or in an adjacent room of equivalent construction. There shall be posted on the outside of each projection room door and within the projection room itself, a conspicuous *sign* with 1-inch (25 mm) block letters stating "Safety Film Only Permitted in this Room."

**411.2 Construction of projection rooms:** Every projection room shall be of permanent construction consistent with the construction requirements for the type of building in which the projection room is located. Openings are not required to be protected.

The room shall have a floor area of not less than 80 square feet (7.44 $m^2$) for a single machine. Each motion picture projector, floodlight, spotlight or similar piece of equipment shall have a clear working space of not less than 30 inches by 30 inches (762 mm by 762 mm) on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors. The projection room and the rooms appurtenant thereto shall have a ceiling height of not less than 7 feet 6 inches (2286 mm). The aggregate of openings for projection equipment shall not exceed 25 percent of the area of the wall between the projection room and the auditorium. All openings shall be provided with glass or other approved material, so as to close completely the opening.

**411.3 Projection booth and equipment ventilation:** Projection booths and equipment shall be *ventilated* in accordance with the mechanical code listed in Chapter 35.

**411.4 Lighting control:** Provisions shall be made for control of the auditorium lighting and the *means of egress* lighting systems of theaters from inside of the room and from at least one other convenient point in the building as required in Section 1024.3.1.

**411.5 Miscellaneous equipment:** Each projection room shall be provided with rewind and film storage facilities.

**411.6 Screening rooms:** Screening rooms shall provide a seating capacity of not more than 30 persons, with not less than two approved *means of egress* complying with Chapter 10. Such rooms shall be enclosed in 1-hour *fire separation assemblies*. All seats shall be permanently fixed in position and the arrangement shall comply with the requirements of Section 1012.0.

**411.7 Sound stage construction:** All sound stages for motion picture or television productions greater than 1,000 square feet (93 $m^2$) in area shall be equipped throughout with an *automatic sprinkler system* installed in accordance with Chapter 9.

## SECTION 412.0 STAGES AND PLATFORMS

**412.1 Applicability:** The provisions of this section shall apply to all parts of buildings and structures which contain *stages* or *platforms* and similar appurtenances as herein defined.

**412.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Platform*:** A raised area within a building for the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lecturers and speakers; boxing and wrestling rings; theater-in-the-round; and similar purposes wherein there are no overhead hanging curtains, drops, scenery or *stage* effects other than lighting. A temporary platform is one installed for not more than 30 days.

**Proscenium wall:** The wall that separates the *stage* from the auditorium or spectator seating area.

***Stage:*** A space within a building utilized for entertainment or presentations. *Stage* area shall be measured to include the entire performance area and adjacent backstage and support areas not separated from the performance area by fireresistance rated construction. *Stage* height shall be measured from the lowest point on the *stage* floor to the highest point of the roof or floor deck above the *stage*.

**412.3 Stages:** *Stage* construction shall comply with Sections 412.3.1 through 412.3.9.

**412.3.1 Stage construction:** *Stages* shall be constructed of materials as required for floors for the type of construction of the building in which such *stages* are located.

**Exceptions**

1. *Stages* of Type 2C or 4 construction with a nominal 2-inch wood deck, provided that the *stage* is separated from all other areas in accordance with Section 412.3.5.
2. In buildings of Types 2B, 3A and 5A construction, a fireresistance rated floor is not required, provided the space below the *stage* is equipped with an *automatic sprinkler system* in accordance with Section 906.0 or 907.0.
3. In all types of construction, the finished floor shall be constructed of wood or approved noncombustible materials. Openings through all *stage* floors shall be equipped with tight-fitting, solid wood trap doors with approved safety locks.

**412.3.2 Gallery:** The fly gallery is the raised floor area above the *stage* from which the movement of scenery and operation of other *stage* effects are controlled. The gridiron is the structural framing over a *stage* which supports the equipment for hanging or flying scenery and other *stage* effects. The pin

rail is the rail on or above a *stage* through which belaying pins are inserted and to which lines are fastened. The fly galleries, gridiron, pin rails and beams utilized only for the attachment of portable or fixed theater equipment shall be constructed of approved materials consistent with the requirements for the type of construction of the building; and a fireresistance rating shall not be required.

**Exception:** Floors of fly galleries and catwalks shall be constructed of any approved material.

**412.3.3 Footlights and stage electrical equipment:** Footlights and border lights shall be installed in troughs constructed of approved noncombustible materials. Ready access shall be provided at all times to the switchboard. The storage or placing of *stage* equipment against the switchboard shall be prohibited.

**412.3.4 Exterior stage doors:** Where protection of openings is required, *exit discharge* door openings to the outer air shall be protected with *fire doors* that comply with Section 717.0. All exterior openings which are located on the *stage* for *means of egress* or loading and unloading purposes, and which are likely to be open during occupancy of the theater, shall be constructed with vestibules to prevent air drafts into the auditorium.

**412.3.5 Proscenium wall:** Where the *stage* height is greater than 50 feet (15240 mm), all portions of the *stage* shall be completely separated from the seating area by a proscenium wall with not less than a 2-hour fireresistance rating extending continuously from the foundation to the roof. There shall not be other openings in the wall separating the *stage* from the auditorium except: the main proscenium opening; two doorways at the *stage* level, one on each side thereof; and one doorway to the musician's pit from the space below the *stage* floor. Each such doorway shall not exceed 45 square feet (4.19 $m^2$) in area and shall be protected with *fire doors* that comply with Section 717.0.

**412.3.5.1 Trim, finish and decorative hangings:** All moldings and decorations around the proscenium opening shall be constructed entirely of approved noncombustible material.

**412.3.6 Proscenium curtain:** The proscenium opening of every *stage* with a height greater than 50 feet (15240 mm) shall be provided with a curtain of approved material or an approved water curtain complying with NFPA 13 listed in Chapter 35. The curtain shall be designed and installed to intercept hot gases, flames and smoke, and to prevent a glow from a severe fire on the *stage* from showing on the auditorium side for a period of 20 minutes. The closing of the curtain from the full open position shall be effected in less than 30 seconds, but the last 8 feet (2438 mm) of travel shall require not less than 5 seconds.

**412.3.6.1 Activation:** The curtain shall be activated by rate-of-rise heat detection operating at a rate of temperature rise of 15 to 20 degrees F. per minute (8 to 11 degrees C. per minute), and by an auxiliary manual control.

**412.3.6.2 Fire test:** A sample curtain with a minimum of two vertical seams shall be subjected to the standard fire test specified in ASTM E119 listed in Chapter 35 for a period of 30 minutes. The curtain shall overlap the furnace edges by an amount that is appropriate to seal the top and sides. The curtain shall have a bottom pocket containing a minimum of 4 lbs. per linear foot (58 N/m) of batten. The exposed surface of the curtain shall not glow, and flame or smoke shall not penetrate the curtain during the test period. Unexposed surface temperature and hose stream test requirements are not applicable to the proscenium firesafety curtain test.

**412.3.6.3 Smoke test:** Curtain fabrics shall have a smoke-developed rating of 25 or less when tested in accordance with ASTM E84 listed in Chapter 35.

**412.3.6.4 Tests:** The completed proscenium curtain shall be subjected to operating tests prior to the issuance of a certificate of occupancy.

**412.3.7 Scenery:** All combustible materials utilized in sets and scenery shall be rendered flameresistant in accordance with the fire prevention code listed in Chapter 35. Foamed plastics and materials containing foamed plastics shall comply with the fire prevention code listed in Chapter 35.

**412.3.8 Stage ventilation:** Emergency *ventilation* shall be provided for *stages* larger than 1,000 square feet (93 $m^2$) in floor area and with a *stage* height greater than 50 feet (15240 mm). Such *ventilation* shall comply with Section 412.3.8.1 or 412.3.8.2.

**412.3.8.1 Roof vents:** Two or more vents constructed to open automatically by approved heat-activated devices and with an aggregate clear opening area of not less than 5 percent of the area of the *stage* shall be located near the center and above the highest part of the *stage* area, except as otherwise provided for in Section 412.3.9. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in Section 2608.2.

**412.3.8.2 Smoke control:** Smoke control in accordance with Section 922.0 shall be provided to maintain the smoke layer interface not less than 6 feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is required by Section 412.3.5.

**412.3.9 Superimposed theaters:** *Additions* or extensions shall not be erected over the *stage* section of a theater, nor shall a second theater be erected above another. Where approved, the prohibition against superimposed theaters and construction above the *stage* shall not apply where approved access is provided for fire fighting with direct means of *ventilation* to the outer air from the *stage* portion.

**412.4 Platforms:** *Platform* construction shall comply with Sections 412.4.1 and 412.4.2.

**412.4.1 Materials:** All permanent *platforms* shall be constructed of approved materials as required for floors for the required type of construction of the building in which the *platform* is located except as provided for in Section 412.4.2. Temporary *platforms* shall be constructed of any approved

material. The finished floor in all types of construction shall be of wood or approved noncombustible materials.

**412.4.2 Space beneath:** The space between the floor and a temporary *platform* above shall not be utilized for any purpose other than electrical wiring or plumbing to *platform* equipment. Where the space between the floor and a permanent *platform* above is utilized for any purpose other than electrical wiring or plumbing, the *platform* shall provide a 1-hour fireresistance rating. Where the space between the floor and a permanent *platform* above is not utilized for any purpose other than plumbing or electrical wiring, the *platform* shall be constructed of any approved materials provided the concealed space is *fireblocked* in accordance with Section 721.6.7.

**412.5 Dressing and appurtenant rooms:** Dressing and appurtenant rooms shall comply with Sections 412.5.1 through 412.5.4.

**412.5.1 Separation from stage:** Where the *stage* height is greater than 50 feet (15240 mm), the *stage* shall be separated from dressing rooms, scene docks, property rooms, workshops, storerooms and all compartments appurtenant to the *stage* and all other parts of the building by *fire separation assemblies* with not less than a 2-hour fireresistance rating with approved opening protectives. For *stage* heights of 50 feet (15240 mm) or less, the required *stage* separation shall be a *fire separation assembly* with not less than a 1-hour fireresistance rating with approved opening protectives.

**412.5.2 Separation from each other:** All dressing rooms, scene docks, property rooms, workshops, storerooms and all compartments appurtenant to the *stage* shall be separated from each other by *fire separation assemblies* with not less than a 1-hour fireresistance rating with approved opening protectives.

**412.5.3 Opening protectives:** Openings other than to trunk rooms and the necessary doorways at *stage* level shall not connect such rooms with the *stage*, and such openings shall be protected with *fire doors* that comply with Section 717.0.

**412.5.4 Stage exits:** At least one approved *means of egress* shall be provided from each side of the *stage*; from each side of the space under the *stage*; from each fly gallery; and from the gridiron. A steel ladder, *alternating tread stairway* or spiral *stairway* shall be provided from the gridiron to a scuttle in the *stage* roof.

**412.6 Automatic sprinkler system:** *Stages* shall be equipped with an *automatic sprinkler system* in accordance with this section and Section 906.0 or Section 907.0. The system shall be installed under the roof and gridiron, in the tie and fly galleries and in all places behind the proscenium wall of the *stage* and in dressing rooms, lounges, workshops and storerooms accessory to such *stages*.

**Exceptions**

1. *Sprinklers* are not required under *stage* areas less than 4 feet (1219 mm) in clear height utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by not less than $^5/_8$-inch Type X gypsum board.
2. *Sprinklers* are not required for *stages* 1,000 square feet (93 $m^2$) or less in area and 50 feet (15240 mm) or less in height where curtains, scenery or other combustible hangings are not retractable vertically. Combustible hangings shall be limited to a single main curtain, borders, legs and a single backdrop.

**412.7 Standpipes:** For *stages* greater than 1,000 square feet (93 $m^2$), and having a stage height greater than 50 feet (15240 mm), a wet *standpipe system* in accordance with Section 915.0 shall be provided and equipped with $1^1/_2$-inch and $2^1/_2$-inch hose connections on each side of the *stage*.

**Exception:** Where the building or area is equipped throughout with an *automatic sprinkler system*, the hose connections that are supplied from the *automatic sprinkler system* shall have a *water supply* of not less than that required by NFPA 13 listed in Chapter 35.

**412.7.1 Hose and cabinet:** The $1^1/_2$-inch hose connections shall be equipped with sufficient lengths of $1^1/_2$-inch hose to provide fire protection for the *stage* area; such connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or on a rack.

**412.8 Sound stages:** All buildings or portions thereof utilized for the specific purpose of sound stages for motion picture or television productions and greater than 1,000 square feet (93 $m^2$) shall be protected with an approved automatic sprinkler system.

## SECTION 413.0 SPECIAL AMUSEMENT BUILDINGS

**413.1 General:** Special amusement buildings shall comply with the requirements for buildings of the appropriate assembly use group in addition to the requirements of this section.

**Exception:** Buildings or portions thereof that are essentially open to the outside air, such as buildings without walls or without a roof and arranged to prevent the accumulation of smoke in the building or structure are not required to comply with this section.

**413.2 Special amusement building:** A special amusement building is any temporary, permanent or mobile building or portion thereof which is occupied for amusement, entertainment or educational purposes and which contains a device or system which conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the *means of egress* path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available due to the nature of the attraction or mode of conveyance through the building or structure.

**413.3 Fire detection:** All special amusement buildings shall be equipped with an automatic fire detection system in accordance with Section 919.0.

**Exception:** In areas where the ambient conditions will cause a smoke detector to activate, an approved alternative type of automatic detector shall be installed.

**413.4 Automatic sprinklers:** All special amusement buildings shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0. Where the special amusement

building is temporary or mobile, the *sprinkler water supply* shall be of an approved temporary means.

**Exception:** An *automatic sprinkler system* is not required where the total floor *area* of a temporary special amusement building is less than 1,000 square feet (93 $m^2$) and the travel distance from any point to an *exit* is less than 50 feet (15240 mm).

**413.5 System response:** The activation of the automatic fire detection system within a single protected area or the *automatic sprinkler system* shall automatically:

1. Cause illumination of the *means of egress* with light of not less than 1 footcandle (10.76 lux) at the walking surface level;
2. Stop any conflicting or confusing sounds and visual distractions; and
3. Activate an approved directional *exit* marking that will become apparent in an emergency.

**413.5.1 Alarm:** Activation of any single smoke detector, the *automatic sprinkler system* or any other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated including the capability of manual initiation of requirements in Section 413.5.

**413.5.2 Public address system:** A public address system, which is also permitted to serve as an alarm system, shall be provided and shall be audible throughout the entire special amusement building.

**413.5.3 Exit marking:** "Exit" signs shall be installed at required *exit* doorways. Approved directional *exit* markings shall also be provided and shall include signs as required by Section 1023.0. Where mirrors, mazes or other designs are used that confound the *means of egress* paths, approved low-level "exit" signs and directional path markings shall be provided and located not more than 8 inches (203 mm) above the walking surface and on or near the *means of egress* path. Such markings shall become visible when activated in accordance with Section 413.5, item 3.

**413.6 Interior finish:** The interior finish shall be Class I in accordance with Section 803.2.

## SECTION 414.0 AIRPORT TRAFFIC CONTROL TOWERS

**414.1 General:** The provisions of this section shall apply to airport traffic control towers not exceeding 1,500 square feet (140 $m^2$) per floor occupied only for air traffic control, electrical and mechanical equipment rooms, radar and electronics rooms, office spaces incidental to tower operation and lounges for employees, including restrooms.

**414.2 Type of construction:** Air traffic control towers shall be constructed to conform to the *height* and *area* limitations of Table 414.2.

**Table 414.2**
**HEIGHT AND AREA LIMITATIONS FOR AIRPORT TRAFFIC CONTROL TOWERS**

| Type of construction | Height[a, b] | Maximum area (square feet)[b] |
|---|---|---|
| 1A, 1B | Unlimited | 1,500 |
| 2A | 240 feet | 1,500 |
| 2B | 100 feet | 1,500 |
| 2C | 85 feet | 1,500 |

**Note a.** Height to be measured from grade to cab floor.
**Note b.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**414.3 Egress:** A minimum of one *exit stairway* shall be permitted for airport traffic control towers of any *height* provided that the occupant load per floor does not exceed 15. The *stairway* shall conform to the requirements of Sections 1014.0 and 1015.0. The *stairway* shall be separated from elevators by a minimum distance of one-half of the diagonal of the area served.

**Exception:** *Smokeproof enclosures* as set forth in Section 1015.0 are not required where required *stairways* are pressurized to a minimum of 0.15 inch of water column (43 Pa) and a maximum of 0.35 inch of water column (101 Pa) in the *shaft* relative to the building with all *stairway* doors closed.

**414.4 Automatic fire detection systems:** Airport traffic control towers shall be provided with an automatic fire detection system installed in accordance with Section 919.0.

**414.5 Standby power:** A standby power system that conforms to Sections 403.9 and 2707.0 shall be provided in airport traffic control towers more than 65 feet (19812 mm) in *height*. Power shall be provided to mechanical equipment servicing *smokeproof enclosures* and *stairway* pressurization systems, *means of egress* lighting, elevator operational equipment and the automatic fire detection system.

## SECTION 415.0 OUTDOOR PROCESSING FACILITIES

**415.1 Industry standards:** Outdoor processing facilities such as chemical plants, refineries and grain elevators shall be constructed in accordance with the accepted engineering practice of the specific industry and the fire prevention code listed in Chapter 35, subject to the approval of the authority having jurisdiction.

## SECTION 416.0 HPM FACILITIES

**416.1 Scope:** The provisions of this section shall apply to buildings and structures using *hazardous production materials* (*HPM*), such as in semiconductor fabrication facilities and areas of comparable research and development. Except as specifically required by this section, such buildings shall comply with the applicable requirements of this code. The specific code provisions of Sections 307.0, 506.3 and Table 1009.2 applicable to high-hazard use groups shall not apply unless stated herein.

**416.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Emergency control station:*** An approved location on the premises where signals from emergency equipment are received and which is staffed by trained personnel.

***Fabrication area*:** An area in which there are processes involving *hazardous production materials* (*HPM*), and includes ancillary rooms or areas, such as dressing rooms and offices, which are supplemental to the area processes.

***Hazardous production material (HPM):*** A solid, liquid or gas that has a degree of hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFPA 704 listed in Chapter 35 and which is used directly in research, laboratory or production processes which have as their end product, materials which are not hazardous.

***Service passage, HPM:*** A passage in which *hazardous production materials* (*HPM*) are transported from a *separate inside HPM storage room* or the exterior of the building to the perimeter wall of the *fabrication area*, for purposes other than required *means of egress*.

***Storage room, HPM, separate inside:*** A room in which *hazardous production materials* (*HPM*) are stored in containers, tanks, drums or other means, and which is separated from other occupancies. Such rooms include:
***HPM cutoff room:*** An *HPM* storage room within a building and having at least one exterior wall.
***HPM inside room:*** An *HPM* storage room totally enclosed within a building and not having exterior walls.

**416.3 Allowable heights, stories and area:** The allowable *height*, number of stories and basic *areas* permitted for HPM buildings and structures shall not exceed the limitations specified in Table 416.3. The provisions of Section 507.0 shall not apply. The *area* limitations are for one- or two-story buildings facing on a street or public space not less than 30 feet (9144 mm) wide. The increases permitted in Sections 506.2 and 506.3 shall apply.

**Table 416.3**
**HEIGHT, NUMBER OF STORIES AND AREA LIMITATIONS FOR HPM USE FACILITIES**

| Type of construction | Number of stories | Height (feet)[a] | Area (square feet/floor)[a] |
|---|---|---|---|
| 1A and 1B | 3 | 55 | Unlimited |
| 2A | 3 | 55 | 34,200 |
| 2B | 3 | 55 | 22,500 |
| 2C | 3 | 40 | 14,400 |
| 3A | 3 | 50 | 19,800 |
| 3B | 3 | 40 | 14,400 |
| 4 | 3 | 55 | 21,600 |
| 5A | 3 | 40 | 15,300 |
| 5B | 2 | 30 | 7,200 |

**Note a.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**416.4 Fire suppression:** *HPM* facilities shall be equipped throughout with an *automatic sprinkler system* in accordance with Chapter 9. The design for the *fabrication areas*, *service passages*, *separate inside HPM storage rooms* without dispensing, and *means of egress corridors* shall meet the requirements for Ordinary Hazard Group 2 in NFPA 13 listed in Chapter 35. The design for *separate inside HPM storage rooms* with dispensing shall meet the requirements for Extra Hazard Group 2 in NFPA 13 listed in Chapter 35.

**416.5 Amount of HPM in a fabrication area:** The total amount of *HPM* permitted in a single *fabrication area* shall be based on the densities in Table 416.5(2), or the quantities in Table 416.5(1), whichever is the larger amount.

**416.6 Egress:** There shall not be less than two *means of egress* provided for any *fabrication area* or any *HPM* facility subdivision thereof larger than 200 square feet (18.62 $m^2$). The maximum length of *exit access* travel in *HPM* facilities shall be 100 feet (30480 mm). Not more than one means of *exit access* shall pass through an adjoining *fabrication area*.

**416.7 Separation:** *Fabrication areas* shall be separated from each other, from *means of egress corridors*, and from other parts of the building by not less than 1-hour *fire separation assemblies* in compliance with Section 709.0, with *fire doors* complying with Section 717.0. Floors forming part of the required separation shall be liquid tight.

**Table 416.5(1)**
**PERMITTED AMOUNTS OF HPM IN A SINGLE FABRICATION AREA — QUANTITY BASIS**

| Material | Maximum quantity[a] |
|---|---|
| Flammable liquids | |
| Class I-A | 90 gallons |
| Class I-B | 180 gallons |
| Class I-C | 270 gallons |
| Combination flammable liquids containing not more than the exempt amounts of Class I-A, I-B or I-C flammable liquids | 360 gallons |
| Combustible liquids | |
| Class II | 360 gallons |
| Class III-A | 750 gallons |
| Flammable gases | 9,000 cubic feet at one atmosphere of pressure at 70° F. |
| Liquefied flammable gases | 180 gallons |
| Flammable solids | 1,500 pounds |
| Corrosive liquids | 500 gallons |
| Oxidizing material - gases | 18,000 cubic feet |
| Oxidizing material - liquids | 150 gallons |
| Oxidizing material -solids | 1,500 pounds |
| Organic peroxides | 30 pounds |
| Highly toxic material and poisonous gas | Included in the aggregate for flammables as noted above |

**Note a.** 1 gallon = 3.8 L; 1 cubic foot = 0.028 $m^3$; 1 pound = 0.454 kg; degrees C. = [(degrees F.) -32]/1.8.

**Table 416.5(2)**
**PERMITTED AMOUNTS OF HPM IN A SINGLE FABRICATION AREA — DENSITY BASIS[a,c]**

| State | Units[d] | Flammable | Oxidizer | Corrosive |
|---|---|---|---|---|
| Solid | pounds per square foot | 0.001 | 0.003 | 0.003 |
| Liquid | gallons per square foot | 0.04[b] | 0.03 | 0.08 |
| Gas | cubic feet per square foot | 1.250 | 1.250 | 3.000 |

**Note a.** HPM within piping shall not be included in the calculated quantities.
**Note b.** The maximum permitted quantities of flammable and combustible liquids shall not exceed the following quantities:
Class (I-A) + (I-B) + (I-C) (Combination flammable liquids) ..... = .025
however Class I-A shall not exceed ..... = .0025
Class II ..... = .01
Class III-A ..... = .02
**Note c.** Highly toxic materials and poisonous gases shall be limited by the maximum quantities specified in Table 416.5(1).
**Note d.** 1 pound per square foot = 4.882 $kg/m^2$; 1 gallon per square foot = 40.6 $L/m^2$; 1 cubic foot per square foot = 0.301 $m^3/m^2$.

**416.8 Floors:** Floors within *fabrication areas* shall be of approved noncombustible construction. Unprotected openings through floors of *fabrication areas* are permitted where the interconnected levels are used solely for mechanical equipment directly related to such *fabrication areas*.

Mechanical, duct and piping penetrations within a *fabrication area* shall not extend through more than two floors. Penetrations shall be effectively *fireblocked* in accordance with Section 721.6.4 at the floor level. The *fabrication area*, including the areas through which ductwork and piping extend, shall be considered a single conditioned space or *fire area*.

**416.9 Ventilation, general:** *Ventilation* systems shall comply with the mechanical code listed in Chapter 35 except as otherwise provided herein. *Ventilation*, including recirculated air, shall be provided throughout the *fabrication area* at the rate of not less than 1 cfm per square foot (5074 $cm^3/s/m^2$) of floor area.

**416.9.1 Interconnection:** The return air system from one *fabrication area* shall not connect to any other system.

**416.9.2 Smoke detectors:** Smoke detectors shall be installed in the recirculating airstream and shall initiate a signal at the *emergency control station*.

**416.9.3 Shutoff switches:** Automatic shutoffs are not required to be installed on air-moving equipment. A manually operated remote switch to shut off the *fabrication area* supply or the recirculation air system, or both, shall be provided at an approved location outside the *fabrication area*.

**416.9.4 Gas detection:** Where *HPM* gas is used or dispensed and the physiological warning properties for the gas are at a higher level than the accepted permissible exposure limitation for the gas, a continuous gas-monitoring system shall be provided to detect the presence of a short-term hazard condition. Where dispensing occurs and *flammable* gases or vapors are liberated in quantities exceeding 20 percent of the lower *explosive* limitation, a continuous gas-monitoring system shall be provided. The monitoring system shall be connected to the *emergency control station*.

**416.10 Transporting HPM:** *HPM* shall be transported to *fabrication areas* through enclosed piping or tubing systems which comply with Section 416.15, through *service passages*, or in *means of egress corridors* as permitted in the exception to Section 416.12.

**416.11 Electrical:** Electrical equipment and devices within the *fabrication area* shall comply with NFPA 70 listed in Chapter 35. The requirements for hazardous locations are not required to be applied where the average rate of air change is at least 4 cfm per square foot (20300 $cm^3/s/m^2$) of floor area and where the rate of air change at any location is not less than 3 cfm per square foot (15200 $cm^3/s/m^2$).

**416.12 Means of egress corridors:** *Means of egress corridors* shall comply with Section 1011.4 and shall be separated from *fabrication areas* as specified in Section 416.7. *Means of egress corridors* shall not be used for transporting *HPM* except as provided for in Sections 416.12.1 and 416.15.2.

**416.12.1 Existing facilities:** In existing *HPM* facilities, when there are *alterations* or modifications to existing *fabrication areas*, the transportation of *HPM* in *means of egress corridors* shall be permitted provided that all of the requirements of Sections 416.12.1.1 and 416.12.1.2 are met.

**416.12.1.1 Corridors:** *Corridors* adjacent to the *fabrication area* under *alteration* shall comply with Table 602, item 4, for a length determined as follows:

1. The length of the common wall of the *corridor* and that *fabrication area*; and
2. For the distance along the *corridor* to the point of entry of *HPM* into the *corridor* serving that *fabrication area*.

**416.12.1.2 Openings:** There shall not be openings between the *corridor* and an *HPM* storage cabinet in a *fabrication area* other than those in compliance with all of the following:

1. 1-hour *fire doors* are installed between the *corridor* and the cabinet;
2. The cabinet is separated from the *corridor* with a 1-hour fireresistance rated *fire partition*; and
3. Automatic *sprinklers* shall be provided inside the cabinets.

**416.13 Service passages:** *Service passages* shall be considered as *HPM* facilities. *Service passages* shall be separated from *means of egress corridors* as required by Section 416.7.

**416.13.1 Ventilation:** *Service passages* shall be *ventilated* as required by Section 416.9.

**416.13.2 Egress:** There shall not be less than two *means of egress* from a *service passage*. Not more than one-half of the required *means of egress* shall be into the *fabrication area*. Doors from *service passages* shall be self-closing and swing in the direction of *means of egress* travel.

**416.13.3 Travel distance:** The maximum distance of travel from any point in a *service passage* to an *exit* or door into a *fabrication area* shall not exceed 75 feet (22860 mm). Dead ends shall not exceed 4 feet (1219 mm) in length.

**416.13.4 Alarms:** Alarms shall be provided for in accordance with Section 416.14.5.

**416.14 Storage of HPM, general:** Rooms used for the storage of *HPM* in quantities greater than those set forth in Tables 307.8(1) and 307.8(2), except for those quantities permitted within a *fabrication area*, shall comply with the provisions of the fire prevention code listed in Chapter 35, provided that the area of an *HPM cutoff room* shall not exceed 6,000 square feet (558 $m^2$). The storage area for any liquid *HPM* shall be provided with drains.

**416.14.1 Location within building:** Where *HPM cutoff rooms* are provided, such rooms shall not be less than 30 feet (9144 mm) from *lot lines*.

**416.14.2 HPM drainage systems:** Drainage systems shall be provided to direct liquid leakage and fire protection water to a safe location away from the building, important valves or adjoining property. The drainage systems shall comply with the fire prevention code listed in Chapter 35.

**416.14.3 Egress:** There shall be two *means of egress* from a *separate inside HPM storage room* where the room exceeds

200 square feet (18.6 m$^2$) in area. Where two *means of egress* are required from *HPM cutoff rooms*, one shall be directly to the outside of the building. All storage room *means of egress* doors shall be self-closing and swing in the direction of *means of egress* travel.

**416.14.4 Ventilation:** Exhaust *ventilation* shall be provided for in accordance with Section 416.9 for all categories of *HPM*.

**416.14.5 Emergency alarm:** An emergency telephone system or local fire alarm system station shall be installed outside of each interior egress door from *HPM cutoff rooms*. The signal shall be relayed to the *emergency control station* and a local signaling device provided.

**416.14.6 Electrical:** *HPM cutoff rooms* containing *flammable liquids* or gases shall be classified as Class I, Division 1, hazardous locations in accordance with NFPA 70 listed in Chapter 35.

**416.14.7 Gas detection:** Gas detection shall be provided for in accordance with Section 416.9.4.

**416.15 Piping and tubing:** *HPM* piping and tubing shall comply with this section and shall be installed in accordance with ASME B31.3 listed in Chapter 35.

**416.15.1 General:** Piping and tubing systems shall be metallic unless the material being transported is incompatible with such system. Systems supplying gaseous *HPM*, having a *health hazard* of 3 or 4 as ranked by NFPA 704 listed in Chapter 35, shall be welded throughout, except for connections, valves and fittings which are within an exhausted enclosure. *HPM* supply piping or tubing in *service passages* shall be exposed to view.

**416.15.2 Installation in egress corridors or above other use groups:** *HPM* shall not be located within *means of egress corridors* or above areas not containing *HPM* facilities except as permitted by this section. *HPM* piping and tubing shall be permitted within the space defined by the *walls* of *means of egress corridors* and the floor or roof above, or in concealed spaces above other use groups under the following conditions:

1. Automatic *sprinklers* shall be installed within the space unless the space is less than 6 inches (152 mm) in least dimension.
2. *Ventilation* at not less than six air changes per hour shall be provided. The space shall not be used to convey air from any other area.
3. All *HPM* supply piping and tubing and *HPM* nonmetallic waste lines shall be separated from the *means of egress corridor* and from any use group other than an *HPM* use facility by a *fire separation assembly* having a fireresistance rating of not less than 1 hour. Where gypsum wallboard is used, *joints* on the piping side of the enclosure are not required to be taped, provided that the *joints* occur over framing members.
4. Where piping or tubing is used to transport *HPM* liquids, a receptor shall be installed below such piping or tubing. The receptor shall be designed to collect and drain any discharge or leakage to an approved location. The 1-hour enclosure required by condition 3 herein shall not be used as part of the receptor.
5. Manual or automatic remotely activated fail-safe emergency shutoff valves, with ready access thereto, shall be installed on piping and tubing, other than waste lines, at branch connections into the *fabrication area*, and at entries into *means of egress corridors*.
6. Where *HPM* supply gas is carried in pressurized piping, a fail-safe system for excess flow control shall shut off flow due to a rupture in the piping.
7. Electrical wiring and equipment located in the piping space shall be approved for Class I, Division 2, hazardous locations in accordance with NFPA 70 listed in Chapter 35.
8. Gas detection shall be as provided for in Section 416.9.4.

**Exception:** Conditions 1 through 8 shall not apply to transverse crossings of the *corridors* by supply piping that is coaxially enclosed within a ferrous pipe or tube for the width of the *corridor*. An enclosing pipe or tube open to an *HPM*-use facility is permitted.

**416.15.3 Identification:** Piping, tubing and *HPM* waste lines shall be identified in accordance with ASME A13.1 listed in Chapter 35.

## SECTION 417.0 HAZARDOUS MATERIALS

**417.1 General:** The provisions of this section shall apply to all buildings and structures occupied for the manufacturing, processing, dispensing, use or storage of *hazardous materials*. All buildings and structures with an occupancy in Use Group H shall also comply with the applicable provisions of Section 418.0 and the fire prevention code listed in Chapter 35.

**Note:** The safe design of *hazardous material* occupancies is material dependent. Individual material requirements are also found in Sections 307.0 and 418.0, and in the mechanical and fire prevention codes listed in Chapter 35. Since the fire department is responsible for inspection of these occupancies for proper utilization and handling of *hazardous materials*, the administrative authority shall cooperate with the fire department in the discharge of the responsibility to enforce these provisions.

**417.2 Control areas/exempt amounts:** *Control areas* shall be those spaces within a building where quantities of *hazardous materials* not exceeding the allowable exempt amounts are stored, dispensed, utilized or handled. *Control areas* shall be separated from all adjacent interior spaces by *fire separation assemblies* in accordance with Section 709.0. The number of permitted *control areas* in a building, and the required fireresistance rating for all *fire separation assemblies* shall be in accordance with Table 417.2. The floor construction of the *control area* and all construction supporting the floor of the *control area* shall require a minimum 2-hour fireresistance rating.

**Table 417.2**
**PERMITTED CONTROL AREAS[a,b]**

| Floor level | Percent of allowable exempt quantities per control area | Control areas per floor | Fireresistance rating of fire separation assemblies (hours) |
|---|---|---|---|
| 1 | 100 | 4 | 1 |
| 2 | 75 | 3 | 1 |
| 3 | 50 | 2 | 1 |
| 4 | 12.5 | 2 | 2 |
| 5 | 12.5 | 2 | 2 |
| 6 | 12.5 | 2 | 2 |
| 7-9 | 5 | 2 | 2 |
| Higher than 9 | 5 | 1 | 2 |

**Note a.** Control areas shall not be located more than two floor levels below grade. The first floor level below grade shall be limited to 75 percent of the maximum allowable exempt quantity per control area with a maximum of three control areas. The second floor level below grade shall be limited to 50 percent of the maximum allowable exempt quantity per control area with a maximum of two control areas.
**Note b.** In mercantile occupancies, a maximum of two control areas per floor shall be permitted in retail sales rooms.

**417.2.1 Hazardous material in mercantile display and storage areas:** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid *hazardous materials* permitted within a single *control area* of a mercantile occupancy is permitted to exceed the exempt amounts specified in Tables 307.8(1) and 307.8(2) without classifying the building as a high-hazard use group, provided that the materials are displayed and stored in accordance with Section 417.2.1.1 and the fire prevention code listed in Chapter 35.

**417.2.1.1 Quantity:** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid *hazardous materials* in a single *control area* of a mercantile occupancy shall not exceed the quantities in Table 417.2.1.1.

**417.3 Equipment rooms:** Heating and ventilating equipment in occupancies involving fire hazards from *flammable* vapors, dusts, *combustible fibers* or other highly combustible substances shall be installed and protected against fire and explosion hazards in accordance with the mechanical code and the fire prevention code listed in Chapter 35.

**417.4 Hazardous material systems:** Systems involving *hazardous materials* shall be suitable for the intended application and shall be designed by persons competent in such design. Controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls, where provided, shall be designed to be fail safe.

**417.5 Inside storage, dispensing and utilization:** The inside storage, dispensing and utilization of *hazardous materials* in excess of the allowable exempt amounts of Tables 307.8(1) and 307.8(2) shall be in accordance with Sections 417.5.1 through 417.5.5 and the fire prevention code listed in Chapter 35.

**417.5.1 Explosion control:** Every structure, room or space occupied for purposes involving explosion hazards shall be provided with explosion venting, explosion suppression systems, *barricades* or equivalent explosion protective devices in accordance with this section and NFPA 495 listed in Chapter 35 where required by Section 418.0 and the fire prevention code listed in Chapter 35.

**Exception:** Explosion venting shall not be utilized as a means to protect buildings from *detonation* hazards.

**417.5.1.1 Explosion venting:** Areas which are provided with explosion venting to relieve *deflagration* shall comply with the following:

1. Walls, ceilings and roofs exposing surrounding areas shall be designed to resist a minimum internal pressure of 100 pounds per square foot (psf) (4788 Pa). The minimum internal design pressure shall not be less than five times the maximum internal relief pressure specified in Section 417.5.1.1(5).
2. Explosion venting shall be permitted only in exterior walls or roofs or through specially designed *shafts* to the exterior of the building.
3. Venting shall be designed to prevent serious structural damage and the production of lethal projectiles.
4. The aggregate clear vent relief area shall be governed by the pressure resistance of the nonrelieving portions of the building.
5. Vents shall be designed to relieve at a maximum internal pressure of 10 pounds per square foot (psf) (479 Pa) in excess of the *wind load* requirements of Section 1609.8 for building components and cladding and shall consist of any one or any combination of the following:
   5.1. Walls of lightweight material.
   5.2. Lightly fastened hatch covers.
   5.3. Lightly fastened, outward-opening swinging doors in exterior walls.
   5.4. Lightly fastened walls or roofs.
6. Venting devices shall discharge directly to the open air or to an unoccupied space not less than 50 feet (15240 mm) in width on the same *lot*.
7. Relieving devices shall be so located that the discharge shall not be less than 10 feet (3048 mm) vertically and 20 feet (6096 mm) horizontally from window openings or *exits* in the same or adjoining buildings or structures.
8. Discharge shall be in the direction of least exposure and not into the interior of the building.

**417.5.1.2 Explosion suppression systems:** Explosion suppression systems shall be of an approved type and installed in accordance with the provisions of this code and NFPA 69 listed in Chapter 35.

**417.5.2 Monitor control equipment:** Monitor control equipment shall be provided where required by the fire prevention code listed in Chapter 35.

**417.5.3 Detection systems:** All occupancies in Use Group H shall be provided with an automatic fire detection system in accordance with NFPA 72 listed in Chapter 35 where required by the fire prevention code listed in Chapter 35. The detection system shall be provided in the areas where the *hazardous materials* are utilized and stored.

**417.5.4 Standby power:** Where mechanical *ventilation*, treatment systems, temperature control, alarm, detection or

other electrically operated systems are required, such systems shall be connected to an emergency electrical system in accordance with Section 2706.0 or a standby power system in accordance with Section 2707.0. Such systems shall be independent of the public supply.

**417.5.5 Spill control, drainage and containment:** Rooms, buildings or areas occupied for the storage of solid and liquid *hazardous materials* shall be provided with a means to control spillage and to contain or drain off spillage and fire protection water discharged in the storage area where required in Section 418.0 and the fire prevention code listed in Chapter 35.

**417.6 Outside storage, dispensing and utilization:** The outside storage, dispensing and utilization of *hazardous materials* in excess of the exempt amounts shall be in accordance with Sections 417.6.1 through 417.6.6 and the fire prevention code listed in Chapter 35.

**417.6.1 Location:** In addition to the general requirements of Sections 417.6.2 through 417.6.5, the outside storage of *hazardous materials* as listed in Section 307.0 shall be separated from buildings and *lot lines* and into individual areas as specified in the fire prevention code listed in Chapter 35.

**417.6.2 Protection from vehicles:** Guard posts or other means shall be provided to protect outside storage tanks from vehicular damage.

**417.6.3 Fire lanes and water supply:** Fire lanes and approved *water supplies* shall be provided for outside storage areas as required by the code official.

1. Fire lanes. Fire lanes shall be provided to within 150 feet (45720 mm) of all portions of an outside storage area. Such fire lanes shall comply with the provisions of the fire prevention code listed in Chapter 35.
2. *Water supply.* An approved *water supply* shall be provided. Fire hydrants capable of supplying the required fire flow shall be provided to within 150 feet (45720 mm) of an outside storage area. The *water supply* and fire hydrants shall comply with the provisions of NFPA 24 and the fire prevention code listed in Chapter 35.

**417.6.4 Weather protection:** Where weather protection is provided for sheltering outside *hazardous material* storage areas, such storage shall not be considered inside storage, provided that all of the following conditions are met:

1. Structure supports and walls shall not obstruct more than one side nor more than 25 percent of the perimeter of the storage area.
2. The distance from the structure and the structure supports to buildings, *lot lines*, *public ways* or *means of egress* to a *public way* shall not be less than the distance required for an outside *hazardous material* storage area without weather protection.

**Table 417.2.1.1**
**EXEMPT AMOUNTS OF HAZARDOUS MATERIALS IN MERCANTILE OCCUPANCIES**
**MAXIMUM QUANTITIES PER CONTROL AREA[a]**

| Material | Class | Solids (pounds)[d] | | | Liquids (gallons)[d] | | |
|---|---|---|---|---|---|---|---|
| | | Unprotected by sprinklers or cabinet[c] | Within cabinet[c] in unsprinklered structure or in sprinklered structure, not in cabinet[c] | In sprinklered structure, within a cabinet[c] | Unprotected by sprinklers or cabinet[c] | Within cabinet[c] in unsprinklered structure or in sprinklered structure, not in cabinet[c] | In sprinklered structure, within a cabinet[c] |
| Corrosive | Not applicable | 9,750 | 19,500 | 39,000 | 975 | 1,950 | 3,900 |
| Highly toxic | Not applicable | 2 | 4 | 8 | 0.2 | 0.4 | 0.8 |
| Oxidizer | 4<br>3<br>2<br>1 | Not applicable<br>1,125<br>2,250<br>18,000 | Not applicable<br>2,250<br>4,500<br>36,000 | Not applicable<br>4,500<br>9,000<br>72,000 | Not applicable<br>112<br>225<br>1,800 | Not applicable<br>225<br>450<br>3,600 | Not applicable<br>450<br>900<br>7,200 |
| Toxic | Not applicable | 975 | 1,950 | 3,900 | 97 | 195 | 390 |
| Unstable (reactive) | 4<br>3<br>2<br>1 | Not applicable<br>562<br>1,125<br>No limit | Not applicable<br>1,125<br>2,250<br>No limit | Not applicable<br>2,250<br>4,500<br>No limit | Not applicable<br>56<br>112<br>No limit | Not applicable<br>112<br>225<br>No limit | Not applicable<br>225<br>450<br>No limit |
| Water reactive[b] | 3<br>2<br>1 | 562<br>1,125<br>No limit | 1,125<br>2,250<br>No limit | 2,250<br>4,500<br>No limit | 56<br>112<br>No limit | 112<br>225<br>No limit | 225<br>450<br>No limit |
| Irritant, sensitizer, other health hazard | Not applicable | 9,750 | 19,500 | 39,000 | 975 | 1,950 | 3,900 |

**Note a.** The maximum quantities apply independently to each material, class and state.
**Note b.** The fire protection system for storage of water-reactive materials shall comply with the suppression system agent compatibility requirements of Section 905.0.
**Note c.** Hazardous materials storage cabinets shall comply with the fire prevention code listed in Chapter 35.
**Note d.** 1 pound = 0.454 kg; 1 gallon = 3.785 l.

3. The overhead structure shall be of approved noncombustible construction with a maximum area of 1,500 square feet (140 $m^2$).

**417.6.5 Security:** Any site occupied for the storage, utilization or handling of *hazardous materials* shall be provided with a fence not less than 6 feet (1829 mm) in height or otherwise secured from public access.

**417.6.6 Fire suppression system:** Areas occupied for the dispensing or utilization of *flammable hazardous materials* which are located within 50 feet (15240 mm) of either a storage area or building, and vehicle-loading racks where *flammable hazardous materials* are dispensed, shall be equipped with an approved *automatic fire suppression system.*

**Exception:** Motor vehicle service stations as defined in NFPA 30A listed in Chapter 35.

## SECTION 418.0 USE GROUPS H-1, H-2, H-3 AND H-4

**418.1 Scope:** The provisions of this section shall apply to the storage and utilization of *hazardous materials* in excess of the exempt amounts listed in Section 307.8. All buildings and structures with an occupancy in Use Group H shall also comply with the applicable provisions of Section 417.0 and the fire prevention code listed in Chapter 35.

**418.2 Use Group H-1:** All occupancies in Use Group H-1 shall be constructed in accordance with the provisions of Sections 418.2.1 and 418.2.2 and the fire prevention code listed in Chapter 35.

**418.2.1 Construction:** Occupancies in Use Group H-1 shall not be located in buildings that are more than one story in *height*, have *basements* or other spaces below grade, or which are attached to other buildings. The minimum *fire separation distance* for all exterior walls of occupancies in Use Group H-1 shall be in accordance with the fire prevention code listed in Chapter 35. All floor surfaces shall be spark resistant.

**418.2.2 Number of exits:** There shall not be less than two *exits* from any area or space wherein Use Group H-1 materials are utilized or stored. All required *exits* shall discharge directly to the exterior of the building or structure.

**418.3 Use Group H-2:** Occupancies in Use Group H-2 shall be constructed in accordance with Sections 418.3.1 through 418.3.4 and the fire prevention code listed in Chapter 35.

**418.3.1 Combustible dusts, grain processing and storage:** The provisions of Sections 418.3.1.1 through 418.3.1.6 shall apply to all buildings in which materials that produce *combustible dusts* are stored or handled. Buildings which store or handle *combustible dusts* shall comply with the applicable provisions of NFPA 61, 65, 120, 651, 654, 655, 664 and 8503 and the fire prevention code listed in Chapter 35.

**418.3.1.1 Type of construction and height exceptions:** All buildings shall be of Type 1, Type 2 or Type 4 construction, within the height and area limitations of Table 503 for Use Group H-2; except that where erected of Type 1 or Type 2 construction, the heights and areas of grain elevators and similar structures shall be unlimited, and where of Type 4 construction, the maximum height shall be 65 feet (19812 mm) and except further that, in isolated areas, the maximum height of Type 4 structures shall be increased to 85 feet (25908 mm).

**418.3.1.2 Grinding rooms:** Every room or space occupied for grinding or other operations that produce *combustible dusts* shall be enclosed with floors and walls that have not less than a 2-hour fireresistance rating where the area is not more than 3,000 square feet (279 $m^2$), and not less than a 4-hour fireresistance rating where the area is greater than 3,000 square feet (279 $m^2$).

**418.3.1.3 Conveyors:** All *conveyors*, chutes, piping and similar equipment passing through the enclosures of rooms or spaces shall be constructed dirt tight and vapor tight, and be of approved noncombustible materials complying with Section 3010.0.

**418.3.1.4 Explosion relief:** Means for explosion relief shall be provided as specified in Section 417.5.1, or spaces shall be equipped with the equivalent mechanical *ventilation* complying with the mechanical code listed in Chapter 35.

**418.3.1.5 Grain elevators:** Grain elevators, malt houses and buildings for similar occupancies shall not be located within 30 feet (9144 mm) of *interior lot lines* or structures on the same *lot*, except where erected along a railroad right-of-way.

**418.3.1.6 Coal pockets:** Coal pockets located less than 30 feet (9144 mm) from *interior lot lines* or from structures on the same *lot* shall be constructed of not less than Type 2A construction. Where more than 30 feet (9144 mm) from *interior lot lines*, or where erected along a railroad right-of-way, the minimum type of construction of such structures not more than 65 feet (19812 mm) in height shall be Type 4.

**418.3.2 Flammable and combustible liquids:** The storage, handling, processing and transporting of *flammable* and *combustible liquids* shall be in accordance with the mechanical code and the fire prevention code listed in Chapter 35. Where a Class I, II or IIIA *flammable* or *combustible liquid* is stored in tanks inside the building, the installation shall conform to Sections 418.3.2.1 through 418.3.2.10 and NFPA 30 listed in Chapter 35. The requirements shall only apply where tanks have an individual storage capacity that exceeds the exempt amounts specified in Tables 307.8(1) and 307.8(2). The *fire area* containing the tank(s) shall be classified as Use Group H-2.

**418.3.2.1 Mixed use groups:** Where the storage tank area is located in a building of two or more use groups, the Use Group H-2 *fire area* shall be completely separated from adjacent *fire areas* in accordance with the requirements of Section 313.1.2.

**418.3.2.1.1 Height exception:** Where storage tanks are located within only a single story, the *height* limitation of Section 503.3 shall not apply for the Use Group H-2 *fire area.*

**418.3.2.2 Tank protection:** All storage tanks shall be noncombustible and protected from physical damage. A *fire separation assembly* around the storage tank(s) shall be permitted to be classified as the method of protection from physical damage.

**418.3.2.3 Deleted.**

**418.3.2.4 Suppression:** The Use Group H-2 *fire area* shall be equipped throughout with an approved *automatic fire sprinkler system*, installed in accordance with Section 906.2.1, or with a foam-extinguishing system. The *automatic fire suppression system* shall be supervised by method 1 of Section 924.1.

**418.3.2.5 Leakage containment:** A liquid-tight containment area compatible with the stored liquid shall be provided to retain 110 percent of the entire capacity of all storage liquid in the event of a leak in a tank plus the capacity of the *automatic fire suppression system* activated for a period of 30 minutes. The storage tanks and the leakage containment area shall be provided with an approved method to drain manually the *flammable* or *combustible liquid*.

**Exception:** In rooms where only double-wall storage tanks are used to store Class I, II and III liquids, flammable and combustible liquids shall not be required to have a leakage containment area.

**418.3.2.6 Leakage alarm:** An approved automatic alarm shall be provided to indicate a leak in a storage tank and room. The alarm shall sound an audible signal, 15 dBa above the ambient sound level, at every point of entry into the room in which the leaking storage tank is located. An approved *sign* shall be posted on every entry door to the tank storage room indicating the potential hazard of the interior room environment, or the *sign* shall state, "Warning, when alarm sounds, the environment within the room may be hazardous." The leakage alarm shall also be supervised in accordance with Section 924.2 to transmit a trouble signal.

**418.3.2.7 Tank vent:** Storage tank vents shall terminate to the outdoor air. The vent termination shall be in an approved location a minimum of 12 feet (3658 mm) above adjacent ground level and 10 feet (3048 mm) from a *lot line*, *ventilation* intake opening, openable window or door.

**418.3.2.8 Room ventilation:** Storage tank areas storing Class I liquids, or Class II or IIIA liquids at temperatures above *flash point*, shall be *ventilated* at a rate sufficient to maintain the concentration of vapors within the area at or below 25 percent of the lower *explosive* limit. *Ventilation* requirements shall be determined by either calculations based on anticipated fugitive emissions or by sampling of the actual vapor concentration levels under normal operating conditions. The sampling shall be conducted at a 5-foot radius from each potential vapor source in the storage area. Provision shall be made for make-up air to avoid short-circuiting the *ventilation*.

**418.3.2.9 Explosion venting:** Where Class I liquids are being stored, explosion venting shall be provided in accordance with Section 417.5.

**418.3.2.10 Tank openings other than vents:** Tank openings other than vents from tanks inside buildings shall be designed to ensure that liquids or vapor concentrations are not released inside the building and shall conform to Sections 418.3.2.10.1 through 418.3.2.10.5.

**418.3.2.10.1 Liquid tight:** All tank openings at the maximum liquid level or below shall be liquid tight.

**418.3.2.10.2 Closed:** All tank openings above the maximum liquid level shall be normally closed.

**418.3.2.10.3 External valve:** Each connection through which liquid is capable of gravity flow from a tank inside a building shall be provided with an external valve located as close as practical to, but not more than 2 feet from, the shell of the tank.

**418.3.2.10.4 Valves on transfer connections:** Tanks storing Class I or Class II liquids shall be provided with either a normally closed, remotely activated valve or an automatic-closing, heat-activated valve or other approved device on each liquid transfer connection below the liquid level, except for connections utilized for emergency disposal.

**418.3.2.10.5 Overflow protection:** Tanks shall be equipped with a device, or other means provided, to prevent overflow into the building.

**418.3.3 Liquefied petroleum gas distribution facilities:** The design and construction of propane, butane, propylene, butylene and other liquefied petroleum gas distribution facilities shall conform to the applicable provisions of Sections 418.3.3.1 through 418.3.3.5.2. The storage and handling of liquefied petroleum gas systems shall conform to the fire prevention code and NFPA 58 listed in Chapter 35. The design and installation of piping, equipment and systems which utilize liquefied petroleum gas shall be in accordance with the mechanical code listed in Chapter 35. Liquefied petroleum gas distribution facilities shall be *ventilated* in accordance with the mechanical code listed in Chapter 35 and Section 418.3.3.1.

**418.3.3.1 Air movement:** Liquefied petroleum gas distribution facilities shall be provided with air inlets and outlets arranged so that air movement across the floor of the facility will be uniform. The total area of both inlet and outlet openings shall be at least 1 square inch (645 $mm^2$) for each 1 square foot (0.093 $m^2$) of floor area. The bottom of such openings shall not be more than 6 inches (152 mm) above the floor.

**418.3.3.2 Construction:** Liquefied petroleum gas distribution facilities shall be constructed in accordance with Section 418.3.3.3 for separate buildings, Section 418.3.3.4 for attached buildings or Section 418.3.3.5 for rooms within buildings.

**418.3.3.3 Separate buildings:** Where located in separate buildings, liquefied petroleum gas distribution facilities

shall be occupied exclusively for that purpose or for other purposes having similar hazards. Such buildings shall be limited to one story in height and shall conform to Sections 418.3.3.3.1 and 418.3.3.3.2.

**418.3.3.3.1 Floors:** The floor shall not be located below ground level and any spaces beneath the floor shall be solidly filled or shall be left unenclosed.

**418.3.3.3.2 Materials:** Walls, floors, ceilings, columns and roofs shall be constructed of noncombustible materials. Exterior walls, ceilings and roofs shall be constructed of material designed for explosion venting or, if of heavy construction such as solid brick masonry, concrete block or concrete, explosion-venting windows or panels in walls or roofs shall be provided having an explosion-venting area of at least 1 square foot (0.093 $m^2$) for each 50 cubic feet (1.40 $m^3$) of enclosed volume.

**418.3.3.4 Attached buildings:** Where liquefied petroleum gas distribution facilities are located in an attached structure, the attached perimeter shall not exceed 50 percent of the perimeter of the space enclosed and the facility shall comply with Sections 418.3.3.3 and 418.3.3.4.1. Where the attached perimeter exceeds 50 percent, such facilities shall comply with Section 418.3.3.5.

**418.3.3.4.1 Fire separation assemblies:** Separation of the attached structures shall be provided by *fire separation assemblies* having a fireresistance rating of not less than 1 hour and shall not have openings. *Fire separation assemblies* between attached structures occupied only for the storage of LP-gas are permitted to have *fire doors* that comply with Section 717.0. Such *fire separation assemblies* shall be designed to withstand a static pressure of at least 100 pounds per square foot (psf) (4788 Pa), except where the building to which the structure is attached is occupied by operations or processes having a similar hazard.

**418.3.3.5 Rooms within buildings:** Where liquefied petroleum gas distribution facilities are located in rooms within buildings, such rooms shall be located in the first story and shall have at least one exterior wall with sufficient exposed area to permit explosion venting as provided for in Section 418.3.3.5.1. The building in which the room is located shall not have a *basement* or unventilated crawl space and the room shall comply with Sections 418.3.3.5.1 and 418.3.3.5.2.

**418.3.3.5.1 Materials:** Walls, floors, ceilings and roofs of such rooms shall be constructed of approved noncombustible materials. Exterior walls and ceilings shall be either of lightweight materials designed for explosion venting or, if of heavy construction such as solid brick masonry, concrete block or reinforced concrete, explosion-venting windows or panels in walls or roofs shall be provided having an explosion-venting area of at least 1 square foot (0.093 $m^2$) for each 50 cubic feet (1.40 $m^3$) of enclosed volume.

**418.3.3.5.2 Common construction:** Walls and floor/ceiling assemblies common to the room and to the building within which the room is located shall have a fireresistance rating of not less than 1 hour and without openings. Common walls for rooms occupied only for storage of LP-gas are permitted to have openings which shall be equipped with $^3/_4$-hour approved opening protectives complying with Section 717.0 or 719.0. Such walls and ceiling shall be designed to withstand a static pressure of at least 100 psf (4788 Pa). Where approved, these provisions shall not apply where the building, within which the room is located, is occupied by operations or processes having a similar hazard.

**418.3.4 Dry cleaning plants:** The construction and installation of dry cleaning plants shall be in accordance with the requirements of this code, the mechanical code, the plumbing code and NFPA 32 listed in Chapter 35.

**418.4 Use Group H-3:** Occupancies in Use Group H-3 shall be constructed in accordance with the applicable provisions of this code and the fire prevention code listed in Chapter 35.

**418.5 Use Group H-4:** Occupancies in Use Group H-4 shall be constructed in accordance with the applicable provisions of this code and the fire prevention code listed in Chapter 35.

## SECTION 419.0 APPLICATION OF FLAMMABLE FINISHES

**419.1 General:** The provisions of this section shall apply to the construction, installation and use of buildings and structures, or parts thereof, for the spraying of *flammable* paints, varnishes and lacquers or other *flammable* materials or mixtures or compounds used for painting, varnishing, staining or similar purposes. All such construction and equipment shall comply with NFPA 33 and 34 listed in Chapter 35.

**419.2 Spray spaces:** All spray spaces shall be *ventilated* with an exhaust system to prevent the accumulation of *flammable* mist or vapors in accordance with the mechanical code listed in Chapter 35. Where such spaces are not separately enclosed, noncombustible spray curtains shall be provided to restrict the spread of *flammable* vapors.

**419.2.1 Spray booths:** All spray booths shall be constructed of approved noncombustible materials and equipped with mechanical ventilating systems in accordance with the mechanical code listed in Chapter 35.

**419.2.2 Spray rooms:** All spray rooms shall be enclosed in *fire separation assemblies* with not less than a 1-hour fireresistance rating. Floors shall be waterproofed and drained in an approved manner.

**419.2.3 Spray storage rooms:** Rooms used for the storage of spraying materials essential to the *flammable* finish operation shall comply with NFPA 30 and the fire prevention code listed in Chapter 35.

**419.3 Fire protection:** An *automatic fire suppression system* shall be provided in all spray, dip and immersing spaces and storage rooms, and shall be installed in accordance with Chapter 9.

## SECTION 420.0 MOBILE UNITS

**420.1 General:** A mobile unit is a structure of vehicular, portable design, built on a chassis and designed to be moved from one site

to another, and to be used with or without a permanent foundation. Mobile units shall be designed, constructed and maintained to be transported from one location to another and not mounted on a permanent foundation. A mobile unit placed on a permanent foundation or on foundation piers shall be designed and constructed to comply with all of the requirements of this code for on-site and prefabricated construction.

**420.2 Construction:** Residential mobile units shall be of an approved design and shall be constructed in accordance with the applicable ordinances and statutes. All other mobile units shall be designed and constructed in accordance with the requirements of this code. All mobile units on a permanent foundation shall be evaluated, inspected and *labeled* in plant in accordance with Section 1703.3.

**420.3 Location:** Mobile units shall be located in approved spaces. The provisions of this code shall not be construed to repeal, modify or constitute an alternative to any lawful *zoning* regulations. In case of conflict between this code and any other ordinance or statute, the most rigid requirements shall apply.

**420.3.1 Anchorage and tie-down:** Every parking space for mobile units shall be provided with devices for anchoring the unit to prevent overturning or uplift. The *owner* of the parking space shall anchor or cause to be anchored all mobile units located on the parking space. Where concrete *platforms* are provided for the parking of mobile units, anchorage shall be provided by eyelets embedded in the concrete with adequate anchor plates or hooks, or other suitable means. The anchorage shall be adequate to withstand wind forces and uplift as required in Chapter 16 for buildings and structures, based upon the size and weight of the units.

## SECTION 421.0 SWIMMING POOLS

**421.1 General:** Swimming and bathing pools shall conform to the requirements of this section, provided that these regulations shall not be applicable to any such pool less than 24 inches (610 mm) deep or having a surface area less than 250 square feet (23.25 $m^2$), except where such pools are permanently equipped with a water-recirculating system or involve structural materials. For the purposes of this code, pools are classified as private swimming pools or public swimming pools, as defined in Section 421.2. Materials and constructions used in swimming pools shall comply with the applicable requirements of this code.

**421.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Pools, swimming, hot tubs and spas**

**Above-ground/on-ground pool:** See definition of private swimming pool.

**Barrier:** A fence, a wall, a building wall, the wall of an above-ground swimming pool or a combination thereof, which completely surrounds the swimming pool and obstructs access to the swimming pool.

**Hot tub:** See definition of private swimming pool.

**In-ground pool:** See definition of private swimming pool.

**Power safety cover:** A pool cover which is placed over the water area, and is opened and closed with a motorized mechanism activated by a control switch.

**Private swimming pool:** Any structure that contains water over 24 inches (610 mm) in depth and which is used, or intended to be used, for swimming or recreational bathing in connection with an occupancy in Use Group R-3 and which is available only to the family and guests of the householder. This includes in-ground, above-ground and on-ground swimming pools, hot tubs and spas.

**Private swimming pool, indoor:** Any private swimming pool that is totally contained within a private structure and surrounded on all four sides by walls of said structure.

**Private swimming pool, outdoor:** Any private swimming pool that is not an indoor pool.

**Public swimming pool:** Any swimming pool other than a private swimming pool.

**Spa:** See definition of private swimming pool.

**421.3 Permits, pool occupant load calculations and construction documents:** A swimming pool or appurtenances thereto shall not be constructed, installed, enlarged or *altered* until *construction documents* have been submitted and a permit has been obtained from the code official having jurisdiction in accordance with Sections 105.1 and 105.2 of this code. The occupant load calculations of Section 421.3.1 shall be used for the purpose of determining jurisdiction and design professional seal requirements. The approval of all city, county and state authorities having jurisdiction over swimming pools shall be obtained before applying to the code official for a permit. Certified copies of these approvals shall be filed as part of the supporting data for the permit application.

**421.3.1 Pool occupant load calculations:** The occupant load of the swimming pool, appurtenances and accessory structures shall be computed at the rate of one occupant per unit of area as prescribed by this section.

**Table 421.3.1**
**POOL OCCUPANT LOAD**

| Occupancy | Net area in square feet per occupant |
|---|---|
| Nonswimmer area (5 feet or less water depth) | 10 |
| Swimmer area (Greater than 5 feet of water depth) Note: Subtract 300 square feet for each diving area. | 24 |
| Bathhouse & sunbather area (In excess of 8 feet wide deck) | 25 |

**421.3.2 Construction documents:** *Construction documents* shall accurately show dimensions and construction of the pool and appurtenances and properly established distances to *lot lines*, buildings, walks and fences, as well as details of the *water supply* system, drainage and water disposal systems, and all appurtenances pertaining to the swimming pool. Detailed *construction documents* of structures, vertical elevations and sections through the pool showing depth shall be included.

**421.4 Locations:** Private swimming pools shall not encroach on any front or side yard required by this code or by the governing

*zoning* law, unless in accordance with specific rules of the jurisdiction in which the pool is located. A wall of a swimming pool shall not be located less than 6 feet (1829 mm) from any rear or side property line or 10 feet (3048 mm) from any street property line, unless in accordance with specific rules of the jurisdiction in which the pool is located.

**421.5 Structural design:** The pool structure shall be engineered and designed to withstand the expected forces to which the pool will be subjected.

**421.5.1 Wall slopes:** To a depth up to 2 feet 9 inches (838 mm) from the top, the wall slope shall not be more than one unit horizontal in five units vertical (1:5).

**421.5.2 Floor slopes:** The slope of the floor on the shallow side of the transition point shall not exceed one unit vertical to seven units horizontal (1:7). For public pools greater than 1,200 square feet (111.6 $m^2$), the slope of the floor on the shallow side of the transition point shall not exceed one unit vertical to ten units horizontal (1:10). The transition point between shallow and deep water shall not be more than 5 feet (1524 mm) deep.

**421.5.3 Deleted.**

**421.5.4 Walkways:** All public swimming pools shall have walkways not less than 4 feet (1219 mm) in width extending entirely around the pool. Curbs or sidewalks around any swimming pool shall have a slip-resistant surface for a width of not less than 1 foot (305 mm) at the edge of the pool, and shall be so arranged as to prevent return of surface water to the pool.

**421.5.5 Steps and ladders:** At least one *means of egress* shall be provided from private pools. Public pools shall provide ladders or other *means of egress* at both sides of the diving section and at least one *means of egress* at the shallow section; or at least one *means of egress* in the deep section and the shallow section if diving boards are not provided. Treads of steps and ladders shall have slip-resistant surfaces and handrails on both sides, except that handrails are not required where there are not more than four steps or where the steps extend the full width of the side or end of the pool. Treads and risers of the pool steps shall conform to the following:

1. Step treads shall have a minimum unobstructed horizontal depth of 10 inches (254 mm) and a minimum unobstructed surface area of 240 square inches (0.15 $m^2$).
2. Risers shall have a maximum uniform height of 12 inches (305 mm) as measured at the centerline of the tread. The height of the bottom riser shall not vary more than plus or minus 2 inches (51 mm) from the uniform riser height.

**421.6 Water supply:** All swimming pools shall be provided with a potable water supply, free of cross connections with the pool or its equipment.

**421.6.1 Water treatment:** Public swimming pools are regulated by the Cabinet for Human Resources, Department of Health Services, for purposes of water distribution and treatment systems and the proper operation and maintenance of all pool facilities (see 902 KAR 10:120, Kentucky Public Swimming and Bathing Facilities Regulation).

Private swimming pools shall be designed and installed so that there is a pool water turnover at least once every 18 hours. Filters shall not filter water at a rate in excess of 5 gallons per minute per square foot (205 L/min/$m^2$) of surface area. The pool *owner* shall be instructed in the care and maintenance of the pool by the supplier or builder, including treatment with high-test calcium hypochlorite (dry chlorine), sodium hypochlorite (liquid chlorine) or equally effective germicide and algicide, and the importance of proper pH (alkalinity and acidity) control.

**421.6.2 Deleted.**

**421.7 Appurtenant structures:** All *appurtenant structures*, installations and equipment, such as showers, dressing rooms, equipment houses or other buildings and structures, including plumbing, heating and air conditioning systems, shall comply with all applicable requirements of this code.

**421.7.1 Accessories:** All swimming pool accessories shall be designed, constructed and installed so as not to be a safety hazard. Installations or structures for diving purposes shall be properly anchored to insure stability.

**421.8 Equipment installations:** Pumps, filters and other mechanical and electrical equipment for public swimming pools shall be enclosed in such a manner as to provide access only to authorized persons and not to bathers. Construction and drainage shall be arranged to avoid the entrance and accumulation of water in the vicinity of electrical equipment.

**421.9 Enclosures for public and private swimming pools:** Public and private swimming pools shall be provided with an enclosure surrounding the pool area. The enclosure shall meet the provisions of Sections 421.9.1 through 421.9.3.

**421.9.1 Enclosure:** The enclosure shall extend not less than 4 feet (1219 mm) above the ground. All gates shall be self-closing and self-latching with latches placed at least 4 feet (1219 mm) above the ground.

**421.9.2 Construction:** Enclosure fences shall be constructed so as to prohibit the passage of a sphere larger than 4 inches (102 mm) in diameter through any opening or under the fence. Fences shall be designed to withstand a horizontal concentrated *load* of 200 pounds (896 N) applied on a 1-square-foot (0.093 $m^2$) area at any point of the fence.

**421.9.3 Alternative devices:** A natural barrier or other protective device approved by the governing body shall be an acceptable enclosure as long as the degree of protection afforded by the substituted device or structure is not less than the protection afforded by the enclosure, gate and latch described herein.

**421.10 Deleted.**

**421.10.1 Deleted.**

**421.10.2 Deleted.**

**421.10.3 Deleted.**

**421.10.4 Deleted.**

**421.11 Diving boards:** Minimum water depths and distances for diving hoppers for pools, based on board height above water, shall comply with Table 421.11(1) for public pools and Table 421.11(2) for private pools.

The maximum slope permitted between point $D_2$ and the transition point shall not exceed one unit vertical to three units horizontal (1:3) in private and public pools. $D_1$ is the point directly under the end of the diving boards. $D_2$ is the point at which the floor begins to slope upwards to the transition point (see Figure 421.11).

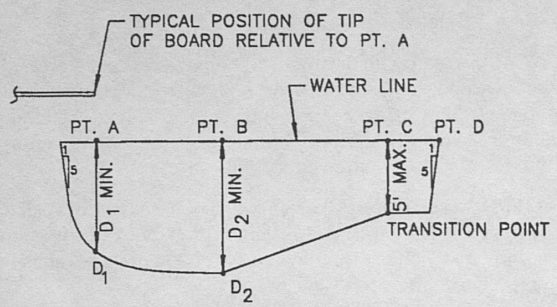



**Figure 421.11**
**MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR PUBLIC AND PRIVATE POOLS**

**Table 421.11(1)**
**MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR PUBLIC POOLS**

| Board height | Minimum depth[a] at $D_1$ directly under end of board | Distance[a] between $D_1$ and $D_2$ | Minimum depth[a] at $D_2$ |
|---|---|---|---|
| 2′2″ ($^2/_3$ meter) | 7′0″ | 8′0″ | 8′6″ |
| 2′6″ ($^3/_4$ meter) | 7′6″ | 9′0″ | 9′0″ |
| 1 meter | 8′6″ | 10′0″ | 10′0″ |
| 3 meter | 11′0″ | 10′0″ | 12′0″ |

**Note a.** 1 foot = 304.8 mm.

**Table 421.11(2)**
**MINIMUM WATER DEPTHS AND DISTANCES BASED ON BOARD HEIGHT FOR PRIVATE POOLS**

| Board height | Minimum depth[a] at $D_1$ directly under end of board | Distance[a] between $D_1$ and $D_2$ | Minimum depth[a] at $D_2$ |
|---|---|---|---|
| 1′8″ ($^1/_2$ meter) | 6′0″ | 7′0″ | 7′6″ |
| 2′2″ ($^2/_3$ meter) | 6′10″ | 7′6″ | 8′0″ |
| 2′6″ ($^3/_4$ meter) | 7′5″ | 8′0″ | 8′0″ |
| 3′4″ (1 meter) | 8′6″ | 9′0″ | 9′0″ |

**Note a.** 1 foot = 304.8 mm.

## SECTION 422.0 DAY CARE CENTERS

**422.1 Scope:** The provisions of this section shall apply to buildings or structures or portions thereof, required to be licensed as a day care center, which are classified in Chapter 3 under Use Group E. Except as specifically modified by Sections 422.1 through 422.12, day care centers shall meet all applicable provisions of this code.

**422.2 Location and construction:** Day care centers shall be limited to the locations/construction types specified in Table 422.2.

**Table 422.2**
**LOCATION/CONSTRUCTION TYPE LIMITATIONS**

| Location of day care | Sprinklered building | Construction type permitted |
|---|---|---|
| 1 story below LED | Yes | Any type other than 2C & 5B |
| Story of exit discharge | No | Any type |
| 1 story above LED | Yes | Any type |
| | No | 1A, 1B, 2A |
| 2 or 3 stories above LED | Yes | Any type other than 2C, 4, & 5B |
| >3 stories above LED but not high rise | Yes | 1A, 1B, 2A, or 2B |
| High rise | Yes | 1A, 1B, or 2A |

**422.2.1 Smoke barriers:** Where day care centers with clients 24 months or less in age or incapable of self-preservation are located one or more stories above the level of exit discharge or where day care centers are located two or more stories above the level of exit discharge, smoke barriers shall be provided to divide such stories into a minimum of two smoke compartments. The smoke barriers shall be constructed in accordance with Section 712.0 but shall not be required to have a fireresistance rating.

**422.3 Mixed use:** Where centers are located in a building containing another occupancy, the occupancy shall be separated by a 1-hour *fire separation assembly*.

**Exceptions**

1. In assembly occupancies used primarily for worship,
2. Centers in apartment buildings.
   - 2.1 If the two exit accesses from the center enter the same corridor as the apartment occupancy, the *exit accesses* shall be separated in the *corridor* by a smoke barrier having not less than a 1-hour fireresistance rating constructed in accordance with Section 712.0. The smoke barrier shall be so located that there is an *exit* on each side of it.
   - 2.2 The door in the smoke barrier shall be not less than 36 inches (914 mm) wide.

**422.3.1 Accessory uses:** Any heating equipment in spaces occupied by children shall be provided with partitions, screens, or other means to protect children under 6 years of age from hot surfaces and open flames.

**422.4 Client load:** The client load established for any floor or floors shall be computed at a rate of 1 person for each 35 square feet (3.25 $m^2$) of net floor area occupied by the persons being cared for, who shall otherwise be referred to in this code as "clients."

**422.5 Egress:** Each floor occupied by clients shall have not less than two remote *exits*. A *mezzanine* shall be considered a floor for the purpose of this Section.

**422.5.1 Length of travel (travel distance):** Travel distances shall be as follows:

1. The travel distance between any room door intended as *exit access* and an exit shall not exceed 100 feet (30480 mm).

2. The travel distance between any point in a room and an *exit* shall not exceed 150 feet (45720 mm).
3. The travel distance between any point in a sleeping room and an *exit* access door of that room shall not exceed 50 feet (15240 mm).

**Exception:** The travel distance in Item Nos. 1 and 2 of this section may be increased by 50 feet (15240 mm) in buildings protected throughout by an approved, supervised *automatic sprinkler system*.

**422.5.2 Corridor width:** The minimum width of *exit access corridors* shall be 44 inches (1118 mm).

**Exceptions**
1. Thirty-six inches (914 mm) where serving an occupant load of 50 or less.
2. The width required for capacity as determined by Section 1009.0.

**422.5.3 Interior corridors:** All *corridors* shall be 1-hour fireresistance rated. The *corridor* walls shall comply with Section 711.0.

**Exceptions**
1. This *corridor* protection shall not be required when all classrooms served by the *corridors* have at least one door directly to the outside or to an exterior balcony constructed in accordance with Section 1011.5.
2. As allowed by Section 1011.4.
3. Toilet rooms need not be separated from the corridors, provided they are separated from all other spaces by fire partitions having not less than a 1-hour fireresistance rating in accordance with Section 711.0.

**422.5.4 Special features:**
1. Every closet door latch shall be such that children can open the door from inside the closet.
2. Every bathroom door lock shall be designed to permit openings of the locked door from the outside in an emergency.

**422.6 Protection from hazards:** Cooking appliances and food preparation areas shall be protected in accordance with Sections 422.6.1 through 422.6.3.

**422.6.1 Commercial cooking appliance:** When a day care center has commercial cooking appliances such as ranges, deep fryers and/or a griddle, both of the following shall apply:
1. The kitchen or room in which the appliance(s) is located shall be enclosed by nonfireresistance rated walls and ceiling designed to resist the passage of smoke. Pass-through openings and door openings shall be equipped with an assembly which will screen possible flash fires from view.
2. All cooking appliances shall be protected by a commercial exhaust system designed and installed in accordance with the mechanical code listed in Chapter 35.

**422.6.2 Domestic cooking appliance:** When a day care center has a domestic range with food preparation which does not produce grease-laden vapors, one of the following shall apply:
1. The kitchen or room in which the appliance is located shall be enclosed by a 1-hour *fire partition* constructed in accordance with Section 711.0. A range hood exhaust and suppression system is not required in this situation; or
2. The kitchen or room in which the appliance is located shall comply with Section 422.6.1, Item Nos. 1 and 2.

**422.6.3 Nongrease-producing cooking appliances:** Day care centers using nongrease-generating cooking appliances such as microwave ovens, wall ovens and crock pots, shall locate these appliances so as not to be accessible to the clients.

**422.7 Interior finish:** All walls and ceilings have a Class I or Class II finish rating in accordance with ASTM E84 listed in Chapter 35.

**422.7.1 Floor finish:** All floor coverings within a *corridor* and *exit* shall be Class I or Class II in accordance with ASTM E648 listed in Chapter 35.

**422.8 Fire protective signaling system:** A manual fire alarm system shall be provided throughout the center.

**Exceptions**
1. Day care centers housed in one room.
2. Day care centers with a calculated client occupant load less than 50.

**422.9 Automatic fire detection system:** Automatic smoke detection systems shall be provided throughout all the day care centers regulated by Section 422.0 in the following locations:
1. On the ceiling in front of the doors to stairways,
2. At no greater than 30 foot spacing in the corridors of all floors containing the center; and
3. In lounges, recreation areas and sleeping rooms in the center.

**Exceptions**
1. Centers housed in one room.
2. Hard-wired, single-station smoke detectors may be installed in day care centers with a calculated client occupant load of less than 50 provided the detectors can be heard throughout the center.

**422.10 Engineers/architects law:** Plans for the construction or redesign of centers having a client load calculated pursuant to Section 422.4 which exceeds 100 shall bear the seal and signature of a Kentucky licensed architect and engineer.

**422.11 Barrier-free design:** All new work shall comply with the applicable provisions of Chapter 11.

**Exception:** Church-operated day care centers.

## SECTION 423.0 BED-AND-BREAKFAST ESTABLISHMENTS

**423.1 Bed-and-breakfast homes:** In addition to the requirements of Section 310.5.1, bed-and-breakfast homes shall comply with the following conditions:
1. All hallways and *means of egress* serving guestrooms shall be permanently illuminated and emergency lighting shall be provided.
2. The maximum overnight guest occupant load shall be 10 and it shall be posted.

3. Interconnected smoke detectors shall be provided in accordance with Sections 919.3.2, 919.4 and 919.5.
4. Each door between guest sleeping rooms and the main egress hallway or *corridor* shall be equipped with an approved self-closing device.
5. There shall be two remote *exits* to the outside from the ground floor.

**423.2 Bed-and-breakfast inns:** Bed-and-breakfast inns shall comply with Section 310.3.1.

# CHAPTER 5

# GENERAL BUILDING LIMITATIONS

## SECTION 501.0 GENERAL

**501.1 Scope:** The provisions of this chapter control the *height* and *area* of all structures hereafter erected, and *additions* to existing structures based on the type of construction, use group, frontage on open space providing exposure protection and access to structures for fire-fighting purposes, and the presence of an *automatic sprinkler system*.

## SECTION 502.0 DEFINITIONS

**502.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Area, building:*** The *area* included within surrounding exterior walls (or exterior walls and *fire walls*) exclusive of vent *shafts* and *courts*. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.

***Basement:*** That portion of a building which is partly or completely below grade (see "*Story above grade*").

***Grade plane:*** A reference plane representing the average of finished ground level adjoining the building at all exterior walls. Where the finished ground level slopes away from the exterior walls, the reference plane shall be established by the lowest points within the area between the building and the *lot line* or, where the *lot line* is more than 6 feet (1829 mm) from the building, between the building and a point 6 feet (1829 mm) from the building.

***Height***

***Building:*** The vertical distance from *grade plane* to the average height of the highest roof surface.

**Story:** The vertical distance from top to top of two successive tiers of beams or finished floor surfaces; and, for the topmost story, from the top of the *floor finish* to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters.

***Mezzanine:*** An intermediate level or levels between the floor and ceiling of any story with an aggregate floor area of not more than one-third of the area of the room in which the level or levels are located (see Section 505.0).

**Story:** That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above (also see "*Mezzanine*").

***Story above grade:*** Any story having its finished floor surface entirely above grade, except that a *basement* shall be considered as a story above grade where the finished surface of the floor above the *basement* is:

1. More than 6 feet (1829 mm) above *grade plane*;
2. More than 6 feet (1829 mm) above the finished ground level for more than 50 percent of the total building perimeter; or
3. More than 12 feet (3658 mm) above the finished ground level at any point.

## SECTION 503.0 GENERAL HEIGHT AND AREA LIMITATIONS

**503.1 General:** The *heights* and *areas* of all buildings and structures between exterior walls or between exterior walls and *fire walls*, shall be governed by the type of construction and the use group classification as defined in Chapters 3 and 6 and shall not exceed the limitations fixed in Table 503, except as specifically modified by this chapter and the following sections:

| Section | Subject |
|---|---|
| 402.7 | Covered mall buildings |
| 403.3.3.1 | High-rise buildings |
| 414.2 | Airport traffic control towers |
| 416.3 | HPM facilities |
| 418.3.1.1 | Grain elevators |
| 422.2 | Day care centers |
| 3103.3.5 | Membrane structures |

**503.1.1 Special industrial occupancies:** All buildings and structures designed to house low-hazard industrial processes that require large *areas* and unusual *heights* to accommodate craneways or special machinery and equipment, including, among others, rolling mills, structural metal fabrication shops and foundries, or the production and distribution of electric, gas or steam power, shall be exempt from the *height* and *area* limitations of Table 503.

**503.1.2 Open parking structures:** Open parking structures shall conform to the *height* and *area* limitations specified in Section 406.4.

**503.1.3 Buildings on same lot:** Two or more buildings on the same *lot* shall be regulated as separate buildings or shall be considered as portions of one building if the *height* of each building and the aggregate *area* of all buildings are within the limitations of Table 503 as modified by Sections 504.0 and 506.0. The provisions of this code applicable to the aggregate building shall be applicable to each building.

## Table 503
## HEIGHT AND AREA LIMITATIONS OF BUILDINGS
**Height limitations of buildings (shown in upper figure as stories and feet above grade plane)[m], and area limitations of one- or two-story buildings facing on one street or public space not less than 30 feet wide (shown in lower figure as area in square feet per floor[m]). See Note a.**

| Use Group | | Note a | Type of construction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Noncombustible | | | | | Noncombustible/Combustible | | | Combustible | |
| | | | Type 1 | | Type 2 | | | Type 3 | | Type 4 | Type 5 | |
| | | | Protected Note b | | Protected | | Unprotected | Protected | Unprotected | Heavy timber | Protected | Unprotected |
| | | | 1A | 1B | 2A | 2B | 2C | 3A | 3B | 4 | 5A | 5B |
| **A-1** | Assembly, theaters | | Not limited | Not limited | 5 St. 65′ 19,950 | 3 St. 40′ 13,125 | 2 St. 30′ 8,400 | 3 St. 40′ 11,550 | 2 St. 30′ 8,400 | 3 St. 40′ 12,600 | 1 St. 20′ 8,925 | 1 St. 20′ 4,200 |
| **A-2** | Assembly, nightclubs and similar uses | | Not limited | Not limited 7,200 | 3 St. 40′ 5,700 | 2 St. 30′ 3,750 | 1 St. 20′ 2,400 | 2 St. 30′ 3,300 | 1 St. 20′ 2,400 | 2 St. 30′ 3,600 | 1 St. 20′ 2,550 | 1 St. 20′ 1,200 |
| **A-3** | Assembly | Lecture halls, recreation centers, terminals, restaurants other than nightclubs | Not limited | Not limited | 5 St. 65′ 19,950 | 3 St. 40′ 13,125 | 2 St. 30′ 8,400 | 3 St. 40′ 11,550 | 2 St. 30′ 8,400 | 3 St. 40′ 12,600 | 1 St. 20′ 8,925 | 1 St. 20′ 4,200 |
| **A-4** | Assembly, churches | Note c | Not limited | Not limited | 5 St. 65′ 34,200 | 3 St. 40′ 22,500 | 2 St. 30′ 14,400 | 3 St. 40′ 19,800 | 2 St. 30′ 14,400 | 3 St. 40′ 21,600 | 1 St. 20′ 15,300 | 1 St. 20′ 7,200 |
| **B** | Business | | Not limited | Not limited | 7 St. 85′ 34,200 | 5 St. 65′ 22,500 | 3 St. 40′ 14,400 | 4 St. 50′ 19,800 | 3 St. 40′ 14,400 | 5 St. 65′ 21,600 | 3 St. 40′ 15,300 | 2 St. 30′ 7,200 |
| **E** | Educational | Note c | Not limited | Not limited | 5 St. 65′ 34,200 | 3 St. 40′ 22,500 | 2 St. 30′ 14,400 | 3 St. 40′ 19,800 | 2 St. 30′ 14,400 | 3 St. 40′ 21,600 | 1 St. 20′ 15,300 Note d | 1 St. 20′ 7,200 Note d |
| **F-1** | Factory and industrial, moderate | | Not limited | Not limited | 6 St. 75′ 22,800 | 4 St. 50′ 15,000 | 2 St. 30′ 9,600 | 3 St. 40′ 13,200 | 2 St. 30′ 9,600 | 4 St. 50′ 14,400 | 2 St. 30′ 10,200 | 1 St. 20′ 4,800 |
| **F-2** | Factory and industrial, low | Note h | Not limited | Not limited | 7 St. 85′ 34,200 | 5 St. 65′ 22,500 | 3 St. 40′ 14,400 | 4 St. 50′ 19,800 | 3 St. 40′ 14,400 | 5 St. 65′ 21,600 | 3 St. 40′ 15,300 | 2 St. 30′ 7,200 |
| **H-1** | High hazard, detonation hazards | Notes e, i, k, l | 1 St. 20′ 16,800 | 1 St. 20′ 14,400 | 1 St. 20′ 11,400 | 1 St. 20′ 7,500 | 1 St. 20′ 4,800 | 1 St. 20′ 6,600 | 1 St. 20′ 4,800 | 1 St. 20′ 7,200 | 1 St. 20′ 5,100 | Not permitted |
| **H-2** | High hazard, deflagration hazards | Notes e, i, j, l | 5 St. 65′ 16,800 | 3 St. 40′ 14,400 | 3 St. 40′ 11,400 | 2 St. 30′ 7,500 | 1 St. 20′ 4,800 | 2 St. 30′ 6,600 | 1 St. 20′ 4,800 | 2 St. 30′ 7,200 | 1 St. 20′ 5,100 | Not permitted |
| **H-3** | High hazard, physical hazards | Notes e, l | 7 St. 85′ 33,600 | 7 St. 85′ 28,800 | 6 St. 75′ 22,800 | 4 St. 50′ 15,000 | 2 St. 30′ 9,600 | 3 St. 40′ 13,200 | 2 St. 30′ 9,600 | 4 St. 50′ 14,400 | 2 St. 30′ 10,200 | 1 St 20′ 4,800 |
| **H-4** | High hazard, health hazards | Notes e, l | 7 St. 85′ Not limited | 7 St. 85′ Not limited | 7 St. 85′ 34,200 | 5 St. 65′ 22,500 | 3 St. 40′ 14,400 | 4 St. 50′ 19,800 | 3 St. 40′ 14,400 | 5 St. 65′ 21,600 | 3 St. 40′ 15,300 | 2 St. 30′ 7,200 |
| **I-1** | Institutional, residential care | | Not limited | Not limited | 9 St. 100′ 19,950 | 4 St. 50′ 13,125 | 3 St. 40′ 8,400 | 4 St. 50′ 11,550 | 3 St. 40′ 8,400 | 4 St. 50′ 12,600 | 3 St. 40′ 8,925 | 2 St. 35′ 4,200 |
| **I-2** | Institutional, incapacitated | | Not limited | Not limited | 4 St. 50′ 17,100 | 2 St. 30′ 11,250 | 1 St. 20′ 7,200 | 1 St. 20′ 9,900 | Not permitted | 1 St. 20′ 10,800 | 1 St. 20′ 7,650 | Not permitted |
| **I-3** | Institutional, restrained | | Not limited | Not limited | 4 St. 50′ 14,250 | 2 St. 30′ 9,375 | 1 St. 20′ 6,000 | 2 St. 30′ 8,250 | 1 St. 20′ 6,000 | 2 St. 30′ 9,000 | 1 St. 20′ 6,375 | Not permitted |
| **M** | Mercantile | | Not limited | Not limited | 6 St. 75′ 22,800 | 4 St. 50′ 15,000 | 2 St. 30′ 9,600 | 3 St. 40′ 13,200 | 2 St. 30′ 9,600 | 4 St. 50′ 14,400 | 2 St. 30′ 10,200 | 1 St. 20′ 4,800 |
| **R-1** | Residential, hotels | | Not limited | Not limited | 9 St. 100′ 22,800 | 4 St. 50′ 15,000 | 3 St. 40′ 9,600 | 4 St. 50′ 13,200 | 3 St. 40′ 9,600 | 4 St. 50′ 14,400 | 3 St. 40′ 10,200 | 2 St. 35′ 4,800 |
| **R-2** | Residential, multiple-family | | Not limited | Not limited | 9 St. 100′ 22,800 | 4 St. 50′ 15,000 Note f | 3 St. 40′ 9,600 | 4 St. 50′ 13,200 Note f | 3 St. 40′ 9,600 | 4 St. 50′ 14,400 | 3 St. 40′ 10,200 | 2 St. 35′ 4,800 |
| **R-3** | Residential, one- and two-family and multiple single-family | | Not limited | Not limited | 4 St. 50′ 22,800 | 4 St. 50′ 15,000 | 3 St. 40′ 9,600 | 4 St. 50′ 13,200 | 3 St. 40′ 9,600 | 4 St. 50′ 14,400 | 3 St. 40′ 10,200 | 2 St. 35′ 4,800 |
| **S-1** | Storage, moderate | | Not limited | Not limited | 5 St. 65′ 19,950 | 4 St. 50′ 13,125 | 2 St. 30′ 8,400 | 3 St. 40′ 11,550 | 2 St. 30′ 8,400 | 4 St. 50′ 12,600 | 2 St. 30′ 8,925 | 1 St. 20′ 4,200 |
| **S-2** | Storage, low | Note g | Not limited | Not limited | 7 St. 85′ 34,200 | 5 St. 65′ 22,500 | 3 St. 40′ 14,400 | 4 St. 50′ 19,800 | 3 St. 40′ 14,400 | 5 St. 65′ 21,600 | 3 St. 40′ 15,300 | 2 St. 30′ 7,200 |
| **U** | Utility, miscellaneous | | Not limited | Not limited | 5 St. 65′ 19,950 | 4 St. 50′ 13,125 | 2 St. 30′ 8,400 | 3 St. 40′ 11,550 | 2 St. 30′ 8,400 | 4 St. 50′ 12,600 | 2 St. 30′ 8,925 | 1 St. 20′ 4,200 |

**Note a.** See the following sections for general exceptions to Table 503:
Section 504.2 Allowable height increase due to automatic sprinkler system installation.
Section 506.2 Allowable area increase due to street frontage.
Section 506.3 Allowable area increase due to automatic sprinkler system installation.
Section 506.4 Allowable area reduction for multistory buildings.
Section 507.0 Unlimited area one-story buildings.

**Note b.** Buildings of Type 1 construction permitted to be of unlimited tabular heights and areas are not subject to special requirements that allow increased heights and areas for other types of construction (see Section 503.1.4).

**Note c.** For height exceptions for auditoriums in occupancies in Use Groups A-4 and E, see Section 504.3.

**Note d.** For height exceptions for day care centers in buildings of Type 5 construction, see Section 504.4.

**Note e.** For exceptions to height and area limitations for buildings with occupancies in Use Group H, see Chapter 4 governing the specific use groups.

**Note f.** For exceptions to height of buildings with occupancies in Use Group R-2 of Types 2B and 3A construction, see Sections 504.6 and 504.7.

**Note g.** For height and area exceptions for open parking structures, see Section 406.0.

**Note h.** For exceptions to height and area limitations for special industrial occupancies, see Section 503.1.1.

**Note i.** Occupancies in Use Groups H-1 and H-2 shall not be permitted below grade.

**Note j.** Rooms and areas of Use Group H-2 containing pyrophoric materials shall not be permitted in buildings of Type 3, 4 or 5 construction.

**Note k.** Occupancies in Use Group H-1 are required to be detached one-story buildings (see Section 707.1.1).

**Note l.** For exceptions to height for buildings with occupancies in Use Group H, see Section 504.5.

**Note m.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**503.1.4 Type 1 construction:** Buildings of Type 1 construction which are permitted to be of unlimited tabular *heights* and *areas* by Table 503, are not subject to the special requirements that allow increased *heights* and *areas* for other types of construction.

**503.2 Area limitations:** The *area* limitations specified in Table 503 shall apply to the maximum horizontally projected *area* of all buildings fronting on a street or a public space not less than 30 feet (9144 mm) in width with access from a public street.

**503.3 Height limitations:** The *height* in feet and the number of *stories above grade* specified in Table 503 shall apply to all buildings and to all separate parts of a building that are enclosed within *fire walls* complying with the provisions of Chapter 7. A *basement* shall be considered as a *story above grade* where the finished surface of the floor above the *basement* is more than 6 feet (1829 mm) above *grade plane*; or more than 6 feet (1829 mm) above the finished ground level for more than 50 percent of the total building perimeter; or more than 12 feet (3658 mm) above the finished ground level at any point.

## SECTION 504.0 HEIGHT MODIFICATIONS

**504.1 General:** The provisions of this section shall modify the *height* limitations of Table 503 as herein specified.

**504.2 Automatic sprinkler systems:** Where a building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the building *height* limitation specified in Table 503 shall be increased one story and 20 feet (6096 mm). The building *height* limitations for buildings with an occupancy in Use Group R specified in Table 503 shall be increased one story and 20 feet (6096 mm) but not to exceed a *height* of four stories and 60 feet (18288 mm) where the building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.2 and the system is supervised in accordance with Section 924.1, method 1.

**Exception:** The *automatic sprinkler system* height increase shall not apply to any of the following conditions:

1. Buildings with an occupancy in Use Group H-1.
2. A *fire area* with an occupancy in Use Groups H-2 or H-3.
3. Buildings of Types 2C, 3A, 4 and 5A construction with an occupancy in Use Group I-2.

**504.3 Auditoriums:** The maximum *height* of auditoriums in Use Groups A-4 and E shall be 65 feet (19812 mm) in buildings of Type 2B, 3A, 4 or 5A construction and 45 feet (13716 mm) in buildings of Type 2C, 3B or 5B construction.

**504.4 Deleted.**

**504.5 High-hazard use groups:** Buildings and structures with an occupancy in Use Group H that requires unusual *heights* necessary to accommodate special manufacturing processes and equipment shall be exempt from the tabular *height* limitations, in feet, of Table 503.

**504.6 Type 3A construction:** The *height* limitation for buildings of Type 3A construction with occupancies in Use Group R-2 shall be increased to six stories and 75 feet (22860 mm) where the first floor construction above the *basement* has a fireresistance rating of not less than 3 hours and the floor *area* is subdivided by 2-hour fireresistance rated *fire walls* into *fire areas* of not more than 3,000 square feet (279 $m^2$).

**504.7 Type 2B construction:** The *height* limitation for buildings of Type 2B construction with occupancies in Use Group R-2 shall be increased to nine stories and 100 feet (30480 mm) where the building is separated by not less than 50 feet (15240 mm) from any other building on the *lot* and from *interior lot lines*, the *exits* are segregated in a *fire area* enclosed by a 2-hour fireresistance rated *fire wall* and the first floor construction has a fireresistance rating of not less than $1^1/_2$ hours.

## SECTION 505.0 MEZZANINES

**505.1 General:** A *mezzanine* or *mezzanines* in compliance with this section shall be considered a portion of the floor below. Such *mezzanines* shall not contribute to the *building area* as regulated by Section 503.2. Such *mezzanines* shall not contribute to the number of stories as regulated by Section 503.3. The area of the *mezzanine* shall be included in determining the *fire area*.

**505.2 Area limitation:** The aggregate area of a *mezzanine* or *mezzanines* within a room shall not exceed one-third of the area of that room. The enclosed portions of rooms shall not be included in a determination of the size of the room in which the *mezzanine* is located. In determining the allowable *mezzanine* area, the area of the *mezzanine* shall not be included in the area of the room.

**Exception:** The aggregate area of *mezzanines* in buildings and structures of Type 1 or 2 construction for special industrial occupancies in accordance with Section 503.1.1 shall not exceed two-thirds of the area of that room.

**505.3 Egress:** Each occupant of a *mezzanine* shall have access to at least two independent *means of egress* where such spaces require two *means of egress* in accordance with Section 1017.2. Where a *stairway* provides a means of *exit access* from a *mezzanine*, the maximum travel distance required by Section 1017.2 shall be measured to the bottom of the *stairway*.

**505.4 Openness:** A *mezzanine* shall be open and unobstructed to the room in which such *mezzanine* is located except for walls not more than 42 inches (1067 mm) high, columns and posts.

**Exceptions**

1. *Mezzanines* or portions thereof are not required to be open to the room in which the *mezzanines* are located, provided that the occupant load of the aggregate area of the enclosed space does not exceed 10.
2. A *mezzanine* having two or more *means of egress* is not required to be open to the room in which the *mezzanine* is located, if at least one of the *means of egress* provides direct access to an *exit* from the *mezzanine* level.

## SECTION 506.0 AREA MODIFICATIONS

**506.1 General:** The provisions of this section shall modify the *area* limitations of Table 503 as herein specified.

**506.2 Street frontage increase:** Where a building or structure has more than 25 percent of the building perimeter fronting on a street or other unoccupied space, the *area* limitations specified in Table 503 shall be increased 2 percent for each 1 percent of excess frontage. The unoccupied space shall be on the same *lot*

or dedicated for public use, and shall not be less than 30 feet (9144 mm) in width. The maximum area increase permitted by this section shall be 150 percent.

**506.2.1 Fire lane access increase:** Where the perimeter of a building or structure qualifies for the street frontage increase of Section 506.2 and the unoccupied space is connected to a street by a continuous paved roadway to serve as a fire lane, the *area limitations* specified in Table 503 shall be increased an additional 1 percent for each 1 percent of the excess frontage and roadway. The fire lane shall meet the design requirements of Section 506.2.1.1 and shall be located so the measurement from the nearest edge of the paved roadway surface to the exterior wall fronting on the unoccupied space does not exceed 50 feet (15250 mm). The maximum area increase permitted by this section shall be 75 percent.

**506.2.1.1 Fire lane design and dimensions:** Fire lanes constructed for the purpose of the area increases allowed by Section 506.2.1 shall be designed to comply with AASHTO standards GDPS-4 and GDHS-3 listed in Chapter 35. The roadway surface shall have a minimum clear width of 18 feet (5486 mm) and a minimum clear vertical clearance of 13 feet 6 inches (4118 mm). The minimum turning radius for a fire lane with a 90-degree turn shall be designed for the largest fire apparatus of the fire department having jurisdiction.

**506.3 Automatic sprinkler system:** Where a building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1, the *area* limitation specified in Table 503 shall be increased 200 percent for one- and two-story buildings and 100 percent for buildings more than two stories in *height*.

**Exceptions**

1. The *automatic sprinkler system* increase shall not apply to buildings with an occupancy in Use Group H-1.
2. The *automatic sprinkler system* increase shall not apply to any *fire area* with an occupancy in Use Group H-2 or H-3.

**506.4 Multistory buildings:** The *area* limitations for buildings two stories in *height* shall be the same as the *area* limitations provided in Table 503 for one-story buildings. In buildings over two stories in *height*, the *area* limitations of Table 503 for one-story buildings shall be reduced as specified in Table 506.4.

**Table 506.4**
**REDUCTION OF AREA LIMITATIONS**

| Number of stories | Type of construction | | |
|---|---|---|---|
| | 1A & 1B | 2A | 2B, 2C, 3A, 3B, 4, 5A, 5B |
| 1 | None | None | None |
| 2 | None | None | None |
| 3 | None | 5% | 20% |
| 4 | None | 10% | 20% |
| 5 | None | 15% | 30% |
| 6 | None | 20% | 40% |
| 7 | None | 25% | 50% |
| 8 | None | 30% | 60% |
| 9 | None | 35% | 70% |
| 10 | None | 40% | 80% |

## SECTION 507.0 UNLIMITED AREAS

**507.1 One-story buildings:** For Use Groups A-3, B, F-1, F-2, I-2, M, S-1 and S-2 and for motion picture theaters, the *area* of buildings that do not exceed one story and 85 feet (25908 mm) in *height*, other than buildings of Type 5 construction, shall not be limited, provided that the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1; and the building is isolated as specified in Section 507.2. Buildings with an occupancy in Use Group I-2 shall not be constructed of Type 3B construction. *Fire areas* of Use Group E are permitted in unlimited area buildings in accordance with Section 507.1.1. *Fire areas* of Use Groups H-2, H-3 and H-4 are permitted in unlimited area buildings in accordance with Section 507.1.2.

**Exceptions**

1. Buildings and structures of special industrial occupancies in accordance with Section 503.1.1 shall be exempt from the above *height* limitations and *fire separation distance* requirements, and the *automatic fire suppression system* shall not be provided where such installations will be detrimental or dangerous to the specific occupancy as approved by the code official. Where located with a *fire separation distance* of less than 30 feet (9144 mm), the exterior walls of such buildings shall be *protected* or constructed to provide a fireresistance rating of not less than 2 hours.
2. An *automatic fire suppression system* shall not be required for buildings of Type 2 or Type 4 construction which are occupied exclusively for the storage of noncombustible materials that are not packed or crated in combustible materials.
3. Buildings and structures of Types 1 and 2 construction for rack storage facilities which do not have access by the public shall not be limited in *height* provided that such buildings conform to the requirements of Section 507.1 and NFPA 231C listed in Chapter 35.
4. The *automatic sprinkler system* shall not be required in areas occupied for indoor participant sports, such as tennis, skating, swimming and equestrian activities, in occupancies in Use Group A-3 provided that:
   4.1. *Exit* doors directly to the outside are provided for all occupants of the participant sport areas; and
   4.2. The building is equipped with a fire alarm system with manual fire alarm boxes installed in accordance with Section 918.0.
5. The *automatic fire suppression system* shall not be required for buildings of Type 2 or Type 4 construction classified as agricultural buildings.

**507.1.1 School buildings:** For occupancies in Use Group E, one-story buildings of Type 2, 3A or 4 construction shall not be limited in *area* where a direct *exit* to the outside of the building is provided from each classroom and the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. Exterior walls on all sides of such buildings shall comply with Section 507.2.

**507.1.2 High-hazard use groups:** Use Group H-2, H-3 and H-4 *fire areas* shall be permitted in unlimited area buildings having occupancies in Use Groups F and S, in accordance with the limitations of this section. *Fire areas* located at the perimeter of the unlimited area building shall not exceed 10 percent of the area of the building nor the area limitations specified in Table 503 as modified by Section 506.2, based upon the percentage of the perimeter of the *fire area* that fronts on a street or other unoccupied space. Other *fire areas* shall not exceed 25 percent of the area limitations specified in Table 503. Fireresistance rating requirements of *fire separation assemblies* shall be in accordance with Table 313.1.2.

**507.2 Exterior walls:** The minimum fireresistance rating of exterior walls of one-story buildings of unlimited *area* shall be determined by the use group and the *fire separation distance* as specified in Table 507.2, but shall not be less than the fireresistance rating required by Table 602 for the type of construction. The entire perimeter of one-story unlimited *area* buildings shall have a minimum *fire separation distance* of 30 feet (9144 mm).

**Exception:** The minimum *fire separation distance* of 30 feet (9144 mm) shall not apply to a wall facing another building on the same *lot*, provided that:

1. Such wall is constructed as a *fire wall* in accordance with Section 707.0;
2. The length of the *fire wall* does not exceed 25 percent of the total perimeter of the unlimited area building;
3. The adjacent building has a minimum *fire separation distance* of 30 feet (9144 mm) on all sides, except for the side that faces the unlimited area building;
4. The adjacent building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1; and
5. A building exceeding one story in *height* adjacent to the unlimited area building shall not contain an occupancy in Use Group H-2 or H-3.

**Table 507.2**
**MINIMUM FIRERESISTANCE RATING OF EXTERIOR WALLS**

| Use Group | Fireresistance rating (hours) based on fire separation distance[a] | |
|---|---|---|
| | 30 feet or greater but less than 50 feet | 50 feet or greater |
| E | 1 1/2 | 0 |
| A-3, B, F-2, I-2, S-2 | 2 | 0 |
| F-1, M, S-1 | 3 | 0 |

**Note a.** 1 foot = 304.8 mm.

**507.2.1 Opening protectives:** Openings in exterior walls required by Table 507.2 to have a fireresistance rating of 3 hours or more shall be *protected* with fire assemblies having a fireresistance rating of not less than 3 hours. Openings in exterior walls required by Table 507.2 to have a fireresistance rating of 2 hours shall be *protected* with fire assemblies having a fire protection rating of not less than 1 1/2 hours.

# CHAPTER 6

# TYPES OF CONSTRUCTION

## SECTION 601.0 GENERAL

**601.1 Scope:** The provisions of this chapter shall control the classification of all buildings as to type of construction.

**601.2 Application of other laws:** The provisions of this chapter shall not be deemed to nullify any provisions of the *zoning* law or any other statute of the jurisdiction pertaining to the location or type of construction of buildings, except as is specifically required by the provisions of this code.

## SECTION 602.0 CONSTRUCTION CLASSIFICATION

**602.1 General:** All buildings and structures erected or to be erected, altered or extended in *height* or *area* shall be classified in one of the five construction types defined in Table 602 and Sections 603.0 through 606.0.

**602.2 False designation:** A building shall not be designated as a given type of construction unless it conforms to the minimum requirements for that type.

**602.3 Minimum requirements:** Where a type of construction is used that is superior to the minimum herein required for any specified use, *height* and *area* of the building, nothing in this code shall be construed to require full compliance with the specifications for the higher type; however, the designated construction classification of the building shall be that of the lesser type, unless all of the requirements for the higher type are fulfilled.

**602.4 Noncombustibility requirements:** Where a structure or a part of a structure is required to be constructed of noncombustible construction, the use of combustible elements shall be permitted subject to the limitations of this section without altering the construction classification.

**602.4.1 Roofs, floors and walls:** Combustible elements in roofs, floors and walls are permitted to be used for the following components:

1. Interior finish and trim materials as regulated by Sections 803.0, 804.0 and 806.0.
2. Light-transmitting *plastics* as permitted by Chapter 26.
3. Fireretardant-treated wood complying with Section 2310.0 as permitted by Table 602.
4. Mastics and caulking materials applied to provide flexible seals between components of exterior wall construction.
5. Roof covering materials as regulated by Chapter 15.
6. Thermal and sound insulation as permitted by Sections 707.5, 723.0, 1509.0, 2309.4 and 2603.0.
7. Exterior veneer and trim as permitted by Section 1406.0.
8. Nailing or furring strips as permitted by Section 804.0.
9. Windows and doors as permitted by Section 706.4.
10. Heavy timber as permitted by Sections 1006.3.1, 715.2 and 715.4.
11. Partitions as permitted by Section 603.2.
12. Roof structures as permitted by Section 1510.0.
13. Platforms as permitted by Section 412.4.1.

**602.4.2 Ducts:** The use of nonmetallic ducts is permitted in accordance with the mechanical code listed in Chapter 35.

**602.4.3 Combustible pipe:** Combustible pipe shall be permitted in all use groups and construction types where approved by Chapters 28 and 29 of this code.

**602.4.4 Electrical:** The use of insulated electrical wiring and related components is permitted in accordance with NFPA 70 listed in Chapter 35.

## SECTION 603.0 TYPES 1 AND 2 CONSTRUCTION

**603.1 General:** Buildings and structures of Types 1 and 2 construction are those in which the walls, partitions, structure elements, floors, ceilings, roofs and *exits* are constructed of approved noncombustible materials. Each structure element shall not be less than the required fireresistance rating specified in Table 602, except as otherwise specifically provided for in this code. Buildings of Types 1 and 2 construction shall be further classified as Type 1A, 1B, 2A, 2B or 2C. Fireretardant-treated wood shall only be used as specified in Table 602 and Section 2310.0.

**603.2 Interior partitions:** In buildings or structures of Types 1, 2A and 2B construction, partitions of a single thickness of wood or approved composite panels, and glass or other approved materials of similar combustible characteristics, are permitted to subdivide rooms or spaces into offices, entries or other similar compartments in all occupancies other than Use Groups I and R, provided that such partitions neither establish a *corridor* serving an occupant load of more than 30 in areas occupied by a single tenant nor exceed 5,000 square feet (465 $m^2$) between *fire separation assemblies* or *fire walls*. The maximum allowable compartment size shall be increased to 7,500 square feet (700 $m^2$) where subdivided with fireretardant-treated wood that complies with Section 2310.0.

## Table 602
## FIRERESISTANCE RATINGS OF STRUCTURE ELEMENTS[k]

| Structure element (Note a) | | Type of construction Section 602.0 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Noncombustible | | | | | Noncombustible/Combustible | | | Combustible | |
| | | Type 1 Section 603.0 | | Type 2 Section 603.0 | | | Type 3 Section 604.0 | | Type 4 Section 605.0 | Type 5 Section 606.0 | |
| | | Protected | | Protected | | Unprotected | Protected | Unprotected | Heavy timber Note c | Protected | Unprotected |
| | | 1A | 1B | 2A | 2B | 2C | 3A | 3B | 4 | 5A | 5B |
| 1 Exterior walls | Loadbearing | 4 | 3 | 2 | 1 | 0 | 2 | 2 | 2 | 1 | 0 |
| | Nonloadbearing | ← Not less than the fireresistance rating based on fire separation distance (see Section 705.2) → | | | | | | | | | |
| 2 Fire walls and party walls (Section 707.0) | | ← Not less than the fireresistance rating based on fire separation distance (see Section 705.2) → | | | | | | | | | |
| | | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | ← Not less than the fireresistance rating required by Table 707.1 → | | | | | | | | | |
| 3 Fire separation assemblies (Section 709.0) | Fire enclosure of exits (Sections 1014.11, 709.0 and Note b) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Shafts (other than exits) and elevator hoistways (Sections 709.0, 710.0 and Note b) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| | Mixed use and fire area separations (Section 313.0) | ← Not less than the fireresistance rating required by Table 313.1.2 → | | | | | | | | | |
| | Other separation assemblies (Note i) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | ← Note d → | | | | | | | | | |
| 4 Fire partitions (Section 711.0) | Exit access corridors (Note g) | ← Not less than the fireresistance rating required by Section 1011.4 → | | | | | | | | | |
| | | ← Note d → | | | | | | | | | |
| | Tenant spaces separations (Note f) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| | | ← Note d → | | | | | | | | | |
| 5 Dwelling unit and guestroom separations (Sections 711.0, 713.0 and Notes f and j) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | ← Note d → | | | | | | | | | |
| 6 Smoke barriers (Section 712.0 and Note g) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 Other nonloadbearing partitions | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | ← Note d → | | | | | | | | | |
| 8 Interior loadbearing walls, loadbearing partitions, columns, girders, trusses (other than roof trusses) and framing (Section 716.0) | Supporting more than one floor | 4 | 3 | 2 | 1 | 0 | 1 | 0 | see Sec. 605.0 | 1 | 0 |
| | Supporting one floor only or a roof only | 3 | 2 | 1½ | 1 | 0 | 1 | 0 | see Sec. 605.0 | 1 | 0 |
| 9 Structural members supporting wall (Section 716.0 and Note g) | | 3 | 2 | 1½ | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| | | ← Not less than fireresistance rating of wall supported → | | | | | | | | | |
| 10 Floor construction including beams (Section 713.0 and Note h) | | 3 | 2 | 1½ Note l | 1 | 0 | 1 | 0 | see Sec. 605.0 Note c | 1 | 0 |
| 11 Roof construction, including beams, trusses and framing, arches and roof deck (Section 715.0 and Notes e, m) | 15′ or less in height to lowest member | 2 | 1½ | 1 | 1 | 0 | 1 | 0 | see Sec. 605.0 Note c | 1 | 0 |
| | | | | ← Note d → | | | | | | | |
| | More than 15′ but less than 20′ in height to lowest member | 1 | 1 | 1 | 0 | 0 | 0 | 0 | see Sec. 605.0 | 1 | 0 |
| | | ← Note d → | | | | | | | | | |
| | 20′ or more in height to lowest member | 0 | 0 | 0 | 0 | 0 | 0 | 0 | see Sec. 605.0 | 0 | 0 |
| | | ← Note d → | | | | | | | | | |

**Note a.** For fireresistance rating requirements for structural members and assemblies which support other fireresistance rated members or assemblies, see Section 716.1.

**Note b.** For reductions in the required fireresistance rating of exit and shaft enclosures, see Sections 1014.11 and 710.3.

**Note c.** For substitution of other structural materials for timber in Type 4 construction, see Section 2304.2.

**Note d.** For fireretardant-treated wood permitted in roof construction and nonloadbearing walls where the required fireresistance rating is 1 hour or less, see Sections 603.2 and 2310.0.

**Note e.** For permitted uses of heavy timber in roof construction in buildings of Types 1 and 2 construction, see Section 715.4.

**Note f.** For reductions in required fireresistance ratings of tenant separations and dwelling unit separations, see Sections 1011.4 and 1011.4.1.

**Note g.** For exceptions to the required fireresistance rating of construction supporting exit access corridor walls, tenant separation walls in covered mall buildings, and smoke barriers, see Sections 711.4 and 712.2.

**Note h.** For buildings having habitable or occupiable stories or basements below grade, see Section 1006.3.1.

**Note i.** Not less than the rating required by this code.

**Note j.** For Use Group R-3, see Section 310.5.

**Note k.** Fireresistance ratings are expressed in hours.

**Note l.** In buildings which are required to comply with the provisions of Section 403.3, the required fireresistance rating for floor construction, including beams, shall be 2 hours, see Section 403.3.3.1.

**Note m.** 1 foot = 304.8 mm.

## SECTION 604.0 TYPE 3 CONSTRUCTION

**604.1 General:** Buildings and structures of Type 3 construction are those in which the exterior walls are constructed of concrete, masonry or other approved noncombustible materials; and the interior structural elements, loadbearing walls, partitions, floors and roofs are constructed of any approved materials. Each structural element shall not have less than the required fireresistance rating specified in Table 602, except as otherwise specifically provided for in this code. Buildings of Type 3 construction shall be further classified as Type 3A or 3B.

## SECTION 605.0 TYPE 4 CONSTRUCTION

**605.1 General:** Buildings and structures of Type 4 construction are those in which the exterior walls are constructed of approved noncombustible materials and the interior structural members are of solid or laminated wood without concealed spaces or the loadbearing walls, partitions, floors and roofs are constructed of any noncombustible materials permitted by this code. Each structure element shall have not less than the required fireresistance rating specified in Table 602. The elements of Type 4 construction shall comply with the provisions of Section 2304.0.

## SECTION 606.0 TYPE 5 CONSTRUCTION

**606.1 General:** Buildings and structures of Type 5 construction are those in which the exterior walls, loadbearing walls, partitions, floors and roofs are constructed of any approved materials. Each structure element shall have not less than the required fireresistance rating specified in Table 602. Buildings of Type 5 construction shall be further classified as Type 5A or 5B.

# CHAPTER 7

# FIRERESISTANT MATERIALS AND CONSTRUCTION

## SECTION 701.0 GENERAL

**701.1 Scope:** The provisions of this chapter shall govern the design and installation of all materials and methods of construction in respect to required fireresistance rating and flameresistance, as determined by the potential fire hazard of the use and occupancy of the building or structure and the location and function of all integral structural and other fireresistive elements of the building, and the installation of safeguards against the spread of fire to and from adjoining structures.

**701.2 Performance standards:** The requirements of this chapter shall constitute the minimum functional performance standards for fire protection purposes, and shall not be deemed to decrease or waive any strength provisions or in any other manner decrease the requirements of this code in respect to structural safety.

**701.3 Combustible materials:** All materials and forms of construction which develop the fireresistance ratings required by this code shall be acceptable for providing the required fireresistance rating and for structural purposes, except that combustible component materials in structural units or structural assemblies shall be limited in the types of construction specified in Sections 603.0, 604.0 and 605.0, and in Sections 602.4 and 701.3.1.

**701.3.1 Combustible components:** Combustible aggregates are permitted in gypsum concrete mixtures approved for fireresistance rated construction. Any approved component material or admixture is permitted in assemblies that meet the fireresistive test requirements of this code.

## SECTION 702.0 DEFINITIONS

**702.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Annular space:** The opening around a penetrating item.

***Damper, fire:*** A damper arranged to seal off airflow automatically through part of an air duct system, so as to restrict the passage of heat.

**Door assembly, fire:** A combination of the *fire door*, frame, hardware and other accessories which together provide a specific degree of fire protection to the opening (see Section 717.0).

***Door, fire:*** A door and its assembly, so constructed and assembled in place as to give protection against the passage of fire (see Section 717.0).

***Draftstopping:*** Building materials installed to prevent the movement of air, smoke, gases and flame to other areas of the building through large concealed passages, such as *attic* spaces and floor assemblies with suspended ceilings or open-web trusses (see Section 721.0).

***Fire area:*** The aggregate floor area enclosed and bounded by *fire walls*, exterior walls or *fire separation assemblies* of a building (see Section 709.2).

***Fire partition:*** A vertical assembly of materials having protected openings and designed to restrict the spread of fire (see Section 711.0).

***Fire protection rating:*** The time in hours, or fractions thereof, that an opening protective assembly will resist fire exposure as determined by the test standard specified in this code (see Sections 706.0, 717.0 and 719.0).

***Fire separation assembly:*** A horizontal or vertical fireresistance rated assembly of materials having protected openings, and designed to restrict the spread of fire (see Section 709.0).

***Fire separation distance:*** The distance in feet measured from the building face to the closest *interior lot line*, to the centerline of a street or *public way* or to an imaginary line between two buildings on the same property.

***Fire window:*** A window constructed and glazed to give protection against the passage of fire (see Section 719.0).

***Fireblocking:*** Building materials installed to prevent the movement of flame and gases to other areas of a building through small concealed passages in building components such as floors, walls and stairs (see Section 721.0).

**Fireresistance:** That property of materials or their assemblies which prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

**Fireresistance rating:** The time in hours or fractions thereof that materials or their assemblies will resist fire exposure as determined by the fire test specified in this code (see Section 704.1.1).

***Fireresistive joint system:*** An assemblage of specific materials or products that are designed, tested and fireresistance rated in accordance with ASTM E119 to resist, for a prescribed period of time, the spread of fire through *joints* made in or between fireresistance rated assemblies.

***Joint:*** The linear opening in or between adjacent fireresistance rated assemblies.

***Protected construction:*** That in which all structural members are constructed, chemically treated, covered or protected so that the individual unit or the combined assemblage of all such units has the required fireresistance rating specified for its particular application in Table 602; and includes protected combustible and protected noncombustible construction.

**Self-closing:** As applied to a *fire door* or other opening protective, means normally closed and equipped with an approved device which will insure closing after having been opened for use (see Section 717.5).

***Shaft:*** An enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and the roof (see Section 710.0).

***Single membrane penetration:*** An opening through a single membrane (one side) of a fireresistance rated wall, roof/ceiling or floor/ceiling assembly made to accommodate electrical, mechanical, plumbing, environmental and communication systems (see Sections 714.1.6 and 714.2.6).

**Smoke barrier:** A continuous membrane that will resist the movement of smoke (see Section 712.0).

***Smoke compartment:*** A space within a building enclosed by smoke barriers or *fire separation assemblies* on all sides, including top and bottom (see Section 712.0).

***Splice:*** The result of a factory or field method of joining or connecting two or more lengths of a *fireresistive joint system* into a continuous assembly.

**Through penetration:** An opening that passes through an entire fireresistance rated assembly.

***Through-penetration firestop system:*** Specific building materials or assemblies of materials that are designed and installed to prevent the spread of fire through openings that are made in fireresistance rated floors and walls to accommodate through penetrations for electrical, mechanical, plumbing, environmental and communication systems. The F rating indicates the period of time that the through-penetration firestop system is capable of preventing the passage of flame to the unexposed (nonfire) side of the assembly in conjunction with an acceptable hose stream test performance. The T rating indicates the period of time that the through-penetration firestop system is capable of preventing the passage of flame and a maximum individual temperature rise of 325 degrees F. (163 degrees C.) above ambient temperature on the unexposed (nonfire) side of the assembly in conjunction with acceptable hose stream test performance (see Sections 714.1.1 and 714.2.3).

**Vertical opening:** An opening through a floor or roof.

**Wall**

***Fire separation wall:*** A fireresistance rated assembly of materials having protected openings which is designed to restrict the spread of fire (see Section 709.0).

***Fire wall:*** A fireresistance rated wall, having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof (see Section 707.0).

**Party wall:** A *fire wall* on an *interior lot line* used or adapted for joint service between two buildings (see Section 707.0).

## SECTION 703.0 CONSTRUCTION DOCUMENTS

**703.1 General:** *Construction documents* for all buildings shall designate the type of construction and the fireresistance rating of all structure elements as required by this code. The *construction documents* shall include documentation or supporting data substantiating all required fireresistance ratings, including details and materials for providing the required fireresistance rating at *joints* and penetrations of fireresistance rated assemblies. The *construction documents* shall also indicate details and methods for *fireblocking*.

**703.1.1 Inspection:** Protection of *joints* and penetrations in fireresistance rated assemblies shall not be concealed from view until inspected and approved.

**703.2 Penetrations:** *Construction documents* for buildings more than two stories in *height* shall indicate where penetrations will be made for electrical, mechanical, plumbing, environmental and communication conduits, pipes and systems.

## SECTION 704.0 FIRE TESTS

**704.1 General:** Building elements and assemblies including loadbearing and nonloadbearing walls and partitions, columns, girders, beams, slabs and floors and roof assemblies, shall provide the minimum fireresistance ratings specified in Table 602 for the type of construction unless otherwise required by the provisions of this code.

**704.1.1 Fireresistance ratings:** The fireresistance ratings of building assemblies and structural elements shall be determined in accordance with the test procedures set forth in ASTM E119 listed in Chapter 35, specific methods as provided for herein, or shall be determined in accordance with an approved analytical method. Where materials, systems or devices are incorporated into the assembly which have not been tested as part of the assembly, sufficient data shall be made available to the code official to show that the required fireresistance rating is not reduced. Materials and methods of construction used to protect *joints* and penetrations in fireresistance rated assemblies shall not reduce the required fireresistance rating. Where an approved analytical method is utilized to establish the fireresistance rating of a structural element or building assembly, the calculations shall be based upon the fire exposure and acceptance criteria specified in ASTM E119 listed in Chapter 35.

**Exception:** In determining the fireresistance rating of exterior loadbearing walls, compliance with the ASTM E119 criteria for unexposed surface temperature rise and ignition of cotton waste due to passage of flame or hot gases, is required only for a period of time corresponding to the required fireresistance rating of an exterior nonloadbearing wall with the same *fire separation distance*, and in a building of the same use group. Where the fireresistance rating determined in accordance with this exception exceeds the fireresistance rating determined in accordance with ASTM E119 listed in Chapter 35, the fire exposure time period, water pressure and application duration crite-

ria for the hose stream test of ASTM E119 listed in Chapter 35, shall be based upon the fireresistance rating determined in accordance with this exception.

**704.2 Alternative protection:** Where documentation is submitted to the code official and approved, fireresistive coverings or insulating enclosure materials are not required for structural framing elements. Such documentation shall show that the required *load*-carrying capacity of the structural framing elements will not be reduced below the required capacity for the applicable design in accordance with Chapter 16 by a fire within the building or in an adjacent building having a severity corresponding to the fireresistance rating required for the elements through the installation of heat shields, separations or other approved means of *protection*.

**704.3 Opening protectives:** Opening protectives shall include the *fire door*, fire shutter, *fire window* or *fire damper* and all required hardware, anchorage, frames and sills necessary for the assembly.

**704.4 Combustibility tests:** Where the behavior of materials under exposure to fire is specified in this code, the characteristics of materials shall be determined by the tests and criteria set forth in Sections 704.4.1, 704.4.1.1 and 704.4.1.2.

**704.4.1 Tests:** The tests indicated in Sections 704.4.1.1 and 704.4.1.2 shall serve as criteria for acceptance of building materials as set forth in Sections 603.0, 604.0 and 605.0 governing the combustibility of building materials in Types 1, 2, 3 and 4 construction. The term "noncombustible" does not apply to the flame spread characteristics of interior finish or trim materials. A material shall not be classified as a noncombustible building construction material which is subject to an increase in the combustible or flame spread rating beyond the limitations herein established through the effects of age, moisture or other atmospheric conditions.

**704.4.1.1 Elementary materials:** Materials which are intended to be classified as noncombustible shall be tested in accordance with ASTM E136 listed in Chapter 35. Such materials shall be acceptable as noncombustible materials when at least three of four specimens tested conform to all of the following criteria:

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54 degrees F. (30 degrees C.) above the furnace temperature at the beginning of the test.
2. There shall not be flaming from the specimen after the first 30 seconds.
3. If the weight loss of the specimen during testing exceeds 50 percent, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

**704.4.1.2 Composite materials:** Materials having a structural base of noncombustible material as defined in Section 704.4.1.1 with a surfacing not more than $^1/_8$ inch thick which has a flame spread rating not greater than 50 when tested in accordance with ASTM E84 listed in Chapter 35, shall be acceptable as noncombustible materials.

## SECTION 705.0 EXTERIOR WALLS

**705.1 General:** All exterior walls shall comply with the applicable provisions of this code and with the fireresistance rating requirements of this section and Section 602.0.

**Exception:** The provisions of Sections 705.2 and 705.3 shall not apply to exterior walls which face buildings on the same *lot* where the buildings are such that, if combined into one structure, the resulting building will otherwise comply with the *height* and *area* limitations of Section 503.0 (see Section 503.1.3).

**705.1.1 Omission of exterior walls:** The provisions of this code shall not be deemed to prohibit the omission of exterior walls for all or part of a story where the provisions of Section 705.2 do not require a nonloadbearing exterior wall to provide a fireresistance rating, and where the provisions of Sections 705.3 and 705.4 do not limit the maximum percentage of unprotected openings. Except as otherwise specifically permitted in Section 716.5, the piers, columns and other structural elements within the open portion shall be constructed with the fireresistance rating required for exterior loadbearing walls in Table 602.

**705.1.2 Combustible exterior wall finish and trim:** In addition to the requirements of this section, combustible materials installed as *exterior wall finish*, half-timbering, balconies and similar appendages, bay and *oriel windows* and light-transmitting *plastic* panels, shall meet the applicable requirements of Sections 1406.0, 2603.5, 2603.6, 2604.0, 2605.0 and 2606.0.

**705.2 Fireresistance ratings:** The fireresistance rating of exterior walls shall comply with Table 705.2, except as otherwise provided for in Section 705.1. Loadbearing exterior walls shall also comply with the fireresistance rating requirements of Section 602.0. The fireresistance rating of exterior walls with a *fire separation distance* of greater than 5 feet (1524 mm) shall be rated for exposure to fire from the inside. The fireresistance rating of exterior walls with a *fire separation distance* of 5 feet (1524 mm) or less shall be rated for exposure to fire from both sides.

**Table 705.2**
**EXTERIOR WALL FIRERESISTANCE RATINGS[b,e]**

| Fire separation distance (feet)[g] | Use Group[a] | | | | |
|---|---|---|---|---|---|
| | H-2 | F-1, H-3, M, S-1, U[d] | R-2 | R-3, U[c] | A, B, E, F-2, H-4, I, R-1, S-2 |
| 0 to 5[f] | 4 | 3 | 1 | 1 | 2 |
| Greater than 5 to 10 | 3 | 2 | 1 | 0 | 1 |
| Greater than 10 to 15 | 2 | 1 | 0 | 0 | 0 |
| Greater than 15 to 30 | 1 | 0 | 0 | 0 | 0 |
| Greater than 30 | 0 | 0 | 0 | 0 | 0 |

**Note a.** For requirements for Use Group H-1, see Section 705.2.1.
**Note b.** Fireresistance ratings are expressed in hours.
**Note c.** Private garages and sheds that are accessory structures to a single-family dwelling.
**Note d.** Utility and miscellaneous occupancies in Table 312.1 but not including private garages and sheds that are accessory structures to a single-family dwelling.
**Note e.** For requirements for aerosol warehouses, see Section 705.2.2.
**Note f.** For requirements for fire walls for buildings with differing roof heights, see Section 707.6.4.
**Note g.** 1 foot = 304.8 mm.

**705.2.1 Use Group H-1:** Buildings and structures with an occupancy in Use Group H-1 shall be located in accordance with the requirements for the storage of *explosives* in the fire prevention code listed in Chapter 35. The allowable quantities of Use Group H-1 materials shall be based on the TNT equivalency of the materials. The *exterior finish* surface of all exterior walls in an occupancy in Use Group H-1 shall be of approved noncombustible materials or fireretardant-treated wood complying with Section 2310.0 for exterior installation.

**705.2.2 Aerosol warehouses:** Exterior walls of *aerosol* warehouses with a *fire separation distance* exceeding 10 feet (3048 mm), but less than 50 feet (15240 mm), shall have not less than a 2-hour fireresistance rating. Exterior walls with a *fire separation distance* of 10 feet (3048 mm) or less shall have not less than a 4-hour fireresistance rating. Openings shall be protected in accordance with Section 705.3.

**705.2.3 Wall support:** The wall shall extend to the height required by Section 705.6, and shall be supported such that the wall will remain in place for the duration of time indicated by the required fireresistance rating.

**705.2.4 Automatic fire suppression:** In buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the required fireresistance rating of nonloadbearing exterior walls shall be reduced by 1 hour, except that where the *fire separation distance* is 5 feet (1524 mm) or less, the fireresistance rating shall not be reduced to less than 1 hour. This reduction shall not apply to occupancies in Use Group H.

**705.2.5 Unexposed surface temperature:** Where protected openings are not limited by Table 705.3, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E119 listed in Chapter 35 shall not apply. Where protected openings are limited by Table 705.3, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E119 listed in Chapter 35 shall not apply provided that a correction is made for radiation from the unexposed exterior wall surface in accordance with the following formula:

$$A_e = A + (A_f \times F_{eo})$$

where:

$A_e$ = Equivalent area of protected openings.
$A$ = Actual area of protected openings.
$A_f$ = Area of exterior wall surface in the story under consideration exclusive of openings, on which the temperature limitations of ASTM E119 listed in Chapter 35 for walls is exceeded.
$F_{eo}$ = An "equivalent opening factor" derived from Figure 705.2.5 based on the average temperature of the unexposed wall surface and the fireresistance rating of the wall required by Section 705.2.

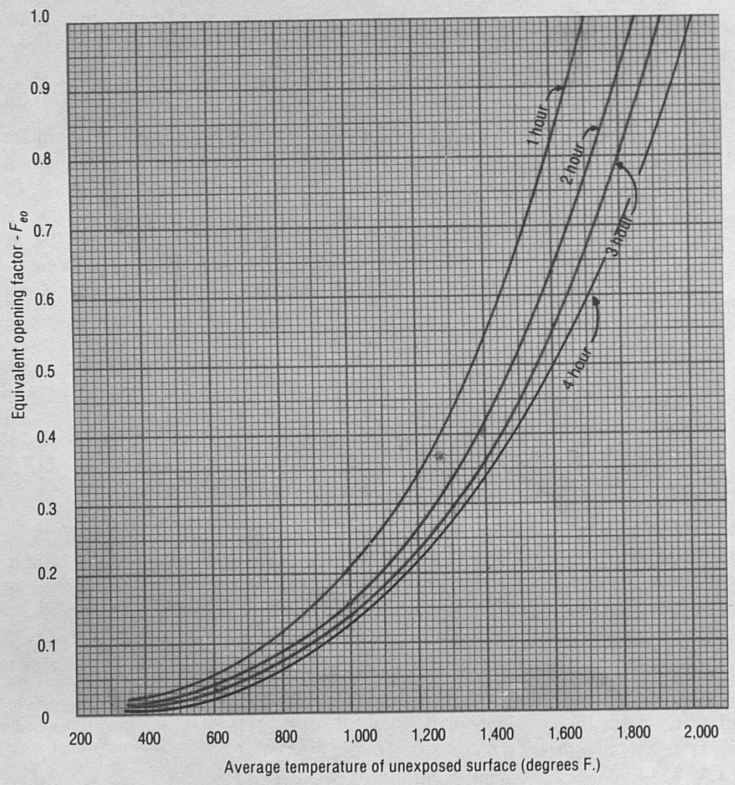



**Figure 705.2.5**
**EQUIVALENT OPENING FACTOR**

**705.3 Openings:** The maximum area of unprotected or protected openings permitted in an exterior wall in any story shall not exceed the values set forth in Table 705.3, except as otherwise provided for in Section 705.1. Where both unprotected and protected openings are located in the exterior wall in any story, the total area of the openings shall comply with the following formula:

$$\frac{A}{a} + \frac{A_u}{a_u} \leq 1.0$$

where:

$A$ = Actual area of protected openings, or the equivalent area of protected openings $A_e$ (see Section 705.2.5).
$a$ = Allowable area of protected openings.
$A_u$ = Actual area of unprotected openings.
$a_u$ = Allowable area of unprotected openings.

**Table 705.3**
**MAXIMUM AREA OF EXTERIOR WALL OPENINGS[a]**

| Classification of opening | Fire separation distance (feet)[f] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 to 3[e] | Greater than 3 to 5 | Greater than 5 to 10[d] | Greater than 10 to 15[c,d] | Greater than 15 to 20[c] | Greater than 20 to 25[c] | Greater than 25 to 30[c] | Greater than 30 |
| Unprotected | Not permitted | Not permitted[b] | 10% | 15% | 25% | 45% | 70% | No limit |
| Protected | Not permitted | 15% | 25% | 45% | 75% | No limit | No limit | No limit |

**Note a.** Values given are percentages of the area of the exterior wall. This table assumes that the openings are reasonably uniformly distributed. Where openings are not reasonably uniformly distributed, the portion of the wall utilized to calculate compliance with Table 705.3 shall be approved.

**Note b.** For occupancies in Use Group R-3, the maximum percentage of unprotected exterior wall openings shall be 5 percent.

**Note c.** The area of openings in an open parking structure with a fire separation distance of greater than 10 feet shall not be limited.

**Note d.** For occupancies in Use Group H-2 or H-3, unprotected openings shall not be permitted for openings with a fire separation distance of 15 feet or less.

**Note e.** For requirements for firewalls for buildings with differing roof heights, see Section 707.6.4.

**Note f.** 1 foot = 304.8 mm.

**705.3.1 Automatic fire suppression:** In buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the maximum allowable area of unprotected openings in all occupancies other than Use Groups H-1, H-2 and H-3 shall be the same as the tabulated limitations for protected openings.

**705.3.2 First story:** In all occupancies other than Use Group H, unlimited unprotected openings are permitted in the first story of exterior walls facing a street which have a *fire separation distance* of greater than 15 feet (4572 mm), or facing an unoccupied space. The unoccupied space shall be not less than 30 feet (9144 mm) in width.

**705.4 Vertical separation of openings:** Openings in exterior walls in adjacent stories shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 5 feet (1524 mm) of each other horizontally and the opening in the lower story is not a protected opening in accordance with Section 706.0. Such openings shall be separated vertically at least 3 feet (914 mm) by spandrel girders, exterior walls or other similar assemblies which have a fireresistance rating of at least 1 hour or by flame barriers which extend horizontally at least 30 inches (762 mm) beyond the exterior wall. Flame barriers shall also have a fireresistance rating of at least 1 hour. The unexposed surface temperature limitations specified in ASTM E119 listed in Chapter 35 shall not apply to the flame barriers or vertical separation unless otherwise required by the provisions of this code.

**Exceptions**

1. This section shall not apply to buildings that are three stories or less in *height*.
2. This section shall not apply to buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**705.5 Vertical exposure:** Approved protectives shall be provided in every opening that is less than 15 feet (4572 mm) vertically above the roof of an adjoining building or adjacent structure which is within a horizontal *fire separation distance* of 15 feet (4572 mm) of the wall in which the opening is located, unless such roof construction affords a fireresistance rating of not less than 1 hour.

**705.6 Continuity of exterior walls:** Exterior walls required to be fireresistance rated by Section 705.2 because of *fire separation distance*, shall be continuous from the foundation to not less than 30 inches (762 mm) above the roof surface.

**Exceptions**

1. Where the roof deck or sheathing is constructed of approved noncombustible materials or of fireretardant-treated wood or of $^5/_8$-inch Type X gypsum board supported directly beneath the underside of the roof sheathing or deck, using minimum 2-inch ledgers attached to the sides of the roof framing members for a minimum distance of 4 feet (1219 mm) from the exterior wall, and where the roof covering has a minimum of a Class C rating, the exterior wall shall be permitted to stop at the underside of the roof deck or sheathing.
2. Exterior walls in buildings not exceeding 1,000 square feet (93 m$^2$) in *area*.
3. Exterior walls of occupancies in Use Group R-3.
4. Exterior walls of a building where the roof has an angle of more than 20 degrees (0.35 rad) with the horizontal.

**705.7 Joints:** All materials utilized to protect *joints* in exterior walls required by this section to have a fireresistance rating shall comply with Section 709.7. This requirement shall not apply to *joints* in exterior walls which are permitted to have unprotected openings.

## SECTION 706.0 EXTERIOR OPENING PROTECTIVES

**706.1 Where required:** Exterior opening protectives shall be provided in all exterior wall openings that are required to be protected by Section 705.0.

**706.2 Automatic protection:** Approved fire protective assemblies shall be fixed, self-closing or equipped with approved automatic-closing devices and shall conform to the requirements of this section and Sections 702.0, 717.0, 718.0, 719.0 and 720.0. Fire protective assemblies are not required where outside auto-

matic *sprinklers* are installed for the protection of the exterior openings. The *sprinklers* shall be installed in accordance with NFPA 13 listed in Chapter 35, and shall have an *automatic water supply* and be provided with a fire department connection.

**706.3 Fireresistance rating:** Exterior openings required to be protected by Section 705.3, when located in a wall required by Section 705.2 to have a fireresistance rating of greater than 1 hour, shall be protected with an assembly having a *fire protection rating* of not less than $1^1/_2$ hours. Exterior openings required to be protected by Section 705.3, when located in a wall required by Section 705.2 to have a fireresistance rating of 1 hour, shall be protected with an assembly having a *fire protection rating* of not less than $^3/_4$ hour. Exterior openings required to be protected by Section 705.4 or 705.5 shall be protected with an assembly having a *fire protection rating* of not less than $^3/_4$ hour.

**706.4 Unprotected openings:** Where protected openings are not required by Section 705.0, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of Chapters 14, 24 and 26.

## SECTION 707.0 FIRE WALLS AND PARTY WALLS

**707.1 General:** Walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall, and shall be constructed of any approved noncombustible materials that provide the required strength and fireresistance rating specified in Table 602 for the type of construction, but not less than the fireresistance rating of the use group specified in Table 707.1. Strength and stability shall comply with the provisions of Chapters 14 and 16.

**Table 707.1**
**FIRE AND PARTY WALL FIRERESISTANCE RATINGS**

| Use Group[a,b] | Minimum fireresistance rating (hours) |
|---|---|
| A-1, A-2, A-3, A-4, A-5, B, E, F-2, H-4, I-1, I-2, M, R, S-2 | 2 |
| F-1, H-3, I-3, S-1, U | 3 |
| H-2 | 4 |

**Note a.** For requirements for Use Group H-1, see Section 707.1.1.
**Note b.** For requirements for aerosol warehouses, see Section 707.1.2.

**707.1.1 Use Group H-1:** Occupancies in Use Group H-1 shall not be located in a building that: is more than one story in *height*; has a *basement*; or is attached to another building. An occupancy in any use group other than H-1 shall not be located in a building with an occupancy in Use Group H-1.

**Exception:** The *story above grade*, where provided with barricaded construction in accordance with the fire prevention code listed in Chapter 35, shall not be considered a *basement*.

**707.1.2 Aerosol warehouses:** *Aerosol* warehouses shall be detached structures or separated from other occupancies by a *fire wall* with a minimum 4-hour fireresistance rating. All protected openings shall have a minimum *fire protection rating* of 3 hours.

**707.2 Cutting walls:** A wall that is 8 inches (203 mm) or less in thickness shall not be cut for chases or socketed for insertion of structural members subsequent to erection (see Section 2108.1.1).

**707.3 Hollow walls:** The wall shall not be less than the minimum thickness specified in ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**707.4 Combustible framing:** In addition to the provisions of Section 2305.6, adjacent combustible members entering into a masonry *fire wall* from opposite sides shall not have less than a 4-inch (102 mm) distance between embedded ends. Where combustible members frame into hollow walls or walls of hollow units, all hollow spaces shall be solidly filled for the full thickness of the wall and for a distance not less than 4 inches (102 mm) above, below and between the structural members, with noncombustible materials approved for *fireblocking* in accordance with Section 721.0.

**707.5 Combustible insulation:** The code official shall permit the application of cork, fiberboard or other combustible insulation where laid up without intervening air spaces and attached directly to the face of the wall, and where protected on the exposed surface as provided for in Sections 723.0 and 2309.1.

**707.6 Continuity of walls:** In all buildings or structures, walls shall be continuous from the foundation to 2 feet 8 inches (813 mm) above both adjacent roof surfaces, except as provided for in Sections 707.6.1 through 707.6.4. *Fire walls* shall be made smoke tight at their junction with exterior walls. In exterior wall construction employing studs, the wall shall extend through the stud space to the exterior sheathing.

**707.6.1 Noncombustible roofs:** The wall shall be continuous to the underside of the roof sheathing, deck or slab where the roof of both buildings is of approved noncombustible construction, the roof of both buildings are provided with a minimum Class B roof covering and the wall is properly *fireblocked* at the roof. Openings in the roof shall not be located within 5 feet (1524 mm) of the fire wall.

**707.6.2 Residential occupancies:** In occupancies in Use Group R-2 and R-3, the wall shall be continuous to the underside of the roof sheathing or deck in Types 3, 4 and 5 construction where all of the following conditions are met:

1. The wall is properly *fireblocked* at the roof sheathing or deck.
2. The roof sheathing or deck is constructed of approved noncombustible materials or of fireretardant-treated wood, for a distance of 4 feet (1219 mm) on both sides of the wall, or such roof sheathing or deck is constructed with $^5/_8$-inch Type X gypsum board supported directly beneath the underside of the roof sheathing or deck, using minimum 2-inch ledgers attached to the sides of the roof framing members, for a minimum distance of 4 feet (1219 mm) on both sides of the *fire wall*.
3. Combustible material does not extend through the wall.
4. The roof covering has a minimum of a Class C rating.
5. Openings in the roof shall not be located within 5 feet (1524 mm) of the *fire wall*.

**707.6.3 Other occupancies:** Two-hour fire walls, other than fire walls regulated by Section 707.6.2, shall be continuous to

the underside of the roof sheathing, deck or slab, provided all of the following conditions are met:

1. The roof assembly within 5 feet (1524 mm) of the wall has not less than a 1-hour fireresistance rating and the entire length and span of all supporting elements for the fireresistance rated roof assembly has a fireresistance rating of not less than 1 hour.
2. Openings in the roof shall not be located within 5 feet (1524 mm) of the fire wall.
3. Each building shall be provided with not less than a Class B roof covering.

**707.6.4 Buildings with differing roof heights:** Where a fire wall separates buildings with a difference in roof levels of 30 inches (762 mm) or greater, the fire wall and the continuation of the exterior wall shall comply with either Section 707.6.4.1 or 707.6.4.2.

**707.6.4.1 Fire wall extension required:** The fire wall shall be continuous to a point not less than 30 inches (762 mm) above the lower roof level, provided the exterior wall for a height of 15 feet (4572 mm) above the lower roof has not less than a 1-hour fireresistance rating based on an exposure from both sides. Openings located within the 1-hour fireresistance rated portion of the exterior wall shall be protected by opening protectives having a $^3/_4$-hour *fire protection rating*.

**Exception:** Where the height of the upper roof is greater than 30 inches (762 mm) and less than 15 feet (4572 mm) above the lower roof, the 1-hour fireresistance rated exterior wall shall extend to the underside of the upper roof deck.

**707.6.4.2 Fire wall extension not required:** The fire wall shall terminate at the underside of the roof sheathing deck or slab of the lower roof provided the lower roof assembly within 10 feet (3048 mm) of the fire wall has not less than a 1 hour fireresistance rating. The entire length and span of all supporting elements for the fireresistance rated roof assembly shall have a fireresistance rating of not less than 1 hour. Openings in the lower roof shall be prohibited within 10 feet (3048 mm) of the fire wall. A fireresistance rating and opening protectives are not required for the exterior wall continuing above the lower roof assembly.

**707.7 Noncombustible frame:** The wall shall not be supported on the structural frame in buildings of noncombustible construction unless such supporting frame and all members, which under fire conditions provide lateral support for the frame, have a fireresistance rating at least equal to that required for the wall.

**707.8 Joints:** All materials utilized to protect *joints* in fire walls shall comply with Section 709.7.

**707.9 Offset fire walls:** Where *fire walls* are offset at intermediate floor levels in protected skeleton-frame construction, the offset floor construction and the intermediate wall supports, including members or assemblies, which under fire conditions provide lateral support therefore, shall be constructed of approved noncombustible materials with a fireresistance rating not less than that required for the *fire wall*.

**707.10 Penetrations:** Penetrations through *fire walls* shall meet the limitations specified in Sections 714.1 through 714.1.6.2.

## SECTION 708.0 FIRE WALL OPENINGS *

**708.1 General:** Openings in *fire walls* shall not exceed the limitations in size and area herein prescribed.

**708.2 Size of opening:** Each opening through a *fire wall* shall not exceed 120 square feet (11 $m^2$). The aggregate width of all openings at any floor level shall not exceed 25 percent of the length of the wall.

**Exception:** Openings shall not be limited to 120 square feet (11 $m^2$) where both buildings are equipped throughout with an *automatic sprinkler system* installed in accordance with Chapter 9.

**708.2.1 First story:** Where the entire first-story floor *areas* on both sides of a *fire wall* are equipped throughout with an approved *automatic sprinkler system* installed in accordance with Section 906.2.1, the maximum allowable size of openings on the first story of the building shall not exceed 240 square feet (22 $m^2$) with a minimum distance of 3 feet (914 mm) between adjacent openings.

**708.3 Opening protectives:** All opening protectives in *fire walls* shall comply with the provisions of Section 704.0 and shall have the minimum *fire protection rating* as set forth in Section 717.0.

## SECTION 709.0 FIRE SEPARATION ASSEMBLIES

**709.1 General:** *Fire separation assemblies* installed for purposes of the enclosure of *exits*, floor openings, *shafts*, areas of refuge and for subdividing purposes shall be constructed of approved materials consistent with the limitations for the building type of construction and shall have not less than the fireresistance rating prescribed by Table 602.

**709.2 Fire area:** A *fire separation assembly* which separates adjacent *fire areas* shall have a fireresistance rating of not less than the fireresistance rating required by Table 313.1.2 based on the use group of the *fire areas* which are separated.

**709.3 Openings:** Openings located in a *fire separation assembly* shall be limited to a maximum aggregate width of 25 percent of the length of the wall, and the maximum area of any single opening shall not exceed 120 square feet (11 $m^2$). Openings in *exit* enclosures, other than unexposed exterior openings, shall be limited to those necessary for *exit access* to the enclosure from normally occupied spaces and for egress from the enclosure.

**Exception:** Openings shall not be limited to 120 square feet (11 $m^2$) where adjoining *fire areas* are equipped throughout with an *automatic sprinkler system* installed in accordance with Chapter 9.

**709.3.1 Protectives:** All opening protectives in *fire separation assemblies* shall comply with the provisions of Section 704.0 and shall have the minimum *fire protection rating* as set forth in Section 717.0.

**709.4 Continuity:** All vertical *fire separation assemblies* shall extend from the top of the fireresistance rated floor/ceiling assembly below to the underside of the floor or roof slab or deck

above and shall be securely attached thereto. These walls shall be continuous through all concealed spaces such as the space above a suspended ceiling. The supporting construction shall be *protected* to afford the required fireresistance rating of the *fire separation assembly* supported. All hollow vertical spaces shall be *fireblocked* at every floor level as required in Section 721.0.

**709.5 Exterior walls:** Except as provided for in Sections 1014.11.1 and 1014.12.2, where exterior walls serve as a part of a required fireresistance rated enclosure, such walls shall comply with the requirements of Section 705.0 for exterior walls and the fireresistance rated enclosure requirements shall not apply.

**709.6 Penetrations:** Penetrations through fireresistance rated wall assemblies shall meet the limitations specified in Sections 714.1 through 714.1.6.2. Penetrations through floor/ceiling and roof/ceiling assemblies shall comply with Sections 714.2 through 714.2.6.5.

**709.7 Joints:** All materials used to protect *joints* in fireresistance rated assemblies shall comply with the requirements of Sections 709.7.1 and 709.7.2. *Joints* made in or between fireresistance rated assemblies shall be protected by a *fireresistive joint system* designed and tested to resist the spread of fire for a time period not less than the required fireresistance rating of the adjacent assemblies.

**709.7.1 Fireresistive joint systems:** *Fireresistive joint systems* shall be tested in accordance with ASTM E119 listed in Chapter 35 under the following conditions:

1. The *joint* system shall be installed full height in wall assemblies and full length in floor and roof assemblies.
2. Floor and roof assemblies shall be tested with a minimum positive pressure differential of 0.01 inch of water column (3 Pa).
3. Wall assemblies shall be tested with a minimum positive pressure differential of 0.01 inch of water column (3 Pa) measured at the mid-height of the wall assembly.
4. *Joint* systems shall contain a splice. For wall assemblies, the splice shall be located above the mid-height of the wall.
5. *Joint* systems shall be tested at the maximum *joint* width for which they are designed. *Joint* systems designed to accommodate movement shall be expanded to the maximum *joint* opening width for which they are intended to function.
6. *Joint* systems designed to be loadbearing shall be loaded to the maximum design load in accordance with their intended application.
7. *Joint* systems designed to accommodate movement shall be preconditioned by cycling between the minimum and the maximum *joint* opening width for which they are intended to function for the number of cycles specified in Table 709.7.

**Table 709.7**
**PRECONDITIONING CYCLES**

| Type of joint system | Number of cycles |
|---|---|
| Expansion/contraction | 500 |
| Seismic | 100 |
| Wind sway | 500 |

**709.7.2 Asymmetrical wall joint systems:** Asymmetrical wall *joint* systems shall be tested from both sides in accordance with Sections 709.7 and 709.7.1. For exterior walls with a horizontal *fire separation distance* greater than 5 feet (1524 mm), the *joint* systems are only required to be tested for interior fire exposure.

## SECTION 710.0 VERTICAL SHAFTS

**710.1 General:** The provisions of this section shall apply to all vertical *shafts* where such *shafts* are required to protect openings and penetrations through floor/ceiling and roof/ceiling assemblies as required by Sections 713.3 and 713.4.

**710.2 Construction:** The *shaft* and the *shaft* enclosure shall be constructed of materials permitted by Section 602.0 for the type of construction of the building. *Shaft* walls which are exterior walls shall be constructed of materials approved for exterior walls in accordance with Chapter 14.

**710.3 Fireresistance rating:** A *shaft* shall be enclosed with *fire separation assemblies* complying with Section 709.0 having a fireresistance rating of not less than 2 hours where a *shaft* connects four stories or more and 1 hour where connecting less than four stories. A *shaft* enclosure shall have a fireresistance rating of not less than the required rating of the floor assembly penetrated but shall not be required to exceed 2 hours.

**Exception:** The fireresistance rating of interior *stairway* enclosures shall comply with Section 1014.11.

**710.3.1 Openings in shaft enclosures:** Openings other than those necessary for the purpose of the *shaft* shall not be permitted in *shaft* enclosures. Openings in *shaft* enclosures shall be protected with approved opening protectives in accordance with Sections 706.0, 717.0, 718.0 and 719.0.

**710.4 Top enclosure:** A *shaft* that does not extend to the underside of the roof deck of the building shall be enclosed at the top with a *fire separation assembly* having a fireresistance rating of not less than that required for the *shaft* enclosure walls.

**710.5 Bottom enclosure:** *Shafts* which do not extend to the bottom of the building shall be enclosed at the lowest level with a *fire separation assembly* having a fireresistance rating of not less than that required for the *shaft* enclosure walls, or shall terminate in a room having an occupancy related to the purpose of the *shaft*. The room shall be separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating with opening protectives of not less than that required for the *shaft* enclosure.

**Exceptions**

1. The fireresistance rated room separation is not required, provided that there are not any openings in or penetrations through the *shaft* enclosure to the remainder of the building except at the bottom. The bottom of the *shaft* shall be closed off around the penetrating items with materials permitted by Section 721.3 for *draftstopping*, or the room shall be equipped throughout with an *automatic sprinkler system* installed in accordance with Chapter 9.
2. The fireresistance rated room separation and *protection* at the bottom of the *shaft* are not required where there

are not any combustible materials in the *shaft* and where there are not any openings in or other penetrations through the *shaft* enclosure to the remainder of the building.

## SECTION 711.0 FIRE PARTITIONS

**711.1 General:** *Fire partitions* shall be constructed of the types of materials and have the minimum fireresistance rating as prescribed by Table 602 for the type of construction.

**Exception:** *Dwelling unit* and guestroom separations in buildings of Types 2C, 3B and 5B construction shall have fireresistance ratings of not less than $^1/_2$ hour in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or Section 906.2.2, provided that *sprinklers* are installed in all closets located against tenant and guestroom separation walls and in all bathrooms.

**711.2 Partition types:** The following wall assemblies that are installed as required by Table 602 shall be *fire partitions*.

1. Corridor walls.
2. Walls separating tenant spaces.
3. Walls separating *dwelling units*.
4. Walls separating guestrooms in occupancies in Use Groups R-1, R-2 and I-1.

**711.3 Protectives:** All opening protectives in *fire partitions* shall comply with the provisions of Section 704.0 and shall have the minimum fireresistance rating as set forth in Section 717.0.

**711.4 Continuity:** All *fire partitions* shall extend from the top of the floor assembly below to the underside of the floor/roof slab or deck above or to the fireresistance rated floor/ceiling or roof/ceiling assembly above, and shall be securely attached thereto. The supporting construction shall be protected to afford the required fireresistance rating of the wall supported, except for guestroom separation walls and *exit access corridor* walls in buildings of Types 2C, 3B and 5B construction and tenant separation walls in covered mall buildings of Type 2C construction. All hollow vertical spaces shall be *fireblocked* at every floor level as required in Section 721.0.

**Exception:** In buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2, *dwelling unit* and guestroom separations shall only be required to extend to the underside of the ceiling membrane of the top floor.

**711.5 Exterior walls:** Where exterior walls serve as a part of a required fireresistance rated enclosure, such walls shall comply with the requirements of Section 705.0 for exterior walls and the fireresistance rated enclosure requirements shall not apply.

**711.6 Penetrations:** Penetrations through fire partitions shall comply with Sections 714.1 through Section 714.1.6.2.

**711.7 Joints:** All materials utilized to protect *joints* in *fire partitions* shall comply with Section 709.7.

## SECTION 712.0 SMOKE BARRIERS

**712.1 Where required:** Smoke barriers shall be provided as required in Section 409.4 for occupancies in Use Group I-2 and Section 410.6 for occupancies in Use Group I-3.

**712.2 Construction:** Smoke barriers shall have a fireresistance rating of not less than 1 hour. Such barriers shall form an effective membrane continuous from outside wall to outside wall and from floor slab to floor or roof deck above, including continuity through all concealed spaces, such as the space above suspended ceilings, and including interstitial structural and mechanical spaces. Transfer grilles, whether equipped with fusible link-operated dampers or not, shall not be installed in these partitions. The supporting construction shall be protected to afford the required fireresistance rating of the wall supported in buildings of other than Types 2C, 3B and 5B construction.

**Exceptions**

1. Smoke barriers are not required in interstitial spaces where such spaces are designed and constructed with ceilings that provide resistance to the passage of fire and smoke equivalent to that provided by the smoke barriers.
2. Smoke barriers in occupancies in Use Group I-3 are permitted to be constructed of nominal 0.10-inch-thick steel plate.

**712.3 Doors:** Doorways separating *corridors* in adjoining *smoke compartments* shall be equipped with a pair of swinging-type doors, each swinging in a direction opposite from the other, and the minimum width of each door leaf shall be 44 inches (1118 mm) for *corridors* utilized for the movement of beds and 34 inches (864 mm) for other *corridors*. Other doors in smoke barriers shall be of the swinging type of required width.

**Exceptions**

1. Horizontal sliding doors that comply with Section 410.0 are permitted in smoke barriers in occupancies in Use Group I-3.
2. Horizontal sliding doors that comply with Section 1017.4.4.

**712.4 Opening protectives:** Doors in smoke barriers shall have a *fire protection rating* of not less than 20 minutes in accordance with Section 717.0. Double *means of egress corridor* doors shall have vision panels of fire protection rated glazing in accordance with Section 717.0. The doors shall close the openings with only the clearance necessary for proper operation under self-closing or automatic-closing operations and shall be without undercuts, louvers or grilles. Rabbets or astragals are required at the meeting edges of double *means of egress* doors, and stops are required on the head and jambs of all doors in smoke barriers. Positive latching devices are required on double *means of egress corridor* doors.

**Exceptions**

1. In occupancies in Use Group I-2, double *means of egress* cross-*corridor* doors shall be $1^3/_4$-inch solid core wood or steel doors. Positive latching devices are not required on double *means of egress* cross-*corridor* doors, and center mullions are prohibited.
2. Security glazing protected on both sides by an *automatic sprinkler system* shall be permitted in doors and windows in smoke barriers in occupancies in Use Group I-3. Individual panels of glazing shall not exceed 1,296 square inches (0.84 $m^2$), shall be in a gasketed frame and installed in such a manner that the framing

system will deflect without breaking (loading) glazing before the *sprinkler* system operates. The *sprinkler* system shall be designed to wet completely the entire surface of the affected glazing when actuated.

**712.4.1 Door closers:** Doors in smoke barriers shall be provided with approved door hold-open devices of the fail-safe type which shall release the doors, causing them to close upon the actuation of smoke detectors as well as upon the application of a maximum manual pull of 50 pounds (244 N) against the hold-open device.

**Exception:** Doors in smoke barriers in occupancies in Use Group I-3 shall be self-closing or automatic-closing by smoke detection.

**712.5 Smoke damper:** An approved damper designed to resist the passage of smoke shall be provided at each point a duct penetrates a smoke barrier. The damper shall close upon detection of smoke by an approved smoke detector located within the duct.

**Exceptions**

1. In lieu of an approved smoke detector located within the duct, ducts that penetrate smoke barriers above smoke barrier doors that are required by Section 712.4 shall have the approved damper arranged to close upon detection of smoke by the local device designed to detect smoke on either side of the smoke barrier door opening.
2. Dampers at the smoke barrier in a fully ducted system are not required.
3. Dampers at the smoke barrier are not required where ducts or air-transfer openings are part of an engineered smoke control system.
4. Dampers at the smoke barrier are not required where the air inlet or outlet openings in ducts are limited to a single smoke compartment.

## SECTION 713.0 FLOOR/CEILING AND ROOF/CEILING ASSEMBLIES

**713.1 General:** All floor and roof assemblies shall comply with the applicable provisions of this code and shall have a fireresistance rating of not less than the fireresistance rating required in Section 602.0.

**Exception:** *Dwelling unit* and guestroom separations in buildings of Types 2C, 3B and 5B construction shall have fireresistance ratings of not less than $^1/_2$ hour in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or Section 906.2.2, provided that *sprinklers* are installed in all closets located against tenant separation walls and in all bathrooms.

**713.1.1 Ceiling panels:** Where the weight of lay-in ceiling panels, used as part of fireresistance rated floor/ceiling or roof/ceiling assemblies, is not adequate to resist an upward force of 1 psf (48 Pa), wire or other approved devices shall be installed above the panels to prevent vertical displacement under such upward force.

**713.1.2 Unusable space:** In an assembly required to have a 1-hour fireresistance rating, the ceiling membrane of a fireresistance rated assembly is not required to be installed where unusable space occurs below the assembly, or the flooring is not required to be installed where unusable space occurs above the assembly.

**713.2 Continuity:** All floor/ceiling and roof/ceiling assemblies shall be continuous without openings or penetrations except as permitted by this section. Floor assemblies which are required to be fireresistance rated shall extend to and be tight against exterior walls, or other provisions shall be made for maintaining the fireresistance rating of the assembly at such locations. Except where required by Section 705.5, skylights and other penetrations through a fireresistance rated roof deck are permitted to be unprotected, provided that the structural integrity of the fireresistance rated roof construction is maintained. All concealed spaces and openings shall be *fireblocked* and *draftstopped* in accordance with Section 721.0.

**713.3 Floor opening enclosure:** All floor openings connecting two or more stories shall be protected by a *shaft* enclosure that complies with Section 710.0.

**Exception:** A *shaft* enclosure is not required for any of the following floor openings:

1. A floor opening serving and contained within a single *dwelling unit* and connecting four stories or less.
2. A floor opening which:
   - 2.1. Is not part of the required *means of egress*;
   - 2.2. Is not concealed within the building construction;
   - 2.3. Does not connect more than two stories;
   - 2.4. Is separated from other floor openings serving other floors by construction conforming to Section 710.3; and
   - 2.5. Is not open to a *corridor* in occupancies in Use Groups I and R, or is not open to a *corridor* on a floor not equipped throughout with an approved *automatic fire suppression system* in other use groups.
3. A floor opening in a mall that complies with Section 402.0.
4. A floor opening between a *mezzanine* that complies with Section 505.0, and the floor below.
5. An atrium that complies with Section 404.0.
6. A floor opening in an open parking structure that complies with Section 406.0.
7. An approved concrete or masonry chimney where annular space protection is provided for in accordance with Section 721.6.4.
8. A floor opening containing an *escalator* and complying with Section 3011.2.
9. A floor opening that complies with Section 410.5 in an occupancy in Use Group I-3.
10. Noncombustible *shafts* connecting communicating floor levels in an occupancy in Use Group I-3 where the area complies with Section 410.5. Where additional stories are located above or below, the *shaft* shall be permitted to continue with fire and smoke damper protection provided at the fireresistance rated floor/ceiling assembly between the noncommunicating stories.

11. A single floor opening containing a *stairway* which is not a required *means of egress* in an occupancy in Use Group B and complying with the following parameters:
    - 11.1. The *stairway* does not connect more than six floor levels.
    - 11.2. The *stairway* does not connect with an *exit access corridor*.
    - 11.3. The *stairway* floor opening shall not exceed 160 square feet (15 $m^2$).
    - 11.4. The *stairway* floor opening shall be protected in the same manner as an *escalator* floor opening complying with Section 3011.2.
    - 11.5. The building is equipped throughout with an approved *automatic sprinkler system* in accordance with Section 906.2.1.

**713.4 Penetrations:** All penetrations of a floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a *shaft* enclosure that complies with Section 710.0. Where one-hour fireresistance rated roof construction is required by Section 705.5, penetrations through the roof deck shall comply with Sections 714.2 through 714.2.6.5. Penetrations in other fireresistance rated roof decks are permitted to be unprotected, provided that the structural integrity of the roof construction is maintained.

**Exceptions**

1. Penetrations within and through a floor opening permitted to be unenclosed by Section 713.3.
2. Penetrations through assemblies required to be fireresistance rated and complying with Sections 714.2 through 714.2.6.5.
3. Penetrations through assemblies without a required fireresistance rating and complying with Sections 714.3 through 714.3.2.

**713.5 Joints:** All materials utilized to protect *joints* in fireresistance rated floor/ceiling and roof/ceiling assemblies shall comply with the requirements of Section 709.7. *Joints* made in or between fireresistance rated assemblies shall be protected by a *fireresistive joint system* designed and tested to resist the spread of fire for a time period not less than the required fireresistance rating of the adjacent assemblies.

**Exception:** *Fireresistive joint systems* are not required for *joints* in:

1. Floors within a single *dwelling unit*.
2. Floors where the *joint* is protected by a shaft enclosure that complies with Section 710.0.
3. Floors within an atrium that complies with Section 404.0 where the space adjacent to the atrium is included in the volume of the atrium for smoke control purposes.
4. Floors within a mall that complies with Section 402.0.
5. Floors within an open parking structure that complies with Section 406.0.
6. *Mezzanine* floors that comply with Section 505.0.
7. Roof decks, other than those required to have a 1-hour fireresistance rating in accordance with Section 705.5, provided that the structural integrity of the roof construction is maintained.

## SECTION 714.0 PENETRATIONS

**714.1 Fireresistance rated wall assemblies:** Penetrations of wall assemblies required to be fireresistance rated in accordance with Sections 707.0, 709.0 or 711.0 shall comply with Sections 714.1.1 through 714.1.6.2. Penetrations of an *exit* enclosure shall also comply with Section 1014.11.2. The required fireresistance rating of the wall assembly shall be determined in accordance with Section 704.1.1.

**714.1.1 Noncombustible penetrations:** Cables and wires without combustible jackets and noncombustible pipes, tubes, conduits and vents which penetrate a fireresistance rated wall assembly shall be tested in accordance with ASTM E119 listed in Chapter 35 as part of a fireresistance rated assembly, or shall be protected by an approved through-penetration firestop system in accordance with Section 714.1.3, or the annular space around the penetrating item shall be protected in accordance with Sections 714.1.4 and 714.1.4.1.

**714.1.2 Combustible penetrations:** Cables and wires with combustible jackets and combustible pipes, tubes, conduits and vents which penetrate an assembly shall be tested in accordance with ASTM E119 listed in Chapter 35 as part of a fireresistance rated assembly, or shall be protected with a through-penetration firestop system in accordance with Section 714.1.3.

**714.1.3 Through-penetration firestop system:** The through-penetration firestop system shall be tested in accordance with ASTM E814 listed in Chapter 35 with a minimum positive pressure differential of 0.01 inch of water column (3 Pa). The penetration firestop system shall have an "F" rating of not less than the required rating of the assembly penetrated.

**714.1.4 Annular space protection:** Where permitted by Section 714.1.1 for noncombustible penetrating items, the annular space between the penetrating item and the fireresistance rated assembly being penetrated shall be protected with a material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions of ASTM E119 listed in Chapter 35, under a minimum positive pressure differential of 0.01 inch water column (3 Pa) at the location of the penetration for the time period equivalent to the required fireresistance rating of the assembly penetrated or shall be protected in accordance with Section 714.1.4.1.

**714.1.4.1 Concrete or masonry wall assemblies:** Penetration of concrete or masonry wall assemblies by a maximum 6-inch nominal diameter copper, iron or steel pipe, tube, conduit or wires and cables with steel jackets shall be permitted provided that the maximum opening size is 144 square inches (0.09 $m^2$) and the penetration is protected with concrete, grout or mortar for the full thickness of the assembly or the thickness required to provide a fireresistance rating equivalent to the required fireresistance rating of the assembly penetrated.

**714.1.4.2 Sleeves:** Where sleeves are installed, the sleeves shall be noncombustible and shall be securely fastened to the assembly penetrated. All space between the item contained in the sleeve and the sleeve itself and any space between the sleeves and the assembly penetrated shall be filled with materials that comply with Section 714.1.4 or 714.1.4.1.

**714.1.4.3 Insulation:** Insulation and coverings on the penetrating item shall not pass through the assembly unless these materials maintain the required fireresistance rating of the assembly.

**714.1.5 Ducts:** Ducts that penetrate a wall assembly shall be provided with approved *fire dampers* that comply with Section 718.0.

**Exceptions**

1. *Fire dampers* are not required at penetrations of *fire separation assembly* walls or *fire partitions* where:
   - 1.1. Steel exhaust air subducts extend at least 22 inches (559 mm) vertically in an exhaust shaft in which there is a continuous air flow upward to the outside.
   - 1.2. Penetrations are tested in accordance with ASTM E119 listed in Chapter 35 as a part of the fireresistance rated assembly.
   - 1.3. Such walls are penetrated by ducted HVAC systems, have a required fireresistance rating of 1 hour or less, are in areas of other than Use Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.
   - 1.4. The penetrations are in garage exhaust or supply shafts which are separated from all other building shafts by not less than a 2-hour fireresistance rated *fire separation assembly*.
2. In occupancies in other than Use Group H, *fire dampers* are not required at the penetration of *fire partitions* where:
   - 2.1. The partitions are tenant separation and corridor walls in buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1.
   - 2.2. The partitions are *corridor* walls and the ducts are constructed of steel and do not have openings which communicate the *corridor* with adjacent spaces or rooms.

**714.1.5.1 Smoke barriers:** Ducts which penetrate smoke barriers shall comply with Section 712.5.

**714.1.6 Single membrane penetrations:** Openings to accommodate noncombustible conduits, pipes and tubes through a single membrane that is an integral component of a fireresistance rated wall assembly shall be permitted, provided that the aggregate area of all such openings does not exceed 100 square inches (0.064 $m^2$) in any 100 square feet (9 $m^2$) of wall area and the openings are *fireblocked* with approved noncombustible materials.

**714.1.6.1 Electrical outlet boxes:** Openings for steel electrical outlet boxes that do not exceed 16 square inches (10323 $mm^2$) in area are permitted. Outlet boxes on opposite sides of the assembly shall be separated by a horizontal distance of not less than 24 inches (610 mm). These limitations shall not apply to openings for electrical boxes of any material, provided that such boxes are tested for installation in fireresistance rated assemblies and installed in accordance with the tested assembly.

**714.1.6.2 Fire sprinkler penetrations:** Where sprinklers penetrate a single membrane of a fireresistance rated assembly in buildings equipped throughout with an approved automatic fire sprinkler system, noncombustible escutcheon plates shall be allowed as a means of *fireblocking* such penetrations, provided that the annular space around each sprinkler penetration does not exceed $^1/_2$ inch (13 mm) measured between the edge of the membrane and the sprinkler.

**714.2 Fireresistance rated floor/ceiling and roof/ceiling assemblies:** Where permitted as an alternative to a shaft enclosure in accordance with Section 713.4, penetrations of fireresistance rated floor/ceiling and roof/ceiling assemblies shall comply with Sections 714.2.1 through 714.2.6.5. The required fireresistance rating of floor/ceiling and roof/ceiling assemblies shall be determined in accordance with ASTM E119 listed in Chapter 35.

**714.2.1 Noncombustible penetrations:** Cables and wires without combustible jackets and noncombustible pipes, tubes, conduits, chimneys and vents which penetrate a fireresistance rated floor/ceiling or roof/ceiling assembly shall be installed in accordance with the approved ASTM E119 rated assembly or shall be protected in accordance with Section 714.2.3.

**Exceptions**

1. Penetrations by noncombustible vents, chimneys, conduits, pipes and tubes through a fireresistance rated floor assembly which connect not more than two stories are permitted. The annular space between the penetrating item and the assembly shall be protected in accordance with Section 714.2.3 or 714.2.4.
2. Penetrations by noncombustible conduit, pipe and tubes through fireresistance rated floor assemblies which connect more than two stories are permitted, provided that the aggregate area of the penetrating items shall not exceed 1 square foot (0.09 $m^2$) in any 100 square feet (9 $m^2$) of floor area. The annular space between the penetrating item and the assembly shall be protected in accordance with Section 714.2.3 or 714.2.4.

**714.2.2 Combustible penetrations:** Cables and wires with combustible jackets and combustible pipes, tubes, conduits and vents which penetrate an assembly shall be tested in accordance with ASTM E119 listed in Chapter 35 as part of a fireresistance rated assembly, or shall be protected with a through-penetration firestop system in accordance with Section 714.2.3.

**714.2.3 Through-penetration firestop system:** Where cables, cable trays, conduits, tubes or pipes penetrate a floor assembly, such penetrations shall be protected by an approved through-penetration firestop system. Through-penetration firestop systems shall be tested in accordance with ASTM E814 listed in Chapter 35 with a minimum positive pressure differential of 0.01 inch of water column (3 Pa). Through-penetration firestop systems shall have an "F" rating and a "T" rating of not less than 1 hour but not less than the required rating of the assembly penetrated.

**Exceptions**

1. A "T" rating shall not be required for floor penetrations that are contained and located within the cavity of a wall.
2. A "T" rating shall not be required for floor penetration by pipe, tube and conduit that are not in direct contact with combustible material.

**714.2.4 Annular space protection:** Where permitted in accordance with the exceptions to Section 714.2.1 for noncombustible penetrating items, the annular space between the penetrating item and the fireresistance rated assembly being penetrated shall be protected with a material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions of ASTM E119 listed in Chapter 35, under a minimum positive pressure differential of 0.01 inch water column (3 Pa) at the location of the penetration for the time period equivalent to the required fireresistance rating of the assembly penetrated or shall be protected in accordance with Section 714.2.4.1.

**714.2.4.1 Concrete floor assemblies:** Penetrations of concrete floor assemblies by a maximum 6-inch nominal diameter copper, iron or steel pipe, tube, conduit or wires and cables with steel jackets shall be permitted provided that the maximum opening size is 144 square inches (0.09 $m^2$) and the penetration is protected with concrete, grout or mortar for the full thickness of the assembly or the thickness required to provide a fireresistance rating equivalent to the required fireresistance rating of the assembly penetrated.

**714.2.4.2 Sleeves:** Where sleeves are installed, the sleeves shall be noncombustible and shall be securely fastened to the assembly penetrated. All space between the item contained in the sleeve and the sleeve itself and any space between the sleeve and the assembly penetrated shall be filled with materials that comply with Section 714.2.4 or 714.2.4.1.

**714.2.4.3 Insulation:** Insulation and coverings on the penetrating item shall not pass through the assembly unless these materials maintain the required fireresistance rating of the assembly.

**714.2.5 Ducts:** Penetrations by an air duct or plenum through a fireresistance rated floor assembly, which connect not more than two stories, are permitted where a *fire damper* that complies with Section 718.0 is installed at the floor line. A *fire damper* is not required at penetrations of a roof/ceiling assembly where the ducts are open to the atmosphere.

**714.2.6 Ceilings:** Penetrations through a ceiling that is an integral component of a fireresistance rated floor/ceiling or roof/ceiling assembly shall be installed in accordance with the approved ASTM E119 rated assembly or shall comply with Sections 714.2.6.1 through 714.2.6.5.

**714.2.6.1 Noncombustible penetrations:** Openings to accommodate noncombustible conduits, pipes and tubes through a single membrane that is an integral component of a fireresistance rated floor/ceiling or roof/ceiling assembly shall be permitted, provided that the aggregate area of all such openings does not exceed 100 square inches (0.064 $m^2$) in any 100 square feet (9 $m^2$) of ceiling area and the openings are *fireblocked* in accordance with Section 721.6.4, or are protected in accordance with Section 714.2.3 or 714.2.4.

**714.2.6.2 Combustible penetrations:** Combustible penetrations shall comply with Section 714.2.2 or 714.2.3.

**714.2.6.3 Noncombustible air duct ceiling penetrations:** Where noncombustible ducts penetrate a ceiling of a fireresistance rated assembly, the aggregate area of all such penetrations shall not exceed 100 square inches (0.064 $m^2$) in any 100 square feet (9 $m^2$) of ceiling area and an approved ceiling damper shall be installed at the ceiling line. Ceiling dampers shall be constructed in accordance with the details listed in a fireresistance rated design or shall be *labeled* to function as a heat barrier for air-handling outlet/inlet penetrations in the ceiling of a fireresistance rated assembly. Ceiling dampers shall not be required where fire tests have shown that ceiling dampers are not necessary in order to maintain the fireresistance rating of the assembly.

**714.2.6.4 Electrical outlet boxes:** Where noncombustible electrical outlet boxes penetrate a ceiling of a fireresistance rated assembly, the aggregate area of all such penetrations shall not exceed 100 square inches (0.064 $m^2$) in any 100 square feet (9 $m^2$) of ceiling area and the openings at such penetrations shall be *fireblocked* in accordance with Section 721.6.4 or shall be protected in accordance with Sections 714.2.3 through 714.2.4.1.

**Exception:** Openings for electrical boxes and fittings that are listed for installation in fireresistance rated assemblies shall be installed in accordance with such listing.

**714.2.6.5 Fire sprinkler penetrations:** Where sprinklers penetrate a single membrane of a fireresistance rated assembly in buildings equipped throughout with an approved automatic fire sprinkler system, noncombustible escutcheon plates shall be allowed as a means of *fireblocking* such penetrations provided that the annular space around each sprinkler penetration does not exceed $^1/_2$ inch (12.7 mm) measured between the edge of the membrane and the sprinkler.

**714.3 Nonfireresistance rated assemblies:** Where permitted as an alternative to a shaft enclosure in accordance with Section 713.4, penetrations of floor assemblies without a required fireresistance rating shall comply with Sections 714.3.1 through

714.3.2. All penetrations through the ceiling membrane of a roof assembly without a required fireresistance rating shall be *fireblocked* in accordance with Section 721.6.4.

**714.3.1 Noncombustible penetrations:** Penetrations by noncombustible vents, chimneys, conduits, pipes, and tubes through unprotected floor assemblies which connect not more than three stories are permitted, provided that the annular space between the penetrating item and the floor is *fireblocked* in accordance with Section 721.6.4.

**714.3.1.1 Ducts:** Penetrations by noncombustible air ducts through unprotected floor assemblies which connect not more than three stories are permitted, provided that a *fire damper* complying with Section 718.0 is installed at each floor line.

**714.3.2 Noncombustible or combustible penetrations:** Penetrations by noncombustible or combustible vents, chimneys, cables, wires, air ducts, conduits, pipes and tubes through unprotected floor assemblies which connect not more than two stories are permitted, provided that the annular space is *fireblocked* in accordance with Section 721.6.4.

## SECTION 715.0 ROOF CONSTRUCTION

**715.1 General:** Roofs shall be constructed of materials or assemblies of materials designed to afford the fireresistance rating required by Table 602 as herein modified.

**715.2 Stadiums:** The roof construction, including beams, trusses, framing, arches and roof decks, enclosing stadiums of Type 1 or Type 2 construction, shall be of approved noncombustible materials without a specified fireresistance rating or of Type 4 construction.

**715.3 Roofs 20 feet or higher:** Where every part of the structural framework of roofs in buildings of Type 1 or Type 2 construction is 20 feet (6096 mm) or more above the floor immediately below, omission of all fire *protection* of the structural members is permitted, including the *protection* of trusses, roof framing and decking.

**715.4 Roof slabs, arches and decking:** Where the omission of fire *protection* from roof trusses, roof framing and decking is permitted, roofs in buildings of Types 1 and 2 construction shall be constructed of noncombustible materials, or of fireretardant-treated wood as permitted in Table 602, without a specified fireresistance rating, or of Type 4 construction in buildings not over five stories or 65 feet (19812 mm) in *height*.

**715.5 Fireblocking:** *Fireblocking* of ceiling and *attic* spaces shall be provided as required by Section 721.0.

## SECTION 716.0 FIRERESISTANCE RATING OF STRUCTURAL MEMBERS

**716.1 Requirements:** The fireresistance rating of structural members and assemblies shall comply with the requirements for the type of construction and shall not be less than the rating required for the fireresistance rated assemblies supported, except as provided for in Section 711.4 for support of *exit access corridor* walls and tenant separation walls in covered mall buildings, and in Section 712.2 for support of smoke barriers. The maximum required fireresistance rating of structural members supporting *fire separation assemblies* of tank storage areas as provided for in Section 418.3.2.1 shall be 2 hours, but not less than required by Table 602 for the building construction type.

**716.2 Protection of structural members:** Columns, girders, trusses, beams, lintels or other structural members which are required to have a fireresistance rating and which support more than two floors or one floor and roof, or support a loadbearing wall or a nonloadbearing wall more than two stories high, shall be individually *protected* on all sides for the full length or *height* with materials having the required fireresistance rating. All other structural members required to have a fireresistance rating shall be *protected* by individual encasement, by a membrane or ceiling protection as specified in Section 713.0, or by a combination of both.

**716.3 Embedments and enclosures:** Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.

**716.4 Impact protection:** Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 5 feet (1524 mm) from the finished floor.

**716.5 Exterior structural members:** Structural members located in exterior walls or along the outer lines of a building or structure shall be *protected* as required by Table 602 for exterior loadbearing walls for the type of construction involved and shall be protected against corrosion in accordance with Section 2210.1. The interior faces of exterior structural members shall be *protected* with coverings of not less than the required fireresistance rating specified for interior structural members in Table 602. Where a fireresistance rating is required in Table 602 for exterior loadbearing walls in buildings of Types 2C, 3B and 5B construction, the interior faces of any exterior structural member of such buildings shall be *protected* to provide a fireresistance rating not less than that required for exterior loadbearing walls.

**716.6 Bottom flange protection:** Fire protection is not required for the bottom flange of lintels, shelf angles and plates which are not designed as a part of the structural frame or which are part of the structural frame and have a span of 6 feet (1829 mm) or less.

**716.7 Stone lintels:** Stone lintels on spans exceeding 4 feet (1219 mm) shall not be permitted, unless supplemented by fireresistance rated structural members, concrete or masonry arches of the required strength to support the superimposed *loads*.

## SECTION 717.0 FIRE DOOR ASSEMBLIES

**717.1 Fire door assemblies:** Approved *fire door* assemblies as defined in this code shall be constructed of any material or assembly of component materials which conforms to the test requirements of ASTM E152 listed in Chapter 35 and the *fire protection rating* herein required in Table 717.1, unless otherwise specifically provided for in this code.

**717.1.1 Twenty-minute doors:** *Fire doors* having a *fire protection rating* of 20 minutes shall be tested in accordance with ASTM E152 listed in Chapter 35 without the hose stream test.

**717.1.2 Doors in exit enclosures:** All doorway opening protectives for *exit* enclosures shall be *labeled means of egress fire doors* and shall have a maximum transmitted temperature end point of not more than 450 degrees F. (232 degrees C.) above ambient at the end of 30 minutes of standard fire test exposure.

**Exception:** The maximum transmitted temperature end point is not required in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.

**Table 717.1**
**OPENING PROTECTIVE FIRE PROTECTION RATING**

| Type of assembly | Required assembly rating (hour) | Minimum opening protection assembly (hour) |
|---|---|---|
| Fire walls and fire separation assemblies having a required fireresistance rating greater than 1 hour | 4<br>3<br>2<br>1 1/2 | 3<br>3<br>1 1/2<br>1 1/2 |
| Fire separation assemblies:<br>Shaft and exit enclosure walls<br>Other fire separation assemblies | <br>1<br>1 | <br>1<br>3/4 |
| Fire partitions:<br>Exit access corridor enclosure wall<br><br>Other fire partitions | <br>1<br>1/2<br>1 | <br>1/3[a]<br>1/3[a]<br>3/4 |

**Note a.** For testing requirements, see Section 717.1.1.

**717.2 Labeled protective assemblies:** All *fire door* assemblies shall be *labeled* by an *approved agency*. *Labeled* protective assemblies that conform to the requirements of this section or UL 10A, 14B and 14C for tin-clad *fire door* assemblies, and NFPA 80 listed in Chapter 35, shall be approved for use as provided for in this code.

**717.2.1 Labeling requirements:** *Fire doors* shall be *labeled* or provide other approved identification showing the name of the manufacturer, the name of the third-party inspection agency, the *fire protection rating* and, where required for *fire doors* in *exit* enclosures by Sections 717.1.2 or 1014.8.3, the maximum transmitted temperature end point. Such *label* shall be approved and shall be permanently affixed. The *label* shall be applied at the factory where fabrication and assembly are done. Inspection shall be made by an *approved agency*.

**717.2.2 Oversized doors:** Approval of doors which cannot be *labeled* because of size shall be based on a certificate of inspection furnished by an *approved testing agency* for such oversized doors. The certificate shall state that the door conforms to the requirements of design, materials and construction, but has not been subjected to the fire test.

**717.3 Multiple doors in fire walls:** Two doors, each with a *fire protection rating* of 1 1/2 hours, installed on opposite sides of the same opening in a *fire wall*, shall be deemed equivalent in *fire protection rating* to one 3-hour *fire door*.

**717.4 Glass panels:** Fire protection rated glazing shall be permitted in *fire door* assemblies in accordance with Section 717.0 unless otherwise specifically provided for in this code, and as herein specifically prescribed.

**717.4.1 Labeling:** Fire protection rated glazing shall bear a *label* or other identification showing the name of the manufacturer, the test standard and the *fire protection rating*. Such *label* shall be issued by an *approved agency* and shall be permanently affixed.

**717.4.2 Safety glazing:** Fire protection rated glazing installed in *fire doors* or *fire windows* in areas subject to human impact in hazardous locations as indicated in Section 2405.2 shall comply with Section 2405.1.

**717.5 Door closing:** *Fire doors* shall be self-closing or automatic-closing in accordance with the requirements of NFPA 80 listed in Chapter 35 and the requirements of Sections 717.5.1 through 717.5.4. Swinging *fire doors* shall be self-latching.

**Exception:** *Fire doors* in guestroom separation walls in occupancies in Use Group R-1 are not required to be self-closing or automatic closing.

**717.5.1 Smoke-activated doors:** *Fire doors* which are not self-closing and which protect openings in *horizontal exits*, *exits* or *exit access corridors* required to be of fireresistance rated construction shall be automatic-closing by the actuation of smoke detectors or by loss of power to the smoke detector or the hold-open device.

**717.5.2 Doors in pedestrian ways:** Vertical sliding or vertical rolling steel *fire doors* in openings through which pedestrians travel shall not be automatic-closing by actuation of smoke detectors.

**Exception:** Doors that are activated by smoke detectors arranged on an *alarm verification* circuit in accordance with Section 919.7.

**717.5.3 Swinging fire doors:** The door closers for swinging *fire doors* that are not required to be automatic-closing by smoke detector activation in accordance with Section 717.5.1, shall be permitted to be activated by a single fusible link incorporated in the hold-open arm of an approved door closer where the ceiling is less than 3 feet (914 mm) above each side of the door opening.

**717.5.4 Closing time:** Doors that are automatic-closing by *automatic fire detectors* or are self-closing shall not have a delay in the initiation of closing or reclosing of more than 10 seconds.

## SECTION 718.0 FIRE DAMPERS

**718.1 Approval:** *Fire dampers* shall comply with the requirements of UL 555 listed in Chapter 35 and shall bear the *label* of an *approved testing agency*. *Fire dampers* shall be classified and identified in accordance with UL 555. *Fire dampers* installed in systems that continue to operate when smoke or heat from a fire is detected shall be *labeled* for installation in dynamic systems as required by UL 555. *Fire dampers* shall be installed in accordance with manufacturer's installation instructions. *Fire dampers*

shall have the minimum *fire protection rating* specified in Table 718.1 for the type of penetration.

**Table 718.1**
**FIRE DAMPER RATING**

| Type of penetration | Minimum damper rating (hour) |
|---|---|
| Fire partitions less than 1 hour | $^1/_2$ |
| Unprotected floor assemblies (see Section 713.4.3.2) | |
| Single membrane of a 1-hour fireresistance rated assembly | |
| 1-hour fireresistance rated assemblies | 1 |
| 2-hour fireresistance rated assemblies | $1^1/_2$ |
| 3-hour or greater fireresistance rated assemblies | 3 |

**718.2 Where required:** *Fire dampers* shall be provided at locations required by this code where air distribution systems penetrate assemblies required to have a fireresistance rating. Where the installation of a *fire damper* will interfere with the operation of a required smoke control system in accordance with Section 922.0 or the operation of an exhaust system conveying *hazardous materials* as defined in the mechanical code listed in Chapter 35, approved alternative protection shall be utilized.

**718.2.1 Smoke damper:** The *fire damper* shall not be utilized as a smoke damper unless the location lends itself to the dual purpose.

**718.3 Access:** Access shall be provided to *fire dampers* for inspection and servicing.

## SECTION 719.0 FIRE WINDOWS AND SHUTTERS

**719.1 Fireresistance rating:** Approved assemblies of *fire windows* and fire shutters shall meet the test requirements of ASTM E163 listed in Chapter 35 and conform to the requirements of NFPA 80 listed in Chapter 35. *Fire windows* shall be in the fixed closed position or be automatic-closing.

**719.1.1 Exception:** Steel window frame assemblies of $^1/_8$-inch (3 mm) minimum solid section or of not less than nominal 0.048-inch-thick formed sheet steel members *fabricated* by pressing, mitering, riveting, interlocking or welding and having provision for glazing with $^1/_4$-inch wired glass as required in Section 720.0 where securely installed in the building construction and glazed with $^1/_4$-inch *labeled* wired glass, shall be deemed to meet the requirements for a $^3/_4$-hour *fire window* assembly.

**719.2 Window mullions:** All metal mullions which exceed a nominal height of 12 feet shall be protected with materials to afford the same fireresistance rating as required for the wall construction in which the protective is located.

**719.3 Swinging fire shutters:** Where fire shutters of the swinging type are installed in exterior openings, not less than one row in every three vertical rows shall be arranged to be readily opened from the outside, and shall be identified by distinguishing marks or letters not less than 6 inches (152 mm) high.

**719.4 Rolling fire shutters:** Where fire shutters of the rolling type are installed, such shutters shall be of approved counterbalanced construction and capable of being readily opened from the outside.

**719.5 Labeled protective assemblies:** All *fire window* assemblies shall be *labeled* by an *approved agency*.

**719.5.1 Labeling requirements:** *Fire window* assemblies shall have a *label* or other identification indicating the name of the manufacturer, the test standard, and the *fire protection rating* or fireresistance rating. Such *label* shall be issued by an *approved agency* and shall be permanently affixed. The *label* shall be applied at the fabrication and assembly factory.

## SECTION 720.0 WIRED GLASS

**720.1 General:** Wired glass installed as an opening protective shall be tested in accordance with ASTM E163 listed in Chapter 35, shall bear the *label* of an *approved agency* and shall be installed in approved frames. Wired glass panels shall conform to the size limitations set forth in Table 720.1.

**Table 720.1**
**LIMITING SIZE[a] OF WIRED GLASS PANELS**

| Opening fire protection rating | Maximum area (square inches) | Maximum height (inches) | Maximum width (inches) |
|---|---|---|---|
| 3 hour | 0 | 0 | 0 |
| $1^1/_2$-hour doors in exterior walls | 0 | 0 | 0 |
| 1 and $1^1/_2$ hours | 100 | 33 | 10 |
| $^3/_4$ hour | 1,296 | 54 | 54 |
| $^1/_3$ hour | Not limited | Not limited | Not limited |
| Fire windows | 1,296 | 54 | 54 |

**Note a.** 1 inch = 25.4 mm; 1 square inch = 645.2 $mm^2$.

**720.1.1 Fire walls:** Wired glass in *fire doors* located in *fire walls* shall be prohibited except that where serving as a *horizontal exit*, a self-closing swinging door shall be permitted to have a vision panel of not more than 100 square inches (0.065 $m^2$) without a dimension exceeding 10 inches (254 mm).

**720.1.2 Fire separation assemblies:** Wired glass vision panels shall not be installed in *fire doors* having a $1^1/_2$-hour *fire protection rating* intended for installation in *fire separation assemblies*, unless the glass panels are not more than 100 square inches (0.065 $m^2$) in area.

**720.2 Exit and elevator protectives:** Except where *fire doors* are specifically required by Chapter 4 to be solid in such locations where unusually hazardous conditions prevail, approved wired glass vision panels used in *fire doors* in elevator and *stairway shaft* enclosures shall be so located as to furnish clear vision of the passageway or approach to the elevator or *stairway* and shall not exceed the size limitations specified in Table 720.1.

**720.3 Fire separation assemblies:** Panels of $^1/_4$-inch wired glass shall not be installed in *fire separation assemblies* intended for subdividing purposes as set forth in Section 709.1 where the required fireresistance rating of the wall exceeds 1 hour. The maximum size of such panels shall not exceed the limitations for a $^3/_4$-hour door.

## SECTION 721.0 FIREBLOCKING AND DRAFTSTOPPING

**721.1 General:** To prevent the free passage of flame and products of combustion through concealed spaces or openings in the event of fire, provisions shall be made to provide effective *fireblocks* or *draftstops* as herein specified.

**721.2 Fireblocking materials:** All *fireblocking* shall consist of approved noncombustible materials securely fastened in place. *Fireblocks* of approved noncombustible materials or of materials of two thicknesses of 1-inch lumber with broken lap-joint, or one thickness of $^{23}/_{32}$-inch wood structural panel with *joints* backed by $^{23}/_{32}$-inch wood structural panel, or of 2-inch lumber installed with tight *joints*, shall be installed in open spaces of wood framing.

**721.3 Draftstopping materials:** *Draftstopping* materials shall not be less than $^{1}/_{2}$-inch gypsum board, $^{3}/_{8}$-inch plywood or other approved materials adequately supported.

**721.4 Integrity:** The integrity of all *fireblocking* and *draftstopping* shall be continuously maintained.

**721.5 Required inspection:** *Fireblocking* and *draftstopping* shall not be concealed from view until inspected and approved.

**721.6 Fireblocking required:** *Fireblocking* shall be installed in the locations specified in Sections 721.6.1 through 721.6.7.

**721.6.1 Concealed wall spaces:** *Fireblocking* shall be installed in concealed spaces of stud walls and partitions, including furred or studded-off spaces of masonry or concrete walls, and at the ceiling and floor or roof levels. *Fireblocking* is not required at the ceiling level of walls, partitions and furred spaces constructed of noncombustible materials as defined by Section 704.4.

**721.6.2 Connections between horizontal and vertical spaces:** *Fireblocking* shall be installed at all interconnections between vertical and horizontal spaces such as occur at soffits over cabinets, drop ceilings, cove ceilings and similar locations. *Fireblocking* is not required at the interconnections between vertical and horizontal spaces where such spaces are constructed of noncombustible materials as defined by Section 704.4.

**721.6.3 Stairways:** *Fireblocking* shall be installed in concealed spaces between *stairway* stringers at the top and bottom of the run.

**721.6.4 Ceiling and floor openings:** Where permitted by Exception 7 of Section 713.3, or by Section 714.2.6 or 714.3, *fireblocking* shall be installed at openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels, with approved noncombustible materials. Factory-built chimneys and fireplaces shall be *fireblocked* in accordance with UL 103 and UL 127 listed in Chapter 35. Where ceilings or floors are required to be fireresistance rated, the openings around vents, pipes, ducts, chimneys and fireplaces shall be protected in accordance with the requirements of Sections 714.2 through 714.2.6.5.

**721.6.5 Architectural trim:** *Fireblocking* shall be installed within concealed spaces of *exterior wall finish* and other exterior architectural elements where permitted of combustible construction in Section 1406.0, or where erected with combustible frames, at maximum intervals of 20 feet (6096 mm). If noncontinuous, such elements shall have closed ends, with at least 4 inches (102 mm) of separation between sections.

**721.6.6 Combustible finish and trim:** *Fireblocking* shall be installed in the space behind combustible trim and finish where permitted under this code and all other hollow spaces where permitted in fireresistance rated construction at 10-foot (3048 mm) intervals; or the space shall be solidly filled with approved noncombustible materials.

**721.6.7 Concealed sleeper spaces:** *Fireblocking* shall be installed in concealed spaces formed by floor sleepers in areas of not more than 100 square feet (9 m$^2$); or the space shall be solidly filled with approved noncombustible materials.

**721.7 Draftstopping required:** *Draftstopping* shall be installed in buildings of Types 3, 4 and 5 construction in the locations specified by Sections 721.7.1 and 721.7.2.

**721.7.1 Floors:** Where ceilings are suspended below solid wood joists or suspended or attached directly to the bottom of open-web wood floor trusses, the space between the ceiling and the floor above shall be divided by *draftstopping* as specified in Sections 721.7.1.1 through 721.7.1.3.

**721.7.1.1 Use Groups R-1 and R-2:** In occupancies in Use Groups R-1 and R-2, *draftstopping* shall be installed in line with tenant and *dwelling unit* separation walls where the walls do not extend to the underside of the floor sheathing above.

**Exception:** *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space.

**721.7.1.2 Use Group R-3:** In occupancies in Use Group R-3, the space shall be divided into approximately equal areas not greater than 500 square feet (46 m$^2$). The *draftstopping* shall be installed parallel to the main framing members.

**Exception:** *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space.

**721.7.1.3 Other use groups:** In all other use groups, *draftstopping* shall be installed so that horizontal areas do not exceed 1,000 square feet (93 m$^2$).

**Exception:** *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in the combustible concealed space above the ceiling.

**721.7.2 Attics and concealed spaces:** *Attics* and concealed roof spaces shall be provided with *draftstopping* as specified in Sections 721.7.2.1 and 721.7.2.2.

**721.7.2.1 Use Group R:** In occupancies in Use Group R, in *attics*, mansards, overhangs or other concealed roof spaces, *draftstopping* shall be installed above, and in line with, tenant and *dwelling unit* separation walls that do not extend to the underside of the roof sheathing above.

**Exceptions**

1. Where *corridor* walls provide a tenant or *dwelling unit* separation, *draftstopping* shall only be required above one of the *corridor* walls.
2. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant and *dwelling unit* separation walls if the joists form a *draftstop*.
3. *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in *attics*, mansards, overhangs and other concealed roof spaces of combustible concealed space.
4. *Draftstopping* is not required in detached *one-* and *two-family dwellings*.
5. In occupancies in Use Group R-2 which do not exceed four stories in *height*, the *attic* space shall be subdivided by *draftstops* into areas not exceeding 3,000 square feet (279 $m^2$) or above every two *dwelling units*, whichever is smaller.
6. When *dwelling unit* separation walls are constructed to the underside of a fireresistance rated roof/ceiling assembly or to a ceiling with a 60-minute finish rating, the *attic draftstopping* complying with Section 720.7.2.2 [i.e., horizontal draftstopped areas not exceeding 3,000 square feet (279 $m^2$)] shall be deemed equivalent.

**721.7.2.2 Other use groups:** *Draftstopping* shall be installed in *attics* and concealed roof spaces, such that any horizontal area does not exceed 3,000 square feet (279 $m^2$).

**Exceptions**

1. Flat roofs with solid joist construction are not required to be provided with *draftstopping* over tenant separation walls if the joists form a *draftstop*.
2. *Draftstopping* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, provided that automatic *sprinklers* are also installed in *attics* and other concealed roof spaces of combustible construction.

**721.8 Ventilation:** *Ventilation* of concealed roof spaces shall be maintained in accordance with Section 1210.0.

## SECTION 722.0 FIRERESISTIVE REQUIREMENTS FOR PLASTER

**722.1 Thickness of plaster:** The required thickness of fireresistance rated plaster protection shall be determined by the prescribed fire tests for the specified use group and type of construction and in accordance with the provisions of Section 2505.0 for interior plastering and Section 2506.0 for exterior plastering. The thickness in all cases shall be measured from the face of the lath where applied to gypsum lath or metal lath.

**722.2 Plaster equivalents:** For fireresistive purposes, $^1/_2$ inch (13 mm) of unsanded gypsum plaster shall be deemed equivalent to $^3/_4$ inch (19 mm) of one-to-three sanded gypsum or 1 inch (25 mm) of portland cement sand plaster.

**722.3 Noncombustible furring:** In buildings of Types 1 and 2 construction, plaster shall be applied directly on concrete or masonry or on approved noncombustible plastering base and furring.

**722.4 Double reinforcement:** Except in solid plaster partitions, or where otherwise determined by the prescribed fire tests, plaster protection more than 1 inch (25 mm) in thickness shall be reinforced with an additional layer of approved lath embedded at least $^3/_4$ inch (19 mm) from the outer surface and fixed securely in place.

**722.5 Plaster alternatives for concrete:** In reinforced concrete construction, gypsum or portland cement plaster is permitted to be substituted for $^1/_2$ inch (13 mm) of the required poured concrete protection, except that a minimum thickness of $^3/_8$ inch (10 mm) of poured concrete shall be provided in all reinforced concrete floors and 1 inch (25 mm) in reinforced concrete columns in addition to the plaster finish. The concrete base shall be prepared in accordance with Section 2506.0.

## SECTION 723.0 THERMAL- AND SOUND-INSULATING MATERIALS

**723.1 General:** Insulating batts, blankets, fills or similar types of materials — other than fiberboard, cellulosic and foam plastic insulation — including *vapor retarders* and breather papers or other coverings which are incorporated in construction elements, shall be installed as required by this section. Fiberboard insulation shall be installed as required by Section 2309.0, cellulosic insulation shall comply with Section 723.5, and foam plastic insulation shall be installed as required by Section 2603.0.

**723.2 Exposed installations:** Such materials, where exposed as installed in rooms or spaces, including *attics* and crawl spaces of buildings of any type construction, shall have a flame spread rating of 25 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in Chapter 35. Plenum installations shall comply with the requirements of Section 2805.0 and the mechanical code listed in Chapter 35.

**723.3 Concealed installations:** Insulating materials, where concealed as installed in buildings of any type of construction, shall have a flame spread rating of 75 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in Chapter 35.

**723.3.1 Facings:** All *vapor retarders*, whether integral or applied separately, shall be installed on the warm side of the building element, and shall have a permeance not exceeding 1 perm. Where insulation materials are installed in concealed spaces (such as wall, floor or ceiling cavities), *attics* or crawl spaces in buildings of Types 3, 4 and 5 construction, the flame spread and smoke-developed rating limitations do not apply to facings, provided that the facing is installed behind and in substantial contact with the unexposed surface of the ceiling, floor or wall finish.

**723.4 Loose-fill insulation testing:** Loose-fill insulation which requires a screen or artificial support for the test arrangement required in the test tunnel of ASTM E84, listed in Chapter 35, shall be tested in the following mounting method. Loose-fill insulation shall be placed on the floor of the ASTM E84 test tunnel in a thickness of 57 mm ±6 mm for the length of the tunnel. A specimen, including density, shall be representative of the material as it is to be installed. Ceramic paper with a nominal density of 0.7 kg per square meter shall be laid on the floor of the tunnel beneath the insulation, with cutouts to accommodate the burners and thermocouple.

**723.4.1 Test procedure modifications:** The following modifications to the test procedure of ASTM E84, listed in Chapter 35, shall apply:

1. Inside windows shall be removed, leaving only the outside windows. The bricks used to create air turbulence outside the tunnel shall also be removed.
2. The burners shall be adjusted so that their centerline is 50 mm ±2 mm above the nominal level of the top of the test sample. The elbows constituting the burner ports shall be rotated until they are pointed downward at an angle of 45 degrees (0.78 rad) to the horizontal in the direction of airflow.
3. An air ramp shall be placed on the floor of the tunnel at the air inlet. The upstream end of the ramp shall rest on the tunnel floor while the downstream end of the ramp shall terminate beneath the centerline of the burner tee and shall overlap the specimen 25 mm. The ramp shall be made of No. 304 stainless steel, minimum thickness 1.7 mm, 660 mm long and sized to fit within 3 mm of the furnace width.

**723.4.2 Flame spread rating:** The flame spread rating shall be determined as follows:

1. If the total area ($A_T$) is less than or equal to 29.7 meter minutes, the flame spread rating ($FSR$) shall be 1.85 times the total area ($A_T$); therefore, $FSR = 1.85\ A_T$.
2. If the total area ($A_T$) is greater than 29.7 meter minutes, the flame spread rating ($FSR$) shall be 1,640, divided by the difference of 59.4 minus the total area ($A_T$); therefore, $FSR = 1{,}640\ (59.4 - A_T)$.

**723.4.3 Smoke-developed rating:** The smoke-developed rating shall be determined in accordance with ASTM E84 listed in Chapter 35.

**723.5 Cellulosic insulation:** Cellulosic insulation shall meet the requirements of CPSC 16 CFR; 1209 and 1404, listed in Chapter 35. Cellulosic insulation shall have a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in Chapter 35.

**723.6 Protection:** Insulating materials applied in the exterior of foundation walls shall be protected in accordance with Section 1405.3.11.

# CHAPTER 8

# INTERIOR FINISHES

## SECTION 801.0 GENERAL

**801.1 Scope:** Interior finish and trim of buildings shall conform to the requirements of this section. Interior finish shall mean the exposed interior surfaces of buildings including, but not limited to, fixed or movable walls and partitions, columns, ceilings, *floor finishes* and wainscotting, paneling or other finish applied structurally or for acoustical treatment, insulation, fireresistance, decoration or similar purposes.

**801.2 Installation and classification:** All materials which are required to restrict the spread of flame or to be flameresistant under the provisions of this code — including, but not limited to, interior finish materials, fireretardant-treated wood, tents and tarpaulins, and interior hangings and decorations — shall meet the requirements for installation and classification as determined by the applicable test procedures listed in this section.

## SECTION 802.0 DEFINITIONS

**802.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Flame spread:** The propagation of flame over a surface.

**Flame spread rating:** The measurement of flame spread on the surface of materials or their assemblies as determined by the tests specified in this code (see Section 803.0).

**Flameresistance:** That property of materials or combinations of component materials which restricts the spread of flame as determined by the flameresistance tests specified in this code (see Section 807.2).

***Floor finish*:** The finish placed on top of the floor, slab or other structural floor element.

## SECTION 803.0 INTERIOR FINISH AND TRIM

**803.1 Exposed construction:** These requirements shall not be considered as requiring the installation of interior finish, but where construction or fire protection materials are exposed in the use groups specified in Section 803.4, the hazard from rate of flame spread of such exposed materials shall not be greater than that of the interior finish permitted for such occupancy.

**803.1.1 Paper finish:** The use of a surface finish of paper or of material that does not have a greater fire hazard than paper shall not be prohibited, provided that such finish does not exceed $^{1}/_{28}$ inch (1 mm) in thickness and is applied directly to a noncombustible base or substrate that conforms to the requirements of Section 2310.0.

**803.1.2 Type 4 construction:** Exposed portions of structural members complying with the requirements for buildings of Type 4 construction in Sections 605.0 and 2304.0 shall not be subject to interior finish regulations.

**803.1.3 Window exception:** Show windows in the first story of buildings are permitted to be constructed of any approved materials.

**803.2 Classification:** All materials used for interior finish and trim shall be classified in accordance with ASTM E84 listed in Chapter 35. The classifications of interior finishes referred to herein correspond to flame spread ratings determined by ASTM E84 listed in Chapter 35 as follows: Class I flame spread, 0 - 25; Class II flame spread, 26 - 75; and Class III flame spread, 76 - 200. Classification in accordance with ASTM E84 shall not be required for textile wall covering materials that comply with Section 803.6(2).

**803.3 Materials:** Materials shall only be installed as interior finish and trim as specifically provided for in this code for the occupancy of the space in which the material is installed. Installation of any material for *floor finish*, interior finish and trim in a building of Type 1 or 2 construction within the scope permitted in this section or in Section 806.0 shall not declassify the building with respect to the type of construction classification.

**803.3.1 Foam plastics:** Foam plastics shall not be installed as interior trim or finish except in compliance with this section and Section 2603.0.

**803.3.2 Smoke development:** Interior wall and ceiling finish materials that have a smoke-developed rating greater than 450 when tested in accordance with ASTM E84 listed in Chapter 35 shall not be permitted. A smoke-developed rating shall not be required for textile wall coverings complying with Section 803.6(2).

**803.4 Required flame spread rating:** Interior finish of walls and ceilings shall have a flame spread rating not greater than that designated by the class prescribed for the various use groups listed in Table 803.4, when tested in accordance with Section 803.2.

**803.4.1 Basements:** In occupancies other than Use Group R-3, Class I or II interior finish shall be required in all *basements* or other underground spaces from which there is

no direct *exit* to the outside of the building, if subject to occupancy for any purpose other than storage or service facilities.

**803.4.2 Maximum flame spread:** Interior finish materials with flame spread classifications greater than 200 shall not be installed in any room or space subject to human occupancy, except to such extent as specifically approved on the basis of a finding that such installation does not significantly increase the life hazard.

**803.4.3 Rooms and enclosed spaces:** Requirements for rooms or enclosed spaces are based upon spaces enclosed in partitions of the building or structure, and where a fireresistance rating is required for the structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered as enclosing spaces and the rooms or spaces on both sides thereof shall be counted as one. In determining the applicable requirements for rooms or enclosed spaces, the specific occupancy thereof shall be the governing factor, regardless of the use group classification of the building or structure. Where an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2 is installed throughout a building, Class II or III interior finish shall be permitted where Class I or II materials, respectively, are required in Table 803.4.

**Table 803.4**
**INTERIOR FINISH REQUIREMENTS[g]**

| Use Group | Required vertical exits and passageways[c] | Corridors providing exit access[i] | Rooms or enclosed spaces[a] |
|---|---|---|---|
| A-1, A-2, A-3 | I | I[e] | II[b] |
| A-4, B, E, F, I-1, R-1, R-2 | I | II | III |
| H | I | II | III[f] |
| I-2 | I[h] | I[h] | I[h] |
| I-3 | I | I | III |
| M: walls | I | II | III |
| ceilings | I | II | II[d] |
| R-3 | III | III | III |
| S, U | II | II | III |

**Note a.** For requirements applicable to rooms and enclosed spaces, see Section 803.4.3.

**Note b.** Class III interior finish materials are permitted in places of assembly with a capacity of 300 persons or less.

**Note c.** Class III interior finish materials are permitted for wainscotting or paneling for not more than 1,000 square feet (93 $m^2$) of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring strips applied to a noncombustible base and fireblocked as required by Section 804.0.

**Note d.** Class III interior finish materials are permitted in mercantile occupancies of 3,000 square feet (279 $m^2$) or less gross area occupied for sales purposes on the street floor only (balcony permitted).

**Note e.** Lobby areas shall not be less than Class II.

**Note f.** Where building height is over two stories, Class II shall be required.

**Note g.** For the classifications of interior finishes referred to herein, see Section 803.2. For interior finish requirements for exposed insulation, see Section 723.2.

**Note h.** Walls and ceilings shall be a minimum of Class II materials in individual rooms of not more than four persons in capacity. Where a building is equipped throughout with an automatic sprinkler system installed in accordance with Section 906.2.1, the minimum requirement for interior finish shall be Class II.

**Note i.** In Use Groups A, I-2 and I-3, Class II interior wall finish material shall be permitted as wainscotting extending not more than 48 inches (1219 mm) above the floor in corridors providing exit access.

**803.5 Interior trim:** Baseboards, chair rails, moldings, trim around openings and other interior trim, not in excess of 10 percent of the aggregate wall and ceiling areas of any room or space, shall be of Class I, II or III materials.

**803.6 Carpet and carpet-like wall coverings:** Textile wall coverings having a napped, tufted, looped, woven, nonwoven or similar surface, shall comply with the following:

1. Such materials shall have a Class I flame spread classification and be installed only in rooms or areas protected by an *automatic sprinkler system* installed in accordance with Chapter 9; or
2. Such materials shall be tested in accordance with an 8-foot by 12-foot by 8-foot high (2438 mm by 3658 mm by 2438 mm) room/corner fire test procedure utilizing a product-mounting system, including adhesive, representative of actual installation. Prior to testing, the sample shall be conditioned at 70 degrees F. (21 degrees C.) ± 5 percent and at a relative humidity of 50 percent ± 5 percent until the sample reaches a rate of weight change of less than 0.1 percent per day. The product shall be exposed to a flame from a gas diffusion burner for 15 minutes. The fire exposure shall be 40 kW for the first 5 minutes, followed by an exposure of 150 kW for an additional 10 minutes. Such tests shall demonstrate that a product will not spread fire to the edge of the specimen or cause flashover in the test room.

**803.7 Design load:** Interior wall finish materials shall be capable of resisting the horizontal *load* specified in Section 1606.9.

## SECTION 804.0 APPLICATION OF INTERIOR FINISH

**804.1 Attachment:** Where interior finish is regulated by the requirements of this chapter, interior finish materials shall be applied or otherwise fastened in such a manner that such materials will not readily become detached when subjected to room temperatures of 200 degrees F. (93 degrees C.) for not less than 30 minutes.

**804.2 Fireresistive and noncombustible construction:** Interior finish materials installed on walls, ceilings or structural elements, which are required to provide a fireresistance rating or to be of noncombustible construction, shall comply with the provisions of Section 804.2.1 or 804.2.2.

**804.2.1 Application to structural elements:** Interior finish materials applied to walls, ceilings or structural elements shall be applied directly against the exposed surface of such structural elements or to furring attached to such surfaces. In concrete or masonry construction, furring of wood or any other material of similar combustible characteristics is permitted. All concealed spaces created by furring shall be *fireblocked* at not more than 10-foot (3048 mm) intervals in any direction (see Section 721.6.6).

**804.2.2 Set-out construction:** Where the interior finish is set out or dropped distances greater than $1^3/_4$ inches (44 mm) from the surface of such elements, only material of which both faces qualify as Class I shall be installed.

**Exceptions**

1. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2, Class II finish materials shall

be permitted, provided that automatic *sprinklers* are also installed in combustible concealed spaces behind the interior finish.

2. Class II or III materials shall be permitted where attached to a backing that complies with Section 804.3 or to furring applied directly to such backing as provided for in Section 804.2.1.

**804.3 Class II and III materials:** Class II and III interior finish materials which are less than $^1/_4$ inch in thickness shall be applied directly against a noncombustible backing or a backing that complies with the requirements of Section 2310.0, unless the tests under which such material has been classified were made with the materials suspended from the noncombustible backing. The backing material shall provide a continuous surface completely behind the finish. Where the backing does not constitute an integral part of the structural elements or system, the backing shall be attached directly to the structural elements or to the furring as required for the application of finish in Section 804.2, or shall be suspended from the structural members at any distance and all concealed spaces created thereby shall be *fireblocked* in accordance with Section 721.0.

**804.4 Type 4 construction:** Interior finish materials shall be applied directly to the wood members and decking of buildings of Type 4 construction, or to furring strips applied to such members or wood decking as provided for in Section 804.2.1.

## SECTION 805.0 FLOOR FINISH

**805.1 General:** Finished floors or floor covering materials of a traditional type, such as wood, vinyl, linoleum, terrazzo and other resilient floor covering materials, are exempt from the requirements of this section. Floor coverings judged by the code official to represent an unusual hazard shall meet the requirements of this section.

**805.2 Classification:** Interior *floor finish* required by Section 805.3 to be of Class I or Class II materials shall be classified in accordance with ASTM E648 listed in Chapter 35. The classifications referred to herein correspond to the classifications determined by ASTM E648 listed in Chapter 35 as follows: Class I, 0.45 watts/cm$^2$; Class II, 0.22 watts/cm$^2$.

**805.2.1 Test report:** All carpet required by this section to meet critical radiant flux limitations in accordance with Section 805.2 shall be tested by an *approved agency*. A copy of the test report identifying and representing the style to be installed shall be provided to the code official upon request. The test report shall identify the carpet by manufacturer (or supplier) and style name, and shall be representative of the current construction of the carpet.

The carpet shall be identified by the manufacturer's designation. The manufacturer's designation shall indicate the classification of the material based upon the limitations specified in Section 805.2.

**805.3 Required classification:** Interior *floor finish* in vertical *exits*, *exit* passageways and *exit access corridors* shall not be less than Class I in Use Group I-2 and not less than Class II in Use Groups A, B, E, I-1, I-3, M, R-1 and R-2. In all other areas, the interior *floor finish* shall comply with the DOC FF-1 "pill test" (CPSC 16 CFR; 1630) listed in Chapter 35.

**Exception:** Where a building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2, Class II materials are permitted in any area where Class I materials are required and materials complying with the DOC FF-1 "pill test" (CPSC 16 CFR; 1630) listed in Chapter 35 are permitted in any area where Class II materials are required.

**805.4 Rooms and enclosed spaces:** Requirements for rooms or enclosed spaces are based upon the spaces being enclosed with partitions extending from the floor to the ceiling. Where partitions do not satisfy this criterion, the room or space is considered part of the *corridor*.

**805.5 Other materials:** All carpet manufactured for sale in the United States is required by federal regulations to pass the DOC FF-1 "pill test" (CPSC 16 CFR; 1630) listed in Chapter 35. If a material other than carpet is installed, the material shall be shown to be at least as resistant to flame propagation as a material that passes DOC FF-1 (minimum critical radiant flux of 0.04 watts/cm$^2$).

## SECTION 806.0 COMBUSTIBLE MATERIALS PERMITTED IN FLOORS OF TYPES 1 AND 2 CONSTRUCTION

**806.1 General:** Except as provided for in Section 1014.0 for *stairways* and in Section 412.0 for *stages* and *platforms*, combustible materials installed in or on floors of buildings of Types 1 and 2 construction shall be as herein specified.

**806.2 Sleepers, bucks and grounds:** Floor sleepers, bucks, nailing blocks and grounds shall not be constructed of combustible materials, unless the space between the fireresistance rated floor construction and the flooring is either solidly filled with approved noncombustible materials or *fireblocked* in accordance with Section 721.6.7, and provided that such open spaces shall not extend under or through permanent partitions or walls.

**806.3 Flooring:** Wood finish flooring is permitted to be attached directly to the embedded or *fireblocked* wood sleepers, and shall be permitted where cemented directly to the top surface of approved fireresistance rated construction or directly to a wood subfloor attached to sleepers as provided for in Section 806.2. Combustible insulating boards not more than $^1/_2$ inch thick and covered with approved finished flooring are permitted for sound deadening or heat insulating where attached directly to a noncombustible floor assembly or to wood subflooring attached to sleepers as provided for in Section 806.2.

## SECTION 807.0 INTERIOR HANGINGS AND DECORATIONS

**807.1 Decorative material restrictions:** In occupancies in Use Groups A, E, I-2, I-3 and R-1, all curtains, draperies, hangings and other decorative materials suspended from walls or ceilings shall be noncombustible or be maintained flameresistant in accordance with Section 807.2 as herein specified.

**807.1.1 Noncombustible:** The permissible amount of noncombustible decorative hangings shall not be limited.

**807.1.2 Flameresistant:** The permissible amount of flameresistant decorative hangings shall not exceed 10 percent of the total wall and ceiling area.

**807.2 Acceptance criteria:** Where required to be flameresistant under the provisions of this code, all materials used for artistic enhancement, decorations, draperies, curtains, scenery and hangings shall comply with this section. If treated to be flameresistant, these materials shall not generate smoke more dense than that given off by untreated wood or paper burning under comparable conditions when tested in accordance with both the small-scale and large-scale tests in NFPA 701 listed in Chapter 35.

**807.2.1 Deleted.**

**807.2.2 Deleted.**

**807.2.3 Deleted.**

# CHAPTER 9

# FIRE PROTECTION SYSTEMS

## SECTION 901.0 GENERAL

**901.1 Scope:** The provisions of this chapter shall specify where *fire protection systems* are required and shall apply to the design, installation, maintenance and operation of all *fire protection systems* in all buildings and structures.

**901.2 Required systems:** All *fire protection systems* required by this code shall be installed, repaired, operated and maintained in accordance with this code and the fire prevention code listed in Chapter 35. All required *fire suppression* and *standpipe systems* shall be provided with at least one automatic supply of fire-extinguishing agent of adequate pressure, capacity and reliability to perform the function intended.

**901.3 Nonrequired systems:** Any *fire protection system* or portion thereof not required by this code shall be permitted to be furnished for partial or complete protection provided that such installed system meets applicable requirements of this code.

**901.4 Maintenance:** All *fire protection systems* shall be maintained in accordance with the requirements of the fire prevention code listed in Chapter 35.

**901.5 Threads:** All threads provided for fire department connections to *sprinkler systems*, *standpipes*, yard hydrants or any other fire hose connection shall be compatible with the connections used by the local fire department.

**901.6 Signs:** All signs required to identify fire protection equipment and equipment location shall be constructed of durable materials, be permanently installed and be readily visible. Letters and numbers shall contrast with the sign background and shall have an appropriate width-to-height ratio to permit the sign to be read easily.

**901.7 Acceptance tests:** All *fire protection systems* shall be tested in accordance with the requirements of this code and the fire prevention code listed in Chapter 35. The tests shall be conducted in the presence of the code official. All tests required by this code and the standards listed in this code shall be conducted at the expense of the owner or the owner's representative.

**901.8 Certification:** The contractor shall provide the code official with a certificate indicating that the system is installed in compliance with this code and the appropriate acceptance tests have been conducted.

## SECTION 902.0 DEFINITIONS

**902.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Alarm verification:*** A feature of automatic fire detection systems to reduce unwanted alarms wherein *automatic fire detectors* report alarm conditions for a minimum period of time, or confirm alarm conditions within a given period, after being automatically reset to be accepted as a valid alarm initiation signal (see Section 919.0).

**Automatic:** As applied to fire protection devices, automatic refers to a device or system that provides an emergency function without the necessity of human intervention and activated as a result of a predetermined temperature rise, rate of temperature rise or increase in the level of combustion products — such as incorporated in an *automatic sprinkler system*, automatic *fire door*, etc.

***Automatic fire suppression system:*** An engineered system using carbon dioxide ($CO_2$), foam, wet or dry chemical, a halogenated extinguishing agent, a clean extinguishing agent, or an *automatic sprinkler system* to detect automatically and suppress a fire through fixed piping and nozzles (see Section 904.0).

**Clean agent:** Electrically nonconducting, volatile, or gaseous extinguishant that does not leave a residue upon evaporation.

***Deluge system:*** An *automatic sprinkler system* consisting of open *sprinklers* with *water supply* valves activated by a separate automatic detection system (see Section 908.0).

**Detector, heat:** An alarm-initiating device that detects abnormally high temperature or rate of temperature rise (see Section 919.0).

**Detector, smoke:** An alarm-initiating device that detects the visible or invisible particles of combustion (see Section 919.0).

**Fire alarm box, manual:** A manually operated alarm-initiating device that activates a fire alarm system (see Section 918.0).

**Fire alarm system:** A system or portion of a combination system consisting of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal initiating devices and to initiate appropriate response to those signals.

***Fire command station:*** The principal location where the status of the detection, alarm, communications and control systems is displayed, and from which the system(s) has the capability for manual control (see Sections 403.7 and 918.9).

***Fire detector, automatic:*** An alarm-initiating device that automatically detects heat, smoke or other products of combustion (see Section 919.0).

***Fire protection system:*** Devices, equipment and systems used to detect a fire, activate an alarm, suppress or control a fire, or any combination thereof.

***Preaction system:*** A fire *sprinkler* system employing automatic *sprinklers* attached to a piping system containing air with a supplemental fire detection system installed in the same areas as the *sprinklers*. Actuation of the fire detection system automatically opens a valve that permits water to flow into the *sprinkler* piping system and to be discharged from any open *sprinklers* (see Section 906.9.6).

**Smoke detector, multiple station:** Single-station smoke detectors that are capable of being interconnected such that actuation of one causes all integral or separate audible alarms to operate (see Section 920.0).

**Smoke detector, single station:** An assembly incorporating the detector, the control equipment and the alarm-sounding device in one unit, which is operated from a power supply either in the unit or obtained at the point of installation (see Section 920.0).

***Sprinkler:*** A device, connected to a *water supply* system, that discharges water in a specific pattern for extinguishment or control of fire (see Section 906.0).

***Sprinkler system, automatic:*** A *sprinkler* system, for fire protection purposes, is an integrated system of underground or overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable *water supply*. The portion of the system above the ground is a network of specially or hydraulically designed piping installed in a building, structure or area, generally overhead, and to which automatic *sprinklers* are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the *fire area* (see Section 906.0).

***Sprinkler system, limited area:*** An *automatic sprinkler system* consisting of not more than 20 *sprinklers* within a *fire area* (see Section 907.0).

***Standpipe system:*** A *standpipe* system is a *fire protection system* consisting of an arrangement of piping, valves, hose outlets and allied equipment installed in a building or structure (see Section 915.0).

**Supervisory device:** An initiating device used to monitor the conditions that are essential for the proper operation of *automatic fire suppression systems* (i.e., switches used to monitor the position of gate valves, a low air-pressure switch on a dry-pipe *sprinkler system*, etc.) (see Section 924.0).

**Voice/alarm signaling system:** A system that provides, to the occupants of a building, dedicated manual or automatic facilities, or both, for originating and distributing voice instructions, as well as alert and evacuation signals that pertain to a fire emergency (see Section 918.0).

***Water supply, automatic:*** A water supply that is not dependent on any manual operation, such as making connections, operating valves or starting pumps (see Section 915.5).

## SECTION 903.0 CONSTRUCTION DOCUMENTS

**903.1 Required:** *Construction documents* or shop drawings, or both, for the installation of *fire protection systems* shall be submitted to indicate conformance to this code and shall be reviewed by the department prior to issuance of the permit.

**Note:** Since the fire department is responsible for inspecting for the proper maintenance of *fire protection systems* in buildings, the administrative authority shall cooperate with the fire department in the discharge of responsibility to enforce this chapter.

**903.2 Construction documents:** The *construction documents* and shop drawings submitted to the department shall contain sufficient detail as outlined herein to evaluate the protected hazard and the effectiveness of the system.

**903.2.1 Information:** *Construction documents* for *fire protection systems* shall be submitted with the *construction documents* for the construction permit. Included shall be information on the contents, the occupancy, the location and arrangement of the structure and the contents involved, the exposure to any hazard, the extent of the system coverage, the suppression system design criteria, the supply and extinguishing agents, the location of any *standpipes*, and the location and method of operation of detection and alarm devices.

**903.2.2 Shop drawings:** Shop drawings for the installation of *fire protection systems* shall be submitted for review and approval prior to the installation of a *fire protection system*. Included on the shop drawings shall be information showing the basis for compliance with the design density, the specific arrangement of the system, the devices and their method(s) of operation, and the suppression agent. The details on the *construction documents* or shop drawings for the *fire protection system* shall include design considerations, spacing and arrangement of fire protection devices, protection agent supply and discharge requirements, calculations with sizes and equivalent lengths of pipe and fittings, and protection agent source. Sufficient information shall be included to identify the apparatus and devices utilized and other information as required by this code.

## SECTION 904.0 FIRE SUPPRESSION SYSTEMS

**904.1 Where required:** *Automatic fire suppression systems* shall be installed where required by this code, and in the locations indicated in Sections 904.2 through 904.11.

**Exceptions**

1. An *automatic fire suppression system* shall not be required in portions of buildings that comply with Section 406.0 for open parking structures.
2. In telecommunications equipment buildings, an *automatic fire suppression system* shall not be required in those spaces or areas occupied exclusively for telecommunications equipment, associated electrical power

distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 919.0 and are separated from the remainder of the building with *fire separation assemblies* consisting of 1-hour fireresistance rated walls and 2-hour fireresistance rated floor/ceiling assemblies.

**904.2 Use Groups A-1 and A-3:** Where a Use Group A-1 or A-3 *fire area* exceeds 12,000 square feet (1116 $m^2$) in area, an *automatic fire suppression system* shall be provided as follows:

1. Throughout the entire story or floor level where the A-1 or A-3 Use Group is located;
2. Throughout all stories and floor levels below the A-1 or A-3 Use Group; and
3. Throughout all intervening stories and floor levels between the A-1 or A-3 Use Group and the highest *level of exit discharge* that serves Use Group A-1 or A-3 *fire areas*, including the highest *level of exit discharge*.

**Exceptions**

1. Auditorium areas of Use Group A-1 or A-3 where the main auditorium floor is at the *level of exit discharge* of the main entrance.
2. Participant sport areas of Use Group A-3 where the main floor of the participant sport area is at the *level of exit discharge* of the main entrance.

**904.3 Use Group A-2:** Where a Use Group A-2 *fire area* is more than 5,000 square feet (465 $m^2$) in area or is located either above or below the *level of exit discharge* of *exits* that serve the Use Group A-2 *fire area*, an *automatic fire suppression system* shall be provided as follows:

1. Throughout the entire story or floor level where the A-2 Use Group is located;
2. Throughout all stories and floor levels below the A-2 Use Group; and
3. Throughout all intervening stories and floor levels between the A-2 Use Group and the *level of exit discharge* of *exits* that serve the Use Group A-2 *fire area*, including the *level of exit discharge*.

**904.4 Deleted.**

**904.5 Use Group H:** An *automatic fire suppression system* shall be provided throughout all Use Group H *fire areas*. An *automatic fire suppression system* shall not be required for magazines used for the storage of Use Group H-1 materials and which are constructed and located in accordance with NFPA 495 and the fire prevention code listed in Chapter 35.

**904.6 Use Group I:** An *automatic fire suppression system* shall be provided throughout all buildings with a Use Group I *fire area*. An *automatic fire suppression system* shall not be required for Use Group I-2 child care facilities located at the *level of exit discharge*, which accommodate 100 children or less and in which each child care room has an *exit* door directly to the exterior.

**904.7 Use Groups M, S-1 and F-1:** Throughout all buildings with a Use Group M, S-1 or F-1 *fire area*, an *automatic fire suppression system* shall be provided as follows:

1. Where any Use Group M, S-1 or F-1 *fire area* exceeds 12,000 square feet (1116 $m^2$) in area;
2. Where the total combined area of all Use Group M, S-1 and F-1 *fire areas* on all floors exceeds 24,000 square feet (2232 $m^2$); or
3. Where any Use Group M, S-1 or F-1 *fire area* is more than three *stories above grade*.

**Exception:** *Public garages* shall conform to Section 408.0.

**904.8 Use Group R-1:** An *automatic fire suppression system* shall be provided throughout all buildings with a Use Group R-1 *fire area* in accordance with Section 906.2.1 or 906.2.2.

**Exception:** Where all guestrooms are not more than three stories above the lowest *level of exit discharge* of the *exits* serving the guestrooms. Each guestroom shall have at least one door opening directly to an exterior *exit access* which leads directly to the *exits*.

**904.9 Use Group R-2:** An *automatic fire suppression system* shall be provided throughout all buildings with an occupancy in Use Group R-2 in accordance with Section 906.2.1 or 906.2.2.

**Exception:** Use Group R-2 buildings in which no dwelling unit is more than one story above the lowest *level of exit discharge* nor more than one story below the highest *level of exit discharge* of exits serving the *dwelling unit*.

**904.10 Windowless story:** An *automatic fire suppression system* shall be provided throughout every story or *basement* of all buildings where there is not provided at least one of the following types of openings:

1. An exterior *stairway* that conforms to the requirements of Section 1014.0, or an outside ramp that conforms to the requirements of Section 1016.0, leading directly to grade in each 50 linear feet (15240 mm) or fraction thereof of exterior wall in the story or *basement*, on at least one side of the building.
2. Openings entirely above the adjoining ground level totaling 20 square feet (1.9 $m^2$) in each 50 linear feet (15240 mm) or fraction thereof of exterior wall in the story or *basement*, on at least one side of the building. Openings shall have a least dimension of not less than 22 inches (559 mm), and shall have a minimum net clear opening of 5 square feet (0.5 $m^2$). Access to such openings from the exterior shall be provided to the fire department and such openings shall be unobstructed to allow fire-fighting and rescue operations from the exterior.

Where openings in a story are provided on only one side and the opposite wall of such story is more than 75 feet (22860 mm) from such openings, the story shall be equipped throughout with an *automatic sprinkler system* or openings as specified herein shall be provided on at least two sides of the exterior walls of the story. If any portion of a *basement* is located more than 75 feet (22860 mm) from the openings required in this section, the *basement* shall be equipped throughout with an *automatic sprinkler system*.

**Exception:** Occupancies in Use Group R-3.

**904.11 Other required suppression systems:** In addition to the requirements of this section, the sections of this code indicated in Table 904.11 also require the installation of an *automatic fire suppression system* for certain buildings and areas.

**Table 904.11**
**ADDITIONAL REQUIRED SUPPRESSION SYSTEMS**

| Section | Subject |
|---|---|
| 302.1.1 | Specific occupancy areas |
| 402.10; 402.15.2 | Covered mall buildings |
| 403.2 | High-rise buildings |
| 404.2 | Atriums |
| 405.3 | Underground structures |
| 408.3.1 | Public garages |
| 408.4 | Fuel-dispensing areas |
| 411.7 | Sound stages |
| 412.6 | Stages and enclosed platforms |
| 413.4 | Special amusement buildings |
| 416.4 | HPM facilities |
| 417.6.6 | Hazardous material dispensing/utilization areas, outside |
| 419.3 | Paint spray booths and storage rooms |
| 507.1 | Unlimited area buildings |
| 1013.2.2 | Smoke-protected assembly seating areas |
| 1020.3 | Exit lobbies |
| 2806.4 | Drying rooms |
| 2807.6 | Waste and linen chutes and termination and incinerator rooms |
| 2808.4 | Refuse vaults |

## SECTION 905.0 SUPPRESSION SYSTEM AGENT COMPATIBILITY

**905.1 Agent compatibility:** The extinguishing agent for each *suppression system* shall be compatible with the type of hazard and fire. Each fixed *fire suppression system* shall be of an approved type and shall be designed and installed in accordance with the requirements of this code.

**905.1.1 Special hazards:** In rooms or buildings containing combustibles (such as aluminum powder, calcium carbide, calcium phosphide, metallic sodium and potassium, quicklime, magnesium powder or sodium peroxide) that are incompatible with water as an extinguishing agent, other extinguishing agents shall be utilized.

## SECTION 906.0 FIRE SPRINKLER SYSTEM

**906.1 General:** *Automatic sprinkler systems* shall be approved and shall be designed and installed in accordance with the provisions of this code.

**906.2 Equipped throughout:** Where the provisions of this code require that a building or portion thereof be equipped throughout with an *automatic sprinkler system*, the system shall be designed and installed in accordance with Section 906.2.1, 906.2.2 or 906.2.3.

**Exception:** Where water as an extinguishing agent is not compatible with the fire hazard (see Section 905.1) or is prohibited by a law, statute or ordinance, the affected area shall be equipped with an approved *automatic fire suppression system* utilizing a suppression agent that is compatible with the fire hazard.

**906.2.1 NFPA 13 systems:** The system shall be designed and installed in accordance with NFPA 13 listed in Chapter 35.

**Exceptions**

1. In Use Group R *fire areas*, *sprinklers* shall not be required in bathrooms that do not exceed 55 square feet (5.12 $m^2$) in area and are located within individual *dwelling units* or guestrooms.
2. In occupancies in Use Group R-1, *sprinklers* shall not be required in guestroom closets that do not exceed 24 square feet (2.23 $m^2$) in area.

**906.2.2 NFPA 13R systems:** In buildings four stories or less in *height*, systems designed and installed in accordance with NFPA 13R listed in Chapter 35 shall be permitted in Use Group I-1 *fire areas* in buildings with not more than 16 occupants and in Use Group R *fire areas*. *Sprinklers* shall not be required in bathrooms that do not exceed 55 square feet (5.12 $m^2$) in area and are located within individual *dwelling units* or guestrooms.

**906.2.3 NFPA 13D systems:** In Use Group R-3 *fire areas* with at least 1-hour fireresistance rated *fire separation assemblies* between *dwelling units*, or in Use Group I-1 *fire areas* in buildings with not more than eight occupants, systems designed and installed in accordance with NFPA 13D listed in Chapter 35 shall be permitted.

**Exceptions**

1. *Sprinklers* shall not be required in bathrooms that do not exceed 55 feet (5.12 $m^2$) in area.
2. A single fire protection *water supply* shall be permitted to serve not more than eight *dwelling units* provided that the *water supply* is increased by 5 gallons per minute (gpm) (18.9 L/min) for each *dwelling unit* served where a common supply serves both the domestic and *sprinkler systems* in more than one *dwelling unit*.

**906.3 Design:** The details of the system indicated on the *construction documents* shall include calculations and information on the *sprinkler* spacing and arrangement, *water supply* and discharge requirements, size and equivalent lengths of pipe and fittings and *water supply* source. Sufficient information shall be included to identify the apparatus and devices used.

**906.4 Actuation:** Water *sprinkler systems* shall be automatically actuated unless otherwise specifically provided for in this code.

**906.5 Sprinkler alarms:** Approved audible or visual alarm devices shall be connected to every water *sprinkler system*. Such alarm devices shall be activated by water flow and shall be located in an approved location on the exterior of the building and an additional audible or visual alarm device shall be installed within the building.

**Exceptions**

1. Alarms and alarm attachments shall not be required for *limited area sprinkler systems* (see Section 907.5).
2. Audible or visual alarm devices shall not be required on the exterior of the building for fire *sprinkler systems* supervised by method 1 or 2 of Section 924.1.

**906.6 Water-control valve identification:** All valves controlling water to *fire protection systems* shall be provided with permanently attached identification tags indicating the valves' function and what is controlled.

**906.7 Sprinkler riser:** A *sprinkler system* riser which also serves as the wet *standpipe* riser in buildings required to have or having both systems, shall conform to Section 915.6.

**906.8 Signs:** Where *sprinkler* control valves are located in a separate room or building, a sign shall be provided on the entrance door. The lettering for such sign shall conform to Section 901.6, shall be at least 4 inches (102 mm) in height and shall read "Sprinkler Control Valves."

**906.9 Acceptance tests:** All *sprinkler systems* shall be tested in accordance with Sections 906.9.1 through 906.9.6.

**906.9.1 Underground connections:** Lead-in connections shall be flushed and tested in accordance with NFPA 13 and 24 listed in Chapter 35.

**906.9.2 Hydrostatic test:** All *sprinkler systems* shall be tested hydrostatically for 2 hours without visible leakage at not less than 200 psi (1379 kPa) or at 50 psi (344.75 kPa) in excess of the maximum static pressure, whichever is greater. The test pressure shall be read from a gauge located at the low elevation point of the individual system or portion of the system being tested.

**Exception:** When climatic conditions will not permit testing with water, an interim test shall be conducted with air pressure in accordance with Section 906.9.3 and the standard hydrostatic test shall be conducted when weather conditions permit.

**906.9.3 Air test:** Before the *water supply* for a dry pipe system is turned on and the system is placed into service, the system shall be tested with air pressure of at least 40 psi (276 kPa) and be allowed to stand 24 hours with a maximum pressure loss of $1^1/_2$ psi (10.34 kPa). To prevent damaging the valve, the clapper valve of a differential-type dry pipe valve shall be held off the valve seat during any test at a pressure in excess of 50 psi (344.75 kPa). Automatic air-pressure maintenance devices shall be capable of restoring normal operating air pressure in the system within 30 minutes except for low-differential dry pipe systems where the maximum recovery time shall be 60 minutes.

**906.9.4 Main drain test:** A drain test shall be performed in order to obtain both static and residual pressure readings.

**906.9.5 Flow test:** All systems shall be tested at the test pipe to determine that water-flow detecting devices, including the associated alarm circuits, are in proper working order. Dry pipe systems shall deliver water to the inspector's test pipe in not more than 60 seconds.

**906.9.6 Preaction and deluge systems:** Testing of the supplemental fire detection system designed to activate *preaction* and *deluge systems* shall be in accordance with Section 918.10.

## SECTION 907.0 LIMITED AREA SPRINKLER SYSTEMS

**907.1 General:** A *limited area sprinkler system* shall be of an approved type and shall be installed in accordance with the provisions of this section.

**907.2 Where permitted:** Where the provisions of this code require the installation of a *fire suppression system*, and a water *sprinkler* extinguishing system is used with a limited number of *sprinklers*, a *limited area sprinkler system* that complies with the requirements of this section is permitted to be installed.

**907.2.1 Within a fire area:** A *limited area sprinkler system* shall be permitted within one *fire area* provided that 20 *sprinklers* or less are required based on the spacing limitations of NFPA 13 listed in Chapter 35.

**907.2.2 Special occupancy areas:** A *limited area sprinkler system* shall be permitted within special occupancy areas as designated in Chapter 4 or within specific occupancy areas as designated in Section 302.1.1, provided that the area is enclosed within *fire separation assemblies* as required by this code, and 20 *sprinklers* or less are required to protect each separately enclosed area. Where nonfireresistance rated separation walls are permitted by Table 302.1.1 to enclose contiguous specific occupancy areas on one floor, the areas shall be considered to be one separately enclosed area for the purposes of determining the number of *sprinklers*.

**907.2.3 Unenclosed floor openings, waste and linen chutes, and kitchen and hazardous exhaust systems:** A *limited area sprinkler system* shall be permitted to protect unenclosed *escalator* floor openings that comply with Section 3011.2.2, chutes used for waste or linen collection, commercial kitchen exhaust systems and duct systems that exhaust *hazardous materials*.

**907.3 Design:** Except as otherwise provided for in this section, a *limited area sprinkler system* shall be designed and installed in accordance with Section 906.0.

**907.4 Actuation:** A *limited area sprinkler system* shall be automatically actuated.

**907.5 Sprinkler alarms:** Alarms and alarm attachments shall not be required.

**907.6 Standpipe connection:** The *water supply* for the *limited area sprinkler system* shall be from the building *standpipe system* where the building is equipped with a *standpipe system* that is sized for a 500-gallon-per-minute (1890 L/min) minimum flow and has an *automatic water supply* (see Section 915.5).

**907.6.1 Domestic supply:** Where *limited area sprinkler systems* are supplied from the domestic water system, the domestic water system shall be designed to support adequately the design flow of the largest number of *sprinklers* required to be hydraulically calculated by NFPA 13 listed in Chapter 35 in any one of the enclosed areas plus the domestic demand.

**907.6.2 Cross connection:** The potable water supply shall be protected against backflow in accordance with the requirements of Section 2901.1 and the plumbing code listed in Chapter 35.

**907.6.3 Domestic connection:** Two (one-way) check valves, one of which may be an alarm check valve, shall be provided at the point where the *suppression system* piping is connected to the domestic water piping. Shutoff valves shall not be permitted in the *suppression system* piping. Water supply shall be controlled by the riser control valve to the domestic water piping.

**Exception:** Shutoff valves in the *sprinkler system* piping are permitted, if the valves are supervised in accordance with Section 924.0.

**907.7 Acceptance tests:** All *limited area sprinkler systems* which are not connected to a building *standpipe system* shall be tested hydrostatically for a minimum of 15 minutes without visible leakage at the working pressure under which the system is to be used. *Limited area sprinkler systems* which are connected to a building *standpipe system* shall be tested in accordance with Section 915.12.2.

## SECTION 908.0 WATER-SPRAY FIXED SYSTEMS

**908.1 General:** Water-spray fixed systems for fire suppression shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 15 listed in Chapter 35. A water-spray fixed system is a system connected to a reliable source of *water supply* and equipped with normally open water-spray nozzles for specific discharge and distribution over the surface or area to be protected.

**908.2 Design:** Complete *construction documents* and hydraulic calculations shall be submitted for review prior to installation. The submittal shall include nozzle layouts, friction loss, calculations, *water supply* data and a detailed layout of the entire area to be protected.

**908.3 Actuation:** Water-spray systems shall be automatically actuated and shall be provided with a manual means of actuation.

**908.4 Acceptance tests:** All new system piping shall be flushed and tested in accordance with the provisions of NFPA 15 listed in Chapter 35.

## SECTION 909.0 CARBON DIOXIDE EXTINGUISHING SYSTEMS

**909.1 General:** Carbon dioxide extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 12 listed in Chapter 35. A carbon dioxide extinguishing system is a system which supplies $CO_2$ from a pressurized vessel through fixed pipes and nozzles.

**909.2 Design:** The details of the system indicated on the *construction documents* shall include information and calculations of the amount of carbon dioxide; the location and flow rate of each nozzle including equivalent orifice area; and the location and size of the carbon dioxide storage facility. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained.

**909.3 Actuation:** Carbon dioxide extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

**909.4 Safety requirements:** Where persons will enter or be trapped in atmospheres made hazardous by carbon dioxide discharge, warning signs and discharge alarms shall be provided.

**909.5 Acceptance tests:** All carbon dioxide extinguishing systems shall be tested in accordance with NFPA 12 listed in Chapter 35. A completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The identification of devices with proper designations and instructions shall be checked. Operational tests shall be conducted on all devices except cylinder valves in multicylinder high-pressure systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge test and concentration analysis shall be made.

## SECTION 910.0 DRY-CHEMICAL EXTINGUISHING SYSTEMS

**910.1 General:** Dry-chemical extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 17 listed in Chapter 35. A dry-chemical extinguishing system is a system consisting of dry chemical and expellant gas storage tanks, fixed piping and nozzles used to assure proper distribution of an approved extinguishing agent to a specific fire hazard or into a potential fire area.

**910.2 Design:** The details of the system indicated on the *construction documents* shall include sufficient information and calculations of the amount of dry chemical; the size, length and arrangement of connected piping, or piping and hose; and a description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained.

**910.3 Actuation:** Dry-chemical extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

**910.4 Safety requirements:** Where persons will be exposed to a dry-chemical discharge, warning signs and discharge alarms shall be provided.

**Exception:** Range hood dry-chemical systems.

**910.5 Acceptance tests:** All dry-chemical extinguishing systems shall be tested in accordance with NFPA 17 listed in Chapter 35. A completed system shall be tested by a discharge of expellant gas through the piping and nozzles. Observations for gas leakage and for continuity of piping with free unobstructed flow shall be made. Observations shall be made of the flow of expellant gas through all nozzles. The identification of devices with proper designations and instructions shall be checked. After testing, all piping and nozzles shall be blown clean using compressed air or nitrogen, and the system shall be properly charged and placed in the normal "set" condition.

**910.5.1 Discharge test:** All systems shall be tested by a discharge of expellant gas through the piping and nozzles with observations being made of the flow of expellant gas through all nozzles as well as observing for leakage and continuity of piping with free unobstructed flow.

**910.6 Range hoods:** In addition to the requirements of this section and the mechanical code listed in Chapter 35, range hood dry-chemical systems shall bear the *label* of an *approved agency*. The system shall be installed in accordance with the manufacturer's installation instructions. The dry-chemical agent of the system shall be nontoxic.

## SECTION 911.0 FOAM-EXTINGUISHING SYSTEMS

**911.1 General:** Foam-extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 11, 11A and 16 listed in Chapter 35. A foam-extinguishing system is a special system designed to discharge, either mechanically or chemically, a foam made from concentrates, over the area to be protected.

**911.2 Design:** The details of the system indicated on the *construction documents* shall include complete computations showing pressure drop in all system piping, friction loss calculations of liquid lines and a detailed layout of the entire hazard area to be protected. Hydraulic characteristics of foam proportioners and foam makers as determined by tests shall be supplied by the manufacturer to the department (including the range of operating conditions required for the proposed installation) to permit determination of the adequacy of the hydraulics of the proposed protection.

**911.3 Actuation:** A foam-extinguishing system shall be automatically actuated and shall be provided with a manual means of actuation.

**911.4 Safety requirements:** In any proposed use of a medium- or high-expansion foam where persons will be exposed to the foam discharge, warning signs and discharge alarms shall be provided.

**911.5 Acceptance tests:** All foam-extinguishing systems shall be tested in accordance with NFPA 11, 11A and 16 listed in Chapter 35. The system shall be subjected to a flow test to ensure that the hazard area is fully protected in compliance with the design specifications, and to determine flow pressures, actual discharge capacity, foam quality, consumption rate of foam-producing materials, manpower requirements and other operating characteristics.

## SECTION 912.0 HALOGENATED EXTINGUISHING SYSTEMS

**912.1 General:** Halogenated extinguishing systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 12A listed in Chapter 35. A halogenated extinguishing system is a system consisting of pipes, open nozzles and a container of halogenated agent under pressure.

**912.2 Design:** The details of the system indicated on the *construction documents* shall include information and calculations of the amount of extinguishing agent; the container storage pressure; the location and flow rate of each nozzle including equivalent orifice area; the location, size and equivalent lengths of pipe, fittings and hose; and the location and size of the storage facility. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained.

**912.3 Actuation:** Halogenated extinguishing systems shall be automatically actuated and shall also be provided with a manual means of actuation.

**912.4 Safety requirements:** Where persons will enter or be trapped in atmospheres made hazardous by a halogenated system discharge, warning signs and discharge alarms shall be provided.

**912.5 Acceptance tests:** All halogenated extinguishing systems shall be tested in accordance with NFPA 12A listed in Chapter 35. A completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The identification of devices with proper designations and instructions shall be checked. Operational tests shall be conducted on all devices except cylinder valves in multicylinder systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge test and concentration analysis shall be made.

## SECTION 913.0 CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

**913.1 General:** Clean agent fire extinguishing systems shall be of an approved type and shall be designed and installed in accordance with the provisions of this section and the manufacturer's instructions. A clean agent fire extinguishing system is a system consisting of pipes, open nozzles and a container of an approved clean agent under pressure.

**913.2 Design:** The details of the system indicated on the construction documents shall include information and calculations of the amount of extinguishing agent; the container storage pressure; the location and flow rate of each nozzle including equivalent orifice area; and the location and size of the storage facility. Information shall be submitted pertaining to the location and function of the detecting devices, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be explained.

**913.3 Actuation:** Clean agent fire extinguishing systems shall be automatically actuated and provided with a manual means of actuation.

**913.4 Safety requirements:** Where persons will enter or be trapped in atmospheres made hazardous by a clean agent system discharge, warning signs and discharge alarms shall be provided.

**913.5 Acceptance tests:** All completed clean agent fire extinguishing systems shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The labeling of devices with proper designations and instructions shall be checked. Operational tests shall be conducted on all devices except cylinder valves in multicylinder systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge test and concentration analysis shall be made.

## SECTION 914.0 WET-CHEMICAL RANGE HOOD EXTINGUISHING SYSTEMS

**914.1 General:** Wet-chemical extinguishing systems shall be installed in accordance with the provisions of this section, and the mechanical code and NFPA 17A listed in Chapter 35. The system shall bear the *label* of an *approved agency* and shall be installed in accordance with the manufacturer's installation in-

structions. A wet-chemical system is a solution of water and potassium-carbonate-based chemical, potassium-acetate-based chemical or a combination thereof which forms the extinguishing agent.

**914.2 Design:** The details of the system indicated on the *construction documents* shall include sufficient information and calculations on the amount of wet chemical; the size, length and arrangement of connected piping; and a description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of *detecting devices*, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features shall be adequately explained.

**914.3 Actuation:** Wet-chemical extinguishing systems shall be automatically actuated and shall be provided with a manual means of actuation.

**914.4 Deleted.**

**914.5 Acceptance tests:** All wet-chemical extinguishing systems shall be tested in accordance with NFPA 17A listed in Chapter 35. A completed system shall be tested by discharge of wet chemical in sufficient amounts to verify that the system is properly installed and functional. Tests shall include a check of the detection systems, the alarms and the releasing devices, including manual stations, fuel and power shutoff devices and other associated equipment.

**914.5.1 Discharge test:** All systems shall be tested by a discharge of expellant gas through the piping and nozzles with observations being made of the flow of expellant gas through all nozzles as well as observing for leakage and continuity of piping with free unobstructed flow.

## SECTION 915.0 STANDPIPE SYSTEMS

**915.1 General:** *Standpipe systems* shall be installed and maintained in accordance with the provisions of this code, and the fire prevention code and NFPA 14 listed in Chapter 35.

**915.2 Where required:** *Standpipe systems* shall be installed where required by this code and in the locations indicated in Sections 915.2.1 through 915.2.4.

**Exception:** Occupancies in Use Group R-3.

**915.2.1 Building height:** *Standpipe systems* shall be installed throughout all buildings in which the floor level of the highest story is located more than 30 feet (9144 mm) above the lowest level of the fire department vehicle access or in which the floor level of the lowest story is located more than 30 feet (9144 mm) below the highest level of fire department vehicle access.

**915.2.2 Building area:** *Standpipe systems* shall be installed in all buildings where any portion of the building floor *area* is more than 400 feet (122 m) of travel from the nearest point of fire department vehicle access.

**Exceptions**

1. Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.
2. Occupancies in Use Group A-4, A-5, F-2, R-2, S-2 or U.
3. Buildings less than 10,000 square feet (930 $m^2$).

**915.2.3 Malls:** *Standpipe systems* shall be installed in all malls in accordance with Section 402.11.

**915.2.4 Stages:** *Standpipe systems* shall be installed in *stages* in accordance with Section 412.7.

**915.3 Types of systems:** A *standpipe system* shall be one of the following types:

1. A wet *standpipe system* having the supply valve open and water pressure maintained at all times;
2. A dry *standpipe system* so arranged through the use of approved devices as to admit water to the system automatically by opening a hose valve;
3. A dry *standpipe system* arranged to admit water to the system through manual operation of approved remote control devices located at each hose connection; or
4. A dry *standpipe system* that does not have a permanent *water supply*.

**915.3.1 Type of system required:** Buildings required by Section 915.2 to be equipped with *standpipe systems* shall be provided with a wet *standpipe system* that complies with Section 915.3, item 1.

**Exceptions**

1. Buildings in which the highest floor is located not more than 75 feet (22860 mm) above the lowest level of fire department vehicle access, shall be permitted to use a *standpipe system* that complies with Section 915.3, item 2 or 3.
2. Buildings which are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 and in which the highest floor is located not more than 150 feet (45720 mm) above the lowest level of fire department vehicle access, shall be permitted to use a *standpipe system* complying with Section 915.3, item 2 or 3.
3. Open parking structures in which the highest floor is located not more than 150 feet (45720 mm) above the lowest level of fire department vehicle access, shall be permitted to use a *standpipe system* complying with Section 915.3, item 2, 3 or 4.

**915.4 Piping design:** The riser piping, supply piping and the water service piping shall be sized to maintain a residual pressure of at least 65 psi (448 kPa) at the topmost outlet of each riser while flowing the minimum quantities of water specified in Sections 915.4.1 and 915.4.2. The pipe size shall be based on the capacity of the *automatic water supply* system or, where an *automatic water supply* is neither required nor provided to maintain the residual pressure of 65 psi (448 kPa), the pipe size shall be based on a pressure of 150 psi (1034 kPa) available at the fire department connection.

**Exception:** The residual pressure of 65 psi (448 kPa) is not required in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 and

where the highest floor level is not more than 150 feet (45720 mm) above the lowest level of fire department vehicle access.

**915.4.1 Riser sizing:** The riser size shall be based on hydraulic calculations for a minimum flow of 500 gallons per minute (gpm) (1892 L/min.).

**Exceptions**

1. Where only $1^1/_2$-inch valves are provided, the riser(s) shall be sized to provide a minimum flow of 100 gpm (378 L/min.).
2. In buildings where *limited area sprinkler systems* are supplied with water from a common *standpipe* riser, the riser shall be sized to satisfy total demand.
3. For occupancies in Use Group B, I, R-1 or R-2 in buildings that are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, each riser shall be sized for a minimum flow of 250 gpm (945 L/min.).
4. Risers that are sized in accordance with the pipe schedule requirements of NFPA 14 listed in Chapter 35 are not subject to this requirement.

**915.4.2 System pipe sizing:** The system piping, including the horizontal or common feeder lines, shall be sized for a minimum flow of 500 gpm (1892 L/min.). Where more than one *standpipe* riser is required or provided, all common system piping shall be sized for a minimum flow of 500 gpm (1892 L/min.) for the first riser plus 250 gpm (945 L/min.) for each additional riser, and the total shall not be required to exceed 1,250 gpm (4731 L/min.).

**Exceptions**

1. Where only $1^1/_2$-inch valves are provided, the supply piping shall be sized for a minimum flow of 100 gpm (378 L/min.) for each riser, and the total shall not be required to exceed 500 gpm (1892 L/min.).
2. In buildings where *limited area sprinkler systems* are supplied with water from a common *standpipe* riser, the supply piping shall be sized for a minimum flow of 500 gpm (1892 L/min.) plus the *sprinkler* demand for the first riser, plus 250 gpm (945 L/min.) for each additional riser, and the total shall not be required to exceed 1,250 gpm (4731 L/min.).
3. For occupancies in Use Group B, I, R-1 or R-2 in buildings that are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, all common supply piping shall be sized for a minimum flow of 250 gpm (945 L/min.) for the first riser plus 250 gpm (945 L/min.) for each additional riser, and the total shall not be required to exceed 750 gpm (2838 L/min.).

**915.5 Water supply:** A *water supply* for fire department equipment shall be available to the building site. The *water supply* shall be capable of a minimum flow as required by Section 915.4.2 for a duration of 30 minutes.

**915.5.1 Automatic water supply:** An *automatic water supply* is required for all *standpipe systems*. The *automatic water supply* and supply piping shall be capable of delivering a flow of 500 gpm (1892 L/min.) at the residual pressure specified in Section 915.4 for a duration of 30 minutes.

**Exceptions**

1. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 where the highest floor is located not more than 150 feet (45720 mm) above the lowest level of fire department vehicle access, the *automatic water supply* is not required to exceed the requirements of NFPA 13 listed in Chapter 35.
2. Dry *standpipe systems* installed in open parking structures.

**915.5.2 Interconnection:** The required *water supply* shall be connected to the base of each *standpipe* riser. Where more than one *standpipe* riser is required, all risers shall be interconnected with a common supply line. An approved indicating valve shall be installed to permit individual risers to be taken out of service.

**915.6 Control valves:** Where a *standpipe system* riser also serves as the *automatic sprinkler system* riser in buildings required to have both systems or in buildings having both systems, *sprinkler* control valves shall be installed at each floor level at the connection to the riser.

**915.7 Hose connection:** A *standpipe* hose connection shall be located at each floor level at every *exit stairway*, and on each side of the wall adjacent to the *exit* opening of a *horizontal exit*.

**Exceptions**

1. Where floor areas adjacent to a *horizontal exit* are reachable from *exit stairway* outlets by a 30-foot (9144 mm) hose stream from a nozzle attached to 100 feet (30480 mm) of hose, a hose connection shall not be required at the *horizontal exit*.
2. *Standpipe* hose connections for systems required by Section 915.2.2 shall be permitted to be located only at *exits* such that all portions of the building floor area are not more than 200 feet (60960 mm) from a hose connection or 400 feet (122 m) from the nearest point of fire department vehicle access.

**915.7.1 Location:** At each floor level, and not more than 5 feet (1524 mm) above the floor, there shall be connected to each *standpipe* a $2^1/_2$-inch hose connection with valves and threads compatible with the connections used by the local fire department.

**915.7.2 Roof hydrants:** Where *standpipes* are installed in buildings more than six stories or 75 feet (22860 mm) in *height*, at least one riser shall extend through the roof and terminate in a two-way, $2^1/_2$-inch hose connection. The main control valve on a roof hydrant or manifolded hose connection shall be located in an area that is not subject to freezing, is as close to the roof access as practical and is plainly identified (see Section 916.8).

**915.7.3 Pressure-regulating devices:** Where residual pressures at any *standpipe* hose outlet exceed 100 psi (690 kPa), approved pressure-regulating devices shall be installed at the outlets to limit the pressure to 100 psi (690 kPa). Such devices

shall regulate pressure under flow and no-flow conditions and shall not be capable of being adjusted to pressures higher than 100 psi (690 kPa) unless approved. The pressure on the inlet side of the pressure-regulating device shall not exceed the rated working pressure of the device.

**Exception:** Pressure-reducing devices are not required where fire hoses are not provided and pressures (static or residual) do not exceed 175 psi (1207 kPa).

**915.7.4 Protection of risers:** Risers and laterals of *standpipe systems* of the types complying with Section 915.3, item 2 or 3, and not located within a fireresistance rated *exit* enclosure shall be enclosed by construction having a minimum fireresistance rating equal to that required for *shaft* enclosures in the building.

**Exception:** Buildings equipped throughout with an *automatic sprinkler system* in accordance with Sections 906.2.1 or 906.2.2.

**915.8 Test gauges:** An approved water pressure gauge shall be attached to each discharge pipe from fire pump and public supply, at the pressure tank, at the air pump that supplies pressure to the tank and the top of each *standpipe* riser for inspection and test purposes. Shutoff valves, with provisions for bleeding pressure from the gauge, shall be installed between the gauge and the top of the riser. Access to the gauges shall be provided and the gauges shall be located in spaces not subject to freezing.

**Exception:** Where more than one *standpipe* riser is interconnected at the top, a single gauge properly located is permitted to be substituted for the gauge at the top of each *standpipe* riser.

**915.9 Materials:** All *standpipes* shall be constructed of approved materials. All pipe, fittings and valves shall be of an extra-heavy pattern where the normal working pressure will exceed 175 psi (1207 kPa).

**915.10 Unheated areas:** Portions of the *standpipe system* which contain water shall be protected from freezing.

**915.11 Signs:** Where control valves are located in a separate room or building, a sign shall be provided on the entrance door. The lettering of such sign shall conform to Section 901.6 and shall be at least 4 inches (102 mm) in height and shall read "Standpipe Control Valves."

**915.12 Acceptance tests:** All *standpipe systems* shall be tested in accordance with Sections 915.12.1 through 915.12.4.

**915.12.1 Underground connections:** Underground mains and lead-in connections shall be flushed and tested in accordance with NFPA 14 and 24 listed in Chapter 35.

**915.12.2 Hydrostatic test:** All systems shall be tested hydrostatically for 2 hours at not less than 200 psi (1379 kPa) or at 50 psi (345 kPa) in excess of the maximum static pressure, whichever is greater. The hydrostatic pressure shall be measured at the low elevation point of the individual system or zone being tested. The inside *standpipe* piping shall not show any leakage.

**915.12.3 Flow test:** All systems shall have a flow test conducted at the hydraulically most-remote outlet to determine compliance with the single-riser criteria of Section 915.4.

**915.12.4 Dry devices:** A working test of valves, quick-opening devices and air maintenance devices installed in systems complying with Sections 915.3, item 2 or 3, shall be made before acceptance. These systems shall deliver water at the most remote hose outlet in not more than 60 seconds.

## SECTION 916.0 FIRE DEPARTMENT CONNECTIONS

**916.1 Required:** All required water fire-extinguishing and *standpipe systems* shall be provided with a fire department connection in accordance with the applicable standards. *Standpipes* in buildings under construction or demolition shall conform to Section 3305.3.

**Exceptions**

1. *Limited area sprinkler systems* supplied from the domestic water system.
2. Where the local fire department approves a single connection for large diameter hose of at least 4 inches (102 mm).
3. An *automatic sprinkler system* with less than 20 *sprinklers*.

**916.2 Connections:** Fire department connections shall be arranged in such a manner that the attachment to any one water *sprinkler* connection will serve all *sprinklers*, and the attachment to any one *standpipe* connection will serve all *standpipes* within the building.

**916.3 Location:** Fire department connections shall be located and shall be visible on a street front or in a location approved by the fire department. Such connections shall be located so that immediate access is provided to the fire department. Fire department connections shall not be obstructed by fences, brushes, trees, walls or any other similar object.

**916.4 Height:** Fire department connections shall not be less than 18 inches (457 mm) and not more than 42 inches (1067 mm) in elevation, measured from the ground level to the centerline of the inlets.

**916.5 Projection:** Where the fire department connection will otherwise project beyond the property line or into the *public way*, a flush-type fire department connection shall be provided.

**916.6 Hose thread:** Hose thread in the fire department connection shall be uniform with that used by the local fire department.

**916.7 Fittings:** Fire department inlet connections shall be fitted with check valves, ball drip valves and plugs with chains or frangible caps.

**916.8 Signs:** A metal sign with raised letters at least 1 inch (25 mm) in height shall be mounted on all fire department connections serving *sprinklers* or *standpipes*. Such signs shall read "Automatic Sprinklers" or "Standpipe," or both, as applicable.

## SECTION 917.0 YARD HYDRANTS

**917.1 Private hydrants:** Fire hydrants installed on private property as part of a private fire protection system shall be located so as to meet the requirements of National Fire Protection Associa-

tion (NFPA) Pamphlet #24 listed in Chapter 35, except that hydrants shall be spaced so that the hose line does not exceed 500 feet (152 m). Yard hydrant installation shall be coordinated with the local fire code officials who shall not make recommendations which exceed the requirements of National Fire Protection Association (NFPA) Pamphlet #24. Yard hydrants shall not be installed on a water main less than 6 inches (152 mm) in diameter.

**917.2 Public hydrants:** Public hydrants not covered by National Fire Protection Association (NFPA) Pamphlet #24 listed in Chapter 35 shall conform to the standards of the administrative authority of the jurisdiction as provided for by local ordinance.

## SECTION 918.0 FIRE ALARM SYSTEMS

**918.1 General:** Fire alarm systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 72 listed in Chapter 35.

**918.2 Construction documents:** Where a fire alarm system is required by this code, the *construction documents* shall show the location and number of all alarm-initiating devices and alarm-notification appliances, and shall provide a description of all equipment to be used, proposed zoning, a list of auxiliary control functions (i.e., elevator capture), location of the control panel(s) and annunciator(s), and a complete sequence of operation for the system.

**918.3 Approval:** All devices, combinations of devices, appliances and equipment shall be approved for the fire alarm purpose for which such equipment is used.

**918.4 Where required:** A fire alarm system shall be installed and maintained in full operating condition in the locations described in Sections 918.4.1 through 918.4.6.

**918.4.1 Use Group A-4 or E:** A fire alarm system shall be installed and maintained in all occupancies in Use Group A-4 or E. A fire alarm system shall not be required for sanctuary and nave areas of churches and similar religious buildings.

**Exception:** Church buildings which do not exceed 10,000 square feet (930 $m^2$) and in which single-station smoke detectors are installed as follows:

1. Smoke detectors may be single station and wired in series so as to sound an alarm in the sanctuary.
2. Smoke detectors shall be installed in fellowship halls and more hazardous areas such as furnace rooms, mechanical rooms and storage rooms, but shall not be required in Sunday school classrooms.
3. Detector spacing shall be 30 feet (9144 mm) on center in *corridors* and 900 square feet (84 $m^2$) per detector in open spaces, or in accordance with the manufacturer's specifications.

**918.4.2 Use Group B:** A fire alarm system shall be installed and maintained in all occupancies in Use Group B where such buildings have occupied floors which are two or more stories above the lowest *level of exit discharge* or which have floors two or more stories below the highest *level of exit discharge*.

**918.4.3 Use Group H:** A fire alarm system shall be installed and maintained in all occupancies in Use Groups H-2, H-3 and H-4.

**918.4.4 Use Group I:** A fire alarm system shall be installed and maintained in all occupancies in Use Group I.

**918.4.5 Use Group R-1:** A fire alarm system shall be installed and maintained in all occupancies in Use Group R-1.

**918.4.6 Use Group R-2:** A fire alarm system shall be installed and maintained in all occupancies in Use Group R-2 where any *dwelling unit* is located three or more stories above the lowest *level of exit discharge* or more than one story below the highest *level of exit discharge* of *exits* serving the *dwelling unit*.

**918.5 Location:** Manual fire alarm boxes shall be located not more than 5 feet (1524 mm) from the entrance to each *exit*.

**Exception:** Manual fire alarm boxes are not required in an occupancy in Use Group B where the highest occupied floor is 75 feet (22860 mm) or less above the lowest level of fire department vehicle access and the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0.

**918.5.1 Manual fire alarm boxes:** The height of the manual fire alarm boxes shall be a minimum of 42 inches (1067 mm) and a maximum of 54 inches (1372 mm) measured vertically, from the floor level to the activating handle or lever of the box. Manual fire alarm boxes shall be red in color. In all occupancies in Use Group I-3, the manual fire alarm boxes shall be permitted to be locked in areas where staff is present whenever such areas are occupied and keys are readily available to unlock the boxes, or the boxes shall be located in a manned staff location which has direct supervision of the sleeping area.

**918.6 Power supply:** The primary and secondary power supply for the fire alarm system shall be provided in accordance with NFPA 72 listed in Chapter 35.

**918.7 Wiring:** All wiring shall conform to the requirements of NFPA 72 listed in Chapter 35. Wireless systems utilizing radio-frequency transmitting devices shall comply with the special requirements for supervision of low-power wireless systems in NFPA 72 listed in Chapter 35.

**918.7.1 Activation:** The alarm-notification appliances shall be automatically activated by all of the following where provided:

1. Smoke detectors, other than single- and multiple-station smoke detectors, as required by Section 920.0;
2. *Sprinkler* water-flow devices;
3. Manual fire alarm boxes; and
4. Other approved types of automatic fire detection devices or *suppression systems*.

**Exception:** Smoke detectors in an occupancy in Use Group I-3 are permitted to actuate an audible alarm-notification appliance at a constantly attended location and are not required to activate a general alarm.

**918.7.2 Presignal system:** Presignal systems shall not be installed unless approved by the code official and by the fire department. Where a presignal system is installed, 24-hour personnel supervision shall be provided at a location ap-

proved by the fire department, in order that the alarm signal can be actuated in the event of fire or other emergency.

**918.7.3 Zones:** Each floor shall be zoned separately and a zone shall not exceed 20,000 square feet (1860 $m^2$). The length of any zone shall not exceed 300 feet (91440 mm) in any direction. A zoning indicator panel and the associated controls shall be provided in an approved location. The visual zone indication shall lock in until the system is reset and shall not be cancelled by the operation of an audible alarm-silencing switch. In buildings that have floors located more than 75 feet (22860 mm) above the lowest level of fire department vehicle access which are occupied for human occupancy, a separate zone by floor shall be provided for the following types of alarm-notification devices where provided:

1. Smoke detectors;
2. *Sprinkler* water-flow devices;
3. Manual fire alarm boxes; and
4. Other approved types of automatic fire detection devices or *suppression systems*.

**Exception:** *Automatic sprinkler system* zones shall not exceed the area permitted by NFPA 13 listed in Chapter 35.

**918.8 Alarm-notification appliances:** Alarm-notification appliances of the approved type shall be provided.

**918.8.1 Visible alarms:** See Chapter 11 for alarm requirements for visual impairment in buildings and facilities required to be accessible to persons with physical disabilities.

**Table 918.8.1**
**VISIBLE AND AUDIBLE ALARMS**

| Number of sleeping rooms or suites | Sleeping rooms or suites with visible and audible alarms |
|---|---|
| 6 to 25 | 1 |
| 26 to 50 | 2 |
| 51 to 75 | 3 |
| 76 to 100 | 4 |
| 101 to 150 | 5 |
| 151 to 200 | 6 |
| 201 to 300 | 7 |
| 301 to 400 | 8 |
| 401 to 500 | 9 |
| 501 to 1,000 | 2% of total |
| 1,001 and over | 20 plus 1 for each 100 over 1,000 |

**918.8.2 Audible alarms:** Audible alarm-notification appliances shall be provided and shall sound a distinctive sound which shall not be used for any purpose other than that of a fire alarm. The audible alarm-notification appliances shall provide a sound pressure level of 15 dBA above the average ambient sound level in every occupied space within the building. The minimum sound pressure levels shall be: 70 dBA in occupancies in Use Groups R and I-1; 90 dBA in mechanical equipment rooms; and 60 dBA in all other use groups. The maximum sound pressure level for audible alarm-notification appliances shall be 130 dBA at the minimum hearing distance from the audible appliance. Where the average ambient noise is greater than 115 dBA, visible alarm-notification appliances shall be provided in accordance with NFPA 72 listed in Chapter 35 and audible alarm-notification appliances shall not be required.

**918.9 Voice/alarm signaling system:** A voice/alarm signaling system shall be provided where required by other sections of this code. When activated in accordance with Section 918.7.1, the voice/alarm signaling system shall automatically sound an alert signal to all occupants within the building on a general or selective basis to the following terminal areas: elevators, elevator lobbies, *corridors*, *exit stairways*, rooms and tenant spaces exceeding 1,000 square feet (93 $m^2$) in area; *dwelling units* in occupancies in Use Group R-2; and guestrooms or suites in occupancies in Use Group R-1. The *fire command station* shall contain controls to transmit manually an evacuation signal and voice instructions on a selective and all-call basis to the terminal areas indicated herein. The voice/alarm system shall be installed in accordance with the provisions of this code and NFPA 72 listed in Chapter 35.

**Exception:** A distinctive signal in lieu of a voice alarm is permitted in an occupancy in Use Group F or S.

**918.10 Acceptance tests:** Upon completion of the fire alarm system, all alarm-notification devices and circuits, alarm-notification appliances and circuits, supervisory-signal initiating devices and circuits, signaling line circuits, and primary and secondary power supplies shall be subjected to a 100-percent acceptance test in accordance with NFPA 72 listed in Chapter 35.

## SECTION 919.0 AUTOMATIC FIRE DETECTION SYSTEMS

**919.1 General:** Automatic fire detection systems shall be of an approved type and shall be installed in accordance with the provisions of this code and NFPA 72 listed in Chapter 35.

**919.2 Construction documents:** Where an automatic fire detection system is required by this code, the *construction documents* shall show the location and number of all *automatic fire detectors* with specifications of the type of fire detector, proposed zoning and a complete sequence of operation for the system. The system shall be installed in accordance with this section and shall be part of and be subject to the requirements of a fire alarm system specified in Section 918.0.

**919.3 Approval:** All devices, combinations of devices, appliances and equipment shall be approved for the fire signaling purpose for which such equipment is used. The *automatic fire detectors* shall be smoke detectors, except an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.

**919.4 Where required:** An automatic fire detection system shall be installed and maintained in full operating condition in the locations described in Sections 919.4.1 through 919.4.4.

**919.4.1 Use Group I-1:** An automatic fire detection system shall be installed and maintained in all occupancies in Use Group I-1.

**919.4.2 Use Group I-2:** An automatic fire detection system shall be installed and maintained in all occupancies in Use Group I-2 other than Use Group I-2 occupancies that are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0 and that comply with Section 409.0.

**919.4.3 Use Group I-3:** An automatic fire detection system shall be installed and maintained in all resident housing areas of Use Group I-3. Smoke detectors shall be arranged and positioned to prevent damage or tampering, provided that the function and speed of detecting a fire is equivalent to that provided by the spacing and arrangement requirements of NFPA 72 listed in Chapter 35. Smoke detectors shall not be required in sleeping rooms with four or less occupants.

**919.4.4 Use Group R-1:** An automatic fire detection system shall be installed and maintained in all occupancies in Use Group R-1.

**Exceptions**

1. An automatic fire detection system is not required in buildings that do not have interior *corridors* serving guestrooms and where all guestrooms have a *means of egress* door opening directly to an exterior *exit access* which leads directly to the *exits*.
2. System smoke detectors are not required in guestrooms provided that the single-station detectors required by Section 920.3.1 are connected to the emergency electrical system and are annunciated by guestroom at a constantly attended location from which the fire alarm system is capable of being manually activated.

**919.5 Sprinklered buildings exception:** Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or Section 906.2.2 are not required to be equipped with an automatic fire detection system, but are required to be equipped with a fire alarm system that conforms to Section 917.0. This exception does not apply to Use Group I-3 Resident Housing Areas, to high-hazard use groups in accordance with Section 417.5.3, to special amusement buildings in accordance with Section 413.0, or to single-station smoke detectors as required in Section 920.3.

**919.6 Zones:** Zoning shall be provided in accordance with Section 918.7.3.

**919.7 Alarm verification:** Alarms activated by smoke detectors required by this section shall be activated by either two cross-zoned smoke detectors within a single protected area or a single smoke detector monitored by an *alarm verification* zone or an approved equivalent method.

**919.8 Local control functions:** *Automatic fire detectors* utilized for the purpose of performing local control functions shall be a part of a fire alarm system. The detector shall, upon actuation, perform the intended function and activate the alarm-notification devices or activate a visible and audible supervisory signal at a constantly attended location. In buildings not required to be equipped with a fire alarm system, the *automatic fire detector* shall be powered by normal electrical service and, upon actuation, perform the intended function. The detectors shall be located in accordance with NFPA 72 listed in Chapter 35.

**919.9 Access:** Access shall be provided to each detector for periodic inspection, maintenance and testing.

**919.10 Other required automatic fire detection systems:** In addition to the requirements of this section, the sections of this code indicated in Table 919.10 also require the installation of an automatic fire detection system or automatic fire detectors for certain buildings and areas.

**Table 919.10**
**ADDITIONAL REQUIRED FIRE DETECTORS OR SYSTEMS**

| Section | Subject |
|---|---|
| 403.4 | High rise buildings |
| 405.5.1 | Underground structures |
| 409.5.1 | Use Groups I-2 |
| 413.3 | Special amusement buildings |
| 414.4 | Air traffic control towers |
| 416.9.2 | HPM Facilities |
| 417.5.3 | Use Group H |
| 922.4.2 | Smoke control systems |
| 1015.8 | Smokeproof enclosure ventilation equipment |

## SECTION 920.0 SINGLE- AND MULTIPLE-STATION SMOKE DETECTORS

**920.1 General:** Single- and multiple-station smoke detectors shall be of an approved type and shall be installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72 listed in Chapter 35.

**920.2 Construction documents:** Where single- and multiple-station smoke detectors are required by this code, the *construction documents* shall show the location and number with specifications of the type of detector.

**920.3 Where required:** Single- or multiple-station smoke detectors shall be installed and maintained in full operating condition in the locations described in Sections 920.3.1 through 920.3.3.

**920.3.1 Use Group R-1:** Single- or multiple-station smoke detectors shall be installed and maintained in the following locations in Use Group R-1:

1. In all sleeping areas;
2. In every room in the path of the *means of egress* from the sleeping area to the door leading from the guestroom or suite; and
3. In each story within the guestroom or suite, including *basements*. For guestrooms or suites with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

**920.3.2 Use Groups R-2 and R-3:** Single- or multiple-station smoke detectors shall be installed and maintained in all occupancies in Use Groups R-2 and R-3 at the following locations:

1. In the immediate vicinity of bedrooms;
2. In all bedrooms; and
3. In each story within a *dwelling unit*, including *basements*.

**Exceptions**

1. In *dwelling units* with split levels and without an intervening door between the adjacent levels, a smoke detector installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.
2. In buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Sec-

tion 906.2.1, 906.2.2 or 906.2.3, smoke detectors are not required in bedrooms where the bedrooms are equipped with residential *sprinklers*.

**920.3.3 Use Group I-1:** Single- or multiple-station smoke detectors shall be installed and maintained in all sleeping areas in occupancies in Use Group I-1. Single or multiple station smoke detectors shall not be required where the building is equipped throughout with an automatic detection system in accordance with Section 919.4.1.

**920.4 Interconnection:** Where more than one detector is required to be installed within an individual *dwelling unit* in an occupancy in Use Group R-2 or R-3, or within an individual guestroom or suite in an occupancy in Use Group R-1, the detectors shall be interconnected in such a manner that the actuation of one alarm will actuate all of the alarms in the individual unit.

**920.5 Battery backup:** In addition to the required AC primary power source, required smoke detectors in occupancies in Use Groups R-2, R-3 and I-1 shall receive power from a battery when the AC primary power source is interrupted. Battery backup shall not be required for smoke detectors in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1, 906.2.2 or 906.2.3.

**920.6 Acceptance testing:** When the installation of the detectors is complete, each detector — and all interconnecting wiring for multiple-station detectors — shall be subject to a 100-percent acceptance test in accordance with the household fire warning equipment provisions of NFPA 72 listed in Chapter 35.

## SECTION 921.0 FIRE EXTINGUISHERS

**921.1 Approval:** Portable fire extinguishers shall bear the *label* of an *approved agency*, be of an approved type and be installed in a location visible and available to the occupants.

**921.2 Where required:** A portable fire extinguisher shall be installed in the following locations in accordance with NFPA 10 listed in Chapter 35:

1. In all occupancies in Use Group A-1, A-2, A-3, E, I-2, R-1 or H;
2. In all areas containing commercial kitchen exhaust hood systems;
3. In all areas where fuel is dispensed;
4. In all areas where a *flammable* or *combustible liquid* is used in the operation of spraying, coating or dipping;
5. In all occupancies in Use Group I-3 at staff locations. Access to portable extinguishers shall be permitted to be locked;
6. On each completed floor of buildings under construction, other than occupancies in Use Group R-3;
7. In any laboratory, shop or other room occupied for similar purposes; and
8. Where required by the fire prevention code listed in Chapter 35.

## SECTION 922.0 SMOKE CONTROL SYSTEMS

**922.1 General:** Smoke control systems required by this code shall conform to the provisions of this section.

**922.2 Design criteria:** The smoke control system shall be designed to keep the smoke layer interface above the highest of either the highest unprotected opening to adjoining spaces, or 6 feet (1829 mm) above the highest floor level of *exit access* open to the atrium for a period of 20 minutes. The limiting height for the smoke layer interface for *stages* shall be in accordance with Section 412.3.8.2. The limiting height of the smoke interface above the floor of the space required to be provided with smoke control is $Z_{cr}$. Provisions shall also be made to provide for smoke removal from the space at a rate of not less than two air changes per hour by means of natural or mechanical *ventilation*.

**922.2.1 Passive system:** Active smoke control is not required where it is shown that the smoke interface level requirement will be met without operating smoke exhaust.

**922.2.1.1 Regular spaces:** For spaces with flat ceilings, a constant horizontal cross-sectional area above the smoke layer interface, and an $A/H^2$ ratio between 0.9 and 14, the following equation shall be used to estimate the height of the interface at 20 minutes:

$$Z = 0.67\ H - 0.28H\ \ln\left[\frac{t\ Q^{1/3}\ H^{2/3}}{A}\right]$$

where:

$Z$ = Height from floor to the smoke interface (feet).
$t$ = Time for interface to descend to $Z$; Use 1,200 seconds.
$H$ = Height of the space required to be provided with smoke control; floor to flat ceiling (feet).
$Q$ = Steady state heat release rate; Use 4,400 Btu/sec. where the primary use group is M, S-1 or F-1. Otherwise use 2,000 Btu/sec.
$A$ = Horizontal cross-sectional area of the above ceiling space being filled (square feet). Maximum $A$ to be used shall be: $A = 14\ H^2$.

**922.2.1.2 Irregular spaces:** For spaces with sloped or irregular ceilings, $A/H^2$ ratios outside the specified range, or varying cross sections, the filling time shall be determined using numerical integration from the ceiling to the critical smoke interface. The following equations shall be used to determine the rate of smoke production:

Where the interface level is above the limiting elevation ($z_1$) use:

$$V = 17.6 Q_c^{1/3} Z^{5/3} + 3.36 Q_c$$

Where the interface level is below the limiting elevation ($z_1$) use:

$$V = 16.64 Q_c^{3/5} Z$$

where:

$V$ = The volumetric rate of smoke production (cubic feet per minute).
$z_1$ = Limiting elevation (feet) = $0.533\ Q_c^{2/5}$.
$Q_c$ = The convective portion of the heat release rate shall be estimated as 70 percent of the total heat release rate, $Q$.

**922.2.2 Mechanical systems:** Where the smoke filling predicted in Section 922.2.1 does not meet the design criteria of Section 922.2, mechanical exhaust shall be provided to maintain these conditions.

**922.2.2.1 Exhaust quantities:** Sufficient mechanical exhaust shall be provided to maintain the smoke layer interface at or above the critical elevation for the 20-minute period. The volumetric rate of smoke production ($V$) shall be determined by the equations in Section 922.2.1.2. If the rate of smoke exhaust is less than the rate of smoke production, the minimum exhaust rate to be supplied for smoke control shall be determined in accordance with Table 922.2.2.1.

**Table 922.2.2.1**
**MINIMUM EXHAUST RATE ADJUSTMENT FACTOR[a]**

| $Z/H$ | $t/t_o$ | | | | | |
|---|---|---|---|---|---|---|
| | $V_e/V$ | | | | | |
| | 0.25 | 0.35 | 0.50 | 0.70 | 0.85 | 0.95 |
| 0.2 | 1.12 | 1.19 | 1.30 | 1.55 | 1.89 | 2.49 |
| 0.3 | 1.14 | 1.21 | 1.35 | 1.63 | 2.05 | 2.78 |
| 0.4 | 1.16 | 1.24 | 1.40 | 1.72 | 2.24 | 3.15 |
| 0.5 | 1.17 | 1.28 | 1.45 | 1.84 | 2.48 | 3.57 |
| 0.6 | 1.20 | 1.32 | 1.52 | 2.00 | 2.78 | 4.11 |
| 0.7 | 1.23 | 1.36 | 1.61 | 2.20 | 3.17 | 4.98 |
| 0.8 | 1.26 | 1.41 | 1.71 | 2.46 | 3.71 | 6.25 |

**Note a.** Notation:
$Z$ = Design height of smoke layer interface above fire source.
$H$ = Ceiling height above fire source.
$t$ = Time for smoke layer interface to descend to $Z$ (with exhaust) (seconds).
$t_o$ = Value of $t$ in absence of smoke exhaust (see Section 922.2.1.1 or 922.2.1.2) (seconds).
$V_e$ = Smoke control exhaust rate (minus any airflow into the smoke layer other than that from the plume).
$V$ = Volumetric smoke production rate (from the equations in Section 922.2.1.2).

**922.2.3 Operation:** The smoke control system shall be a dedicated system or shall be integrated with the mechanical *ventilation* system of the building. Operation of the smoke control system shall automatically shut down all systems and devices which interfere with the effective operation of the smoke control system. Where the mechanical *ventilation* system is designed for smoke control, the return air shall be moved directly to the outside without recirculation to other areas of the building.

**922.2.4 Alternative systems:** An engineered design which will achieve the same level of smoke control as described in this section is permitted in lieu of these requirements.

**922.3 Smoke removal:** Provisions shall be made to provide *ventilation* at a rate of at least two air changes per hour from the space required to be provided with smoke control. This *ventilation* shall be through openable vents, separate mechanical exhaust, or through the building mechanical *ventilation* system. The exhaust inlets shall be located a minimum of 6 feet (1829 mm) above any *exit access* walkway and above any openings into adjoining spaces. The smoke removal system shall be activated by manual controls provided for fire department use unless it is part of the smoke control system.

**922.4 Activation:** The smoke control system shall be activated by actuation of the following:

1. *Automatic sprinkler system*;
2. Smoke detectors required by this section that comply with NFPA 72 listed in Chapter 35; and
3. Manual controls provided for fire department use.

The system shall not be activated by a manual fire alarm system.

**922.4.1 Manual control:** Manual controls shall be provided at a location approved by the fire department.

**922.4.2 Smoke detector activation:** Where the height of the ceiling of the space required to be provided with smoke control exceeds 30 feet (9144 mm) above the floor of the space, approved smoke detectors shall be provided to detect smoke above the highest floor open to an atrium or at the highest point of another space required to be provided with smoke control. The installation of smoke detectors shall comply with Section 919.0.

**922.5 Standby power:** All equipment required to provide smoke control in floor openings connecting three or more stories and stage areas in accordance with Section 412.3.8.2 shall be equipped with a standby source of power that complies with Section 2707.0.

**922.6 Acceptance:** Any required smoke control design that requires operation of mechanical equipment shall be functionally tested in accordance with Section 922.6.2 until proper operation of all required mechanical equipment and controls is demonstrated.

**922.6.1 System operation report:** Prior to acceptance testing, a report of the required system operations shall be provided to the code official. The following items shall be included in the report if part of the required system:

1. Identify type(s) of smoke control activation signal(s), such as *sprinkler* waterflow, smoke detection, manual, etc., and associated smoke control system operation(s) that are activated by the signals.
2. Identify *building area(s)* where maximum mechanical exhaust to the outside is implemented and supply air is not provided.
3. Identify *building area(s)* where maximum air supply is implemented and exhaust to the outside is not provided.
4. Identify fan(s) which shall be "On" as required to implement the smoke control system. If multiple-speed fans are used, the capacity at which the fans shall operate in the smoke control mode shall be identified.
5. Identify fan(s) which shall be "Off" as required to implement the smoke control system.
6. Identify damper(s) which shall be "Open" to implement the smoke control system.
7. Identify damper(s) which shall be "Closed" to implement the smoke control system.
8. Identify other functions required to implement the smoke control system.
9. Identify *building areas* with smoke and heat vents and method of operation of vents.

10. If required, identify the type(s) of standby power and the equipment that is served.

**922.6.2 Testing procedures:** The acceptance test procedure shall be approved. Acceptance testing shall be conducted in the presence of the code official or shall include documentation indicating that all mechanical equipment, control sequences, devices and components have been operationally tested and are functioning properly in accordance with the system operation report. All documentation from operational testing shall be available for inspection. Acceptance testing shall include the following:

1. Prior to beginning acceptance testing, all building smoke control equipment shall be placed in the normal operating mode.
2. Acceptance testing shall demonstrate that each initiating device, fan, damper and other required equipment is operational and performs to the limits and capacity required.
3. Acceptance testing shall demonstrate that correct control outputs are produced for a given control input for each control sequence specified by the system operation report.
4. If standby power is required for the operation of the smoke control system, acceptance tests shall be conducted while on both normal building power and standby power.
5. Opening of smoke/heat vents shall be demonstrated if the vent is capable of being opened in a manner that does not require destructive testing.

## SECTION 923.0 SMOKE AND HEAT VENTS

**923.1 General:** Where *exit access* travel distance is increased in accordance with Section 1006.5.1, smoke and heat vents shall be constructed and installed in accordance with this section.

**923.2 Vent size and spacing:** The vent area and the spacing of the vents shall comply with Table 923.2.

**923.2.1 Releasing devices:** Smoke and heat vents shall open automatically by activation of a heat-responsive device rated at 100 degrees F. (38 degrees C.) to 220 degrees F. (104 degrees C.) above ambient. The releasing mechanism shall be capable of operation such that the vent shall fully open when the vent is exposed to a time-temperature gradient that reaches an air temperature of 500 degrees F. (260 degrees C.) within 5 minutes. Vents shall be capable of being opened by an approved manual operation.

**923.3 Curtain board construction:** Curtain boards shall be provided to subdivide a vented building. Curtain boards shall be constructed of material that will resist the passage of smoke and is consistent with the building type of construction. Curtain board location and depth shall comply with Table 923.2. The bottom of the curtain board shall be level.

## SECTION 924.0 SUPERVISION

**924.1 Fire suppression systems:** All *automatic fire suppression systems* required for occupancies in Use Group A, B, E, H, I, M or R shall be supervised by method 1. All *automatic fire suppres-*

**Table 923.2**
**SMOKE AND HEAT VENT SIZE AND SPACING[b]**

| Use Group | Hazard classification of contents[a] | Vent height above the floor, *H* (feet) | Minimum curtain board depth from vent bottom (feet) | Maximum area formed by curtain boards (square feet) | Vent area to floor area ratio | Maximum spacing of vent centers (feet) | Maximum distance from wall of curtain boards (feet) | Maximum distance between curtain boards |
|---|---|---|---|---|---|---|---|---|
| F-1 | — | — | $0.2 \times H$ but $\geq 4$ | 50,000 | 1:100 | 120 | 60 | $8 \times H$ but $\leq 250$ feet |
| S-1 | I thru IV | 20 or less | 6 | 10,000 | 1:100 | 100 | 60 | $8 \times H$ |
| S-1 | I thru IV | Over 20 to 40 | 6 | 8,000 | 1:75 | 100 | 55 | $8 \times H$ but $\leq 250$ feet |
| S-1 | I thru IV | 20 or less | 4 | 3,000 | 1:75 | 100 | 55 | $8 \times H$ |
| S-1 | I thru IV | Over 20 to 40 | 4 | 3,000 | 1:50 | 100 | 50 | $8 \times H$ but $\leq 250$ feet |
| S-1 | V | 20 or less | 6 | 6,000 | 1:50 | 100 | 50 | $8 \times H$ |
| S-1 | V | Over 20 to 30 | 6 | 6,000 | 1:40 | 90 | 45 | $8 \times H$ |
| S-1 | V | 30 or more | 4 | 2,000 | 1:30 | 75 | 40 | $8 \times H$ but $\leq 100$ feet |

**Note a.** See NFPA 231C listed in Chapter 35 for classification of Contents Class I through IV. Class V commodities are products that present special fire hazards beyond those of Class I, II, III or IV, such as aerosols, foam plastic, PVC, PU, PS and asphalt paper.
**Note b.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

*sion systems* in other use groups shall be supervised by one of the following methods:

1. Central-station system, proprietary system, remote-station system or supervisory service which will cause the actuation of an audible appliance at a constantly attended location, in accordance with NFPA 72 listed in Chapter 35; or
2. Locking open all valves on connections to *water supplies*, sectional control valves and other valves in supply pipes to fire protection devices.

**Exceptions**

1. Underground gate valves with roadway boxes.
2. Halogenated extinguishing systems that are not an integral part of a required *automatic fire suppression system*.
3. Carbon dioxide extinguishing systems that are not an integral part of a required *automatic fire suppression system*.
4. Dry- and wet-chemical extinguishing systems.
5. *Limited area sprinkler systems* (see Section 907.6.3).
6. Occupancies in Use Group R complying with Section 906.2.2 and supervised in accordance with NFPA 13R listed in Chapter 35.

**924.2 Fire alarm systems:** All required fire protective signaling systems in the following occupancies shall transmit alarm and trouble signals to an approved central-station system, proprietary system or remote-station system.

1. Day care centers with more than 100 clients.
2. Health care facilities licensed by the Cabinet for Human Resources.

# CHAPTER 10

# MEANS OF EGRESS

## SECTION 1001.0 GENERAL

**1001.1 Scope:** The provisions of this chapter shall control the design, construction and arrangement of building elements required to provide a reasonably safe *means of egress* from all structures.

**1001.2 Modification of egress requirements:** Where strict compliance with the provisions of this code is not practical, the code official shall approve alternative *means of egress* which will accomplish the same purpose, by the procedure established in Chapter 1 for modification of this code, or by adoption of *approved rules*.

**1001.3 Minimum requirements:** It shall be unlawful to *alter* any building or structure in any manner that will reduce the number of *exits* or the capacity of *exits* below the requirements of this code for new buildings of the proposed occupancy.

## SECTION 1002.0 DEFINITIONS

**1002.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Aisle accessway:*** That portion of an *exit access* which provides a path of travel to an aisle (see Section 1012.0).

***Alternating tread stairway:*** A stair that has a series of steps between 50 and 70 degrees (0.87 and 1.22 rad) from horizontal, usually attached to a center support rail in an alternating manner so that the user of the stairs never has both feet on the same level at the same time (see Section 1014.6.6).

***Bleachers:*** A *grandstand* where the seats are not provided with backrests (see Section 1013.0.)

***Common path of travel:*** That portion of *exit access* which the occupants are required to traverse before two separate and distinct paths of travel to two *exits* are available. Paths that merge are common paths of travel. A common path of travel is measured the same as travel distance but terminates at that point where two separate and distinct routes become available (see Section 1011.2.1).

***Corridor:*** An enclosed passageway which limits the *means of egress* to a single path of travel (see Section 1011.0).

***Exit:*** That portion of a *means of egress* which is separated from all other spaces of a building or structure by construction and opening protectives as required for exits to provide a protected way of travel to the *exit discharge* (see Section 1006.0). Exits include exterior exit doors, exit *stairways* (see Sections 1014.0 and 1015.0), exit passageways (see Section 1020.0) and *horizontal exits* (see Section 1019.0).

***Exit access:*** That portion of a *means of egress* which leads to an entrance to an *exit* (see Section 1011.0).

***Exit discharge:*** That portion of a *means of egress* between the termination of an *exit* and a *public way* (see Section 1006.3).

***Exit discharge, level of:*** The horizontal plane located by the point at which an *exit* terminates and an *exit discharge* begins (see Section 1006.3.1).

***Exit, horizontal:*** A way of passage from one building to an area of refuge in another building on approximately the same level, or a way of passage through or around a *wall* or partition to an area of refuge on approximately the same level in the same building, which affords safety from fire or smoke from the area of incidence and areas communicating therewith (see Section 1019.0).

***Floor area, gross:*** The floor area within the perimeter of the outside walls of the building under consideration, without deduction for hallways, stairs, closets, thickness of walls, columns or other features (see Section 1008.0).

***Floor area, net:*** To determine the number of persons for whom *exits* are to be provided, the net floor area shall be the actual occupied area and shall not include unoccupied accessory areas or thickness of walls (see Section 1008.0).

***Grade hallway, grade lobby, grade passageway:*** An enclosed hallway or *corridor* that is an element of an *exit,* and terminates at a street or an open space or *court* communicating with a street (see Section 1020.0).

***Grandstand:*** A structure providing tiered or stepped seating (see Section 1013.0).

**Guard system:** A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level (see Section 1021.0).

**Handrail:** A horizontal or sloping rail intended for grasping by the hand for guidance or support, for arresting falls on the adjacent walking surface and for providing a visual cue for change in elevations (see Section 1022.0).

***Means of egress:*** A continuous and unobstructed path of travel from any point in a building or structure to a *public way*. A

means of egress consists of three separate and distinct parts: the *exit access*; the *exit*; and the *exit discharge*. A means of egress comprises the vertical and horizontal means of travel and shall include intervening room spaces, doors, hallways, *corridors*, passageways, balconies, ramps, stairs, enclosures, lobbies, *horizontal exits*, *courts* and yards (see Section 1006.0).

**Occupant load:** The total number of persons that are permitted to occupy a building or portion thereof at any one time.

***Public way:*** Any street, alley or other parcel of land open to the outside air leading to a public street, which has been deeded, dedicated or otherwise permanently appropriated to the public for public use and which has a clear width and height of not less than 10 feet (3048 mm).

**Slidescape:** A straight or spiral chute, erected on the interior or exterior of a building, which is designed as a *means of egress* direct to a street or other *public way* (see Section 1026.0).

***Smokeproof enclosure:*** An enclosed *stairway*, with access from the floor *area* of the building either through outside balconies or ventilated vestibules, opening on a street, yard or open *court,* and with a separately enclosed direct *exit* to the street at the grade floor (see Section 1015.0).

***Stairway:*** One or more flights of stairs, and the necessary landings and *platforms* connecting them, to form a continuous and uninterrupted passage from one floor to another (see Section 1014.0).

**Winder:** A step in a winding *stairway* (see Section 1014.6.3).

## SECTION 1003.0 CONSTRUCTION DOCUMENTS

**1003.1 Arrangement of egress:** The *construction documents* shall show in sufficient detail the location, construction, size and character of all *exits*, together with the arrangement of *aisles*, *corridors*, passageways and hallways leading thereto in compliance with the provisions of this code.

**1003.2 Number of occupants:** In other than occupancies in Use Groups R-2, R-3 and I-1, the *construction documents* and the application for a permit shall designate the number of occupants to be accommodated on every floor, and in all rooms and spaces as required by the code official. Unless otherwise specified, the minimum number of occupants to be accommodated by the *exits* shall be determined by the occupant load prescribed in Section 1008.0. The posted occupant load of the building shall be limited to that number. The fire prevention code official shall be informed in *writing* of the calculated occupant load.

**1003.3 Posted occupant load:** Every assembly room or space in an assembly occupancy shall have the approved occupant load of the room or space posted in a conspicuous place, near the main entrance to the room or space. Rooms or spaces which have multiple-use capabilities shall be posted for all such occupancies. All posted signs shall be of an approved legible permanent design.

## SECTION 1004.0 USE GROUP AND OCCUPANCY REQUIREMENTS

**1004.1 New buildings:** Every building and structure, and part thereof, hereafter erected shall have the prescribed number of *exits* of one or more of the approved types defined in this chapter. *Exits*, in combination with the *exit access* and *exit discharge*, shall provide safe and continuous *means of egress* to a street or to an open space with direct access to a street.

**1004.2 Multiple occupancies:** Where a building is occupied by two or more occupancies, the *means of egress* requirements shall apply to each portion of the building based on the occupancy of that space.

**1004.3 Multiple tenants:** Where more than one tenant occupies any one floor of a building or structure, each tenant shall be provided with direct access to approved *exits*.

## SECTION 1005.0 GENERAL LIMITATIONS

**1005.1 Exits:** An *exit* shall not be utilized for any purpose that interferes with its function as a *means of egress*.

**1005.2 Floor openings:** Manholes or floor access panels which reduce the clearance to less than 32 inches (813 mm) shall not be located in the line of *means of egress*.

**1005.3 Protruding objects:** A minimum headroom of 80 inches (2032 mm) shall be provided for any walking surface, including walks, halls, *corridors*, aisles and passageways. Structural elements, fixtures or furnishings shall not project from either side more than 4 inches (102 mm) over any walking surface between the heights of 27 (686 mm) and 80 inches (2032 mm) above the walking surface. A free-standing object mounted on a post(s) or pylon(s) shall not overhang that post(s) or pylon(s) more than 12 inches (305 mm) where the lowest point of the leading edge is more than 27 inches (686 mm) and less than 80 inches (2032 mm) above the walking surface. Door closers and stops shall not reduce headroom to less than 78 inches (1981 mm).

**1005.4 Floor surface:** All walking surfaces, including the floors of *corridors*, *stairways* and other components of the *means of egress*, shall have a slip-resistant surface.

**1005.5 Open-sided walking areas:** Guards shall be located along open-sided walking surfaces, *mezzanines*, *stairways*, ramps and landings which are located more than $15^1/_2$ inches (394 mm) above the floor or grade below. The guards shall be constructed in accordance with Section 1021.0.

**Exception:** Guards are not required for the following locations:

1. On the loading side of loading docks.
2. On the auditorium side of *stages* and raised *platforms*.
3. On raised *stage* and *platform* floor areas such as runways, ramps and side *stages* utilized for entertainment or presentations.
4. At vertical openings in the performance area of *stages* and *platforms*.
5. At elevated walking surfaces appurtenant to *stages* and *platforms* for access to and utilization of special lighting or equipment.

**1005.5.1 Screen porches:** Porches and decks which are enclosed with insect screening shall be provided with guards in accordance with Section 1021.0 where the walking surface is located more than 30 inches (762 mm) above the floor or grade below.

**Exception:** Guards are not required where a protective bar is installed 34 inches to 38 inches (864 mm to 965 mm) above the porch or deck on the side of the screening having access thereto. The bar shall be capable of resisting a horizontal *load* of 50 pounds per linear foot (730 N/m) without contacting the screen and be a minimum of $1^1/_2$ inches (38 mm) in height.

**1005.6 Elevation change:** Where changes in elevation exist in the *means of egress*, ramps complying with Section 1016.0 shall be used where the difference in elevation is less than 12 inches (305 mm). The ramp shall be equipped either with handrails or with *floor finish* materials that contrast with adjacent *floor finish* materials.

**Exceptions**

1. A maximum step height of 8 inches (203 mm) shall be permitted for buildings with occupancies in Use Groups F, H, R, S and U at exterior doors not required to be accessible by Chapter 11.
2. Fewer than three risers shall be permitted, provided that the risers and treads comply with Section 1014.0, the minimum depth of the tread is 13 inches (330 mm), and at least one handrail complying with Section 1022.0 is provided within 30 inches (762 mm) of the normal path of travel on the *stairway*, or the *floor finish* material of treads shall contrast with the adjacent *floor finish* material.

**1005.7 Air movement in egress elements:** *Exits* and *exit access corridors* shall not serve as supply, return, exhaust, relief or *ventilation* air ducts or plenums.

**Exceptions**

1. Utilization of an *exit access corridor* as a source of makeup air for exhaust systems in rooms that open directly onto such *corridors*, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall not be prohibited, provided that each such *corridor* is directly supplied with outdoor air at a rate not less than the rate of makeup air taken from the *corridor*.
2. The utilization of the space between the *corridor* ceiling and the floor or roof structure above as a return air plenum shall not be prohibited for one or more of the following conditions:
   - 2.1. The *corridor* is not required to be of fireresistance rated construction;
   - 2.2. The *corridor* is separated from the plenum by the underside membrane of a fireresistance rated floor/ceiling or roof/ceiling assembly;
   - 2.3. The *corridor* is separated from the plenum by fireresistance rated construction;
   - 2.4. The air handling system serving the *corridor* is shut down upon activation of the air handling unit smoke detectors required by the mechanical code listed in Chapter 35;
   - 2.5. The air handling system serving the *corridor* is shut down upon detection of *sprinkler* waterflow where the building is equipped throughout with an *automatic sprinkler system*; or
   - 2.6. The space between the *corridor* ceiling and the floor or roof structure above the *corridor* is utilized as a component of an approved engineered smoke control system.
3. Where located within a *dwelling unit*, the utilization of egress *corridors* as return air plenums shall not be prohibited.
4. Where located within tenant spaces of 1,000 square feet (92 $m^2$) or less in area, utilization of *exit access corridors* as return air plenums shall not be prohibited.

## SECTION 1006.0 TYPES AND LOCATION OF MEANS OF EGRESS

**1006.1 General:** All approved *means of egress*, including doorways, passageways, *corridors*, interior *stairways*, exterior *stairways*, *smokeproof enclosures*, ramps, *horizontal exits*, bridges, balconies, fire escapes and combinations thereof, shall be arranged and constructed as provided for in this code.

**1006.2 Arrangement:** All required *exits* shall be so located as to be discernable with unobstructed access thereto.

**1006.2.1 Egress through adjoining spaces:** Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas are accessory to the area served; are not a high-hazard occupancy; and provide a discernible path of travel to an *exit*. A maximum of one *exit access* shall be permitted to pass through a kitchen, storeroom, restroom, closet or similar space provided that passage through such space is not the only means of access to an *exit*. An *exit access* shall not pass through a room subject to locking. *Means of egress* from *dwelling units*, or sleeping areas shall not lead through other *dwelling units* or sleeping areas and shall not lead through toilet rooms or bathrooms.

**1006.2.2 Assembly buildings:** All buildings occupied for assembly purposes shall have a main entrance and *exit discharge* that fronts on at least one street or an unoccupied space of not less than 10 feet (3048 mm) in width that adjoins a street or *public way*. Where there is a single main entrance, the entrance shall be capable of serving as the main *exit* and shall provide an egress capacity for at least one-half of the total occupant load. In addition to having access to a main *exit*, each level of an occupancy in Use Group A shall be provided with additional *exits* which shall provide a *means of egress* capacity for at least one-half of the total occupant load served by that level.

**1006.2.3 Skating rinks:** Places of assembly used for skating rinks shall not be located below the floor nearest grade.

**1006.2.4 Foyers and waiting spaces:** The term "foyer" shall mean an enclosed space surrounding, or in the rear of, the auditorium of a theater or other place of assembly which is completely separated from the auditorium and is used as an assembly or waiting space for the occupants. In Use Group

A-1, a foyer, waiting space or lobby shall be provided with a *net floor area*, exclusive of stairs or landings, of not less than $1^1/_2$ square feet (0.14 $m^2$) for each occupant having access thereto. The use of foyers and lobbies and other available spaces for harboring occupants until seats become available shall not encroach upon the clear floor area herein prescribed or upon the required clear width of front *exits*.

**1006.2.4.1 Egress:** Where the foyer is not directly connected to the public street through the main lobby, an unobstructed *corridor* or passage shall be provided which leads to, and equals the required minimum width of, main entrances and *exits*. A mirror shall not be placed so as to give the appearance of a doorway, *exit* or passageway.

**1006.2.4.2 Gradient:** The rear foyer shall be at the same level as the back of the auditorium and the *means of egress* leading therefrom shall not have a steeper gradient than one unit vertical in eight units horizontal (1:8).

**1006.2.4.3 Construction:** In occupancies in Use Group A-1, other than motion picture theaters, the *fire separation assemblies* separating the foyer from the auditorium and other adjoining rooms and spaces shall be constructed with not less than a 2-hour fireresistance rating. Where opening protectives are constructed of noncombustible materials, a fireresistance rating of the opening protectives is not required.

**1006.3 Exit discharge:** All *exits* shall discharge directly at a *public way* or at a yard, *court* or open space of the required width and size to provide all occupants with a safe access to a *public way*.

**1006.3.1 Level of exit discharge protection:** In all buildings having habitable or occupiable stories or *basements* below grade, the floor/ceiling assemblies and supports which are below the *level of exit discharge* shall provide a fireresistance rating of not less than 1 hour.

**Exceptions**

1. Occupancies in Use Group R-3.
2. Buildings of Type 1 construction.
3. Where floor/ceiling assemblies and supports are constructed of Type 4 construction.
4. Where the floor areas below the *level of exit discharge* are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.
5. Occupiable stories or *basements* below grade which have *exits* that discharge directly to grade.

**1006.3.2 Protection of egress:** A required *means of egress* shall not discharge directly into a vehicular path unless guards are provided to protect vehicles from hitting the *exit* door in its outward opened position and to direct pedestrians in a path running parallel to the vehicular path. The guards shall prevent the exit door from being blocked by movable objects such as dumpsters or parked vehicles.

**1006.4 Remote location:** Wherever more than one *exit* is required from any room, space or floor of a building, such *exits* shall be placed as remote from each other as practicable, and shall be arranged and constructed to provide direct access in separate directions from any point in the area served so as to minimize the possibility that multiple *exits* will be blocked by any one fire or other emergency condition.

**1006.4.1 Remoteness:** Where two *exits* or two *exit access* doors are required, each shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served. Where *exit* enclosures are provided as a portion of the required *means of egress* and are interconnected by a *corridor* conforming to the requirements for *corridor* construction, the *exit* separation distance shall be measured along the line of travel within the *corridor*. In all other cases, the separation distance shall be measured in a straight line between *exits* or *exit access* doors.

**Exception:** In buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2, the minimum separation distance shall be one-fourth of the length of the maximum overall diagonal dimension.

**1006.4.1.1 Three or more:** Where three or more *exits* or *exit access* doors are required, at least two *exits* or *exit access* doors shall be separated as provided for in Section 1006.4.1. The additional exits shall be arranged a reasonable distance apart so that if one becomes blocked, the others will be available.

**1006.5 Length of travel:** All *exits* shall be so located that the maximum length of *exit access* travel, measured from the most remote point to an approved *exit* along the natural and unobstructed line of travel, shall not exceed the distances given in Table 1006.5.

**Table 1006.5**
**LENGTH OF EXIT ACCESS TRAVEL[a]**

| Use Group | Without sprinkler system (feet)[c] | With sprinkler system[b] (feet)[c] |
|---|---|---|
| A, B, E, F-1, I-1, M, R, S-1, U | 200 | 250 |
| F-2, S-2 | 300 | 400 |
| H-1 | 25 | 75 |
| H-2 | 50 | 100 |
| H-3 | 100 | 150 |
| H-4 | 125 | 175 |
| I-2, I-3 | 150 | 200 |

**Note a.** See the following sections for modifications to travel distance requirements.
Section 402.5.1: For the exit access travel distance limitation in malls.
Section 404.7: For the exit access travel distance limitation through an atrium space.
Section 416.6: For the exit access travel distance limitation in HPM use facilities.
Section 1006.5.1: For increased limitation in Use Groups F-1 and S-1.
Section 1006.5.2: For increased limitation in Use Group A-5.
Section 1010.3: For buildings with one exit.
Section 3104.9: For the exit access travel distance limitation in temporary structures.
**Note b.** Buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1 or 906.2.2.
**Note c.** 1 foot = 304.8 mm.

**1006.5.1 Roof vent increase:** In buildings which are one story in *height*, equipped with automatic heat and smoke roof vents complying with Section 923.0 and equipped throughout

with an *automatic sprinkler system* in accordance with Section 906.2.1, the *exit access* travel distance limitation in Table 1006.5 for occupancies in Use Group F-1 or S-1 shall be increased to 400 feet (122 m).

**1006.5.2 Use Group A-5:** Occupancies in Use Group A-5, where all portions of the *means of egress* are essentially open to the outside, shall have an *exit access* travel distance of not more than 400 feet (122 m), except that such occupancies in buildings and structures of Type 1 or 2 construction shall not have an *exit access* travel distance limitation.

**1006.6 Elevators, escalators and moving walks:** Elevators, *escalators* and *moving walks* shall not be accepted as a required element of the *means of egress*.

**1006.7 Common path of travel:** The *common path of exit access travel* distance for occupants to reach a point where two separate and distinct paths of travel are available to two *exits* shall not exceed 100 feet (30480 mm) in occupancies in Use Group I-3.

## SECTION 1007.0 ACCESSIBLE MEANS OF EGRESS

**1007.1 Accessible means of egress:** See Chapter 11 for buildings and facilities required to be accessible to persons with physical disabilities.

**1007.2 Deleted.**

**1007.3 Deleted.**

**1007.4 Deleted.**

**1007.5 Deleted.**

**1007.5.1 Deleted.**

**1007.5.2 Deleted.**

**1007.5.3 Deleted.**

**1007.5.4 Deleted.**

**1007.6 Deleted.**

## SECTION 1008.0 OCCUPANT LOAD

**1008.1 Design occupant load:** In determining required facilities, the number of occupants for whom *exit* facilities shall be provided shall be established by the largest number computed in accordance with Sections 1008.1.1 through 1008.1.3.

**1008.1.1 Actual number:** The actual number of occupants for whom each occupied space, floor or building is designed.

**1008.1.2 Number by Table 1008.1.2:** The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1008.1.2.

**1008.1.3 Number by combination:** The number of occupants of any space as computed in Section 1008.1.1 or 1008.1.2 plus the number of occupants similarly computed for all spaces that discharge through the space in order to gain access to an *exit*.

**1008.1.4 Increased occupant load:** The occupant load permitted in any building or portion thereof is permitted to be increased from that number established for the occupancies in Table 1008.1.2 provided that all other requirements of the code are also met based on such modified number. Where required by the code official, an approved aisle, seating or fixed equipment diagram to substantiate any increase in occupant load shall be submitted. Where required by the code official, such diagram shall be posted.

**Table 1008.1.2**
**MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

| Occupancy | Floor area[b] in square feet per occupant |
|---|---|
| Assembly with fixed seats | See Section 1008.1.6 |
| Assembly without fixed seats | |
| Concentrated (chairs only — not fixed) | 7 net |
| Standing space | 3 net |
| Unconcentrated (tables and chairs) | 15 net |
| Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas | 7 net |
| Business areas | 100 gross |
| Courtrooms — other than fixed seating areas | 40 net |
| Educational | |
| Classroom area | 20 net |
| Shops and other vocational room areas | 50 net |
| Industrial areas[a] | 100 gross |
| Institutional areas | |
| Inpatient treatment areas | 240 gross |
| Outpatient areas | 100 gross |
| Sleeping areas | 120 gross |
| Library | |
| Reading rooms | 50 net |
| Stack area | 100 gross |
| Mercantile, basement and grade floor areas | 30 gross |
| Areas on other floors | 60 gross |
| Storage, stock, shipping areas | 300 gross |
| Parking garages | 200 gross |
| Residential | 200 gross |
| Stages and platforms | 15 net |
| Storage areas, mechanical equipment room | 300 gross |

**Note a.** Use a value of 200 gross for purposes of determining jurisdiction under Sections 105.1 and 105.2 and design professional seal requirements in Section 114.0.

**Note b.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**1008.1.5 Maximum occupant load:** The occupant load of any space or portion thereof shall not exceed one occupant per 3 square feet (0.28 $m^2$) of occupiable floor space.

**1008.1.6 Fixed seats:** The occupant load for an assembly or educational area having fixed seats shall be determined by the number of fixed seats installed. The capacity of fixed seats without dividing arms shall equal one person per 18 inches (457 mm). For booths, the capacity shall be one person per 24 inches (610 mm).

**1008.2 Mezzanine levels:** The occupant load of a *mezzanine* level discharging through a floor below shall be added to that floor's occupant load, and the capacity of the *exits* shall be designed for the total occupant load thus established.

**1008.3 Roofs:** Roof areas occupied as roof gardens or for assembly, educational, storage or other purposes, shall be provided with *exit* facilities to accommodate the required occupant load, but there shall not be less than two approved *means of egress* from roof areas of Use Groups A and E.

## SECTION 1009.0 CAPACITY OF EGRESS COMPONENTS

**1009.1 General:** The capacity of *means of egress* for a floor, balcony, tier or other occupied space shall be sufficient for the occupant load thereof.

**1009.2 Minimum width:** The width of each *means of egress* component shall not be less than the width computed in accordance with Table 1009.2 for the required capacity of the component, but not less than the minimum width as prescribed by this code for each such component.

**Table 1009.2**
**EGRESS WIDTH PER OCCUPANT**

| Use Group | Without sprinkler system (inches per person)[b] | | With sprinkler system[a] (inches per person)[b] | |
|---|---|---|---|---|
| | Stairways | Doors ramps and corridors | Stairways | Doors ramps and corridors |
| A, B, E, F, M, R, S, U | 0.3 | 0.2 | 0.2 | 0.15 |
| H | 0.7 | 0.4 | 0.3 | 0.2 |
| I-1 | 0.4 | 0.2 | 0.2 | 0.2 |
| I-2 | 1.0 | 0.7 | 0.3 | 0.2 |
| I-3 | 0.3 | 0.2 | 0.3 | 0.2 |

**Note a.** Buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1 or 906.2.2.
**Note b.** 1 inch = 25.4 mm.

**1009.3 Exit design per floor:** Where *exits* serve more than one floor, only the occupant load of each floor considered individually shall be used in computing the required capacity of the *exits* at that floor, provided that the *exit* capacity shall not decrease in the direction of *means of egress* travel.

**1009.4 Egress convergence:** Where *means of egress* from floors above and below converge at an intermediate floor, the capacity of the *means of egress* from the point of convergence shall not be less than the sum of the two.

## SECTION 1010.0 NUMBER OF EXITS

**1010.1 General:** The general requirements of this section apply to buildings of all use groups. Where more restrictive requirements are provided in this code, such requirements shall take precedence over the general provisions of this section.

**1010.2 Minimum number:** Every floor area shall be provided with the minimum number of approved independent *exits* as required by Table 1010.2 based on the occupant load, except as modified in Section 1010.3.

**Exception:** In buildings with occupancies in Use Group R having multistory *dwelling units*, the *means of egress* from a *dwelling unit* to the required *exits* is permitted to be provided from one level only. Within the *dwelling unit*, access to the *means of egress* from the unit shall conform to the applicable provisions of this chapter.

**Table 1010.2**
**MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD**

| Occupant load | Minimum number of exits |
|---|---|
| 500 or less | 2 |
| 501 - 1,000 | 3 |
| over 1,000 | 4 |

**1010.3 Buildings with one exit:** Only one *exit* shall be required in:

1. Occupancies in the use groups shown in Table 1010.3, provided that the building has not more than one level below the *level of exit discharge*; and
2. Occupancies in Use Group R-3.

**Table 1010.3**
**BUILDINGS WITH ONE EXIT**

| Use Group | Maximum number of stories above grade | Maximum per floor occupants, travel distance[d] dwelling units |
|---|---|---|
| A, B, E, F, M<br>H-2, H-3 | 1 Story<br>1 Story | 50 occupants and 75 feet travel<br>3 occupants and 25 feet travel |
| H-4, I, R<br>S[a] | 1 Story<br>1 Story | 10 occupants and 75 feet travel<br>30 occupants and 100 feet travel |
| B[b], F, M, S[a], U<br>R-2 | 2 Stories<br>2 Stories[c] | 30 occupants and 75 feet travel<br>4 dwelling units |

**Note a.** For the required number of exits for open parking structures, see Section 1010.5.
**Note b.** For the required number of exits for air traffic control towers, see Section 414.0.
**Note c.** Buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1 or 906.2.2 with an occupancy in Use Group R-2 shall have a maximum height of three stories above grade.
**Note d.** 1 foot = 304.8 mm.

**1010.4 Emergency escape and rescue:** Every sleeping room below the fourth story in occupancies in Use Groups R and I-1 shall have at least one operable window or exterior door approved for emergency escape or rescue. Each emergency escape and rescue window shall have a minimum net clear opening of 5.7 square feet (0.53 $m^2$). The net clear opening shall be at least 24 inches (610 mm) in height and at least 20 inches (508 mm) in width. The net clear opening dimensions shall be obtained by the normal operation of the window from the inside. Where windows are provided for emergency escape and rescue, the windows shall have the bottom of the clear opening not more than 44 inches (1118 mm) above the floor.

Bars, grilles or screens placed over emergency escape windows shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the window.

**Exceptions**

1. The minimum net clear opening for grade floor windows shall be 5 square feet (0.47 $m^2$).
2. An outside window or an exterior door for emergency escape is not required in buildings where the sleeping room is provided with a door to a *corridor* having access to two remote *exits* in opposite directions.
3. An outside window or an exterior door for emergency escape is not required in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.

**1010.5 Open parking structures:** Parking structures shall not have less than two *exits* from each parking tier, except that only one *exit* is required where vehicles are mechanically parked. Unenclosed vehicle ramps shall not be considered as required *exits* unless pedestrian facilities are provided. Interior *exit stairways* are not required to be enclosed.

## SECTION 1011.0 EXIT ACCESS PASSAGEWAYS AND CORRIDORS

**1011.1 Access passageway:** Direct *exit access* shall be provided to required *exits* through continuous passageways, *aisle accessways*, aisles or *corridors* which are conveniently available to all occupants and maintained free of obstruction. In every area containing seating, displays, exhibits, counters, shelving and other furnishings or fixtures, a path of travel that connects with each of the *means of egress* doorways serving the area and which complies with the minimum width requirements of aisles, shall be provided.

**1011.1.1 Use Group I-2:** In occupancies in Use Group I-2, suites of rooms, other than patient sleeping rooms, shall have no more than one intervening room where the travel distance within the suite to the *exit* access door is not greater than 100 feet (30480 mm) and shall have no more than two intervening rooms where the travel distance within the suite to the *exit* access door is not greater than 50 feet (15240 mm).

**1011.1.2 Deleted.**

**1011.1.3 Turnstiles and gates:** Access through turnstiles, gates, rails or similar devices shall not be permitted unless such a device is equipped to swing readily in the direction of *exit* travel under a total force of not more than 15 pounds (73.23 N).

**1011.1.4 Restrictions:** The required width of passageways, *aisle accessways*, aisles and *corridors* shall be maintained free of projections and restrictions; except that the minimum clear width resulting from doors opening into such spaces shall be one-half of the required width. When fully open, the door shall not project more than 7 inches (178 mm) into the required width. Handrail projections are permitted in accordance with Section 1022.2.1.

**1011.2 Dead ends:** *Exit access* passageways and *corridors* in all stories which serve more than one *exit* shall provide direct connection to such *exits* in opposite directions from any point in the passageway or *corridor*, insofar as practicable. The length of a dead-end passageway or *corridor* shall not be more than 20 feet (6096 mm).

**Exceptions**

1. In occupancies in Use Group I-3 of Occupancy Conditions II, III or IV (see Section 308.4), the dead end in a *corridor*, hallway or aisle shall not exceed 50 feet (15240 mm).
2. In occupancies in Use Group B where passageways are bounded by furniture, counters, partitions or similar dividers not more than 6 feet (1829 mm) in height, the length of a dead-end passageway shall not be more than 50 feet (15240 mm).
3. In occupancies in Use Group B where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the length of dead-end *corridors* or passageways shall not exceed 50 feet (15240 mm).
4. Passageways or *corridors* within spaces with one *means of egress*.
5. A dead-end passageway or *corridor* shall not be limited in length where the length of the dead-end passageway or *corridor* is less than 2.5 times the least width of the dead-end passageway or *corridor*.

**1011.2.1 Common path of travel:** In occupancies in Use Group B, the length of a *common path of travel* shall not exceed 75 feet (22860 mm).

**Exceptions**

1. The length of a *common path of travel* in an occupancy in Use Group B shall not be more than 100 feet (30480 mm), provided that the building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1.
2. Where a tenant space in an occupancy in Use Group B has an occupant load of not more than 30, the length of a *common path of travel* shall not be more than 100 feet (30480 mm).

**1011.3 Width:** The minimum required width of passageways, *aisle accessways*, aisles and *corridors* shall be determined by the most restrictive of the following criteria:

1. 44 inches (1118 mm) where serving an occupant load of greater than 50.
2. 36 inches (914 mm) where serving an occupant load of 50 or less.
3. 96 inches (2438 mm) in an occupancy in Use Group I-2 utilized for the movement of beds.
4. 72 inches (1829 mm) in an occupancy in Use Group E with more than 100 occupants.
5. The width required for capacity as determined by Section 1009.0.
6. 24 inches (610 mm) for access to and utilization of electrical, mechanical, or plumbing systems or equipment.

Aisles and *aisle accessways* shall conform to the requirements of this section or Section 1012.0.

**1011.3.1 Capacity:** The required capacity of a *corridor* shall be determined by dividing the occupant load that utilizes the *corridor* for *exit access* by the number of *exits* to which the *corridor* connects, and shall be not less than the required capacity of the *exit* element to which the *corridor* leads.

**1011.4 Enclosure:** All *corridors* shall be fireresistance rated in accordance with Table 1011.4 based on the use group of the space and the total required capacity of all of the *exits* from the *corridor*. The *corridor* walls shall comply with Section 711.0.

**Exceptions**

1. A fireresistance rating is not required for *corridors* in an occupancy in Use Group E where each room that is occupied for instruction or assembly purposes has at least one-half of the required *means of egress* doors opening directly to the exterior of the building at ground level.
2. A fireresistance rating is not required for *corridors* contained within a *dwelling unit* or a guestroom in an occupancy in Use Group R.

**Table 1011.4**
**CORRIDOR FIRERESISTANCE RATING**

| Use Group | Total required capacity of all exits from corridor | Required fireresistance rating (hours) | |
|---|---|---|---|
| | | Without sprinkler system | With sprinkler system[d] |
| H-1, H-2, H-3 | All | 1 | 1 |
| H-4 | Greater than 30 | 1 | 1 |
| A, B, E, F, M, S, U | Greater than 30 | 1 | 0 |
| I-1, R[a] | Greater than 10 | 1 | 1/2 |
| I-2 | All | 1 | 0[b] |
| I-3 | All | Not permitted | 0[c] |

**Note a.** For a reduction in the fireresistance rating for occupancies in Use Group R, see Section 1011.4, Exception 2.
**Note b.** For requirements for occupancies in Use Group I-2, see Section 409.3.
**Note c.** For a reduction in the fireresistance rating for occupancies in Use Group I-3, see Section 410.7.
**Note d.** Buildings equipped throughout with an automatic sprinkler system in accordance with Section 906.2.1 or 906.2.2.

**1011.4.1 Corridor walls as separation walls:** Tenant, *dwelling unit* and guestroom separation walls which are also *corridor* walls shall comply with this section and the requirements of Table 602.

**Exception:** Tenant, *dwelling unit* and guestroom separation walls which are also *corridor* walls shall not be required to have a fireresistance rating greater than that required by Table 1011.4 where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.

**1011.4.2 Opening protectives:** All door assemblies from rooms opening onto a *corridor* that is required to be of fireresistance rated construction shall be *fire doors* complying with Section 717.0.

**1011.5 Exterior balconies:** Exterior *exit access* balconies shall conform to the requirements of this section for *corridors* and shall be protected to prevent the accumulation of snow and ice in climates subject to those elements.

**1011.5.1 Wall separation:** Exterior *exit access* balconies shall be separated from the interior of the building by walls and opening protectives as required by Section 1011.4. A fireresistance rating for the wall is not required where the balcony is provided with not less than two approved *stairways* or other approved *means of egress* elements and a dead end does not require travel past an unprotected opening for access to the *stairway* or *means of egress* element.

## SECTION 1012.0 ASSEMBLY AISLES AND AISLE ACCESSWAYS

**1012.1 Where required:** In occupancies in Use Group A which contain seats, tables, displays, equipment or other material shall be provided with *aisle accessways* and aisles in accordance with this section. These provisions shall also apply to tiered or stepped seating facilities except as modified by Section 1013.0.

**1012.2 Aisle and aisle accessway width:** The width of *aisle accessways* and aisles shall provide sufficient *means of egress* capacity for the number of persons accommodated by the catchment area served by the *aisle accessway* or aisle (see Section 1012.2.5). The catchment area served by an *aisle accessway* or aisle is the portion of the total space which is naturally served by that section of the *aisle accessway* or aisle. In establishing catchment areas the assumption shall be made that there is a balanced use of all *means of egress*, with the number of persons in proportion to *means of egress* capacity.

**1012.2.1 Measurement of required minimum width of aisles and aisle accessways:** Where seating is located at a table or counter and is adjacent to an aisle or *aisle accessway*, the measurement of required clear width of the aisle or *aisle accessway* shall be made to a line 19 inches (483 mm) away from the edge of the table or counter. The 19-inch (483 mm) distance shall be measured perpendicular to the side of the table or counter. In the case of other side boundaries for aisles or *aisle accessways*, the clear width shall be measured to walls, edges of seating and tread edges, except that handrail projections are permitted.

**1012.2.2 Converging aisles and aisle accessways:** Where *aisle accessways* or aisles converge to form a single path of *means of egress* travel, the required *means of egress* capacity of such path shall not be less than the combined required capacity of the converging *aisle accessways* or aisles.

**1012.2.3 Uniform width of aisles:** Those portions of aisles where *means of egress* is possible in either of two directions shall be uniform in required width.

**1012.2.4 Uniform width of aisle accessways:** Those portions of *aisle accessways* having a required width exceeding 12 inches (305 mm), where *means of egress* is possible in more than one direction, shall be uniform in required width.

**1012.2.5 Capacity of aisles and aisle accessways:** The width of aisles and *aisle accessways* shall provide sufficient capacity in accordance with the following criteria where clear width is measured in accordance with Section 1012.2.1.

1. At least 0.3 inch (7.5 mm) of width for each person served shall be provided on stairs having riser heights of 7 inches (178 mm) or less and tread depths of 11 inches (279 mm) or greater, measured horizontally between tread nosings.
2. At least 0.005 inch (0.1 mm) of additional stair width for each person shall be provided for each 0.10 inch (2.5 mm) of riser height above 7 inches (178 mm).
3. Where a *means of egress* requires stair descent, at least 0.075 inch (2 mm) of additional width for each person shall be provided on those portions of stair width not having handrails within a horizontal distance of 30 inches (762 mm).
4. Level or ramped *means of egress* with slopes less than one unit vertical in eight units horizontal (1:8), shall have at least 0.2 inch (5 mm) of clear width for each person served.

**1012.2.6 Minimum width of aisles:** The minimum clear width of aisles shall be: 48 inches (1219 mm) for stairs having seating on each side; 36 inches (914 mm) for stairs having seating on only one side; 23 inches (584 mm) between a stair handrail or guardrail and seating where the aisle is subdivided by a handrail (see Section 1012.5); 42 inches (1067 mm) for level or ramped aisles having theater-style seating on both sides; 36 inches (914 mm) for all other level or ramped aisles; and 23 inches (584 mm) between a stair handrail and seating where an aisle does not serve more than five rows on one side.

**1012.2.7 Minimum width of aisle accessways:** *Aisle accessways* shall conform to the requirements of Section 1012.6 in the case of theater-type seating and to the requirements of Section 1012.7 in the case of all seating at tables or counters.

**1012.3 Termination:** Each end of a cross aisle shall terminate at an aisle, foyer, doorway or vomitory giving access to an *exit*. Dead-end aisles which terminate only at one end with a cross aisle, foyer, doorway or vomitory giving access to an *exit* shall not be greater than 20 feet (6096 mm) in length.

**Exception:** A longer dead-end aisle is permitted where seats served by the dead-end aisle are not more than 24 seats from another aisle, measured along a row of seats having a minimum clear width of 12 inches (305 mm) plus 0.6 inch (15 mm) for each additional seat above seven in the row.

**1012.4 Walking surfaces:** Aisles with a gradient of one unit vertical in eight units horizonal (1:8) or less shall consist of a ramp having a slip-resistant walking surface. Aisles with a gradient exceeding one unit vertical in eight units horizonal (1:8) shall consist of a series of risers and treads which extend across the full width of aisles and comply with Sections 1012.4.1 and 1012.4.2.

**1012.4.1 Treads:** Tread depths shall be a minimum of 11 inches (279 mm) and be uniform within each aisle.

**Exception:** Nonuniformities shall not exceed $^{3}/_{16}$ inch (5 mm) between adjacent treads.

**1012.4.2 Risers:** Where the gradient of aisle stairs is to be the same as the gradient of adjoining seating areas, the riser height shall not be less than 4 inches (102 mm) nor more than 8 inches (203 mm) and shall be uniform within each flight.

**Exception:** Riser height nonuniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate sightlines. Where nonuniformities exceed $^{3}/_{16}$ inch (5 mm) between adjacent risers, the exact location of such nonuniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the nonuniform risers. Such stripe shall be a minimum of 1 inch (25 mm) wide and a maximum of 2 inches (51 mm) wide.

**1012.5 Handrails:** Ramped aisles having a gradient exceeding one unit vertical in fifteen units horizontal (1:15) and aisle stairs shall be provided with handrails located either at the side or within the aisle width.

**Exceptions**

1. Handrails are not required if, at the side of the aisle, there is a guardrail that complies with the requirements for handrails.
2. Handrails are not required for *aisles* with seating on both sides unless there is more than one riser per row of seating. The single riser shall be indicated by a distinctive marking stripe on the leading edge of the tread.

**1012.5.1 Discontinuous rails:** Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the handrail shall have rounded terminations or bends.

**1012.5.2 Intermediate rails:** Where handrails are provided in the middle of aisle stairs, there shall be an additional intermediate handrail located approximately 12 inches (305 mm) below the main handrail.

**1012.6 Row width:** The minimum clear row width shall not be less than 12 inches (305 mm) measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic or self-rising seats, the measurement shall be made with the seats in the raised position. Where any chair in the row does not have an automatic or self-rising seat, the measurement shall be made with the seat in the down position. Where tablet-arm chair seating is used, the measurement shall be made with the tablet-arm in the usable position.

**1012.6.1 Dual access:** For rows of seating served by aisles or doorways at both ends, there shall not be more than 100 seats per row. The minimum clear width of 12 inches (305 mm) between rows shall be increased by 0.3 inch (7.5 mm) for every additional seat beyond 14 seats, but the minimum clear width is not required to exceed 22 inches (559 mm).

**1012.6.2 Single access:** For rows of seating served by an aisle or doorway at only one end of the row, the minimum clear width of 12 inches (305 mm) between rows shall be increased by 0.6 inch (15 mm) for every additional seat beyond seven seats, but the minimum clear width is not required to exceed 22 inches (559 mm). The path of travel, however, shall not exceed 30 feet (9144 mm) from any seat to a point where a person has a choice of two paths of travel to two *exits*.

**1012.7 Aisle accessways for tables and seating:** *Aisle accessways* serving arrangements of seating at tables or counters shall have sufficient clear width to conform to the capacity requirements of Section 1012.2.5, but shall not have less than the appropriate minimum clear width specified in Section 1012.7.1.

**1012.7.1 Width:** In addition to the width required by Section 1012.2, *aisle accessways* shall provide a minimum of 12 inches (305 mm) plus 0.5 inch (13 mm) of width for each additional 1 foot (305 mm), or fraction thereof, beyond 12 feet (3660 mm) of *aisle accessway* length measured from the center of the seat farthest from an aisle.

**Exception:** Portions of an *aisle accessway* having a length not exceeding 6 feet (1830 mm) and used by a total of not more than four persons.

**1012.7.2 Length:** The length of travel along the *aisle accessway* shall not exceed 36 feet (10973 mm) from any seat to the closest aisle. The path of travel shall not exceed 30 feet (9144 mm) from any seat to the point where a person has a choice of two or more paths of travel to separate *exits*.

**1012.8 Railings:** Railings shall be provided on balconies and galleries in accordance with Section 1021.4.

## SECTION 1013.0 GRANDSTANDS

**1013.1 Scope:** These provisions shall apply to all structures with an occupancy in Use Group A which provide permanent, temporary or portable tiered or stepped seating facilities, such as *grandstands*, *bleachers*, folding and telescopic seating. Except as modified by this section, Section 1012.0 shall apply to all such structures.

**1013.2 Smoke-protected assembly seating:** Assembly seating which is served by a *means of egress* that is not subject to blocking by smoke accumulation within or under a structure shall be considered smoke protected and shall comply with the requirements of Sections 1013.2.1 through 1013.2.3.

**1013.2.1 Roof height:** A smoke-protected assembly seating area with a roof shall have the lowest portion of the roof not less than 15 feet (4572 mm) above the highest aisle or *aisle accessway*.

**1013.2.2 Automatic sprinklers:** All areas enclosed with walls and ceilings in structures containing smoke-protected assembly seating shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.0.

**Exception:** An *automatic sprinkler system* is not required for either of the following:

1. The floor area used for a contest, performance or entertainment provided that the roof construction is more than 50 feet (15240 mm) above the floor level and the use of the floor is restricted to low fire-hazard occupancies.
2. Press boxes and storage facilities less than 1,000 square feet (93 $m^2$) in area in conjunction with outdoor seating facilities where all *means of egress* in the seating area are essentially open to the outside.

**1013.2.3 Smoke control:** All *means of egress* serving a smoke-protected assembly seating area shall be provided with a smoke control system complying with Section 922.0 or natural *ventilation* designed to maintain the smoke level at least 6 feet (1829 mm) above the floor of the *means of egress*.

**1013.3 Travel distance:** The *exit access* travel distance shall comply with Section 1006.5 except that in a smoke-protected assembly seating area, the travel distance from each seat to the nearest entrance to an egress vomitory portal or egress concourse shall not exceed 200 feet (60960 mm). The travel distance from the entrance to a vomitory portal or egress concourse to an approved egress stair, ramp or walk at the building exterior shall not exceed 200 feet (60960 mm). Where aisles are required, the distance shall be measured along the aisles and *aisle accessways* without travel over or on the seats.

**1013.4 Minimum egress widths:** The minimum clear width of *stairways*, passageways, doorways, ramps and other *means of egress* shall provide sufficient capacity in accordance with the provisions of this chapter, except as modified by Table 1013.4.

**Table 1013.4**
**MINIMUM EGRESS WIDTHS**
**SMOKE-PROTECTED ASSEMBLY SEATING**

| Number of seats in the space | Inches[b] of clear width per seat served | | | |
|---|---|---|---|---|
| | Stairs with handrails[a] within 30 inches | Stairs without handrails[a] within 30 inches | Aisles, accessways, doorways and ramps not steeper than 1 in 10 slope | Ramps steeper than 1 in 10 slope |
| 2,000 or less | 0.300 | 0.375 | 0.200 | 0.220 |
| 5,000 | 0.200 | 0.250 | 0.150 | 0.165 |
| 10,000 | 0.130 | 0.163 | 0.100 | 0.110 |
| 15,000 | 0.096 | 0.120 | 0.070 | 0.077 |
| 20,000 | 0.076 | 0.095 | 0.056 | 0.066 |
| 25,000 or more | 0.060 | 0.075 | 0.044 | 0.048 |

**Note a.** If risers exceed 7 inches in height, the minimum clear width of stairs determined from the table shall be multiplied by factor *A* where $A = 1 + [(\text{Riser Height} - 7.0) \div 5]$.
**Note b.** 1 inch = 25.4 mm.

**1013.4.1 Use Group A-5 seating systems:** The requirements of Table 1013.4 shall not apply to aisles serving seating systems of a Use Group A-5 where the minimum clear width of the aisle complies with the following criteria:

1. Aisles serving seating areas with 200 or greater seats shall not be less than 48 inches (1219 mm) in clear width.
2. Aisles serving seating areas with greater than 60 seats but less than 200 seats shall not be less than 44 inches (1118 mm) in clear width.
3. Aisles serving seating areas with less than 60 seats shall not be less than 30 inches (762 mm) in clear width.

**1013.5 Aisles:** Aisles shall be provided in all seating facilities. An aisle is not required where all of the following conditions exist:

1. Seats are without backrests.
2. The rise from row to row does not exceed 6 inches (152 mm) per row.
3. The row spacing does not exceed 28 inches (711 mm) unless the seatboards and footboards are at the same elevation.
4. The number of rows does not exceed 16 in height.
5. The first seatboard is not more than 12 inches (305 mm) above the ground, floor surface or cross aisle below.
6. Seatboards have a continuous flat surface.
7. Seatboards provide a walking surface with a minimum width of 11 inches (279 mm).
8. Egress from seating is not restricted by rails, guards or other obstructions.

**1013.5.1 Termination:** Where seats are without backrests, dead ends in vertical aisles shall not exceed a distance of 16 rows. For smoke-protected assembly seating, the dead ends in vertical aisles shall not exceed a distance of 21 rows. For smoke-protected assembly seating, a longer dead-end aisle is permitted where seats served by the dead-end aisle are not more than 40 seats from another aisle, measured along a row of seats having an *aisle accessway* with a minimum clear width of 12 inches (305 mm) plus 0.3 inch (8 mm) for each additional seat above seven in the row.

**1013.5.2 Row width:** For smoke-protected assembly seating, the maximum number of seats in a row that has a minimum clear *aisle accessway* width of 12 inches (305 mm) shall be as specified in Table 1013.5.2.

Where the number of seats per row exceeds that specified in Table 1013.5.2, the minimum clear *aisle accessway* width for rows served by aisles or doorways at both ends shall be 12 inches (305 mm) plus 0.3 inch (7.5 mm) for every additional seat beyond that specified in Table 1013.5.2 and there shall be not more than 100 seats per row; and for rows served by an aisle or doorway at only one end of the row, the minimum clear *aisle accessway* width shall be 12 inches (305 mm) plus 0.6 inch (15 mm) for every additional seat beyond that specified in Table 1013.5.2.

**Table 1013.5.2**
**ROW LENGTH WITH 12-INCH AISLE ACCESSWAY SMOKE-PROTECTED ASSEMBLY SEATING**

| Total number of seats in the space | No. of seats per row permitted to have a minimum 12-inch[a] clear width aisle accessway | |
|---|---|---|
| | Aisle or doorway at both ends of row | Aisle or doorway at one end of row |
| Less than 4,000 | 14 | 7 |
| 4,000 | 15 | 7 |
| 7,000 | 16 | 8 |
| 10,000 | 17 | 8 |
| 13,000 | 18 | 9 |
| 16,000 | 19 | 9 |
| 19,000 | 20 | 10 |
| 22,000 or more | 21 | 11 |

**Note a.** 1 inch = 25.4 mm.

**1013.5.3 Single access row:** For rows of seating served by an aisle or doorway at only one end of the row in smoke-protected assembly seating, the *common path of travel* from any seat to a point where a person has a choice of two directions of egress travel shall not exceed 50 feet (15240 mm).

**1013.6 Bleacher footboards:** *Bleacher* footboards shall be provided for all rows of seats above the third row or beginning at such a point where the seatboard is more than 2 feet (610 mm) above the ground, floor surface or cross aisle below. A separate footboard is not required where the same *platform* is used for both seating and the footboard, provided that each level or *platform* is not less than 24 inches (610 mm) wide. On a horizontally projected plane, horizontal gaps between footboards and seatboards shall not exceed $^1/_4$ inch (6 mm). Openings between footboards and seatboards which are located more than 30 inches (762 mm) above the floor or grade below shall be provided with intermediate construction such that a sphere with a diameter of 4 inches (102 mm) cannot pass through the opening.

**1013.7 Spaces underneath seats:** Spaces underneath *grandstand* seats shall be kept free of all combustible and *flammable* materials and shall not be occupied or used for other than *exits*; except that where enclosed in not less than 1-hour fireresistance rated construction, the code official shall approve the use of such spaces for other purposes, provided that the safety of the public is not endangered.

## SECTION 1014.0 STAIRWAYS

**1014.1 General:** All *stairways* shall comply with the provisions of this section. Section 1014.11 shall be applicable only to interior *stairways*. Section 1014.12 shall be applicable only to exterior *stairways*.

**1014.1.1 Walking surface slope:** The maximum slope of the walking surface of treads and landings shall be one unit vertical in 48 units horizontal (1:48).

**Exception:** The maximum slope shall not apply to portions of treads that are rounded or beveled in accordance with Section 1014.6.1.

**1014.2 Egress capacity:** The egress capacity of *stairways* and doors shall be computed in accordance with Section 1009.0.

**1014.3 Width:** All *means of egress stairways* shall not be less than 44 inches (1118 mm) in width.

**Exceptions**

1. *Stairways* serving buildings of single-*exit* construction where permitted by Section 1010.3 shall not be less than 36 inches (914 mm) in width.
2. Spiral *stairways* as provided for in Section 1014.6.4.
3. *Stairways* serving an occupancy in Use Group R-3 shall not be less than 36 inches (914 mm) in width.
4. *Stairways* serving buildings having a total occupant load of 50 or less shall not be less than 36 inches (914 mm) in width.
5. Where a *stairway* lift is installed on *stairways* serving occupancies in Use Group R-3 or within *dwelling units* in occupancies in Use Group R-2, a clear passage width not less than 20 inches (508 mm) shall be provided.

**1014.3.1 Restrictions:** *Means of egress stairways* shall not reduce in width in the direction of egress travel. Projections into a required *stairway* width are prohibited.

**Exceptions**

1. At and below handrail height where, at each handrail, projections into the required width of a *stairway* shall not exceed $4^1/_2$ inches (114 mm).
2. Above the minimum headroom height required in Section 1014.4, projections into the required width shall not be limited.

**1014.3.2 Landing width:** The least dimension of landings and *platforms* in *means of egress stairways* shall not be less than the required width of the *stairway*, except that the landing dimension in the direction of egress travel is not required to exceed 4 feet (1219 mm) where the travel from one stair flight to the next stair flight is a straight run.

**1014.4 Headroom:** The minimum headroom in all parts of a *stairway* shall not be less than 80 inches (2032 mm), or 78 inches (1981 mm) for a spiral *stairway,* measured vertically from the tread nosing or from the floor surface of the landing or *platform*.

**1014.5 Vertical rise:** A *means of egress stairway* shall not have a height of vertical rise of more than 12 feet (3658 mm) between landings and intermediate *platforms*.

**1014.6 Treads and risers:** Maximum riser height shall be 7 inches (178 mm) and minimum riser height shall be 4 inches (102 mm). The riser height shall be measured vertically between the leading edges of the adjacent treads. Minimum tread depth shall be 11 inches (279 mm), measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge.

**Exceptions**

1. Winders in accordance with Section 1014.6.3.
2. Spiral *stairways* in accordance with Section 1014.6.4.
3. Circular *stairways* in accordance with Section 1014.6.5.
4. *Alternating tread stairways* in accordance with Section 1014.6.6.
5. *Stairways* serving as aisles in assembly seating areas where the *stairway* pitch or slope is set, for sightline reasons, by the slope of the adjacent seating area.
6. Any *stairway* replacing an existing *stairway* within a space where, because of existing construction, the pitch or slope cannot be reduced.
7. Existing *stairways*.
8. In occupancies in Use Group R-3, within *dwelling units* in occupancies in Use Group R-2 and in occupancies in Use Group U which are accessory to an occupancy in Use Group R-3, the maximum riser height shall be $8^1/_4$ inches (210 mm) and the minimum tread depth shall be 9 inches (229 mm). A nosing not less than $^3/_4$ inches (19 mm) but not more than $1^1/_4$ inches (32 mm) shall be provided on *stairways* with solid risers where the tread depth is less than 11 inches (279 mm).
9. *Stairways* in penal facilities serving guard towers, observation stations and control rooms not more than 250 square feet (23 $m^3$) in area shall be permitted to have risers not exceeding 8 inches (203 mm) in height and treads not less than 9 inches (229 mm) in depth.

**1014.6.1 Tread nosing:** See Chapter 11 for buildings and facilities required to be accessible to persons with physical disabilities.

**Exceptions: Deleted.**

**1014.6.2 Dimensional uniformity:** There shall not be variation exceeding $^3/_{16}$ inch (5 mm) in the depth of adjacent treads or in the height of adjacent risers. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed $^3/_8$ inch (10 mm) in any flight of stairs.

**Exceptions**

1. Where the bottom riser adjoins a sloping *public way*, walk or driveway which has an established grade and serves as a landing, a variation in the height of the bottom riser shall not exceed 3 inches (76 mm) in every 3 feet (914 mm) of *stairway* width.
2. On *stairways* serving as aisles in assembly seating, where necessitated by changes in the gradient of adjoining seating areas to maintain adequate sightlines, the maximum nonuniformity of riser heights within a flight and the nonuniformity between adjacent risers shall not apply. Where a nonuniformity exceeds $^3/_{16}$ inch (5 mm) between adjacent risers, the exact location of the nonuniformity shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the nonuniform risers.

**1014.6.3 Winders:** Winders shall not be permitted in required *means of egress stairways* except *stairways* serving a single *dwelling unit*. Such winders shall have a tread depth of not less than 10 inches (254 mm) at a point not more than 12 inches (305 mm) from the side where the tread is narrower and the minimum tread depth shall not be less than 6 inches (152 mm). The continuous handrail required by Section 1014.7 shall be located on the side where the tread is narrower.

**1014.6.4 Spiral stairways:** Spiral *stairways* shall not be used as an element of a *means of egress* except: within a single *dwelling unit*; from a *mezzanine* area not more than 250 square feet (23 $m^2$) in area which serves not more than five occupants; and in penal facilities from a guard tower, observation station or control room not more than 250 square feet (23 $m^2$) in area. The minimum width of all spiral *stairways* shall be 26 inches (660 mm) with each tread having a $7^1/_2$-inch (191 mm) minimum tread depth at 12 inches (305 mm) from the narrow edge. All treads shall be identical and the rise shall not be more than $9^1/_2$ inches (241 mm). A minimum headroom of 6 feet 6 inches (1981 mm) shall be provided.

**1014.6.5 Circular stairways:** Circular *stairways* shall have a minimum tread depth and a maximum riser height in accordance with Section 1014.6 and the smaller radius shall not be less than twice the width of the *stairway*. The minimum tread depth measured 12 inches (305 mm) from the narrower end of the tread shall not be less than 11 inches (279 mm).

**1014.6.6 Alternating tread stairways:** *Alternating tread stairways* are permitted as an element of a *means of egress* in buildings from a *mezzanine* area not more than 250 square feet (23 $m^2$) in *area* and which serves not more than five occupants; and in penal facilities, from a guard tower, observation station or control room not more than 250 square feet (23 $m^2$) in area. *Alternating tread stairways* are also permitted for access to roofs as provided for in Section 1027.0.

**1014.6.6.1 Handrails of alternating tread stairways:** Handrails shall be provided on both sides of *alternating tread stairways* and shall conform to Section 1022.0.

**1014.6.6.2 Treads of alternating tread stairways:** *Alternating tread stairways* shall have a minimum projected tread of 5 inches (127 mm), a minimum tread depth of $8^1/_2$ inches (216 mm), a minimum tread width of 7 inches (178 mm) and a maximum riser to the next surface of the alternating tread of $9^1/_2$ inches (241 mm). The initial tread of the *stairway* shall begin at the same elevation as the *platform*, landing or floor surface.

**Exception:** *Alternating tread stairways* used as an element of a *means of egress* in buildings from a *mezzanine* area not more than 250 square feet (23 $m^2$) in area which serves not more than five occupants shall have a minimum projected tread of $8^1/_2$ inches (216 mm) with a minimum tread depth of $10^1/_2$ inches (267 mm). The rise

to the next alternating tread surface shall not be more than 8 inches (203 mm).

**1014.7 Stairway guards and handrails:** *Stairways* shall have continuous handrails on both sides. Guards shall be provided where required by Section 1005.5. Intermediate handrails are required so that all portions of the required width of stairs are within 30 inches (762 mm) of a handrail. On monumental stairs, handrails shall be located along the most direct path of egress travel. Handrails shall be provided for *alternating tread stairways* in accordance with Section 1014.6.6.1. Guards shall be constructed in accordance with Section 1021.0. Handrails shall be constructed in accordance with Section 1022.0.

**Exceptions**

1. *Stairways* with fewer than three risers are not required to have handrails where serving a single *dwelling unit* or where such *stairways* are not in an *exit access corridor* or aisle, *exit* or *exit discharge*.
2. Aisle stairs provided with a center handrail or serving seating on one side shall be equipped with a minimum of one handrail.
3. *Stairways* within a *dwelling unit* shall be equipped with a minimum of one handrail.
4. Spiral *stairways* shall be equipped with a minimum of one handrail.
5. *Stairway* handrails within a *dwelling unit* shall be considered continuous in accordance with Section 1022.2 Exception No. 2.

**1014.8 Egress doors:** *Means of egress stairway* doors shall provide an egress capacity of not less than the required capacity of the *stairway* which serves the floor or area from which the egress door leads.

**1014.8.1 Width:** The minimum required width of every door to or from a *means of egress stairway* shall be determined by the most restrictive of the following criteria:

1. $29^{3}/_{4}$-inch (756 mm) clear width within a *dwelling unit* that is not required to be accessible.
2. 32-inch (813 mm) clear width in all other cases.

**1014.8.2 Direction of swing:** All *means of egress* doors shall swing on a landing in the direction of egress travel. When opening, egress doors shall not reduce the width of landings to less than one-half of the required width. When fully open, *means of egress* doors shall not project more than 7 inches (178 mm) into the required width.

**Exception:** Doors leading from a room or tenant space to a *stairway* in buildings in which only one *exit* is required are not required to swing in the direction of egress travel.

**1014.8.3 Door construction:** All doorway opening protectives shall be *fire doors* complying with Section 717.0.

**1014.8.4 Maximum transmitted temperature:** *Labeled means of egress fire doors* shall have a maximum transmitted temperature end point of not more than 450 degrees F. (232 degrees C.) above ambient at the end of 30 minutes of standard fire test exposure.

**Exception:** The maximum transmitted temperature end point is not required in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 or 906.2.2.

**1014.9 Stairway construction:** All *stairways* shall be built of materials consistent with the types of materials permitted for the type of construction of the building; except that wood handrails shall be permitted for all types of construction. Such *stairways* shall have solid treads and landing *platforms*, and all finish floor surfaces shall be of securely attached, slip-resistant materials.

**Exception:** In Use Group F, H and S occupancies, other than areas of parking structures accessible to the public, openings in treads and landing *platforms* shall not be prohibited provided a sphere with a diameter of 1.125 inches (28 mm) cannot pass through any opening.

**1014.9.1 Strength:** All *stairways*, *platforms* and landings shall be adequate to support a *live load* of 100 pounds per square foot (4788 Pa) and a concentrated *load* of 300 pounds (1334 N).

**1014.10 Discharge identification:** *Exit stairways* which continue beyond the *level of exit discharge* shall be interrupted at the *level of exit discharge* by partitions, doors or other effective means of preventing persons from continuing past the floor of discharge while egressing.

**1014.11 Interior stairway enclosures:** Interior *exit stairways* shall be enclosed with *fire separation assemblies* having a fireresistance rating of not less than 2 hours except that such *stairways* in occupancies in Use Group A, B, E, F, H-4, I, M, R or S which connect less than four stories shall be enclosed with *fire separation assemblies* having a fireresistance rating of not less than 1 hour. An *exit stairway* enclosure shall not be used for any purpose other than *means of egress*. Openings in *exit* enclosures, other than unexposed exterior openings, shall be limited to those necessary for *exit access* to the enclosure from normally occupied spaces and for egress from the enclosure.

**Exceptions**

1. *Stairways* are not required to be enclosed in occupancies in Use Group A-5 in which all portions of the *means of egress* are essentially open to the outside.
2. *Stairways* serving and contained within a single residential *dwelling unit* in occupancies in Use Group R-2 or R-3 are not required to be enclosed.
3. *Stairways* that are not a required *means of egress* element are not required to be enclosed where such *stairways* comply with Section 713.3.
4. *Stairways* in open parking structures which serve only the parking structure are not required to be enclosed.
5. *Stairways* in occupancies in Use Group I-3 as provided for in Section 410.3.7.
6. *Means of egress stairways* as required by Section 412.5.4 are not required to be enclosed.

**1014.11.1 Exterior walls:** Exterior walls of an enclosed *exit stairway* shall comply with the requirements of Section 705.0 for exterior walls. Where nonrated walls or unprotected openings enclose the exterior of the *stairway* and the walls or openings are exposed by other parts of the building at an angle of less than 180 degrees (3.14 rad), the building exterior walls within 10 feet (3048 mm) horizontally of a nonrated wall or

unprotected opening shall be constructed as required for *stairway* enclosures, including opening protectives, but are not required to exceed a 1-hour fireresistance rating with $^3/_4$-hour opening protectives. This construction shall extend vertically from a point 10 feet (3048 mm) above the topmost landing of the *stairway* or to the roof line, whichever is lower, and down to the ground.

**1014.11.2 Penetrations:** Penetrations into and openings through an *exit* enclosure assembly are prohibited except for required *exit* doors, ductwork and equipment necessary for independent stair pressurization, required *ventilation*, *sprinkler* piping, *standpipes* and electrical conduit serving the *stairway* and terminating at a steel box that does not exceed 16 square inches (10323 mm$^2$) in area. There shall not be any penetrations or communicating openings, whether protected or not, between adjacent *stairway* enclosures.

**1014.11.3 Door locks:** All interior *stairway means of egress* doors shall be openable from both sides without the use of a key or special knowledge or effort.

**Exceptions**

1. *Stairway* discharge doors shall be openable from the egress side and shall only be locked from the opposite side.
2. This section shall not apply to doors arranged in accordance with Sections 403.10 and 1017.4.

**1014.11.4 Deleted.**

**1014.11.5 Stairway floor number signs:** A sign shall be provided at each floor landing in all interior *exit stairways* connecting more than three stories designating the floor level above and below the *level of exit discharge*, the identification of the *stairway* and the availability of roof access from that *stairway*. The sign shall be located approximately 5 feet (1524 mm) above the floor landing in a position which is readily visible when the doors are in the open and closed positions.

**1014.12 Exterior stairways:** Exterior *stairways* shall have openings on at least one side facing an *outer court*, yard or *public way*. The openings shall have an aggregate width of not less than 20 percent of the *stairway* perimeter and an aggregate area on each level of not less than 12 percent of the total perimeter wall area of each level. Exterior *stairways* shall not be accepted as an *exit* in the following cases:

1. Buildings of Use Group I-2 which exceed four stories or 50 feet (15240 mm) in *height*.
2. Floors that exceed five stories or 65 feet (19812 mm) in *height* above the *level of exit discharge*.

**1014.12.1 Location:** Exterior *exit stairways* shall not project beyond the *street lot line*. Exterior *exit stairways* shall be located at least 10 feet (3048 mm) from adjacent *lot lines* and from other buildings on the same *lot* unless openings in such buildings are protected by $^3/_4$-hour opening protectives.

**Exception:** Noncombustible exterior *stairways* constituting not more than 50 percent of the required *means of egress* shall be exempt from the 10-foot (3048 mm) *fire separation distance* requirement.

**1014.12.2 Protection:** Exterior *exit* stairs shall be separated from the interior of the building by walls with a fireresistance rating of not less than 1 hour, with fixed or self-closing opening protectives as required in Section 1014.11. This protection shall extend vertically from a point 10 feet (3048 mm) above the topmost landing or the roof line, whichever is lower, down to the ground, and shall extend horizontally 10 feet (3048 mm) from each side of the *stairway*. Openings within the horizontal 10-foot (3048 mm) extension of the protected walls beyond the *stairway* shall be equipped with fixed $^3/_4$-hour opening protective assemblies.

**Exceptions**

1. Occupancies, other than those in Use Group R-1 or R-2, in buildings that are two *stories* or less *above grade* where the *level of exit discharge* is the first *story above grade*.
2. Separation from the interior of the building is not required where the exterior *stairway* is served by an exterior *exit access* balcony that connects two remote exterior *stairways* or other approved *exits*, with a perimeter which is not less than 50 percent open. To be considered open, the opening shall be a minimum of 50 percent of the height of the enclosing wall, with the top of the openings not less than 7 feet (2134 mm) above the top of the balcony.
3. Separation from the interior of the building is not required for an exterior *stairway* located in a building or structure that is permitted to have unenclosed interior *exit stairways* in accordance with Section 1014.11.

## SECTION 1015.0 SMOKEPROOF ENCLOSURES

**1015.1 General:** A *smokeproof enclosure* shall consist of an enclosed interior *exit stairway* that conforms to Section 1014.0 and an outside balcony or a *ventilated* vestibule meeting the requirements of this section. Where access to the roof is required by Section 1027.0, such access shall be from the *smokeproof enclosure* where a *smokeproof enclosure* is required.

**1015.2 Where required:** All *exit stairways* serving occupants of a floor level located more than 75 feet (22860 mm) above the *level of exit discharge*, or located more than 30 feet (9144 mm) below the *level of exit discharge* serving such floor levels, shall be protected by a *smokeproof enclosure*.

**Exception:** Occupancies in Use Group I-2.

**1015.3 Access:** Access to the stair shall be from every story and shall be by way of a vestibule or by way of an open exterior balcony, except that a vestibule or balcony is not required for a *smokeproof enclosure* that consists of a pressurized *stairway* complying with Section 1015.7. The minimum dimension of the vestibule shall not be less than the required width of the *corridor* leading to the vestibule but shall not have a width of less than 44 inches (1118 mm) and shall not have a length of less than 72 inches (1829 mm) in the direction of egress travel.

**1015.4 Construction:** The *smokeproof enclosure* shall be separated from the remainder of the building by not less than a 2-hour fireresistance rated *fire separation assembly* without openings other than the required *means of egress* doors. The vestibule shall

be separated from the *stairway* by not less than a 2-hour fireresistance rated *fire separation assembly*. The open exterior balcony shall be constructed in accordance with the fireresistance rating requirements for floor construction.

**1015.4.1 Door closers:** All doors in a *smokeproof enclosure* shall be self-closing or shall be automatic-closing by actuation of a smoke detector installed at the floor side entrance to the *smokeproof enclosure* in accordance with Section 717.5. The actuation of the smoke detector on any door shall activate the closing devices on all doors in the *smokeproof enclosure* at all levels. Smoke detectors shall be installed in accordance with Section 919.8.

**1015.5 Natural ventilation alternative:** The provisions of Sections 1015.5.1 through 1015.5.3 shall apply to *ventilation* of *smokeproof enclosures* by natural means.

**1015.5.1 Balcony doors:** Where access to the *stairway* is by way of an open exterior balcony, the door assembly into the enclosure shall be a *fire door* in accordance with Section 717.0.

**1015.5.2 Vestibule doors:** Where access to the *stairway* is by way of a vestibule, the door assembly into the vestibule shall be a *fire door* complying with Section 717.0. The door assembly from the vestibule to the *stairway* shall have not less than a 20-minute *fire protection rating* complying with Section 717.0.

**1015.5.3 Vestibule ventilation:** Each vestibule shall have a minimum net area of 16 square feet (1.5 $m^2$) of opening in a wall facing an *outer court*, yard or *public way* which is at least 20 feet (6096 mm) in width.

**1015.6 Mechanical ventilation alternative:** The provisions of Sections 1015.6.1 through 1015.6.4 shall apply to *ventilation* of *smokeproof enclosures* by mechanical means.

**1015.6.1 Vestibule doors:** The door assembly from the building into the vestibule shall be a *fire door* complying with Section 717.0. The door assembly from the vestibule to the *stairway* shall have not less than a 20-minute *fire protection rating* in accordance with Section 717.0. The door from the building into the vestibule shall be provided with gaskets or other provisions to minimize air leakage.

**1015.6.2 Vestibule ventilation:** The vestibule shall be supplied with not less than one air change per minute, and the exhaust shall not be less than 150 percent of supply. Supply air shall enter and exhaust air shall discharge from the vestibule through separate, tightly constructed ducts used only for that purpose. Supply air shall enter the vestibule within 6 inches (152 mm) of the floor level. The top of the exhaust register shall be located at the top of the smoke trap but not more than 6 inches (152 mm) down from the top of the trap, and shall be entirely within the smoke trap area. Doors in the open position shall not obstruct duct openings. Duct openings with controlling dampers are permitted where necessary to meet the design requirements, but dampers are not otherwise required.

**1015.6.2.1 Engineered ventilation system:** Where a specially engineered system is used, the system shall exhaust a quantity of air equal to not less than 90 air changes per hour from any vestibule in the emergency operation mode and shall be sized to handle three vestibules simultaneously. Smoke detectors shall be located at the floor side entrance to each vestibule and shall activate the system for the affected vestibule. Smoke detectors shall be installed in accordance with Section 919.8.

**1015.6.3 Smoke trap:** The vestibule ceiling shall be at least 20 inches (508 mm) higher than the door opening into the vestibule to serve as a smoke and heat trap and to provide an upward moving air column. The height shall not be decreased unless approved and justified by design and test.

**1015.6.4 Stair shaft air movement system:** The stair *shaft* shall be provided with a dampered relief opening and supplied with sufficient air to maintain a minimum positive pressure of 0.10 inch of water column (29 Pa) in the *shaft* relative to the vestibule with all doors closed.

**1015.7 Stair pressurization alternative:** Where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the vestibule is not required, provided that all interior *exit stairways* are pressurized to a minimum of 0.15 inch of water column (44 Pa) and a maximum of 0.35 inch of water column (102 Pa) in the *shaft* relative to the building measured with all *stairway* doors closed under maximum anticipated stack pressures.

**1015.8 Ventilating equipment:** The activation of *ventilating* equipment required by the alternatives in Sections 1015.6 and 1015.7 shall be by smoke detectors installed at each floor level at an approved location at the entrance to the *smokeproof enclosure*. When the closing device for the stair *shaft* and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and operate at the required performance levels. Smoke detectors shall be installed in accordance with Section 919.8.

**1015.8.1 Ventilation systems:** *Smokeproof enclosure ventilation* systems shall be independent of other building *ventilation* systems. The equipment and ductwork shall comply with one of the following:

1. Equipment and ductwork shall be located exterior to the building and shall be directly connected to the *smokeproof enclosure* or connected to the *smokeproof enclosure* by ductwork enclosed by 2-hour fireresistance rated *fire separation assemblies*.
2. Equipment and ductwork shall be located within the *smokeproof enclosure* with intake or exhaust directly from and to the outside or through ductwork enclosed by 2-hour fireresistance rated *fire separation assemblies*.
3. Equipment and ductwork shall be located within the building if separated from the remainder of the building, including other mechanical equipment, by 2-hour fireresistance rated *fire separation assemblies*.

**1015.8.2 Standby power:** Mechanical vestibule and stair *shaft ventilation* systems and automatic fire detection systems shall be powered by an approved standby power system conforming to Sections 403.9.1 and 2707.0.

**1015.8.3 Acceptance and testing:** Before the mechanical equipment is approved, the system shall be tested in the code official's presence to confirm that the system is operating in compliance with these requirements.

## SECTION 1016.0 RAMPS

**1016.1 Capacity:** The capacity of a ramp used as a *means of egress* component shall be computed in accordance with Section 1009.0.

**1016.2 Minimum dimensions:** The minimum dimensions of *means of egress* ramps shall comply with Sections 1016.2.1 through 1016.2.3.

**1016.2.1 Width:** The minimum width of a *means of egress* ramp shall not be less than that required for *corridors* by Section 1011.3.

**1016.2.2 Headroom:** The minimum headroom in all parts of the *means of egress* ramp shall not be less than 80 inches (2032 mm).

**1016.2.3 Restrictions:** *Means of egress* ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited except at and below handrail height where, at each handrail, the projections shall not exceed $3^1/_2$ inches (89 mm) into the required width. See Chapter 11 for door opening limitations in buildings and facilities required to be accessible to persons with physical disabiities.

**1016.3 Maximum slope:** The maximum slope of *means of egress* ramps shall be 1 unit vertical in 8 units horizontal (1:8); except ramps required for persons with physical disabilities (see Chapter 11).

**1016.4 Landings:** Ramp slopes of one unit vertical in 12 units horizontal (1:12) or steeper shall have landings at the top, bottom, all points of turning, entrance, *exit* and at doors. See Chapter 11 for maximum vertical rise limitations for buildings and facilities required to be accessible to persons with physical disabilities. The maximum slope of landings shall be one unit vertical in 48 units horizontal (1:48). The least dimension of a landing shall not be less than the required width of the ramp except that the landing dimension in the direction of travel is not required to exceed 4 feet (1219 mm) where the travel from one ramp to the next ramp is a straight run.

**Exception:** Aisles in areas of Use Group A shall comply with Section 1012.0.

**1016.5 Guards and handrails:** Guards shall be provided where required by Section 1005.5 and shall be constructed in accordance with Section 1021.0. Handrails conforming to Section 1022.0 shall be provided on both sides of every ramp. Handrails are not required on curb ramps or on ramps where the vertical rise between landings is 6 inches (152 mm) or less and the ramp run is 72 inches (1829 mm) or less.

**Exception:** Handrails in aisles in occupancies in Use Group A shall comply with Section 1012.0.

**1016.5.1 Drop-offs:** See Chapter 11 for buildings and facilities required to be accessible to persons with physical disabilities.

**1016.6 Ramp construction:** Ramps used as an *exit* shall conform to the applicable requirements of Section 1014.9 as to materials of construction and enclosure.

**1016.6.1 Surface:** For all slopes exceeding one unit vertical in 20 units horizontal (1:20) and where the use is such as to involve danger of slipping, the ramp shall be surfaced with approved slip-resistant materials.

**1016.6.2 Exterior ramps:** Exterior ramps and landings shall be designed and constructed to prevent water from accumulating on the walking surface.

## SECTION 1017.0 MEANS OF EGRESS DOORWAYS

**1017.1 General:** The requirements of this section shall apply to all doorways serving as a component or element of a *means of egress*, except as provided for in Sections 1014.8, 1014.12.2, 1015.5.1, 1015.5.2 and 1015.6.1.

**1017.1.1 Floor surface:** The floor surface on both sides of a door shall be at the same elevation. The floor surface over which the door swings shall be at the same elevation as the floor level at the threshold and shall extend from the door in the closed position a distance equal to the door width.

**Exception:** This requirement shall not apply to:

1. Exterior doors, as provided for in Section 1005.6, which are not on an accessible route.
2. Variations in elevation due to differences in finish materials, but not more than $^1/_2$ inch (13 mm).

Thresholds at doorways shall not exceed $^3/_4$ inch (19 mm) in height above the finished floor surface for exterior residential sliding doors or $^1/_2$ inch (13 mm) for all other doors. Raised thresholds and floor level changes greater than $^1/_4$ inch (6 mm) at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (1:2).

**1017.2 Number of doorways:** Each occupant of a room or space shall have access to at least two *exits* or *exit access* doors from the room or space where the occupant load of the space exceeds that listed in Table 1017.2, or where the travel distance from any point within the space to an *exit* or *exit access* door exceeds that listed in Table 1017.2. Where the occupant load of a room or space is between 501 and 1,000, a minimum of three *exits* or *exit access* doors shall be provided. Where the occupant load of a room or space exceeds 1,000, a minimum of four *exits* or *exit access* doors shall be provided.

**Exceptions**

1. Occupancies in Use Group R-3.
2. Boiler, incinerator and furnace rooms shall be provided with two egress doorways where the area exceeds 500 square feet (47 $m^2$) and individual fuel-fired equipment exceeds 400,000 Btuh (117 kW) input capacity. Doorways shall be separated by a horizontal distance equal to not less than one-half of the diagonal dimension of

the room. Where two doorways are required by this exception, a fixed ladder access out of the room shall be permitted in lieu of one doorway.

3. In an occupancy in Use Group I-2, any patient sleeping room and any suite of rooms as permitted in Section 1011.1.2, Exception No. 3, of more than 1,000 square feet (93 $m^2$), shall have at least two *exit access* doors remote from each other. Any room or any suite of rooms, other than patient sleeping rooms of more than 2,500 square feet (230 $m^2$) shall have at least two *exit access* doors remote from each other.

**Table 1017.2**
**SPACES WITH ONE MEANS OF EGRESS**

| Use Group | Maximum occupant load | Maximum travel distance (feet)[b] |
|---|---|---|
| A, B, E, F, M | 50 | 75 |
| H-1[a], H-2, H-3 | 3 | 25 |
| H-4 | 10 | 75 |
| I, R | 10 | 75 |
| S, U | 30 | 100 |

**Note a.** For requirements for areas and spaces in Use Group H-1, see Section 418.2.2.
**Note b.** 1 foot = 304.8 mm.

**1017.2.1 Entrance and egress doorways:** Where separate doors are provided for entrance and *means of egress*, the entrance door shall be clearly identified in an approved manner "Entrance Only" in letters not less than 6 inches (152 mm) in height and legible from both inside and outside.

**1017.2.2 Location of doors:** The required doorways opening from a room or space within a building and leading to an *exit access* shall be located as remote as practicable from each other and shall conform to Section 1006.4.1. The distance of *exit access* travel from any point in a room or space to a required *exit* door shall not exceed the limitations of Section 1006.5.

**1017.2.3 Door arrangement:** The space between doors in series shall not be less than 7 feet (2134 mm) as measured when the doors are in the closed position.

**Exception:** Power-operated doors and occupancies in Use Groups I-1 and R-3.

**1017.3 Size of doors:** The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 32 inches (813 mm). Where this section requires a minimum clear width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 32 inches (813 mm). The maximum width of a swinging door leaf shall be 48 inches nominal. *Means of egress* doors in an occupancy in Use Group I-2 used for the movement of beds shall provide a clear width not less than $41^1/_2$ inches (1050 mm). The height of doors shall not be less than 80 inches (2032 mm).

**Exceptions**

1. A *means of egress* door serving a storage area of not more than 800 square feet (74 $m^2$) and which is normally unoccupied shall have a maximum width of 10 feet (3048 mm).
2. The minimum and maximum width shall not apply to door openings that are not part of the required *means of egress* in occupancies in Use Groups R-2 and R-3.
3. Door openings to resident sleeping rooms in occupancies in Use Group I-3 shall have a clear width of not less than 28 inches (711 mm).
4. Door openings to storage closets less than 10 square feet (0.93 $m^2$) in area shall not be limited by the minimum width.
5. Width of door leafs in revolving doors that comply with Section 1018.0 shall not be limited.
6. Door openings within a *dwelling unit* shall not be less than 78 inches (1981 mm) in height.
7. Exterior door openings in *dwelling units*, other than the required *exit* door, shall not be less than 76 inches (1930 mm) in height.
8. Interior egress doorways within a *dwelling unit* not required to be accessible shall have a minimum clear width of $29^3/_4$ inches (755 mm). Door openings to storage closets and all other nonhabitable spaces within a *dwelling unit* not required to be accessible, shall not be limited by the minimum width.
9. Deleted.

**1017.4 Door hardware:** All *means of egress* doors shall be of a side-swinging type. All doors shall swing in the direction of egress where serving an occupant load of 50 or more persons or where serving a high-hazard occupancy. The opening force for interior side-swinging doors without closers shall not exceed a 5-pound (22 N) force. For all other side-swinging, sliding and folding doors, the door latch shall release when subjected to a 15-pound (66 N) force. The door shall be set in motion when subject to a 30-pound force (132 N) force. The door shall swing to a full-open position when subjected to a 15-pound (66 N) force. Forces shall be applied to the latch side. See Chapter 11 for additional requirements for door operation in buildings and facilities required to be accessible to persons with physical disabilities.

**Exceptions**

1. Doors to *private garages*, factory and storage areas with an occupant load of 10 or less.
2. Horizontal sliding-type doors complying with Section 410.4.2 shall be permitted in a *means of egress* in occupancies in Use Group I-3.
3. Doors within or serving a single *dwelling unit* which is not required to be accessible by Chapter 11, are not required to be provided with lever-handled operating devices.
4. Revolving doors conforming to Section 1018.0.
5. Horizontal sliding doors complying with Section 1017.4.4 shall be permitted in a *means of egress*.
6. Horizontal sliding doors for sleeping areas within suites which comply with Section 1011.1.2, Exception 3.
7. Horizontal sliding doors complying with Section 1017.4.3.
8. Horizontal sliding doors shall not be prohibited within a single *dwelling unit* serving an occupant load of less than 10.

**1017.4.1 Locks and latches:** All *means of egress* doors shall be readily openable from the side from which egress is to be made without the use of a key or special knowledge or effort.

**Exceptions**

1. Key operation shall be permitted from a *dwelling unit* provided that the key cannot be removed from the lock when the door is locked from the side from which egress is to be made.
2. Locking devices conforming to Section 409.3.2 shall be permitted in occupancies in Use Group I-2.
3. Locks conforming to Section 410.4 shall be permitted in occupancies in Use Group I-3.
4. *Means of egress* doors from individual *dwelling units* and guestrooms of occupancies in Use Group R having an occupant load of 10 or less shall be permitted to be equipped with a night latch, dead bolt or security chain, provided that such devices are openable from the inside without the use of a key or tool and are mounted at a height not to exceed 48 inches (1219 mm) above the finished floor.
5. Special locking arrangements conforming to Section 1017.4.1.2 or Section 1017.4.1.3.
6. In occupancies in Use Groups B, F, M and S, the main exterior *means of egress* door is permitted to be equipped with a key-operated locking device from the egress side where in compliance with the following three conditions:
   - 6.1. The locking device is of a type that is readily distinguishable as locked.
   - 6.2. A readily visible, durable sign is posted on the egress side on or adjacent to the door stating "This Door To Remain Unlocked When This Building Is Occupied." The sign shall be in letters not less than 1 inch (25 mm) high on a contrasting background.
   - 6.3. The main exterior door is a single door or a pair of doors which, when unlocked, the door or both leafs of a pair of doors swing free.
7. Locking arrangements conforming to Section 1017.4.5.

**1017.4.1.1 Flush and surface bolts:** Manually operated edge or surface-mounted flush bolts and surface bolts are prohibited. Where *means of egress* doors are used in pairs and approved automatic flush bolts are used, the door leafs having the automatic flush bolts shall not have a door knob or surface-mounted hardware. The unlatching of any leaf shall not require more than one operation.

**1017.4.1.2 Special locking arrangements:** In buildings that are equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or with an automatic fire detection system, doors in a *means of egress* serving occupancies in Use Group B, E, F, I, M, S or R, shall be unlocked or shall be equipped with approved egress control devices which shall unlock in accordance with items 1 through 7 below. A building occupant shall not be required to pass through more than one door equipped with a special locking device before entering an *exit*.

1. Actuation of the *automatic sprinkler system* or automatic fire detection system.
2. Loss of power to the egress control device.
3. Loss of power to the building.
4. Capability of being unlocked manually by a signal from an *emergency control station*.
5. The initiation of an irreversible and automatic process that will release the latch within 15 seconds when a force of not more than 15 pounds (66 N) is applied for 1 second to the release device and not relock until the door has been opened and returned to the closed position for not less than 30 seconds. Any reopening of the door shall restart the 30-second relocking cycle. Any attempt to *exit* which exceeds 1 second shall render the door openable. The time delay and the minimum relocking cycle time shall not be field adjustable.

   **Exceptions**

   1. An increase in the time delay to 30 seconds shall not be permitted except as approved by the code official.
   2. An increase in the relocking cycle time to 45 seconds shall not be permitted except as approved by the code official.
6. Initiation of the irreversible process shall activate an audible alarm in the vicinity of the door.
7. A sign having block letters of 1 inch (25 mm) in height shall be provided on the door above and within 12 inches (305 mm) of the release device stating "Push until alarm sounds. Door can be opened in 15 seconds."

**1017.4.1.3 Security locking arrangements in penal facilities:** In occupancies in Use Groups A-3, A-4, B, E, F, I, M and S within penal facilities, doors in *means of egress* serving rooms or spaces occupied by persons whose movements must be controlled for security reasons shall be permitted to be locked if equipped with egress control devices which shall unlock manually and by at least one of the following means.

1. Actuation of an *automatic fire suppression system* required by Section 904.1.
2. Actuation of a key-operated manual alarm station required by Section 918.4.
3. A signal from a central control station.

**1017.4.2 Panic hardware:** All doors equipped with latching or locking devices in occupancies in Use Groups A and E or portions of buildings occupied for assembly or educational purposes and serving rooms or spaces with an occupant load greater than 100, shall be equipped with approved panic hardware. Acceptable panic hardware shall be a door latching assembly incorporating a device which causes the door latch to release and the leaf to open when a force of 15 pounds (66 N) is applied in the direction of egress to a bar or panel, the activating portion of which extends not less than one-half of the width of the door leaf, and is applied at a height greater than 30 inches (762 mm) but less than 44 inches (1118 mm) above the floor. The force shall be applied at the lock side of the door or 30 inches (762 mm) from the hinged side, which-

ever is farther from the hinge. Where *fire door* assemblies are required to have panic hardware, approved fire *exit* hardware shall be used.

**Exception:** Panic hardware for Use Groups A-3 and A-4 shall not be required for principal entrance/exit doors if:

1. They are free-swinging;
2. The calculated occupant load does not exceed 150; and
3. The latch/lock device is a thumb latch/lock or a key-operated lock device in which the key cannot be removed from the side from which egress is to be made when it is locked.

**1017.4.3 Power-operated doors:** Where *means of egress* doors are operated by power, such as doors with a photoelectric-actuated mechanism to open the door upon the approach of a person, or doors with power-assisted manual operation, the design shall be such that in the event of power failure, the door is capable of being opened manually to permit *means of egress* travel or closed where necessary to safeguard *means of egress*. The forces required to open these doors manually shall not exceed those specified in Section 1017.4, except that the force to set the door in motion shall not exceed 50 pounds (222 N). The door shall be capable of swinging from any position to the full width of the opening in which such door is installed when a force is applied to the door on the side from which egress is made.

Horizontal sliding doors complying with this section shall be permitted. A sign shall be placed on the egress side of the door in a conspicuous location which reads, "In case of emergency, push to open." The sign shall be in letters not less than 2 inches (51 mm) high and mounted approximately 60 inches (1524 mm) above the finished floor.

**Exceptions**

1. Occupancies in Use Group I-3.
2. Horizontal sliding doors complying with Section 1017.4.4.

**1017.4.4 Horizontal sliding doors:** In other than occupancies in Use Group H, horizontal sliding doors that are considered a component of a *means of egress* shall comply with all of the following criteria:

1. The door shall be power operated and be capable of being operated manually in the event of power failure;
2. The door shall be openable from both sides without special knowledge or effort;
3. The force required to operate the door shall not exceed 30 pounds (132 N) to set the door in motion and 15 pounds (66 N) to close the door or to open such door to the minimum required width;
4. The door shall be openable with a force not to exceed 15 pounds (66 N) when a force of 250 pounds (1112 N) is applied perpendicular to the door adjacent to the operating device;
5. The door assembly shall comply with the applicable *fire protection rating* and, where rated, shall be self-closing or automatic-closing by smoke detection, shall be installed in accordance with NFPA 80 listed in Chapter 35, and shall comply with Section 717.0;
6. The door assembly shall have a standby power supply;
7. The door shall open to the minimum required width within 10 seconds after activation of the operating device; and
8. The door assembly power supply shall be electrically supervised at a constantly attended location.

**1017.4.5 Access-controlled egress doors:** The entrance doors in a *means of egress* in buildings with an occupancy in Use Group A, B, E, M, R-1 or R-2 and entrance doors to tenant spaces in occupancies in Use Groups A, B, E, M, R-1 and R-2 are permitted to be equipped with an approved entrance and egress access control system which shall be installed in accordance with items 1 through 6 below.

1. A sensor shall be provided on the egress side arranged to detect an occupant approaching the doors. The doors shall be arranged to unlock by a signal from or loss of power to the sensor.
2. Loss of power to that part of the access control system which locks the doors shall automatically unlock the doors.
3. The doors shall be arranged to unlock from a manual unlocking device located 40 inches (1016 mm) to 48 inches (1219 mm) vertically above the floor and within 5 feet (1524 mm) of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign. When operated, the manual unlocking device shall result in direct interruption of power to the lock — independent of the access control system electronics — and the doors shall remain unlocked for a minimum of 30 seconds.
4. Activation of the building fire alarm system, if provided, shall automatically unlock the doors, and the doors shall remain unlocked until the fire alarm system has been reset.
5. Activation of the building *automatic sprinkler* or fire detection *system*, if provided, shall automatically unlock the doors. The doors shall remain unlocked until the fire protective signaling system has been reset.
6. Entrance doors in buildings with an occupancy in Use Group A, B, E or M shall not be secured from the egress side during periods that the building is open to the general public.

**1017.5 Security grilles:** Horizontal sliding or vertical security grilles which are part of a required *means of egress* shall be openable from the inside without the use of a key or special knowledge or effort during periods that the space is occupied. The grilles shall remain secured in the full-open position during the period of occupancy by the general public. Grilles shall not be brought to the closed position when there are more than ten persons occupying spaces served by a single *exit* or 50 persons occupying spaces served by more than one *exit*. Where two or more *exits* are required, not more than one-half of the *exits* shall be equipped with horizontal sliding or vertical security grilles.

**1017.6 Level of exit discharge doors:** Where glazed, doors at the *level of exit discharge* shall be glazed with approved safety glazing. Approved doors having one or more unframed edges shall be constructed of safety glazing not less than $^1/_2$ inch thick.

## SECTION 1018.0 REVOLVING DOORS

**1018.1 General:** All revolving doors shall comply with Sections 1018.2 through 1018.5. In other than occupancies in Use Group H, revolving doors that are considered a component of the *means of egress* shall comply with Sections 1018.2 through 1018.6.

**1018.2 Collapse:** Each revolving door shall be capable of collapsing into a book-fold position with parallel egress paths having an aggregate width of not less than 36 inches (914 mm). The revolving door shall collapse when a force of not more than 180 pounds (800 N) is applied within 3 inches (76 mm) of the outer edge of a wing.

**Exception:** The maximum collapsing force shall not apply if the force required to collapse the door is reduced to not more than 130 pounds (578 N) when:

1. There is a power failure or power is removed to the device holding the wings in position.
2. There is an actuation of the *automatic sprinkler system* where such system is provided.
3. There is an actuation of an automatic fire detection system installed in accordance with Section 919.0 for all *areas* within the building which are within 75 feet (22860 mm) of the revolving doors. The collapse of the door(s) shall not be delayed by the *alarm verification* required by Section 919.7.
4. There is an actuation of a manual control switch which reduces the holding force to not more than the 130-pound (578 N) force level. Such switch shall be in an approved location and shall be clearly identified.

**1018.3 Dispersal area:** A revolving door shall not be located within 10 feet (3048 mm) of the foot or top of *stairways* or *escalators*. A dispersal area shall be provided between the *stairways* or *escalators* and the revolving doors.

**1018.4 Speed control:** The revolutions per minute for a revolving door shall not exceed the speeds indicated in Table 1018.4.

**1018.5 Adjacent area:** Each revolving door shall have a conforming side-hinged swinging door in the same wall as, and within 10 feet (3048 mm) of, the revolving door. See Chapter 11 for buildings and facilities required to be accessible to persons with physical disabilities.

**Exception:** The adjacent swinging door is not required for street floor elevator lobbies if a *stairway*, *escalator* or door from other parts of the building does not discharge through the lobby and the lobby does not have any occupancy other than as a means of travel between the elevators and street.

**Table 1018.4**
**REVOLVING DOOR SPEED**

| Inside diameter[a] | Power-driven type speed control (rpm) | Manual-type speed control (rpm) |
|---|---|---|
| 6′6″ | 11 | 12 |
| 7′0″ | 10 | 11 |
| 7′6″ | 9 | 11 |
| 8′0″ | 9 | 10 |
| 8′6″ | 8 | 9 |
| 9′0″ | 8 | 9 |
| 9′6″ | 7 | 8 |
| 10′0″ | 7 | 8 |

**Note a.** 1 foot = 304.8 mm; 1 inch = 25.4 mm.

**1018.6 Means of egress:** A revolving door to be considered as a component of a *means of egress* shall comply with Sections 1018.2 through 1018.5 and the following conditions:

1. Revolving doors shall not be given credit for more than 50 percent of the required *exit* capacity of the building.
2. Each revolving door shall not be credited with more than a 50-person capacity.
3. Each revolving door shall be capable of being collapsed when a force of not more than 130 pounds (578 N) is applied within 3 inches (76 mm) of the outer edge of a wing.

## SECTION 1019.0 HORIZONTAL EXITS

**1019.1 General:** *Horizontal exits* shall be accepted as an approved *exit* element of a required *means of egress*. The connection between an area of a building which the *horizontal exit* serves and the area of refuge as herein required shall be accomplished by protected openings in a fireresistance rated wall, or by an open-air balcony or bridge.

**1019.2 Separation:** The separation between buildings or areas of refuge connected by a *horizontal exit* shall be provided by at least a 2-hour fireresistance rated *fire wall* or *fire separation assembly* with approved opening protectives complying with Chapter 7 and Table 602.

**1019.2.1 Doors:** All doors shall swing in the direction of egress travel. Where the *horizontal exit* serves as an *exit* from both sides of the wall, there shall be adjacent openings with swinging *fire doors* opening in opposite directions.

**Exception:** Horizontal sliding doors complying with Section 1017.4.4.

**1019.3 Area of refuge:** The discharge area of a *horizontal exit* shall be either public areas or spaces occupied by the same tenant, and each such area of refuge shall be adequate to hold the total occupant load of both connected areas. The capacity of areas of refuge shall be computed on a minimum *net floor area* allowance for each occupant to be accommodated therein, not including areas of *stairways*, elevators and other *shafts* or *courts*, as follows:

1. 30 square feet (3 $m^2$) per patient for hospitals and nursing homes.
2. 6 square feet (0.56 $m^2$) per occupant on stories not housing patients confined to a bed or litter in an occupancy in Use Group I-2.
3. 6 square feet (0.56 $m^2$) per occupant in an occupancy in Use Group I-3.
4. 3 square feet (0.28 $m^2$) in all other cases.

**1019.4 Egress from area of refuge:** The path of egress travel from the *horizontal exit* through the area of refuge to another *exit* shall be continuously available. In other than occupancies in Use Group I-3, there shall be at least one *exit* on each side of the *horizontal exit* which is not a *horizontal exit*. Any area of refuge not having access to an *exit*, other than a *horizontal exit*, shall be considered as part of an adjoining area of refuge with such *exit*. In the area(s) served by the *horizontal exit*, the length of *exit access* travel distance to the *horizontal exit* or another *exit* shall not exceed the requirements of Section 1006.5. Occupancies in Use Group I-3 shall conform to Section 410.3.3.

## SECTION 1020.0 LEVEL OF EXIT DISCHARGE PASSAGEWAYS USED AS AN EXIT ELEMENT

**1020.1 Passageways:** Every required interior and exterior *exit* element which does not adjoin a *public way* shall be directly connected to the *public way* or to an open *court* leading to the *public way* by an enclosed passageway at the *level of exit discharge*, constructed in accordance with the requirements for the enclosure of the *exit* it serves, or through lobbies or vestibules as provided for in this section. *Building areas* below the *level of exit discharge* shall be separated from the passageway in accordance with the requirements for the enclosure of *exits*.

**1020.2 Vestibule:** Where an *exit* discharges into an interior vestibule, the vestibule shall be used for ingress and *means of egress* only, and the vestibule shall comply with Sections 1020.2.1 and 1020.2.2.

**1020.2.1 Depth and width:** The vestibule depth from the exterior of the building shall not be greater than 10 feet (3048 mm) and the width shall not be greater than 20 feet (6096 mm).

**1020.2.2 Separation:** The vestibule shall be separated from the remainder of the *level of exit discharge* by self-closing doors and the equivalent of $^1/_4$-inch-thick wired glass in steel frames.

**1020.3 Lobby:** Where an *exit* discharges into an interior *lobby* located at the *level of exit discharge*, the story containing the *lobby* shall be equipped throughout with an *automatic sprinkler system* installed in accordance with Section 906.2.1 or 906.2.2. Opening protectives shall be required in accordance with Table 717.1 at the point in which an enclosed *exit stairway* discharges into a lobby.

**Exception:** An *automatic sprinkler system* is not required in areas that are separated from the *lobby* by *fire separation assemblies* (see Section 709.0) having a fireresistance rating of not less than that required for *exit* enclosures.

**1020.4 Width and height:** The clear width of the passageway shall not be less than the width required for the capacity of the *exit stairways* leading thereto and all required *exit* doorways opening into the passageway. Such passageway shall have a minimum width of 44 inches (1118 mm) and a minimum clear ceiling height of 8 feet (23438 mm).

**1020.5 Maximum stairway limitations:** Not more than 50 percent of the required *stairways* shall discharge through the same passageway. Multiple *lobbies* constructed in accordance with Section 1020.3 located adjacent to one another shall be separated from each other in accordance with the requirements for enclosure of *exits*.

## SECTION 1021.0 GUARDS

**1021.1 Design and construction:** Where required by the provisions of Sections 406.5, 408.3.2, 1005.5, 1014.7, 1016.5 and 1825.5, guards shall be designed and constructed in accordance with the requirements of this section and Section 1606.4.

**1021.2 Height:** The guards shall be at least 42 inches (1067 mm) in height measured vertically above the leading edge of the tread or adjacent walking surface.

**Exceptions**

1. In other than occupancies in Use Group E, guards shall not be less than 36 inches (914 mm) in height above the leading edge of the tread along stairs which are not more than 20 feet (6096 mm) in height or which reverse direction at an intermediate landing with 12 inches (305 mm) or less measured horizontally between successive flights.
2. Guards along open-sided floor areas, *mezzanines* and landings within a single *dwelling unit* in Use Group R-2 and serving a single *dwelling unit* in Use Group R-3 shall not be less than 36 inches (914 mm) in height.
3. Guards along open-sided floor areas located less than 30 inches (762 mm) above the floor or grade below shall not be less than 36 inches (914 mm) in height.

**1021.3 Opening limitations:** In occupancies in Use Groups A, B, E, H-4, I-1, I-2, M and R, and in *public garages* and open parking structures, open guards shall have balusters or be of solid material such that a sphere with a diameter of 4 inches (102 mm) cannot pass through any opening. Guards shall not have an ornamental pattern that would provide a ladder effect.

**Exceptions**

1. The triangular openings formed by the riser, tread and bottom rail at the open side of a *stairway* shall be of a maximum size such that a sphere 6 inches (152 mm) in diameter cannot pass through the opening.
2. At elevated walking surfaces for access to and utilization of electrical, mechanical, or plumbing systems or equipment, guards shall have balusters or be of solid materials such that a sphere with a diameter of 21 inches (533 mm) cannot pass through any opening.

In occupancies in Use Groups I-3, F, H-1, H-2, H-3, S, (other than *public garages* and open parking structures), and along open-sided floor areas located less than 30 inches (762 mm) above the floor or grade below, balusters, horizontal intermediate rails or other construction shall not permit a sphere with a diameter of 21 inches (533 mm) to pass through any opening.

**1021.4 Railings:** Metal or other approved noncombustible railings shall be provided on balconies and galleries as prescribed in Sections 1021.4.1 through 1021.4.3.

**1021.4.1 At fascia:** Railings shall be provided at the fascia of boxes, balconies and galleries and shall not be less than 26 inches (660 mm) in height; at the end of aisles extending to the fascia for the full width of the aisle and shall not be less than 36 inches (914 mm) in height; and at the foot of steps for the full width of the steps and shall not be less than 42 inches (1067 mm) in height.

**1021.4.2 At cross aisles:** Railings shall be provided along cross aisles, and shall not be less than 26 inches (660 mm) in height except that railings are not required where the backs of the seats along the front of the aisles project 24 inches (610 mm) or more above the floor of the aisle.

**1021.4.3 Successive tiers:** Where seatings are arranged in successive tiers, and where the height of rise between *platforms* exceeds 18 inches (457 mm), railings not less than 26 inches (660 mm) in height shall be provided along the entire row of seats at the edge of the *platform*.

## SECTION 1022.0 HANDRAILS

**1022.1 General:** Where required by the provisions of Sections 1012.5, 1013.0, 1014.6.6.1, 1014.7, 1016.5 or Chapter 11, handrails shall be designed and constructed in accordance with this section and Section 1606.4.

**1022.2 Handrail details:** Handrails shall be continuous, without interruption by newel posts, other structure elements or obstructions. A handrail and any wall or other surface adjacent to the handrail shall be free of any sharp or abrasive elements. The clear space between the handrail and the adjacent wall or surface shall not be less than $1^1/_2$ inches (38 mm), except that the clear space shall not be less than $2^1/_4$ inches (57 mm) for *stairways*. Edges shall have a minimum radius of $^1/_8$ inch (3 mm).

**Exceptions**

1. Handrail brackets or balusters attached to the bottom surface of the handrail and which do not project horizontally beyond the sides of the handrail within 1 inch (25 mm) of the bottom of the handrail shall not be considered to be obstructions.
2. Stair handrails within a *dwelling unit* shall be permitted to be discontinuous between the top and bottom of a flight of stairs where the ends of the discontinued rail is returned to a wall or post and the maximum distance between the ends of discontinued rails is not greater than 4 inches (102 mm).

**1022.2.1 Projection:** Handrails shall not project more than $3^1/_2$ inches (89 mm) into the required passageway, aisle, *corridor* or ramp width, and not more than $4^1/_2$ inches (114 mm) into the required *stairway* width.

**1022.2.2 Height:** Handrails shall not be less than 34 inches (864 mm) nor more than 38 inches (965 mm), measured vertically, above the leading edge of the treads or above the finished floor of the landing or walking surfaces.

**Exceptions**

1. Handrails that form part of a guard shall have a height not less than 36 inches (914 mm) and not more than 42 inches (1067 mm).
2. Handrails within individual *dwelling units* shall not be less than 30 inches (762 mm) nor more than 38 inches (965 mm), measured vertically, above the leading edge of the treads or above the finished floor.

* **1022.2.3 Handrail ends:** At locations where handrails are not continuous between *stairway* flights, including the top and bottom of a *stairway*, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. The handrail ends shall be returned to a wall or post.

Where handrails are not continuous between ramp segments, including the top and bottom of a ramp, the handrails shall extend at least 12 inches (305 mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface. The handrail ends shall be returned to a wall or post.

**Exceptions**

1. Within a *dwelling unit*, the horizontal extension beyond the top riser of the *stairway* flight or top of the ramp segment, and the extension beyond the bottom riser of the *stairway* flight or bottom of the ramp segment, is not required.
2. Within a *dwelling unit*, the use of a volute, turnout or starting easing is allowed on the lowest tread.

**1022.2.4 Handrail grip size:** All *stairway* handrails shall have a circular cross section with an outside diameter of at least $1^1/_4$ inches (32 mm) and not greater than 2 inches (51 mm) (see Exception No. 2 for accessible handrails).

**Exceptions**

1. Any other shape with a perimeter dimension of at least 4 inches (100 mm), but not greater than $6^1/_4$ inches (158 mm) with the largest cross-sectional dimension not exceeding $2^1/_4$ inches (57 mm).
2. New handrails in facilities required to be accessible shall comply with Figure 39 of ADAAG.

**1022.2.5 Handrails of alternating tread stairways:** Stair handrails of *alternating tread stairways* shall be of such a configuration as to provide an adequate hand-hold for a person grasping the handrail to avoid falling. A minimum distance of 6 inches (152 mm) shall be provided between the stair handrail and any other object. A minimum distance of 12 inches (305 mm) shall be provided between the stair handrails of adjacent *alternating tread stairways*. Handrails on *alternating tread stairways* shall be spaced a minimum width of 17 inches (432 mm), not to exceed 24 inches (610 mm), between the handrails.

## SECTION 1023.0 EXIT SIGNS AND LIGHTS

**1023.1 Location:** In all buildings, rooms or spaces required to have more than one *exit* or *exit access*, all required *means of egress* shall be indicated with approved signs reading "Exit," visible from the *exit access* and, where necessary, supplemented by directional signs in the *exit access corridors* indicating the direction and way of egress. All "Exit" signs shall be located at *exit* doors or *exit access* areas, so as to be readily visible. Sign placement shall be such that any point in the *exit access* shall not be more than 100 feet (30480 mm) from the nearest visible sign.

**Exceptions**

1. "Exit" signs are not required in sleeping room areas in occupancies in Use Group I-3.
2. Main exterior *exit* doors which are obviously and clearly identifiable as *exits* are not required to have "Exit" signs where approved.

**1023.2 Size and color:** "Exit" signs shall have red letters at least 6 inches (152 mm) high and the minimum width of each stroke shall be $^3/_4$ inch (19 mm) on a white background or in other approved distinguishable colors. The word "Exit," except the letter I, shall have letters having a width of not less than 2 inches (51 mm) and the minimum spacing between letters shall not be less than $^3/_8$ inch (10 mm). Signs larger than the minimum size herein required shall have letter widths and spacing in the same

proportions to the height as indicated in this section. If an arrow is provided as part of an "Exit" sign, the construction shall be such that the arrow direction cannot be readily changed. The word "Exit" shall be clearly discernible when the sign illumination means is not energized.

**1023.3 Illumination:** Each sign shall be illuminated by a source providing not less than 5 footcandles (54 lux) at the illuminated surface and shall have a contrast ratio of not less than 0.5.

**Exception:** Approved self-luminous signs which provide evenly illuminated letters shall have a minimum luminance of 0.06 foot lamberts (0.21 cd/m$^2$).

**1023.4 Power source:** All "Exit" signs shall be illuminated at all times that the building is occupied. To assure continued illumination for a duration of not less than 1 hour in case of primary power loss, the "Exit" signs shall be connected to an emergency electrical system that complies with Section 2706.0.

**Exception:** Approved self-luminous signs which provide continuous illumination independent of external power sources are not required to comply with Section 2706.0.

## SECTION 1024.0 MEANS OF EGRESS LIGHTING

**1024.1 Artificial lighting:** All *means of egress* in other than occupancies in Use Group R-3, the interior of *dwelling units* in occupancies in Use Group R-2 and Use Group U which are *accessory structures* to an occupancy in Use Group R-3, shall be equipped with artificial lighting facilities to provide the intensity of illumination herein prescribed continuously during the time that conditions of occupancy of the building require that the *exits* be available. All stairs within or serving a *dwelling unit* shall be provided with illumination and controls in accordance with Section 1207.0. Lighting shall also be provided to illuminate the *exit discharge*. *Means of egress* lighting in occupancies in Use Group R-2, other than lighting within a *dwelling unit*, shall be wired on a circuit independent of circuits within any *dwelling unit*. The disconnecting means and overcurrent protection device shall not be located within a *dwelling unit* or such that access to such devices must be obtained by going through a *dwelling unit*.

**1024.2 Intensity of illumination:** The intensity of floor lighting shall not be less than 1 footcandle (11 lux) except as provided for in Section 1024.3.

**1024.3 Use Groups A and E:** In occupancies in Use Groups A and E for the exhibition of motion pictures or other projections by means of directed light, the minimum required illumination of aisles during such period of projection shall be 0.2 footcandle (2 lux).

**1024.3.1 Control:** The lighting of *exits*, aisles and auditoriums shall be controlled from a location that does not provide access to unauthorized persons. Supplementary control shall be provided as specified in Section 411.4 in the motion picture projection room.

**1024.4 Power source:** *Means of egress* lighting in all buildings, rooms or spaces required to have more than one *exit* or *exit access* shall be connected to an emergency electrical system that complies with Section 2706.0 to assure continued illumination for a duration of not less than 1 hour in case of emergency or primary power loss.

## SECTION 1025.0 FIRE ESCAPES

**1025.1 Where permitted:** Fire escapes shall be permitted only as provided for in Sections 1025.1.1 through 1025.1.4.

**1025.1.1 New buildings:** Fire escapes shall not constitute any part of the required *means of egress* in new buildings.

**1025.1.2 Existing fire escapes:** Existing fire escapes shall be continued to be accepted as a component in the *means of egress* in existing buildings only.

**1025.1.3 New fire escapes:** New fire escapes for existing buildings shall be permitted only where exterior stairs cannot be utilized due to *lot lines* limiting stair size or due to the sidewalks, alleys or roads at grade level. New fire escapes shall not incorporate ladders or access by windows.

**1025.1.4 Limitations:** Fire escapes shall comply with this section and shall not constitute more than 50 percent of the required number of *exits* nor more than 50 percent of the required *exit* capacity.

**1025.2 Location:** Where located on the front of the building and where projecting beyond the building line, the lowest landing shall not be less than 7 feet (2134 mm) or more than 12 feet (3658 mm) above grade, and shall be equipped with a counterbalanced *stairway* to the street. In alleyways and thoroughfares less than 30 feet (9144 mm) wide, the clearance under the lowest landing shall not be less than 12 feet (3658 mm).

**1025.3 Construction:** The fire escape shall be designed to support a *live load* of 100 pounds per square foot (4788 Pa) and shall be constructed of steel or other approved noncombustible materials. Fire escapes constructed of wood not less than nominal 2 inches thick are permitted on buildings of Type 5 construction. Walkways and railings located over or supported by combustible roofs in buildings of Types 3 and 4 construction are permitted to be of wood not less than nominal 2 inches thick.

**1025.3.1 Dimensions:** Stairs shall be at least 22 inches (559 mm) wide with risers not more than, and treads not less than, 8 inches (203 mm) and landings at the foot of stairs not less than 40 inches (1016 mm) wide by 36 inches (914 mm) long, located not more than 8 inches (203 mm) below the door.

**1025.3.2 Opening protectives:** Doors and windows along the fire escape shall be protected with $^3/_4$-hour opening protectives.

## SECTION 1026.0 SLIDESCAPES

**1026.1 Where permitted:** Existing slidescapes and safety chutes shall be permitted in existing occupancies in Use Groups E, H and I where approved. Slidescapes and safety chutes shall be permitted in occupancies in Use Groups H-1 and H-2 where constructed in an approved manner.

**1026.2 Location:** The arrangement and location of slidescapes shall conform to this chapter for *means of egress* and shall be designated by "Exit" signs and lights as provided for in Section 1023.0.

**1026.3 Construction:** All chutes shall be constructed of approved noncombustible materials with a pitch in the line of travel of not less than 24 nor more than 42 degrees (0.42 rad to 0.73

rad), measured on the developed circumference of spiral chutes. Straight chutes shall not be less than 24 inches (610 mm) and spiral chutes shall not be less than 28 inches (711 mm) in clear width, nor more than 44 inches (1118 mm) wide in any case. Where erected on the interior of a building, the chutes shall be enclosed as required in Section 1014.11 for interior *stairways* with direct *means of egress* to a street or other *public way*.

**1026.4 Capacity:** Slidescapes shall have a rated egress capacity of 60 occupants per slide. Slidescapes, except as permitted for occupancies in Use Groups H-1 and H-2, shall not constitute more than 25 percent of the required *means of egress* capacity from any building or structure or any individual story.

## SECTION 1027.0 ACCESS TO ROOF

**1027.1 By stairway or ladder:** In buildings more than three stories in *height*, except those with a roof slope greater than four units vertical in 12 units horizontal (4:12), access to the roof shall be provided by means of a *stairway*, an *alternating tread stair* in accordance with Section 1014.6.6 or a ladder and trap door. The ladder shall not be on the exterior of the building. Where the roof is used as a roof garden or for other habitable purposes, sufficient *stairways* shall extend to the roof to provide the necessary *exit* facilities from the roof as required for such occupancy. Roof trap doors shall be constructed to comply with Section 1510.2.

**1027.1.1 Optional stairway or ladder:** In buildings not required to have a *stairway*, *alternating tread stair* or ladder to the roof, such devices, if provided, shall conform to the provisions of this section. Ladders placed on the exterior of the building shall be of metal and, if exceeding 20 feet (6096 mm) in height, shall have a protective cage or other safety device. The siderails of exterior ladders shall be carried over the coping or parapet to serve as handrails. Other design details of such exterior ladders are subject to approval.

**1027.2 Roof enclosures:** *Stairways* extending through roofs shall be enclosed in roof structures of fireresistance rated construction which conform to the requirements of Section 1510.0.

## SECTION 1028.0 MAINTENANCE OF EXITS

**1028.1 Obstructions:** It shall be unlawful to obstruct, or reduce in any manner, the clear width of any doorway, hallway, passageway or other *means of egress* required by the provisions of this code.

**1028.2 Maintenance:** All exterior *stairways* and fire escapes shall be kept free of snow and ice. Exterior *stairways* and fire escapes constructed of materials requiring the application of weather protecting products, shall have these products applied in an approved manner and shall be applied as often as necessary to maintain the *stairways* and fire escapes in safe condition.

# CHAPTER 11

# ACCESSIBILITY

## SECTION 1101.0 GENERAL

**1101.1 Scope:** The provisions of this chapter shall control the design and construction of facilities for accessibility to physically disabled persons. Facilities that comply with this chapter and the applicable accessibility standards published by the Department of Justice listed in Chapter 35, shall be considered accessible. These DOJ Standards shall hereafter be referred to as "ADAAG" (Americans with Disabilities Act Accessibility Guidelines).

**1101.2 Accessible means of egress:** Spaces that are required to be accessible shall be provided with accessible means of egress in accordance with Section 1111.0.

**1101.3 Preschool, day care and elementary school modifications:** The provisions set forth in *Recommendations for Accessibility to serve Physically Handicapped Children in Elementary Schools* dated March, 1986; or *Recommendations for Accessibility Guidelines for Children's Environs* may be used for providing accessibility for children with disabilities in lieu of the listed dimensions and heights identified in this chapter. These documents are available through the Access Board, Suite 1000, 1331 F Street, NW, Washington, DC 20004-1111. Copies are also available at the Department of Housing, Buildings and Construction, The 127 Building, 1047 U.S. 127 South, Frankfort, Kentucky, between 8:00 a.m. and 4:30 p.m., Monday through Friday.

## SECTION 1102.0 DEFINITIONS

**1102.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Accessible:** Describes a site, building, facility or portion thereof that complies with this section and ADAAG and that can be approached, entered and used by a physically disabled person.

**Accessible route:** A continuous unobstructed path connecting all accessible elements and spaces in a building or facility which can be negotiated by a person with a severe disability using a wheelchair and which is also safe for and usable by people with other disabilities. Interior accessible routes include *corridors*, floors, ramps, elevators, lifts and clear floor space at fixtures. Exterior accessible routes include parking access aisles, curb ramps, walks, ramps and lifts.

**ADAAG:** The *Americans with Disabilities Act Accessibility Guidelines* for buildings and facilities developed by the U.S. Architectural and Transportation Barriers Compliance Board for use in new construction involving public accommodations, commercial facilities and state and local government buildings. The U.S. Department of Justice has published these standards and they are listed in Chapter 35.

**Adaptability:** The capability of certain building spaces and elements, such as kitchen counters, sinks and grab bars, to be altered or added so as to accommodate the needs of persons with and without disabilities, or to accommodate the needs of persons with different types or degrees of disabilities.

**Facility:** All or any portion of a building, structure or area, including the site on which building, structure or area is located, wherein specific services are provided or activities are performed and associated equipment, roads, walks, passageways and parking lots.

**Physically disabled person:** An individual who has a physical impairment, including impaired sensory, manual or speaking abilities, that results in a functional limitation in gaining access to and using a building or facility.

**Site:** A parcel of land bounded by a *lot line* or a designated portion of a public right-of-way.

**Technically infeasible:** An *alteration* of a building or a facility that has little likelihood of being accomplished because the existing structural conditions require the removal or *alteration* of a loadbearing member that is an essential part of the structural frame, or because other existing physical or site constraints prohibit modification or *addition* of elements, spaces or features which are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility.

## SECTION 1103.0 APPLICABILITY

**1103.1 Where required:** All new buildings and facilities, including temporary structures, their associated sites and facilities, shall be accessible to persons with disabilities including but not limited to occupants, employees, students, spectators, participants and visitors.

**Exceptions**

1. Accessibility is not required in buildings and facilities, or portions thereof, to the extent permitted by this chapter and ADAAG.
2. Areas where work cannot reasonably be performed by persons having a severe impairment (mobility, sight or

hearing) are not required to have the specific features providing accessibility to such persons.
3. Church buildings, single-family dwellings and apartment complexes consisting of less than 25 units.
4. Use Group U.
5. Temporary structures, sites and equipment directly associated with the construction process, such as construction site trailers, scaffolding, bridging or material hoists.
6. Detached *one-* and *two-family dwellings* and *accessory structures*, and their associated sites and facilities, are not required to be accessible.

**1103.2 Standard:** Details, dimensions and construction specifications for items required by this section shall comply with ADAAG.

**1103.3 Alterations and additions to existing buildings:** *Alterations*, repairs and *additions* may be made to any structure without requiring other areas of the existing structure to comply with this chapter; provided that such new work conforms to that of a new structure and the work does not result in decreased accessibility or usability of a building or facility.

**Exception:** Primary function *alterations* as required by the owner pursuant to Section 1110.2.

## SECTION 1104.0 ACCESSIBLE ROUTE

**1104.1 Where required:** Accessible routes within the site shall be provided from public transportation stops, accessible parking and accessible passenger loading zones, and public streets or sidewalks to the accessible building entrance served.

**1104.2 Connected spaces:** At least one accessible route shall connect accessible spaces, elements, facilities and buildings that are on the same site. Where only one accessible route is provided, the accessible route shall not pass through kitchens, storage rooms, restrooms, closets or similar spaces.

**Exceptions**
1. A single accessible route shall be permitted to pass through a kitchen or storage room in an accessible or adaptable *dwelling unit*.
2. The exceptions listed in Section 4.1.3(5) of ADAAG.

**1104.3 Interior accessible route:** Where floor levels are required to be connected by an accessible route, and an interior path of travel is provided between the levels, the accessible route between the levels shall also be interior.

## SECTION 1105.0 PARKING FACILITIES

**1105.1 Required:** Where parking is provided, accessible parking spaces shall comply with ADAAG except as required by Sections 1105.2 and 1105.3.

**1105.2 Multiple-family dwellings:** Assigned parking spaces shall be provided in accordance with Section 13.3.2(4)(a) of ADAAG for apartments occupied by a resident with a disability.

**1105.3 Medical facilities:** Ten percent of parking spaces provided for medical outpatient facilities shall be accessible. Twenty percent of parking spaces provided for medical facilities that specialize in treatment or services for persons with mobility impairments shall be accessible.

**1105.4 Van spaces:** For every eight or fraction of eight accessible parking spaces, at least one shall be a van-accessible parking space.

**Table 1105.1**
**ACCESSIBLE PARKING SPACES**

| Total parking spaces provided | Required minimum number of accessible spaces |
|---|---|
| 1 to 5 | 1[a] |
| 6 to 25 | 1 |
| 26 to 50 | 2 |
| 51 to 75 | 3 |
| 76 to 100 | 4 |
| 101 to 150 | 5 |
| 151 to 200 | 6 |
| 201 to 300 | 7 |
| 301 to 400 | 8 |
| 401 to 500 | 9 |
| 501 to 1,000 | 2% of total |
| more than 1,000 | 20 plus one for each 100 over 1,000 |

**Note a.** The accessible space shall be provided but is not required to be designated as reserved for physically disabled (see Section 1109.2).

**1105.5 Location:** Accessible parking spaces shall be located on the shortest accessible route of travel from adjacent parking to an accessible building entrance. In parking facilities that do not serve a particular building, accessible parking spaces shall be located on the shortest route to an accessible pedestrian entrance to the parking facility. Where buildings have multiple accessible entrances with adjacent parking, accessible parking spaces shall be dispersed and located near the accessible entrances.

**Exception:** In multilevel parking structures, van-accessible parking spaces shall be permitted on one level.

## SECTION 1106.0 ACCESSIBLE ENTRANCES

**1106.1 Required:** At least 50 percent but not less than one entrance to each building and structure, and each separate tenant space within the building or structure, shall comply with the accessible route provisions of ADAAG.

**Exceptions**
1. Entrances to spaces not required to be accessible as provided for in Section 1107.0.
2. Loading and service entrances.

**1106.2 Multiple accessible entrances:** Where a building or facility has entrances which normally serve accessible parking facilities, transportation facilities, passenger loading zones, taxi stands, public streets and sidewalks, or accessible interior vertical access, then at least one of the entrances serving each such function shall comply with the accessible route provisions of ADAAG.

## SECTION 1107.0 USE GROUP REQUIREMENTS

**1107.1 General:** In addition to the other requirements of this section, the requirements of Sections 1107.2 through 1107.4 shall apply to specific occupancies.

**1107.2 Use Group A:** Occupancies in Use Group A shall provide for accessible features in accordance with Sections 1107.2.1 through 1107.2.4.

**1107.2.1 Services:** Services and facilities provided in areas not required to be accessible shall be provided on an accessible level and shall be accessible.

**1107.2.2 Listening systems:** Concert and lecture halls, playhouses and movie theaters, meeting rooms and other areas where audible communications are integral to the use of the space shall provide for assistive listening equipment, devices or systems as required by Section 4.1.3(19)(b) of ADAAG.

**1107.2.3 Wheelchair spaces:** Except as required by Section 1107.2.4, wheelchair spaces shall be provided in each assembly area in accordance with Table 1107.2.3. Removable seats shall be permitted in the wheelchair spaces. Where the number of seats exceeds 300, wheelchair spaces shall be provided in more than one location. Dispersion of wheelchair locations shall be based on the availability of accessible routes to various seating areas, including seating at various levels in multilevel facilities as required by Section 4.1.3(19)(a) of ADAAG.

**Exception:** Accessible viewing position may be clustered for *bleachers*, balconies and other areas having sight lines that require slopes of greater than 5 percent. Equivalent accessible viewing positions may be located on levels having accessible egress.

**Table 1107.2.3**
**WHEELCHAIR SPACES REQUIRED IN ASSEMBLY AREAS**

| Capacity of seating in assembly spaces | Number of required wheelchair spaces |
|---|---|
| 4 to 25 | 1 |
| 26 to 50 | 2 |
| 51 to 300 | 4 |
| 301 to 500 | 6 |
| over 500 | 6 plus 1 for each 200 over 500 |

**1107.2.4 Dining areas, restaurants and cafeterias:** In dining areas of occupancies in Use Groups A-2 and A-3, the total floor area allotted for seating and tables shall be accessible.

**Exceptions**

1. Where necessary for line of sight, requirements of Section 1107.2.3 for number and dispersion of wheelchair spaces shall be applied.
2. In buildings without elevators, an accessible route to a mezzanine dining area is not required, provided that the mezzanine contains less than 33 percent of the total area and the same services are provided in the accessible area.
3. Where fixed or built-in seating or tables are provided, at least 5 percent, but not less than one such seat or table, shall be accessible and be distributed throughout the facility.
4. Knee clearances and table heights shall comply with Section 4.32 of ADAAG.

**1107.3 Use Group I:** Occupancies in Use Group I shall provide for accessible features in accordance with Sections 1107.3.1 through 1107.3.3.

**1107.3.1 Use Group I-1:** In occupancies in Use Group I-1, at least 4 percent, but not less than one, of the resident sleeping rooms and their bathing and toilet facilities shall be accessible.

**1107.3.2 Use Group I-2:** In nursing homes and long-term care facilities of Use Group I-2, at least 50 percent, but not less than one, of the patient sleeping rooms and their bathing and toilet facilities shall be accessible.

In general purpose hospitals, psychiatric facilities and detoxification facilities of Use Group I-2, at least 10 percent, but not less than one, of the patient sleeping rooms and their bathing and toilet facilities shall be accessible.

In hospitals and rehabilitation facilities of Use Group I-2 which specialize in treating conditions that affect mobility, or units within either which specialize in treating conditions that affect mobility, 100 percent of the patient rooms and their bathing and toilet facilities shall be accessible.

In occupancies in Use Group I-2, at least one accessible entrance shall include a passenger loading zone complying with Sections 4.6.6 and 6.2 of ADAAG.

All public use and common use areas are required to be designed and constructed to be accessible.

**1107.3.3 Use Group I-3:** Occupancies in Use Group I-3 (Detention and Correctional Facilities) shall comply with Section 12 of ADAAG.

**1107.3.4 Alterations:** *Alterations* to facilities listed in Use Group I-1 or I-2 shall comply with Section 6.1(4) of ADAAG.

**1107.4 Use Group R:** Occupancies in Use Group R shall provide for accessible features in accordance with Sections 1107.4.1 through 1107.4.6.

**1107.4.1 Accessible guestrooms:** In occupancies in Use Group R-1 containing six or more guestrooms, Section 9 of ADAAG shall apply, and not less than one accessible guestroom for the first 25 guestrooms shall be provided. In hotels with more than 50 guestrooms, roll-in type showers shall be provided in one-half, but not less than one, of the required accessible guestrooms.

**1107.4.2 Accessible dwelling units:** In *multiple-family dwellings* of Use Groups R-2 and R-3 containing at least 25 *dwelling units*, the *dwelling units* shall be accessible in accordance with Section 1107.4.3. All *dwelling units* on a site shall be considered to determine the total number of *dwelling units* and the required number of accessible units. All rooms and spaces available to the general public and all such spaces available for the use of the residents serving accessible or adaptable *dwelling units* shall be accessible.

**Exceptions**

1. In buildings without *elevators*, multistory *dwelling units* are not required to be accessible.
2. Recreational facilities in accordance with Section 1107.4.4.
3. *Dwelling units* in buildings in which all units on the ground floor or all units where an elevator is provided are adaptable pursuant to KRS 344.360(11)-(13) (see Appendix B).

**1107.4.3 Minimum requirements for multiple-family dwellings:** A required accessible or adaptable *dwelling unit* shall be on an accessible or adaptable route and shall have accessible elements and spaces complying with Sections 13.3.2 and 13.4 of ADAAG

**1107.4.4 Recreational facilities:** Where recreational facilities are provided serving accessible or adaptable *dwelling units* in occupancies in Use Groups R-2 or R-3, 25 percent but not less than one of each type in each group of such facilities shall be accessible. All recreational facilities of each type on a site shall be considered to determine the total number of each type which are required to be accessible.

**1107.4.5 Dispersement of elements:** Sleeping units in R1 occupancies shall be dispersed throughout the facility in accordance with Section 13.2.2 of ADAAG.

**1107.4.5.1 Minimum number:** When sleeping units in R1 occupancies are altered in an existing facility, one in 25, but not less than one, of the sleeping units altered shall comply with the requirements of Section 13.3 and 13.4 of ADAAG for each alteration until the number of accessible sleeping units in each facility equals the number required to be accessible by Section 1107.4.1.

**1107.4.5.2 Dispersion:** When existing sleeping units are altered and are required to be accessible, they shall be dispersed in accordance with Section 13.2.2 of ADAAG, to the maximum extent feasible.

**1107.5 Judicial, legislative and regulatory facilities:** Judicial, legislative and regulatory facilities shall comply with Section 11 of ADAAG.

**1107.6 Libraries:** Libraries shall comply with Section 8 of ADAAG.

## SECTION 1108.0 BUILDING FEATURES AND FACILITIES

**1108.1 General:** In addition to the other requirements of this section, the requirements of Sections 1108.2 through 1108.8 shall apply to certain building features and facilities which are provided and are required to be accessible.

**1108.2 Toilet and bathing facilities:** Toilet rooms and bathing facilities shall be accessible and shall be on an accessible route. At least one of each type fixture or element in each accessible toilet room and bathing facility shall be accessible.

**1108.2.1 Water closet compartment:** Where water closet compartments are provided in a toilet room or bathing facility, a wheelchair-accessible compartment shall be provided. Where six or more water closet compartments are provided in a toilet room or bathing facility, at least one ambulatory-accessible compartment shall be provided in addition to the wheelchair-accessible compartment. Wheelchair-accessible and ambulatory-accessible compartments shall comply with the plumbing code and ADAAG.

**1108.3 Accessible elevators:** All passenger elevators shall conform to ADAAG.

**1108.4 Drinking fountains:** At least 50 percent of drinking fountains, but not less than one, provided on every floor shall be accessible, as required by Section 4.1.3(10) of ADAAG.

**1108.5 Storage and locker facilities:** Where storage facilities such as cabinets, shelves, closets, lockers and drawers are provided in required accessible or adaptable spaces, at least one of each type shall contain storage space complying with ADAAG.

**1108.6 Fixed or built-in seating or tables:** Where fixed or built-in seating or tables are provided, at least 5 percent, but not less than one, shall be accessible and be distributed throughout the facility, as required by Section 4.32 of ADAAG.

**1108.7 Customer service facilities:** Customer service facilities shall comply with Sections 1108.7.1 through 1108.7.3 in accordance with the dimensions set forth in Sections 7.2 and 7.3 of ADAAG.

**1108.7.1 Dressing and fitting rooms:** Where dressing or fitting rooms are provided, at least 5 percent, but not less than one, in each group of rooms serving distinct and different functions shall be accessible and on an accessible route and shall comply with Section 4.35 of ADAAG.

**1108.7.2 Counters and windows:** Where customer sales and service counters or windows are provided, a portion of the counter, or at least one window, shall be accessible.

**1108.7.3 Check-out aisles:** Where check-out aisles are provided, accessible check-out aisles shall be installed in accordance with Table 1108.7.3. Traffic control devices, security devices and turnstiles located in accessible check-out aisles or lanes shall be accessible.

**Table 1108.7.3**
**REQUIRED CHECK-OUT AISLES**

| Total check-out aisles | Minimum number of accessible check-out aisles |
|---|---|
| 1 to 4 | 1 |
| 5 to 8 | 2 |
| 9 to 15 | 3 |
| Over 15 | 3 plus 1 for each additional 5 over 15 |

**1108.8 Controls, operating mechanisms and hardware:** Controls, operating mechanisms and hardware, including switches that control lighting, *ventilation* or electrical outlets, in accessible spaces, along accessible routes or as parts of accessible elements, shall be accessible as required by Section 4.27 of ADAAG.

**1108.9 Specifications for tread nosing:** Interior and exterior stairs which connect levels that are not connected by an elevator, ramp or other accessible means of travel shall not have open risers and shall comply with Section 4.9 of ADAAG.

**Exception:** Solid risers are not required for *stairways* serving *dwelling units* which are not required to be accessible in accordance with Section 1107.4.2, provided that the opening between treads does not permit the passage of a sphere with a diameter of 4 inches (102 mm).

**1108.10 Exit signs:** Each door to an enclosed *exit stairway* shall be equipped with tactile signage reading "Exit" complying with ADAAG and installed on the side of the door from which egress is to be made.

## SECTION 1109.0 WARNINGS AND SIGNAGE

**1109.1 Detectable warnings:** Passenger transit platform edges bordering a drop-off and not protected by platform screens or guards shall have a detectable warning.

**Exception:** Bus stops.

**1109.2 Signs:** Signs which designate permanent rooms and spaces shall comply with Sections 4.30.1, 4.30.4, 4.30.5 and 4.30.6 of ADAAG. Required accessible elements shall be identified by the International Symbol of Accessibility at the following locations:

1. Accessible parking spaces required by Section 1105.1.
2. Accessible passenger loading zones.
3. Accessible areas of refuge required by Section 1111.2.
4. Accessible toilet and bathing units.
5. Accessible entrances.

**1109.2.1 Directional signage:** Directional signage indicating the route to the nearest like accessible element shall be provided at the following locations (see ADAAG Sections 4.30.1, 4.30.2, 4.30.3 and 4.30.5):

1. Inaccessible building entrances;
2. Inaccessible public toilets and bathing facilities; and
3. Elevators not serving an accessible route.

**1109.3 Visible alarms:** Visible alarm-indicating appliances shall be provided in public and common areas of all buildings and areas of buildings housing the hearing impaired in accordance with Section 917.0 of this code and Section 4.28.3 of ADAAG.

## SECTION 1110.0 EXISTING FACILITIES

**1110.1 Maintenance of facilities:** Any building, facility, *dwelling unit* or site which is constructed or altered to be accessible or adaptable shall be maintained accessible during its occupancy.

**1110.2 Alterations:** Each element or space of a building or facility that is altered shall comply with these provisions, unless technically infeasible. Where full compliance is technically infeasible, the element or space shall be made accessible to the extent to which it is not technically infeasible.

**1110.2.1 Deleted.**

**1110.2.2 Deleted.**

**1110.3 Deleted.**

**1110.4 Deleted.**

## SECTION 1111.0 ACCESSIBLE MEANS OF EGRESS

**1111.1 New construction:** In new construction, all spaces required to have an accessible *means of egress* by Section 4.1.3(9) of ADAAG shall comply with this section and applicable requirements of ADAAG.

**1111.2 Area of rescue assistance:** Areas of rescue assistance shall be provided as required by Section 4.1.3(9) of ADAAG.

**1111.3 Drop-offs:** The sides of ramps and landings with a drop-off shall have a curb with a minimum 4-inch (102 mm) height above the walking surface or shall be provided with a guardrail.

**1111.4 Surface:** For all slopes exceeding one unit vertical in 20 units horizontal (1:20) and where the use is such as to involve danger of slipping, the ramp shall be surfaced with approved slip-resistant materials.

**1111.5 Exterior ramps:** Exterior ramps and landings shall be designed and constructed to prevent water from accumulating on the walking surface and shall comply with Section 4.8 of ADAAG.

**1111.6 Adjacent area:** Each revolving door shall have a conforming side-hinged swinging door.

## SECTION 1112.0 ACCESSIBLE TELEPHONES

**1112.1 Telephones:** If telephones are provided, they shall comply with Section 4.31 of ADAAG.

# CHAPTER 12

# INTERIOR ENVIRONMENT

## SECTION 1201.0 GENERAL

**1201.1 Scope:** The provisions of this chapter shall govern the means of light, *ventilation*, sound transmission control and rat-proofing required in all buildings.

**1201.2 Buildings on same lot:** Where more than one building is hereafter placed on a *lot*, or where a building is placed on the same *lot* with existing buildings and the several buildings are treated as a single structure for the purposes of this chapter, equivalent uncovered *lot* area or other adequate sources of light and *ventilation* shall be provided for all occupied buildings.

## SECTION 1202.0 DEFINITIONS

**1202.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Attic:*** The space between the ceiling beams of the top story and the roof rafters.

***Court:*** An open, uncovered and unoccupied space on the same *lot* as a building where such space is enclosed wholly or partly by buildings, walls or other enclosing devices (see Section 1212.0).
***Inner:*** Any *court* enclosed wholly by buildings, walls or other enclosing devices.
***Outer:*** A *court* extending to and opening upon a street, public alley or other approved open space that is not less than 15 feet (4572 mm) wide, or upon a required yard.

**Court height:** The vertical distance from the lowest level of the *court* to the mean height of the top of the enclosing walls.

**Court width:** As applied to an *inner court*, means the least horizontal dimension. As applied to an *outer court*, means the shortest horizontal dimension measured in a direction substantially parallel with the principal open end of such *court*.

***Habitable space:*** Space in a structure for living, sleeping, eating or cooking. Bathrooms, toilet compartments, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.

***Occupiable space:*** A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes, or in which occupants are engaged at labor; and which is equipped with *means of egress* and light and *ventilation* facilities meeting the requirements of this code.

***Vapor retarder:*** A material having a perm rating of 1.0 or less, such as foil, plastic sheeting, or insulation facing, installed to retard the passage of water vapor or moisture through the exterior envelope.

***Ventilation:*** The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

**Yard:** An unoccupied open space other than a *court* (see Sections 1212.0 and 1213.0).

## SECTION 1203.0 CONSTRUCTION DOCUMENTS

**1203.1 General:** *Construction documents* for all buildings and structures that are designed for human occupancy, other than buildings with occupancies in Use Groups I-1, R-2 and R-3, shall designate the number of occupants to be accommodated in the various rooms and spaces; where means of artificial lighting and *ventilation* are required, the application shall include sufficient details and description of the mechanical system to be installed as herein required or as specified in the mechanical code listed in Chapter 35.

**1203.2 Alternative mechanical system:** Heating, ventilating and air conditioning (HVAC) systems in occupancies reviewed under NFPA 101 pursuant to Section 119.1 of this code shall be installed in accordance with NFPA 90A or NFPA 90B in lieu of the mechanical code listed in Chapter 35.

## SECTION 1204.0 ROOM DIMENSIONS

**1204.1 Ceiling heights:** *Habitable (spaces)* rooms, hallways, *corridors*, bathrooms, toilet rooms, laundry rooms and *habitable basements* shall have a ceiling height of not less than 7 feet (2134 mm) measured to the lowest projection from the ceiling.

**Exception:** In occupancies in Use Group R-3, the maximum projection below the required ceiling height of beams and girders spaced not less than 4 feet (1219 mm) on center shall be 6 inches (152 mm).

**1204.1.1 Use Groups A, B, E and M:** A clear height from the finished floor to the finished ceiling or lowest projection of not less than 7 feet 6 inches (2286 mm) shall be provided in all *exit access* and *occupiable rooms* of structures of Use Groups A, B, E and M.

**1204.1.2 Sloping ceilings:** If any room in a building has a sloping ceiling, the prescribed ceiling height for the room is required in one-half the area thereof. Any portion of the room

measuring less than 5 feet (1524 mm) from the finished floor to the finished ceiling shall not be included in any computation of the minimum area thereof.

**1204.1.3 Furred ceilings:** If any room has a furred ceiling, the prescribed ceiling height is required in two-thirds of the area thereof, but the height of the furred ceiling shall not be less than 7 feet (2134 mm).

**Exception:** In Use Group R-3 *basement* recreation rooms, a furred ceiling height of 6 feet 8 inches (2032 mm) around the ducts may be made in the soffit area only for structural beams and mechanicals. The two-thirds *area* requirement listed in this section shall still be met.

**1204.2 Floor area:** Every *dwelling unit* shall have at least one room which shall have not less than 150 square feet (13.95 $m^2$) of floor area. Other *habitable* rooms, except kitchens, shall have an area of not less than 70 square feet (6.51 $m^2$).

**1204.3 Width:** A *habitable* room other than a kitchen shall not be less than 7 feet (2134 mm) in any dimension.

## SECTION 1205.0 LIGHT AND VENTILATION REQUIRED

**1205.1 Light required:** Every room or space intended for human occupancy shall be provided with natural or artificial light.

**1205.1.1 Bathroom and toilet room lighting:** Every bathroom and toilet room shall be provided with artificial light. The illumination shall have an average intensity of 3 footcandles (32.29 lux) measured at a level of 30 inches (762 mm) above the floor.

**1205.2 Ventilation required:** Every room or space intended for human occupancy shall be provided with natural or mechanical *ventilation*.

## SECTION 1206.0 NATURAL LIGHT

**1206.1 General:** In the application of the provisions of this chapter, the standard of natural light for all *habitable* and *occupiable rooms*, unless otherwise specifically required by the provisions of Chapter 4 for special occupancies, shall be based on 250 footcandles (2691 lux) of illumination on the vertical plane adjacent to the exterior of the light-transmitting device in the enclosure wall and shall be adequate to provide an average illumination of 6 footcandles (64.58 lux) over the area of the room at a height of 30 inches (762 mm) above the floor level.

**1206.2 Minimum glazing area:** Every room or space intended for human occupancy shall have an exterior glazing area of not less than 8 percent of the floor area. Natural light shall be provided by glazing areas that open onto *courts* or yards which comply with the requirements of Section 1212.0, or by other approved means.

**1206.2.1 Adjoining spaces:** Where natural light for rooms or spaces without exterior glazing areas is provided through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8 percent of the floor area of the interior room or space, but not less than 25 square feet (2.33 $m^2$). The exterior glazing area shall be based on the total floor area being served.

**1206.3 Hallways:** Natural light shall be capable of penetrating the full length of the hallway.

## SECTION 1207.0 ARTIFICIAL LIGHT

**1207.1 General:** Artificial light shall be capable of providing the minimum illumination specified for natural light.

**1207.2 Stairway illumination:** All *stairways* within *dwelling units* shall be provided with a minimum illumination level of 10 footcandles (107 lux) measured at every tread nosing. Exterior *stairways* serving a *dwelling unit* shall have an illumination level on tread runs of 1 footcandle.

**1207.2.1 Controls:** The control for activation of the required *stairway* lighting within a *dwelling unit* shall be operable from the top and bottom of each *stairway* without traversing any step of the *stair*. All switches that control interior *stairway* lights shall be illuminated switches. The illumination of an exterior *stairway* serving a *dwelling unit* shall be controlled from inside the *dwelling unit*, unless continuously illuminated or automatically activated.

## SECTION 1208.0 NATURAL VENTILATION

**1208.1 General:** Natural *ventilation* of an occupied space shall be through windows, doors, louvers or other natural openings to the outdoor air.

**1208.2 Ventilation area required:** The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated.

**1208.2.1 Adjoining spaces:** Where rooms and spaces without openings to the outdoors are *ventilated* through an adjoining room, the unobstructed opening to the adjoining room shall be at least 8 percent of the floor area of the interior room or space, but not less than 25 square feet (2.33 $m^2$). The *ventilation* openings to the outdoors shall be based on the total floor area being *ventilated*.

**1208.2.2 Openings below grade:** Openings below grade shall be acceptable for natural *ventilation* provided that the outside horizontal clear space measured perpendicular to the opening is one and one-half times the depth below the average adjoining grade.

**1208.3 Contaminants exhausted:** Contaminants in the breathing atmosphere shall be exhausted to the outdoor air in accordance with the mechanical code listed in Chapter 35.

**1208.4 Openings onto yards or courts:** Natural *ventilation* shall be provided by openings onto yards or *courts* which comply with the requirements of Section 1212.0, or by other approved means.

## SECTION 1209.0 MECHANICAL VENTILATION

**1209.1 General:** Mechanical *ventilation* shall conform to the requirements of the mechanical code listed in Chapter 35.

## SECTION 1210.0 VENTILATION OF SPECIAL SPACES

**1210.1 Roof spaces:** Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross *ventilation* for each separate space

by *ventilation* openings. The *ventilation* openings shall be tested for rain and snow infiltration in a manner representative of the intended installation and shall not permit the entrance of rain and snow when so tested. *Ventilation* openings shall not be provided in roof areas, or portions thereof, which are subject to snow drift as determined by Section 1608.0.

The minimum required net free ventilating area shall be $^1/_{150}$ of the area of the space ventilated. Where ridge or gable vents are utilized, one-half of the *ventilation* openings shall be provided by ridge or gable vents, with the balance of the *ventilation* openings provided by eave or cornice vents. The openings shall be covered with corrosion-resistant mesh or other approved materials with openings not more than $^1/_2$ inch (13 mm) in any direction.

**Exception:** The minimum required area is permitted to be reduced to $^1/_{300}$, provided that a *vapor retarder* having a permeance not exceeding 1 perm is installed on the warm side of the ceiling; or the ridge or gable *ventilation* openings are located in the upper third of the space to be ventilated with the balance of the required *ventilation* provided by eave or cornice vents.

**1210.2 Crawl spaces:** Crawl space areas, other than those used as an underfloor plenum, shall be *ventilated* by an approved mechanical means or by openings in exterior foundation walls. Openings shall be located as close to corners as practicable and shall provide cross *ventilation* on at least two approximately opposite sides. The openings shall be covered with corrosion-resistant mesh not less than $^1/_4$ inch (6 mm) nor more than $^1/_2$ inch (13 mm) in any direction.

**1210.2.1 Opening size:** Openings shall have a net area of not less than 1 square foot (0.093 $m^2$) for each 150 square feet (13.95 $m^2$) of foundation space. Where an approved *vapor retarder* is installed over the ground surface, the required net area of openings shall be reduced to 0.1 square foot (0.093 $m^2$) for each 150 square feet (13.95 $m^2$) and vents shall have manually operable louvers.

**1210.3 Alternative mechanical ventilation:** Enclosed *attic*, rafter and crawl spaces which are not *ventilated* as herein required shall be equipped with a mechanical *ventilation* system conforming to the requirements of the mechanical code listed in Chapter 35.

## SECTION 1211.0 ACCESS TO CRAWL SPACES AND ATTICS

**1211.1 Access to crawl spaces:** Access shall be provided to crawl spaces by an opening not less than 18 inches by 24 inches (457 mm by 610 mm).

**1211.2 Access to attics:** An opening not less than 22 inches by 30 inches (559 mm by 762 mm) with ready access thereto shall be provided to any *attic* area having a clear height of over 30 inches (762 mm). Where doors or other openings are installed in the *draftstopping*, such doors shall be self-closing and be of approved materials as specified in this section, and the construction shall be tightly fitted around all pipes, ducts or other assemblies piercing the *draftstopping*.

## SECTION 1212.0 COURTS AND YARDS

**1212.1 General:** All *courts* and yards required to serve rooms for natural light or *ventilation* purposes shall comply with the requirements of this section.

**1212.2 Minimum width:** Every such *court* or yard shall have a minimum width of 3 inches (76 mm) for each 1 foot (305 mm) of height or fraction thereof, but not less than 5 feet (1524 mm) for *outer courts* and twice these values for *inner courts*.

**1212.2.1 Irregular court or yard width:** In the case of irregular or gore-shaped *courts* or yards, the average width shall not be less than the required width of a *court* in accordance with Section 1212.2, but shall not be less than 5 feet (1524 mm) at any point.

**1212.3 Area of court:** The cross-sectional area of a required *court* shall not be less than one and one-half times the square of its width, nor shall the length of any *court* be more than twice its width.

**1212.4 Access to court:** A door or other means of access shall be provided at the bottom of every *court* that is not otherwise provided with convenient access for purposes of cleaning.

**1212.5 Air intakes:** Every *court* which serves one or more *habitable* rooms and which does not open for its full height on one or more sides to a street or legal yard, shall be connected at or near the bottom with a street or yard by a horizontal intake or passage of fireresistance rated construction. Such intake or passage shall have a cross-sectional area of not less than 21 square feet (1.95 $m^2$) and shall remain fully open at both ends and unobstructed for its full size and length, except that grilles of noncombustible construction are permitted at the ends of the intake.

**1212.5.1 Fireresistance rating:** The walls, floors and ceilings of such intakes or passages shall have a fireresistance rating of not less than 2 hours in buildings of Type 1, 2, 3 or 4 construction and not less than a 1-hour fireresistance rating in buildings of Type 5 construction.

**1212.6 Court walls:** Where, in the opinion of the code official, windows facing on *courts* do not receive adequate direct light by reason of peculiar arrangement or orientation, the code official shall require the walls to be constructed of light-colored concrete or masonry, or to be painted and maintained a light color to furnish additional reflected light, or shall require other approved means of providing additional light.

**1212.7 Court drainage:** The bottom of every *court* shall be properly graded and drained to a public sewer or other approved disposal system complying with the plumbing code listed in Chapter 35, and shall be paved with concrete or other nonabsorbent material where required by the code official.

## SECTION 1213.0 OBSTRUCTION OF COURTS AND YARDS

**1213.1 Permissible projections:** Every required *court* and yard shall remain unobstructed for its required area and full height, except for the projections permitted in Sections 1213.2 through 1213.7.

**1213.2 Maximum encroachment:** A part of any building or structure shall not extend into side *courts*, *inner courts* or yards

required for light and *ventilation* of habitable and *occupiable rooms* by the *zoning* law or other statutes controlling building construction. The encroachment shall not exceed 20 percent of the legal area of the yard or *court* which is required for light and *ventilation* purposes.

**1213.3 Accessories:** In Use Groups R and I, clothes poles, arbors, garden trellises and other such accessories shall not be prohibited in the open spaces at ground level.

**1213.4 Roof eaves:** Roof eaves shall not project more than 3 feet (914 mm) beyond the face of the wall.

**1213.5 Steps and architectural features:** Steps, window sills, belt courses and similar architectural features, as well as rain leaders and chimneys, shall not project more than 2 feet (610 mm) beyond the face of the wall.

**1213.6 Exterior stairways and fire escapes:** Outside *stairways*, smokeproof tower balconies, fire escapes or other required elements of a *means of egress* shall not project more than 4 feet (1219 mm) beyond the face of the wall.

**1213.7 Motor vehicle parking:** Where approved, required *court* and yard areas for automobile parking spaces or *private garages* not exceeding one story in *height* where accessory to and only for the occupants of a Use Group R occupancy are permitted, provided that required windows for light and *ventilation* are not obstructed thereby.

## SECTION 1214.0 SOUND TRANSMISSION CONTROL IN RESIDENTIAL BUILDINGS

**1214.1 Scope:** This section shall apply to all common interior walls, partitions and floor/ceiling assemblies between adjacent *dwelling units* or between *dwelling units* and adjacent public areas such as halls, *corridors*, stairs or service areas in all occupancies in Use Group R.

**1214.2 Air-borne noise:** Walls, partitions and floor/ceiling assemblies separating *dwelling units* from each other or from public or service areas shall have a sound transmission class (STC) of not less than 45 for air-borne noise when tested in accordance with ASTM E90 listed in Chapter 35. This requirement shall not apply to *dwelling unit* entrance doors; however, such doors shall be tight fitting to the frame and sill.

**1214.3 Structure-borne sound:** Floor/ceiling assemblies between *dwelling units* or between a *dwelling unit* and a public or service area within the structure shall have an impact insulation class (IIC) rating of not less than 45 when tested in accordance with ASTM E492 listed in Chapter 35.

## SECTION 1215.0 RATPROOFING

**1215.1 Ratproofing:** All buildings or structures and the walls enclosing *habitable* or *occupiable rooms* and spaces in which persons live, sleep or work, or in which feed, food or foodstuffs are stored, prepared, processed, served or sold, shall be constructed in accordance with the provisions of this section.

**1215.2 Grade protection:** Buildings not provided with a continuous foundation shall be provided with protection against rodents at grade in accordance with either Section 1215.2.1 or 1215.2.2.

**1215.2.1 Apron:** Where an apron is provided, the apron shall not be less than 8 inches (203 mm) above, nor less than 24 inches (610 mm) below grade. In all cases the apron shall not terminate below the lower edge of the siding material. The apron shall be constructed of an approved nondecayable, water-resistant and ratproofing material of required strength and shall be installed around the entire perimeter of the building. Where constructed of masonry or concrete materials, the apron shall not be less than 4 inches (102 mm) in thickness.

**1215.2.2 Grade floors:** Where continuous concrete grade floor slabs are provided, open spaces shall not be left between the slab and walls, and all openings in the slab shall be protected.

**1215.3 Opening protection:** Openings shall be protected in accordance with Sections 1215.3.1 through 1215.3.3.

**1215.3.1 Wall openings:** Openings in the wall or apron required for *ventilation* or other purposes shall be guarded with corrosion-resistant ratproof shields of not less than nominal 0.034-inch perforated steel sheets, or No. 20 B&S Gage aluminum (0.032 inch) or nominal 0.064-inch expanded steel or wire mesh screens, with not more than $^1/_2$-inch (13 mm) mesh openings.

**1215.3.2 Slab openings:** Access openings in grade floor slabs shall be protected with concrete, masonry, metal or other corrosion-resistant noncombustible cover of adequate strength to support the floor *loads*.

**1215.3.3 Pipe and conduit openings:** All openings for pipe, conduit, cable and similar purposes at or near grade shall have snugly fitted collars to eliminate all open spaces.

# CHAPTER 13

# ENERGY CONSERVATION

## SECTION 1301.0 GENERAL

**1301.1 Scope:** Buildings shall be designed and constructed in compliance with the energy code listed in Chapter 35.

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# CHAPTER 14

# EXTERIOR WALL COVERINGS

## SECTION 1401.0 GENERAL

**1401.1 Scope:** The provisions of this chapter shall establish the minimum requirements for exterior walls. Exterior walls shall be designed and constructed in accordance with these provisions.

## SECTION 1402.0 DEFINITIONS

**1402.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Exterior wall finish:*** A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including veneers, siding, exterior insulation and finish systems, architectural trim and embellishments such as cornices, soffits, facias, gutters and leaders.

**Wall**

**Apron wall:** That portion of a skeleton wall below the sill of a window.

**Skeleton or panel wall:** A nonbearing wall supported by each story on a skeleton frame.

**Spandrel wall:** That portion of a skeleton wall above the head of a window or door.

**Veneered wall:** A wall having a facing of masonry or other weather-resistant noncombustible material that is securely attached to the backing, but not so bonded as to exert common action under *load*.

## SECTION 1403.0 PERFORMANCE REQUIREMENTS

**1403.1 General:** The provisions of this section shall apply to exterior walls and components thereof.

**1403.2 Durability:** All exterior walls and components thereof shall be of approved materials which maintain the performance characteristics required herein for the duration of use.

**1403.3 Weather resistance:** The exterior walls shall be faced with an approved weather-resistant covering that is properly attached to resist wind and rain. The cellular spaces shall be so ventilated as not to vitiate the *fireblocking* at floor, *attic* and roof levels, or shall be provided with an approved interior noncorrodible *vapor retarder*, or other approved means to avoid condensation and leakage of moisture.

**1403.4 Structural:** Exterior walls shall be designed and constructed to resist safely all superimposed *loads* as required by Chapter 16.

**1403.4.1 Structural strength against wind forces:** In all buildings required to resist the wind pressures described in Section 1609.0, exterior doors, door frames, door lateral supports and glazing in exterior window openings shall be designed to resist the *wind loads* specified in Section 1609.0 for components and cladding.

**1403.4.2 Structural strength of sash or frames:** Mullions, sash and frames of glazed exterior window openings shall be designed to resist the *wind loads* specified in Section 1609.0 for components and cladding.

**1403.5 Fireresistance:** All exterior walls shall comply with the fireresistance rating requirements of Section 705.0.

**1403.5.1 Fireresistance rated openings:** Openings in exterior walls, where required to have a fire protection rating, shall comply with the provisions of Chapter 7.

**1403.6 Flood-resistant construction:** Exterior walls of structures that are erected in areas prone to flooding shall comply with the provisions of Section 3107.0.

**1403.7 Ratproofing:** Exterior walls of buildings that are required to be ratproofed shall comply with the provisions of Section 1215.0.

## SECTION 1404.0 MATERIALS

**1404.1 Wood:** Exterior walls of wood construction shall be designed and constructed in accordance with Chapter 23.

**1404.2 Masonry:** Exterior walls of masonry construction shall be designed and constructed in accordance with Chapter 21.

**1404.3 Metal:** Exterior walls of formed steel construction, structural steel or lightweight metal alloys shall be designed in accordance with Chapter 22 and Chapter 20, respectively.

**1404.4 Concrete:** Exterior walls of concrete construction shall be designed and constructed in accordance with Chapter 19.

**1404.5 Structural glass:** Exterior walls of structural glass block shall be designed and constructed in accordance with Section 2118.0.

**1404.6 Plastics:** *Plastic* panel, apron or spandrel walls as defined in this code shall not be limited in thickness, provided that such *plastics* and their assemblies conform to the requirements of Chapter 26 and are constructed of approved weather-resistant materials of adequate strength to resist the *wind loads* specified in Section 1609.0.

**1404.7 Other:** Materials not prescribed herein shall be permitted provided that any such alternative has been approved. Exterior walls constructed of alternative materials shall be shown to be durable, weather resistant, structurally adequate, fireresistant, flood resistant and ratproof as required herein.

## SECTION 1405.0 VENEERS

**1405.1 General:** All veneers consisting of nonstructural facing of brick, concrete, stone, tile, metal, *plastic*, synthetic stucco or other approved exterior coverings attached to a backing, shall be designed and constructed in accordance with the applicable provisions of this section.

**1405.2 Structural support:** Surfaces to which veneer is attached shall be designed to support the additional *loads* imposed by the veneer.

**1405.2.1 Backing surfaces for veneers:** Veneers for other than buildings of Type 5 construction shall be attached only to substantial, rigid and noncombustible surfaces which are plumb, straight and of true plane. Wood backing surfaces shall not be used, except in buildings of Type 5 construction. The backing shall provide sufficient rigidity, stability and weather resistance, and the veneer shall be installed and anchored as required in this code for the specific material.

**1405.3 Materials:** The materials of the minimum nominal thickness specified in Table 1405.3 shall be acceptable as approved weather coverings.

**Table 1405.3**
**MINIMUM THICKNESS OF WEATHER COVERINGS**

| Covering type | Minimum thickness[c] |
|---|---|
| Aluminum siding | 0.019 inch |
| Asbestos-cement boards | 1/8 inch |
| Asbestos shingles | 5/32 inch |
| Brick and concrete masonry veneers | 2 inches |
| Ceramic veneer (architectural terra cotta, anchored type) | 1 inch |
| Clay tile (flat slab) | 1/4 to 1 inch |
| Clay tile (structural) | 1 3/4 inches |
| Exterior plywood (with sheathing) | 5/16 inch |
| Exterior plywood (without sheathing) | see Section 2307.0 |
| Glass-fiber reinforced concrete panels | 3/8 inch |
| Hardboard siding | 1/4 inch |
| Marble slabs | 1 inch |
| Particleboard (with sheathing) | see Section 2308.5 |
| Particleboard (without sheathing) | see Section 2308.5 |
| Precast stone facing | 5/8 inch |
| Protected fiberboard siding | 1/2 inch |
| Rigid PVC siding | 0.035 inch |
| Steel (approved corrosion-resistant) | 0.017 inch |
| Stone (cast artificial) | 1 1/2 inches |
| Stone (natural) | 2 inches |
| Structural glass | 11/32 inch |
| Stucco or exterior portland cement plaster | |
| three-coat work over: | |
| metal plaster base | 7/8 inch[b] |
| unit masonry | 5/8 inch[b] |
| cast-in-place or precast concrete | 5/8 inch[b] |
| two-coat work over: | |
| unit masonry | 1/2 inch[b] |
| cast-in-place or precast concrete | 3/8 inch[b] |
| Wood shingles | 3/8 inch |
| Wood siding (without sheathing)[a] | 1/2 inch |

**Note a.** For wood siding of a lesser thickness, see Section 1405.3.5.
**Note b.** Exclusive of texture.
**Note c.** 1 inch = 25.4 mm.

**1405.3.1 Basic hardboard:** Basic hardboard shall conform to the requirements of AHA A135.4 listed in Chapter 35.

**1405.3.2 Hardboard siding:** Hardboard siding shall conform to the requirements of AHA A135.6 listed in Chapter 35 and, where used structurally, shall be so identified by the label of an *approved agency*.

**1405.3.3 Rigid PVC siding:** Rigid PVC siding shall conform to the requirements of ASTM D3679 listed in Chapter 35.

**1405.3.4 Aluminum siding:** Aluminum siding shall conform to the requirements of AAMA 1402 listed in Chapter 35.

**1405.3.5 Wood siding:** Wood siding of thicknesses less than 1/2 inch shall be placed over sheathing which conforms to Section 2305.13.

**1405.3.6 Building paper:** Where veneers of brick, clay tile, concrete or natural or artificial stone are used, 14-pound felt or paper shall be attached to the sheathing with flashing wherever necessary to prevent moisture penetration behind the veneer.

**1405.3.7 Nailing:** All weather boarding and wall coverings shall be securely nailed with aluminum, copper, zinc, zinc-coated or other approved corrosion-resistant nails in accordance with the nailing schedule in Table 2305.2 or the approved manufacturer's installation instructions. Shingles and other weather coverings shall be attached with appropriate standard-shingle nails to furring strips securely nailed to studs, or with approved mechanically bonding nails, except where sheathing is of wood not less than 1-inch nominal thickness or of wood structural panels not less than 5/16 inch thick.

**1405.3.8 Metal siding:** Exposed metal siding or sheathing shall be protected from corrosion at the ground level by supporting the foundation channel at sufficient height above grade on the concrete apron or other approved water-resistant foundation.

**1405.3.9 Exterior wall pockets:** In exterior walls of all buildings or structures, wall pockets or crevices in which moisture can accumulate shall be avoided or protected with adequate caps or drips, or other approved means shall be provided to prevent water damage.

**1405.3.10 Flashings:** Approved corrosion-resistant flashings shall be provided at the top and sides of all exterior window and door openings in such a manner as to be leakproof. Approved corrosion-resistant flashings shall be installed at the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings; under and at the ends of masonry, wood or metal copings and sills; continuously above all projecting wood trim; at the intersection of exterior walls and porches and decks; at wall and roof intersections; and at built-in gutters.

**Exception:** When approved, flashing is not required where an approved water-resistant sheathing is installed and an approved water-resistant caulking is applied at the top and sides of all window and door openings in such a manner as to be leakproof.

**1405.3.11 Foundation insulation:** Insulating materials applied on the exterior of foundation walls and the edges of slab-on-ground floors shall be protected to prevent the degradation of thermal performance. The protection shall extend at least 6 inches (152 mm) below the finish ground level.

**1405.4 Metal veneers:** Veneers of metal shall be fabricated from approved corrosion-resistant materials or shall be protected front and back with porcelain enamel or shall otherwise be treated to render the metal resistant to corrosion. Such veneers shall not be less than 0.017-inch nominal thickness galvanized sheet steel mounted on wood or metal furring strips or approved sheathing on the wood construction.

**1405.4.1 Construction:** Metal veneer for buildings of other than Type 5 construction shall be securely attached to concrete or masonry; supported on approved metal framing protected by painting, galvanizing or other approved protection; or supported by wood furring strips treated with an approved *preservative* process that complies with Section 2311.3.

**1405.4.2 Waterproofing:** All joints and edges exposed to the weather shall be caulked with approved durable waterproofing material or by other approved means to prevent penetration of moisture.

**1405.4.3 Grounding metal veneers:** Grounding of metal veneers on all buildings shall comply with the requirements of Chapter 27 and NFPA 70 listed in Chapter 35.

**1405.5 Anchored masonry veneer:** Anchored masonry veneer shall conform to the requirements of Chapter 12 of ACI 530/ASCE 5/TMS 402 listed in Chapter 35 and Sections 1405.5.1 through 1405.5.3.

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**1405.5.1 Stone veneer:** Stone veneer units not exceeding 10 inches in thickness are permitted to be anchored directly to masonry, concrete or to stud construction by one of the following methods.

1. With concrete or masonry backing, anchor ties shall not be less than No. 12 gage corrosion-resistant wire formed beyond the base of the backing. The legs of the loops shall not be less than 6 inches (153 mm) in length bent at right angles and laid in the mortar joint and spaced so that the eyes or loops are 12 inches (305 mm) maximum on center in both directions. There shall be provided not less than a No. 12 gage corrosion-resistant wire tie threaded through the exposed loops for every 2 square feet (0.186 $m^2$) of stone veneer. This tie shall be a loop having legs not less than 15 inches (381 mm) in length bent so that the tie will lie in the stone veneer mortar joint. The last 2 inches (51 mm) of each wire leg shall have a right-angle bend. One inch (25 mm) of cement grout shall be placed between the backing and the stone veneer.
2. With stud backing, a 2-inch by 2-inch No. 16 gage corrosion-resistant wire mesh with two layers of waterproof paper backing shall be applied directly to wood studs spaced a maximum of 16 inches (406 mm) on center. On studs, the mesh shall be attached with 2-inch-long (51mm) corrosion-resistant steel wire furring nails at 4 inches (102 mm) on center providing a minimum $1^1/_8$-inch (28 mm) penetration into each stud and with 8d common nails at 8 inches (200 mm) on center into top and bottom plates. The corrosion-resistant wire mesh is permitted to be attached to steel studs with equivalent wire ties. There shall not be less than a No. 12 gage corrosion-resistant wire, looped through the mesh for every 2 square feet (0.186 $m^2$) of stone veneer. This tie shall be a loop having legs not less than 15 inches (38 mm) in length, so bent that the tie will lie in the stone veneer mortar joint. The last 2 inches (51 mm) of each wire leg shall have a right-angle bend. One-inch (25 mm) minimum thickness of cement grout shall be placed between the backing and the stone veneer.

**1405.5.2 Slab-type veneer:** Slab-type veneer units not exceeding 2 inches (51 mm) in thickness are permitted to be anchored directly to masonry, concrete or stud construction. For veneer units of marble, travertine, granite or other stone units of slab form, ties of corrosion-resistant dowels in drilled holes shall be located in the middle third of the edge of the units spaced a maximum of 24 inches (610 mm) apart around the perimeter of each unit with not less than four ties per veneer unit. Units shall not exceed 20 square feet (1.86 $m^2$) in area.

If the dowels are not tight fitting, the holes are permitted to be drilled not more than $^1/_{16}$ inch (1.6 mm) larger in diameter than the dowel with the hole countersunk to a diameter and depth equal to twice the diameter of the dowel in order to provide a tight-fitting key of cement mortar at the dowel locations when the mortar in the joint has set. All veneer ties shall be corrosion-resistant metal capable of resisting in tension or compression a force equal to two times the weight of the attached veneer.

Sheet metal veneer ties shall not be smaller in area than No. 22 gage by 1 inch. Wire veneer ties shall not be smaller in diameter than No. 9 gage wire.

**1405.5.3 Terra cotta or ceramic veneer:** Anchored terra cotta or ceramic units not less than $1^5/_8$ inches (41 mm) thick are permitted to be anchored directly to masonry, concrete or stud construction. Tied terra cotta or ceramic veneer units shall not be less than $1^5/_8$ inches (41 mm) thick with projecting dovetail webs on the back surface spaced approximately 8 inches (203 mm) on center. The facing shall be tied to the backing wall with corrosion-resistant metal anchors of not less than No. 8 gage wire installed at the top of each piece in horizontal bed joints not less than 12 inches (305 mm) nor more than 18 inches (457 mm) on center. These anchors shall be secured to $^1/_4$-inch (6 mm) corrosion-resistant pencil rods which pass through the vertical aligned loop anchors in the backing wall. The veneer ties shall have sufficient strength to support the full weight of the veneer in tension. The facing shall be set with not less than a 2-inch (51 mm) space from the backing wall and the space shall be filled solidly with portland cement grout and pea gravel. Immediately prior to setting, the backing wall and the facing shall be drenched with clean water and shall be damp when the grout is poured.

**1405.6 Adhered masonry veneer:** Adhered veneer is a veneer secured and supported through the adhesion of an approved bonding material applied to an approved backing. All masonry units used in adhered veneer walls shall meet the physical re-

quirements of Chapter 21. Adhered veneer units shall be less than $1^5/_8$ (41 mm) inches thick and the units shall not support any superimposed *loads*. With the exception of ceramic tile, adhered veneer and backing shall be designed to provide a bond to the supporting element sufficient to withstand a shearing stress of 50 psi (344 kPa) after curing 28 days.

**Exception:** Adhered masonry veneers in accordance with Chapter 14 are not required to meet the tolerances of Section 3.3 F1 of ACI 530.1/ASCE 6/TMS 602 listed in Chapter 35.

**1405.6.1 Backing surface:** Backing permitted for adhered veneer shall be continuous and shall be of any approved material. The backing shall have surfaces prepared to secure and support the imposed *loads* of the adhered veneer.

**1405.6.2 Height of adhered veneer:** Exterior adhered veneer shall not be attached to wood frame construction at a point more than 30 feet (9144 mm) in height above the noncombustible foundation. Height increases are permitted where an engineering analysis is prepared by a *registered design professional* and approved.

**1405.6.3 Sizing of adhered veneer:** Adhered veneer units shall not exceed 36 inches (914 mm) in the greatest dimension, nor more than 720 square inches (0.46 $m^2$) in total area, and shall not weigh more than 15 pounds per square foot (718 Pa) unless approved.

**Exception:** Adhered veneer units weighing less than 3 pounds per square foot (144 Pa) shall not be limited in dimension or area.

**1405.6.4 Interior masonry veneers:** Interior masonry veneers shall have a maximum weight of 20 pounds per square foot (958 Pa) and shall be installed in accordance with Section 1405.6. Where the interior veneer is supported by wood construction, the supporting members shall be designed to limit deflection to $^1/_{600}$ of the span of the supporting members.

**1405.6.5 Construction:** Adhered veneer units shall be adhered directly to the backing by one of the following methods.

1. A paste of neat portland cement shall be brushed on the backing and the back of the veneer unit. Type S mortar shall then be applied to the backing and the veneer unit. Sufficient mortar shall be used to create a slight excess to be forced out the edges of the units. The units shall be tapped into place so as to fill completely the space between the units and the backing. The resulting thickness of mortar in back of the units shall not be less than $^1/_2$ inch (13 mm) nor more than $1^1/_4$ inches (32 mm).
2. Units of masonry, stone or terra cotta, not over 1 inch (25.4 mm) in thickness shall be restricted to 81 square inches (0.052 $m^2$) in area unless the back side of each unit is ground or box screened to true up any deviation from plane. Those units not over 2 inches by 2 inches by $^3/_8$ inch (51 mm by 51 mm by 9 mm) in size are permitted to be adhered by means of portland cement. Backing shall be of masonry, concrete or portland cement plaster on metal lath. Metal lath shall be fastened to the supports in accordance with the requirements of Chapter 25. Mortar that complies with Table 1405.6.4 shall be applied to the backing as a setting bed. The setting bed shall be a minimum of $^3/_8$ inch (9 mm) thick and a maximum of $^3/_4$ inch (19 mm) thick. A paste of neat portland cement or half portland cement and half graded sand shall be applied to the back of the exterior veneer units and to the setting bed and the veneer pressed and tapped into place to provide complete coverage between the mortar bed and veneer unit. A portland cement grout shall be used to point the veneer.

**Table 1405.6.5**
**ADHERED VENEER SETTING MORTAR**

| Wall area | Coat | Volume Type I portland cement | Volume Type S hydrated lime | Volume sand | | Maximum thickness of coat (inches)[a] | Minimum interval between coats (hours) |
|---|---|---|---|---|---|---|---|
| | | | | Dry | Damp | | |
| Walls over 10 square feet | Scratch | 1<br>1 | $^1/_2$<br>0 | 4<br>3 | 5<br>4 | $^3/_8$<br>$^3/_8$ | 24<br>24 |
| | Float or leveling | 1<br>1 | $^1/_2$<br>1 | 4<br>6 | 5<br>7 | $^3/_4$<br>$^3/_4$ | 24<br>24 |
| Walls 10 square feet or less | Scratch and float | 1 | $^1/_2$ | $2^1/_2$ | 3 | $^3/_8$<br>$^3/_4$ | 24 |

**Note a.** 1 inch = 25.4 mm; 1 square foot = 0.093 $m^2$.

**1405.6.6 Adhered ceramic tile:** Adhered veneer of ceramic tile shall be bonded to the backing as provided for in Section 2105.10.

**1405.6.7 Building paper:** Adhered veneer over wood frame construction shall be backed by solid sheathing covered with 14-pound felt building paper as required by Section 1405.3.6.

**1405.7 Structural glass veneers:** The minimum thickness of glass veneer shall be $^{11}/_{32}$ inch (9 mm) and the area of individual panels shall not exceed 10 square feet (0.93 $m^2$), with a maximum length of 4 feet (1219 mm). The edge of each unit shall be ground square with a slight arris. All exposed external corners and angles shall be rounded to a radius of not more than $^3/_{16}$ inch (5 mm).

**1405.7.1 Backing surface:** The glass veneer shall be set in mastic cement on a float coat of 1-inch-thick (25 mm) cement mortar reinforced with wire lath attached to noncombustible furring spaced not more than 12 inches (305 mm) on center.

**1405.7.2 Support of veneer:** The base course of glass units shall be supported on a corrosion-resistant metal frame anchored to the backing and caulked with a waterproof compound at grade.

**1405.7.3 Reinforcement:** Metal reinforcement of cold-formed corrosion-resistant angles of not less than 0.064-inch nominal thickness galvanized sheet steel or other approved reinforcement shall be provided in all horizontal joints anchored into the concrete or masonry wall with expansion or toggle bolts.

**1405.7.4 Expansion joints:** Expansion joints shall be provided at ends and at intermediate sections which are caulked with an approved waterproofing compound. Where necessary for water tightness, exposed edges shall be protected with corrosion-resistant metal or other approved noncombustible flashing.

**1405.7.5 Other loads:** *Signs*, awning brackets or other *loads* shall not be hung directly from glass veneers, but shall be supported on framing anchored to or otherwise supported by the concrete or masonry wall, free from contact with the glass.

**1405.8 Exterior insulation and finish systems (EIFS):** Special inspection shall be required for EIFS applications having areas greater than 10,000 square feet (930 $m^2$) and shall be in accordance with Section 1705.0.

## SECTION 1406.0 COMBUSTIBLE MATERIALS ON THE EXTERIOR SIDE OF EXTERIOR WALLS

**1406.1 General:** This section shall apply to *exterior wall finish*, half-timbering, balconies and similar appendages, and bay and *oriel windows* constructed of combustible materials including light-transmitting *plastic* panels and foam plastic.

**1406.2 Combustible exterior wall finish:** Combustible *exterior wall finish* shall be tested and installed in accordance with Sections 1406.2.1 through 1406.2.4.

**Exceptions**

1. Light-transmitting *plastic* wall panels and glazing shall be constructed and installed in accordance with Chapter 26.
2. Foam plastic installed in or on the exterior side of walls of buildings in accordance with Section 2603.6 shall not be required to comply with Section 1406.2.1, provided that the foam plastic is protected on the outside by:
   2.1. A thermal barrier complying with Section 2603.4;
   2.2. A minimum 1-inch (25 mm) thickness of masonry or concrete;
   2.3. A minimum $^7/_8$-inch (22 mm) thickness of stucco complying with Section 2506.0;
   2.4. A minimum 0.019-inch (0.48 mm) thickness of aluminum; or
   2.5. A minimum 0.016-inch (0.41 mm) thickness or corrosion-resistant steel.

**1406.2.1 Radiant heat exposure:** Combustible *exterior wall finish* shall be tested for exposure to radiant heat. Test specimens shall be prepared in accordance with Section 1406.2.1.1 and tested in accordance with Section 1406.2.1.2. The criteria for acceptance shall be in accordance with Section 1406.2.1.3.

**Exception:** The testing shall not be required for:

1. Wood or wood-based products.
2. Other combustible materials covered with a material listed in Table 1405.3.
3. Aluminum having a minimum thickness of 0.019 inch.
4. *Exterior wall finish* on exterior walls of Type 5 construction.

**1406.2.1.1 Test specimen:** The test specimen shall be constructed to reflect the end-use configuration. Where a material is intended to be installed in more than one thickness, tests of the minimum and maximum thickness intended to be used shall be performed. Test specimens shall consist of a minimum 4-foot-wide by 8-foot-high (1219 mm by 2438 mm) assembly which shall be mounted in a vertical position.

**1406.2.1.2 Test exposure and apparatus:** The test exposure and apparatus shall conform to Sections 1406.2.1.2.1 through 1406.2.1.2.4.

**1406.2.1.2.1 Apparatus:** A 3-foot by 3-foot (914 mm by 914 mm) propane-fired radiant panel shall be provided and shall operate at a constant temperature of 1,600 degrees F. (871 degrees C.) ±50 degrees F. (28 degrees C.).

**1406.2.1.2.2 Configuration:** The radiant panel and the test specimen shall be configured in a parallel plate orientation such that the axis perpendicular to, and running through, the center of the radiant panel face and the test specimen are concurrent.

**1406.2.1.2.3 Heat flux:** The temperature of the radiant heat panel shall be fixed to produce an average heat flux of 12.5 ±5 percent $kW/m^2$ over the center square foot of the test assembly. Average heat flux shall be determined as the average of 4 calorimeter readings located at the corners of the center square foot of the test assembly.

**1406.2.1.2.4 Exposure:** The 4-foot by 8-foot (1219 mm by 2438 mm) test specimen shall be exposed to a "square wave" exposure for a period of 20 minutes. A spark igniter shall be installed and located at a point 18 inches (457 mm) vertically above the center point of the test specimen and $^5/_8$ inch (16 mm) off the face of the test specimen. The spark igniter shall be operated throughout the 20-minute test period. If the spark igniter is operated in an intermittent mode, the "off" portion of the cycle shall not be longer than 2 seconds and the "on" portion of each cycle shall be at least 5 seconds in duration.

**1406.2.1.3 Conditions of acceptance:** Materials shall qualify for installation under the provisions of Section 1406.2.1.3.1 or 1406.2.1.3.2.

**1406.2.1.3.1 Unrestricted installation:** For any *fire separation distance*, an assembly shall be acceptable for installation in accordance with this section and Sections 1405.0 and 2603.6 if, during the exposure described in Section 1406.2.1.2, continuous flaming ignition does not occur for a time period greater than 5 seconds. Continuous flaming ignition shall be judged to occur when continuous flaming is visually observed by laboratory personnel for greater than 5 seconds.

**1406.2.1.3.2 Restricted installation:** For *fire separation distances* greater than 5 feet (1524 mm), an assembly shall be permitted with increased *fire separation distance* if a test specimen in accordance with Section 1406.2.1.1, while being exposed to a reduced level of incident radiant heat energy in accordance with Section 1406.2.1.2, meets the conditions of acceptance in Section 1406.2.1.3.1. The minimum *fire separation distance* required for the assembly shall be determined from Table 1406.2.1.3.2 based on the maximum tolerable level of incident radiant heat energy determined by this section.

**1406.2.2 Construction requirements:** Combustible *exterior wall finish*, other than fireretardant-treated wood complying with Section 2310.0 for exterior installation, shall not exceed 10 percent of an exterior wall surface area where the *fire separation distance* is 5 feet (1524 mm) or less. In buildings of Types 1, 2, 3 and 4 construction, all architectural trim which exceeds 40 feet (12192 mm) in height above *grade plane* shall be constructed of approved noncombustible materials and shall be secured to the wall with metal or other approved noncombustible brackets.

**Exception:** Foam plastics, installed in accordance with Section 2603.6, as required, shall not be subject to these limitations.

**Table 1406.2.1.3.2**
**MINIMUM FIRE SEPARATION DISTANCE FOR COMBUSTIBLE VENEERS BASED ON MAXIMUM TOLERABLE LEVEL OF INCIDENT RADIANT HEAT ENERGY**

| Fire separation distance (feet)[a] | Tolerable level incident radiant heat energy ($kW/m^2$) | Fire separation distance (feet)[a] | Tolerable level incident radiant heat energy ($kW/m^2$) |
|---|---|---|---|
| 5 | 12.5 | 16 | 5.9 |
| 6 | 11.8 | 17 | 5.5 |
| 7 | 11.0 | 18 | 5.2 |
| 8 | 10.3 | 19 | 4.9 |
| 9 | 9.6 | 20 | 4.6 |
| 10 | 8.9 | 21 | 4.4 |
| 11 | 8.3 | 22 | 4.1 |
| 12 | 7.7 | 23 | 3.9 |
| 13 | 7.2 | 24 | 3.7 |
| 14 | 6.7 | 25 | 3.5 |
| 15 | 6.3 | | |

**Note a.** 1 foot = 304.8 mm.

**1406.2.3 Location:** Where combustible *exterior wall finish* is located along the top of exterior walls, such trim shall be completely backed up by the exterior wall and shall not extend over or above the top of exterior walls.

**1406.2.4 Fireblocking:** Continuous *exterior wall finish* constructed of combustible materials shall be *fireblocked* as required in Section 721.0.

**1406.3 Combustible half-timbering:** In buildings of Types 3 and 4 construction which do not exceed three stories or 40 feet (12192 mm) in *height* above *grade plane*, exterior half-timbering and similar architectural decorations are permitted to be constructed of wood or other equivalent combustible material, provided that such trim is backed up solidly with approved noncombustible materials.

**1406.4 Balconies and similar appendages:** All balconies, porches, decks and supplemental exterior *stairways* attached to or supported by buildings of Types 1 and 2 construction shall be constructed of approved noncombustible materials. Such appendages attached to or supported by buildings of Types 3, 4 and 5 construction shall be of either noncombustible or combustible construction. Such appendages of combustible construction, other than fireretardant-treated wood, shall afford the fireresistance rating required by Table 602 for floor construction or shall be of Type 4 construction as described in Section 2304.0 and the aggregate length shall not exceed 50 percent of the building perimeter on each floor.

**Exceptions**

1. Untreated wood is permitted for pickets and rails, or similar guardrail devices which are limited to 42 inches (1067 mm) in height.
2. Balconies and similar appendages on buildings of Types 3, 4 and 5 construction shall be permitted to be of Type 5 construction, and shall not be required to have a fireresistance rating where *sprinkler* protection is extended to these areas.

**1406.5 Bay and oriel windows:** A bay window is a window that projects beyond the wall line of a building and extends down to the foundation. All bay and *oriel windows* attached to or supported by walls in other than buildings of Type 5 construction, shall be of noncombustible construction and be framed with brackets of steel, concrete or other approved noncombustible materials.

# CHAPTER 15

# ROOFS AND ROOF STRUCTURES

## SECTION 1501.0 GENERAL

**1501.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of roofs and roof coverings. *

## SECTION 1502.0 DEFINITIONS

**1502.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Mansard:** A sloping roof which projects from the wall of a building and has a pitch of 45 degrees or greater to the horizontal, or a roof having a double slope, the lower slope being steeper than the upper slope.

***Penthouse:*** An enclosed structure above the roof of a building, other than a roof structure or bulkhead, occupying not more than $33^1/_3$ percent of the roof area (see Section 1510.3).

**Roof:** The flat slab or sloped deck of a structure including its supporting members, not including vertical supports.

**Roof covering:** The covering applied to the roof for weather resistance, fireresistance or appearance.

**Roof structure:** An enclosed structure on or above the roof of any part of a building (see Section 1510.0).

## SECTION 1503.0 CONSTRUCTION DOCUMENTS

**1503.1 General:** For all roofs and roof coverings required by this code, the *construction documents* shall illustrate, describe and clearly delineate the type of roofing system, materials, fastening requirements and flashing requirements which are to be installed.

## SECTION 1504.0 WEATHER PROTECTION

**1504.1 General:** All roofs shall be covered with approved roof coverings properly secured to the building or structure to resist wind and rain. Roof coverings shall be designed, installed and maintained in accordance with approved manufacturer's installation instructions such that the roof covering shall serve to protect the building or structure.

## SECTION 1505.0 PERFORMANCE REQUIREMENTS

**1505.1 Performance requirements:** All roofs and roof coverings shall comply with Sections 1505.2 through 1505.4.

**1505.2 Wind resistance of low-slope roof systems:** The low-slope roof systems described in Section 1507.5 which are mechanically attached, adhered to the roof deck or ballasted shall be designed to resist the design wind load pressures of Section 1609.0. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single-ply, metal panels, and other types of membrane roof coverings shall also be tested in accordance with FM 4450, FM 4470, UL 580 or UL 1897 listed in Chapter 35.

**1505.2.1 Roofing wind test:** Aggregate, ballast and roof pavers shall be wind tested and shall be shown by test to stay in place when subjected to the basic wind speeds of Figure 1609.3, adjusted for building *height* above grade, building exposure, wind gust effect and wind importance factor.

**1505.3 Wind resistance of steep-slope roof systems:** The steep-slope roof coverings described in Section 1507.4 shall be designed to resist the basic wind speeds of Figure 1609.3, adjusted for *building height* above grade, building exposure, wind gust effect and wind importance factor. *

**Exception:** Asphalt shingles shall be connected to the roof deck in accordance with Section 1507.4.3.

**1505.4 Durability:** All roofs and roof coverings shall be of approved materials such that those properties which establish fire classification, wind resistance and weather protection shall be maintained in accordance with Sections 1505.4.1 and 1505.4.2.

**1505.4.1 Physical properties:** Roof coverings shall demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G23, G26 or G53 listed in Chapter 35. Those roof coverings which are subject to cyclical flexural response due to *wind loads* shall not demonstrate any significant loss of tensile strength for unreinforced membranes or breaking strength for reinforced membranes when tested as herein required.

**1505.4.2 Impact resistance:** Roof coverings shall resist impact damage based on the results of tests conducted in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M or FM 4470 listed in Chapter 35. *

## SECTION 1506.0 FIRE CLASSIFICATION

**1506.1 Classification:** Roof covering materials shall be classified in accordance with Sections 1506.1.1 through 1506.1.4 when tested in accordance with ASTM E108 listed in Chapter 35.

**1506.1.1 Class A roof coverings:** Class A roof coverings are those which are effective against severe fire test exposure. Class A roof coverings shall include the following: masonry,

concrete, slate, tile, cement-asbestos or assemblies listed and identified as Class A by an *approved testing agency* and manufacturer's designation. Class A roof coverings shall be permitted for use in buildings or structures of all types of construction.

**1506.1.2 Class B roof coverings:** Class B roof coverings are those which are effective against moderate fire test exposure. Class B roof coverings shall include metal sheets and shingles or assemblies listed and identified as Class B by an *approved testing agency* and manufacturer's designation. Class B roof coverings shall be permitted as the minimum for use in buildings or structures of Type 1 construction.

**1506.1.3 Class C roof coverings:** Class C roof coverings are those which are effective against light fire test exposure. Class C roof coverings shall include assemblies listed and identified as Class C by an *approved testing agency* and manufacturer's designation. Class C roof coverings shall be permitted as the minimum for use in buildings or structures of Types 2, 3, 4 and 5A construction.

**1506.1.4 Nonclassified roof coverings:** Nonclassified roof coverings shall not be permitted.

**Exceptions**

1. Buildings and structures of Type 5B construction with a *fire separation distance* of not less than 30 feet (9144 mm) from the leading edge of the roof.
2. Occupancies in Use Group R-3 located in detached buildings and accessory buildings thereto which have a *fire separation distance* of not less than 6 feet (1829 mm) from the leading edge of the roof.

**1506.2 Testing:** When testing wood shingles and shakes in accordance with ASTM E108 (including the rain test) and ASTM D2898 listed in Chapter 35, the fire tests shall include the intermittent flame test, spread of flame test, burning brand test and flying brand test; additionally, at the conclusion of the rain test, test panels shall be subjected to the intermittent flame test, burning brand test and flying brand test.

**1506.3 Fireretardant-treated shingles and shakes:** Fireretardant-treated wood shakes and shingles shall be treated by impregnation with chemicals by the full-cell vacuum-pressure process, in accordance with AWPA C1 listed in Chapter 35. Each bundle shall be marked to identify the manufactured unit and the manufacturer, and shall also be labeled to identify the classification of the material in accordance with the testing required in Section 1506.2 (Class B or C), the treating company and the quality control agency.

## SECTION 1507.0 MATERIAL AND INSTALLATION REQUIREMENTS

**1507.1 General:** The requirements of Sections 1507.2 through 1507.5 shall apply to all roofs and roof coverings. The installation shall comply with the wind resistance and durability requirements of Section 1505.0. The roofing connections specified in this section shall be utilized only where the requirements of Sections 1505.2 and 1505.3 are satisfied by the specified connections. Unless otherwise noted, all required underlayment shall be Type 1 in accordance with ASTM D226 listed in Chapter 35.

**1507.2 Compatibility of materials:** All roofs and roof coverings shall be of materials that are compatible with each other and with the building or structure to which the materials are applied.

**1507.3 Material specifications and physical characteristics:** All materials for roofs and roof coverings shall conform to the applicable standards listed in this chapter. In the absence of applicable standards or where materials are of questionable suitability, testing by an *approved testing agency* shall be required by the code official to determine the character, quality and limitations of application of the materials.

**1507.4 Steep-slope roof coverings:** Steep-slope roof covering materials and installations shall comply with Sections 1507.4.1 through 1507.4.9. In areas where the average daily temperature in January is 25 degrees F. (-4 degrees C.) or less or where there is a possibility of ice forming along the eaves causing a backup of water, an ice shield that consists of at least two layers of underlayment cemented together or of a waterproofing membrane, shall extend from the eave's edge to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**1507.4.1 Asbestos-cement shingles:** Asbestos-cement shingles shall conform to ASTM C222 listed in Chapter 35. Asbestos-cement shingles shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required for all roof applications. Asbestos-cement shingles shall be secured to the roof with two fasteners per shingle.

**1507.4.2 Asphalt roll roofing:** Asphalt roll roofing shall conform to ASTM D224, D249, D371 or D3909 listed in Chapter 35. Asphalt roll roofing shall not be installed on roof slopes below one unit vertical in 12 units horizontal (1:12), and shall not be installed on roof slopes below three units vertical in 12 units horizontal (3:12) unless applied parallel to the eaves. Single-layer underlayment is required on all roof slopes. Asphalt roll roofing shall be secured to the roof in accordance with approved manufacturer's installation instructions.

**1507.4.3 Asphalt shingles:** Asphalt shingles shall conform to ASTM D225 or D3462 listed in Chapter 35. Asphalt shingles shall not be installed on roof slopes below two units vertical in 12 units horizontal (2:12). Double-layer underlayment shall be required on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required on all other roof slopes. Asphalt shingles shall be secured to the roof with not less than four fasteners per strip shingle, or not less than two fasteners per individual shingle. Asphalt strip shingles shall have a minimum of six fasteners per shingle where the structure is located in hurricane oceanline areas along the Atlantic and Gulf of Mexico coastal areas and 100 miles (160 km) inland where the basic wind speed is 80 miles per hour (128 km/hr) or greater, determined in accordance with Figure 1609.3. Shingle headlap shall not be less than 2 inches (51 mm).

**1507.4.4 Interlocking clay or cement tile:** Interlocking clay or cement tile shall be installed only over solid sheathing or spaced structural sheathing boards. Interlocking clay or cement tile shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Horizontal battens shall

be required on roof slopes over seven units vertical in 12 units horizontal (7:12). Single-layer underlayment is required over solid sheathing on all roof slopes. Reinforced underlayment shall be required where spaced sheathing is installed. Regardless of roof slope, the first three tile courses and all tile within 3 feet (914 mm) of roof edges, changes in roof slope or changes in slope direction, shall be fastened to the roof. For the field of the roof, fastening is not required on roof slopes below five units vertical in 12 units horizontal (5:12); every other tile course shall be fastened on roof slopes five units vertical in 12 units horizontal (5:12) to less than 12 units vertical in 12 units horizontal (12:12); and every tile shall be fastened on roof slopes 12 units vertical in 12 units horizontal (12:12) and over. Tile overlap shall be in accordance with approved manufacturer's installation instructions.

**1507.4.5 Noninterlocking clay or cement tile:** Noninterlocking clay or cement tile shall not be installed on roof slopes below two and one-half units vertical in 12 units horizontal ($2^1/_2$:12). Double-layer underlayment is required on roof slopes below three units vertical in 12 units horizontal (3:12). Single-layer underlayment is required on all other roof slopes. Noninterlocking clay or cement tile shall be secured to the roof with two fasteners per tile. The minimum tile overlap shall be 3 inches (76 mm).

**1507.4.6 Metal shingles:** Metal shingles shall not be installed on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment is required for all metal shingles other than flat metal shingles on all roof slopes. Metal shingles shall be secured to the roof in accordance with approved manufacturer's installation instructions.

**1507.4.7 Slate shingles:** Slate shingles shall conform to ASTM C406 listed in Chapter 35. Slate shingles shall not be installed on roof slopes below two units vertical in 12 units horizontal (2:12). Double-layer underlayment shall be required on roof slopes below four units vertical in 12 units horizontal (4:12). Single-layer underlayment shall be required on all other roof slopes. Slate shingles shall be secured to the roof with two fasteners per slate. The minimum slate headlap shall be 3 inches (76 mm).

**1507.4.8 Wood shingles:** Wood shingles shall be identified by a *label* and subject to a quality control program administered by an *approved agency*. Wood shingles shall not be installed on roof slopes below three units vertical in 12 units horizontal (3:12). A single layer of underlayment is required at eaves, ridges, hips, valleys and all other changes of roof slope or direction. Wood shingles shall be secured to the roof with a maximum of two approved fasteners per shingle. The maximum weather exposures for wood shingles shall be in accordance with Table 1507.4.8.

**1507.4.9 Wood shakes:** Wood shakes shall be identified by a *label* and subject to a quality control program administered by an *approved agency*. Wood shakes shall not be installed on roof slopes less than four units vertical in 12 units horizontal (4:12). A single layer of felt interlayment shall be shingled between each course of wood shakes on all roof slopes. Wood shakes shall be secured to the roof with a maximum of two fasteners per shake. Fasteners for preservative-treated southern yellow pine taper-sawn shakes shall be of Type 304 or 316 stainless steel, hot-dipped galvanized steel, aluminum or other corrosion-resistant materials. The maximum weather exposure shall be $7^1/_2$ inches (191 mm) for 18-inch-long shakes (457 mm) and 10 inches (254 mm) for 24-inch-long shakes.

**Exception:** The maximum weather exposures of No. 2 grade southern yellow pine taper-sawn shakes shall be $5^1/_2$ inches (140 mm) for 18-inch (457 mm) shakes and $7^1/_2$ inches (191 mm) for 24-inch (610 mm) shakes.

**Table 1507.4.8**
**MAXIMUM WEATHER EXPOSURES FOR WOOD SHINGLES**

| Grade | Shingle length (inches)[a] | Exposure (inches) based on slope (units vertical:units horizontal) | |
|---|---|---|---|
| | | 3:12 to 4:12 | 4:12 and steeper |
| No. 1 grade | 16 | $3^3/_4$ | 5 |
| | 18 | $4^1/_4$ | $5^1/_2$ |
| | 24 | $5^3/_4$ | $7^1/_2$ |
| No. 2 grade | 16 | $3^1/_2$ | 4 |
| | 18 | 4 | $4^1/_2$ |
| | 24 | $5^1/_2$ | $6^1/_2$ |
| No. 3 grade | 16 | 3 | $3^1/_2$ |
| | 18 | $3^1/_2$ | 4 |
| | 24 | 5 | $5^1/_2$ |

**Note a.** 1 inch = 25.4 mm.

**1507.5 Low-slope roof coverings:** Low-slope roof covering materials and installations shall comply with Sections 1507.5.1 through 1507.5.7. Roofs shall have a design slope of a minimum of one-fourth unit vertical in 12 units horizontal ($^1/_4$:12) for drainage, except for coal-tar built-up roofs which shall have a design slope of a minimum one-eighth unit vertical in 12 units horizontal ($^1/_8$:12). The attachment of insulation above the roof deck, the weight and distribution of ballast, the fastener type and fastening pattern, and the bitumen or adhesive application utilized in the installation of low-slope roof coverings shall meet the wind resistance requirements of Section 1505.2.

**1507.5.1 Built-up roofing:** Built-up roof covering materials shall comply with the standards in Table 1507.5.1. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the built-up roof covering and flashing materials. On slopes greater than two units vertical in 12 units horizontal (2:12), provisions shall be made for blind nailing the built-up roof covering to the roof to prevent slipping. Aggregate surfacing shall not be installed, and plies shall be applied parallel to the slope of the deck (strapping method) on roof slopes above three units vertical in 12 units horizontal (3:12). Built-up roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

**1507.5.2 Thermoset single-ply roof coverings:** Thermoset single-ply roof coverings shall comply with RMA RP-1, RP-2 or RP-3, or ASTM D4637 or CGSB 37-GP-52M listed in Chapter 35. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the thermoset single-ply roof covering and flashing materials. Ballasted roof coverings shall not be installed on roof slopes

above two units vertical in 12 units horizontal (2:12). Thermoset single-ply roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

**Table 1507.5.1**
**BUILT-UP ROOFING MATERIAL STANDARDS**

| Material | Standard[a] |
|---|---|
| Aggregate surfacing | ASTM D1863 |
| Asphalt-coated glass fiber venting base sheet | ASTM D4601 |
| Asphalt glass felt | ASTM D2178 |
| Asphalt-saturated and asphalt-coated organic felt base sheet | ASTM D2626 |
| Asphalt-saturated organic felt (perforated) | ASTM D226 |
| Asphalt used in roofing | ASTM D312 |
| Coal-tar saturated organic felt | ASTM D227 |
| Coal-tar used in roofing | ASTM D450 Types I or III |
| Mineral-surfaced inorganic cap sheet | ASTM D3909 |

**Note a.** Specific standards referenced are those listed in Chapter 35.

**1507.5.3 Thermoplastic single-ply roof coverings:** Thermoplastic single-ply roof coverings shall comply with ASTM D4434 or CGSB 37-GP-54M listed in Chapter 35. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the thermoplastic single-ply roof covering and flashing materials. Ballasted roof coverings shall not be installed on roof slopes above two units vertical in 12 units horizontal (2:12). Thermoplastic single-ply roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

**1507.5.4 Modified bitumen roof coverings:** Modified bitumen roof coverings shall comply with CGSB 37-GP-56M listed in Chapter 35. Provisions shall be made at deck edges, terminations and penetrations for mechanical fastening of the modified bitumen roof covering and flashing materials. Modified bitumen roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

**1507.5.5 Spray-applied polyurethane-foam roof covering systems:** Spray-applied polyurethane-foam insulation shall comply with ASTM C1029 listed in Chapter 35. A liquid-applied roof coating that complies with Section 1507.5.6 shall be applied to the top surface of the cured foam insulation in accordance with approved manufacturer's installation instructions. Foam plastics shall also conform to Section 2603.0.

**1507.5.6 Liquid-applied roof coatings:** Liquid-applied roof coatings shall comply with ASTM C836, C957, D1227 or D3468 listed in Chapter 35. Liquid-applied roof coatings shall be applied in accordance with approved manufacturer's installation instructions.

**1507.5.7 Metal-sheet roof coverings:** Metal-sheet roof covering systems which incorporate supporting structural members shall be designed in accordance with Section 2206.0. Metal-sheet roof coverings installed over structural decking shall comply with ASTM A361, A755 or B101 listed in Chapter 35. Metal-sheet roof coverings shall be installed in accordance with approved manufacturer's installation instructions.

## SECTION 1508.0 FLASHINGS

**1508.1 General:** Flashings shall be installed at wall and roof intersections; at gutters; wherever there is a change in roof slope or direction; and around all roof openings.

## SECTION 1509.0 ROOF INSULATION

**1509.1 General:** Rigid combustible roof insulation shall be permitted, provided that the insulation is covered with approved roof coverings directly applied thereto (see Section 2603.4.1.5).

## SECTION 1510.0 ROOF STRUCTURES

**1510.1 General:** All construction, other than aerial supports, clothes dryers and similar structures less than 12 feet (3658 mm) high, water tanks and cooling towers as hereinafter provided and flag poles erected above the roof of any part of any building or structure more than 40 feet (12192 mm) in *height*, shall be constructed of approved noncombustible materials.

**1510.2 Scuttles:** Trap doors and scuttles as required by Section 1027.0 shall not be less than 2 feet by 3 feet (610 mm by 914 mm) in size. In buildings of Types 1 and 2 construction, trap doors and scuttles shall be of approved noncombustible materials.

**1510.3 Penthouses:** *Penthouses* shall be considered a part of the next lower story, and the enclosure shall conform to the requirements for exterior walls of the building type as regulated by Table 602 and Chapter 14, except as modified herein.

**1510.3.1 Recessed walls:** Where the exterior wall of a *penthouse* is recessed 5 feet (1524 mm) or more from the exterior wall of the next lower story and the exterior wall of the next lower story is required to have a fireresistance rating of greater than $1^1/_2$ hours, the *penthouse* exterior wall shall be constructed with a fireresistance rating of not less than $1^1/_2$ hours; covered on the outside with noncombustible, weatherproof material; and supported on *protected* steel or reinforced concrete construction.

**1510.3.2 Unprotected openings:** Where *protected* openings are not required by Section 705.0, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of Chapters 14, 24 and 26.

**1510.4 Other enclosed roof structures:** Enclosed roof structures, other than *penthouses*, shall be considered a story of the building and shall conform to the requirements for the building type as regulated by Table 602 and Chapter 14.

**1510.5 Mansards and other sloping roofs:** Mansards and other sloping roofs shall comply with Sections 1510.5.1 and 1510.5.2.

**1510.5.1 High-slope roofs:** Every mansard roof or other sloping roof having a pitch of more than 60 degrees (1.05 rad) to the horizontal hereafter erected on any building or structure of other than Type 5 construction which is more than three stories or 40 feet (12192 mm) in *height*, shall be constructed of noncombustible materials with a fireresistance rating of not less than 1 hour. Where the building is more than seven stories or 85 feet (25908 mm) in *height*, such roofs shall afford the same fireresistance rating required for the exterior walls of the building, but are not required to exceed a $1^1/_2$-hour fireresistance rating.

**1510.5.2 Low-slope roofs:** Where the pitch is 60 degrees (1.05 rad) or less to the horizontal, the mansard or other sloping roof located on any building shall be constructed of not less than the same materials as required for the roof of the building.

**1510.6 Dormers:** The sides and roofs of dormers shall be of the same type of construction as the main roof, except that where a side of the dormer is a vertical extension of an exterior wall, that side of the dormer shall be subject to the same fireresistance rating requirements as apply to the wall of the building. The roofs of dormers shall be protected with approved roof coverings complying with Section 1506.0. The sides of dormers shall be protected with approved roof coverings or with material permitted for covering the exterior walls of the building.

**1510.7 Water tanks:** Water tanks shall be constructed and installed in accordance with Sections 1510.7.1 through 1510.7.5.

**1510.7.1 Supports:** Water tanks having a capacity of more than 500 gallons (1893 L) placed in or on a building shall be supported on masonry, concrete, steel or other approved noncombustible framing or on timber conforming to Type 4 construction; provided that, where such supports are located in the building above the lowest story, the support shall be fireresistance rated as required for Type 1A construction.

**1510.7.2 Emergency discharge:** A pipe or outlet shall be located in the bottom or in the side close to the bottom, or the tank shall be fitted with a quick-opening valve, to enable the contents to be discharged in an emergency to a suitable drain that complies with the plumbing code listed in Chapter 35.

**1510.7.3 Location:** A tank shall not be located over or near a *stairway* or elevator *shaft* unless a solid roof or floor deck is constructed underneath the tank.

**1510.7.4 Tank cover:** All roof tanks exposed to the weather shall have approved covers sloping towards the outer edges.

**1510.7.5 Hoop and strap protection:** Where metal hoops are utilized in the construction of wood tanks, such hoops shall be protected with approved corrosion-resistant coatings or manufactured from approved corrosion-resistant alloys.

**1510.8 Cooling towers:** Cooling towers erected on the roofs of buildings where the base of the tower is more than 55 feet (16764 mm) above *grade plane* shall be constructed of approved noncombustible material or fireretardant-treated wood except that drip bars are not required to be of noncombustible material or fireretardant-treated wood.

**1510.9 Miscellaneous roof structures:** Except as herein specifically provided for, all towers, spires, dormers or cupolas shall be erected of the type of construction and fireresistance rating required for the building to which such structures are accessory as regulated by Tables 503 and 602. Where the *height* of such *appurtenant structures* exceeds 85 feet (25908 mm) above *grade plane* or where the area at any horizontal section of the tower, spire, dormer or cupola exceeds 200 square feet (19 $m^2$), or where utilized for any purpose other than as a belfry or architectural embellishment, the structure and the associated supports shall be of Type 1 or 2 construction, or of fireretardant-treated wood complying with Section 2310.0. Radio and television towers and antennas shall be constructed to comply with Sections 3108.0 and 3109.0.

## SECTION 1511.0 ROOFTOP HELIPORTS

**1511.1 General:** This section governs the design and construction of rooftop facilities intended to accommodate the landing of helicopters. The utilization of a roof for landing shall be subject to the approval of the Federal Aviation Administration.

**1511.2 Structural loads:** The roof and all pertinent building components shall be designed for the *dead loads*, *live loads*, *impact loads* and vibrations imparted to the structure due to helicopter landing, including the single-skid point landing.

**1511.3 Referenced standard:** All rooftop heliports shall comply with NFPA 418 listed in Chapter 35.

## SECTION 1512.0 REROOFING

**1512.1 General:** Materials and methods of application used for recovering or replacing not more than 25 percent of an existing roof covering shall comply with the requirements of Section 1505.0 or 1507.0. The repair of existing roofs and roof coverings shall comply with the provisions of Chapter 34, but more than 25 percent of the roof covering of any building shall not be removed and replaced within any 12-month period unless the entire roof covering is made to conform to the requirements for new roofing.

**1512.2 Structural and construction loads:** The structural roof components shall be capable of supporting the roof covering system and the material and equipment *loads* that will be encountered during installation of the roof covering system.

**1512.3 Recovering vs. replacement:** New roof coverings shall not be installed without first removing existing roof coverings where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is wood shake, slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

**Exception:** Complete and separate roofing systems, such as standing-seam metal roof systems, which are designed to transmit all roof *loads* directly to the building's structural system and which do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.

**1512.4 Reinstallation of materials:** Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashings, metal edgings, drain outlets, collars and metal counterflashings shall not be reinstalled where rusted, damaged or deteriorated. Aggregate surfacing materials shall not be reinstalled.

**1512.5 Flashings:** Flashings shall be reconstructed in accordance with approved manufacturer's installation instructions. Metal flashings to which bituminous materials are to be adhered shall be primed prior to installation.

# CHAPTER 16

# STRUCTURAL LOADS

## SECTION 1601.0 GENERAL

**1601.1 Scope:** The provisions of this chapter shall control the structural design of all buildings and structures, or portions thereof, hereafter erected.

## SECTION 1602.0 DEFINITIONS

**1602.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Balcony (exterior):** An exterior floor projecting from and supported by a structure without additional independent supports (see Section 1606.0).

**Deck:** An exterior floor supported on at least two opposing sides by an adjacent structure, posts, piers or other independent supports (see Section 1606.0).

***Load:*** Forces or other actions that arise on structural systems from the weight of all permanent construction, occupants and their possessions, environmental effects, differential settlement and restrained dimensional changes.

***Dead load:*** The weight of all 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 components, and fixed service equipment including the weight of cranes.

***Duration of load:*** The period of continuous application of a given *load*, or the aggregate of periods of intermittent applications of the same *load*.

***Earthquake load:*** The assumed lateral *load* acting in any horizontal direction on the structural frame due to the dynamic action of earthquakes.

***Impact load:*** The *load* resulting from moving machinery, elevators, craneways, vehicles and other similar forces and kinetic *loads*.

* ***Lateral soil load:*** The lateral pressure in pounds per square foot (psf) [pascals (Pa)] due to the weight of the adjacent soil, including due allowance for hydrostatic pressure and possible surcharge from fixed or moving *loads*.

***Live load:*** Those *loads* produced by the occupancy of the building or structure, not including construction loads or environmental *loads* such as *wind loads*, snow *loads*, rain loads, *earthquake loads,* flood loads or *dead loads*. Live loads on a roof are those produced during maintenance by workers, equipment and materials, and during the life of a structure by people and moveable objects.

***Wind load:*** The lateral pressure on the building or structure in pounds per square foot (psf) [pascals (Pa)] due to wind blowing in any direction.

**Panel (part of a structure):** The section of a floor or wall comprised between the supporting frame of two adjacent rows of columns and girders or column bands of floor construction.

**Wall**

**Loadbearing wall:** A wall supporting any vertical *load* in addition to its own weight.

**Nonloadbearing wall:** A wall which does not support vertical *loads* other than its own weight.

## SECTION 1603.0 CONSTRUCTION DOCUMENTS

**1603.1 General:** *Construction documents* shall show the size, section and relative locations of all structural members with floor levels, column centers and all offsets fully dimensioned. The design *loads* and other information pertinent to the structural design required by Sections 1603.2 through 1603.7 shall be clearly indicated on the *construction documents* for all parts of the building or structure.

**1603.2 Floor live load:** The uniformly distributed, concentrated and impact floor *live load* utilized in the design shall be indicated for all floor areas (Section 1606.0). *Live load* reduction of the uniformly distributed floor *live loads* (Section 1606.7), if utilized, shall be indicated.

**1603.3 Roof live load:** The roof *live load* utilized in the design shall be indicated for all roof areas (Section 1607.0).

**1603.4 Roof snow load:** The ground snow *load* ($P_g$) shall be indicated (Section 1608.3). In areas where the ground snow *load* ($P_g$) exceeds 10 pounds per square foot (psf) (479 Pa), the following additional information shall also be provided, regardless of whether snow *loads* govern design of the roof:

1. Flat-roof snow *load* ($P_f$) (Section 1608.4);
2. Snow exposure factor ($C_e$) (Table 1608.4); and
3. Snow load importance factor ($I$) (Table 1609.5).

**1603.5 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 (mph) (Section 1609.3);
2. Wind load importance factor ($I$) (Table 1609.5);
3. Wind exposure — if more than one wind exposure is utilized, the wind exposure and applicable wind direction shall be indicated (Section 1609.4); and

4. Wind design pressure ($P$) — if more than one exposure is utilized, $P$ for each exposure shall be indicated (Section 1609.7).

**1603.6 Earthquake design data:** Where *earthquake loads* are applicable, the following earthquake design data shall be indicated on the *construction documents*:

1. The peak velocity-related acceleration ($A_v$) in accordance with Section 1610.1.3;
2. The peak acceleration ($A_a$) in accordance with Section 1610.1.3;
3. The Seismic Hazard Exposure Group in accordance with Section 1610.1.5;
4. The Seismic Performance Category in accordance with Section 1610.1.7;
5. The soil-profile type in accordance with Table 1610.3.1;
6. The basic structural system and seismic-resisting system in accordance with Table 1610.3.3;
7. The response modification factor ($R$) and the deflection amplification factor ($C_d$) in accordance with Table 1610.3.3; and
8. The analysis procedure utilized in accordance with Section 1610.4 or 1610.5 as applicable.

**1603.7 Special loads:** Special *loads* (Section 1612.0) which are applicable to the design of the building or structure shall be indicated.

## SECTION 1604.0 DESIGN SAFE LOAD

**1604.1 Basic requirements:** The basic requirements of strength, serviceability, self-straining forces and analysis for buildings and other structures shall be in accordance with Section 1.3 of ASCE 7 listed in Chapter 35.

**1604.2 General structural integrity:** The requirements for general structural integrity shall be in accordance with Section 1.4 of ASCE 7 listed in Chapter 35.

**1604.3 In-situ load tests:** The code 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 Section 1707.0 or 1709.0.

**1604.4 Preconstruction load tests:** Materials and methods of construction which are not capable of being designed by approved engineering analysis or which do not comply with the applicable material design standard listed in Chapter 35, or alternative test procedures in accordance with Section 1707.0, shall be load tested in accordance with Section 1710.0.

**1604.5 Deflection limitations:** The deflection of structural members shall not exceed the more stringent limitations of Sections 1604.5.1 through 1604.5.3 or Sections 1604.5.4 through 1604.5.6.

**1604.5.1 Reinforced concrete:** The deflection of reinforced concrete structural members shall not exceed that permitted by ACI 318 listed in Chapter 35.

**1604.5.2 Steel:** The deflection of steel structural members shall not exceed that permitted by AISC ASD, AISC LRFD, AISI CFSD-ASD, 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* listed in Chapter 35 as applicable.

**1604.5.3 Masonry:** The deflection of masonry structural members shall not exceed the limitations permitted by ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**1604.5.4 Floors:** The deflection due to *live load* of structural members supporting floors shall not exceed $^1/_{360}$ of the span.

**1604.5.5 Roofs:** The deflection due to *live*, snow or *wind load* of structural members supporting roofs shall not exceed the following:

1. $^1/_{360}$ of the span where a plaster ceiling is attached or suspended;
2. $^1/_{180}$ of the span for high slope (more than three in 12) rafter construction without a ceiling *load*;
3. $^1/_{150}$ of the span for structural members supporting metal sheeting and without a ceiling load, provided the roof meets the minimum design slope in Section 1507.5; or
4. $^1/_{240}$ of the span for other structural members supporting roofs or suspended ceilings other than plaster.

**1604.5.6 Walls:** The deflection of structural members in walls shall not exceed:

1. $^1/_{180}$ of the span of structural members in interior walls or partitions when subjected to the horizontal *load* specified in Section 1606.9;
2. $^1/_{240}$ of the span of structural members in exterior walls when subjected to the design *wind load*; or
3. $^1/_{120}$ of the span of structural members in exterior walls supporting metal siding or that are designed to accommodate the deflection when subjected to the design wind load.

## SECTION 1605.0 DESIGN DEAD LOAD

**1605.1 Weights of materials and construction:** In estimating *dead loads* for the purposes of structural design, the actual weights of materials and constructions shall be utilized. In the absence of definite information, any values assumed by the designers shall be subject to the approval of the code official.

**1605.2 Weight of fixed service equipment:** In estimating *dead loads* for the purposes of design, the weight of fixed service equipment such as plumbing stacks and risers, electrical feeders, heating, *ventilating*, air conditioning and *fire protection systems*, shall be included.

## SECTION 1606.0 LIVE LOADS

**1606.1 Design live load:** The *live loads* to be assumed in the design of buildings and structures shall be the greatest *load* produced by the intended occupancy, but not less than the minimum uniformly distributed unit *loads* required in Section 1606.2 for specific occupancies.

**1606.1.1 Loads not specified:** The code official shall approve the required *live load* for any occupancy not specifically provided for in Table 1606.

**Table 1606**
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND MINIMUM CONCENTRATED LIVE LOADS**

| Occupancy | Uniform Live load (psf)[e] | Concentrated load (pounds) |
|---|---|---|
| Apartments (see Residential) | | |
| Access floor systems | | |
| Office use | 50 | 2,000 |
| Computer use | 100 | 2,000 |
| Armories and drill rooms | 150 | |
| Assembly areas: | | |
| Fixed seats | 60 | |
| Lobbies | 100 | |
| Movable seats | 100 | |
| Platforms (assembly) | 125 | |
| Projection and control rooms | 50 | |
| Stage catwalks | 40 | |
| Stage floors | 125 | |
| Balcony (exterior) | 100 | |
| One- and two-family dwelling balconies that do not exceed 100 square feet. | 60 | |
| Bowling centers, poolrooms and similar recreational uses | 75 | |
| Corridors, except as otherwise indicated | | |
| First floor | 100 | |
| Other floors | same as occupancy served | |
| Dance halls and ballrooms | 100 | |
| Decks | Same as occupancy served | |
| Dining rooms and restaurants | 100 | |
| Dwellings (see Residential) | | |
| Elevator machine room grating (on area of 4 square inches) | | 300 |
| Finish light floor plate construction (on area of 1 square inch) | | 200 |
| Fire escapes | 100 | |
| Single-family residential buildings only | 40 | |
| Garages | | |
| Passenger cars only | 50[a] | Note a |
| Trucks and buses | see Section 1606.2.1 | |
| Grandstands (see Reviewing stands) | | |
| Gymnasiums, main floors and balconies | 100[b] | |
| Handrails, guards, and grab bars | See Section 1606.4 | |
| Hospitals: | | |
| Operating rooms, laboratories | 60 | 1,000 |
| Private rooms | 40 | 1,000 |
| Wards | 40 | 1,000 |
| Corridors, above first floor | 80 | 1,000 |
| Hotels (see Residential) | | |
| Institutional — residential care (see Residential) | | |
| Libraries: | | |
| Reading rooms | 60 | 1,000 |
| Stack rooms | 150[c] | 1,000 |
| Corridors above first floor | 80 | 1,000 |

**Table 1606 (cont'd.)**
**MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS AND MINIMUM CONCENTRATED LIVE LOADS**

| Occupancy | Uniform Live load (psf)[e] | Concentrated load (pounds) |
|---|---|---|
| Manufacturing: | | |
| Light | 125 | 2,000 |
| Heavy | 250 | 3,000 |
| Marquees and canopies | 75 | |
| Office buildings: | | |
| Offices | 50 | 2,000 |
| Lobbies | 100 | 2,000 |
| Corridors, above first floor | 80 | 2,000 |
| File and computer rooms require heavier loads based upon anticipated occupancy | | |
| Penal institutions: | | |
| Cell blocks | 40 | |
| Corridors | 100 | |
| Residential: | | |
| Attics — see Section 1606.2.2 and 1606.2.3 | 20 | |
| Multiple-family dwellings: | | |
| Dwelling units and corridors | 40 | |
| Public rooms and corridors | 100 | |
| One- and two-family dwellings: | 40 | |
| Sleeping rooms | 30 | |
| Hotels: | | |
| Guestrooms and corridors | 40 | |
| Public rooms and corridors | 100 | |
| Reviewing stands, grandstands and bleachers — see Note b | 100 | |
| Schools: | | |
| Classrooms | 40 | 1,000 |
| Corridors above first floor | 80 | 1,000 |
| First floor corridors | 100 | 1,000 |
| Scuttles, skylight ribs, and accessible ceilings | | 200 |
| Sidewalks, vehicular driveways, subject to trucking | 250 | 8,000[d] |
| Stadiums and arenas — See Note b | | |
| Bleachers | 100 | |
| Fixed seats (fastened to floor) | 60 | |
| Skating rinks | 100 | |
| Stairs, including landings and platforms, and exits | 100 | 300 (on area of 4 square inches of tread) |
| Storage areas: | | |
| Light | 125 | |
| Heavy | 250 | |
| Above ceiling | 20 | |
| Stores: | | |
| Retail, first floor | 100 | 1,000 |
| Retail, upper floors | 75 | 1,000 |
| Wholesale, all floors | 125 | 1,000 |
| Vehicle barriers | See Section 1606.4 | |
| Walkways and elevated platforms (other than exits) | 60 | |
| Yards and terraces, pedestrians | 100 | |

**Notes to Table 1606 appear on next page.**

**Notes to Table 1606**

**Note a.** Floors in garages or portions of buildings utilized for the storage of motor vehicles shall be designed for the uniformly distributed live loads of Table 1606 or the following concentrated load: (1) for passenger cars accommodating not more than 9 passengers; 2000 pounds acting on an area of 20 square inches; and (2) mechanical parking structures without slab or deck, passenger cars only; 1500 pounds per wheel.

**Note b.** In addition to the vertical live loads, loads of 120 pounds per lineal foot on footboards and seatboards shall be utilized. Lateral sway-bracing loads of 24 pounds per lineal foot parallel to and 10 pounds per lineal foot perpendicular to seatboards and footboards shall be utilized.

**Note c.** The weight of books and shelving shall be computed utilizing an assumed density of 65 lb/ft$^3$ and converted to a uniformly distributed load, which shall be utilized if this load exceeds 150 lb/ft$^2$.

**Note d.** The concentrated wheel load shall be applied on an area of 20 square inches.

**Note e.** 1 psf = 47.9 Pa; 1 pound = 4.4 N.

**1606.2 Uniformly distributed load:** The minimum uniformly distributed *live load* in pounds per square foot shall be as provided for in Table 1606, and for all concentrated *loads* wherever such *loads* occur as provided for in Section 1606.3. The *live loads* in Table 1606 are the minimum *loads* to be used for the occupancies listed. Where the building will be subjected to greater *live loads*, such *loads* shall be utilized for design.

**1606.2.1 Truck and bus garages:** Minimum *live loads* for *garages* having trucks or buses shall be as specified in Table 1606.2.1, but shall not be less than 50 psf (2394 Pa).

**Table 1606.2.1**
**UNIFORM AND CONCENTRATED LOADS**

| Loading class[a] | Uniform load (lbs./linear foot of lane) | Concentrated loads[b] (lbs.) | |
|---|---|---|---|
| | | For moment design | For shear design |
| H20-44 and HS20-44 | 640 | 18,000 | 26,000 |
| H15-44 and HS15-44 | 480 | 13,500 | 19,500 |

**Note 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.

**Note b.** See Section 1606.2.1.1 for the loading of multiple spans.

**1606.2.1.1 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 (3657 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 1606.2.1 and one simultaneous concentrated load positioned to produce the maximum effect. Multiple spans shall be designed for the uniform load in Table 1606.2.1 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.

**1606.2.2 Residential attics with joists:** A *live load* shall be applied to joists only in those portions of the *attic* space having a clear height of 42 inches (1067 mm) or more between joist and rafter in conventional rafter construction. Joists shall be designed, however, to sustain the imposed *dead load* or 10 psf (479 Pa), whichever is greater, uniformly distributed over the entire span.

A further ceiling *dead-load* reduction to a minimum of 5 psf (239 Pa) or the actual *dead load*, whichever is greater, applied to joists in conventional rafter construction is permitted under either or both of the following conditions:

1. Where the clear height is not over 30 inches (762 mm) between joist and rafter in conventional construction.
2. Where a clear height of greater than 30 inches (762 mm), as defined in item 1, does not exist for a horizontal distance of more than 12 inches (305 mm) along the member.

**1606.2.3 Residential attics with trusses:** A *live load* shall be applied to those portions of the bottom chord of not less than two adjacent trusses with the same web configuration containing a rectangle 42 inches (1067 mm) high or greater by 2 feet (610 mm) wide or greater, located within the plane of the truss. The rectangle shall fit between the top of the bottom chord and the bottom of any other truss member, provided each of the following criteria are met:

1. The attic area is accessible by a permanent stairway, pull-down stairway, or scuttle opening meeting the size specifications of Section 1211.2, and
2. The truss shall have a bottom chord pitch less than 2 in 12.

Bottom chords of trusses shall be designed for the greater of the actual imposed *dead load* or 10 psf (478 Pa), uniformly distributed over the entire span.

A ceiling *dead load* of 5 psf (239 Pa) or the actual *dead load*, whichever is greater, uniformly distributed over the entire bottom chord of trusses applies to either or both of the following conditions:

1. Where the clear height is not over 30 inches (762 mm) between the bottom chord and any other member of the truss, or
2. Where a clear height of greater than 30 inches (762 mm) as defined in item 1, does not exist for a horizontal distance of more than 12 inches (304 mm) along the member.

**1606.2.4 Partition load:** In offices and other buildings in which subdividing partitions are subsequently erected, rearranged or relocated, provisions shall be made to support the actual weight of such partitions where the partitions occur, or for an equivalent uniform *load*, which shall be assumed to be not less than 20 psf (958 Pa) of floor area in addition to the specified uniformly distributed *live load*. Provisions for partition weight shall be made whether or not partitions are shown on the *construction documents*, unless the specified *live load* exceeds 80 psf (3830 Pa).

**1606.3 Concentrated loads:** Floors and other structural elements of buildings in the locations specified in Table 1606 shall be designed to support the uniformly distributed *live loads* prescribed in Section 1606.2 or the minimum concentrated *loads* in pounds prescribed in Table 1606, whichever produces the greater stresses. If the anticipated actual *loads* are higher, the actual *loads* shall be utilized. Unless otherwise specified, the indicated concentration shall be assumed to occupy an area of $2^1/_2$ feet square (6.25 ft.$^2$) (0.58 m$^2$) and shall be so located as to produce the maximum stress conditions in the structural members.

**1606.4 Loads on handrails, guards, grab bars and vehicle barriers:** All required handrails, guards, grab bars and vehicle barriers shall be designed and constructed to the structural loading conditions in Section 4.4 of ASCE 7 listed in Chapter 35.

**1606.5 Partial loading:** The full intensity of the appropriately reduced *live load* applied only to a portion of the length of a structure or member shall be considered if such applied *load* produces a more unfavorable effect than the same intensity applied over the full length of the structure or member.

**1606.6 Impact loads:** The live loads specified in Section 1606.2 include allowance for impact conditions. Provisions shall be made in the structural design for occupancies and loads which involve vibration and impact forces as required in Section 4.7 of ASCE 7 listed in Chapter 35.

**1606.7 Reduction in live loads:** The minimum required design live load reduction shall be limited to that in Section 1606.7.1 and 1606.7.2.

**1606.7.1 Permissible reduction:** Except as otherwise indicated in Section 1606.7.2, the minimum required design *live load* for members having an influence area of 400 square feet (37.20 $m^2$) or more is permitted to be reduced in accordance with the following equation:

$$L = L_o\left(0.25 + \frac{15}{\sqrt{A_i}}\right)$$

where:

$L$ = Reduced design *live load* in pounds per square foot.

$L_o$ = Unreduced design *live load* in pounds per square foot from Table 1606.

$A_i$ = Influence area in square feet, taken as four times the tributary area for a column, two times the tributary area for a beam and the panel area for a two-way slab.

**1606.7.2 Limitations:** The provisions of Sections 1606.7.2.1 through 1606.7.2.3 shall limit the applications of *live load* reductions permitted by this section.

**1606.7.2.1 Maximum reduction:** The reduced design *live load* permitted by Section 1606.7.1 shall not be less than 50 percent of the unreduced *live load* for members supporting one floor and not less than 40 percent of the unreduced *live load* for members supporting more than one floor.

**1606.7.2.2 Live loads 100 psf or less:** For *live loads* of 100 psf (4788 Pa) or less, reductions shall not be made for occupancies in Use Groups A and E, for *public garages* or open parking structures (except as indicated in Section 1606.7.2.3), for one-way slabs or for roofs (except as indicated in Section 1607.0).

**1606.7.2.3 Live loads greater than 100 psf:** For *live loads* which exceed 100 psf (4788 Pa) and for Group 2 *public garages* and open parking structures, minimum design *live loads* on members supporting more than one floor shall be reduced by 20 percent.

**1606.8 Crane loads:** All craneways and supporting construction shall be designed and constructed to comply with Section 4.10 in ASCE 7 listed in Chapter 35.

**1606.9 Interior walls and partitions:** Interior walls and partitions, including their finish materials, shall have adequate strength to resist a horizontal load of not less than 5 psf (239 Pa).

## SECTION 1607.0 ROOF LOADS

**1607.1 General:** The structural supports of roofs and marquees shall be designed to resist *wind* (see Section 1609.0) and, where applicable, snow (see Section 1608.0) and *earthquake loads* (see Section 1610.0), in addition to the *dead load* of construction and the appropriate *live loads* as prescribed in this section, or in Table 1606.

**1607.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Fabric awning:*** A fabric awning is an architectural projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid or retractable skeleton structure over which a fabric cover is attached.

***Fabric canopy:*** A fabric canopy is an architectural projection that provides weather protection, identity or decoration and is ground supported in addition to being supported by the building to which the canopy is attached. A canopy is comprised of a lightweight skeleton structure over which a fabric cover is attached. A fabric canopy is not a primary structure or a roof.

**1607.3 Minimum roof live loads:** Ordinary roofs, either flat, pitched or curved, shall be designed for the *live loads* as specified in Table 1607.3 or Section 4.9 of ASCE 7 listed in Chapter 35.

**1607.4 Overhanging eaves:** In other than occupancies in Use Group R-3, 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 psf (2873 Pa).

**Table 1607.3**
**MINIMUM ROOF LIVE LOADS[a]**

| Roof slope | Tributary loaded area in square feet[b] for any structural member | | |
|---|---|---|---|
| | 0 to 200 | 201 to 600 | Over 600 |
| Flat or rise less than 4 inches per foot (1:3) Arch or dome with rise less than $^1/_8$ of span | 20 | 16 | 12 |
| Rise 4 inches per foot (1:3) to less than 12 inches per foot (1:1) Arch or dome with rise $^1/_8$ of span or less than $^3/_8$ of span | 16 | 14 | 12 |
| Rise 12 inches per foot (1:1) and greater Arch or dome with rise $^3/_8$ of span or greater | 12 | 12 | 12 |

**Note a.** Loads are expressed in pounds per square foot of horizontal projection.
**Note b.** 1 square foot = 0.093 $m^2$; 1 psf = 47.9 Pa.

**1607.5 Rain loads:** Rain loads utilized in the combination of loads specified in Section 1613.0 shall be calculated in accordance with Section 8 of ASCE 7 listed in Chapter 35. For roofs with a slope less than one-fourth unit vertical in 12 units horizontal ($^1/_4$:12), the design calculations shall include verification of the prevention of ponding instability in accordance with Section 8.4 of ASCE 7 listed in Chapter 35. Roofs with provisions for controlled drainage shall be designed in accordance with Section 8.5 of ASCE 7 listed in Chapter 35.

**1607.6 Special purpose roofs:** Where occupied for incidental promenade purposes, roofs shall be designed for a minimum *live load* of 60 psf (2873 Pa) and 100 psf (4788 Pa) where designed for roof gardens or assembly or educational occupancies.

**1607.6.1 Landscaped roofs:** Where roofs are to be landscaped, the uniform design *live load* in the landscaped area shall be 20 psf (958 Pa). The weight of the landscaping materials shall be considered as *dead load* and shall be computed on the basis of saturation of the soil.

**1607.6.2 Fabric awnings and canopies:** Where awnings and canopies are covered with a *fabric* material, such awnings and canopies shall be designed for a uniform *live load* of 5 psf (1168 Pa) as well as for snow *loads* and *wind loads* as specified in Sections 1608.0 and 1609.0.

**1607.6.3 Special purpose roofs:** Roofs to be utilized for other special purposes shall be designed for appropriate *loads*, or as otherwise approved.

## SECTION 1608.0 SNOW LOADS

**1608.1 General:** Design snow *loads* shall be determined in accordance with this section, or shall comply with Section 7 of ASCE 7 listed in Chapter 35, but the design roof *load* shall not be less than that determined by Section 1607.0.

**1608.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Greenhouse**

**Continuously heated greenhouse:** A production or retail greenhouse with a constantly maintained interior temperature of 50 degrees F. (10 degrees C.) or more during winter months. Such greenhouse shall also have a maintenance attendant on duty at all times or an adequate temperature alarm system to provide warning in the event of a heating system failure. Additionally, the greenhouse roof material shall have a thermal resistance ($R$) less than 2.0.

**Production greenhouse:** A greenhouse occupied for growing large numbers of flowers and plants on a production basis or for research, without public access.

**Retail greenhouse:** A greenhouse occupied for growing large numbers of flowers and plants and having general public access for the purposes of viewing and purchasing the various products. Included in this category are greenhouses occupied for educational purposes.

**1608.3 Ground snow loads:** Ground snow *loads* to be utilized in determining the design snow *loads* for roofs are given in Figures 1608.3(1), 1608.3(2) and 1608.3(3) for the contiguous United States. In some areas the amount of local variation in snow *loads* is so extreme as to preclude meaningful mapping. Such areas are not zoned in these figures but are shown in black. In other areas, the snow *load* zones are meaningful, but the mapped values are not intended to be utilized for certain geographic settings, such as high country, within these zones. Such areas are shaded in as a warning that the zoned value for those areas applies only to normal settings. Ground snow *loads* for shaded areas in high country and those areas shown in black shall be determined by the local jurisdiction requirements.

**1608.4 Flat-roof and low-slope snow loads:** The snow *load* on unobstructed flat roofs and roofs having a slope of 30 degrees (0.2 rad) or less ($P_f$) shall be calculated in pounds per square foot using the following formula:

$$P_f = C_e I P_g$$

where:

$C_e$ = Snow exposure factor determined from Table 1608.4.

$I$ = Snow *load* importance factor determined from Table 1609.5.

$P_g$ = Ground snow *load* expressed in pounds per square foot, determined from Figures 1608.3(1), 1608.3(2) or 1608.3(3).

**Exception:** The flat-roof snow *load* on continuously heated greenhouses shall be calculated utilizing the following formula:

$$P_f = C_{tg} C_e I P_g$$

where the thermal factor for greenhouses ($C_{tg}$) = 0.83.

**Table 1608.4**
**SNOW EXPOSURE FACTOR ($C_e$)**

| | |
|---|---|
| Roofs located in generally open terrain extending one-half mile or more from the structure | 0.6 |
| Structures located in densely forested or sheltered areas | 0.9 |
| All other structures | 0.7 |

**1608.5 Sloped roof snow loads:** Snow *loads* acting on a sloping surface shall be considered to act on the horizontal projection of that surface. The sloped roof snow *load* ($P_s$) on roofs having a slope greater than 30 degrees (0.52 rad) shall be calculated using the following formula:

$$P_s = C_s P_f$$

where:

$P_f$ = Flat-roof snow *load* expressed in pounds per square foot.

The roof slope factor ($C_s$) is determined by the following formula:

$$C_s = 1 - \frac{(a-30)}{40}$$

where $a$ is the slope of the roof expressed in degrees.

**Exception:** The roof slope factor ($C_s$) for continuously heated greenhouses is determined by the following formula:

$$C_s = 1 - \frac{(a-15)}{55}$$

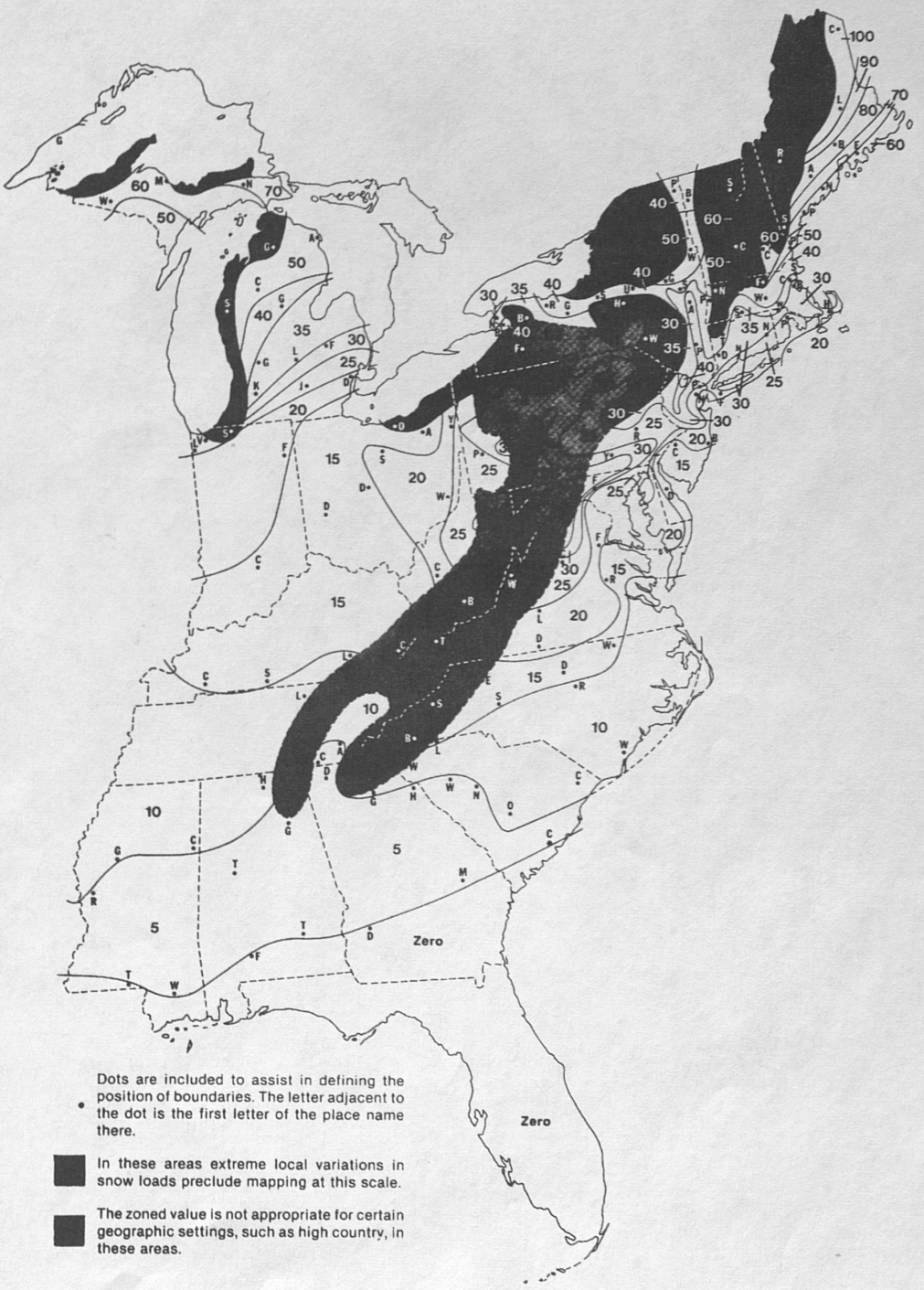



**Figure 1608.3(1)**
**GROUND SNOW LOADS ($P_g$) FOR THE EASTERN UNITED STATES**
**(pounds per square foot)**

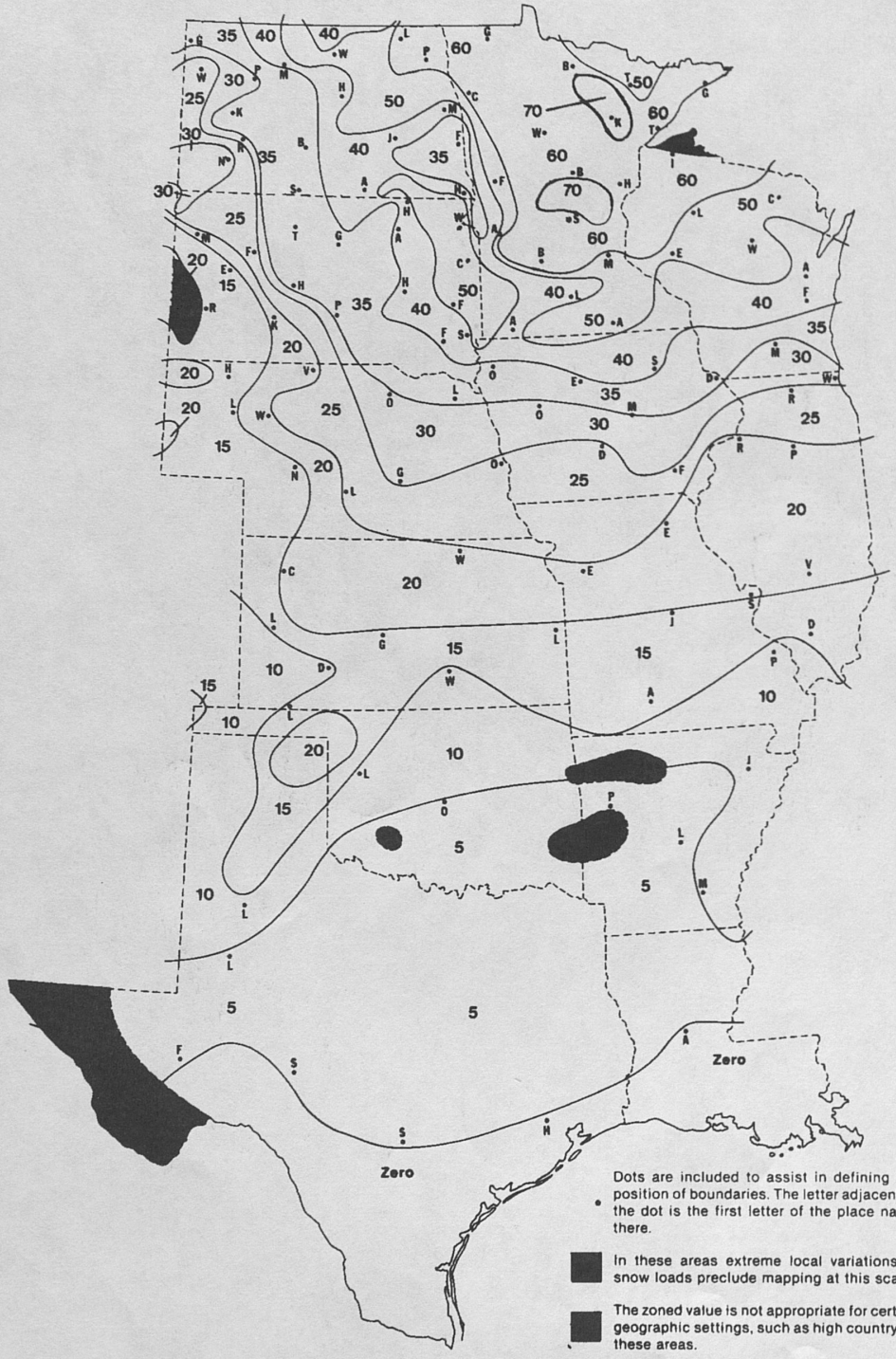



**Figure 1608.3(2)**
**GROUND SNOW LOADS ($P_g$) FOR THE CENTRAL UNITED STATES**
**(pounds per square foot)**

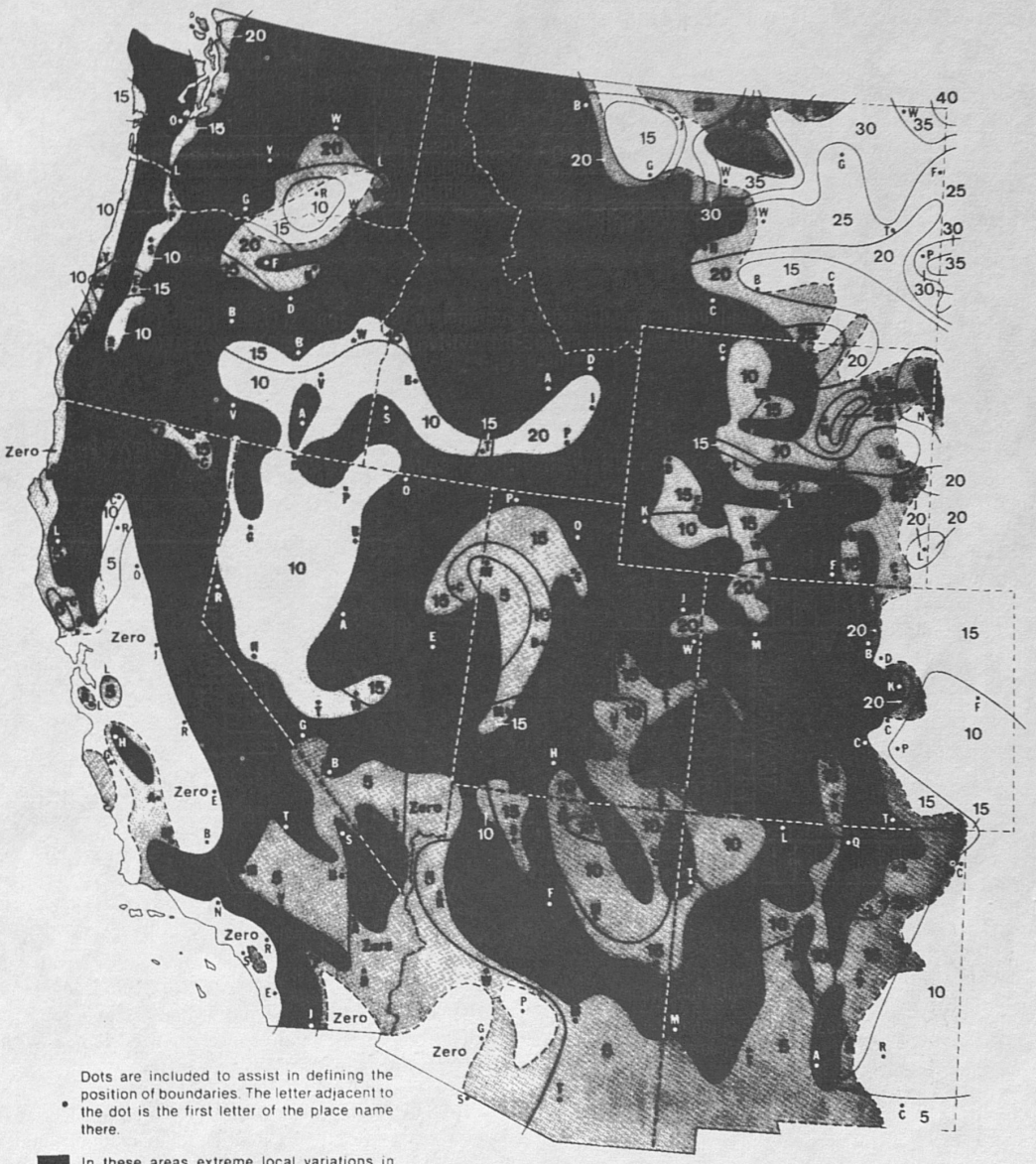



**Figure 1608.3(3)**
**GROUND SNOW LOADS ($P_g$) FOR THE WESTERN UNITED STATES**
**(pounds per square foot)**

**1608.5.1 Roof slope factor for curved roofs:** Portions of curved roofs having a slope exceeding 70 degrees (1.22 rad) shall be considered free from snow *load*. The point at which the slope exceeds 70 degrees (1.22 rad) shall be considered the "eave" for such roofs. For curved roofs, the slope factor shall be determined by basing the slope on the vertical angle from the "eave" to the crown.

**1608.5.2 Roof slope factor for multiple roofs:** For multiple folded plate, sawtooth and barrel vault roofs with parallel ridge lines, the roof slope factor ($C_s$) shall be considered to be equal to 1.0, regardless of the slope of the roof.

**1608.6 Unbalanced snow loads:** Winds from all directions shall be considered when determining unbalanced snow *loads*.

**1608.6.1 Unbalanced snow load for hip and gable roofs:** For hip and gable roofs with a slope less than 2.5 degrees (0.044 rad), or exceeding 70 degrees (1.22 rad), unbalanced snow *loads* are not required to be included in the design. For slopes of 2.5 degrees (0.044 rad) and up to 20 degrees (0.35 rad), the roof slope shall be designed to sustain a uniformly distributed *load* of 0.5 $P_f$ acting on one slope and 1.0 $P_f$ acting on the opposite slope, where $P_f$ is the flat-roof snow *load,* except that this is not required for solid web, single-span beams or single-span frames with solid webs. For slopes between 20 degrees (0.35 rad) and 70 degrees (1.22 rad), the structure shall be designed to sustain an unbalanced uniform snow *load* on the lee side equal to 1.25 times the sloped roof snow *load*. In the unbalanced situation, the windward side shall be considered free of snow.

**1608.6.2 Unbalanced snow load for curved roofs:** Portions of curved roofs having a slope exceeding 70 degrees (1.22 rad) shall be considered free of snow. The equivalent slope of a curved roof is equal to the slope of a line from the eave, or the point at which the slope exceeds 70 degrees (1.22 rad), to the crown. If the equivalent slope is less than 10 degrees (0.17 rad) or greater than 60 degrees (1.05 rad), unbalanced snow *loads* are not required to be considered. Unbalanced snow *loads* shall be determined according to the *loading* diagrams in Figure 1608.6.2. In all cases, the windward side shall be considered free of snow. If the ground or another roof abuts a Case II or Case III (see Figure 1608.6.2) arched roof structure at or within 3 feet (914 mm) of its eave, the snow *load* shall not be decreased between the 30 degree (0.52 rad) point and the eave but shall remain constant at 2 $P_s$ as indicated by the dashed line in Figure 1608.6.2, where $P_s$ is the sloped roof snow *load*.

**1608.6.3 Unbalanced snow load for multiple roofs:** For multiple folded plate, sawtooth and barrel vault roofs with parallel ridge lines, the roof snow *load* shall be increased from one-half of the balanced *load* at the ridge or crown (0.5 $P_f$), to three times the balanced *load* at the valley (3.0 $P_f$), where $P_f$ is the flat-roof snow *load*. Balanced and unbalanced *loading* diagrams for a sawtooth roof are presented in Figure 1608.6.3. The snow surface above the valley, however, shall not be at an elevation higher than that above the ridge, and if this condition limits the unbalanced *load* to less than 3.0 $P_f$, the minimum design unbalanced *load* shall be the lesser value.

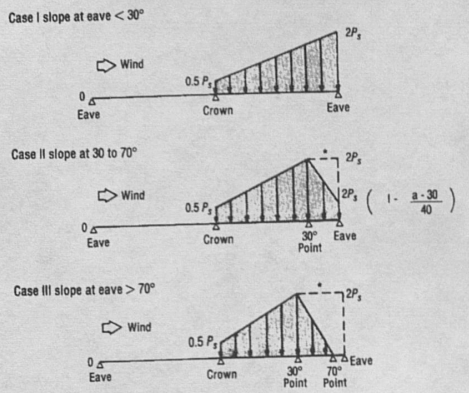



**Figure 1608.6.2**
**UNBALANCED LOADING CONDITIONS FOR CURVED ROOFS**

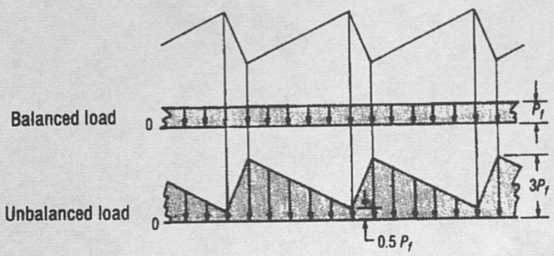



**Figure 1608.6.3**
**BALANCED AND UNBALANCED LOADS FOR A SAWTOOTH ROOF**

**1608.7 Drifts on lower roofs:** In areas where the ground snow *load* is greater than 10 pounds per square foot [see Figures 1608.3(1), 1608.3(2) and 1608.3(3)], multilevel roofs, lower roofs and decks of adjacent structures and roofs adjacent to projections shall be designed in accordance with Sections 1608.7.1 through 1608.7.4.

**1608.7.1 Design loads for lower roofs:** The drift *load* on lower roofs or decks shall be taken as the triangular loading surcharge superimposed on the uniform roof snow *load* ($P_f$). The geometry of the drifting shall be in accordance with Figures 1608.7.1 through 1608.7.4. The height of the drift ($h_d$), in feet, shall be determined by the following formula:

$$h_d = 0.43^3\sqrt{W_b}^4\sqrt{P_g+10} - 1.5$$

where:

$W_b$ = Horizontal dimension in feet of the upper roof normal to the line of change of roof level, but not less than 25 feet (7620 mm).

$P_g$ = Ground snow *load* expressed in pounds per square foot, determined from Figures 1608.3(1), 1608.3(2) or 1608.3(3).

Alternatively, $h_d$ shall be determined from Figure 1608.7. The value of $h_d$ shall not exceed $(h_r - h_b)$, where $h_r$ is the difference in height between the upper and lower roof or deck (expressed in feet) and $h_b$ is the height of the balanced snow *load* on the lower roof or deck expressed in feet (see Figure 1608.7.1). For the purposes of evaluating the height of the snow drift, the ground snow and the roof snow, the snow density ($D$) expressed in pounds per cubic foot (pcf) shall be calculated from the formula:

$$D = 0.13P_g + 14$$

but not more than 35 pounds per cubic foot (561 kg/m$^3$). The width of the drift ($W_d$) in feet shall be taken as the smaller of 4 $h_d$ or 4 $(h_r - h_b)$ (see Figure 1608.7.1). Drift *loads* are only required to be considered when:

$$\frac{h_r - h_b}{h_b} > 0.2 \text{ where } h_b = \frac{P_f}{D}$$

and the flat-roof snow *load* ($P_f$) is evaluated on the basis of the lower roof. The maximum intensity of the snow *load* at the high point of the drift ($P_m$) shall be determined by the formula:

$$P_m = D\,(h_d + h_b)$$

except that the maximum intensity of the snow *load* at the high point of the drift ($P_m$) shall not exceed $Dh_r$, where $D$ is the snow density and $h_r$ is the difference in height between the upper and lower roof or deck.

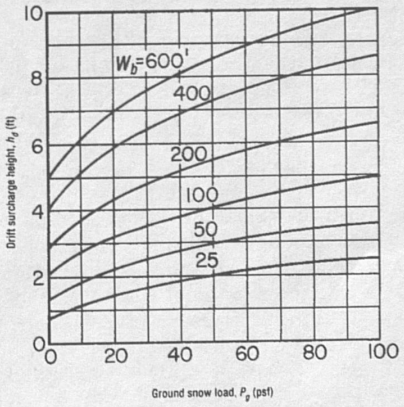



**Figure 1608.7**
**DETERMINATION OF THE MAXIMUM HEIGHT OF DRIFT SURCHARGE ($h_d$) IN FEET[a,b,c]**

$$h_d = 0.43\sqrt[3]{W_b}\sqrt[4]{P_g + 10} - 1.5$$

**Note a.** If the horizontal dimension in feet of the upper roof ($W_b$) is less than 25 feet, use $W_b$ of 25 feet.

**Note b.** If the horizontal dimension in feet of the upper roof ($W_b$) is more than 600 feet, use equation above.

**Note c.** $P_g$ = Ground snow load expressed in pounds per square foot [see Figures 1608.3(1), 1608.3(2) or 1608.3(3)].

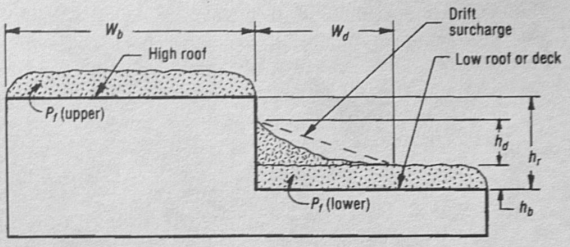



**Figure 1608.7.1**
**DRIFTING SNOW ON LOW ROOFS AND DECKS**

**1608.7.2 Roof of adjacent lower structure:** A drift surcharge shall be applied to lower roofs or structures sited within 20 feet (6096 mm) of a higher structure as depicted in Figure 1608.7.2. The height of the surcharge on the lower structure shall be taken as $h_d$ multiplied by (1 - $S$/20) to account for the horizontal separation between structures ($S$) in feet.

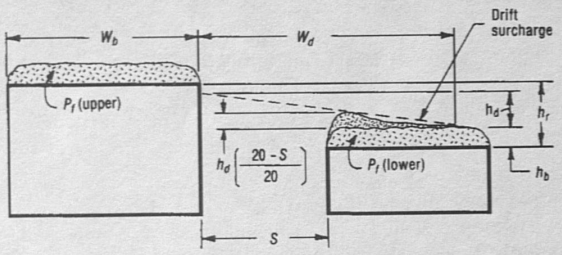



**Figure 1608.7.2**
**DRIFTING SNOW ONTO ADJACENT LOW STRUCTURES**

**1608.7.3 Roof projections:** Drift *loads* due to mechanical equipment, *penthouses*, parapets and other projections above the roof shall be applied as depicted in Figure 1608.7.3. Such drift *loads* shall be calculated on all sides of projections having horizontal dimensions exceeding 15 feet (4572 mm). Where determining the drift *load*, the maximum distance from the roof projection to the edge of the roof ($W_{b1}$ or $W_{b2}$) shall be utilized, or 25 feet (7620 mm), whichever is greater.

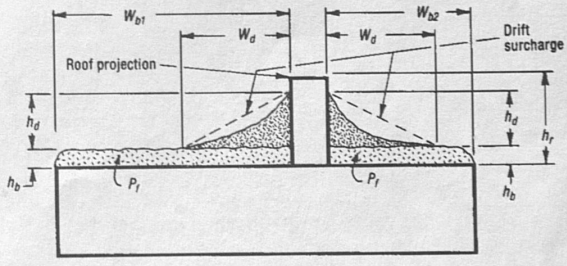



**Figure 1608.7.3**
**SNOW DRIFTING AT ROOF PROJECTIONS**

**1608.7.4 Intersecting drifts:** Where one snow drift intersects another at an angle as depicted in Figure 1608.7.4, the maximum unit pressure of the drift shall be taken as the greater of the two individual drifts, but not the sum of the two.

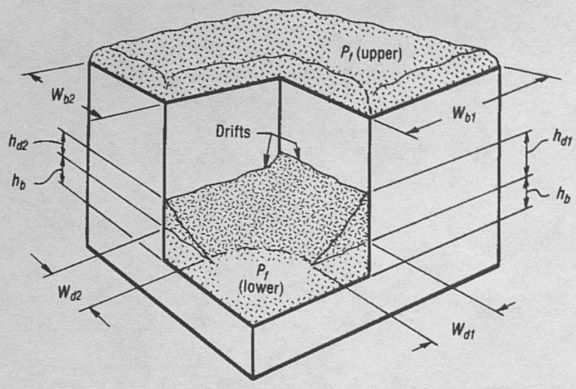



**Figure 1608.7.4**
**INTERSECTING SNOW DRIFTS**

**1608.8 Sliding snow:** Lower roofs which are located below roofs having a slope greater than 20 degrees (0.35 rad) shall be designed for an increase in drift height of 0.4 $h_d$, provided that the total drift surcharge ($h_d$ + 0.4 $h_d$) shall not exceed the height of the roof above the uniform snow depth ($h_r$ - $h_b$) (see Figure 1608.8 for depiction of $h_d$ and $h_r$). Sliding snow shall not be considered where the lower roof is horizontally separated from the higher roof by a distance ($S$) greater than the difference in height between the upper and lower roofs ($h_r$) or 20 feet (6096 mm) (see Figure 1608.8).

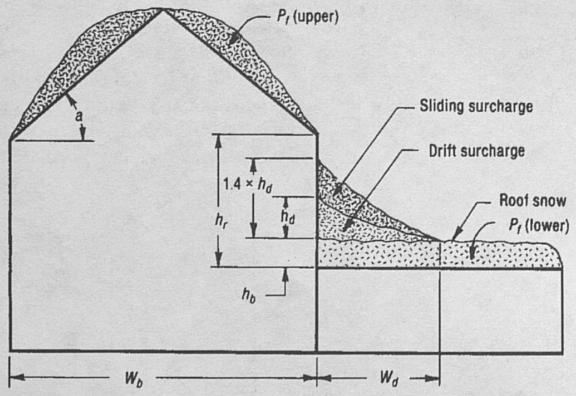



**Figure 1608.8**
**ADDITIONAL SURCHARGE DUE TO SLIDING SNOW**

## SECTION 1609.0 WIND LOADS

**1609.1 General:** All buildings, other exposed structures, components, cladding and roof coverings shall be designed to resist the pressures caused by wind in any direction as provided for herein, or shall comply with Section 6 of ASCE 7 listed in Chapter 35. Where the provisions of ASCE 7 listed in Chapter 35 are utilized, the provisions of Section 1609.1.4 shall apply. The basic wind speed shall be determined in accordance with Section 1609.3. The exposure category shall be determined in accordance with Section 1609.4. The importance factor and the minimum design *wind load* shall be determined in accordance with Sections 1609.5 and 1609.6. *Wind loads* on the building's main windforce-resisting system shall be determined in accordance with Section 1609.7. Building component and cladding *wind loads* shall be determined in accordance with Section 1609.8. *Wind loads* on structures other than buildings shall be determined in accordance with Section 1609.9. Roof overhangs shall be designed for *wind loads* in accordance with Section 1609.10. Radio and television towers shall be designed for *wind loads* in accordance with Section 3108.4.

**1609.1.1 Design provision limitations:** The design provisions in Section 1609.0 are limited to buildings or other structures which are sited such that wind channeling effects or buffeting in the wake of upwind obstructions do not merit alternative design procedures. The design provisions in this section shall not be utilized for the design of dome buildings or structures. Buildings and other structures which are outside of the scope of the design provisions of this section shall be designed for *wind loads* by an approved alternative design procedure or the wind tunnel test procedure in ASCE 7 listed in Chapter 35.

**1609.1.2 Wind loads during erection and construction phases:** Adequate temporary bracing shall be provided to resist *wind loading* on structural components and structural assemblages during the erection and construction phases.

**1609.1.3 Overturning and sliding:** The overturning moment due to *wind load* shall not exceed two-thirds of the *dead-load* stabilizing moment unless the building or structure is anchored to resist the excess moment. Where the total resisting force due to friction is insufficient to prevent sliding, anchorage shall be provided to resist the excess sliding force.

**1609.1.4 Uplift resistance:** Roof deck and framing shall be anchored to supporting construction and the supporting construction, including the foundation, shall be anchored where required to resist the *wind* uplift *load*. A maximum of two-thirds of the *dead load* shall be considered in determining the resistance to the uplift *load*. Uplift in excess of the total reduced *dead loads* shall be resisted by foundation anchorage.

**1609.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Components and cladding:** Elements that are directly *loaded* by the wind or transfer *wind loads* to the main windforce-resisting system.

**Main windforce-resisting system:** An assemblage of major structural elements designed to provide support for components and cladding and provide lateral stability for the building.

**Mean roof height (*h*):** The distance from grade to the average height of the roof or to the eave height for buildings or other structures having a roof slope equal to or less than 10 degrees (0.17 rad).

**Wind tributary area (*A*):** That portion of the surface area receiving *wind loads* supported by the element considered. For a rectangular tributary area, the width of the area need not be less than one-third the length of the area.

**1609.3 Basic wind speed:** The basic wind speed, in miles per hour, for the design of a structure shall be based on location of the structure determined by Figure 1609.3 or Table 1609.3. Basic wind speed for the special wind regions indicated on Figure 1609.3 or in Note a of Table 1609.3 shall be in accordance with local jurisdiction requirements. Basic wind speeds determined by the local jurisdiction shall be based on fastest-mile wind speeds at 33 feet (10058 mm) above the ground, Exposure C, with an annual probability of 0.02. Measurements taken at locations not meeting these criteria shall be adjusted accordingly. Reductions in the basic wind speed due to direct shielding afforded by adjacent buildings, structures or terrain features shall not be permitted.

**Table 1609.3**
**BASIC WIND SPEED (*V*)[a]**

| Location | *V* (miles per hour)[b] |
|---|---|
| Hawaii | 80 |
| Puerto Rico | 95 |

**Note a.** Basic wind speed near mountainous terrain, gorges and ocean promontories shall be in accordance with local jurisdiction requirements.
**Note b.** 1 mile per hour = 1.6 km/hr.

**1609.4 Exposure category:** The appropriate wind exposure shall be determined for each side of the building or structure consistent with the site terrain as required by this section. *Wind loads* for the design of the main windforce-resisting system shall be based on the site exposure category, as follows:

**Exposure A:** Large city centers with at least 50 percent of the buildings having a height in excess of 70 feet (21336 mm). Use of this exposure category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least one-half mile or ten times the height of the building or structure, whichever is greater. Possible channeling effects or increased velocity pressures due to the building or structure being located in the wake of adjacent buildings shall be taken into account in the determination of the design wind pressures.

**Exposure B:** Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of *single-family dwellings* or larger. This exposure category shall be limited to those areas for which terrain representative of Exposure B prevails in the upwind direction for a distance of at least 1,500 feet (457 m) or ten times the *height* of the building or structure, whichever is greater.

**Exposure C:** Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat, open country and grasslands.

**Exposure D:** Flat, unobstructed areas exposed to wind flowing over large bodies of water which are greater than 1 mile (1.6 km) in width in the upwind direction. This exposure shall apply only to those buildings and other structures exposed to wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet (457 m) or ten times the height of the building or structure, whichever is greater.

**1609.4.1 Exposure category for design of components and cladding:** Components and cladding for buildings with a mean roof height of 60 feet (18288 mm) or less shall be designed on the basis of Exposure C. Components and cladding for buildings with a mean roof height in excess of 60 feet (18288 mm) and for other structures shall be designed on the basis of the exposure categories in Section 1609.4, except that Exposure B shall be assumed for buildings and other structures sited in terrain representative of Exposure A.

**1609.5 Importance factor:** Buildings and other structures shall be assigned a *wind load* importance factor (*I*) in accordance with Table 1609.5.

**Table 1609.5**
**IMPORTANCE FACTOR (*I*)**

| Nature of occupancy | Wind Load Importance Factor (*I*)[a] | | Snow load importance factor (*I*) |
|---|---|---|---|
| | 100 miles[c] from hurricane oceanline, and in other areas | At hurricane oceanline[b] | |
| All buildings and structures except those listed below | 1.00 | 1.10 | 1.0 |
| Occupancies in Use Group A in which more than 300 people congregate in one area | 1.15 | 1.23 | 1.1 |
| Buildings and structures having essential facilities, including buildings containing any one or more of the indicated occupancies.<br>1. Fire, rescue and police stations.<br>2. Use Group I-2 having surgery or emergency treatment facilities.<br>3. Emergency preparedness centers.<br>4. Designated shelters for hurricanes.<br>5. Power generating stations and other utilities required as emergency backup facilities.<br>6. Primary communication facilities. | 1.15 | 1.23 | 1.2 |
| Buildings and structures that represent a low hazard to human life in the event of failure, such as agricultural buildings, production greenhouses, certain temporary facilities and minor storage facilities | 0.90 | 1.00 | 0.8 |

**Note a.** For regions between the hurricane oceanline and 100 miles inland, the importance factor (*I*) shall be determined by linear interpolation.
**Note b.** Hurricane oceanlines are the Atlantic and Gulf of Mexico coastal areas.
**Note c.** 1 mile = 1.6 km.

Figure 1609.3
BASIC WIND SPEED, *V* (miles per hour)[a]

**Note a.** 1 mile per hour = 1.6 Km/hr.

**1609.6 Minimum design wind load:** The design *wind load* shall be determined in accordance with Sections 1609.7 through 1609.10 or the minimum design *wind load* in this section, whichever is greater. The *wind load* utilized in the design of the main windforce-resisting system for buildings and other structures shall not be less than 10 psf (479 Pa) multiplied by the area of the building or structure projected on a vertical plane that is normal to the wind direction.

In the calculation of design *wind loads* for components and cladding for buildings, the pressure difference between opposite faces shall be taken into consideration. The combined design pressure shall be not less than 10 psf (479 Pa) acting in either direction normal to the surface.

The *wind load* used in the design of components and cladding for other structures shall be not less than 10 psf (479 Pa) multiplied by the projected area of the component or cladding.

**1609.7 Building main windforce-resisting system:** The building's main windforce-resisting system shall be designed for external and internal pressure effects caused by the basic wind speed from any direction, as determined in this section. The design pressure shall be applied simultaneously on windward and leeward walls, and on roof surfaces as shown in Figure 1609.7. Positive pressure shall be considered to act toward the surface and negative pressure shall be considered to act away from the surface. The external and internal pressures shall be combined to determine the most critical *load*. The calculated pressures are in pounds per square foot.

Windward wall design pressure, $P$:

$$P = P_v\ I\ [K_z\ G_h\ C_p - K_h\ (GC_{pi})]$$

Leeward wall, side walls and roof design pressure, $P$:

$$P = P_v\ I\ [K_h\ G_h\ C_p - K_h\ (GC_{pi})]$$

where:

$P_v$ = Basic velocity pressure in Table 1609.7(3).

$I$ = *Wind load* importance factor in Table 1609.5.

$K_z$ = Velocity pressure exposure coefficient, at the height of interest ($z$) in Table 1609.7(4).

$G_h$ = Gust response factor in Table 1609.7(5), evaluated at height ($h$). The gust response factor for buildings which have a height to least horizontal dimension ratio greater than 5 or a fundamental frequency less than one cycle per second (period greater than 1 second) shall be calculated by an approved rational analysis that incorporates the dynamic properties of the main windforce-resisting system.

$C_p$ = External pressure coefficient in Table 1609.7(1), Table 1609.7(2) and Table 1609.7(7).

$K_h$ = Velocity pressure exposure coefficient, evaluated at the mean roof height ($h$) in Table 1609.7(4).

$GC_{pi}$ = Product of internal pressure coefficient and gust response factor in Table 1609.7(6).

$h$ = Mean roof height; the distance from grade to the average height of the roof or to the eave height for buildings or other structures having a roof slope equal to or less than 10 degrees (0.17 rad).

**Table 1609.7(1)**
**WALL PRESSURE COEFFICIENTS ($C_p$)**

| Surface | $L/B$ | $C_p$ | For use with |
|---|---|---|---|
| Windward wall | All values | 0.8 | $K_z$ |
| Leeward wall | 0 to 1<br>2<br>≥4 | -0.5<br>-0.3<br>-0.2 | $K_h$ |
| Side walls | All values | -0.7 | $K_h$ |

**Table 1609.7(2)**
**ROOF PRESSURE COEFFICIENTS[a, b, c, d] ($C_p$), FOR USE WITH $K_h$**

| Wind Direction | Windward | | | | | | | Leeward |
|---|---|---|---|---|---|---|---|---|
| | $h/L$ | Angle, θ (degrees)[f] | | | | | | |
| | | 0 | 10-15 | 20 | 30 | 40 | 50 | >60 | |
| Normal to ridge | ≤0.3 | -0.7 | 0.2[e]<br>-0.9[e] | 0.2 | 0.3 | 0.4 | 0.5 | 0.01θ | -0.7 for all values of $h/L$ and θ |
| | 0.5 | -0.7 | -0.9 | -0.75 | -0.2 | 0.3 | 0.5 | 0.01θ | |
| | 1.0 | -0.7 | -0.9 | -0.75 | -0.2 | 0.3 | 0.5 | 0.01θ | |
| | ≥1.5 | -0.7 | -0.9 | -0.9 | -0.9 | -0.35 | 0.2 | 0.01θ | |
| Parallel to ridge | $h/B$ or $h/L$ < 2.5 | -0.7 | | | | | | | -0.7 |
| | $h/B$ or $h/L$ > 2.5 | -0.8 | | | | | | | -0.8 |

**Note a.** Refer to Table 1609.7(7) for arched roofs.

**Note b.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.

**Note c.** Linear interpolation is permitted for values of θ, $h/L$ and $h/B$ ratios other than shown.

**Note d.** Notation:

$z$ = Height above ground, in feet.

$h$ = Mean roof height, in feet, or the eave height is permitted for θ < 10 degrees.

$B$ = Horizontal dimension of building, in feet, measured normal to wind direction.

$L$ = Horizontal dimension of building, in feet, measured parallel to wind direction.

θ = Roof slope from horizontal, in degrees (See Figure 1609.7).

**Note e.** Both values of $C_p$ shall be utilized in assessing load effects.

**Note f.** 1 degree = 0.01745 rad.

**Table 1609.7(3)**
**BASIC VELOCITY PRESSURE ($P_v$)**

| Basic Wind Speed[a] ($V$) (miles per hour)[c] | 70 | 75 | 80 | 85 | 90 | 100 | 110 | 120 | 130 |
|---|---|---|---|---|---|---|---|---|---|
| Basic Velocity Pressure[b] $P_v$ (lb./ft.$^2$)[c] | 12.5 | 14.4 | 16.4 | 18.5 | 20.7 | 25.6 | 31.0 | 36.9 | 43.3 |

**Note a.** Basic wind speed to be determined in accordance with Section 1609.3.

**Note b.** The Basic Velocity Pressure ($P_v$) is permitted to be determined in accordance with the following formula: $P_v = 0.00256V^2$.

where: $V$ = Basic wind speed (miles per hour) determined in accordance with Section 1609.3.

**Note c.** 1 mile per hour = 1.6 km/hr; 1 pound per square foot = 47.9 Pa.

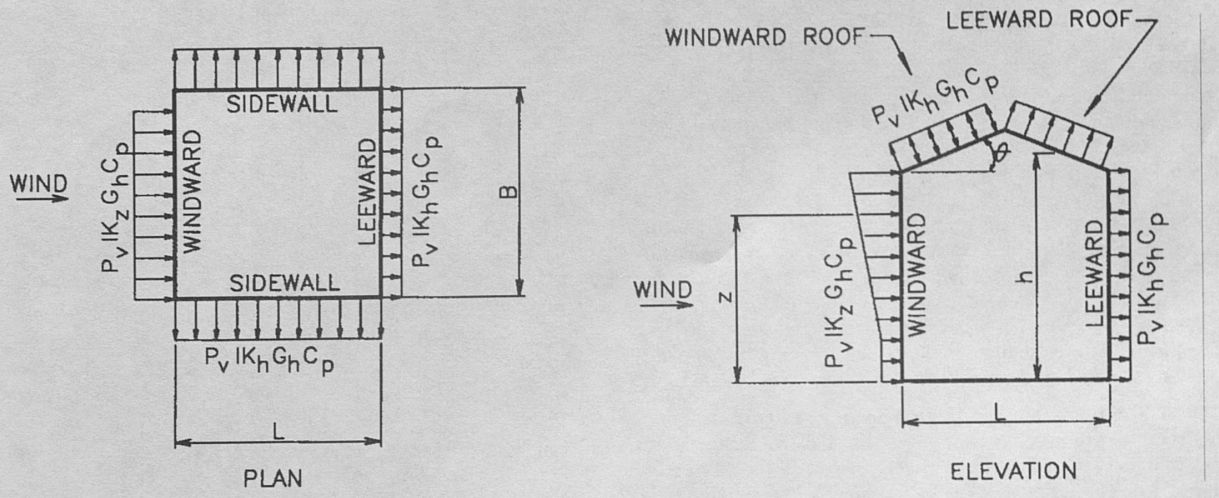



**Figure 1609.7**
**EXTERNAL PRESSURE FOR AVERAGE LOADS ON MAIN WINDFORCE-RESISTING SYSTEMS**
***$C_p$* values used in conjunction with this figure are found in Tables 1609.7(1) and 1609.7(2).**

**Table 1609.7(4)**
**VELOCITY PRESSURE EXPOSURE COEFFICIENTS [a,b] ($K_z$ AND $K_h$)**

| Height above ground level, $z$ (feet)[c] | Coefficients $K_z$ and $K_h$ | | | |
|---|---|---|---|---|
| | Exposure A | Exposure B | Exposure C | Exposure D |
| 0-15 | 0.12 | 0.37 | 0.80 | 1.20 |
| 20 | 0.15 | 0.42 | 0.87 | 1.27 |
| 25 | 0.17 | 0.46 | 0.93 | 1.32 |
| 30 | 0.19 | 0.50 | 0.98 | 1.37 |
| 40 | 0.23 | 0.57 | 1.06 | 1.46 |
| 50 | 0.27 | 0.63 | 1.13 | 1.52 |
| 60 | 0.30 | 0.68 | 1.19 | 1.58 |
| 70 | 0.33 | 0.73 | 1.24 | 1.63 |
| 80 | 0.37 | 0.77 | 1.29 | 1.67 |
| 90 | 0.40 | 0.82 | 1.34 | 1.71 |
| 100 | 0.42 | 0.86 | 1.38 | 1.75 |
| 120 | 0.48 | 0.93 | 1.45 | 1.81 |
| 140 | 0.53 | 0.99 | 1.52 | 1.87 |
| 160 | 0.58 | 1.05 | 1.58 | 1.92 |
| 180 | 0.63 | 1.11 | 1.63 | 1.97 |
| 200 | 0.67 | 1.16 | 1.68 | 2.01 |
| 250 | 0.78 | 1.28 | 1.79 | 2.10 |
| 300 | 0.88 | 1.39 | 1.88 | 2.18 |
| 350 | 0.98 | 1.49 | 1.97 | 2.25 |
| 400 | 1.07 | 1.58 | 2.05 | 2.31 |
| 450 | 1.16 | 1.67 | 2.12 | 2.36 |
| 500 | 1.24 | 1.75 | 2.18 | 2.41 |
| > 500 | The velocity pressure exposure coefficients shall be determined in accordance with an approved rational procedure that incorporates the dynamic properties of the main windforce-resisting system | | | |

**Note a.** Linear interpolation for intermediate values of height (*z*) is acceptable.
**Note b.** Exposure categories are defined in Section 1609.4.
**Note c.** 1 foot = 304.8 mm.

**Table 1609.7(5)**
**GUST RESPONSE FACTORS [a,b,c] ($G_h$ AND $G_z$)**

| Height above ground level, $z$ (feet)[d] | Factors $G_h$ and $G_z$ | | | |
|---|---|---|---|---|
| | Exposure A | Exposure B | Exposure C | Exposure D |
| 0-15 | 2.36 | 1.65 | 1.32 | 1.15 |
| 20 | 2.20 | 1.59 | 1.29 | 1.14 |
| 25 | 2.09 | 1.54 | 1.27 | 1.13 |
| 30 | 2.01 | 1.51 | 1.26 | 1.12 |
| 40 | 1.88 | 1.46 | 1.23 | 1.11 |
| 50 | 1.79 | 1.42 | 1.21 | 1.10 |
| 60 | 1.73 | 1.39 | 1.20 | 1.09 |
| 70 | 1.67 | 1.36 | 1.19 | 1.08 |
| 80 | 1.63 | 1.34 | 1.18 | 1.08 |
| 90 | 1.59 | 1.32 | 1.17 | 1.07 |
| 100 | 1.56 | 1.31 | 1.16 | 1.07 |
| 120 | 1.50 | 1.28 | 1.15 | 1.06 |
| 140 | 1.46 | 1.26 | 1.14 | 1.05 |
| 160 | 1.43 | 1.24 | 1.13 | 1.05 |
| 180 | 1.40 | 1.23 | 1.12 | 1.04 |
| 200 | 1.37 | 1.21 | 1.11 | 1.04 |
| 250 | 1.32 | 1.19 | 1.10 | 1.03 |
| 300 | 1.28 | 1.16 | 1.09 | 1.02 |
| 350 | 1.25 | 1.15 | 1.08 | 1.02 |
| 400 | 1.22 | 1.13 | 1.07 | 1.01 |
| 450 | 1.20 | 1.12 | 1.06 | 1.01 |
| 500 | 1.18 | 1.11 | 1.06 | 1.00 |
| > 500 | The gust response factors shall be determined in accordance with an approved rational procedure that incorporates the dynamic properties of the main windforce-resisting system | | | |

**Note a.** For main windforce-resisting systems, the building or structure height (*h*) shall be taken as $h = z$.
**Note b.** Linear interpolation is acceptable for intermediate values of *z*.
**Note c.** Value of gust response factor shall not be less than 1.0.
**Note d.** 1 foot = 304.8 mm.

**Table 1609.7(6)**
**INTERNAL PRESSURE COEFFICIENTS FOR BUILDINGS [a, b, c, d, e] ($GC_{pi}$)**

| | Condition | $GC_{pi}$ |
|---|---|---|
| Condition I | All conditions except as noted under Condition II. | +0.25<br>-0.25 |
| Condition II | Buildings which have both of the following wall opening characteristics:<br>1. The area of openings in the windward wall, and windward roof if under positive pressure, exceeds the sum of the area of openings in the remaining walls and roof surfaces by 5 percent or more; and<br>2. The openings in any one of the remaining walls or roof do not exceed 20 percent of the wall or roof area. | +0.75<br>-0.25 |

**Note a.** Values are to be utilized with the provisions of Sections 1609.7 and 1609.8.

**Note b.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.

**Note c.** To ascertain the critical load requirements for the appropriate condition, two cases shall be considered: a positive value of $GC_{pi}$ applied simultaneously to all surfaces, and a negative value of $GC_{pi}$ applied to all surfaces.

**Note d.** Percentages of openings in a wall or roof surface are determined by the ratio of area of openings to gross area for the wall or roof surface considered.

**Note e.** Openings that are permanent openings and those which are likely to be breached by wind-borne projectiles where the basic wind speed is 110 miles per hour or greater, determined in accordance with Figure 6-1 in ASCE 7 listed in Chapter 35.

**Table 1609.7(7)**
**EXTERNAL PRESSURE COEFFICIENTS FOR ARCHED ROOFS ($C_p$) [a,d]**

| Condition | Rise-to-span ratio, $r$ | Coefficient $C_p$ [b] | | |
|---|---|---|---|---|
| | | Windward quarter | Center half | Leeward quarter |
| Roof on elevated structure | $0 < r < 0.2$<br>$0.2 \le r < 0.3$ [c]<br>$0.3 \le r \le 0.6$ | -0.9<br>$1.5r$ - 0.3<br>$2.75r$ - 0.7 | -0.7-$r$<br>-0.7-$r$<br>-0.7-$r$ | -0.5<br>-0.5<br>-0.5 |
| Roof springing from ground level | $0 < r \le 0.6$ | $1.4r$ | -0.7-$r$ | -0.5 |

**Note a.** Values listed are for the determination of average loads on the main windforce-resisting system.

**Note b.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.

**Note c.** Where the rise-to-span ratio is $0.2 \le r \le 0.3$, alternate coefficients given by $6r$-2.1 shall also be utilized for the windward quarter.

**Note d.** For components and cladding: At roof perimeter, utilize the external pressure coefficients in Figure 1609.8.1(2) with $\theta$ based on spring-line slope and $P_v/K_h$ based on Exposure C; and for remaining roof areas, utilize external pressure coefficients of this table multiplied by 1.2 and $P_v/K_h$ based on Exposure C.

**1609.8 Building components and cladding:** Building components and cladding shall be designed for external and internal pressure effects, caused by the basic wind speed, as determined by this section. The wind pressure direction and combination of internal and external pressures shall comply with Section 1609.7. Components and cladding supporting wind tributary areas greater than 700 square feet (65 m$^2$) are permitted to be designed utilizing the provisions for main windforce-resisting systems.

**1609.8.1 Building height less than or equal to 60 feet:** The design wind pressure ($P$) for components and cladding of buildings which have a mean roof height ($h$) of 60 feet (18288 mm) or less shall be determined as follows:

$$P = P_v I K_h [(GC_p) - (GC_{pi})]$$

where:

$P_v$ = Basic velocity pressure in Table 1609.7(3).
$I$ = *Wind load* importance factor in Table 1609.5.
$K_h$ = Velocity pressure exposure coefficient, evaluated at the mean roof height, using Exposure C for all terrains, in Table 1609.7(4).
$GC_p$ = Product of external pressure coefficient and gust response factor in Figures 1609.8.1(1) and 1609.8.1(2).
$GC_{pi}$ = Product of internal pressure coefficient and gust response factor in Table 1609.7(6).

**1609.8.2 Building height greater than 60 feet:** The design wind pressure for components and cladding of buildings which have a mean roof height ($h$) of more than 60 feet (18288 mm) shall be determined in accordance with this section.

Positive pressure ($P$) evaluated at height ($z$) above grade:

$$P = P_v I K_z [(GC_p) - (GC_{pi})]$$

Negative pressure ($P$) evaluated at mean roof height:

$$P = P_v I K_h [(GC_p) - (GC_{pi})]$$

where:

$P_v$ = Basic velocity pressure in Table 1609.7(3).
$I$ = *Wind load* importance factor in Table 1609.5.
$K_z$ = Velocity pressure exposure coefficient, at height $z$, in Table 1609.7(4).
$GC_p$ = Product of external pressure coefficient and gust response factor in Figure 1609.8.2. In the design of components and cladding for buildings having a mean roof height ($h$) greater than 60 feet (18288 mm) and less than 90 feet (27432 mm), $GC_p$ values of Figure 1609.8.1(1) and Figure 1609.8.1(2) are permitted to be utilized provided that ($P_v I K$) is taken as ($P_v I K_h$) and Exposure C is utilized for all terrains.
$GC_{pi}$ = Product of internal pressure coefficient and gust response factor in Table 1609.7(6).
$K_h$ = Velocity pressure coefficient, evaluated at the mean roof height ($h$) in Table 1609.7(4).

**1609.9 Other structures:** The main windforce-resisting system and components and cladding shall be designed for external pressure effects, caused by the basic wind speed, as determined in this section. Components and cladding supporting wind tributary areas greater than 700 square feet (65 m$^2$) are permitted to be designed utilizing the formula for main windforce-resisting systems.

The design windforce ($F$), in pounds, for main windforcere-sisting systems:

$$F = P_v I K_z G_h C_f A_f$$

The design windforce ($F$) for components and cladding:

$$F = P_v I K_z G_z C_f A^f$$

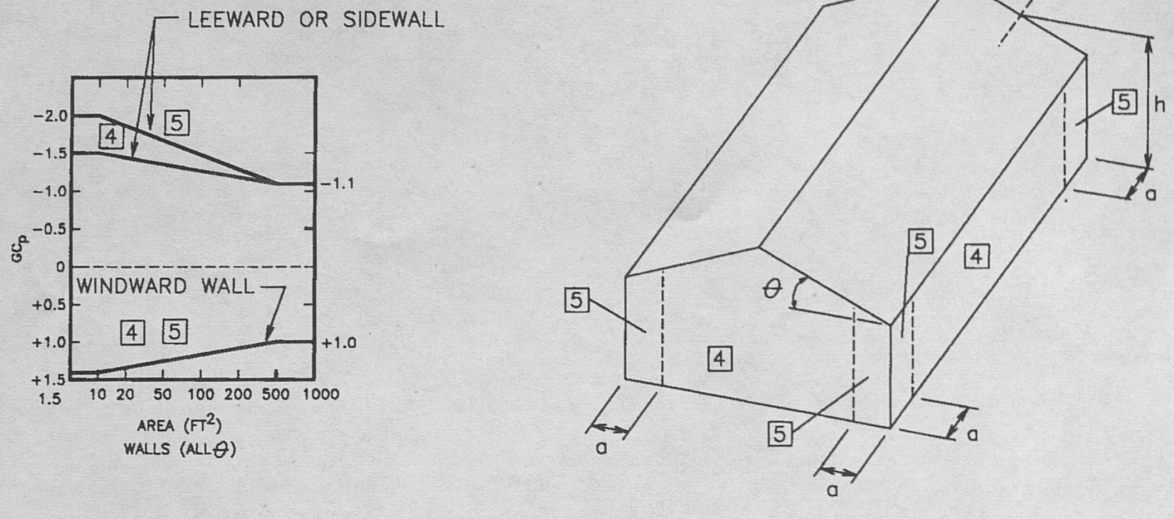



**Figure 1609.8.1(1)**
**EXTERNAL PRESSURE COEFFICIENTS ($CG_p$) FOR LOADS ON EXTERIOR WALL COMPONENTS AND CLADDING FOR BUILDINGS WHICH HAVE A MEAN ROOF HEIGHT ($h$) LESS THAN OR EQUAL TO 60 FEET [a, b, c, d, e, f]**

**Note a.** The vertical scale denotes $GC_p$ to be used, based on Exposure C.
**Note b.** The horizontal scale denotes the wind tributary area ($A$) in square feet.
**Note c.** External pressure coefficients for walls are permitted to be reduced by 10 percent where $\theta \leq 10$ degrees.
**Note d.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
**Note e.** Each component shall be designed for maximum positive and negative pressures.
**Note f.** Notation:
$a$ = 10 percent of minimum building width or $0.4h$, whichever is smaller, but not less than either 4 percent of the minimum building width or 3 feet.
$h$ = Mean roof height, in feet, except that the eave height is permitted to be utilized where $\theta \leq 10$ degrees.
$\theta$ = Roof slope from horizontal, in degrees.

where:

$P_v$ = Basic velocity pressure in Table 1609.7(3).

$I$ = *Wind load* importance factor in Table 1609.5.

$K_z$ = Velocity pressure exposure coefficient, at height $z$, in Table 1609.7(4).

$G_h$ = Gust response factor in Table 1609.7(5), evaluated at the structure height. The gust response factor for other structures which have a structure height to a least horizontal dimension ratio greater than 5 or a fundamental frequency less than one cycle per second (period greater than 1 second) shall be calculated by an approved rational analysis that incorporates the dynamic properties of the main windforce-resisting system.

$C_f$ = Force coefficient in Table 1609.9(1) through Table 1609.9(5).

$G_z$ = Gust response factor in Table 1609.7(5), evaluated at height $z$, above grade.

$A_f$ = Projected area of the structure normal to the wind. Where the force coefficient ($C_f$) is given for the surface area, $A_f$ shall be the surface area.

**Table 1609.9(1)**
**FORCE COEFFICIENTS FOR OPEN SIGNS[a] AND LATTICE FRAMEWORKS ($C_f$) [b,c]**

| Ratio of solid area to gross area | Coefficient $C_f$ | | |
|---|---|---|---|
| | Flat-sided members | Rounded members | |
| | | $D\sqrt{P_V/K_Z} \leq 2.5$ | $D\sqrt{P_V/K_Z} > 2.5$ |
| 0.1 or less | 2.0 | 1.2 | 0.8 |
| 0.1 to 0.29 | 1.8 | 1.3 | 0.9 |
| 0.3 to 0.7 | 1.6 | 1.5 | 1.1 |

**Note a.** Signs with openings comprising 30 percent or more of the gross area are classified as open signs.
**Note b.** The calculation of the design windforces shall be based on the area of all exposed members and elements projected on a plane normal to the wind direction. Forces shall be assumed to act parallel to the wind direction.
**Note c.** Notation:
$D$ = Diameter of a typical round member, in feet.
$P_v$ = Basic velocity pressure in Table 1609.7(3).
$I$ = Wind load importance factor in Table 1609.5.
$K_z$ = Velocity pressure exposure coefficient, at height $z$, in Table 1609.7(4).

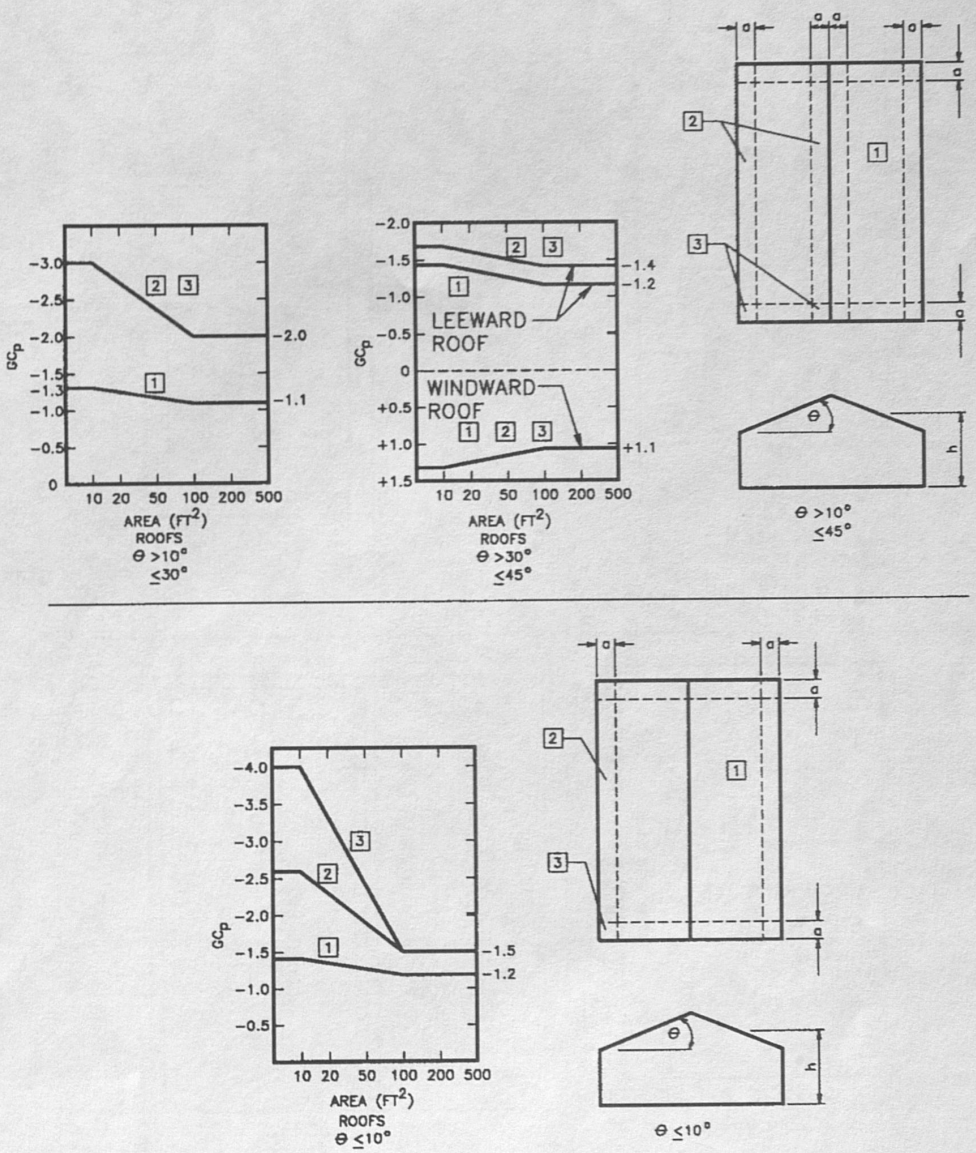



**Figure 1609.8.1(2)**
**EXTERNAL PRESSURE COEFFICIENTS ($GC_p$) FOR LOADS ON ROOF COMPONENTS AND CLADDING FOR BUILDINGS WHICH HAVE A MEAN ROOF HEIGHT ($h$) LESS THAN OR EQUAL TO 60 FEET[a, b, c, d, e, f]**

**Note a.** The vertical scale denotes $GC_p$ to be used, based on Exposure C.
**Note b.** The horizontal scale denotes the wind tributary area ($A$) in square feet.
**Note c.** If a parapet equal to or higher than 3 feet is provided around the perimeter of roof with $\theta \leq 10$ degrees, Zone 3 shall be treated as Zone 2.
**Note d.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
**Note e.** Each component shall be designed for maximum positive and negative pressures.
**Note f.** Notation:

$a$ = 10 percent of minimum building width or $0.4h$, whichever is smaller, but not less than either 4 percent of the minimum building width or 3 feet.
$h$ = Mean roof height, in feet, except that the eave height is permitted to be used where $\theta \leq 10$ degrees.
$\theta$ = Roof slope from horizontal, in degrees.

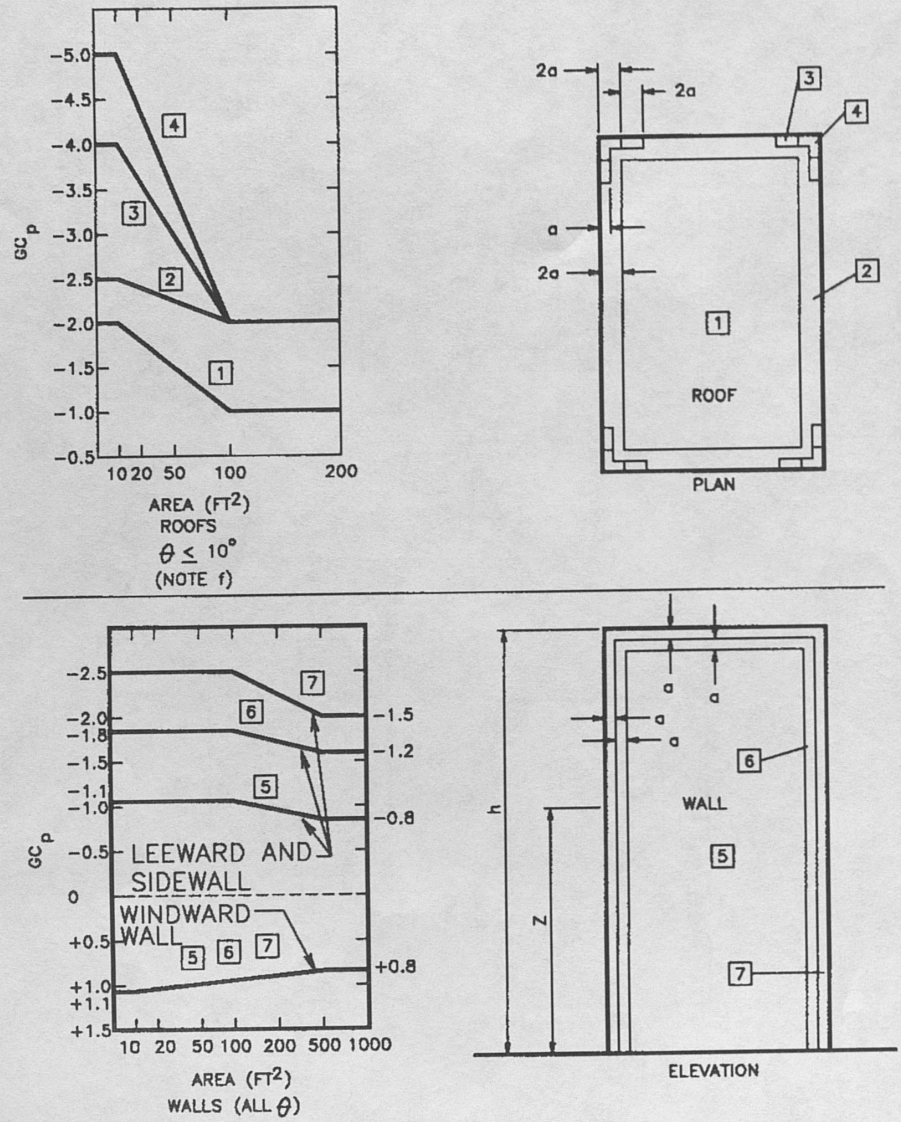



**Figure 1609.8.2**
**EXTERNAL PRESSURE COEFFICIENTS ($GC_p$) FOR LOADS ON COMPONENTS AND CLADDING FOR BUILDINGS WHICH HAVE A MEAN ROOF HEIGHT ($h$) GREATER THAN 60 FEET[a, b, c, d, e, f, g, h]**

**Note a.** Vertical scale denotes $GC_p$ to be used with appropriate $P_v / K_z$ or $P_v / K_h$, in accordance with Section 1609.8.2.
**Note b.** Horizontal scale denotes wind tributary area ($A$) in square feet.
**Note c.** Use $P_v / K_h$ with negative values of $GC_p$, and $P_v / K_z$ with positive values of $GC_p$, in accordance with Section 1609.8.2.
**Note d.** Each component shall be designed for maximum positive and negative pressures.
**Note e.** If a parapet equal to or higher than 3 feet is provided around the roof perimeter, Zones 3 and 4 shall be treated as Zone 2.
**Note f.** For roofs with slopes of more than 10 degrees, use $GC_p$ from Figure 1609.8.1(2) and attendant $P_v / K_h$ based on Exposure C.
**Note g.** Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
**Note h.** Notation:
$a$ = 5 percent of minimum building width or 0.5$h$, whichever is smaller.
$h$ = Mean roof height, in feet.
$z$ = Height above ground, in feet.

**Table 1609.9(2)**
**FORCE COEFFICIENTS FOR TRUSSED TOWERS ($C_f$) [a,b,c,e,f,g,h]**

| Ratio of solid area to gross area | Coefficient $C_f$ | |
|---|---|---|
| | Square towers[e] | Triangular towers[d] |
| 0.025 or less | 4.0 | 3.6 |
| 0.025 to 0.44 | 4.1 - 5.2 $\epsilon$ | 3.7 - 4.5 $\epsilon$ |
| 0.45 to 0.69 | 1.8 | 1.7 |
| 0.7 to 1.0 | 1.3 + 0.7 $\epsilon$ | 1.0 + $\epsilon$ |

**Note a.** The area ($A_f$) consistent with these force coefficients is the solid area of the front face projected normal to the wind direction.

**Note b.** Force coefficients are given for towers with structural angles or similar flat-sided members.

**Note c.** For towers with rounded members, the design windforce shall be determined utilizing the values in the above table multiplied by the following factors:

$\epsilon$ = Ratio of solid area to gross area of tower.

$\epsilon < 0.29$, factor = 0.67

$0.3 < \epsilon < 0.79$, factor = 0.67 $\epsilon$ + 0.47

$0.8 < \epsilon < 1.0$, factor = 1.0

**Note d.** For triangular section towers, the design windforces shall be assumed to act normal to a tower face.

**Note e.** For square section towers, the design windforces shall be assumed to act normal to a tower face. To allow for the maximum horizontal wind load which occurs when the wind is oblique to the faces, the wind load acting normal to a tower face shall be multiplied by the factor 1.0 + 0.7 $\epsilon$ for $\epsilon \leq 0.5$ and shall be assumed to act along a diagonal.

**Note f.** Windforces on tower appurtenances, such as ladders, conduits, lights, elevators and the like, shall be calculated utilizing appropriate force coefficients for these elements.

**Note g.** For guyed towers, the cantilever portion of the tower shall be designed for 125 percent of the design windforce.

**Note h.** A reduction of 25 percent of the design windforce in any span between guys shall be made for determination of controlling moments and shears.

**Table 1609.9(3)**
**FORCE COEFFICIENTS FOR MONOSLOPE ROOFS OVER UNENCLOSED BUILDINGS AND OTHER STRUCTURES ($C_f$)[a,b]**

| $\theta$[c] (degrees) | Coefficient $C_f$ for $L/B$ values of: | | | | | | |
|---|---|---|---|---|---|---|---|
| | 5 | 3 | 2 | 1 | 1/2 | 1/3 | 1/5 |
| 10 | 0.2 | 0.25 | 0.3 | 0.45 | 0.55 | 0.7 | 0.75 |
| 15 | 0.35 | 0.45 | 0.5 | 0.7 | 0.85 | 0.9 | 0.85 |
| 20 | 0.5 | 0.6 | 0.75 | 0.9 | 1.0 | 0.95 | 0.9 |
| 25 | 0.7 | 0.8 | 0.95 | 1.15 | 1.1 | 1.05 | 0.95 |
| 30 | 0.9 | 1.0 | 1.2 | 1.3 | 1.2 | 1.1 | 1.0 |

| $\theta$[c] (degrees) | Location of center of pressure, $X/L$, for $L/B$ values of: | | |
|---|---|---|---|
| | 2 to 5 | 1 | 1/5 to 1/2 |
| 10 to 20 | 0.35 | 0.3 | 0.3 |
| 25 | 0.35 | 0.35 | 0.4 |
| 30 | 0.35 | 0.4 | 0.45 |

**Note a.** Windforces act normal to the surface and shall be directed inward or outward.

**Note b.** Notation:

$B$ = Dimension of roof measured normal to wind direction, in feet.
$L$ = Dimension of roof measured parallel to wind direction, in feet.
$X$ = Distance to center of pressure from windward edge of roof, in feet.
$\theta$ = Angle of plane of roof from horizontal, in degrees.

**Note c.** The roof angle shall be assumed to deviate by plus and minus 10 degrees from the actual angle. The force coefficients that produce the most unfavorable effects in the building, foundation or structural members shall be used for the design thereof.

**Table 1609.9(4)**
**FORCE COEFFICIENTS FOR CHIMNEYS, TANKS AND SIMILAR STRUCTURES ($C_f$)[a,c]**

| Shape | Coefficient $C_f$ for $h/D$[b] values of: | | |
|---|---|---|---|
| | 1 | 7 | 25 |
| Square (wind normal to a face) | 1.3 | 1.4 | 2.0 |
| Square (wind along diagonal) | 1.0 | 1.1 | 1.5 |
| Hexagonal or octagonal ($D\sqrt{P_V/K_Z} > 2.5$) | 1.0 | 1.2 | 1.4 |
| Round ($D\sqrt{P_V/K_Z} > 2.5$) | 0.7 | 0.8 | 0.9 |
| Round ($D\sqrt{P_V/K_Z} \leq 2.5$) | 0.7 | 0.8 | 1.2 |

**Note a.** The design windforce shall be calculated based on the area of the structure projected on a plane normal to the wind direction. The force shall be assumed to act parallel to the wind direction.

**Note b.** Linear interpolation is permitted for $h/D$ values other than shown.

**Note c.** Notation:

$D$ = Diameter or least horizontal dimension, in feet.
$h$ = Height of structure, in feet.

**Table 1609.9(5)**
**FORCE COEFFICIENTS FOR SOLID SIGNS[a] ($C_f$)[c]**

| At ground level[b] | | Above ground level | |
|---|---|---|---|
| Ratio of height to width (feet) | Coefficient $C_f$ | Ratio of larger to smaller sign dimension (feet) | Coefficient $C_f$ |
| $\leq 3$ | 1.2 | $\leq 6$ | 1.2 |
| 5 | 1.3 | 10 | 1.3 |
| 8 | 1.4 | 16 | 1.4 |
| 10 | 1.5 | 20 | 1.5 |
| 20 | 1.75 | 40 | 1.75 |
| 30 | 1.85 | 60 | 1.85 |
| $\geq 40$ | 2.0 | $\geq 80$ | 2.0 |

**Note a.** Signs with openings comprising less than 30 percent of the gross area shall be considered as solid signs.

**Note b.** Signs for which the distance from the ground to the bottom edge is less than 0.25 times the vertical dimension shall be considered to be at ground level.

**Note c.** To allow for both normal and oblique wind directions, two cases shall be considered:

1. Resultant force acts normal to sign at geometric center; and
2. Resultant force acts normal to sign at level of geometric center and at a distance from windward edge of 0.3 times the horizontal dimension.

**1609.10 Roof overhangs:** Roof overhangs shall be designed for pressures acting on the top surface as set forth in Table 1609.7(2) in combination with positive pressures on the bottom surface corresponding to $C_p = 0.8$.

## SECTION 1610.0 EARTHQUAKE LOADS

**1610.1 General:** Every building and structure shall be designed and constructed to resist the ultimate strength loads and story drift effects of earthquake motions determined in accordance with this section, or shall comply with Section 9 of ASCE 7 listed in Chapter 35. *Additions* and *changes of occupancy* to existing buildings and structures shall be designed and constructed to resist the effects of earthquake motions determined in accordance with this section. Special structures, including but not limited to vehicular bridges, transmission towers, industrial towers and equipment, piers and wharves, and hydraulic structures,

shall be designed for *earthquake loads* utilizing an approved, substantiated analysis.

**Exceptions**

1. Detached *one-* and *two-family dwellings* that are located in seismic map areas having an effective peak velocity-related acceleration ($A_v$) value less than 0.15, in accordance with Section 1610.1.3, are exempt from the requirements of this section.
2. Agricultural storage buildings which are intended only for incidental human occupancy are exempt from the requirements of this section.
3. Buildings or structures located where the seismic coefficient representing the effective peak velocity-related acceleration ($A_v$) is less than 0.05, are only required to comply with Section 1610.3.6.1.
4. The seismic force-resisting system of wood frame buildings that conform to the provisions of Section 2305.8 and are constructed in accordance with Section 2305.0 and Section 1610.3.6.1 are not required to be analyzed as specified in Sections 1610.3 through 1610.5.

**1610.1.1 Additions to existing buildings:** An *addition* that is structurally independent from an existing building shall be designed and constructed in accordance with the seismic requirements for new buildings. An *addition* that is not structurally independent from an existing building shall be designed and constructed such that the entire building conforms to the seismic requirements for new buildings unless the following three provisions are complied with:

1. The *addition* complies with the seismic requirements for new buildings;
2. The *addition* shall not increase the seismic forces in any structural element of the existing building by more than 5 percent unless the increased forces on the element are still in compliance with these provisions; and
3. The *addition* shall not decrease the seismic resistance of any structural element of the existing building below that required for new buildings.

**1610.1.2 Change of occupancy:** Where a *change of occupancy* results in an existing building being reclassified to a higher Seismic Hazard Exposure Group, the building shall conform to the seismic requirements for new buildings.

**Exception:** Upgrading the building for the seismic requirements of this section is not required for buildings located in seismic map areas having an effective peak velocity-related acceleration ($A_v$) value of less than 0.15 where the *change of occupancy* results in a building being reclassified from Seismic Hazard Exposure Group I to Seismic Hazard Exposure Group II.

**1610.1.3 Seismic ground acceleration table:** The effective peak velocity-related acceleration ($A_v$) and the effective peak acceleration ($A_a$) shall be determined from Table 1610.1.3. For the application of the formulas in Sections 1610.4 and 1610.5 which incorporate the effective peak acceleration coefficient ($A_a$), the value of $A_a$ shall be determined from Table 1610.1.3.

**1610.1.4 Site-specific response spectra:** Where site-specific response spectra are required for buildings assigned to Seismic Performance Categories D and E, in accordance with Table 1610.3.5.3, the site-specific response spectra shall be developed based on ground motions which have a 90-percent probability of not being exceeded in 50 years.

**1610.1.5 Seismic Hazard Exposure Groups:** All buildings shall be assigned to one of the Seismic Hazard Exposure Groups in accordance with Table 1610.1.5.

**1610.1.5.1 Multiple occupancies:** Where a building is occupied for two or more occupancies not included in the same Seismic Hazard Exposure Group, the building shall be assigned the classification of the highest Seismic Hazard Exposure Group occupancy.

**Table 1610.1.5**
**SEISMIC HAZARD EXPOSURE GROUP**

| Seismic Hazard Exposure Group type and description | Nature of occupancy |
|---|---|
| Group I | All occupancies except those listed below |
| Group II<br>Seismic Hazard Exposure Group II buildings are those which have a substantial public hazard due to occupancy or use, including buildings containing any one or more of the indicated occupancies. | 1. Use Group A in which more than 300 people congregate in one area.<br>2. Use Group E with an occupant load greater than 250.<br>3. Use Group B used for college or adult education with an occupant load greater than 500.<br>4. Use Group I-2 with an occupant load greater than 50, not having surgery or emergency treatment facilities.<br>5. Use Group I-3.<br>6. Power-generating stations and other public utility facilities not included in Seismic Hazard Exposure Group III.<br>7. Any other occupancy with an occupant load greater than 5,000. |
| Group III<br>Seismic Hazard Exposure Group III buildings are those having essential facilities which are required for post-earthquake recovery, including buildings containing any one or more of the indicated occupancies. | 1. Fire, rescue and police stations.<br>2. Use Group I-2 having surgery or emergency treatment facilities.<br>3. Emergency preparedness centers.<br>4. Post-earthquake recovery vehicle garages.<br>5. Power-generating stations and other utilities required as emergency backup facilities.<br>6. Primary communication facilities.<br>7. Highly toxic materials as defined by Section 307.0 where the quantity of the material exceeds the exempt amounts of Section 307.8. |

**Table 1610.1.3**
**SEISMIC GROUND ACCELERATION TABLE**

Earthquake Risk Zone #1
$A_v / A_a < 0.10$
Design Coefficient Values: $A_v = 0.07$ (unless noted, $A_v / A_a$); $A_a = 0.05$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Adair | | Estill | .08/.05 | Lee | .08/.05 | Pendleton | |
| Allen | | Fayette | | Leslie | .09/.09 | Perry | .09/.09 |
| Anderson | | Fleming | | Lewis | | Pike | .09/.09 |
| Barren | | Floyd | .09/.08 | Lincoln | .08/.05 | Powell | |
| Bath | | Franklin | | Logan | .08/.06 | Pulaski | .08/.06 |
| Boone | | Gallatin | | Madison | | Robertson | |
| Bourbon | | Garrard | | Magoffin | .08/.05 | Rockcastle | .08/.05 |
| Boyd | | Grant | | Marion | | Rowan | |
| Boyle | | Grayson | .08/.05 | Martin | .08/.05 | Russell | .08/.05 |
| Bracken | | Green | | Mason | | Scott | |
| Breathitt | .09/.05 | Greenup | | Meade | .08/.05 | Shelby | |
| Breckinridge | .08/.05 | Hancock | .09/.07 | Menifee | | Simpson | .05/.06 |
| Bullitt | | Hardin | | Mercer | | Spencer | |
| Butler | .08/.06 | Harrison | | Metcalfe | | Taylor | |
| Campbell | | Hart | | Monroe | .08/.05 | Todd | .09/.07 |
| Carroll | | Henry | | Montgomery | | Trimble | |
| Carter | | Jackson | .08/.05 | Morgan | .08/.05 | Warren | |
| Casey | .08/.05 | Jefferson | | Muhlenberg | .09/.08 | Washington | |
| Christian | .09/.09 | Jessamine | | McCreary | .09/.08 | Wayne | .08/.07 |
| Clark | | Johnson | .08/.05 | McLean | .09/.09 | Whitley | .09/.09 |
| Clay | .09/.08 | Kenton | | Nelson | | Wolfe | .08/.05 |
| Clinton | .08/.06 | Knott | .09/.08 | Nicholas | | Woodford | |
| Cumberland | .08/.05 | Knox | .09/.09 | Ohio | .09/.07 | | |
| Daviess | .09/.09 | Larue | | Oldham | | | |
| Edmonson | | Laurel | .09/.06 | Owen | | | |
| Elliott | | Lawrence | .08/.05 | Owsley | .08/.05 | | |

Earthquake Risk Zone #2
$A_v / A_a \geq$ but $< 0.15$
Design Coefficient Values: $A_v$ & $A_a = 0.10$ (unless noted, $A_v / A_a$)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bell | | Crittenden | .14/.14 | Hopkins | .11/.11 | Trigg | .13/.12 |
| Caldwall | .12/.12 | Harlan | | Letcher | | Union | .14/.13 |
| Calloway | .14/.14 | Henderson | .12/.11 | Lyon | .14/.13 | Webster | .12/.12 |

Earthquake Risk Zone #3
$A_v / A_a \geq 0.15$ but $\leq 0.25$

| Design Coefficient Values: $A_v$ & $A_a = 0.15$ (unless noted, $A_v / A_a$) | | | | Design Coefficient Values: $A_v$ & $A_a = 0.20$ (unless noted, $A_v / A_a$) | | | |
|---|---|---|---|---|---|---|---|
| Graves | .18/.18 | Marshall | .16/.15 | Ballard | .22/.22 | Fulton | .25/.25 |
| Livington | .15/.16 | McCracken | .19/.19 | Carlisle | .22/.22 | Hickman | .23/.23 |

**Figure 1610.1.3(1)**
**DELETED**

**Figure 1610.1.3(2)**
**DELETED**

**1610.1.6 Group III building protected access:** Where operational access to a Seismic Hazard Exposure Group III building is required through an adjacent building, the adjacent building shall conform to the requirements for Group III buildings. Where operational access is less than 10 feet (3048 mm) from the *interior lot line* or another building on the same *lot*, protection from potential falling debris from adjacent property shall be provided by the owner of the Seismic Hazard Exposure Group III building.

**1610.1.7 Seismic Performance Category:** All buildings shall be assigned a Seismic Performance Category in accordance with Table 1610.1.7.

**1610.1.8 Site limitation for Seismic Performance Category E:** A building assigned to Category E shall not be sited over a known fault that has previously caused a rupture of the ground surface immediately under the proposed building.

**Table 1610.1.7**
**SEISMIC PERFORMANCE CATEGORIES**

| Effective peak velocity-related acceleration ($A_v$) | Seismic Hazard Exposure Group | | |
|---|---|---|---|
| | I | II | III |
| $A_v < 0.05$ | A | A | A |
| $0.05 \leq A_v < 0.10$ | B | B | C |
| $0.10 \leq A_v < 0.15$ | C | C | C |
| $0.15 \leq A_v < 0.20$ | C | D | D |
| $0.20 \leq A_v$ | D | D | E |

**1610.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Acceleration**

**Effective peak acceleration:** Coefficient $A_a$, in accordance with Section 1610.1.3, for determining the prescribed seismic forces.

**Effective peak velocity-related acceleration:** Coefficient $A_v$, in accordance with Section 1610.1.3, for determining the prescribed seismic forces.

**Base:** The level at which the horizontal seismic ground motions are considered to be imparted to the building.

**Base shear:** Total design lateral force or shear at the base of the building.

**Bay (part of a structure):** The space between two adjacent piers or mullions or between two adjacent lines of columns.

**Design earthquake:** The earthquake that produces ground motions at the site under consideration which has a 90-percent probability of not being exceeded in 50 years.

**Designated seismic systems:** The seismic-resisting system and those architectural, electrical and mechanical systems and their components that require special performance characteristics.

**Diaphragm:** A horizontal, or nearly horizontal, portion of the seismic-resisting system, which is designed to transmit seismic forces to the vertical elements of the seismic-resisting system.

**Frame**

**Braced:** An essentially vertical truss, or its equivalent, of the concentric or eccentric type that is provided in a loadbearing wall, building frame or dual system to resist seismic forces.

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

**Eccentrically braced frame (EBF):** A diagonally braced steel frame in which at least one end of each brace frames into a beam a short distance from a beam-column joint or from another diagonal brace. These short beam segments are called link beams. The following EBF definitions apply:

**Diagonal brace:** A member of an EBF placed diagonally in the bay of the frame.

**Lateral support members:** Secondary members designed to prevent lateral or torsional buckling of beams in an EBF.

**Link beam:** The horizontal beam in an EBF which has a length of the clear distance between the diagonal braces or between the diagonal brace and the column face.

**Link beam end web stiffeners:** Vertical web stiffeners placed on the sides of the web at the diagonal brace end(s) of the link beam.

**Link beam intermediate web stiffener:** Vertical web stiffeners placed within the link beam.

**Link beam rotation angle:** The angle between the beam outside of the link beam and the link beam occurring at a total story drift of the deflection amplification factor ($C_d$) times the elastic drift at the prescribed design forces. The rotation angle is permitted to be computed assuming the EBF bay is deformed as a rigid, ideally plastic mechanism.

**Intermediate moment frame:** A frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members. Intermediate moment frames of reinforced concrete shall conform to Section 1903.2.2.

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

**Space frame:** A structural system composed of interconnected members, other than loadbearing walls, that is capable of supporting vertical *loads* and, if so designed, resist the seismic forces.

**Special moment frame:** A frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members. Special moment frames shall conform to the applicable requirements of Section 1903.0 or 2204.0.

**Frame system**

**Building:** A structural system with an essentially complete space frame providing support for vertical *loads*. Seismic force resistance is provided by shear walls or braced frames.

**Dual:** A structural system with an essentially complete space frame providing support for vertical *loads*. A moment-resisting frame shall be provided which shall be capable of resisting at least 25 percent of the prescribed seismic forces. The total seismic force resistance is provided by the combination of the

moment-resisting frame together with shear walls or braced frames in proportion to their relative rigidities.
**Moment resisting:** A structural system with an essentially complete space frame providing support for vertical *loads*. Seismic force resistance is provided by special, intermediate or ordinary moment frames capable of resisting the total prescribed forces.

**High-temperature energy source:** A fluid, gas or vapor whose temperature exceeds 220 degrees F. (104 degrees C.).

**Inverted pendulum-type structures:** Structures that have a large portion of their mass concentrated near the top and thus have essentially one degree of freedom in horizontal translation. The structures are usually T-shaped with a single column supporting the beams or slab at the top.

**Light-framed wall with shear panels:** Wood or steel stud walls with finishes other than masonry veneer.

**Loadbearing wall system:** A structural system with loadbearing walls providing support for all, or major portions of, the vertical *loads*. Shear walls or braced frames provide seismic force resistance.

**P-delta effect:** The secondary effect on shears and moments of frame members due to the action of the vertical *loads* induced by displacement of the building frame resulting from lateral forces.

**Resilient stable-mounting system:** A system incorporating helical springs, air cushions, rubber-in-shear mounts, fiber-in-shear mounts, or other comparable approved systems. The force displacement ratios are equal in the horizontal and vertical directions.

**Restraining device:** A device used to limit the vertical or horizontal movement of the mounting system due to earthquake motions.
**Elastic:** A fixed restraining device that incorporates an elastic element to reduce the seismic forces transmitted to the structure due to impact from the resilient mounting system.
**Fixed:** A nonyielding or rigid type of restraining device.
**Seismic activated:** An interactive restraining device that is activated by earthquake motion.

**Seismic-resisting system:** That part of the structural system that has been considered in the design to provide the required resistance to the seismic forces prescribed herein.

**Shear wall:** A wall, loadbearing or nonloadbearing, designed to resist seismic forces, from other than its own mass, acting in the plane of the wall.

**Story drift ratio:** The story drift divided by the story height.

**Story shear:** The summation of design lateral forces at levels above the story under consideration.

**1610.3 Structural design requirements:** The seismic analysis and design procedures utilized in the design of buildings and their structural components shall be in accordance with the requirements of this section. The design seismic forces, and their distribution over the height of the building, shall be in accordance with the procedures in Section 1610.4 or 1610.5. The corresponding internal forces in the structural components of the building shall be determined by a linearly elastic model. Structural concepts other than those in this section shall be permitted where evidence is submitted showing that equivalent ductility and energy dissipation are provided. Other procedures utilized to establish the seismic forces and the distribution of such forces shall be permitted if the corresponding internal forces and deformations in the structural components are determined by a model consistent with the approved procedure. Individual structural members shall be designed for the shears, axial forces and moments determined in accordance with this section. Connections shall be designed to develop the strength of the connected members or the analysis forces, whichever is less. The design story drift of the building shall not exceed the allowable story drift requirements of Section 1610.3.7 where the building is subjected to the design seismic forces. All structural components of the building that transmit seismic force shall be connected, with adequate strength and stiffness, through a continuous path to the final point of resistance. The foundation shall be designed to accommodate the forces developed and the movements imparted to the building by the design ground motions. The foundation design shall account for the dynamic nature of the seismic forces and the design ground motions.

**1610.3.1 Site coefficient:** The value of the site coefficient ($S$) shall be determined from Table 1610.3.1. In locations where the soil properties are not known in sufficient detail to determine the soil-profile type or where the soil profile does not fit any of the four types indicated in Table 1610.3.1, a site coefficient ($S$) of 2.0 shall be used.

**Table 1610.3.1**
**SITE COEFFICIENT**

| Soil-profile type | Description[a] | Site coefficient $S$ |
|---|---|---|
| $S_1$ | A soil profile with either:<br>Rock of any characteristic, either shale-like or crystalline in nature, which has a shear wave velocity greater than 2,500 feet per second; or<br>Stiff soil conditions where the soil depth is less than 200 feet and the soil types overlying rock are stable deposits of sands, gravels or stiff clays. | 1.0 |
| $S_2$ | A soil profile with deep cohesionless or stiff clay conditions, where the soil depth exceeds 200 feet and soil types overlying rock are stable deposits of sands, gravels or stiff clays. | 1.2 |
| $S_3$ | A soil profile containing 20 to 40 feet in thickness of soft to medium-stiff clays with or without intervening layers of cohesionless soils. | 1.5 |
| $S_4$ | A soil profile characterized by a shear wave velocity less than 500 feet per second, containing more than 40 feet of soft clays or silts. | 2.0 |

**Note a.** 1 foot = 304.8 mm.

**1610.3.2 Soil-structure interaction:** The design base shear, story shears, overturning moments and deflections determined by the requirements of Section 1610.4 or 1610.5 are permitted to be modified in accordance with approved proce-

dures which account for the effects of soil-structure interaction.

**1610.3.3 Structural framing systems:** The basic structural framing systems to be utilized are indicated in Table 1610.3.3. Each type is subdivided by the types of vertical structural elements that will resist the design lateral forces. The structural system utilized shall be in accordance with the seismic performance category and height limitations indicated in Table 1610.3.3. The appropriate response modification factor ($R$) and the deflection amplification factor ($C_d$) indicated in Table 1610.3.3 shall be utilized in determining the base shear and the design story drift. Structural framing and seismic-resisting systems which are not contained in Table 1610.3.3 shall be permitted if analysis and test data are submitted that establish the dynamic characteristics and demonstrate the lateral force resistance and energy absorption capacity to be equivalent to the structural systems listed in Table 1610.3.3 for equivalent response modification factor ($R$) values.

**1610.3.3.1 Dual system:** For a dual system, the moment frame shall be capable of resisting at least 25 percent of the design seismic forces. The total seismic force resistance is to be provided by the combination of the moment frame and the seismic-resisting elements in proportion to their rigidities.

**1610.3.3.2 Combinations of framing systems:** Different structural framing systems are permitted along the two orthogonal axes of the building. Combinations of framing systems shall comply with the requirements of Sections 1610.3.3.2.1 and 1610.3.3.2.2.

**1610.3.3.2.1 Combination framing factor ($R$):** The response modification factor ($R$) in the direction under consideration at any story shall not exceed the lowest response modification factor ($R$) obtained from Table 1610.3.3 for the seismic-resisting system in the same direction considered above that story.

**Exception:** Supported structural systems with a weight equal to or less than 10 percent of the weight of the building are not required to comply with this requirement.

**1610.3.3.2.2 Combination framing detailing requirements:** The detailing requirements of Section 1610.3.6 required by the higher response modification factor ($R$) shall apply to structural components common to systems having different response modification factors.

**1610.3.3.3 Seismic Performance Categories A, B and C:** The structural framing system for buildings assigned to Seismic Performance Categories A, B and C shall comply with the *building height* and structural system limitations in Table 1610.3.3.

**1610.3.3.4 Seismic Performance Category D:** The structural framing system for buildings assigned to Seismic Performance Category D shall comply with Section 1610.3.3.3 and the additional provisions of this section.

**1610.3.3.4.1 Limited building height:** Buildings having a structural system of steel or cast-in-place concrete-braced frames or shear walls are limited to a height of 240 feet (73152 mm) where there are braced frames or shear walls so arranged that braced frames or shear walls in one plane resist not more than the following proportion of the seismic design force in each direction, including torsional effects:

1. 60 percent where the braced frame or shear walls are arranged only on the perimeter;
2. 40 percent where some of the braced frames or shear walls are arranged on the perimeter; or
3. 30 percent for other arrangements.

**1610.3.3.4.2 Interaction effects:** Moment-resisting frames that are enclosed or adjoined by more rigid elements not considered to be part of the seismic-resisting system shall be designed so that the action or failure of the enclosing or adjoining elements will not impair the vertical *load* and seismic force-resisting capability of the frame. The design shall provide for the effect of these rigid elements on the structural system at building deformations corresponding to the design story drift ($\Delta$) as determined in Section 1610.4.5.

**1610.3.3.4.3 Deformational compatibility:** Every structural component not included in the seismic force-resisting system in the direction under consideration shall be designed to be adequate for the vertical load-bearing capacity and the induced moments resulting from the design story drift ($\Delta$) as determined in accordance with Section 1610.4.5.

**1610.3.3.4.4 Special moment frames:** A special moment frame that is utilized but not required by Table 1610.3.3 is permitted to be discontinuous and supported by a more rigid system with a lower response modification factor ($R$) provided that the requirements of Section 1610.3.6.2.4 are met. Where a special moment frame is required by Table 1610.3.3, the frame shall be continuous to the foundation.

**1610.3.3.5 Seismic Performance Category E:** The framing systems of buildings assigned to Category E shall conform to the requirements of Section 1610.3.3.4 for Category D and to the additional requirements and limitations of this section. The *building height* limitation in Section 1610.3.3.4.1 is reduced to 160 feet (48768 mm) for buildings assigned to Seismic Performance Category E.

**1610.3.4 Building configuration:** Buildings shall be classified as regular or irregular based on the plan and vertical configuration.

**1610.3.4.1 Plan irregularity:** Buildings having one or more of the features listed in Table 1610.3.4.1 shall be designated as having plan irregularity and shall comply with the requirements in the referenced code sections of Table 1610.3.4.1.

**Table 1610.3.3[a]**
**STRUCTURAL SYSTEMS**

| Basic structural system / Seismic-resisting system | Response modification factor ($R$) | Deflection amplification factor ($C_d$) | Structural system limitations and building height (feet) limitations (see Note b) — Seismic Performance Category A and B | C | D[e] | E[f] |
|---|---|---|---|---|---|---|
| 1. Loadbearing wall system | | | | | | |
| Light-framed walls with shear panels | 6½ | 4 | Not limited | Not limited | 160 | 100 |
| Reinforced concrete shear walls | 4½ | 4 | Not limited | Not limited | 160 | 100 |
| Reinforced masonry shear walls | 3½ | 3 | Not limited | Not limited | 160 | 100 |
| Concentrically braced frames | 4 | 3½ | Not limited | Not limited | 160 | 100 |
| Unreinforced masonry shear walls | 1¼ | 1¼ | Not limited | Note c | Not permitted | Not permitted |
| Plain concrete shear walls | 1½ | 1½ | Not limited | Note d | Not permitted | Not permitted |
| 2. Building frame system | | | | | | |
| Eccentrically braced frames, moment-resisting connections at columns away from link beam | 8 | 4 | Not limited | Not limited | 160 | 100 |
| Eccentrically braced frames, nonmoment-resisting connections at columns away from link beam | 7 | 4 | Not limited | Not limited | 160 | 100 |
| Light-framed walls with shear panels | 7 | 4½ | Not limited | Not limited | 160 | 100 |
| Concentrically braced frames | 5 | 4½ | Not limited | Not limited | 160 | 100 |
| Reinforced concrete shear walls | 5½ | 5 | Not limited | Not limited | 160 | 100 |
| Reinforced masonry shear walls | 4½ | 4 | Not limited | Not limited | 160 | 100 |
| Unreinforced masonry shear walls | 1½ | 1½ | Not limited | Note c | Not permitted | Not permitted |
| Plain concrete shear walls | 2 | 2 | Not limited | Note d | Not permitted | Not permitted |
| 3. Moment-resisting frame system | | | | | | |
| Special moment frames of steel | 8 | 5½ | Not limited | Not limited | Not limited | Not limited |
| Special moment frames of reinforced concrete | 8 | 5½ | Not limited | Not limited | Not limited | Not limited |
| Intermediate moment frames of reinforced concrete | 5 | 4½ | Not limited | Not limited | Not permitted | Not permitted |
| Ordinary moment frames of steel | 4½ | 4 | Not limited | Not limited | 160 | 100 |
| Ordinary moment frames of reinforced concrete | 3 | 2½ | Not limited | Not permitted | Not permitted | Not permitted |
| 4. Dual system with a special moment frame capable of resisting at least 25 percent of the prescribed seismic forces | | | | | | |
| Eccentrically braced frames, moment-resisting connections at columns away from link beam | 8 | 4 | Not limited | Not limited | Not limited | Not limited |
| Eccentrically braced frames, nonmoment-resisting connections at columns away from link beam | 7 | 4 | Not limited | Not limited | Not limited | Not limited |
| Concentrically braced frames | 6 | 5 | Not limited | Not limited | Not limited | Not limited |
| Reinforced concrete shear walls | 8 | 6½ | Not limited | Not limited | Not limited | Not limited |
| Reinforced masonry shear walls | 6½ | 5½ | Not limited | Not limited | Not limited | Not limited |
| Wood-sheathed shear walls | 8 | 5 | Not limited | Not limited | Not limited | Not limited |
| 5. Dual system with an intermediate moment frame of reinforced concrete or an ordinary moment frame of steel capable of resisting at least 25 percent of the prescribed seismic forces | | | | | | |
| Concentrically braced frames | 5 | 4½ | Not limited | Not limited | 160 | 100 |
| Reinforced concrete shear walls | 6 | 5 | Not limited | Not limited | 160 | 100 |
| Reinforced masonry shear walls | 5 | 4½ | Not limited | Not limited | 160 | 100 |
| Wood-sheathed shear walls | 7 | 4½ | Not limited | Not limited | 160 | 100 |
| 6. Inverted pendulum structures | | | | | | |
| Special moment frames of structural steel | 2½ | 2½ | Not limited | Not limited | Not limited | Not limited |
| Special moment frames of reinforced concrete | 2½ | 2½ | Not limited | Not limited | Not limited | Not limited |
| Ordinary moment frames of structural steel | 1¼ | 1¼ | Not limited | Not limited | Not permitted | Not permitted |

**Note a.** Response modification factor ($R$) for application of Sections 1610.4 and 1610.5. Deflection amplification factor ($C_d$) for application of Sections 1610.4 and 1610.5.

**Note b.** The building height shall not exceed the general height limitation of Sections 503.0 and 504.0 based on the type of construction.

**Note c.** The masonry shear walls shall have nominal reinforcement as required by Section 10.5 of ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**Note d.** The concrete shear walls shall have nominal reinforcement as required by Section 1904.3.3.

**Note e.** See Section 1610.3.3.4.1 for description of building systems which are limited to buildings with a height of 240 feet or less.

**Note f.** See Section 1610.3.3.5 for description of building systems which are limited to buildings with a height of 160 feet or less.

**Table 1610.3.4.1**
**PLAN STRUCTURAL IRREGULARITIES**

| Irregularity type and description | Referenced section | Seismic Performance Category Application |
|---|---|---|
| 1. Torsional irregularity — to be considered where diaphragms are rigid in relation to the vertical structural elements which resist the lateral seismic forces.<br><br>Torsional irregularity shall be considered to exist where the maximum story drift computed, including accidental torsion, at one end of the structure transverse to an axis is more than 1.2 times the average of the story drifts at the two ends of the structure. | Section 1610.3.6.4.2<br><br>Section 1610.4.3.1 | D and E<br><br>C, D and E |
| 2. Re-entrant corners<br><br>Plan configurations of a structure and its lateral force-resisting system contain re-entrant corners, where both projections of the structure beyond a re-entrant corner are greater than 15 percent of the plan dimension of the structure in the given direction. | Section 1610.3.6.4.2 | D and E |
| 3. Diaphragm discontinuity<br><br>Diaphragms with abrupt discontinuities or variations in stiffness, including those having cutout or open areas greater than 50 percent of the gross enclosed area diaphragm, or changes in effective diaphragm stiffness of more than 50 percent from one story to the next. | Section 1610.3.6.4.2 | D and E |
| 4. Out-of-plane vertical element offsets<br><br>Discontinuities in a lateral force-resistance path, such as out-of-plane offsets of the vertical elements which resist the lateral seismic forces. | Section 1610.3.6.4.2 | D and E |
| 5. Nonparallel systems<br><br>The vertical lateral force-resisting elements are not parallel to, or are not symmetric about, the major orthogonal axes of the lateral force-resisting system. | Section 1610.3.6.3.1 | C, D and E |

**1610.3.4.2 Vertical irregularity:** Buildings having one or more of the features listed in Table 1610.3.4.2 shall be designated as having vertical irregularity and shall comply with the requirements in the referenced code sections of Table 1610.3.4.2.

**Exceptions**

1. Structural irregularities of Type 1 or 2 in Table 1610.3.4.2 do not apply where the building story drift ratio is less than 130 percent of the story drift ratio of the next story above. Torsional effects are not required to be considered in the calculation of story drifts. The story drift ratio relationship for the top two stories of the building is not required to be evaluated.
2. Irregularity Types 1 and 2 of Table 1610.3.4.2 are not required to be considered for one- and two-story buildings.

**Table 1610.3.4.2**
**VERTICAL STRUCTURAL IRREGULARITIES**

| Irregularity type and description | Referenced section | Seismic Performance Category Application |
|---|---|---|
| 1. Stiffness irregularity — soft story<br><br>A soft story is one in which the lateral stiffness is less than 70 percent of that in the story above or less than 80 percent of the average stiffness of the three stories above. | Section 1610.3.5.3 | D and E |
| 2. Weight (mass) irregularity<br><br>Mass irregularity shall be considered to exist where the effective mass of any story is more than 150 percent of the effective mass of an adjacent story. A roof that is lighter than the floor below is not required to be considered. | Section 1610.3.5.3 | D and E |
| 3. Vertical geometric irregularity<br><br>Vertical geometric irregularity shall be considered to exist where the horizontal dimension of the lateral force-resisting system in any story is more than 130 percent of that in an adjacent story. | Section 1610.3.5.3 | D and E |
| 4. In-plane discontinuity in vertical lateral force-resisting elements<br><br>An in-plane offset of the lateral force-resisting elements greater than the length of those elements. | Section 1610.3.6.4.2 | D and E |
| 5. Discontinuity in capacity — weak story<br><br>A weak story is one in which the story lateral strength is less than 80 percent of that in the story above. The story strength is the total strength of all seismic-resisting elements sharing the story shear for the direction under consideration. | Section 1610.3.6.2.4 | B, C, D and E |

**1610.3.5 Analysis procedures:** A structural analysis shall be made for all buildings in accordance with the requirements of this section. An alternative generally accepted procedure, including utilization of an approved site-specific response spectrum, is permitted, where approved by the code official. The limitations on the base shear in Section 1610.5 apply to dynamic modal analysis.

**1610.3.5.1 Seismic Performance Category A:** Regular or irregular buildings assigned to Category A are not required to be analyzed for seismic forces for the building as a whole. The requirements of Sections 1610.3.6.1 apply.

**1610.3.5.2 Seismic Performance Categories B and C:** Regular or irregular buildings assigned to Category B or C shall be analyzed in accordance with the procedures in Section 1610.4.

**1610.3.5.3 Seismic Performance Categories D and E:** Buildings assigned to Category D or E shall be analyzed in accordance with the referenced sections in Table 1610.3.5.3.

**Table 1610.3.5.3**
**ANALYSIS PROCEDURES FOR SEISMIC PERFORMANCE CATEGORIES D AND E**

| Building description | Referenced section and procedures |
|---|---|
| 1. Buildings designated as regular which do not exceed 240 feet in height. | Section 1610.4 |
| 2. Buildings that have only vertical irregularities of Type 1, 2 or 3 in Table 1610.3.4.2 and have a height exceeding five stories or 65 feet, and all buildings exceeding 240 feet in height. | Section 1610.5 |
| 3. All other buildings designated as having plan or vertical irregularities in accordance with Tables 1610.3.4.1 and 1610.3.4.2. | Section 1610.4 or 1610.5 |
| 4. Buildings in Seismic Hazard Exposure Groups II and III in areas with $A_a$ greater than 0.40 within 10 kilometers of faults having the capability of generating magnitude 7 or greater earthquakes. | A site-specific response spectrum shall be utilized but the design base shear shall not be less than that determined from Section 1610.4. |
| 5. Buildings in areas with $A_v$ of 0.2 and greater with a building period of 0.7 seconds or greater, located on type $S_4$ soils. | A site-specific response spectrum shall be utilized but the design base shear shall not be less than that determined from Section 1610.4. The modal seismic design coefficient ($C_{sm}$) shall not be limited in accordance with Section 1610.5.5. |

**1610.3.6 Design, detailing requirements and structural component load effects:** The design and detailing of structural components of the seismic-resisting system shall comply with the requirements of this section. Foundation design shall conform to the applicable requirements of Chapter 18.

**1610.3.6.1 Seismic Performance Category A:** The design and detailing of buildings assigned to Seismic Performance Category A shall comply with the requirements of this section.

**1610.3.6.1.1 Ties and continuity:** Except for connections exempted by Section 1610.6, all parts of the building that transmit seismic force shall be interconnected to form a continuous path to the building's seismic-resisting system. Any smaller portion of the building shall be tied to the remainder of the building with elements having a strength capable of transmitting the seismic force ($F_p$) determined in accordance with Section 1610.6, but not less than one-third of the effective peak velocity-related acceleration ($A_v$) times the weight of the smaller portion ($W_c$) or 5 percent of the portion's weight, whichever is greater. For a building which is exempt from a full seismic analysis by Section 1610.1 and is only required to comply with Section 1610.3.6.1, the building's main windforce-resisting system in accordance with Section 1611.0 shall be deemed to be the seismic-resisting system.

A positive connection for resisting a horizontal force acting parallel to the member shall be provided for each beam, girder or truss to its support. The connection shall have a minimum strength of 5 percent of the *dead* plus *live load* reaction.

**1610.3.6.1.2 Concrete or masonry wall anchorage:** Concrete and masonry walls shall be anchored to the roof and all floors that provide lateral support for the wall. The anchorage shall provide a direct connection between the walls and the roof or floor construction. Toe nailing or nails subject to withdrawal forces is not permitted. Wood ledgers shall not be subjected to cross-grain bending or cross-grain tension. The connections shall be capable of resisting a lateral seismic force ($F_p$) in accordance with either Section 1610.3.6.2.8 or Section 1610.6, for loadbearing and nonloadbearing walls respectively, but not less than 1,000 times the effective peak velocity-related acceleration ($A_v$) (pounds) per lineal foot of wall. Walls shall be designed to resist bending between anchors where the anchor spacing exceeds 4 feet (1219 mm).

**1610.3.6.2 Seismic Performance Category B:** Buildings assigned to Category B shall conform to the requirements of Section 1610.3.6.1 for Category A and the requirements of this section.

**1610.3.6.2.1 Materials:** The materials and the systems composed of those materials shall conform to the requirements of this code.

**1610.3.6.2.2 Openings:** Where openings occur in shear walls, diaphragms or other plate-type elements, the edges of the openings shall be designed to transfer the stresses into the structure. The edge chord shall extend into the body of the wall or diaphragm a distance sufficient to develop the stress of the chord member.

**1610.3.6.2.3 Orthogonal effects:** The design seismic forces shall be applied separately in each of two orthogonal directions.

**1610.3.6.2.4 Discontinuities in vertical system:** Buildings with a discontinuity in lateral capacity, vertical irregularity Type 5 as defined in Table 1610.3.4.2, shall not be more than two stories or 30 feet (9144 mm)

in height where the "weak" story has a calculated strength of less than 65 percent of the story above.

**Exception:** Where the "weak" story is capable of resisting a total seismic force equal to 75 percent of the deflection amplification factor ($C_d$) times the design force prescribed in Section 1610.4.

**1610.3.6.2.5 Nonredundant systems:** The building design shall comply with Section 1604.2.

**1610.3.6.2.6 Collector elements:** Collector elements shall be provided which are capable of transferring the seismic forces originating in other portions of the building to the element providing the resistance to those forces.

**1610.3.6.2.7 Diaphragms:** The deflection in the plane of the diaphragm, as determined by engineering analysis, shall not exceed the allowable deflection of the attached elements. Allowable deflection shall be that deflection which will permit the attached element to maintain its structural integrity under the individual *loading* and continue to support the prescribed *loads*.

Floor and roof diaphragms shall be designed to resist the following seismic forces: a minimum force equal to 50 percent the effective peak velocity-related acceleration ($A_v$) times the weight of the diaphragm and other elements of the building attached thereto, plus the portion of the seismic shear force at that level ($V_x$) required to be transferred to the components of the vertical seismic-resisting system because of offsets or changes in stiffness of the vertical components above and below the diaphragm.

Diaphragms shall provide for both the shear and bending stresses resulting from these forces. Diaphragms shall have ties or struts to distribute the wall anchorage forces into the diaphragm. Diaphragm connections shall be positive, mechanical-type connections.

**1610.3.6.2.8 Loadbearing walls:** Exterior and interior loadbearing walls and their anchorage shall be designed for a force of the effective peak velocity-related acceleration ($A_v$) times the weight of wall, normal to the surface, with a minimum force of 10 percent of the weight of the wall. Interconnection of wall elements and connections to supporting framing systems shall have sufficient ductility, rotational capacity or sufficient strength to resist shrinkage, thermal changes and differential foundation settlement where combined with seismic forces.

**1610.3.6.2.9 Inverted pendulum-type structures:** Supporting columns or piers of inverted pendulum-type structures shall be designed for the bending moment calculated at the base determined by the procedures given in Section 1610.4 and shall vary uniformly to a moment at the top equal to one-half the calculated bending moment at the base.

**1610.3.6.3 Seismic Performance Category C:** Buildings assigned to Category C shall conform to the requirements of Section 1610.3.6.2 for Category B and the requirements of this section.

**1610.3.6.3.1 Plan irregularity:** Buildings that have plan structural irregularity Type 5 in Table 1610.3.4.1 shall be analyzed for the critical *load* effect due to direction of application of seismic forces. Alternatively, the building shall be analyzed in any two orthogonal directions. Structural elements and foundations shall be designed for 100 percent of the forces for one direction plus a simultaneous *load* of 30 percent of the forces for the perpendicular direction.

**1610.3.6.4 Seismic Performance Categories D and E:** Buildings assigned to Category D or E shall conform to the requirements of Section 1610.3.6.3 for Category C and to the requirements of this section.

**1610.3.6.4.1 Orthogonal load effects:** Buildings shall be designed for 100 percent of the seismic forces for one direction plus a simultaneous *load* of 30 percent of the seismic forces for the perpendicular direction. The *load* combination requiring the maximum structural component strength shall be used.

**Exception:** Diaphragms and components of the seismic-resisting system utilized in only one of the two orthogonal directions are not required to be designed for the combined *load* effects.

**1610.3.6.4.2 Plan or vertical irregularities:** For buildings having a plan irregularity of Type 1, 2, 3 or 4 in Table 1610.3.4.1 or a vertical irregularity of Type 4 in Table 1610.3.4.2, the design forces determined from Section 1610.4 shall be increased 25 percent for connections of diaphragms to vertical elements and to collectors and for connections of collectors to the vertical elements.

**1610.3.6.4.3 Vertical seismic loads:** The vertical component of earthquake ground motion shall be accounted for in the design of horizontal cantilever and horizontal prestressed components. Horizontal prestressed components shall be designed for the load calculated utilizing the equation in item 4 of Section 1610.3.7 in addition to the other applicable *loads* and *load* combination of Section 1610.3.7. Horizontal cantilever structural components shall be designed for a net upward force of 0.2 times the *dead load* in addition to the other applicable *loads* and *load* combinations of Section 1610.3.7.

**1610.3.7 Combination of load effects:** The effects on the building and its components from seismic forces shall be combined with gravity *loads* in accordance with the combination of *load* effects provided in Section 2 of ASCE 7 listed in Chapter 35. The earthquake-induced force effect *(E)* shall include vertical and horizontal effects as determined by the following equations:

1. For Equation 5 in Section 2.3.2, or Equation 4 in Section 2.4.1 of the basic combinations, of ASCE 7 listed in Chapter 35.

$$E = \pm 1.0\, Q_E + 0.5\, A_v D$$

2. For Equation 6 in Section 2.3.2, or Equation 3 in Section 2.4.1 of the basic combinations, of ASCE 7 listed in Chapter 35.

$$E = \pm 1.0\, Q_E - 0.5\, A_v D$$

3. For columns supporting discontinuous lateral force-resisting elements, the axial compression in the columns shall be computed utilizing the following load in Equation 5 in Section 2.3.2, or Equation 4 in Section 2.4.1 of the basic combinations, of ASCE 7 listed in Chapter 35.

$$E = (2\,R/5)\, Q_E + 0.5\, A_v D$$

where:

$$(2\,R/5) \geq 1.0$$

The axial forces in such columns shall not be required to exceed the capacity of other elements of the structure to transfer such loads to the column.

4. For horizontal prestressed members in buildings assigned to Seismic Performance Category D or E (see Section 1610.3.6.4.3), Equation 6 in Section 2.3.2, or Equation 3 in Section 2.4.1 of the Basic Combinations, of ASCE 7 listed in Chapter 35.

$$E = (2\,R/5)\, Q_E - 0.5\, A_v D$$

where:

$$(2\,R/5) \geq 1.0$$

$E$ = the effect of horizontal and vertical earthquake-induced forces
$A_v$ = the coefficient representing effective peak velocity-related acceleration
$D$ = the effect of dead load, $D$
$Q_E$ = the effect of horizontal seismic (earthquake-induced) forces
$R$ = the response modification factor in Table 1610.3.3

**1610.3.8 Deflection and drift limits:** The design story drift ($\Delta$) as determined in Section 1610.4.5 or 1610.5.8, shall not exceed the allowable story drift ($\Delta_a$) from Table 1610.3.8 for any story. For structures with significant torsional deflections, the maximum drift shall include torsional effects. The total deflection of a building due to seismic design forces shall not encroach on an *interior lot line*. All portions of the building shall be designed and constructed to act as an integral unit in resisting seismic forces unless separated structurally by a distance sufficient to avoid contact causing damage to the structural system of the building under total deflection ($\delta_x$) as determined by Section 1610.4.5.1.

**Table 1610.3.8**
**ALLOWABLE STORY DRIFT ($\Delta_a$) [a]**

| Building | Seismic Hazard Exposure Group | | |
|---|---|---|---|
| | I | II | III |
| One-story buildings without equipment attached to the seismic-resisting structural system and with interior walls, partitions, ceilings, and exterior wall systems which have been designed to accommodate the story drifts. | No limit | 0.020 $h_{sx}$ | 0.015 $h_{sx}$ |
| Buildings having four stories or less with interior walls, partitions, ceilings, and exterior wall systems which have been designed to accommodate the story drifts. | 0.025 $h_{sx}$ | 0.020 $h_{sx}$ | 0.015 $h_{sx}$ |
| Masonry shear wall buildings | 0.007 $h_{sx}$ | 0.007 $h_{sx}$ | 0.007 $h_{sx}$ |
| All other buildings. | 0.020 $h_{sx}$ | 0.015 $h_{sx}$ | 0.010 $h_{sx}$ |

**Note a.** $h_{sx}$ is the story height below level $x$.

**1610.4 Equivalent lateral force procedure:** This section provides requirements for the equivalent lateral force procedure of seismic analysis of buildings. For purposes of analysis, the building is considered to be fixed at the base. See Section 1610.3.5 for limitations on the applicability of this procedure.

**1610.4.1 Seismic base shear:** The seismic base shear ($V$) in a given direction shall be determined in accordance with the following formula:

$$V = C_s W$$

where:

$C_s$ = The seismic design coefficient determined in accordance with Section 1610.4.1.1.
$W$ = The total *dead load* and applicable portions of other *loads* listed below:

1. For occupancies in Use Group S, a minimum of 25 percent of the floor *live load* shall be applicable.

   **Exception:** Floor *live load* in *public garages* and open parking structures is not applicable.

2. Where an allowance for partition *load* is included in the floor *load* design, the actual partition weight or a minimum weight of 10 psf (479 Pa) of floor area, whichever is greater, shall be applicable.
3. Total operating weight of permanent equipment.
4. In areas where the ground snow *load* is equal to or greater than 30 pounds per square foot (2436 Pa) of short duration and approved, snow *load*

reductions of 80 percent are permitted. Where the ground snow *load* is less than 30 pounds per square foot (1436 Pa), the snow *load* is not required to be included.

**1610.4.1.1 Calculation of seismic coefficient ($C_s$):** In computing the fundamental period of the building, the seismic design coefficient ($C_s$) shall be determined in accordance with the following formulas:

$$C_s = \frac{1.2\,A_v\,S}{RT^{2/3}}$$

where:

$A_v$ = The coefficient representing effective peak velocity-related acceleration from Section 1610.1.3.

$S$ = The coefficient for the soil-profile characteristics of the site in Table 1610.3.1.

$R$ = The response modification factor in Table 1610.3.3.

$T$ = The fundamental period of the building determined in Section 1610.4.1.2.

A soil-structure interaction reduction is permitted where determined from an approved procedure.

Alternatively, the seismic design coefficient ($C_s$) is not required to be greater than the following equation:

$$C_s = \frac{2.5\,A_a}{R}$$

where:

$A_a$ = The seismic coefficient representing the effective peak acceleration as determined in Section 1610.1.3.

$R$ = The response modification factor in Table 1610.3.3.

**1610.4.1.2 Period determination:** The fundamental period ($T$), in seconds, of the building, in the direction under consideration, shall be established based on the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. The fundamental period ($T$) shall not exceed the product of the coefficient for the upper limit on calculated period ($C_a$) from Table 1610.4.1.2, and the approximate fundamental period ($T_a$).

Alternatively, the fundamental period ($T$) shall be determined from Section 1610.4.1.2.1.

**Table 1610.4.1.2**
**COEFFICIENT FOR UPPER LIMIT ON CALCULATED PERIOD ($C_a$)**

| $A_v$ Coefficient representing effective peak velocity-related acceleration | $C_a$ |
|---|---|
| 0.4 | 1.2 |
| 0.3 | 1.3 |
| 0.2 | 1.4 |
| 0.15 | 1.5 |
| 0.1 | 1.7 |
| 0.05 | 1.7 |

**1610.4.1.2.1 Approximate fundamental period ($T_a$):** The approximate fundamental period ($T_a$), in seconds, shall be determined from the following formula:

$$T_a = C_T\,h_n^{3/4}$$

where:

$h_n$ = The height (in feet) from the base to the highest level of the building.

$C_T$ = 0.035 For moment-resisting frame systems of steel which provide 100 percent of the required lateral force resistance, where the frame is not enclosed or adjoined by more rigid components.

$C_T$ = 0.03 For moment-resisting frame systems of concrete which provide 100 percent of the required lateral force resistance, where the frame is not enclosed or adjoined by more rigid components.

$C_T$ = 0.03 For building frame systems with an eccentrically braced steel frame or dual systems with an eccentrically braced frame.

$C_T$ = 0.02 For seismic-resisting systems with shear walls, shear panels or concentrically braced frames and all other building systems.

Alternatively, the approximate fundamental period ($T_a$), in seconds, shall be determined from the following formula for buildings in which the lateral force-resisting system consists of concrete or steel moment-resisting frames capable of resisting 100 percent of the required lateral force and where such frames are not enclosed or adjoined by more rigid components tending to prevent the frames from deflecting when subjected to seismic forces. Such buildings shall not exceed 12 stories in height and shall have a story height of not less than 10 feet (3048 mm).

$$T_a = 0.1\,N$$

where:

$N$ = Number of stories.

**1610.4.2 Vertical distribution of seismic forces:** The lateral force ($F_x$) induced at any level shall be determined from the following formulas:

$$F_x = C_{vx}V$$

$$C_{vx} = \frac{w_x h_x^k}{\sum_{i=1}^{n} w_i h_i^k}$$

where:

$C_{vx}$ = Vertical distribution factor.

$V$ = Total design lateral force or shear at the base of the building.

$w_i$ and $w_x$ = The portion of the total gravity *load* of the building ($W$) located or assigned to level $i$ or $x$.

$h_i$ and $h_x$ = The height (in feet) from the base to level $i$ or $x$.

$k$ = An exponent related to the building period as follows:
For buildings having a period of 0.5 seconds or less, $k = 1$.
For buildings having a period of 2.5 seconds or more, $k = 2$.
For buildings having a period between 0.5 and 2.5 seconds, $k$ shall be 2 or shall be determined by linear interpolation between 1 and 2.

**1610.4.3 Horizontal shear distribution:** The seismic design story shear in any story ($V_x$) shall be determined from the following formula:

$$V_x = \sum_{i=x}^{n} F_i$$

where:

$F_i$ = The portion of the seismic base shear ($V$) induced at level $i$.

The seismic design story shear ($V_x$) shall be distributed to the various vertical elements of the seismic-resisting system in the story under consideration based on the relative lateral stiffnesses of the vertical resisting elements and the diaphragm.

**1610.4.3.1 Torsion:** The design shall include the torsional moment ($M_t$) resulting from the location of the building masses plus the accidental torsional moments ($M_{ta}$) caused by assumed displacement of the mass each way from its actual location by a distance equal to 5 percent of the dimension of the building perpendicular to the direction of the applied forces.

In buildings of Seismic Performance Categories C, D and E, where Type 1 torsional irregularity exists as defined in Table 1610.3.4.1, the effects shall be accounted for by increasing the accidental torsion at each level by a torsional amplification factor ($A_x$) determined from the following formula:

$$A_X = \left[ \frac{\delta_{max}}{1.2\delta_{avg}} \right]^2$$

where:

$\delta_{max}$ = The maximum displacement at level $x$.

$\delta_{avg}$ = The average of the displacements at the extreme points of the structure at level $x$.

The torsional amplification factor ($A_x$) is not required to exceed 3.0.

**1610.4.4 Overturning:** The building shall be designed to resist overturning effects caused by the seismic forces determined in Section 1610.4.2. At any story, the increment of overturning moment in the story under consideration shall be distributed to the various vertical resisting elements in the same proportion as the distribution of the horizontal shears to those elements.

The overturning moments at level $x$ ($M_x$) shall be determined from the following formula:

$$M_x = \tau \sum_{i=x}^{n} F_i (h_i - h_x)$$

where:

$F_i$ = The portion of the seismic base shear ($V$) induced at level $i$.

$h_i$ and $h_x$ = The height (in feet) from the base to level $i$ or $x$.

$\tau$ = 1.0 for the top ten stories;
0.8 for the 20th story from the top and below; and
a value between 1.0 and 0.8 determined by a straight-line interpolation for stories between the tenth and 20th stories below the top.

The foundations of buildings, except inverted pendulum structures, shall be designed for the foundation overturning design moment ($M_f$) at the foundation-soil interface determined by the equation for the overturning moment at level $x$ ($M_x$) with an overturning moment reduction factor ($\tau$) of 0.75 for all *building heights*.

**1610.4.5 Drift determination and P-delta effects:** Story drifts and, where required, member forces and moments due to P-delta effects, shall be determined in accordance with Sections 1610.4.5.1 and 1610.4.5.2.

**1610.4.5.1 Story drift determination:** The design story drift ($\Delta$) shall be computed as the difference of the deflections at the top and bottom of the story under consideration. The deflections of level $x$ at the center of the mass ($\delta_x$) shall be determined in accordance with following formula:

$$\delta_x = C_d \delta_{xe}$$

where:

$C_d$ = The deflection amplification factor in Table 1610.3.3.

$\delta_{xe}$ = The deflections determined by an elastic analysis.

The elastic analysis of the seismic-resisting system shall be made utilizing the required seismic design forces of Section 1610.4.2.

For determining compliance with the story drift limitation of Section 1610.3.7, the deflections of level $x$ at the center of mass ($\delta_x$) shall be calculated as required in this section. For the purposes of this drift analysis only, the computed fundamental period ($T$) of the building is not required to include the upper bound limitation specified in Section 1610.4.1.2 when determining drift level seismic design forces.

Where applicable, the design story drift ($\Delta$) shall be increased by the incremental factor relating to the P-delta effects as determined in Section 1610.4.5.2.

**1610.4.5.2 P-delta effects:** P-delta effects on story shears and moments, the resulting member forces and moments, and the story drifts induced by these effects are not required to be considered where the stability coefficient ($\theta$),

as determined by the following formula, is equal to or less than 0.10:

$$\theta = \frac{P_x \Delta}{V_x h_{sx} C_d}$$

where:

$P_x$ = The total vertical design *load* at story level $x$. In calculating the vertical design *load* for the purpose of determining P-delta effects, individual *load* factors are not required to exceed 1.0.

$\Delta$ = The design story drift occurring simultaneously with the story shear ($V_x$).

$V_x$ = The seismic shear force between levels $x$ and $x$-1.

$h_{sx}$ = The story height below level $x$.

$C_d$ = The deflection amplification factor in Table 1610.3.3.

The stability coefficient ($\theta$) shall not exceed $\theta_{max}$ determined as follows:

$$\theta_{max} = \frac{0.5}{\beta C_d} \leq 0.25$$

where:

$\beta$ = The ratio of shear demand to shear capacity for the story between levels $x$ and $x$-1. This ratio is permitted to be considered as 1.0.

Where the stability coefficient ($\theta$) is greater than 0.10 but less than or equal to $\theta_{max}$, the incremental factor related to P-delta effects shall be determined by rational analysis. To obtain the story drift for including the P-delta effect, the design story drift determined in Section 1610.4.5.1 shall be multiplied by 1.0/(1-$\theta$).

**1610.5 Modal analysis procedure:** This section provides required standards for the modal analysis procedure of seismic analysis of buildings. Section 1610.3.5 specifies the limitations on the applicability of this procedure.

**1610.5.1 General:** The symbols in this method of analysis have the same meaning as those for similar terms used in Section 1610.4, with the subscript "$m$" denoting quantities in the $m^{th}$ mode.

**1610.5.2 Modeling:** The building shall be modeled as a system of masses lumped at the floor levels with each mass having one degree of freedom; lateral displacement in the direction under consideration.

**1610.5.3 Modes:** The analysis shall include, for each of two mutually perpendicular axes, at least the lowest three modes of vibration or all modes of vibration with periods greater than 0.4 second, whichever is greater. The number of modes shall equal the number of stories for buildings less than three stories in height.

**1610.5.4 Periods:** The required periods and mode shapes of the building in the direction under consideration shall be calculated by established methods of structural analysis for the fixed base condition utilizing the masses and elastic stiffnesses of the seismic-resisting system.

**1610.5.5 Modal base shear:** The portion of the base shear contributed by the $m^{th}$ mode ($V_m$) shall be determined from the following formula:

$$V_m = C_{sm} W_m$$

where:

$C_{sm}$ = The modal seismic design coefficient determined by the following formula.

$W_m$ = The effective modal gravity *load* determined by the following formula.

$$W_m = \frac{\left[\sum_{i=1}^{n} w_i \phi_{im}\right]^2}{\sum_{i=1}^{n} w_i \phi_{im}^2}$$

where:

$w_i$ = The portion of the total gravity *load* of the building at level $i$.

$\phi_{im}$ = The displacement amplitude at the $i^{th}$ level of the building when vibrating in its $m^{th}$ mode.

The modal seismic design coefficient ($C_{sm}$) shall be determined in accordance with the following formula:

$$C_{sm} = \frac{1.2 A_v S}{R T_m^{2/3}}$$

where:

$A_v$ = Seismic coefficient representing the effective peak velocity-related acceleration as determined in Section 1610.1.3.

$S$ = The coefficient for the soil-profile characteristics of the site as determined by Table 1610.3.1.

$R$ = The response modification factor determined from Table 1610.3.3.

$T_m$ = The modal period of vibration, in seconds, of the $m^{th}$ mode of the building.

The modal seismic design coefficient ($C_{sm}$) is not required to exceed two and one-half times the seismic coefficient representing the effective peak acceleration ($A_a$) divided by the response modification factor ($R$).

**Exceptions**

1. The limiting value of the modal seismic design coefficient ($C_{sm}$) is not applicable to Category D and E buildings with a period of 0.7 seconds or greater located on type $S_4$ soils.
2. For buildings on soil-profile characteristics $S_3$ or $S_4$, the modal seismic design coefficient ($C_{sm}$) for modes other than the fundamental mode that have periods less than 0.3 seconds is permitted to be determined by the following formula:

$$C_{sm} = \frac{A_a (1.0 + 5.0 T_m}{R}$$

3. For buildings where any modal period of vibration ($T_m$) exceeds 4.0 seconds, the modal seismic design

coefficient ($C_{sm}$) for that mode is permitted to be determined by the following formula:

$$C_{sm} = \frac{3A_vS}{RT_m^{4/3}}$$

where:

$A_a$ = Seismic coefficient representing the effective peak acceleration as determined in Section 1610.1.3.

$A_v$ = Seismic coefficient representing the effective peak velocity-related acceleration as determined in Section 1610.1.3.

$R$ = The response modification factor determined from Table 1610.3.3.

$T_m$ = The modal period of vibration, in seconds, of the $m^{th}$ mode of the building.

$S$ = The coefficient for the soil profile characteristics of the site as determined by Table 1610.3.1.

**1610.5.6 Modal forces, deflections and drifts:** The modal force ($F_{xm}$) at each level shall be determined by the following formulas:

$$F_{xm} = C_{vxm} V_m$$

$$C_{vxm} = \frac{w_x \phi_{xm}}{\sum_{i=1}^{n} w_i \phi_{im}}$$

where:

$C_{vxm}$ = The vertical distribution factor in the $m^{th}$ mode.

$V_m$ = The total design lateral force or shear at the base in the $m^{th}$ mode.

$w_i$ and $w_x$ = The portion of the total gravity *load* of the building ($W$) located or assigned to level $i$ or $x$.

$\phi_{xm}$ = The displacement amplitude at the $x^{th}$ level of the building when vibrating in the $m^{th}$ mode.

$\phi_{im}$ = The displacement amplitude at the $i^{th}$ level of the building when vibrating in the $m^{th}$ mode.

The modal deflection at each level ($\delta_{xm}$) shall be determined by the following formulas:

$$\delta_{xm} = C_d \delta_{xem}$$

$$\delta_{xem} = \left[\frac{g}{4\pi^2}\right]\left[\frac{T_m^{\,2} F_{xm}}{w_x}\right]$$

where:

$C_d$ = The deflection amplification factor determined from Table 1610.3.3.

$\delta_{xem}$ = The deflection of level $x$ in the $m^{th}$ mode at the center of the mass at level $x$ determined by an elastic analysis.

$g$ = The acceleration due to gravity (feet per second$^2$).

$T_m$ = The modal period of vibration, in seconds, of the $m^{th}$ mode of the building.

$F_{xm}$ = The portion of the seismic base shear in the $m^{th}$ mode, induced at level $x$.

$w_x$ = The portion of the total gravity *load* of the building ($W$) located or assigned to level $x$.

The modal drift in a story ($\Delta_m$) shall be computed as the difference of the deflections ($\delta_{xm}$) at the top and bottom of the story under consideration.

**1610.5.7 Modal story shears and moments:** The story shears, story overturning moments, and the shear forces and overturning moments in walls and braced frames at each level, due to the seismic forces determined from the appropriate equation in Section 1610.5.6, shall be computed for each mode by linear static methods.

**1610.5.8 Design values:** The design value for the modal base shear ($V_t$), each of the story shear, moment and drift quantities, and the deflection at each level shall be determined by combining their modal values, obtained from Sections 1610.5.6 and 1610.5.7. The combination shall be determined by taking the square root of the sum of the squares of each of the modal values.

The base shear ($V$) utilizing the equivalent lateral force procedure in Section 1610.4 shall be calculated based on a fundamental period of the building ($T$), in seconds, of 1.2 times the coefficient for the upper limit on the calculated period ($C_a$) times the approximate fundamental period of the building ($T_a$). Where the design value for the modal base shear ($V_t$) is less than the calculated base shear ($V$) utilizing the equivalent lateral force procedure, the design story shears, moments, drifts and floor deflections shall be multiplied by the following modification factor:

$$\frac{V}{V_t}$$

where:

$V$ = The equivalent lateral force procedure base shear, calculated in accordance with this section and Section 1610.4.

$V_t$ = The modal base shear, calculated in accordance with this section.

The modal base shear ($V_t$) is not required to exceed the base shear from the equivalent lateral force procedure in Section 1610.4.

**1610.5.8.1 Category D and E buildings on soil-profile type $S_4$:** In Category D and E buildings in areas with an effective peak velocity-related acceleration ($A_v$) value of 0.2 and greater with a building period of 0.7 seconds or greater located on soil-profile type $S_4$, the design base shear shall not be less than that determined utilizing the equivalent lateral force procedure in Section 1610.4, in accordance with Table 1610.3.5.3.

**1610.5.9 Horizontal shear distribution:** The distribution of horizontal shear shall be in accordance with the requirements of Section 1610.4.3.

**1610.5.10 Foundation overturning:** The foundation overturning moment at the foundation-soil interface shall not be reduced by more than 10 percent.

**1610.5.11 P-delta effects:** The P-delta effects shall be determined in accordance with Section 1610.4.5.2. The story drifts and story shears shall be determined in accordance with Section 1610.5.8.

**1610.6 Architectural, mechanical and electrical components and systems:** All components and systems, including sprinkler systems, in buildings shall be designed and constructed to resist seismic forces determined in accordance with this section.

**Exceptions**

1. Architectural components in buildings assigned to Seismic Performance Category A are exempt from the requirements of this section.
2. Mechanical and electrical components and systems in buildings assigned to Seismic Performance Category A or B are exempt from the requirements of this section.
3. Architectural, mechanical and electrical components and systems in buildings that are assigned to Seismic Performance Category B or C, are in Seismic Hazard Exposure Group 1 buildings, and have a performance criteria factor of 0.5, are exempt from the requirements of this section.
4. Elevator components and systems in buildings assigned to Seismic Performance Category A or B are exempt from the requirements of this section. Elevator components and systems in buildings that are assigned to Seismic Performance Category C and are in Seismic Hazard Exposure Group 1 buildings, are exempt from the requirements of this section.
5. Architectural, mechanical and electrical components and systems in buildings located in Seismic Hazard Groups 1 and 2, Risk Zone 1, as shown in Table 1610.1.3.

**1610.6.1 Component force application:** The component seismic force shall be applied at the center of gravity of the component nonconcurrently in any horizontal direction. Mechanical and electrical components and systems shall be designed for a nonsimultaneous vertical force of 33 percent of the horizontal force.

**1610.6.2 Component force transfer:** Components shall be attached such that the component forces are transferred to the structural system of the building. Component seismic attachments shall be positive connections without consideration of frictional resistance.

**1610.6.3 Architectural component design:** Architectural components and their attachments shall be designed for seismic forces ($F_p$) determined in accordance with the following formula:

$$F_p = A_v C_c P W_c$$

where:

$A_v$ = The coefficient representing effective peak velocity-related acceleration from Section 1610.1.3.

$C_c$ = The seismic coefficient for architectural components from Table 1610.6.3.

$P$ = Performance criteria factor from Table 1610.6.3.

$W_c$ = The weight of the architectural component.

**Exception:** The contents to be included in $W_c$ above, as required in Line 9 of Table 1610.6.3, shall not be required to exceed 50 percent of the rated capacity of steel storage rack systems, provided the columns and framing of such systems are designed and connected to act as braced or moment-resisting frames.

**Table 1610.6.3**
**ARCHITECTURAL COMPONENT SEISMIC COEFFICIENT ($C_c$) AND PERFORMANCE CRITERIA FACTOR ($P$)[a]**

| Architectural component | Component seismic coefficient ($C_c$) | Performance criteria factor ($P$) Seismic Hazard Exposure Group | | |
|---|---|---|---|---|
| | | I | II | III |
| 1. Exterior nonloadbearing walls[b] | 0.9 | 1.5 | 1.5 | 1.5 |
| 2. Interior nonloadbearing walls[b] | | | | |
| Stair and elevator enclosures | 1.5 | 1.0 | 1.0 | 1.5 |
| Other vertical shaft enclosures | 0.9 | 1.0 | 1.0 | 1.5 |
| Other nonloadbearing walls | 0.9 | 1.0 | 1.0 | 1.5 |
| 3. Cantilever elements: Parapets, chimneys or stacks | 3.0 | 1.5 | 1.5 | 1.5 |
| 4. Wall attachments | 3.0 | 1.5 | 1.5 | 1.5 |
| 5. Veneer connections | 3.0 | 0.5 | 1.0 | 1.0 |
| 6. Penthouses | 0.6 | 0.5 | 1.0 | 1.0 |
| 7. Membrane fire protection | 0.9 | 1.0 | 1.0 | 1.5 |
| 8. Ceilings | | | | |
| Fireresistance rated membrane | 0.9 | 1.0 | 1.0 | 1.5 |
| Nonfireresistance rated membrane | 0.6 | 0.5 | 1.0 | 1.0 |
| 9. Storage racks, contents included | 1.5 | 1.0 | 1.0 | 1.5 |
| 10. Access floors, supported equipment included | 2.0 | 0.5 | 1.0 | 1.5 |
| 11. Elevator and counterweight guardrails and supports | 1.25 | 1.0 | 1.0 | 1.5 |

**Note a.** See Section 1610.6 for general exceptions.
**Note b.** See Section 1610.3.6.2.8 for exterior and interior loadbearing wall requirements.

**1610.6.3.1 Exterior wall panel connections:** The connections of exterior wall panels to the building seismic-resisting system shall be designed for the design story drift determined in accordance with Section 1610.4.5.1 or in accordance with Sections 1610.5.6 and 1610.5.8.

**1610.6.3.2 Architectural component deformation:** Architectural components shall be designed for the design story drift of the structural seismic-resisting system determined in accordance with Section 1610.4.5.1 or in accordance with Sections 1610.5.6 and 1610.5.8. Architectural components shall be designed for vertical deflection due to joint rotation of cantilever structural members.

**Exception:** Architectural components having a performance criteria factor of 0.5 shall be designed for 50 percent of the design story drift.

**1610.6.3.3 Ceilings:** Provision shall be made for the lateral support and interaction of other architectural, mechanical

and electrical systems or components incorporated into the ceiling which impose seismic forces into the ceiling system.

**1610.6.4 Mechanical, electrical component and system design:** Mechanical, electrical components and systems and their attachments shall be designed for seismic forces ($F_p$) determined in accordance with the following formula:

$$F_p = A_v\, C_c\, P\, a_c\, W_c$$

where:

$A_v$ = The coefficient representing effective peak velocity-related acceleration from Section 1610.1.3.

$C_c$ = The seismic coefficient for mechanical, electrical components and systems from Table 1610.6.4(1).

$P$ = Performance criteria factor from Table 1610.6.4(1).

$a_c$ = The attachment amplification factor determined in accordance with Table 1610.6.4(2).

$W_c$ = The operating weight of the mechanical, electrical component or system.

Alternatively, the seismic forces ($F_p$) shall be determined by a properly substantiated dynamic analysis subject to approval.

**Exception:** Bracing of fire *sprinkler systems* shall be permitted to be in accordance with NFPA 13 listed in Chapter 35 in buildings sited where the effective peak velocity-related acceleration ($A_v$) is less than 0.20 in accordance with Section 1610.1.

**1610.6.4.1 Component period:** The fundamental period of the component and its attachments ($T_C$ ), in seconds, shall be determined by the following formula:

$$T_c = 0.32\sqrt{\frac{W_c}{K}}$$

where:

$W_c$ = Weight of the component (lbs.).

For stable resilient-mounting attachments:

$K$ = Spring stiffness constant (lb./in.).

For other resilient-mounting attachments:

$K$ = Slope of the *load* versus deflection curve (lb./in.) at the point of *loading*.

Alternatively, the fundamental period of the component ($T_C$), in seconds, shall be determined by experimental test data or by a properly substantiated analysis.

**1610.6.4.2 Component attachment:** Systems, components and the means of their attachment shall be designed to accommodate relative seismic displacements between points of support. Displacements at points of support shall be determined in accordance with Section 1610.4.5 or 1610.5.8. Relative lateral displacements at points of support shall be determined considering the difference in elevation between the supports and considering full out-of-phase displacements across portions of the building that are capable of moving in a differential manner such as at seismic and expansion joints. Anchor bolts shall be designed for combined shear and tension. Restraining devices shall be provided to limit the horizontal and vertical motions, to prevent component resonance and to prevent overturning.

**Table 1610.6.4(1)**
**MECHANICAL, ELECTRICAL COMPONENT AND SYSTEM SEISMIC COEFFICIENT ($C_c$) AND PERFORMANCE CRITERIA FACTOR ($P$)[a]**

| Mechanical, electrical component or system | Component or system seismic coefficient ($C_c$) | Performance criteria factor ($P$) Seismic Hazard Exposure Group | | |
|---|---|---|---|---|
| | | I | II | III |
| 1. Fire protection equipment and systems | 2.0 | 1.5 | 1.5 | 1.5 |
| 2. Emergency or standby electrical systems | 2.0 | 1.5 | 1.5 | 1.5 |
| 3. Elevator drive, suspension system and controller anchorage | 1.25 | 1.0 | 1.0 | 1.5 |
| 4. General equipment<br>A. Boilers, furnaces, incinerators, water heaters and other equipment utilizing combustible energy sources or high-temperature energy sources<br>B. Communication systems<br>C. Electrical bus ducts and primary cable systems[b]<br>D. Electrical motor control centers, motor control devices, switchgear, transformers and unit substations<br>E. Reciprocating or rotating equipment<br>F. Tanks, heat exchangers and pressure vessels | 2.0 | 0.5 | 1.0 | 1.5 |
| 5. Manufacturing and process machinery | 0.67 | 0.5 | 1.0 | 1.5 |
| 6. Pipe systems<br>Gas and high-hazard piping<br>Fire suppression piping<br>Other pipe systems[c] | <br>2.0<br>2.0<br>0.67 | <br>1.5<br>1.5<br>0.5 | <br>1.5<br>1.5<br>1.0 | <br>1.5<br>1.5<br>1.5 |
| 7. HVAC ducts[d] | 0.67 | 0.5 | 1.0 | 1.5 |
| 8. Electrical panel boards | 0.67 | 0.5 | 1.0 | 1.5 |
| 9. Lighting fixtures[e] | 0.67 | 0.5 | 1.0 | 1.5 |

**Note a.** See Section 1610.6 for general exceptions.

**Note b.** Electrical conduit seismic restraints are not required for any one of the following conditions:

1. Conduit suspended by individual hangers 12 inches (305 mm) or less in length from the top of the conduit to the supporting structure.
2. Conduit which has less than $2^1/_2$ inches inside diameter.

**Note c.** Seismic restraints are not required for any one of the following conditions for other pipe systems:

1. Piping suspended by individual hangers 12 inches (305 mm) or less in length from the top of the pipe to the supporting structure.
2. Piping in boiler and mechanical rooms which has less than $1^1/_4$ inches inside diameter.
3. Piping in other areas which has less than $2^1/_2$ inches inside diameter.

**Note d.** Seismic restraints are not required for any one of the following conditions for HVAC ducts:

1. Ducts suspended by hangers 12 inches (305 mm) or less in length from the top of the duct to the supporting structure.
2. Ducts which have a cross-sectional area less than 6 square feet (.56 $m^2$).

**Note e.** Pendulum lighting fixtures shall be designed based on a component seismic coefficient ($C_c$) of 1.5. The vertical support shall be designed with a factor of safety of 4.0.

**Table 1610.6.4(2)**
**ATTACHMENT AMPLIFICATION FACTOR ($a_c$)**

| Component mounting system | Attachment amplification factor ($a_c$) |
|---|---|
| Fixed or direct connection | 1.0 |
| Resilient-mounting system | |
| Seismic-activated restraining device | 1.0 |
| Elastic restraining device where: | |
| $\frac{T_c}{T} < 0.6$ or $\frac{T_c}{T} > 1.4$[a] | 1.0 |
| $\frac{T_c}{T} \geq 0.6$ or $\frac{T_c}{T} \leq 1.4$[a] | 2.0 |

**Note a.** $T$ is the fundamental period of the building, in seconds, determined by Section 1610.4.1.2 or Section 1610.5.4. $T_c$ is the fundamental period, in seconds, of the component and its attachment determined by Section 1610.6.4.1.

**1610.6.4.3 Component certification:** Where direct component attachment is utilized for components with performance criteria factors ($P$) of 1.0 or greater, in buildings assigned an effective peak velocity-related acceleration ($A_v$) equal to or greater than 0.15 per Section 1610.1, the manufacturer's certification of the component seismic acceleration operational capacity which meets the requirements of Section 1610.6.4 shall be submitted to the code official.

**1610.6.5 Elevator design requirements:** The design and construction of elevators and elevator components in buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1, shall comply with the requirements in Appendix F of ASME A17.1 listed in Chapter 35.

## SECTION 1611.0 LATERAL SOIL LOADS

**1611.1 General**: Foundation walls and retaining walls shall be designed to resist *lateral soil loads*. In the absence of a geotechnical soil analysis, the *soil loads* of Table 1611.1 shall be the design *lateral soil load*.

**1611.1.1 Soil moisture:** The design *lateral soil loads* in Table 1611.1 are for moist conditions for the specified soils at their optimum densities. Submerged or saturated soil pressures shall include the weight of the buoyant soil plus the hydrostatic *loads*.

**Table 1611.1**
**SOIL LATERAL LOAD**

| Soil description | Unified soil classification | Design lateral soil load (pounds per square foot per foot of depth)[b] |
|---|---|---|
| Well-graded, clean gravels; gravel-sand mixes | GW | 30 |
| Poorly graded clean gravels; gravel-sand mixes | GP | 30 |
| Silty gravels, poorly graded gravel-sand mixes | GM | 41 |
| Clayey gravels, poorly graded gravel-sand-clay mixes | GC | 46 |
| Well-graded, clean sands; gravelly-sand mixes | SW | 30 |
| Poorly graded clean sands; sand-gravel mixes | SP | 30 |

**Table 1611.1 (cont'd.)**
**SOIL LATERAL LOAD**

| Soil description | Unified soil classification | Design lateral soil load (pounds per square foot per foot of depth)[b] |
|---|---|---|
| Silty sands, poorly graded sand-silt mixes | SM | 41 |
| Sand-silt clay mix with plastic fines | SM-SC | 44 |
| Clayey sands, poorly graded sand-clay mixes | SC | 48 |
| Inorganic silts and clayey silts | ML | 45 |
| Mixture of inorganic silt and clay | ML-CL | 44 |
| Inorganic clays of low to medium plasticity | OL | 45 |
| Organic silts and silt-clays, low plasticity | OL | Note a |
| Inorganic clayey silts, elastic silts | MH | 55 |
| Inorganic clays of high plasticity | CH | Note a |
| Organic clays and silty clays | OH | Note a |

**Note a.** Soil shall be replaced with controlled backfill.
**Note b.** 1 pound per square foot = 47.9 Pa; 1 foot = 304.8 mm.

## SECTION 1612.0 SPECIAL LOADS

**1612.1 General:** Provisions shall be made for all special *loads* herein prescribed and all other special *loads* to which the building or structure is subjected. *

**1612.2 Hydrostatic uplift:** All foundation slabs and other footings subjected to water pressure shall be designed to resist a uniformly distributed uplift equal to the full hydrostatic pressure. All foundation slabs, footings and walls of buildings located in flood-hazard zones (A Zones) and high-hazard zones (V Zones) according to Section 3107.0 shall be designed to resist uplift and lateral loads associated with hydrostatic pressure resulting from flooding to the base flood elevation. The loads shall be determined in accordance with Section 5 of ASCE 7 listed in Chapter 35.

**1612.3 Hydrodynamic loads:** For buildings located in flood-hazard zones (A Zones) or high-hazard zones (V Zones) according to Section 3107.0, all structural components located below the base flood elevation shall be designed to resist hydrodynamic forces resulting from velocity waters during flooding to the base flood elevation. The loads shall be determined in accordance with Section 5 of ASCE 7 listed in Chapter 35.

**1612.4 Flood loads:** Buildings and structures located in flood-hazard zones (A Zones) and high-hazard zones (V zones) as defined on the flood hazard map (see Section 3107.2.1) shall be designed, constructed, connected and anchored to resist flood loads. Flood loads shall be determined in accordance with Section 5.3 of ASCE 7 listed in Chapter 35.

**1612.5 Construction loads and erection stresses:** Provisions shall be made for temporary construction loads which occur during the erection of the building; and all structural members and connections shall be designed and erected so as to prevent overstressing during construction. *

## SECTION 1613.0 COMBINATION OF LOADS

**1613.1 General:** Combinations of structural loads shall be as provided for in Section 2 of ASCE 7 listed in Chapter 35. Where

allowable stresses are increased for seismic design in accordance with Sections 1903.1.1, 2101.2, 2203.2 and 2206.0, load combinations in Section 2.3, Combining Factored Loads Using Strength Design, of ASCE 7 listed in Chapter 35 shall be utilized.

*

## SECTION 1614.0 EXISTING BUILDINGS

**1614.1 General:** Existing structures to which *additions* are being made or undergoing repair, or a *change of occupancy*, shall comply with Sections 1614.2 through 1614.5.

**1614.2 Additions:** The *addition* to an existing structure shall not increase the forces in any structural element of the existing structure by more than 5 percent, unless the increased forces on the element are still in compliance with this code for new structures. The *addition* shall not decrease the strength of any structural element of the existing structure to less than that required by this code for new structures.

**1614.3 Repairs:** Where repairs are made to structural elements of an existing structure, and uncovered structural elements are found to be unsound or otherwise structurally deficient, such elements shall be made to conform to the requirements for new structures.

**1614.4 Existing live load:** Where an existing structure heretofore approved is *altered* or repaired, the minimum design *loads* for the structure shall be the *loads* applicable at the time of erection, provided that the public safety is not endangered thereby.

**1614.5 Change of occupancy:** Any existing structure heretofore approved, in which there is not a *change of occupancy* to an occupancy requiring greater floor *live loads*, is permitted to be continued in use for the originally approved *live loads*, provided that the structure is structurally safe and adequate for the proposed occupancy, and the public safety is not endangered thereby. If the approved *live load* is less than required by Section 1606.0, the areas designed for the reduced *live load* shall be posted with the approved *load*. Placards shall be of an approved design.

# CHAPTER 17

# STRUCTURAL TESTS AND INSPECTIONS

## SECTION 1701.0 GENERAL

**1701.1 Scope:** The provisions of this chapter shall govern the quality, workmanship and requirements for all materials hereafter used in the construction of buildings and structures. All materials of construction and tests shall conform to the applicable standards listed in this code.

**1701.2 New materials:** All new building materials, equipment, appliances, systems or methods of construction not provided for in this code, and any material of questioned suitability proposed for use in the construction of a building or structure, shall be subjected to the tests prescribed in this chapter and in the *approved rules* to determine character, quality and limitations of use.

**1701.3 Used materials:** The use of all second-hand materials which meet the minimum requirements of this code for new materials shall be permitted.

## SECTION 1702.0 DEFINITIONS

**1702.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Approved agency:*** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved (see Section 1704.0).

***Fabricated item:*** Structural, loadbearing or lateral *load*-resisting assemblies consisting of materials assembled prior to installation in a building or structure, or subjected to operations such as heat treatment, thermal cutting, cold working or reforming after manufacture and prior to installation in a building or structure. Materials produced in accordance with standard specifications referenced by this code, such as rolled structural steel shapes, steel-reinforcing bars, masonry units and plywood sheets, shall not be considered "fabricated items."

***Inspection certificate:*** An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency which indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1704.3 and also Mark, Manufacturer's designation and Label).

***Inspection, special:*** Inspection as herein required of the installation, fabrication, erection or placement of components and connections requiring special expertise to ensure adequacy (see Sections 114.0 and 1705.0).

***Label:*** An identification applied on a product by the manufacturer which contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency and which indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 1704.3 and also Mark, Manufacturer's designation and Inspection certificate).

***Manufacturer's designation:*** An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also Mark, Label and Inspection certificate.)

***Mark:*** An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also Manufacturer's designation, Label and Inspection certificate.)

## SECTION 1703.0 INFORMATION REQUIRED

**1703.1 Material performance:** Where the quality of materials is essential for conformance to this code, specific information shall be given to establish such quality; and this code shall not be cited, or the term "legal" or the term's equivalent be used as a substitute for specific information. This information shall consist of test reports conducted by an *approved testing agency* in accordance with the standards referenced in Chapter 35, or other such information as necessary for the code official to determine that the material meets the applicable code requirements.

**1703.1.1 Labeling:** Where materials or assemblies are required by this code to be *labeled*, such materials and assemblies shall be *labeled* by an *approved agency* in accordance with Section 1704.0.

**1703.2 Research and investigation:** Sufficient technical data shall be submitted to substantiate the proposed use of any material or assembly. If it is determined that the evidence submitted is satisfactory proof of performance for the use intended, the code official shall approve the use of the material or assembly subject to the requirements of this code. The cost of all tests, reports and investigations required under these provisions shall be paid by the permit applicant.

**1703.2.1 Research reports:** Supporting data, where necessary to assist in the approval of all materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

**1703.3 Evaluation and follow-up inspection services:** Prior to the approval of a closed prefabricated assembly, the permit applicant shall submit an evaluation report of each prefabricated assembly. The report shall indicate the complete details of the assembly, including a description of the assembly and the assembly's components, the basis upon which the assembly is being evaluated, test results and similar information, and other data as necessary for the code official to determine conformance to this code.

**1703.3.1 Evaluation service:** The code official shall review evaluation reports from approved sources for adequacy and conformance to the code.

**1703.3.2 Follow-up inspection:** The owner shall provide for *special inspections* of *fabricated items* in accordance with Section 1705.2.

**1703.3.3 Test and inspection records:** Copies of all necessary test and inspection records shall be filed with the code official.

## SECTION 1704.0 APPROVALS

**1704.1 Written approval:** Any material, appliance, equipment, system or method of construction meeting the requirements of this code shall be approved in *writing* within a reasonable time after satisfactory completion of all the required tests and submission of required test reports.

**1704.2 Approved record:** For any material, appliance, equipment, system or method of construction that has been approved, a record of such approval, including all of the conditions and limitations of the approval, shall be kept on file in the code official's office and shall be open to public inspection at all appropriate times.

**1704.3 Labeling:** Products and materials required to be *labeled* shall be *labeled* in accordance with the procedures set forth in Sections 1704.3.1 through 1704.3.3.

**1704.3.1 Testing:** An *approved agency* shall test a representative sample of the product or material being *labeled* to the relevant standard or standards. The *approved agency* shall maintain a record of all of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

**1704.3.2 Inspection and identification:** The *approved agency* shall periodically perform an inspection, which shall be in-plant if necessary, of the product or material that is to be *labeled*. The inspection shall verify that the *labeled* product or material is representative of the product or material tested.

**1704.3.2.1 Independent:** The *agency* to be approved shall be objective and competent. The *agency* shall also disclose all possible conflicts of interest so that objectivity can be confirmed.

**1704.3.2.2 Equipment:** An *approved agency* shall have adequate equipment to perform all required tests. The equipment shall be periodically calibrated.

**1704.3.2.3 Personnel:** An *approved agency* shall employ experienced personnel educated in conducting, supervising and evaluating tests.

**1704.3.3 Label information:** The *label* shall contain the manufacturer's or distributor's identification, model number, serial number, or definitive information describing the product or material's performance characteristics and *approved agency's* identification.

**1704.4 Heretofore-approved materials:** The use of any material already *fabricated* or of any construction already erected, which conformed to requirements or approvals heretofore in effect, shall be permitted to continue, if not detrimental to life, health or safety of the public.

## SECTION 1705.0 SPECIAL INSPECTIONS

**1705.1 General:** The owner shall provide *special inspections* as required by this section. The special inspectors required by Sections 1705.1 through 1705.12 shall apply to seismic-related construction only, and this section shall not be mandatory for any other permit or construction. The special inspectors shall be provided by the permit applicant and shall be qualified and approved for the inspection of the work described herein.

**Exceptions**

1. *Special inspections* are not required for work of a minor nature or where warranted by conditions approved by the code official.
2. *Special inspections* are not required for building components unless the design involves the practice of professional engineering or architecture as defined by KRS Chapters 322 and 323.
3. *Special inspections* are not required for occupancies in Use Group R-3 or R-4.
4. Buildings located in Risk Zone 1, which are not required to be designed by a design professional.

**1705.1.1 Building permit requirement:** The permit applicant shall submit a statement of *special inspections* prepared by the registered design professional in responsible charge in accordance with Section 114.2.1 as a condition for permit issuance. This statement shall include a complete list of materials and work requiring *special inspection* by this section, the *inspections* to be performed and a list of the individuals, *approved agencies* and firms intended to be retained for conducting such inspections.

**1705.1.2 Report requirement:** Special inspectors shall keep records of all *inspections*. The special inspector shall furnish *inspection* reports to the code official, and to the *registered design professional* in responsible charge. All discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the code official and to the *registered design professional* in responsible charge prior to the completion of that phase of the work. A final report of *inspections* documenting completion of all required *special inspections* and correction of any discrepan-

cies noted in the *inspections* shall be submitted prior to the issuance of a certificate of occupancy. Interim reports shall be submitted periodically at a frequency agreed upon by the permit applicant and the code official prior to the start of work.

**1705.2 Inspection of fabricators:** Where fabrication of structural loadbearing members and assemblies is being performed on the premises of a fabricator's shop, *special inspection* of the *fabricated items* shall be required. The *fabricated items* shall be *inspected* as required by this section and as required elsewhere in this code.

**1705.2.1 Fabrication procedures:** The special inspector shall verify that the fabricator maintains detailed fabrication and quality control procedures which provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved drawings, project specifications and referenced standards. The special inspector shall review the procedures for completeness and adequacy relative to the code requirements for the fabricator's scope of work.

**1705.2.2 Procedures implementation:** The special inspector shall verify that the fabricator is properly implementing the fabrication and quality control procedures outlined in Section 1705.2.1.

**Exception:** *Special inspections* as required by Section 1705.2 shall not be required where the fabricator maintains an agreement with an *approved independent inspection or quality control agency* to conduct periodic in-plant *inspections* at the fabricator's plant, at a frequency that will assure the fabricator's conformance to the requirements of the *inspection agency's* approved quality control program.

**1705.3 Steel construction:** The *special inspections* for steel elements of buildings and structures shall be as required by Sections 1705.3.1 through 1705.3.3.

**1705.3.1 Inspection of steel fabricators:** The permit applicant shall provide *special inspection* of steel *fabricated items* in accordance with the provisions of Section 1705.2.

**Exception:** *Special inspection* of the steel fabrication process shall not be required where the fabricator does not perform any welding, thermal cutting or heating operation of any kind as part of the fabrication process. In such cases, the fabricator shall be required to submit a detailed procedure for material control which demonstrates the fabricator's ability to maintain suitable records and procedures such that, at any time during the fabrication process, the material specification, grade and mill test reports for the main stress-carrying elements and bolts are capable of being determined.

**1705.3.2 Material receiving:** All main stress-carrying elements, welding material and bolting material shall be *inspected* for conformance to Table 1705.3.2.

**1705.3.3 Erection:** *Special inspections* are required for bolts, welding and details as specified in Sections 1705.3.3.1 through 1705.3.3.3.

**1705.3.3.1 Installation of high-strength bolts:** *Inspection* shall be as specified in Section 9 of the RCSC *Specification for Structural Joints Using A325 or A490 Bolts* listed in Chapter 35.

**Table 1705.3.2**
**INSPECTION FOR STEEL MATERIALS**

| Material | Inspection required | Reference[a] for criteria |
|---|---|---|
| Bolts, nuts, washers | 1. Material identification markings.<br>2. Conformance to ASTM standards specified by the design engineer. Manufacturer's designation (certificate of compliance) is required. | Applicable ASTM material specifications; AISC ASD, Section A3.4; AISC LRFD, Section A3.3 |
| Structural steel | 1. Material identification markings.<br>2. Conformance to ASTM standards specified in the approved plans and specifications. | ASTM A6 or ASTM A588<br><br>Provide certified test reports in accordance with ASTM A6 or ASTM A568 |
| Weld filler materials | 1. Conformance to AWS specification as specified in the approved plans and specifications. Manufacturer's designation (certificate of compliance) is required. | AISC ASD, Section A3.6; AISC LRFD, Section A3.5 |

**Note a.** The specific standards referenced are those listed in Chapter 35.

**1705.3.3.2 Welding:** Weld *inspection* shall be in compliance with Section 6 of AWS D1.1 listed in Chapter 35. Weld inspectors shall be certified in accordance with AWS D1.1 listed in Chapter 35.

**1705.3.3.2.1 Welding of the structural seismic-resisting system:** Welding of the structural seismic-resisting system of buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7, shall be inspected in accordance with Sections 1705.3.3.2.2 and 1705.3.3.2.3. Each complete penetration groove weld in joints and splices shall be tested for the full length of the weld either by ultrasonic testing or by other approved methods, for special moment frames and eccentrically braced frames.

**Exception:** The nondestructive testing rate for welds made by an individual welder is permitted to be reduced to 25 percent of the welds, with the approval of the *registered design professional* responsible for the structural design, provided the weld inspection reject rate is 5 percent or less.

**1705.3.3.2.2 Column splice welds:** Column splice welds, which are partial penetration groove welds, shall be tested by ultrasonic testing or other approved methods at a percentage rate established by the *registered design professional* responsible for the structural design. All partial penetration column splice welds designed for axial or flexural tension from seismic forces shall be tested.

**1705.3.3.2.3 Base metal testing:** Base metal having a thickness more than $1^1/_2$ inches (38 mm) and subject to through-thickness weld shrinkage strains shall be ultrasonically tested for discontinuities behind and adjacent to the welds after joint welding. Any material discontinuities shall be evaluated based on the criteria estab-

lished in the *construction documents* by the *registered design professional* responsible for the structural design.

**1705.3.3.3 Details:** The special inspector shall perform an *inspection* of the steel frame to verify compliance with the details shown on the approved *construction documents*, such as bracing, stiffening, member locations and proper application of joint details at each connection.

**1705.4 Concrete construction:** The *special inspections* for concrete elements of buildings and structures and concreting operations shall be as required by Sections 1705.4.1 through 1705.4.7.

**Exception:** *Special inspections* shall not be required for:

1. Concrete footings of buildings three stories or less in height which are fully supported on earth or rock.
2. Nonstructural concrete slabs supported directly on the ground, including prestressed slabs on grade, where the effective prestress in the concrete is less than 150 psi (0.11 kg/mm$^2$).
3. Plain concrete foundation walls constructed in accordance with Table 1812.3.2.
4. Concrete patios, driveways and sidewalks, on grade.

**1705.4.1 Materials:** In the absence of sufficient data or documentation providing evidence of conformance to quality standards for materials in Chapter 3 of ACI 318 listed in Chapter 35, the code official shall require testing of materials in accordance with the appropriate standards and criteria for the material in Chapter 3 of ACI 318 listed in Chapter 35. Weldability of reinforcement, except that which conforms to ASTM A706 listed in Chapter 35, shall be determined in accordance with the requirements of Section 1906.5.2.

**1705.4.2 Installation of reinforcing and prestressing steel:** The location and installation details of reinforcing and prestressing steel shall be *inspected* for compliance with the approved *construction documents* and ACI 318 (such as Sections 7.4, 7.5, 7.6 and 7.7) listed in Chapter 35. Welding of reinforcing of the structural seismic-resisting system shall be inspected for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7.

**1705.4.3 Formwork:** Forms for concrete, if used, shall be *inspected* for compliance with Section 6.1 of ACI 318 listed in Chapter 35, and with any additional design requirements indicated on the approved *construction documents*. *Inspection* of form removal and reshoring shall be conducted to verify compliance with Section 6.2 of ACI 318 listed in Chapter 35.

**1705.4.4 Concreting operations:** During placing and curing of concrete, the *special inspections* listed in Table 1705.4.4 shall be performed.

**1705.4.5 Inspection during prestressing:** *Inspection* during the application of prestressing forces shall be performed to determine compliance with Section 18.18 of ACI 318 listed in Chapter 35.

**1705.4.5.1 Inspection during grouting:** In buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7, inspection during the grouting of bonded prestressing tendons in the structural seismic-resisting system shall be performed.

**Table 1705.4.4**
**REQUIRED INSPECTIONS DURING CONCRETING**

| Required inspection | Reference[a] for criteria |
|---|---|
| 1. Evaluation of concrete strength, except as exempted by Section 1908.3.1(3) of this code. | ACI 318 Section 5.6 |
| 2. Inspection for use of proper mix proportions and proper mix techniques. | ACI 318 Chapter 4, Sections 5.2, 5.3, 5.4 and 5.8 |
| 3. Inspection during concrete placement, for proper application techniques. | ACI 318 Sections 5.9 and 5.10 |
| 4. Inspection for maintenance of specified curing temperatures and techniques. | ACI 318 Sections 5.11, 5.12 and 5.13 |

**Note a.** ACI 318 listed in Chapter 35.

**1705.4.6 Manufacture of precast concrete:** The manufacture of precast concrete, as required by Section 1705.2, shall be subject to a quality control program administered by an *approved agency*.

**1705.4.7 Erection of precast concrete:** Erection of precast concrete shall be *inspected* for compliance with the approved plans and erection drawings.

**1705.5 Masonry construction:** The *special inspections* listed in Table 1705.5 shall be required for masonry construction where masonry is designed in accordance with ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**Table 1705.5**
**SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION**

| Inspection or test | Referenced[a] criteria | |
|---|---|---|
| | ACI 530/ ASCE 5/ TMS 402 | ACI 530.1/ ASCE 6/ TMS 602 |
| 1. Material | | Sec. 2.3 |
| 2. Masonry strength | | Sec. 1.4 |
| 3. Construction operations: a. Proportioning, mixing consistency of mortar and grout | | Sec. 2.6 |
| b. Application of mortar and grout; installation of masonry units | | Sec. 3.2 Sec. 3.5 |
| c. Condition, size, location and spacing of reinforcement | Chapter 8 | |
| d. Protection of masonry during cold weather (temperature below 40 degrees F.) or hot weather (temperature above 100 degrees F.) | | Sec. 1.8 |
| e. Anchorage | Sec. 4.2 Sec. 5.14 | |
| 4. Inspection of welding of reinforcement, grouting, consolidation and reconsolidation for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7. | Note b | Note b |

**Note a.** The specific standards referenced are those listed in Chapter 35.
**Note b.** Referenced criteria not applicable.

**1705.6 Wood construction:** *Special inspections* of the fabrication process of wood structural elements and assemblies shall be

in accordance with Section 1705.2. *Special inspection* is required for nailing, bolting, structural gluing or other fastening of the structural seismic-resisting system of buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7.

**1705.7 Prepared fill:** The *special inspections* for prepared fill shall be as required by Sections 1705.7.1 through 1705.7.3. The approved report, required by Section 1804.1, shall be used to determine compliance.

**1705.7.1 Site preparation:** Prior to placement of the prepared fill, the special inspector shall determine that the site has been prepared in accordance with the approved report.

**1705.7.2 During fill placement:** During the placement and compaction of the fill material, the special inspector shall determine that the material being used and the maximum lift thicknesses comply with the approved report.

**1705.7.3 Evaluation of in-place density:** The special inspector shall determine, at the approved frequency, that the in-place dry density of the compacted fill complies with the approved report.

**1705.8 Pile foundations:** *Special inspections* of pile foundations are required as provided for in Section 1816.13 of this code.

**1705.9 Pier foundations:** *Special inspection* is required for pier foundations of buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7.

**1705.10 Wall panels and veneers:** *Special inspection* is required for exterior and interior architectural wall panels and the anchoring of veneers for buildings assigned to Seismic Performance Category E, in accordance with Section 1610.1.7.

**1705.11 Mechanical and electrical components:** Mechanical and electrical components that are located in buildings assigned to Seismic Performance Category E shall be inspected, tested and certified as required by this section, in accordance with Section 1610.1.7.

**1705.11.1 Component inspection:** *Special inspection* is required for the installation of the following components where the component has a performance criteria factor of 1.0 or 1.5 in accordance with Section 1610.6.4.

1. Equipment using combustible energy sources.
2. Electrical motors, transformers, switchgear unit substations and motor control centers.
3. Reciprocating and rotating-type machinery.
4. Piping distribution systems, 3 inches and larger.
5. Tanks, heat exchangers and pressure vessels.

**1705.11.2 Component and attachment testing:** The component manufacturer shall test or analyze the component and the component mounting system or anchorage for the design forces in Section 1610.6.4 for those components having a performance criteria factor of 1.0 or 1.5 in accordance with Section 1610.6.4. The manufacturer shall submit a certificate of compliance for review and acceptance by the *registered design professional* responsible for the design, and for approval by the code official. The basis of certification shall be by test on a shaking table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces from Section 1610.6.4 or by more rigorous analysis. The special inspector shall inspect the component and verify that the *label*, anchorage or mounting conform to the certificate of compliance.

**1705.11.3 Component manufacturer certification:** Each manufacturer of equipment to be placed in a building assigned to Seismic Performance Category E, in accordance with Section 1610.1.7, where the equipment has a performance criteria factor of 1.0 or 1.5 in accordance with Section 1610.6.4, shall maintain an approved quality control program. Evidence of the quality control program shall be permanently identified on each piece of equipment by a label.

**1705.12 Sprayed cementitious and mineral fiber fireresistive materials:** Special inspections for sprayed cementitious and mineral fiber fireresistive materials applied to structural elements and decks shall be in accordance with Sections 1705.12.1 through 1705.12.5. Special inspections shall be based upon the fireresistance design as designated in the approved construction documents.

**1705.12.1 Structural member surface conditions:** The surfaces shall be prepared in accordance with the approved fireresistance design and the approved manufacturer's written instructions. The prepared surface of all structural members to be sprayed shall be inspected before the application of the sprayed fireresistive material.

**1705.12.2 Application:** The substrate shall have a minimum ambient temperature before and after application as specified in the approved manufacturer's written instructions. The area for application shall be ventilated during and after application as required by the approved manufacturer's written instructions.

**1705.12.3 Thickness:** The thickness of the sprayed cementitious and mineral fiber fireresistive materials applied to structural elements shall not be less than the thicknesses required by the approved fireresistance design. Thickness shall be determined by an approved method. Samples of the sprayed cementitious and mineral fiber fireresistive materials shall be selected in accordance with Sections 1705.12.3.1 and 1705.12.3.2.

**1705.12.3.1 Floor, roof and wall assemblies:** The thickness of the sprayed cementitious and mineral fiber fireresistive material applied to the underside of floor, roof and wall assemblies shall be determined by taking the average of ten measurements in a 144-square-inch (0.093 $m^2$) sample area, having a minimum width of 6 inches (152 mm), for each 1,000 square feet (93 $m^2$) of the sprayed area on each floor or part thereof.

**1705.12.3.2 Structural frame members:** The thickness of the sprayed cementitious and mineral fiber fireresistive material applied to structural members shall be determined by taking nine measurements at a single cross section for structural frame beams or girders, seven measurements at a single cross section for joists and trusses and twelve measurements at single cross section for columns. Thickness testing shall be performed on 25 percent of the structural members on each floor.

**1705.12.4 Density:** The density of the sprayed cementitious and mineral fiber fireresistive material shall not be less than the density specified in the approved fireresistance design. Density of the sprayed cementitious and mineral fiber fireresistive material shall be determined by an approved method at the frequency specified in Sections 1705.12.3.1 and 1705.3.2.

**1705.12.5 Bond strength:** The cohesive/adhesive bond strength of the cured sprayed cementitious and mineral fiber fireresistive material applied to structural elements shall not be less than the cohesive/adhesive bond strength specified in the approved fireresistance design. The cohesive/adhesive bond strength shall be determined by taking samples of the sprayed cementitious and mineral fiber fireresistive material as specified in Sections 1705.12.3.1 and 1705.12.3.2.

**1705.13 Exterior insulation and finish systems (EIFS):** Special inspections are required for field application of EIFS and prefabricated EIFS panels (see Section 1405.8).

**1705.14 Special cases:** *Special inspections* shall be required for proposed work which is, in the opinion of the code official, unusual in its nature, such as:

1. Construction of materials and systems which are alternatives to materials and systems prescribed by this code.
2. Unusual design applications of materials described in this code.
3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in this code or in standards referenced by this code.

## SECTION 1706.0 DESIGN STRENGTHS OF MATERIALS

**1706.1 Conformance to standards:** The design strengths and permissible stresses of any structural material that is identified by a manufacturer's designation as to manufacture and grade by mill tests, or the strength and stress grade is otherwise confirmed to the satisfaction of the code official, shall conform to the specifications and methods of design of accepted engineering practice or the *approved rules* in the absence of applicable standards.

**1706.2 New materials:** For materials which are not specifically provided for in this code, the design strengths and permissible stresses shall be established by tests as provided for in Sections 1708.0 and 1709.0.

## SECTION 1707.0 ALTERNATIVE TEST PROCEDURE

**1707.1 General:** In the absence of *approved rules* or other approved standards, the code official shall make, or cause to be made, the necessary tests and investigations; or the code official shall accept duly authenticated reports from *approved agencies* in respect to the quality and manner of use of new materials or assemblies as provided for in Section 106.0. The cost of all tests and other investigations required under the provisions of this code shall be borne by the permit applicant.

## SECTION 1708.0 TEST SAFE LOAD

**1708.1 Where required:** Where proposed construction is not capable of being designed by approved engineering analysis, or where proposed construction design method does not comply with the applicable material design standard listed in Chapter 35, the system of construction or the structural unit and the connections shall be subjected to the tests prescribed in Section 1710.0. The code official shall accept certified reports of such tests conducted by an *approved testing agency*, provided that such tests meet the requirements of this code and approved procedures.

## SECTION 1709.0 IN-SITU LOAD TESTS

**1709.1 General:** Whenever there is a reasonable doubt as to the stability or loadbearing capacity of a completed building, structure or portion thereof for the expected *loads*, an engineering assessment shall be required. The engineering assessment shall involve either a structural analysis or an in-situ load test, or both. The structural analysis shall be based upon actual material properties and other as-built conditions which affect stability or loadbearing capacity, and shall be conducted in accordance with the applicable design standard listed in Chapter 35. If the structural assessment determines that the loadbearing capacity is less than that required by the code, load tests shall be conducted in accordance with Section 1709.2. If the building, structure or portion thereof is found to have inadequate stability or loadbearing capacity for the expected *loads*, modifications to ensure structural adequacy or the removal of the inadequate construction shall be required.

**1709.2 Test standards:** All structural components and assemblies shall be tested in accordance with the appropriate material standards listed in Chapter 35. In the absence of a standard listed in Chapter 35 that contains an applicable load test procedure, the test procedure shall be developed by a *registered design professional* and approved. The test procedure shall simulate the *loads* and conditions of application that the completed structure or portion thereof will be subjected to in normal use.

**1709.3 In-situ load tests:** All in-situ load tests shall be conducted in accordance with Section 1709.3.1 or 1709.3.2 and shall be supervised by a *registered design professional*. The test shall simulate the applicable *loading* conditions specified in Chapter 16 as necessary to address the concerns regarding structural stability of the building, structure or portion thereof.

**1709.3.1 Load test procedure specified:** Where a standard listed in Chapter 35 contains an applicable load test procedure and acceptance criteria, the test procedure and acceptance criteria in the standard shall apply. In the absence of specific *load* factors or acceptance criteria, the *load* factors and acceptance criteria in Section 1709.3.2 shall apply.

**1709.3.2 Load test procedure not specified:** In the absence of applicable load test procedures contained within a standard referenced by this code or acceptance criteria for a specific material or method of construction, such existing structure shall be subjected to a test load equal to two times the design *load*. The test load shall be left in place for a period of 24 hours. The structure shall be considered to have met successfully the test requirements if all of the following criteria are satisfied:

1. Under the design *load*, the deflection shall not exceed the limitations specified in Section 1604.5;

2. Within 24 hours after removal of the test load, the structure shall have recovered not less than 75 percent of the maximum deflection; and
3. During and immediately after the test, the structure shall not show evidence of failure.

## SECTION 1710.0 PRECONSTRUCTION LOAD TESTS

**1710.1 General:** In evaluating the physical properties of materials and methods of construction which are not capable of being designed by approved engineering analysis or which do not comply with the applicable material design standards listed in Chapter 35, the structural adequacy shall be predetermined based on the load test criteria established by Sections 1710.2 through 1710.5.

**1710.2 Load test procedures specified:** Where specific load test procedures, *load* factors and acceptance criteria are included in the applicable design standards listed in Chapter 35, such test procedures, *load* factors and acceptance criteria shall apply. In the absence of specific test procedures, *load* factors or acceptance criteria, the corresponding provisions in Section 1710.3 shall apply.

**1710.3 Load test procedures not specified:** Where load test procedures are not specified in the applicable design standards listed in Chapter 35, the loadbearing capacity of structural components and assemblies shall be determined on the basis of load tests conducted in accordance with Sections 1710.3.1 and 1710.3.2. Load tests shall simulate all of the applicable *loading* conditions specified in Chapter 16.

**1710.3.1 Test procedure:** The test assembly shall be subjected to an increasing superimposed load equal to not less than two times the superimposed design *load*. The test load shall be left in place for a period of 24 hours. The tested assembly shall be considered to have met successfully the test requirements if the assembly recovers not less than 75 percent of the maximum deflection within 24 hours after the removal of the test load. The test assembly shall then be reloaded and subjected to an increasing superimposed load until either structural failure occurs or the superimposed load is equal to two and one-half times the load at which the deflection limitations specified in Section 1710.3.2 were reached, or the load is equal to two and one-half times the superimposed design *load*. In the case of structural components and assemblies for which deflection limitations are not specified in Section 1710.3.2, the test specimen shall be subjected to an increasing superimposed load until structural failure occurs or the load is equal to two and one-half times the desired superimposed design *load*. The allowable superimposed design *load* shall be taken as the lesser of:

1. The load at the deflection limitation given by Section 1710.3.2;
2. The failure load divided by 2.5; or
3. The maximum load applied divided by 2.5.

**1710.3.2 Deflection:** The deflection of structural members under the design *load* shall not exceed the limitations in Section 1604.5.

**1710.4 Wall and partition assemblies:** Loadbearing wall and partition assemblies shall sustain the test load both with and without window framing. The test load shall include all design *load* components.

**1710.5 Test specimens:** All test specimens and construction shall be representative of the materials, workmanship and details normally used in practice. The properties of the materials used to construct the test assembly shall be determined on the basis of tests on samples taken from the load test assembly or on representative samples of the materials used to construct the load test assembly. All required tests shall be conducted or witnessed by an *approved agency*. Wall and partition assemblies shall be tested both with and without door and window framing.

# CHAPTER 18

# FOUNDATIONS AND RETAINING WALLS

## SECTION 1801.0 GENERAL

**1801.1 Scope:** The provisions of this chapter shall control the foundation design and construction of all buildings and structures hereafter erected to ensure adequate strength of all parts thereof for the safe support of all superimposed *live* and special *loads*, in addition to their own *dead load*, without exceeding the allowable stresses or design capabilities.

**1801.2 Certificate of compliance:** Design compliance with the provisions of this chapter and Chapter 16 shall be satisfied when certification of an architect or engineer registered in Kentucky to that effect is placed on drawings submitted to the code official, unless the code official shall notify the design professional that a specific code violation exists.

## SECTION 1802.0 FOUNDATION INVESTIGATIONS

**1802.1 Where required:** In the absence of satisfactory data from immediately adjacent areas, the owner or applicant shall make borings, test pits or other soil investigations of the loadbearing materials at such locations and to such sufficient depths as to satisfy the code official. For all buildings which are more than three stories or 40 feet (12192 mm) in *height*, and whenever it is proposed to use float, mat or any type of deep foundation, there shall be at least one exploratory boring to rock or to an adequate depth below the loadbearing strata for every 2,500 square feet (232.5 $m^2$) of built-over area, and such additional tests as the code official requires. Where the safe sustaining power of the soil is in doubt, or where a loadbearing value superior to that specified in this code is claimed, the code official shall require that the necessary borings or tests be made.

**1802.1.1 Seismic investigation:** Foundations of buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7, shall conform to the requirements of this section. A soil investigation report, which determines the potential hazards due to slope instability, liquefication and surface rupture during an earthquake, shall be submitted to the code official.

## SECTION 1803.0 SOIL TEST PROCEDURE

**1803.1 Soil investigation:** The test procedure and testing apparatus shall be approved by the code official before such procedures and apparatus are used. A complete record of the tests, together with a record of the soil profile, shall be filed by the *registered design professional* who shall have a fully qualified representative on the site during all boring and test operations.

**1803.2 Soil samples:** For spread footings,the soil shall be loaded at one or more places and at the required level or levels. The loaded area shall be approximately 4 square feet (0.37 $m^2$) for all loadbearing materials; except that where the footing overlies wet clay or other soft materials, the test load shall be applied to an area of not less than 10 square feet (0.93 $m^2$).

**1803.3 Varying soil values:** Loads shall be applied in continuous increments of not more than one-fourth of the proposed safe load. When the proposed load has been reached, the load shall remain undisturbed and readings shall be recorded to determine the rate of settlement until the settlement in 8 consecutive hours is less than 0.01 inch (0.25 mm). A 50-percent excess load shall then be applied and allowed to remain in place until the rate of settlement is less than 0.01 inch (0.25 mm) in 24 hours.

**1803.4 Costs of tests:** Test loads applied by mechanical devices shall be automatically controlled so as to insure not more than a 5-percent variation in applied load. Such devices shall be calibrated prior to the test.

## SECTION 1804.0 LOADBEARING VALUE OF SOILS

**1804.1 Soils report:** All applications for permits for the construction of new buildings or structures, and for the *alteration* of permanent structures which require changes in foundation *loads* and distribution shall be accompanied by a report describing the soil in the ultimate loadbearing strata, including sufficient data to establish its character, nature and loadbearing capacity. The report shall be prepared by a *registered design professional*.

**1804.1.1 Prepared fill:** Where foundations will bear on prepared fill material, *special inspections* shall be performed in accordance with Section 1705.7, where required by Section 1705.1, and the report required by Section 1804.1 shall include, but not be limited to, the following:

1. Specifications for the preparation of the site to receive the fill.
2. Specifications for material to be used for the fill.
3. Test method to be used to determine the maximum dry density and optimum moisture content of the material to be used for the fill.
4. Maximum allowable thickness of each uncompacted lift.
5. Field test method for determining the in-place dry density of the compacted fill.
6. Minimum acceptable in-place dry density expressed as a minimum percentage of the maximum dry density determined in accordance with item 3.
7. Number and frequency of field tests required to determine compliance with item 6.

**1804.2 Satisfactory foundation materials:** Satisfactory loadbearing materials for spread footings shall include: ledge rock on its natural bed; natural deposits of sand, gravel or firm clay; or a combination of such materials, provided that they do not overlie an appreciable amount of peat, organic silt, soft clay or other objectionable materials.

**1804.3 Presumptive loadbearing values:** The maximum allowable pressure on supporting soils under spread footings at or near the surface shall not exceed the values specified in Table 1804.3 or the maximum allowable pressure shall be determined by load tests conducted in the field or as otherwise provided herein. Presumptive loadbearing values shall apply to all materials with similar physical characteristics and dispositions. Surface values shall be adjusted for deep footings, and for the loadbearing strata under piles, as provided for in this code. Where foundation piles are driven to penetrate into sound rock, the maximum allowable loadbearing values specified in Table 1804.3 shall be increased as prescribed in Section 1824.0.

**Table 1804.3**
**PRESUMPTIVE LOADBEARING VALUES OF FOUNDATION MATERIALS**

| Class of material | Loadbearing pressure (pounds per square foot)[a] |
|---|---|
| 1. Crystalline bedrock | 12,000 |
| 2. Sedimentary rock | 6,000 |
| 3. Sandy gravel or gravel | 5,000 |
| 4. Sand, silty sand, clayey sand, silty gravel and clayey gravel | 3,000 |
| 5. Clay, sandy clay, silty clay & clayey silt | 2,000 |

**Note a.** 1 psf = 47.9 Pa.

**1804.4 Lightweight structures:** Mud, organic silt or unprepared fill shall not be assumed to have a presumptive loadbearing capacity unless approved based on test results, except where the loadbearing capacity is deemed adequate by the code official for the support of lightweight and temporary structures.

## SECTION 1805.0 ALLOWABLE FOUNDATION LOADS

**1805.1 General:** The maximum allowable *loads* under all types of foundations shall be limited as provided herein.

**1805.2 Soil capacity:** For the *load* combinations, including seismic as specified in Section 1613.0, the soil loadbearing strength shall be sufficient to resist *loads*, at acceptable strains, considering both the short duration of loading and the dynamic properties of the soil.

**1805.3 Soil seismic lateral pressure:** Lateral soil pressure on below-ground-surface building walls and retaining walls due to earthquake motions shall be included in the design of buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7.

**1805.4 Rock foundations:** Where subsurface explorations at the project site indicate variations or doubtful characteristics in the structure of the rock upon which foundations are to be constructed, a sufficient number of borings shall be made to a depth of not less than 10 feet (3048 mm) below the level of the footings to provide assurance of the soundness of the foundation bed and its loadbearing capacity.

## SECTION 1806.0 DEPTH OF FOOTINGS

**1806.1 Frost protection:** Except where erected upon solid rock or otherwise protected from frost, foundation walls, piers and other permanent supports of all buildings and structures larger than 100 square feet (9.30 $m^2$) in *area* or 10 feet (3048 mm) in *height* shall extend to the frost line of the locality, or to a minimum depth of 24 inches (610 mm), whichever is deeper, and spread footings of adequate size shall be provided if necessary to distribute properly the *load* within the allowable loadbearing value of the soil. Alternatively, the structures shall be supported on piles if solid earth or rock is not available. Footings shall be founded on frozen soils unless such frozen condition is of a permanent character.

**1806.2 Isolated footings:** Footings on granular soil shall be so located that the line drawn between the lower edges of adjoining footings shall not have a steeper slope than 30 degrees (0.52 rad) with the horizontal, unless the material supporting the higher footing is braced or retained or otherwise laterally supported in an approved manner or a greater slope has been properly established by engineering analysis.

**1806.3 Floating mat:** Floating mat foundations shall be located on soil of adequate loadbearing capacity. The code official shall approve a continuous foundation mat which is located directly on the ground where adequate subsoil drainage and a ratproof apron as specified in Section 1215.0 are provided. Where subject to freezing, the footings shall be designed to resist frost action.

## SECTION 1807.0 FOOTING DESIGN

**1807.1 Design loads:** Footings shall be designed for the most unfavorable effects due to the combinations of *loads* specified in Section 1613.0. The *dead load* shall include the weight of foundations, footings and overlying fill. Reduced *live loads*, as specified in Section 1606.7, shall be permitted to be used in designing footings.

**1807.2 Vibratory loads:** Where machinery operations or other vibrations are transmitted through the foundation, consideration shall be given in the footing design to prevent detrimental disturbances of the soil.

**1807.3 Varying unit pressures:** Footings shall be designed so that the unit soil pressure under the *dead load* shall be as uniform as possible under all parts of the building or structure. Where necessary for stability in the structure due to settlement or varying soil conditions, approved variations are permitted in the unit pressure under different footings.

**1807.4 Protection of footings:** Trenching installed parallel to footings shall not extend below the line of a 45-degree (0.79 rad) angle downward from the loadbearing plane of the footing.

## SECTION 1808.0 TIMBER FOOTINGS AND WOOD FOUNDATIONS

**1808.1 Timber footings:** Timber footings are permitted for buildings of Type 5 construction and as otherwise approved. Such footings shall be treated in accordance with AWPA C2 or C3 listed in Chapter 35. Treated timbers are not required where placed entirely below permanent water level, or where used as capping for wood piles which project above the water level over submerged or marsh lands. The compressive stresses perpendicular to grain in untreated timber footings supported upon piles shall not exceed 70 percent of the allowable stresses for the

species and grade of timber as specified in AFPA NDS listed in Chapter 35.

**1808.2 Pole buildings:** Pole-type buildings shall be designed and erected in an approved manner. The poles shall be treated in accordance with AWPA C2 or C4 listed in Chapter 35.

**1808.3 Wood foundations:** Wood foundation systems shall be designed and installed in accordance with AFPA TR7 listed in Chapter 35. All lumber and plywood shall be treated in accordance with AWPA C22 listed in Chapter 35 and shall be identified in accordance with Section 2311.3.1.

## SECTION 1809.0 STEEL GRILLAGES

**1809.1 General:** All steel grillage beams shall be separated with approved steel spacers and shall be entirely encased in at least 3 inches (76 mm) of concrete and the spaces between the beams shall be completely filled with concrete or cement grout. Where used on yielding soils, steel grillages shall rest on approved concrete beds not less than 6 inches (152 mm) thick.

## SECTION 1810.0 CONCRETE FOOTINGS

**1810.1 Concrete strength:** Concrete in footings shall have a specified compressive strength of not less than 2,500 psi (17235 kPa) at 28 days.

**1810.2 Design:** Concrete footings shall comply with Chapter 19 and ACI 318 listed in Chapter 35.

**1810.2.1 Footing seismic ties:** Individual spread footings, located on soil-profile type $S_2$, $S_3$ or $S_4$, in accordance with Section 1610.3.1, and supporting buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7, shall be interconnected by ties. All ties shall be capable of resisting, in tension or compression, a force equal to 25 percent of the effective peak velocity-related acceleration ($A_v$) times the column *dead* plus *live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, hard cohesive soils, very dense granular soils or other approved means.

**1810.3 Thickness:** The thickness of concrete footings shall comply with Sections 1810.3.1 and 1810.3.2.

**1810.3.1 Plain concrete:** In plain concrete footings, the edge thickness shall not be less than 8 inches (203 mm) for footings on soil; except that for occupancies of Use Group R-3 and buildings less than two stories in *height* of Type 5 construction, the required edge thickness shall be reduced to 6 inches (152 mm), provided that the footing does not extend beyond 4 inches (102 mm) on either side of the supported wall.

**1810.3.2 Reinforced concrete:** In reinforced concrete footings, the thickness above the bottom reinforcement shall not be less than 6 inches (152 mm) for footings on soil, nor less than 12 inches (305 mm) for footings on piles. The cover provided for reinforcement shall comply with Section 1910.6.

**1810.4 Deposition:** Concrete footings shall not be placed through water unless otherwise approved. Where placed under or in the presence of water, the concrete shall be deposited by approved means to ensure minimum segregation of the mix and negligible turbulence of the water.

**1810.5 Protection of concrete:** Concrete footings shall be protected from freezing during depositing and for a period of not less than 5 days thereafter. Water shall not be allowed to flow through the deposited concrete.

**1810.6 Forming of concrete:** Concrete footings shall not be cast against the earth where, in the opinion of the code official, soil conditions warrant forming. Where forming is required, forming shall be in accordance with Chapter 6 of ACI 318 listed in Chapter 35.

## SECTION 1811.0 MASONRY-UNIT FOOTINGS

**1811.1 Dimensions:** Masonry-unit footings shall be laid in Type M or S mortar complying with Section 2104.7, and the depth shall not be less than twice the projection beyond the wall, pier or column. The width shall not be less than 8 inches (203 mm) wider than the wall supported thereon.

**1811.2 Offsets:** The maximum offset of each course in brick foundation walls stepped up from the footings shall be $1^1/_2$ inches (38 mm) if laid in single courses, and 3 inches (76 mm) if laid in double courses.

## SECTION 1812.0 FOUNDATION WALLS

**1812.1 Design:** Foundation walls shall be designed to resist frost action and the structural *loads* of Chapter 16 in accordance with the provisions of this section.

**1812.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Wall**

**Foundation wall:** A wall below the floor nearest grade which serves as a structural support for a wall, pier, column or other part of a building, or the wall of a *basement* that resists *lateral soil load*.

**Retaining wall:** A wall that is not laterally supported at the top, designed to resist *lateral soil load*.

**1812.3 Minimum thickness:** The minimum thickness of concrete and masonry foundation walls that are laterally supported at the top and bottom shall comply with Sections 1812.3.1 through 1812.3.3, or shall be designed in accordance with ACI 530/ASCE 5/TMS 402 or ACI 318 listed in Chapter 35. Foundation walls that are not laterally supported at the top and bottom and foundation walls that are not within the parameters of Table 1812.3.2(1) or Table 1812.3.2(2) shall be designed in accordance with ACI 530/ASCE 5/TMS 402 or ACI 318 listed in Chapter 35.

**1812.3.1 Thickness based on walls supported:** The thickness of foundation walls shall not be less than the thickness of the wall supported, except that foundation walls of at least 8-inch nominal width shall be permitted to support brick-veneered frame walls and 10-inch-wide (254 mm) cavity walls where the total height of the wall supported, including gables, is not more than 20 feet (6096 mm), provided the requirements of Section 1812.3.2 are met. Corbeling of masonry shall be in accordance with Section 2111.2. Where an 8-inch (203 mm) wall is corbeled, the top corbel shall be a full course of headers at least 6 inches (152 mm) in length, extending not higher than the bottom of the floor framing.

**Table 1812.3.2(1)**
**PLAIN MASONRY AND PLAIN CONCRETE FOUNDATION WALLS[a]**

| Plain masonry[e] | | | | |
|---|---|---|---|---|
| Wall height (feet)[f] | Depth of unbalanced backfill height (feet)[f] | Minimum nominal wall thickness (inches)[f] | | |
| | | Soil classes and lateral soil load[a] (pounds per square foot per foot of depth)[f] | | |
| | | GW, GP, SW and SP soils 30 | GM, GC, SM, SM-SC and ML soils 45 | SC, MH, ML-CL, and inorganic CL soils 60 |
| 7 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 10 |
| | 6 | 10 | 12 | 10 (solid[b]) |
| | 7 | 12 | 10 (solid[b]) | 12 (solid[b]) |
| 8 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 12 |
| | 6 | 10 | 12 | 12 (solid[b]) |
| | 7 | 12 | 12 (solid[b]) | Note c |
| | 8 | 10 (solid[b]) | 12 (solid[b]) | Note c |
| 9 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 12 |
| | 6 | 12 | 12 | 12 (solid[b]) |
| | 7 | 12 (solid[b]) | 12 (solid[b]) | Note c |
| | 8 | 12 (solid[b]) | Note c | Note c |
| | 9 | Note c | Note c | Note c |

| Plain concrete | | | | |
|---|---|---|---|---|
| Wall height (feet)[f] | Depth of unbalanced backfill height (feet)[f] | Minimum wall thickness (inches)[f] | | |
| | | Soil classes and lateral soil load[a] (pounds per square foot per foot of depth)[f] | | |
| | | GW, GP, SW and SP soils 30 | GM, GC, SM, SM-SC and ML soils 45 | SC, MH, ML-CL and inorganic CL soils 60 |
| 7 | 4 (or less) | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 5 | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 6 | $7^1/_2$ | $7^1/_2$ | 8 |
| | 7 | $7^1/_2$ | 8 | 10 |
| 8 | 4 (or less) | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 5 | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 6 | $7^1/_2$ | $7^1/_2$ | 10 |
| | 7 | $7^1/_2$ | 10 | 10 |
| | 8 | 10 | 10 | 12 |
| 9 | 4 (or less) | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 5 | $7^1/_2$ | $7^1/_2$ | $7^1/_2$ |
| | 6 | $7^1/_2$ | $7^1/_2$ | 10 |
| | 7 | $7^1/_2$ | 10 | 10 |
| | 8 | 10 | 10 | 12 |
| | 9 | 10 | 12 | Note d |

**Note a.** For design lateral soil loads and descriptions of soil classes, see Section 1611.0. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
**Note b.** Solid grouted hollow units or solid masonry units.
**Note c.** An analysis in compliance with ACI 530/ASCE 5/TMS 402 or reinforcement in accordance with Table 1812.3.2(2) is required.
**Note d.** An analysis in compliance with ACI 318 is required.
**Note e.** Mortar shall be Type M or S and masonry shall be laid in running bond.
**Note f.** 1 foot = 304.8 mm; 1 inch = 25.4 mm; 1 pound per square foot = 47.9 Pa.

**Table 1812.3.2(2)**
**REINFORCED MASONRY FOUNDATION WALLS[a, b, c, d]**

| Wall height (feet)[e] | Depth of unbalanced backfill height (feet)[e] | Vertical reinforcement for 8-inch nominal wall thickness[e] | | |
|---|---|---|---|---|
| | | Soil classes and lateral soil load[a] (pounds per square foot per foot of depth)[e] | | |
| | | GW, GP, SW and SP soils 30 (inches on center) | GM, GC, SM, SM-SC and ML soils 45 (inches on center) | SC, MH, ML-CL and inorganic CL soils 60 (inches on center) |
| 7 | 4 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5 | #4 at 48 | #4 at 48 | #4 at 40 |
| | 6 | #4 at 48 | #5 at 48 | #5 at 40 |
| | 7 | #4 at 40 | #5 at 40 | #6 at 48 |
| 8 | 4 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5 | #4 at 48 | #4 at 48 | #4 at 40 |
| | 6 | #4 at 48 | #5 at 48 | #5 at 40 |
| | 7 | #5 at 48 | #6 at 48 | #6 at 40 |
| | 8 | #5 at 40 | #6 at 40 | #7 at 40 |
| 9 | 4 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5 | #4 at 48 | #4 at 48 | #5 at 48 |
| | 6 | #4 at 48 | #5 at 48 | #6 at 48 |
| | 7 | #5 at 48 | #6 at 48 | #7 at 48 |
| | 8 | #5 at 40 | #7 at 48 | #8 at 48 |
| | 9 | #6 at 40 | #8 at 48 | #8 at 32 |

**Note a.** For design lateral soil loads and descriptions of soil classes, see Section 1611.0. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
**Note b.** Provisions of this table are based on construction requirements specified in Section 1812.3.2.1.
**Note c.** For alternative reinforcement, see Section 1812.3.2.2.
**Note d.** Mortar shall be Type M or S and masonry shall be laid in running bond.
**Note e.** 1 foot = 304.8 mm; 1 inch = 25.4 mm; 1 pound per square foot = 47.9 Pa.

**1812.3.2 Thickness based on soil loads, unbalanced backfill height and wall height:** The thickness of foundation walls shall comply with the requirements of Table 1812.3.2(1) for plain masonry and plain concrete walls or Table 1812.3.2(2) for reinforced masonry walls.

**1812.3.2.1 Reinforcement requirements:** Masonry foundation walls constructed in accordance with Table 1812.3.2(2) shall comply with all of the following:

1. Vertical reinforcement shall have a minimum yield strength of 60,000 psi (413700 kPa).
2. The measurement from the face of the soil side of the wall to the center of vertical reinforcement shall be 5 inches (127 mm) or more.

**1812.3.2.2 Alternative reinforcement:** In lieu of the reinforcement provisions in Table 1812.3.2(2), alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be utilized, provided the spacing of reinforcement does not exceed 72 inches (1829 mm) and reinforcing bar sizes do not exceed No. 11.

**1812.3.3 Rubble stone:** Foundation walls of rough or random rubble stone shall not be less than 16 inches (406 mm) thick.

**1812.4 Hollow masonry walls:** At least 4 inches (102 mm) of solid masonry shall be provided at girder supports at the top of hollow masonry unit foundation walls.

## SECTION 1813.0 WATERPROOFING AND DAMPPROOFING

**1813.1 Where required:** Walls or portions thereof that retain earth and enclose interior spaces and floors below grade shall be waterproofed and dampproofed in accordance with this section, with the exception of those spaces containing use groups other than residential and institutional where such omission is not detrimental to the building or occupancy.

**1813.1.1 Story above grade:** Where a *basement* is considered a *story above grade* and the finished ground level adjacent to the *basement* wall is below the *basement* floor elevation for 25 percent or more of the perimeter, the floor and walls shall be dampproofed in accordance with Section 1813.3 and a foundation drain shall be installed in accordance with Section 1813.5.2. The foundation drain shall be installed around the portion of the perimeter where the *basement* floor is below ground level. The provisions of Sections 1813.2, 1813.4 and 1813.5.1 shall not apply in this case.

**1813.1.2 Underfloor space:** The finished ground level of an underfloor space such as a crawl space shall not be located below the bottom of the footings. Where there is evidence that the ground water table rises to within 6 inches (152 mm) of the ground level at the outside building perimeter or where there is evidence that the surface water does not readily drain from the building site, the ground level of the underfloor space shall be as high as the outside finished ground level, unless an approved drainage system is provided. The provisions of

Sections 1813.2, 1813.3, 1813.4, 1813.5 and 1813.6 shall not apply in this case.

**1813.2 Ground water table investigation:** The owner or applicant shall perform a subsurface soil investigation to determine the possibility of the ground water table rising above the proposed elevation of the floor or floors below grade.

**Exception:** A subsurface soil investigation shall not be required where:

1. Waterproofing is to be provided;
2. Satisfactory data from adjacent areas are available which demonstrate that ground water has not been a problem; or
3. Floodproofing is to be provided in accordance with Section 3107.0.

**1813.2.1 Ground water control:** Where the ground water table is lowered and maintained at an elevation not less than 6 inches (152 mm) below the bottom of the lowest floor, the floor and walls shall be dampproofed in accordance with Section 1813.3. The design of the system to lower the ground water table shall be based upon accepted principles of engineering which shall consider, but not necessarily be limited to: permeability of the soil; rate at which water enters the drainage system; rated capacity of pumps; head against which pumps are to pump; and the rated capacity of the disposal area of the system.

**1813.3 Dampproofing required:** Where hydrostatic pressure will not occur as determined by Section 1813.2, floors and walls for other than wood foundation systems shall be dampproofed in accordance with this section. Wood foundation systems shall be constructed in accordance with AFPA TR7 listed in Chapter 35.

**1813.3.1 Floor applications:** The required dampproofing materials shall be installed between the floor and the base course required by Section 1813.5.1, except where a separate floor is provided above a concrete slab.

**1813.3.1.1 Floor dampproofing materials:** Where installed beneath the slab, dampproofing shall consist of not less than 6-mil (.006 inch; 152 μm) polyethylene with joints lapped not less than 6 inches (152 mm), or other approved methods or materials. Where permitted to be installed on top of the slab, dampproofing shall consist of mopped-on bitumen, not less than 4-mil (.004 inch; 102 μm) polyethylene, or other approved methods or materials. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer s installation instructions.

**1813.3.2 Walls:** Dampproofing materials shall be installed on the exterior surface of walls, and shall extend from the top of the footing to above ground level.

**1813.3.2.1 Surface preparation of walls:** Prior to application of dampproofing materials on concrete walls, all holes and recesses resulting from the removal of form ties shall be sealed with a bituminous material or other approved methods or materials. Unit masonry walls shall be parged on the exterior surface below ground level with not less than $^{3}/_{8}$ inch (10 mm) of portland cement mortar. The parging shall be coved at the footing.

**Exception:** Parging of unit masonry walls is not required where a material is approved for direct application to the masonry.

**1813.3.2.2 Wall dampproofing materials:** Dampproofing shall consist of a bituminous material, 3 pounds per square yard of acrylic modified cement, $^{1}/_{8}$-inch (3 mm) coat of surface-bonding mortar complying with ASTM C887 listed in Chapter 35, any of the materials permitted for waterproofing by Section 1813.4.2.2, or other approved methods or materials.

**1813.4 Waterproofing required:** Where the ground water investigation required by Section 1813.2 indicates that a hydrostatic pressure condition exists, walls and floors shall be waterproofed in accordance with this section.

**1813.4.1 Floors:** Floors required to be waterproofed shall be of concrete, designed and constructed to withstand the hydrostatic pressures to which the floors will be subjected.

**1813.4.1.1 Floor waterproofing materials:** Waterproofing shall be accomplished by placing a membrane of rubberized asphalt, butyl rubber, neoprene, or not less than 6-mil (.006 inch; 152 μm) polyvinyl chloride or polyethylene with joints lapped not less than 6 inches (152 mm) or other approved materials under the slab. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer s installation instructions.

**1813.4.2 Walls:** Walls required to be waterproofed shall be of concrete or masonry and shall be designed and constructed to withstand the hydrostatic pressures and other *lateral loads* to which the walls will be subjected.

**1813.4.2.1 Surface preparation of walls:** Prior to the application of waterproofing materials on concrete or masonry walls, the walls shall be prepared in accordance with Section 1813.3.2.1.

**1813.4.2.2 Wall waterproofing materials:** Waterproofing shall be applied from the bottom of the wall to not less than 12 inches (305 mm) above the maximum elevation of the ground water table. The remainder of the wall shall be dampproofed in accordance with Section 1813.3.2.2. Waterproofing shall consist of two-ply hot-mopped felts, not less than 6-mil (.006 inch; 152 μm) polyvinyl chloride, 40-mil (.040 inch; 1013 μm) polymer-modified asphalt, 6-mil (.006 inch; 152 μm) polyethylene or other approved methods or materials capable of bridging nonstructural cracks. Joints in the membrane shall be lapped and sealed in accordance with the manufacturer s installation instructions.

**1813.4.3 Joints and penetrations:** Joints in walls and floors, joints between the wall and floor, and penetrations of the wall and floor shall be made water tight utilizing approved methods and materials.

**1813.5 Subsoil drainage system:** Where a hydrostatic pressure condition does not exist, dampproofing shall be provided and a base shall be installed under the floor and a drain installed around the foundation perimeter. A subsoil drainage system designed and constructed in accordance with Section 1813.2.1 shall be deemed adequate for lowering the ground water table.

**1813.5.1 Floor base:** Floors of *basements*, except as provided for in Section 1813.1.1, shall be placed over a base course not less than 4 inches (102 mm) in thickness that consists of gravel or crushed stone containing not more than 10 percent of material that passes through a No. 4 sieve.

**Exception:** Where a site is located in well-drained gravel or sand/gravel mixture soils, a floor base is not required.

**1813.5.2 Foundation drain:** A drain shall be placed around the perimeter of a foundation that consists of gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve. The drain shall extend a minimum of 12 inches (102 mm) beyond the outside edge of the footing. The thickness shall be such that the bottom of the drain is not higher than the bottom of the base under the floor, and that the top of the drain is not less than 6 inches (152 mm) above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain tile or perforated pipe is used, the invert of the pipe or tile shall not be higher than the floor elevation. The top of joints or the top of perforations shall be protected with an approved filter membrane material. The pipe or tile shall be placed on not less than 2 inches (51 mm) of gravel or crushed stone complying with Section 1813.5.1, and shall be covered with not less than 6 inches (152 mm) of the same material.

**1813.5.3 Drainage disposal:** The floor base and foundation perimeter drain shall discharge by gravity or mechanical means into an approved drainage system that complies with the plumbing code listed in Chapter 35.

**Exception:** Where a site is located in well-drained gravel or sand/gravel mixture soils, a dedicated drainage system is not required.

**1813.6 Placement of backfill:** The excavation outside the foundation shall be backfilled with soil that is free of organic material, construction debris and large rocks. The backfill shall be placed in lifts and compacted in a manner which does not damage the foundation, the waterproofing or the dampproofing material.

**1813.7 Site grading:** The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than one unit vertical in 12 units horizontal (1:12) for a minimum distance of 8 feet (2438 mm) measured perpendicular to the face of the wall or an approved alternate method of diverting water away from the foundation shall be used. The procedure utilized to establish the final ground level adjacent to the foundation shall account for all additional settlement of the backfill.

**1813.8 Erosion protection:** Where water impacts the ground from the edge of the roof, downspout, scupper or other rainwater collection or diversion device, provisions shall be made to prevent soil erosion and direct the water away from the foundation.

## SECTION 1814.0 MAT, RAFT AND FLOAT FOUNDATIONS

**1814.1 General:** Mat, raft and float foundations shall only be used where the applied *loads* of the building or structure are so arranged as to result in practically uniformly balanced *loading*, and the soil immediately below the mat is of uniform loadbearing capacity. The characteristics of the soil under the mat or raft shall be considered in the analysis of loading on mats and other continuous footings, and due allowance shall be made for possible concentrated soil pressures under heavily loaded columns.

## SECTION 1815.0 PIER FOUNDATIONS

**1815.1 Lateral dimensions and height:** Except for occupancies in Use Group R-3 and light structures, the minimum dimension of isolated piers used as foundations shall be 2 feet (610 mm), and the height shall not exceed 12 times the least horizontal dimension, unless constructed of reinforced concrete or structural steel, or where entirely encased in a steel shell at least $^1/_4$-inch (6 mm) thick. Approved heights greater than herein specified are permitted where the surrounding foundation materials furnish adequate lateral support.

**1815.2 Pier foundation seismic ties:** Pier foundations shall be interconnected by ties for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7. All ties shall be capable of resisting, in tension or compression, a force equal to 25 percent of the effective peak velocity-related acceleration ($A_v$) times the column *dead* plus *live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, hard cohesive soils, very dense granular soils or other approved means.

**1815.3 Belled bottoms:** Where pier foundations are belled at the bottom, the edge thickness of the bell shall not be less than that required for the edge of footings. If the sides of the bell slope at an angle less than 60 degrees (1.05 rad) from the horizontal, the effects of vertical shear shall be considered.

**1815.4 Masonry and plain concrete:** Where the unsupported height of foundation piers exceeds six times the least dimension, the allowable working stress on piers of unit masonry shall be reduced in accordance with ACI 530/ASCE 5/TMS 402 listed in Chapter 35. The unsupported height of plain concrete foundation piers shall not exceed three times the least plan dimension and the design shall be in accordance with ACI 318 listed in Chapter 35.

**1815.5 Reinforced concrete:** Where constructed of reinforced concrete, foundation piers shall conform to the requirements for columns in ACI 318 listed in Chapter 35. Where adequate lateral support is furnished by the surrounding materials as defined in Section 1816.5, the requirements for column slenderness effects shall not be required.

**1815.6 Steel shell:** Where concrete piers are entirely encased with a circular steel shell, and the area of the shell steel is considered as reinforcing steel, the steel shall be protected under the conditions specified in Section 1816.0. All horizontal joints in the shell shall be spliced to comply with Section 1816.0.

**1815.7 Dewatering:** Where piers are carried to depths below water level, the piers shall be constructed by a method which will ensure accurate preparation and inspection of the bottom, and the depositing or construction of sound concrete or other masonry in the dry.

## SECTION 1816.0 PILE FOUNDATIONS

**1816.1 Investigation:** Pile foundations shall be designed and installed on the basis of a foundation investigation and report which shall include borings, test pits or other subsurface exploration at locations and depths sufficient to determine the position and adequacy of the loadbearing soils, except where sufficient data upon which to base the design and installation are available. The investigation and report shall include, but not be limited to, the following:

1. Recommended pile types and installed capacities;
2. Driving criteria;
3. Installation and field inspection procedures;
4. Pile load test requirements;
5. Durability of pile materials; and
6. Designation of loadbearing stratum or strata.

**1816.2 Special types of piles:** The use of types of piles not specifically mentioned herein is permitted, subject to approval, upon the submission of acceptable test data, calculations and other information relating to the structural properties and *load* capacity of such piles. The allowable stresses shall not in any case exceed the limitations specified herein.

**1816.3 Pile bending seismic design:** Piling for buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7, shall be designed for the maximum imposed curvatures resulting from seismic forces on free-standing piles where the piles are located in loose granular soils or in soil-profile type $S_3$ or $S_4$, in accordance with Section 1610.3.1. The piles shall be designed and detailed in accordance with the special moment frame requirements of Section 1903.2.3 or Section 2203.2 for a length equal to 120 percent of the flexural length. The flexural length shall be the distance from the point of fixity to the pile cap.

**1816.4 Protection of pile materials:** Where boring records or site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels or other factors, the pile materials shall be adequately protected by approved materials, methods or processes. Protective materials shall be applied to the piles so as not to be rendered ineffective by driving.

**1816.5 Lateral support:** Any soil other than fluid soil shall be deemed to afford sufficient lateral support to the pile to prevent buckling and to permit the design of the pile in accordance with the applicable provisions of this code. All piles that stand unbraced in air, water or soils not capable of providing lateral support shall be designed as columns in accordance with the provisions of this code.

**1816.6 Group action:** In cohesive soils, the compressive *load* capacity of a group of friction piles shall be analyzed by an approved, rational method and, where such analysis indicates, the individual allowable pile *load* shall be reduced accordingly.

**1816.7 Stability:** All piles shall be braced to provide lateral stability in all directions. Three or more piles connected by a rigid cap shall be considered as being braced, provided that the piles are located in a radial direction from the centroid of the group, not less than 60 degrees (1.05 rad) apart. A two-pile group in a rigid cap shall be considered to be braced along the axis connecting the two piles. Methods used to brace piles shall be subject to approval.

Piles supporting walls shall be driven alternately in lines at least 1 foot (305 mm) apart and located symmetrically under the center of gravity of the wall *load* carried, unless effective measures are taken to provide for eccentricity and lateral forces, or the wall piles are adequately braced to provide for lateral stability. Where a single row of piles without lateral bracing is used for occupancies in Use Group R-3 or for lightweight construction not exceeding two stories or 35 feet (10668 mm) in *height*, the centers of the piles shall be located within the width of the foundation wall.

**1816.8 Structural integrity:** Piles shall be installed in such a manner and sequence as to prevent distortion or damage to piles being installed or already in place, to the extent that such distortion or damage affects the structural integrity of the piles.

**1816.9 Spacing:** The minimum center-to-center spacing of piles shall not be less than twice the average diameter of a round pile, nor less than $1^3/_4$ times the diagonal dimension of a rectangular pile. Where driven to or penetrating into rock, the spacing shall not be less than 24 inches (610 mm). Where receiving principal support at the end from materials other than rock, or through friction resistance, the spacing shall not be less than 30 inches (762 mm) except that for piles having enlarged bases formed either by compacting concrete or driving a precast base, the minimum center-to-center spacing shall be $4^1/_2$ feet (1372 mm). The spacing of piles shall be such that the average *load* on the supporting strata will not exceed the safe loadbearing value of those strata as determined by test borings or other approved methods.

**1816.10 Splices:** Splices shall be constructed so as to provide and maintain true alignment and position of the component parts of the pile during installation and subsequent thereto, and shall be of adequate strength to transmit the vertical and *lateral loads* and moments occurring at the location of the splice during driving and under service loading. Splices shall develop not less than 50 percent of the least value of the pile in bending. Additionally, all pile splices occurring in the upper 10 feet (3048 mm) of the embedded portion of the pile shall be capable of resisting at allowable working stresses the moment and shear that results from an assumed eccentricity of the pile *load* of 3 inches (76 mm); or the pile shall be braced in accordance with Section 1816.7 to other piles that do not have splices in the upper 10 feet (3048 mm) of embedment.

**1816.11 Pile caps:** Pile caps shall be of reinforced concrete. The soil immediately below the pile cap shall not be considered as carrying any vertical *load*. The tops of all piles shall be embedded not less than 3 inches (76 mm) into pile caps and the caps shall extend at least 4 inches (102 mm) beyond the edges of all piles. The tops of all piles shall be cut back to sound material before capping.

**1816.11.1 Pile cap seismic connection:** All concrete piles shall be connected to the pile cap for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7. The connection shall consist of embedment of the pile reinforcement in the pile cap for a distance equal to the development length as specified in ACI 318 listed in Chapter 35.

Field-placed dowels anchored in the plastic concrete piles are acceptable. The development length to be provided is the full development length for compression without reduction in length for excess area. Where seismic confinement reinforcement at the top of the pile is required, alternative measures for laterally confining concrete and maintaining toughness and ductile-like behavior at the top of the pile shall be permitted, provided consideration is given to forcing the hinge to occur in the confined region.

Where a minimum length for reinforcement or the extent of closely spaced confinement reinforcement is specified at the top of the pile, provisions shall be made so that those specified lengths or extents are maintained after pile cut-off.

**1816.11.2 Pile foundation seismic ties:** Piles or pile caps shall be interconnected by ties for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7. All ties shall be capable of resisting, in tension or compression, a force equal to 25 percent of the effective peak velocity-related acceleration ($A_v$) times the column *dead* plus *live load*. Individual tie beams are not required when it is demonstrated that equivalent restraint will be provided by structural members within slabs on grade or reinforced concrete slabs on grade or confinement by competent rock, cohesive soils, very dense granular soils or other approved means.

**1816.12 Preexcavation:** The use of jetting, augering or other methods of preexcavation shall be subject to approval. Where approved, preexcavation shall be carried out in the same manner as used for piles subject to load tests and in such a manner that will not impair the loadbearing capacity of the piles already in place or damage adjacent structures. Pile tips shall be driven below the preexcavated depth until the required resistance or penetration is obtained.

**1816.13 Inspection:** An approved, qualified inspector shall be present when pile foundations are being installed or during tests. The inspector shall make and submit to the code official detailed records of the installation of each pile and the results of load tests. Records shall include the cutoff and tip elevation of each pile relative to a permanent reference.

**1816.14 Identification:** All pile materials shall be identified for conformity to the specified grade with this identification maintained continuously from the point of manufacture to the point of installation or shall be tested by an *approved agency* to determine conformity to the specified grade and the *approved agency* shall furnish an affidavit of compliance to the code official.

**1816.15 Pile location plan:** A plan showing the location and designation of all piles by an identification system shall be filed with the code official prior to installation of such piles. All detailed records for individual piles shall bear an identification corresponding to that shown on the plan.

**1816.16 Use of existing piles:** Piles left in place where a structure has been demolished shall not be used for the support of new construction unless satisfactory evidence is submitted to the code official which indicates that the piles are sound and meet all of the requirements of this code. Such piles shall be load tested or redriven to verify their capacities. The design *load* applied to such piles shall be the lowest allowable *load* as determined by tests or redriving data.

**1816.17 Pile driveability:** Pile cross sections shall be of sufficient size and strength to withstand driving stresses without damage to the pile, and to provide sufficient stiffness to transmit the required driving forces.

**1816.18 Heaved piles:** All piles that have heaved during the driving of adjacent piles shall be redriven as necessary to develop the required capacity and penetration, or the capacity of the pile shall be verified by load tests in accordance with Section 1817.4.

**1816.19 Settlement analysis:** The settlement of individual piles or groups of piles shall be estimated based upon approved methods of analysis. The predicted settlement shall neither cause harmful distortion of, or instability in, the structure, nor cause any stresses to exceed allowable values.

**1816.20 Use of vibratory drivers:** Vibratory drivers shall only be used to install piles where the pile *load* capacity is verified by load tests in accordance with Section 1817.4. The installation of production piles shall be controlled according to power consumption, rate of penetration or other approved means that assure pile capacities equal to or exceeding those of the test piles.

**1816.21 Installation sequence:** Piles shall be installed in such sequence as to avoid compacting the surrounding soil to the extent that other piles cannot be installed properly, and to prevent ground movements that are capable of damaging adjacent structures.

## SECTION 1817.0 ALLOWABLE PILE LOADS

**1817.1 Determination of allowable loads:** The allowable axial and *lateral loads* on piles shall be determined by an approved formula, load test or method of analysis.

**1817.2 Piles in subsiding areas:** Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer materials, the downward friction forces which are imposed on the piles by the subsiding upper strata shall be included in the design.

**1817.3 Driving formula:** The allowable compressive *load* on any pile when determined by the application of an approved driving formula shall not exceed 40 tons (356 kN). The formula load shall be determined for gravity drop or power-actuated hammers, and the hammer energy used shall be the maximum consistent with the size, strength and weight of the driven piles. The use of a follower shall be permitted only when approved. The introduction of fresh hammer cushion or pile cushion material just prior to final penetration shall not be permitted.

**1817.4 Load tests:** Where greater compressive *loads* per pile than permitted by Section 1817.3 are desired or when the design *load* for any pile foundation is in doubt, control test piles shall be tested in accordance with ASTM D1143 listed in Chapter 35. At least one pile shall be test loaded in each area of uniform subsoil conditions. Where required by the code official, additional piles shall be load tested if necessary to establish the safe design capacity. The resulting allowable *loads* shall not be more than one-half of that test load which produces a permanent net settlement of not more than 0.01 inch per ton (0.0285 mm/kN) of test load, and not more than $^3/_4$ inch (19 mm). In subsequent

driving of the balance of foundation piles, all piles shall be deemed to have a supporting capacity equal to the control pile where such piles: are of the same type, size and relative length as the test pile; are installed using the same or comparable methods and equipment as the test pile; are installed in similar subsoil conditions as the test pile; and where the rate of penetration of such piles is equal to or less than that of the test pile through a comparable driving distance.

**1817.5 Use of higher allowable stresses:** Allowable stresses greater than those specified for each pile type in this chapter shall be permitted where supporting data justifying such higher stresses are filed with the code official. Such substantiating data shall include a foundation investigation in accordance with Section 1816.1 and pile load tests in accordance with Section 1817.4, regardless of the *load* supported by the pile. The design and installation of the pile foundation shall be under the direct supervision of a *registered design professional* knowledgeable in the field of soil mechanics and pile foundations, who shall certify to the code official that the piles as installed satisfy the design criteria.

**1817.6 Allowable lateral load:** Where required by the design, the *lateral load* capacity of a single pile or a pile group shall be determined by an approved method of analysis or by lateral load tests to at least twice the proposed design working *load*. The resulting allowable *load* shall not be more than one-half of that test load which produces a gross lateral movement of 1 inch (25 mm) at the ground surface.

**1817.7 Uplift capacity:** Where required by the design, the uplift capacity of a single pile shall be determined in accordance with ASTM D3689 listed in Chapter 35 or an approved method of analysis based upon a minimum safety factor of 3. The maximum allowable uplift *load* shall be one-half of that load which produces an upward movement of the pile butt equal to the gross elastic extension of the pile plus 0.1 inch (3 mm). For pile groups subjected to uplift, the allowable working uplift *load* for the group shall be the lesser of the proposed individual pile uplift working *load* times the number of piles in the group, or two-thirds of the effective weight of the pile group and the soil contained within a block defined by the perimeter of the group and the length of the pile.

**1817.8 Loadbearing capacity:** Individual piles and groups of piles shall develop ultimate *load* capacities of at least twice the design working *loads* in the designated loadbearing layers. Analysis shall show that the soil layer underlying the designated loadbearing layers does not cause the loadbearing capacity safety factor to be less than 2.

**1817.9 Bent piles:** The loadbearing capacity of piles discovered to have a sharp or sweeping bend shall be determined by an approved method of analysis or by load testing a representative pile.

**1817.10 Overloads on piles:** The maximum compressive *load* on any pile due to mislocation shall not exceed 110 percent of the allowable design *load*.

## SECTION 1818.0 STRUCTURAL STEEL PILES

**1818.1 Materials:** Structural steel piles, steel pipe and fully welded steel piles fabricated from plates shall conform to ASTM A36, A252, A283, A572 or A588 listed in Chapter 35.

**1818.2 Allowable stress:** The allowable design compressive stress shall not exceed 0.35 of the minimum specified yield strength of the steel, except that maximum allowable design stress shall be 0.50 of the minimum specified yield strength of steel where substantiated by Section 1817.5.

**1818.3 Pile cap seismic connection:** All structural steel piles shall be connected to the pile cap for buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7. The connection between the pile cap and the structural steel piles shall be designed for a tensile force equal to 10 percent of the pile compression design *load*.

**1818.4 Dimensions of H-piles:** Sections of H-piles shall comply with the criteria of Sections 1818.4.1 through 1818.4.3.

**1818.4.1 Flanges:** The flange projections shall not exceed 14 times the minimum thickness of metal in either the flange or the web, and the flange widths shall not be less than 80 percent of the depth of the section.

**1818.4.2 Depth:** The nominal depth of the direction of the web shall not be less than 8 inches.

**1818.4.3 Thickness:** Flanges and webs shall have a minimum nominal thickness of $^3/_8$ inch.

**1818.5 Dimensions of steel pipe piles:** Steel pipe piles driven open ended shall have a nominal outside diameter of not less than 10 inches and a minimum wall thickness of not less than $^1/_4$ inch (6 mm) for diameters less than 14 inches (356 mm), and of not less than $^3/_8$ inch (10 mm) for diameters 14 inches (356 mm) and over. Where pipe of less wall thickness is driven open ended, a suitable cutting shoe shall be provided.

## SECTION 1819.0 CONCRETE-FILLED STEEL PIPE AND TUBE PILES

**1819.1 Material:** Steel pipe and tube piles shall conform to ASTM A252 or A283 listed in Chapter 35. Concrete shall conform to Section 1820.1.1. The maximum coarse aggregate size shall be $^3/_4$ inch (19 mm).

**1819.2 Allowable stress:** The allowable design compressive stress in the concrete shall not exceed 0.33 of the 28-day specified compressive strength ($f'_c$). The allowable design compressive stress in the steel shall not exceed 0.35 of the minimum specified yield strength of the steel, except that the maximum allowable design compressive stress shall be 0.50 of the minimum specified yield strength of the steel where substantiated by Section 1817.5.

**1819.3 Seismic reinforcement:** All concrete-filled steel pipe and tube piles shall have minimum reinforcement of 1 percent of the pile cross-sectional area for buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7. The longitudinal reinforcement shall be provided in the top of the pile with a length equal to two times the required cap embedment anchorage into the pile cap.

**1819.4 Minimum dimensions:** Piles shall have a nominal outside diameter of not less than 8 inches and a minimum wall thickness in accordance with Section 1818.5. For mandrel-driven pipe piles, the minimum wall thickness shall be $^1/_{10}$ inch (3 mm).

**1819.5 Reinforcement:** Reinforcement steel shall conform to Section 1820.1.2. Reinforcement shall not be placed within 1 inch (25 mm) of the steel casing.

**1819.6 Placing concrete:** The placement of concrete shall conform to Section 1820.1.3.

## SECTION 1820.0 CAST-IN-PLACE CONCRETE PILES

**1820.1 General:** The materials, reinforcement and installation of cast-in-place concrete piles shall conform to Sections 1820.1.1 through 1820.1.3.

**1820.1.1 Material:** All concrete shall have a 28-day specified compressive strength ($f'_c$) of not less than 2,500 psi (17235 kPa). Where concrete is placed through a funnel hopper at the top of the pile, the concrete mix shall be designed and proportioned so as to produce a cohesive workable mix having a slump of not less than 4 inches (102 mm) and not more than 6 inches (152 mm). If concrete is to be pumped, the mix design including slump shall be adjusted to produce a pumpable concrete.

**1820.1.2 Reinforcement:** Except for steel dowels embedded 5 feet (1524 mm) or less in the pile and as provided for in Section 1820.2, reinforcement, where required, shall be assembled and tied together and shall be placed in the pile as a unit before the reinforced portion of the pile is filled with concrete.

**1820.1.2.1 Seismic reinforcement:** All cast-in-place concrete piles shall have minimum reinforcement of 0.25 percent of the pile cross-sectional area for buildings assigned to Seismic Performance Category C, and a minimum reinforcement of 0.50 percent for buildings assigned to Seismic Performance Category D or E in accordance with Section 1610.1.7. The reinforcing shall be placed in the top one-third of the pile length or extend 10 feet (3048 mm) from the top of the pile, whichever is the longer length. For Seismic Performance Category C buildings, the pile reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of $^1/_4$ inch. The ties shall be provided at a maximum spacing of 16 times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top 2 feet (610 mm) of the pile length shall be 4 inches (102 mm). Tie detailing shall be in accordance with Section 1903.4.2. For Seismic Performance Category D or E buildings, the pile reinforcing shall be a minimum of four longitudinal bars with closed ties, or equivalent spirals, having a minimum diameter of $^3/_8$ inch, for piles with a diameter of 20 inches (508 mm) or less; and a minimum tie diameter of $^1/_2$ inch, for piles with a diameter more than 20 inches (508 mm). The ties shall be provided at a maximum spacing of eight times the longitudinal reinforcing bar diameter. The maximum tie spacing in the top 4 feet (1219 mm) of the pile length shall be 3 inches (76 mm).

**Exception:** Pile ties are not required where spiral-welded metal casing is used, provided the casing has thickness of not less than 0.068 inch (1.7 mm), and is adequately protected from corrosion due to soil, changing water levels, or other subgrade material indicated by the site soil investigation.

**1820.1.3 Installation:** Concrete shall be placed in such a manner as to ensure the exclusion of any foreign matter and to secure a full-sized shaft. Concrete shall not be placed through water except where tremie methods are approved. When depositing concrete from the top of the pile, the concrete shall not be chuted directly into the pile but shall be poured in a rapid and continuous operation through a funnel hopper centered at the top of the pile.

**1820.2 Drilled or augered uncased piles:** Drilled or augered uncased piles shall conform to Sections 1820.2.1 through 1820.2.4.

**1820.2.1 Allowable stress:** The allowable design stress in the concrete of drilled uncased piles shall not exceed 33 percent of the 28-day specified compressive strength ($f'_c$). The allowable design stress in the concrete of augered cast-in-place piles shall not exceed 25 percent of the 28-day specified compressive strength ($f'_c$).

**1820.2.2 Dimensions:** The pile length shall not exceed 30 times the average diameter. The minimum diameter shall be 12 inches (305 mm).

**Exception:** The length of the pile shall be permitted to exceed 30 times the diameter, provided that the design and installation of the pile foundation is under the direct supervision of a *registered design professional* knowledgeable in the field of soil mechanics and pile foundations. The *registered design professional* shall certify to the code official that the piles were installed in compliance with the approved design.

**1820.2.3 Installation:** If pile shafts are formed through unstable soils and concrete is placed in an open-drilled hole, a steel liner shall be inserted in the hole prior to placing the concrete. If the steel liner is withdrawn during concreting, the level of concrete shall be maintained above the bottom of the liner at a sufficient height to offset any hydrostatic or lateral soil pressure.

If concrete is placed by pumping through a hollow-stem auger, the auger shall not be permitted to rotate during withdrawal and shall be withdrawn in a steady continuous motion. Concreting pumping pressures shall be measured and shall be maintained high enough at all times to offset hydrostatic and lateral earth pressures. Concrete volumes shall be measured to ensure that the volume of concrete placed in each pile is equal to or greater than the theoretical volume of the hole created by the auger. If the installation process of any pile is interrupted or a loss of concreting pressure occurs, the pile shall be redrilled to the original depth and reformed. Augered cast-in-place piles shall not be installed within six pile diameters center to center of a pile filled with concrete less than 24 hours old, unless approved. If the concrete level in any completed pile drops, the pile shall be rejected and replaced.

**1820.2.4 Reinforcement:** For piles installed with a hollow-stem auger, where longitudinal steel reinforcement is placed without lateral ties, the reinforcement shall be placed through ducts in the auger prior to filling the pile with concrete. All pile reinforcement shall have a concrete cover of not less than $2^1/_2$ inches (64 mm).

**1820.3 Driven uncased piles:** Driven uncased piles shall conform to Sections 1820.3.1 through 1820.3.4.

**1820.3.1 Allowable stress:** The allowable design stress in the concrete shall not exceed 25 percent of the 28-day specified compressive strength ($f'_c$) applied to a cross-sectional area not greater than the inside area of the drive casing or mandrel.

**1820.3.2 Dimensions:** The pile length shall not exceed 30 times the average diameter. The minimum diameter shall be 12 inches (305 mm).

**1820.3.3 Installation:** Piles shall not be driven within six pile diameters center to center in granular soils or within one-half of the pile length in cohesive soils of a pile filled with concrete less than 48 hours old, unless approved. If the concrete surface in any complete pile rises or drops, the pile shall be rejected and replaced. Piles shall not be installed in soils which are capable of causing pile heave.

**1820.3.4 Concrete cover:** All pile reinforcement shall have a concrete cover of not less than $2^1/_2$ inches (64 mm), measured from the inside face of the drive casing or mandrel.

**1820.4 Enlarged base piles:** Enlarged base piles shall conform to the requirements of Sections 1820.4.1 through 1820.4.5.

**1820.4.1 Materials:** The maximum size for coarse aggregate for all concrete shall be $^3/_4$ inch (19 mm). Compacted concrete shall have a zero slump.

**1820.4.2 Allowable stress:** The maximum allowable design compressive stress for concrete not placed in a permanent steel casing shall be 25 percent of the 28-day specified compressive strength ($f'_c$). Where the concrete is placed in a permanent steel casing, the maximum allowable concrete stress shall be 33 percent of the 28-day specified compressive strength ($f'_c$).

**1820.4.3 Installation:** Enlarged bases formed either by compacting concrete or driving a precast base shall be formed in or driven into granular soils. All piles shall be constructed in the same manner as successful prototype test piles driven for the project. Pile shafts extending through peat or other organic soil shall be encased in a permanent steel casing. If a cased shaft is used, the shaft shall be adequately reinforced to resist column action or the annular space around the pile shaft shall be filled sufficiently to reestablish the lateral support of the soil. If pile heave occurs, the pile shall be rejected unless it is demonstrated that the pile is undamaged and capable of carrying twice its design *load*.

**1820.4.4 Loadbearing capacity:** Pile loadbearing capacity shall be verified by load tests in accordance with Section 1817.4.

**1820.4.5 Concrete cover:** The minimum concrete cover shall be $2^1/_2$ inches (64 mm) for uncased shafts and 1 inch (25 mm) for cased shafts.

**1820.5 Steel-cased piles:** Steel-cased piles shall comply with the requirements of Sections 1820.5.1 through 1820.5.4.

**1820.5.1 Material:** Pile shells or casings shall be of steel and shall be sufficiently strong to resist collapse and sufficiently water tight to exclude any foreign materials during the placing of concrete. Steel shells shall have a sealed tip with a diameter of not less than 8 inches (203 mm).

**1820.5.2 Allowable stress:** The allowable design compressive stress in the concrete shall not exceed 33 percent of the 28-day specified compressive strength ($f'_c$). The allowable concrete compressive stress shall be $0.40\,f'_c$ for that portion of the pile meeting the conditions specified in Sections 1820.5.2.1 through 1820.5.2.4.

**1820.5.2.1 Thickness:** The thickness of the steel shell shall not be less than No. 14 Gage (0.068 inch) minimum.

**1820.5.2.2 Shell type:** The shell shall be seamless or shall be provided with seams of strength equal to the basic material and be of a configuration which will provide confinement to the cast-in-place concrete.

**1820.5.2.3 Strength:** The ratio of steel yield strength ($f_y$) to design $f'_c$ shall not be less than 6.

**1820.5.2.4 Diameter:** The nominal pile diameter shall not be greater than 16 inches.

**1820.5.3 Installation:** Piles shall have steel shells that are mandrel driven their full length in contact with the surrounding soil, left permanently in place and filled with concrete. A pile shall not be driven within four and one-half average pile diameters of a pile filled with concrete less than 24 hours old unless approved. Concrete shall not be placed in steel shells within heave range of driving.

**1820.5.4 Reinforcement:** Reinforcement shall not be placed within 1 inch (25 mm) of the steel shell. Reinforcing shall be provided for unsupported pile lengths and for piles that are designed to resist uplift or unbalanced *lateral loads*.

**1820.5.4.1 Seismic reinforcement:** All steel-cased piles in buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7, shall have seismic reinforcement as required by Section 1820.1.2.1.

## SECTION 1821.0 PRECAST CONCRETE PILES

**1821.1 Design and manufacture:** All piles shall be designed and manufactured in accordance with accepted engineering practice to resist all stresses induced by handling, driving and service *loads*. The minimum lateral dimension shall be 10 inches (254 mm). All corners of square piles shall be chamfered. Longitudinal steel shall be arranged in a symmetrical pattern and shall be laterally tied with steel ties or wire spiral spaced not more than 3 inches (76 mm) apart, center to center, for a distance of 2 feet (610 mm) from the ends of the pile; and not more than 6 inches (152 mm) elsewhere except that at the ends of each pile, the first five ties or spirals shall be spaced 1 inch (25 mm) center to center.

**1821.1.1 Installation:** All piles shall be handled and driven so as not to cause injury or overstressing, which affects durability or strength.

**1821.2 Reinforced piles:** Reinforced precast concrete piles shall conform to Sections 1821.2.1 through 1821.2.5.

**1821.2.1 Design:** The minimum amount of longitudinal reinforcement shall be 2 percent of the concrete section and shall consist of at least four bars.

**1821.2.2 Material:** All concrete shall have a 28-day specified compressive strength ($f'_c$) of not less than 4,000 psi (27579 kPa).

**1821.2.3 Allowable stress:** The allowable compressive stress in the concrete shall not exceed 33 percent of the 28-day specified compressive strength ($f'_c$) applied to the gross cross-sectional area of the pile.

**1821.2.4 Concrete cover:** All pile reinforcement shall have a concrete cover of not less than 2 inches (51 mm), except that piles exposed to sea water shall have a minimum protective concrete cover of 3 inches (76 mm).

**1821.2.5 Installation:** A precast concrete pile shall not be driven before the concrete has attained a compressive strength of at least 3,000 psi (20684 kPa), but not less than such strength sufficient to withstand handling and driving forces.

**1821.3 Prestressed piles:** Prestressed concrete piles shall conform to the requirements of Sections 1821.3.1 through 1821.3.6.

**1821.3.1 Design:** The effective prestress in the pile shall not be less than 700 psi (4826 kPa).

**1821.3.2 Material:** Prestressing steel shall conform to ASTM A416 listed in Chapter 35. All concrete shall have a 28-day specified compressive strength ($f'_c$) of not less than 5,000 psi (34473 kPa).

**1821.3.3 Allowable stress:** The maximum allowable design compressive stress ($f_c$) in concrete shall be determined as follows:

$$f_c = 0.33 f'_c - 0.27 f_{pc}$$

where $f_{pc}$ is the effective prestress on the gross area of the pipe section.

**1821.3.4 Installation:** A prestressed pile shall not be driven before the concrete has attained a compressive strength of at least 4,000 psi (27579 kPa), but not less than such strength sufficient to withstand handling and driving forces.

**1821.3.5 Pile cap seismic connection:** Prestressed pile connection to the pile cap shall be in accordance with the requirements of Section 1816.11.1 or by extension of the pile reinforcing strand into the pile cap. The embedment into the pile cap shall develop the strength of the reinforcing strand. Prestressed pile cap connections in buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7, shall not be by development of exposed strand.

**1821.3.6 Spiral seismic reinforcing:** The spiral reinforcement in prestressed piles for buildings assigned to Seismic Performance Category D or E, in accordance with Section 1610.1.7, shall not be less than 0.6 percent for the length of the fully embedded piling where subjected to vertical *loads* only or where the design bending moment does not exceed 20 percent of the unfactored ultimate moment capacity at balanced strain conditions computed in accordance with ACI 318 listed in Chapter 35.

## SECTION 1822.0 TIMBER PILES

**1822.1 Materials:** Round timber piles shall conform to ASTM D25 listed in Chapter 35. Sawn timber piles shall conform to the appropriate grading rule for the species used.

**1822.2 Preservative treatment:** Timber piles used to support permanent structures shall be treated in accordance with this section unless it is established that the tops of the untreated timber piles will be below the lowest ground water level assumed to exist during the life of the structure. *Preservative* and minimum final retention shall be in accordance with AWPA C3 listed in Chapter 35 for round timber piles and AWPA C24 listed in Chapter 35 for sawn timber piles. Preservative-treated timber piles shall be subject to a quality control program administered by an *approved agency*. Pile cutoffs shall be treated in accordance with AWPA M4 listed in Chapter 35.

**1822.3 Allowable stress:** The allowable stresses for treated round timber piles shall not exceed those set forth in Table 1822.3 and as provided for in Sections 1822.3.1 and 1822.3.2.

**Table 1822.3**
**ALLOWABLE UNIT STRESSES[a] FOR TREATED ROUND TIMBER PILES, NORMAL LOAD DURATION — VALUES AT TIP OF PILE**

| Species | Compression parallel to grain (psi) | Bending (psi) | Shear horiz. (psi) | Compression perpendicular to grain (psi) | Modulus of elasticity |
|---|---|---|---|---|---|
| Pacific Coast Douglas fir (see Section 1822.3.1) | 1,250 | 2,450 | 115 | 230 | 1,500,000 |
| Red oak — Northern and Southern | 1,100 | 2,450 | 135 | 350 | 1,250,000 |
| Red pine (grown in the United States) | 900 | 1,900 | 1,900 | 85 | 1,280,000 |
| Southern pine — longleaf, slash, loblolly and shortleaf (see Section 1822.3.1) | 1,200 | 2,400 | 110 | 250 | 1,500,000 |

**Note a.** 1 psi = 6.9 kPa.

**1822.3.1 Stress increase:** The allowable unit stresses in compression parallel to grain for Pacific Coast Douglas fir and Southern pine shall be increased 0.2 percent for each 1 foot (305 mm) of length from the tip of the pile to the critical section. The increase shall not exceed 10 percent for any pile. The stress increase is cumulative with the increase in section properties associated with pile taper.

**1822.3.2 Dried or untreated piles:** The working stresses in Table 1822.3 have been adjusted to compensate for strength reductions caused by conditioning prior to treatment. Where piles are air dried or kiln dried prior to pressure treatment, or where untreated piles are to be used, the compression, bend-

ing and shear stresses shall be increased by multiplying the tabulated values by the following factors:

| | |
|---|---|
| Pacific Coast Douglas fir, red oak, red pine | 1.11 |
| Southern pine | 1.18 |

**1822.4 End-supported piles:** Any sudden decrease in driving resistance of an end-supported timber pile shall be investigated with regard to the possibility of damage. If the sudden decrease in driving resistance cannot be correlated to loadbearing data, the pile shall be removed for inspection or rejected.

## SECTION 1823.0 COMPOSITE PILES

**1823.1 Design:** Composite piles consisting of two or more approved pile types shall be designed to meet the conditions of installation.

**1823.2 Limitation of load:** The maximum allowable *load* shall be limited by the capacity of the weakest section incorporated in the pile.

**1823.3 Splices:** Splices between concrete and steel or wood sections shall be designed to prevent separation both before and after the concrete portion has set, and to ensure the alignment and transmission of the total pile *load*. Splices shall be designed to resist uplift caused by upheaval during driving of adjacent piles, and shall develop the full compressive strength and not less than 50 percent of the tension and bending strength of the weaker section.

## SECTION 1824.0 CAISSON PILES

**1824.1 Construction:** Caisson piles shall consist of a shaft section of concrete-filled pipe extending to bedrock with an uncased socket drilled into the bedrock and filled with concrete. The caisson pile shall have a full-length structural steel core or a stub core installed in the rock socket and extending into the pipe portion a distance equal to the socket depth.

**1824.2 Design:** The depth of the rock socket shall be sufficient to develop the full loadbearing capacity of the caisson pile with a minimum safety factor of 2, but the depth shall not be less than the outside diameter of the pipe. The design of the rock socket is permitted to be predicated on the sum of the allowable loadbearing pressure on the bottom of the socket plus bond along the sides of the socket. The minimum outside diameter of the caisson pile shall be 18 inches (457 mm), and the diameter of the rock socket shall be approximately equal to the inside diameter of the pile.

**1824.3 Seismic reinforcement:** All caisson piles in buildings assigned to Seismic Performance Category C, D or E, in accordance with Section 1610.1.7, shall have seismic reinforcement required by Section 1820.1.2.1.

**1824.4 Material:** Pipe and steel cores shall conform to the material requirements in Section 1818.0. Pipe shall have a minimum wall thickness of $^3/_8$ inch (10 mm) and shall be fitted with a suitable steel driving shoe welded to the bottom of the pipe. All concrete shall have a 28-day specified compressive strength ($f'_c$) of not less than 4,000 psi (27579 kPa). The concrete mix shall be designed and proportioned so as to produce a cohesive workable mix with a slump of 4 inches (102 mm) to 6 inches (152 mm).

**1824.5 Structural core:** The gross cross-sectional area of the structural steel core shall not exceed 25 percent of the gross area of the caisson. The minimum clearance between the structural core and the pipe shall be 2 inches (51 mm). If cores are to be spliced, the ends shall be milled or ground to provide full contact and shall be full-depth welded.

**1824.6 Allowable stress:** The allowable design compressive stresses shall not exceed the following: concrete, $0.33 f'_c$; steel pipe, $0.35 f_y$; and structural steel core, $0.50 f_y$.

**1824.7 Installation:** The rock socket and pile shall be thoroughly cleaned of all foreign materials before filling with concrete. Steel cores shall be bedded in cement grout at the base of the rock socket. Concrete shall not be placed through water except where tremie methods are approved.

## SECTION 1825.0 RETAINING WALLS

**1825.1 General:** Walls built to retain or support the lateral pressure of earth or water or other superimposed *loads* shall be designed and constructed of masonry, concrete, steel sheet piling or other approved materials (see Section 2311.7).

**1825.2 Design:** Retaining walls shall be designed to resist the design *lateral soil loads* in Section 1611.0, including both *dead* and *live load* surcharges to which such walls are subjected, and to ensure stability against overturning, sliding, excessive foundation pressure and water uplift.

**1825.3 Hydrostatic pressure:** Unless drainage is provided, the hydrostatic head of the water pressure shall be assumed to be equal to the height of the wall.

**1825.4 Coping:** Masonry retaining walls shall be protected with an approved coping.

**1825.5 Guards:** Where retaining walls with differences in grade level on either side of the wall in excess of 4 feet (1219 mm) are located closer than 2 feet (610 mm) to a walk, path, parking lot or driveway on the high side, such retaining walls shall be provided with guards that are constructed in accordance with Section 1021.0 or other approved protective measures.

# CHAPTER 19

# CONCRETE

## SECTION 1901.0 CONCRETE DESIGN STANDARDS

**1901.1 Plain and reinforced concrete:** Structural members of plain and reinforced concrete, including prestressed concrete, shall be designed and constructed in accordance with the provisions of this chapter and ACI 318 listed in Chapter 35, hereafter referred to in this chapter as ACI 318. Structural concrete slabs cast on stay-in-place, noncomposite steel form deck shall comply with this chapter and ACI 318. The design and construction of composite slabs of concrete on stay-in-place steel form deck shall comply with ASCE 3 listed in Chapter 35. Plain concrete shall not be used for structural members where special design considerations are required for blast forces, unless specifically approved.

## SECTION 1902.0 DEFINITIONS

**1902.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Admixture:** Material other than water, aggregate or hydraulic cement, used as an ingredient of concrete and added to concrete before or during mixing to modify the properties of the concrete.

**Cementitious material:** A material specified in Section 1906.0 which has cementing value when used in concrete either by itself, such as portland cement, blended hydraulic cements or expansive cement, or when used in combination with portland cement, blended hydraulic cement or expansive cement, such as fly ash, raw or calcined natural pozzolans, silica fume or ground-granulated blast-furnace slag.

**Concrete:** A mixture of portland cement or any other hydraulic cement, fine and coarse aggregates and water, with or without admixtures, of such proportions and manipulation as to meet specific requirements.

**Plain concrete:** Concrete that is unreinforced or contains less reinforcement than the minimum specified for reinforced concrete by ACI 318.

**Reinforced concrete:** Concrete with no less reinforcement than required by this code, prestressed or nonprestressed, and designed on the assumption that the two materials act together in resisting forces (see Section 1901.1).

**Member**

**Primary:** Any member of the structural frame of a building or structure used as a column or grillage beam, or to support concrete or masonry walls and partitions, including trusses, isolated lintels spanning an opening of 8 feet (2438 mm) or more, and any other member required to brace a column or a truss.

**Secondary:** Any member of the structural framework other than a primary member, including fill-in beams of floor systems.

## SECTION 1903.0 SEISMIC REQUIREMENTS FOR REINFORCED CONCRETE

**1903.1 General:** The design and construction of reinforced concrete components that resist seismic forces shall conform to the requirements of this section and ACI 318 except as modified by Section 1903.1.1.

**1903.1.1 Modifications to ACI 318:** The sections of ACI 318 shall be modified as indicated in the following items 1 through 13.

1. Modify Section 8.1.2 to read: "Except where load combinations of Section 1613.0 of this code, including seismic forces, are used, design of nonprestressed reinforced concrete members using Appendix A, Alternate Design Method, shall be permitted."
2. Replace ACI 318 Section 9.2.3 with Section 1613.0 of this code.
3. Add the following definitions to Section 21.1 of ACI 318:

   "Confined region: That 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."

   "Joint: That portion of a column bounded by the highest and lowest surfaces of the other members framing into it."

   "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."

4. Replace ACI 318 Sections 21.2.1.3 and 21.2.1.4 with the requirements of Sections 1903.3 through 1903.6 of this code.
5. Modify Section 21.2.1.5 to read: "A reinforced concrete structural system not satisfying the requirements of this chapter, including those composed of precast elements, is allowed if it is demonstrated by experimental evidence and analysis that the proposed system will have strength and toughness equal to or exceeding that provided by a comparable monolithic reinforced concrete structure satisfying this chapter."
6. Add the following to the end of Section 21.2.5.1: "Post-tensioning tendons are allowed in flexural members of frames, provided the average prestress ($f_{pc}$) calculated for an area equal to the member's shortest cross-sectional dimension multiplied by the perpendicular dimension, does not exceed 350 psi."
7. Add a new Section 21.3.2.5 to read: "For members in which prestressing tendons are used together with ASTM A615 (Grades 40 or 60) or A706 reinforcement to resist earthquake-induced forces, prestressing tendons shall not provide more than one-quarter of the strength for both positive moments and negative moments at the joint face. Anchorages for tendons shall be demonstrated to perform satisfactorily for seismic loadings. Anchorage assemblies shall withstand, without failure, a minimum of 50 cycles of loading ranging between 40 and 85 percent of the minimum specified strength of the tendon. Tendons shall extend through exterior joints and be anchored at the exterior face of the joint or beyond."
8. Add a new Section 21.4.5.3 to read: "At any section where the design strength ($\phi P_n$) of the column is less than the sum of the shear ($V_c$) computed in accordance with 21.4.5.1 for all of the beams framing into the column above the level under consideration, special transverse reinforcement shall be provided. For beams framing into opposite sides of the column, the moment components are allowed to be assumed to be of opposite sign. For determination of the nominal strength ($P_n$) of the column, these moments are allowed to be assumed to result from the deformation of the frame in any one principal axis."
9. Add to the end of Section 21.6.1: "A cast-in-place topping on a precast floor system is allowed to serve as a diaphragm provided that the cast-in-place topping is proportioned and detailed to resist the design shear forces. Where untopped precast elements are used as diaphragms, the strength reduction factor ($\phi$) for connections between elements shall be 0.5 except that for connection elements that form a continuous tie across and through the untopped element, extending across the diaphragm, the strength reduction factor ($\phi$) shall be 0.7."
10. Modify Section 21.6.3 to read: "The design shear force ($V_u$) shall be obtained from the lateral load analysis in accordance with the factored loads and combinations of loads specified in Section 1616.0 of this code."
11. Renumber existing Sections 21.6.6 through 21.6.8 to Sections 21.6.7 through 21.6.9, respectively, and add a new Section 21.6.6 to read:

    "21.6.6 Coupling beams: A coupling beam (beam which interconnects two shear walls in their own plane) with clear-span-to-effective-depth ratio ($l_n/d$) of less than 4 and with factored shear force ($V_u$) exceeding $4\sqrt{f'_c}b_w d$ shall be provided with shear reinforcement as specified in 21.6.6.1 through 21.6.6.3.

    21.6.6.1 Factor shear force ($V_u$) shall be resisted by two intersecting groups of symmetrical diagonally placed bars extending across the full length of the member and adequately anchored within the shear walls. Each group shall consist of a minimum of four bars providing an area ($A_{vd}$) not less than that calculated by the following formula:

$$A_{vd} = \frac{V_u}{2 f_y \sin\alpha}$$

    where: $\alpha$ is the angle between the diagonal reinforcement and the longitudinal axis of the member.

    21.6.6.2 Contribution of the diagonal reinforcement to nominal flexural strength of the coupling beam shall be included.

    21.6.6.3 Each group of diagonally placed bars shall be enclosed in special transverse reinforcement conforming to Sections 21.4.4.1 through 21.4.4.3. For the purpose of computing $A_g$ in accordance with Equations 10-5 and 21-3, minimum cover as specified in Section 7.7 shall be assumed over each group of diagonally placed reinforcing bars."
12. Modify the title of Section 21.8 to read: "Requirements for Intermediate Moment Frames."

**1903.2 Moment frames:** Moment frames shall comply with Section 1903.2.1, 1903.2.2 or 1903.2.3.

**1903.2.1 Ordinary moment frames:** Ordinary moment frames shall comply with the requirements of ACI 318, exclusive of Chapter 21.

**1903.2.2 Intermediate moment frames:** Intermediate moment frames shall comply with the requirements of Section 21.8 of ACI 318, and with the requirements of Section 1903.2.1 for ordinary moment frames.

**1903.2.3 Special moment frames:** Special moment frames shall comply with the requirements of Sections 21.2 through 21.5 of ACI 318 as modified in Section 1903.1.1, and with the requirements of Section 1903.2.1 for ordinary moment frames.

**1903.3 Seismic Performance Category A or B:** Buildings assigned to Seismic Performance Category A or B, in accordance with Section 1610.1.7, are allowed to be of any construction permitted in ACI 318 and this code. Additionally, ordinary mo-

ment frames forming part of the seismic-resisting system in buildings assigned to Seismic Performance Category B shall comply with Section 1903.3.1.

**1903.3.1 Ordinary moment frames in Seismic Performance Category B:** In Seismic Performance Category B buildings in flexural members of ordinary moment frames forming part of the seismic-resisting system, at least two main flexural reinforcing bars shall be provided continuously top and bottom throughout the flexural members and extending through or developed within exterior columns or boundary members.

**1903.4 Seismic Performance Category C:** Buildings assigned to Seismic Performance Category C shall conform to all of the requirements for Seismic Performance Category B, and to the requirements of Sections 1903.4.1 and 1903.4.2.

**1903.4.1 Moment frames:** All moment frames that are part of the seismic-resisting system shall be intermediate moment frames conforming to Section 1903.2.2, or special moment frames conforming to Section 1903.2.3.

**1903.4.2 Discontinuous members:** Columns supporting reactions from discontinuous stiff members, such as walls, shall be provided with special transverse reinforcement at the spacing ($s_o$) as defined in Section 21.8.5.1 of ACI 318 over their full height beneath the level at which the discontinuity occurs. This special transverse reinforcement shall be extended above and below the column as required by Section 21.4.4.5 of ACI 318.

**1903.5 Seismic Performance Category D or E:** Buildings assigned to Seismic Performance Category D or E shall conform to all of the requirements for Seismic Performance Category C, and to the requirements of Sections 1903.5.1 through 1903.5.3.

**1903.5.1 Moment frames:** All moment frames that are part of the seismic-resisting system, regardless of height, shall be special moment frames conforming to Section 1903.2.3.

**1903.5.2 Seismic-resisting system:** All materials and components in the seismic-resisting system shall conform to Sections 21.2 through 21.6 in ACI 318, as modified by Section 1903.1.1.

**1903.5.3 Frame members not proportioned to resist earthquake forces:** All frame components which are not part of the seismic-resisting system shall conform to Section 21.7.2 or 21.7.3 of ACI 318 depending on the magnitude of moments induced in those members when subjected to the lateral displacements of Section 1610.3.3.4.3 of this code. Where the effects of lateral displacements are not explicity checked, it shall be permitted to apply the requirements of Section 21.7.3 of ACI 318.

## SECTION 1904.0 SEISMIC REQUIREMENTS FOR PLAIN CONCRETE

**1904.1 General:** The design and construction of plain concrete components that resist seismic forces shall conform to the requirements of ACI 318, except as modified by this section.

**1904.2 Seismic Performance Category A or B:** Structural members of plain concrete permitted by ACI 318 or by this code are permitted in buildings assigned to Seismic Performance Category A or B in accordance with Section 1610.1.7.

**1904.3 Seismic Performance Category C:** Structural members of plain concrete in buildings assigned to Seismic Performance Category C shall conform to all of the requirements for Seismic Performance Categories A and B and the additional provisions and limitations of this section.

**1904.3.1 Footings:** Plain concrete footings supporting walls shall be provided with not less than two continuous longitudinal reinforcing bars. Bars shall not be smaller than #4, and shall have a total area of not less than 0.002 times the gross cross-sectional area of the footing. Continuity of reinforcement shall be provided at corners and intersections.

**Exceptions**

1. Longitudinal reinforcement is not required in footings for detached *one-* and *two-family dwellings* located in seismic map areas where the effective velocity-related acceleration ($A_v$) value is less than 0.15.
2. Longitudinal reinforcement is not required in footings for detached *one-* and *two-family* dwellings three stories or less in *height* and constructed with stud-bearing walls.

For isolated plain concrete footings supporting columns or pedestals in structures other than detached *one-* and *two-family dwellings* three stories or less in *height*, the projection of the footing beyond the face of the supported member shall not exceed the footing thickness.

**1904.3.2 Pedestals:** Plain concrete pedestals shall not be used to resist lateral forces due to earthquake.

**1904.3.3 Walls:** Not less than two No. 5 bars shall be provided around all window and door openings in *basement* and foundation walls, and such bars shall extend not less than 24 inches (610 mm) beyond the corners of the openings. Other walls shall be reinforced vertically and horizontally as required by Sections 1904.3.3.1 and 1904.3.3.2.

**1904.3.3.1 Vertical reinforcement:** Vertical reinforcement consisting of at least one #4 bar shall be provided continuously from support to support at each corner, at each side of each opening and at ends of walls or panels.

**1904.3.3.2 Horizontal reinforcement:** Horizontal reinforcement consisting of at least one #4 bar shall be provided as follows:

1. At the top and bottom of each wall opening, extending not less than 24 inches (610 mm) beyond the sides of the opening; and
2. Continuously at structurally connected roofs and floors, at the top of walls, at the bottom of the wall or in the top of the foundation where the foundation is doweled to the wall, and at a maximum vertical spacing of 10 feet (3048 mm).

Reinforcement at the top and bottom of wall openings shall be continuous to qualify as reinforcement required by item 2.

**1904.4 Seismic Performance Category D or E:** Structural members of plain concrete are not permitted in buildings assigned to Seismic Performance Category D or E.

**Exceptions**

1. In detached *one-* and *two-family dwellings* three stories or less in *height* constructed with stud-bearing walls, plain concrete footings without longitudinal reinforcement supporting walls and isolated plain concrete footings supporting columns or pedestals are permitted.
2. In all other buildings, plain concrete footings supporting walls shall be permitted, provided that such footings are reinforced longitudinally as specified in Section 1904.3.1.
3. In detached *one-* and *two-family dwellings* three stories or less in *height* constructed with stud-bearing walls, plain concrete foundation or *basement* walls having a thickness of not less than $7^1/_2$ inches (191 mm) and retaining 4 feet (1219 mm) or less of unbalanced fill shall be permitted.

## SECTION 1905.0 MINIMUM SLAB THICKNESS

**1905.1 General:** The thickness of concrete floor slabs supported directly on the ground shall not be less than $3^1/_2$ inches (89 mm). A 6-mil (0.006 inch; 152 µm) polyethylene *vapor retarder* with joints lapped not less than 6 inches (152 mm) shall be placed between the base course or subgrade and the concrete floor slab, or other approved equivalent methods or materials shall be used to retard vapor transmission through the floor slab.

**Exception:** A *vapor retarder* is not required:

1. For detached *structures accessory* to occupancies in Use Group R-3, such as garages, utility buildings or other unheated facilities;
2. For unheated storage rooms having an area of less than 70 square feet (6.5 $m^2$) and carports attached to occupancies in Use Group R-3;
3. For buildings of other use groups where migration of moisture through the slab from below will not be detrimental to the intended occupancy of the building;
4. For driveways, walks, patios and other flatwork which will not be enclosed at a later date; or
5. Where approved based upon local site conditions.

## SECTION 1906.0 MATERIALS

**1906.1 General:** Materials used to produce concrete and admixtures for concrete shall comply with the requirements of this section and ACI 318.

**1906.2 Cements:** Cement shall conform to ASTM C150 or ASTM C595 listed in Chapter 35. Type S or SA cement manufactured under ASTM C595 listed in Chapter 35 shall not be utilized as the principal cementitious material in structural concrete.

**1906.3 Aggregates:** Concrete aggregates shall conform to ASTM C33 or to ASTM C330 listed in Chapter 35.

**1906.3.1 Special tests:** Aggregates failing to meet the specifications listed in Section 1906.3 shall not be used unless approved and shown by special test or actual service to produce concrete of adequate strength and durability.

**1906.3.2 Nominal size:** Nominal maximum size of coarse aggregate shall not be larger than:

1. One-fifth of the narrowest dimension between sides of forms;
2. One-third of the depth of slabs; nor
3. Three-fourths of the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts.

**Exception:** These limitations shall not apply where information is submitted by the engineer and is approved showing that the workability and methods of consolidation are such that concrete will be placed without honeycomb or voids.

**1906.4 Water:** Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that are deleterious to concrete or reinforcement.

**1906.4.1 Chloride ions:** Mixing water for prestressed concrete or for concrete that will contain aluminum embedments, including that portion of mixing water contributed in the form of free moisture on aggregates, shall not contain deleterious amounts of chloride ion (see Section 1907.1.4).

**1906.4.2 Potability:** Nonpotable water shall not be used in concrete unless the specific requirements of ACI 318 allowing the use of nonpotable water are satisfied.

**1906.5 Steel reinforcement:** Reinforcement and welding of reinforcement to be placed in concrete construction shall conform to the requirements of this section.

**1906.5.1 Reinforcement type:** Reinforcement shall be of the deformed type, except for plain reinforcement used for spirals or tendons and reinforcement consisting of structural steel, steel pipe or steel tubing as specified in ACI 318. Reinforcement shall conform to the applicable ASTM standards listed in ACI 318.

**1906.5.2 Welding:** Welding of reinforcing bars shall conform to AWS D1.4 listed in Chapter 35. The type and location of welded splices and other required welding of reinforcing bars shall be indicated on the *construction documents*. ASTM reinforcing bar specifications, except for ASTM A706 listed in Chapter 35, shall be supplemented by the *construction documents* to require a report of material properties necessary to conform to welding procedures specified in AWS D1.4 listed in Chapter 35.

**1906.6 Admixtures:** Admixtures used in concrete shall comply with Sections 1906.6.1 through 1906.6.4. All other admixtures shall comply with ACI 318.

**1906.6.1 Chloride:** Calcium chloride or admixtures containing chloride from other than impurities from admixture ingredients shall not be used in prestressed concrete, in concrete containing embedded aluminum, in concrete cast against stay-in-place galvanized steel forms, or in concrete to be exposed to severe or very severe sulfate-containing solutions as defined in ACI 318 (see Sections 1907.1.3 and 1907.1.4).

**1906.6.2 Standards:** Air-entraining admixtures shall conform to ASTM C260 listed in Chapter 35. Water-reducing

admixtures, retarding admixtures, accelerating admixtures, water-reducing and retarding admixtures, and water-reducing and accelerating admixtures shall conform to ASTM C494 listed in Chapter 35.

**1906.6.3 Pozzolans:** Fly ash or other pozzolans used as admixtures shall conform to ASTM C618 listed in Chapter 35.

**1906.6.4 Blast-furnace slag:** Ground-granulated blast-furnace slag used as an admixture shall conform to ASTM C989 listed in Chapter 35.

**1906.7 Tests of materials:** Tests of concrete and the materials used in concrete shall be in accordance with ACI 318.

## SECTION 1907.0 DURABILITY REQUIREMENTS

**1907.1 Durability requirements:** Where concrete is exposed to special conditions as described in Sections 1907.1.1 through 1907.1.5, the requirements set forth in those sections shall be met.

**1907.1.1 Freezing and thawing and deicer chemicals:** Normal-weight and lightweight concrete exposed to freezing and thawing or deicer chemicals shall be air entrained with the air content indicated in Table 1907.1.1. Tolerance on air content as delivered shall be ±1.5 percent. For a specified compressive strength ($f'_c$) greater than 5,000 psi (34475 kPa), the required air content indicated in Table 1907.1.1 shall be reduced by 1 percent. Where finely divided materials of fly ash or natural pozzolans are used as mineral admixtures (see Section 1906.6.3) in air-entrained portland cement concrete, air content tests shall be made in accordance with ASTM C231 listed in Chapter 35, to assure compliance with the air content requirements of Table 1907.1.1. The frequency of air content tests shall be the same as that for strength tests required by Section 1908.3.1.

**Table 1907.1.1**
**TOTAL AIR CONTENT FOR FROST-RESISTANT CONCRETE**

| Nominal maximum aggregate size[b] (inches) | Air content, percent | |
|---|---|---|
| | Severe[a] exposure | Moderate[a] exposure |
| 3/8 | 7 1/2 | 6 |
| 1/2 | 7 | 5 1/2 |
| 3/4 | 6 | 5 |
| 1 | 6 | 4 1/2 |
| 1 1/2 | 5 1/2 | 4 1/2 |
| 2[c] | 5 | 4 |
| 3[c] | 4 1/2 | 3 1/2 |

**Note a.** The severe and moderate exposures referenced in this table are not based upon the weathering regions shown in Figure 1907.1.2. For the purposes of this section, severe and moderate exposures shall be defined as follows:

Severe exposure occurs when concrete will be in almost continuous contact with moisture prior to freezing, or where deicing salts are used. Examples are pavements, bridge decks, sidewalks, parking garages and water tanks.

Moderate exposure occurs when concrete will be only occasionally exposed to moisture prior to freezing, and where deicing salts are not used. Examples are certain exterior walls, beams, girders and slabs not in direct contact with soil.

**Note b.** See ASTM C33 listed in Chapter 35 for oversize tolerances for various nominal maximum size designations.

**Note c.** These air contents apply to total mix, as for the preceding aggregate sizes. When testing these concretes, however, aggregate larger than 1 1/2 inches is removed by handpicking or sieving and air content is determined on the minus-1 1/2-inch fraction of mix. (Tolerance on air content as delivered applies to this value.) Air content of the total mix is computed from the value determined on the minus-1 1/2-inch fraction.

**1907.1.2 Water-cementitious material ratio and strength:** For occupancies and appurtenances thereto in Use Group R-3, and occupancies in Use Group R-2 that are in buildings less than four stories in *height*, normal-weight aggregate concrete that is subject to weathering (freezing and thawing), as determined from Figure 1907.1.2, or deicer chemicals shall comply with the requirements of Table 1907.1.2(1). In all other buildings, concrete that is intended to have a low permeability to water, or concrete that will be subject to freezing and thawing in a moist condition or that will be exposed to deicing chemicals, salt, salt water, brackish water, sea water or spray from these sources, shall conform to the requirements of Table 1907.1.2(2). Additionally, concrete that will be exposed to deicing chemicals shall conform to the limitations of Section 1907.1.2.2.

**Table 1907.1.2(1)**
**MINIMUM SPECIFIED COMPRESSIVE STRENGTH ($f'_c$)[c] OF CONCRETE SUBJECT TO WEATHERING[b] OR DEICER CHEMICALS**

| Type or location of concrete construction | Minimum specified compressive strength ($f'_c$ at 28 days, psi) | | |
|---|---|---|---|
| | Negligible exposure | Moderate exposure | Severe exposure |
| Basement walls and foundations not exposed to the weather | 2,500 | 2,500 | 2,500[a] |
| Basement slabs and interior slabs on grade, except garage floor slabs | 2,500 | 2,500 | 2,500[a] |
| Basement walls, foundation walls, exterior walls and other vertical concrete surfaces exposed to the weather | 2,500 | 3,000[b] | 3,000[b] |
| Driveways, curbs, walks, patios, porches, carport slabs, steps and other flatwork exposed to the weather, and garage floor slabs | 2,500 | 3,000[b] | 3,500[b] |

**Note a.** Concrete in these locations which can be subjected to freezing and thawing during construction shall be of air-entrained concrete in accordance with Table 1907.1.1.

**Note b.** Concrete shall be air entrained in accordance with Table 1907.1.1.

**Note c.** 1 psi = 6.9 kPa.

**Table 1907.1.2(2)**
**REQUIREMENTS FOR SPECIAL EXPOSURE CONDITIONS**

| Exposure condition | Maximum water-cementitious materials ratio (by weight), normal-weight aggregate concrete | Minimum $f'_c$ normal-weight and lightweight aggregate concrete (psi)[a] |
|---|---|---|
| Concrete intended to have low permeability when exposed to water | 0.50 | 4,000 |
| Concrete exposed to freezing and thawing in a moist condition | 0.45 | 4,500 |
| For corrosion protection of reinforcement in concrete exposed to chlorides from deicing chemicals, salt, salt water, brackish water, seawater or spray from these sources | 0.40 | 5,000 |

**Note a.** 1 psi = 6.9 kPa.

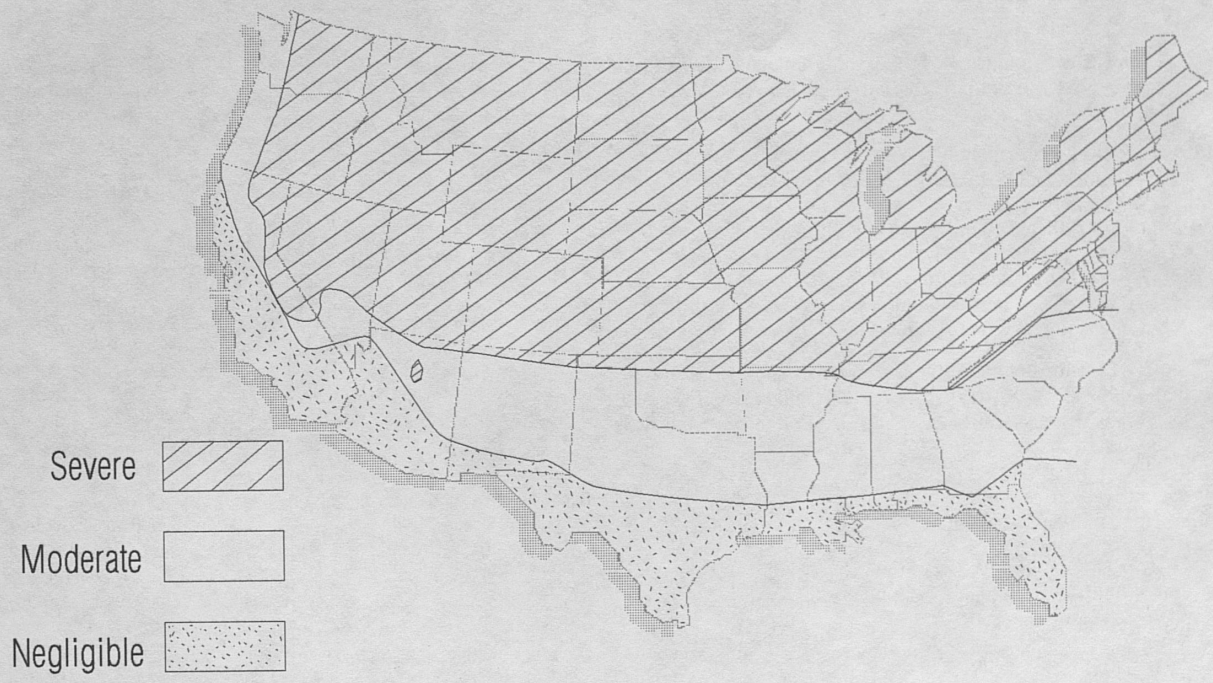



**Figure 1907.1.2**
**WEATHERING PROBABILITY MAP FOR CONCRETE[a, b, c]**

**Note a.** Lines defining areas are approximate only. Local areas can be more or less severe than indicated by the region classification.

**Note b.** A "severe" classification is where weather conditions encourage or require the use of deicing chemicals or where there is potential for a continuous presence of moisture during frequent cycles of freezing and thawing. A "moderate" classification is where weather conditions occasionally expose concrete in the presence of moisture to freezing and thawing, but where deicing chemicals are not generally used. A "negligible" classification is where weather conditions rarely expose concrete in the presence of moisture to freezing and thawing.

**Note c.** Alaska and Hawaii are classified as severe and moderate respectively.

**1907.1.2.1 Calculation of water-cementitious materials ratio:** Calculations to determine compliance with the maximum water-cementitious materials ratio requirement of Tables 1907.1.2(2) and 1907.1.3 shall be in accordance with ACI 318.

**1907.1.2.2 Limitations on use of certain cementitious materials:** For concrete exposed to deicing chemicals, the maximum weight of fly ash or other pozzolan, silica fume or ground-granulated blast-furnace slag that is included in the concrete, shall not exceed the percentages of the total weight of cementitious materials specified in ACI 318.

**1907.1.3 Protection from sulfate:** Concrete that will be exposed to sulfate-containing solutions or soils shall conform to the requirements of Table 1907.1.3. Pozzolan (see Section 1906.6.3) that is required to be added to Type V cement for very severe sulfate exposure shall be determined by test or service records to improve sulfate resistance when used in concrete containing Type V cement.

**1907.1.4 Corrosion protection:** For corrosion protection of reinforcement in concrete, the maximum water-soluble chloride ion concentrations in concrete shall not exceed the limitations established in ACI 318.

**1907.1.5 Protection from salt:** Where concrete with reinforcement will be exposed to chlorides from deicing chemicals, salt, salt water, brackish water, seawater or spray from these sources, the requirements of Table 1907.1.2(2) for the water-cementitious materials ratio, and concrete strength and minimum concrete cover requirements of Section 1910.6, shall be satisfied.

## SECTION 1908.0 CONCRETE QUALITY, MIXING AND PLACING

**1908.1 General:** Concrete shall be proportioned to provide an average compressive strength as prescribed by ACI 318, and to satisfy the durability criteria of Section 1907.0. Concrete shall be produced to minimize frequency of strengths below $f'_c$ as prescribed in Section 1908.3.2. The specified compressive strength (f ¢c) for concrete designed and constructed in accordance with this chapter shall not be less than 2,500 psi (17238 kPa).

Unless otherwise specified, $f'_c$ shall be based on 28-day strength. If other than 28 days is used in the design, the length of time to reach $f'_c$ shall be indicated on the construction documents.

**1908.2 Selection of concrete proportions:** Concrete proportions shall be determined in accordance with ACI 318.

**1908.3 Evaluation for acceptance of concrete:** For evaluation and acceptance of concrete, the procedures established in Sections 1908.3.1 through 1908.3.4 shall be followed.

**1908.3.1 Frequency of testing:** Testing shall be conducted as required by the following:

1. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards (115 $m^3$) of concrete, nor less than once for each 5,000 square feet (465 $m^2$) of surface area for slabs or walls.
2. On a given project, if the total volume of concrete is such that the frequency of testing required by Section 1908.3.1, item 1, provides less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
3. Where total quantity of a given class of concrete is less than 50 cubic yards (38 $m^3$), strength tests are not required when approved and evidence of satisfactory strength is provided. Satisfactory evidence shall include, but not be limited to, certification from the concrete supplier that the concrete to be provided will be proportioned to achieve the specified compressive strength based on "field experience" or "trial batches" in accordance with ACI 318.
4. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at the test age designated for determination of $f'_c$.

**Table 1907.1.3**
**REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS OR SOILS**

| Sulfate exposure | Water-soluble sulfate ($SO_4$) in soil, percent by weight | Sulfate ($SO_4$) in water, ppm | Cement type | | Maximum water-cementitious materials ratio, by weight, normal-weight aggregate concrete | Minimum $f'_c$ normal-weight and lightweight aggregate concrete (psi)[b] |
|---|---|---|---|---|---|---|
| | | | ASTM C150 | ASTM C595 | | |
| Negligible | 0.00-0.10 | 0-150 | — | — | — | — |
| Moderate[a] | 0.10-0.20 | 150-1500 | II | IP (MS), IS (MS), P (MS), I (PM) (MS), I (SM) (MS) | 0.50 | 4000 |
| Severe | 0.20-2.00 | 1500-10,000 | V | — | 0.45 | 4500 |
| Very severe | Over 2.00 | Over 10,000 | V plus pozzolan | — | 0.45 | 4500 |

**Note a.** Seawater.
**Note b.** 1 psi = 6.9 kPa.

**1908.3.2 Laboratory-cured specimens:** Laboratory-cured specimens shall conform to the following criteria:

1. Samples for strength tests shall be taken in accordance with ASTM C172 listed in Chapter 35.
2. Cylinders for strength tests shall be molded and laboratory cured in accordance with ASTM C31 listed in Chapter 35, and tested in accordance with ASTM C39 listed in Chapter 35.
3. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
   3.1. Every arithmetical average of all sets of three consecutive strength tests equals or exceeds $f'_c$; and
   3.2. All individual strength tests (average of two cylinders) shall not fall below $f'_c$ by more than 500 psi (3448 kPa).
4. If either of the requirements of Section 1908.3.2, item 3, is not met, steps shall be taken to increase the average of subsequent strength test results. The requirements of Section 1908.3.4 shall apply if the requirement in Section 1908.3.2, item 3.2, is not met.

**1908.3.3 Field-cured specimens:** Where the code official requires strength tests of cylinders cured under field conditions to check adequacy of curing and protection of concrete in the structure, the field-cured specimens shall conform to the following criteria:

1. Field-cured cylinders shall be cured under field conditions in accordance with ASTM C31 listed in Chapter 35.
2. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test cylinders.
3. Procedures for protecting and curing concrete shall be improved where the strength of field-cured cylinders at the test age designated for determination of $f'_c$ is less than 85 percent of that of companion laboratory-cured cylinders. The 85-percent criterion is not required where the field-cured strength exceeds $f'_c$ by more than 500 psi (3448 kPa).

**1908.3.4 Investigation of low-strength test results:** If the investigation of concrete indicates low-strength conditions, the following procedures shall apply:

1. If any strength test (see Section 1908.3.1, item 4) of laboratory-cured cylinders falls below the specified value of $f'_c$ by more than 500 psi (3448 kPa) (see Section 1908.3.2, item 3.2) or if tests of field-cured cylinders indicate deficiencies in protection and curing (see Section 1908.3.3, item 3), steps shall be taken to assure that the loadbearing capacity of the structure is not jeopardized.
2. If the likelihood of low-strength concrete is confirmed and computations indicate that the loadbearing capacity will be significantly reduced, tests of cores drilled from the area in question shall be made in accordance with ACI 318.
3. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is not less than 85 percent of $f'_c$ and if a single core is not less than 75 percent of $f'_c$. Where necessary to check testing accuracy, locations represented by erratic core strengths shall be retested.
4. If the criteria of Section 1908.3.4, item 3, are not met, and if structural adequacy remains in doubt, load tests shall be ordered at the discretion of the engineer or the code official as outlined in Chapter 20 of ACI 318 for the questionable portion of the structure, or other appropriate action taken.

**1908.4 Preparation of equipment and place of deposit:** Preparation before concrete placement shall include the following criteria:

1. All equipment for mixing and transporting concrete shall be clean.
2. All debris and ice shall be removed from spaces to be occupied by concrete.
3. Forms shall be properly coated.
4. Masonry filler units that will be in contact with concrete shall be well drenched.
5. Reinforcement shall be thoroughly clean of ice or other deleterious coating.
6. Water shall be removed from the place of deposit before concrete is placed, unless a tremie is to be used, or unless otherwise approved by the code official.
7. All laitance and other unsound material shall be removed before additional concrete is placed against hardened concrete.

**1908.5 Mixing:** All concrete shall be mixed until there is a uniform distribution of materials, and shall be discharged completely before the mixer is recharged.

**1908.5.1 Ready-mixed concrete:** Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94 or ASTM C685 listed in Chapter 35.

**1908.5.2 Job-mixed concrete:** Job-mixed concrete shall be mixed in accordance with ACI 318.

**1908.6 Conveying:** Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation or loss of materials. Conveying equipment shall be capable of providing a supply of concrete at the site of placement without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments.

**1908.7 Depositing:** Concrete shall be deposited as nearly as practicable in its final position to avoid segregation caused by rehandling or flowing.

**1908.7.1 Placement timing:** Concrete placement shall be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.

**1908.7.2 Unacceptable concrete:** Concrete that has partially hardened or has been contaminated by foreign materials shall not be deposited in the structure.

**1908.7.3 Retempering:** Retempered concrete or concrete that has been remixed after initial set shall not be used unless approved by the *registered design professional*.

**1908.7.4 Continuous concreting:** Once started, concreting shall be carried on as a continuous operation until the placement of a panel or section, as defined by panel or section

boundaries or predetermined joints, is completed except as provided for in Section 1909.4.

**1908.7.5 Placement in walls:** Top surfaces of vertically formed lifts shall be generally level.

**1908.7.6 Construction joints:** Where construction joints are required, such joints shall be made in accordance with Section 1909.4.

**1908.7.7 Consolidation:** All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

**1908.8 Curing:** Concrete (other than high-early-strength) shall be maintained above 50 degrees F. (10 degrees C.) and in a moist condition for at least the first seven days after placement, except when cured in accordance with Section 1908.8.2.

**1908.8.1 High-early-strength concrete:** High-early-strength concrete shall be maintained above 50 degrees F. (10 degrees C.) and in a moist condition for at least the first three days after placement, except when cured in accordance with Section 1908.8.2.

**1908.8.2 Accelerated curing:** If curing is to be accelerated, such curing shall be done in accordance with ACI 318.

**1908.9 Cold-weather requirements:** Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.

**1908.9.1 Frost:** All concrete materials and all reinforcement, forms, fillers and ground with which concrete is to come in contact shall be free from frost.

**1908.9.2 Ice:** Frozen materials or materials containing ice shall not be used.

**1908.10 Hot-weather requirements:** During hot weather, attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that would impair required strength or serviceability of the member or structure.

## SECTION 1909.0 FORMWORK, EMBEDDED PIPES AND CONSTRUCTION JOINTS

**1909.1 Design of formwork:** The design, fabrication and erection of forms shall result in a final structure that conforms to shapes, lines and dimensions of the members as required by the *construction documents*.

**1909.1.1 Form strength:** Forms shall be substantial and shall be sufficiently tight to prevent leakage of concrete.

**1909.1.2 Form bracing:** Forms shall be properly braced or tied together to maintain position and shape.

**1909.1.3 Form placement:** Forms and their supports shall be designed so as not to damage previously placed structures.

**1909.2 Removal of forms and shores, and reshoring:** The removal of forms and shores, and the installation of reshores shall comply with the requirements of Sections 1909.2.1 and 1909.2.2.

**1909.2.1 Safety:** Forms shall be removed in such a manner so as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged by removal operations.

**1909.2.2 Applicability:** The provisions of Sections 1909.2.2.1 through 1909.2.2.3 shall apply to slabs and beams, except where cast on the ground.

**1909.2.2.1 Schedule for removal of shores and reshoring:** Before starting construction, the contractor shall develop a procedure and schedule for removal of shores and installation of reshores and for calculating the *loads* transferred to the structure during the process.

**1909.2.2.1.1 Submittals:** The structural analysis and concrete strength data utilized in planning and implementing the removal of shores shall be furnished by the contractor to the code official where required by the code official.

**1909.2.2.1.2 Construction loads:** Construction *loads* shall not be supported on, nor any shoring removed from, any part of the structure under construction except where that portion of the structure, in combination with the remaining forming and shoring system, has sufficient strength to support safely its weight and *loads* placed thereon.

**1909.2.2.1.3 Structural analysis:** Sufficient strength shall be demonstrated by structural analysis considering proposed *loads*, strength of the forming and shoring system, and concrete strength data. Concrete strength data shall be based on tests of field-cured cylinders or, where approved, on other procedures to evaluate concrete strength.

**1909.2.2.2 Construction loads on unshored construction:** Construction *loads* exceeding the combination of superimposed *dead load* plus specified *live load* shall not be supported on any unshored portion of the structure under construction, unless analysis indicates adequate strength to support such additional *loads*.

**1909.2.2.3 Prestressed members:** Form supports for prestressed concrete members shall not be removed until sufficient prestressing has been applied to enable the members to carry their *dead load* and anticipated construction *loads*.

**1909.3 Conduits and pipes embedded in concrete:** Where conduits, pipes and sleeves of any material not harmful to concrete and within limitations of this section are embedded in concrete with the approval of the engineer, such embedments shall not be considered to replace structurally the displaced concrete, except as provided for in Section 1909.3.5.

**1909.3.1 Aluminum conduit and pipe:** Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

**1909.3.2 Structural effect:** Conduits, pipes and sleeves passing through a slab, wall or beam shall not impair significantly the strength of the construction.

**1909.3.3 Columns:** Conduits and pipes, including fittings, embedded within a column, shall not displace more than 4 percent of the area of the cross section on which strength is calculated or which is required for fire protection.

**1909.3.4 Slabs, walls or beams:** Except where *construction documents* for conduits and pipes are approved by the *registered design professional* and the code official, conduits and pipes embedded within a slab, wall or beam (other than those merely passing through) shall:

1. Not be larger in outside dimension than one-third of the overall thickness of the slab, wall or beam in which such conduits and pipes are embedded.
2. Not be spaced closer than three diameters or widths on center.
3. Not impair significantly the strength of the construction.

**1909.3.5 Displaced concrete:** Conduits, pipes and sleeves shall not be considered in compression as replacing structurally the displaced concrete unless such conduits, pipes and sleeves:

1. Are not exposed to rusting or other deterioration.
2. Are of uncoated or galvanized iron or steel not thinner than standard Schedule 40 steel pipe.
3. Have a nominal inside diameter not over 2 inches and are spaced not less than three diameters on center.

**1909.3.6 Additional considerations:** In addition to the other requirements of Section 1909.3, pipes that will contain liquid, gas or vapor which are embedded in structural concrete shall conform to the following conditions:

1. Pipes and fittings shall be designed to resist effects of the material, pressure and temperature to which the pipes and fittings will be subjected.
2. Liquid, gas or vapor, except water not exceeding 90 degrees F. (32 degrees C.) or 50 psi (345 kPa) pressure, shall not be placed in the pipes until the concrete has attained design strength.
3. In solid slabs, piping that is not used for radiant heating or snow melting shall be placed between top and bottom reinforcement.
4. Concrete cover for pipes, conduit and fittings shall not be less than $1^1/_2$ inches (38 mm) for concrete exposed to earth or weather conditions or $^3/_4$ inch (19 mm) for concrete not exposed to weather conditions or in contact with ground.
5. Reinforcement with an area of not less than 0.002 times the area of the concrete section shall be provided normal to piping.
6. Piping and conduit shall be fabricated and installed so that cutting, bending or displacement of reinforcement from the proper location will not be required.

**1909.4 Construction joints:** Construction joints shall be created using the procedures set forth in Sections 1909.4.1 through 1909.4.6.

**1909.4.1 Surface cleaning:** Surface of concrete construction joints shall be cleaned and laitance removed.

**1909.4.2 Preparation of joint:** Immediately before new concrete is placed, all construction joints shall be wetted and standing water shall be removed.

**1909.4.3 Effect on strength:** Construction joints shall be so made and located as not to impair the strength of the structure. Provisions shall be made for the transfer of shear and other forces through construction joints.

**1909.4.4 Location of joints:** Construction joints in floors shall be located within the middle third of the spans of slabs, beams and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.

**1909.4.5 Support conditions:** Beams, girders or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is not in a plastic state.

**1909.4.6 Monolithic pours:** Beams, girders, haunches, drop panels and capitals shall be placed monolithically as part of a slab system, unless otherwise shown on the *construction documents*.

## SECTION 1910.0 DETAILS OF REINFORCEMENT

**1910.1 General:** Details of reinforcement shall comply with the requirements of this section and ACI 318.

**1910.2 Bending reinforcement:** All reinforcement shall be bent cold, unless otherwise permitted by the *registered design professional* and approved. Reinforcement partially embedded in concrete shall not be field bent, except as shown on the *construction documents* or as authorized by the *registered design professional* and approved.

**1910.3 Surface conditions of reinforcement:** At the time concrete is placed, reinforcement shall be free from mud, oil or other nonmetallic coatings that adversely affect bonding capability.

**1910.3.1 Rust or mill scale:** Reinforcement, except prestressing tendons, with rust or mill scale, or a combination of both, shall be considered satisfactory, provided that the minimum dimensions (including height of deformations) and the weight of a hand-wire-brushed test specimen are not less than the specification requirements of the applicable ASTM standard referenced by ACI 318.

**1910.3.2 Prestressing tendons:** Prestressing tendons shall be clean and free of oil, dirt, scale, pitting and excessive rust. A light oxide is permissible.

**1910.4 Placing reinforcement:** Reinforcement, prestressing tendons and ducts shall be accurately placed and supported before concrete is placed, and shall be secured against displacement within the tolerances permitted in Sections 1910.4.1 through 1910.4.3.

**Exception:** Embedded items (such as dowels or inserts) of precast concrete members that either protrude from concrete or remain exposed for inspection shall not be embedded while the concrete is in a plastic state, unless authorized by the

*registered design professional* and the following conditions are met:

1. Embedded items are not required to be hooked or tied to reinforcement.
2. Embedded items shall be maintained in the correct position while concrete remains plastic.
3. Embedded items shall be properly anchored to develop required factored *loads*.

**1910.4.1 Reinforcement, prestressing tendons and prestressing ducts:** Unless otherwise specified by the engineer, reinforcement, prestressing tendons and prestressing ducts shall be placed within the following tolerances:

1. The tolerance for depth ($d$) and the minimum concrete cover in flexural members, walls and compression members shall be as specified in Table 1910.4.1, except that the tolerance for the clear distance to formed soffits shall be minus $^1/_4$ inch (6 mm) and the tolerance for cover shall not exceed minus one-third of the minimum concrete cover required in the design drawings or specifications.
2. The tolerance for longitudinal location of bends and ends of reinforcement shall be ±2 inches (51 mm) except at discontinuous ends of members where the tolerance shall be $^1/_2$ inch (13 mm).

**Table 1910.4.1**
**TOLERANCES[a]**

| Depth ($d$) | Tolerance on $d$ | Tolerance on $d$ minimum concrete cover |
|---|---|---|
| $d$ less than or equal to 8 inches | $\pm^3/_8$ inch | $-^3/_8$ inch |
| $d$ greater than 8 inches | $\pm^1/_2$ inch | $-^1/_2$ inch |

**Note a.** 1 inch = 25.4 mm.

**1910.4.2 Welded wire fabric:** Where welded wire fabric (with wire size not greater than W5 or D5) used in slabs not exceeding 10 feet (3048 mm) in span is curved from a point near the top of slab over the support to a point near the bottom of slab at midspan, such reinforcement shall be either continuous over, or securely anchored at, the support.

**1910.4.3 Welding:** Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the engineer.

**1910.5 Spacing limitations for reinforcement:** The clear distance between reinforcing bars, bundled bars, prestressing tendons and ducts shall be in accordance with the limitations of ACI 318.

**1910.6 Concrete protection for reinforcement:** Reinforcement shall be provided with the protection required by Sections 1910.6.1 through 1910.6.5.

**1910.6.1 Cast-in-place concrete:** In cast-in-place concrete (nonprestressed), the minimum concrete cover for reinforcement shall be as indicated in Table 1910.6.1.

**1910.6.2 Precast concrete:** The minimum cover for reinforcement in precast concrete manufactured under plant control conditions and for prestressed concrete shall be in accordance with ACI 318.

**Table 1910.6.1**
**MINIMUM COVER**

| Structural element and condition | Minimum cover (inches)[a] |
|---|---|
| 1. Concrete cast against and permanently exposed to earth | 3 |
| 2. Concrete exposed to earth or weather: | |
| #6 through #18 bars | 2 |
| #5 bar, W31 or D31 wire, and smaller | $1^1/_2$ |
| 3. Concrete not exposed to weather or in contact with ground | |
| Slabs, walls, joists: | |
| #14 and #18 bars | $1^1/_2$ |
| #11 bar and smaller | $^3/_4$ |
| Beams, columns: | |
| Primary reinforcement, ties, stirrups, spirals | $1^1/_2$ |
| Shells, folded plate members: | |
| #6 bar and larger | $^3/_4$ |
| #5 bar, W31 or D31 wire, and smaller | $^1/_2$ |

**Note a.** 1 inch = 25.4 mm.

**1910.6.3 Corrosive environments:** In corrosive environments or other severe conditions, the amount of concrete protection shall be suitably increased, and the density and nonporosity of protection concrete shall be considered, or other protection shall be provided.

**1910.6.4 Future extensions:** Exposed reinforcement, inserts and plates intended for bonding with future extensions shall be protected from corrosion.

**1910.6.5 Fire protection:** Where this code requires a thickness of cover for fire protection greater than the minimum concrete cover specified in Section 1910.6.1 or ACI 318, such greater thickness shall be used.

## SECTION 1911.0 SHOTCRETE

**1911.1 General:** Except as specified in this section, shotcrete shall conform to the requirements for plain concrete or reinforced concrete. Shotcrete is mortar or concrete which is pneumatically projected at a high velocity onto a surface.

**1911.2 Proportioning:** Shotcrete proportions shall be selected that allow suitable placement procedures using the delivery equipment selected, and that results in in-place hardened shotcrete conforming to the strength requirements of this code.

**1911.3 Aggregate:** Coarse aggregate, if used, shall not exceed $^3/_4$ inch (19 mm) in size.

**1911.4 Reinforcement:** Reinforcement shall comply with Sections 1911.4.1 through 1911.4.3.

**1911.4.1 Size:** The maximum size of reinforcement shall be No. 5 bars. The code official shall approve the use of larger bars where it is demonstrated that adequate encasement of the larger bars will be achieved.

**1911.4.2 Spacing:** The minimum clearance between parallel reinforcing bars shall be $2^1/_2$ inches (64 mm). Welded wire fabric shall have a minimum wire spacing of 2 inches (51 mm) by 2 inches (51 mm).

**1911.4.3 Splices:** Lap splices of reinforcing bars shall be by the noncontact lap-splice method with at least 2 inches (51 mm) of clearance between bars. The code official shall permit the use of contact lap splices where necessary for the support of the reinforcing and provided that it is demonstrated that adequate encasement of the bars at the splice will be achieved.

**1911.5 Rebound:** Any rebound or accumulated loose aggregate shall be removed from the surfaces to be covered prior to placing the initial or any succeeding layers of shotcrete. Rebound shall not be reused as aggregate.

**1911.6 Joints:** Except where permitted herein, unfinished work shall not be allowed to stand for more than 30 minutes unless all edges are sloped to a thin edge. For structural elements which will be under compression and for construction joints shown on the approved *construction documents*, square joints are permitted. Before placing additional material adjacent to previously applied work, sloping and square edges shall be cleaned and wetted.

**1911.7 Damage:** Shotcrete that exhibits sags, sloughs, segregation, honeycombing, sand pockets or other obvious defects, shall be removed and replaced.

**1911.8 Curing:** During the curing periods specified herein, shotcrete shall be maintained above 40 degrees F. (4 degrees C.) and in a moist condition.

**1911.8.1 Initial curing:** Shotcrete shall be kept continuously moist for 24 hours after shotcreting is completed or shall be sealed with an approved curing compound.

**1911.8.2 Final curing:** Final curing shall continue for seven days after shotcreting, or for three days if high-early-strength cement is used, or until the specified strength is obtained. Final curing shall consist of the initial curing process or the shotcrete shall be covered with an approved moisture-retaining cover.

**1911.8.3 Natural curing:** Natural curing shall not be used in lieu of that specified in this section unless the relative humidity remains at or above 85 percent, and is authorized by the *registered design professional*, and approved by the code official.

**1911.9 Strength test:** A strength test of shotcrete shall be made in accordance with the quality assurance provisions of ACI 506.2 listed in Chapter 35.

## SECTION 1912.0 CONCRETE-FILLED PIPE COLUMNS

**1912.1 General:** Concrete-filled pipe columns shall be manufactured from standard, extra-strong or double-extra-strong steel pipe or tubing which is filled with concrete so placed and manipulated as to secure maximum density and to ensure complete filling of the pipe without voids.

**1912.2 Design:** The safe supporting capacity of concrete-filled pipe columns shall be computed in accordance with the *approved rules* or as determined by a test.

**1912.3 Connections:** All caps, base plates and connections shall be of approved types and shall be positively attached to the shell and anchored to the concrete core. Welding of brackets without mechanical anchorage shall be prohibited. Where the pipe is slotted to accommodate webs of brackets or other connections, the integrity of the shell shall be restored by welding to ensure hooping action of the composite section.

**1912.4 Reinforcement:** To increase the safe *load*-supporting capacity of concrete-filled pipe columns, the steel reinforcement shall be in the form of rods, structural shapes or pipe embedded in the concrete core with sufficient clearance to ensure the composite action of the section, but not nearer than 1 inch (25 mm) to the exterior steel shell. All structural shapes used as reinforcement shall be milled to ensure bearing on cap and base plates.

**1912.5 Fireresistance rating protection:** Pipe columns shall be of such size or so *protected* as to develop the required fireresistance ratings specified in Table 602. Where an outer steel shell is used to enclose the fireresistive covering, the shell shall not be included in the calculations for strength of the column section. The minimum diameter of pipe columns shall be 4 inches (102 mm) except that in structures of Type 5 construction not exceeding three stories or 40 feet (12192 mm) in *height*, pipe columns used in the *basement* and as secondary steel members shall have a minimum diameter of 3 inches (76 mm).

**1912.6 Approvals:** All details of column connections and splices shall be shop fabricated by approved methods and shall be approved only after tests in accordance with the *approved rules*. Shop-fabricated concrete-filled pipe columns shall be inspected by the code official or by an approved representative of the manufacturer at the plant.

## SECTION 1913.0 HEADED BOLTS AND HEADED STUD ANCHORS IN CONCRETE

**1913.1 Headed bolts and headed stud anchors in concrete:** Headed bolts and headed stud anchors shall be solidly cast in concrete. The factored *loads* on embedded headed bolts and headed stud anchors shall not exceed the design strengths determined by Section 1913.1.2.

**1913.1.1 Load factor multipliers:** In addition to the *load* factors in Section 1613.1, a multiplier of 2 shall be used if *special inspection* is not provided, or a multiplier of 1.3 shall be used if *special inspection* is provided. Where anchors are embedded in the tension zone of a member, the *load* factors in Section 1613.1 shall have a multiplier of 3 if *special inspection* is not provided, or of 2 if it is provided.

**1913.1.2 Strength of anchors:** The strength of headed bolts and headed stud anchors solidly cast in concrete shall be taken as the average of 10 tests for each concrete strength and anchor size or calculated in accordance with Sections 1913.1.2.1 through 1913.1.2.3. The loadbearing area of headed anchors shall be at least one and one-half times the shank area for anchors of not more than 60,000 psi (413.6 MPa) yield strength.

**1913.1.2.1 Strength in tension:** The strength of anchors in tension shall be the minimum of $P_s$ or $\phi P_c$ where:

$$P_s = 0.9 A_b f_s'$$

and

$$\phi P_c = \phi \lambda \sqrt{f_c'} (2.8 A_s + 4 A_t)$$

where:

$A_b$ = Area (in square inches) of bolt or stud. Must be used with the corresponding steel properties to determine the weakest part of the assembly in tension. In shear, the insert leg is not required to be checked.

$A_s$ = The sloping area (in square inches) of an assumed failure surface. For a single anchor or anchors in a group where the distance between anchors is equal to or greater than twice their embedment length, the surface is assumed to be that of a truncated cone radiating at a 45-degree slope from the loadbearing edge of the anchor to the surface (i.e., $A_t = 0$).

For anchors in a group where the distance between anchors is less than twice their embedment length, the failure surface is assumed to be that of a truncated pyramid radiating at a 45-degree slope from the loadbearing edge of the anchor group to the surface. Additionally, for thin sections with anchor groups, the failure surface shall be assumed to follow the extension of this slope through to the far side rather than truncate as in $A_t$ (i.e., $A_t = 0$), and the failure mode resulting in the lower value of $\phi P_c$ shall control.

$A_t$ = The area (in square inches) of the flat bottom of the truncated pyramid of an assumed concrete failure surface. Where anchors in a group are closer than twice their embedment length, the failure surface pyramid is assumed to truncate at the anchor loadbearing edge rather than form separate cones.

$f'_c$ = Specified compressive strength of concrete (psi), which shall not be taken greater than 6,000 psi (41.4 MPa).

$f'_s$ = Ultimate tensile strength (in psi) of the bolt, stud or insert leg wires, which shall not be taken greater than 60,000 psi (413.6 MPa). For A307 bolts or A108 studs, $f'_s$ shall be permitted to be assumed to be 60,000 psi (413.6 MPa).

$P_u$ = Tensile strength required due to factored *loads* (pounds).

$V_u$ = Shear strength required due to factored *loads* (pounds).

$\lambda$ = One for normal-weight concrete, 0.75 for all lightweight concrete, and 0.85 for sand-lightweight concrete.

$\phi$ = Strength reduction factor shall be taken as 0.65, except $\phi$ is permitted to be taken as 0.85 where the anchor is attached to or hooked around reinforcing steel or otherwise terminated so as to transfer effectively forces to reinforcing steel that is designed to distribute forces and avert sudden local failure.

Where the edge distance is less than embedment length, reduce $\phi P_c$ proportionately. For multiple edge distances less than the embedment length, use multiple reductions.

**1913.1.2.2 Strength in shear:** The strength of anchors in shear shall be the minimum of $V_s$ or $\phi V_c$ where:

$$V_s = 0.75 A_b f'_s$$

and where loaded toward an edge greater than 10 diameters away:

$$\phi V_c = \phi 800 A_b \lambda \sqrt{f'_c}$$

or where loaded toward an edge less than 10 diameters away:

$$\phi V_c = \phi 2\pi d_e^2 \lambda \sqrt{f'_c}$$

where:

$d_e$ = Edge distance from the anchor axis to the free edge.

For groups of anchors, the concrete design shear strength shall be taken as the smallest of:

1. The strength of the weakest anchor times the number of anchors;
2. The strength of the row of anchors nearest the free edge in the direction of shear times the number of rows; or
3. The strength of the row farthest from the free edge in the direction of shear.

For shear loading toward an edge less than 10 diameters away, or tension or shear not toward an edge less than 4 diameters away, reinforcing sufficient to carry the *load* shall be provided to prevent failure of the concrete in tension. In no case shall the edge distance be less than $3^1/_3$ diameters for shear loading toward an edge, or $1^1/_3$ diameters for tension or shear not toward an edge.

**1913.1.2.3 Combined tension and shear:** Where tension and shear act simultaneously, both of the following shall be met:

$$\frac{1}{\phi}\left[\left(\frac{P_u}{P_c}\right)^2 + \left(\frac{V_u}{V_c}\right)^2\right] \le 1$$

and

$$\left[\left(\frac{P_u}{P_s}\right)^2 + \left(\frac{V_u}{V_s}\right)^2\right] \le 1$$

**1913.1.3 Special provisions for anchor bolts in tops of columns:** Anchor bolts at the tops of columns shall be enclosed with not less than two #4 ties located within 4 inches from the top of the column. Bolts in the tops of columns shall be embedded not less than 9 bolt diameters.

# CHAPTER 20

# LIGHTWEIGHT METALS

## SECTION 2001.0 GENERAL

**2001.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of aluminum and other lightweight metal alloys.

## SECTION 2002.0 MATERIALS

**2002.1 General:** Aluminum used for structural purposes in buildings and structures shall comply with AA ASM 35 and Parts 1-A and 1-B of the Aluminum Design Manual listed in Chapter 35. Other lightweight metal alloys used for structural purposes in buildings and structures shall be of approved materials.

# CHAPTER 21

# MASONRY

## SECTION 2101.0 GENERAL

**2101.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of masonry. Masonry shall comply with the engineered masonry design provisions of Section 2101.1.1 or shall comply with the empirical masonry design provisions of Section 2101.1.2.

**2101.1.1 Engineered masonry design:** Engineered masonry shall conform to the requirements of Chapters 1 through 8 of ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**2101.1.2 Empirical masonry design:** Empirically designed masonry shall conform to this chapter or Chapters 1 through 4 and Chapter 9 of ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**Exception:** Masonry veneer designed and constructed in accordance with Section 1405.5 or 1405.6.

**2101.1.2.1 Limitations:** Empirical masonry design shall not be utilized for any of the following conditions:

1. The design or construction of masonry in buildings assigned to Seismic Performance Category D or E as specified in Section 1610.1.7, and the design of the lateral force-resisting system for buildings assigned to Seismic Performance Category B or C;
2. The design or construction of masonry structures located in areas where the velocity pressure $q_z$ at height $z$ exceeds 25 psf (1197 Pa) as determined in accordance with the following equation:

$$q_z = 0.00256\, K_z\, I V^2$$

where:

$K_z$ = Velocity pressure exposure coefficient in Table 1609.7(4).
$I$ = Wind load importance factor in Table 1609.5.
$V$ = Basic wind speed (miles per hour) determined in accordance with Section 1609.3; or

3. Buildings more than 35 feet (10670 mm) in *height* which have masonry wall lateral force-resisting systems.

In buildings that comply with one or more of the above criteria, masonry shall be designed in accordance with the engineered design provisions of Section 2101.1.1.

**2101.2 Seismic requirements:** Masonry shall comply with the following requirements of Sections 2101.2.1 and 2101.2.2 based on the Seismic Performance Category assigned in Section 1610.1.7.

**2101.2.1 Seismic Performance Category A:** Masonry in buildings assigned to Seismic Performance Category A shall comply with the requirements of Section 1610.3.6.1.2 and either Section 2101.1.1 or 2101.1.2.

**2101.2.2 Seismic Performance Category B, C, D or E:** Masonry in buildings assigned to Seismic Performance Category B, C, D or E shall comply with the requirements of Section 2101.2.1 and Chapter 10 of ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

## SECTION 2102.0 DEFINITIONS

**2102.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Anchor:** Metal rod, wire or strap that secures masonry to its structural support.

**Architectural terra cotta:** Plain or ornamental hard-burned plastic clay units, larger in size than brick, with glazed or unglazed ceramic finish.

**Area, gross cross-sectional:** The areas delineated by the out-to-out dimensions of masonry in the plane under consideration.

**Bed joint:** The horizontal layer of mortar on which a masonry unit is laid.

**Brick**

**Calcium silicate brick (sand lime brick):** A building unit made of sand and lime.

**Clay or shale:** A solid masonry unit made of clay or shale, usually formed into a rectangular prism while in the plastic state and burned or fired in a kiln.

**Concrete brick:** A solid masonry unit having the approximate shape of a rectangular prism and composed of inert aggregate particles embedded in a hardened cementitious matrix.

**Hollow brick:** A masonry unit made of clay or shale whose net cross-sectional area in any plane parallel to the loadbearing surface is less than 75 percent of its gross cross-sectional area measured in the same plane.

**Buttress:** A projecting part of a masonry wall built integrally therewith to furnish lateral stability which is supported on proper foundations.

**Chimney:** A primarily vertical enclosure containing one or more passageways for conveying flue gases to the outside atmosphere.

**Chimney types**

**High-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, high-heat appliances producing combustion gases in excess of 2,000 degrees F. (1093 degrees C.) measured at the appliance fuel outlet.

**Low-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, low-heat appliances producing combustion gases not in excess of 1,000 degrees F. (538 degrees C.) under normal operating conditions, but capable of producing combustion gases of 1,400 degrees F. (760 degrees C.) during intermittent forced firing for periods up to 1 hour. All temperatures shall be measured at the appliance flue outlet (see Section 2115.0).

**Masonry type:** A field-constructed chimney of solid masonry units or stones (see Section 2114.0).

**Medium-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, medium-heat appliances producing combustion gases not exceeding 2,000 degrees F. (1093 degrees C.) measured at the appliance flue outlet (see Section 2116.0).

**Collar joint:** Vertical longitudinal joint between wythes of masonry or between masonry and back-up construction which is permitted to be filled with mortar or grout.

**Connector:** A mechanical device for securing two or more pieces, parts or members together, including anchors, wall ties and fasteners.

**Diaphragm:** A roof or floor system designed to transmit lateral forces to shear walls or other lateral load-resisting elements.

**Dimensions**

**Actual dimensions:** The measured dimensions of a masonry unit or element.

**Nominal dimensions:** Equal to a specified dimension plus an allowance for the mortar joints with which the units are to be laid. Nominal dimensions of the unit are stated by thickness first, followed by height and then length. Dimensions and thicknesses specified in this chapter are nominal dimensions.

**Effective height:** Clear height of a braced member between lateral supports and used for calculating the slenderness ratio of a member. Effective height for unbraced members shall be calculated.

**Fireplace throat:** The opening between the top of the firebox and the smoke chamber.

**Head joint:** Vertical mortar joint placed between masonry units within the wythe at the time the masonry units are laid.

**Header (Bonder):** A masonry unit that connects two or more adjacent wythes of masonry.

**Height, walls:** The vertical distance from the foundation wall or other immediate support of such wall to the top of the wall.

**Masonry:** A built-up construction or combination of building units or materials of clay, shale, concrete, glass, gypsum, stone or other approved units bonded together with mortar.

**Ashlar facing masonry:** Facing of solid rectangular units larger in size than brick and made of burned clay or shale, natural or cast stone, with sawed, dressed and squared beds and mortar joints.

**Ashlar masonry:** Masonry composed of bonded, rectangular units, larger in size than brick, with sawed, dressed or squared beds and mortar joints.

**Solid masonry:** Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar.

**Masonry unit**

**Clay:** A building unit larger in size than a brick, composed of burned clay, shale, fire clay or mixtures thereof.

**Concrete:** A building unit or block larger in size than 12 by 4 by 4 inches (305 mm by 102 mm by 102 mm) made of cement and suitable aggregates.

**Hollow:** A masonry unit whose net cross-sectional area in any plane parallel to the loadbearing surface is less than 75 percent of its gross cross-sectional area measured in the same plane.

**Solid:** A masonry unit whose net cross-sectional area in every plane parallel to the loadbearing surface is 75 percent or more of its gross cross-sectional area measured in the same plane.

**Mortar:** A plastic mixture of approved cementitious materials, fine aggregates and water used to bond masonry or other structural units (see Section 2104.0).

**Mortar, surface-bonding:** A mixture used to bond concrete masonry units which contains hydraulic cement; glass fiber reinforcement with or without inorganic fillers or organic modifiers; and water (see Section 2104.8).

**Rubble masonry:** Masonry composed of roughly shaped stones.

**Coursed rubble:** Masonry composed of roughly shaped stones fitting approximately on level beds and well bonded.

**Random rubble:** Masonry composed of roughly shaped stones laid without regularity of coursing but well bonded and fitted together to form well-defined joints.

**Rough or ordinary rubble:** Masonry composed of unsquared field stones laid without regularity of coursing but well bonded.

**Running bond:** The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

**Stack bond:** The placement of masonry units in a bond pattern is such that head joints in successive courses are vertically aligned. For the purpose of this code, requirements for stack bond shall apply to all masonry laid in other than running bond.

**Stone masonry:** Masonry composed of field, quarried or caststone units bonded by mortar.

**Ashlar stone masonry:** Stone masonry composed of rectangular units having sawed, dressed or squared bed surfaces and bonded by mortar.

**Rubble stone masonry:** Stone masonry composed of irregular-shaped units bonded by mortar.

**Tie, wall:** Metal connector that connects wythes of masonry walls together.

**Tile:** A ceramic surface unit, usually relatively thin in relation to facial area, made from clay or a mixture of clay and other ceramic materials, called the body of the tile, having either a "glazed" or "unglazed" face and fired above red heat in the course of manufacture to a temperature sufficiently high enough to produce specific physical properties and characteristics (see Section 2104.0).

**Tile, structural clay:** A hollow masonry unit composed of burned clay, shale, fire clay or mixtures thereof, and having parallel cells (see Section 2104.0).

**Wall**

**Cavity wall:** A wall built of masonry units or of concrete, or a combination of these materials, arranged to provide an air space within the wall, and in which the inner and outer parts of the wall are tied together with metal ties.

**Composite wall:** A wall built of a combination of two or more masonry units of different materials bonded together, one forming the backup and the other the facing elements.

**Dry-stacked, surface-bonded walls:** A wall built of concrete masonry units where the units are stacked dry, without mortar on the bed or head joints, and where both sides of the wall are coated with a surface-bonding mortar (see Section 2105.3).

**Faced wall:** A wall in which the masonry facing and backing are so bonded as to exert common action under *load*.

**Masonry-bonded hollow wall:** A wall built of masonry units so arranged as to provide an air space within the wall, and in which the facing and backing of the wall are bonded together with masonry units.

**Parapet wall:** That part of any wall entirely above the roof line.

**Wythe:** Each continuous, vertical section of a wall, one masonry unit in thickness.

## SECTION 2103.0 CONSTRUCTION DOCUMENTS

**2103.1 Drawings:** The drawings and details shall show all the items required to be shown on the drawings by this code including the following:

1. Specified size, grade, type and location of reinforcement, anchors and wall ties;
2. Reinforcing bars to be welded and welding procedure;
3. Size and location of all structural elements; and
4. Provisions for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture.

**2103.2 Fireplace drawings:** The *construction documents* shall describe in sufficient detail the location, size and construction of all masonry fireplaces. The thickness and characteristics of all material and the clearances from walls, partitions and ceilings shall be clearly indicated.

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## SECTION 2104.0 MASONRY CONSTRUCTION MATERIALS

**2104.1 Concrete masonry units:** Concrete masonry units shall conform to the following standards listed in Chapter 35: ASTM C55 for concrete brick; ASTM C73 for calcium silicate face brick; ASTM C90 for loadbearing concrete masonry units; or ASTM C744 for prefaced concrete and calcium silicate masonry units.

**2104.2 Clay or shale masonry units:** Clay or shale masonry units shall conform to the following standards listed in Chapter 35: ASTM C34 for structural clay loadbearing wall tile; ASTM C56 for structural clay nonloadbearing wall tile; ASTM C62 for building brick (solid masonry units made from clay or shale); ASTM C1088 for solid units of thin veneer brick; ASTM C126 for ceramic-glazed structural clay facing tile, facing brick and solid masonry units; ASTM C212 for structural clay facing tile; ASTM C216 for facing brick (solid masonry units made from clay or shale); and ASTM C652 for hollow brick (hollow masonry units made from clay or shale).

**Exception:** Structural clay tile for nonstructural use in fireproofing of structural members and in wall furring shall not be required to meet the compressive strength specifications. The fireresistance rating shall be determined in accordance with ASTM E119 listed in Chapter 35 and shall comply with the requirements of Table 602.

**2104.3 Stone masonry units:** Stone masonry units shall conform to the following standards listed in Chapter 35: ASTM C503 for marble building stone (exterior); ASTM C568 for limestone building stone; ASTM C615 for granite building stone; ASTM C616 for sandstone building stone; or ASTM C629 for slate building stone.

**2104.4 Ceramic tile:** Ceramic tile shall be as defined in ANSI A137.1 listed in Chapter 35 and shall conform to the requirements of ANSI A137.1 listed in Chapter 35.

**2104.5 Glass block:** Glass block shall be partially evacuated, hollow masonry units made of clear, colorless glass (with or without a highly reflective oxide surface coating), having a thickness of not less than $3^1/_8$ inches (79 mm) or shall be solid glass-block units, having a thickness of not less than 3 inches (76 mm).

**2104.6 Second-hand units:** Second-hand masonry units shall not be reused unless the units conform to the requirements for new units. The units shall be of whole, sound material and be free from cracks and other defects that will interfere with proper laying or use. All old mortar shall be cleaned from the units before reuse.

**2104.7 Mortar:** Mortar for masonry construction shall conform to ASTM C270 listed in Chapter 35.

**2104.8 Surface-bonding mortar:** Surface-bonding mortar shall comply with ASTM C887 listed in Chapter 35. Surface bonding of concrete masonry units shall comply with ASTM C946 listed in Chapter 35.

**2104.9 Metal reinforcement and accessories:** Metal reinforcement and accessories shall conform to Sections 2104.9.1 through 2104.9.7.

**2104.9.1 Deformed reinforcing bars:** Deformed reinforcing bars shall conform to the following standards listed in Chapter 35: ASTM A615 for deformed and plain billet-steel bars for concrete reinforcement; ASTM A616 for rail-steel deformed and plain bars for concrete reinforcement; ASTM A617 for axle-steel deformed and plain bars for concrete reinforcement; and ASTM A706 for low-alloy-steel deformed bars for concrete reinforcement.

**2104.9.2 Joint reinforcement:** Joint reinforcing wire shall conform to the following standards listed in Chapter 35: ASTM A82 for steel wire, plain, for concrete reinforcement; and ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip.

Longitudinal wires shall be deformed. One set of two deformations shall occur around the perimeter of the wire at a maximum spacing of 0.7 times the diameter of the wire but not less than eight sets per 1 inch (25 mm) of length. The overall length of each deformation within the set shall be such that the summation of gaps between the ends of the deformations shall not exceed 25 percent of the perimeter of the wire. The height or depth of the deformations shall be 0.012 inch (0.30 mm) for wire size W2.8 or larger; 0.011 inches (0.28 mm) for wire size W2.1; and 0.009 inch (0.23 mm) for wire size W1.7. Cross wires shall be plain.

**2104.9.3 Deformed reinforcing wire:** Deformed reinforcing wire shall conform to ASTM A496 listed in Chapter 35.

**2104.9.4 Wire fabric:** Wire fabric shall conform to ASTM A185 listed in Chapter 35 for plain steel-welded wire fabric for concrete reinforcement or ASTM A497 listed in Chapter 35 for welded deformed steel wire fabric for concrete reinforcement.

**2104.9.5 Anchors, ties and accessories:** Anchors, ties and accessories shall conform to the following standards listed in Chapter 35: ASTM A36 for structural steel; ASTM A82 for plain steel wire for concrete reinforcement; ASTM A185 for plain steel-welded wire fabric for concrete reinforcement; ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip; and ASTM A366 for cold-rolled carbon steel sheet, commercial quality.

**2104.9.6 Corrosion protection:** Joint reinforcement anchors, wall ties and accessories, except those of Type 304 stainless steel complying with ASTM A167 listed in Chapter 35, shall be protected from corrosion by galvanizing as follows.

Metal accessories for use in exterior wall construction shall be hot-dipped galvanized after fabrication with a minimum coating of 1.5 ounces per square foot (458 g/m$^2$) in accordance with ASTM A153 listed in Chapter 35. Metal accessories for use in interior wall construction shall be mill galvanized with a minimum coating of 0.1 ounce per square foot (31 g/m$^2$) in accordance with ASTM A641 listed in Chapter 35 for joint reinforcement, wire anchors and ties; and Class G-60, for sheet metal anchors and ties.

**2104.9.7 Tests:** Where unidentified reinforcement is approved for use, not less than three tension and three bending tests shall be made on representative specimens of the reinforcement from each shipment and grade of reinforcing steel proposed for use in the work.

**2104.10 Mortars for ceramic wall and floor tile:** Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1A and A108.1B listed in Chapter 35 and be of the compositions indicated in Table 2104.10.

**2104.10.1 Dry-set portland cement mortars:** Premixed prepared portland cement mortars, which require only the addition of water and which are used in the installation of ceramic tile, shall comply with ANSI A118.1 listed in Chapter 35. The shear bond strength for tile set in such mortar shall be as required in accordance with ANSI A118.1 listed in Chapter 35. Tile set in dry-set portland cement mortar shall be installed in accordance with ANSI A108.5 listed in Chapter 35.

**2104.10.2 Electrically conductive dry-set mortars:** Premixed prepared portland cement mortars, which require only the addition of water and which comply with ANSI A118.2 listed in Chapter 35, shall be used in the installation of electrically conductive ceramic tile. Tile set in electrically conductive dry-set mortar shall be installed in accordance with ANSI A108.7 listed in Chapter 35.

**Table 2104.10**
**CERAMIC TILE MORTAR COMPOSITIONS**

| | | |
|---|---|---|
| Walls | Scratchcoat | 1 cement; 1/5 hydrated lime; 4 dry or 5 damp sand |
| | Setting bed and leveling coat | 1 cement; 1/2 hydrated lime; 5 damp sand to 1 cement; 1 hydrated lime; 7 damp sand |
| Floors | Setting bed | 1 cement; 1/10 hydrated lime; 5 dry or 6 damp sand; or 1 cement; 5 dry or 6 damp sand |
| Ceilings | Scratchcoat and sand bed | 1 cement; 1/2 hydrated lime; 2 1/2 dry sand or 3 damp sand |

**2104.10.3 Latex-modified portland cement mortars:** Latex-modified portland cement thin-set mortars — in which latex is added to dry-set mortar as a replacement for all or part of the gauging water — which are used for the installation of ceramic tile shall comply with ANSI A118.4 listed in Chapter 35. Tile set in latex-modified portland cement shall be installed in accordance with ANSI A108.5 listed in Chapter 35.

**2104.10.4 Epoxy mortar:** Ceramic tile set and grouted with chemical-resistant epoxy shall comply with ANSI A118.3 listed in Chapter 35. Tile set and grouted with epoxy shall be installed in accordance with ANSI A108.6 listed in Chapter 35.

**2104.10.5 Furan mortar and grout:** Chemical-resistant furan mortar and grout which are used to install ceramic tile shall comply with ANSI A118.5 listed in Chapter 35. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8 listed in Chapter 35.

**2104.10.6 Modified epoxy-emulsion mortar and grout:** Modified epoxy-emulsion mortar and grout which are used to install ceramic tile shall comply with ANSI A118.8 listed in Chapter 35. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9 listed in Chapter 35.

**2104.10.7 Organic adhesives:** Water-resistant organic adhesives used for the installation of ceramic tile shall comply with ANSI A136.1 listed in Chapter 35. The shear bond strength after water immersion shall not be less than 40 psi (275 kPa) for Type I adhesive, and not less than 20 psi (138 kPa) for Type II adhesive, when tested in accordance with ANSI

A136.1 listed in Chapter 35. Tile set in organic adhesives shall be installed in accordance with ANSI A108.4 listed in Chapter 35.

**2104.10.8 Portland cement grouts:** Portland cement grouts used for the installation of ceramic tile shall comply with ANSI A118.6 listed in Chapter 35. Portland cement grouts for tilework shall be installed in accordance with ANSI A108.10 listed in Chapter 35.

**2104.11 Grout:** Grout shall conform to ASTM C476 listed in Chapter 35.

## SECTION 2105.0 LATERAL STABILITY

**2105.1 Shear walls:** Where the structure depends upon masonry walls for lateral stability, shear walls shall be provided parallel to the direction of the lateral forces resisted.

**2105.1.1 Shear wall thickness:** Minimum nominal thickness of masonry shear walls shall be 8 inches (203 mm).

**Exception:** Shear walls of one-story buildings are permitted to be a minimum nominal thickness of 6 inches (152 mm).

**2105.1.2 Cumulative length of shear walls:** In each direction in which shear walls are required for lateral stability, the minimum cumulative length of shear walls provided shall be 0.4 times the long dimension of the building. Cumulative length of shear walls shall not include openings.

**2105.1.3 Maximum diaphragm ratio:** Masonry shear walls shall be provided so that the span-to-width (or depth) ratio of floor or roof diaphragms does not exceed that indicated in Table 2105.1.3.

**Table 2105.1.3**
**MAXIMUM SPAN-TO-WIDTH (DEPTH) RATIO OF FLOOR AND ROOF DIAPHRAGMS**

| Floor or roof diaphragm construction | Maximum span-to-width (depth) ratio of diaphragm |
|---|---|
| Cast-in-place concrete | 5:1 |
| Precast concrete | 4:1 |
| Metal deck with concrete fill | 3:1 |
| Metal deck without fill | 2:1 |
| Wood diaphragm | 2:1 |

**2105.2 Roofs:** The roof construction shall be designed so as not to impart out-of-plane lateral thrust to the walls under roof gravity *load*.

**2105.3 Surface-bonded walls:** Dry-stacked, surface-bonded concrete masonry walls shall comply with the requirements of this code for masonry wall construction, except where otherwise noted in this section.

**2105.3.1 Strength:** Dry-stacked, surface-bonded concrete masonry walls shall be of adequate strength and proportions to support all superimposed *loads* without exceeding the allowable stresses listed in Table 2105.3.1. Allowable stresses not specified in Table 2105.3.1 shall comply with the requirements of ACI 530/ASCE 5/TMS 402 listed in Chapter 35.

**Table 2105.3.1**
**ALLOWABLE STRESS GROSS CROSS-SECTIONAL AREA[a] FOR DRY-STACKED, SURFACE-BONDED CONCRETE MASONRY WALLS**

| | |
|---|---|
| Compression | |
| Standard block | 45 psi |
| Shear | 10 psi |
| Flexural tension | |
| Vertical span | 18 psi |
| Horizontal span | 30 psi |

**Note a.** 1 psi = 6.9 kPa.

**2105.4 Construction:** Construction of dry-stacked, surface-bonded masonry walls, including stacking and leveling of units, mixing and application of mortar, and curing and protection, shall comply with ASTM C946 listed in Chapter 35.

## SECTION 2106.0 COMPRESSIVE STRESS REQUIREMENTS

**2106.1 Vertical dead plus live loads:** Compressive stresses in masonry due to vertical *dead* plus *live loads* (excluding *wind* or seismic *loads*) shall be determined in accordance with Section 2106.2.1. *Dead* and *live loads* shall be in accordance with Chapter 16, with such *live load* reductions as are permitted in Section 1606.7.

**2106.2 Maximum values:** The compressive stresses in masonry shall not exceed the values given in Table 2106.2. Stress shall be calculated based on actual rather than nominal dimensions.

**2106.2.1 Calculated compressive stresses:** Calculated compressive stresses for single-wythe walls and for multiple-wythe composite masonry walls shall be determined by dividing the design *load* by the gross cross-sectional area of the member. The area of openings, chases or recesses in walls shall not be included in the gross cross-sectional area of the wall.

**2106.2.2 Multiple-wythe walls:** The allowable stress shall be as given in Table 2106.2 for the weakest combination of the units and mortar used in each wythe.

**Table 2106.2**
**ALLOWABLE COMPRESSIVE STRESSES FOR EMPIRICAL DESIGN OF MASONRY**

| Construction; compressive strength of unit, gross area, psi | Allowable compressive stresses[a] gross cross-sectional area, psi[c] | |
|---|---|---|
| | Type M or S mortar | Type N mortar |
| Solid masonry of brick and other solid units of clay or shale; sand-lime or concrete brick: | | |
| 8,000 or greater | 350 | 300 |
| 4,500 | 225 | 200 |
| 2,500 | 160 | 140 |
| 1,500 | 115 | 100 |
| Grouted masonry of clay or shale, sand-lime or concrete: | | |
| 4,500 or greater | 225 | 200 |
| 2,500 | 160 | 140 |
| 1,500 | 115 | 100 |
| Solid masonry of solid concrete masonry units: | | |
| 3,000 or greater | 225 | 200 |
| 2,000 | 160 | 140 |
| 1,200 | 115 | 100 |

**Table 2106.2 (cont'd.)**
**ALLOWABLE COMPRESSIVE STRESSES FOR EMPIRICAL DESIGN OF MASONRY**

| Construction; compressive strength of unit, gross area, psi | Allowable compressive stresses[a] gross cross-sectional area, psi[c] | |
|---|---|---|
| | Type M or S mortar | Type N mortar |
| Masonry of hollow loadbearing units: | | |
| 2,000 or greater | 140 | 120 |
| 1,500 | 115 | 100 |
| 1,000 | 75 | 70 |
| 700 | 60 | 55 |
| Hollow walls (noncomposite masonry bonded[b]) | | |
| Solid units: | | |
| 2,500 or greater | 160 | 140 |
| 1,500 | 115 | 100 |
| Hollow units | 75 | 70 |
| Stone ashlar masonry: | | |
| Granite | 720 | 640 |
| Limestone or marble | 450 | 400 |
| Sandstone or cast stone | 360 | 320 |
| Rubble stone masonry | | |
| Coursed, rough or random | 120 | 100 |

**Note a.** Linear interpolation for determining allowable stresses for masonry units having compressive strengths which are intermediate between those given in the table is permitted.

**Note b.** Where floor and roof loads are carried upon one wythe, the gross cross-sectional area is that of the wythe under load; if both wythes are loaded, the gross cross-sectional area is that of the wall minus the area of the cavity between the wythes. Walls bonded with metal ties shall be considered as noncomposite walls unless collar joints are filled with mortar or grout.

**Note c.** 1 psi = 6.9 kPa.

## SECTION 2107.0 LATERAL SUPPORT

**2107.1 General:** Masonry walls shall be laterally supported in either the horizontal or the vertical direction at intervals not exceeding those given in Table 2107.1.

**2107.1.1 Thickness:** Except for cavity walls and cantilever walls, the thickness of a wall shall be the nominal thickness measured perpendicular to the face of the wall. For cavity walls, the thickness shall be determined as the sum of the nominal thicknesses of the individual wythes. For cantilever walls, except for parapets, the ratio of height to nominal thickness shall not exceed 6:1 for solid masonry or 4:1 for hollow masonry. The thickness and height of parapets shall conform to Section 2108.2.

**2107.2 Lateral support:** Lateral support shall be provided by cross walls, pilasters, buttresses or structural frame members where the limiting distance is taken horizontally, or by floors, or roofs acting as diaphragms or structural frame members where the limiting distance is taken vertically.

**Table 2107.1**
**WALL LATERAL SUPPORT REQUIREMENTS**

| Construction | Maximum ratio of wall length to thickness or wall height to thickness |
|---|---|
| Loadbearing walls | |
| Solid or solid grouted | 20 |
| All other | 18 |
| Nonloadbearing walls | |
| Exterior | 18 |
| Interior | 36 |

## SECTION 2108.0 THICKNESS OF MASONRY

**2108.1 Thickness of walls:** The nominal thickness of masonry walls shall conform to the requirements of this section.

**2108.1.1 Minimum thickness:** The minimum thickness of masonry loadbearing walls more than one story high shall be 8 inches (203 mm). The minimum thickness of masonry loadbearing walls of one-story buildings shall not be less than 6 inches (152 mm).

**2108.1.2 Rubble stone walls:** The minimum thickness of rough, random or coursed rubble stone walls shall be 16 inches (406 mm).

**2108.1.3 Change in thickness:** Where a wall of masonry of hollow units or a masonry-bonded hollow wall is decreased in thickness, a course or courses of solid masonry shall be interposed between the wall below and the thinner wall above, or special units or construction shall be used to transmit the *loads* from face shells or wythes above to those below.

**2108.2 Parapet walls:** Unreinforced parapet walls shall be at least 8 inches (203 mm) thick, and the height shall not exceed three times the thickness.

**2108.3 Masonry foundation walls:** Masonry foundation walls shall comply with Section 1812.0 and Chapter 21.

## SECTION 2109.0 BOND

**2109.1 General:** The facing and backing of multiple-wythe masonry walls shall be bonded in accordance with Section 2109.2, 2109.3 or 2109.4.

**2109.2 Bonding with masonry headers:** Bonding with solid or hollow masonry headers shall comply with Sections 2109.2.1 and 2109.2.2.

**2109.2.1 Solid units:** Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, not less than 4 percent of the wall surface of each face shall be composed of headers extending not less than 3 inches (76 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least 3 inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least 3 inches (76 mm).

**2109.2.2 Hollow units:** Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding 34 inches (864 mm) by lapping at least 3 inches (76 mm) over the unit below, or by lapping at vertical intervals not exceeding 17 inches (432 mm) with units which are at least 50 percent greater in thickness than the units below.

**2109.3 Bonding with wall ties or joint reinforcement:** Bonding with wall ties or joint reinforcement shall comply with Sections 2109.3.1 through 2109.3.2.

**2109.3.1 Bonding with wall ties:** Except as required by Section 2109.3.1.1, where the facing and backing (adjacent

wythes) of masonry walls are bonded with wire size W2.8 wall ties or metal wire of equivalent stiffness embedded in the horizontal mortar joints, there shall be at least one metal tie for each $4^1/_2$ square feet (0.42 $m^2$) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance between ties shall not exceed 24 inches (610 mm), and the maximum horizontal distance shall not exceed 36 inches (914 mm). Rods or ties bent to rectangular shape shall be used with hollow masonry units laid with the cells vertical. In other walls, the ends of ties shall be bent to 90-degree (1.57 rad) angles to provide hooks not less than 2 inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than 3 feet (914 mm) apart around the perimeter and within 12 inches (305 mm) of the opening.

**2109.3.1.1 Bonding with adjustable wall ties:** Where the facing and backing (adjacent wythes) of masonry are bonded with adjustable wall ties, there shall be at least one tie for each 1.77 square feet (0.16 $m^2$) of wall area. Neither the vertical nor horizontal spacing of the adjustable wall ties shall exceed 16 inches (406 mm). The maximum vertical offset of bed joints from one wythe to the other shall be $1^1/_4$ inches (32 mm). The maximum clearance between connecting parts of the ties shall be $^1/_{16}$ inch (1.6 mm). Where pintle legs are used, ties shall have at least two wire size W2.8 legs.

**2109.3.2 Bonding with prefabricated joint reinforcement:** Where the facing and backing (adjacent wythes) of masonry are bonded with prefabricated joint reinforcement, there shall be at least one cross wire serving as a tie for each $2^2/_3$ square feet (0.25 $m^2$) of wall area. The vertical spacing of the joint reinforcement shall not exceed 24 inches (610 mm). Cross wires on prefabricated joint reinforcement shall not be smaller than wire size W1.7. The longitudinal wires shall be embedded in the mortar.

**2109.4 Bonding with natural or cast stone:** Bonding with natural or cast stone shall conform to Sections 2109.4.1 and 2109.4.2.

**2109.4.1 Ashlar masonry:** In ashlar masonry, uniformly distributed bonder units shall be provided to the extent of not less than 10 percent of the wall area. Such bonder units shall extend not less than 4 inches (102 mm) into the backing wall.

**2109.4.2 Rubble stone masonry:** Rubble stone masonry 24 inches (610 mm) or less in thickness shall have bonder units with a maximum spacing of 3 feet (914 mm) vertically and 3 feet (914 mm) horizontally. Rubble stone masonry greater than 24 inches (610 mm) in thickness shall have one bonder unit for each 6 square feet (0.56 $m^2$) of wall surface on both sides.

**2109.5 Masonry bonding pattern:** Masonry laid in running and stack bond shall conform to Sections 2109.5.1 and 2109.5.2.

**2109.5.1 Masonry laid in running bond:** In each wythe of masonry laid in running bond, head joints in successive courses shall be offset by not less than one-fourth the unit length, or the masonry walls shall be reinforced longitudinally as required in Section 2109.5.2.

**2109.5.2 Masonry laid in stack bond:** Where unit masonry is laid with less head joint offset than in Section 2109.5.1, the minimum area of horizontal reinforcement placed in mortar bed joints or in bond beams spaced not more than 48 inches (1219 mm) apart shall be 0.0007 times the vertical cross-sectional area of the wall.

## SECTION 2110.0 ANCHORAGE

**2110.1 General:** Masonry elements shall be anchored in accordance with this section.

**2110.2 Intersecting walls:** Masonry walls depending upon one another for lateral support shall be anchored or bonded at locations where the walls meet or intersect by one of the following methods indicated in Sections 2110.2.1 through 2110.2.5.

**2110.2.1 Bonding pattern:** Fifty percent of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than 3 inches (76 mm) on the unit below.

**2110.2.2 Steel connectors:** Walls shall be anchored by steel connectors having a minimum cross section of $^1/_4$ inch (6 mm) by $1^1/_2$ inches (38 mm) with ends bent up at least 2 inches (51 mm), or with cross pins to form anchorage. Such anchors shall be at least 24 inches (610 mm) long and the maximum spacing shall be 4 feet (1219 mm).

**2110.2.3 Joint reinforcement:** Walls shall be anchored by joint reinforcement spaced at a maximum distance of 8 inches (203 mm). Longitudinal wires of such reinforcement shall be at least wire size W1.7 and shall extend at least 30 inches (762 mm) in each direction at the intersection.

**2110.2.4 Interior nonloadbearing walls:** Interior nonloadbearing walls shall be anchored at the intersection of the walls at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement or $^1/_4$-inch (6 mm) galvanized mesh hardware cloth.

**2110.2.5 Ties, joint reinforcement and anchors:** Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by this section.

**2110.3 Floor and roof anchorage:** Floor and roof diaphragms providing lateral support to masonry shall comply with Section 1610.3.6.1.2 and shall be connected to the masonry by one of the methods specified in Sections 2110.3.1 through 2110.3.3.

**2110.3.1 Wood floor joists:** Wood floor joists bearing on masonry walls shall be anchored to the wall at intervals not to exceed 6 feet (1829 mm) by metal strap anchors. Joists parallel to the wall shall be anchored with metal straps spaced not more than 6 feet (1829 mm) on centers extending over or under and secured to at least three joists. Blocking shall be provided between joists at each strap anchor.

**2110.3.2 Steel floor joists:** Steel floor joists bearing on masonry walls shall be anchored to the wall with $^3/_8$-inch (9.5 mm) round bars, or their equivalent, spaced not more than 6 feet (1829 mm) on center. Where joists are parallel to the wall, anchors shall be located at joist bridging.

**2110.3.3 Roof diaphragms:** Roof diaphragms shall be anchored to masonry walls with $^1/_2$-inch (13 mm) diameter bolts 6 feet (1829 mm) on center or their equivalent. Bolts shall

extend and be embedded at least 15 inches (381 mm) into the masonry, or be hooked or welded to not less than 0.20 square inches (129 $mm^2$) of bond beam reinforcement placed not less than 6 inches (152 mm) from the top of the wall.

**2110.4 Walls adjoining structural framing:** Walls that are dependent upon the structural frame for lateral support shall be anchored to the structural members with metal anchors or otherwise keyed to the structural members. Metal anchors shall consist of $^1/_2$-inch (13 mm) diameter bolts spaced at 4 feet (1219 mm) on center embedded 4 inches (102 mm) into the masonry, or of other bolts of equivalent area.

## SECTION 2111.0 MASONRY CONSTRUCTION

**2111.1 Masonry construction:** Masonry construction shall comply with the requirements of Sections 2111.1.1 through 2111.5.

**2111.1.1 Tolerances:** Masonry shall be constructed within the tolerances specified in ACI 530.1/ASCE 6/TMS 602 listed in Chapter 35.

**2111.1.2 Placing mortar and units:** Placement of mortar and units shall comply with Sections 2111.1.2.1 through 2111.1.2.4.

**2111.1.2.1 Bed and head joints:** Unless otherwise required or indicated on the project drawings, head and bed joints shall be $^3/_8$-inch (10 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than $^1/_4$ inch (6 mm) and not more than $^3/_4$ inch (19 mm).

**2111.1.2.2 Hollow units:** Hollow units shall be placed such that face shells of bed joints are fully mortared, webs are fully mortared in all courses of piers, column and pilasters, in the starting course on foundations, where adjacent cells or cavities are to be grouted and where otherwise required, and head joints are mortared a minimum distance from each face equal to the face shell thickness of the unit.

**2111.1.2.3 Solid units:** Unless otherwise required or indicated on the project drawings, solid units shall be placed in fully mortared bed and head joints. The ends of the units shall be completely buttered. Head joints shall not be filled by slushing with mortar. Head joints shall be constructed by shoving mortar tight against the adjoining unit. Bed joints shall not be furrowed deep enough to produce voids.

**2111.1.2.4 All units:** Units shall be placed while the mortar is soft and plastic. Any unit disturbed to the extent that the initial bond is broken after initial positioning shall be removed and relaid in fresh mortar.

**2111.1.3 Installation of wall ties:** The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least $^1/_2$ inch (13 mm). Wire wall ties shall be embedded at least $1^1/_2$ inches (38 mm) into the mortar bed of solid masonry units or solid-grouted hollow units. Wall ties shall not be bent after being embedded in grout or mortar.

**2111.1.4 Chases:** Chases shall be constructed as masonry units are laid.

**2111.1.5 Bracing of masonry:** Bracing that will assure stability of masonry during construction shall be provided and installed.

**2111.1.6 Construction loads:** Construction *loads* shall not exceed the superimposed *loads* that the masonry, with supplemental supports, is capable of supporting safely.

**2111.1.7 Masonry protection:** The top of unfinished masonry work shall be covered to protect the masonry from the weather.

**2111.1.8 Weepholes:** Weepholes shall be provided in the outside wythe of masonry walls at a maximum spacing of 33 inches (838 mm) on center. Weepholes shall not be less than $^3/_{16}$ inch (5 mm) in diameter.

**2111.2 Corbeled masonry:** Solid masonry units shall be used for corbeling. The maximum corbeled projection beyond the face of the wall shall not be more than one-half of the wall thickness nor one-half the wythe thickness for hollow walls. The maximum projection of one unit shall neither exceed one-half the height of the unit nor one-third the thickness at right angles to the wall.

**2111.2.1 Molded cornices:** Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of all projecting masonry or molded cornices shall lie within the middle one-third of the supporting wall. Terra cotta and metal cornices shall be provided with a structural frame of approved noncombustible material anchored in an approved manner.

**2111.3 Cold-weather construction:** The following cold-weather procedures shall be implemented when either the ambient temperature falls below 40 degrees F. (4 degrees C.) or the temperature of masonry units is below 40 degrees F. (4 degrees C.):

1. Temperatures of masonry units shall not be less than 20 degrees F. (-7 degrees C.) when laid in the masonry. Visible ice on masonry units shall be removed before the unit is laid in the masonry.
2. Mortar sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F. (4 degrees C.) and 120 degrees F. (49 degrees C.) at the time of mixing. Mortar shall be maintained above freezing until used in masonry.
3. Heat sources shall be used where ambient temperatures are between 20 degrees F. (-7 degrees C.) and 25 degrees F. (-4 degrees C.) on both sides of the masonry under construction and wind breaks shall be installed when wind velocity is in excess of 15 mph (24 km/hr).
4. Where ambient temperatures are below 20 degrees F. (-7 degrees C.), an enclosure for the masonry under construction shall be provided and heat sources shall be used to maintain temperatures above 32 degrees F. (0 degrees C.) within the enclosure.
5. Where mean daily temperatures are between 32 degrees F. (0 degrees C.) and 40 degrees F. (4 degrees C.), completed masonry shall be protected from rain or snow by covering

with a weather-resistant *membrane* for 24 hours after construction.

6. Where mean daily temperatures are between 25 degrees F. (-4 degrees C.) and 32 degrees F. (0 degrees C.), completed masonry shall be completely covered with a weather-resistant *membrane* for 24 hours after construction.
7. Where mean daily temperatures are between 20 degrees F. (-7 degrees C.) and 25 degrees F. (-4 degrees C.), completed masonry shall be completely covered with insulating blankets or equal protection for 24 hours after construction.
8. Where mean daily temperatures are below 20 degrees F. (-7 degrees C.), masonry temperature shall be maintained above 32 degrees F. (0 degrees C.) for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps or by other approved methods.

**2111.4 Hot-weather construction:** The following hot-weather procedures shall be implemented when either of the following conditions exist: the ambient temperature equals or exceeds 100 degrees F. (38 degrees C.) or the ambient temperature equals or exceeds 90 degrees F. (32 degrees C.) with a wind velocity greater than 8 mph (13 km/hr).

1. Mortar beds shall not be spread more than 4 feet (1219 mm) ahead of masonry.
2. Masonry units shall be laid within 1 minute after mortar placement.

**2111.5 Wetting of brick:** Brick (clay or shale) at the time of laying shall require wetting if the unit's initial rate of water absorption exceeds 30 grams per 30 square inches (30 g/19350 $mm^2$) per minute or 0.035 ounces per square inch (1 g/645 $mm^2$), as determined by ASTM C67 listed in Chapter 35.

## SECTION 2112.0 MISCELLANEOUS REQUIREMENTS

**2112.1 Chases and recesses:** Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels.

**2112.2 Lintels:** The design for lintels shall be in accordance with the engineered masonry design provisions of Section 2101.1.1. Minimum length of end support shall be 4 inches (102 mm).

**2112.3 Support on wood:** Masonry shall not be supported on wood girders or other forms of wood construction. Glass-block panels complying with Section 2114.0 shall not be supported by wood members unless the supporting construction has been designed to carry such *loads*.

## SECTION 2113.0 FIREPLACES AND CHIMNEY FLUES

**2113.1 Scope:** The provisions of this section shall govern the design, installation, maintenance, repair and approval of concrete and masonry fireplaces and masonry chimney flues.

**2113.2 Masonry chimneys:** Masonry chimneys for fireplaces shall comply with Sections 2114.0 and 2115.0.

**2113.3 Dimensions:** Masonry fireplaces and chimney flues shall have the dimensions indicated in Sections 2113.3.1 and 2113.3.2.

**Exceptions**

1. The depth of Rumford fireplaces shall not be less than one-third of the width of the fireplace opening and not less than 12 inches (305 mm). The throat of Rumford fireplaces shall not be less than 12 inches (305 mm) above the fireplace opening, and shall have a cross-sectional area not less than 5 percent of the cross-sectional area of the fireplace opening.
2. This section shall not apply to other masonry fireplace designs that are based on an approved engineering analysis.

**2113.3.1 Fireplaces:** The firebox of a concrete or masonry fireplace shall have a minimum depth of 20 inches (508 mm). The throat shall not be less than 8 inches (203 mm) above the fireplace opening. The throat opening shall not be less than 4 inches (102 mm) in depth. The cross-sectional area of the passageway above the firebox, including the throat, damper and smoke chamber, shall not be less than the cross-sectional area of the flue.

**2113.3.2 Flue sizing:** The cross-sectional area of the chimney flue shall be determined in accordance with Figure 2113.3.2. The height of the chimney shall be measured from the firebox floor to the top of the chimney flue liner. The ratio between the longest and shortest inside dimensions of the cross-section of rectangular flues shall not be greater than 2:1.

**2113.4 Wall construction:** Fireplace walls lined with a minimum of 2 inches (51 mm) of approved low-duty refractory brick shall have a minimum total thickness of 8 inches (203 mm) of concrete or solid masonry. Approved medium-duty fire-clay mortar or an equivalent shall be utilized with the low-duty refractory brick. Unlined fireplace walls shall be constructed of concrete or solid masonry having a minimum total thickness of 12 inches (305 mm).

**2113.4.1 Extension of liners:** The liner of the fireplace walls shall extend a minimum of 4 inches (102 mm) into the throat of the fireplace.

**2113.4.2 Throat and smoke chamber:** The walls of the throat and smoke chamber shall be constructed of concrete or solid masonry having a minimum total thickness of 8 inches (203 mm). Alternatively, a minimum $^5/_8$-inch-thick (16 mm) clay flue lining, complying with ASTM C315 listed in Chapter 35, shall form the inside surface of the 8-inch-thick (203 mm) smoke chamber walls. The throat and smoke chamber walls are permitted to be reduced in thickness to 4 inches (102 mm) of concrete or solid masonry, provided that such walls are lined with at least 1 inch (25 mm) of insulating refractory masonry so that the heat transferred through this wall is not more than the heat transferred through 8 inches (203 mm) of solid masonry.

**2113.4.3 Heat exchanger:** Gravity-fed heat exchangers installed in the walls of concrete or masonry fireplaces shall not reduce the total thickness of concrete or solid masonry.

**2113.5 Foundation and hearth:** The foundation of a fireplace shall be constructed of noncombustible materials and shall conform to the requirements of Chapter 18. The hearth and hearth

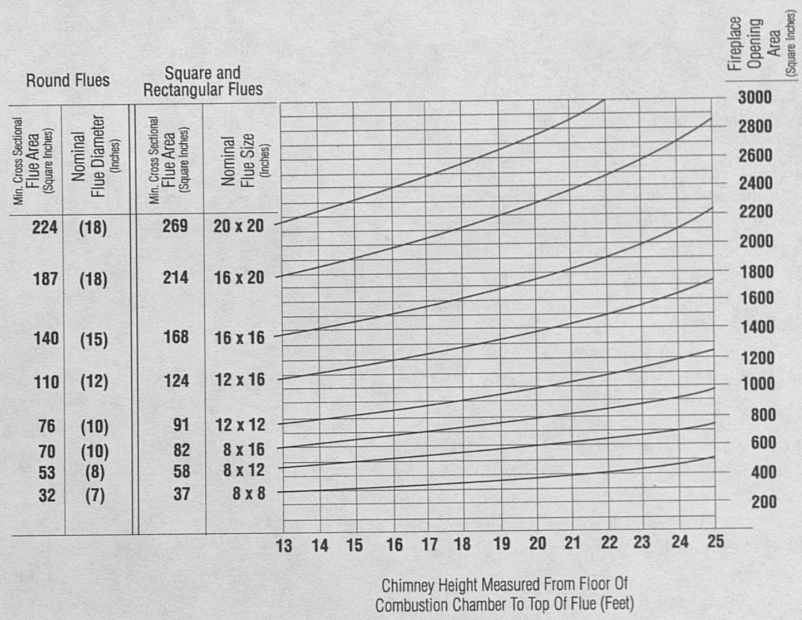



**Figure 2113.3.2**
**FLUE SIZES FOR MASONRY CHIMNEYS[a,b]**

**Note a.** The smaller flue area shall be utilized where the fireplace open area and the chimney height selected intersect between the flue area curves.
**Note b.** 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 square inch = 645.2 $mm^2$.

extension shall be constructed of concrete or solid masonry having a minimum thickness of 4 inches (102 mm).

**2113.5.1 Hearth extension:** The hearth shall extend a minimum of 16 inches (406 mm) beyond the face of the fireplace opening and a minimum of 8 inches (203 mm) on each side of the fireplace opening for fireplaces having an opening of less than 6 square feet (0.56 $m^2$). The hearth of larger-sized fireplaces shall extend a minimum of 20 inches (508 mm) beyond the face of the fireplace opening and a minimum of 12 inches (305 mm) on each side of the fireplace opening. Combustible forms used during construction of the hearth and hearth extension shall be removed.

**2113.6 Clearance to combustibles:** The exterior surface of fireplace walls shall have a minimum of 4 inches (102 mm) clearance to combustibles. Combustible material, including framing and sheathing, shall have a minimum clearance of 2 inches (51 mm) from the exterior surface of smoke chamber walls. Combustible material attached to a fireplace face, such as trim and mantels, shall have a minimum clearance of 6 inches (152 mm) from a fireplace opening. Combustible material above and projecting more than $1^1/_2$ inches (38 mm) from a fireplace face shall have a minimum clearance of 12 inches (305 mm) above a fireplace opening.

**2113.7 Opening to the chimney:** Means shall be provided to shut off the opening to the chimney when the fireplace is not in operation.

**2113.7.1 Dampers:** Dampers shall be constructed of metal having a minimum thickness of No. 12 Manufacturer's Standard Gage (0.105 inch).

**2113.8 Metal hoods:** Metal hoods shall extend a minimum of 6 inches (152 mm) beyond the firebox. The hoods shall comply with the requirements for metal chimneys.

## SECTION 2114.0 MASONRY CHIMNEYS, GENERAL REQUIREMENTS

**2114.1 Scope:** the provisions of this section apply to masonry chimneys for fireplaces, and low-heat, medium-heat and high-heat appliances.

**2114.2 Foundations:** Masonry chimneys shall be supported on approved noncombustible foundations.

**2114.3 Structural design:** Masonry chimneys shall not support any structural *load* other than the weight of the chimney unless such chimneys are designed to act as supporting members. Chimneys shall be anchored laterally at the ceiling lines and at each floor line which is more than 6 feet (1829 mm) above grade.

**2114.4 Corbeling:** Masonry chimneys shall not be corbeled from a wall more than 6 inches (152 mm). A masonry chimney shall not be corbeled from a wall that is less than 12 inches (305 mm) in thickness, unless the chimney projects equally on each side of the wall. In the second story of a two-story building, corbeling of masonry chimneys on the exterior of the enclosing walls shall not exceed the exterior wall thickness. The maximum horizontal projection of each course of brick shall not exceed one-half of the height of the masonry unit and one-third of the thickness or depth of the masonry unit.

**2114.5 Change in size or shape:** Masonry chimneys shall not change in size or shape within 6 inches (152 mm) above or below

any combustible floor, ceiling or roof component penetrated by the chimney.

**2114.6 Offsets:** Where a masonry chimney is constructed with a fire-clay flue liner surrounded by one wythe of masonry, the maximum offset shall be such that the centerline of the flue above the offset does not extend beyond the center of the chimney wall below the offset. Where the chimney offset is supported by masonry below the offset in an approved manner, the maximum offset limitations shall not apply. Each individual corbeled masonry course of the offset shall not exceed the projection limitations specified in Section 2114.4.

**2114.7 Cleanouts:** All masonry chimneys, except chimneys serving fireplaces, shall be provided with an approved cleanout having a tight-fitting cover. Such cleanouts shall be installed at least 12 inches (305 mm) below the lowest chimney inlet opening.

**2114.8 Fireblocking:** All spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material. The *fireblocking* of spaces between chimneys and wood joists, beams or headers shall be to a depth of 1 inch (25 mm) and shall only be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

**2114.9 Gas-fired appliances:** Masonry chimneys utilized to vent gas-fired appliances shall be located, constructed and sized as specified in the manufacturer's installation instructions for the appliances being vented.

**2114.10 Lining systems:** Except as provided in Sections 2115.0, 2116.0 and 2117.0, chimney lining systems designed for installation in new or existing masonry chimneys shall bear the *label* of an *approved agency* and shall be installed in accordance with the manufacturer's installation instructions.

**2114.11 Existing masonry chimneys:** Existing masonry chimneys are permitted to vent open fireplaces only — even if the existing chimneys lack the clearances to combustibles as required by Section 2115.5 — provided that such chimneys otherwise conform to the requirements of Sections 2114.0 and 2115.0 or are made to conform to such requirements through repair or relining.

## SECTION 2115.0 MASONRY CHIMNEYS FOR LOW-HEAT APPLIANCES AND FIREPLACES

**2115.1 General:** Masonry chimneys for fireplaces and low-heat appliances shall comply with Section 2114.0 and the requirements of this section.

**2115.2 Construction:** Masonry chimneys for low-heat appliances shall be constructed of solid masonry units or reinforced concrete with walls not less than 4 inches (102 mm) thick or rubble stone masonry not less than 12 inches (305 mm) thick. Masonry shall be constructed with full bed and head mortar joints.

**2115.3 Lining:** Masonry chimneys for low-heat appliances shall be lined with fire-clay lining complying with ASTM C315 listed in Chapter 35 or an approved equivalent, not less than $^5/_8$-inch (16 mm) thick, or with a liner of other approved material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1,800 degrees F. (982 degrees C.).

**2115.3.1 Fire-clay flue liner:** The fire-clay flue liner shall be installed ahead of the construction of the chimney as the chimney is carried up and carefully bedded one on the other in an approved medium-duty refractory mortar, with close-fitting joints left smooth on the inside.

**2115.3.2 Space between liner and chimney:** Liners shall be separate from the chimney wall, and the space between the liner and masonry shall not be filled. Only enough mortar shall be placed to make the joint and hold the liners in position.

**2115.3.3 Extension of lining:** Flue liners shall start from a point a minimum of 8 inches (203 mm) below the lowest vent connector entrance. The lining shall extend vertically for the entire height of the chimney.

**2115.3.4 Two adjoining flues:** Where two adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered a minimum of 7 inches (178 mm).

**2115.3.5 More than two flues:** Where more than two flues are located in the same chimney, masonry wythes (partitions) a minimum of 4 inches (102 mm) wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings so that there are not more than two flues in any group of adjoining flues without such wythe separation.

**2115.4 Termination height:** Masonry chimneys shall terminate outdoors above the roof of the building. Chimney outlets shall be located a minimum of 3 feet (914 mm) above the highest point that the chimney penetrates the roof. Chimney outlets shall be a minimum of 2 feet (610 mm) higher than any portion of the building within 10 feet (3048 mm).

**2115.5 Clearances:** Any portion of a masonry chimney located within the exterior wall of the building shall have a minimum airspace clearance of 2 inches (51 mm) to combustible materials. Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum airspace clearance of 1 inch (25 mm). The airspace shall not be filled, except to provide *fireblocking* in accordance with Section 2114.8.

**Exception:** Masonry chimneys equipped with a chimney lining system tested and *labeled* for installation in contact with combustible material in accordance with UL 1777 listed in Chapter 35, and installed in accordance with the manufacturer's instructions, are permitted to have combustible material in contact with the masonry chimney exterior surfaces. Noncombustible *fireblocking* shall be provided in accordance with Section 2114.8.

**2115.6 Fireblocking:** Floor and ceiling penetrations shall be fireblocked in accordance with Section 2114.8.

## SECTION 2116.0 MASONRY CHIMNEYS FOR MEDIUM-HEAT APPLIANCES

**2116.1 General:** Masonry chimneys for medium-heat appliances shall comply with Section 2114.0 and the requirements of this section.

**2116.2 Construction:** Masonry chimneys for medium-heat appliances shall be constructed of solid masonry units or of reinforced concrete with walls a minimum of 8 inches (203 mm) thick, or with stone masonry a minimum of 12 inches (305 mm) thick.

**2116.3 Lining:** Masonry for medium-heat appliance chimneys shall be lined with an approved medium-duty refractory brick, a minimum of $4^1/_2$ inches (114 mm) thick laid on the $4^1/_2$-inch (114 mm) bed in an approved medium-duty refractory mortar. The lining shall start 2 feet (610 mm) or more below the lowest chimney connector entrance and shall extend to a minimum height of 25 feet (7620 mm) above the highest chimney connector entrance. Chimneys terminating 25 feet (7620 mm) or less above a chimney connector entrance shall be lined to the top.

**2116.4 Multiple passageway:** Masonry chimneys containing more than one passageway shall have the liners separated by a minimum 4-inch-thick (102 mm) solid masonry wall.

**2116.5 Termination height:** Masonry chimneys for medium-heat appliances shall extend a minimum of 10 feet (3048 mm) higher than any portion of any building within 25 feet (7620 mm).

**2116.6 Clearance:** A minimum clearance of 4 inches (102 mm) shall be provided between the exterior surfaces of a masonry chimney for medium-heat appliances and combustible material.

## SECTION 2117.0 MASONRY CHIMNEYS FOR HIGH-HEAT APPLIANCES

**2117.1 General:** Masonry chimneys for high-heat appliances shall comply with Section 2114.0 and the requirements of this section.

**2117.2 Construction:** Masonry chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or reinforced concrete, each wall to be a minimum of 8 inches (203 mm) thick with a minimum airspace of 2 inches (51 mm) between the walls.

**2117.3 Lining:** The inside of the interior wall shall be lined with an approved high-duty refractory brick, a minimum of $4^1/_2$ inches (102 mm) thick laid on the $4^1/_2$-inch (102 mm) bed in an approved high-duty refractory mortar. The lining shall start at the base of the chimney and extend continuously to the top.

**2117.4 Termination height:** Masonry chimneys for high-heat appliances shall extend a minimum of 20 feet (6096 mm) higher than any portion of any building within 50 feet (15240 mm).

**2117.5 Clearance:** Masonry chimneys for high-heat appliances shall have approved clearance from buildings and structures to prevent overheating combustible material, to permit inspection and maintenance operations on the chimney, and to prevent danger of burns to persons.

## SECTION 2118.0 GLASS-BLOCK WALLS

**2118.1 General:** Masonry of glass blocks used in nonloadbearing exterior or interior walls and in window openings, either isolated or in continuous bands, shall have a minimum thickness of 3 inches (76 mm) at the mortar joint and all the mortared surfaces of the glass block shall be treated for mortar bonding. Sizes of structural members supporting glass-block panels shall be determined by structural analysis to avoid excessive or harmful deflection. Maximum deflection of such members shall not exceed 1/600 of the span of the supporting members.

Solid or hollow approved glass blocks shall not be used in *fire walls*, party walls, *fire separation assemblies* or *fire partitions*, or for loadbearing construction. Such blocks shall be erected with mortar and reinforcement in metal channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors as provided for both exterior and interior walls or other approved joint materials. Wood strip framing shall not be used in *fire separation assemblies* that are required to be fireresistance rated.

**Exceptions**

1. Glass-block assemblies having a fireresistance rating of not less than $^3/_4$ hour shall be permitted as opening protectives in *fire separation assemblies* or in *fire partitions* which have a required fireresistance rating of 1 hour or less and do not enclose *exit stairways* or *exit* passageways.
2. Glass-block assemblies as permitted in Section 404.5, Exception 2.

**2118.2 Size of panels:** The maximum dimensions of all hollow glass-block wall panels in both exterior and interior walls, where used singly or in multiples to form continuous bands of glass blocks between structural supports, shall be 25 feet (7620 mm) in length and 20 feet (6096 mm) in height between structural supports and expansion joints; and the area of each individual panel shall not be more than 144 square feet (13.39 $m^2$) for exterior panels and 250 square feet (23.25 $m^2$) for interior panels. Intermediate structural supports shall be provided to support the *dead load* of the wall and all other superimposed *loads*. Where individual panels are more than the maximum area permitted for those panels, a supplementary structural stiffener shall be provided to anchor the panels to the structural supports.

The maximum area of all solid glass-block wall panels in both exterior and interior walls shall not be more than 100 square feet (9.3 $m^2$).

**2118.3 Joint materials:** Glass block shall be laid up in Type S or N mortar. Both vertical and horizontal mortar joints shall be at least $^1/_4$ inch (6 mm) and not more than $^1/_2$-inch (13 mm) thick and shall be completely filled. The sills of glass-block panels shall be coated with approved water-based asphaltic emulsion, or other elastic waterproofing material, prior to laying the first mortar course. All individually framed glass-block panels shall be provided with $^3/_8$-inch-thick (10 mm) expansion joints at the sides and top. Expansion joints shall be entirely free of mortar and shall be caulked to a depth of not less than $^1/_2$-inch (13 mm) with nonhardening caulking compound on both faces, or other approved expansion joints shall be provided.

**2118.4 Reinforcement:** Glass-block panels shall have joint reinforcement in every other mortar bed joint, extending the entire length of the panel, but not across expansion joints. Joint reinforcement is permitted to be spliced by lapping longitudinal wires at least 6 inches (152 mm). Joint reinforcement shall be placed in the bed joint immediately below and above any opening in the panel. Joint reinforcement shall be hot-dipped galvanized after fabrication.

**2118.5 Wind and earthquake loads:** Exterior wall panels shall be held in place in the wall opening to resist both the internal and external pressures due to *wind* and *earthquake loads* as specified in Sections 1609.0 and 1610.0, with metal channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors at the sides and top. Where recess-type of framing is used, glass block shall be recessed within the framing not less than 1 inch (25 mm).

# CHAPTER 22

# STEEL

## SECTION 2201.0 GENERAL

**2201.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of structural steel members.

## SECTION 2202.0 DEFINITIONS

**2202.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Steel construction, cold-formed:** That type of construction made up entirely, or in part, of steel structural members cold formed to shape from sheet or strip steel such as roof deck, floor and wall panels, studs, floor joists, roof joists and other structural elements.

**Steel joist:** Any steel structural member of a building or structure made of hot-rolled or cold-formed solid or open-web sections, or riveted or welded bars, strip or sheet steel members, or slotted and expanded, or otherwise deformed rolled sections.

**Steel member, structural:** Any steel structural member of a building or structure consisting of a rolled steel structural shape other than cold-formed steel, light-gage steel or steel joist members.

## SECTION 2203.0 STRUCTURAL STEEL CONSTRUCTION

**2203.1 General:** Structural steel construction used in all buildings and structures shall be fabricated from materials of uniform quality which are free from defects that vitiate the strength or stability of the structure. All structural steel shall be designed and constructed in accordance with either the AISC *Specification for Structural Steel Buildings — Allowable Stress Design and Plastic Design*, hereafter referred to AISC ASD, or the AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings*, hereafter referred to as AISC LRFD, listed in Chapter 35, except as modified by the provisions of Section 2204.0.

**2203.2 Structural steel seismic requirements:** The design of structural steel members and connections to resist seismic forces shall be in accordance with Section 2203.1 and the AISC *Seismic Provisions for Structural Steel Buildings*, listed in Chapter 35, except as modified by Section 2203.2.1.

**2203.2.1 Modifications to AISC seismic provisions:** The AISC *Seismic Provisions for Structural Steel Buildings* shall be modified as indicated in items 1 and 2.

1. In Part 1, Section 1, of the AISC Provisions, modify the first sentence of the second paragraph to read: "Seismic provisions and the nominal loads for each Seismic Performance Category, Seismic Hazard Exposure Group or Seismic Zone shall be as specified by the applicable code under which the structure is designed."
2. Table 1610.1.5 in the *BOCA National Building Code/1996* shall be used in lieu of Table 2-1 in Part 1 of the AISC Provisions.

**2203.3 Temporary and special stresses:** Provisions shall be made in the design of structural steel construction for temporary stresses that occur during erection, and for the influence of special *loads* producing impact or vibrations as provided for in Sections 1606.6 and 1606.8. Stresses caused by eccentric loading shall be fully provided for and eccentric details shall be shown on the design and shop drawings.

**2203.4 Shop drawings:** Complete shop drawings shall be prepared in compliance with the best modern practice in advance of the actual fabrication. Such drawings shall clearly distinguish between shop and field rivets, bolts and welds in all connections and details.

**2203.5 Painting and special protection:** All painting shall comply with the requirements contained in AISC ASD or AISC LRFD listed in Chapter 35. Where exposed to highly corrosive fumes or vapors, or where subject to destruction from other highly hazardous industrial processes, all structural steelwork shall be protected by an approved method.

## SECTION 2204.0 SEISMIC REQUIREMENTS FOR STRUCTURAL STEEL

**2204.1 General:** Steel structural elements that resist seismic forces shall be designed in accordance with the applicable provisions of Sections 2203.0, 2205.0, 2206.0 and 2207.0. Steel structures shall also be designed in accordance with the requirements of Sections 2204.2, 2204.3 and 2204.4 for specific Seismic Performance Categories.

**2204.2 Seismic Performance Categories A and B:** Buildings assigned to Seismic Performance Categories A and B in accordance with Section 1610.1.7 shall be permitted to be of any type

of steel construction permitted by Sections 2203.0, 2205.0, 2206.0 and 2207.0.

**2204.3 Seismic Performance Category C:** Buildings assigned to Seismic Performance Category C in accordance with Section 1610.1.7 shall be designed in accordance with Section 2203.2.

**2204.4 Seismic Performance Categories D and E:** Buildings assigned to Seismic Performance Categories D and E in accordance with Section 1610.1.7 shall be designed in accordance with Section 2203.2 and the additional requirements of this section.

**2204.4.1 Light-framed walls:** Cold-formed steel stud walls designed in accordance with Section 2206.0 shall also comply with the requirements of this section.

**2204.4.1.1 Boundary members:** All boundary members, chords and collectors shall be designed to transmit the induced axial force.

**2204.4.1.2 Connections:** Connections for diagonal bracing members, top chord splices, boundary members and collectors shall be designed to develop the tensile strength of the member or, in those cases where (2R/5) is equal to or greater than 1.0, (2R/5) multiplied by the design seismic force, where R is the response modification factor determined from Table 1610.3.3. The pull-out resistance of screws shall not be used to resist seismic forces.

**2204.4.1.3 Braced bay members:** Vertical and diagonal members in braced bays shall be anchored such that the bottom track is not required to resist uplift forces by bending of the track web. Both flanges of studs shall be braced to prevent lateral torsional buckling.

## SECTION 2205.0 OPEN-WEB STEEL JOIST CONSTRUCTION

**2205.1 General:** Steel joists and joist girders used as structural members in floor and roof construction shall be designed and constructed in accordance with the standard specifications of SJI *Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders* listed in Chapter 35.

**2205.2 Seismic requirement:** Steel joists and joist girders designed as part of the seismic-resisting system shall be designed as trusses in accordance with the applicable provisions of Sections 2203.2, 2204.0 and 2206.0.

**2205.3 Painting:** Painting of steel joists shall be in accordance with the requirements of the standard specifications of SJI *Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders* listed in Chapter 35 and with Section 2206.4.2.

## SECTION 2206.0 FORMED STEEL CONSTRUCTION

**2206.1 Design:** The design of all cold-formed carbon and low-alloy steel structural members and assembled wall, floor and roof panels, used alone or in combination with other structural members, or with component materials, shall be in accordance with the AISI *Specification for the Design of Cold-Formed Steel Structural Members*, allowable stress design, hereafter referred to as AISI CFSD-ASD or the AISI *Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members* hereafter referred to as AISI CFSD-LRFD, listed in Chapter 35, except as modified by the provisions of this section. The design of all cold-formed stainless steel structural members and components shall be based on a *load* and resistance factor design method or an allowable stress design method and maximum deflections in accordance with the ASCE *Specification for the Design of Cold-Formed Stainless Steel Structural Members*, hereafter referred to as ASCE 8-SSD-LRFD, or ASCE 8-SSD-ASD listed in Chapter 35, except as modified by the provisions of Sections 2206.3 and 2206.3.1.

**2206.1.1 Composite slabs:** Composite slabs of concrete on steel deck shall be designed and constructed in accordance with ASCE 3 listed in Chapter 35.

**2206.2 Secondary structural systems:** Formed steel floor, wall and roof systems are permitted to be designed and constructed to resist all vertical and horizontal moments and shears resulting from lateral forces. Such members, where designed to transmit horizontal shears due to wind or other lateral forces, shall be connected to the supporting structure so as to resist adequately all primary and secondary stresses. Where concrete topping or other approved decking is installed and strength of the composite member is included in the calculations, the concrete topping or decking shall be installed in such a manner as to insure composite action of the assembly.

**2206.3 Cold-formed steel structural member seismic requirements:** The AISI CFSC-LRFD and ASCE 8-SSD-LRFD listed in Chapter 35 for the design based on the *load* and resistance factor design method, and the AISI CFSD-ASD and ASCE 8-SSD-ASD listed in Chapter 35 for the design based on the allowable stress design method, shall be modified as indicated in this section. The references to sections and paragraph numbers are to those of the particular specification modified.

1. AISI CFSD-ASD: The nominal strength of members and connections shall be in accordance with AISI CFSD-ASD, except that the nominal strength for shear and web crippling shall be determined by multiplying the allowable strength by 1.7. Design strengths shall be determined by multiplying the nominal strengths by the following resistance factors:

   Shear strength for $h/t > (Ek_v/F_y)^{1/2}$ . . . . . 0.9
   Shear strength for $h/t \leq (Ek_v/F_y)^{1/2}$ . . . . . 1.0
   Web crippling for members with single unreinforced webs . . . . . 0.75
   Web crippling for "I" sections . . . . . 0.80
   All other cases . . . . . 1.55/Factor of Safety

   The notation shall have the same meaning as in AISI CFSD-ASD.
2. *Load* factors: Modify Section A5.1.4 in AISI CFSD-LRFD by substituting a *load* factor of 1.0, in place of 1.5, for nominal *earthquake loads*.
3. The strength of stainless steel structural members and connections subject to seismic forces in combination with other prescribed *loads* shall be determined by the provisions of ASCE 8, except that combinations of *load* effects shall comply with the requirements of Section 1613.0.

**2206.3.1 Steel deck diaphragms:** Steel deck diaphragms shall be made from materials conforming to the requirements of AISI CFSD-ASD, AISI CFSD-LRFD or ASCE 8-SSD-ASD listed in Chapter 35. Nominal strengths shall be deter-

mined in accordance with approved test procedures developed by a *registered design professional*. Design strengths shall be determined by multiplying the nominal strength by a resistance factor of 0.60.

The steel deck installation for the building, including fasteners, shall comply with the test assembly arrangement.

**2206.4 Protection:** Formed steel shall be protected in accordance with Sections 2206.4.1 through 2206.4.4.

**2206.4.1 Shop coat:** All individual structural members and assembled panels of light gage and formed steel construction, except where fabricated of approved corrosion-resistant metallic steel or of steel having a corrosion-resistant or other approved coating, shall be protected against corrosion with an approved shop coat of paint, enamel or other approved protection.

**2206.4.2 Field coat:** After erection where directly exposed to the weather, except where encased in concrete made of noncorrosive aggregates, or where fabricated of approved corrosion-resistant steel, or of galvanized or otherwise adequately protected steel, individual structural members and assembled panels of light gage and formed steel construction shall be given an additional coat of approved protection.

**2206.4.3 Siding:** Exposed siding or sheathing shall be fabricated of approved corrosion-resistant steel or otherwise protected at the ground level for sufficient height above grade as determined by the depth of average snowfall in the locality, but not less than 8 inches (203 mm).

**2206.4.4 Protection at exterior walls:** Floor or roof construction which extends into an exterior wall shall be adequately waterproofed and protected from the weather to prevent corrosion.

**2206.5 Tests:** Where not capable of design by approved engineering analysis, the code official shall require tests of the individual or assembled structural units and the connections as prescribed in Sections 1709.0 and 1710.0. At least three specimens truly representative of the construction to be used in practice shall be subjected to the prescribed test and the mean of the results shall determine the safe working value, provided that any individual test varying more than 10 percent from the mean value shall cause rejection of the series.

**2206.6 Identifying mark:** Each structural member, siding panel and roof panel of a metal building system, other than hardware items such as bolts, nuts, washers, shims and rivets, shall be marked by the manufacturer. The identifying mark shall include the manufacturer's name or logo, and the part number or part name consistent with assembly instructions.

## SECTION 2207.0 SPECIAL STEEL AND STEEL CABLE STRUCTURAL SYSTEMS

**2207.1 Special steels:** Alloy, high-carbon or other special high-strength steels not covered in this chapter, where used in the design and construction of buildings and structures, shall conform to Section 1706.0.

**2207.2 Structural steel cable systems:** The design, fabrication and erection of steel cables used as loadbearing members in buildings and structures shall be in accordance with the AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in Chapter 35, except as modified by the provisions of Section 2207.2.1.

**2207.2.1 Steel cable seismic requirements:** The AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in Chapter 35 shall be modified as indicated in this section. The references to sections are those of the AISI *Criteria for Structural Applications of Steel Cables for Buildings* listed in Chapter 35.

1. *Load* combination "d" of Section 5 shall be modified by substituting $1.5T_4$ instead of $2.0T_4$, where $T_4$ is the net tension in the cable due to *dead load*, prestress, *live load* and seismic *load*.
2. A *load* factor of 1.1 shall be applied to the prestress forces to be added to the *load* combination in Section 3 of the steel cable specification.
3. The effective design breaking strength in Section 6 shall be multiplied by the following resistance factors:
   Members, connections and base plates that develop the strength of the members of structural systems . . . . . 0.90
   Connections that do not develop the strength of the member or structural system, including connections to base plates and anchor bolts . . . . . 0.67

## SECTION 2208.0 CAST-STEEL CONSTRUCTION *

**2208.1 Materials:** Carbon steel casting for building construction shall be cast from steel conforming to AISC ASD or AISC LRFD listed in Chapter 35. All castings shall be free from injurious blow holes or other defects which will impair the structural strength.

**2208.2 Higher strength cast steel:** Higher strength cast steel shall not be used unless approved.

**2208.3 Welding cast steel:** Cast steel designed for use in welding shall be of weldable grade.

## SECTION 2209.0 CAST-IRON CONSTRUCTION

**2209.1 Materials:** Cast iron for building construction shall be a good foundry mixture providing clean, tough, gray iron that is free from serious blow holes, cinder spots and cold shuts, and that conforms to ASTM A48 listed in Chapter 35 for medium gray-iron castings.

**2209.2 Limitations of use:** Cast-iron columns shall not be used where subject to eccentric *loads* that produce a net tension in the section, nor in any part of a structural frame that is required to resist stress due to wind. The maximum stresses for cast iron shall be as indicated in Table 2209.2.

**Table 2209.2**
**CAST-IRON STRESSES**

| Type of stress | Maximum stress (psi) [a] |
|---|---|
| Extreme compression (fiber stress in bending) | 16,000 |
| Extreme tension (fiber stress in bending) | 3,000 |
| Column compression | 9,000 minus 40 *l/r* |
| Shear | 3,000 |
| Tension | 3,000 |
| Ratio *l/r* not to exceed 70 | |

**Note a.** 1 psi = 6.9 kPa.

**2209.3 Multistory columns:** Cores of superimposed columns shall be of the same dimensions above and below a splice. Where a column of smaller diameter is superimposed over one of larger diameter, the larger column shall be tapered down to the smaller diameter over a length of not less than 6 inches (152 mm).

**2209.4 Thickness of metal:** The minimum thickness of cast iron shall not be less than specified in Sections 2209.4.1 through 2209.4.3.

**2209.4.1 Columns:** In columns, the metal shall not be less than one-twelfth of the smallest dimension of the cross section and not less than $^3/_4$ inch (19 mm).

**2209.4.2 Bases and brackets:** In bases and flanges, the metal shall not be less than 1 inch (25 mm) thick, and shall be reinforced with fillets and brackets.

**2209.4.3 Lintels:** In lintels, the metal shall not be less than $^3/_4$-inch (19 mm) thick, and shall be limited to use on spans of not more than 6 feet (1829 mm).

**2209.5 Inspection:** A cast-iron column shall not be erected in place before such column has been inspected and approved. The use of any cast-iron column in which blow holes or imperfections reduce the effective area of the cross section more than 10 percent shall be prohibited. Where required by the code official, $^3/_8$-inch (10 mm) round inspection holes shall be drilled in the section to expose the thickness of metal for inspection purposes.

## SECTION 2210.0 EXTERIOR STEEL FRAME CORROSION PROTECTION UNDER MASONRY

**2210.1 Required:** Exterior steel columns and girders, before embedment in masonry of the required fireresistance rating specified in Table 602, shall be protected from moisture by an approved waterproofing material, a parging coat of cement mortar or by a minimum of 8 inches of weather-tight masonry.

# CHAPTER 23

# WOOD

## SECTION 2301.0 GENERAL

**2301.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of wood.

**2301.2 Inspections:** The code official shall inspect the installation of wood framing members and sheathing to determine that the installation of connections conforms to this section and Sections 2304.9, 2305.2, 2305.17, 2306.4.2.3, 2306.4.5, 2306.4.6.2, 2309.8 and 2312.0. Where such inspections are conducted by an approved representative, reports shall be furnished in accordance with Section 1705.1.2.

## SECTION 2302.0 DEFINITIONS

**2302.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**Nominal dimension**
**Lumber:** A dimension that varies from actual dimensions in accordance with DOC PS 20 listed in Chapter 35.

***Particleboard*:** Particleboard is a mat-formed panel consisting of particles of wood or a combination of wood particles and wood fibers bonded together with synthetic resins or other suitable bonding systems (see Section 2308.0).

***Preservative treatment (treated material):*** Unless otherwise noted, means impregnation under pressure with a wood preservative. A wood preservative is any suitable substance that is toxic to fungi, insects, borers and other living wood-destroying organisms.

**Wood structural panels:** Panels manufactured from veneer; or wood strands or wafers; or a combination of veneer and wood strands or wafers; bonded together with synthetic resins or other suitable bonding systems. Examples of wood structural panels are plywood, oriented strand board (OSB) or composite panels (see Section 2307.0).

## SECTION 2303.0 PERFORMANCE REQUIREMENTS

**2303.1 Structural design:** All structural wood members and connections shall be of sufficient size or capacity to carry all design *loads* as required by Chapter 16 without exceeding the allowable design values specified in AFPA NDS listed in Chapter 35. Trusses and long-span girders shall be designed with sufficient camber, or other provision shall be made to counteract any deflection other than that permitted in Section 1604.5. Design values shall be adjusted for wood that is pressure impregnated with fireretardant chemicals. Such adjustment shall be in accordance with Section 2310.2.1.

**2303.1.1 Identification:** All lumber utilized for load-supporting purposes, including end-jointed or edged-glue lumber, shall have the grade identified on the label (grade mark) of an approved lumber grading or an *approved inspection agency*. Grading practices and identification shall be in accordance with rules published by an *approved agency*. In lieu of such a label on the material, a certificate of inspection as to species and grade which is issued by an approved lumber grading or an *approved inspection agency* shall be accepted for precut, remanufactured or rough-sawn lumber, and for sizes larger than 3 inches nominal in thickness. Fireretardant-treated wood shall be *labeled* in accordance with Section 2310.2.2.

**2303.2 Fireresistance:** All wood structural elements shall comply with Table 602.

**2303.3 Flameresistance:** All wood surfaces used as interior finishes and all exposed surfaces as described in Section 801.1 shall conform to the requirements of Section 803.0.

**2303.4 Combustibility:** Wood used as structural elements or portions thereof shall be limited to combustible structural elements as required by this code.

**Exceptions**
1. Fireretardant-treated wood as permitted by Table 602, Note d, and which complies with Section 2310.0.
2. As specifically permitted by Section 602.4.1.

## SECTION 2304.0 HEAVY TIMBER CONSTRUCTION

**2304.1 Material grade and design:** All structural wood members, sawn or glue-laminated, which are installed in buildings and structures of Type 4 construction shall be stress-grade timbers identified as to grade and strength by the label of an approved inspection agency or bureau. All structural timber members shall have the minimum dimensions specified in Sections 2304.3 through 2304.6 for buildings and structures of Type 4 construction and shall be designed, fabricated and installed in accordance with AFPA NDS and AITC 108, 112, 117, 119 and A190.1 listed in Chapter 35.

**2304.2 Steel or concrete:** Structural steel or reinforced concrete members shall not be substituted for timber in any part of the structural frame unless *protected* to develop the required fireresistance rating specified in Table 602, but not less than a 1-hour

fireresistance rating. Structural members that support walls shall be *protected* to afford the same fireresistance rating as the wall supported.

**2304.3 Columns:** Wood columns shall be sawn or glue-laminated and shall not be less than 8 inches nominal in any dimension where supporting floor *loads;* not less than 6 inches nominal in width and not less than 8 inches nominal in depth where supporting only roof and ceiling *loads*. Columns shall be continuous or superimposed throughout all stories by means of reinforced concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other approved methods. Girders or trusses which support columns shall have at least a 1-hour fireresistance rating.

**2304.4 Floors:** Floors shall be without concealed spaces and shall be constructed of sawn, glue-laminated, splined or tongue-and-groove planks not less than 3 inches nominal thickness and covered with a 1-inch nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, or $^{15}/_{32}$-inch wood structural panel or $^{1}/_{2}$-inch *particleboard*; or shall be constructed of planks not less than 4 inches nominal in width that are set on edge, close together and securely spiked, and covered with 1-inch *particleboard*. The lumber shall be laid so that a continuous line of joints will not occur except at points of support and so that planks are not spiked to supporting girders that are parallel to the lamination of the floor. Floors and flooring shall not extend closer than $^{1}/_{2}$-inch (13 mm) to walls so as to provide an expansion joint. Such $^{1}/_{2}$-inch (13 mm) spaces shall be covered by a molding fastened to the wall either above or below the floor and arranged such that the molding will not obstruct the expansion or contraction movements of the floor, or, as an alternative, corbeling of concrete or masonry walls under floor shall be utilized in place of molding.

**2304.4.1 Floor joists, beams and girders:** Joists, beams and girders of wood shall be constructed of sawn or glue-laminated timber and shall not be less than 6 inches nominal in width, and not less than 10 inches nominal in depth. Framed sawn or glue-laminated timber arches that spring from the floor line and support floor *loads* shall not be less than 8 inches nominal in any dimension. Framed timber trusses supporting floor *loads* shall have members of not less than 8 inches nominal in any dimension.

**2304.5 Roofs:** Roofs shall be without concealed spaces and roof decks shall be constructed of: sawn, glue-laminated, splined or tongue-and-groove planks not less than 2 inches nominal in thickness; $1^{1}/_{8}$-inch-thick interior wood structural panel (exterior glue); or of planks not less than 3 inches nominal in width that are set on edge close together and laid as required for floors in Section 2304.4.

**2304.5.1 Arches:** Framed or glue-laminated arches for roof construction which spring from the floor line or from grade and do not support floor *loads* shall have members not less than 6 inches nominal in width, not less than 8 inches nominal in depth for the lower half of the height, and not less than 6 inches nominal in depth for the upper half. Framed or glue-laminated arches for roof construction which spring from the top of walls or wall abutments, framed timber trusses and other roof framing which does not support floor *loads* shall have members not less than 4 inches nominal in width and not less than 6 inches nominal in depth. Spaced members shall be composed of two or more pieces not less than 3 inches nominal in thickness where blocked solidly throughout their intervening spaces or where such spaces are tightly closed by a continuous wood cover plate of not less than 2 inches nominal in thickness, secured to the underside of the members. Splice plates shall not be less than 3 inches nominal in thickness. Where equipped with an *automatic sprinkler system* installed in accordance with Section 906.2.1, 906.2.2 or 907.0 under the roof deck, framing members shall not be less than 3 inches nominal in width.

**2304.6 Interior wall construction:** Walls shall be of solid wood construction formed by not less than two layers of 1-inch matched boards, laminated construction 4 inches in thickness, or of 1-hour fireresistance rated construction.

**2304.7 Exterior structural members:** Wood columns and arches conforming to heavy timber sizes shall only be installed externally where a *fire separation distance* of 20 feet (6096 mm) or more is provided. Where a *fire separation distance* of less than 20 feet (6096 mm) is provided, columns and arches shall be permitted where located inside an exterior wall, and the exterior wall has a fireresistance rating not less than required by Table 602, for exterior walls.

**2304.8 Beams and girders:** Beams and girder supports and connections shall comply with Sections 2305.6.3 and 2305.6.4.

**2304.9 Column connections:** Girders and beams shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal *loads* across the joint. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only.

**2304.10 Maintenance:** All connections in the joints of timber trusses and structural frames shall be inspected periodically. Bolts and other connectors shall be maintained tight.

**2304.11 Framing around flues and chimneys:** Clearances for combustible framing members from all flues, chimneys and fireplaces shall be in accordance with Section 2305.12.

## SECTION 2305.0 WOOD FRAME CONSTRUCTION

**2305.1 Design and construction:** Exterior walls, interior partitions, floors and roofs of wood construction shall be designed and constructed in accordance with this section, Section 2303.0 and Sections 2307.0 through 2312.0.

**2305.2 Fastening:** The quantity and size of fasteners connecting wood frame members together and sheathing materials to wood frame members shall not be less than that specified in Table 2305.2.

**2305.3 Cutting and notching:** A structural member shall not be cut, notched or pierced in excess of the limitations specified herein, unless a structural analysis is performed demonstrating that the load-carrying capacity of the member has not been reduced below the capacity required for the member in accordance with Chapter 16.

**Table 2305.2**
**FASTENING SCHEDULE**

| Building element | Nail or staple size and type | Number and location |
|---|---|---|
| 1. Floor construction | | |
| Built-up girders and beams | 20d common | 32″ o.c. direct |
| Bridging to joists | 8d common | 2 each direct end |
| Floor joists to studs (No ceiling joists) | 10d common | 5 direct or |
| | 10d common | 3 direct |
| Floor joists to studs (With ceiling joists) | 10d common | 2 direct |
| Floor joists to sill or girder | 8d common | 3 toe nail |
| Ledger strip | 16d common | 3 each direct joist |
| 1″ subflooring (6″ or less) | 8d common | 2 each direct joist |
| 1″ subflooring (8″ or more) | 8d common | 3 each direct joist |
| 2″ subflooring | 16d common | 2 each direct joist |
| Particleboard underlayment ($^1/_4$″-$^3/_4$″) | 6d annular threaded | 6″ o.c. direct edges and 12″ o.c. intermediate |
| * Wood structural panel subflooring ($^1/_2$″ or less) | 6d common *or* 6d annular or spiral thread | 6″ o.c. direct edges and 12″ o.c. intermediate |
| ($^{19}/_{32}$″ - $^3/_4$″) | 8d common *or* 6d annular or spiral thread | 6″ o.c. direct edges and 12″ o.c. intermediate |
| ($^7/_8$″ - 1$^1/_8$″) | 10d common *or* 8d ring shank *or* 8d annular or spiral thread | 6″ o.c. direct edges and 6″ o.c. intermediate |
| ($^1/_2$″ or less) | 16 gage galvanized wire staples | 4″ o.c. edges and 7″ o.c. intermediate |
| ($^{19}/_{32}$″, $^5/_8$″) | $^3/_8$″minimum crown, 1$^5/_8$″ length | 2$^1/_2$″ o.c. edges and 4″ o.c. intermediate |
| 2. Wall construction | | |
| Stud to sole plate | 8d common | 4 toe nail or |
| | 16d common | 2 direct nail |
| Stud to cap plate | 16d common | 2 toe nail or 2 direct nail |
| Double studs | 10d common | 12″ o.c. direct |
| Corner studs | 16d common | 24″ o.c. direct |
| Sole plate to joist or blocking | 16d common | 16″ o.c. |
| Interior-braced wall sole plate to parallel joist | 16d common | 12″ o.c. |
| Double cap plate | 10d common | 16″ o.c. direct nail |
| Cap plate laps | 10d common | 2 direct nail |
| Ribbon strip, 6″ or less | 10d common | 2 each direct bearing |
| Ribbon strip, 6″ or more | 10d common | 3 each direct bearing |
| Diagonal brace (to stud and plate) | 8d common | 2 each direct bearing |
| Interior-braced wall top plate to joist or blocking | 10d common | 12″ o.c. |
| Tail beams to headers (where nailing is permitted) | 20d common | 1 each end 4 sq. ft. floor area |
| Header beams to trimmers (where nailing is permitted) | 20d common | 1 each end 8 sq. ft. floor area |
| Continuous header to stud | 8d common | 4 toe nail |
| Continuous header, two pieces | 16d common | 16″ o.c. direct |
| 3. Roof and ceiling construction | | |
| Ceiling joists to plate | 16d common | 3 toe nail |
| Ceiling joists (laps over partition) | 10d common | 3 direct nail |
| Ceiling joists (parallel to rafter) | 10d common | 3 direct nail |
| Collar beam | 10d common | 3 direct |
| Roof rafter to plate | 8d common | 3 toe nail |
| Roof rafter to ridge | 16d common | 2 toe nail or direct nail |
| Jack rafter to hip | 10d common | 3 toe nail or |
| | 16d common | 2 direct nail |
| 1″ roof decking (6″ or less in width) | 8d common | 2 each direct rafter |
| 1″ roof decking (over 6″ in width) | 8d common | 3 each direct rafter |
| 4. Wall and roof sheathing | | |
| 1″ wall sheathing (8″ or less in width) | 8d common | 2 each direct stud |
| 1″ wall sheathing (over 8″ in width) | 8d common | 3 each direct stud |
| Diagonal wall sheathing (seismic bracing) | See Table 2306.4.5 | |
| $^1/_2$″ fiberboard sheathing | 1$^1/_2$″ galvanized roofing nail *or* 6d common nail *or* 16 gage staple, 1$^1/_8$″ long with minimum crown of $^7/_{16}$″ | 3″ o.c. exterior edge, 6″ o.c. intermediate |
| $^{25}/_{32}$″ fiberboard sheathing | 1$^3/_4$″ galvanized roofing nail *or* 8d common nail *or* 16 gage staple, 1$^1/_2$″ long with minimum crown of $^7/_{16}$″ | 3″ o.c. exterior edge, 6″ o.c. intermediate |
| Gypsum sheathing | 12 gage 1$^1/_4$″ large head, corrosion resistant | 4″ o.c. on edge, 8″ o.c. intermediate |

**Table 2305.2 (cont'd.)**
**FASTENING SCHEDULE**

| Building element | Nail or staple size and type | Number and location |
|---|---|---|
| 4. Wall and roof sheathing (cont'd.) Gypsum sheathing (seismic bracing) | 11 gage $1^3/_4$″ long $^7/_{16}$ inch head, diamond point, galvanized | 4″ o.c. all bearing points |
| Particleboard wall sheathing ($^1/_2$″ or less) | 6d common | 6″ o.c. direct edges and 12″ o.c. intermediate |
| ($^5/_8$″ or less) | 8d common | 6″ o.c. direct edges and 12″ o.c. intermediate |
| Wood structural panel roof and wall sheathing ($^1/_2$″ or less) | 6d common (walls); 8d common (roofs)[b,c] | 6″ o.c. direct edges and 12″ o.c. intermediate |
| ($^{19}/_{32}$″ to 1″) | 8d common[b,c] | 6″ o.c. direct edges and 12″ o.c. intermediate[d] |
| (1″ or greater) | 10d common[b,c] | 6″ o.c. direct edges and 12″ o.c. intermediate |
| ($^1/_2$″ or less) | 16 gage galvanized wire staples, $^3/_8$″ minimum crown; length of 1″ plus panel thickness | 4″ o.c. edges and 8″ o.c. intermediate |
| ($^{19}/_{32}$″, $^5/_8$″) | Same as immediately above | $2^1/_2$″ o.c. edges and 5″ o.c. intermediate |
| Shingles, wood[a] | No. 14 B&S Gage corrosion resistant | 2 each bearing |
| Weatherboarding | 8d corrosion resistant | 2 each bearing |

**Note a.** Single nails shall penetrate not less than $^3/_4$ inch into nailing strips, sheathing or supporting construction except as otherwise provided for in Section 1507.0.

**Note b.** For regions having a basic wind speed of 90 miles per hour or greater where the mean roof height is less than 25 feet and for regions having basic wind speed of 80 miles per hour or less, nails which attach wood structural panel roof sheathing to gable end wall framing shall be spaced 6 inches on center. Where basic wind speed is greater than 80 miles per hour, nails which attach panel roof sheathing to intermediate supports shall be spaced 6 inches on center of a minimum of a 48-inch distance from ridges, eaves and gable end walls; and 4 inches on center to gable end wall framing.

**Note c.** For regions having a basic wind speed of 90 miles per hour or grater, 8d deformed shank nails shall be utilized to attach wood structural panel roof sheathing to framing within a minimum 48-inch distance from gable end walls provided the mean roof height is between 25 feet and 35 feet. For roof heights greater than 35 feet in a 90 miles per hour or greater wind region, attachment of wood structural panel roof sheathing shall be designed for the wind loads in Section 1609.0.

**Note d.** Nails shall be spaced 6 inches on center direct to panel edges and 6 inches on center to intermediate supports where panel spans are 48 inches on center or greater.

**Note e.** 1 inch = 25.4 mm; 1 foot = 304.8 mm.

**2305.3.1 Solid lumber joists:** Notches in solid lumber joists, rafters and beams shall not exceed one-sixth of the depth of the member, shall not be longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Notch depth at the ends of the member shall not exceed one-fourth of the depth of the member. Holes bored or cut into solid lumber joists, rafters or beams shall not be closer than 2 inches (51 mm) to the top or bottom of the joist, or to any other hole located in the member. Where the members are notched, the hole shall not be closer than 2 inches (51 mm) to the notch. The diameter of the hole in joists shall not exceed one-third of the depth of the member.

**Exceptions**

1. A notch over the support is permitted to extend the full width of the support.
2. Notches on cantilevered portions of the member are permitted to extend the full length of the cantilever if the strength and deflection of the cantilever is calculated based on the reduced member section.
3. The tension side of beams, joists and rafters, which are 4 inches or greater in nominal thickness, shall not be notched, except at ends of members.

**2305.3.2 Engineered wood products:** Cuts, notches and holes bored in trusses, laminated veneer lumber, glue-laminated members, or I-joists shall be based on research and investigation in accordance with Section 1703.2.

* **2305.3.3 Reinforcement:** Where the stud is cut or bored in excess of one-third of its depth, the stud shall be reinforced to be equal in loadbearing capacity to a stud that is notched not more than one-third of its depth.

**2305.4 Loadbearing walls:** Posts and studs in loadbearing walls and partitions shall be designed as columns, with due allowance for lateral support furnished by sheathing, intermediate bracing, horizontal bridging, wall coverings and the floor and roof assemblies. The walls shall be fabricated in such a manner as to provide adequate support for the materials that enclose the building and to provide for transfer of all lateral *loads* to the foundation in accordance with Section 1710.4.

**2305.4.1 Wall framing:** Studs shall be placed with the wide dimension perpendicular to the wall. Not less than three studs shall be installed at each corner of an exterior wall.

**Exception:** At corners, a third stud is not required where wood spacers or backup cleats of $^3/_8$-inch-thick wood structural panel, $^3/_8$-inch Grade M-S and M-2 "Exterior Glue" particleboard, 1-inch-thick lumber or other approved devices which serve as an adequate backing for the attachment of facing materials are used. Where fireresistance ratings or shear *loads* apply, wood spacers, backup cleats or other devices shall not be installed unless specifically approved.

**2305.4.2 Double top plates:** Stud walls shall be capped with double top plates installed to provide overlapping corners and wall intersections. Top plate joints shall be offset not less than 48 inches (1219 mm).

**Exception:** Buildings or structures located in seismic map areas having a peak velocity-related acceleration ($A_v$) less than 0.05, in accordance with Section 1610.1, detached *one-* and *two-family dwellings* located in seismic map areas having an $A_v$ less than 0.15, and agricultural storage buildings that are intended only for incidental human

occupancy are permitted to have a single top plate, provided that the plate is adequately tied at joints, corners and intersecting walls by at least the equivalent of galvanized steel that is 3 inches (76 mm) by 6 inches (152 mm) by 0.036 inches thick and nailed to each wall or segment of wall by three 8d nails or the equivalent, and the rafters, joists or trusses are centered over the studs with a tolerance of not more than 1 inch (25 mm).

**2305.4.3 Bottom plates:** Studs shall have full support by a plate or sill. The sill shall have not less than a 2-inch nominal thickness and a width at least equal to the width of the studs.

**2305.4.4 Notching and boring:** Notches in solid lumber studs shall not exceed 25 percent of the stud depth. Bored holes shall not exceed 40 percent of the stud depth and the edge of the hole shall not be closer than $^5/_8$ inches (15 mm) to the edge of the stud. Notches and holes shall not occur in the same cross-section.

**Exception:** Bored holes shall not exceed 60 percent of the stud depth where studs are doubled.

**2305.5 Nonloadbearing walls:** Studs in nonloadbearing walls and partitions shall not be spaced more than 48 inches (1219 mm) o.c., and are permitted to be erected with the long dimension parallel to the wall, unless otherwise approved as an integrated assembly by testing. A single top plate shall be prohibited except where such plate is installed in accordance with Section 2305.4.2.

**2305.5.1 Notching and boring:** Notches in studs shall not exceed 40 percent of the stud depth. Bored holes shall not exceed 60 percent of the stud depth and shall not be closer than $^5/_8$ inches (15 mm) to the edge. Notches and holes shall not occur in the same cross-section.

**2305.6 Support and anchorage:** Support and anchorage of members on girders, walls and beams shall conform to Sections 2305.6.1 through 2305.6.4.

**2305.6.1 Support and anchorage on girders:** All members framing into girders shall be anchored or tied to secure continuity. The ends of all wood beams that rest on girders shall bear not less than 4 inches (102 mm) or shall be supported in approved metal stirrups, hangers or on wood clips or ribbon strips. Beams framing from opposite sides shall either lap at least 6 inches (152 mm) and be bolted or spiked together or, where framed end-to-end, the beams shall be secured together by approved ties, straps, dogs, plates or sheathing.

**2305.6.2 Support and anchorage on walls or beams:** Except where supported on a $1 \times 4$ ribbon strip and nailed to the adjoining stud, joists shall bear on walls or beams of wood or steel not less than $1^1/_2$ inches (38 mm) or shall be supported by metal stirrups, hangers or a nominal 2-inch wood ledger strip. The minimum concrete or masonry support shall be 3 inches (76 mm). Joists framing over beams from opposite sides shall either lap at least 3 inches (76 mm) and be securely fastened together or, where framed end-to-end, the joists shall be secured together by approved ties, straps, dogs, plates or sheathing.

**2305.6.3 Girder supports:** Wall plate boxes of the self-releasing type, or approved hangers, shall be provided where beams and girders are supported by concrete or masonry. An air space of $^1/_2$ inch (13 mm) shall be provided at the top, end and sides of the member unless approved naturally durable or *preservative-treated* wood in accordance with Section 2311.0 is installed. Wood beams and girders supported by walls required to have a fireresistance rating of 2 hours or more shall have not less than 4 inches (102 mm) of solid concrete or solid masonry between their ends and the outside face of the wall and between adjacent beams.

**2305.6.4 Fire cuts:** Wood and other combustible floor, roof and other structural members framing into concrete or masonry walls shall be cut to a bevel of 3 inches (76 mm) in depth and shall project not more than 4 inches (102 mm) into the wall.

**2305.7 Wind bracing:** Structural members and connections that resist wind pressures shall be designed for the wind loads specified in Section 1609.0. In buildings more than one story in *height* and where necessary for strength in one-story buildings, the corner posts shall be the equivalent of not less than two pieces of 2-inch by 4-inch studs. Bracing elements shall be continuous diagonal wood members which are let into the wall studs, diagonal wood board sheathing, wood structural panels, particleboard or other sheathing specified in Section 2305.13. Bracing sheathing shall be applied with all edges supported. Other sheathing materials shall be permitted when tested in accordance with ASTM E72 listed in Chapter 35.

The lateral *load* resistance shall be established by the lesser of: the values determined by dividing the maximum load reported in the test by 2.5; or the load at which the deflection reported in the test exceeds $h/480$, where $h$ is the height of the test assembly.

**2305.8 Seismic bracing:** Where structural analysis of the seismic force-resisting system is not provided, buildings shall meet the provisions of this section and shall have roof and exterior wall *dead loads* less than or equal to 15 psf (718 Pa) and floor *dead loads* less than or equal to 10 psf (479 Pa).

**Exceptions**

1. Detached *one-* and *two-family dwellings* located in seismic map areas having an effective peak velocity-related acceleration ($A_v$) value less than 0.15.
2. The exterior wall weight limitation shall not apply to masonry veneer attached to one-story Seismic Performance Category B buildings.

**2305.8.1 Wall bracing required:** All exterior walls and required interior-braced walls shall be braced by one of the types of sheathing prescribed in Table 2305.8.1 for each 25 lineal feet (7620 mm) of exterior wall or required interior-braced wall line. The required length of sheathing shall be distributed along the length of the braced wall with sheathing placed at each end of the exterior wall or interior-braced wall. A minimum 4-foot (1219 mm) length of sheathing shall be located at the end of each braced wall. The construction of braced walls shall comply with the requirements of Section 2305.9.

**2305.8.2 Double-sheathed walls:** Where braced walls are sheathed on both sides with identical sheathing, the required length of sheathing in Table 2305.8.1 is permitted to be taken as one-half the tabular length. Where different sheathing

**Table 2305.8.1**
**MINIMUM SEISMIC WALL BRACING PER 25 LINEAL FEET OF INTERIOR AND EXTERIOR WALL LENGTH[a, g]**

| Story location | Sheathing[b] | $0.05 \le A_v < 0.10$ | $0.10 \le A_v < 0.15$ | $0.15 \le A_v < 0.20$ | $0.20 \le A_v < 0.30$ | $0.30 \le A_v < 0.40$ |
|---|---|---|---|---|---|---|
| Top or only story | GP | 5′ 0″[c] | 7′ 0″ | 9′ 0″ | 14′ 0″ | 18′ 0″[e] |
| | W/SP | 4′ 0″ | 4′ 0″ | 5′ 0″ | 8′ 0″ | 10′ 0″[e] |
| First of two stories or second of three stories | GP | 9′ 0″[d] | 13′ 0″ | 17′ 0″[e] | 25′ 0″[e] | 32′ 0″[e] |
| | W/SP | 5′ 0″ | 7′ 0″ | 10′ 0″[e] | 14′ 0″[e] | 18′ 0″[e] |
| First of three stories | GP | 13′ 0″ | Note f | | | |
| | W/SP | 7′ 0″ | | | | |

**Note a.** Interpolation of the tabular values is permitted where the length of wall between exterior walls or interior-braced walls is less than 25 feet.
**Note b.** GP = Gypsum or particleboard sheathing; W/SP = Diagonal wood boards or wood structural panels.
**Note c.** Fiberboard, installed in accordance with Table 2309.8, is permitted as bracing at 10 feet per 25 feet of wall length.
**Note d.** Fiberboard, installed in accordance with Table 2309.8, is permitted as bracing at 18 feet per 25 feet of wall length.
**Note e.** Applies to detached one- and two-family dwellings only.
**Note f.** Analysis of the seismic force-resisting system required.
**Note g.** 1 foot = 304.8 mm.

materials are used on either side of a wall, the required length of sheathing in Table 2305.8.1 is permitted to be taken as one-half of the tabular length for the material requiring the greater length. Double-sheathed walls shall have a minimum length of 4 feet (1219 mm).

**Table 2305.8**
**WALL SPACING AND HEIGHT LIMITATIONS FOR WOOD FRAME CONSTRUCTION**

| Seismic Performance Category | Maximum distance between interior-braced walls (feet)[c] | Maximum stories (height) permitted[c] |
|---|---|---|
| A | See Section 1610.1, Exception #3 | |
| B | 35 | 3 (40 feet) |
| C | 25 | 2 (30 feet) |
| D[a] | 25 | 1 (20 feet)[b] |
| E | Engineering analysis required, see Section 2306.0 | |

**Note a.** Applies only to Seismic Hazard Exposure Group I; engineering analysis required for Seismic Hazard Exposure Group II.
**Note b.** Detached one- and two-family dwellings shall not exceed two stories or 30 feet in height.
**Note c.** 1 foot = 304.8 mm.

**2305.8.3 Stud walls:** Stud walls that are less than the full height of the story shall be braced as required for exterior walls or interior-braced walls and shall be considered an additional story.

**2305.8.4 Sheathing installation:** Sheathing shall be installed in accordance with the provisions of Table 2305.13 where acting as wall bracing. To be considered effective as bracing, the sheathing shall be at least 48 inches in width covering three 16-inch stud spaces or two 24-inch stud spaces and be fastened to the wall studs in accordance with Table 2305.2. Sheathing shall be fastened to the wall studs, sole plate and top plate in accordance with Table 2305.2. All vertical joints of panel sheathing shall occur over studs and all horizontal joints shall occur over blocking at least equal in size to the studs. All framing in connection with sheathing used for bracing shall not be less than 2 inches nominal in thickness.

**2305.9 Braced wall:** All exterior walls and interior-braced walls required by Table 2305.8, shall be constructed to transfer forces from roofs and floors to braced walls and from the braced walls in upper stories to the braced walls in the story below. Braced wall lines from the story above to the story below are permitted to be offset a maximum of 24 inches (610 mm). Blocking, where required by this section, need only be provided for the length of the wall specified in Table 2305.8.1.

**2305.9.1 Roof to braced wall connections:** Roof to interior-braced wall connections for buildings with maximum dimensions not over 50 feet (15240 mm) are permitted to be made at the intersection of exterior walls. Double top plates shall be lapped at the intersection and nailed in accordance with Table 2305.2. For buildings with maximum dimensions greater than 50 feet (15240 mm), the interior-braced walls shall be fastened directly to the ceiling joist in accordance with Section 2305.9.2 or 2305.9.3.

**2305.9.2 Parallel floor joist and braced wall connections:** Where the floor framing is parallel to the braced wall line, joists shall be doubled directly beneath the braced wall line and nailed in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, the joist spaces between the offset braced walls shall be blocked with a minimum blocking size of 2 inches by 6 inches, spaced at 32 inches (813 mm) on center, within the joist cavity under the braced wall, and positioned in the upper portion of the cavity. The upper braced wall is permitted to be nailed to the blocking with two 16d nails at each piece of blocking. The lower braced wall shall be toe nailed, in accordance with Table 2305.2, to a joist located directly above the top plates.

**2305.9.3 Perpendicular floor joist and braced wall connections:** Where the floor framing is perpendicular to the braced wall line, solid blocking for the full depth of the floor joist shall be provided for the length of bracing required. The interior-braced wall shall be nailed to the blocking in accordance with Table 2305.2.

Where the upper and lower braced walls are offset, a minimum of 2-inch by 6-inch blocking shall be located in the upper portion of the joist space, directly beneath the upper braced wall and in the lower portion of the joist space, directly above the lower braced wall.

**2305.10 Multiple stories:** Where the frame is more than one story in *height* and studs and posts are not continuous from sill

to roof, the members shall be secured together with approved clips, splices or other connections to ensure a continuous, well-integrated structure. Sheet metal clamps, ties or clips shall be formed of galvanized steel or other approved corrosion-resistant material equivalent to 0.040-inch nominal thickness steel sheets for 2-inch framing members and not less than 0.052-inch nominal thickness steel sheets for 3-inch structural members. For 4-inch and larger members, column splices and beam and girder supports shall comply with Section 2304.1.

**2305.11 Framing over openings:** Headers, double joists, trusses or other approved assemblies which are of adequate size to transfer all superimposed *loads* to the vertical members shall be provided over all window and door openings in loadbearing walls and partitions.

**2305.12 Framing around flues and chimneys:** Combustible framing shall be a minimum of 2 inches (51 mm), but shall not be less than the distance specified in Section 2113.0 and the mechanical code listed in Chapter 35, from all flues, chimneys and fireplaces, and 6 inches (152 mm) away from flue openings.

**2305.13 Wall sheathing:** Except as provided for in Section 1405.3 for weatherboarding or where stucco construction that complies with Section 2506.0 is installed, all enclosed buildings shall be sheathed with one of the materials of the nominal thickness specified in Table 2305.13 or any other approved material of equivalent strength and durability.

**Table 2305.13**
**MINIMUM THICKNESS OF WALL SHEATHING**

| Sheathing type | Minimum thickness | Maximum shear wall stud spacing[a] |
|---|---|---|
| Wood boards | $^5/_8$ inch | 24 inches on center |
| Fiberboard | $^7/_{16}$ inch | 16 inches on center |
| Wood structural panel | In accordance with Table 2307.3.5 | |
| M-S and M-2 "Exterior Glue" Particleboard | In accordance with Table 2308.5(2) | |
| Gypsum sheathing | $^1/_2$ inch | 16 inches on center |
| Gypsum wallboard | $^1/_2$ inch | 24 inches on center |
| Reinforced cement mortar | 1 inch | 24 inches on center |

**Note a.** 1 inch = 25.4 mm.

**2305.13.1 Wood structural panel wall bracing:** In buildings assigned to Seismic Performance Category D or E, where wood structural panel sheathing is installed structurally as covering on the exterior of outside walls, such sheathing shall be of the exterior type. Where used elsewhere structurally, wood structural panel sheathing shall be bonded by intermediate or exterior glue.

**2305.13.2 Paper-backed lath sheathing:** In occupancies in Use Group R-3 and one-story commercial buildings with brick or similar veneers, the sheathing shall conform to Section 2305.13 or shall consist of a layer of paper-backed lath complying with Section 2505.0 and a 1-inch (25 mm) intermediate space which shall be mortar filled as each course of veneering is applied.

**2305.14 Flooring:** The flooring of wood frame construction shall be of adequate strength and stiffness to support required *loads* and, where necessary for strength and for lateral support of the building, subflooring shall be provided.

**2305.14.1 Floor spans:** Design stresses of floor joists shall be determined in accordance with AFPA NDS listed in Chapter 35 and shall be braced in accordance with Section 2305.16. Metal-plate-connected floor trusses shall be designed in accordance with TPI 1 and AFPA NDS listed in Chapter 35. *

**2305.15 Roof spans:** Design stresses of rafters shall be determined in accordance with AFPA NDS listed in Chapter 35 and shall be braced in accordance with Section 2305.16. Metal-plate-connected roof trusses shall be designed in accordance with TPI 1 and AFPA NDS listed in Chapter 35, and shall be braced to prevent rotation and provide lateral stability.

**2305.15.1 Roof decking and sheathing:** Roof deck sheathing shall consist of not less than $^5/_8$-inch boards, wood structural panel of the thickness specified in Section 2307.3, or other approved materials of equivalent strength and rigidity. Where open deck sheathing is used on pitched roofs, such sheathing shall consist of not less than 1-inch by 4-inch roofers spaced not more than 6 inches (152 mm) on center, or of material of equivalent strength and rigidity.

**2305.16 Bridging:** All floor, attic and roof framing with a nominal depth-to-thickness ratio greater than or equal to 5:1, shall have one edge braced for the entire span. Where the nominal depth-to-thickness ratio of the framing member exceeds 6:1, there shall be one line of bridging for each 8 feet (2438 mm) of span. The bridging shall consist of not less than 1-inch by 3-inch lumber, double nailed at each end, or of equivalent metal bracing of equal rigidity. A line of bridging shall also be required at supports where equivalent lateral support is not otherwise provided.

**2305.17 Foundation anchorage:** Wall sill plates, minimum of 2-inch by 4-inch members, shall be sized and anchored to foundation walls or piers and at intermediate intervals as required to resist wind uplift. Foundation anchorage shall be provided by the installation of anchor bolts or other approved anchoring method. Anchor bolts shall be of a minimum diameter of $^1/_2$ inch. The bolts shall be embedded in poured-in-place concrete or grouted unit masonry or solid masonry foundations to a depth of not less than 7 inches (178 mm). There shall be a minimum of two anchor bolts per section of plate and anchor bolts shall be placed 12 inches (305 mm) from the end of each section of plate, with intermediate bolts spaced a maximum of 6 feet (1829 mm) on center for one- and two-story buildings and not more than 4 feet (1219 mm) on center for buildings over two stories in height.

**Exception:** All buildings or structures located in seismic map areas having a peak velocity-related acceleration ($A_v$) equal to or less than 0.05 in accordance with Section 1610.1, and detached *one-* and *two-family dwellings* located in seismic map areas having a peak velocity-related acceleration ($A_v$) less than 0.15, and agricultural storage buildings which are intended only for incidental human occupancy, are permitted to

have maximum intermediate bolt spacings of 8 feet (2438 mm).

**2305.18 Fire cuts:** Wood structural members which frame into concrete or masonry walls shall conform to Section 2305.6.4.

## SECTION 2306.0 SEISMIC REQUIREMENTS FOR WOOD AND TIMBER

**2306.1 General:** All buildings for which a seismic analysis is required, in accordance with Section 1610.1, and which are constructed partially or wholly of wood or wood-based materials shall be designed in accordance with the provisions of this section and Section 2305.0.

**2306.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Blocked diaphragm:** A diaphragm in which all sheathing edges not occurring on a framing member are supported on and connected to blocking.

**Diaphragm:** A horizontal or nearly horizontal system designed to transmit lateral forces to the vertical elements of the seismic-resisting system.

**Wood shear panel:** A wood floor, roof or wall component sheathed to act as a shear wall or diaphragm.

**2306.3 Strength of members and connections:** The allowable *load* capacities of this section are to be utilized with allowable stress design *load* combinations.

**2306.4 Engineered timber construction:** Where seismic analysis is required in accordance with Section 1610.1, the proportioning and design of wood systems, members and connections shall be in accordance with this section and AFPA NDS listed in Chapter 35.

**2306.4.1 Column framing requirements:** All wood columns shall be provided with full end support. Columns shall be provided with adequate support to maintain stability. Positive connections shall be provided to resist uplift and lateral displacement.

**2306.4.2 Wood shear panels:** Wood shear panels shall comply with Sections 2306.4.2.1 through 2306.4.2.6. Diaphragm construction shall comply with Section 2306.4.3. Shear wall construction shall comply with Section 2306.4.4. The construction of wood shear panels shall comply with Section 2306.4.5 for diagonally sheathed lumber shear panels, Section 2306.4.6 for wood structural panel sheathed shear panels, Section 2306.4.7 for *particleboard* shear wall sheathing, or Section 2306.4.8 for other shear panel sheathing.

**2306.4.2.1 Framing members:** All framing members installed in shear panel construction shall be at least 2 inches nominal in thickness. Boundary members, and chords in diaphragms and shear walls and collectors transferring forces to such elements shall be designed and detailed for the axial forces. Boundary members shall be connected at all corners.

**2306.4.2.2 Opening details:** Openings in shear panels shall be designed and detailed to transfer the shear and axial forces induced by the discontinuity created by the opening and the details shall be shown on the approved plans.

**2306.4.2.3 Connection and anchorage details:** Positive connections and anchorages, capable of resisting the design forces, shall be provided between the shear panel and the attached components. Concrete or masonry wall anchorage shall not be accomplished by installation of toe nails, or nails subject to withdrawal and wood ledgers shall not be installed in cross-grain bending or tension.

**2306.4.2.4 Wood structural panel fastening:** In Seismic Performance Category E buildings, wood structural panels installed in shear panels that are a part of the seismic-resisting system shall be applied directly to the framing members.

**Exception:** Wood structural panel nailed over solid lumber decking or laminated decks.

**2306.4.2.5 Torsion:** The diaphragms in buildings having torsional irregularity, where the lateral stiffness ratio of the structural members is greater than 4:1, or in buildings with one line of resistance in either orthogonal direction, shall be sheathed with diagonal boards or wood structural panels. The length of the diaphragm normal to the soft side shall not exceed 25 feet (7620 mm) nor shall the diaphragm length-to-width ratio exceed 1.0 for one-story buildings or 0.67 for buildings over one story in height.

**Exception:** Where calculations demonstrate that the diaphragm deflections will be tolerated, the length limitation of 25 feet (7620 mm) does not apply and the length-to-width ratio of 1.5 is permitted for diaphragms sheathed with single diagonal boards; and a ratio of 2.0 is permitted where sheathed with double diagonal boards or wood structural panels.

**2306.4.2.6 Panel height-to-width ratio:** The width of a shear panel in a diaphragm or shear wall shall not be less than 2 feet and the $h/w$ ratio of a shear wall shall not be greater than 2, where $h$ is the height of a shear panel or shear wall and $w$ is the width of a shear panel or shear wall.

**2306.4.3 Diaphragms:** Wood diaphragms shall not be installed to resist torsional forces induced by concrete or masonry construction in buildings of Seismic Performance Category D or E which are more than two stories in height.

**2306.4.3.1 Ties and splices:** Diaphragm sheathing shall not be installed as the ties and splices required by Section 1610.3.6.1.1 and Section 1610.3.6.1.2.

**Exception:** Diaphragm sheathing in buildings of Seismic Performance Categories A and B, Seismic Performance Category C buildings of Seismic Hazard Exposure Groups I and II, and Seismic Performance Category C buildings of Seismic Hazard Exposure Group III with an effective peak velocity-related acceleration ($A_v$) of less than 0.10.

**2306.4.3.2 Unblocked diaphragms:** Unblocked diaphragms shall not be installed as part of the seismic-resist-

ing system in buildings of Seismic Performance Category E.

**2306.4.4 Shear walls:** Shear wall construction shall comply with the requirements of this section.

**2306.4.4.1 Design shear increases:** The design shear capacity is permitted to be doubled where identical materials are applied to both sides of the wall. Where the shear capacities of the materials are not equal, the allowable shear shall be considered to be equal to either the shear for the side with the higher capacity or twice the shear for the side with the lower capacity.

**2306.4.4.2 Material limitations:** Shear walls shall be sheathed with wood structural panels in Seismic Performance Category B, C, D and E buildings.

**Exceptions**

1. In Seismic Performance Category B and C buildings: *particleboard*, gypsum sheathing, gypsum wallboard, fiberboard and wire lath and cement plaster shear walls are permitted.
2. In Seismic Performance Category D buildings: *particleboard*, gypsum sheathing, gypsum wallboard and wire lath and cement plaster shear walls in one-story buildings and the top story of buildings two stories or more in height are permitted.

**2306.4.5 Diagonally sheathed lumber shear panels:** Diagonally sheathed lumber shear panels shall be nailed in accordance with Table 2306.4.5.

**Table 2306.4.5**
**DIAGONALLY SHEATHED SHEAR PANEL NAILING SCHEDULE**

| Sheathing nominal dimension | Nailing to intermediate and end-supported studs | | Nailing at the shear panel boundaries | |
|---|---|---|---|---|
| | Number of nails per board and nail size | | | |
| | Common nails | Box nails | Common nails | Box nails |
| 1″ × 6″ | (2) 8d | (3) 8d | (3) 8d | (5) 8d |
| 1″ × 8″ | (3) 8d | (4) 8d | (4) 8d | (6) 8d |
| 2″ × 6″ | (2) 16d | (3) 16d | (3) 16d | (5) 16d |
| 2″ × 8″ | (3) 16d | (4) 16d | (4) 16d | (6) 16d |

**2306.4.5.1 Single diagonal construction:** Single diagonally sheathed lumber shear panels shall be constructed of minimum 1-inch-thick nominal sheathing boards laid at an angle of approximately 45 degrees (0.78 rad) to the supports. The shear capacity for single diagonally sheathed lumber shear panels of Southern pine or Douglas fir-larch shall not exceed 200 pounds per lineal foot (2919 N/m) of width. The shear capacities shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in Chapter 35.

**2306.4.5.1.1 End joints:** Joints in adjacent boards shall be separated by not less than one stud or joist space and there shall not be less than two boards between joints on the same support.

**2306.4.5.1.2 Two-inch nominal lumber:** Wood shear panels made up of 2-inch-thick diagonal lumber sheathing fastened with 16d nails shall be designed with the same shear capacities as shear panels using 1-inch boards fastened with 8d nails, provided that there are not splices in adjacent boards on the same support and the supports are not less than 4 inches nominal in depth or 3 inches nominal in thickness.

**2306.4.5.2 Double diagonal construction:** Double diagonally sheathed lumber shear panels shall be constructed of two layers of diagonal sheathing boards laid at 90 degrees (1.57 rad) to each other on the same face of the supporting members. Each chord shall be considered as a beam loaded with uniform *load* per foot equal to 50 percent of the unit shear due to diaphragm action. The *load* shall be assumed as acting normal to the chord in the plane of the diaphragm in either direction. The span of the chord or portion thereof shall be the distance between framing members of the diaphragm such as the joists, studs and blocking that serve to transfer the assumed *load* to the sheathing. The shear capacity of double diagonally sheathed diaphragms of Southern pine or Douglas fir-larch, shall not exceed 600 pounds per lineal foot (8756 N/m) of width. The shear capacity shall be adjusted by a reduction factor of 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and a reduction factor of 0.65 for species with a specific gravity of less than 0.42 as contained in AFPA NDS listed in Chapter 35.

**2306.4.6 Wood structural panel shear panels:** The design and shear capacity of wood structural panel shear panels shall be in accordance with Section 2306.4.6.1 for diaphragms and Section 2306.4.6.2 for shear walls, or shall be calculated by using the nail strengths in AFPA NDS and the wood structural panel shear capacities as given in DOC PS 1 listed in Chapter 35.

Shear panels shall be constructed of wood structural panels manufactured with exterior glue not less than 4 feet by 8 feet, except at boundaries and changes in framing. Wood structural panels shall be designed to resist shear only, and chords, collector members and boundary members shall be designed to transfer the axial forces. Boundary members shall be connected at all corners. Wood structural panels less than 12 inches (305 mm) wide shall be blocked.

**2306.4.6.1 Wood structural panel floor and roof diaphragm construction:** The nail size and spacing at diaphragm boundaries and at the edges of each sheet of wood structural panel shall be provided as shown in Table 2306.4.6.1 and Figure 2306.4.6.1, and by the provisions of Sections 2306.4.6.1.1 through 2306.4.6.1.4. Nails of the same size shall be placed along all intermediate framing members at 12 inches (305 mm) on center.

**2306.4.6.1.1 Other wood species:** Shear capacities for fasteners in framing members of other wood species, shall be calculated by multiplying the shear capacities

for Structural I panels by 0.82 for species with a specific gravity of 0.42 and greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in Chapter 35.

**2306.4.6.1.2 Framing and panel layout:** The orientation of the structural framing and wood structural panels shall comply with Case 1, 2, 3, 4, 5 or 6 of Table 2306.4.6.1 and with Figure 2306.4.6.1. For blocked diaphragms, the maximum shear for Cases 3, 4, 5 and 6 shall not exceed 1,200 pounds per lineal foot (17.51 kN/m).

**2306.4.6.1.3 Fastener spacings of 2 and $2^1/_2$ inches:** Where either 2-inch (51 mm) or $2^1/_2$-inch (64 mm) fastener spacings are installed with 2-inch-wide framing members in accordance with Table 2306.4.6.1, the framing member adjoining panel edges shall be 3 inches nominal in width and nails at panel edges shall be placed in two lines.

**2306.4.6.1.4 Panels $1^1/_8$-inch thick:** Unblocked $1^1/_8$-inch panels with tongue-and-groove edges are permitted to use the blocked diaphragm shear capacities for $^{19}/_{32}$-inch minimum nominal panel thickness values, where 1-inch by $^3/_8$-inch crown by No. 16 gage staples are driven through the tongue-and-groove edges $^3/_8$ inch (10 mm) from the panel edge so as to penetrate the tongue. Staples shall be spaced at one-half the boundary nail spacing for Cases 1 and 2 and at one-third the boundary nail spacing for Cases 3, 4, 5 and 6.

**2306.4.6.2 Wood structural panel shear wall construction:** The nail size and spacing at the edge of each wood structural panel shall be provided as shown in Table 2306.4.6.2 and by the provisions of Sections 2306.4.6.2.1 through 2306.4.6.2.3. For $^3/_8$-inch and $^7/_{16}$-inch panels, installed on studs spaced 24 inches (610 mm) on center, nails shall be spaced at 6 inches (152 mm) on center along intermediate framing members. For all other thicknesses and spacing of studs, intermediate framing members shall have nails of the same size spaced at 12 inches (305 mm) on center. All panel edges shall be backed with 2-inch or wider framing members.

In buildings assigned to Seismic Performance Category E, the allowable shear capacity for wood structural panel shear walls installed to resist horizontal forces in buildings with masonry or concrete walls shall be one-half of the allowable *loads* in Table 2306.4.6.2.

**2306.4.6.2.1 Other wood species:** Shear capacities for fasteners in framing members of other wood species shall be calculated by multiplying the shear capacities for Structural I panels by 0.82 for species with a specific gravity of 0.42 or greater but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in AFPA NDS listed in Chapter 35.

**2306.4.6.2.2 Three-inch nominal width framing:** Framing shall be 3 inches nominal or wider and the nails shall be staggered where nails are spaced 2 inches (51 mm) on center or where 10d nails having a penetration into framing of more than $1^5/_8$ inches (41 mm) are used with a 3-inch (76 mm) nail spacing.

**2306.4.6.2.3 Panels $^3/_8$ inch and $^7/_{16}$ inch thick:** The shear capacity for $^3/_8$-inch and $^7/_{16}$-inch panels applied direct to framing with 8d nails is permitted to be increased to the values shown for $^{15}/_{32}$-inch panels with the same nailing where the framing studs are spaced a maximum of 16 inches (406 mm) on center or the panels are applied with the long dimension across the studs.

Shear capacity for $^3/_8$-inch and $^7/_{16}$-inch panels shall be as indicated in Table 2306.4.6.2. *

**2306.4.7 Particleboard shear wall sheathing:** Shear walls shall be sheathed with *particleboard* sheets not less than 4 feet by 8 feet, except at boundaries and changes in framing. The required nail size and spacing in Table 2306.4.7 shall apply to panel edges only. All panel edges shall be backed with 2-inch nominal or wider framing. Sheets shall be installed either horizontally or vertically. For $^3/_8$-inch *particleboard* sheets installed with the long dimension parallel to the studs spaced 24 inches (610 mm) on center, nails shall be spaced at 6 inches (152 mm) on center along intermediate framing members. For all other conditions, nails of the same size shall be spaced at 12 inches (305 mm) on center along intermediate framing members.

**Table 2306.4.7**
**ALLOWABLE SHEAR FOR PARTICLEBOARD SHEAR WALL SHEATHING FOR SEISMIC LOADING**

| Panel grade | Minimum nominal panel thickness (inch) | Minimum nail penetration in framing (inches) | Panels applied direct to framing | | | | |
|---|---|---|---|---|---|---|---|
| | | | Nail size (common or galvanized box) | Allowable shear (pounds per foot)[a] nail spacing at panel edges (inches)[a] | | | |
| | | | | 6 | 4 | 3 | 2 |
| M-S and M-2 "Exterior Glue" | $^3/_8$ | $1^1/_2$ | 6d | 120 | 180 | 230 | 300 |
| | $^3/_8$ | $1^1/_2$ | 8d | 130 | 190 | 240 | 315 |
| | $^1/_2$ | | | 140 | 210 | 270 | 350 |
| | $^1/_2$ | $1^5/_8$ | 10d | 185 | 275 | 360 | 460 |
| | $^5/_8$ | | | 200 | 305 | 395 | 520 |

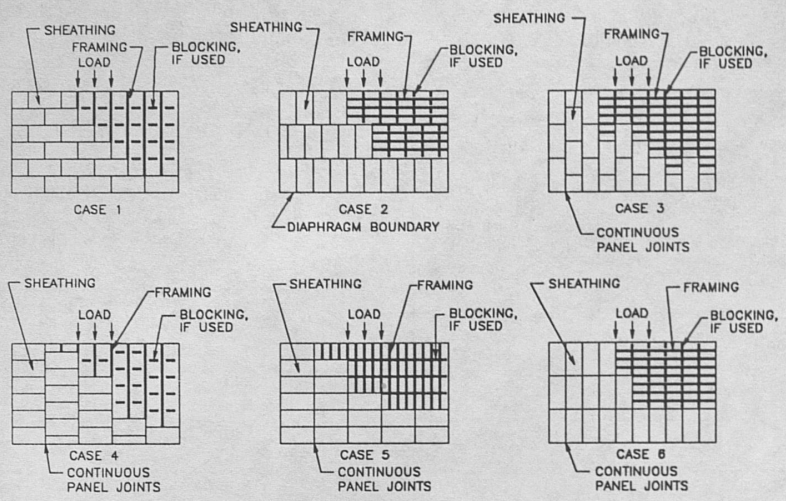
**Note a.** 1 inch = 25.4 mm; 1 pound per foot = 14.6 N/m.

**2306.4.8 Shear panels sheathed with other materials:** Wood stud walls sheathed with lath and plaster, gypsum sheathing board or gypsum wallboard, constructed in accordance with Section 2502.0, or fiberboard sheathing constructed in accordance with Section 2309.8, shall be permitted to resist earthquake forces in wood frame buildings. Nails shall be spaced at least $^3/_8$ inch (10 mm) from the edges and ends of boards and panels. The maximum height-to-width ratio shall be 1.5. The shear capacities utilized in design shall not be cumulative with the shear capacities of other materials applied to the same wall.

## Table 2306.4.6.1
## HORIZONTAL WOOD STRUCTURAL PANEL DIAPHRAGM ALLOWABLE SHEAR WITH FRAMING MEMBERS OF DOUGLAS FIR-LARCH OR SOUTHERN PINE

| Panel grade | Fastener type | Fastener minimum penetration in framing (inches) | Specified panel thicknesses (inch) | Minimum nominal width of framing member (inches) | Lines of fasteners | Allowable shear (pounds per foot)[b] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Blocked diaphragms[a] | | | | | | | Unblocked diaphragms[a] | |
| | | | | | | Fastener spacing (inches) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 and 4), and at all panel edges (Cases 5 and 6) | | | | | | | Fastener spacing at 6 inches at supported edges | |
| | | | | | | 6 | 4 | | $2^1/_2$ | | 2 | | Case 1 | Cases 2, 3, 4, 5 and 6 |
| | | | | | | Spacing (inches) per line at other panel edges (Cases 1, 2, 3 and 4) | | | | | | | | |
| | | | | | | 6 | 6 | 4 | 4 | 3 | 3 | 2 | | |
| Structural I | 6d common | $1^1/_4$ | $^5/_{16}$ | 2 | 1 | 185 | 250 | — | 375 | — | 420 | — | 165 | 125 |
| | | | | 3 | 1 | 210 | 280 | — | 420 | — | 475 | — | 185 | 140 |
| | 8d common | $1^1/_2$ | $^3/_8$ | 2 | 1 | 270 | 360 | — | 530 | — | 600 | — | 240 | 180 |
| | | | | 3 | 1 | 300 | 400 | — | 600 | — | 675 | — | 265 | 200 |
| | 10d common | $1^5/_8$ | $^{15}/_{32}$ | 2 | 1 | 320 | 425 | — | 640 | — | 730 | — | 285 | 215 |
| | | | | 3 | 1 | 360 | 480 | — | 720 | — | 820 | — | 320 | 240 |
| | 10d common | $1^5/_8$ | $^{23}/_{32}$ | 3 | 2 | — | 650 | 870 | 940 | 1,230 | — | — | — | — |
| | | | | 4 | 2 | — | 755 | 980 | 1,080 | 1,410 | — | — | — | — |
| | | | | 4 | 3 | — | 940 | 1,305 | 1,375 | 1,810 | — | — | — | — |
| | 14-gage staples | 2 | $^{23}/_{32}$ | 3 | 2 | — | 600 | 600 | 840 | 900 | 1,040 | 1,200 | — | — |
| | | | | 4 | 3 | — | 840 | 900 | 1,140 | 1,350 | 1,440 | 1,800 | — | — |
| C-D, C-C and other similar grades | 6d common | $1^1/_4$ | $^5/_{16}$ | 2 | 1 | 170 | 225 | — | 335 | — | 380 | — | 150 | 110 |
| | | | | 3 | 1 | 109 | 250 | — | 380 | — | 430 | — | 170 | 125 |
| | | | $^3/_8$ | 2 | 1 | 185 | 250 | — | 375 | — | 420 | — | 165 | 125 |
| | | | | 3 | 1 | 210 | 280 | — | 420 | — | 475 | — | 185 | 140 |
| | 8d common | $1^1/_2$ | $^3/_8$ | 2 | 1 | 240 | 320 | — | 480 | — | 545 | — | 215 | 160 |
| | | | | 3 | 1 | 270 | 360 | — | 540 | — | 610 | — | 240 | 180 |
| | | | $^7/_{16}$ | 2 | 1 | 255 | 340 | — | 505 | — | 575 | — | 230 | 170 |
| | | | | 3 | 1 | 285 | 380 | — | 570 | — | 645 | — | 255 | 190 |
| | | | $^{15}/_{32}$ | 2 | 1 | 270 | 360 | — | 530 | — | 600 | — | 240 | 180 |
| | | | | 3 | 1 | 300 | 400 | — | 600 | — | 675 | — | 265 | 200 |
| C-D, C-C and other similar grades | 10d common | $1^5/_8$ | $^{15}/_{32}$ | 2 | 1 | 290 | 385 | — | 575 | — | 655 | — | 255 | 190 |
| | | | | 3 | 1 | 325 | 430 | — | 650 | — | 735 | — | 290 | 215 |
| | | | $^{19}/_{32}$ | 2 | 1 | 320 | 425 | — | 640 | — | 730 | — | 285 | 215 |
| | | | | 3 | 1 | 360 | 480 | — | 720 | — | 820 | — | 320 | 240 |
| | | | $^{23}/_{32}$ | 3 | 2 | — | 645 | 870 | 935 | 1,225 | — | — | — | — |
| | | | | 4 | 2 | — | 750 | 980 | 1,075 | 1,395 | — | — | — | — |
| | | | | 4 | 3 | — | 935 | 1,305 | 1,390 | 1,510 | — | — | — | — |
| | 14-gage staples | 2 | $^{23}/_{32}$ | 3 | 2 | — | 600 | 600 | 820 | 900 | 1,020 | 1,200 | — | — |
| | | | | 4 | 3 | — | 820 | 900 | 1,120 | 1,350 | 1,400 | 1,510 | — | — |

**Note a.** For sheathing and framing configuration Cases 1 through 6, see Figure 2306.4.6.1.
**Note b.** 1 inch = 25.4 mm; 1 pound per foot = 14.6 N/m.




NOTE: FRAMING IS PERMITTED TO BE LOCATED IN EITHER DIRECTION FOR BLOCKED DIAPHRAGMS.

**Figure 2306.4.6.1**
**SHEATHING AND FRAMING CONFIGURATIONS**

**Table 2306.4.6.2**
**ALLOWABLE SHEAR FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR WIND OR SEISMIC LOADING**

| Panel grade | Minimum nominal panel thickness (inch) | Minimum nail penetration in framing (inches) | Panels applied direct to framing | | | | | Panels applied over 1/2-inch or 5/8-inch gypsum sheathing | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nail size (common or galvanized box) | Allowable shear (pounds per foot)[a] based on nail spacing at panel edges (inches) | | | | Nail size (common or galvanized box) | Allowable shear (pounds per foot)[a] based on nail spacing at panel edges (inches) | | | |
| | | | | 6 | 4 | 3 | 2 | | 6 | 4 | 3 | 2 |
| Structural I | 5/16 | 1 1/4 | 6d | 200 | 300 | 390 | 510 | 8d | 200 | 300 | 390 | 510 |
| | 3/8 | 1 1/2 | 8d | 230 | 360 | 460 | 610 | 10d | 280 | 430 | 550 | 730 |
| | 7/16 | | | 255 | 395 | 505 | 670 | | | | | |
| | 15/32 | | | 280 | 430 | 550 | 730 | | | | | |
| | 15/32 | 1 5/8 | 10d | 340 | 510 | 665 | 870 | — | — | — | — | — |
| Sheathing, Plywood siding | 5/16 | 1 1/4 | 6d | 180 | 270 | 350 | 450 | 8d | 180 | 270 | 350 | 450 |
| | 3/8 | | | 200 | 300 | 390 | 510 | | 200 | 300 | 390 | 510 |
| | 3/8 | 1 1/2 | 8d | 220 | 320 | 410 | 530 | 10d | 260 | 380 | 490 | 640 |
| | 7/16 | | | 240 | 350 | 450 | 585 | | | | | |
| | 15/32 | | | 260 | 380 | 490 | 640 | | | | | |
| | 15/32 | 1 5/8 | 10d | 310 | 460 | 600 | 770 | — | — | — | — | — |
| | 19/32 | | | 340 | 510 | 665 | 870 | | | | | |
| | | | Nail size (galvanized casing) | | | | | Nail size (galvanized casing) | | | | |
| Plywood siding | 5/16 | 1 1/4 | 6d | 140 | 210 | 275 | 360 | 8d | 140 | 210 | 275 | 360 |
| | 3/8 | 1 1/2 | 8d | 160 | 240 | 310 | 410 | 10d | 160 | 240 | 310 | 410 |

**Note a.** 1 inch = 25.4 mm; 1 pound per foot = 14.6 N/m.

## SECTION 2307.0 WOOD STRUCTURAL PANELS

**2307.1 Standards:** All wood structural panels that are utilized structurally shall comply with the requirements of DOC PS 1, DOC PS 2, HPVA HP-1 and HPVA HP-SG listed in Chapter 35 for the type, grade and span rating or species group of wood structural panels involved, and shall be so identified by the grade mark on the label or certificate of inspection issued by an *approved agency*.

**2307.2 Types:** Wood structural panels for interior installations shall be of the interior type, moisture-resistant type or exterior type. Wood structural panels for exterior installations shall be of the exterior-waterproof type, except that wood structural panel roof sheathing exposed to the outdoors on the underside is permitted to be of the interior type and bonded with exterior glue. Exterior wood structural panels shall not be applied directly to the framing as a siding unless the wood structural panel has a minimum nominal thickness of $^3/_8$ inch. Joints shall occur over framing members, unless wood or wood structural panel sheathing is used or joints are lapped horizontally a minimum of $1^1/_2$ inches (38 mm) or otherwise made waterproof in an approved manner. Where a wood structural panel is utilized as lapped siding without sheathing, the wall framing to which such wood structural panel is attached shall be diagonally braced.

**2307.3 Spans:** The maximum spans for wood structural panel sheathing shall be limited by the allowable stresses and deflections for the design *live load*, but shall not be greater than the spans specified in Tables 2307.3.1(1), 2307.3.1(2), 2307.3.3 and 2307.3.5. The spans specified in these tables shall apply to wood structural panels not treated with fireretardant chemicals. The design criteria for fireretardant-treated wood structural panels shall be provided by valid research reports from approved sources.

**2307.3.1 Floor and roof sheathing:** Allowable spans for floor and roof sheathing shall be as specified in Tables 2307.3.1(1) and 2307.3.1(2). The values in Table 2307.3.1(1) apply to Structural I, C-D and C-C sheathing and single floor grades only, and are limited to the spans shown because of the possible effects of concentrated *loads*.

**2307.3.2 Floor sheathing:** Edges of wood structural panel floor sheathing shall have approved tongue-and-groove joints or shall be supported with blocking, unless $^1/_4$-inch minimum thickness underlayment or $1^1/_2$ inches (38 mm) of approved cellular or lightweight concrete is installed, or unless the finish floor is of $^3/_4$-inch wood strip. The allowable uniform *load* based on a deflection of $^1/_{360}$ of the span is 100 pounds per square foot (psf) (4788 Pa) at maximum span.

**2307.3.3 Wood structural panel combination subfloor underlayment:** Allowable spans for combination subfloor underlayment shall be as specified in Table 2307.3.3.

**2307.3.4 Limitations:** Table 2307.3.3 is applicable to underlayment grade, C-C (plugged), single-floor grade and all grades of sanded exterior-type plywood. For panels with a span rating of other than 48 inches (1219 mm) on center (o.c.), the allowable uniform *load* based on a deflection of $^1/_{360}$ of the span is 100 psf (4788 Pa). Panels with a span rating of 48 inches o.c. are limited to a total *load* of 65 psf (3112 Pa) at the maximum span. Wood structural panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless $^1/_4$-inch minimum thickness underlayment or $1^1/_2$ inches (38 mm) of approved cellular or lightweight concrete is installed, or unless the finish floor is of $^3/_4$-inch wood strip. If wood strips are perpendicular to the supports, thicknesses or span ratings shown for 16-inch (406 mm) and 20-inch (508 mm) spans shall be used on 24-inch (610 mm) spans. Spans are limited to the values shown in Table 2307.3.3 because of the possible effects of concentrated *loads*.

**Table 2307.3.3**
**ALLOWABLE SPANS FOR WOOD STRUCTURAL PANEL COMBINATION SUBFLOOR UNDERLAYMENT,[a] PANELS CONTINUOUS OVER TWO OR MORE SPANS AND LONG PANEL DIMENSION PERPENDICULAR TO SUPPORT (THICKNESS IN INCHES)[d]**

| Identification | Maximum spacing of joists (inches) | | | | |
|---|---|---|---|---|---|
| Species groups[b] | 16 | 20 | 24 | 32 | 48 |
| 1 | $^1/_2$ | $^5/_8$ | $^3/_4$ | — | — |
| 2, 3 | $^5/_8$ | $^3/_4$ | $^7/_8$ | — | — |
| 4 | $^3/_4$ | $^7/_8$ | 1 | — | — |
| Single floor span rating[c] | 16 o.c. | 20 o.c. | 24 o.c. | 32 o.c. | 48 o.c. |

**Note a.** For limitations on the use of Table 2307.3.3, see Section 2307.3.4.
**Note b.** Applicable to all grades of sanded exterior-type plywood.
**Note c.** Applicable to underlayment grade and C-C (plugged) plywood and single-floor grade panels.
**Note d.** 1 inch = 25.4 mm; 1 psf = 47.9 Pa.

**2307.3.5 Vertical maximum stud spacing:** Stud spacing for vertical sheathing shall be as specified in Table 2307.3.5.

**Table 2307.3.5**
**ALLOWABLE STUD SPACING FOR WOOD STRUCTURAL PANEL WALL SHEATHING**

| Panel span rating | Panel thickness (inch)[d] and construction | Maximum stud spacing (inches)[d] Exterior coverings nailed to:[a] | |
|---|---|---|---|
| | | Stud | Sheathing |
| 12/0, 16/0, 20/0 or wall — 16 o.c. | $^5/_{16}$, $^3/_8$ | 16 | 16[b] |
| 24/0, 24/16, 32/16 or wall — 24 o.c. | $^3/_8$, $^7/_{16}$, $^{15}/_{32}$, $^1/_2$ | 24 | 24[c] |

**Note a.** Blocking of horizontal joints shall not be required.
**Note b.** Plywood sheathing $^3/_8$ inch thick or less shall be applied with long dimension across studs.
**Note c.** Three-ply plywood panels shall be applied with long dimension across studs.
**Note d.** 1 inch = 25.4 mm.

**2307.4 Stressed skin panel:** For use in stressed skin or other prefabricated construction, wood structural panel design shall be determined by approved engineering analysis or by the tests prescribed in Section 1710.0 for prefabricated assemblies.

## SECTION 2308.0 PARTICLEBOARD

**2308.1 General:** *Particleboard* shall conform to the provisions of this section or Section 2307.0.

**2308.2 Standards:** *Particleboard* shall conform to ANSI A208.1 listed in Chapter 35. *Particleboard* shall be identified by the grade mark on the label or the certificate of inspection issued by an *approved agency*. *Particleboard* shall not be utilized for applications other than indicated in this section unless the *particleboard* complies with the provisions of Section 2307.0.

**Table 2307.3.1(1)**
**ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING GRADES AND SINGLE FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS WITH LONG DIMENSION PERPENDICULAR TO SUPPORTS[a,b,g]**

| Sheathing grades | | Roof | | | | Floor |
|---|---|---|---|---|---|---|
| Span rating[h] | Panel thickness (inch)[i] | Maximum span (inches)[i] | | Load (pounds per square foot)[i] | | Maximum span (inches)[i] |
| Roof/floor span | | With edge support[c] | Without edge support | Total load | Live load | |
| 12/0 | 5/16 | 12 | 12 | 40 | 30 | 0 |
| 16/0 | 5/16, 3/8 | 16 | 16 | 40 | 30 | 0 |
| 20/0 | 5/16, 3/8 | 20 | 20 | 40 | 30 | 0 |
| 24/0 | 3/8, 7/16, 1/2 | 24 | 20[d] | 40 | 30 | 0 |
| 24/16 | 7/16, 1/2 | 24 | 24 | 50 | 40 | 16 |
| 32/16 | 15/32, 1/2, 5/8 | 32 | 28 | 40 | 30 | 16[f] |
| 40/20 | 19/32, 5/8, 3/4, 7/8 | 40 | 32 | 40 | 30 | 20[e,f] |
| 48/24 | 23/32, 3/4, 7/8 | 48 | 36 | 45 | 35 | 24 |
| Single floor grades | | Roof | | | | Floor |
| Span rating[h] | Panel thickness (inches)[i] | Maximum span (inches)[i] | | Load (pounds per square foot)[i] | | Maximum span (inches)[i] |
| | | With edge support[c] | Without edge support | Total load | Live load | |
| 16 o.c. | 19/32, 5/8 | 24 | 24 | 50 | 40 | 16[f] |
| 20 o.c. | 19/32, 5/8, 3/4 | 32 | 32 | 40 | 30 | 20[e,f] |
| 24 o.c. | 23/32, 3/4 | 48 | 36 | 35 | 25 | 24 |
| 32 o.c. | 7/8, 1 | 48 | 40 | 50 | 40 | 32 |
| 48 o.c. | 13/32, 1 1/8 | 60 | 48 | 50 | 40 | 48 |

**Note a.** The allowable loads were determined based on a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.
**Note b.** For limitations on the applicability of this table to wood structural panel grade, see Section 2307.3.1.
**Note c.** Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking, or other. Only lumber blocking shall satisfy blocked diaphragm requirements.
**Note d.** Twenty-four inches for 1/2-inch panels.
**Note e.** Maximum framing space shall be 24 inches on center for floors where 1 1/2 inches of cellular or lightweight concrete is applied over the panels.
**Note f.** Maximum frame spacing shall be 24 inches on center where 3/4-inch wood strip flooring is installed at right angles to joist.
**Note g.** Shall apply only to panels 24 inches or wider.
**Note h.** Span rating shall appear on all panels in the construction grades listed in Section 2307.3.1.
**Note i.** 1 inch = 25.4 mm; 1 psf = 47.9 Pa.

**Table 2307.3.1(2)**
**ALLOWABLE LOADS FOR WOOD STRUCTURAL PANEL ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND LONG DIMENSION PARALLEL TO SUPPORTS**
**(Plywood Structural Panels are 5 ply/5 layer unless otherwise noted)[a]**

| Panel grade | Thickness (inch)[c] | Span rating | Maximum span (inch)[c] | Load at maximum span (psf)[c] | |
|---|---|---|---|---|---|
| | | | | Live | Total |
| Structural I sheathing | 7/16 | 24/0, 24/16 | 24 | 20 | 30 |
| | 15/32 | 32/16 | 24 | 35[b] | 45[b] |
| | 1/2 | 32/16 | 24 | 40[b] | 50[b] |
| | 19/32, 5/8 | 40/20 | 24 | 70 | 80 |
| | 23/32, 3/4 | 48/24 | 24 | 90 | 100 |
| Sheathing | 7/16 | 24/0, 24/16 | 16 | 40 | 50 |
| | 15/32 | 32/16 | 24 | 20 | 25 |
| | 1/2 | 24/0, 32/16 | 24 | 25 | 30 |
| | 19/32 | 40/20 | 24 | 40[b] | 50[b] |
| | 5/8 | 32/16, 40/20 | 24 | 45[b] | 55[b] |
| | 23/32, 3/4 | 40/20, 48/24 | 24 | 60[b] | 65[b] |

**Note a.** Uniform load deflection limitations: 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.
**Note b.** For composite and 4-ply plwood panels, load shall be reduced by 15 psf.
**Note c.** 1 inch = 25.4 mm; 1 psf = 47.9 Pa.

**2308.3 Floor underlayment:** Underlayment shall conform to Grade PBU of ANSI A208.1 listed in Chapter 35. Underlayment shall not be less than $^1/_4$ inch in thickness and shall be installed in accordance with the manufacturer's installation instructions.

**2308.4 Siding and sheathing:** Allowable spans and grades of *particleboard* siding and sheathing shall be as specified in Tables 2308.4(1) and 2308.4(2).

**Table 2308.4(1)**
**ALLOWABLE SPANS FOR EXPOSED PARTICLEBOARD PANEL SIDING**

| Grade | Stud spacing (inches)[a] | Minimum thickness (inches) | |
|---|---|---|---|
| | | Siding | |
| | | Direct to studs | Continuous support |
| M-S, and M-2 "Exterior Glue" | 16 | $^5/_8$ | $^3/_8$ |
| | 24 | $^3/_4$ | $^3/_8$ |

**Note a.** 1 inch = 25.4 mm.

**Table 2308.4(2)**
**ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING[a]**

| Grade | Thickness (inches) | Stud spacing (inches)[b] | |
|---|---|---|---|
| | | Siding nailed to studs | Sheathing under coverings parallel or perpendicular to studs |
| M-S, and M-2 "Exterior Glue" | $^3/_8$ | 16 | 16 |
| | $^1/_2$ | 16 | 16 |

**Note a.** Where not exposed to the weather and where the long dimension of the panel is parallel or perpendicular to the studs.
**Note b.** 1 inch = 25.4 mm.

## SECTION 2309.0 FIBERBOARD

**2309.1 Standards:** Insulating boards manufactured with wood or other vegetable fibers which are used as building boards for sheathing, roof decks, interior wall and ceiling finishes, roof insulation or sound deadening, shall be vermin-proof, resistant to rot-producing fungi, water-repellant and shall conform to the strength and durability tests specified in ASTM C208 or AHA A194.1 listed in Chapter 35. Sheathing that is utilized structurally shall be identified by the label of an *approved agency*. Where required under the provisions of Chapter 7 or 8, the boards shall be *protected* or treated to develop the required fireresistance rating or flameresistance as determined by test.

**2309.2 Jointing:** To insure tight-fitting assemblies, edges shall be manufactured with square, shiplapped, beveled, tongue-and-groove or U-shaped joints.

**2309.3 Roof insulation:** Where used as roof insulation in all types of construction, fiberboards shall be protected with an approved roof covering.

**2309.4 Wall insulation:** Where installed and *fireblocked* to comply with Chapter 7, fiberboards are permitted as wall insulation in all types of construction. In *fire wall* and *fire separation wall* constructions, unless treated to comply with Section 803.2 for Class I materials, the boards shall be cemented directly to the concrete, masonry or other noncombustible base and shall be protected with an approved noncombustible veneer anchored to the base without intervening air spaces.

**2309.4.1 Protection:** Fiberboard wall insulation applied on the exterior of foundation walls shall be protected in accordance with Section 1405.3.11.

**2309.5 Drywall construction:** Where fireresistance ratings are required, provision shall be made for interlocking, lapping or otherwise protecting the joints between adjacent boards to ensure smoke and flame tightness.

**2309.6 Insulating roof deck:** Where used as roof decking in open beam construction, fiberboard insulating roof deck shall have a nominal thickness of not less than 1 inch.

**2309.7 Siding:** Hardboard siding shall comply with AHA A135.6 listed in Chapter 35.

**2309.8 Shear capacity:** Wood stud walls sheathed with fiberboard sheathing are permitted to resist horizontal *loads* provided that such walls comply with Table 2309.8. Fiberboard shear walls shall not be utilized to resist horizontal *loads* from concrete or masonry walls.

**Table 2309.8**
**ALLOWABLE SHEAR CAPACITY FOR WIND OR SEISMIC LOADING ON SHEAR WALLS OF FIBERBOARD SHEATHING BOARD**

| Thickness and grade | Fastener type[a, b] | Shear capacity for 3-inch nail spacing around perimeter and 6-inch nail spacing at intermediate studs (pounds per foot of wall)[c, d] |
|---|---|---|
| $^1/_2$-inch Regular | Roofing nail 11 ga. galv. $1^1/_2$" long, $^7/_{16}$" head | 50 |
| $^1/_2$-inch Structural | Roofing nail 11 ga. galv. $1^1/_2$" long, $^7/_{16}$" head | 60 |
| $^{25}/_{32}$-inch Structural | Roofing nail 11 ga. galv. $1^3/_4$" long, $^7/_{16}$" head | 60 |

**Note a.** Walls shall be constructed with blocking to support all edges.
**Note b.** Fiberboard sheathing is permitted to be stapled using 16-gage galvanized staples $1^1/_8$ inches long for $^1/_2$-inch sheathing and $1^1/_2$ inches long for $^{25}/_{32}$-inch sheathing. Staples shall have a minimum crown of $^7/_{16}$ inch and shall be spaced 3 inches o.c. at edges and 6 inches o.c. at studs.
**Note c.** Where studs are permitted to be located at 24 inches o.c., the shear capacity shall not be greater than 50 pounds per linear foot (plf).
**Note d.** 1 inch = 25.4 mm; 1 plf = 14.6 N/m.

**2309.8.1 Framing:** Four-foot by 8-foot fiberboard sheathing panels shall be applied vertically to wood studs not less than 2 inches nominal in thickness spaced 16 inches (406 mm) on center. Where $^1/_2$-inch structural sheathing and $^{25}/_{32}$-inch structural sheathing in accordance with Table 2309.8 are utilized, the maximum stud spacing shall be 24 inches (610 mm) on center.

**2309.8.2 Nailing:** Nailing shall be in accordance with Table 2309.8. Nails shall be spaced not less than $^3/_8$ inch (10 mm) from edges and ends of sheathing.

## SECTION 2310.0 FIRERETARDANT-TREATED WOOD

**2310.1 Applications:** Fireretardant-treated wood shall comply with this section. Where Table 602 permits fireretardant-treated wood in Types 1 and 2 construction, fireretardant-treated wood

shall not be utilized in loadbearing walls or in assemblies with a required fireresistance rating of more than 1 hour.

**2310.2 General:** Fireretardant-treated wood shall be any wood product which, when impregnated with chemicals by a pressure process in accordance with AWPA C20 or AWPA C27 listed in Chapter 35, or other means during manufacture, shall have, when tested in accordance with ASTM E84 listed in Chapter 35, a flame spread rating not greater than 25 when the test is continued for a period of 30 minutes, without evidence of significant progressive combustion; and the flame front shall not progress more than $10^1/_2$ feet (3048 mm) beyond the centerline of the burner at any time during the test.

Fireretardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for plywood before use.

**2310.2.1 Strength modifications:** Design values for untreated lumber, as specified in Section 2303.1, shall be adjusted for lumber that is pressure impregnated with fireretardant chemicals. Adjustments to the design values shall be based upon an approved method of investigation which takes into consideration the effects of the anticipated temperature and humidity to which the fireretardant-treated wood will be subjected, the type of treatment and redrying procedures.

**2310.2.2 Labeling:** Fireretardant-treated lumber and plywood shall bear the *label* of *approved agencies* in accordance with Section 1704.3.3. Such *labels* shall indicate compliance with the appropriate treating standard in accordance with Section 2310.2 and indicate compliance with Section 2310.2.1.

**2310.3 Exposure to weather:** Where fireretardant-treated wood is to be exposed to the weather, the material shall be further identified to indicate that there is not an increase in the listed flame spread classification after being weathered in accordance with ASTM D2898 listed in Chapter 35. Fireretardant-treated wood subjected to high-humidity conditions shall be identified by the label of an approved agency to indicate that the treated wood has a moisture content of not over 28 percent when tested at 92-percent relative humidity in accordance with ASTM D3201 listed in Chapter 35.

## SECTION 2311.0 NATURALLY DURABLE AND PRESERVATIVE-TREATED WOOD

**2311.1 Required:** Where protection of wood members is required because of exposure to soil or weather, protection shall be provided by using naturally durable or *preservative-treated* wood as required by this section.

**2311.2 Naturally durable wood:** The term "naturally durable wood" refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90 percent or more of the width of each side on which it occurs is heartwood.

| | |
|---|---|
| Decay resistant: | Redwood, cedar, black locust and black walnut. |
| Termite resistant: | Redwood and Eastern red cedar. |

**2311.3 Preservative-treated wood:** The term "preservative-treated wood" refers to wood (including plywood) pressure treated with *preservatives*, that conforms to retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in AWPA C1, C2 and C9 listed in Chapter 35. *Preservatives* shall conform to AWPA P1/P13, P2, P5, P8 and P9 listed in Chapter 35. Lumber and plywood in wood foundation systems shall conform to Section 1808.3.

**2311.3.1 Labeling:** All piles, poles, lumber and plywood which are required to be *preservative treated* shall bear the label of an *approved agency* that maintains continuing supervision, testing and inspection over the quality of the product. Quality-control inspection agencies for *preservative-treated* wood shall be certified as to competency and performance by an approved organization. Said label shall include the following information in a legible format: identifying mark of the inspection agency; the standard to which the product is treated; the identifying mark of the treating plant; and the purpose for which the product has been treated. The label shall be permanently affixed to each piece unless specifically waived by the code official.

**2311.3.2 Moisture content:** Where wood that is pressure treated with a water-borne *preservative* is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other material.

**2311.3.3 Fasteners:** Fasteners for *preservative-treated* wood shall be of hot-dipped zinc-coated galvanized, stainless steel, silicon bronze, copper or other corrosion-resistant materials. Fasteners for wood foundations shall be as required in AFPA TR7 listed in Chapter 35.

**2311.4 Wood used above ground:** Wood installed above ground in the locations specified in Sections 2311.4.1 through 2311.4.6 shall be naturally durable wood or *preservative-treated* wood that uses water-borne *preservatives*, and shall be treated in accordance with AWPA C2 or C9 listed in Chapter 35 for aboveground use.

**2311.4.1 Joists and girders:** Where wood joists or the bottom of a wood structural floor without joists are closer than 18 inches (457 mm), or wood girders are closer than 12 inches (305 mm), to the exposed ground in crawl spaces or unexcavated areas located within the perimeter of the building foundation, the floor assembly (including posts, girders, joists and subfloor) shall be of approved naturally durable or *preservative-treated* wood.

**2311.4.2 Framing:** All wood framing members, including wood sheathing, which rest on exterior foundation walls and are less than 8 inches (203 mm) from exposed earth shall be of approved naturally durable or *preservative-treated* wood.

**2311.4.3 Sleepers and sills:** Sleepers and sills on a concrete or masonry slab which is in direct contact with earth shall be of approved naturally durable or *preservative-treated* wood.

**2311.4.4 Girder ends:** The ends of wood girders entering exterior masonry or concrete walls shall be provided with a $^1/_2$-inch (13 mm) air space on top, sides and end, unless approved naturally durable or *preservative-treated* wood is used.

**2311.4.5 Clearance:** Clearance between wood siding and earth on the exterior of a building shall not be less than 6 inches (152 mm) except where siding, sheathing and wall framing are of approved *preservative-treated* wood.

**2311.4.6 Posts or columns:** Posts or columns supporting permanent structures and supported by a concrete or masonry slab or footing which is in direct contact with the earth shall be of approved naturally durable or *preservative-treated* wood.

**Exceptions**

1. Posts or columns which are either exposed to the weather or located in basements or cellars, supported by concrete piers or metal pedestals projecting at least 1 inch (25 mm) above the slab or deck and 6 inches (152 mm) above exposed earth, and are separated therefrom by an impervious moisture barrier.
2. Posts or columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building, supported by a concrete pier or metal pedestal at a height greater than 8 inches (203 mm) from exposed ground, and are separated therefrom by an impervious moisture barrier.

**2311.5 Wood in contact with the ground:** All wood in contact with the ground (exposed earth) which supports permanent structures that are intended for human occupancy, shall be of approved naturally durable or *preservative-treated* wood using waterborne *preservatives* and shall be treated in accordance with AWPA C2 or C9 listed in Chapter 35 for ground contact, where used in the locations specified in Sections 2311.5.1 and 2311.5.2.

**Exception:** Untreated wood is permitted where such wood is entirely below the ground water level or where continuously submerged in fresh water.

**2311.5.1 Posts or columns:** Sawn posts and columns supporting permanent structures that are intended for human occupancy and which are embedded in concrete in direct contact with the earth or embedded in concrete exposed to the weather, or in direct contact with the earth, shall be of approved *preservative-treated* wood.

**2311.5.2 Wood structural members:** Wood structural members that support moisture-permeable floors or roofs which are exposed to the weather — such as concrete or masonry slabs — shall be of approved naturally durable or *preservative-treated* wood unless separated from such floors or roofs by an impervious moisture barrier.

**2311.6 Geographical areas:** In geographical areas where experience has demonstrated a specific need, approved naturally durable or *preservative-treated* wood shall be utilized for those portions of wood members which form the structural supports of buildings, balconies, porches or similar permanent building *appurtenances* where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members include, but are not limited to, the following:

1. Horizontal members such as girders, joists and decking;
2. Vertical members such as posts, poles and columns; or
3. Both horizontal and vertical members.

**2311.7 Wood used in retaining walls:** Wood installed in retaining or crib walls shall be of approved *preservative-treated* wood treated in accordance with AWPA C2 or C9 listed in Chapter 35 for ground contact, except as indicated in Sections 2311.7.1 through 2311.7.3.

**2311.7.1 Untreated wood:** Where the wall is not more than 2 feet (610 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, the wall is permitted to be of untreated wood.

**2311.7.2 Naturally durable wood on the lot line:** Where a retaining wall or a crib wall is not more than 2 feet (610 mm) in height and is located on the *lot line*, approved naturally durable wood is permitted.

**2311.7.3 Naturally durable wood separated:** Where a retaining wall or a crib wall is not more than 4 feet (1219 mm) in height and is separated from the *lot line* or a permanent building by a minimum distance equal to the height of the wall, approved naturally durable wood is permitted.

## SECTION 2312.0 JOIST HANGERS

**2312.1 Test standard:** The vertical loadbearing capacity, torsional moment capacity, and deflection characteristics of joist hangers shall be determined in accordance with ASTM D1761 listed in Chapter 35, using lumber having a specific gravity of 0.49 or greater, but not greater than 0.55, as determined in accordance with AFPA NDS listed in Chapter 35 for the joist and headers.

**2312.2 Vertical load capacity:** The vertical *load* capacity for the joist hanger shall be determined by testing three joist hanger assemblies as specified in ASTM D1761 listed in Chapter 35. If the ultimate vertical load for any one of the tests varies more than 20 percent from the average ultimate vertical load, at least three additional tests shall be conducted. The allowable vertical *load* for a normal *duration of loading* of the joist hanger shall be the lowest value determined from the following:

1. The lowest ultimate vertical load from any test divided by 2.5 (where three tests are conducted and each ultimate vertical load does not vary more than 20 percent from the average ultimate vertical load).
2. The average ultimate vertical load for all tests divided by six (where six or more tests are conducted).
3. The vertical load at which the vertical movement of the joist with respect to the header is 0.125 inch (3 mm) in any test.
4. The allowable design *load* for nails or other fasteners utilized to secure the joist hanger to the wood members.
5. The allowable design *load* for the wood members forming the connection.

**2312.3 Torsional moment capacity:** The torsional moment capacity for the joist hanger shall be determined by testing at least three joist hanger assemblies as specified in ASTM D1761 listed in Chapter 35. The allowable torsional moment for normal *duration of loading* of the joist hanger shall be the average torsional moment at which the lateral movement of the top or

bottom of the joist with respect to the original position of the joist is 0.125 inch.

**2312.4 Design value modifications:** Allowable design values for joist hangers which are determined by failure of the metal-to-wood connection shall be permitted to be modified by the appropriate *duration of loading* factors as specified in AFPA NDS listed in Chapter 35. Allowable design values determined by failure of the metal joist hanger shall not be modified by *duration of loading* factors.

## SECTION 2313.0 PREFABRICATED COMPONENTS

**2313.1 Structural glue-laminated members:** Buildings and structures designed and erected of glue-laminated structural members or of composite members of dimension lumber and wood structural panels shall comply with this section.

**2313.1.1 Exposed structural glue-laminated timber:** Those portions of glue-laminated timbers which form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave overhang or similar covering, shall be treated in accordance with AITC 109 listed in Chapter 35 or shall be manufactured from approved naturally durable woods.

**2313.1.2 Glue-laminated members:** Design and fabrication of built-up beam and column sections, which consist of one or more webs with glued-lumber flanges and stiffeners, shall be based upon an approved method which takes into consideration the conditions of use. Glue-laminated elements shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with Section 1704.3. Such *label* shall contain the information required by Section 1704.3.3.

**2313.1.3 Gluing surfaces:** In glued-lumber constructions, the surfaces to be glued shall be worked to a smooth, flat surface without sanding and shall be free from wax, grease or oil to ensure a complete glue bond over the entire contact. Factory-sanded wood structural panels shall be permitted.

**2313.2 Sandwich panels:** Design and fabrication of sandwich panels or other integrated assemblies which are *fabricated* of dimension lumber with wood stress coverings glued thereto, or which consist of structural units of metal-covered or molded wood structural panels or other approved *plastics* formed and molded into prefabricated loadbearing members, shall be based upon an approved method which takes into consideration the conditions of installation or meets the test requirements of Sections 1704.0, 1709.0 and 1710.0. Sandwich panels shall be subject to a quality control program administered by an *approved agency* and shall bear a *label* in accordance with Section 1704.3. Such *label* shall contain the information required by Section 1704.3.3.

**2313.2.1 Splices:** Splices and connections between panels shall be weather tight and shall be of sufficient strength to resist two and one-half times the design *live load* to which such splices will be subjected in normal installation. The fastening of coverings to structural studs, ribs or joists shall provide a rigidity equivalent to approved gluing. Nailing shall not be acceptable for that purpose.

**2313.3 Prefabricated trusses:** Prefabricated trusses shall be designed to resist all superimposed design *loads*.

**2313.3.1 Roof trusses:** Metal-plate-connected roof trusses shall be designed in accordance with TPI 1 and AFPA NDS listed in Chapter 35, and shall be braced to prevent rotation and provide lateral stability.

**2313.3.2 Floor trusses:** Metal-plate-connected floor trusses shall be designed in accordance with TPI 1 and AFPA NDS listed in Chapter 35.

**2313.4 Special inspection:** The fabrication process for prefabricated wood components shall be subject to *special inspection* as required by Section 1705.2.

**2313.5 Prefabricated wood I-joists:** Structural capacities and design provisions for prefabricated wood I-joists shall be established and monitored in accordance with ASTM D5055 listed in Chapter 35.

# CHAPTER 24

# GLASS AND GLAZING

## SECTION 2401.0 GENERAL

**2401.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of glass and glazing in vertical and sloped applications. For the definition of approved light-transmitting *plastic*, see Section 2604.1.

**2401.1.1 Labeling requirements:** Each light of safety glazing material manufactured, distributed, imported or sold for use in hazardous locations or installed in a location within the Commonwealth of Kentucky shall be permanently *labeled* by etching, sandblasting or firing ceramic material on the safety glazing material. The *label* shall identify the labeler, whether manufacturer, fabricator or installer, the nominal thickness and the type of safety glazing material, and the fact that said material meets the test requirements of ANSI Z97.1 listed in Chapter 35. The *label* shall be legible and visible after installation. Safety glazing *labeling* shall not be used on materials other than safety glazing materials.

## SECTION 2402.0 GENERAL REQUIREMENTS FOR GLASS

**2402.1 Marking:** Each light shall bear the manufacturer's mark designating the type and thickness of glass. The mark shall not be omitted unless approved and an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with approved plans and specifications in accordance with the provisions of this chapter. Safety glazing shall be marked in accordance with Section 2405.1.1. The mark shall not be omitted from tempered glass. Each unit of tempered glass shall be permanently identified by the manufacturer's mark. The identifying mark shall be etched or ceramic fired on the glass and shall be visible when the unit is glazed. Tempered spandrel glass is exempted from permanent marking, but shall be provided with a removable paper marking by the manufacturer.

**2402.2 Glass supports:** Where one or more sides of any light of glass is not firmly supported, or is subjected to unusual *load* conditions, detailed *construction documents*, detailed shop drawings and analysis or test data assuring safe performance for the specific installation shall be prepared by a *registered design professional* and approved. Analysis shall be based on the *wind loads* required by Section 1609.8 for components and cladding. The elevation of the glazed openings shall be computed by adding the distances from grade to the head and sill, respectively, and dividing the sum by two.

**2402.3 Interior glazed areas:** Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot (730 N/m) is applied horizontally to one panel at any point up to 42 inches (1067 mm) above the walking surface.

**2402.4 Glass dimensional tolerance:** Glass thickness tolerances shall comply with those established in Table 2402.4. Where the thickness is to be controlled, nominal values are stated subject to the tolerances shown in Table 2402.4.

**Table 2402.4**
**MINIMUM GLASS THICKNESS**

| Nominal thickness (inches) | Plate glass minimum thickness (inches)[a] | Sheet glass minimum thickness (inches)[a] |
|---|---|---|
| Single strength (SS) | — | 0.085 |
| Double strength (DS) | — | 0.115 |
| 1/8 | 0.094 | — |
| 3/16 | 0.156 | 0.182 |
| 13/64 | 0.172 | — |
| 7/32 | — | 0.205 |
| 1/4 | 0.218 | 0.236 |
| 5/16 | 0.281 | — |
| 3/8 | 0.343 | 0.357 |
| 1/2 | 0.468 | 0.478 |
| 5/8 | 0.562 | — |
| 3/4 | 0.689 | — |
| 7/8 | 0.750 | — |
| 1 | 0.875 | — |
| 1 1/4 | 1.125 | — |

**Note a.** 1 inch = 25.4 mm.

**2402.5 Louvered windows or jalousies:** Regular float, wired and patterned glass in louvered windows and jalousies shall not be thinner than nominal 3/16 inch and not longer than 48 inches (1219 mm). Where other glass types are used, design shall be submitted to the code official for approval. Exposed glass edges shall be smooth. Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.

## SECTION 2403.0 WIND, SNOW AND DEAD LOADS ON GLASS

**2403.1 Vertical glass:** All glass within 15 degrees (0.26 rad) of vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the *wind loads* in Section 1609.8 for components and cladding. Maximum allowable sizes shall be based on Figure 2403.1. The equivalent *load* for use in the figure shall be determined by dividing the design *wind load* by the applicable factor from Table 2403.1. Figure 2403.1 is for rectangular glass firmly supported on all four edges.

**Table 2403.1**
**FACTORS FOR VERTICAL GLASS**

| Glass type | Factor for use with Figure 2403.1 |
|---|---|
| Single Glass | |
| Regular (annealed) | 1.0 |
| Heat strengthened | 2.0 |
| Fully tempered | 4.0 |
| Wired | 0.5 |
| Patterned[d] | 1.0 |
| Sandblasted[e] | 0.5 |
| Laminated, regular plies[a,b] | 0.75 |
| Laminated, heat-strengthened plies[a,b] | 1.5 |
| Laminated, fully tempered plies[a,b] | 3.0 |
| Insulating Glass[c] | |
| Regular (annealed) | 1.8 |
| Heat strengthened | 3.6 |
| Fully tempered | 7.2 |
| Laminated, regular plies[a,b] | 1.4 |
| Laminated, heat-strengthened plies[a,b] | 2.7 |
| Laminated, fully tempered plies[a,b] | 5.4 |

**Note a.** For laminated glass, use the line in Figure 2403.1 for total glass thickness (after adjusting wind load by the factor in Table 2403.1).

**Note b.** For laminated glass, the values are based on two plies of the same thickness and type.

**Note c.** For insulating glass, values are based on two panes of identical thickness and type. Utilize thickness for one pane. For example, the maximum allowable area for an insulating glass unit consisting of two plies of fully tempered $^1/_4$-inch glass is determined using the line for $^1/_4$-inch glass.

**Note d.** Values for patterned glass are based on the thinnest part of the pattern. Interpolation between lines in the figure is permitted.

**Note e.** Value for sandblasted glass is minimum and depends on severity and depth of the sandblast.

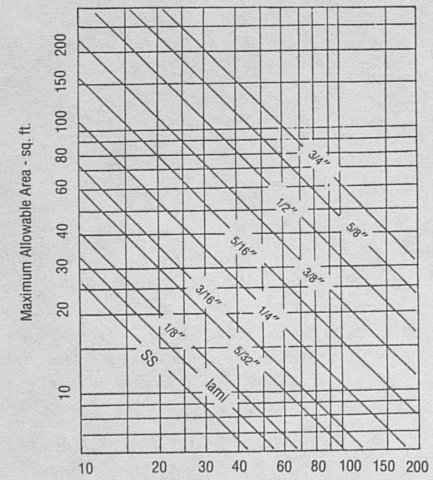



**Figure 2403.1**
**MAXIMUM ALLOWABLE AREA FOR VERTICAL AND SLOPED GLASS**

**2403.2 Sloped glass:** All glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, sunspaces, sloped roofs and other exterior applications shall be designed to resist the combination of *wind loads* in Section 1609.8 for components and cladding, the snow *loads* in Section 1608.0, and the glass *dead load*. Maximum allowable sizes shall be based on Figure 2403.1. Figure 2403.1 is for rectangular glass firmly supported on all four edges.

The combined *load* shall be calculated as follows. The largest of 1, 2 or 3 shall be used:

1. Negative *wind load*; - $F \times$ *dead load*
2. Positive *wind load*; + $F \times$ (*dead load* + $^1/_2$ *wind load*)
3. $F \times$ (snow *load* + *dead load*) + $^1/_2$ positive *wind load*

where:

$F$ = 2.0 where any pane or ply is regular glass.

$F$ = 1.5 where any pane or ply is heat-strengthened glass and the remainder are fully tempered glass.

$F$ = 1.2 where all panes and plies are fully tempered glass.

The glass *dead load* is equal to the cosine of the slope from horizontal $\times$ the total glass thickness in inches $\times$ 13.

The equivalent *load* for use in Figure 2403.1 shall be determined by dividing the combined *load* by the applicable factor from Table 2403.2.

**Table 2403.2**
**FACTORS FOR SLOPED GLASS**

| Glass type | Factor for use with Figure 2403.1 |
|---|---|
| Single Glass | |
| Regular (annealed) | 0.72 |
| Heat strengthened | 1.7 |
| Fully tempered | 3.6 |
| Wired | 0.36 |
| Laminated, regular plies[a,b] | 0.54 |
| Laminated, heat-strengthened plies[a,b] | 1.3 |
| Laminated, tempered plies[a,b] | 2.7 |
| Insulating Glass[c] | |
| Regular (annealed) | 1.3 |
| Heat strengthened | 3.1 |
| Fully tempered | 6.6 |
| Laminated, regular plies[a,b] | 1.0 |
| Laminated, heat-strengthened plies[a,b] | 2.3 |
| Laminated, fully tempered plies[a,b] | 4.9 |

**Note a.** For laminated glass, use the line in Figure 2403.1 for total glass thickness (after adjusting wind load by the factor in Table 2403.2).

**Note b.** For laminated glass, the values are based on two plies of the same thickness and type.

**Note c.** For insulating glass, values are based on two panes of identical thickness and type. Utilize thickness for one pane. For example, the maximum allowable area for an insulating glass unit consisting of two plies of fully tempered $^1/_4$-inch glass is determined using the line for $^1/_4$-inch glass.

## SECTION 2404.0 SLOPED GLAZING AND SKYLIGHTS

**2404.1 Sloped glazing:** Any installation of glass or other transparent, translucent or opaque glazing material which is installed at a slope of 15 degrees (0.26 rad) or more from the vertical plane — including skylights, roofs and sloped walls — shall comply with this section.

**2404.2 Allowable glazing materials:** Sloped glazing shall be any of the following materials, subject to the limitations specified in Section 2404.3 and the exceptions specified in Section 2404.4:

1. For monolithic glazing systems, the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil (762 μm) polyvinyl butyral interlayer, wired

glass, approved *plastic* materials, heat-strengthened glass or fully tempered glass.
2. For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in item 1 above.

For additional requirements for *plastic* skylights, see Section 2608.0. Glass-block construction shall conform to the requirements of Section 2118.0.

**2404.3 Limitations:** Where used in monolithic glazing systems, heat-strengthened glass and fully tempered glass shall have screens installed below the glazing material, subject to the exceptions in Section 2404.4, to protect building occupants from falling glass should breakage occur. The screens shall be capable of supporting the weight of the glass and shall be substantially supported below and installed within 4 inches (102 mm) of the glass. The screens shall be constructed of a noncombustible material not thinner than No. 12 B&S Gage (0.0808 inch) with a mesh not larger than 1 inch by 1 inch (25 mm by 25 mm). In a corrosive atmosphere, structurally equivalent noncorrosive screening materials shall be used. Where used in multiple-layer glazing systems as the bottom glass layer over the walking surface, heat-strengthened glass, fully tempered glass and wired glass shall be equipped with screening that conforms to the requirements specified for monolithic glazing systems.

**2404.4 Exceptions:** In monolithic and multiple-layer sloped glazing systems, the following exceptions apply:
1. Fully tempered glass installed without protective screens where glazed between intervening floors at a slope of 30 degrees (0.52 rad) or less from the vertical plane shall have the highest point of the glass 10 feet (3048 mm) or less above the walking surface.
2. Screens are not required below any glazing material, including annealed glass, where the walking surface below the glazing material is permanently protected from the risk of falling glass or the area below the glazing material is not a walking surface.
3. Any glazing material, including annealed glass, is permitted to be installed without screens in the sloped glazing systems of commercial or detached greenhouses used exclusively for growing plants and not open to the public, provided that the height of the greenhouse at the ridge does not exceed 20 feet (6096 mm) above grade. Greenhouse frames shall be noncombustible if the height of the sloped glazing exceeds 20 feet (6096 mm) above grade.
4. Screens shall not be required within *dwelling units* of occupancies in Use Groups R-2 and R-3 where fully tempered glass is used as single glazing or as both panes in an insulating glass unit, and all of the following conditions are met:
    4.1. Each pane of glass is 16 square feet (1.5 $m^2$) or less in area;
    4.2. The highest point of the glass is 12 feet (3658 mm) or less above any walking surface or other area having access thereto; and
    4.3. The glass thickness is $^3/_{16}$ inch (5 mm) or less.

**2404.5 Framing:** In Types 1 and 2 construction, all sloped glazing and skylight frames shall be constructed of noncombustible materials. In buildings where acid fumes deleterious to metal are incidental to the occupancy of the buildings, approved pressure-treated woods or other approved noncorrosive materials shall be permitted for sash and frames. All sloped glazing and skylights shall be designed to meet all structural requirements for roofs specified in Chapter 16. All skylights set at an angle of less than 45 degrees (0.79 rad) from the horizontal plane shall be mounted at least 4 inches (102 mm) above the plane of the roof on a curb construction as required for the frame. Skylights shall not be installed in the plane of the roof where the roof pitch is less than 45 degrees (0.79 rad) from the horizontal.

**Exception:** Curbs for skylights are not required on roofs with a minimum slope of three units vertical in 12 units horizontal (3:12) in occupancies in Use Group R-3.

## SECTION 2405.0 SAFETY GLAZING

**2405.1 Human impact loads:** Individual glazed areas, including glass mirrors, in hazardous locations such as those indicated in Section 2405.2 shall pass the test requirements of CPSC 16 CFR; 1201, listed in Chapter 35. The requirements of this section and Sections 2405.2 and 2407.0 shall apply equally to replacement glass and new glass installation. Additional requirements as specified in Section 2407.2 are to be satisfied for glass used in locations where the hazard is of a continuous nature, such as glass enclosures for sporting activities as identified in Section 2407.1.

**Exceptions**
1. Polished wired glass used in required fireresistance rated assemblies shall comply with ANSI Z97.1 listed in Chapter 35.
2. *Plastic* glazing shall meet the weathering requirements of ANSI Z97.1 listed in Chapter 35.
3. Glass-block walls shall comply with Section 2118.0.

**2405.1.1 Marking:** Each light of safety glazing material installed in hazardous locations as defined in Section 2405.2 shall bear a permanent identifying mark issued by an *approved agency* which specifies the marking agency, whether manufacturer or installer, and the test standard.

**2405.2 Specific hazardous locations:** The following shall be considered specific hazardous locations for the purposes of glazing:
1. Glazing in ingress and *means of egress* doors except jalousies (see Section 2402.5).
2. Glazing in fixed and sliding panels of sliding (patio) door assemblies and panels in swinging doors.
3. Glazing in storm doors.
4. Glazing in all unframed swinging doors.
5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers. Glazing in any portion of a building wall enclosing these compartments where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above a standing surface.
6. Glazing in an individual fixed or operable panel adjacent to a door where the nearest exposed edge of the glazing is within a 24-inch (610 mm) arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is less than 60 inches (1525 mm) above the walking surface.

7. Glazing in an individual fixed or operable panel, other than in those locations described in preceding items 5 and 6, which meets all of the following conditions:
   7.1. Exposed area of an individual pane greater than 9 square feet (0.84 $m^2$);
   7.2. Exposed bottom edge less than 18 inches (460 mm) above the floor;
   7.3. Exposed top edge greater than 36 inches (915 mm) above the floor; and
   7.4. The finished floor or walking surface within 36 inches (915 mm) on both sides of the glazing.
8. All glazing in guards and railings regardless of area or height above a walking surface. Included are structural baluster panels and nonstructural in-fill panels.
9. Glazing in walls and fences enclosing indoor and outdoor swimming pools where the bottom edge of the glazing on the pool side is less than 60 inches (1525 mm) above a walking surface and within 36 inches (914 mm) horizontally of a walking surface. This shall apply to single glazing and all panes in multiple glazing.

**Exception:** The following products, materials and uses shall not be considered specific hazardous locations:

1. Openings in doors through which a 3-inch (76 mm) sphere is unable to pass.
2. Assemblies of leaded glass or faceted glass and items of carved glass used for decorative purposes in locations described in Section 2405.2, items 1, 6 or 7.
3. Glazing materials used as curved glazed panels in revolving doors.
4. Commercial refrigerated cabinet glazed doors.
5. Glazing as described in Section 2405.2, item 6, where there is an intervening wall or some other permanent barrier that will prevent a person approaching the door from accidentally striking the glazing.
6. Glazing as described in Section 2405.2, item 7, where a protective bar is installed 34 inches to 38 inches (864 mm to 965 mm) above the floor on the side of the glazing having access thereto. The bar shall be capable of withstanding a horizontal *load* of 50 pounds per linear foot (730 N/m) without contacting the glass and be a minimum of $1^1/_2$ inches (38 mm) in height.
7. Outboard panes in insulating glass units and other multiple-glazed panels as described in Section 2405.2, item 7, where the bottom exposed edge of the glass is 25 feet (7620 mm) or more above any grade, roof, walking surface or other horizontal or sloped (within 45 degrees of horizontal) surface adjacent to the glass exterior.
8. Louvered windows and jalousies complying with the requirements of Section 2402.5.
9. Glazing which is mounted or hung on a surface that provides a continuous backing support.

**2405.3 Glass in fire-fighter access panels:** In cases where tempered glass is required in fire-fighter access panels, both panes in double glazing shall be tempered glass.

## SECTION 2406.0 GLASS IN HANDRAILS AND GUARDRAILS

**2406.1 Materials:** Glass used as structural balustrade panels in railings shall be constructed of either single fully tempered glass, laminated fully tempered glass or laminated heat-strengthened glass. Glazing in railing in-fill panels shall conform to ANSI Z97.1 listed in Chapter 35 or shall be of an approved safety glazing material that conforms to the provisions of Section 2405.1. For all glazing types, the minimum nominal thickness shall be $^1/_4$ inch. Fully tempered glass and laminated glass shall comply with Category II of CPSC 16 CFR; 1201, listed in Chapter 35. Wired glass shall comply with ANSI Z97.1 listed in Chapter 35.

**2406.1.1 Loads:** The panels and their support system shall be designed to withstand the *loads* specified in Section 1606.4. A safety factor of 4 shall be used.

**2406.1.2 Support:** Each handrail or guardrail section shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one baluster panel fail. Glass balusters shall not be installed without an attached handrail or guardrail.

**2406.1.3 Parking garages:** Glazing materials shall not be installed in railings in parking *garages* except for pedestrian areas not exposed to impact from vehicles.

## SECTION 2407.0 GLAZING IN RACQUETBALL AND SQUASH COURTS

**2407.1 Continuously hazardous locations:** The following shall be considered continuously hazardous locations for the purposes of glazing:

1. Glazing in squash and racquetball courts which forms whole or partial wall sections.
2. Glazing in squash and racquetball courts which is used as a door or part of a door.

**2407.2 Testing:** Test methods and loads for individually glazed areas such as those described in Section 2407.1 shall conform to those of CPSC 16 CFR; 1201, listed in Chapter 35, with impacts being applied at a height from ground level of 59 inches (1499 mm) to an actual or simulated glass wall installation with fixtures, fittings and methods of assembly identical to those used in practice.

In order to be deemed acceptable, the following conditions shall be achieved for glass walls:

1. Any glass wall in a squash or racquetball court shall remain intact following a test impact.
2. The deflection of such walls shall not be greater than $1^1/_2$ inches (38 mm) at the point of impact.

In order to be deemed acceptable, the following conditions shall be achieved for glass doors:

1. Glass doors shall remain intact following a test impact at the prescribed height in the center of the door.
2. The relative deflection between the edge of a glass door and the adjacent wall shall not exceed the following values for the impact test bag-drop heights:
   2.1. The thickness of the wall plus $^1/_8$ inch (3 mm) for a drop height of 24 inches (610 mm).
   2.2. The thickness of the wall plus $^1/_4$ inch (6 mm) for a drop height of 36 inches (914 mm).
   2.3. The thickness of the wall plus $^1/_2$ inch (13 mm) for a drop height of 48 inches (1219 mm).

# CHAPTER 25

# GYPSUM BOARD AND PLASTER

## SECTION 2501.0 GENERAL

**2501.1 Scope:** The provisions of this chapter shall govern the materials, design, construction and quality of gypsum and plaster.

## SECTION 2502.0 SHEAR WALLS

**2502.1 General:** Wood frame shear walls constructed in accordance with the materials and provisions of Table 2502.1 are permitted to resist wind and seismic forces. Where such construction is designed to resist seismic forces, the panel size provisions of Section 2306.4.7 and the installation provisions of Section 2306.4.8 shall be met in addition to this section.

**2502.1.1 Nailing:** All studs, top and bottom plates and blocking shall be nailed in accordance with Table 2502.1.

**2502.1.2 Limitations:** Shear walls shall not be used to resist horizontal *loads* from masonry or concrete walls.

## SECTION 2503.0 GYPSUM BOARD MATERIALS

**2503.1 General:** All gypsum board materials and accessories shall be identified by the *manufacturer's designation* to indicate compliance with the appropriate standards referenced in this section and stored so as to protect such materials from the weather.

**2503.2 Standards:** All gypsum board materials shall conform to the appropriate standards listed in Table 2503.2 and Chapter 35 and, where required for fire protection, shall conform to the provisions of Chapter 7.

**Table 2502.1**
**SHEAR CAPACITY FOR SHEAR WALLS OF LATH AND PLASTER, GYPSUM SHEATHING BOARD, AND GYPSUM WALLBOARD WOOD FRAME ASSEMBLIES[b,c,d]**

| Type of material | | Thickness of material (inch) | Wall construction | Nail spacing maximum (inches) | Allowable shear pounds per foot of wall[a] | Fastener size |
|---|---|---|---|---|---|---|
| Woven or welded wire lath and portland cement plaster | | 7/8 | Unblocked | 6 | 180 | No. 11 gage, 1 1/2 inches long, 7/16-inch head, or No. 16 gage staples having 7/8-inch-long legs |
| Gypsum lath, plain or perforated | | 3/8 lath and 1/2 plaster | Unblocked | 5 | 100 | No. 13 gage, 1 1/8 inches long, 19/64-inch head, plasterboard blued nail |
| Gypsum sheathing board | 2 feet × 8 feet | 1/2 | Unblocked | 4 | 75 | No. 11 gage, 1 3/4 inches long, 7/16-inch head, diamond point, galvanized |
| | 4 feet × 8 feet | | Blocked | 4 | 175 | |
| | 4 feet × 8 feet | | Unblocked | 7 | 100 | |
| Gypsum wallboard or veneer base | | 1/2 | Unblocked | 7 | 100 | 5d cooler nails |
| | | | Unblocked | 4 | 125 | |
| | | | Blocked | 7 | 125 | |
| | | | Blocked | 4 | 150 | |
| | | 5/8 | Blocked | 4 | 175 | 6d cooler nails |
| | | | Blocked two ply | Base ply 9 inches Face ply 7 inches | 250 | Base ply — 6d cooler nails Face ply — 8d cooler nails |

**Note a.** Shear values are based on a maximum framing spacing of 16 inches (406 mm) on center.
**Note b.** Shear values shall be doubled where identical materials are applied to both sides of the wall.
**Note c.** Values are for short time loading from wind and earthquake loads and shall be reduced 25 percent for normal loading.
**Note d.** 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per foot = 14.6 N/m.

**Table 2503.2**
**GYPSUM BOARD MATERIALS AND ACCESSORIES**

| Material | Standard |
|---|---|
| Gypsum sheathing | ASTM C79 |
| Gypsum wallboard | ASTM C36 |
| Joint reinforcing tape and compound | ASTM C474; C475 |
| Nails for gypsum boards | ASTM C514 |
| Steel screws | ASTM C954; C1002 |
| Steel studs, nonloadbearing | ASTM C645 |
| Water-resistant gypsum backing board | ASTM C630 |

**2503.3 Installation:** Installation of these materials shall conform to Section 2504.0 and Table 2503.3, except as otherwise required by this code.

**2503.4 Water-resistant gypsum backing board:** In all areas subjected to repeated damp conditions and moisture accumulation such as bathtub and shower compartments, water-resistant gypsum backing board complying with ASTM C630 listed in Chapter 35 shall be used as a substratum unless protected with a moistureproof and vaporproof covering.

## SECTION 2504.0 GYPSUM CONSTRUCTION

**2504.1 General:** Gypsum board and plaster construction shall be of the materials listed in Table 2503.2 and Table 2505.2. These materials shall be assembled and installed in compliance with the appropriate standards listed in Table 2504.1 and Chapter 35.

**Table 2504.1**
**INSTALLATION OF GYPSUM CONSTRUCTION**

| Material | Standard |
|---|---|
| Gypsum plaster | ASTM C842 |
| Gypsum veneer base | ASTM C844 |
| Gypsum veneer plaster | ASTM C843 |
| Interior lathing and furring | ASTM C841 |
| Steel framing for gypsum boards | ASTM C754; C1007 |

**2504.2 Limitations:** Gypsum construction shall not be used in any exterior location where such gypsum construction will be exposed directly to the weather.

**2504.3 Inspection:** The code official shall be notified not less than 24 hours in advance of all plastering work or installation of any gypsum board except gypsum lath. Plaster shall not be applied until after the lathing or other plaster base has been inspected and approved.

**2504.4 Weather protection:** When plastering work is in progress, the building or structure shall be enclosed and conditioned to provide proper *ventilation* and temperatures not less than 40 degrees F. (4 degrees C.) nor more than 80 degrees F. (27 degrees

**Table 2503.3**
**MAXIMUM SPACING OF GYPSUM WALLBOARD FASTENERS[d,e]**

| Thickness of gypsum wallboard (inch) | Plane of framing surface | Long dimension of gypsum wallboard sheets in relation to direction of framing members | Maximum spacing of framing members (center-to-center in inches) | Maximum spacing of fasteners (center-to-center in inches) | | Nails[a] to wood |
|---|---|---|---|---|---|---|
| | | | | Nails[a, b] | Screws[c] | |
| 1/2 | Horizontal | Either direction | 16 | 7 | 12 | No. 13 gage, 1 3/8″ long, 19/64″ head, .098 inch diameter, 1 1/4″ long, Annular ringed, 5d cooler nail |
| | Horizontal | Perpendicular | 24 | 7 | 12 | |
| | Vertical | Either direction | 24 | 8 | 12 | |
| 5/8 | Horizontal | Either direction | 16 | 7 | 12 | No. 13 gage, 1 5/8″ long, 19/64″ head, .098 inch diameter, 1 3/8″ long, Annular ringed, 6d cooler nail |
| | Horizontal | Perpendicular | 24 | 7 | 12 | |
| | Vertical | Either direction | 24 | 8 | 12 | |
| Fastening required with adhesive application | | | | | | |
| 1/2 or 5/8 | Horizontal | Either direction | 16 | 16 | 16 | As required for 1/2″ and 5/8″ gypsum wallboard, see above |
| | Horizontal | Perpendicular | 24 | 12 | 16 | |
| | Vertical | Either direction | 24 | 16 | 24 | |
| 2 layers each 3/8″ (3/4″ total) | Horizontal | Perpendicular | 24 | 16 | 16 | Base ply nailed as required for 1/2″ gypsum wallboard and face ply placed with adhesive |
| | Vertical | Either direction | 24 | 24 | 24 | |

**Note a.** Where the metal framing has a clinching design formed to receive the nails by two edges of metal, the nails shall not be less than 5/8 inch longer than the wallboard thickness, and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d cooler nails (No. 13 1/2 Gage, 1 5/8 inches long, 15/64-inch head) for 1/2-inch gypsum wallboard; 6d cooler (No. 13 Gage, 1 7/8 inches long, 15/64-inch head) for 5/8-inch gypsum wallboard.
**Note b.** Two nails at 2 inches to 2 1/2 inches apart are permitted to be used if the pairs are spaced 12 inches center-to-center except around perimeters.
**Note c.** Screws shall be No. 6 with tapered head and long enough to penetrate into wood framing not less than 5/8 inch and metal framing not less than 1/4 inch.
**Note d.** For fireresistance rated construction assemblies, see the pertinent fire test information.
**Note e.** 1 inch = 25.4 mm.

C.) from one week prior to the plastering operation and until one week following or until the plaster is dry.

## SECTION 2505.0 INTERIOR LATHING AND GYPSUM PLASTERING

**2505.1 General:** All interior lathing and gypsum plastering materials and accessories shall be marked by the *manufacturer's designation* to indicate compliance with the appropriate standards referenced in this section and stored in such a manner as to protect them from the weather.

**2505.2 Standards:** All interior lathing and gypsum plastering materials shall conform to the standards listed in Table 2505.2 and Chapter 35 and, where required for fire protection, shall also conform to the provisions of Chapter 7.

**Table 2505.2**
**PLASTERING MATERIALS AND ACCESSORIES**

| Material | Standard |
|---|---|
| Exterior plaster bonding compounds | ASTM C932 |
| Gypsum base for veneer plasters | ASTM C588 |
| Gypsum casting and molding plaster | ASTM C59 |
| Gypsum Keene's cement | ASTM C61 |
| Gypsum lath | ASTM C37 |
| Gypsum plaster | ASTM C28 |
| Gypsum veneer plaster | ASTM C587 |
| Interior bonding compounds, gypsum | ASTM C631 |
| Lime plasters | ASTM C5; C206 |
| Metal lath | ASTM C847 |
| Plaster aggregates | |
| Sand | ASTM C35; C897 |
| Perlite | ASTM C35 |
| Vermiculite | ASTM C35 |
| Portland cement | ASTM C150 |
| Steel studs and track | ASTM C645; C955 |
| Steel screws | ASTM C1002; C954 |
| Welded wire lath | ASTM C933 |

**2505.3 Installation:** Installation of interior lathing and gypsum plastering materials shall conform to Section 2504.0.

## SECTION 2506.0 PORTLAND CEMENT STUCCO LATHING AND PLASTERING

**2506.1 General:** All exterior and interior portland cement stucco lathing and plastering shall be done with the appropriate materials listed in Table 2505.2 and Chapter 35.

**2506.2 Weather protection:** All materials shall be stored in such a manner as to protect such materials from the weather.

**2506.3 Installation:** Installation of these materials shall be in compliance with ASTM C926 and ASTM C1063 listed in Chapter 35 and Section 2506.4.

**2506.4 Protection after application:** At all times during application and for a period of not less than 48 hours after application of each coat, provisions shall be made to keep stucco work above 40 degrees F. (4 degrees C.).

# CHAPTER 26

# PLASTIC

## SECTION 2601.0 GENERAL

**2601.1 Scope:** The provisions of this chapter shall govern the design, construction and quality of light-transmitting *plastic* materials and foam plastics. Section 2601.0 shall apply to all light-transmitting *plastic* materials and foam plastics. Section 2603.0 shall only apply to foam plastics. Sections 2604.0 through 2608.0 shall only apply to light-transmitting *plastic* materials.

**2601.2 Approved materials:** The use of all *plastics* that conform to the strength, durability, sanitary and fireresistive requirements of this code and ASTM D635, D1929, D2843 and E84 listed in Chapter 35, shall be permitted subject to the limitations of this chapter.

**2601.3 Application for approval:** Applicants for approval of a *plastic* material shall furnish, in accordance with Section 1704.0, all necessary technical data required by the code official. The data shall include, if necessary, chemical composition; applicable physical, mechanical and thermal properties, such as fireresistance, flammability and flame spread; weather resistance; electrical properties; products of combustion; and coefficients of expansion.

**2601.4 Identifying mark:** All *plastic* materials approved for use under this code shall be identified by the trade formula number or name or other acceptable identifying mark applied to each unit or package.

**2601.5 Interior finish and trim:** Light-transmitting *plastic* materials installed as interior finish or trim shall comply with Section 803.0. Foam plastics shall only be installed as interior finish in accordance with Section 2603.8. Foam plastics installed as interior trim shall comply with Section 2603.7.

## SECTION 2602.0 DEFINITIONS

**2602.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

*Plastic*

**Light-diffusing system:** A suspended construction consisting in whole or in part of lenses, panels, grids or baffles suspended below independently mounted electrical lighting sources.

**Plastic glazing:** *Plastic* materials which are glazed or set in frame or sash and not held by mechanical fasteners which pass through the glazing material.

**Plastic roof panels:** *Plastic* materials which are fastened to structural members, or to structural panels or sheathing, and which are used as light-transmitting media in roofs.

**Plastic wall panels:** *Plastic* materials which are fastened to structural members, or to structural panels or sheathing, and which are used as light-transmitting media in exterior walls.

**Reinforced plastic, glass fiber:** *Plastic* reinforced with glass fiber having not less than 20 percent of glass fibers by weight.

**Thermoplastic material:** A *plastic* material which is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

**Thermosetting material:** A *plastic* material which is capable of being changed into a substantially nonreformable product when cured.

## SECTION 2603.0 FOAM PLASTIC

**2603.1 General:** The provisions of this section shall govern the requirements and uses of foam plastic in buildings or structures.

**2603.2 Labeling:** Foam plastics or their packages of foam plastics, and containers of foam-in-place plastic system ingredients, shall be *labeled* in compliance with Section 1704.3.

**2603.3 Surface-burning characteristics:** Unless otherwise indicated in this section, all foam plastic and foam plastic cores of manufactured assemblies shall have a flame spread rating of not more than 75 and a smoke-developed rating of not more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 listed in Chapter 35.

**Exceptions**

1. Smoke-developed ratings for interior trim as provided for in Section 2603.7.4.
2. Flame spread ratings for exterior wall installations as provided for in Sections 2603.6.3 and 2603.6.8.
3. Flame spread and smoke-developed ratings for roof applications as provided for in Section 2603.4.1.5.
4. Where foam plastic is tested in a thickness of 4 inches (102 mm) and is used in a thickness of greater than 4 inches (102 mm) up to 10 inches (254 mm), the building shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 and the foam plastic shall be protected by a thermal barrier.

**2603.4 Thermal barrier:** Except as provided for in Section 2603.4.1, all foam plastic shall be separated from the interior of a building by an approved thermal barrier of $^1/_2$-inch (13 mm) gypsum wallboard or equivalent thermal barrier material which

will limit the average temperature rise of the unexposed surface to not more than 250 degrees F. (121 degrees C.) after 15 minutes of fire exposure, complying with the standard time-temperature curve of ASTM E119 listed in Chapter 35. The thermal barrier shall be installed such that said thermal barrier will stay in place for a minimum of 15 minutes under the same test conditions.

**2603.4.1 Thermal barrier not required:** The thermal barrier specified in Section 2603.4 is not required under the conditions set forth in any one of Sections 2603.4.1.1 through 2603.4.1.10.

**2603.4.1.1 Siding backer board:** Foam plastic to be used as siding backer board, or where applied as insulation with re-siding over existing exterior wall construction, shall have a maximum thickness of $^1/_2$ inch (13 mm) and shall be separated from the interior of the building by not less than 2 inches (51 mm) of mineral fiber insulation or other approved materials.

**2603.4.1.2 Walk-in coolers:** Where foam plastic is used in a maximum thickness of 4 inches (102 mm) in walk-in coolers or in freezer units less than 400 square feet (37.2 $m^2$) in floor area, the foam plastic shall be covered by a metal facing of not less than 0.032-inch-thick (0.8 mm) aluminum or corrosion-resistant steel having a minimum base metal thickness of 0.016 inch (0.4 mm).

**2603.4.1.3 Masonry or concrete construction:** Where the foam plastic is protected by a 1-inch (25 mm) minimum thickness of masonry or concrete, a thermal barrier is not required.

**2603.4.1.4 Attics and crawl spaces:** Within an *attic* or crawl space where entry is made only for service of utilities, foam plastic shall be protected against ignition by $1^1/_2$-inch-thick (38 mm) mineral fiber insulation, $^1/_4$-inch-thick (6 mm) wood structural panel, *particleboard* or hardboard, $^3/_8$-inch gypsum wallboard, corrosion-resistant steel having a base metal thickness of 0.016 inch (0.4 mm), or other approved material installed in such a manner that the foam plastic is not exposed. The protective covering shall be consistent with the requirements for the type of construction.

**2603.4.1.5 Roofing:** Foam plastic used in a roof covering assembly that employs a wood roof deck without the thermal barrier shall have the foam plastic separated from the interior of the building by wood structural panel sheathing or tongue-and-groove wood plank sheathing not less than $^{15}/_{32}$ inch (12 mm) in thickness or other approved materials. All wood structural panel roof sheathing shall be bonded with exterior glue with edges supported by blocking, tongue-and-groove joints or other approved type of edge support.

The requirements of Sections 2603.3 and 2603.4 are not applicable to foam plastic roof insulation used in roof deck construction that complies as an assembly with FM 4450 or UL 1256 listed in Chapter 35.

For all roof applications, the smoke-developed rating shall not be applicable.

**2603.4.1.6 Doors not required to have a fireresistance rating:** Where doors are permitted without a fireresistance rating and foam plastic is used as a core material, the door facing shall be of metal having a minimum thickness of 0.032-inch aluminum or 0.016-inch steel.

**2603.4.1.7 Exterior doors in buildings of Use Group R-3:** In occupancies classified in Use Group R-3, foam-filled exterior entrance doors that do not require a fireresistance rating shall be faced with wood or other approved materials.

**2603.4.1.8 Garage doors:** In other than occupancies classified in Use Groups R-3 and U, where garage doors are not required to have a fireresistance rating and foam plastic is utilized as a core material, the door facing shall be metal having a minimum thickness of 0.032-inch (0.8 mm) aluminum or 0.010-inch (0.25 mm) steel or the facing shall be a minimum of $^1/_8$-inch thick (3 mm) wood.

**2603.4.1.9 Residential garage doors:** Where foam plastic is utilized in exterior garage doors classified as Use Group R-3 and U, a thermal barrier is not required.

**2603.4.1.10 Exterior walls, one-story buildings:** A thermal barrier is not required in the exterior wall application provided for in Section 2603.6.8.

**2603.5 Exterior applications:** Foam plastic installed in or on the exterior side of walls of buildings shall also comply with the applicable requirements of Section 1406.0.

**2603.5.1 Protection:** Foam plastics applied to the exterior of foundation walls shall be protected in accordance wth Section 1405.3.11.

**2603.6 Exterior walls:** Foam plastic installed in or on the exterior side of exterior walls in buildings of Type 1, 2, 3 or 4 construction shall comply with the requirements of Sections 2603.6.1 through 2603.6.7 or, in one-story buildings, shall comply with the requirements of Section 2603.6.8.

**2603.6.1 Fireresistance rating:** Foam plastic is permitted within exterior walls provided that the wall assembly affords the required fireresistance rating.

**2603.6.2 Thickness:** The foam plastic shall be limited to a maximum thickness of 4 inches (102 mm).

**2603.6.3 Flame spread:** The foam plastic core, coatings and facings, when tested individually, shall each have a flame spread rating of 25 or less when tested in accordance with ASTM E84 listed in Chapter 35.

**2603.6.4 Fastening:** Facing, coating and core materials shall be fastened to each other, and the overall assembly shall be fastened to the building frame to prohibit failure in bond due to temperatures that occur in a building fire, *wind loads* or other conditions.

**2603.6.5 Full-scale tests:** Results of full-scale fire tests, which reflect an end-use configuration and which demonstrate that the assembly in its final form does not show any tendency to propagate flame over the surface or through the core when exposed on the exterior face to a fire source, shall be submitted to the code official. Such testing shall be per-

formed on the finished manufactured foam plastic assemblies and on the maximum thickness intended for installation.

**2603.6.6 Thermal barrier:** Any foam plastic shall be separated from the building interior by a thermal barrier unless specific approval is obtained on the basis of Section 2603.8.

**2603.6.7 Identification:** The edge or face of each piece of foam plastic insulation shall be *labeled* in accordance with Section 1704.3.

**2603.6.8 Exterior walls, one-story buildings:** Foam plastic insulation having a flame spread rating of not more than 25 and installed without a thermal barrier in or on exterior walls of one-story buildings, shall have a thickness of not more than 4 inches (102 mm). The foam plastic shall be covered by a thickness of not less than 0.032-inch (0.8 mm) aluminum or corrosion-resistant steel having a base metal thickness of 0.016 inch (0.4 mm) and the *building area* shall be equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2603.7 Interior trim:** Foam plastic used as interior trim shall comply with Sections 2603.7.1 through 2603.7.4.

**2603.7.1 Density:** The minimum density of the interior trim shall be 20 pounds per cubic foot (320 kg/m$^3$).

**2603.7.2 Thickness:** The maximum thickness of the interior trim shall be $^1/_2$ inch (13 mm) and the maximum width shall be 4 inches (102 mm).

**2603.7.3 Area limitation:** The interior trim shall not constitute more than 10 percent of the aggregate wall and ceiling area of any room or space.

**2603.7.4 Flame spread:** The flame spread rating shall not exceed 75 when tested in accordance with ASTM E84 listed in Chapter 35. The smoke-developed rating shall not be limited.

**2603.8 Alternative approval:** Foam plastic is not required to comply with the requirements of Sections 2603.4 through 2603.7 when specifically approved based on tests such as FM 4880, UL Subject 1040 or UL 1715 listed in Chapter 35. Such testing shall be performed on the finished manufactured foam plastic assemblies and on the maximum thickness intended for use. Foam plastics which are used as interior finish on the basis of diversified tests shall also conform to the flame spread requirements of Section 803.0. All assemblies tested shall include seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.

## SECTION 2604.0 GENERAL REQUIREMENTS FOR LIGHT-TRANSMITTING PLASTICS

**2604.1 Approved light-transmitting plastics:** An approved light-transmitting *plastic* shall be any thermoplastic, thermosetting or reinforced thermosetting *plastic* material which has a self-ignition temperature of 650 degrees F. (343 degrees C.) or greater when tested in accordance with ASTM D1929 listed in Chapter 35; a smoke-developed rating not greater than 450 when tested in the manner intended for use in accordance with ASTM E84 listed in Chapter 35, or a smoke density rating not greater than 75 percent when tested in the thickness intended for use in accordance with ASTM D2843 listed in Chapter 35; and which conforms to one of the following combustibility classifications:

**Class C1:** *Plastic* materials which have a burning extent of 1 inch (25 mm) or less when tested at a nominal thickness of .060 inch, or in the thickness intended for use, in accordance with ASTM D635 listed in Chapter 35; or

**Class C2:** *Plastic* materials which have a burning rate of 2.5 inches per minute (1.06 mm/s) or less when tested at a nominal thickness of .060 inch, or in the thickness intended for use, in accordance with ASTM D635 listed in Chapter 35.

**2604.2 Structural requirements:** All *plastic* materials and associated assemblies shall be of adequate strength and durability to withstand the *loads* and forces specified in Chapter 16 for the approved application.

**2604.3 Connections and supports:** All fastenings, connections and supports shall be proportioned to transmit safely two and one-half times the design *live load*. Adequate allowance shall be made in the fastenings and supports for differential expansion and contraction of the connected materials.

**2604.4 Other applicable requirements:** Light-transmitting *plastics* installed as exterior wall panels shall conform to Section 2605.0. Light-transmitting *plastics* installed in glazing of unprotected openings shall conform to Section 2606.0. Light-transmitting *plastics* installed as roof panels shall conform to Section 2607.0. Light-transmitting *plastics* installed in skylight assemblies shall conform to Section 2608.0.

**2604.5 Light-diffusing systems:** Light-diffusing systems shall not be installed in occupancies in Use Group I-2 or I-3, nor in *exits*, unless the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1. *Plastic* diffusers shall be supported directly or indirectly from ceiling or roof construction by use of noncombustible hangers. Hangers shall be at least No. 12 steel-wire gage (0.106 inch) galvanized wire or equivalent.

**2604.5.1 Installation:** Approved light-transmitting *plastic* diffusers shall comply with Section 803.0 unless the *plastic* panels will fall from the mountings before igniting and at an ambient temperature of at least 200 degrees F. (93 degrees C.) below the ignition temperature of the panels. The panels shall remain in place at an ambient room temperature of 175 degrees F. (79 degrees C.) for a period of not less than 15 minutes.

**2604.5.2 Size limitations:** Individual panels or units shall not exceed 10 feet (3048 mm) in length nor 30 square feet (2.79 m$^2$) in area.

**2604.5.3 Fire suppression system:** In buildings that are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, *plastic* light-diffusing systems shall be protected both above and below unless the *sprinkler* system has been specifically approved for installation only above the light-diffusing system. Areas of light-diffusing systems that are protected in accordance with this section shall not be limited.

**2604.5.4 Electrical lighting fixtures:** *Plastic* light-transmitting panels and light diffuser panels which are installed in approved electrical lighting fixtures shall comply with the

requirements of Section 803.0 unless the *plastic* panels conform to the requirements of Section 2604.5.1. The area of approved *plastic* materials that are used in required *exits* or *corridors* shall not exceed 30 percent of the aggregate area of the ceiling in which such panels are installed, unless the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2604.6 Partitions:** Approved light-transmitting *plastics* used in or as partitions shall comply with the requirements of Sections 603.2 and 803.0.

**2604.7 Bathroom accessories:** Approved *plastics* shall be permitted as glazing in shower stalls, shower doors, bathtub enclosures and similar accessory units (see Section 2405.0).

**2604.8 Awnings and similar structures:** Approved light-transmitting *plastics* used on awnings and similar structures shall comply with the general performance provisions of this code.

## SECTION 2605.0 LIGHT-TRANSMITTING WALL PANELS

**2605.1 General:** Approved light-transmitting *plastic* materials shall not be used as wall panels in exterior walls in occupancies in Use Groups A-1, A-2, I-2 and I-3. In all other use groups, approved light-transmitting *plastic* materials shall be permitted to be used as wall panels in exterior walls, provided that the walls are not required to have a fireresistance rating and the installation conforms to the requirements of this section. Such panels shall be erected and anchored on a foundation coat, waterproofed or otherwise protected from moisture absorption and sealed with a coat of mastic or other approved waterproof coating. Refer to Section 2604.0 for requirements for approved light-transmitting *plastics*.

**2605.2 Installation:** Exterior wall panels installed as provided for herein shall not alter the type of construction classification of the building.

**2605.3 Height limitation:** Light-transmitting *plastics* shall not be installed more than 75 feet (22860 mm) above grade plane, except as allowed by Section 2605.7.

**2605.4 Area limitation and separation:** The maximum area of a single wall panel and minimum vertical and horizontal separation requirements for exterior *plastic* wall panels shall be as provided for in Table 2605.4. The maximum percentage of wall area of any story in *plastic* wall panels shall not exceed that indicated in Table 2605.4 or the percentage of unprotected openings permitted by Section 705.3, whichever is smaller.

**Exception:** Veneers of approved weather-resistant *plastics* used as exterior siding in buildings of Type 5 construction in compliance with Section 1406.2.

* **2605.5 Fire canopies:** In structures which are provided on any floor above the first with continuous architectural projections constituting an effective fire canopy extending at least 36 inches (914 mm) from the surface of the wall in which *plastic* wall panels are installed, vertical separation at that floor is not required except as provided by the vertical thickness of the projection.

**2605.6 Automatic sprinkler system:** Where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the maximum percentage area of exterior wall in any story in *plastic* wall panels and the maximum square footage of a single area given in Table 2605.4 shall be increased 100 percent, but the area of *plastic* wall panels shall not exceed 50 percent of the wall area in any story, or the area permitted by Section 705.3.1 for unprotected openings, whichever is smaller. These installations shall be exempt from height limitations.

**Table 2605.4**
**AREA LIMITATION AND SEPARATION REQUIREMENTS FOR LIGHT-TRANSMITTING PLASTIC WALL PANELS[a]**

| Fire separation distance (feet)[d] | Class of plastic | Maximum percentage area of exterior wall in plastic panels | Maximum single area (square feet)[d] | Minimum separation of panels (feet)[d] | |
|---|---|---|---|---|---|
| | | | | Vertical | Horizontal |
| Less than 6 | — | NP[c] | NP | — | — |
| 6 or more but less than 11 | C1<br>C2 | 10<br>NP | 50<br>NP | 8<br>— | 4<br>— |
| 11 or more but less than 30 | C1<br>C2 | 25<br>15 | 90<br>70 | 6<br>8 | 4<br>4 |
| Over 30 | C1<br>C2 | 50<br>50 | Not limited<br>100 | 3[b]<br>6[b] | 0<br>3 |

**Note a.** For combination of glazing and wall panel areas permitted, see Section 2605.5.
**Note b.** For reductions in vertical separation allowed, see Section 2605.5.
**Note c.** NP = Not permitted.
**Note d.** 1 foot = 304.8 mm; 1 square foot = 0.093 $m^2$.

**2605.7 Combinations of glazing and plastic wall panels:** Combinations of *plastic* glazing and *plastic* wall panels shall be subject to the area, height and percentage limitations and the separation requirements applicable to the class of *plastic* as prescribed for *plastic* wall panel installations.

## SECTION 2606.0 LIGHT-TRANSMITTING PLASTIC GLAZING OF UNPROTECTED OPENINGS

**2606.1 Where permitted:** *Plastic* glazing is permitted in doors, sashes and framed openings where *protected* openings are not required in accordance with Section 705.0 and the installation conforms to the requirements of Section 2606.2 or Section 2606.3.

**2606.2 Approved plastic glazing:** Approved *plastic* glazing shall comply with Sections 2606.2.1 through 2606.2.3.

**2606.2.1 Area:** The area of the glazing shall not exceed 25 percent of the wall face of the story in which such glazing is installed or the area of unprotected openings permitted by Section 705.3, whichever is smaller.

**Exception:** Where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, the area of the glazing shall not exceed 50 percent of the wall face of the story in which such glazing is located or the area of unprotected openings permitted by Section 705.3.1, whichever is smaller.

**2606.2.2 Size:** The area of a unit or pane of glazing installed above the first story shall not exceed 16 square feet (1.49 $m^2$) and the vertical dimension of a unit or pane shall not exceed

4 feet (1219 mm). There shall be a minimum 3-foot (914 mm) vertical spandrel wall between stories.

**2606.2.3 Height:** Approved *plastic* glazing shall not be installed more than 75 feet (22860 mm) above *grade plane*.

**2606.3 Approved thermoplastic glazing:** Approved thermoplastic materials installed in areas up to 50 percent of the wall area of each story, but not exceeding the area of unprotected openings permitted by Section 705.3, are permitted in structures less than 150 feet (45720 mm) in *height,* provided that each floor above the first floor is equipped with continuous architectural projections constituting an effective fire canopy extending at least 3 feet (914 mm) from the surface of the wall in which the glazing is installed. The size and the dimensions of individual units shall not be limited in such installations except as required to meet structural *loading* requirements.

## SECTION 2607.0 LIGHT-TRANSMITTING PLASTIC ROOF PANELS

**2607.1 General:** Approved light-transmitting *plastic* roof panels shall not be installed in occupancies in Use Groups H, I-2 and I-3. In all other use groups, approved light-transmitting *plastic* roof panels shall not be installed unless one of the following conditions applies:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1;
2. The roof construction is not required to have a fireresistance rating by Table 602; or
3. The roof panels meet the requirements for roof coverings.

**2607.2 Separations:** Individual roof panels shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane, except that the separation between roof panels is not required in a building equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2607.3 Location:** Where exterior wall openings are required to be *protected* by Section 705.0, a roof panel or unit shall not be installed within 6 feet (1829 mm) of such exterior wall.

**2607.4 Area limitations:** Roof panels or units shall be limited in area and the aggregate area of panels shall be limited by a percentage of the floor area of the room or space sheltered in accordance with Table 2607.4.

**Exceptions**

1. The area limitations of Table 2607.4 shall be increased by 100 percent in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.
2. Low-hazard occupancy buildings, such as swimming pool shelters and greenhouses, are exempt from the area limitations of Table 2607.4, provided that the buildings do not exceed 5,000 square feet (465 $m^2$) in *area* and have a minimum *fire separation distance* of 4 feet (1219 mm).
3. Roof coverings over terraces and patios in occupancies in Use Group R-3 are exempt from the area limitations of Table 2607.4 and shall be permitted with approved *plastics*.

**Table 2607.4**
**AREA LIMITATIONS FOR ROOF PANELS**

| Class of plastic | Maximum area individual unit or panel (square feet)[a] | Maximum aggregate area (percent of floor area) |
|---|---|---|
| C1 | 300 | 30 |
| C2 | 100 | 25 |

**Note a.** 1 square foot = 0.093 $m^2$.

## SECTION 2608.0 LIGHT-TRANSMITTING SKYLIGHT GLAZING

**2608.1 Light-transmitting plastic glazing of skylight assemblies:** Skylight assemblies glazed with approved light-transmitting *plastic* materials shall conform to the provisions of this section.

**Exceptions**

1. These provisions shall not apply to a skylight of approved light-transmitting *plastic* on a building which is not more than one story in *height*, has a *fire separation distance* of at least 30 feet (9144 mm) and the room or space sheltered by the roof is not classified as Use Group I-2 or I-3 or as a *means of egress*.
2. These provisions shall not apply to skylights in which the approved light-transmitting *plastic* conforms to the required roof covering class in accordance with Section 1506.0.

**2608.2 Mounting:** The *plastic* shall be mounted above the plane of the roof on a curb constructed in accordance with the requirements for the type of construction classification, but at least 4 inches (102 mm) above the plane of the roof. Edges of *plastic* skylights or domes shall be protected by metal or other approved noncombustible material, or the *plastic* dome or skylight shall be shown to be able to resist ignition when exposed at the edge to a flame from a Class B brand as described in ASTM E108 listed in Chapter 35.

**Exceptions**

1. Curbs are not required for skylights used on roofs having a minimum slope of three units vertical in 12 units horizontal (3:12) in occupancies in Use Group R-3 and on buildings with an unclassified roof covering.
2. The metal or noncombustible edge material is not required where unclassified roof coverings are permitted.

**2608.3 Slope:** Flat or corrugated *plastic* skylights shall slope at least four units vertical in 12 units horizontal (4:12). Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome, but not less than 3 inches (76 mm).

**Exception:** Skylights that pass the Class B Burning Brand Test specified in ASTM E108 listed in Chapter 35.

**2608.4 Maximum area of skylight units:** Each skylight unit shall have a maximum area within the curb of 100 square feet (9.30 $m^2$) except that the area of skylight units shall not be limited in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2608.5 Aggregate area of skylights:** The aggregate area of skylights shall not exceed 33 percent of the floor area of the room or space sheltered by the roof in which such skylights are

installed where Class C1 materials are utilized, and 25 percent where Class C2 materials are utilized.

**Exception:** The aggregate area limitations of approved *plastic* skylights shall be increased 100 percent beyond the limitations set forth in this section where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2608.6 Separation:** Skylights shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane, except that the separation shall not be required where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2608.7 Location:** Where exterior wall openings are required to be *protected* by Section 705.0, a skylight shall not be installed within 6 feet (1829 mm) of such exterior wall.

**2608.8 Combinations of roof panels and skylights:** Combinations of *plastic* roof panels and skylights shall be subject to the area and percentage limitations and separation requirements applicable to roof panel installations.

## SECTION 2609.0 LIGHT-TRANSMITTING PLASTIC INTERIOR SIGNS

**2609.1 General:** Approved light-transmitting *plastic* interior wall signs shall be limited as specified in Sections 2609.2 through 2609.4. Approved light-transmitting *plastic* interior wall signs in covered malls shall comply with Section 402.13.

**2609.2 Aggregate area:** The *sign* shall not exceed 20 percent of the wall area.

**2609.3 Maximum area:** The *sign* shall not exceed 24 square feet (2.58 $m^2$).

**2609.4 Encasement:** All edges and backs shall be fully encased in metal.

# CHAPTER 27

# ELECTRIC WIRING, EQUIPMENT AND SYSTEMS

## SECTION 2701.0 GENERAL

**2701.1 Scope:** The provisions of this chapter shall control the design and construction of all new installations of electrical conductors, equipment and systems in buildings or structures; and all *alterations* to existing wiring systems therein to ensure safety. All such installations shall conform to the provisions of NFPA 70 listed in Chapter 35. Tentative Interim Amendments issued to NFPA 70 and accepted by the department shall be permitted to be used for interpretations of NFPA 70.

**2701.2 Exceptions:** Electrical wiring shall not be installed in a building or structure, nor shall an *alteration* of an existing electric wiring system be made, until a permit has been issued therefor as required in Section 2703.0, except as provided for in Sections 2701.2.1 through 2701.2.3.

**2701.2.1 Public service agencies:** The provisions of this code shall not apply to installations for electric supply or communication agencies in the generation, transmission or distribution of electricity, or the operation of signals, or the transmission of intelligence, or to installations located within or on buildings or premises occupied exclusively by such agency, or on public thoroughfares.

**2701.2.2 Railway utilities:** The provisions of this code shall not apply to installations or equipment which are employed by a railway utility in the exercise of said railway utility's function as a public carrier, and which are located outdoors or in buildings occupied exclusively for that purpose.

**2701.2.3 Radio and television transmitting stations:** The provisions of this code shall not apply to electrical equipment used for radio and television transmissions, except equipment and wiring for power supply and the installations of towers and antennas, whether erected on buildings or on the ground.

**2701.3 Electric installation standards:** Conformance of installation of electric conductors and equipment to NFPA 70 listed in Chapter 35 shall be the prima facie evidence that such installations are reasonably safe for use in the service intended and in compliance with the provisions of this code.

**2701.4 Electric equipment standards:** The materials, appliances and other equipment that have been tested and listed in published reports of inspected electrical equipment by an *approved agency*, and installed in accordance with all instructions included as part of such listing, shall be approved as meeting the requirements of this code.

**2701.5 Electrical inspections:** Inspections conducted to determine compliance with NFPA 70 shall be conducted by certified inspectors in accordance with Kentucky Administrative Regulation 815 KAR 35:015.

**2701.6 Electrical machinery:** Electrical machinery shall comply with NFPA 79 listed in Chapter 35.

## SECTION 2702.0 CONSTRUCTION DOCUMENTS

**2702.1 General:** *Construction documents* in sufficient detail shall be filed with the code official showing the location and capacity of all lighting facilities, electrically operated equipment and electrical circuits required for all service equipment of the building or structure except as modified by the code official.

**2702.2 Items covered:** All electrically controlled devices, including signal, communicating and lighting systems and associated wiring, wherever required under the provisions of this code, shall be shown on the *construction documents* for the building or structure for the following occupancies:

1. Places of public assembly and education and control of emergency lighting systems in accordance with Section 1024.0 and hazardous occupancies in Chapter 4.
2. *Stairway* and *exit* illumination in accordance with Chapter 12 and Section 1024.0; "Exit" sign lighting circuits in accordance with Section 1023.0; elevator car illumination in accordance with Section 3013.0.
3. Electrical equipment and control of heating, refrigerating and *ventilating* machinery and devices in accordance with the mechanical code listed in Chapter 35.
4. Fire alarm systems, *automatic fire detection* systems, fire department communications and supervisory services in accordance with Sections 918.0, 919.0 and 924.0.
5. Deleted.
6. Wiring of display *signs* in accordance with Section 3102.0; and radio and television towers and antennas in accordance with Sections 3108.0 and 3109.0.
7. Power control electric operation and circuit wiring of elevators and *escalators* in accordance with Chapter 30.
8. Illumination of toilets and bathrooms equivalent to 3 footcandles (32 lux) in accordance with Section 1205.1.1.

**2702.3 Deleted.**

## SECTION 2703.0 PERMIT AND CERTIFICATE OF INSPECTION

**2703.1 General:** Electrical wiring or equipment shall not be installed within or on any building, structure or premises, nor shall any *alteration* be made in any such existing installation, without first securing approval and a permit from the code official except as provided for in Section 2703.2. It shall be unlawful to use or allow the use of, or to supply current for, an electrical system in a building or structure, unless the required

*certificate* of inspection and permit have been issued by the code official.

**2703.2 Exemptions:** A permit shall not be required for the execution and use of the classes of work specified in Sections 2703.2.1 through 2703.2.4.

**2703.2.1 Repairs and maintenance:** A permit shall not be required for minor repair work, including the replacement of lamps or the connection of approved portable electrical equipment to approved permanently installed receptacles.

**2703.2.2 Public service agencies:** A permit shall not be required for the installation, *alteration* or repair of electrical equipment for the operation of communications and signals or the transmission of intelligence by wire by public service agencies, except as provided for in Chapter 9 for fire alarm systems.

**2703.2.3 Power companies:** A permit shall not be required for the installation, *alteration* or repair of electrical equipment of a power or public service company for its use in the generation, transmission, distribution or metering of electricity.

**2703.2.4 Temporary testing systems:** A permit shall not be required for the installation of any temporary system required for the testing or servicing of electrical equipment or apparatus.

**2703.3 Deleted.**

**2703.4 Deleted.**

## SECTION 2704.0 INSPECTION AND TESTS

**2704.1 During installation:** During the installation of electric systems and equipment, the certified electrical inspector shall make inspections to insure compliance with the provisions of this chapter, except as provided for in Section 2703.0.

**2704.2 Concealing work:** Work in connection with an electric system shall not be covered or concealed until such work has been inspected and permission to conceal such work has been approved.

**2704.3 Final inspection and test:** On completion of the work, the certified electrical inspector shall inspect the work and cause tests to be made of the operation of the entire system to insure compliance with all requirements.

## SECTION 2705.0 TEMPORARY USE

**2705.1 Permission:** The certified electrical inspector is authorized to give temporary permission for a reasonable time to supply and use current in part of an electric installation before such installation has been fully completed and the final *certificate* of approval has been issued. The part covered by the temporary *certificate* shall comply with all of the requirements specified for temporary lighting, heat or power in NFPA 70 listed in Chapter 35.

## SECTION 2706.0 EMERGENCY ELECTRICAL SYSTEMS

**2706.1 General:** Emergency electrical systems are those systems required to supply power automatically for illumination and equipment in the event of failure of the normal power supply. The emergency electrical system shall conform to Article 700 of NFPA 70 listed in Chapter 35, except as otherwise provided for herein. The systems shall pick up their connected loads within 10 seconds after failure of the normal power supply and shall operate under all weather conditions.

**2706.2 Capacity:** The emergency systems shall have the capacity to operate equipment such as *means of egress* lighting, *exit* signs, door locks and any other emergency equipment as required by other sections of this code.

**2706.3 Power source:** The emergency electrical system shall not be connected to a standby power system unless the load pickup time complies with Section 2706.1 and the standby system is sized for the additional load.

## SECTION 2707.0 STANDBY POWER SYSTEMS

**2707.1 General:** Standby power systems are those intended to supply power automatically to selected loads required by this code, other than those classified as emergency systems, in the event of failure of the normal power source. Standby power systems shall conform to Article 701 of NFPA 70 listed in Chapter 35, except as otherwise provided for herein. The systems shall pick up their connected loads within 60 seconds of failure of the normal power supply and shall operate under all weather conditions.

**2707.2 Capacity:** Standby power systems shall have the capacity and rating to operate equipment such as mechanical systems, fire pumps, lighting, communication, elevators and other standby equipment as required by other sections of this code. The capacity and rating shall include the ability to start all rotating equipment from a standing start. The system capacity is not required to be sized to operate all of the connected equipment simultaneously where loads are subject to manual control.

**2707.3 Connection of emergency systems:** Where an emergency electrical system is connected to the standby power system as provided for in Section 2706.3, the load pickup time for emergency equipment shall comply with Section 2706.1 and the standby system shall be sized for the additional load.

## SECTION 2708.0 EXISTING INSTALLATIONS

**2708.1 General:** *Alterations* shall not be made to any existing installations of electric wiring or equipment for which a permit is required within or on any building, structure or premises, except as provided for in Section 2703.0, without first securing the approval of, and a permit from, the code official.

**2708.2 Defective wiring:** If, upon inspection, an electric wiring system is found defective and unsafe, the code official shall revoke all *certificates* and permits in effect. Use of such system shall be discontinued until such system has been made to conform to this chapter and the *approved rules* and after a new permit has been issued.

**2708.3 Additional loads:** When additional electrical loads are to be connected to existing services in buildings or structures in other than buildings with occupancies in Use Group R, the existing load shall be established as not less than the actual maximum demand figures. New loads shall be computed in accordance with the requirements of NFPA 70 listed in Chapter 35.

# CHAPTER 28

# MECHANICAL SYSTEMS

## SECTION 2801.0 GENERAL

**2801.1 Scope:** The provisions of this chapter shall control the construction, inspection and maintenance of all mechanical equipment and systems in respect to structural strength, fire safety and operation.

**2801.2 Mechanical code:** All mechanical equipment and systems shall be constructed, installed and maintained in accordance with the mechanical code listed in Chapter 35.

**2801.2.1 Mechanical ventilation alternative:** Mechanical *ventilating* systems may be designed in accordance with the provisions of ASHRAE 62 listed in Chapter 35 as an equivalent alternative to the mechanical code listed in Chapter 35.

**2801.2.2 Design of mechanical systems:** The code official may use the actual occupant load in lieu of Table 1008.1.2 in the design of mechanical *ventilating* systems. This applies to both the *BOCA National Mechanical Code/1993* and ASHRAE 62.

**2801.3 Boilers:** All boilers, pressure vessels and associated pressure piping shall meet the standards for construction, installation and inspection as set forth in Title 815, Chapter 15, Kentucky Administrative Regulations.

**2801.4 Unfired pressure vessels:** All unfired pressure vessels shall meet the standards set forth in Section VIII of the 1989 edition of the ASME *Boiler and Pressure Vessel Code*, American National Standards Institute, Inc./American Society of Mechanical Engineers (ANSI/ASME) BPV-VIII-1, as required by Kentucky boiler administrative regulations set forth in Title 815, Chapter 15, Kentucky Administrative Regulations.

**2801.5 Mechanical refrigeration:** Mechanical refrigeration systems shall comply with ASHRAE 15 listed in Chapter 35.

**2801.6 Gas-fired appliances:** Fuel gas-fired appliances shall comply with NFPA 54 listed in Chapter 35.

## SECTION 2802.0 CONSTRUCTION DOCUMENTS

**2802.1 General:** The *construction documents* for the installation, repair, extension or removal of any mechanical equipment or system shall be submitted in accordance with the mechanical code listed in Chapter 35, and a permit shall be secured prior to the commencement of any work.

**2802.2 Matter covered:** The *construction documents* shall show in sufficient detail all applicable features and clearances of the appliances and systems, including: size and type of apparatus; construction of flue, stack or chimney; stack connections; type of fuel; method of operation; and the method of compliance with all regulations for the class and type of equipment installed.

**2802.3 Details:** An application for permit shall be accompanied by *construction documents* complying with the provisions of the mechanical code listed in Chapter 35 before a permit shall be issued for the mechanical equipment or system. The *construction documents* shall be drawn to a scale of not less than $^1/_8$ inch to the foot (1:100), and shall show the location and arrangement of all equipment and distribution elements including safeties and pressure-controlling devices.

## SECTION 2803.0 FEES

**2803.1 General:** A permit to begin work for new construction or *alteration* shall not be issued until the prescribed application and permit fees have been paid, nor shall an amendment to a permit necessitating an additional fee because of the additional work involved be issued until the additional fee has been paid.

## SECTION 2804.0 INSPECTIONS AND TESTS

**2804.1 Inspection:** All mechanical equipment and systems requiring a permit shall be inspected in accordance with the mechanical code listed in Chapter 35 and shall not be placed in operation until having been tested and approved.

**2804.2 Concealment:** It shall be unlawful for *owners*, contractors or workers to lath over or in any way conceal any piping, outlet boxes or other parts of the mechanical equipment or system requiring a permit until an inspection has been made thereof and due notice has been given that the work has been approved.

**2804.3 Defects and repairs:** Upon inspection or reinspection of a mechanical system, any defects or deficiencies which require repair to ensure safe operation shall be rectified before the system is placed in service.

**2804.4 Power to deem unsafe:** A system or any part thereof that is found to be unsafe to life or property, shall be deemed unsafe and shall not be restored to service until such system has been made safe and approved.

## SECTION 2805.0 PLENUMS

**2805.1 General:** The term "plenum" shall mean an enclosed portion of the building structure which forms part of an air distribution system and is designed to allow the movement of air. Supply, return, exhaust, relief and *ventilation* air plenums shall

be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, or *attic* spaces and mechanical equipment rooms. The location of supply and return air plenums shall also comply with Section 1005.7. Plenums shall be limited to one *fire area*. Fuel-fired equipment shall not be installed within a plenum. In buildings of Type 1 or 2 construction, all plenums shall be noncombustible and shall comply with Section 2805.2. In buildings of Type 3, 4 or 5 construction, noncombustible plenums in accordance with Section 2805.2, combustible plenums in accordance with Section 2805.3, and stud and joist space plenums in accordance with Section 2805.4, shall be permitted.

**2805.2 Noncombustible plenums:** Plenums shall be constructed with noncombustible material. Combustible material shall not be exposed within a plenum except as permitted in Sections 2805.2.1 through 2805.2.6.

**2805.2.1 Pipe:** Pipe shall be noncombustible except that plastic fire *sprinkler* piping in wet pipe systems shall be permitted where the piping has a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread not greater than 5.0 feet (1524 mm) when tested in accordance with UL 1887 listed in Chapter 35. Piping shall bear the *label* of an *approved agency*.

**2805.2.2 Ceiling and thermal material:** Thermal materials, including building insulation, piping insulation and spray-applied fireresistance materials and acoustical materials including ceiling panels shall have a flame spread of 25 or less and a smoke-developed rating of 50 or less when tested in accordance with ASTM E84 listed in Chapter 35.

**2805.2.3 Ducts:** Rigid or flexible ducts and connectors shall conform to the mechanical code listed in Chapter 35.

**2805.2.4 Duct coverings:** Duct coverings, linings, tape and connectors shall conform to the mechanical code listed in Chapter 35.

**2805.2.5 Electrical wiring, optical fiber cables and optical fiber raceways:** Electrical wiring shall be only low voltage or power-limited wire and cable. Optical fiber cables shall be plenum-rated nonconductive type only (OFNP). Optical fiber raceways shall be permitted only with OFNP-type cables. Electrical wiring, optical fiber cables and optical fiber raceways shall comply with the requirements of NFPA 70 listed in Chapter 35. Electrical wiring, optical fiber cables and optical fiber raceways shall bear the *label* of an *approved agency*, shall be identified in accordance with NFPA 70 listed in Chapter 35 and shall have a peak optical density not greater than 0.50, an average optical density of not greater than 0.15 and a flame spread of not greater than 5 feet (1524 mm) when tested in accordance with UL 910 listed in Chapter 35.

**2805.2.6 Combustible pneumatic tubing:** Combustible pneumatic tubing shall have a peak optical density not greater than 0.50, an average optical density not greater than 0.15 and a flame spread of not greater than 5 feet (1524 mm) when tested in accordance with UL 1820 listed in Chapter 35, and shall bear the *label* of an *approved agency*.

**2805.3 Combustible plenums:** The plenum shall be constructed with approved material. Combustible material, pipe or wire exposed within the plenum shall be permitted.

**2805.3.1 Size:** Combustible plenums shall be *draftstopped* every 3,000 square feet (279 $m^2$) in area.

**Exception:** Plenums shall be limited to one *fire area* without *draftstopping* in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1.

**2805.4 Stud cavity and joist space plenums:** Stud wall cavities and the spaces between solid floor joists to be utilized as air plenums shall comply with the following conditions:

1. Such cavities or spaces shall not be utilized as a plenum for supply air.
2. Such cavities or spaces shall not be part of a required fireresistance rated assembly.
3. Stud wall cavities shall not convey air from more than one floor level.
4. Stud wall cavities and joist space plenums shall comply with the floor penetration protection requirements of Section 713.4.
5. Stud wall cavities and joist space plenums shall be isolated from adjacent concealed spaces by approved *fireblocking* in accordance with Section 721.0.

## SECTION 2806.0 DRYING ROOMS

**2806.1 General:** A drying room or dry kiln installed within a building shall be constructed entirely of approved noncombustible materials or assemblies of such materials with the required fireresistance rating based on the fire hazard of the contents and the process, as regulated by the *approved rules* or as required in Chapter 4 for special occupancies.

**2806.2 Piping clearance:** All overhead heating pipes shall have a clearance of not less than 2 inches (51 mm) from combustible contents of the dryer.

**2806.3 Insulation:** Where the operating temperature of the dryer is 175 degrees F. (79 degrees C.) or more, metal enclosures shall be insulated from adjacent combustible materials by not less than 12 inches (305 mm) of airspace, or the metal walls shall be lined with $^1/_4$-inch (6 mm) insulating mill board or other approved equivalent insulation.

**2806.4 Fire protection:** Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in Chapter 4, shall be protected by an approved *automatic fire suppression system* conforming to the provisions of Chapter 9.

## SECTION 2807.0 WASTE- AND LINEN-HANDLING SYSTEMS

**2807.1 General:** Waste (refuse) and linen (laundry) handling systems shall be installed in accordance with this section and the provisions of Chapter 3 of NFPA 82 listed in Chapter 35.

**Exception:** Systems serving and contained within a single *dwelling unit*.

**2807.2 Waste and linen chute enclosures:** A *shaft* containing a refuse or linen chute shall not be used for any other purpose and shall be enclosed in accordance with Section 710.0. All openings into the *shaft*, including those from access rooms and termination rooms, shall be protected with approved fireresistance rated assemblies. Such opening protectives shall be self-closing or

automatic-closing upon detection of smoke, except that a heat-activated device for closing the opening protective between the *shaft* and the termination room is permitted.

**2807.3 Waste and linen chute access rooms:** Access openings for waste and linen chutes shall be located in rooms or compartments which are completely enclosed by *fire separation assemblies* having a fireresistance rating of not less than 1 hour with openings into the access rooms protected by *fire doors* that comply with Section 717.0 or the rooms shall be equipped with an automatic fire suppression system and the walls constructed as smoke partitions in accordance with Section 302.1.1.1. Access openings to waste and linen chutes shall not be located in *exit access corridors* or *exit* enclosures.

**2807.4 Termination room:** Waste and linen chutes shall discharge into an enclosed room that is completely separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating of not less than 1 hour; and openings into the termination room shall be protected by *fire doors* that comply with Section 717.0. Waste chutes shall not terminate in an incinerator room.

**2807.5 Incinerator room:** Where located within a building, incinerators shall be enclosed within a room that is separated from the remainder of the building by *fire separation assemblies* having a fireresistance rating of not less than 2 hours; and openings into the incinerator room shall be protected by *fire doors* that comply with Section 717.0.

**2807.6 Automatic fire suppression:** An approved *automatic fire suppression system* shall be installed at the top and at alternate floor levels in a waste or linen chute and in the termination and incinerator rooms. An *automatic fire suppression system* shall not be required in incinerator rooms where the incinerator burns only Type 4 waste. Type 4 waste is human parts and animal remains consisting of carcasses, organs and solid organic wastes. This type of waste contains up to 85-percent moisture, 5-percent noncombustible solids, has a bulk density of 45 to 55 pounds per cubic foot (720 to 817 kg/m$^3$) and has a heating value of 1,000 Btu per pound ($0.23 \times 10^7$ J/kg) as fired.

## SECTION 2808.0 REFUSE VAULTS

**2808.1 Refuse vault enclosures:** A vault for receiving combustible refuse from an exhaust system shall be enclosed with *fire separation assemblies* having not less than a 3-hour fireresistance rating.

**2808.2 Openings to boiler rooms:** The opening between a vault and a boiler room shall not exceed 9 square feet (0.84 m$^2$) in *area* and shall be located at least 8 feet (2438 mm) from the firing door of the boiler, and the bottom of the opening shall not be less than 6 inches (152 mm) above the boiler room floor. All openings shall be equipped with *fire doors* having a *fire protection rating* of not less than $1^1/_2$ hours and complying with Section 717.0.

**2808.3 Location:** Where located within a building, a refuse vault shall extend above the roof or shall be directly vented to the outer air with ducts that comply with the mechanical code listed in Chapter 35.

**2808.4 Fire protection:** A vault for combustible refuse which exceeds 360 cubic feet (10 m$^3$) in volume shall be protected by an approved *automatic fire suppression system* that conforms to Chapter 9. *

## SECTION 2809.0 EXISTING BUILDINGS

**2809.1 Unsafe orders:** All existing mechanical equipment and systems shall be maintained and operated in accordance with the requirements of this code and the mechanical code listed in Chapter 35. Any such equipment which does not comply with the requirements, and the operation of which is deemed unsafe to the building occupants, shall be *altered* as ordered by the code official to secure adequate safety.

# CHAPTER 29

# PLUMBING SYSTEMS

## SECTION 2901.0 GENERAL

**2901.1 Scope:** The design and installation of all plumbing systems, including sanitary and storm water sewage disposal in buildings shall comply with the requirements of Chapter 318 of the Kentucky Revised Statutes and the *Kentucky State Plumbing Code* as set out in Title 815, Chapter 20, Kentucky Administrative Regulations. Copies are available from the Kentucky Division of Plumbing, The 127 Building, 1047 U.S. Highway 127 South, Suite 1, Frankfort, Kentucky 40601.

## SECTION 2902.0 MEDICAL GASES

**2902.1 Medical gases:** Medical gas systems shall be designed and installed in accordance with NFPA 99C listed in Chapter 35.

**2902.2 Definitions:**

**2902.2.1 "Medical gas piping"** means a permanent fixed piping system in a health care facility which is used to convey oxygen, nitrous oxide, nitrogen, carbon dioxide, helium, medical air and mixtures of these gases from its source to the point of use. This definition includes the fixed piping associated with medical, surgical and gas scavenging vacuum system, as well as bedside suction systems.

**2902.2.2 "Health care facility"** means hospitals, nursing homes, limited care facilities, clinics, ambulatory care centers and office practice medical and dental offices, as defined in NFPA 99C listed in Chapter 35.

**2902.3 Licensed plumber required:** All medical gas systems shall be installed by Kentucky licensed plumbers. A master plumber shall obtain the permit for the installation prior to the commencement of the work. The journeyman plumber who installs the system shall be a certified brazer.

## SECTION 2903.0 SEWER AND WATER SUPPLY DATA DELETED

## SECTION 2904.0 PERMITS AND CERTIFICATES OF APPROVAL DELETED

## SECTION 2905.0 WATER SUPPLY SYSTEMS DELETED

## SECTION 2906.0 PRIVATE SEWAGE DISPOSAL DELETED

## SECTION 2907.0 PLUMBING FIXTURE SURROUNDS DELETED

## SECTION 2908.0 EXISTING BUILDINGS AND INSTALLATIONS DELETED

# CHAPTER 30

# ELEVATORS AND CONVEYING SYSTEMS

## SECTION 3001.0 GENERAL

**3001.1 Scope:** Except as otherwise provided by statute, the provisions of this chapter shall control the design, construction, installation, maintenance and operation of all elevators, *dumbwaiters*, *escalators*, *moving walks* and *special hoisting and conveying equipment* hereafter operated, installed, relocated or *altered* in all buildings and structures. The design, construction, installation, maintenance and operation of all *miscellaneous hoisting and elevating equipment* and amusement devices shall be subject to such special requirements as are deemed necessary by the code official to secure safe operation. The provisions of this chapter shall not apply to portable elevating devices which are used to handle materials only and which are located and operated entirely within one story.

**3001.2 Referenced standards:** Except as otherwise provided for in this code, the installation, construction, *alteration*, maintenance, operation, inspection and testing of elevators, *dumbwaiters*, *moving walks*, *escalators* and *special hoisting and conveying equipment*, except *personnel* and *material hoists*, shall conform to the applicable provisions of ALI B153.1, and ASME A17.1, A90.1 and B20.1, listed in Chapter 35.

*Personnel* and *material hoists* shall be designed utilizing an approved method that accounts for the conditions imposed during the intended operation of the hoist device. The design shall include, but is not limited to, anticipated *loads*, structural stability, impact, vibration, stresses and seismic restraint. The design shall account for the construction, installation, operation and inspection of the hoist tower, car, machinery and control equipment, guide members and hoisting mechanism. Additionally, the design of *personnel hoists* shall include provisions for field testing and maintenance which will demonstrate that the hoist device functions in accordance with the design. Field tests shall be conducted upon the completion of an installation or following a major *alteration* of a *personnel hoist*.

**3001.3 Change in use:** Elevators that change in use from freight to passenger, passenger to freight, or from one freight class to another shall comply with Part XII of ASME A17.1 listed in Chapter 35.

## SECTION 3002.0 DEFINITIONS

**3002.1 General:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

***Dumbwaiter:*** A hoisting and lowering mechanism with a car of limited capacity and size which moves in guides in a substantially vertical direction and is used exclusively for carrying material.

**Elevator:** A hoisting and lowering mechanism equipped with a car or *platform* which moves in guides for the transportation of individuals or freight in a substantially vertical direction through successive floors or levels of a building or structure (see Section 3006.0).

***Freight elevator:*** An elevator primarily used for carrying freight and on which only the operator and the persons necessary for loading or unloading and employees having special permission of the code official are permitted to ride.

***Hand elevator:*** A *freight elevator* that is driven by manual power.

***Hydraulic elevator:*** A *power elevator* in which the motion of the car is obtained through the application of force from liquid under pressure.

***Passenger elevator:*** An elevator for the transportation of individuals.

***Power elevator:*** An elevator in which the motion of the car is obtained through the application of force other than by hand or gravity.

***Sidewalk elevator:*** A *freight elevator* which operates between a sidewalk or other area exterior to the building and floor levels inside the building below such area, which does not have a landing opening into the building at its upper limit of travel and which is not used to carry automobiles.

***Elevator repairs:*** All work necessary to maintain present elevator equipment in a safe and serviceable condition and to adjust or replace defective, broken or worn parts with parts made of equivalent material, strength and design, and only where the replacing part performs the same function as the replaced part.

***Escalator*:** A power-driven, inclined, continuous *stairway* used for raising and lowering passengers (see Section 3011.0).

***Hoist***

***Material*:** A nonpermanent manually or power-operated mechanism and its hoistway for use in conjunction with the construction, *alteration* or demolition of a building or structure. It is equipped with a suspended *platform*, car, cage or bucket that moves vertically on guide members and is used exclusively for the raising or lowering of materials, which is operated and controlled from a point outside the conveyance.

***Personnel:*** A nonpermanent, manually or power-operated mechanism and its hoistway for utilization in conjunction with the construction, *alteration* or demolition of a building or structure. It is utilized for the raising and lowering of people or materials, and is equipped with a car that moves vertically on guide members.

***Hoisting and conveying equipment, special:*** Manually or power-operated hoisting, lowering or conveying mechanisms — other than elevators, *escalators* or *dumbwaiters* — for the transport of persons or freight in a vertical, inclined or horizontal direction on one floor or in successive floors (see Section 3001.2).

***Automotive lift:*** A fixed mechanical device for raising an entire motor vehicle above the floor level, but not through successive floors of the building or structure.

***Conveyors:*** A system of machinery and manual or mechanized devices other than elevator and *dumbwaiter* equipment, consisting of belts, chains, rollers, buckets, aprons, slides and chutes and other miscellaneous equipment for hoisting, lowering and transporting materials and merchandise in packages or in bulk in any direction in a building or structure (see Section 3010.0).

***Freight lift:*** A power-operated raising and lowering device for transporting freight vertically, operating entirely within one story of the building or structure.

***Manlifts:*** A power-operated belt device with steps and handholds for transporting persons in a vertical position through successive floors or levels of the building or structure.

***Hoisting and elevating equipment, miscellaneous:*** All power-operated hoisting and elevating equipment for raising, lowering and moving persons or merchandise from one level to another, such as inclined elevators; slings and hooks; tiering and piling machines not permanently located in a fixed position; mine elevators; skip hoists for blast furnaces; *stage* and orchestra lifts; lift bridges; temporary builders' hoists; and similar equipment (see Section 3001.2).

**Inclined elevator:** An elevator which travels at an angle of inclination of 70 degrees of less from the horizontal.

**Inclined wheelchair lift:** A lift where the use and application is limited by size, capacity, speed and angle of inclination, and is intended for use by the physically disabled.

**Limited use, limited access elevator (LULA):** A power passenger elevator where the use or application is limited by size, capacity, speed and rise; and is intended principally to provide vertical transportation for persons with physical disabilities.

***Moving walk:*** A type of passenger-carrying device on which passengers stand or walk, and in which the passenger-carrying surface remains parallel to its direction of motion and is uninterrupted (see Section 3001.2).

**Rack and pinion elevator:** A power elevator with or without a counterweight which is supported, raised and lowered by a motor or motors which drive a pinion or pinions on a stationary rack mounted in the hoistway.

**Stairway chairlift:** A lift designed with a seat, backrest and armrests, and is limited by capacity, speed and angle of inclination.

**Vertical wheelchair lift:** A lift where the use and application is limited by size, capacity, speed and rise; and is intended for use by the physically disabled.

## SECTION 3003.0 CONSTRUCTION DOCUMENTS AND PERMITS

**3003.1 Application:** The application for a permit shall be accompanied by *construction documents* in sufficient detail and indicating the location of the machinery room and equipment to be installed, relocated or *altered*; and all supporting structural members, including foundations. The *construction documents* shall indicate all materials to be used and all *loads* to be supported or conveyed.

**3003.2 Permits:** Equipment or devices subject to the provisions of this code shall not be constructed, installed, relocated or *altered* unless a permit has been received from the code official before the work is commenced. A copy of such permit shall be kept at the construction site at all times while the work is in progress.

**3003.3 Identification of equipment:** In buildings containing more than one elevator or device and where such devices are subject to periodic inspections, each such elevator or device shall be identified by a serial number, in figures not less than 1 inch (25 mm) high, attached to, painted, stenciled or otherwise registered on the crosshead of the elevator car and on the motor or machine; and on devices other than elevators, on the motor or machine. After such devices have been so designated, the serial numbers shall not be changed, except where approved by the code official, and all correspondence in regard to such device shall refer to said number.

## SECTION 3004.0 TESTS AND INSPECTIONS

**3004.1 General:** All equipment and devices covered by the provisions of this code shall be subjected to acceptance and maintenance tests and periodic inspections as required herein.

**3004.2 Acceptance tests:** Acceptance tests and inspections shall be required on all new, relocated and *altered* equipment subject to the provisions of this chapter. Tests and inspections shall be of such a nature as to determine whether the entire installation is designed, constructed and installed in compliance with this code, and shall include all parts of the equipment and machinery. All such tests shall be made in compliance with the requirements of Section 3004.5 and in the presence of the code official, by the person installing such equipment.

**3004.3 Periodic tests and periodic inspections:** Periodic tests shall be required on all new and existing *power elevators*, and periodic inspections shall be made of all new and existing equipment subject to the provisions of this chapter.

**3004.3.1 Periodic tests:** Periodic tests shall be made by the code official, or by an *approved agency*, and shall be made at the expense and responsibility of the *owner*. Where such tests are not made by the code official, the *approved agency* shall submit a detailed report of the tests to the code official on approved forms not more than 30 days after completion of the tests.

**3004.3.2 Periodic inspections:** Periodic inspections shall be made by the code official or by an *approved agency*. Where

such inspections are not made by the code official, the *approved agency* shall submit a detailed report of the inspection to the code official on approved forms not more than 30 days after completion of the inspection.

**3004.4 Frequency of tests and inspections:** Tests and inspections shall be conducted at frequencies specified in Sections 3004.4.1 and 3004.4.2.

**3004.4.1 Periodic inspection intervals:** Periodic inspections shall hereafter be made at intervals of not more than twelve months for all passenger elevators, *manlifts* and *escalators*.

**3004.4.2 Periodic test intervals:** Periodic tests shall be made at intervals not exceeding those set forth in ASME A17.1 listed in Chapter 35.

**3004.5 Minimum requirements for tests and inspections:** The minimum requirements for the inspection and test of the devices subject to this chapter shall conform to this section.

**3004.5.1 Elevators, dumbwaiters, escalators, material lifts, moving walks, stairway chair lifts and wheelchair lifts:** The equipment and machinery of elevators, *dumbwaiters*, *escalators*, material lifts, moving walks, stairway chairlifts and weehchair lifts, as defined in Section 3002.2 shall be inspected and tested in accordance with ASME A17.1 listed in Chapter 35.

**3004.5.2 Freight lifts and amusement devices:** *Freight lifts* and amusement devices shall be inspected and subjected to tests to ensure the *load* capacity and safe operation. The tests shall cover all operating protectives and safety devices, structural adequacy of the supports, and anchorage to floors, walls, ceilings and foundations.

**3004.5.3 Manlifts:** All equipment and machinery of *manlifts* shall be inspected and tested to ensure safety of operation and shall include tests of the brake, terminal and emergency stopping devices and belt tension. Acceptance tests shall also include a *load* capacity test as specified in ASME A90.1 listed in Chapter 35.

**3004.5.4 Miscellaneous hoisting and elevating equipment:** All *miscellaneous hoisting and elevating equipment* shall be subjected to tests and inspections as required by the code official to ensure safe operation.

**3004.5.5 Conveyors:** *Conveyors* and related equipment shall be inspected and tested in accordance with ASME B20.1 listed in Chapter 35.

## SECTION 3005.0 CERTIFICATE OF COMPLIANCE

**3005.1 General:** The operation of all equipment governed by the provisions of this chapter and hereafter installed, relocated or *altered* shall be unlawful by persons other than the installer thereof until such equipment has been inspected and tested as herein required and a final or limited *certificate* of compliance has been issued therefor by the code official.

**3005.2 Final certificate of compliance:** The code official shall issue a final *certificate* of compliance for each unit of equipment which has satisfactorily met all of the inspections and tests required by this chapter. Such final *certificate* shall bear the signature of the person who made the inspection and tests, and shall designate the rated *load* and speed, the date of the acceptance tests and inspections, and the name of the code official who made or witnessed such tests and inspections. The final *certificate* shall also include the necessary space for inserting the name of the person who made the periodic inspection and witnessed the periodic and maintenance tests and the date of the periodic inspection and the maintenance test.

**3005.3 Limited certificate of compliance:** The code official is authorized to issue a limited *certificate* of compliance for any equipment covered by this chapter, which is hereafter installed, relocated or *altered*, to permit limited use by the person designated therein during the period of such installation, relocation or *alteration*. Such *certificate* shall be signed by the code official, shall bear the dates of issue, renewal and expiration, and shall designate the class of service allowed.

**3005.3.1 Tests and minimum safeguards required:** A limited *certificate* shall not be issued for an elevator until such elevator has satisfactorily passed tests for rated *load*, car and counterweight safety, and terminal stopping devices. Permanent or temporary guards and enclosures shall be installed on the car, around the hoistway and at the landing entrances. Equipment other than elevators shall be tested and protectives shall be provided as deemed necessary by the code official to ensure safe operation for the limited service specified.

**3005.3.2 Special conditions:** Automatic and continuous-pressure operation elevators shall not be placed in temporary operation from the landing pushbuttons unless the door-locking device and interlocks required by ASME A17.1 listed in Chapter 35 are installed and operative. Where the car is operable only from the inside, landing entrance guards shall be provided with locks that are releasable from the hoistway side only.

**3005.3.3 Time limitation:** Limited *certificates* of operation shall be issued for periods of not more than 30 days. The code official is authorized to renew the limited certificates of operation for additional periods of not more than 30 days each.

**3005.4 Posting certificates of compliance:** The *owner* or lessee shall post the last-issued *certificate* of compliance in a conspicuous place on the elevator, available to the code official.

## SECTION 3006.0 POWER ELEVATOR OPERATION

**3006.1 Designated operator:** Every *power elevator*, except automatic and continuous-pressure operation types and *sidewalk elevators*, shall be in the charge of a competent designated operator.

**3006.2 Emergency operation:** All elevators shall conform to the requirements of Section 211 of ASME A17.1 listed in Chapter 35.

**3006.2.1 Smoke detectors:** Smoke detectors shall be installed in accordance with NFPA 72 and Section 211 of ASME A17.1 listed in Chapter 35.

**3006.2.2 Activation:** The emergency operation shall be activated by smoke detectors installed in accordance with Section 211 of ASME A17.1 listed in Chapter 35.

**3006.2.3 Automatic sprinklers:** Where an *automatic sprinkler* is installed in elevator hoistways or elevator equipment

rooms, means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water from sprinklers located in the machine room or elevator hoistway. This means shall be independent of the elevator control and shall not be self-resetting. The activation of sprinklers outside of the hoistway or machine room shall not disconnect the main line power supply. Smoke detectors shall not be used to activate sprinklers in these spaces or to disconnect the main line power supply.

**3006.3 Accessible elevators:** See Chapter 11 for buildings and facilities required to be accessible to persons with physical disabilities.

## SECTION 3007.0 HOISTWAY ENCLOSURES AND VENTING

**3007.1 Hoistway enclosures:** Hoistway enclosures shall be constructed in accordance with Sections 3007.1.1 through 3007.1.3.

**3007.1.1 Elevator enclosures:** All elevator and other hoistway enclosures other than *dumbwaiter shafts* shall be constructed to afford at least the fireresistance rating specified in Table 602 with approved opening protectives conforming to Section 3008.0 and Chapter 7.

**3007.1.2 Dumbwaiter enclosures:** *Shaft* enclosures and *dumbwaiters* having a car area of more than 3 square feet (0.28 $m^2$) which travel through more than one story and serve more than two adjacent floors shall be of 1-hour fireresistance rated construction with approved $^3/_4$-hour opening protectives or the approved *labeled* equivalent complying with Chapter 7, except that where the *load* capacity exceeds 100 psf (4788 Pa), the enclosure and opening protectives shall comply with the requirements of Section 3007.1.1 for fireresistance rating.

**3007.1.3 Special dumbwaiter enclosures:** The enclosure of *dumbwaiters* not more than 3 square feet (0.28 $m^2$) in area with a *load* capacity of not more than 25 pounds (111 N), and all *dumbwaiters* serving not more than two adjacent levels, shall be enclosed with approved noncombustible materials.

**3007.2 Number of elevators permitted in hoistway:** Where four or more elevators serve all or the same portion of a building, the elevators shall be located in not less than two hoistways, and not more than four elevators shall be located in any one hoistway.

**3007.3 Vents required:** Hoistways of elevators and *dumbwaiters* serving more than three stories shall be provided with a means for venting smoke and hot gases to the outer air in case of fire.

**Exceptions**

1. In occupancies of other than Use Groups R-1, R-2, I-1, I-2 and similar occupancies with overnight sleeping quarters, venting of hoistways is not required where the building is equipped throughout with an approved *automatic fire suppression system* which is connected to the building *water supply* system or which conforms to Section 906.0.
2. *Sidewalk elevator* hoistways are not required to be vented.

**3007.3.1 Mechanical ventilation:** Mechanical *ventilation* shall be allowed in occupancies of other than Use Groups R-1, R-2, I-1, I-2 and similar occupancies with overnight sleeping quarters if outside exposure for the required vents is not possible. Mechanical *ventilation* shall conform to Chapter 28 of this code.

**3007.4 Location of vents:** Vents shall be located at the top of the hoistway, and shall open either directly to the outer air or through noncombustible ducts to the outer air. Holes in the machine room floors for the passage of ropes, cables or other moving elevator equipment shall be limited so as not to provide greater than 2 inches (51 mm) of clearance on all sides.

**3007.5 Area of vents:** Except as provided for herein, the area of the vents shall not be less than $3^1/_2$ percent of the area of the hoistway nor less than 3 square feet (0.28 $m^2$) for each elevator car, and not less than $3^1/_2$ percent nor less than $^1/_2$ square foot (0.047 $m^2$) for each *dumbwaiter* car in the hoistway, whichever is greater. Of the total required vent area, not less than one-third shall be of the permanently open type unless all vents activate upon detection of smoke from any of the elevator lobby smoke detectors. Where mechanical *ventilation* conforming to the mechanical code listed in Chapter 35 provides equivalent venting, the required vent area shall be reduced, if compliance with Section 3007.3.1 is met.

**3007.5.1 Restricted occupancy:** The occupancy is not in Use Group R-1, R-2, I-1 or I-2 or of a similar occupancy with overnight sleeping quarters.

**3007.5.2 Vent location:** The vents required by Section 3007.4 shall not have outside exposure.

**3007.6 Closed vents:** Closed portions of the required vent area shall consist of windows or duct openings glazed with plain glass not more than $^1/_8$-inch thick.

**3007.6.1 Windows:** Windows used as required vents shall conform to Section 719.0 and shall be glazed with $^1/_8$-inch (3 mm) plain glass.

**3007.7 Plumbing and mechanical systems:** Plumbing and mechanical systems, other than floor drains, sumps and sump pumps at the base of the *shaft*, shall not be located in an elevator *shaft*.

## SECTION 3008.0 ELEVATOR OPENING PROTECTIVES

**3008.1 General:** All hoistway enclosure doors for elevators, *dumbwaiters* and other hoisting equipment shall be constructed in accordance with the provisions of Chapter 7 and as herein required.

**3008.2 Hoistway doors:** Door openings of elevator hoistway enclosures that are required to have a 2-hour fireresistance rating shall be equipped with protective assemblies having a *fire protection rating* of not less than $1^1/_2$ hours or an approved *labeled* equivalent. However, where the *shaft* opens into a vestibule enclosed with *fire separation assemblies* with not less than a 2-hour fireresistance rating in which all vestibule openings are protected with assemblies having a *fire protection rating* of not less than 1 hour, the required *fire protection rating* of the hoistway doors shall be $^3/_4$ hour.

**3008.3 Hardware:** All hardware on opening protectives shall be of an approved type installed as tested, except that interlocks, mechanical elevator door locks and electric contacts and door-

operating mechanisms of approved types shall be exempt from the fire test requirements.

**3008.4 Additional doors:** Doors other than the hoistway door and the elevator car door shall be prohibited at the point of access to an elevator car.

**Exception:** Doors which are readily openable from the car side without a key, tool, special knowledge or effort.

## SECTION 3009.0 ELEVATOR CAR EMERGENCY SIGNALS AND SIGNS

**3009.1 Emergency signs:** A pictograph sign, of an approved standardized type, shall be posted over each elevator call station on all floors, indicating that in case of fire, occupants shall not use elevators and that *stairways* are the approved method of *exit*.

**Exception:** The emergency sign shall not be required for elevators which are part of an accessible *means of egress* as complying with Section 1007.3.

## SECTION 3010.0 CONVEYORS

**3010.1 Enclosures:** All package elevators, boosters or lifts connecting successive floors or levels shall be enclosed with *fire separation assemblies* in compliance with the requirements of Section 3007.0 and Chapter 7.

**3010.2 Opening protectives:** Opening protectives shall be provided in accordance with Sections 3010.2.1 through 3010.2.3.

**3010.2.1 Construction documents:** Whenever *conveyor* or other material-handling devices are designed to pass through floors, ceilings, partitions or walls, the *construction documents* shall give the necessary details of the opening protectives in respect to location, structural strength and fireresistance rating.

**3010.2.2 Fire curtains:** Openings in partitions and walls through which *conveyors* pass shall have automatic *fire dampers* or curtains to prevent the spread of fire where, in the opinion of the code official, such protection is necessary due to the hazard of operation of the *conveyors*.

**3010.2.3 Fire doors:** All opening protectives shall meet the *fire protection rating* requirements of Chapter 7 for the location, type of construction and use group of the building or structure.

**3010.3 Machinery guards:** All conveying devices shall be manufactured, installed and guarded in accordance with ASME B20.1 listed in Chapter 35.

**3010.4 Chute enclosures:** All slides and chutes shall be enclosed with *fire separation assemblies*, or shall be protected with approved automatic shutters of noncombustible construction, to ensure a full *fireblock* between floors of the building or structure.

**3010.5 Conveyor safeties:** All power-operated *conveyors*, belts and other material-moving devices shall be equipped with automatic limit switches which will shut off the power in an emergency and automatically stop all operation of the device.

## SECTION 3011.0 ESCALATORS AND MOVING WALKS

**3011.1 Materials:** *Escalators* and *moving walks* shall be constructed of approved noncombustible and fireretardant materials except electrical equipment, wiring, wheels, handrails and the use of $^1/_{28}$-inch (0.9 mm) wood veneers on balustrades backed up with noncombustible materials.

**3011.2 Floor opening:** A *shaft* enclosure for an *escalator* floor opening is not required where a *shaft* enclosure is not required for floor openings in accordance with Section 713.3 or where the building is equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1 and the *escalator* opening is protected in accordance with Section 3011.2.1 or 3011.2.2.

**3011.2.1 Automatic fire shutter:** *Escalators* shall be equipped with a power-operated automatic shutter at every floor pierced thereby, constructed of approved noncombustible materials with a *fire protection rating* of not less than $1^1/_2$ hours. The shutter shall close immediately upon the automatic detection of fire or smoke by an approved device and shall completely shut off the well opening. The shutter shall operate at a speed of not more than 30 feet per minute (0.15 m/s) and shall be equipped with a sensitive leading edge to arrest the shutter's progress when in contact with any obstacle, and to continue the shutter's progress on release therefrom.

**3011.2.2 Water curtain:** The area of the floor opening shall not exceed twice the horizontal projected area of the *escalator* and the opening shall not connect more than four stories in occupancies in other than Use Groups B and M and the opening shall be protected by a draft curtain and a closed *sprinkler* water curtain conforming to NFPA 13 listed in Chapter 35.

## SECTION 3012.0 MAINTENANCE AND ACCIDENTS

**3012.1 Owner responsibility:** The *owner* or the *owner*'s legal agent for the building in which the equipment is located shall be responsible for the care, maintenance and safe operation of all equipment covered by this chapter after the installation thereof and acceptance by such *owner* or agent. The *owner* or legal agent shall make or cause to be made all periodic tests and inspections, and shall maintain all equipment in a safe operating condition, as required by this chapter.

**3012.2 Contractor responsibility:** The person installing any device covered by this chapter shall make all acceptance tests and shall be responsible for the care and safe operation of such equipment during its construction and until temporarily or finally accepted by the building *owner* or the *owner*'s legal agent.

**3012.3 Maintenance items:** All operating and electrical parts and *accessory* equipment or devices subject to this chapter shall be maintained in a safe operating condition. The maintenance of all equipment covered by this chapter shall conform to ASME A17.1, ASME B20, or ANSI A10.5 listed in Chapter 35.

**3012.4 Accidents reported and recorded:** The *owner* of the building shall immediately notify the code official of every accident involving personal injury or damage to apparatus on, about or in connection with any equipment covered by this chapter, and shall afford the code official every facility for investigating such accident. When an accident involves the failure, breakage, damage or destruction of any part of the apparatus or mechanism, it shall be unlawful to use such device until after an examination by the code official is made and approval of the equipment for continued use is granted. It shall be the duty of the

code official to make a prompt examination into the cause of the accident and to enter a full and complete report thereof in the records of the building department. Such records shall be open for public inspection at all reasonable hours.

**3012.5 Removal of damaged parts:** It shall be unlawful to remove from the premises any part of the damaged construction or operating mechanism of elevators, or other equipment subject to the provisions of this chapter, until permission to do so has been granted by the code official.

### SECTION 3013.0 EXISTING ELEVATORS AND ESCALATORS

**3013.1 Referenced standard:** All existing elevators, *escalators* and moving walks shall conform to ASME A17.3 listed in Chapter 35.

### SECTION 3014.0 VERTICAL CHAIRLIFTS AND WHEELCHAIR LIFTS

**3014.1 General:** Inclined stairway chairlifts and inclined and vertical wheelchair lifts shall conform to the requirements of ASME A17.1 listed in Chapter 35.

### SECTION 3015.0 MACHINE ROOMS AND RELATED CONSTRUCTION FOR PASSENGER AND FREIGHT ELEVATORS AND DUMBWAITERS

**3015.1 General:** The construction of machine rooms and related construction for passenger elevators, freight elevators and dumbwaiters shall be protected from the weather and shall be enclosed with fireresistance rated construction. Enclosures of machine rooms located adjacent to the elevator shaft shall have a minimum fireresistance equal to that required by Table 602 for hoistway enclosures. Machine rooms that are not located adjacent to elevator shafts shall be enclosed with construction having a fireresistance rating of not less than 1 hour.

# CHAPTER 31

# SPECIAL CONSTRUCTION

## SECTION 3101.0 GENERAL

**3101.1 Scope:** In addition to the general requirements of this code governing the design and construction of all structures, the provisions of this chapter shall control the special structures and construction features as herein provided.

## SECTION 3102.0 SIGNS

**3102.1 General:** The provisions of this section shall govern the construction, *alteration*, repair and maintenance of outdoor *signs* together with the associated appurtenant and auxiliary devices in respect to structural and fire safety. Section 2609.0 shall govern approved light-transmitting *plastic* interior wall *signs*. Section 402.13 shall govern approved *plastic* signs in covered mall buildings.

**3102.2 Definitions:** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

*Sign:* Any fabricated sign or outdoor display structure, including its structure, consisting of any letter, figure, character, mark, point, plane, marquee sign, design, poster, pictorial, picture, stroke, stripe, line, trademark, reading matter or illuminating device, which is constructed, attached, erected, fastened or manufactured in any manner so that the same shall be used for the attraction of the public to any place, subject, person, firm, corporation, public performance, article, machine or merchandise, and displayed in any manner out of doors for recognized advertising purposes.

**Closed sign:** A *sign* in which more than 50 percent of the entire area is solid or tightly enclosed or covered.

**Ground sign:** A *sign* supported by uprights or braces in or upon the ground surface.

**Marquee sign:** A *sign* attached to or hung from a marquee, canopy or other covered structure, projecting from and supported by the building and extending beyond the building wall, building line or *street lot line*.

**Open sign:** A *sign* in which at least 50 percent of the enclosed area is uncovered or open to the transmission of wind.

**Portable sign:** A *sign*, usually of a temporary nature, not securely anchored to the ground or to a building or structure and which obtains some or all of its structural stability with respect to wind or other normally applied forces by means of its geometry or character.

**Projecting sign:** A display *sign* which is attached directly to the building wall, and which extends more than 15 inches (381 mm) from the face of the wall.

**Roof sign:** A *sign* which is erected, constructed and maintained above the roof of the building.

**Temporary sign:** A *sign* constructed of cloth, fabric or other lightweight temporary material with or without a structural frame intended for a limited period of display; including decoration displays for holidays or public demonstrations.

**Wall sign:** A *sign* which is painted on or attached directly to a fence or on the surface of masonry, concrete, frame or other approved building walls, and which extends not more than 15 inches (381 mm) from the face of the fence or wall.

**3102.3 Zoning law:** Where more restrictive in respect to location, purpose, size or height of *signs*, the limitations of *zoning* laws that affect required light and *ventilation* requirements and occupancy of land shall take precedence over the regulations of this code.

**3102.4 Permits and construction documents:** Permits for *signs* shall be required as specified in Sections 3102.4.1 and 3102.4.2 except as provided for in Section 3102.4.3. *Construction documents* shall be prepared and filed in accordance with Sections 3102.4.4 and 3102.4.5.

**3102.4.1 New signs:** A new *sign* shall not hereafter be erected, constructed, *altered* or maintained except as provided for herein, and until a permit has been issued by the code official.

**3102.4.2 Alterations:** A *sign* shall not be enlarged or relocated unless such *sign* conforms to the provisions of this section for new *signs*, or until a proper permit has been secured. The changing of movable parts of an approved *sign* that is designed for such changes, or the repainting or reposting of display matter, shall not be deemed an *alteration*, provided that the conditions of the original approval and the requirements of this section are not violated.

**3102.4.3 Permit exemptions:** A permit shall not be required for the *signs* specified in Sections 3102.4.3.1 through 3102.4.3.5. Such exceptions, however, shall not be construed to relieve the owner of the *sign* from responsibility for the *sign's* erection and maintenance in a safe manner.

**3102.4.3.1 Wall signs:** A permit shall not be required for a *sign* painted on the surface of a fence or approved building wall, or any nonilluminated wall *sign* on a build-

ing or structure which is not more than 10 square feet (0.93 $m^2$) in area.

**3102.4.3.2 Sale or rent:** A permit shall not be required for ground *signs* erected to announce the sale or rent of property, provided that such *signs* are not more than 25 square feet (2.33 $m^2$) in area.

**3102.4.3.3 Transit directions:** A permit shall not be required for the erection or maintenance of a ground *sign* designating the location of a transit line, a railroad station or other public carrier provided that such *signs* are not more than 3 square feet (0.28 $m^2$) in area.

**3102.4.3.4 Street signs:** A permit shall not be required for ground *signs* erected by a jurisdiction for street direction.

**3102.4.3.5 Projecting signs:** A permit shall not be required for a projecting *sign* not exceeding $2^1/_2$ square feet (0.23 $m^2$) of display surface.

**3102.4.4 Construction documents and owner's consent:** Before any permit is issued for the erection of a *sign*, *construction documents* shall be filed with the code official showing the dimensions, materials and required details of construction, including *loads*, stresses and anchorage. The applications shall be accompanied by the *written* consent of the owner or lessee of the premises upon which the *sign* is to be erected.

**3102.4.5 Identification:** Every *sign* for which a permit has been issued and which is hereafter erected, constructed or maintained, shall be plainly identified by the name of the person, firm or corporation owning, erecting, maintaining or operating such *sign*. The method and location of this identification shall appear on the *construction documents* filed with the code official.

**3102.5 Maintenance and inspection:** *Sign* maintenance and inspection shall comply with Sections 3102.5.1 through 3102.5.4.

**3102.5.1 Removal:** The code official is authorized to order the removal of any *sign* that is not maintained in accordance with the provisions of this section.

**3102.5.2 Maintenance:** All *signs* for which a permit is required, together with all supports, braces, guys and anchors, shall be kept in repair in accordance with the provisions of this section and Chapter 1. Where not galvanized or constructed of approved corrosion-resistant noncombustible materials, *signs* shall be painted.

**3102.5.3 Housekeeping:** The owner or lessee of every *sign* shall maintain the immediate premises occupied by the *sign* in a clean, sanitary and healthful condition.

**3102.5.4 Inspection:** Every *sign* shall be subject to inspection and approval.

**3102.6 General requirements:** All *signs* shall be designed and constructed to comply with the provisions of this code for materials, *loads* and stresses, and with the requirements of Sections 3102.6.1 through 3102.6.5.

**3102.6.1 Wind load:** All *signs* shall be designed and constructed to withstand wind pressure as provided for in Sections 1609.4.1 and 1609.8.

**3102.6.2 Earthquake load:** *Signs* designed to withstand wind pressures shall be considered capable of withstanding *earthquake loads*, except as provided for in Sections 1610.0 and 1613.0.

**3102.6.3 Illumination:** A *sign* shall not be illuminated by other than electrical means, and electrical devices and wiring shall be installed in accordance with the requirements of NFPA 70 listed in Chapter 35. Any open spark or flame shall not be used for display purposes unless specifically approved.

**3102.6.4 Use of combustibles:** The requirements of Sections 3102.6.4.1 and 3102.6.4.2 shall apply to combustible material for *signs*.

**3102.6.4.1 Ornamental features:** Wood or approved *plastic* as provided for in Chapter 26, or other materials of combustible characteristics similar to wood, used for moldings, cappings, nailing blocks, letters and latticing, shall comply with Section 3102.7, and shall not be used for other ornamental features of *signs*, unless approved.

**3102.6.4.2 Internally illuminated signs:** Except as provided for in Sections 402.13 and 2609.0, where internally illuminated *signs* have *sign* facings of wood or approved combustible *plastic*, the area of such facing section shall not be more than 120 square feet (11.16 $m^2$) and the wiring for electric lighting shall be entirely enclosed in the *sign* cabinet with a clearance of not less than 2 inches (51 mm) from the facing material. The dimensional limitation of 120 square feet (11.16 $m^2$) shall not apply to *sign* facing sections made from flameresistant-coated fabric (ordinarily known as "flexible *sign* face *plastic*") that weighs less than 20 ounces per square yard (678 $g/m^2$) and which, when tested in accordance with NFPA 701 listed in Chapter 35, meets the requirements of both the small-scale test and the large-scale test, or which, when tested in accordance with an approved test method, exhibits an average burn time for ten specimens of 2 seconds or less and a burning extent of 15 centimeters or less.

**3102.6.5 Animated devices:** *Signs* that contain moving sections or ornaments shall have fail-safe provisions to prevent the section or ornament from releasing and falling or shifting its center of gravity more than 15 inches (381 mm). The fail-safe device shall be in addition to the mechanism and the mechanism's housing which operate the movable section or ornament. The fail-safe device shall be capable of supporting the full dead weight of the section or ornament when the moving mechanism releases.

**3102.7 Ground signs:** The structural frame of ground *signs* shall not be erected of combustible materials to a height of more than 35 feet (10668 mm) above the ground. In all locations, where constructed entirely of noncombustible material, ground *signs* shall not be erected to a height of greater than 100 feet (30480 mm) above the ground. Greater heights are permitted where approved and located so as not to create a hazard or danger to the public.

**3102.8 Roof signs:** Roof *signs* shall comply with Sections 3102.8.1 through 3102.8.4.

**3102.8.1 Materials:** All roof *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in Section 3102.6.4. Provisions shall be made for electric grounding of all metallic parts. Where combustible materials are permitted in letters or other ornamental features, all wiring and tubing shall be kept free and insulated therefrom.

**3102.8.2 Bottom clearance:** There shall be a clear space of not less than 6 feet (1829 mm) between the lowest part of the *sign* and the roof level, except for necessary structural supports.

**3102.8.3 Closed signs:** A closed roof *sign* shall not be erected to a height greater than 50 feet (15240 mm) above the roof of buildings of Types 1 and 2 construction, nor more than 35 feet (10668 mm) above the roof of buildings of Types 3, 4 and 5 construction.

**3102.8.4 Open signs:** An open roof *sign* shall not exceed a height of 100 feet (30480 mm) above the roof of buildings of Types 1 and 2 construction; and not more than 60 feet (18288 mm) above the roof of buildings of Types 3, 4 and 5 construction.

**3102.9 Wall signs:** Wall *signs* shall comply with Sections 3102.9.1 and 3102.9.2.

**3102.9.1 Materials:** Wall *signs* which have an area exceeding 40 square feet (3.72 $m^2$) shall be constructed of metal or other approved noncombustible material, except for nailing rails and as provided for in Section 3102.6.4.

**3102.9.2 Extension:** Wall *signs* shall not be erected to extend above the top of the wall, nor to extend beyond the ends of the wall to which the *signs* are attached unless such *signs* conform to all of the requirements for roof *signs*, projecting *signs* or ground *signs*.

**3102.10 Projecting signs:** Projecting *signs* shall comply with Sections 3102.10.1 through 3102.10.4.

**3102.10.1 Materials:** Projecting *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in Section 3102.6.4.

**3102.10.2 Maximum projection:** A projecting *sign* shall not extend beyond a vertical plane that is 2 feet (610 mm) inside the curb line.

**3102.10.3 Clearance:** A vertical clearance of not less than 8 feet (2438 mm) shall be provided below all parts of projecting *signs*.

**3102.10.4 Additional loads:** Projecting *sign* structures which will be used to support an individual on a ladder or other servicing device — whether or not specifically designed for the servicing device — shall be capable of supporting the anticipated additional *load*, but not less than a 100-pound (445 N) concentrated horizontal *load* and a 300-pound (1334 N) concentrated vertical *load* applied at the point of assumed or most eccentric *loading*. The building component to which the projecting *sign* is attached shall also be designed to support the additional *loads*.

**3102.11 Marquee signs:** Marquee *signs* shall comply with Sections 3102.11.1 through 3102.11.3.

**3102.11.1 Materials:** Marquee *signs* shall be constructed entirely of metal or other approved noncombustible material except as provided for in Section 3102.6.4.

**3102.11.2 Attachment:** Marquee *signs* shall be attached to approved marquees that are constructed in accordance with Section 3203.11.

**3102.11.3 Dimensions:** Marquee *signs* shall not project beyond the perimeter of the marquee.

**3102.12 Temporary signs:** Temporary *signs* shall comply with Sections 3102.12.1 through 3102.12.4.

**3102.12.1 Banner and cloth signs:** Temporary *signs* and banners which are attached to or suspended from a building, and which are constructed of cloth or other combustible material, shall be constructed in an approved manner and shall be securely supported. Such *signs* and banners shall be removed as soon as torn or damaged, and not later than 60 days after erection. Permits for temporary *signs* that are suspended from or attached to a canopy or marquee shall be limited to a period of ten days.

**3102.12.2 Maximum size:** Temporary *signs* of combustible construction shall not be more than 10 feet (3048 mm) in one dimension nor more than 500 square feet (46.5 $m^2$) in area.

**3102.12.3 Supports:** Where more than 100 square feet (9.3 $m^2$) in area, temporary *signs* and banners shall be constructed and fastened to supports that are capable of withstanding the design *loads* listed in Section 1608.0.

**3102.12.4 Special permits:** Temporary *signs* used for holidays, public demonstrations or promotions of civic welfare or charitable purposes, which extend across streets or other public spaces shall be subject to special approval of the authority having jurisdiction.

**3102.13 Illuminated signs:** Illuminated *signs* shall comply with Sections 3102.13.1 through 3102.13.3.

**3102.13.1 Certificates:** All electrically illuminated *signs* shall be certified as to electric wiring and devices by the agency having jurisdiction, and all wiring and accessory electrical equipment shall conform to the requirements of NFPA 70 listed in Chapter 35.

**3102.13.2 Additional permits:** Electrical permits shall be issued for the erection or maintenance of illuminated *signs*.

**3102.13.3 Relettering signs:** The requirements of this section shall not apply to the relettering of illuminated *signs*, except where such relettering requires a change of wiring or piping of the *sign*.

**3102.14 Portable signs:** Portable *signs* shall conform to all requirements for ground, roof, projecting, flat and temporary *signs* where such *signs* are used in a similar capacity. The requirements of this section shall not be construed to require portable *signs* to have connections to surfaces, tie-downs or

foundations where provisions are made by temporary means or configuration of the structure to provide stability for the expected duration of the installation.

**3102.14.1 Electrical:** Portable *signs* that require electrical service shall have a positive connecting device on the *sign*. Electrical service lines to the *sign* shall be protected from damage from all anticipated traffic.

## SECTION 3103.0 MEMBRANE STRUCTURES

**3103.1 General:** The provisions of this section shall apply to air-supported, air-inflated, *membrane*-covered cable and *membrane*-covered frame structures, collectively known as *membrane* structures, erected for a period of 90 days or longer. Those erected for a shorter period of time shall comply with the applicable provisions of the fire prevention code listed in Chapter 35 and Section 3104.0. *Membrane* structures covering water storage facilities, water clarifiers, water treatment plants, sewage treatment plants and similar facilities not used for human occupancy, are required to meet only the requirements of Sections 3103.3.2 and 3103.6.

**3103.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Membrane:*** As it pertains to membrane structures, a thin, flexible, impervious material capable of being supported by an air pressure of 1.5 inches (435 Pa) of water column.

**Membrane structures**

**Air-inflated structure:** A building where the shape of the structure is maintained by air pressurization of cells or tubes to form a barrel vault over the usable area. Occupants of such a structure do not occupy the pressurized area used to support the structure.

**Air-supported structure:** A building wherein the shape of the structure is attained by air pressure and occupants of the structure are within the elevated pressure area. Air-supported structures are of two basic types:

**Double skin:** Similar to a single skin, but with an attached liner that is separated from the outer skin and provides an air space which serves for insulation, acoustic, aesthetic or similar purposes.

**Single skin:** Where there is only the single outer skin and the air pressure is directly against that skin.

**Cable-restrained, air-supported structure:** A structure in which the uplift is resisted by cables or webbings which are anchored to either foundations or dead men. Reinforcing cable or webbing is attached by various methods to the *membrane* or is an integral part of the *membrane*. This is not a cable-supported structure.

**Membrane-covered cable structure:** A nonpressurized structure in which a mast and cable system provides support and tension to the *membrane* weather barrier and the *membrane* imparts structural stability to the structure.

**Membrane-covered frame structure:** A nonpressurized building wherein the structure is composed of a rigid framework to support tensioned *membrane* which provides the weather barrier.

**Noncombustible membrane structure:** A *membrane* structure in which the *membrane* and all component parts of the structure are noncombustible.

**Tent:** Any structure, enclosure or shelter which is constructed of canvas or pliable material supported in any manner except by air or the contents it protects.

**3103.3 Construction requirements:** Construction of *membrane* structures shall comply with Sections 3103.3.1 through 3103.3.5.

**3103.3.1 Type of construction:** All noncombustible *membrane* structures shall be classified as Type 2C construction. Noncombustible frame- or cable-supported structures covered by an approved *membrane* in accordance with Section 3103.3.2 shall be classified as Type 2C construction. Heavy timber frame-supported structures covered by an approved *membrane* in accordance with Section 3103.3.2 shall be classified as Type 3B construction. A noncombustible *membrane* structure that is used exclusively as a roof and is located more than 20 feet (6096 mm) above any floor, balcony or gallery, is deemed to comply with the roof construction requirements for Type 1 and Type 2 construction, provided that such a structure complies with the requirements of this section. All other *membrane* structures shall be classified as Type 5B construction.

**3103.3.2 Membrane material:** *Membranes* shall be either noncombustible as defined by Section 704.4, or flameresistant as determined in accordance with both the small-scale and large-scale tests in NFPA 701 listed in Chapter 35.

**Exception:** *Plastic* less than 20 mil (500 μm) in thickness, used in greenhouses where occupancy by the general public is not permitted and for aquaculture pond covers, is not required to be flameresistant.

**3103.3.3 Applicability of other provisions:** Except as otherwise specifically required by this section, *membrane* structures shall meet all applicable provisions of this code. The *membrane* shall meet the roof covering requirements of Section 1506.0.

**3103.3.4 Allowable floor areas:** The *area* of a *membrane* structure shall not exceed the limitations set forth in Table 503, except as provided for in Section 506.0.

**3103.3.5 Maximum height:** *Membrane* structures shall not exceed one story nor shall such structures exceed the *height* limitations in feet set forth in Table 503.

**Exception:** Noncombustible *membrane* structures that serve as roof construction only.

**3103.4 Inflation systems:** Air-supported and air-inflated structures shall be provided with primary and auxiliary inflation systems to meet the minimum requirements of Sections 3103.4.1 and 3103.4.2.

**3103.4.1 Equipment requirements:** The inflation system shall consist of one or more blowers and shall include provisions for automatic control to maintain the required inflation pressures. The system shall be so designed as to prevent overpressurization of the system.

In addition to the primary inflation system, in buildings exceeding 1,500 square feet (140 $m^2$) in *area*, an auxiliary

inflation system shall be provided with sufficient capacity to maintain the inflation of the structure in case of primary system failure. The auxiliary inflation system shall operate automatically when there is a loss of internal pressure and when the primary blower system becomes inoperative.

Blower equipment shall meet the following requirements:

1. Blowers shall be powered by continuous-rated motors at the maximum power required for any flow condition as required by the structural design.
2. Blowers shall be provided with inlet screens, belt guards and other protective devices as required by the code official to provide protection from injury.
3. Blowers shall be housed within a weather-protecting structure.
4. Blowers shall be equipped with backdraft check dampers to minimize air loss when inoperative.
5. Blower inlets shall be located to provide protection from air contamination. The location of inlets shall be approved.

**3103.4.2 Standby power:** Wherever an auxiliary inflation system is required, an approved standby power-generating system shall be provided. The system shall be equipped with a suitable means for automatically starting the generator set upon failure of the normal electrical service and for automatic transfer and operation of all of the required electrical functions at full power within 60 seconds of such service failure. Standby power shall be capable of operating independently for a minimum of 4 hours.

**3103.5 Support provisions:** A system capable of supporting the *membrane* in the event of deflation shall be provided for in all air-supported and air-inflated structures having an occupant load of more than 50 or where covering a swimming pool regardless of occupant load. The support system shall be capable of maintaining *membrane* structures used as a roof for Type 1 or Type 2 construction not less than 20 feet (6096 mm) above floor or seating areas. The support system shall be capable of maintaining all other *membranes* at least 7 feet (2134 mm) above the floor, seating area or surface of the water.

**3103.6 Engineering design:** All *membrane* structures shall be structurally designed in accordance with approved criteria that are developed by a *registered design professional*.

## SECTION 3104.0 TEMPORARY STRUCTURES

**3104.1 General:** The provisions of this section shall apply to tents, *membrane* structures and other structures erected for a period of less than 180 days. Those erected for a longer period of time shall comply with Section 3103.0 or with all applicable sections of this code where Section 3103.0 is not applicable.

**3104.1.1 Permit required:** All temporary structures that cover an *area* in excess of 120 square feet (11.16 $m^2$), including all connecting *areas* or spaces with a common *means of egress* or entrance which are used or intended to be used for the gathering together of ten or more persons, shall not be erected, operated or maintained for any purpose without obtaining a permit from the code official. Tents used exclusively for recreational camping purposes shall be exempt from the above requirements. Special permits required by this code shall be secured from the code official.

**3104.2 Construction documents:** A permit application and *construction documents* shall be submitted for each installation of a temporary structure. The *construction documents* shall include a site plan indicating the location of the temporary structure and information delineating the *means of egress* and the occupant load.

**3104.3 Location:** All temporary structures shall be located in accordance with the requirements of Table 705.2 based on the fireresistance rating of the exterior walls for the proposed type of construction.

**3104.4 Construction:** Tents and air-supported structures shall be constructed as required by this code and NFPA 102 listed in Chapter 35.

**3104.5 Membrane material:** The *membrane* material for all tents shall be of: approved noncombustible material as defined in Section 704.4; flameresistant material as determined in accordance with both the small-scale and large-scale tests in NFPA 701 listed in Chapter 35; or material treated in an approved manner to render the material flameresistant.

**3104.6 Certification:** An affidavit or affirmation shall be submitted to the code official and a copy retained on the premises on which the tent or air-supported structure is located. The affidavit shall attest to the following information relative to the flameresistance of the fabric:

1. Names and addresses of the owners of the tent or air-supported structure.
2. Date the fabric was last treated with flameresistant solution.
3. Trade name or kind of chemical used in treatment.
4. Name of person or firm treating the material.
5. Name of testing agency and test standard by which the fabric was tested.

**3104.7 Inflation pressure:** Operating pressure shall be maintained at the design pressure specified by the manufacturer to assure structural stability and to avoid excessive distortion during high *wind* or *snow loads*.

**3104.8 Door operation:** In high winds over 50 mph (80.45 km/h) or in snow conditions, the doors in air-supported structures shall be controlled to avoid excessive air loss. Doors shall not be left open under any conditions.

**3104.9 Means of egress:** All temporary structures including tents and *membrane* structures shall conform to the *means of egress* requirements of Chapter 10 and shall have a maximum *exit access* travel distance of 100 feet (30480 mm).

## SECTION 3105.0 CANOPIES AND AWNINGS

**3105.1 General:** Rigid canopies or awnings supported in whole or in part by members resting on the ground and used for patio covers, car ports, summer houses or other similar uses shall comply with the requirements of Sections 3105.2 through 3105.5 for design and construction. Such structures shall be braced as required to provide rigidity.

**3105.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

**Awning:** An awning is an architectural projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid skeleton structure over which a rigid covering is attached.

**Canopy:** A canopy is an architectural projection that provides weather protection, identity or decoration and is supported by the building to which it is attached and at the outer end by not less than two stanchions. A canopy is comprised of a rigid structure over which a rigid covering is attached.

**3105.3 Design and construction:** Fixed awnings, canopies and similar structures shall be designed and constructed to withstand *wind* or other *lateral loads* and *live loads* as required by Chapter 16 with due allowance for shape, open construction and similar features that relieve the pressures or *loads*. Structural members shall be protected to prevent deterioration.

**3105.4 Canopy materials:** Canopies shall be constructed of a metal framework with an approved covering, that is flameresistant as determined by both the small-scale and large-scale tests in accordance with NFPA 701 listed in Chapter 35 or that has a flame spread rating not greater than 25 when tested in accordance with ASTM E84 listed in Chapter 35. Canopies shall be attached to the building at the inner end and supported at the outer end by not less than two stanchions, with braces anchored in an approved manner. The stanchions shall be placed not less than 44 inches (1118 mm) apart. The horizontal portion of the framework shall not be less than 8 feet (2438 mm) nor more than 12 feet (3658 mm) above the walking surface and the clearance between the covering or valance and the walking surface shall not be less than 7 feet (2134 mm).

**3105.5 Projections:** In addition to these provisions, awnings and canopies that are constructed in the public right-of-way shall conform to the requirements of Chapter 32.

## SECTION 3106.0 PEDESTRIAN WALKWAYS

**3106.1 General:** An exterior pedestrian walkway that connects buildings shall comply with this section. The walkway shall not contribute to the *building area* or the number of stories or *height* of connected buildings.

**3106.1.1 Separate structures:** Connected buildings shall be considered to be separate structures.

**Exception:** Buildings on the same *lot* in accordance with Section 503.1.3.

**3106.2 Construction:** The walkway shall be of noncombustible construction.

**Exception:** Combustible construction shall be permitted where all connected buildings are of combustible construction.

**3106.3 Occupancy:** The walkway shall not be occupied for other than low fire-hazard uses and only approved materials and decorations shall be located in the space.

**3106.4 Separation assemblies between walkways and buildings:** Walkways shall be separated from the interior of the building by *fire separation walls* with a fireresistance rating of not less than 2 hours. This protection shall extend vertically from a point 10 feet (3048 mm) above the walkway roof surface or the connected building roof line, whichever is lower, down to a point 10 feet (3048 mm) below the walkway and horizontally 10 feet (3048 mm) from each side of the walkway. Openings within the 10-foot (3048 mm) horizontal extension of the *protected* walls beyond the walkway shall be equipped with fixed or automatic $^3/_4$-hour exterior opening protectives in accordance with Section 706.2.

**Exception:** The walls separating the walkway from a connected building are not required to have a fireresistance rating by this section, given compliance with one of the following:

1. Where the distance between the connected buildings is more than 10 feet (3048 mm), the walkway and connected buildings are equipped throughout with an *automatic sprinkler system* in accordance with Section 906.2.1, and the wall is constructed of a tempered, wired or laminated glass wall and doors subject to the following:
   - 1.1. The glass shall be protected by an *automatic sprinkler system* in accordance with Section 906.2.1 and the *sprinkler* system shall completely wet the entire surface of interior sides of the glass wall when actuated.
   - 1.2. The glass shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the *sprinkler* operates.
   - 1.3. Obstructions shall not be installed between the *sprinkler* heads and the glass;
2. Where the distance between the connected buildings is more than 10 feet (3048 mm), and both sides are at least 50 percent open with the open area uniformly distributed to prevent the accumulation of smoke and toxic gases;
3. Buildings on the same *lot*, in accordance with Section 503.1.3; or
4. Where exterior walls of connected buildings are required by Section 705.0 to have a fireresistance rating greater than 2 hours, the walkway shall be equipped throughout with an *automatic sprinkler system* installed in accordance with Chapter 9.

**3106.5 Public way:** The installation of a pedestrian walkway over a *public way* shall be subject to the approval of local authorities. Construction criteria for approved walkways shall meet the requirements of this section.

**3106.6 Egress:** Access shall be provided at all times to a pedestrian walkway that serves as a required *exit*.

**3106.7 Width:** The unobstructed width of pedestrian walkways shall not be less than 36 inches (914 mm). The total width shall not exceed 30 feet (9144 mm).

**3106.8 Exit access travel:** The length of *exit access* travel shall not exceed 200 feet (60960 mm).

**Exceptions**

1. *Exit access* travel distance on a walkway equipped throughout with an *automatic sprinkler system* in accordance with Chapter 9 shall not exceed 250 feet (76200 mm) in length.

2. *Exit access* travel distance on a walkway constructed with both sides at least 50 percent open shall not exceed 300 feet (91440 mm) in length.

## SECTION 3107.0 FLOOD-RESISTANT CONSTRUCTION

**3107.1 General:** All buildings and structures erected in areas prone to flooding shall be constructed and elevated as required by the provisions of this section.

**3107.1.1 Approval of plans:** Plans showing compliance with this section shall be submitted to the Kentucky Division of Water pursuant to KRS 151.250 and 260. Approval of plans by or through that agency together with their final approval of construction shall constitute compliance with these sections.

**3107.2 Base flood elevation:** The base flood elevation shall be used to define areas prone to flooding, and shall describe, at a minimum, the depth or peak elevation of flooding (including wave height) which has a 1-percent (100-year flood) or greater chance of occurring in any given year.

**3107.2.1 Elevation data sources:** In identifying areas prone to flooding, the governing body having jurisdiction shall utilize the most current flood elevation data available and such areas shall be identified accordingly on an official flood-hazard map.

**Note:** The most recent Flood Insurance Rate Map published by the Federal Emergency Management Agency shall be considered in establishing the official flood-hazard map.

**3107.3 Hazard zones:** Areas which have been determined to be prone to flooding shall be classified as either flood-hazard zones (A Zones) or high-hazard zones (V Zones) in accordance with Sections 3107.4 and 3107.5.

**3107.4 Flood-hazard zones (A Zones):** All areas which have been determined to be prone to flooding but not subject to high-velocity waters or wave action shall be designated as flood-hazard zones. All buildings and structures erected in flood-hazard zones shall be designed and constructed in accordance with Sections 3107.4.1 through 3107.4.4.

**3107.4.1 Elevation:** All buildings or structures erected within a flood-hazard zone shall be elevated so that the lowest floor is located at or above the base flood elevation. All *basement* floor surfaces shall be located at or above the base flood elevations.

**Exceptions**

1. Floors usable for human occupancy below the base flood elevation in occupancies in any use group other than Use Group R shall conform to Section 3107.4.4.
2. Floors of occupancies in any use group which are utilized solely for structure *means of egress*, incidental storage *garages* and parking, and which are located below the base flood elevation, shall conform to Section 3107.4.3.

**3107.4.2 Anchorage:** The structural systems of all buildings or structures shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural *loads* and stresses from flooding equal to the base flood elevation and shall be designed in accordance with Sections 1612.2 and 1612.3.

**3107.4.3 Enclosures below base flood elevation:** Enclosed spaces below the base flood elevation shall not be used for human occupancy with the exception of structure *means of egress*, entrance foyers, *stairways* and incidental storage. Fully enclosed spaces shall be designed to equalize automatically hydrostatic forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement shall either be certified by a *registered design professional* in accordance with Section 3107.12 or conform to the following minimum criterion: a minimum of two openings having a total net area of not less than 1 square inch (645 $mm^2$) for every 1 square foot (0.1 $m^2$) of enclosed area subject to flooding shall be provided. The bottom of all openings shall not be higher than 12 inches (305 mm) above grade. Openings shall not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

**3107.4.4 Water-resistant construction:** Occupancies in any use group other than Use Group R shall, in lieu of meeting the elevation provisions of Section 3107.4.1, be erected with floors usable for human occupancy below the base flood elevation provided that the following conditions are met:

1. All space below the base flood elevation shall be constructed with walls and floors that are substantially impermeable to the passage of water.
2. All structural components subject to hydrostatic and hydrodynamic *loads* and stresses during the occurrence of flooding to the base flood elevation shall be capable of resisting such forces, including the effects of buoyancy.
3. All openings below the base flood elevation shall be provided with water-tight closures and shall have adequate structural capacity to support all flood *loads* acting upon the closure surfaces.
4. All floor and wall penetrations for plumbing, mechanical and electrical systems shall be made water tight to prevent floodwater seepage through spaces between the penetration and wall construction materials. Sanitary sewer and storm drainage systems that have openings below the base flood elevation shall be provided with shutoff valves or closure devices to prevent backwater flow during conditions of flooding.

**3107.5 High-hazard zones (V Zones):** Areas of tidal influence which have been determined to be subject to wave heights in excess of 3 feet (914 mm) or subject to high-velocity wave run-up or wave-induced erosion shall be classified as high-hazard zones. All buildings or structures erected in a high-hazard zone shall be designed and constructed in accordance with Sections 3107.5.1 through 3107.5.3.

**Note:** Areas shown as V Zones on the most recent Flood Insurance Rate Map published by the Federal Emergency Management Agency shall be considered in establishing high-hazard zones.

**3107.5.1 Elevation:** All buildings or structures erected within a high-hazard zone shall be elevated so that the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, piling, pile caps, columns, grade beams and bracing, is located at or above the base flood elevation.

**3107.5.2 Enclosures below base flood elevation:** All spaces below the base flood elevation in a high-hazard zone shall not be used for human occupancy and shall be free of obstruction except as permitted herein:

1. Mat or raft foundations, piling, pile caps, bracing, grade beams and columns which provide structural support for the building.
2. Entrances and *exits* which are necessary for required ingress and *means of egress*.
3. Incidental storage of portable or mobile items readily moved in the event of a storm.
4. Walls and partitions are permitted to enclose all or part of the space below the elevated floor, provided that such walls and partitions are not part of the structural support of the building and are constructed with insect screening, open wood lattice, or nonsupporting walls designed to break away or collapse without causing collapse, displacement or other structural damage to the elevated portion of the building or supporting foundation system due to the effect of *wind loads* as specified in Section 1609.0 and water *loads* as specified in Section 1612.0 acting simultaneously. Any such nonsupporting solid wall shall be certified as specified in Section 3107.12.3.

**3107.5.3 Foundations:** All buildings or structures erected in high-hazard zones shall be supported on pilings or columns and shall be adequately anchored to such pilings or columns. The piling shall have adequate soil penetrations to resist the combined wave and *wind loads* (lateral and uplift) to which such piles are likely to be subjected during a flood to the base flood elevation. Pile embedment shall include consideration of decreased resistance capacity caused by scour of soil strata surrounding the piling. Pile system design and installation shall also be made in accordance with the provisions of Sections 1816.0 and 1817.0. Mat or raft foundations which support columns shall not be permitted where soil investigations required in accordance with Section 1802.1 indicate that soil material under the mat or raft is subject to scour or erosion from wave-velocity flow conditions.

**3107.6 Protection of mechanical and electrical systems:** New and replacement electrical equipment and heating, *ventilating*, air conditioning and other service equipment shall be either placed above the base flood elevation or protected so as to prevent water from entering or accumulating within the system components during floods up to the base flood elevation in accordance with the mechanical code listed in Chapter 35. Installation of electrical wiring and outlets, switches, junction boxes and panels below the base flood elevation shall conform to the provisions of NFPA 70 listed in Chapter 35 for location of such items in wet locations. Duct insulation subject to water damage shall not be installed below the base flood elevation.

**3107.7 Construction materials, methods and practices:** All buildings or structures erected in flood-hazard zones (A Zones) or in high-hazard zones (V Zones) shall be constructed with materials resistant to flood damage and be constructed by methods and practices that minimize flood damage. Construction materials shall be resistant to water damage in accordance with the provisions of Sections 1808.0, 1810.2, 1813.4, 2307.2, 2309.1, 2311.4, 2311.6 and 2503.4.

**3107.8 Mobile units:** New or replacement *mobile units* to be located in any hazard zone shall be placed in accordance with the applicable elevation requirements of Sections 3107.4.1 and 3107.5.1 and the anchor and tie-down requirements of Section 420.3.1.

**3107.9 Water supply and sanitary sewage systems:** New and replacement water supply systems shall be designed to minimize infiltration of floodwaters into the systems in accordance with the provisions of the plumbing code listed in Chapter 35. New and replacement sanitary sewage systems shall be designed to minimize infiltration of floodwaters into the systems and discharges from the systems into floodwaters in accordance with the provisions of the plumbing code listed in Chapter 35.

**3107.10 Alterations and repairs:** *Alterations* and repairs to buildings located in any hazard zone shall require code compliance with Sections 118.0 and 3404.0 except that in the case of damages or cost of reconstruction or restoration in excess of 50 percent of the replacement cost of the building, exclusive of foundations, such structure shall comply in all respects with the requirements of this section.

**3107.11 Increases in building height and floor area:** Any increases in *height* or floor *area* of a building in any hazard zone shall be in accordance with Section 3403.0.

**3107.12 Certifications:** Certifications shall be submitted in accordance with Sections 3107.12.1 through 3107.12.3.

**3107.12.1 As-built elevation certifications:** A licensed land surveyor or *registered design professional* shall certify the actual elevation (in relation to mean sea level) of the lowest structural member required to be elevated by the provisions of this section.

**3107.12.2 Water-resistant construction:** Where buildings or structures are to be constructed in accordance with Section 3107.4.4, the code official shall require that a *registered design professional* provide *construction documents* showing details of floor, wall and foundation support components, *loading* computations and other essential technical data used in meeting the conditions of Section 3107.4.4. The *construction documents* shall be accompanied by a statement bearing the signature of the *registered design professional* indicating that the design and proposed methods of construction are in accordance with all applicable provisions of Section 3107.4.4.

**3107.12.3 High-hazard construction:** Where buildings or structures are to be constructed in accordance with Section 3107.5, the code official shall require that a *registered design professional* provide *construction documents* showing details of foundation support and connection components which are used in meeting the requirements of Section 3107.5.3. Where solid walls or partitions are proposed below the base flood elevations, wall, framing and connection details of such walls shall be provided, including *loading* computations for the

wall and foundation system used in meeting the conditions of Section 3107.5.2. The *construction documents* shall be accompanied by a statement bearing the signature of the *registered design professional* indicating that the design and proposed methods of construction are in accordance with all applicable provisions of Section 3107.5.

## SECTION 3108.0 RADIO AND TELEVISION TOWERS

**3108.1 General:** Subject to the structural provisions of Section 1609.0 for *wind loads* and the requirements of Section 1510.0 governing the fireresistance ratings of buildings for the support of roof structures, all radio and television towers shall be designed and constructed as herein provided.

**3108.2 Location and access:** Towers shall be located and equipped with step bolts and ladders so as to provide ready access for inspection purposes. Guy wires or other accessories shall not cross or encroach upon any street or other public space, or over any electric power lines, or encroach upon any other privately owned property without *written* consent of the owner.

**3108.3 Construction:** All towers shall be constructed of approved corrosion-resistant noncombustible material. The minimum type of construction of isolated radio towers not more than 100 feet (30480 mm) in height shall be Type 4.

**3108.4 Loads:** Towers shall be designed to resist *wind loads* in accordance with EIA/TIA 222-E listed in Chapter 35. Consideration shall be given to conditions involving *wind load* on ice-covered sections in localities subject to sustained freezing temperatures.

**3108.4.1 Dead load:** Towers shall be designed for the *dead load* plus the ice *load* in regions where ice formation occurs.

**3108.4.2 Uplift:** Adequate foundations and anchorage shall be provided to resist two times the calculated wind uplift.

**3108.5 Grounding:** All towers shall be permanently and effectively grounded.

## SECTION 3109.0 RADIO AND TELEVISION ANTENNAS

**3109.1 Permits not required:** A building permit is not required for roof installation of antennal structures not more than 12 feet (3658 mm) in height for private radio or television reception. Such a structure shall not be erected so as to injure the roof covering, and when removed from the roof, the roof covering shall be repaired to maintain weather and water tightness. The installation of any antennal structure mounted on the roof of a building shall not be erected nearer to the *lot line* than the total height of the antennal structure above the roof, nor shall such structure be erected near electric power lines or encroach upon any street or other public space.

**3109.2 Permits required:** Approval shall be secured for all roof-mounted antennal structures more than 12 feet (3658 mm) in height above the roof. The application shall be accompanied by detailed drawings of the structure and methods of anchorage. All connections to the roof structure shall be properly flashed to maintain water tightness. The design and materials of construction shall comply with the requirements of Section 3108.3 for character, quality and minimum dimension.

**3109.3 Dish antennas:** An antenna consisting of a radiation element which transmits or receives radiation signals generated as electrical, light or sound energy, and supported by a structure with or without a reflective component to the radiating dish, usually in a circular shape with a parabolic curve design constructed of a solid or open mesh surface, shall be known as a dish antenna.

**3109.3.1 Permits:** The approval of the code official shall be secured for all dish antennal structures more than 2 feet (610 mm) in diameter erected on the roof of or attached to any building or structure. A permit is not required for dish antennas not more than 2 feet (610 mm) in diameter erected and maintained on the roof of any building.

**3109.3.2 Structural provisions:** Dish antennas larger than 2 feet (610 mm) in diameter shall be subject to the structural provisions of Sections 1608.0, 1609.0 and 3108.4. The snow *load* provisions of Section 1608.0 shall not apply where the antenna has a heater to melt falling snow.

## SECTION 3110.0 WINDOW-CLEANING SAFEGUARDS

**3110.1 General:** All buildings and structures over 50 feet (15240 mm) or four stories in *height*, in which the windows are cleaned from the outside, shall be provided with anchors, belt terminals or other approved safety devices for all window openings. Such devices shall be of an approved design, and shall be constructed of corrosion-resistant materials securely attached to the window frames or anchored in the enclosure walls of the building. Cast-iron or cast-bronze anchors shall be prohibited.

# CHAPTER 32

# CONSTRUCTION IN THE PUBLIC RIGHT-OF-WAY

## SECTION 3201.0 GENERAL

**3201.1 Scope:** The provisions of this chapter shall govern encroachment and projection of structures into the public right-of-way.

## SECTION 3202.0 STREET ENCROACHMENTS

**3202.1 General:** Except as provided herein, a part of any building hereafter erected and *additions* to an existing building heretofore erected shall not project beyond the *lot lines* or beyond the building line where such lines are established by the *zoning* law or any other statute controlling building construction.

**3202.2 Below grade:** A part of a building hereafter erected below grade that is necessary for structural support of the building shall not project beyond the *lot lines*, except that the footings of street walls or their supports which are located at least 8 feet (2438 mm) below grade shall not project more than 12 inches (305 mm) beyond the *street lot line*.

**3202.3 Above grade:** All projections hereafter permitted beyond the *street lot line* or the building line above grade shall be so constructed as to be readily removable without endangering the safety of the building.

**3202.4 Projections necessary for safety:** In any specific application, the code official is authorized to designate by *approved rules* such architectural features and accessories which are deemed desirable or necessary for the health or safety of the public as well as the maximum extent to which such features shall project beyond the *street lot line* or the building line where established by statute, subject to all provisions and restrictions that are otherwise prescribed by law, ordinance or rule of the authorities having jurisdiction over streets or public spaces.

**3202.5 Permit revocable:** Any permit granted or permission expressed or implied in the provisions of this code to construct a building so as to project beyond the *street lot line* or building line shall be revocable by the jurisdiction at will.

**3202.6 Existing encroachments:** Parts of existing buildings and structures which already project beyond the *street lot line* or building line are not required to be altered until their removal is directed by the proper authorities of the jurisdiction.

**3202.7 Drainage:** Roof drainage water from a roof, awning, marquee, canopy or mansard other than awnings and canopies constructed of fabric shall not flow over a public walking surface.

## SECTION 3203.0 PERMISSIBLE STREET PROJECTIONS

**3203.1 General:** Subject to such provisions as are otherwise prescribed by law or ordinance, or by rules of the authorities having jurisdiction over streets, highways and public spaces, the projections described in Sections 3203.3 through 3203.12.1 and canopies and mansard roofs shall not be limited to the *street lot line* or the building line.

**3203.2 Definitions:** The following words and terms shall, for the purposes of this section and as used elsewhere in this code, have the meanings shown herein.

***Areaway (form of construction):*** An uncovered subsurface space adjacent to a building (see Section 3203.12.1).

**Curb level:** The elevation of the street curb as established in accordance with law.

**Building or wall height:** The elevation of the street grade opposite the center of the wall nearest to and facing the *street lot line*.

***Oriel window:*** A window projected beyond and suspended from the wall of the building or cantilevered therefrom (see Section 3203.7).

**3203.3 Cornices and eaves:** Main cornices or roof eaves located at least 12 feet (3658 mm) above the curb level shall not project more than 3 feet (914 mm).

**3203.4 Architectural decorations:** Belt courses, lintels, sills, architraves, pediments and similar architectural decorations shall not project more than 4 inches (102 mm) where less than 10 feet (3048 mm) above the curb level, and not more than 10 inches (254 mm) where 10 feet (3048 mm) or more above the curb level.

**3203.5 Ornamental columns:** Ornamental columns or pilasters, including the bases and moldings which emphasize the main entrance of the building, shall not project more than 12 inches (305 mm).

**3203.6 Entrance steps:** Entrance steps and doors shall not project more than 12 inches (305 mm) and shall be guarded by check pieces not less than 3 feet (914 mm) high, or shall be located between ornamental columns or pilasters.

**3203.7 Oriel windows:** *Oriel windows* with the lowest portion at least 10 feet (3048 mm) above the curb level shall not project more than $2^1/_2$ feet (762 mm).

**3203.8 Balconies:** Balconies located at least 10 feet (3048 mm) above the curb level shall not project more than 3 feet (914 mm),

except that where the balcony is required in connection with a fire escape or exterior *stairway* as an element of a *means of egress*, the projection shall not exceed 4 feet (1219 mm).

**3203.9 Awnings:** Retractable or fixed awnings shall have clearances above grade and shall be installed in accordance with the requirements of Sections 3105.0 and 3205.0.

**3203.10 Awning covers or boxes:** Awning covers or boxes located at least 8 feet (2438 mm) above the curb level shall not project more than 3 feet (914 mm).

**3203.11 Marquees:** A marquee is a permanent roofed structure including attached objects or decorations, attached to and supported by the building.

**3203.11.1 Projection and clearance:** The horizontal clearance between a marquee and the curb line shall not be less than 2 feet (610 mm). A marquee projecting more than two-thirds of the distance from the property line to the curb line shall not be less than 10 feet (3048 mm) above the ground or pavement below.

**3203.11.2 Thickness:** The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed 3 feet (914 mm) where the marquee projects more than two-thirds of the distance from the property line to the curb line, and shall not exceed 9 feet (2743 mm) where the marquee is less than two-thirds of the distance from the property line to the curb line.

**3203.11.3 Roof construction:** Where the roof or any part thereof is a skylight, the materials shall consist of approved *plastics* or wired glass not less than $^1/_4$-inch thick with a single pane not more than 18 inches (457 mm) wide. Every roof and skylight of a marquee shall be sloped to downspouts that shall conduct any drainage from the marquee in such a manner so as not to spill over the sidewalk.

**3203.11.4 Location prohibited:** Every marquee shall be so located as not to interfere with the operation of any exterior *standpipe*, and such that the marquee does not obstruct the clear passage of *stairways* or *exit discharge* from the building or the installation or maintenance of street lighting.

**3203.11.5 Construction:** A marquee shall be supported entirely from the building and constructed of noncombustible materials. Marquees shall be designed and constructed to withstand *wind* or other *lateral loads* and *live loads* as required in Chapter 16. Structural members shall be protected to prevent deterioration.

**3203.12 Vaults:** Vaults below the sidewalk level shall not extend closer than 3 feet (914 mm) to the curb line. The construction and utilization of such vaults shall be subject to the terms and conditions of the authority or legislative body having jurisdiction.

**3203.12.1 Areaways:** *Areaways* shall not project beyond the *street lot line* more than 4 feet (1219 mm), provided that every such *areaway* shall be covered over at the street grade by an approved grating of metal or other noncombustible material.

## SECTION 3204.0 SPECIAL AND TEMPORARY PROJECTIONS

**3204.1 Alley projections:** The permissible projection beyond *street lot lines* shall apply in general to building projections into alleyways, except as modified by the authority having jurisdiction or by special deed restriction.

**3204.2 Special permits:** Where authorized by special permit, vestibules and storm doors shall be erected for periods of time not exceeding seven months in any one year, and shall not project more than 3 feet (914 mm) nor more than one-fourth of the width of the sidewalk beyond the *street lot line*. Temporary entrance awnings shall be erected with a minimum clearance of 7 feet (2134 mm) to the lowest portion of the hood or awning where supported on removable steel, or other approved noncombustible supports.

## SECTION 3205.0 AWNINGS AND CANOPIES

**3205.1 Permit:** A permit shall be obtained from the code official for the erection, repair or replacement of any fixed awning, canopy or hood, except as provided for in Section 3205.1.1, and for any retractable awning located at the first-story level and extending over the public street or over any portion of a *court* or yard beside a building serving as a passage from a required *exit* or *exit discharge* to a public street.

**3205.1.1 Exemption from permit:** A permit shall not be required for the erection, repair or replacement of fixed or retractable awnings installed on occupancies in Use Group R-3 unless such awnings project over public property; for retractable awnings installed above the first story; or where the awning does not project over the public street or over any *court* or yard serving as a passage from a required *exit* to a public street.

**3205.2 Retractable awnings:** There shall be a minimum clearance of 7 feet (2134 mm) from the sidewalk to the lowest part of the framework or any fixed portion of any retractable awning, except that the bottom of the valance of canvas awnings shall have a minimum clearance of 6 feet 9 inches (2057 mm) above the sidewalk. Retractable awnings shall be securely fastened to the building and shall not extend closer than 12 inches (305 mm) in from the curb line. Retractable awnings shall be equipped with a mechanism or device for raising and holding the awning in a retracted or closed position against the face of the building.

**3205.3 Fixed or permanent awnings:** The clearance from the sidewalk to the lowest part of any fixed or permanent awning shall be the same as required in Section 3205.2 for retractable awnings. Fixed or permanent awnings installed above the first story shall not project more than 4 feet (1219 mm).

**3205.4 Canopies:** Stanchions that support canopies shall be placed not less than 2 feet (610 mm) in from the curb line. The horizontal portion of the canopy framework shall not be less than 8 feet (2438 mm) nor more than 12 feet (3658 mm) above the sidewalk and the clearance between the covering or valance and the sidewalk shall not be less than 7 feet (2134 mm).

# CHAPTER 33

# SITE WORK, DEMOLITION AND CONSTRUCTION

## SECTION 3301.0 GENERAL

**3301.1 Scope:** The provisions of this chapter shall apply to all construction in connection with work requiring a permit for structures in accordance with this code.

**3301.2 Other laws:** Nothing herein contained shall be construed to nullify any rules, regulations or statutes of state or federal agencies governing the protection of the public or workers from health or other hazards.

**3301.3 Combustible and explosive hazards:** The provisions of this code which apply to the storage, use or transportation of *explosives*, highly *flammable* and combustible substances, gases and chemicals shall be construed as supplemental to the requirements of the federal laws, the regulations of the Department of Transportation (DOTn) and the rules and regulations of the jurisdiction.

## SECTION 3302.0 CONSTRUCTION DOCUMENTS AND SPECIAL PERMITS

**3302.1 Temporary construction:** Before any construction operation is started, *construction documents* shall be filed with the code official showing the design and construction of all sidewalk sheds, temporary vehicular passageways, trestles, foot bridges, guard fences and other similar devices required in the operation. Approval shall be secured from the authority having jurisdiction before the commencement of any work.

**3302.2 Special permits:** All special licenses and permits for the storage of materials on sidewalks and highways, for the use of water or other public facilities and for the storage and handling of *explosives*, shall be secured from the administrative authorities having jurisdiction.

**3302.3 Temporary encroachments:** Sidewalk sheds, underpinning and other temporary protective guards and devices shall not project beyond the *interior* and *street lot lines* except where required to ensure the safety of the adjoining property and the public, subject to approval. Where necessary, the consent of the adjoining property owner shall be obtained.

## SECTION 3303.0 TESTS

**3303.1 Loading:** It shall be unlawful to *load* any structure, temporary support, sidewalk bridge or sidewalk shed or any other device during the construction or demolition of any building or structure in excess of its safe working capacity as provided for in Chapter 16 for allowable *loads* and working stresses.

## SECTION 3304.0 PROTECTION OF PUBLIC

**3304.1 General:** Wherever a building or structure is erected, *altered*, repaired, removed or demolished, the operation shall be conducted in a safe manner and suitable protection for the general public shall be provided.

**3304.2 Fences:** Every excavation or area of construction on a site located 5 feet (1524 mm) or less from the *street lot line* shall be enclosed with a barrier not less than 6 feet (1829 mm) high to prevent the entry of unauthorized persons. Where located more than 5 feet (1524 mm) from the *street lot line*, a barrier shall be erected where required by the code official. All barriers shall be of adequate strength to resist wind pressure as specified in Section 1609.0.

**3304.3 Sidewalk bridge:** Wherever the ground is excavated under the sidewalk, a sidewalk bridge shall be constructed at least 4 feet (1219 mm) wide, or a protected walkway of equal width shall be erected in the street, provided that the required permit for such walkway is obtained from the administrative authority.

**3304.4 Sidewalk shed:** Sidewalk sheds shall be as provided for in accordance with Sections 3304.4.1 through 3304.4.4 except where sidewalks are closed by the authority having jurisdiction.

**3304.4.1 Within 10 feet of street lot line:** Where any building or part thereof which is located within 10 feet (3048 mm) of the *street lot line* is to be erected or raised to exceed 40 feet (12192 mm) in *height*, or wherever a building which is more than 40 feet (12192 mm) in *height* and is within 10 feet (3048 mm) of the *street lot line* is to be demolished, a sidewalk shed shall be erected and maintained for the full length of the building on all street fronts for the entire time that work is performed on the exterior of the building.

**3304.4.2 Within 20 feet of street lot line:** Where the building being demolished or erected is located within 20 feet (6096 m) of the *street lot line* and is more than 40 feet (12192 mm) in *height*, exterior flare fans or catch platforms shall be erected at vertical intervals of not more than two stories.

**3304.4.3 Buildings higher than six stories:** Where the building being demolished or erected is more than six stories or 75 feet (22860 mm) in *height*, unless set back from the *street lot line* a distance of more than one-half of the height of the building, a sidewalk shed shall be provided.

**3304.4.4 Walkway:** An adequately lighted walkway at least 4 feet (1219 mm) wide and 8 feet (2438 mm) high in the clear

shall be maintained under all sidewalk sheds for pedestrians. Where ramps are required, the ramps shall conform to the provisions of this chapter and Section 1016.0.

**3304.5 Thrust-out platforms:** Thrust-out platforms or other substitute protection in lieu of sidewalk sheds shall not be used unless approved and deemed adequate to ensure the public safety. Thrust-out platforms shall not be used for the storage of materials.

**3304.6 Watchman:** Wherever a building is being demolished, erected or *altered*, a watchman shall be employed to warn the general public when intermittent hazardous operations are conducted across the sidewalk or walkway.

### SECTION 3305.0 FIRE HAZARDS

**3305.1 General:** The provisions of this code and of the fire prevention code listed in Chapter 35 shall be strictly observed to safeguard against all fire hazards attendant upon construction operations.

**3305.2 Portable fire extinguishers:** All buildings under construction, *alteration* or demolition shall be provided with at least one portable fire extinguisher with a minimum 2-A:20-B:C rating at each *exit* on all floor levels where combustible materials have accumulated. A portable fire extinguisher with a minimum 2-A:20-B:C rating shall also be provided in every storage and construction shed. Additionally, at least one portable fire extinguisher shall be provided in accordance with the fire prevention code listed in Chapter 35 where special hazards, such as *flammable* or *combustible liquid* storage, exist.

**3305.3 Standpipes:** *Standpipes* required in buildings by Section 915.0 shall be installed when the work of the building progresses more than 40 feet (12192 mm) above the lowest level of fire department vehicle access. The *standpipes* shall be either temporary or permanent in nature, and with or without a *water supply*, provided that such *standpipes* conform to the requirements of Section 915.0 as to number of risers, capacity, outlets and materials. Access from the street to such *standpipes* shall be maintained at all times.

**3305.3.1 Height:** The *standpipe system* shall be carried up with each floor and shall be installed and ready for use as each floor progresses. *Standpipes* shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring.

**3305.3.2 Outlets:** Hose outlets shall be provided with caps and attachment chains.

**3305.3.3 Fire department connections:** For each temporary or permanent *standpipe* installation, there shall be provided, at the street level, one or more two-way fire department inlet connections. Access shall be provided to fire department inlet connections at all times, and such connections shall be prominently identified in an approved manner (see Section 916.8).

**3305.3.4 Buildings under demolition:** Where a building is being demolished and a *standpipe* is existing within such a building, such *standpipe* shall be maintained in an operable condition so as to be available for use by the fire department. Such *standpipe* shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

### SECTION 3306.0 MAINTENANCE

**3306.1 General:** It shall be unlawful to remove or render inoperative any structural, fire protection or sanitary safeguard or device herein required except where necessary for the actual installation and prosecution of the work.

### SECTION 3307.0 HEALTH HAZARDS

**3307.1 General:** Every construction or maintenance operation which results in the diffusion of dust, stone and other small particles, *toxic* gases or other harmful substances in quantities hazardous to health shall be safeguarded by means of local *ventilation* or other protective devices to ensure the safety of the public as required by the regulations of the administrative authority.

**3307.2 Removal of dust:** Dust, sand blasts or other harmful agents which are used or which occur in construction operations shall be disposed of at or near the point of origin to prevent diffusion over adjoining premises or streets.

**3307.3 Protective equipment:** Facilities shall be provided in approved closed containers for housing the necessary vision, respiratory and protective equipment required in welding operations, and in accordance with the regulations of the administrative authority.

### SECTION 3308.0 PROTECTION OF ADJOINING PROPERTY

**3308.1 General:** Adjoining property shall be completely protected from any damage caused by the construction of a structure when the owner of the adjoining property permits free access to the structure at all reasonable times to provide the necessary safeguards in accordance with Section 3310.0.

### SECTION 3309.0 EXISTING BUILDINGS

**3309.1 Protection:** All adjoining public and private property shall be protected from damage caused by construction.

**3309.2 Chimney, soil and vent stacks:** Wherever a new building or structure is erected to greater or lesser *heights* than an adjoining building, the construction and extension of new or existing chimneys shall conform to the provisions of the mechanical code listed in Chapter 35, and the construction and extension of soil and vent stacks and the location of window openings shall comply with the provisions of Section 2908.3.

**3309.3 Adjoining walls:** The owner of the new or *altered* structure shall preserve all adjoining independent and party walls from damage as provided for herein. The owner shall underpin where necessary and support the adjoining building or structure by proper foundations to comply with Section 3310.0.

**3309.3.1 Maintenance:** In case an existing party wall is intended to be used by the person who causes an excavation to be made, and such party wall is in good condition and sufficient for the use of both the existing and proposed building, such person shall preserve the party wall from injury and shall support the party wall by proper foundations at said person's own expense, so that the wall is and remains as safe and useful as the party wall was before the excavation was

commenced. During the demolition, the party wall shall be maintained weatherproof and structurally safe by adequate bracing until such time as the permanent structural supports have been provided.

**3309.3.2 Beam holes:** Where a structure involving a party wall is being demolished, the owner of the demolished structure shall, at his or her own expense, bend over all wall anchors at the beam ends of the standing wall and shall brick up all open beam holes and otherwise maintain the safety and usefulness of the wall.

**3309.3.3 Party wall exits:** A party wall balcony or *horizontal exit* shall not be destroyed unless and until a substitute *means of egress* has been provided and approved.

**3309.4 Adjoining roofs:** Where a new building or demolition of an existing building is being conducted at a greater *height*, the roof, roof outlets and roof structures of adjoining buildings shall be protected against damage with adequate safeguards by the person doing the work.

## SECTION 3310.0 DEMOLITION AND EXCAVATION

**3310.1 Notice of intent:** The person intending to cause a demolition or an excavation shall deliver *written* notice of such intent to the owner of each potentially affected adjoining *lot*, building or structure at least one week prior to the commencement of work. The notice shall request license to enter the potentially affected *lot*, building or structure prior to the commencement of work and at reasonable intervals during the work to inspect and preserve the *lot*, building or structure from damage.

**3310.2 Protection of adjoining property:** If afforded the necessary license to enter the adjoining *lot*, building or structure, the person causing the demolition or excavation to be made shall at all times and at his or her own expense preserve and protect the *lot*, building or structure from damage or injury. If the necessary license is not afforded, it shall be the duty of the owner of the adjoining *lot*, building or structure to make safe his or her own property, for the prosecution of which said owner shall be granted the necessary license to enter the premises of the demolition or excavation.

**3310.2.1 Removal of debris:** All waste materials shall be removed in a manner which prevents injury or damage to persons, adjoining properties and public rights-of-way.

**3310.3 Notice to the code official:** If the person causing a demolition or excavation to be made is not afforded license to enter an adjoining structure, that person shall immediately notify in *writing* both the code official and the owner of the adjoining property that the responsibility of providing support to the adjoining *lot*, building or structure has become the exclusive responsibility of the owner of the adjoining property.

**3310.4 Grading of lot:** Where a structure has been demolished or removed and a building permit has not been approved, the vacant *lot* shall be filled, graded and maintained in conformity to the established elevation of the street grade at curb level nearest to the point of demolition or excavation. Provision shall be made to prevent the accumulation of water or damage to any foundations on the premises or the adjoining property.

**3310.5 Utility connections:** All service utility connections shall be discontinued and capped in accordance with the *approved rules* and the requirements of the authority having jurisdiction.

## SECTION 3311.0 RETAINING WALLS AND PARTITION FENCES

**3311.1 General:** Where the adjoining grade is not higher than the legal level, the person causing an excavation to be made shall erect, where necessary, a retaining wall at his or her own expense and on his or her own land. Such wall shall be built to a height sufficient to retain the adjoining earth, shall be properly coped as required in Section 1825.0 and shall be provided with a guardrail or fence not less than 42 inches (1067 mm) in height.

## SECTION 3312.0 STORAGE OF MATERIALS AND CONSTRUCTION EQUIPMENT

**3312.1 General:** The term "construction equipment" shall mean the machinery, tools, derricks, hoists, scaffolds, platforms, runways, ladders and all material-handling equipment, safeguards and protective devices used in construction operations. The term "runway" shall mean an aisle or walkway constructed or maintained as a temporary passageway for pedestrians or vehicles. All construction materials and equipment required for the permitted construction shall be stored and placed so as not to endanger the public, the workers or adjoining property.

**3312.2 Design capacity:** Construction materials and equipment stored within the building, or on sidewalks or sheds, shall be placed so as not to overload any part of the construction beyond the design capacity, nor interfere with the safe prosecution of the work.

**3312.3 Pedestrian walkways:** Construction materials and equipment shall not be stored on the street without a permit issued by the administrative authority having jurisdiction. Where so stored, such materials or equipment shall not unduly interfere with vehicular traffic or the orderly travel of pedestrians on the highway or street. The piles shall be arranged to maintain a safe walkway not less than 4 feet (1219 mm) wide, unobstructed for its full length, and adequately lighted at night and at all necessary times for the use of the public.

**3312.4 Obstructions:** Construction materials and equipment shall not be placed or stored so as to obstruct access to fire hydrants, *standpipes*, fire or police alarm boxes, utility boxes, catch basins or manholes, nor shall such material and equipment be located within 20 feet (6096 mm) of a street intersection, or placed so as to obstruct normal observations of traffic signals or to hinder the use of public transit loading platforms.

## SECTION 3313.0 REMOVAL OF WASTE MATERIAL

**3313.1 General:** Material shall not be dropped by gravity or thrown outside the exterior walls of a building during demolition or erection. Wood or metal chutes shall be provided for the removal of such materials. Where the removal of any material will cause an excessive amount of dust, such material shall be wet down to prevent the creation of a nuisance.

## SECTION 3314.0 STAIRWAYS

**3314.1 Temporary stairways:** Where a building has been constructed to a *height* greater than 50 feet (15240 mm) or four stories, or where an existing building exceeding 50 feet (15240

mm) in *height* is *altered*, at least one temporary lighted *stairway* shall be provided unless one or more of the permanent *stairways* are erected as the constructiont progresses.

## SECTION 3315.0 LIGHTING

**3315.1 General:** All *stairways* and parts of buildings under demolition, erection or repair shall be adequately lighted while persons are engaged at work, in accordance with the provisions of Sections 1024.0 and 2702.2, item 5.

# CHAPTER 34

# EXISTING STRUCTURES

## SECTION 3401.0 GENERAL

**3401.1 Scope:** The provisions of this chapter shall control the *alteration*, repair, *addition* and *change of occupancy* of existing structures. *Alterations*, repairs, *additions* and *changes of occupancy* to existing structures shall comply with Sections 3403.0 through 3407.0 or with the requirements for compliance alternatives in accordance with Section 3408.0.

**3401.2 Maintenance and repairs:** All equipment, systems, devices and safeguards required by this code or by a previous statute or code for the structure or premises when erected or altered, shall be maintained in good working order. The requirements of this chapter shall not provide the basis for removal or abrogation of fire protection and safety systems and devices in existing structures.

**3401.3 Compliance with other codes:** Alterations, repair, *additions* and changes of occupancy to existing structures shall comply with the provisions for alterations, repair, *additions* and changes of occupancy in the plumbing and mechanical codes listed in Chapter 35.

**3401.4 Periodic testing:** The owner shall be responsible for periodic tests and inspections of all equipment where required by this code, the property maintenance code and the fire prevention code listed in Chapter 35.

## SECTION 3402.0 GENERAL REQUIREMENTS

**3402.1 Application:** In addition to the other requirements of this chapter, this section shall apply to all existing structures.

**3402.2 Existing stairs:** Existing stairs in existing structures shall be permitted to remain in service, or to be rebuilt in accordance with Section 1014.6.

**3402.3 Fire escapes:** Fire escapes shall be permitted as a component in the *means of egress* in existing structures in accordance with Section 1025.0.

**3402.4 Slidescapes:** Existing slidescapes and safety chutes shall be permitted as a component in the *means of egress* in existing structures in accordance with Section 1026.0.

**3402.5 Loads:** The design for structural *loads* shall comply with Section 1614.0. The design for seismic *loads* shall comply with Sections 1610.1.1 and 1610.1.2 except as exempt in accordance with Section 1610.1.

**3402.6 Reroofing:** Reroofing shall comply with Section 1512.0.

**3402.7 Accessibility:** The design for accessibility shall comply with Section 1110.0.

**3402.8 Deleted.**

**3402.9 Elevators and escalators:** Existing elevators and escalators shall comply with Section 3013.1.

## SECTION 3403.0 ADDITIONS

**3403.1 Compliance:** An *addition* to a structure shall conform to the requirements for a new structure without requiring the existing structure to comply with the requirements of this code for new structures except as required by Section 102.2. The *addition* shall not result in an increase in hazard to the occupants in the existing structure, the *addition* or the building as a whole. Any existing structure plus *additions* shall not exceed the height and area requirements of Section 503.0, even if a fire wall separates the existing portion from the *addition*. Existing *fire areas* increased by the *addition* shall comply with Chapter 9. Any *alterations* made to the existing structure shall comply with the requirements of this chapter and Chapter 1.

## SECTION 3404.0 ALTERATIONS

**3404.1 Approval:** The provisions of this chapter shall not be deemed to prohibit *alterations* within the limitations of Section 102.2, provided that an unlawful *change of occupancy* is not involved.

**3404.2 Requirements:** An *alteration* to any structure shall conform to the code requirements for a new structure and shall not result in an increase in hazard to the occupants in the existing structure or building as a whole. Portions of the structure not altered and not adversely affected by the *alteration*, and the unaltered portion which does not create a hazard for the area under *alteration*, are not required to comply with the code requirements for a new structure. If a hazard to the altered or unaltered portion is created, the requirements for new structures shall apply as required by Section 102.2.

**3404.2.1 HPM facilities:** *Alterations* to *HPM* facilities shall comply with Section 416.0.

**3404.2.2 Means of egress:** The *means of egress* shall comply with Section 1001.2.

**3404.2.3 Structural loads:** The structural *loads* shall comply with Sections 1614.4 and 1614.5.

**3404.2.4 Electrical:** The design and construction of *alterations* to existing wiring systems shall comply with Section 2701.1.

**3404.2.5 Sewer and water supply:** The design and construction of *alterations* to existing plumbing systems shall comply with Section 2903.0.

**3404.2.6 Signs:** Alterations to signs shall comply with Section 3102.4.2.

## SECTION 3405.0 CHANGE OF OCCUPANCY

**3405.1 Approval:** A change shall not be made in the use of a structure which createes the potential for a greater hazard to the public because of increased structural or fire loading or inadequate *exits* for the number of occupants without approval of the code official. If the code official determines that the structure meets the intent of the provisions of this code for new structures under the proposed new use and occupancy, and that the proposed change does not result in any greater hazard to public safety or welfare, the code official shall approve the change. In making this decision, the code official may require a written opinion from a design professional and the State Fire Marshal.

## SECTION 3406.0 HISTORIC STRUCTURES

**3406.1 Compliance:** The restoration or renovation of a building on a federal, state or local historic register solely to return the building to its original design shall not require the remainder of the building to comply with this code, except for *changes of occupancy* or *alterations* governed by Section 3404.2 or 3405.1.

## SECTION 3407.0 MOVED STRUCTURES

**3407.1 Compliance:** Structures moved into or within the jurisdiction shall comply with the provisions of this code for new structures or shall comply with Section 3408.0, provided that the siting and *fire separation distance* comply with the requirements for new structures.

## SECTION 3408.0 COMPLIANCE ALTERNATIVES

**3408.1 Compliance:** The provisions of this section are intended to maintain or increase the current degree of public safety, health and general welfare in existing buildings while permitting repair, *alteration*, *addition* and *change of occupancy* without requiring full compliance with Chapters 2 through 33, or Sections 3403.0 through 3407.0, except where compliance with other provisions of this code is specifically required in this section.

**3408.2 Applicability:** Structures existing prior to August 15, 1982, in which there is work involving *additions*, *alterations* or *changes of occupancy*, shall be made to conform to the requirements of this section or the provisions of Sections 3403.0 through 3407.0. The provisions in Sections 3408.2.1 through 3408.2.5 shall apply to existing occupancies that will continue to be, or are proposed to be, in Use Groups A, B, E, F, M, R and S. These provisions shall not apply to buildings with occupancies in Use Group H or I.

**3408.2.1 Change in use group:** Where an existing building is changed to a new use group classification and this section is applicable, the provisions of this section for the new use group shall be used to determine compliance with this code.

**3408.2.2 Part change in use group:** Where a portion of the building is changed to a new use group classification, and that portion is separated from the remainder of the building with *fire separation assemblies* having a fireresistance rating as required by Table 313.1.2 for the separate use groups, or with approved compliance alternatives, the portion changed shall be made to conform to the provisions of this section.

Where a portion of the building is changed to a new use group classification, and that portion is not separated from the remainder of the building with *fire separation assemblies* having a fireresistance rating as required by Table 313.1.2 for the separate use groups, or with approved compliance alternatives, the provisions of this section which apply to each use group shall apply to the entire building. Where there are conflicting provisions, those requirements which secure the greater public safety shall apply to the entire building or structure.

**3408.2.3 Additions:** *Additions* to existing buildings shall comply with all of the requirements of this code for new construction. The combined *height* and *area* of the existing building and the new *addition* shall not exceed the *height* and *area* allowed by Section 503.0. Where a *fire wall* that complies with Section 707.0 is provided between the *addition* and the existing building, the *addition* shall be considered a separate building.

**3408.2.4 Alterations and repairs:** An existing building or portion thereof which does not comply with the requirements of this code for new construction shall not be *altered* or repaired in such a manner that results in the building being less safe or sanitary than such building is currently. If, in the *alteration* or repair, the current level of safety or sanitation is to be reduced, the portion *altered* or repaired shall conform to the requirements of Chapters 2 through 12 and Chapters 14 through 33.

**3408.2.5 Accessibility requirements:** All portions of the buildings proposed for *change of occupancy* shall conform to the accessibility provisions of Section 1110.0.

**3408.3 Acceptance:** For repairs, *alterations*, *additions* and *changes of occupancy* to existing buildings that are evaluated in accordance with this section, compliance with this section shall be accepted by the code official.

**3408.3.1 Hazards:** Where the code official determines that an unsafe condition exists, as provided for in Section 119.0, such unsafe condition shall be abated in accordance with Section 119.0.

**3408.3.2 Compliance with other codes:** All buildings that are evaluated in accordance with this section shall comply with the fire prevention and property maintenance codes listed in Chapter 35.

**3408.4 Investigation and evaluation:** For all proposed work covered by this section, the building owner shall cause the existing building to be investigated and evaluated in accordance with the provisions of this section.

**3408.4.1 Structural analysis:** The owner shall have a structural analysis of the existing building made to determine adequacy of all structural systems for the proposed *alteration*, *addition* or *change of occupancy*. The existing building shall be capable of supporting the minimum *load* requirements of Section 1606.0.

**3408.4.2 Submittal:** The results of the investigation and evaluation as required in Section 3408.4, along with all proposed compliance alternatives, shall be submitted to the code official.

**3408.4.3 Determination of compliance:** The code official shall determine whether the existing building, with the proposed *addition*, *alteration* or *change of occupancy*, complies with the provisions of this section in accordance with the evaluation process in Sections 3408.5 through 3408.9.

**3408.5 Evaluation:** The evaluation shall be comprised of three categories: fire safety, *means of egress* and general safety, as defined in Sections 3408.5.1 through 3408.5.3.

**3408.5.1 Fire safety:** Included within the fire safety category are the structural fireresistance, *automatic fire detection*, fire alarm and *fire suppression system* features of the facility.

**3408.5.2 Means of egress:** Included within the *means of egress* category are the configuration, characteristics and support features for *means of egress* in the facility.

**3408.5.3 General safety:** Included within the general safety category are the fire safety parameters and the *means of egress* parameters.

**3408.6 Evaluation process:** The evaluation process specified herein shall be followed in its entirety to evaluate existing buildings. Table 3408.7 shall be utilized for tabulating the results of the evaluation. References to other sections of this code indicate that compliance with those sections is required in order to gain credit in the evaluation herein outlined. In applying this section to a building with mixed use groups, where the separation between the mixed use groups does not qualify for any category indicated in Section 3408.6.16, the score for each use group shall be determined and the lower score determined for each section of the evaluation process shall apply to the entire building.

Where the separation between the mixed use groups qualifies for any category indicated in Section 3408.6.16, the score for each use group shall apply to each portion of the building based on the use group of the space.

**3408.6.1 Building height:** The value for *building height* shall be the lesser value determined by the formula in Section 3408.6.1.1. Section 503.0 shall be used to determine the allowable *height* of the building, including allowable increases due to *automatic sprinklers* as provided for in Section 504.2. Subtract the actual *building height* from the allowable and divide by $12^1/_2$ feet. Enter the *height* value and its sign (positive or negative) in Table 3408.7 under Safety Parameter 3408.6.1, *Building Height*, for fire safety, *means of egress* and general safety. The maximum score for a building shall be 10.

**3408.6.1.1 Height formula:** The following formulas shall be used in computing the building *height* value.

$$\text{Height value in feet} = \frac{(AH)-(EBH)}{12.5} \times CF$$

$$\text{Height value in stories} = (AS - EBS) \times \text{CF}$$

where:

$AH$ = Allowable *height* in feet from Table 503.
$EBH$ = Existing building *height* in feet.
$AS$ = Allowable height in stories from Table 503.
$EBS$ = Existing building height in stories.
$CF$ = 1 if $(AH)$ - $(EBH)$ is positive.
$CF$ = Type of construction factor shown in Table 3408.6.6(2) if $(AH)$ - $(EBH)$ is negative.

**Note:** Where mixed use groups are separated and individually evaluated as indicated in Section 3408.6, the values *AH*, *AS*, *EBH* and *EBS* shall be based on the height of the fire area of the use group being evaluated.

**3408.6.2 Building area:** The value for *building area* shall be determined by the formula in Section 3408.6.2.2. Section 503.0 and the formula in Section 3408.6.2.1 shall be used to determine the allowable *area* of the building. This shall include any allowable increases due to open perimeter, *automatic sprinklers* and reductions to the *area* due to height as provided for in Section 506.0. Subtract the actual building *area* from the allowable *area* and divide by 1,200 square feet (112 $m^2$). Enter the *area* value and its sign (positive or negative) in Table 3408.7 under Safety Parameter 3408.6.2, Building Area, for fire safety, *means of egress* and general safety. In determining the *area* value, the maximum permitted positive value for *area* is 50 percent of the fire safety score as listed in Table 3408.8, Mandatory Safety Scores.

**3408.6.2.1 Allowable area formula:** The following formula shall be used in computing allowable *area*.

$$AA = \frac{(SP+OP-HR+100) \times (\textit{area} \text{ in Table } 503)}{100}$$

where:

$AA$ = Allowable *area*.
$SP$ = Percent increase for *sprinklers* (Section 506.3).
$OP$ = Percent increase for open perimeter (Section 506.2).
$HR$ = Percent reduction for excess *height* (Section 506.4).

**Note:** Where mixed use groups are separated and individually evaluated as indicated in Section 3408.6, the value for *HR* shall be based on the height of the fire area of the use group being evaluated.

**3408.6.2.2 Area formula:** The following formula shall be used in computing the area value. Determine the Area Value for each use group fire area on a floor by floor basis. For each use group, choose the minimum Area Value of the set of values obtained for the particular use group.

$$\text{Area value}_i = \frac{\text{Allowable area}_i}{1{,}200 \text{ square feet}} \left[ 1 - \left( \frac{\text{Actual area}_i}{\text{Allowable area}_i} + \ldots + \frac{\text{Actual area}_n}{\text{Allowable area}_n} \right) \right]$$

where:

$i$ = value for an individual separated use group on a floor.
$n$ = number of separated use groups on a floor.

**3408.6.3 Compartmentation:** Evaluate the compartments created by *fire separation assemblies* which comply with Sections 3408.6.3.1 and 3408.6.3.2 and which are exclusive of the wall elements considered under Sections 3408.6.4 and 3408.6.5. Conforming compartments shall be figured as the

*net area* and do not include *shafts*, chases, *stairways*, walls or columns. Using Table 3408.6.3, determine the appropriate compartmentation value (*CV*) and enter that value into Table 3408.7 under Safety Parameter 3408.6.3, Compartmentation, for fire safety, *means of egress* and general safety.

**3408.6.3.1 Wall construction:** A wall used to create separate compartments shall be a fire separation assembly conforming to Section 709.0 with a fireresistance rating of not less than 2 hours. Where the building is not divided into more than one compartment, the compartment size shall be taken as the total floor area on all floors. Where there is more than one compartment within a story, each compartmented area on such story shall be provided with a horizontal exit conforming to Section 1019.0. The *fire door* serving as the *horizontal exit* between compartments shall be so installed, fitted and gasketed that such *fire door* will provide a substantial barrier to the passage of smoke and shall comply with Section 1019.2.1.

**3408.6.3.2 Floor/ceiling construction:** A floor/ceiling assembly used to create compartments shall conform to Section 713.0 and shall have a fireresistance rating of not less than 2 hours.

**3408.6.4 Tenant and dwelling unit separations:** Evaluate the fireresistance rating of floors and walls separating tenants, including dwelling units, and not evaluated under Sections 3408.6.3 and 3408.6.5. Under the categories and use groups in Table 3408.6.4, determine the appropriate value and enter that value in Table 3408.7 under Safety Parameter 3408.6.4, Tenant and Dwelling Unit Separation, for fire safety, means of egress and general safety.

**3408.6.4.1 Categories:** The categories for tenant and dwelling unit separations are:

1. Category a — No fire partitions; incomplete fire partitions; no doors; doors not self-closing or automatic closing.
2. Category b — Fire partitions or floor assembly less than 1 hour fireresistance rating or not constructed in accordance with Sections 711.0 or 713.0, respectively.
3. Category c — Fire partitions with 1 hour or greater fireresistance rating constructed in accordance with Section 711.0 and floor assemblies with 1 hour but less than 2 hour fireresistance rating constructed in accordance with Section 713.0, or with only one tenant within the fire area.
4. Category d — Fire separation walls with 1 hour but less than 2 hours fireresistance rating constructed in accordance with Section 709.0 and floor assemblies with 2 hours or greater fireresistance rating constructed in accordance with Section 713.0.
5. Category e — Fire separation wall and floor assemblies with 2 hours or greater fireresistance rating and constructed in accordance with Sections 709.0 and 713.0, respectively.

**Table 3408.6.4**
**SEPARATION VALUES**

| Use Group | Categories | | | | |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| A-1 | 0 | 0 | 0 | 0 | 1 |
| A-2 | -5 | -3 | 0 | 1 | 3 |
| R | -4 | -2 | 0 | 2 | 4 |
| A-3, A-4, B, E, F, M, S-1 | -4 | -3 | 0 | 2 | 4 |
| S-2 | -5 | -2 | 0 | 2 | 4 |

**3408.6.5 Corridor walls:** Evaluate the fireresistance rating and degree of completeness of walls which create *corridors* serving the floor, and constructed in accordance with Section 1011.0. This evaluation shall not include the wall elements considered under Sections 3408.6.3 and 3408.6.4. Under the categories and use groups in Table 3408.6.5, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.5, *Corridor* Walls, for fire safety, *means of egress* and general safety.

**3408.6.5.1 Categories:** The categories for *corridor* walls are:

1. Category a — No *fire partitions*; incomplete *fire partitions*; no doors; or doors not self-closing.
2. Category b — Less than 1 hour fireresistance rating or not constructed in accordance with Section 711.4.
3. Category c — 1 hour to less than 2 hours fireresistance rating, with doors conforming to Section

**Table 3408.6.3**
**COMPARTMENTATION VALUES**

| Use Group | Categories[a] | | | | |
|---|---|---|---|---|---|
| | a Compartment size equal to or greater than 15,000 square feet[b] | b Compartment size of 10,000 square feet[b] | c Compartment size of 7,500 square feet[b] | d Compartment size of 5,000 square feet[b] | e Compartment size of 2,500 square feet[b] or less |
| A-1, A-3 | 0 | 6 | 10 | 14 | 18 |
| A-2 | 0 | 4 | 10 | 14 | 18 |
| A-4, B, E, S-2 | 0 | 5 | 10 | 15 | 20 |
| F, M, R, S-1 | 0 | 4 | 10 | 16 | 22 |

**Note a.** For areas between categories, the compartmentation value shall be obtained by linear interpolation.
**Note b.** 1 square foot = 0.093 $m^2$.

1011.4.2 or without *corridors* as permitted by Section 1011.4.

4. Category d — 2 hours or greater fireresistance rating, with doors conforming to Section 1011.4.2.

**Table 3408.6.5**
**CORRIDOR WALL VALUES**

| Use Group | Categories | | | |
|---|---|---|---|---|
| | a | b | c[a] | d[a] |
| A-1 | -10 | -4 | 0 | 2 |
| A-2 | -30 | -12 | 0 | 2 |
| A-3, F, M, R, S-1 | -7 | -3 | 0 | 2 |
| A-4, B, E, S-2 | -5 | -2 | 0 | 5 |

**Note a.** Corridors not providing at least one-half the travel distance for all occupants on a floor shall use Category b.

**3408.6.6 Vertical openings:** Evaluate the fireresistance rating of vertical *exit* enclosures, hoistways, *escalator* openings and other *shaft* enclosures within the building, and all openings between two or more floors. Table 3408.6.6(1) contains the appropriate protection values. Multiply that value by the construction-type factor found in Table 3408.6.6(2). Enter the vertical opening value and its sign (positive or negative) in Table 3408.7 under Safety Parameter 3408.6.6, Vertical Openings, for fire safety, *means of egress* and general safety. If the structure is a one-story building, enter a value of 2. Unenclosed vertical openings that conform to the requirements of Section 713.3 shall not be considered in the evaluation of vertical openings.

**3408.6.6.1 Vertical opening formula:** The following formula shall be used in computing vertical opening value.

$$VO = PV \times CF$$

$VO$ = Vertical opening value.
$PV$ = Protection value [Table 3408.6.6(1)].
$CF$ = Construction-type factor [Table 3408.6.6(2)].

**Table 3408.6.6(1)**
**VERTICAL OPENING PROTECTION VALUE**

| Protection | Value |
|---|---|
| None (unprotected opening) | -2 times number of floors connected |
| Less than 1 hour<br>1 to less than 2 hours | -1 times number of floors connected<br>1 |
| 2 hours or more | 2 |

**Table 3408.6.6(2)**
**CONSTRUCTION-TYPE FACTOR**

| Factor | Type of construction (refer to Section 602.0) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1A | 1B | 2A | 2B | 2C | 3A | 3B | 4 | 5A | 5B |
| | 1 | 1.2 | 1.5 | 2.2 | 3.5 | 2.5 | 3.5 | 2.3 | 3.3 | 7 |

**3408.6.7 HVAC systems:** Evaluate the ability of the HVAC system to resist the movement of smoke and fire beyond the point of origin. Under the categories in Section 3408.6.7.1, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.7, HVAC Systems, for fire safety, *means of egress* and general safety.

**3408.6.7.1 Categories:** The categories for HVAC systems are:

1. Category a — Plenums not in accordance with Section 2805.1: -10 points.
2. Category b — Air movement in egress elements not in accordance with Section 1005.7: -5 points.
3. Category c — Both categories a and b are applicable: -15 points.
4. Category d — Compliance of the HVAC system with Sections 1005.7 and 2805.0: 0 points.
5. Category e — Systems serving one story; or a central boiler/chiller system without ductwork connecting two or more stories: +5 points.

**3408.6.8 Automatic fire detection:** Evaluate the smoke detection capability based on the location and operation of *automatic fire detectors* in accordance with Section 919.0 and the mechanical code listed in Chapter 35. Under the categories and use groups in Table 3408.6.8, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.8, Automatic Fire Detection, for fire safety, *means of egress* and general safety.

**3408.6.8.1 Categories:** The categories for *automatic fire detection* are:

1. Category a — None.
2. Category b — Existing smoke detectors in HVAC systems and maintained in accordance with the fire prevention code listed in Chapter 35.
3. Category c — Smoke detectors in HVAC systems. The detectors are installed in accordance with the requirements for new buildings in the mechanical code listed in Chapter 35.
4. Category d — Smoke detectors throughout all floor areas other than individual guest rooms, tenant spaces and dwelling units.
5. Category e — Smoke detectors installed throughout the fire area.

**Table 3408.6.8**
**AUTOMATIC FIRE DETECTION VALUES**

| Use Group | Categories | | | | |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| A-1, A-3, F, M, R, S-1 | -10 | -5 | 0 | 2 | 6 |
| A-2 | -25 | -5 | 0 | 5 | 9 |
| A-4, B, E, S-2 | -4 | -2 | 0 | 4 | 8 |

**3408.6.9 Fire alarm systems:** Evaluate the capability of the fire alarm system in accordance with Section 918.0. Under the categories and use groups in Table 3408.6.9, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.9, Fire Alarm, for fire safety, *means of egress* and general safety.

**3408.6.9.1 Categories:** The categories for fire alarm systems are:

1. Category a — None.
2. Category b — Manual fire alarm with pull boxes in accordance with Section 918.5 and alarm indicating appliances in accordance with Section 918.8.2.

3. Category c — Fire alarm system in accordance with Section 918.0.
4. Category d — Category c plus a required voice/alarm signaling system and a *fire command station* that conforms to Section 403.7 and contains the voice/alarm signaling system controls, fire department communication system controls and any other controls specified in Section 403.7 where those systems are provided.

**Table 3408.6.9**
**FIRE ALARM SYSTEM VALUES**

| Use Group | Categories | | | |
|---|---|---|---|---|
| | a | b[a] | c | d |
| A-1, A-2, A-3, A-4, B, E, R | -10 | -5 | 0 | 5 |
| M, F, S | 0 | 5 | 10 | 15 |

**Note a.** For buildings equipped throughout with an automatic sprinkler system, add 2 points for activation by a sprinkler water flow device.

**3408.6.10 Smoke control:** Evaluate the ability of a natural or mechanical venting, exhaust or pressurization system to control the movement of smoke from a fire. Under the categories and use groups in Table 3408.6.10, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.10, Smoke Control, for *means of egress* and general safety.

**Table 3408.6.10**
**SMOKE CONTROL VALUES**

| Use Group | Categories | | | | | |
|---|---|---|---|---|---|---|
| | a | b | c | d | e | f |
| A-1, A-2, A-3 | 0 | 1 | 2 | 3 | 6 | 6 |
| A-4, E | 0 | 0 | 0 | 1 | 3 | 5 |
| B, M, R | 0 | 2[a] | 3[a] | 3[a] | 3[a] | 4[a] |
| F, S | 0 | 2[a] | 2[a] | 3[a] | 3[a] | 3[a] |

**Note a.** This value shall be 0 if compliance with Category d, or e in Section 3408.6.8.1 has not been obtained.

**3408.6.10.1 Categories:** The categories for smoke control are:

1. Category a — None.
2. Category b — The building is equipped throughout with an automatic sprinkler system. Openings are provided in exterior walls at the rate of 20 square feet (1.86 $m^2$) per 50 linear feet (15240 mm) of exterior wall in each story and distributed around the building perimeter at intervals not exceeding 50 feet (15240 mm). Such openings shall be readily openable from the inside without a key or separate tool and shall be provided with ready access thereto. In lieu of operable openings, clearly and permanently marked tempered glass panels shall be used.
3. Category c — One enclosed exit stairway, with ready access thereto, from each occupied floor of the building. The stairway has operable exterior windows and the building has openings in accordance with Category b.
4. Category d — One smokeproof enclosure and the building has openings in accordance with Category b.
5. Category e — The building is equipped throughout with an automatic sprinkler system. Each fire area is provided with a mechanical air-handling system designed to accomplish smoke containment. Return and exhaust air shall be moved directly to the outside without recirculation to other fire areas of the building under fire conditions. The system shall exhaust not less than six air changes per hour from the fire area. Supply air by mechanical means to the fire area is not required. Containment of smoke shall be considered as confining smoke to the fire area involved without migration to other fire areas. Any other tested and approved design which will adequately accomplish smoke containment is permitted.
6. Category f — Each stairway shall be one of the following: a smokeproof enclosure in accordance with Section 1015.0; pressurized in accordance with Section 1015.7; or shall have operable exterior windows.

**3408.6.11 Means of egress capacity and number:** Evaluate the means of egress capacity and the number of *exits* available to the building occupants. In applying this section, the means of egress are required to conform to Sections 1006.0 (with the exception of Section 1006.5), 1008.0, 1009.0 (except that the minimum width required by this section shall be determined solely by the width for the required capacity in accordance with Table 1009.2), 1010.0, 1020.0 and 1025.0. The number of exits credited are the number that are available to each occupant of the area being evaluated. Under the categories and use groups in Table 3408.6.11, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.11, Means of Egress Capacity, for *means of egress* and general safety.

**3408.6.11.1 Categories:** The categories for means of egress capacity and number of exits are:

1. Category a — Compliance with the minimum required means of egress capacity or number of exits is achieved through the use of a fire escape in accordance with Section 1025.0.
2. Category b — Capacity of the means of egress complies with Section 1009.0 and the number of *exits* complies with the minimum number required by Section 1010.0.
3. Category c — Capacity of the means of egress is equal to or exceeds 125 percent of the required means of egress capacity, the means of egress complies with the minimum required width dimensions specified in the code and the number of exits complies with the minimum number required by Section 1010.0.
4. Category d — The number of *exits* provided exceeds the number of exits required by Section 1010.0. All exits shall be located a distance apart from each other equal to not less than that specified in Section 1006.4.1.

5. Category e — The area being evaluated meets both Categories c and d.

**Table 3408.6.11**
**MEANS OF EGRESS VALUES**

| Use Group | Categories | | | | |
|---|---|---|---|---|---|
| | a[a] | b | c | d | e |
| A-1, A-2, A-3, A-4, E | -10 | 0 | 2 | 8 | 10 |
| M | -3 | 0 | 1 | 2 | 4 |
| B, F, S | -1 | 0 | 0 | 0 | 0 |
| R | -3 | 0 | 0 | 0 | 0 |

**Note a.** The values indicated are for buildings six stories or less in height. For buildings over six stories in height, add an additional -10 points.

**3408.6.12 Dead ends:** In spaces required to be served by more than one means of egress, evaluate the length of the *exit access* travel path in which the building occupants are confined to a single path of travel. Under the categories and use groups in Table 3408.6.12, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.12, Dead Ends, for *means of egress* and general safety.

**3408.6.12.1 Categories:** The categories for dead ends are:

1. Category a — Dead end of 35 feet (10670 mm) in unsprinklered buildings or 70 feet (21340 mm) in sprinklered buildings.
2. Category b — Dead end of 20 feet (6096 mm); or 50 feet (15240 mm) in Use Group B in accordance with Section 1011.2, exception 2.
3. Category c — No dead ends; or ratio of length to width (l/w) is less than 2.5:1.

**Table 3408.6.12**
**DEAD-END VALUES**

| Use Group | Categories[a] | | |
|---|---|---|---|
| | a | b | c |
| A-1, A-3, A-4, B, E, F, M, R, S | -2 | 0 | 2 |
| A-2, E | -2 | 0 | 2 |

**Note a.** For dead-end distances between categories, the dead-end value shall be obtained by linear interpolation.

**3408.6.13 Maximum travel distance to an exit:** Evaluate the length of *exit access* travel to an approved *exit*. Determine the appropriate points in accordance with the following equation and enter that value into Table 3408.7 under Safety Parameter 3408.6.13, Maximum *Exit Access* Travel Distance, for *means of egress* and general safety. The maximum allowable exit access travel distance shall be determined in accordance with Section 1006.5.

$$\text{Points} = 20 \times \frac{\text{Maximum allowable travel distance} - \text{Maximum actual travel distance}}{\text{Maximum allowable travel distance}}$$

**3408.6.14 Elevator control:** Evaluate the passenger elevator equipment and controls that are available to the fire department to reach all occupied floors. Elevator recall controls shall be provided in accordance with fire prevention code listed in Chapter 35. Under the categories and use groups in Table 3408.6.14, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.14, Elevator Control, for fire safety, *means of egress* and general safety. The values shall be zero for a single story building.

**3408.6.14.1 Categories:** The categories for elevator controls are:

1. Category a — No elevator.
2. Category b — Any elevator without Phase I and II recall.
3. Category c — All elevators with Phase I and II recall as required by the fire prevention code listed in Chapter 35.
4. Category d — All meet category c; or category b where permitted to be without recall; and at least one elevator that complies with new construction requirements serves all occupied floors.

**Table 3408.6.14**
**ELEVATOR CONTROL VALUES**

| Elevator travel | Category | | | |
|---|---|---|---|---|
| | a | b | c | d |
| Less than 25 feet of travel above or below the primary level of elevator access for emergency fire-fighting or rescue personnel[a] | -2 | 0 | 0 | +2 |
| Travel of 25 feet or more above or below the primary level of elevator access for emergency fire-fighting or rescue personnel[a] | -4 | NP | 0 | +4 |

**Note a.** 1 foot = 304.8 mm.

**3408.6.15 Means of egress emergency lighting:** Evaluate the presence of and reliability of *means of egress* emergency lighting. Under the categories and use groups in Table 3408.6.15, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.15, *Means Of Egress* Emergency Lighting, for *means of egress* and general safety.

**3408.6.15.1 Categories:** The categories for *means of egress* emergency lighting are:

1. Category a — Means of egress lighting and exit signs not provided with emergency power in accordance with Section 2706.0.
2. Category b — Means of egress lighting and exit signs provided with emergency power in accordance with Section 2706.0.
3. Category c — Emergency power provided to means of egress lighting and exit signs which provides protection in the event of power failure to the site or building.

**Table 3408.6.15**
**MEANS OF EGRESS EMERGENCY LIGHTING VALUES**

| Number of exits required by Section 1010.0 | a | b | c |
|---|---|---|---|
| Two or more exits | NP | 0 | 4 |
| Minimum of 1 exit | 0 | 1 | 1 |

**3408.6.16 Mixed use groups:** Where a building has two or more occupancies that are not in the same use group classification, the separation between the mixed use groups shall be evaluated in accordance with this section. Where there is no separation between the mixed use groups or the separation between mixed use groups does not qualify for any of the categories indicated in Section 3408.6.16.1, the building shall

be evaluated as indicated in Section 3408.6 and the value for mixed use groups shall be zero. Under the categories and use groups in Table 3408.6.16, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.16, Mixed Use Groups, for fire safety and general safety. For buildings without mixed use groups, the value shall be zero.

**3408.6.16.1 Categories:** The categories for mixed use groups are:

1. Category a — Minimum 1-hour fire separation assemblies between use groups.
2. Category b — Fire separation assemblies between use groups in accordance with Section 313.1.2.
3. Category c — Fire separation assemblies between use groups having a fireresistance rating of not less than twice that required by Section 313.1.2.

**Table 3408.6.16**
**MIXED USE GROUP VALUES**

| Use Group | Categories[a] | | |
|---|---|---|---|
| | a | b | c |
| A-1, A-2, R | -10 | 0 | 10 |
| A-3, A-4, B, E, F, M, S | -5 | 0 | 5 |

**Note a.** For fireresistance ratings between categories, the value shall be obtained by linear interpolation.

**3408.6.17 Sprinklers:** Evaluate the ability to suppress a fire based on the installation of an *automatic sprinkler system* in accordance with Section 906.2. "Required sprinklers" shall be based on the requirements of Sections 904.1 through 904.10; and as referenced in Table 904.11 for covered mall buildings, high-rise buildings, public garages and unlimited area buildings. Under the categories and use groups in Table 3408.6.17, determine the appropriate value and enter that value into Table 3408.7 under Safety Parameter 3408.6.17, *Automatic Sprinklers*, for fire safety, *means of egress* divided by 2 and general safety.

**3408.6.17.1 Categories:** The categories for *automatic sprinkler system* protection are:

1. Category a — Sprinklers are required throughout; sprinkler protection is not provided or the sprinkler system design is not adequate for the hazard protected in accordance with Section 906.0.
2. Category b — Sprinklers are required in a portion of the building; sprinkler protection is not provided or the sprinkler system design is not adequate for the hazard protected in accordance with Section 906.0.
3. Category c — Sprinklers are not required; none are provided.
4. Category d — Sprinklers are required in a portion of the building; sprinklers are provided in such portion; the system is one which complied with the code at the time of installation and is maintained and supervised in accordance with Section 924.1.
5. Category e — Sprinklers are required throughout; sprinklers are provided throughout in accordance with Chapter 9.
6. Category f — Sprinklers are not required throughout; sprinklers are provided throughout in accordance with Chapter 9.

**Table 3408.6.17**
**SPRINKLER SYSTEM VALUES**

| Use groups | Categories | | | | | |
|---|---|---|---|---|---|---|
| | a | b | c | d | e | f |
| A-1, A-3, F, M, R, S-1 | -6 | -3 | 0 | 2 | 4 | 6 |
| A-2 | -4 | -2 | 0 | 1 | 2 | 4 |
| A-4, B, E, S-2 | -12 | -6 | 0 | 3 | 6 | 12 |

**3408.6.18 Specific occupancy areas:** Evaluate the protection of specific occupancy areas in accordance with Section 302.1.1. Also evaluate compliance with Table 904.11. Do not include those which Table 904.11 requires suppression throughout the building including covered mall buildings, high-rise buildings, public garages and unlimited area buildings. Assign the lowest score for the building or fire *area* being evaluated. If there are no specific occupancy areas in the building or fire *area* being evaluated, the value shall be zero.

**3408.7 Building score:** After determining the appropriate data from Section 3408.6, enter those data in Table 3408.7 and total the building score.

**Table 3408.6.18**
**SPECIFIC OCCUPANCY AREA VALUES[a]**

| Protection Required by Table 302.1.1 | Protection Provided | | | | | | |
|---|---|---|---|---|---|---|---|
| | None | 1 Hour | A.F.S.S. | A.F.S.S. with S.P. | 1 Hour and A.F.S.S. | 2 Hours | 2 Hours and A.F.S.S. |
| 2 Hours and A.F.S.S. | -4 | -3 | -2 | -2 | -1 | -2 | 0 |
| 2 Hours; or 1 Hour and A.F.S.S. | -3 | -2 | -1 | -1 | 0 | 0 | 0 |
| 1 Hour and A.F.S.S. | -3 | -2 | -1 | -1 | 0 | -1 | 0 |
| 1 Hour | -1 | 0 | -1 | 0 | 0 | 0 | 0 |
| 1 Hour; or A.F.S.S. with S.P. | -1 | 0 | -1 | 0 | 0 | 0 | 0 |
| A.F.S.S. with S.P. | -1 | -1 | -1 | 0 | 0 | -1 | 0 |
| 1 Hour; or A.F.S.S. | -1 | 0 | 0 | 0 | 0 | 0 | 0 |

**Note a.** A.F.S.S. = Automatic fire suppression system; S.P. = Smoke partitions (see Section 302.1.1.1).
**Note b.** S.P. = Smoke partitions (see Section 302.1.1.1).

**3408.8 Safety scores:** The values in Table 3408.8 are the required mandatory safety scores for the evaluation process listed in Section 3408.6.

**Table 3408.8**
**MANDATORY SAFETY SCORES[a]**

| Use Group | Fire safety (MFS) | Means of egress (MME) | General safety (MGS) |
|---|---|---|---|
| A-1 | 16 | 27 | 27 |
| A-2 | 19 | 30 | 30 |
| A-3 | 18 | 29 | 29 |
| A-4, E | 23 | 34 | 34 |
| B | 24 | 34 | 34 |
| F | 20 | 30 | 30 |
| M | 19 | 36 | 36 |
| R | 17 | 34 | 34 |
| S-1 | 15 | 25 | 25 |
| S-2 | 23 | 33 | 33 |

**Note a.** MFS = Mandatory Fire Safety;
MME = Mandatory Means of Egress;
MGS = Mandatory General Safety.

**3408.9 Evaluation of building safety:** The mandatory safety score in Table 3408.8 shall be subtracted from the building score in Table 3408.7 for each category. Where the final score for any category equals zero or more, the building is in compliance with the requirements of this section for that category. Where the final score for any category is less than zero, the building is not in compliance with the requirements of this section.

**Table 3408.9**
**EVALUATION FORMULAS[a]**

| Formula | Table 3408.7 | | Table 3408.8 | | Score | Pass | Fail |
|---|---|---|---|---|---|---|---|
| FS-MFS ≥ 0 | _____ (FS) | - | _____ (MFS) | = | ____ | ____ | ____ |
| ME-MME ≥ 0 | _____ (ME) | - | _____ (MME) | = | ____ | ____ | ____ |
| GS-MGS ≥ 0 | _____ (GS) | - | _____ (MGS) | = | ____ | ____ | ____ |

**Note a.**
FS = Fire Safety
ME = Means of Egress
GS = General Safety
MFS = Mandatory Fire Safety
MME = Mandatory Means of Egress
MGS = Mandatory General Safety

**3408.9.1 Mixed use groups:** For mixed use groups, the following provisions shall apply:

1. Where the separation between mixed use groups does not qualify for any category indicated in Section 3408.6.16, the mandatory safety scores for the use group with the lowest general safety score in Table 3408.8 shall be utilized (see Section 3408.6).
2. Where the separation between mixed use groups qualifies for any category indicated in Section 3408.6.16, the mandatory safety scores for each use group shall be placed against the evaluation scores for the appropriate use group.

**Table 3408.7**
**SUMMARY SHEET — BUILDING SCORE**

Existing use group _____ Proposed use group _____
Year building was constructed _____ Number of stories _____ Height in feet _____
Type of construction _____ Area per floor _____
Percentage of open perimeter _____% Percentage of height reduction _____ %
Completely suppressed: Yes _____ No _____ Corridor wall rating _____
Compartmentation: Yes _____ No _____ Required door closers: Yes _____ No _____
Fireresistance rating of vertical opening enclosures _____
Type of HVAC system _____, serving number of floors _____
Automatic fire detection: Yes _____ No _____, type and location _____
Fire alarm system: Yes _____ No _____, type _____
Smoke control: Yes _____ No _____, type _____
Adequate exit routes: Yes _____ No _____ Dead ends: Yes _____ No _____
Maximum exit access travel distance _____ Elevator controls: Yes _____ No _____
Means of egress emergency lighting: Yes _____ No _____ Mixed use groups: Yes _____ No _____

| Safety parameters | Fire safety (FS) | Means of egress (ME) | General safety (GS) |
|---|---|---|---|
| 3408.6.1 Building height | | | |
| 3408.6.2 Building area | | | |
| 3408.6.3 Compartmentation | | | |
| 3408.6.4 Tenant and dwelling unit separations | | | |
| 3408.6.5 Corridor walls | | | |
| 3408.6.6 Vertical openings | | | |
| 3408.6.7 HVAC systems | | | |
| 3408.6.8 Automatic fire detection | | | |
| 3408.6.9 Fire alarm system | | | |
| 3408.6.10 Smoke control | * * * * | | |
| 3408.6.11 Means of egress | * * * * | | |
| 3408.6.12 Dead ends | * * * * | | |
| 3408.6.13 Max. travel distance | * * * * | | |
| 3408.6.14 Elevator control | | | |
| 3408.6.15 Means of egress emergency lighting | * * * * | | |
| 3408.6.16 Mixed use groups | | * * * * | |
| 3408.6.17 Sprinklers | | ÷ 2 = | |
| 3408.6.18 Specific occupancy area protection | | | |
| Building score — total value | | | |

* * * * No applicable value to be inserted.

# CHAPTER 35

## REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 102.4.

### AA

The Aluminum Association
Suite 300
900 19th Street NW
Washington, DC 20006

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| AA – 94 | Aluminum Design Manual; Part 1-A — Specifications for Aluminum Structures, Allowable Stress Design and Part 1-B — Specification for Aluminum Structures, Load and Resistance Factor Design of Buildings and Similar Type Structures | 2002.1 |
| ASM 35 – 80 | Specification for Aluminum Sheet Metal Work in Building Construction | 2002.1 |

### AAMA

American Architectural Manufacturers Association
Suite 310
1540 E. Dundee Road
Palatine, IL 60067

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 1402 – 86 | Standard Specifications for Aluminum Siding, Soffit and Fascia | 1405.3.4 |

### AASHTO

American Association of State Highway and Transportation Officials
Suite 225
444 North Capitol
Washington, DC 20001

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| GDPS-4 | Guide for Design of Pavement Structures | 506.2.1.1 |
| GDHS-3 | Geometric Design of Highways and Streets | 506.2.1.1 |

### ACI

American Concrete Institute
3880 International Way
Farmington Hills, MI 48331

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 318 – 95 | Building Code Requirements for Structural Concrete | 1604.5.1, 1705.4.1, 1705.4.2, 1705.4.3, 1705.4.5, Table 1705.4.4, 1810.2, 1810.6, 1812.3, Table 1812.3.2(1), 1815.4, 1815.5, 1816.11.1, 1821.3.6, 1901.1, 1902.1, 1903.1, 1903.1.1, 1903.2.1, 1903.2.2, 1903.2.3, 1903.3, 1903.4.2, 1903.5.2, 1903.5.3, 1904.1, 1904.2, 1906.1, 1906.4.2, 1906.5.1, 1906.6, 1906.6.1, 1906.7, 1907.1.2.1, 1907.1.2.2, 1907.1.4, 1908.1, 1908.2, 1908.3.1, 1908.3.4, 1908.5.2, 1908.8.2, 1910.1, 1910.3.1, 1910.5, 1910.6.2, 1910.6.5 |
| 506.2 – 90 | Specification for Materials, Proportioning, and Application of Shotcrete | 1911.9 |
| ACI 530/ASCE 5/ TMS 402 – 95 | Building Code Requirements for Masonry Structures | 707.3, 1405.5, 1604.5.3, Table 1610.3.3, 1705.5, Table 1705.5, 1812.3, Table 1812.3.2(1), 1815.4, 2101.1.1, 2101.1.2, 2101.2.2, 2105.3.1 |
| ACI 530.1/ASCE 6/ TMS 602 – 95 | Specifications for Masonry Structures | 1405.6 Table 1705.5, 2111.1.1 |

### AFPA

American Forest and Paper Association
1250 Connecticut Ave. NW /Suite 200
Washington, DC 20036

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| NDS – 91 | National Design Specification for Wood Construction — with 1991 Supplement; Design Values for Wood Construction | 1808.1, 2303.1, 2304.1, 2305.14.1, 2305.15, 2306.4, 2306.4.5.1, 2306.4.5.2, 2306.4.6, 2306.4.6.1.1, 2306.4.6.2.1, 2312.1, 2312.4, 2313.3.1, 2313.3.2 |
| TR7 – 87 | Basic Requirements for Permanent Wood Foundation System | 1808.3, 1813.3, 2311.3.3 |

## AHA

American Hardboard Association
1210 W. Northwest Highway
Palatine, IL 60067

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| A135.4 – 95 | Basic Hardboard | 1405.3.1 |
| A135.6 – 90 | Hardboard Siding | 1405.3.2<br>2309.7 |
| A194.1 – 85 | Cellulosic Fiber Board | 2309.1 |

## AISC

American Institute of Steel Construction, Inc.
Suite 3100
One East Wacker Drive
Chicago, IL 60601-2001

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| AISC – 92 | Seismic Provisions for Structural Steel Buildings | 2203.2<br>2203.2.1 |
| ASD – 89 | Specification for Structural Steel Buildings — Allowable Stress Design, Plastic Design | 1604.5.2<br>Table 1705.3.2, 2203.1, 2203.5, 2208.1 |
| LRFD – 93 | Load and Resistance Factor Design Specification for Structural Steel Buildings | 1604.5.2<br>Table 1705.3.2, 2203.1, 2203.5, 2208.1 |

## AISI

American Iron and Steel Institute
Suite 1300
1101 17th Street, N.W.
Washington, DC 20036-4700

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| AISI – 73 | Criteria for Structural Applications of Steel Cables for Buildings | 2207.2<br>2207.2.1 |
| CFSD-ASD – 86 | Specification for Design of Cold-Formed Steel Structural Members — with 1989 Addendum | 1604.5.2<br>2206.1, 2206.3, 2206.3.1 |
| CFSD-LRFD – 91 | Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members | 2206.1<br>2206.3, 2206.3.1 |

## AITC

American Institute of Timber Construction
Suite 140
7012 S. Revere Parkway
Englewood, CO 80112

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 108 – 93 | Standard for Heavy Timber Construction | 2304.1 |
| 109 – 90 | Standard for Preservative Treatment of Structural Glued Laminated Timber | 2313.1.1 |
| 112 – 93 | Standard for Tongue-and-Groove Heavy Timber Roof Decking | 2304.1 |
| 117 – 93 | Standard Specifications for Structural Glued Laminated Timber of Softwood Species (Design) | 2304.1 |
| 119 – 96 | Standard Specifications for Hardwood Glued Laminated Timber | 2304.1 |
| A190.1 – 92 | Structural Glued Laminated Timber | 2304.1 |

## ALI

Automotive Lift Institute
P.O. Box 33116
Indialantic, FL 32903-3116

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| B153.1 – 90 | Safety Requirements for the Construction, Care, and Use of Automotive Lifts | 3001.2 |

## ANSI

American National Standards Institute
11 West 42nd Street
New York, NY 10036

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| A108.1A – 92 | Specifications for the Installation of Ceramic Tile: Wet-Set Method with Portland Cement Mortar | 2104.10 |
| A108.1B – 92 | Specifications for the Installation of Ceramic Tile: Dry-Set or Latex Portland Cement Mortar on a Cured Portland Cement Mortar Setting Bed. | 2104.10 |
| A108.4 – 92 | Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive | 2104.10.7 |
| A108.5 – 92 | Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar | 2104.10.1<br>2104.10.3 |
| A108.6 – 92 | Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy | 2104.10.4 |
| A108.7 – 92 | Specifications for Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar | 2104.10.2 |
| A108.8 – 92 | Installation of Ceramic Tile with Chemical Resistant Furan Mortar and Grout | 2104.10.5 |
| A108.9 – 92 | Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout | 2104.10.6 |
| A108.10 – 92 | Installation of Grout in Tilework | 2104.10.8 |
| A118.1 – 92 | Specifications for Dry-Set Portland Cement Mortar | 2104.10.1 |
| A118.2 – 92 | Specifications for Conductive Dry-Set Portland Cement Mortar | 2104.10.2 |
| A118.3 – 92 | Specifications for Chemical Resistant Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive | 2104.10.4 |
| A118.4 – 92 | Specifications for Latex-Portland Cement Mortar | 2104.10.3 |
| A118.5 – 92 | Specifications for Chemical Resistant Furan. | 2104.10.5 |
| A118.6 – 92 | Specifications for Ceramic Tile Grouts | 2104.10.8 |
| A118.8 – 92 | Specifications for Modified Epoxy Emulsion Mortar/Grout. | 2104.10.6 |
| A136.1 – 92 | Organic Adhesives for Installation of Ceramic Tile | 2104.10.7 |
| A137.1 – 88 | Specifications for Ceramic Tile | 2104.4 |
| A208.1 – 93 | Particleboard | 2308.2<br>2308.3 |
| Z97.1 – 84 | Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings. | 2405.1<br>2406.1 |

## ASCE

American Society of Civil Engineers
345 East 47th Street
New York, NY 10017

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| ASCE 3 – 84 | Specifications for the Design and Construction of Composite Slabs | 1604.5.2<br>1901.1, 2206.1.1 |

**ASCE (cont'd.)**

| | | |
|---|---|---|
| ASCE 5/ACI 530/ TMS 402 – 95 | Building Code Requirements for Masonry Structures | 707.3, 1405.5, 1604.5.3, Table 1610.3.3, 1705.5, Table 1705.5 1812.3, Table 1812.3.2(1), 1815.4, 2101.1.1, 2101.1.2, 2101.2.2, 2105.3.1 |
| ASCE 6/ACI 530.1/ TMS 602 – 95 | Specifications for Masonry Structures | 1405.6, Table 1705.5, 2111.1.1 |
| ASCE 7 – 95 | Minimum Design Loads for Buildings and Other Structures | 1604.1, 1604.2, 1606.4, 1606.6, 1606.8, 1607.3, 1607.5, 1608.1, 1609.1, 1609.1.1, Table 1609.7(6), 1610.1, 1610.3.7, 1612.2, 1612.3, 1612.4, 1613.1 |
| ASCE 8-SSD-LRFD/ASD – 90 | Specification for Design of Cold-Formed Stainless Steel Structural Members | 1604.5.2, 2206.1, 2206.3, 2206.3.1 |

## ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, N.E.
Atlanta, GA 30329-2305

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 15-92 | Mechanical Refrigeration Systems | 2801.5 |
| 62-89 | Ventilation for Acceptable Indoor Air Quality | 2801.2.1, 2801.2.2 |
| 90A-80 | Energy Conservation in New Building Design — with Addendum 90A-a-87 | 1301.2, 1305.1 |
| 90B-75 | Energy Conservation in New Building Design | 1301.2 |
| 62A-90 | Addendum | 1301.2, 1304.2, 1305.1 |

## ASME

American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017-2392

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| A13.1 – 81(85) | Scheme for the Identification of Piping Systems | 416.15.3 |
| A17.1 – 93 | Safety Code for Elevators and Escalators — with A17.1a-94 Addendum | 1108.5, 1610.6.5, 3001.2, 3001.3, 3004.4.1, 3004.4.2, 3004.5.1, 3005.3.2, 3006.2, 3012.3 |
| A17.3 – 93 | Safety Code for Existing Elevators and Escalators — with A17.3a-94 Addendum | 3013.1 |
| A90.1 – 92 | Safety Standard for Belt Manlifts — with A90.1a-95 Addendum | 3001.2, 3004.5.3 |
| B20.1 – 94 | Safety Standard for Conveyors and Related Equipment — with B20.1a-94 Addendum | 3001.2, 3004.5.5, 3010.3 |
| B31.3 – 93 | Chemical Plant and Petroleum Refinery Piping — with B31.3a-93, B31.3b-94 & B31.3c-95 Addenda | 416.15 |

## ASTM

American Society for Testing and Materials
100 Barr Harbor Drive
West Conshocken, PA 19428-2956

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| A6 – 95c | Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use | Table 1705.3.2 |
| A36 – 94 | Specification for Structural Steel | 1818.1, 2104.9.5 |
| A48 – 94a | Specification for Gray Iron Castings | 2209.1 |
| A82 – 95 | Specification for Steel Wire, Plain, for Concrete Reinforcement | 2104.9.2, 2104.9.5 |
| A153 – 95 | Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware | 2104.9.6 |
| A167 – 94a | Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip | 2104.9.2, 2104.9.5, 2104.9.6 |
| A185 – 94 | Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement | 2104.9.4, 2104.9.5 |
| A252 – 93 | Specification for Welded and Seamless Steel Pipe Piles | 1818.1, 1819.1 |
| A283 – 93a | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates | 1818.1, 1819.1 |
| A361 – 94 | Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding | 1507.5.7 |
| A366 – 91 | Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality | 2104.9.5 |
| A416 – 94a | Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete | 1821.3.2 |
| A496 – 95 | Specification for Steel Wire, Deformed, for Concrete Reinforcement | 2104.9.3 |
| A497 – 95 | Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement | 2104.9.4 |
| (Note: ASTM A525 – 91b has been discontinued and not replaced by ASTM) | | |
| A568 – 95 | Specification for Steel Sheet, Carbon and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For | Table 1705.3.2 |
| A572 – 94c | Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality | 1818.1 |
| A588 – 94 | Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick | 1818.1 |
| A615 – 95c | Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement | 1903.1.1, 2104.9.1 |
| A616 – 95b | Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement | 2104.9.1 |
| A617 – 95b | Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement | 2104.9.1 |
| A641 – 92 | Specification for Zinc-Coated (Galvanized) Carbon Steel Wire | 2104.9.6 |
| A706 – 95b | Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement | 1705.4.1, 1903.1.1, 1906.5.2, 2104.9.1 |
| A755 – 95 | Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products | 1507.5.7 |
| B101 – 92 | Specification for Lead-Coated Copper Sheets | 1507.5.7 |
| C5 – 79 | Specification for Quicklime for Structural Purposes | Table 2505.2 |
| C28 – 92 | Specification for Gypsum Plasters | Table 2505.2 |
| C31 – 95 | Practice for Making and Curing Concrete Test Specimens in the Field | 1908.3.2, 1908.3.3 |
| C33 – 93 | Specification for Concrete Aggregates | 1906.3, Table 1907.1 |

**ASTM (cont'd.)**

C34 – 93 Specification for Structural Clay Load-Bearing Wall Tile . . . . . 2104.2
C35 – 95 Specification for Inorganic Aggregates for Use in Gypsum Plaster . . . . . Table 2505.2
C36 – 95b Specification for Gypsum Wallboard . . . . . Table 2503.2
C37 – 92 Specification for Gypsum Lath . . . . . Table 2505.2
C39 – 94 Test Method for Compressive Strength of Cylindrical Concrete Specimens . . . . . 1908.3.2
C55 – 95 Specification for Concrete Building Brick . . . . . 2104.1
C56 – 93 Specification for Structural Clay Non-Load-Bearing Tile . . . . . 2104.2
C59 – 91 Specification for Gypsum Casting and Molding Plaster . . . . . Table 2505.2
C61 – 95 Specification for Gypsum Keene's Cement . . . . . Table 2505.2
C62 – 95a Specification for Building Brick (Solid Masonry Units Made from Clay or Shale) . . . . . 2104.2
C67 – 94 Test Methods of Sampling and Testing Brick and Structural Clay Tile . . . . . 2111.5
C73 – 95 Specification for Calcium Silicate Face Brick (Sand Lime Brick) . . . . . 2104.1
C79 – 95 Specification for Gypsum Sheathing Board . . . . . Table 2503.2
C90 – 95 Specification for Load-Bearing Concrete Masonry Units . . . . . 2104.1
C94 – 95 Specification for Ready-Mixed Concrete . . . . . 1908.5.1
C126 – 95 Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units . . . . . 2104.2
C150 – 95 Specification for Portland Cement . . . . . 1906.2 Table 1907.1.3, Table 2505.2
C172 – 90 Practice For Sampling Freshly Mixed Concrete . . . . . 1908.3.2
C206 – 84 Specification for Finishing Hydrated Lime . . . . . Table 2505.2
C208 – 95 Specification for Cellulosic Fiber Insulating Board . . . . . 2309.1
C212 –93 Specification for Structural Clay Facing Tile . . . . . 2104.2
C216 – 95a Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) . . . . . 2104.2
C222 – 91 Specification for Asbestos-Cement Roofing Shingles . . 1507.4.1
C231 – 91b Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method . . . . . 1907.1.1
C260 – 95 Specification for Air-Entraining Admixtures for Concrete . . . . . 1906.6.2
C270 – 95 Specification for Mortar for Unit Masonry . . . . . 2104.7
C315 – 95 Specification for Clay Flue Linings . . . . . 2113.4.2 2115.3
C330 – 89 Specification for Lightweight Aggregates for Structural Concrete . . . . . 1906.3
C406 – 89 Specification for Roofing Slate . . . . . 1507.4.7
C474 – 94 Test Methods for Joint Treatment Materials for Gypsum Board Construction . . . . . Table 2503.2
C475 – 94 Specification for Joint Compound and Joint Tape for Finishing Gypsum Board . . . . . Table 2503.2
C476 – 95 Specification for Grout for Masonry . . . . . 2104.11
C494 – 92 Specification for Chemical Admixtures for Concrete . . . 1906.6.2
C503 – 89 Specification For Marble Dimension Stone (Exterior) . . . . 2104.3
C514 – 94 Specification for Nails for the Application of Gypsum Wallboard . . . . . Table 2503.2
C568 – 89 Specification for Limestone Dimension Stone . . . . . 2104.3
C587 – 91 Specification for Gypsum Veneer Plaster . . . . . Table 2505.2
C588 – 95 Specification for Gypsum Base for Veneer Plasters . . . . . Table 2505.2
C595 – 95a Specification for Blended Hydraulic Cements . . . . . 1906.2 Table 1907.1.3
C615 – 92 Specification for Granite Dimension Stone . . . . . 2104.3
C616 – 95 Specification for Quartz-Based Dimension Stone . . . . . 2104.3
C618 – 95 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete . . . . . 1906.6.3
C629 – 89 Specification for Slate Dimension Stone . . . . . 2104.3
C630 – 95 Specification for Water-Resistant Gypsum Backing Board . . . . . Table 2503.2 2503.4
C631 – 95a Specification for Bonding Compounds for Interior Gypsum Plastering . . . . . Table 2505.2

**ASTM (cont'd.)**

C645 – 95a Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board . . . . . Table 2503.2 Table 2505.2
C652 – 95c Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale) . . . . . 2104.2
C685 – 95 Specification for Concrete Made by Volumetric Batching and Continuous Mixing . . . . . 1908.5.1
C744 – 95a Specification for Prefaced Concrete and Calcium Silicate Masonry Units . . . . . 2104.1
C754 – 95a Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board . . . . . Table 2504.1
C836 – 89a Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course . . . . . 1507.5.6
C841 – 90 Specification for Installation of Interior Lathing and Furring . . . . . Table 2504.1
C842 – 85 Specification for Application of Interior Gypsum Plaster . . . . . Table 2504.1
C843 – 94 Specification for Application of Gypsum Veneer Plaster . . . . . Table 2504.1
C844 – 85 Specification for Application of Gypsum Base to Receive Gypsum Veneer Plaster . . . . . Table 2504.1
C847 – 93 Specification for Metal Lath . . . . . Table 2505.2
C887 – 95 Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar . . . . . 1813.3.2.2 2104.8
C897 – 95a Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters . . . . . Table 2505.2
C926 – 95 Specification for Application of Portland Cement-Based Plaster . . . . . 2506.3
C932 – 80 Specification for Surface-Applied Bonding Agents for Exterior Plastering . . . . . Table 2505.2
C933 – 80 Specification for Welded Wire Lath . . . . . Table 2505.2
C946 – 91 Practice for Construction of Dry-Stacked, Surface-Bonded Walls . . . . . 2104.8 2105.4
C954 – 93 Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness . . . . . Table 2505.2 Table 2503.2
C955 – 95b Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases . . . . . Table 2505.2
C957 – 93 Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface . . . . . 1507.5.6
C989 – 95 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars . . . . . 1906.6.4
C1002 – 93 Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases . . . . . Table 2503.2 Table 2505.2
C1007 – 83 Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories . . Table 2504.1
C1029 – 90 Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation . . . . . 1507.5.5
C1063 – 95a Specification for Installation of Lathing and Furring for Portland Cement-Based Plaster . . . . . 2506.3
C1088 – 94 Specification for Thin Veneer Brick Units Made from Clay or Shale . . . . . 2104.2
D25 – 91 Specification for Round Timber Piles . . . . . 1822.1
D56 – 93 Test Method for Flash Point by Tag Closed Tester . . . . . 307.2
D86 – 95 Test Method for Distillation of Petroleum Products . . . . . 307.2
D93 – 94 Test Methods for Flash Point by Pensky-Martens Closed Tester . . . . . 307.2
D224 – 89 Specification for Smooth-Surfaced Asphalt Roll Roofing (Organic Felt) . . . . . 1507.4.2
D225 – 95 Specification for Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules . . . . . 1507.4.3

**ASTM (cont'd.)**

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|---|---|---|
| D226 – 95 | Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing | 1507.1<br>Table 1507.5.1 |
| D227 – 95 | Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing | Table 1507.5.1 |
| D249 – 89 | Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules | 1507.4.2 |
| D312 – 95 | Specification for Asphalt Used in Roofing | Table 1507.5.1 |
| D323 – 94 | Test Method for Vapor Pressure of Petroleum Products (Reid Method) | 307.2 |
| D371 – 89 | Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules; Wide-Selvage | 1507.4.2 |
| D450 – 91 | Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing | Table 1507.5.1 |
| (Note: ASTM D568 – 77 has been discontinued and not replaced by ASTM.) | | |
| D635 – 91 | Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position | 2601.2<br>2604.1 |
| D1143 – 81 | Test Method for Piles Under Static Axial Compressive Load | 1817.4 |
| D1227 – 87 | Specification for Emulsified Asphalt Used as a Protective Coating for Roofing | 1507.5.6 |
| D1761 – 88 | Test Methods For Mechanical Fasteners in Wood | 2312.1<br>2312.2, 2312.3 |
| D1863 – 86 | Specification for Mineral Aggregate Used on Built-Up Roofs | Table 1507.5.1 |
| D1929 – 93 | Test Method for Ignition Properties of Plastics | 2601.2<br>2604.1 |
| D2178 – 89 | Specification for Asphalt Glass Felt Used in Roofing and Waterproofing | Table 1507.5.1 |
| D2626 – 95 | Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing | Table 1507.5.1 |
| D2843 – 93 | Test Method for Density of Smoke from the Burning or Decomposition of Plastics | 2601.2<br>2604.1 |
| D2898 – 94 | Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing | 1506.2<br>2310.3 |
| D3201 – 94 | Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Base Products | 2310.3 |
| D3462 – 93a | Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules | 1507.4.3 |
| D3468 – 90 | Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing | 1507.5.6 |
| (Note: ASTM D3672 – 86 has been discontinued and not replaced by ASTM.) | | |
| D3679 – 94 | Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding | 1405.3.3 |
| D3689 – 90 | Test Method For Individual Piles Under Static Axial Tensile Load | 1817.7 |
| D3746 – 85 | Test Method for Impact Resistance of Bituminous Roofing Systems | 1505.4.2 |
| D3909 – 95a | Specification for Asphalt Roll Roofing (Glass Felt) Surfaced With Mineral Granules | 1507.4.2<br>Table 1507.5.1 |
| D4272 – 90a | Test Method for Total Energy Impact of Plastic Films By Dart Drop | 1505.4.2 |
| D4434 – 87 | Specification for Poly (Vinyl Chloride) Sheet Roofing | 1507.5.3 |
| D4601 – 95 | Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing | Table 1507.5.1 |
| D4637 – 87 | Specification for Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane | 1507.5.2 |
| D5055 – 95a | Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists | 2313.5 |
| E72 – 95 | Methods of Conducting Strength Tests of Panels for Building Construction | 2305.7 |
| E84 – 95b | Test Method for Surface Burning Characteristics of Building Materials | 412.3.6.3<br>704.4.1.2, 723.2, 723.3, 723.4, 723.4.1, 723.4.3, 723.5, 803.2, 803.3.2, 2310.2, 2601.2, 2603.3, 2603.7.4, 2604.1, 2805.2.2, 3105.4 |

**ASTM (cont'd.)**

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|---|---|---|
| E90 – 90 | Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions | 1214.2 |
| E108 – 95 | Test Method for Fire Tests of Roof Coverings | 1506.1<br>1506.2, 2608.2, 2608.3 |
| E119 – 95a | Test Methods for Fire Tests of Building Construction and Materials | 412.3.6.2<br>702.1, 704.1.1, 705.2.5, 705.4, 709.7.1, 714.1.1, 714.1.2, 714.1.4, 714.1.5, 714.2, 714.2.1, 714.2.2, 714.2.4, 714.2.6, 2104.2 |
| E136 – 95 | Test Method for Behavior of Materials in a Vertical Tube Furnace at 750° C | 704.4.1.1 |
| E152 – 81a | Methods of Fire Tests of Door Assemblies | 717.1<br>717.1.1 |
| E163 – 84 | Methods of Fire Tests of Window Assemblies | 719.1<br>720.1 |
| E492 – 90 | Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine | 1214.3 |
| E648 – 95 | Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source | 805.2 |
| E814 – 94b | Test Method for Fire Tests of Through-Penetration Fire Stops | 714.1.3<br>714.2.3 |
| (Note: ASTM E838 – 81 has been discontinued and not replaced by ASTM.) | | |
| G23 – 95 | Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials | 1505.4.1 |
| G26 – 95 | Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials | 1505.4.1 |
| G53 – 95 | Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials | 1505.4.1 |

## AWPA

American Wood-Preservers' Association
P.O. Box 286
Woodstock, MD 21163-0286

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| C1 – 95 | All Timber Products — Preservative Treatment by Pressure Processes | 1506.3<br>2311.3 |
| C2 – 95 | Lumber, Timbers, Bridge Ties and Mine Ties — Preservative Treatment by Pressure Processes | 1808.1<br>1808.2, 2311.3, 2311.4, 2311.5, 2311.7 |
| C3 – 95 | Piles — Preservative Treatment by Pressure Processes | 1808.1<br>1822.2 |
| C4 – 95 | Poles — Preservative Treatment by Pressure Processes | 1808.2 |
| C9 – 95 | Plywood — Preservative Treatment by Pressure Processes | 2311.3<br>2311.4, 2311.5, 2311.7 |
| C20 – 93 | Structural Lumber — Fire-Retardant Treatment by Pressure Processes | 2310.2 |
| C22 – 93 | Lumber and Plywood for Permanent Wood Foundations — Preservative Treatment by Pressure Processes | 1808.3 |
| C24 – 95 | Sawn Timber Piles Used for Residential and Commercial Building | 1822.2 |
| C27 – 93 | Plywood — Fire-Retardant Treatment by Pressure Processes | 2310.2 |
| M4 – 95 | Standard for the Care of Preservative-Treated Wood Products | 1822.2 |
| P1/P13 – 95 | Standard for Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water) Use | 2311.3 |
| P2 – 95 | Standard for Creosote Solutions | 2311.3 |
| P5 – 95 | Standards for Waterborne Preservatives | 2311.3 |
| P8 – 95 | Standards for Oil-Borne Preservatives | 2311.3 |
| P9 – 92 | Standards for Solvents and Formulations for Organic Preservative Systems | 2311.3 |

## AWS

American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| D1.1 – 92 | Structural Welding Code — Steel | 1705.3.3.2 |
| D1.4 – 92 | Structural Welding Code — Reinforced Steel | 1906.5.2 |

## CGSB

Canadian General Standards Board
222 Queens Street
14th Floor, Suite 1402
Ottawa, Ontario, Canada K1A 1G6

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 37-GP-52M – 84 | Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric | 1505.4.2<br>1507.5.2 |
| 37-GP-54M – 79 | Roofing and Waterproofing Membrane, Sheet Applied, Flexible, Polyvinyl Chloride | 1507.5.3 |
| 37-GP-56M – 80 | Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing — with December 1985 Amendment | 1507.5.4 |

## CODES*

Building Officials and Code Administrators International, Inc.
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| KYFPC – 96 | Kentucky Fire Prevention Code | 102.2<br>201.3, 307.2, 307.8, Table 307.8(1), Table 307.8(2), 408.6, 412.3.7, 415.1, 416.14, 416.14.2, 417.1, 417.2.1, Table 417.2.1.1, 417.3, 417.5, 417.5.1, 417.5.2, 417.5.3, 417.5.5, 417.6, 417.6.1, 417.6.3, 418.1, 418.2, 418.2.1, 418.3, 418.3.1, 418.3.2, 418.3.3, 418.4, 418.5, 419.2.3, 705.2.1, 707.1.1, 901.2, 901.4, 901.7, 904.5, 915.1, 921.2, 3103.1, 3305.1, 3305.2, 3401.2, 3401.4, 3408.3.2, 3408.6.8.1, 3408.6.14, 3408.6.14.1 |
| BNMC – 93 | BOCA National Mechanical Code | 201.3<br>307.8, 408.4.1, 408.5, 411.3, 416.9, 417.1, 417.3, 418.3.1.4, 418.3.2, 418.3.3, 418.3.4, 419.2, 419.2.1, 602.4.2, 602.4.3, 718.2, 723.2, 910.6, 914.1, 1005.7, 1203.1, 1208.3, 1209.1, 1210.3, 2305.12, 2702.2, 2801.2, 2802.1, 2802.3, 2804.1, 2805.2.3, 2805.2.4, 2808.3, 2809.1, 3007.5, 3107.6, 3309.2, 3401.3, 3408.6.8, 3408.6.8.1 |
| KPC | Kentucky Plumbing Code — with 1996 Supplement | 201.3<br>408.4, 418.3.4, 602.4.3, 907.6.2, 1102.1, 1108.2, 1108.2.1, 1108.3, 1212.7, 1510.7.2, 1813.5.3, 2901.1, 2902.3, 2904.3, 2905.4.2, 2908.1, 2908.2, 3107.9, 3401.3 |
| OTFDC – 95 | CABO One & Two Family Dwelling Code | 310.6 |
| MEC – 92 | CABO Model Energy Code | 1301.1 |

* All publications are available from BOCA

## CPSC

Consumer Product Safety Commission
Office of the Secretary
Washington, DC 20207

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 16 CFR; 1201 – 77 | Safety Standard for Architectural Glazing | 2405.1<br>2406.1, 2407.2 |
| 16 CFR; 1209 – 79 | Interim Safety Standard for Cellulose Insulation | 723.5 |
| 16 CFR; 1404 – 79 | Cellulose Insulation | 723.5 |
| 16 CFR; 1500 – 84 | Hazardous Substances and Articles; Administration and Enforcement Regulations | 307.2 |
| 16 CFR; 1630 (DOC FF-1) – 70 | Standard for the Surface Flammability of Carpets and Rugs | 805.3<br>805.5 |

## DOC

United States Department of Commerce
National Institute of Standards and Technology
Gaithersburg, MD 20899

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| PS 1 – 95 | Construction and Industrial Plywood | 2306.4.6<br>2307.1 |
| PS 2 – 95 | Performance Standard for Wood-Based Structural-Use Panels | 2307.1 |
| PS 20 – 94 | American Softwood Lumber Standard | 2302.1 |
| FF-1 (CPSC 16 CFR; 1630) – 70 | Standard for the Surface Flammability of Carpets and Rugs | 805.3<br>805.5 |

## DOJ

U.S. Department of Justice
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402-9325

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 28 CFR, Part 36, Appendix A – 91 | Nondiscrimination on the Basis of Disability by Public Accommodations in Commercial Facilities: ADA Accessibility Guidelines for Buildings and Facilities | 202.1<br>1101.1, 1102.1, 1103.1, 1103.2, 1104.4, 1105.1, 1105.2, 1106.1, 1106.2, 1107.2.2, 1107.2.3, 1107.2.4, 1107.3.2, 1107.3.3, 1107.3.4, 1107.4.1, 1107.4.3, 1107.4.5, 1107.4.5.1, 1107.4.5.2, 1107.5, 1107.6, 1108.2.1, 1108.3 1108.4, 1108.5, 1108.6, 1108.7, 1108.7.1 1108.8, 1108.9, 1108.10, 1109.2, 1109.3, 1111.1, 1111.2, 1111.5, 1112.1 |

**DOJ (cont'd.)**

| | | |
|---|---|---|
| Federal Regulations, Vol. 57, No. 245, Monday, December 21, 1992 | Americans with Disability Act Guidelines for Buildings and Facilities: State and Local Government Facilities Proposed Rulemaking | 202.1 |
| | | 1101.1, 1102.1, 1103.1, 1103.2, 1104.4, 1105.1, 1105.2, 1106.1, 1106.2, 1107.2.2, 1107.2.3, 1107.2.4, 1107.3.2, 1107.3.3, 1107.3.4, 1107.4, 1107.4.3, 1107.4.5, 1107.4.5.1, 1107.4.5.2, 1107.5, 1107.6, 1108.2.1, 1108.3, 1108.4, 1108.5, 1108.6, 1108.7, 1108.7.1, 1108.8, 1108.9, 1108.10, 1109.2, 1109.3, 1111.1, 1111.2, 1111.5, 1112.1 |

## DOTn

U.S. Department of Transportation
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402-9325

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 49CFR; 100-199 – 88 | Specification for Transportation of Explosive and Other Dangerous Articles, Shipping Containers | 307.2 |

## EIA

Electronics Industries Association
2500 Wilson Boulevard
Arlington, VA 22201-3834

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| EIA/TIA 222-E – 91 | Structural Standards for Steel Antenna Towers and Antenna Supporting Structures | 3108.4 |

## FM

Factory Mutual
Standards Laboratories Department
1151 Boston Providence Turnpike
Norwood, MA 02062

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 4450 – 90 | Approval Standard for Class 1 Insulated Steel Deck Roofs — with Supplements thru July 1992 | 1505.2, 2603.4.1.5 |
| 4470 – 86 | Approval Standard for Class 1 Roof Coverings — with Supplements thru August 1992 | 1505.2, 1505.4.2 |
| 4880 – 94 | Approval Standard for Class 1: A) Insulated Wall or Wall & Roof/Ceiling Panels, B) Plastic Interior Finish Materials, C) Plastic Exterior Building Panels, D) Wall/Ceiling Coating Systems and E) Interior or Exterior Finish Systems | 2603.8 |

## HPVA

Hardwood Plywood Veneer Association
1825 Michael Faraday Drive
P.O. Box 2789
Reston, VA 22090

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| HP-1 – 94 | Hardwood and Decorative Plywood | 2307.1 |
| HP-SG – 86 | Structural Design Guide for Hardwood Plywood Wall Panels | 2307.1 |

## NFPA

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 10 – 94 | Portable Fire Extinguishers | 921.2 |
| 11 – 94 | Low Expansion Foam | 911.1, 911.5 |
| 11A – 94 | Medium- and High-Expansion Foam Systems | 911.1, 911.5 |
| 12 – 93 | Carbon Dioxide Extinguishing Systems | 909.1, 909.5 |
| 12A – 92 | Halon 1301 Fire Extinguishing Systems | 912.1, 912.5 |
| (Note: NFPA 12B – 90 has been withdrawn and not replaced by NFPA.) | | |
| 13 – 96 | Installation of Sprinkler Systems | 412.3.6, 412.7, 416.4, 706.2, 906.2.1, 906.9.1, 907.2.1, 907.6.1, 915.5.1, 918.7.3, 1610.6.4, 3011.2.2 |
| 13D – 96 | Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes | 906.2.3 |
| 13R – 96 | Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height | 906.2.2, 924.1 |
| 14 – 95 | Standpipe and Hose Systems | 915.1, 915.4.1, 915.12.1 |
| 15 – 96 | Water Spray Fixed Systems for Fire Protection | 908.1, 908.4 |
| 16 – 95 | Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems | 911.1, 911.5 |
| 17 – 94 | Dry Chemical Extinguishing Systems | 910.1, 910.5 |
| 17A – 94 | Wet Chemical Extinguishing Systems | 914.1, 914.5 |
| 24 – 95 | Installation of Private Fire Service Mains | 417.6.3, 906.9.1, 915.12.1 |
| 30 – 96 | Flammable and Combustible Liquids Code | 307.8, 418.3.2, 419.2.3 |
| 30A – 96 | Automotive and Marine Service Station Code | 408.6, 417.6.6 |
| 30B – 94 | Manufacture and Storage of Aerosol Products | 307.8 |
| 32 – 96 | Drycleaning Plants | 418.3.4 |
| 33 – 95 | Spray Application Using Flammable and Combustible Materials | 307.8, 419.1 |
| 34 – 95 | Dipping and Coating Processes Using Flammable or Combustible Liquids | 307.8, 419.1 |
| 40 – 94 | Storage and Handling of Cellulose Nitrate Motion Picture Film | 411.1 |
| 50 – 96 | Bulk Oxygen Systems at Consumer Sites | 2810.1 |
| 51 – 92 | Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes | 2810.1 |
| 54 – 96 | National Fuel Gas Code | 2801.6 |
| 58 – 95 | Storage and Handling of Liquefied Petroleum Gases | 418.3.3 |
| 61 – 95 | Prevention of Fires and Dust Explosions in Agricultural Food Products Facilities | 418.3.1 |

**NFPA (cont'd.)**

(Note: NFPA 61A – 89, 61B – 89, 61C – 89 and 61D – 89 are replaced by NFPA 61 – 95.)

65 – 93 Processing and Finishing of Aluminum . . . . . 418.3.1
69 – 92 Explosion Prevention Systems . . . . . 417.5.1.2
70 – 96 National Electrical Code . . . . . 416.11 416.14.6, 416.15.2, 602.4.4, 1405.4.3, 2701.1, 2701.3, 2705.1, 2706.1, 2707.1, 2708.3, 2805.2.5, 3102.6.3, 3102.13.1, 3107.6
72 – 96 National Fire Alarm Code . . . . . 403.6 417.5.3, 918.1, 918.6, 918.7, 918.8.2, 918.9, 918.10, 919.1, 919.4.3, 919.8, 920.1, 920.6, 922.4, 924.1
79 – 94 Electrical Standard for Industrial Machinery . . . . . 2701.6
80 – 95 Fire Doors and Windows . . . . . 302.1.1.1 717.2, 717.5, 1017.4.4
82 – 94 Incinerators and Waste and Linen Handling Systems and Equipment . . . . . 2807.1
90A – 96 Installation of Air Conditioning and Ventilation Systems . . . . . 1203.2
90B – 96 Installation of Warm Air Heating and Air Conditioning Systems . . . . . 1203.2
99 – 96 Health Care Facilities . . . . . 2809.1, 2809.2
99C – 96 Standard on Gas and Vacuum Systems . . . . . 2902.1, 2902.2.2
101 – 85 Life Safety Code . . . . . 119.1, 305.1.1, 409.1, 1203.2
102 – 95 Assembly Seating, Tents, and Membrane Structures . . . . . 3104.4
120 – 94 Coal Preparation Plants . . . . . 418.3.1
231C – 95 Rack Storage of Materials . . . . . 507.1 Table 923.2
418 – 95 Standard for Heliports . . . . . 1511.3
495 – 96 Explosive Materials Code . . . . . Table 307.8(1) 417.5.1, 904.5
651 – 93 Manufacture of Aluminum Powder . . . . . 418.3.1
654 – 94 Prevention of Fire and Dust Explosions in the Chemical, Dye, Pharmaceutical, and Plastics Industries . . . . . 418.3.1
655 – 93 Prevention of Sulfur Fires and Explosions . . . . . 418.3.1
664 – 93 Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities . . . . . 418.3.1
701 – 95 Methods of Fire Tests for Flame-Resistant Textiles and Films . . . . . 807.2 3102.6.4.2, 3103.3.2, 3104.5, 3105.4
704 – 90 Identification of the Fire Hazards of Materials . . . . . 416.2 416.15.1
8503 – 92 Pulverized Fuel Systems . . . . . 418.3.1

These National Fire Protection Association (NFiPA) Pamphlets are listed for use in fire suppression design and installation only if referenced in a specific code required by this code.

Aircraft Hangars . . . . . # 409
Pyroxylin Plastics . . . . . # 40C
Laboratories . . . . . # 45
Fireworks . . . . . # 1124
L. P. Gas Storage . . . . . # 58
General Storage . . . . . # 231
Rubber Tire Storage . . . . . # 231D
Baled Cotton Storage . . . . . # 231E
Rolled Paper Storage . . . . . # 231F
Rangehoods . . . . . # 96
Computer Rooms . . . . . # 75
Archives and Record Centers . . . . . # 232AM
L. P. Gas Storage and Handling . . . . . # 59A
Code for the Manufacture and Storage of Aerosol Products . . . . . # 30B
Installation of Closed-head Foam Water Sprinkler Systems . . . . . # 16A
Fur Storage . . . . . # 81
Cooling Towers . . . . . # 214
Marinas and Boatyards . . . . . # 303
Racetrack Stables . . . . . # 150
Clean Rooms . . . . . # 318
Oven . . . . . # 86
Protection of Records . . . . . # 232

## RCSC

Research Council on Structural Connections
c/o American Institute of Steel Construction, Inc.
One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| RCSC – 85(88) | Specification for Structural Joints Using A325 or A490 Bolts (ASD/LRFD) | 1705.3.3.1 |

## RMA

Rubber Manufacturers Association
1400 K Street, N.W.
Washington, DC 20005

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| RP-1 – 90 | Minimum Requirements for Non-Reinforced Black EPDM Rubber Sheets | 1507.5.2 |
| RP-2 – 90 | Minimum Requirements for Fabric-Reinforced Black EPDM Rubber Sheets | 1507.5.2 |
| RP-3 – 85 | Minimum Requirements for Fabric-Reinforced Black Polychloroprene Rubber Sheets | 1507.5.2 |

## SJI

Steel Joist Institute
Suite A
1205 48th Avenue North
Myrtle Beach, SC 29577

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| SJI – 94 | Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders | 1604.5.2 2205.1, 2205.3 |

## TIA

Telecommunications Industry Association
2500 Wilson Boulevard
Arlington, VA 22201-3834

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| TIA/EIA 222-E – 91 | Structural Standards for Steel Antenna Towers and Antenna Supporting Structures | 3108.4 |

## TMS

The Masonry Society
Suite 6
3775 Iris Avenue
Boulder, CO 80301-2043

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| TMS 402/ACI 530/ ASCE 5 – 95 | Building Code Requirements for Masonry Structures | 707.3, 1405.5, 1604.5.3, Table 1610.3.3, 1705.5, Table 1705.5, 1812.3, Table 1812.3.2(1), 1815.4, 2101.1.1, 2101.1.2, 2101.2.2, 2105.3.1 |
| TMS 602/ACI 530.1/ ASCE 6 – 95 | Specifications for Masonry Structures | 1405.6, Table 1705.5, 2104.2, 2112.1.1 |

## TPI

Truss Plate Institute
Suite 200
583 D'Onofrio Drive
Madison, WI 53719

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| TPI 1 – 95 | National Design Standard for Metal-Plate-Connected Wood Truss Construction | 2305.14.1, 2305.15, 2313.3.1, 2313.3.2 |

## UL

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| 10A – 93 | Tin-Clad Fire Doors — with Revisions thru October 1994 | 717.2 |
| 14B – 93 | Sliding Hardware for Standard, Horizontally Mounted Tin-Clad Fire Doors | 717.2 |
| 14C – 93 | Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs | 717.2 |
| 103 – 94 | Chimneys, Factory-Built, Residential Type and Building Heating Appliance — with Revisions thru August 1995 | 721.6.4 |
| 127 – 88 | Factory-Built Fireplaces — with Revisions thru November 1994 | 721.6.4 |
| 555 – 95 | Fire Dampers | 718.1 |
| 580 – 94 | Test for Uplift Resistance of Roof Assemblies — with Revisions thru April 1995 | 1505.2 |
| 910 – 95 | Test for Cable Flame - Propagation and Smoke Density Values — with Revisions thru May 1995 | 2805.2.5 |
| 1256 – 85 | Standard for Safety Test of Roof Deck Construction | 2603.4.1.5 |
| 1715 – 94 | Fire Test of Interior Finish Material — with Revisions thru November 1994 | 2603.8 |
| 1777 – 95 | Chimney Liners | 2115.5 |
| 1820 – 94 | Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics | 2805.2.6 |
| 1887 – 95 | Fire Tests of Plastic Sprinkler Pipe for Flame and Smoke Characteristics | 2805.2.1 |
| 1897 – 93 | Uplift Tests for Roof Covering Systems | 1505.2 |
| Subject 1040 – 89 | Outline of Proposed Investigation for Insulated Wall Construction | 2603.8 |

## USC

United States Code
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402-9325

| Standard reference number | Title | Referenced in code Section number |
|---|---|---|
| Title 18; Chapter 40 – 70 | Importation, Manufacture, Distribution and Storage of Explosive Materials | 307.2 |

# APPENDIX A
# DESIGN PROFESSIONAL REQUIREMENTS

Projects involving new structures, additions or renovations require design professional services when the building size or calculated occupant load exceeds the limits indicated by the following table.

| Use Group classification or special use | Building size[e] | Calculated occupant load[e] | Architect | Engineer | Either | None |
|---|---|---|---|---|---|---|
| Assembly | | 100[a] | X | X | | |
| Business | 10,000 square feet | 100 | X | X | | |
| Educational | Any size | Any size | X | X | | |
| Factory & industrial | 20,000 square feet | | | | X | |
| High hazard | Any size | Any size | | | X | |
| Institutional | Any size | Any size | X | X | | |
| Mercantile | | 100 | X | X | | |
| Residential | 12 dwelling units[g] | 50[g] | X | X | | |
| Storage | 20,000 | | | | X | |
| **Special Uses** | | | | | | |
| Church buildings[f] | 6,000 | 400 | X | X | | |
| Day care | 3,500[b] | 100[b] | X | X | | |
| Farm structures | Any size | Any size | | | | X |
| Mixed uses | Note c | Note c | X | X | | |
| Smaller buildings | Note d | Note d | | | | X |
| Nonbuilding structures | | | | | | X |

**Note a.** Assembly uses having 700 square feet to 1,500 square feet may actually have calculated occupant load exceeding 100 persons depending on the specific use of assembly areas.

**Note b.** Net floor area occupied by clients is 35 square feet per client and calculated occupant load is actually client load.

**Note c.** Buildings having two or more different uses require both architect and engineer when the combined calculated occupant loads exceed 100 persons unless the mixed uses are exclusively used for factory, high hazard or storage.

**Note d.** Smaller buildings of any use having total area or calculated occupant load less than specified for that use do not require design professional services.

**Note e.** Projects involving additions to existing buildings shall include existing building areas and/or calculated occupant loads when determining requirements for design professional services. Use the actual occupant load if it is greater than the calculated occupant load.

**Note f.** No architect or engineer is required unless the church building size reaches 6,000 total square feet and a calculated occupant load of 400 persons.

**Note g.** The number of dwelling units shall be the determining factor except where dormitories or boarding homes are concerned. In these cases, the occupant load shall be determined by area or actual occupant load.

**Note h.** 1 square foot = 0.093 $m^2$.

# APPENDIX B
# FAIR HOUSING ACT

**344.010. Definitions for chapter. —**

(7) "Housing accommodations" includes improved and unimproved property and means any building, structure, lot or portion thereof, which is used or occupied, or is intended, arranged, or designed to be used or occupied as the home or residence f one (1) or more families, and any vacant land which is offered for sale or lease for the construction or location thereon of any such building or structure.

**(11)344.360. Unlawful housing practices — Design and construction requirements. —**

(c) In connection with the design and construction of covered multifamily housing accommodations for first occupancy after January 1, 1993, a failure to design and construct those housing accommodations in a manner ensuring that they have at least one (1) entrance on an accessible route unless impractical to do so because f the terrain or unusual characteristics of the site. Housing accommodations with a building entrance on an accessible route shall comply with the following requirements:

1. The public use and common use portions of the housing accommodations shall be readily accessible to and usable by disabled persons;
2. All the doors designed to allow passage into and within all premises within the housing accommodations shall be sufficiently wide to allow passage by disabled persons in wheel chairs; and
3. All premises within the housing accommodations shall contain the following features of adaptive design:

a. An accessible route into and through the housing accommodation;
b. Light switches, electrical outlets, thermostats, and other environmental controls in accessible locations;
c. Reinforcements in bathroom walls to allow later installation of grab bars; and
d. Usable kitchens and bathrooms so that an individual in a wheelchair can maneuver about the space.

(12) Compliance with the appropriate requirements of the American National Standard for buildings and facilities providing accessibility and usability for physically disabled persons, (commonly cited as "ANSI A117.1 — 1986") suffices to satisfy the requirements of subsection (11)(c)3. of this section.

(13) As used in subsection (11) of this section, the term "covered multifamily housing accommodation" means:

(a) Buildings consisting of four (4) or more units if the buildings have one (1) or more elevators; and
(b) Ground floor units in other buildings consisting of two (2) or more units.

(14) Nothing in this section requires that a housing accommodation be made available to an individual whose tenancy would constitute a direct threat to the health or safety of other individuals or whose tenancy would result in substantial physical damage to the property of others. (Enact. Act 1968, ch. 167, § 3; 1972, Ch. 225, § 12; 1992, ch. 282, § 36, effective July 14, 1992.)

# INDEX

By section number

## A


A, use group, assembly, 303.0
Access
- Attics, 1211.2
- Courts, 1212.4
- Crawl spaces, 1211.1
- Panel, fire fighter, 2405.3
- Roofs, 1027.0

Accessibility
- Accessible entrances, 1106.0
- Accessible route, 1104.0
- Alterations, 1110.2
- Applicability, 1103.0
- Building features and facilities, 1108.0
- Definitions, 1102.1
- Existing facilities, 1110.0, 3402.7
- General, 1101.0
- Historic buildings, 1103.1
- Means of egress, 1007.0
- Parking facilities, 1105.0
- Standard, 1103.2
- Use group requirements, 1107.0
- Warnings and signage, 1109.0
- Where required, 1103.1

Accessory structures
- Definition, 202.0
- Use Group U, utility and miscellaneous, 312.0

Additions (see Existing buildings)
Adjoining property
- Demolition and excavation, 3310.0
- Existing buildings, 3309.0
- Fences, 3311.0
- Grade control, 3310.4
- Notice to owners, 3310.1
- Protection of, 3308.0
- Storage of materials, 3312.0

Administrative
- Administration, Chapter 1
- Alternative materials and methods, 105.1, 106.4
- Application for permits, 107.0
- Board of appeals, 121.0
- Building classified by code official, 302.1
- Certificate of occupancy, 118.0
- Code official approves plans, 108.5
- Code official, definition, 202.0
- Conditions of permit, 111.0
- Drawings and specifications required, 107.5, 107.6, 107.7
- Existing structures, 102.2, 3401.0
- Foundation permits, 108.7
- Inspections required, 113.0
- Inspectors appointed, 105.4
- Liability, 104.6
- Maintenance of buildings, 107.1.1, 3401.2
- Organization of building department, 104.3
- Permit fees, 112.0
- Permits required, 107.1
- Powers and duties of code official, 105.0
- Records of department, 104.7
- Requirements not in code, 102.3
- Restrictions on employees, 104.5
- Revocation of permits, 108.0
- Scope of code, 101.2
- Stop work orders, 117.0
- Tests and test reports, 1708.0
- Unsafe structures, 119.0, 120.0
- Validity of code, 103.0
- Violations and penalties, 116.0

Aerosol warehouse, 307.8, 705.2.2, 707.1.2
Aged, homes for
- Use Group I, institutional, 308.0

Aggregates
- Concrete, 1906.0
- Masonry, mortar and grout, 2104.0
- Special tests, 1906.3.1

Agricultural buildings, Use Group U, 312.1
Air ducts (see Ducts)
Air intakes
- Courts, 1212.5

Air plenum (see Plenums)
Airplane hangars (see Garages)
Airport traffic control towers, 414.0
Air-supported structures
- Definition, 3103.2
- Membrane structures, general, 3103.0
- Temporary, 3104.0

Aisles
- Assembly, Use Group A, 1011.3, 1012.0
- Exit access, other use groups, 1011.0
- Illumination, 1024.0

Alarm systems (see Fire protection systems and Leakage alarms)
Allowable areas and heights of buildings (also see Areas, building)
- Existing buildings, 3403.1
- General, 503.0, Table 503
- Unlimited areas, 507.0

Alloys
- Aluminum, 2002.1
- Special steel, 2207.1

Alterations
- Additions, 3404.2, 3408.2.3
- Area and height limitations, 3403.1
- Certificate of occupancy, 118.1
- Definition, 202.0
- Existing buildings, 3401.0, 3404.0
- Inspections, 113.1
- Light and ventilation in existing buildings, 3401.0
- Minor changes, 3404.1
- Nonstructural alterations and repairs, 3401.2
- Permit fees, 112.1, 112.3
- Permit required, 113.1
- Signs, 3102.4.2
- Structural alterations and repairs, 3404.0

Alternative materials and construction
- Approved by code official, 105.1, 106.4
- Board of appeals, 121.1
- Suitability of, 1707.1

Aluminum alloys, 2002.0
Amendments to plans, 107.8
Amusement buildings, special, 413.0
Anchorage, anchors
- Flood-resistant construction, 3107.4.2, 3107.5.3
- Framing into girders, 2305.6.1
- Intersecting masonry walls, 2110.2
- Masonry, general, 2109.0, 2110.0
- Masonry, veneer, 1405.5

Metal veneers, 1405.4.1
Projecting masonry, 2111.0
Wood, sill, 2305.16
Antennas, radio and television, 3109.0
Apartment house (see Multiple dwellings)
Appeals, board of, 121.0
Local, state, 122.0
Application for permit
Action by code official on application, 108.1
Application form, 107.2
Awnings, 3205.1
Conditions of permit, 111.0
Drawings required, 107.5, 107.6,
For demolition of buildings, 110.0
Foundation permits, 108.7
Moving buildings, 3407.1
Permit fees, 112.0
Plot diagram required, 107.6
Records to be kept, 105.7
Registered architect or engineer, 107.3
Signs, 3102.4
Swimming pools, 421.3
Temporary structures, 3104.0
What required, 107.3, 107.5, 107.6, 107.7
When required, 107.1
Appointment of code official, 104.1
Approval
Alternative materials and methods of construction, 106.4, 1704.0
Certificate of occupancy, 118.0
For use of plastic material, 2601.3
General, 106.0
Inspections, 113.0
Materials, 1704.0
Modifications, 106.2
Moving buildings, 3407.0
Of plans for permit, 108.5
Used materials, 106.3
Approved, definition, 202.0
Approved agency
Criteria, 1704.3
Definition, 1702.0
Architect
Affidavit, permits issued, 107.3
Drawings and specifications, by, 114.1
Special professional services, 114.2
Architectural trim (see Exterior trim restrictions)
Areas, building
Allowable areas for buildings (also see Allowable areas and heights of buildings), 503.0, Table 503, 3408.6.2
Allowable, required reductions of, 506.4, Table 506.4
Definition, 502.0
Existing buildings, 3403.1
Floor area, definition, 1002.0
General area limitations, 503.0
HPM facilities, 416.3
Increase for street frontage, 506.2
Increase for suppression, 506.3
Mezzanines, 505.2
Modifications, 506.0, 506.4
Open parking structures, 406.4
Separate buildings, 313.1.3, 503.1, 402.16
Special industrial uses, 503.1.1
Unlimited areas, 507.0
Areaways, 3203.12.1
Artificial light, 1207.0, 1024.1
Asphalt roof shingles, 1507.4.3
Assembly buildings
Aisles, 1012.0
Area allowed, 503.0
Classification of, 303.0
Determining capacity of means of egress, 1009.0
Fire suppression requirements, 904.0, 915.0
Occupancy load requirements, 1008.0
Stages and platforms, 412.0
Use Group A, 303.0
Atriums, 404.0
Attic
Access, 1211.2
Definition, 1202.0
Draftstopping, 721.7.2
Insulation, exposed, 723.2
Ventilation of, 1210.1
Auditoriums
Foyers and waiting spaces, 1006.2.4
Means of egress, 1006.2.2
Use Group A-1, assembly, 303.2
Use Group A-3, assembly, 303.4
Automatic fire detection systems (see Detection systems, automatic fire)
Automatic fire suppression systems (also see Sprinklers)
Atriums, 404.2
Carbon dioxide systems, 909.0
Clean agent extinguishing system, 913.0
Covered mall buildings, 402.10
Definition, 902.0
Dry-chemical systems, 910.0
Foam systems, 911.0
General, 901.0
Halogenated systems, 912.0
High-rise buildings, 403.2, 403.3
Limited area sprinkler systems, 907.0
Plans and specifications, 903.0
System selection, 905.0
Water spray fixed system 908.0
Water sprinkler systems, 906.0
Wet chemical systems, 914.0
Where required, 904.0
Automobiles, parking
Open parking structures, 313.2, 406.0
Private garages, 202.0, 407.0
Public garages, 202.0, 402.15, 408.0
Automotive service station, Use Group M, 309.1
Awnings
Clearance, 3205.0
Covers and boxes, 3203.10
Fixed, 3205.3
Loads, 1609.6.2, 3105.4
Movable, 3205.2
Over public property, 3203.9, 3205.1
Permit for, 3205.1
Plastic, 2604.8
Retractable, 3205.2


## B


B, use group, business, 304.0
Balcony
Exits, 1006.2.2
Exterior balconies, 3203.8
Exterior construction of, 1406.4
Live loads, 1606.0

Over public property, 3203.8
Permissible street projections, 3203.8
Railings, 1012.8, 1021.4, 1606.4
Steps, 1012.0
Banner and cloth signs, 3102.12.1
Barricades
Construction, where required, maintenance, 3304.2, 3310.1
Bars, reinforcing
Clear cover in concrete footings, 1810.3.2
Details of reinforcement, 1910.0, 1911.4
Rust protection, 1910.3.1
Basement
Dampproofing, 1813.0
Definition, 502.0
Enclosure of stairways, 1014.11
Fire suppression system required, 904.10
Floors above, protection of, 1006.3.1
Ratproofing, 1215.0
Required exits, 1010.2
Stairway construction, 1014.9
Underground structures, 405.0
Waterproofing, 1813.0
Bathrooms
Light and ventilation, 1205.0
Mechanical ventilation allowed, 1205.2
Window area required for, 1208.2
Bay window (also see Windows, bay)
Construction of, 1406.5
Over public property, projection, 3203.7
Beams
Bottom flange protection, 716.6
Fireresistance, rating of, Table 602, 716.0
Fireresistance, reinforced concrete, Table 602
Reinforced concrete, 1901.0
Steel, formed, 2206.0
Steel, structural, 2203.0
Structural, glued-laminated, 2313.1
Wood, 2303.0, 2305.0
Wood in heavy timber construction, 2304.0
Bearing (Loadbearing)
For wood beams and girders, 2305.6.1, 2305.6.3
On hollow masonry units, 1812.4, 2111.1.2.2
Bearing partitions (see Walls)
Bearing, soil capacity, 1804.0
Bearing walls (see Walls)
Bed and breakfasts, 423.1
Bleachers, 1013.0
Blocks, concrete masonry units (see Masonry)
Board and care facilities (see I, Use Group, institutional)
Board of appeals, 121.0
Boarding houses
Definition, 310.2
Use Group R, residential, 310.0
Boilers, 2801.3
Bond, masonry
Foundation walls, 1812.3.5
Masonry veneers, 1405.5
Masonry walls, 2109.0, 2110.0
Borings and tests of soils, 1802.0, 1803.0, 1804.0
Bracing
Adjoining existing buildings, 3309.3
Exterior stud walls, 2305.7
For stud walls and partitions, bearing, 2305.4.2
Masonry walls, lateral, 2107.0
Seismic, 1903.0, 1904.0, 2204.0, 2305.8, 2306.0
Brick (see Masonry)
Bridges
Over sidewalks (wrecking), 3304.3
Pedestrian walkways, 3106.0
Bridging, wood floors, 2305.16
Building
Allowable areas and heights, 503.0 Table 503
Alterations of existing buildings, 3401.0, 3404.0
Certificate of use and occupancy, 118.0
Change in use, 107.1, 3405.0
Classified by type of construction, 602.1
Classified by use or occupancy, 302.1
Condemnation of, 120.0
Construction precautions, Chapter 33
Definition, 202.0
Flood resistant, 3107.0
General limitations, Chapter 5
Height, definition, 202.0
Height modifications, 504.0
Heights, allowable, 503.0, Table 503, 504.0, 507.0
High-rise, 403.0
Historic, 3406.0
Maintenance, 3401.2
Moving, 3407.0
Permissible street projections, 3203.0
Temporary, 109.0
Two or more on same lot, 503.1.3, 1201.2
Unlimited area, 507.0
Unsafe, 119.0, 120.0
Building department
Required inspections, 105.8
General, 104.0
Records, 104.7
Building official (see Code official)
Building paper, 1405.3.6
Building permits (see Permits)
Business buildings, Use Group B, 304.0


## C


Caisson piles, 1824.0
Calculations required, 107.7
Canopies
Construction, 3105.5, 3205.4
Loads, 1609.6.2
On exterior walls, 3205.4
Over public property, 3205.1
Carbon dioxide extinguishing system (see Automatic fire suppression systems)
Cast iron, 2209.0
Cast stone
Bonding, 2109.0
General requirements, 2104.3
Catchment areas, 1012.2
Cavity walls
Definition (see Walls), 2102.0
Ceilings
Fireresistance rated assemblies, 713.0
Furred, 1204.1.3
Height, 1204.0
Panels, 713.1.1
Plenums, 2805.0
Cellar (see Basement)
Cement
Concrete, materials, mixes, 1906.0
Stucco, 2506.0
Water-cement ratio, 1908.2

Central-station system
Fire suppression system supervision, 924.1
Ceramic tile
Mortar, types and mix, 2104.0
Veneers, 1405.5
Certificate of occupancy
Existing buildings, 118.2, 118.4
General, 118.0
Temporary occupancy, 118.2
Chair lift, 1014.3
Change of occupancy, 107.1, 202.0, 3001.3, 3401.1, 3405.0
Changes to buildings
Alterations, 3401.1, 3404.0
Existing, 3401.0
Rehabilitation, 3401.1, 3404.0
Chases (see Masonry)
Chemicals
High-hazard use group, 307.0
Processing plants, 415.0
Child day care center
Use Group E, 305.0
Use Group R, 310.4.1
CHR regulated buildings, 119.0
Churches
Use Group A-4, assembly, 303.0
Chutes
Linen and refuse, 2807.0
Classification
Of buildings, by code official, 302.1
Of buildings, by occupancy, 302.0
Of buildings, by types of construction, 602.0
Of types of construction, 603.0, 604.0, 605.0, 606.0
Clay tile
General, 2104.0
Veneer, 1405.0
Clearances
Around concrete reinforcing, 1810.3.2
Around fireplaces, 2114.6
Around timber in masonry, 2305.6.3
Awnings, movable, 3203.9, 3203.10, 3205.2
Marquee awnings, 3203.11
Minimum ceiling heights, 1204.0
Of balconies above grade, 3203.8
Of wood above grade, 2311.4.2
Projection over sidewalks, 3203.0
Under first floor joists, 2311.4.1
Coal pockets, 418.3.1.6
Code official
Appoints inspectors, 104.3
Charge of building department, 104.1
Classifies building, 302.1
Definition, 202.0
Duties and powers of, 105.0
Inspections by, 105.4, 113.0
Issues permits, 105.2, 108.0
Liability, 104.6
Record of permits required, 105.7
Records, official, 104.7, 105.7
Reports, 105.8
Rule-making authority, 105.6
Columns
Cast-iron construction, 2209.4.1
Concrete-filled pipe, 1912.0
Fireresistance and protection of, Table 602, 716.0
Fireresistance tests, 704.0
Heavy timber construction, 605.1, 2304.0
Live load reduction, 1606.7
Working stresses, cast iron, Table 2210.2
Combustibility tests, 704.4
Combustible
Dusts, grain processing and storage, 307.4, 418.3.1
Fibers, 307.5
Liquids, 307.4, 418.3.2
Combustible materials
Decorative material restrictions, 807.0
Definition, 202.0
Exterior trim restrictions, 1406.0
Flameresistance tests, 807.2
Insulation, 707.5, 723.0
Interior trim, 803.5
Permitted in noncombustible construction, 602.4, 806.0
Compliance with permit, 111.3, 111.4
Computations, required, 107.7
Concealed spaces, 605.1, 721.6, 721.7, 723.3
Concentrated loads, 1613.0
Concrete
Aggregates, 1906.3
Caissons, 1824.0
Cementitious material, limitations, 1907.1.2.2
Columns, concrete-filled pipe, 1912.0
Definition, 1902.0
Footings, 1810.0
Minimum dimensions, 1905.0
Piles, 1816.0, 1817.0, 1821.0, 1823.0, 1824.0
Pipes in, 1909.3
Plain concrete, 1901.0, 1904.0
Reinforced (also see Reinforced concrete), 1901.0, 1910.0
Shotcrete, 1911.0
Units (also see Masonry), 2104.0
Concrete, masonry blocks (see Blocks, concrete masonry units)
Condensation, 1210.0, 1405.3.10
Condition of permits, 111.0
Construction
Approval of materials, etc., 104.0, 105.0, 106.0, 1704.0
Classification of construction materials, 1707.0
Concrete, 1908.0
Covered by code, 102.0
Equipment storage, 3312.0
Fences, 3304.2
General requirements, 602.0, 1701.0
Inspection, 113.0, 1705.0
Masonry, 2111.0
Material storage, 3312.0
Stage, 412.3
Steel, 2203.0, 2205.0, 2206.0, 2207.0, 2209.0, 2210.0
Types of construction, 603.0, 604.0, 605.0, 606.0
Wood, 2305.0
Construction documents
Alternative mechanical system, 108.5
Approval of, 108.5
Changes in, 107.1
Required, 107.5, 107.6
Construction operations
Demolition, 3310.0
Excavation, 3310.0
Existing buildings, 3309.0
Fire hazards, 3305.0
General, 3301.0
Lighting, 3315.0
Retaining walls, 3311.0
Storage, materials, 3312.0

Control areas (for hazardous materials), 417.2
Conveyors, 3010.0
Cooling towers, 1510.8
Coping
    Flashing, 1405.3.10
    On retaining walls, 1825.4
Corbeling, masonry, 2111.0
Cornices
    Masonry, 2111.2.1
    Projections, 3203.0
    Type of construction, 1406.0
Corridors
    Arrangements, 1006.1, 1011.1
    Capacity of egress width, 1009.0
    Dead ends, 1011.2
    Definition, 1002.0
    Fireresistance ratings, Table 602
    Height, 1204.0
    Obstructions, 1011.1
    Prohibited use, 1005.0
    Widths, 1009.0, 1011.3
Courts
    Definition, 1202.0
    General, 1212.0.0
    Obstructions, 1213.0
    Permissible encroachments, 1213.0
Covered mall buildings
    Definition, 402.2
    General, 402.0
    Smoke control systems, 921.1
Coverings
    For exterior stairs, 1014.12
    For exteriors, weather protection, 1405.2.1
    Interior finishes, 803.0
    Roofs, Chapter 15
Crawl spaces
    Access to, 1211.1
    Foam plastics, 2603.4.1.4
    Plenums, 2805.1
    Ventilation, 1210.2
    Waterproofing, 1813.1.2
Cupolas, construction, 1510.9
Curtain boards, 923.3
Curtain wall
    Ratproofing, 1215.0
Curtains (also see Decorations)
    Atrium separations, sprinkler obstructions, 404.5
    Decorative material restrictions, 404.3, 807.1
    Proscenium, 412.3.6.4


## D


Dampers
    Ceiling, where required, 713.4.2.3
    Fire, accessibility, 718.3
    Fire, approved type, 718.1
    Fire, definition, 702.0
    Fire, where required, 718.2
    Smoke, 718.2.1
    Smoke, where required, 712.5
Dampproofing 1813.0
Dance halls
    Use Group A-2, assembly, 303.0
Dangerous structures, 119.0, 120.0
Day care facilities (see Child day care center), 422.1-422.11
    Use Group E, 305.0
Dead loads
    Definition (see Load), 1602.0
    Design, 1605.0
Decisions of board of appeals, 121.6
Decorations (also see Interior finish and trim)
    Atriums, 404.3
    Curtains, 404.5, 412.3.6, 807.1
    Flameresistance tests, 807.2
    Restrictions, 807.0
    Stages, 412.3.5.1
Decorative features
    Projections, 3203.0
Definitions, 202.0
Deflection criteria, 1604.5, 1709.3.2
Demolition
    General, 110.0
    Permit, when required, 110.1
    Standpipes maintained, 3305.3.4
    Unsafe buildings, 119.0
Depth of footings
    Governed by frost line, 1806.0
    Governed by loading, 1805.0
Design
    Approved by code official, 1704.1
    Cast-in-place concrete piles, 1820.0
    Composite piles, 1823.1
    Dead load, 1605.0
    Fire protective requirements (see Fire protection systems)
    Formed steel construction, 2206.1
    Foundation walls, 1812.1
    General, 1601.0
    Glass, glazing, 2402.0, 2403.0
    Live loads, 1606.0, 1607.0
    Lumber and timber construction, 2303.1
    Masonry wall construction, 2101.0
    Plain concrete, 1901.1
    Plastics, 2603.0
    Precast concrete piles, 1821.0
    Proscenium curtains, 412.3.6
    Reinforced concrete, 1901.0
    Retaining walls, 1825.2
    Safe load, 1604.0
    Seismic (earthquake), 1610.0
    Signs, general requirements, 3102.6
    Special steels, 2207.1
    Steel pipe and tapered tubular piles, 1819.0
    Wind loads, 1609.0
Detection systems, automatic fire (also see Fire protection systems)
    Airport traffic control towers, 414.4
    Approval, 919.3
    Atriums, 404.6
    Definition, 902.0
    Elevator lobbies, machine rooms and hoistways, 3006.2.1
    General requirements, 919.0
    High-rise buildings, 403.4
    HPM facilities, 416.9.2
    Plans and specifications, 919.2
    Smoke control systems, 922.4
    Special amusement buildings, 413.3
    Sprinklered buildings exception, 919.5
    Underground structures, 405.5.1
    Use Group H, 417.5.3
    Where required, 919.4, 919.10
    Zones, 919.6

Deviations
From code, 106.4
Display of permit, 108.8
Doors
Air-supported structures, 3104.8
Approved type, fire, 717.1, 717.2
Arrangement, 1006.2, 1017.2.3
Automatic-closing devices for, 717.5
Bolts, surface, 1017.4.1.1
Corridors, 1011.1.4, 1011.4.2
Egress, means of, 1017.0
Exterior walls, 706.4
Fire (see Fire doors)
Fire partitions, 711.0
Fire separation walls, 709.0
Fire walls, 707.0
Floor surface at, 1017.1.1
In horizontal exits, 1019.2
In pedestrian ways, 716.5.2
Locks and latches, 1017.4.1
Location of, 1006.0, 1017.4
Panic hardware, 1017.4.2
Power operated, 1017.4.3
Rated fire door assemblies, 717.1
Required to open out, 1017.4
Revolving, 1018.0
Stairways, exterior, 1014.12.2
Stairways, interior, 1014.8
Security grilles, 1017.5
Signs, 1017.4.1, 1017.4.1.2
Sliding, 717.5.2, 1017.4.4
Smokeproof enclosures, 1015.4.1, 1015.5.1, 1015.5.2, 1015.6.1
Stages, 412.3.4
Use Group I-3, 410.3, 410.4
Width of, 1017.3
Wired glass in, 720.0
Dormers, 1510.6
Dormitories
Definition (see Dwellings), 310.2
Use Group R-1, residential, 310.0
Doubtful use classification, 302.1
Downspout
For roofs, 3203.11.3
Materials, 1406.0
Draftstopping (also see Fireblocking)
Definition, 702.0
General, 721.0
Where required, 721.7
Drainage
Foundation systems, 1813.5
Marquees, 3203.11.3
Dressing rooms (see Theaters)
Dust, combustible, 418.3.1
Dry cleaning plants
General, 418.3.4
Use group classification, 306.0
Drying rooms, 2806.0
Drywall (see Gypsum board)
Ducts
Fire dampers required in, 718.0
Firestopping openings, 721.6.4
Dumbwaiter
Definition, 3002.0
Enclosures, 3007.1.2, 3007.1.3
Hoistway vent requirements, 3007.3, 3007.4, 3007.5
Opening protectives, 3008.0
Dusts, combustible, 307.4, 418.3.1
Duties
Of board of appeals, 121.0
Of code official, 105.0
Of employees, 104.5
Dwellings
Area and height limitations, general, 503.0, Table 503
Ceiling height, 1204.1
Definition, 310.2
Fire partitions in, 310.5, 711.1, 711.2
Floor area, minimum, 1204.2
Separation (see walls)
Use Group R, residential, 310.0

## E

E, use group, educational, 305.0
EIFS (see Exterior insulation and finishing systems)
Earthquake (seismic) design
Concrete, 1903.0, 1904.0
Foundations, 1810.2.1, 1815.2, 1816.3, 1816.11, 1818.3, 1819.3, 1820.1.2, 1820.5.4, 1821.3.5, 1821.3.6, 1824.3
Inspection related to, 1705.3.3.2, 1705.4.5, 1705.9, 1705.10, 1705.11
Loads, 1610.0
Masonry, 2101.2, 2104.0
Soils, 1802.1.1, 1805.2, 1805.3
Steel, 2203.2, 2203.2.1, 2204.0, 2206.3, 2207.2.1
Wood, 2305.8, 2305.9, 2306.0
Eaves
Construction, 1406.0
Draftstopping, 721.7.2
Projection, 3203.0
Educational buildings, Use Group E, 305.0
Egress (see Means of egress)
Electrical equipment and systems, Chapter 27
Elevated walkways, 3106.0
Elevators
Certificate of compliance, 3005.0
Change in use, 3001.3
Definition, 3002.0
Electric wiring and equipment, 3001.0
Enclosures, 3007.1.1
Existing, 3013.0
Exit restrictions, 1006.6
Fire department use, 3006.2
For high-rise buildings, 403.8
General, 3001.0
Hoistway venting, 3007.3, 3007.4, 3007.5, 3007.6
Identification of, 3003.3
Machinery room, 3015.0
Maintenance, 3012.0
Opening protectives, 3008.0
Operator, 3006.0
Permits, 3003.2
Plans and specifications, 3003.1
Referenced standards, 3001.2, 3014.0
Tests and inspections for, 3004.0, 3005.3.1
Wheelchair lifts, 3002.0
Emergency
Control station (HPM), 416.2
Controls, proscenium curtains, 412.3.6.4
Electrical systems, 2706.0
Escape, 1010.4

Lighting, 1024.0
Signs for exits, 1023.0
Emergency electrical systems (also see Standby power systems)
Exit signs, 1023.4
General, 2706.0
High-rise buildings, 403.9.3
Means of egress lighting, 1024.4
Underground structures, 405.9
Use Group I-3, 410.4.5
Emergency measures
Closing streets, 120.3
Temporary safeguards, 120.2
Vacating structures, 120.1
Employees, restrictions on, 104.5
Enclosure
For elevators, 3007.1.1
For interior stairs, 1014.11
For motion picture projection rooms, 411.2
Of exterior stairways, 1014.12
Ramps, 1016.0
Shafts, 710.0
Enclosure walls (see Walls)
Encroachments
Awnings and canopies, 3203.9
Court, 1213.0
Existing, 3202.6
General, 3201.0
Special and temporary, 3204.0
Street, 3202.0
Yard, 1213.0
Energy conservation, Chapter 13
Enforcement of code, 105.0
Engineering calculations, 107.7
Engineering practice, 114.1
Escalators, 1006.6, 3011.0
Escape and rescue windows, 1010.4
Excavations
Protection of, 3310.0
Protection of adjoining property, 3308.0
Walkways over, 3304.3
Exempt amounts (of hazardous materials), Tables 307.8(1) and 307.8(2)
Exhaust systems
Contaminants to outdoor air, 1208.3
Spray spaces, 419.2
Existing buildings
Additions, alterations, repairs, Chapter 34
Areas, allowable, Table 503, 3403.1
Certificate of occupancy, 118.0
Change in existing use, 3405.0
Change of occupancy, 3405.0
Condemnation of, 119.1
Continuation of, 102.2
Definition (see Building), 202.0
Demolition, 110.0
General requirements, 3401.0
Inspection of, 105.4, 113.0
Maintenance, 3401.2
Moving, 3407.0
Nonstructural alterations and repairs, 3404.0
Protection during construction operations, 3304.0
Roof coverings, 1512.0
Unsafe, 119.0
Existing electrical installations, 2708.0
Existing signs, 3401.0
Exit lights, 1023.0, 1024.0
Exit signs, 1023.0
Exits (see Means of egress)
Expiration of permit, 108.2
Explosion
Hazards, 307.3
Relief, 418.3.1.4
Suppression, 417.5.1.2
Venting, 417.5.1.1, 418.3.2.9
Exterior insulation and finishing systems (EIFS), 1405.8, 1705.13
Exterior opening, protection required, 706.0
Exterior stairways, 1014.12
Exterior trim restrictions, 1406.0, 705.1.2
Exterior walls
Fireresistance ratings, 507.2, Table 602, 705.0
General, Chapter 14
Extinguishers, fire, 921.0


## F


F, use group, factory and industrial, 306.0
Faced (veneered) walls (see Walls)
Factory buildings
Use Group F, factory and industrial, 306.0
Use Group H, high-hazard, 307.0
Farm structures, 101.4
Fasteners
Roof construction, 1505.2, 1507.0
Schedule, Table 2305.2
Weather coverings, 1405.3.7
Wood construction, 2305.2
Fees
For demolition, 112.2
For moving of buildings, 112.2
For new construction and alterations, 112.3.1
For signs, 112.2
General, 112.0
Payment of, 111.1, 112.1
Schedule, 112.3.1
Special, 112.2
Fences
Excavations, 3310.0
For construction purposes, 3304.2
General requirements, 3311.0
Use Group U, 312.0
Film
Projection rooms, 411.0
Storage and use of flammable film, 411.1
Finish, interior (see Interior finish and trim)
Fire
Alarm system (see Fire protection system)
Area, definition, 702.0
Dampers, 718.0
Emergency ventilation system, 402.7.1
Firestopping, 107.7, 721.0
Hydrants, 917.0
Sprinklers and standpipes, 904.0, 906.0, 915.0
Fireblocking (see also Draftstopping)
Architectural trim, 721.6.5, 1406.2.4
Between wood sleepers, 721.6.7, 806.2
Definition, 702.0
General requirements, 721.0
In floor construction, 806.3

In roof construction, 715.5
Where required, 721.6
Fire dampers (see Dampers)
Fire department
Fire command station for, 403.7, 902.0, 918.9
Connections, 916.0
Fire detection systems, 919.0
Fire doors
Closing devices, 717.5
Corridors, 1011.4.2
Definition (see Doors), 702.0
Dressing rooms, 412.5.2
Exterior walls, 706.0
Fire partitions, 711.3
Fire separation walls, 709.3
Fire walls, 708.3
General, 704.3, 717.0
Horizontal exits, 1019.2.1
Proscenium walls, 412.3.5
Shafts, 710.3.1
Smoke barriers, 712.4
Stage enclosures, 412.3.4
Stairways, 1014.8.3
Wired glass, 717.4, 720.0
Fire emergency ventilation system, 402.7.1
Fire escapes
General, 1025.0
Maintenance of, 1028.0
Fire extinguishers, 921.0
Fire lane, 506.2
Fire protection systems (see also Detection systems, automatic fire)
Area increased by, 506.3
Automatic fire detection systems, 919.0
Automatic fire detection, where required, 919.4
Carbon dioxide extinguishing system, 909.0
Clean agent fire extinguishing system, 913.0
Construction documents, 903.0
Dry-chemical extinguishing system, 910.0
Fire department connection, 916.0
Foam-extinguishing system, 911.0
General requirements, 901.0
Halogenated fire-extinguishing system, 912.0
Height increased by, 504.2
Hydrants, 917.0
Limited area sprinkler system, 907.0
Manual fire alarm system, 918.0
Manual fire alarm system, where required, 918.4
Nonrequired systems, 901.3
Outside sprinklers, 706.2, 906.2.1
Plans and specifications (see Construction documents)
Smoke control systems, 922.0
Where required, 404.4, 410.8, 1013.2.3
Standpipes, where required, 915.2
Supervision, 924.0
Suppression system selection, 905.0
Temporary standpipe requirements, 3305.0
Voice alarm system, definition, 902.0; 403.5, 404.6, 405.6, 918.9
Water-spray fixed systems, 908.0
Water sprinkler system, 906.0; where required, 904.0
Wet chemical range hood extinguishing system, 914.0
Yard hydrants, 917.0
Fire pumps, power source, 403.9.1.3
Fire separation distance, 507.1, Table 602, 702.0, 705.0
Fire shutters, 719.0
Fire suppression system (see Automatic fire suppression systems)
Fire towers (see Smokeproof enclosure), 1015.0
Fire walls, 707.0
Fire windows, 719.0
Fireplaces, 2114.0
Fireresistance ratings
Assemblies, Table 602, 704.0
Definition, 702.0
Embedments, 715.3, 1909.3.3
Exterior opening protectives, 706.0
Exterior walls, 705.0
Fire dampers, 718.0
Fire doors, 717.0
Fire partitions, 711.0
Fire separation walls, 709.0
Fire wall openings, 708.0
Fire walls, 707.0
Fire windows, 719.0
Floor construction, 313.2, 313.3, 709.0, 713.0
General, 701.0
Plans and specifications, 703.1
Roof construction, 715.0
Shafts, 710.0
Smoke barriers, 712.0
Special requirements, 504.6, 504.7
Structural members, 716.0
Tests, 704.0
Fireresistance ratings of structure elements, Table 602
Fireresistive joint system, definition, 702.0, 713.5
Fireretardant-treated wood
Labeling, 2310.2.2
Strength modifications, 2310.2.1
Tests, 2310.2
Use limitations, 2310.1
Firestopping (see Fireblocking)
Through-penetration firestop system, 714.2.3
Flag poles, 1510.1
Flameresistance
General, 807.2
Interior floor finishes, 805.0
Interior hangings and decorations, 807.0
Interior trim, 803.5
Interior wall and ceiling finishes, 803.4
Tests, 807.2
Textile wall coverings, 803.6
Flammable liquids, 307.0, 417.0, 418.0
Flashing, 1405.3.10
Floodproofing, 3107.0
Floor
Area, 503.0, Table 503, 506.0, 507.0
Assemblies, construction, 713.0
Combustible materials permitted in Types 1 and 2 construction, 602.4, 806.0
Finish, 802.0, 805.0
Floor area, definition, 1002.0
Level of exit discharge protection, 1006.3.1
Loads, 1606.0
Public garages, 408.3.3
Ratproofing, 1215.0
Surface, at doors, 1017.1.1
Surface, slip resistance, 1005.4
Theater stages, 412.3.1
Wood panel sheathing, 2307.0

Floor openings
- Atriums, 404.0
- Shaft enclosure exceptions, 713.3

Foam-extinguishing systems, 911.0
Foam plastics
- Diversified tests, 2603.8
- Exterior walls, 2603.4.1.10
- General, 2603.1
- Insulation, 722.0, 2603.4.1.5
- Interior finish and trim, 804.3.1, 2603.7
- Labeling, 2603.2
- Prescriptive installations, 2603.4.1

Footings
- Allowable loads, 1804.0, 1805.0
- Concrete, design, 1810.0
- Depth, 1806.0
- Design, 1807.0
- Forming, 1810.6
- Frost protection, 1806.1
- Masonry, 1811.0
- Prepared fill, 1705.7
- Reinforced concrete, 1810.3.2
- Soils report, 1804.1, 1804.1.1
- Steel grillage, 1809.0
- Timber, 1808.0

Formed steel construction, 2206.0
Foundation systems
- Allowable loads, 1805.0
- Caissons, 1824.0
- Design, 1812.1
- Footings (see Footings)
- For neighboring building, 3310.2
- May project beyond property line, 3202.2
- Minimum depth, 1806.0
- Minimum thickness, 1812.3
- Piers, 1815.0
- Piles, 1816.0 through 1824.0
- Ratproofing, 1215.1
- Steel grillage, 1809.0
- Walls, 1812.0
- Wood and timber, 1808.0

Foyer, 1006.2.4
Frame construction, wood
- General requirements, 2303.0, 2305.0, 2306.0

Frost protection
- Depth of footings, 1806.1


## G


Garages
- Beneath a dwelling, 407.3
- Beneath other uses, 313.2
- Construction of public garages, 408.3
- Definition, 407.2, 408.2
- Fire doors, 407.6
- Floor construction, 408.3.3
- Open parking structures, 406.0
- Private, 407.0
- Public, 408.0
- Separations, 407.3, 407.4, 407.7
- Storage of flammables, 408.4, 408.5
- Ventilation, 408.5

Garages, private
- Connected to dwelling, 407.3, 407.4, 407.7
- Definition, 407.2
- Use Group U, utility and miscellaneous, 312.0

Garages, public
- Construction limited, 408.3
- Definition, 408.2
- Fire suppression system required, 408.3.1
- Use Group S-1, storage, 311.0
- Ventilation required, 408.5

Gardens, roof, 1008.3
Gas
- Fired appliances, 2801.6
- Hazardous, 307.0, 417.0, 418.0

Glass and glazing
- Area required for natural light, 1206.2
- Atrium enclosure, 404.5
- Block reinforcement, 2118.4
- Block walls, 2104.4, 2118.0
- Dimensional tolerances, 2402.4
- Doors, 2405.2
- Fire windows, 719.0
- Greenhouses, 2404.4
- Guards, 2406.0
- Handrails, 2406.0
- Impact loads, 2405.1
- In fire doors, 719.0, 720.0
- Jalousies, 2402.5
- Labeling, 2402.1
- Plastic (see Light-transmitting plastics)
- Protected openings, 719.0, 720.0
- Racquetball and squash courts, 2407.0
- Safety, 2405.0
- Skylights, 2404.0
- Sloped, 2404.0
- Supports, 2402.2
- Unsupported edges, 2402.3
- Veneer, structural, 1405.7
- Wind loads, 1611.0, 2403.1
- Wired glass, 720.0

Glazed masonry units, 2104.2
Glazing (see Glass and glazing)
Glued-laminated lumber construction, 2313.1
Grade/Grade plane
- Definition, 502.0
- Depth of footings below, 1806.0

Grading a lot, 3310.4
Grain processing and storage, 415.1, 418.3.1
Grandstands, 1002.0, 1013.0, 1614.5
Greenhouses
- Definition, 1608.2
- Glazing, 2404.4, 2607.4
- Loads, 1608.0
- Membrane structure materials, 3103.3.2

Grounding
- Metal veneer, 1405.4.3
- Radio and television towers, 3108.5

Group homes
- Use Group I-1, institutional, 308.0

Grout (also see Mortar), 2104.0
Guards
- Balconies, 1005.5
- General, 1021.0
- Glass in, 2406.0
- Guardrail system, definition, 1021.1
- Open parking structures, 406.5
- Retaining walls, 1825.5
- Stairways, 1014.7
- Structural design, 1606.4
- Wheel, 406.6, 408.3.2

Gutters
For roof 3203.11.3
Materials, 1406.0
Gypsum
Construction, 2504.0
Gypsum board
Installation, 2503.3
Materials, 2503.1
Standards, 2503.2

## H

H, use group, high-hazard, 307.0
Habitable space
Definition, 1202.2
Halogenated extinguishing systems, 912.0
Handicapped and aged, requirements for, Chapter 11, 3006.3
Handrails
Definition, 1022.1
Details, 1022.2
General, 1022.0
Grandstands and bleachers, 1022.0
Ramped aisles, 1012.5
Ramps, 1016.5, 1022.2
Stairways, 1014.7, 1022.2
Structural design, 1606.4
Hardware on exit doors, 1017.4
Hazardous uses
General, 416.0, 417.0, 418.0
High-hazard, 307.0
Low-hazard, 311.0
Moderate-hazard, 311.0
Production materials (HPM), 416.0
Prohibited locations, 313.2
Storage segregation, 417.0
Headroom
Ceiling heights, 1204.0
Ramps, 1016.2.2
Stairways, 1014.4
Hearth for fireplace, 2114.5
Heating systems
Fireplaces, 2114.0
Gas-fired equipment, 2801.2
General requirements, 2801.0
Heavy timber construction, 605.0, 2304.0, 2306.1
Height
Awnings, 3203.9, 3203.10
Buildings (see Height, buildings)
Ceiling, 1204.0
Guards, 1021.2
Handrails, 1022.2.2
Marquees, 3203.11.1
Masonry veneers, 1405.5
Parapet walls, 705.6, 707.6
Permissible street projections, 3203.0
Stairway, maximum vertical rise, 1014.5
Towers, spires, cupolas, aerial supports, poles, etc., 1510.0
Height, buildings
Airport traffic control towers, 414.0
Allowable, 503.0, Table 503
Alterations for existing buildings, 3403.1
Covered mall buildings, 402.1, 402.7
Definition, 502.0
High-rise, 403.1, 403.3.3.1
HPM facilities, 416.3
Membrane structures, 3103.3.5
Modifications, 504.0
Open parking structures, 406.4
Restrictions, 503.3, 507.1
Special industrial uses, 503.1.1
Unlimited area buildings, 507.0
Heliport, rooftop, 1511.0
High-hazard
Accessory areas to, 302.1.2.1
Application of flammable finishes, 419.0
Classification, 302.1
Control areas, 307.8, 417.2
Exceptions, 307.8
Exempt quantities, 307.8, Table 307.8(1), Table 307.8(2)
Explosion control, 417.5.1
Flammable and combustible liquids, 418.3.2
Hazardous materials, 417.0
Liquefied petroleum gas distribution facilities, 418.3.3
Multiple hazards, 307.7
Outside storage, dispensing and utilization, 417.6
Unlimited area structures, 507.1, 507.1.2
Use group requirements, 417.0, 418.0
Use group structure height exemption, 504.5
Use groups, 307.0
High-rise buildings
Alarm and communication systems, 403.5, 403.6
Applicability, 403.1
Automatic sprinkler system, 403.2, 403.3
Central control station, 403.7
Elevators, 403.8
Emergency systems, 403.9
Exits in, 403.10
Seismic consideration in, 1610.6
Smoke detection systems, 403.4
Historic buildings and districts, 3406.0
Homes for aged
Use Group I-1, institutional, 308.0
Horizontal exits
Definition (See Means of egress), 1002.0
General requirements, 1019.0
Hospitals
Use Group I-2, institutional, 308.0
Hotels
Bed and breakfasts, 310.2
Definition (see Dwellings), 310.2
Use Group R-1, residential, 310.0
House, lodging
Use Group R, residential, 310.0
HPM use facilities, 416.0
Hydrants, fire yard systems, 916.0

## I

I, use group, institutional, 119.0, 308.0
Identification
For plastics, 2601.2
For signs, 3102.4.5
For fire protection system values, 906.6
Illuminated signs, 3102.13
Industrial
Use Group F, factory and industrial, 306.0
Infirmaries
Use Group I-2, institutional, 308.0
Inner court
Definition (see Courts), 1202.0

Insane asylums
Use Group I-3, institutional, 308.0
Inspection
By code official, 105.4, 113.0
Final, 113.3
Of electrical wiring, 2701.5, 2704.0
Of existing buildings, 105.4
Of heating systems, 2804.0
Of prefabricated construction, 113.2.2
Of signs, 3102.5.4
Of unsafe buildings, 119.0
Required preliminary, 113.1, 113.2
Special, 1702.0, 1705.0
Insulation
Cellulosic, 723.1, 723.4
Fiberboards for roof, 2309.3
Fiberboards for wall, 2309.4
Foam plastics, 803.3.1, 2603.0
Thermal insulating materials, requirements, 723.0
Interior environmental requirements, Chapter 12
Interior finish and trim
Application of, 804.0
Classification of materials, 803.2, 803.4
Decorative material restrictions, 807.0
Flame spread of, 803.2, 803.4
Flameresistance tests, 807.2
Floor finishes, 805.1, 805.2
Foam plastics, 803.3.1, 2603.0
General requirements, 803.0
Restrictions in Types 1 and 2 buildings, 806.0
Special amusement buildings, 413.6
Textile wall coverings, 803.6
Use group requirements, 803.4, Table 803.4
Interior lot lines, definition (See Lot), 202.0


## J


Jails
Use Group I-3, institutional, 308.0
Jalousies
Windows and doors, 2402.5
Joints
Control, 602.4.1
Collar, definition, 2102.0
Expansion, 2118.3
Head, definition, 2102.0
Jurisdiction
Adopting this code, 101.1


## L


Label, definition, 1702.0
Labeling, 1703.1.1, 1704.3
Ladder
Roof access, 412.5.3, 1027.1
Swimming pool, 421.5.5
Landing of stairs, 1014.3.2, 1014.5
Landings of ramps, 1016.4
Lathing and plastering, 2505.0, 2506.0
Leakage alarms, 418.3.2.6
Liability, code official, 104.6
Licenses
Fees for, 112.0
Lift, chair (see Chair lift)
Light, illumination
Artificial, 1207.0
Court requirements for, 1212.0
For existing buildings, 3401.0
For exit signs, 1023.0
General, 1201.0
Natural, 1206.0
Required, 1205.0
Window requirements, 1206.2
Light-transmitting plastics
Approved types, 2604.1
Bathroom accessories, 2604.7
Connections, 2604.3
Definition (see Plastics), 2602.0
Glazing of unprotected openings, 2606.0
Light-diffusing systems, 2604.5
Partitions, 2604.6
Roof panels, 2607.0
Skylights, 2608.0
Linen chutes, 2807.0
Lintel
Fire protection, 716.2
Over openings, frame construction, 2305.11
Liquids
Flammable and combustible, 307.4, 417.0, 418.0
Liquefied petroleum gases, 307.4, 418.3.3
Load, design, 1604.0, 1605.0, 1607.0, 1708.0
Load, earthquake (see Earthquake design)
Load, glass
Impact loads, 2405.1
Jalousies, 2402.5
Wind loads, 2403.1
Load, impact
Assembly structures, 1614.5
Craneways, 1614.4
Definition, 1602.0
Elevators, 1614.2
Grandstands, 1614.5
General, 1614.1
Machinery, 1614.3
Load (live, dead, floor)
Combination of, 1613.1
Concentrated, 1613.0
Craneways, 1614.4
Definition, 1602.0
Deflections allowable, 1604.5
Documentation of, 1603.0
Earthquake, 1612.0
Floor loads, occupancy, 1606.1, Table 1606.1
Footings and foundations, 1805.0, 1807.0
For concrete footings, 1807.0, 1810.0
For retaining wall design, 1825.0
Glass (see Load, glass)
Guards, 1606.4
Impact (see Load, impact)
Interior finish, 803.7
Piles, allowable, 1817.0
Railings, 1606.4
Reductions allowed, 1608.0
Roof, 1609.0, 1611.0
Snow, 1610.0
Soil, bearing capacity, 1804.0
Special, 1615.0
Tests, 1604.3
Uniform, 1606.0
Wind (see Load, wind)

Load, wind
Chimneys, 1611.0
Exterior walls, 1611.0
General requirements, 1611.0
Glass, 2403.1
Roofs, 1609.0, 1611.0
Signs, 1611.0
Lobbies and passageways as exits, 1020.0; definition, 1002.0
Lodging houses (see Boarding houses)
Lot
Definition, 202.0
Interior lot line, definition (see Lot line), 202.0
Line fences, 3311.1
Plot plan required, 107.6
Regulations for, 3310.4, 3310.5
Lumber (also see Wood construction)
Grade of, 2301.1

## M

M, use group, mercantile, 309.0
Machinery, 2701.6
Maintenance
Of buildings and structures, 3401.2
Of exit facilities, 1028.2
Of fire protection systems, 901.4
Of signs, 3102.5.2
Malls, covered (see Covered mall buildings)
Manlifts, 3001.2
Mansard roofs, 1510.5
Manual fire alarm systems, 918.0
Marquees (also see Canopies)
Construction requirements, 3105.0, 3203.11.5, 3205.3
Definition, 3203.11
Drainage of water, 3203.11.3
Signs, 3102.11, 3203.11
Masonry
Anchorage, 2110.0
Bonding, 2109.0
Brick, 2104.0
Chases and recesses, 2112.1
Concrete units, 2104.0
Construction requirements, 2111.0
Corbeled and projected, 2111.2
Cornices, 2111.2.1
Definition, 2102.0
Design, 2101.1.1, 2101.1.2
Fireplaces, 2114.0
Footings, 1811.0
Foundations, 1812.0
Freezing protection, 2111.3
Glass block, 2118.0
Glazed units, 2104.2
Hollow, definition of, 2102.0
Hollow units, 2104.1
Lateral bracing, 2105.0, 2107.0
Lintels, 2112.2
Minimum thickness, 2108.0
Mortar, 2104.7
Reinforced, 2101.1.1
Reuse of, 2104.6
Solid, definition of, 2102.0
Solid units, 2104.1, 2104.2
Stone, cast, 2104.3
Stone, natural, 2104.3
Support on wood, 2112.3
Tests, general, 1701.0
Tile, structural, 2104.2
Veneers, 1405.5
Matches
Use Group H, high-hazard, 307.0
Materials
Alternative, 106.4, 1701.2
Approvals, 106.1, 1704.0
Used, 1701.3
Matters not provided for, 102.3
Means of egress
Aisles and aisle accessways, 1012.0
Arrangement, 1006.2
Buildings with one exit, 1010.3, Table 1010.3
Capacity, 1009.0
Corridors, 1011.0
Corridors and passageways, required width for, 1011.3, 1012.0
Definition, 1002.0
Doors, revolving, 1018.0
Doorways, 1011.4.2, 1014.8, 1017.0, 1018.0, 1019.2.1
Elevator and escalator restrictions, 1006.6
Enclosure, 1011.4, 1014.11, 1015.0
Exit signs, 1023.0
Exterior exit stairways, 1014.12
Fire escapes, 1025.0
From places of assembly, 1006.2.2
General provisions, 1001.0
Hardware, 1017.4
Hazards to, 1005.0
Horizontal exits, 1019.0
Interior exit stairways, 1014.0
Length of travel, 1006.5
Level of exit discharge passageways and lobbies, 1020.0
Lighting, 1024.0
Location and type of, 1006.0
Maintenance of exits, 1028.0
Number of exits required, 1010.0
Occupant load, 1008.0
Opening protectives, 1011.4
Protection of passageways and corridors, 1011.0
Prohibited use, 1005.0
Ramps, 1016.0
Remoteness, 1006.4
Slidescapes, 1026.0
Smokeproof enclosure, 1015.0
Spiral stairways, 1014.6.4
Stairway, construction, 1014.9
Through adjoining spaces, 1006.2.1
To roof, 1027.0
Mechanical refrigeration (see Refrigeration)
Mechanical ventilation (see Ventilation)
Medical gases, 2902.0
Membrane structures
Definition, 3103.2
General, 3103.0
Mercantile display (of hazardous materials), 417.2.1
Metal siding
Corrosion protection, 1405.3.8
Thickness, 1405.3
Mezzanines
Definition, 502.0
General, 505.0
Mirrors, 1006.2.4.1
Miscellaneous buildings
Use Group U, utility and miscellaneous, 312.0

Miscellaneous signs, 3102.0
Mixed uses, 313.0
Mobile units, requirements, 420.0
Modification of code provisions
By board of appeals, 121.0
Of area, 506.0
Of height, 504.0
Variations, 105.6, 106.2, 106.4
Written, 106.2.1
Mortar, 2104.0, 2111.0
Motion picture film storage, 411.1
Motion picture projection and screening rooms, 411.0
Motion picture screening rooms, 411.6
Motion picture studios, 411.7
Moved structures, 3407.0
Multiple dwelling
Definition (see Dwellings), 310.2
Use Group R-2, residential, 310.0

## N

Nails
Fastening schedule, 2305.2, Table 2305.2
New materials or methods of construction
Alternative materials and methods of construction, 106.4, 1701.0
Board of adjustments and appeals, 121.1
Night club, Use Group A-3, assembly, 303.0
Noncombustible construction, 603.0
Noncombustible building material (see Definitions), 704.4, 704.4.1.1
Notching (wood frame construction) (see Wood construction, cutting and notching)
Notices
Board of appeals meeting, 121.3
Of violations, 116.1
Of work starting, 108.9
Posting occupancy load, 1003.2, 1003.3
Posting permits, 108.8
Stop work order, 117.0
Unsafe buildings,120.1

## O

Occupancy
Certificate of, 118.0
Change in occupancy, 3405.0
Covered by code, 102.0
Definition, 202.0
Occupant load
Allowances, 1008.0, Table 1008.1.2
Definition, 1002.0
Maximum, 1008.1.5
Posted, 1003.3
Occupiable space, definition, 1202.0
Office buildings
Use Group B, business, 304.0
Open parking structures
Beneath other uses, 313.2
Definition, 406.1
Exits, 1010.5
Height and area, 406.4
Protective railings, 406.5
Type of construction permitted, 406.2
Use Group S-2, storage, low-hazard, 311.0
Wheel guards required, 406.6
Openings
Exterior opening protectives, 706.0
Horizontal protection, 705.3
In fire partitions, 711.0
In floors, 713.3
In shaft enclosure walls, 710.3.1
On or near exterior stairways, 1014.12.2
Protected with fire doors or windows, 704.3
Separation, 705.4
Vertical protection, 705.5
Ordinary repairs, 3401.2
Oriel window
Definition, 3203.2
Materials, 3203.2
Oriented stand board (OSB) (see Wallboard, wood structu panel)
Outdoor (outside)
Assembly, Use Group A-5, 303.6
Processing facilities, 415.0
Storage of hazardous materials, 417.6
Owner
Definition, 202.0
Responsibility, 3401.2

## P

Paint
Of formed steel, 2206.4
Of structural steel, 2203.5
Spraying and spray booths, 419.0
Storage, 307.8, 419.2.3
Panel walls
Glass block, 2118.0
Thickness, 1404.6
Panels
Fire fighter access, glass in, 2405.3
Stressed skin, 2313.2
Panic hardware, on exit doors, 1017.4
Parapet wall, 705.6, 707.6
Parking structure, open (see Open parking structures)
Particleboard
Definition, 2302.0
Requirements, 2308.0
Party walls
Affected by excavations, 3310.0
Construction of, 707.0
Continuity, 707.6
Definition (see Walls), 702.0
Parapets required, 707.6
Size and construction of openings, 708.0
Passageways
Corridors, 1011.0
Horizontal exits, 1019.0
Lobbies as exits, 1020.0
Obstructions prohibited, 1028.1
Pedestrian walkways, 3106.0
Penalties and violations, provided by code, 116.0
Penthouse
Definition, 1502.0
General requirements, 1510.3
Permits
Action on applications, 108.1
Amendments to, 107.8
Application for, 107.2, 107.3, 107.4
Approval in part, 108.7
Awnings, 3205.1

Conditions of, 110.0, 111.0
Definition, 202.0
Electrical, 2703.0
Examination of drawings, 108.5
Expiration, 108.2
Fees, 112.0
For awnings and canopies, 3205.1
Issued upon affidavits, 107.3
Posting of, 108.8
Records to be kept, 106.2.1, 108.5
Required, 107.1
Revoked, 108.6
Signs, 3102.4
Suspension of, 108.2
Temporary, 108.7
Time limitation, 107.9
To demolish buildings, 110.1
To move buildings, 3407.0
Validity, 103.0
Valuations, 112.0
When required, 107.1
Petroleum storage
Flammable and combustible liquids, 417.0, 418.0
Liquefied petroleum gases, 418.3.3
Piers
Isolated masonry, 2109.0
Piles
Cast-in-place concrete, 1820.0
Composite, 1823.0
Foundations, 1816.0
Loads allowable, 1817.0
Precast concrete, 1821.0
Special, 1824.0
Steel pipe and tubular, 1819.0
Structural steel, 1818.0
Timber, 1822.0
Pipe
Columns, concrete-filled, 1912.0
Combustible piping, 602.4.3
Piles, 1819.0
Plans and specifications (see Construction documents)
Plastering and lathing
Application, interior, 2505.1
Fireresistance requirements, 722.0
General requirements, 2505.0, 2506.0
Gypsum plaster, 2505.0
Interior lathing and gypsum plastering, 2505.0
Materials, 2505.0
Portland cement stucco, 2506.0
Plastic
Approval for use, 2601.3
Approved, 2601.2
Bathroom accessories, 2604.7
Definition, 2602.0
Design and installation, 2604.0
Fastenings, 2604.0
Foam, 803.3, 2603.0
Glazing of unprotected openings, 2606.0
Interior finish and trim, 803.0
Light-diffusing systems, 2604.5
Partitions, 2604.6
Roof panels, 2607.0
Scope and use, 2601.1
Signs, 402.14, 3102.6.4.2
Skylights, 2608.0
Structural requirements, 2604.2
Thermoplastics, definition, 2602.0, 2604.1
Thermosetting, definition, 2602.0, 2604.1
Veneer, 2605.1
Wall panels exterior, 2605.1
Platforms
Construction of, 412.4
Fire suppression, 412.6
Plenums, 1005.7, 2805.0
Plot plan, required, 107.6
Plumbing, 2901.0
Plywood, 2307.0
Portable signs, 3102.14
Posting
Occupant load, 1003.3
Permits, 108.8
Signs, 123.0
Projecting signs, 3102.10
Projection rooms
Construction of, 411.2
General requirements, 411.0
Ventilation of, 411.3
Projections from buildings
Awnings and canopies, 3203.9, 3205.0
Balconies and stairs, 3203.8
Bay windows, 3203.7
Below sidewalk, 3202.2
Belt courses, 3203.4
Cornices and eaves, 3203.3
Fire escapes, 1025.2
General, 3202.1
In alleys, 3204.0
Marquees, 3203.11
Oriel windows, 3203.7
Signs, 119.0, 3102.11, 3202.10
Special and temporary, 3204.0
Street encroachments, 3202.0
Street projections, permissible, 3203.0
Yard and court, 1213.0
Protected construction
Definition, 702.0
Protection against corrosion
Formed steel, 2206.4
Structural steel, 2203.5
Protection against dampness
Of crawl spaces, 1210.2
Of foundation walls, 1813.0
Protection against decay and termites, 2311.0
Protection during construction
During wrecking, 3304.0
Of adjoining property, 3308.0
Of excavation, 3310.0
Protection of exterior openings
Of exterior wall, 706.0, 719.0
Of fire wall opening, 708.0
Public address system, 405.7
Public assembly
Use Group A, assembly, 303.0
Public right of way, Chapter 32
Public way, definition, 1002.0


## R


R, use group, residential, 310.0
Above B or M uses, 313.3
Radio antennas and towers, 3108.0, 3109.0
Railings (see Handrails)

Ramps, 1016.0
Ratproofing, 1215.0
Recesses (see Masonry and Walls)
Records
  Of decisions, 121.6
  Of departments, 104.7
Recreation buildings
  Use Group A, assembly, 303.0
Reductions, live load, 1606.7
Refineries
  Use Group H, high-hazard, 307.0, 415.1
Reformatories
  Use Group I-3, institutional, 308.0
Refrigeration, 2801.5
Refuse, chutes, 2807.0
Refuse vaults, 2808.0
Reinforced
  Definition, concrete, 1902.0
  Foundation walls, concrete, 1812.3.1
  Masonry, foundation walls, 1812.3.2
  Walls, 1812.0
Reinforced concrete (also see Concrete)
  Definition (see Concrete), 202.0
  Design, 1901.1
  Footings, 1815.5
  Pipes in, 1909.3
Remoteness (of exits) (see Means of egress)
Removal
  Of buildings and structures, 119.0
  Of waste during construction, 3313.0
Repair
  Definition, 202.0
  Of existing buildings, 107.1.1, 3401.2, 3404.0
  Permit not required, 107.1.1
  To roofs of existing buildings, 1512.0
Repair shops, motor vehicle
  Definition (see Garage, public), 408.2
  Public garages, 408.0
  Use Group S-1, storage, moderate-hazard, 311.0
Reroofing, 1512.0
Residential buildings
  Bed and breakfasts, 423.1
  Sound transmission control, 1214.0
  Use Group R, 310.0
Restaurants
  Use group A-3, assembly, 303.0
Restrictions
  Area, 503.2
  Height, 503.3
  On employees, 104.5
  Special occupancy, 401.0
Retail stores
  Use Group M, mercantile, 309.0
Retaining wall
  Definition (see Walls), 1812.2
  Design, 1825.2
  General, 1825.1
  Guardrails for, 1825.5
  Loads, special, 1615.2
Reviewing stands, 1013.0
Revocation of permit, 108.6
Revolving doors, 1018.0
Right of entry, 113.4
Risers for stairways (see Stairways)
Roof access, 1014.6.6., 1027.0
Roof/ceiling assembly, 713.0
Roof construction
  As required by type of construction, 603.0, 604.0, 605.0, 606.0
  Cooling towers, 1510.8
  Covering, 1503.0
  Definition of roof structure, 1502.0
  Fireresistance requirements, Table 602
  Landscaped, 1609.6.1
  Loads, 1607.0, 1609.0
  Mansard or ordinary construction, 1510.5
  Of approved plastics, 2604.1, 2607.0
  Parapets above, 705.6, 707.5
  Ponding 1609.5
  Stadiums, 715.2
  Wind loads, 1609.0
  Wood construction, 2305.15
Roof covering
  Classified, 1506.0
  For covered malls, 402.8
  General, Chapter 15
Roof occupancy, 1008.3, 1607.6
Roof signs, 3102.8
Roof structures, 1510.0; definition, 1502.0
Roofing repairs on existing buildings, 1512.0
Rooftop heliport, 1511.3
Rooming houses
  Use Group R, residential, 310.0
Rubbish chutes, 2807.0
Rubble stone foundation walls, 1812.3.3
Rule-making authority
  Promulgated by code official, 105.6
Rust protection
  For concrete reinforcement, 1910.3.1
  For formed steel, 2206.4
  For structural steel, 2203.5


## S


S, use group, storage, 311.0
Safe loads on soil, 1804.0
Safeguards during construction, 3301.0
Safety devices for window cleaning, 3110.0
Sallyports, 410.3.6
Sanitariums
  Use Group I-2, institutional, 308.0
Scale of plans, 107.5
Schools
  Use Group E, educational, 305.0
Scope of code
  General, 101.0
Screening rooms, motion picture, 411.0
Screens for skylights, 2404.3
Scuttle
  Scuttle size and construction, 1510.2
Seating
  Aisles and, 1012.0
  Folding and telescopic, 1013.0
Seismic (earthquake) design
  Concrete, 1903.0, 1904.0
  Foundations, 1810.2.1, 1815.2, 1816.3, 1816.11, 1818.3, 1819.3, 1820.1.2, 1820.5.4, 1821.3.5, 1821.3.6, 1824.3
  Inspection related to, 1705.3.3.2, 1705.4.5, 1705.9, 1705.10, 1705.11
  Loads, 1612.0
  Masonry, 2101.2

Soils, 1802.1.1, 1805.2, 1805.3
Steel, 2203.2, 2203.2.1, 2204.0, 2206.3, 2207.2.1
Wood, 2305.8, 2305.9, 2306.0
Sewage treatment plants, 415.0
Shaft
Definition, 702.0
General, 710.0
Shall, definition, 202.0
Shear wall, definition, 1612.2
Sheathing
Floor, 2307.0, 2308.0
For exterior lathing and stucco, 2506.3
General requirements for, 2307.0, 2308.0, 2309.0
Roof, 2305.15.1, 2307.3.1
Subfloor, 2307.3.3
Wall, 2305.13
Shed
Sidewalk, 3304.4
Use Group U, utility), 312.0
Shingles and shakes
Materials, 1507.0
Shutters
Shutters on exterior wall openings, 719.0
Sidewalks
Bridge, 3304.3
Elevated pedestrian walkways, 3106.0
Siding
Minimum material requirements, 1403.3
Signs
Alterations to, 3102.1
Banner and cloth, 3102.12.1
Definition, 3102.2
Design loads, 3102.6, 3102.10.4
Doors, 1017.4.1, 1017.4.1.2
Elevator, 3009.1
Exemptions, 3102.4.3
Existing, 102.2
Extending over curb prohibited, 3102.10.2
For exits, 1023.0
General requirements, 3102.6
Ground, 3102.7
Identification, 3102.4.5
Illuminated, 3102.6.3, 3102.13
Inspection of, 3102.5.4
Maintenance, 3102.5.2
Marquee, 3102.11, 3203.11
Miscellaneous, 3102.12
Permits for, 3102.4
Plans and specifications, 3102.4
Plastics for, 402.14, 3102.6.4.2, 2601.2
Pole, 3102.7
Portable, 3102.14
Projecting, 3102.10
Roof, 3102.8
Sprinkler control valve room, 906.8
Stairways, floor identification, 1014.11.5
Temporary, 3102.12
Unsafe, unlawful, 119.0
Wall, 3102.9
Wind loads, 1611.0, 3102.6.1
Skylights
General, 2404.0
Plastic, 2601.2, 2608.1
Slidescapes, definition, 1002.0, 1026.0
Smoke and heat vents, 923.0
Smoke barrier, 712.0
Smoke compartment
Definition, 702.0
In Use Group I-2, 409.4
In Use Group I-3, 410.6
Smoke control systems (see Fire protection systems)
Smoke detectors (see Fire protection systems)
Smoke exhaust system, 405.5
Smoke partition, 302.1.1.1
Smokeproof enclosure, definition,1002.0; 1015.0
Snow load, 1608.0
Soil
Bearing, allowable, 1804.0, 1805.0
Bearing capacity, 1804.0, 1805.0
Prepared fill, 1705.7, 1804.1.1
Soils report, 1804.1, 1804.1.1
Tests, 1802.0, 1803.0
Sound stages, motion picture, 411.0
Sound transmission control in residential buildings
Air-borne noise, 1214.2
Scope, 1214.1
Structure-borne sound, 1214.3
Special amusement buildings, 413.0
Special fireresistance requirements
For grade floor protection, 1006.3.1
For residential buildings, 313.3
For uses above open parking structures, 313.2
Spray painting
Booths, 419.2.1
Construction requirements for booths, 419.2.1
Fire protection, 419.3
Rooms, 419.2.2
Sprinklers (also see Automatic fire suppression systems)
Area increase permitted, 506.3
Capacity of means of egress, width permitted, 1009.0, Table 1009.2
General requirements, 906.1
Length of travel, increase permitted, 1006.5
Outside, 706.2
Where required, 904.0
Stadiums
Roof construction, 715.2
Use Group A-5, assembly, 303.0
Stages
Construction, 412.3
Curtain, proscenium, 412.3.6
Definition, 412.2
Fire suppression, 412.6
Proscenium wall, 412.3.5
Rooms, accessory, 412.5
Standpipes, 412.7
Ventilation of, 412.3.8
Stairways
Access to roof, 1027.0
Alternating tread, 1014.6.6
Circular, 1014.6.5
Construction, 1014.9
Definition, 1002.0
Door to stairway, 1014.8
Elevator, 3009.1
Enclosures, exterior, 1014.12
Enclosures, interior, 1014.11
Exterior, 1014.12
Fire escapes, 1025.0
Guardrails, 1014.7, 1021.0
Handrails, 1014.7, 1022.0
Headroom clearance, 1014.4

Landings, width, 1014.3.2, 1014.5
Means of egress, 505.3, 1010.2, 1014.0
Means of egress lighting, 1024.0
Penetrations of enclosures, 1014.11.2
Projections into, 1014.3.1
Rise between landings, 1014.5
Slidescapes, 1026.0
Spiral stairway, 1014.6.4
Treads and risers, 1014.1.1, 1014.6
Weather protection, 1014.12
Width, 1014.3
Winders, 1014.6.3
Standards, referenced, which governs, 102.4
Standby power systems, 2707.0 (also see Emergency electrical systems)
Airport traffic control towers, 414.5
High rise, 403.9.1
Underground structures, 405.8
Smoke control systems, 922.5
Smokeproof enclosures, 1015.8.2
Standpipes
Definition, 902.0
During construction, 3305.0
Fire department connection for, 916.0
Water supply, 915.5
Where required, 915.2
Starting work
Notice to building official, 108.9
Steel, construction
Cast-iron construction, 2209.0
Cast-steel construction, 2208.0
Definition, 2202.0
Fire escapes, 1025.0
Grillages in footings, 1809.0
Joists, open-web construction, 2205.0
Light gage and formed steel construction, 2206.0
Painting, 2203.5
Reinforcing, 2104.9.3, 2104.9.4
Special steel, 2207.0
Structural, 2203.0
Steel pipe and tube piles
Concrete-filled, 1819.0
Stone
Cast, 2104.3
Foundation walls, 1812.3.3
Natural, 2104.3
Veneer, 1405.5.1
Stop work orders, 117.0
Storage
Of combustible dusts, grain processing and storage, 418.3.1
Of flammable liquids, 418.3.2
Of HPM, 416.4
Of liquefied petroleum gas, 418.3.3
Use Group S, storage, 311.0
Story above grade, definition, 502.0
Street
Definition, 202.0
Encroachments, 3202.0
Frontage increase, 506.2
Permissible projections, 3203.0
Structural clay tile, 2104.2
Structural glass block, 2118.1
Structural panels, wood, Chapter 23
Structural requirements for plastics, 2604.2
Structural steel (see Steel, construction)
Structure
Definition, 202.0
Unsafe, 119.0
Stucco, 2506.0
Supervision
Fire alarm systems, 924.2
Fire suppression systems, 924.1
Leakage alarms, 418.3.2.6
Swimming pools
Construction documents, 421.3.2
Definition, 421.2
Design and construction, 421.5
Hot tub, 421.2
Occupant load, 421.3.1
Permit and plans, 421.3
Safety precaution, 421.9
Spa, 421.2
Water supply treatment and drainage system, 421.6


## T


Tanks
On roofs, 1510.7
Storage of flammable liquids, 418.3.2
Storage of liquefied petroleum gas, 418.3.3
Telescopic seating, 1013.0
Television antennas and towers, 3108.0, 3109.0
Temporary
Buildings or structures, 109.0, 3104.0
Electrical use, 2705.0
Occupancy, 118.2
Permits, 108.7
Safeguards, 120.1
Signs, 3102.12
Stairs, 3314.1
Termination of approval for temporary buildings, 109.3
Tenant separation (see Walls)
Tents, air-supported structures, requirements, 3104.0
Termite protection
Approved pressure preservative treatment of wood, 2311.3
Tests
Fireresistance, 704.0
Flameresistance, 803.0
General, Chapter 17
New materials and devices, 1701.2
Of construction equipment, 3303.0
Of electrical systems, 2704.3
Of fire protection systems, Chapter 9
Pile capacity, 1817.0
Prefabricated construction, 1703.3
Procedure for soil, 1803.0
Soil bearing values, 1804.0
Structural steel unit, 2203.0
Theaters
Aisles, 1012.0
Use Group A-1, assembly, 303.0
Thermal insulating materials, 723.0
Thermoplastics, accepted, Chapter 26
Thermosetting plastics, accepted, Chapter 26
Through-penetration firestop system, 715.2.3
Towers
Cooling, 1510.8
Radio and television, requirements, 3108.0
Wind, loads, 3108.4, 1609.0
Travel, length of, to exits, 1006.5
Treads, stairs (see Stairways)

Trim, exterior, 1406.0
Trim, interior (see Interior finish and trim)
Trusses
Individual encasement, 716.2
Roof slabs and arches, 715.4
Roofs, 20 feet or higher, 715.3
Wood construction, 2305.14, 2305.15
Tunnel flame spread test, 803.2
Types of construction
Type 1, noncombustible, 603.0
Type 2, noncombustible, 603.0
Type 3, noncombustible/combustible, 604.0
Type 4, heavy timber, 605.0
Type 5, combustible, 606.0

## U

U, use group, utility and miscellaneous, 312.0
Underground structures, 405.0
Underpinning, 3309.3
Unfired pressure vessels, 2801.2
Unlimited area, buildings, 507.0
Unusable space, 713.1.2
Use Group
Classification, 302.0
Doubtful classification, 302.1
Mixed use classification, 313.0
Utilities, public, discontinuance of
In demolition of structures, 110.1

## V

Vapor retarder, 1403.3, 723.3.1
Vaults, refuse, 2808.0
Veneers
Height of, for frame buildings, 1405.0
Masonry, 1405.5, 1405.6
Metal, 1405.4
Plastic, 1404.6
Stone and tile, 1405.5.1
Structural glass, 1405.7
Wall facings and, 1403.3
Weather resistance, 1403.3
Ventilation
Attics, 1210.1
Court requirements for, 1212.0
Crawl space, 1210.2
Definition, 1202.0
For existing buildings, 3401.0
Garages, 408.5
General requirements, 1201.0
Mechanical, 1209.0
Motion picture projection rooms, 411.3
Natural, 1204.0
Windows, 1208.2
Vertical openings
Conveyor openings, 3010.1, 3010.2
Enclosures, 710.0
Vestibules, 1015.3, 1020.2
Violations and penalties
Abatements, 116.5
Notice of, 116.2
Penalties, 116.4
Stop work, 117.0
Unsafe building, 119.0
Voice alarm system (see Fire protection systems)

## W

Walkways, pedestrian, 3106.0
Wall signs, 3102.9
Wallboard (also see Sheathing)
Fiberboard, 2309.0
For frame construction, 2305.13
Gypsum, 2503.0
Hardboard, 1405.3
Particleboard, 2308.0
Wood structural panel, 2307.0
Walls (also see Masonry)
Bearing, chases and recesses in, 2112.1
Bearing, lateral bracing of, 2107.2
Bearing, wood frame construction, 2305.4.2
Bonding of, 2109.0, 2110.0
Concrete masonry units, 2104.1
Continuity, 705.6, 707.6, 709.4, 711.4
Corbeled and projecting masonry, 2111.0
Definition, 202.0
Design for wind on vertical surfaces, 1609.0
Ducts in fireresistance rated walls, 718.0
Dwelling unit separation, 310.5, Table 602, 1011.4.1
Enclosures for theater stages, 412.3
Fire and party, 707.0
Fire partitions, 711.0
Fire separation, 709.0
Fire wall openings, 708.0
Foundation walls, 1812.0
Glass block, 2115.0
Hollow, 2105.1, 2105.2
Hollow panels, thickness of, 1404.6
Lateral support of bearing, 2108.2
Masonry wall construction, 2113.1
Panel, 1404.6
Parapet, 705.6, 707.5
Penetrations, 714.0
Penthouse, 1510.3
Plain concrete, 1901.2
Proscenium, 412.3.5
Protection of exterior openings in, 706.0
Reinforced concrete, 1901.1, 1910.0
Retaining, 1825.0
Roof structure, 1510.0
Shaft enclosure, 710.0
Smoke barriers, 712.0
Stone foundation, 1812.3.3
Tenant separation, 402.4, Table 602, 1004.3, 1011.4.1
Thickness of panel, 1404.6
Veneers, glass, 1405.7
Veneers, metal, 1405.4
Veneers, plastic, 2605.0
Veneers, thickness of, 1405.3
Veneers, thin and tile, 1405.5.6
Warehouse
Use Group S, storage, 311.0
Waste chutes, 2807.0
Waste to be removed, 3313.0
Water
Supply, automatic; definition, 902.0
Supply, for plumbing, 2905.0
Supply, for storage of hazardous materials, 417.6.2
Supply, for swimming pools, 421.6
Tanks, 1510.7
Waterproofing of exterior structural elements, 1813.0
Waterproofing of foundation walls, 1813.4

Weather protection, 1504.0
Protection, for hazardous material storage, 417.6.4
Resistance, 1403.3
Welding
Inspection, 1705.3.3.2
Width
Aisles, 1012.0
Corridors, 1011.3
Courts and yards, 1212.2
Doors, means of egress, 1017.3
Habitable rooms, 1204.3
Lobbies used as an exit element, 1020.2
Passageways, 1011.3, 1020.4
Ramps 1016.2.1
Stairs, means of egress, 1014.3
Vestibule, used as exit discharge, 1020.2.1
Wind load design
Buildings, 1609.0
Glass, 2403.1
Radio and television towers, 3108.4
Signs, 1609.0, 3102.6.1
Winders, 1014.6.3
Windowless
Building, 410.8
Story, 904.10
Windows
Bay, 1406.5
Cleaning safeguards, 3110.0
Dormer, 1510.6
Escape and rescue, 1010.4
Fire, 719.0
Fireresistive design, 719.1
Glass area required, 1206.2, 1208.2
Jalousies, glass in, 2402.5
Louvred, glass in, 2402.5
Oriel, 3203.2
Required for light and ventilation, 1205.0
Wired glass
In fireresistive doors and windows, 720.0, 2405.1
Wiring (see Electrical equipment)
Wood construction
Bearing walls, 2305.4
Bracing, 2305.7
Bridging, 2305.16
Cambering, 2303.1
Cornices, 1406.2.2
Cutting and notching, 2305.3
Designated type of, 606.1
Fiberboards, 2309.0
Fireretardant-treated, 707.5.2, 2310.0
Flashing, 1405.3.10
Floor sheathing, 2307.3.1
Foundation anchorage, 2305.16
Foundation, general, 1812.0
Framing around flues and chimneys, 2304.11
Heavy timber construction, 2304.0
Nailing, 1405.3.7, 2305.2
Naturally durable, 2311.0
Nonbearing walls, 2305.5
Piles, 1822.0
Plywood, 2307.0
Prefabricated I-joists, 2313.5
Protection near grade, 2311.4
Roof sheathing, 2305.15.1, 2307.3.1
Seismic requirements, 2306.0
Shear panel, definition, 2306.2
Shear walls, 2502.0
Sheathing lath, 2305.13.2
Shingles and shakes, 1506.3, 1507.4.8, 1507.4.9
Spans for plywood sheathing, 2307.3
Stressed skin panels, 2313.2
Structural glue-laminated timber, 2313.1
Structural members, 2303.0
Structural panels, 2307.0
Stud spacing, 2307.3.5
Subfloors, 2307.3.3
Veneer, height of, 1405.5.1
Veneer, masonry, 1405.5
Veneer, metal, 1405.4
Wall sheathing, 2305.13
Weatherboarding, exterior, 1403.3, 1405.3
Wood structural panels, 2307.0
Work
Abandoned, 108.2
Start, 108.9
Stop order, 117.0
Suspended, 108.2
Workmanship, 115.1
Written
Definition, 202.0


## Y


Yard
Definition, 1202.0
Obstruction of, 1213.0
Permissible encroachments, 1213.2
Yard system fire mains, 917.0


## Z


Zones, Fire alarm system, 918.7.3, 919.6
Zoning law
Construction in public right of way, 3202.1
Courts and yards, 1213.2
Definition, 202.0
General, 301.2, 601.2
Mobile units, 420.3
Special construction, 3102.3
Swimming pools, 421.4