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SAN BERNARDINO COUNTY

Land Use Services Department
Building and Safety Division

SIGNIFICANT CHANGES
2022 CALIFORNIA BUILDING CODES PART 2, VOLUMES 1 & 2
FOR RESIDENTIAL CODE SEE CRC SIGNIFICANT CHANGES

BUILDING CODES:

- **CBC Section 411.5**

  Puzzle rooms (escape rooms) are now defined and regulated as special amusement areas, requiring compliance with Section 411 and special means of egress requirements.

  CHANGE SIGNIFICANCE: Special conditions are applicable to buildings, or portions of buildings, defined as special amusement areas. Previously identified in the CBC as special amusement buildings, these areas have typically been limited to walk-through and ride-through attractions at amusement parks, as well as haunted houses. Such buildings and areas have much in common with other assembly uses, and as such are classified as Group A occupancies where the occupant load is 50 or more. As expected, a Group B classification is assigned where the occupant load does not exceed 49. Except where modified by Section 411, the code requirements applicable to special amusement areas are those that are mandated for other types of assembly uses. However, Section 411 recognizes the unique characteristics of those buildings and areas defined as special amusement areas and establishes specific provisions to address the unique hazards that are created. A new type of building use, that of puzzle rooms, is now regulated by the code in a manner consistent with other traditional special amusement areas. In addition, unique means of egress requirements have been established that are applicable only to such puzzle rooms.

Photo courtesy of Best View Stock

Escape room.

Puzzle rooms, often identified as escape rooms, are a relatively new business model where individuals enter a room and are required to solve a puzzle of some sort before they can exit the facility or travel to the next room in the puzzle. The rooms are typically small with a limited number of occupants within in each space. Puzzle rooms are designed in a manner to provide a unique and challenging experience for the customer. The intended design philosophy often incorporates several different features that are intended to disorient the occupants and/or disguise the egress route, resulting in a condition contrary to the foundation of code specified means of egress provisions.

From a performance standpoint, three key assumptions should be considered regarding the regulation of puzzle rooms. One, occupants are awake, alert and predominantly able to exit without the assistance of others but are also unfamiliar with the area. Two, the risk of injury assumed by occupants during their use of the area is potentially high and involuntary. Three, public expectations regarding the protection that is afforded to the occupants is also high.

The newly set forth definition of a puzzle room is that it is a "type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms." Of primary importance is the recognition that a puzzle room is considered as a special amusement area, and as such is subject to all applicable code provisions set forth in Section 411. This would include requirements mandating an automatic sprinkler system, an automatic smoke detection system, an emergency voice/alarm communications system, special exit marking and Class A interior finishes. Of particular note is that these requirements are all applicable regardless of the occupancy classification of the puzzle room, as the special provisions of Section 411 apply in a consistent manner

to both Group A and Group B puzzle rooms.
In addition to compliance with all provisions applicable to other special amusement areas, puzzle rooms must also meet one of three exiting methodologies as set forth in Section 411.5. The means of egress system shall either 1) comply with the applicable provisions based upon occupancy classification as established in Chapter 10, 2) gain building official approval of an alternative means of egress design, or 3) meet the performance goal of the exit being open and readily available upon activation by the automatic sprinkler system, the automatic fire alarm system, as well as a manual control at a constantly attended location.
Through the regulation of puzzle rooms, this special type of building use can now be addressed in a manner specific to its hazards. Their recognition as special amusement buildings and the introduction of various means of egress solutions provides a very high level of protection for the occupants experiencing such facilities.

- **CBC Section 202**

Child-Care, Day-Care, Toddler, Inflatable Amusement Device

CHANGE SIGNIFICANCE: The change is representative of current regulation as it is printed in California Code of Regulations (CCR) Title 22. For approximately 10 years, the Department of Social Services (DSS) has been transitioning from the term “Day-Care” to “Child-Care.” The profession of child-care has evolved into a more inclusive type of care that can include early learning and child development. The caring aspect of the facilities are more emphasized. The State Fire Marshal work group is including the definition to be more consistent between regulations. CCR 22 Section 101152c(7) “Child-Care Center” or “Day-Care Center” (or “center”) means any child-care facility of any capacity, other than a family childcare home as defined in Section 102352f (1), in which less than 24-hour per day non-medical care and supervision are provided to children in a group setting. The term “Child-Care Center” supersedes the term “Day-Care Center” as used in previous regulations. This will allow the building and fire code officials to classify the occupancy of I-4 or E based on Social Services classifications for licensing. This will be determined by the age of the children within the child-care facility.
Day-Care facilities are licensed by the Department of Social Services. The classifications of the children are infants: age 0 to 24 months; toddlers: 18 to 36 months; and preschool, etc. The intent of these regulations is to provide a level of safety to the children that are nonambulatory or unable to self-evacuate in an emergency. The conflict is that there is an overlap of the definition of infants and toddlers. The Office of the State Fire Marshal conducted a Day-Care Workgroup to address issues with the current regulations. The workgroup recommended the legal definition of toddlers be picked up from the Health & Safety Code Section 1596.55 and included in the regulations to remove the conflict in the definitions. This proposal will also remove the conflict with the Social Service’s classification of day-cares.

A toddler that would require greater level of safety in accordance with the new definition.

It is important to note that an amendment in the Referenced Standards was also made that now includes ASTM F2374, *Standard Practice for Design, Manufacture, Operation, and Maintenance of Inflatable Amusement Devices*. These devices are continuing to become more popular throughout the State of California. Similarly, the number of injuries related to these devices is significant; therefore, the State Fire Marshal proposed the language be included and the ASTM standard be referenced to provide a greater level of safety for the users of these devices and a tool for enforcement by local jurisdictions.

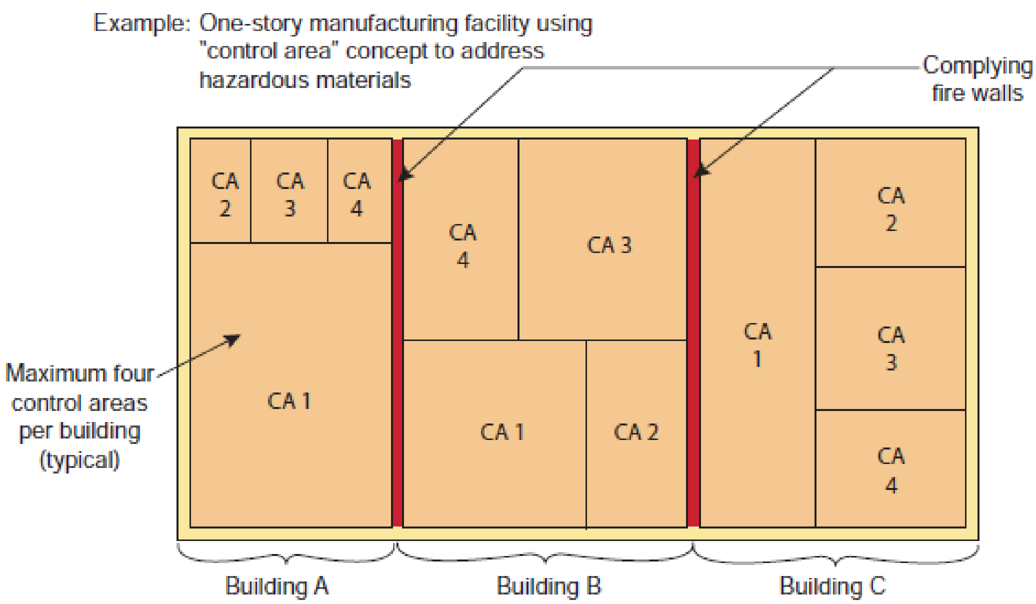
An inflatable amusement device as defined.

- **CBC Section 414.2.3**

For the purposes of determining the allowable number of control areas in a building, each portion separated by one or more fire walls is now considered as a separate building

CHANGE SIGNIFICANCE: Occupancy classifications of buildings containing hazardous materials are based on the maximum allowable quantities (MAQs) concept. As established in CBC Tables 307.1(1) and 307.1(2), the maximum amounts are identified for the various hazardous materials based on a variety of conditions. Where the MAQs are exceeded, the uses are to be classified as Group H occupancies. In those cases where the amounts do not exceed the MAQs, a classification other than Group H that best represents the building's use is assigned. It is often quite desirable to the designer that an occupancy classification of other than Group H be assigned due to the restrictive nature of the code when it regulates high-hazard uses. A fundamental method of maintaining a non-Group H condition is the creation of control areas.

Control areas are portions of a building that contain hazardous materials in amounts that do not exceed the MAQs and that are separated from other areas containing hazardous materials by fire-resistant construction. Any combination of hazardous materials, up to the MAQs, is permitted in a control area. The intent is that each control area is regulated for MAQs rather than the building as a whole, thereby increasing the amounts of hazardous materials that can be present without triggering a Group H classification. However, there is a limit to the number of control areas that can be created in a building as set forth in Table 414.2.2. For example, in



a single-story building no more than four control areas can be provided. Therefore, a Group H classification will be mandated where the quantities of hazardous materials require the creation of more than four control areas. The use of one or more fire walls to create separate buildings is now applicable to the control area concept, allowing the permissible number of control areas to be increased. Where a structure is divided into separate buildings through the use of complying fire walls, each such separate building may now contain the maximum number of control areas permitted by Table 414.2.2.

The primary purpose of fire walls as regulated by Section 706 is to create separate buildings under one roof, providing an opportunity for the designer to regulate each of these buildings independently rather than as the entire structure. This highly regulated fire-resistance-rated vertical separation provides the necessary independence so that the portion of the structure on each side of the fire wall can be regulated individually. However, the application of the separate building concept is very limited. Section 503.1 mandates that a fire wall only creates separate buildings for the purposes of determining area limitations, height limitations and type of construction. This very short list, which reflects the scoping limitations of a fire wall's use to create separate buildings, has been expanded through a new allowance applicable to the limitation on the number of control areas permitted. As a result, an increased amount of hazardous materials may now be present without classification as a Group H occupancy where fire walls divide a structure into separate buildings.

- **CBC Section 1207**

In Group E occupancies, enhanced classroom acoustics in compliance with ICC A117.1 are to be provided in all classrooms having of volume of 20,000 cubic feet or less.

CHANGE SIGNIFICANCE: Good classroom acoustics are essential to support language acquisition and learning for all children, particularly younger children. There are three primary styles of learning in a classroom:
visual, auditory and kinesthetic or tactile. Visual learning is a teaching and learning style in which ideas, concepts, data and other information are associated with images. This style highlights the importance of good lighting in classrooms, so students can read or see different images.
Auditory learning is a learning style in which a person learns through listening. An auditory learner depends on hearing and speaking. In the instruction of auditory learners, teachers use techniques such as verbal direction, group discussions, verbal reinforcement, group activities, reading aloud and putting information into a rhythmic pattern such as a rap, poem or song. The third style, kinesthetic or tactile learning, is learning while carrying out a physical activity, such as physical manipulation or experiments. Learning modality strengths can occur independently or in combination, they can change over time, and they become ingrained with age. It is estimated that auditory learners make up about 30 percent of the population.

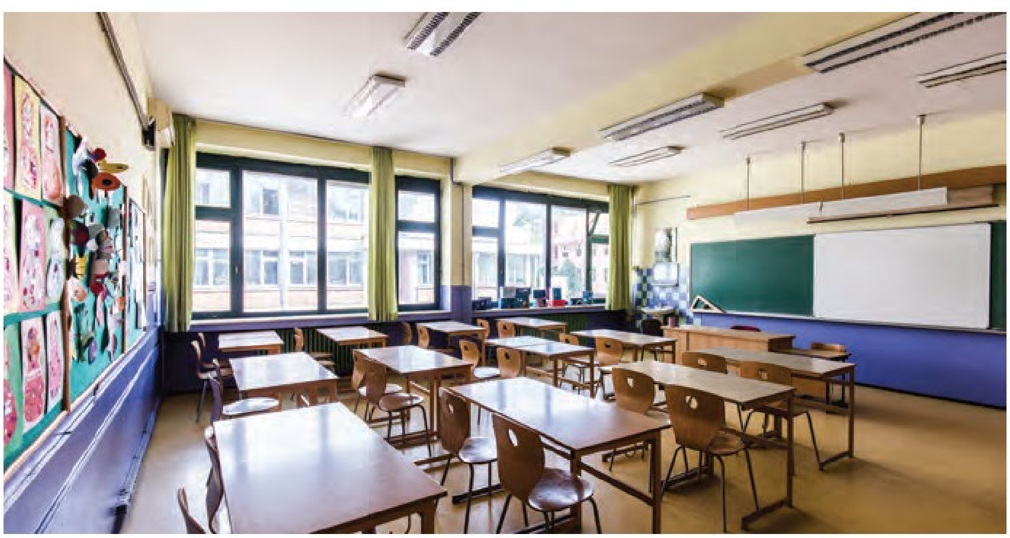


Photo courtesy of skynesher

Classroom acoustics are based on ceiling, wall and floor materials.

For children who have hearing loss and those who use cochlear implants, there is no substitute for a good acoustic environment. Assistive technologies typically only amplify the teacher and do not amplify discussions among children or between the teacher and individual child. Additionally, children with disabilities not related to hearing, such as autism and learning disabilities, may be adversely affected by high ambient-noise levels, while students learning English also benefit from clear speech and low background noise.

The new enhanced acoustic requirements only apply to those rooms where the volume doesn't exceed 20,000 cubic feet. Assuming a 10-foot ceiling height, classrooms of up to 2000 square feet are required to meet these requirements. The criteria in ICC A117.1, Section 808 are intended to be applicable to standard-sized self-contained classrooms, while not including larger spaces used for activities such as band and choir. The criteria are not intended to apply to ancillary learning spaces, such as individual tutoring spaces, corridors or a cafeteria.

A classroom is limited to a maximum reverberation time for classroom acoustics, determined through the measurement of room performance or by a calculation based on materials on the floor, ceiling and walls. Performance in a fully furnished, unoccupied classroom should include a maximum reverberation time of 0.6-0.7 seconds, depending upon the size of the classroom, and a maximum background noise of either 35 dBA (A-weighted sound pressure level) or 55 dBC (C-weighted sound pressure level). The ambient sound levels must be measured in both dBA and dBC.

The dBA filter measures mid-range frequencies, while the dBC filter measures low and high frequencies. Reverberation time measures how quickly sound decays in a room.

The volume of the space and the surfaces in the room will affect the reverberation time. The intent of the 0.6 to 0.7 second reverberation time is to increase the sound level from the teacher throughout the room while maintaining clarity. ASTM E2235, *Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods*, is used for testing sound decay rates.

The prescriptive calculation requires noise reduction coefficient (NRC) ratings for every surface finish, including finishes on the floor, ceiling and all walls. Ratings range from zero to one, with one indicating the surface absorbs most of the speech sound energy and zero indicating the surface reflects most of the speech sound energy. The NRC for each material is multiplied by the square footage of that material. The surface area of these materials are to be subtracted from the area of the mounting surface – for example, if a wall is 10 feet in length by 10 feet in height, and two 2-foot by 10-foot panels are attached to the wall, the calculation would be based on 60 square feet of uncovered wall and 40 square feet of panels.

The ICC A117.1 criterion also considers other sound sources including ambient sound sources outside the classrooms. These sources may include playground noises, airplane or traffic sources and student movement in hallways. There are multiple ways to mitigate these issues. Some outdoor environment sources can be addressed by careful placement of the classrooms on the site or through the choice of the exterior materials for walls and roofs. Building noises can be mitigated by the proper selection of wall systems, location of doors and placement of mechanical systems.

- **CBC Section 1406.10**

The requirements for metal composite materials and systems (MCM) installed on the exterior walls of Types I, II, III and IV construction were simplified and sprinkler allowances were deleted

CHANGE SIGNIFICANCE: A metal composite material (MCM) is a factory manufactured panel consisting of metal skins bonded to both sides of a solid plastic core. Recent global fire events have raised multiple questions regarding the use of MCM panels on exterior walls of Type I, II, III and IV construction. Although many, if not all, of the fires have involved wall assemblies that did not comply with provisions of the CBC, it was deemed necessary to evaluate the current regulation of such assemblies and revise the provisions to address current thinking. From an application perspective, the requirements have been significantly simplified and limited by the deletion of alternate conditions previously set forth in Section 1406.11. In other than Type V construction, the installation of MCM panels and MCM systems are now regulated based on one of two thresholds:

1) those applications where MCMs are installed no more than 40 feet above grade plane, and
2) those conditions where MCM panels and systems are installed at heights more than 40 feet above grade plane.

MCM use for cladding of an urban building.

Where the MCM or MCM systems are installed at a height greater than 40 feet above grade plane, the three previous criteria continue to be applicable regarding surface-burning characteristics, thermal barriers and full-scale tests based on NFPA 285. Where the installation height is 40 feet or less, full-scale testing is not mandated. Testing for flame spread of the MCM when installed in buildings of Type I, II, III and IV construction needs to be of the MCM itself, in other words, of the sandwich panel alone and not of the system that includes a series of other components.

The recognition of alternate conditions dealing with fire separation distance, self-ignition temperature, panel size, occupancy limitations and automatic sprinkler system protection has been deleted. MCMs were the only system in Chapter 14 where the presence of sprinklers inside the building was the reason to eliminate height and coverage limitations associated with fires along the exterior wall envelope. However, interior sprinkler systems for high-rise buildings are not intended to control outside exposure fires. The presence of sprinklers inside the building should not provide a full exception from testing to NFPA 285 or from height limitations considered necessary to ensure a minimum level of safety.

- **CBC Section 3115**

The use of intermodal shipping containers as buildings is now specifically addressed through provisions intended to supplement existing applicable IBC requirements.

CHANGE SIGNIFICANCE: A wide variety of structures are regulated throughout the CBC. In addition to those typical structures constructed of wood, masonry, concrete or steel, or a combination of such materials, other types of construction are also addressed. Chapter 31 addresses membrane structures, greenhouses and relocatable buildings. However, there are many other types of materials and methods being utilized in the design and construction of buildings that are not regulated by the CBC.

As such, Section 104.11 allows for the use of alternative materials and methods of construction provided such methods and materials have been approved by the building official. The use of intermodal shipping containers as buildings and structures is now specifically recognized in the CBC and criteria have been established to address the minimum safety requirements without duplicating existing code provisions.

Photo courtesy of RADCO, a Twining Company

Multi-level structure of intermodal shipping containers.

Over thirty million International Organization for Standardization (ISO) intermodal shipping containers are in use around the world today.

These containers, both new and used, are being repurposed and converted to occupiable structures at a significant pace. The applications are widely diverse as is the extent to which the container is used as a structural building element. Before the introduction of the specific requirements now in the 2022 CBC, the lack of code provisions to address such structures had left state and local jurisdictions without appropriate regulations needed to apply and achieve a reasonable and consistent level of code compliance.

Such construction practices and materials have required approval through the alternate methods and materials provisions of Section 104.11. ICC G5-2019 *Guideline for the Safe Use of ISO Shipping Containers Repurposed as Buildings and Building Components* was recently published to assist building officials in their evaluation. To provide consistency in design, construction and regulation, Section 3115 has now been introduced into the CBC to provide a consistent and comprehensive set of code provisions specific to such building materials and methods.

A number of key issues are addressed to supplement existing CBC requirements that are applicable to the use of shipping containers as part of a building's construction. A new definition has been developed to identify the scope of this particular type of building component and to avoid any confusion with other types of containers in the marketplace. The charging statement indicates the code's application to only intermodal shipping containers that are repurposed for use as buildings or structures.

Four exceptions address conditions where such containers would be acceptable for use through the application of another code, such as the CFC or the *California Existing Building Code*, where the containers are listed as equipment, and where the containers house experimental equipment.

As with any other building regulated by the CBC, construction documents must be provided and contain the necessary information required to ensure compliance with all applicable codes and standards.

Of utmost importance is the verification of the characteristics of the intermodal shipping container prior to it being repurposed as a building or structure. Key is the need for an inspection by an approved agency and verification of the data plate that is attached to the container. Specifics as to the qualifications of the approved agency are not provided to allow the building official and/or state law to apply the appropriate scope, and, further, to avoid dictating that jurisdictions must follow the international agreements that are employed by manufacturers worldwide.

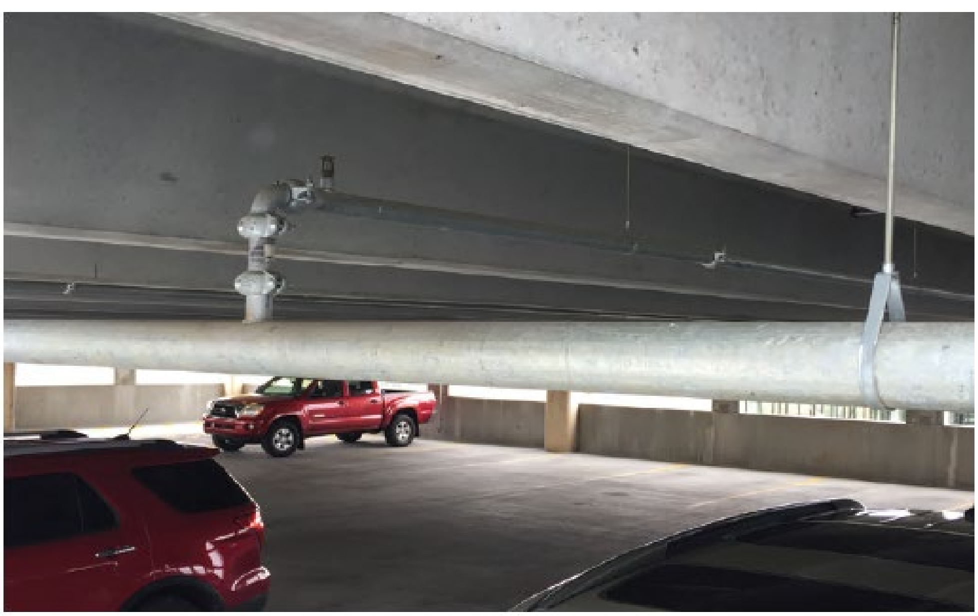
References are made to current provisions of the CBC that are typically applicable to building construction practices using shipping containers.

Such areas specifically addressed include protection against decay and termites, under-floor ventilation, roof assemblies, joints and voids. In addition, a number of specific structural considerations are set forth including those for foundations and anchorage. The structural design for the repurposed containers must comply with either the detailed design procedure set forth in Section 3115.8.4 or the simplified structural design method for single-unit containers outlined in Section 3115.8.5. Three ISO standards relevant to the construction of intermodal shipping containers have also been added to Chapter 35 as reference standards. These industry standards have policies and procedures for the inspection of containers throughout the world. Through the application of the new Section 3115, building officials and the business industry will no longer be faced with a patchwork of potentially conflicting or duplicative requirements regarding the use of shipping containers as buildings.

- **CBC Section 903.2.10**

Automatic sprinkler protection is now required in Group S-2 open parking garages where any fire area exceeds 48,000 square feet

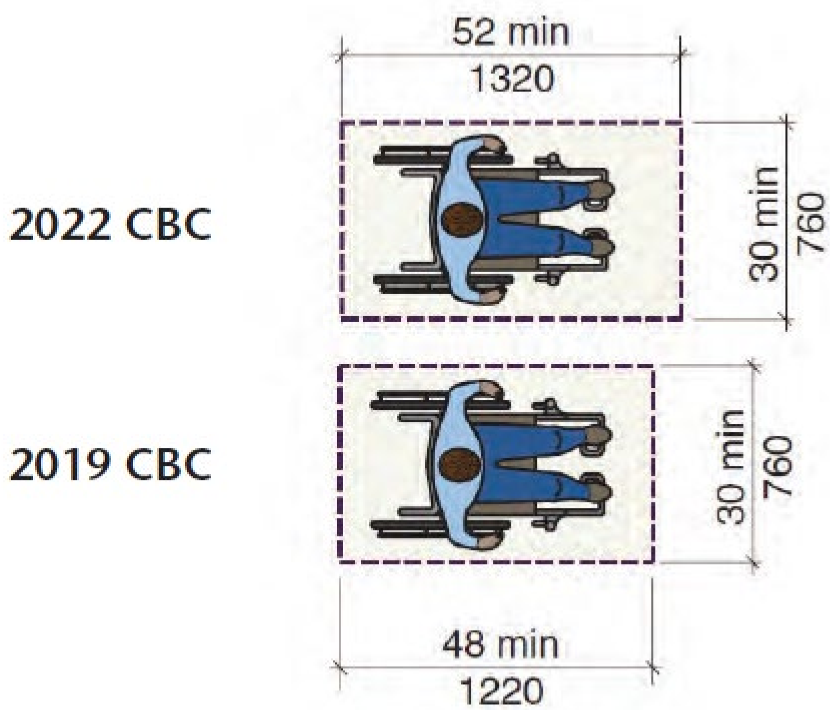
CHANGE SIGNIFICANCE: Open parking garages have historically been exempted from the sprinkler system requirements due to both a relatively good fire record and previous fire test data. However, with the change in the construction of automobiles, there is an increased use of plastics and lightweight materials as opposed to the metals that were previously used.
In addition, the types of fuels being used to power the vehicles are also different. Based on the greater hazards due to a vehicle's fire fuel loading and on a fire that occurred in a parking garage in Liverpool, England on December 31, 2017, it was determined that sprinkler protection should be provided at an established threshold.
The 48,000 square-foot fire area threshold was selected predominately because it was four times the general 12,000 square foot limit and thus would lessen the impact of the new sprinkler requirement. This seemed like a reasonable step that would only impact larger garages. An additional justification for the area limit selected was its approximate equivalency to a 200-foot by 200-foot area and the limit of preconnected fire hoses. It should be noted that where any parking garage fire area exceeds 48,000 square feet, the entire building must be protected with an automatic sprinkler system.
Within the high-rise provisions of Section 403.3, there has historically been an exemption to eliminate sprinklers in open parking garages in high-rise buildings. That exemption has been removed, resulting in the required sprinkler protection of a high-rise building extending to any open parking garage in a high-rise building regardless of the size of the garage fire area.
A similar exception deletion occurred in Section 903.2.11.3 addressing buildings having one or more stories with an occupant load of 30 or more located 55 feet or more above the lowest level of fire department vehicle access. In those buildings containing an open parking garage where the occupant load and height thresholds are exceeded, the entire building, including the parking garage, is required to be sprinklered. Again, the sprinkler protection of the open garage is mandated regardless of the garage's fire area size. It is important to note that the provisions apply to both single-occupancy open parking garages as well as to mixed occupancy conditions where a Group S-2 open parking garage is not the only occupancy in the building.



Sprinklered open parking garage.

- **CBC Sections 1009.6.3 & 3008.6.4**

The 2017 edition of ICC A117.1 was adopted



Increased size of clear floor space.

CHANGE SIGNIFICANCE: In the 2017 edition of the ICC A117.1 Standard, the minimum required length of a clear floor space for a wheelchair was increased from 48 inches to 52 inches. The standard was revised due to research focusing on “wheeled mobility devices” including manual and power wheelchairs as well as scooters that are used for accessibility. The research indicated that the previous 48-inch length would accommodate the occupied length of approximately 75 percent of the manual chair users and about 50 percent of the occupied powered chair and scooter users.

By increasing the length of the clear floor space to at least 52 inches, it is expected that the new length will accommodate approximately 95 percent of the occupied manual chair users and 90 percent of powered chair users.

Although this change to the clear floor space occurred in the 2017 edition of ICC A117.1, it is important to note that the standard will only impose this increased size requirement in new construction. Existing buildings will continue to be regulated based on the previous 48-inch length. When dealing with the accessible means of egress, the CBC provides the scoping and many of the details that are needed for areas of refuge including the construction protection and size requirements for areas of refuge. Therefore, it is important that the minimum required size of the wheelchair clear floor space be increased in locations where building occupants in wheeled mobility devices are expected to wait for assistance, such as in an area of refuge (CBC Section 1009.6) or in a lobby serving an occupant evacuation elevator (CBC Section 3008.6.4). Because many users of power-operated wheelchairs are also the people with the greatest accessibility challenges and a more vulnerable part of the population, it was important that the spaces where they are expected to await assistance would be adequately sized to allow them to enter into the protected space and wait.

Additional information related to this size increase is available in the ICC publication *Significant Changes to the ICC A117.1 Accessibility Standard*, as well as at the University of Buffalo's Center for Inclusive Design and Environmental Access website at http://idea.ap.buffalo.edu/projects/anthropometry/. It is important to recognize that although the recommendations of the report suggest even larger clear floor spaces, the A117.1 standard committee elected to modify the recommendations. As the Americans with Disabilities Act (ADA) references the CBC for accessible means of egress, these increased size clear floor spaces are to be applied within an area of refuge.

California has added additional requirements to this modified code section by requiring two wheelchair spaces in each area of refuge. Further, the California amendments also require one space for every two hundred persons of calculated occupant load that serve the area of refuge thereby potentially requiring a greater number of wheelchair spaces in these locations.

- **CBC Section 1504.9**

Parapets of a minimum height are now required for aggregate-surfaced roofs to prevent blow-off.

~~**TABLE 1504.8** Maximum Allowable Mean Roof Height Permitted for Buildings with Aggregate on the Roof in Areas Outside A Hurricane-Prone Region~~

TABLE 1504.9 Minimum Required Parapet Height (inches) for Aggregate Surfaced Roofs[a,b,c]

Aggregate Size	Mean Roof Height (ft)	Wind Exposure and Basic Design Wind Speed (mph): Exposure B									Exposure C[d]								
		≤95	100	105	110	115	120	130	140	150	≤95	100	105	110	115	120	130	140	150
ASTM D1863 (No.7 or No.67)	15	2	2	2	2	12	12	16	20	24	2	13	15	18	20	23	27	32	37
	20	2	2	2	2	12	14	18	22	26	12	15	17	19	22	24	29	34	39
	30	2	2	2	13	15	17	21	25	30	14	17	19	22	24	27	32	37	42
	50	12	12	14	16	18	21	25	30	35	17	19	22	25	28	30	36	41	47
	100	14	16	19	21	24	27	32	37	42	21	24	26	29	32	35	41	47	53
	150	17	19	22	25	27	30	36	41	46	23	26	29	32	35	38	44	50	56
ASTM D1863 (No.6)	15	2	2	2	2	12	12	12	15	18	2	2	2	13	15	17	22	26	30
	20	2	2	2	2	12	12	13	17	21	2	2	12	15	17	19	23	28	32
	30	2	2	2	2	12	12	16	20	24	2	12	14	17	19	21	26	31	35
	50	12	12	12	12	14	16	20	24	28	12	15	17	19	22	24	29	34	39
	100	12	12	14	16	19	21	26	30	35	16	18	21	24	26	29	34	39	45
	150	12	14	17	19	22	24	29	34	39	18	21	23	26	29	32	37	43	48

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a. Interpolation shall be permitted for mean roof height and parapet height.

b. Basic design wind speed, *V*, and wind exposure shall be determined in accordance with Section 1609.

c. Where the minimum required parapet height is indicated to be 2 inches (51 mm), a gravel stop shall be permitted and shall extend not less than 2 inches (51 mm) from the roof surface and not less than the height of the aggregate.

d. For Exposure D, add 8 inches (203 mm) to the parapet height required for Exposure C and the parapet height shall not be less than 12 inches (305 mm).

CHANGE SIGNIFICANCE: Past provisions regulating aggregate blow-off from aggregate-surfaced roofs were not based on a quantitative analysis of observed roofing system performances in real wind events. Rather, the requirements were based on variations in surface pressure with building height, which is known to be an inaccurate predictor of aggregate blow-off due to pressure equalization effects.

Fully revised Section 1504.9 is now based on wind speeds for blowoff and only deals with smaller aggregate used for the surfacing of built-up roofs (BUR) and sprayed polyurethane foam (SPUF) roofs, both of which are different systems than ballasted roofs.
Table 1504.9 considers aggregate size, roof height and wind speed to determine the minimum required parapet height. The table provides an engineering and scientific basis for roof design to prevent aggregate blow-off that is based on wind tunnel tests and subsequent field studies of hurricane damage. Unsafe conditions where no parapets are provided to retain aggregates are no longer allowed.
Critical parameters, such as aggregate size and parapet height, will now govern performance. The use of aggregate-surfaced roofing systems is a viable option in high-wind areas with appropriate aggregate sizing and parapet height.
Note: ASTM D1863 maintains an aggregate size No. 67 that is sized between aggregates No. 7 and No. 6.

Photo courtesy of Baloncici

Aggregate-surfaced roof with parapet.

- **CBC Table 1604.5**

Mixed occupancy buildings with assembly spaces are placed in Risk Category III when the total public assembly occupant load is greater than 2500 people.

TABLE 1604.5 Risk Category of Buildings and Other Structures

Risk Category	Nature of Occupancy
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of the public assembly spaces of greater than 2,500. • Buildings and other structures containing Group E or Group I-4 occupancies or combination thereof, with an occupant load greater than 250. *(Other Risk Category III criteria remain unchanged)*

CHANGE SIGNIFICANCE: Group R-1 hotels often have convention center facilities with multiple large ballrooms and other assembly spaces, but public assembly is not the primary occupancy of the building. These buildings have historically been classified as Risk Category II. Conversely, there are smaller buildings consisting solely of one or more assembly rooms where the primary occupancy is public assembly with a cumulative occupant load of over 300 that must be designed to the higher Risk Category III requirements although the total assembly occupant load is much lower when compared to a hotel.

To deal with this imbalance, Table 1604.5 includes a new condition under Risk Category III for those buildings containing at least one assembly space with an occupant load greater than 300 while also having a cumulative occupant load for all assembly spaces of more than 2,500.

Buildings that meet these criteria are now assigned to Risk Category III rather than Risk Category II.

To illustrate the revised provisions, the following example is based on a hotel with an adjoining convention area. The primary use of the building is considered to be Group R-1; however, there are also a number of assembly spaces having a significant occupant load. The building housing the hotel and convention facilities is now considered to be Risk Category III due to the new criteria.

Example: Hotel Conference Center

Photo courtesy of mustafagull

5-story hotel with conference center

440 guest rooms

2 ballrooms with 1,200 occupants each

3 meeting rooms with 90 occupants each

Total assembly occupants: 2,670 people **Risk Category III**

The new threshold requires the existence of two conditions for the establishment of a Risk Category III classification. First, at least one of the assembly spaces must have an occupant load that exceeds 300, and second, the cumulative occupant load of all assembly spaces must exceed 2,500. In the example shown, both conditions have been met, and the building is to be assigned to Risk Category III.

- **CBC Section 1608.2**

The 2021 IBC snow map is updated to match ASCE 7-16 snow maps by adding a reference to ASCE 7 snow tables in states with large case study areas.

CHANGE SIGNIFICANCE: Updating Section 1608 harmonizes snow load provisions with the 2016 edition of ASCE 7, which is the reference standard for snow loads used in building design. ASCE 7 has a ground snow map that contains new ground-snow load tables; these include tables for seven states: Colorado, Idaho, Montana, Washington, New Mexico, Oregon and New Hampshire. The state tables list ground snow loads and maximum elevations for major cities and towns in each region of a given state. The tables are based on state ground snow reports by regional experts and include specialized knowledge of local climatic conditions. Table 7.2-5, Ground Snow Loads for Selected Locations in Washington [State] is an excerpt from ASCE 7-16.

CBC Figures 1608.2(1) and 1608.2(2) indicate which states have supplemental data within the ASCE 7 standard.

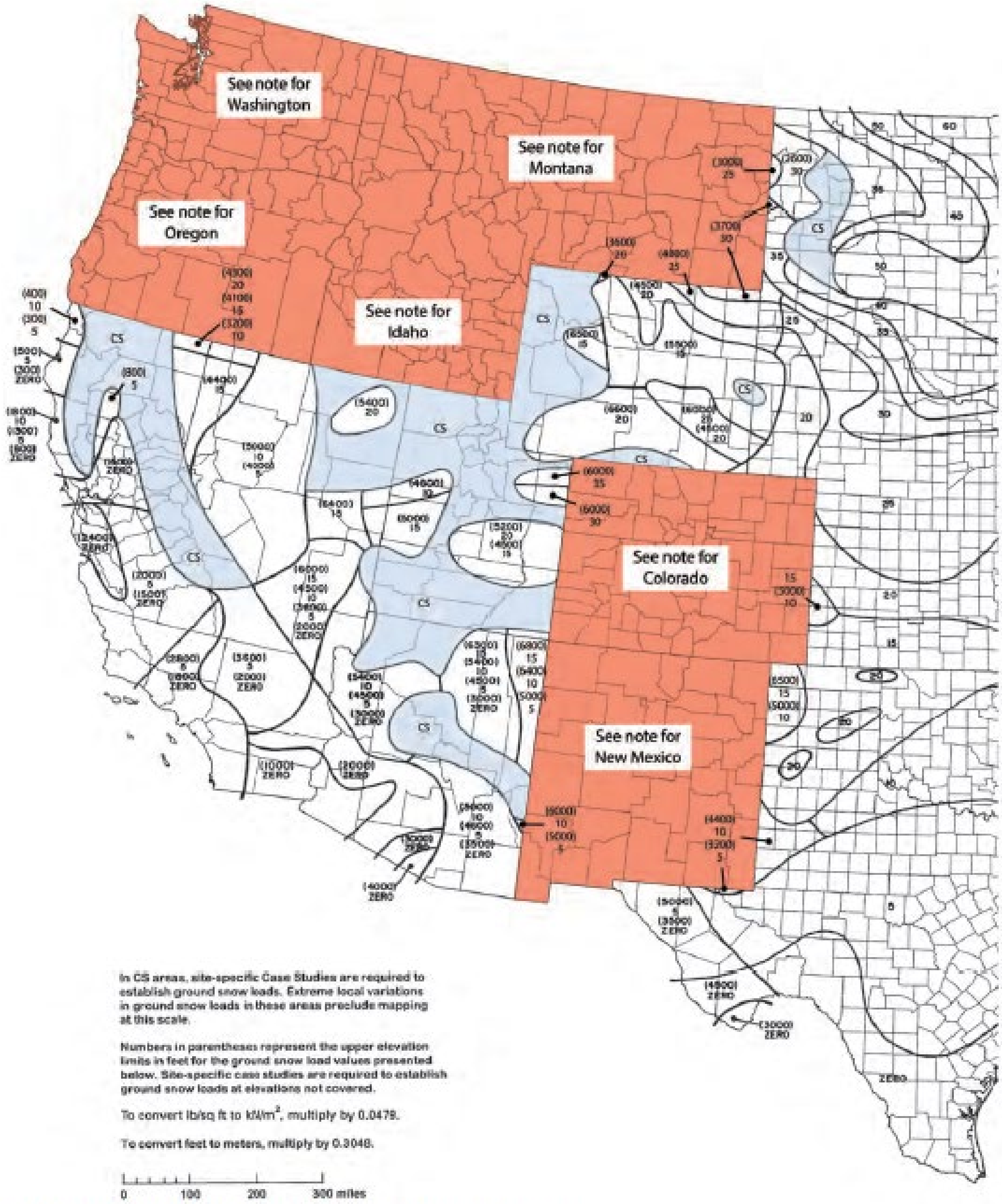


Figure 1608.2(1) Ground Snow Loads, p_g, for the United States (psf).

- **CBC Section 1611**

Secondary drainage system rain loads are updated to be consistent with ASCE 7

CHANGE SIGNIFICANCE: Secondary (overflow) system design has been harmonized with roof rain load provisions for a structure to provide realistic expectations of the roof drainage system and potential roof loading by rainfall. The CBC is now consistent with ASCE 7 provisions. Calculations for the design mean recurrence interval and duration for determining the hydraulic head, *dh*, are available in both ASCE 7 and the CBC.

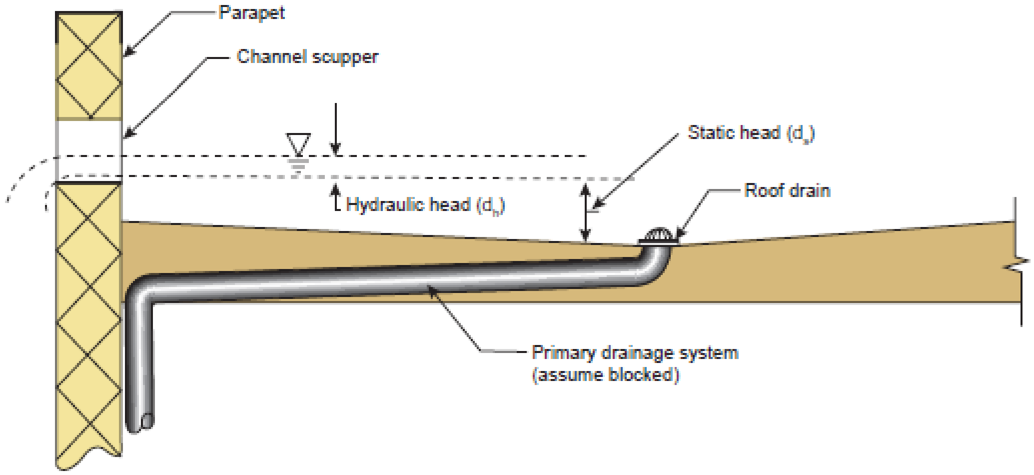
Legacy ASCE load standards' design rainfall durations for plumbing systems were between 15- and 60-minutes for a 100-year mean recurrence interval. The 1995 *Standard Plumbing Code* used the 100-year/60-minute duration for primary drainage system design and a 100-year/15-minute duration storm for the secondary drainage system. In the 2019 *California Building Code* (CBC) a 100-year/60-minute duration is used for both the primary and secondary systems. Note that the use of twice the 60-minute duration is close to the 15-minute duration rainfall rate. Also note that 2022 CBC rainfall maps (Figures 1106.1(1-5) and 1611.1(1-5), respectively) both include a 60-minute duration rather than the 15-minute storm duration. However, the 2022 CBC, by giving two options ‐ the 15-minute duration or twice the 60-minute duration ‐ results in values similar to ASCE 7.

The best source for rainfall data is the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Precipitation Frequency Data Server ‐ Hydrometeorological Design Studies Center (hdsc.nws.noaa.gov/hdsc/pfds/index.html) for precipitation intensity (inches per hour) based on the 100-year mean recurrence interval. NOAA's data lists both 15-minute and 60-minute duration data.

Details of load and drain size calculations:

To understand why this makes a difference, the following examples show how to determine rain load, *R*, assuming rainfall for the city of Cedar Rapids, Iowa. The first example uses the 2019 CBC requirements and the second uses the 2022 CBC requirements.

Secondary drain sizes and geometries affect the structural engineer's determination of a maximum height of water above the roof surface by the use of variables d*s* and d*h* for static and hydraulic head. Secondary drains should be specified, if possible, to keep rain loads reasonable. Engineers should be aware of different secondary drain options available to plumbers and clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a building. Important parameters to communicate include the assumed static head, hydraulic head associated with the secondary drain or scupper size and geometry, rain load and rainfall rate.



Secondary drainage design assumptions.

Example 1: 60-minute rainfall total for primary and secondary systems (2019 CBC).

Design rainfall: 3.30 inches for 100-year mean recurrence, Cedar Rapids Station No. 1.

Calculate primary and secondary drain size and resulting rain load, *R*.

Primary Drain

Depth of water (in 1 hr): 3.30 inches (NOAA) Tributary area (primary drain): 100 ft by 50 ft = 5,000 ft2

Flow rate (volume) to maintain roof drainage:

$Q = 0.0104 \times A \times I$ **(ASCE 7-16 Equation C8.3-1*)**

where:

Q = flow rate to maintain drainage rate equal to rainfall rate

A = tributary area

i = water depth in inches per hour

*The 0.0104 factor in the equation converts area, which is in square feet, and rainfall rate, which is in inches per hour, to gallons per minute.

A = 50 ft × 100 ft = 5,000 ft2

i = 3.30 inches/hr

Q = 0.0104 × 5,000 ft2 × 3.30 inches/hr = 172 gal/min*

From Table 1103.1 of the 2019 CPC, the minimum drain size is … 4-inch vertical pipe

Secondary Drain and Rain Load (*R*) Calculation

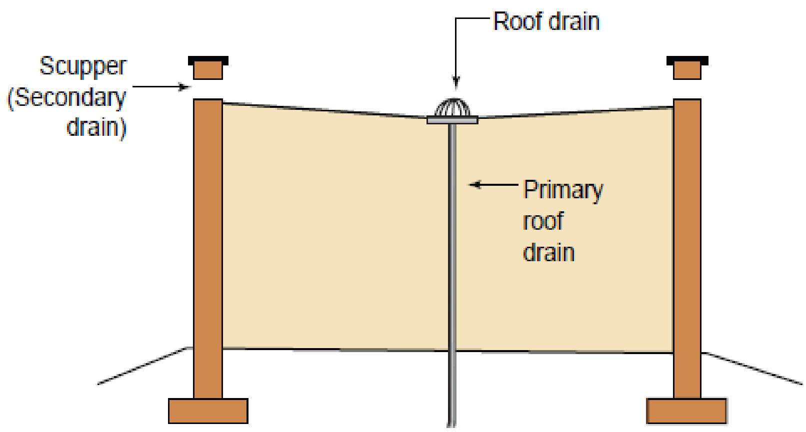
Given:

ds = specified distance from the roof surface to the bottom of scupper

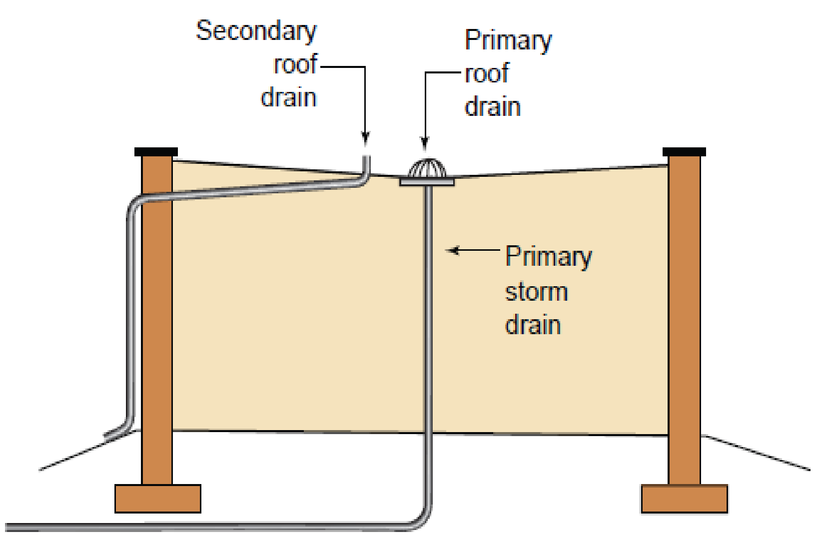
dh = calculated (tabulated) height of water above base of scupper or

secondary drain based on drain geometry

Flow rate (volume) to maintain roof drainage through a scupper or secondary drain is calculated for the secondary drain since the primary drain is assumed to be completely blocked. The secondary system's design rainfall is 3.30 inches per hour per the 2019 CBC. The flow rate, *Q*, will be 172 gal/min, identical to the primary drain system. This rain load must leave the roof at least at the same rate it is falling. Typically, once the structural engineer determines the rainfall, static head, hydraulic head, *dh*, and rain load on a roof, a plumber can size the secondary system pipes or scuppers to a flow rate of 172 gal/min or greater. The structural engineer does this check as an iterative process to keep rain loads on the roof reasonable by limiting the hydraulic head to a reasonable value. Engineers should be aware of different secondary drain options available to plumbers and clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a building.



Secondary drainage using scuppers.



Secondary drainage using pipe with visible outlet.

To calculate *R*:

dh (hydraulic head) = 5 inches for a 6-inch-wide, 6-inch-high, closed-top scupper which corresponds to a flow rate of 194 gpm (per 2018 IBC Commentary Figure 1611.1(2)), which is sufficient for the calculated flow rate of 172 gpm.

ds (static head) = 6 inches (specified distance from the roof surface to the bottom of the scupper)

$R = 5.2(ds + dh) = 5.2(6\text{ in.} + 5\text{ in.}) = 57.2$ psf **(CBC Equation 16-19)**

As a second iteration, a 24-inch-wide scupper (open- or closed-top of any height) handles 200 gpm with a corresponding 2-inch hydraulic head.

This would reduce the rain load to a more reasonable 41.6 psf.

Note: The 5.2 value in the equation converts the depth of water, which is in inches, to pressure in pounds/square foot (psf) using the density of water of 62.5 pounds per cubic foot (pcf) and the conversion of inches to feet (12 inches per foot); therefore, (62.5 pcf)/(12 in./ft) = 5.2 psf per inch of water depth.

Example 2: 60-minute rainfall duration for the primary system, 15- minute rainfall duration for the secondary system (2022 CBC). Design rainfall for Cedar Rapids Station No. 1:

3.30 inches for 100-year mean recurrence (60-minute)

1.72 inches for 100-year mean recurrence (15-minute)

Calculate primary and secondary drain size and resulting rain load, *R*.

Primary Drain

Using the parameters from Example 1, calculation of the primary drain diameter per Table 1103.1 of the 2022 CPC requires a minimum:

4-inch vertical pipe

Secondary Drain and Rain Load (*R*) Calculation

Flow rate (volume) to maintain roof drainage through a scupper or secondary drain is the flow rate calculated for the secondary drain. The primary drain is assumed to be completely blocked.

Flow rate (volume) to maintain roof drainage rate equal to rainfall rate:

$Q = 0.0104 \times A \times I$ **(ASCE 7-16 Equation C8.3-1*)**

where:

Q = flow rate to maintain drainage rate equal to rainfall rate

A = tributary area

i = water depth in inches per hour (must convert 15 min interval to equivalent hour interval)

*The 0.0104 factor in the equation converts area, which is in square feet, and rainfall rate, which is in inches per hour, to gallons per minute.

A = 50 ft × 100 ft = 5,000 ft2

i = 1.72 inches/15 minutes × 60 minutes/hour = 6.88 inches/hour

Q = 0.0104(5,000 ft2) (6.88 inches/hr) = 358 gal/min

Note that a 15-minute design rainfall has a flow rate approximately 2 times the flow rate of the 2019 CBC 60-minute design rainfall. This is true for much of the United States, but check each location to make sure it is true in that region rather than assuming a fixed 100-percent increase in flow rate.

To calculate *R*:

dh (hydraulic head) = 3 inches for a 24-inch-wide, open- or closed-top scupper corresponding to a flow rate of 360 gpm (2018 IBC Commentary Figure 1611.1(2)) which is sufficient for the calculated flow rate of 358 gpm.

ds (static head) = 6 inches (specified distance from the roof surface to the bottom of the scupper)

$R = 5.2(ds + dh) = 5.2(6\text{ in.} + 3\text{ in.}) = 46.8$ psf **(CBC Equation 16-19)**

Note: The 5.2 value in the equation converts the depth of water, which is in inches, to pressure in pounds/square foot (psf) using the density of water of 62.5 pounds per cubic foot (pcf) and the conversion of inches to feet (12 inches per foot); therefore, (62.5 pcf)/(12 in/ft) = 5.2 psf per inch of water depth.

Notes:
Not only does secondary drain size impact flow rate, but drain size and geometry impacts hydraulic head levels. To keep the rain load to reasonable design levels, larger secondary drains and geometries should be explored to minimize hydraulic head levels. As shown in the examples,
flow rates in the 2022 CBC are approximately double for secondary drain design, 2022 CBC flow rate to 2019 CBC flow rate = 358/171 = 2.08. However, for comparably sized roofs and secondary drains (24-inch scuppers), the difference in the hydraulic head is only 1 inch, which only increases the rain load by about 5 psf.
Discussion must occur for the plumber to be aware of the change in the CBC and ASCE 7 to a 15-minute per 100-year rainfall duration. Engineers should clearly communicate how changes, especially to secondary drain geometry, can impact design rain loads on a roof.

- **CBC Sections 1705.5.3 & 1705.20**

Special inspection requirements were added to address the anchorage and connection of mass timber structural elements.

TABLE 1705.5.3 Required Special Inspections of Mass Timber Construction

Type	Continuous Special Inspection	Periodic Special Inspection
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		X
2. Inspect erection of mass timber construction.		X
3. Inspection of connections where installation methods are required to meet design loads.		
Threaded fasteners.		
Verify use of proper installation equipment.		X
Verify use of pre-drilled holes where required.		X
Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.	X	
Adhesive anchors not defined in the preceding cell.		X
Bolted connections.		X
Concealed connections.		X

CHANGE SIGNIFICANCE: Special inspection provisions have been added to Section 1705 for mass timber elements in Types IV-A, IV-B and IV-C construction. This unique type of construction requires a level of inspection consistent with other large buildings and applications. The special inspections are similar to requirements for other prefabricated systems such as precast concrete and structural steel.
The specific elements requiring special inspection for construction Types IV-A, IV-B and IV-C include:

1. The connection of mass timber elements to timber deep foundation elements. These connections are critical to transfer loads from the mass timber elements to the piles, particularly for lateral loading. Connections to concrete foundations are addressed in CBC Table 1705.3 for concrete special inspections.

2. Erection of mass timber elements. Similar to precast concrete, tall wood buildings utilizing prefabricated elements need verification that the correct elements are placed in the correct location in accordance with the design drawings.
3. Specialized connections between mass timber products that utilize threaded, bolted, or concealed connections. Similar to concrete connections, the strength of many connections is predicated on specific screw lengths and installation angles. Bolted connections require specific diameters, and for lag screws, specific lengths and diameters. Concealed connectors, many of which are proprietary, must be installed correctly for structural performance.
4. Adhesive anchorage installed in horizontal or upwardly inclined positions resisting sustained tension loads. A continuous special inspection is necessary because of issues with adhesive creep under long-term tension loading. All other adhesive anchors need only be inspected periodically.

If, in the judgment of the building official, there are other unusual connections or assemblies not covered in Table 1705.5.3, special inspection per Section 1705.1.1 will be required. The building official can require special inspections where a manufacturer's installation instructions prescribe requirements not contained in the code. For example, field-glued mass timber beam or panel splices, while currently rare in North America, may become more prevalent in the future. Section 1705.1.1 would allow the building official to require special inspection for either proprietary or non-proprietary field-glued splices. Additionally, many design engineers will specify special inspections for unusual conditions in both their structural notes within the construction documents and in the statement of special inspections.

Connections between mass timber products that utilize threaded, bolted or concealed connections require special inspection.

The new Section 1705.20 requires periodic special inspection of sealants or adhesives where the sealant or adhesive required by CBC Section 703.7 is applied to mass timber building elements as designated in the approved construction documents. Additionally, the new Section 703.7 requires sealing between mass timber elements in Type IV-A, IV-B and IV-C construction to resist the passage of air at the following locations:
1. At abutting edges and intersections of mass timber building elements required to be fire-resistance rated.
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated.

Sealants must meet the requirements of the ASTM International standard ASTM C920, *Standard Specification for Elastomeric Joint Sealants,* and adhesives must meet the requirements of ASTM D3498, *Standard*

Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.
Special inspection of mass timber sealing does not apply to “joints” as defined in Section 202 since these fire-resistant joint systems have their own requirements for placement and inspection in Section 715 and special inspections in Section 1705.18. Joints are defined as having an opening that is designed to accommodate building tolerances or to allow independent movement. Panels and members that are connected do not meet the definition of a joint since they are rigidly connected and do not have an opening. It should be noted that some mass timber panels are manufactured under proprietary processes to ensure there are no voids at intersections. Where this proprietary process is incorporated and tested, there is no requirement for a sealant or adhesive.

Photo courtesy of ATF Fire Research Laboratory

Sealants and adhesives specified to resist the passage of air require special inspection.

- **CBC Section 1705.18**

Installation of firestop, fire-resistant joint systems and perimeter fire barrier systems in residential-use buildings now requires special inspection in Group R fire areas having an occupant load exceeding 250 people.

CHANGE SIGNIFICANCE: Firestop, fire-resistant joint system and perimeter fire containment system special inspections are required for buildings in Risk Categories III and IV, as well as in high-rise buildings.
However, fire-resistance-rated compartmentation is a critical fire protection feature in many Risk Category II Group R buildings as well. When through-penetration firestop systems and fire-resistant joint systems are not properly installed, the integrity of the fire-rated separations is compromised.
To adequately protect people where they live, the requirement for special inspection of firestop, fire-resistant joints and perimeter containment systems has been expanded to include larger buildings containing residential occupancies.
The scope of the special inspection requirement is limited to Group R fire areas containing an occupant load of more than 250 people within the fire area. Unless a high-rise condition exists, such special inspection is not required provided the Group R building has an occupant load of 250 or less, or where the building has been subdivided into complying fire areas so that no Group R fire area occupant load exceeds 250.

Photo courtesy of buzbuzzer

Hotels may require special inspection of firestop systems.

- **CBC Section 1809.5.1**

Frost protection for egress doors was added to the foundation requirements.

CHANGE SIGNIFICANCE: Frost protection must now be provided for exterior landings at all required means of egress doors. Where frost protection is required, landing areas immediately adjacent to egress doors must be provided with the same frost protection systems as that of the building being served by the exits. This protection is designed to prevent concrete landings from heaving, thereby compromising normal operation of required egress doors. Such heaving actions can render an egress door entirely unusable, creating an untenable situation.
There are multiple conditions that contribute to concrete heaving, making it impossible to predict when and where such heaving may occur.
Section 1809.5.1 is intended to provide heave protection only for the area of a landing immediately adjacent to exit doors and only for the area required to allow the door to swing open at least 90 degrees from a closed position. The remaining portions of a larger patio or sidewalk need not be provided with frost protection. Doors that do not swing–for example, a revolving door at a lobby entrance–do not require frost protection.

Photo courtesy of Bim

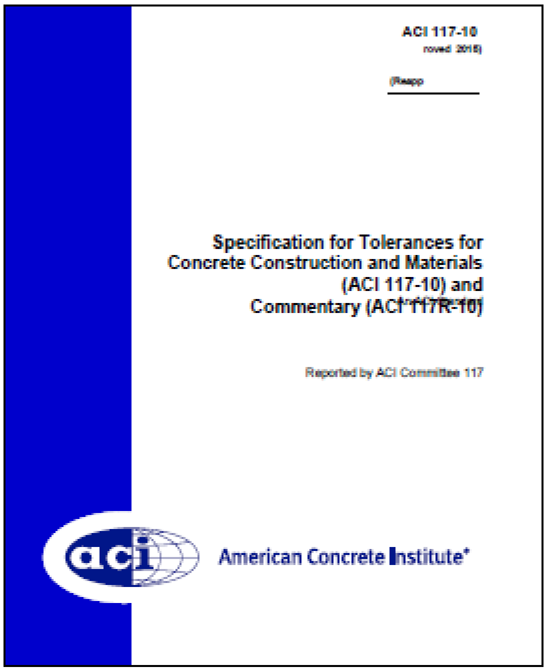
Frost protection is required in front of a swinging door only.

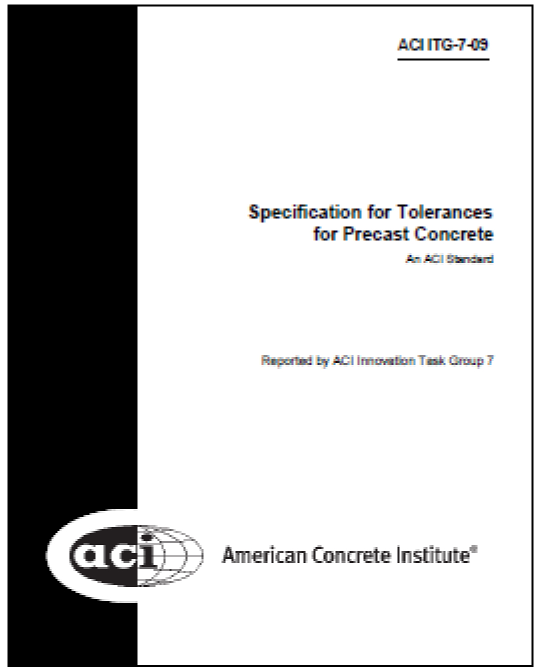
- **CBC Section 1901.7**

ACI standards ACI 117 and ITG 7 were added by reference to provide acceptable tolerances for concrete construction

Chapter 35
ACI 117—10: Specification for Tolerances for Concrete Construction and Materials

ACI ITG-7—09: Specification for Tolerances for Precast Concrete





Images courtesy of American Concrete Institute

ACI 117 and ACI ITG-7.

CHANGE SIGNIFICANCE: Two standards are now referenced regarding the allowable tolerances of structural concrete elements when such tolerances have not been indicated in construction documents, providing building departments, designers, contractors and special inspectors with information necessary for concrete design and construction within appropriate tolerances.

ACI 117-10, *Specification for Tolerances for Concrete Construction and Materials,* designates standard tolerances for concrete construction.

Applicable to exposed concrete and architectural concrete, tolerances in the specification are for typical concrete construction and construction procedures. Materials that interface with, or connect to, concrete elements may have tolerance requirements that are not compatible with those contained in ACI 117. Care should be taken to verify that concrete tolerances work with the steel or wood tolerances of each structural assembly. This specification does not apply to precast concrete or to shotcrete.

As a best practice, a series of preconstruction tolerance coordination meetings should be scheduled and held before the commencement of concrete work. The contractor,

subcontractors, material suppliers and other key parties should all attend. At the meeting, all parties should be given an opportunity to identify any tolerance questions and conflicts applicable to the work with materials, prefabricated elements and work to be assembled or installed in the field by the contractor.
ACI ITG 7-09, *Specification for Tolerances for Precast Concrete*, provides standard tolerances for precast concrete construction, deals with dimensional tolerances for precast concrete members used in building construction, and addresses erection tolerances for the individual members.
A specifier can supplement the provisions of ITG-7 as needed by including project-specific requirements in the contract documents.

- **CBC Sections 602.4.1-602.4.3**

  Three new types of construction (Types IV-A, IV-B, and IV-C) allow mass timber buildings of taller heights, more stories above grade, and greater allowable areas compared to existing provisions for heavy timber buildings.

Photo courtesy of ATF Fire Research Laboratory

Mass timber construction fire test.

CHANGE SIGNIFICANCE: The primary purposes of providing three unique types of mass timber construction are to recognize and accommodate the use of solid timber structural elements in buildings of considerable height and area. The three new types vary based upon the percentage of mass timber surfaces that can be unprotected. The three established levels of protection include complete noncombustible protection of the mass timber members (Type IV-A), partial protection of such members (Type IV-B), and no required noncombustible protection of the mass timber (Type IV-C). An important consideration was the extent of any required protection, based on the degree to which noncombustible protection limits fuel contribution of mass timber to a fire. As such, it was determined that the conditions, materials and assemblies associated with Types IV-A, IV-B and IV-C construction be limited only to those that had been tested. See the discussion on Sections 703.6 and 722.7. This differs significantly from Type IV-HT construction where the fire-resistance is almost solely achieved through an evaluation of the cross-sectional dimensions of the mass timber members.

By definition, mass timber includes structural elements that primarily consist of solid, built-up, panelized or engineered wood products that meet the minimum dimensional criteria for Type IV construction. Combustible light-frame materials are specifically and totally excluded from these three new types of construction. In the three new types of construction, those materials of construction that do not qualify as mass timber must be noncombustible.

The three new types of construction are all defined by the specific requirements established in Sections 602.4.1 through 602.4.3. There is one major commonality, that the buildings are composed wholly, or in part, of heavy timber elements. The details of each individual construction type may differ when it comes to fire-resistive protection and other issues; however, the recognition of mass timber as a viable construction material for buildings of a significant size has been established.

The defining characteristic of Type IV-A construction is the mandate of completely protected mass timber structural elements. The details of the noncombustible protection are established in Section 602.4. Noncombustible assemblies are also permitted, such as light-gage steel framing, but combustible assemblies are specifically excluded. In addition, the minimum fire protection ratings required by Table 601 for construction type and Section 705.5 for exterior walls must be applied regardless of the materials of construction.

Type IV-B construction is unique in that some degree of exposed interior wood surfaces of walls, ceilings, columns and beams are allowed.

However, a significant amount of the mass timber elements must be protected in the same manner as applicable to Type IV-A buildings.

The details identifying those elements that may be protected, and the allowable percentages of unprotected mass timber elements, are set forth in Sections 602.4.2.1 through 602.4.2.6. The allowance for unprotected building elements does not eliminate the need for any fire-resistance rating that may be mandated by the code. Mass timber structural elements permitted without noncombustible protection must still be evaluated for compliance with any required fire-resistance rating. Consistent with the limits on Type IV-A buildings, combustible light-frame construction, including the use of fire-retardant-treated wood, is not permitted.

Type IV-C construction differs significantly from Types IV-A and IV-B in that the mass timber located on the interior of the building can be fully exposed, with limited exceptions. No noncombustible protection is mandated except for components such as concealed spaces, shaft enclosures and interior exit stairways. Type IV-C differs from the traditional Type IV-HT construction when it comes to required fire-resistance-rated protection of the building elements. Minimum 2-hour ratings must be achieved by the bearing walls, floors and primary structural frame elements; however, such rated elements are not required to be covered with noncombustible protection.

Additional areas of commonality and differences among the new construction types include those related to exterior wall protection, floor and roof construction, concealed spaces and shaft enclosures. A comprehensive discussion regarding all of the 2022 code provisions related to the regulation of mass timber buildings can be found in the publication *Mass Timber Buildings and the IBC*, jointly published by ICC and the American Wood Council.

- **CBC Section 1610.2**

Soil-Caused Uplift.

CHANGE SIGNIFICANCE: Section 1610 has not previously addressed uplift loads from hydrostatic pressure or expansive soils. Requirements addressing uplift forces are now to be applied when appropriate and included in the design. The hydrostatic pressure provisions include a required determination of loads based on measuring to the underside of the construction per ASCE 7, Section 3.2.2. While this is a straightforward provision of fluid mechanics, the new provisions are intended to prevent the use of common elevations shown on construction drawings, such as floor elevations or the top of foundation construction, as the elevation at which to apply hydrostatic forces. The new language explicitly states that hydrostatic pressures should be applied to the underside of a foundation's lowest horizontal element.

A pointer has been added to Section 1808.6, Design for Expansive Soils, to help in determining the minimum required uplift or upward load due to the movement of soils below a building when expansive soils are present.

Photo courtesy of Mark Winfrey

Slab foundations require design for soil heave.

- **CBC Sections 1705.13.7 & 2209**

Steel Storage Racks

TABLE 1705.13.7 Required Inspections of Storage Rack Systems

Type	Periodic Inspection	Referenced Standard	CBC Reference
1. Materials used, to verify compliance with one or more of the material test reports in accordance with the approved construction documents.	X		
2. Fabricated storage rack elements.	X		1704.2.5
3. Storage rack anchorage installation.	X	ANSI/MH16.1 Section 7.3.2	
4. Completed storage rack system, to indicate compliance with the approved construction documents.	X		

CHANGE SIGNIFICANCE: The design of storage rack components is based on a minimum steel thickness and minimum yield strength. It is imperative that these minimum properties be included in the design for component fabrication and considered in storage rack installation. Storage rack systems may have complex load paths. Installation must comply with approved drawings to create the necessary load paths. Verification must be made of material minimum quality requirements during fabrication and correct anchorage during installation.

It has been clarified that periodic special inspection is required for steel storage racks, regular or cantilevered, that are eight feet or more in height in Seismic Design Category D, E or F locations. In addition, a definition of cantilevered steel storage racks has been added for clarity.

Additional commentary on the storage rack definitions can be found in the significant changes discussion of Section 2209.

The addition of a steel cantilevered storage rack definition acknowledges that this common type of storage rack has different load and design requirements than a standard steel storage rack. The definition of a steel cantilevered storage rack is consistent with that found in ASCE 7, Section 11.2 and specifically states that the racks will be made of structural steel, that the arms cantilever and that the definition is not applicable to other types of steel storage racks.

The design of the components utilized in steel storage racks are based on minimum thicknesses and minimum yield strength. Storage rack systems can be complex, and their fabrication and installation must comply with the approved drawings. The installation and anchorage of storage racks in high seismic regions require special inspection. In addition, a certificate of compliance is to be provided to the owner stating that the rack was installed following the approved construction documents.

Cantilevered storage rack.

- **CBC Section 2302.2**

FRT Wood

CHANGE SIGNIFICANCE: How to test fire-retardant-treated wood has been a discussion point for several years. Surveyed fire test labs indicate that there are only two applicable fire test requirements from ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*:

1. Flame spread index of not more than 25.
2. Flame front that does not progress more than 10½ feet beyond the burners' centerline when the ASTM E84 test is extended by 20 minutes for a total test time of 30 minutes.

The referenced 2019 edition of ASTM E84 incorporates requirements for conducting an extended 30-minute test. Previously, ASTM E84 did not specify any time frame beyond its 10-minute test. Consequently, ASTM E84 did not provide details on how to assess either "no evidence of significant progressive combustion" or "the flame front shall not progress more than 10½ feet beyond the centerline of the burners." Information for how to determine both of those characteristics is contained in ASTM E2768, *Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test),* and is now directly referenced by ASTM E84.

Photo courtesy of American Wood Council

FRT Lumber.