



# Highlights of ICC 500- 2020

ICC/NSSA Standard for the Design and Construction  
of Storm Shelters

August 2021



FEMA

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## Acronyms and Abbreviations

ACI	American Concrete Institute
AHJ	authority having jurisdiction
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
IBC	International Building Code
ICC	International Code Council
IEBC	International Existing Building Code
IPC	International Plumbing Code
IPS	impact-protective systems
IRC	International Residential Code
ISEA	International Safety Equipment Association
mph	miles per hour
NFPA	National Fire Protection Association
NSSA	National Storm Shelter Association
RDP	Registered Design Professional
SEI	Structural Engineering Institute
SSPEOP	Storm Shelter Preparedness and Emergency Operations Plan

# 1. Introduction

Published by the International Code Council® (ICC®) and the National Storm Shelter Association (NSSA®), the *ICC/NSSA Standard for the Design and Construction of Storm Shelters* (ICC 500), is a referenced standard in the International Codes (I-Codes). The ICC, in partnership with the NSSA, formed a national committee in 2003 that developed and released a consensus standard to codify the design and construction requirements of tornado and hurricane storm shelters. The ICC 500 was first published in the summer of 2008 and updated in December of 2014 and 2020. ICC 500 provides:

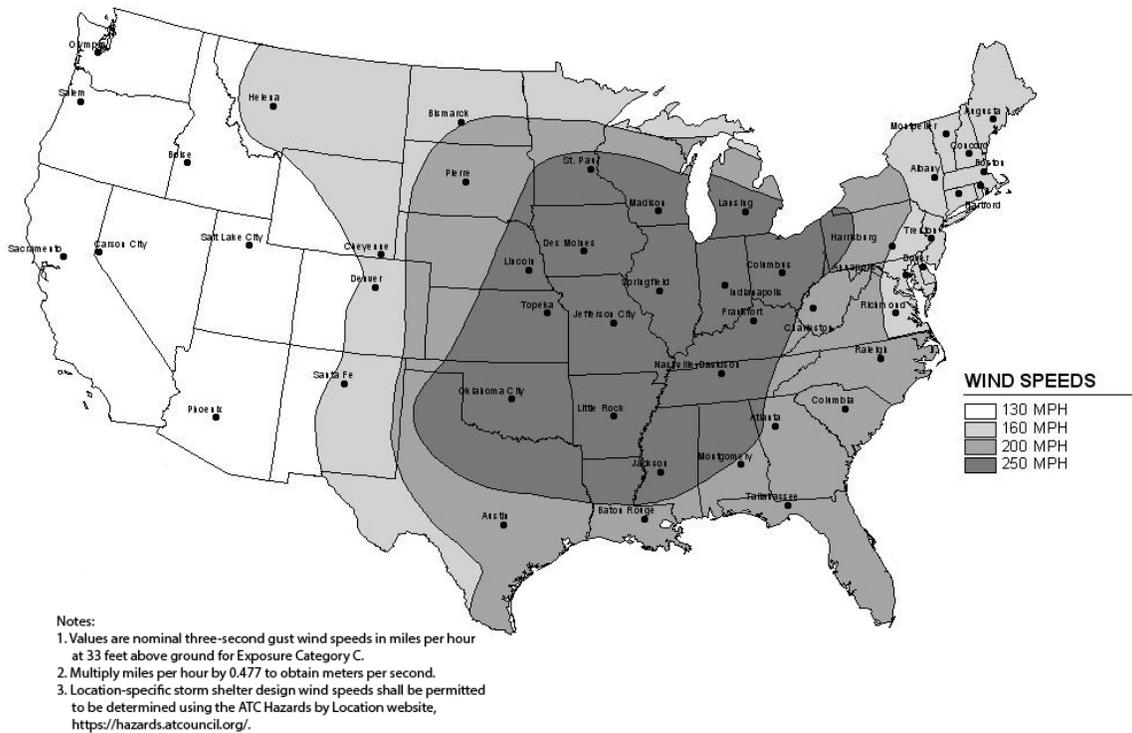
*the minimum requirements to safeguard the public health, safety, and general welfare relative to the design, construction, and installation of storm shelters constructed for protection from tornadoes, hurricanes, and other severe windstorms. This standard is intended for adoption by government agencies and organizations for use in conjunction with applicable codes to achieve uniformity in the technical design and construction of storm shelters (ICC 500 Section 101.1).*

ICC 500 applies to the design, construction, installation, and inspection of community and residential storm shelters. **Residential** storm shelters serve occupants of dwelling units and have an occupant capacity not exceeding 16 people. **Community** storm shelters are storm shelters that are not residential storm shelters; they may include shelters intended for use by the general public, by occupants of a specific campus or building, or a combination of both. Storm shelters are permitted to be either separate, detached buildings, or enclosed or partially enclosed within a host building.

Since the 2009 editions of the ICC's *International Residential Code* (IRC) and *International Building Code* (IBC), ICC 500 has been referenced as the governing standard for the design and construction of storm shelters. Additionally, Section 423 of the 2015, 2018, and 2021 editions of the IBC requires new buildings with certain uses or occupancies and geographic locations to be built with a storm shelter. The following structures must include a storm shelter constructed in accordance with ICC 500 when located in a 250 mph wind speed zone for tornadoes per Figure 304.2(1) of ICC 500 (refer to Figure 1):

- 911 call stations
- Emergency operations centers
- Fire, rescue, and ambulance stations
- Police stations
- K-12 school buildings with an occupant load of 50 or more, with certain exceptions

Further, the 2018 and 2021 editions of the International Existing Building Code (IEBC) provide storm shelter requirements for additions to existing buildings that parallel the storm shelter requirements for new buildings in IBC Section 423.



SOURCE: ICC 500 (2020) FIGURE 304.2(1); USED WITH PERMISSION

**Figure 1: Design wind speeds for tornado storm shelters**

ICC 500 sets forth requirements for a range of topics related to the design and construction of storm shelters, including administration; structural design and testing; siting; occupant density, access, accessibility, egress, and signage; fire safety; essential features and accessories; and test methods for impact and pressure testing. Highlights of ICC 500 (2020 edition) are described below.

## 2. Highlights of the 2020 Edition of ICC 500

### 2.1. Application and Administration

- ICC 500 specifies the information required on submittal documents, which must be prepared and sealed by a registered design professional with every permit application. The standard also includes provisions for quality assurance plans, contractor responsibilities, peer review, special inspection, and structural observations.
- New requirements (described in the following section) have been added to address owner responsibilities for new shelters and the evaluation, maintenance, and repair of existing shelters.

- Listing and labeling requirements are provided. Labels indicating compliance with the standard are mandatory on impact-protective systems (IPS). The requirements also dictate what information must be shown on labels.

## 2.2. Structural Design and Testing Criteria

- The standard requires testing where the capacity of the storm shelter envelope cannot be determined by engineering calculations.
- Loads and load combinations derived from the American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI) standard ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (2016) are required for storm shelter design. Wind load parameters that are modified by ICC 500 for all shelters include wind speed, exposure category, directionality factor, and enclosure classification. For tornado storm shelters, changes in internal pressures due to atmospheric pressure change and topographic effects must also be considered.
- Aside from wind loads, ICC 500 provides requirements for rain loads, floor live loads, roof live loads, hydrostatic loads, and flood loads that differ from ASCE 7.
- Requirements for shielding of shelters from host and adjacent buildings and for the connections between a storm shelter and its host building are specified. Storm shelter designers are not permitted to lessen wind loads or wind-borne debris impacts that may result from shielding by the host (or adjacent) buildings, because the other building may fail. Further, the storm shelter must be able to resist the maximum forces that could be transmitted through connections between the host building and the shelter.
- Resistance to wind-borne debris hazards is addressed through missile impact testing requirements. Representative test missile sizes are a function of the shelter's designated storm type, whereas test missile speeds vary with storm type, shelter design wind speed, and orientation (vertical or horizontal) of the shelter assembly or component.
- Laydown and falling debris hazard requirements have been revised in the 2020 edition. ICC 500 now defines laydown radius and fall radius and requires storm shelters to be designed to resist the impact loads from potential laydown and falling debris hazards. It also requires impact loads from these hazards to be considered one at a time additively with the uniform roof live load.
- Limitations on joints, gaps, voids, and penetrations in the storm shelter envelope are provided. Where the limitations are exceeded, opening protection is required.
- Foundations and slabs that support a residential storm shelter within one- or two-family dwellings must be designed in accordance with either American Concrete Institute (ACI) 318, *Building Code Requirements for Structural Concrete*, or ACI 332, *Code Requirements for Residential Concrete and Commentary*, for all applicable loads of ICC 500 Chapter 3. All other

storm shelters must comply with ACI 318 for all applicable loads of ICC 500 Chapter 3. An exception for existing slabs supporting heavy storm shelters is included.

### **2.3. Siting**

- Criteria based on storm shelter type and location of the shelter in three defined flood hazard areas are provided so users can determine whether Chapter 4 flood design requirements and minimum floor elevations apply.
- Flood siting restrictions that apply to all storm shelters are provided. An additional siting restriction is maximum travel distance for residential tornado storm shelters. Also, a new reference is provided to IBC Section 423 for maximum travel distance to community storm shelters that are required for educational occupancies.

### **2.4. Occupant Density, Access, Accessibility, Egress, and Signage**

- Storm shelter occupant density tables with minimum usable floor area per occupant are provided along with criteria for determining usable floor area.
- Provisions for community storm shelter access and egress include accessibility, egress doors, emergency escape openings, and requirements unique to multi-story shelters. Simplified access and egress requirements are provided in a separate section for residential storm shelters. Both sections reference a new free-standing section for vertical access and egress requirements where emergency stairs, ladders, alternating tread devices, or overhead hatches are used to meet access and egress requirements.
- Latching mechanism requirements for IPS are provided to address engagement of the system, multi-latching systems, and operable hardware on the unprotected side.
- Storm shelter signage requirements are provided to ensure the protected areas are easily identifiable.

### **2.5. Fire Safety**

- Where required for the normal use of the storm shelter, fire protection systems are not required to be protected from the storm shelter design event.
- Fire-resistant rated construction requirements (including exceptions) are provided for community storm shelters.
- Fire extinguisher requirements are provided for community storm shelters.

## 2.6. Essential Features and Accessories

- Tables showing the number of required water closets and lavatories are provided for both hurricane and tornado storm shelters. Hurricane shelters are also required to provide a sanitation support method capable of supplying water and containing waste.
- Drinking water requirements per occupant are provided for community hurricane storm shelters.
- Rainfall drainage requirements are provided for hurricane storm shelters and can be calculated using either the rainfall rate maps given in Chapter 3 or approved local weather data.
- Natural and mechanical ventilation requirements are covered for tornado and hurricane storm shelters. Tornado storm shelters are permitted to be ventilated by natural or mechanical means. Hurricane shelters must have natural ventilation, and those with a design occupant capacity of 50 or more must also have mechanical ventilation.
- Requirements for other storm shelter critical support systems, such as emergency lighting, standby lighting, and standby power, are also covered in the standard. To maintain functionality throughout the design storm event, storm shelter critical systems located outside the shelter envelope must be protected from wind loads, debris impact, and flood loads (where applicable) to the same level as the storm shelter.

## 2.7. Test Methods

- The standard specifies missile impact and pressure (static and cyclic) testing requirements for storm shelters and storm shelter components.
- Pass/fail criteria for the required storm shelter testing is also provided.

# 3. Significant Changes in the 2020 Edition of ICC 500

The 2020 edition of ICC 500 features several overall changes intended to enhance consistency and organization within the standard and provide better correlation with the applicable codes.

Cumulatively, the following revisions should improve user experience for designers, code officials, owners/operators, builders/contractors, and ultimately, the storm shelter occupants.

- Similar to current ICC codes, a 'General' section has been added to the beginning of each chapter to provide scope and general provisions that apply to all subsequent sections as needed.
- Appendix A (Storm Shelter Preparedness and Emergency Operations Plan [SSPEOP]) has been added to complement new requirements on owners' responsibilities in Chapter 1.
- Although most chapters have been reorganized to promote clarity and parallel construction across sections, the reorganizations of Chapters 5 and 7 are likely the most substantial.

- For better overall organization, provisions for ‘Weather protection’ and ‘Shelter grounding and bonding’ have been moved from Chapter 3 (Structural Design and Testing Criteria) to Chapter 7 (Storm Shelter Essential Features and Accessories).
- To improve alignment with the IBC and other applicable I-Codes, occupant-driven triggers for community storm shelter requirements have been changed from “greater than 50 occupants” to “50 or greater occupants.” As a result, the threshold for peer review, fire separation exceptions, and multiple Chapter 7 requirements is lowered by 1.

The sections below provide a brief representation of the most significant changes by chapter.

### 3.1. Chapter 1, Application and Administration

- **Section 104, Construction and Occupancy:** New Section 104.3.2 requires application of ICC 500 hurricane shelter provisions for storm shelters located on islands of the Western North Pacific Ocean and South Pacific Ocean, where hurricanes are called typhoons and cyclones, and in Alaska, where extra-tropical storms have hurricane-like effects and duration.
- **Section 106, Submittal Documents:**
  - **Section 106.1, General:** Storm shelter submittal documents, formerly referred to as “construction documents,” are now required for every permit application and must be sealed by a Registered Design Professional (RDP). Previous editions of the standard were silent on qualifications for the individual(s) who prepared the submittal documents, whether seals were required, and whether a single submittal could be applied to multiple permit applications. Previous editions of the standard only required preparation of construction documents “where required by the authority having jurisdiction.”
  - **Section 106.2.1 Design Information:** New design information required to be included with submittal documents includes (1) use of the community shelter (by the general public, building occupants, or combination of both), and (2) design wind pressure and applicable zones, with dimensions needed for specification of components and cladding of the shelter envelope. Also, additional details are required for shelters subject to the flood siting and elevation provisions of Section 402.1 and for minimum foundation capacity requirements. Lastly, calculations are required to support the usable floor area and minimum venting area.
- **NEW Section 108, Owner’s Responsibility:** The new section requires storm shelter owners to (1) submit a statement of responsibility for ongoing operations and maintenance of the facility with the application for permit, and (2) submit a SSPEOP, which is needed for approval of the certificate of occupancy. Prior to the 2020 edition, ICC 500 did not address ongoing operations and maintenance or preparedness and emergency operations plans for storm shelters.
- **Section 109, Peer Review:** Relocated from Section 106.1.1 and 106.1.2 to its own free-standing section (109), peer review requirements have been expanded as follows:

- **Section 109.2, Peer Review:** The 2014 edition of the standard required peer review of Chapters 3, 5, 6, and 7; the 2020 edition adds peer review requirements for Chapter 4 and Sections 106, 107, 110, and 111. Further, to discourage potential peer reviewer bias, the section now assigns the responsibility of hiring the peer reviewer to the storm shelter's owner.
- **NEW Section 109.3: Disclosure:** In support of peer reviewer independence, this new section requires the project's peer reviewers to disclose potential conflicts of interest to the authority having jurisdiction (AHJ) and owner or owner's representative. ICC 500-2014 included a definition of 'peer review' that indicated the reviewer(s) should be independent of the RDP in responsible charge of storm shelter design. However, definitions are not enforceable, so the definition was removed, and the new section was added to Chapter 1 with the responsibility of disclosure placed on proposed reviewers.
- **NEW Section 109.4, Qualifications:** The new section requires peer reviewers to provide written documentation to the owner or owner's representative that demonstrates relevant experience and training for the chapters and/or sections of ICC 500 that they propose to review. Previous editions of the standard were silent on peer reviewer qualifications.
- **NEW Section 109.5.1, Changes:** The new section requires the storm shelter's RDP in responsible charge to submit to the peer reviewer any design changes to the main wind force resisting system or components and cladding that are made after submittal of the peer review report but before issuance of permits. If the peer reviewer determines the report requires amending to address the change, then the amended report must be resubmitted. Previous editions of the standard were silent on whether design changes made after submittal of the report were subject to peer review. Based on evidence of differing jurisdictional interpretations, the standard committee decided clarification was needed in ICC 500-2020.
- **Section 112, Listing and Labeling:** Storm shelter labeling requirements have been relocated from Section 108.2 to a new free-standing section that also requires listing of storm shelter IPS to denote compliance with the standard. The section has also added 'Marking' requirements that specify the minimum information shown on each label.
- **NEW Section 113, Evaluation, Maintenance and Repairs:** The new section establishes criteria for the evaluation, maintenance, and repair of existing community storm shelters. Evaluation criteria for storm shelter envelopes and IPS are provided along with triggers and requirements for repairs of damaged or missing components and replacement of assemblies. Recordkeeping protocols are also included. Prior to the 2020 edition, ICC 500 did not address the evaluation, maintenance, and repair of existing community storm shelters.

## 3.2. Chapter 3, Structural Design and Testing Criteria

- **Section 302, Load Combinations:** Sections 302.2, Strength Design, and 302.3, Allowable Stress Design, no longer reference ASCE 7 for load combinations but have been customized for storm shelters while maintaining consistency with ASCE 7.
- **Section 303, Loads:**
  - **Section 303.1, Rain loads: Subsection 303.1.1, Rainfall rates,** has been revised to include new 100-year, 1-hour rainfall rate maps for Alaska, Hawaii, and the Western United States. Additionally, the section now allows for the 100-year, 1-hour rainfall rate to be determined from the referenced maps or from “approved local weather data.” Previous editions of the standard only provided rainfall rate maps for the eastern and central United States and did not provide the option to determine rainfall rates using approved local weather data.
  - **NEW Section 303.2, Floor live loads:** This new section adds floor live loads to better reflect occupant density per storm type. Previous editions of ICC 500 did not specify modifications for storm shelter live floor loads.
  - **Section 303.3, Roof live loads: NEW Subsection 303.3.1, Wheel loads,** has been added for storm shelters subject to vehicle loads (typically in-ground shelters). Where applicable, vehicle loads are required to be determined in accordance with the referenced codes (IBC or IRC) or standard (ASCE 7). Previous editions of ICC 500 did not require consideration of wheel loads for the structural design of storm shelters.
- **Section 304, Wind Loads:** New and updated storm shelter design wind speed figures are referenced in **Section 304.2, Design wind speed,** as follows:
  - The hurricane storm shelter design wind speed map, Figure 304.2(2) of ICC 500 (refer to Figure 2 below), has been updated. The current hurricane storm shelter design wind speed map still reflects the 10,000-year Mean Recurrence Interval used in the previous two editions but is based on further refinements to the hurricane model and updated climatology that were used to develop the revised wind speed maps currently proposed for inclusion in ASCE 7-22. Unlike the previous editions in which models included historical hurricane track and landfall data from 1900 to 2006, the updated model includes data through the 2018 hurricane season.

The tornado shelter design wind speed map contours are unchanged from the previous editions and are shown above in Figure 1.

- The new hurricane storm shelter design wind speed map includes the table that lists the design wind speeds for Hawaii and U.S. island territories that was erroneously included on tornado storm shelter and safe room wind speed maps in previous editions. Also, the Northern Mariana Islands have been added to the above-described table.

- The storm shelter design wind speeds for Alaska have been moved from the tornado storm shelter design wind speed map to a separate design wind speed map in the latest edition of ICC 500. Aside from the separate design wind speed map, the standard now specifies that Alaskan storm shelters comply with hurricane shelter criteria as described above in the Chapter 1 (Section 104) highlights.

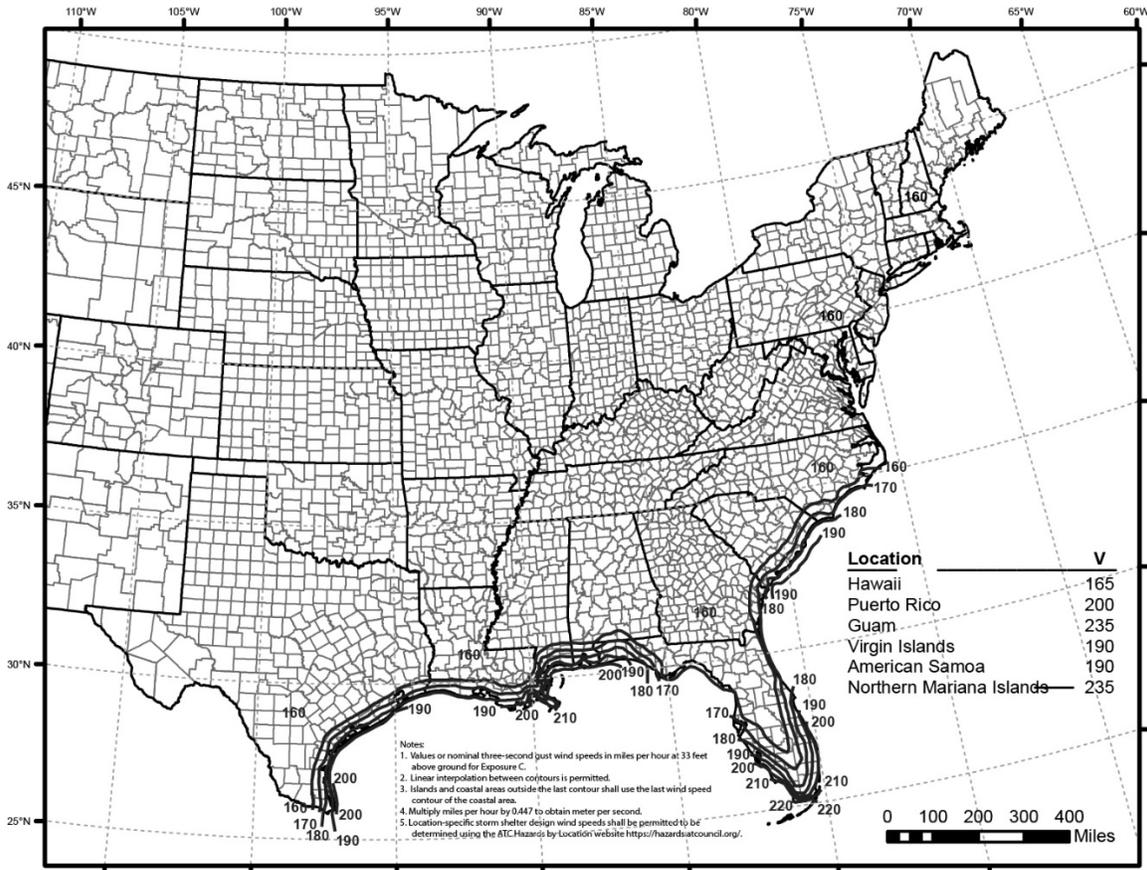


Figure 2: Design wind speeds for hurricane storm shelters

- **Section 305, Debris Hazards:**
  - **Section 305.3, Laydown and falling debris hazards:** The revised section adds criteria for determining whether laydown or falling debris hazards must be applied to the shelter and removes considerations for rollover and collapse loading. Previous editions required that laydown, rollover, and collapse hazards be considered by the design professional only when determining shelter siting.
  - **Section 305.3.3, Impact loads:** This new section requires a minimum impact load factor of 2.0 (times the estimated weight of the hazard) where laydown or falling debris hazards must be applied to the shelter.
- **Section 306, Component Design and Testing:**

- **Section 306.4.1.3, Anchorage for IPS:** The section now specifies anchorage must be designed to resist shear and pull-out for wind loads in accordance with Section 304 for installations inconsistent with manufacturer’s listing. Previous editions of the standard required that shear and pull-out design loads be determined in accordance with “accepted engineering practice,” which led to varying interpretations.
- **Section 306.5, Joints, gaps or voids in storm shelter envelope:** This existing section adds a new exception for precast concrete panel joints with maximum widths up to  $\frac{3}{4}$  inch for minimum 6-inch-thick wall panels or 4-inch-thick roof panels. Limitations on joints, gaps, and voids in the shelter envelope were added to the 2014 edition and included an exception with equal tolerances for masonry, concrete, and precast concrete panel construction joints. Missile impact test results for precast concrete panel joints were provided to support the free-standing exceptions that are based on maximum allowable joint widths.
- **Section 306.6, Penetrations of storm shelter envelopes by mechanical, electrical and plumbing systems:** The threshold for circular penetrations in the storm shelter envelope requiring IPS increased from a diameter of 2-1/16 inches to 2-1/2 inches to allow commonly sized plumbing vent pipes to be used without IPS.

### 3.3. Chapter 4, Siting

- **Former Section 402, Hazardous Materials:** The Chapter 4 section on hazardous materials was deleted because of concerns that requirements in the first two editions could potentially prevent or significantly delay shelter construction in urban and suburban areas.
- **Section 402, Flood Criteria:**
  - **NEW Section 402.1, General:**<sup>1</sup> New section provides new Table 402.1, “Storm Shelters Required to Comply with Section 402” so users can quickly determine if the flood criteria of Section 402 will apply to any type of storm shelter based on whether it is located in the 100-year flood hazard area, 500-year flood hazard area, or the storm surge flood hazard area. The section was added in response to shelter designers who indicated the existing requirements were often interpreted as applying to all shelters regardless of location with respect to flood hazard area.
  - **NEW Section 402.3, Determining flood elevations and floodway:** This new section provides an IBC-consistent approach for determining flood elevations and the location of floodways where not included on the adopted flood hazard map. The new provisions replace the “flood of record” approach for determining minimum flood elevations where detailed information is

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<sup>1</sup> Refer to FEMA Funding Criteria in Part B of FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, Fourth Edition*, April 2021, for amendments to this standard requirement.

not available on the adopted flood hazard map and correlates better with the model codes and ASCE 24, *Flood Resistant Design and Construction*.

- **Section 402.5, Storm shelter siting:**<sup>2</sup> This updated section covers all storm shelters instead of only scoping community shelters as in previous editions. Further, Coastal A Zones have been added to the list of restricted high-risk flood areas.
- **Section 402.6, Minimum floor elevations of storm shelters:**<sup>3</sup> This section has been expanded to cover hurricane and tornado shelters separately for community and residential shelters. New criteria have been added for community tornado shelters in the identified flood hazard areas to allow: (1) unregulated or lower floor elevations for shelters not classified as Risk Category IV (per IBC Table 1604.5), and (2) exceptions for dry floodproofing and storm shelters added to existing buildings.
- **Section 403, Maximum travel distance for tornado shelters:** Formerly entitled “Siting Proximity for Residential Shelters,” Section 403 has been expanded to include Section 403.1 (Community tornado shelters in educational occupancies), which references IBC Section 423 requirements for consistency. The requirements for residential shelters are unchanged from the 2014 edition.

### 3.4. Chapter 5, Occupant Density, Access, Accessibility, Egress and Signage

- **Section 502, Occupant Density in Community Storm Shelters:**
  - **Section 502.2, Design occupant capacity:** For better correlation with the model codes, the new term “design occupant capacity” is introduced to replace most uses of “occupant load” in the standard. New subsections have been added to distinguish between “assigned” and “calculated” design occupant capacity, but notably, storm shelter “occupant density” (aka usable floor area per occupant) requirements are unchanged.
  - **Section 502.4, Provided usable floor area:** Both prescribed methods for calculating usable floor area are unchanged from previous editions, but the standard now permits combining the two methods to determine the overall storm shelter usable floor area (i.e., users can decide to apply method one to some areas and method two to others).
  - **Section 502.5, Tornado shelter usable floor area:** In accordance with the new definition provided in Chapter 2, “usable floor areas” exclude occupant support areas. However, new Section 502.5 permits specified occupant support areas of community tornado shelter toilet rooms to be considered usable floor areas. The specified areas include single-occupant toilet

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<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

rooms that make up the entire storm shelter and common areas of multi-stall restrooms within the shelter (i.e., toilet stalls must be excluded).

- **Section 504, Access and Egress in Community Shelters: New Section 504.6, Multi-story shelters,** requires one emergency means of vertical access and egress within the storm shelter to a level of exit discharge. An exception is specified where an emergency escape opening or overhead hatch is installed to provide access and egress the storm shelter roof.
- **Section 507, Latching: NEW Section 507.3, Operating hardware on the unprotected side,** requires that engaged IPS operating hardware on the unprotected side of the shelter envelope be locked, disabled, or inactive to prevent susceptibility to unintentional unlatching by debris impact.
- **Section 508, Signage:**
  - **Section 508.1, Signage requirements:** This section clarifies that design information signage (formerly Section 108) applies to all storm shelters, but the remainder of the signage section requirements apply to community shelters only. Additionally, the section clarifies that all signs must comply with the visual character requirements of ICC A117.1, Accessible and Usable Buildings and Facilities. ICC 500-2008 required signs “be both tactile and visual,” whereas ICC 500-2014 required compliance with the “applicable requirements of ICC A117.1.”
  - **NEW Sections 508.3, Exterior directional signage, 508.4, and Directional signage for a multi-building site, 508.5, Directional signage within a host building:** These three new sections provide detailed requirements for signage to guide intended occupants to the community storm shelter.
  - **NEW Section 508.7, Perimeter signage:** This new section requires a perimeter sign adjacent to every community shelter access or egress opening to alert shelter occupants that the indicated opening(s) lead out of the shelter (i.e., to an unprotected area). Previous edition requirements for identifying signs appeared to have similar objectives to the new requirements for perimeter signs and directional signs but were unclear in purpose and lacked sufficient detail to effectively implement or enforce.

### 3.5. Chapter 6, Fire Safety

- **NEW Section 602.1, Fire Protection Systems:** This new section provides that community storm shelter fire protection systems, where required by the applicable code for normal use of the shelter space, are not required to remain functional for the design storm event or to be protected from wind load and impact requirements of Chapter 3 or the flood-resistant requirements of Chapter 4. Previous editions of ICC 500 did not specifically address fire protection systems but included “life safety systems” in the definition of “storm shelter critical support systems,” which require protection from the design storm event in accordance with Section 701. For consistency

with the new requirements in Section 602, ICC 500-2020 removed “life safety systems” from the Chapter 2 definition of “storm shelter critical support systems.”

- **Section 603.1, Fire separation:**<sup>4</sup> This section has been updated to (1) clarify that walls and horizontal assemblies between community storm shelters and other host building areas must have a minimum 2-hour fire-resistance rating, and (2) provide exceptions where the 2-hour minimum rating can be waived. Although FEMA and ICC 500-2014 commentary interpreted fire separation requirements in previous editions as a minimum of 2 hours between the shelter and host building areas, some users interpreted the requirement as allowing a separation less than 2 hours.
- **NEW Section 603.1.1, Doors and shutters:** This new section provides that, where community storm shelter doors and shutters are required solely to meet the fire separation requirements of 603.1, they are not required to be automatic or self-closing.

### 3.6. Chapter 7, Storm Shelter Essential Features and Accessories

- **Sections 702.3 (Tornado) and 703.3 (Hurricane), Minimum number of water closets and lavatories:**
  - **NEW Sections 702.3.2 (tornado) and 703.3.2 (hurricane), Water closet and lavatory calculations:** The new requirement references Section 403.1.1 of the 2021 International Plumbing Code (IPC) for allocation of water closets and fixtures, which specifies the ratios of male to female water closets and lavatories. It is important to note that although the table referenced in IPC Section 403.1.1 includes the minimum number of plumbing fixtures for different occupancy types, ICC 500-2020 still governs the minimum number of storm shelter water closets and lavatories (see Sections 702.3 and 703.3), which is nearly identical to the previous standard edition requirements.
  - **NEW Sections 702.3.2.1 (tornado) and 703.3.2.1 (hurricane), Urinals:** These new sections permit urinals to be submitted for water closets in accordance with the IPC (reference 2021 IPC Section 424).
  - **NEW Sections 702.3.3 (tornado) and 703.3.3 (hurricane), Water closet privacy:** These new sections include a requirement for each water closet to occupy a separate compartment.
  - **Section 703.3.4, Sanitation support method:** Given the practical considerations involving cost and relatively short design storm events, the requirements for tornado shelter sanitation support methods have been removed from ICC 500-2020. Requirements for hurricane shelter sanitation support methods (formerly referred to as “sanitation support systems”) as

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<sup>4</sup> Ibid.

well as storage capacity for water supply and wastewater (703.3.4.1) and drinking water (703.4) are reorganized but have not significantly changed from ICC 500-2014.

- **Section 702.4 (tornado) and 703.6 (hurricane), Ventilation:**
  - **NEW Sections 702.4.1.2 (tornado) and 703.6.1.2 (hurricane), Mechanical vents:** These new sections specify that mechanical vents required to operate ventilation openings must be connected to standby power.
  - **NEW Sections 702.4.2 (tornado) and 703.6.2 (hurricane), Mechanical ventilation:** The minimum mechanical ventilation rate of 5 cubic feet per minute per occupant is now required for tornado and hurricane storm shelters that rely on mechanical ventilation to meet ICC 500 ventilation requirements. Previous editions of the standard required the rate to be determined “in accordance with the applicable building code provisions for the normal use of the space.”
- **Sections 702.5.1 (tornado) and 703.7.1 (hurricane), Standby power capacity:** The existing sections have been clarified to specify that standby power capacity must be sufficient to supply ICC 500-required standby lighting and mechanical ventilation systems.
- **Sections 702.6 (tornado) and 703.8 (hurricane), Electrical grounding and bonding:** These sections have been moved from Chapter 3 and updated to require exposed metal surfaces within the shelter to be bonded and grounded where required by Article 250 of National Fire Protection Association (NFPA) 70 or the AHJ.
- **Sections 702.7 (tornado) and 703.9 (hurricane), Exit signs and emergency lighting:** These sections include new and updated requirements for emergency power systems in community shelters to supply power to exit signs and emergency exit lighting in accordance with the IBC. Note that usage of “emergency” power and lighting versus “standby” power and lighting has been modified in ICC 500-2020 for consistency with the International Fire Code and Chapter 27 of the IBC (refer to FEMA P-361, Section B7.2.6 for more information).
- **Sections 702.9 (tornado) and 703.11 (hurricane), First aid kits:** These sections have been updated to require first aid kits that comply with American National Standards Institute / International Safety Equipment Association (ANSI/ISEA) Z308, *Minimum Requirements for Workplace First Aid Kits*, in all community shelters (i.e., standard reference was added and the minimum design occupant capacity trigger was removed).

### 3.7. Chapter 8, Test Methods for Impact and Pressure Testing

- **Section 802, Test Specimens: NEW Section 802.5, Testing for fire-resistance rating,** provides that storm shelter material, elements, or assemblies that are required to comply with fire-resistance ratings or fire-protection ratings (per Section 603) and the pressure and impact testing of Chapter 8 may be fire tested using separate specimens from those subjected to Chapter 8 test methods.

- **Section 803, Impact Testing:**
  - **Sections 803.4, Missile properties and 804.4.2, Missile length and weight tolerances:** The weight and weight tolerances for both tornado and hurricane missiles are unchanged, but missile lengths are now provided in ranges (e.g., 10 feet to 15 feet for tornado missiles) instead of lengths with tolerances. Because impact energy and momentum are independent of missile length, the range of missile lengths has increased significantly compared with the length tolerances required in previous editions. The increased range of missile lengths accounts for differences across allowable missile wood species and is intended to facilitate impact testing.
  - **Section 803.9.4.1, Side-swinging door assemblies:** Impact testing for double doors has been revised to distinguish between assemblies where both door leaves have identical hardware and those with differing hardware. For leaves with identical hardware, requirements to impact only one leaf as a single door are unchanged. Where hardware differs, both leaves must be impact tested.
  - **NEW Section 803.9.4.2, Rolling door assemblies:** The new section provides impact testing criteria for rolling door assemblies.
  - **NEW Section 803.9.4.3, Sectional door assemblies:** The new section provides impact testing criteria for sectional door assemblies.
  - **Section 803.10.3, Spall:** This section has been revised to clarify the required distance between the test specimen and witness screen and to delete the exception provided in the first two standard editions.
- **Section 805, Static and pressure testing procedures:** This section has been reorganized to eliminate redundancies, but requirements are substantially unchanged.

### **3.8. NEW Appendix A, Storm Shelter Preparedness and Emergency Operations Plan (SSPEOP)**

As described in the Chapter 1 update highlights, ICC 500-2020 has been updated to require all community storm shelter owners to submit a preparedness and emergency operations plan to the AHJ (reference Section 108). In conjunction with the new administrative requirement, Appendix A has also been added to the 2020 edition to provide “optional criteria” for the SSPEOP. Appendix A planning criteria cover basic information, preparedness, and emergency operations procedures for community storm shelters. Notably, ICC code and standard appendices are only mandatory where specifically adopted by the AHJ, but ICC 500 Appendix A may serve as a template for the development of a preparedness and emergency operations plan even where it is not adopted.