Chapter 1: Application and Administration

General Comments

This chapter provides provisions regarding the purpose, scope, application, and administration of subsequent requirements of ICC 500. In addition to the statement of purpose and scope of the standard, this chapter provides for the occupancy classification of a storm shelter when it is a stand-alone, dedicated facility and when it is a room within a building used for other purposes. This chapter also details special inspection requirements and provides specific information that must be supplied on construction documents when submitted for permit approval. Finally, the chapter addresses labeling and signage for storm shelters.

SECTION 101 GENERAL

101.1 Purpose. The purpose of this standard is to establish 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 high winds associated with tornadoes and hurricanes. This standard is intended for adoption by government agencies and organizations for use in conjunction with model codes to achieve uniformity in the technical design and construction of storm shelters.

❖ This standard provides minimum requirements for the design of hurricane and tornado shelters. Buildings or portions thereof constructed in accordance with ICC 500 are designed to resist the extreme wind loads generated by tornadoes and hurricanes and thus provide shelter to people during such events. The wind and rain loads specified in this standard exceed the typical design wind and rain loads mandated by building codes.

In keeping with the general intent of building codes and reference standards, the structural, fire, egress, and mechanical requirements in this standard are those considered by the ICC Storm Shelter Committee to provide adequate life safety protection and safeguard the health and welfare of individuals seeking shelter from a tornado or hurricane. The standard allows for selection of wind loads based on the climatology and historic risk to a particular region.

This standard is intended to be adopted as a legally enforceable document to regulate the design, construction, installation, and inspection of storm shelters. Since 2009 the *International Building Code*® (IBC®) and *International Residential Code*® (IRC®) have referenced ICC 500 as the applicable standard for the design and construction of storm shelters.

101.2 Scope. This standard applies to the design, construction, installation, and inspection of storm shelters constructed for protection from high winds associated with tornadoes and hurricanes. Storm shelters may be separate detached buildings or rooms and areas within buildings. Shelters designed and constructed to this standard shall be designated as either hurricane shelters, tornado shelters, or combined hurricane and tornado shelters.

❖ Storm shelters can be buildings used solely for sheltering ("single-use"), or they can be buildings containing multiple occupancies, uses or functions ("multi-use"). Storm shelters can also be constructed external to another building, or internal as an area within a building. For example, a multi-use storm shelter at a school may also function as a classroom, a lunchroom, a laboratory, or an assembly room. In a commercial building, a storm shelter may also function as a restroom, conference room, or auditorium. A storm shelter intended to serve a manufactured housing community or development of single-family dwellings may also function as a community center. Storm shelter uses (either single or multi-use) may affect the type of storm shelter selected and its location.

101.3 Requirements not included. Where requirements are not provided by this standard, the applicable provisions of the construction codes adopted by the authority having jurisdiction shall apply to the storm shelter.

❖ The standard is not written to comprehensively deal with provisions that might be applicable to the construction of the shelter or the building containing the shelter. For instance, in areas where the IBC is applicable, the exterior wall of the shelter might need to have a fire-resistance rating because of the fire separation distance of the building to a lot line. The standard contains requirements for fire separation of a storm shelter from its host building but does not address fire-resistance ratings for the exterior wall and/or fire protection of exterior openings in accordance with the applicable code provisions. The importance of integrating sound storm shelter design with building codes is emphasized in Waller and Kiesling (2003).

101.4 Special needs. Provisions that are necessary for persons with special needs, including any special electrical or mechanical equipment, sanitary facilities or other special features, are outside the scope of this standard.

❖ The ICC 500 is intended to provide basic requirements for a population of occupants without significant physical or mental conditions that require special equipment or special facilities. The possible types of required special amenities or facilities are so many and so varied that it would be unwise to try to identify any group of special needs that should require attention at any given time; however, planners and designers of facilities should take such special needs into consideration where it is likely that such a facility is required. For instance, if the shelter is in conjunction with a hospital, the designer should consider providing facilities for bedridden patients.

101.5 Referenced standards. The specific year, date and editions of the standards referenced by this standard are listed in Chapter 9.

❖ When the standard needs to rely on another standard referenced in this code, it is important to use the specific standard year and edition, which are referenced in Chapter 9. When composing the text with the reference, the committee made its decision to use the specific requirements as written in a certain edition of the standard. The only way to be sure that the intent of ICC 500 is followed in those cases is to use the document that the committee reviewed and referenced.

SECTION 102
COMPLIANCE ALTERNATIVES

102.1 Compliance alternatives. Nothing in this standard is intended to prevent the use of designs, technologies or products as alternatives to any prescriptions in this standard, provided equivalence is demonstrated and approved by the authority having jurisdiction.

❖ This language is very similar to language placed in all of the ICC codes and standards. It allows the possibility that new technology could become available in the future, which may not meet prescribed requirements but would meet the intent of the standard.

The standard is not intended to prohibit innovative ideas or technological advances. A performance-based approach is most applicable for providing a basis for the approval of an increasing number of newly developed innovative materials, systems and methods for which no code requirements or reference standards exist. The building official is expected to apply sound technical judgment accepting materials, systems or methods that can be demonstrated to offer equivalent performance. The building official is responsible for determining if a requested alternative provides the equivalent level of protection of public health, safety and welfare required by the provisions in the standard.

SECTION 103
CONVENTIONS

103.1 Dimensions. All dimensions that are not stated as "maximum" or "minimum" are nominal. All dimensions are subject to conventional industry tolerances unless otherwise noted.

❖ This is standard text common to construction standards. The intent is to clarify what the meaning of a dimension callout is.

SECTION 104
OCCUPANCY

104.1 Rooms or spaces within other uses. Where designated storm shelters are constructed as a room or space within a building which will normally be occupied for other purposes, the requirements of the applicable building code for the occupancy of the building, or the individual rooms or spaces thereof, shall apply unless otherwise stated in this standard.

❖ Quite often the storm shelter will be a designated room or space within a larger facility that is designed to function as a storm shelter in emergencies but also to be used for some other purpose normally. A common example is a classroom, study hall, gymnasium, or cafeteria space in a school building. The purpose of adding this statement to the standard is to establish that the standard is not intended to supplant the requirements for the normal use of the space. For instance, determination of occupant load for the use of the space as a shelter does not change the occupant load of the space in its "normal" function.

104.2 Dedicated facilities. Where a facility is designed to be occupied solely as a storm shelter, the designated occupancy shall be A-3 as defined by the *International Building Code*® for purposes of determination of applicable requirements that are not included in this standard.

Exception: Where the facility has an occupant load of less than 50 persons as determined in accordance with Chapter 5, the designated occupancy shall be in accordance with Section 303 of the *International Building Code*.

❖ Where a facility is provided for the sole purpose of functioning as a storm shelter, the committee determined that the facility would most likely resemble a Group A-3 facility as described in the IBC. For the 2015 edition an exception was added, which recognizes that a relaxation of wall and ceiling finish requirements in corridors, number of plumbing fixtures in restrooms and bathrooms, and slope and handrail requirements for means of egress may be appropriate for a small shelter serving at most a few dozen people. The exception points to a provision in the IBC that allows a building or structure used for

assembly purposes but having an occupant load less than 50 persons to be designated as a Group B occupancy rather than a Group A occupancy.

104.3 Combination storm shelters. Where the purpose of a storm shelter is to provide protection from both tornadoes and hurricanes, the entire storm shelter shall be designed and constructed using the most restrictive requirements for each hazard.

❖ This provision is consistent with the general philosophy of building codes and standards regarding the applicability of multiple provisions concerning an element or elements of construction. In cases where the standard establishes a specific requirement for a specific shelter, that requirement is applicable even if it is less restrictive than a general requirement specified elsewhere in the standard. However, in all cases, the most restrictive requirement applies.

SECTION 105
APPLICABLE BUILDING CODE

105.1 Applicable code. Where construction of a storm shelter is to take place where no applicable construction codes are adopted, the provisions of the *International Building Code* shall apply.

❖ In addition to the requirements provided in the standard, a storm shelter, whether single-use or multi-use, must comply with any applicable building code provisions adopted by the authority having jurisdiction. Storm shelters constructed in jurisdictions where no state or local building code has been adopted should be designed and constructed to ICC 500 and the provisions of the 2015 IBC.

SECTION 106
INSPECTIONS AND STRUCTURAL OBSERVATIONS

106.1 General. Construction of storm shelters and installation of all equipment shall be subject to inspections in accordance with the applicable building code.

❖ Building inspections are one of the more important functions of the building department or authority having jurisdiction. The authority having jurisdiction is authorized to inspect the work for which a permit has been issued and requires that the work to be inspected remain accessible until inspected and approved. Typical building department inspections include footings and foundations, concrete slabs, framing, and fire-resistant construction. Where mechanical, electrical and plumbing systems are required and included in the plans, rough-in inspections must be requested and approved before the construction moves forward.

The goal of a storm shelter is to provide life safety protection from wind events exceeding those normally designed for under building codes; therefore, a higher level of scrutiny is called for during the design and construction phases for storm shelters. To provide this oversight, the standard calls for special inspection over and above those typically mandated by the building code and authority having jurisdiction, and it additionally calls for independent peer review for large community storm shelters or storm shelters serving critical facilities.

106.1.1 Peer review. A peer review by an independent registered design professional for compliance with the requirements of Chapters 3, 5, 6 and 7 shall be conducted for the following storm shelter types:

1. Community shelters with an occupant load greater than 50.
2. Storm shelters in elementary schools, secondary schools, and day care facilities with an occupant load greater than 16.
3. Storm shelters in Risk Category IV (essential facilities) as defined in Table 1604.5 in the *International Building Code*.

❖ Surveys of storm shelter installations after hurricanes and tornadoes and reviews of construction documents during the design phase for storm shelters have uncovered issues, such as inadequate design, specification of noncompliant opening protective devices, insufficient useable space, and inadequate anchoring to foundations. For this reason, ICC 500 requires peer review by an independent registered design professional for shelters serving certain populations or facilities.

The original edition of ICC 500 triggered a peer review for community shelters with an occupant load greater than 300. That trigger was reduced in this edition to greater than 50 persons in recognition of the fact that storm shelters for many critical facilities, such as schools, police and fire stations, and emergency operation centers, may hold less than 300 occupants. To further capture shelters associated with critical and essential facilities, explicit peer review requirements were added for educational facilities (e.g., elementary, middle and high schools and day care centers) and essential facilities (e.g., emergency operation centers, hospitals, and power-generating facilities) in addition to the existing requirement for larger community shelters. The scope of the peer review was also extended to include means of egress and accessibility (Chapter 5), fire safety (Chapter 6), and ventilation, sanitation facilities, and lighting (Chapter 7). These additional criteria are deemed equally important to providing the desired level of protection to occupants of the shelter.

The peer review should be completed by design professionals with experience in the specific areas of practice under review. Where review involves specific technical fields outside the competence of the individual or firm performing the peer review, review of those specific areas should be conducted by design professionals (associates, consultants, and employees) who are qualified by education and experience in the applicable technical field. Thus, a peer review

may involve multiple individual reviewers or design professional firms. The peer reviewers should not be the same design professionals who provide structural observation in accordance with Section 106.4.

Item 3 refers specifically to a storm shelter constructed in or accessory to a Risk Category IV building or structure (essential facility). IBC Table 1604.5 specifies what uses qualify a building or structure as Risk Category IV. While the IBC includes "designated earthquake, hurricane or fire shelters" in Risk Category IV, it is not the intent of the IBC or ICC 500 to require a storm shelter or its host building be designed as Risk Category IV unless the occupancy or use of the host building would otherwise require such a classification. This has been clarified by a formal ICC interpretation (ICC 2013).

106.1.2 Peer review report. Where a peer review is required by Section 106.1.1, a signed and sealed report shall be submitted to the authority having jurisdiction with the construction documents identified in Section 107 prior to issuance of a permit for construction. The report shall fully describe the items reviewed, their compliance or non-compliance with applicable codes and standards, and recommend acceptance or rejection of the storm shelter design, or modifications to render the design acceptable.

❖ This section specifies the required contents of the peer reviewer's report and requires submission of the signed-and-sealed report to the code official at the same time the construction documents are submitted for review and permitting. The report should include detailed descriptions of the items reviewed, whether or not the items are compliant with the applicable standards and codes, and whether or not the storm shelter design is acceptable. If not acceptable, the report should also include recommendations to make it acceptable.

106.2 Special inspections. Special inspections shall be provided for construction and installation of materials as required by the authority having jurisdiction in accordance with the applicable building code and Section 106.3 of this standard.

❖ The authority to require special inspections, to specify the extent, number and timing of special inspections, and to approve special inspectors rests with the authority having jurisdiction, typically the local building department. The authority having jurisdiction has the power to require additional special inspections not detailed in the standard or in IBC Section 1705, or to waive any special inspection requirements of the IBC where permitted by IBC Section 1702. The special inspections of Section 106.3 cannot be waived except in the limited case specified in the standard for anchorage of residential storm shelters. Special inspection is usually desirable for, and specified for, construction activities requiring unique expertise or where additional assurance of quality beyond the standard building department inspections is deemed necessary. Common special inspections required by the building code include concrete placement, masonry construction, welding of structural members, and installation of high-strength bolts.

The IBC provides requirements for the qualification of special inspectors, their retention by the owner or the engineer or architect of record, the duties and responsibilities of the special inspector, and the timing of special inspections (continuous versus periodic). With the exception of long-span trusses, the IRC does not require special inspection, nor does it provide specific requirements. Definitions of special inspector and special inspection are provided in Chapter 2 for cases where a storm shelter is installed in a building governed by the IRC or where no building code is adopted. It is noted that the design criteria for storm shelters exceed the limits of the prescriptive structural provisions of the IRC. Thus, the IBC should be considered to govern the design of the storm shelter, its structural elements, and its components, and special inspections per Chapter 17 of the IBC should be provided.

106.2.1 Inspection of fabricators. Where fabrication of structural load-bearing and debris-impact-resistant components and assemblies is being performed on the premises of a fabricators shop, special inspection of the fabricator shall be provided.

Exception: Prefabricated or panelized storm shelter components that have been inspected and labeled by an approved agency meeting the requirements of the applicable building code.

❖ Special inspections required by the building code or this standard apply to components, elements, or assemblies manufactured off-site in a fabricator's shop, as well as to work performed on the building site. Typically, this would require the special inspector to travel to the fabricator's shop as well as visiting the job site, or a special inspector in closer proximity to the fabricator's shop be retained. The exception requires a shop-fabricated storm shelter or component of a storm shelter to be inspected by an approved agency and to have a label indicating the shelter or component complies with the requirements of ICC 500 and any applicable test standards.

106.3 Special cases. Special inspections shall be provided for proposed work comprised of:

1. Construction materials and systems that are alternatives to traditional materials and systems prescribed by the applicable code.
2. Unusual design and construction applications.
3. Anchors post-installed in hardened concrete and masonry, when used for anchorage of shelter components forming a part of the shelter enclosure or for anchorage of the shelter structure to foundations shall be in accordance with Section 106.3.1.

❖ This edition of the standard adds requirements for special inspection of certain anchors. In particular, special inspections are required for post-installed anchors used to attach storm shelters to existing

slabs-on-grade (e.g., a prefabricated residential shelter installed in a garage) as well as storm shelters provided in new construction but whose anchors are not installed until after the concrete for the new foundation has been set. Special inspection is also required for post-installed anchors used to attach shelter components such as door frames or opening protective devices to masonry or to existing or already-placed and hardened concrete walls, roofs, or other concrete or masonry components of shelters.

106.3.1 Special inspections to verify anchor installation. Special inspection shall be provided to verify the post-installed anchor installation and capacity as specified in accordance with Section 107.2.1. For post-installed anchorage to foundations, special inspection shall be provided to verify foundation adequacy in accordance with Sections 308.

Exception: For residential shelters, where the authority having jurisdiction verifies that the anchorage and, where required, the foundation complies with the requirements of the shelter design as provided in documentation required by Section 107, special inspection is permitted to be waived by the authority having jurisdiction.

❖ Existing slab-on-grade foundations, particularly those provided in residential buildings, are typically not adequate to resist the extreme wind loads associated with a storm shelter. Therefore, the adequacy of the existing slab must be verified through engineering calculations, and the slab must comply with the minimum slab thickness and minimum steel reinforcement requirements of the standard. In addition to installing a storm shelter on an adequate slab, post-installed applications require extra attention to be paid to anchorage capacity, location, and proper installation. The installation of post-installed anchors should always be performed in accordance with the specifications within the manufacturer's printed installation instructions. If installers of storm shelters find different conditions in the field than required as shown on the storm shelter design plans, they should contact the designer and determine the appropriate course of action.

It is important for a special inspector to verify that the foundation being used, anchor specifications, and anchor locations are consistent with the design plans. Post-installed anchors typically depend on adhesive bonding for pull-out resistance, making the performance of the connection highly dependent on the installation. Furthermore, whenever an existing slab is used as the foundation for a storm shelter, the special inspector should ensure the adequacy of the slab to resist the wind loads acting on the storm shelter.

An exception allows the special inspection requirements to be waived for residential storm shelters if the authority having jurisdiction verifies that the foundation and anchoring complies with the installation requirements for the storm shelter. Particularly in rural areas, owners of dwellings or other residential buildings may have difficulty locating engineers, engineering firms or third-party inspection agencies to perform special inspections. In these cases, the local building official or authority having jurisdiction is responsible for ensuring the installation of the storm shelter complies with the construction documents and manufacturer's installation instructions before granting a waiver for the special inspection.

The shelter designer or installer should provide all necessary information, including engineering calculations verifying the adequacy of the slab, documentation of the slab thickness and any required steel reinforcement, and data on any other relevant existing conditions, to the authority having jurisdiction prior to construction or installation of the storm shelter.

106.4 Structural observations. During construction of community shelters, the building owner shall employ a registered design professional to conduct visual observations of the construction of the structural system for general conformance to the approved construction documents at significant construction stages and at completion of the construction of the structural system. Structural observation shall not obviate the need for other inspections or testing required by this standard or the applicable building code.

Deficiencies shall be reported in writing to the owner and to the authority having jurisdiction. At the conclusion of the work, the registered design professional who made the structural observations shall submit to the authority having jurisdiction a written statement that the site visits have been made and shall identify any reported deficiencies that, to the best of the structural observer's knowledge, have not been resolved.

❖ This section requires the building owner to retain a registered design professional to visually observe the construction of the structural system for general conformance with the approved construction documents. These observations should take place at significant construction stages such as just prior to concrete placement when reinforcing can be seen, and when the structural system is completed (but before any wall, roof or ceiling finishes are installed). Structural observations do not eliminate the need for building department inspections, or for special inspections and testing, as specified by the standard or the applicable building code. The language on reporting deficiencies is consistent with the requirements for special inspections in Section 106.2.

For many projects the engineer of record will also be retained by the owner to provide construction phase services such as structural observations. The engineer of record should provide a schedule identifying the frequency and extent of structural observations to the owner and the authority having jurisdiction. IBC Section 1704 requires submission of this schedule to the authority having jurisdiction.

SECTION 107
CONSTRUCTION DOCUMENTS

107.1 General. Where required by the authority having jurisdiction, construction documents shall be prepared. Such doc-