ICC/NSSA STANDARD FOR THE DESIGN AND CONSTRUCTION OF STORM SHELTERS

ICC 500-2008
American National Standard
ICC/NSSA STANDARD

FOR THE DESIGN AND
CONSTRUCTION OF
STORM SHELTERS

ICC 500-2008
American National Standard

International Code Council
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National Storm Shelter Association
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American National Standards Institute
25 West 43rd Street
New York, NY 10036
The cover photo: L’Ouverture Computer Technology Magnet, Unified School District 259, Wichita, Kansas. Designed by PBA Architects, this shelter is one of 30 in the school district. It consists of a precast concrete multipurpose room designed for approximately 450 occupants. Photo by Tom Pott.
American National Standard

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

FOREWORD

[The information contained in this foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to this standard.]

Introduction

In May of 2002 the International Code Council (ICC) and the National Storm Shelter Association (NSSA) initiated a joint project to write a standard for the design and construction of storm shelters. A standard development committee was created, and the first meeting of that committee was in May of 2003. The scope of the standard is to provide minimum design and construction requirements for storm shelters that provide a safe refuge from storms that produce high winds, hurricanes and tornadoes. Hurricanes and tornadoes generate high winds that produce wind pressures on buildings and structures and that create flying debris at levels and intensities than are higher than those for which most commercial building and residences are designed. The magnitude of the wind speeds associated with these storms are such that building occupants and residents are required to evacuate the area or seek protection in a shelter designed for resistance to extraordinary loads and flying debris. This standard provides design requirements for the main wind-resisting structural system and components and cladding of these shelters, and provides basic occupant life safety and health requirements for these shelters, including means of egress, lighting, sanitation, ventilation, fire safety and minimum required floor space for occupants.

Development

This is the first edition of the International Code Council (ICC) and National Storm Shelter Association’s (NSSA) Standard for the Design and Construction of Storm Shelters. This standard was developed by the ICC/NSSA Consensus Committee on Storm Shelters (IS-STM) that operates under ANSI Approved ICC Consensus Procedures for the Development of ICC Standards. The consensus process of ICC for promulgating standards is accredited by ANSI. The Storm Shelter Committee is a balanced committee formed and operated in accordance with ICC rules and procedures.

The meetings of the ICC/NSSA IS-STM Consensus Committee were open to the public and interested individuals and organizations from across the country participated. The technical content of currently published documents on storm shelters, including documents of the National Storm Shelter Association, the Federal Emergency Management Agency (FEMA), the Red Cross, and the State of Florida, was reviewed and considered by the committee. The information from these documents helped form a basis for the regulations installed in this standard, but the exact provisions adopted by the committee were determined based upon the scope and intent of this standard. The requirements of ICC/NSSA 500 are based on the intent to establish provisions consistent with the scope of the ICC family of codes and standards that are written to adequately protect public health, safety and welfare; provisions that do not necessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Adoption

ICC/NSSA 500 Standard for the Design and Construction of Storm Shelters is available for adoption and use by any jurisdictions. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference in accordance with proceedings establishing the jurisdiction’s laws. At the time of adoption, jurisdictions should insert the appropriate information in provisions requiring specific local information, such as the name of the jurisdiction.
Formal Interpretations

Requests for Formal Interpretations on the provisions of ICC 500-2008 should be addressed to: ICC, Chicago District Office, 4051 West Flossmoor Road, Country Club Hills, IL 60478.

Maintenance – Submittal of Proposals

All ICC standards are revised as required by ANSI. Proposals for revising this edition are welcome. Please visit the ICC website at www.iccsafe.org for the official “Call for Proposals” announcement. A proposal form and instructions can also be downloaded from www.iccsafe.org.

ICC, its members and those participating in the development of ICC 500-2008 do not accept any liability resulting from compliance or noncompliance with the provisions of ICC 500-2008. ICC does not have the power or authority to police or enforce compliance with the contents of this standard. Only the governmental body that enacts this standard into law has such authority.

International Code Council/National Storm Shelter Association Consensus Committee on Storm Shelters (IS-STM)

Consensus Committee SCOPE: The ICC/NSSA Consensus Committee on Storm Shelter (IS-STM) shall have primary responsibility for minimum requirements to safeguard the public health, safety and general welfare through design, construction and installation requirements for storm shelters.

This standard was processed and approved for submittal to ANSI by the ICC/NSSA Consensus Committee on Storm Shelters (IS-STM). Committee approval of the standard does not necessarily imply that all committee members voted for its approval.

Representatives on the Consensus Committee are classified in one of three voting interest categories. The committee has been formed in order to achieve consensus as required by ANSI Essential Requirements. At the time it approved this standard, the IS-STM Consensus Committee consisted of the following members:

General Interest (G) - User Interest (U) - Producer Interest (P)

Mr. Majed Dabdoub (G), City of Cincinnati, Cincinnati, OH

Mr. Kenneth Ford (P), National Association of Home Builders, Washington, DC

Mr. Jaime D. Gascon (G), Miami-Dade County Building Code Compliance Office, Miami, FL

Mr. Dennis W. Graber (P), National Concrete Masonry Association, Herndon, VA

Mr. John D. Holmes (U), Louisiana State University LSU Hurricane Center, Baton Rouge, LA

Mr. Mitchell Hort (G), Community Development - City of Yukon, Yukon, OK

Dr. Ernst W. Kiesling (U), Wind Engineering Research Center, Texas Tech University, Lubbock, TX

Mr. Danny John Kilcollins (G), Florida Department of Community Affairs, Tallahassee, FL

Dr. Marc L. Levitan (U), Louisiana State University LSU Hurricane Center, Baton Rouge, LA

Mr. Joseph J. Messersmith, Jr. (P), Portland Cement Association, Rockville, VA

Mr. Timothy A. Reinhold (U), Institute for Business and Home Safety, Tampa, FL

Mr. Roger M. Robertson (G), Chesterfield County Department of Building Inspections, Chesterfield, VA

Mr. Kurt A. Roeper (P), Ingersoll-Rand Security & Safety, Cincinnati, OH

Mr. Corey Schultz (U), PBA Architects, P.A., Wichita, KS

Mr. E. Scott Tezak, P.E. (U), URS Corporation, Boston, MA

Mr. James E. Waller, P.E. (P), Remagen Safe Rooms, Monteagle, TN

Mr. Mark Whitaker (G), City of Little Rock, Little Rock, AR

Mr. Robert J. Wills (P), American Iron & Steel Institute, Birmingham, AL

Committee Secretary: David A. Bowman, P.E., Manager, Codes, Codes & Standards, International Code Council, Country Club Hills, IL
Voting Membership in Each Category

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Interest Categories

**General Interest:** Individuals assigned to the General Interest category are those who represent the interests of an entity, including an association of such entities, representing the general public or entities that promulgate or enforce the provisions within the committee scope. These entities include consumers and government regulatory agencies.

**User Interest:** Individuals assigned to the User Interest category are those who represent the interests of an entity, including an association of such entities, which is subject to the provisions or voluntarily utilizes provisions within the committee scope. These entities include academia, applied research laboratory, building owner, design professional, government nonregulatory agency, insurance company, private inspection agency and product certification/evaluation agency.

**Producer Interest:** Individuals assigned to the Producer Interest category are those who represent the interests of an entity, including an association of such entities, which produces, installs or maintains a product, assembly or system subject to the provisions within the committee scope. These entities include builder, contractor, distributor, labor, manufacturer, material association, standards promulgator, testing laboratory and utility.

**NOTE — Multiple Interests:** Individuals representing entities in more than one of the above interest categories, one of which is a Producer Interest, are assigned to the Producer Interest. Individuals representing entities in the General Interest and User Interest categories are assigned to the User Interest.
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STANDARD FOR THE DESIGN AND CONSTRUCTION OF STORM SHELTERS—2008 ix
CHAPTER 1
APPLICATION AND ADMINISTRATION

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.

101.2 Scope. This standard applies to design, construction, installation, and inspection of storm shelters constructed as separate detached buildings or constructed as safe rooms within buildings for the purpose of providing safe refuge from storms that produce high winds, such as tornadoes and hurricanes. Shelters designed and constructed to this standard shall be designated to be hurricane shelters, tornado shelters or combined hurricane and tornado shelters.

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.

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.

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

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.

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.

SECTION 104
OCCUPANCY

104.1 Rooms or spaces within other uses. Where storm shelters are designated areas normally occupied for other purposes, the requirements of the applicable construction codes for the occupancy of the building shall apply unless otherwise stated in this standard.

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.

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.

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.

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.

106.1.1 Peer review. Construction documents for community shelters designed for greater than 300 occupants shall undergo a peer review by an independent registered design professional for compliance with the requirements of Chapter 3.

106.2 Special inspections. Special inspections shall be provided for construction and installation of materials as required by the applicable building code, and Section 106.3 of this standard.

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
SECTION 107
CONSTRUCTION DOCUMENTS

107.1 General. Where required by the authority having jurisdiction, construction documents shall be prepared. Such documents shall contain information as required by the applicable building code and this section.

107.2 Information required. The following information applicable to construction and operation of the storm shelter shall be supplied on the construction documents.

107.2.1 Design information. For the areas of a building designed for occupancy as a storm shelter, the following information shall be provided within the construction documents:

1. Type of shelter: tornado, hurricane or a combination of both.

2. A statement that the wind design conforms to the provisions of the ICC/NSSA Standard for the Design and Construction of Storm Shelters, with the edition year specified.

3. The shelter design wind speed, mph.

4. The importance factor, I.

5. The wind exposure category (indicate all if more than one is used).

6. The internal pressure coefficient, GCpi.


8. The directionality factor, Kc.

9. A statement that the shelter has not been constructed within an area susceptible to flooding in accordance with Chapter 4 of this standard.

10. The Design Flood Elevation and Base Flood Elevation for the site (if applicable).

11. Documentation showing that components of the shelter envelope will meet the pressure and missile impact test requirements identified in Chapters 3 and 8 of this standard.

12. A floor plan drawing or image indicating location of the storm shelter on a site or within a building or facility; including a drawing or image indicating the entire facility.

13. The lowest shelter floor elevation and corresponding datum, except for residential shelters outside of special flood hazard areas.

14. The occupant load of the storm shelter.

15. The usable storm shelter floor area.

16. Venting area (square inches) provided and locations in the shelter.

107.2.2 Enclosure. When a storm shelter is to be constructed as a portion of a host building, the walls and floors enclosing the shelter shall be clearly indicated on the drawings.

107.2.3 Signage. The type and location of signs required by this standard shall be indicated on the floor plans.

107.2.4 Inspections. Where any special details are utilized in the design of the structure, or where any special investigations are required that are additional to those required by the applicable building code, the construction documents shall contain a schedule of the inspections required and the criteria for the special installation.

107.2.5 Special details. The construction documents shall provide any special manufacturer’s details or installation instructions for systems or equipment designed for the storm shelter.

107.2.6 Special instructions. The construction documents shall contain details of special instructions required for the specified functional operation of the storm shelter, such as:

1. Type and location of equipment and amenities required within the shelter, including water supply, sanitary facilities, fire extinguishers, batteries, flashlights, special emergency lighting equipment or any other equipment required to be installed in the shelter.

2. Specifications for any alarm system to be installed.

3. Instructions for the installation or deployment of any special protection equipment such as shutters, screens, special latching of doors or windows, any equipment or switching for mechanical, electrical and plumbing equipment.

107.3 Quality assurance plan. The construction documents for community shelters shall contain a quality assurance plan in accordance with Sections 107.3.1 through 107.3.3.
107.3.1 Detailed requirements. A quality assurance plan shall be provided for the following:

1. Roof cladding and roof framing connections.
2. Wall connections to roof and floor diaphragms and framing.
3. Roof and floor diaphragm systems, including connectors, drag struts and boundary elements.
4. Main wind-force resisting systems, including braced frames, moment frames and shear walls.
5. Main wind-force resisting system connections to the foundation.
6. Fabrication and installation of components and assemblies of the shelter envelope required to meet missile impact test requirements of Chapter 3.
7. Requirements for components and cladding including soffits.
8. Corrosion resistance or protection of metal connectors exposed to the elements that provide load path continuity.
9. Requirements for critical support systems connections and debris impact protection of the components and connections.

107.3.2 Quality assurance plan preparation. The design of each main wind-force resisting system and each wind-resisting component shall include a quality assurance plan prepared by a registered design professional.

The quality assurance plan shall identify the following:

1. The main wind-force resisting systems and wind-resisting components.
2. The special inspections and testing to be required in accordance with Section 106.2.
3. The type and frequency of testing required.
4. The type and frequency of special inspections required.
5. The structural observations to be performed in accordance with Section 106.4.
6. The required distribution, type, and frequency of reports of test, inspections, and structural observations.

107.3.3 Contractor responsibility. Each contractor responsible for the construction of a main wind-force resisting system or any component listed in the quality assurance plan shall submit a written statement of responsibility to the authority having jurisdiction, the responsible design professional, and the owner prior to the commencement of work on the system or component. The contractor’s statement of responsibility shall contain:

1. Acknowledgement of awareness of the special requirements contained in the quality assurance plan.
2. Acknowledgement that control will be exercised to obtain compliance with the construction documents.
3. Procedures for exercising control within the contractor’s organization, the method and frequency of reporting and the distribution of reports.
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

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

SECTION 108
DESIGN INFORMATION SIGNAGE AND LABELING

108.1 Design information. All shelters shall have a sign on or within the shelter with the name of the manufacturer or builder of the shelter and the storm type(s) and respective design wind speed(s). The sign shall remain legible and visible.

108.2 Labeling. Products, materials or systems shall be labeled by an approved agency when required by the applicable code or jurisdiction.
CHAPTER 2

DEFINITIONS

SECTION 201

GENERAL

201.1 General. For the purposes of this standard, the terms listed in Section 202 shall have the indicated meaning.

201.2 Undefined terms. The terms not specifically defined in this standard or in standards referenced herein shall have ordinarily accepted meanings such as the context implies.

SECTION 202

DEFINITIONS

APPLICABLE CODE. The regulation for design and building construction of buildings and structures adopted by the authority having jurisdiction over the construction of the specific shelter.

AUTHORITY HAVING JURISDICTION. The organization, political subdivision, office or individual charged with the responsibility for administering and enforcing the provisions of this standard.

COLLAPSE HAZARDS. See “Hazards, Collapse.”

CRITICAL SUPPORT SYSTEMS. Structures, systems and components required to ensure the health, safety and well-being of occupants. Critical support systems include, but are not limited to, potable and waste water systems, electrical power systems, life safety systems and HVAC systems.

DESIGN WIND PRESSURE. The wind pressure on a specific location of the shelter envelope, as determined in accordance with Section 304, Wind Loads, which controls the design of components and cladding (C & C) of the shelter envelope or the main wind-force resisting system (MWFRS) for the shelter.

FIRE BARRIER. A fire-resistance-rated vertical assembly of materials designed to restrict the spread of fire in which openings are protected.

HAZARDS

Collapse. Debris from wind damage to adjacent, taller structures which could fall onto the shelter.

Laydown. Nearby structures such as towers or large trees that could fall onto the shelter, if the shelter is within the laydown radius of the structure.

Rollover. Vehicles and small buildings, such as temporary classroom buildings, that could roll over due to extreme winds and impact the shelter.

HOST BUILDING. A building which is not designed or constructed as a storm shelter that totally or partially encloses a storm shelter.

INTERIOR SURFACE OF THE SHELTER COMPONENT. The inside surface of any structural component of the storm shelter envelope.

LABEL. An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency, and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency.

LAYDOWN HAZARDS. See “Hazards, Laydown.”

LOCAL EMERGENCY PLANNING COMMITTEE. A group of citizens defined by the community as having responsibility for local emergency planning. The committee shall be recognized by the governing body as having this responsibility.

NATURAL VENTILATION. Passive ventilation, not requiring a power source, resulting from convection of heated air, movement of inside air and movement of outside air over and around the storm shelter resulting in air exchange through vent openings.

OCCUPANT SUPPORT AREAS. The areas required to ensure the health, safety and well-being of occupants. Occupant support areas include, but are not limited to, shelter management, food preparation, water and food storage, electrical and mechanical rooms, toilet and other sanitation rooms and first-aid stations.

OCCUPIED SHELTER AREAS. The designated storm shelter area.

ON-SITE. Either inside, immediately adjacent to, or on the same site as the designated storm shelter facility, and under the control of the owner or lawful tenant.

PROTECTED OCCUPANT AREA. The portions of the shelter area that are protected from intrusion of storm debris by alcove or baffled entry systems in accordance with Section 804.9.7.

REBOUND IMPACT. The rebound impact by a test missile, or fragments thereof, on a portion of the shelter protective envelope after the test missile has impacted another surface of the shelter protective envelope.

ROLOVER HAZARDS. See “Hazards, Rollover.”

SHELTER ENTRY SYSTEM, ALCOVE. An entry system that uses walls and passageways to allow access and egress to the shelter interior while providing shielding from windborne debris in accordance with Section 306.5.

SHELTER ENTRY SYSTEM, BAFFLED. See definition of “Shelter Entry System, Alcove.”

SHELTER ENVELOPE. The protective walls, roofs, doors and other protected openings which are designed to meet the requirements of Chapter 3 to provide protection to occupants during a severe windstorm.

STORM SHELTER. A building, structure or portion(s) thereof, constructed in accordance with this standard, desig-