International Code Council

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

ICC 500—2020 edition

2nd Public Comment Draft – June 2020

The ICC Consensus Committee on Design and Construction of Storm Shelters has held 1 public meeting over several conference calls to develop this Public Comment Draft of the ICC 500-2020 Standard for Design and Construction of Storm Shelters. Public comment is requested on this Public Comment Draft on the strike out/underline portions only. Please show the proposed NEW or REVISED or DELETED TEXT in legislative format: ~~Line through text to be deleted.~~ Underline text to be added.

The public comment deadline is July 24, 2020 for committee votes and August 10, 2020 for the public.

Go to **ICC 500 page on the ICC website** for more information. To purchase a copy of ICC 500-2014 go to **ICC 500-2014 in the ICC store**. A code and commentary is available at **ICC 500-2014 Code and Commentary at the ICC store**. To view a read only version of ICC 500-2014 go to **ICC 500-2014 read only**.

ICC/NSSA Standard for the Design and Construction of Storm Shelters—~~2014~~2020 (ICC 500—~~2014~~2020)

Note: Revisions from the 2014 ICC 500 are shown in legislative text. The black sections were not revised, so those sections are not subject to comment and are shown for context only. Red text is open for comment. Comments received must be associated with on the of the change proposals listed in front of the revised section.

CHAPTER 1

APPLICATION AND ADMINISTRATION

SECTION 101
GENERAL

(IS-STM 01-02-18 AM; IS-STM 03-09-18 AM/AMPC)
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 and other severe windstorms. This standard is intended for adoption by government agencies and organizations for use in conjunction with ~~model~~ *applicable codes* to achieve uniformity in the technical design and construction of *storm shelters*.

(IS-STM 01-01-18-AFM, IS-STM 10-01-18 AM; IS-STM 01-29-18 AS; IS-STM 03-09-18 AM/AMPC)
101.2 Scope. This standard applies to the design, construction, installation and inspection of *storm shelters* constructed for the purpose of providing protection from ~~the effects of high winds and associated hazards during associated with~~ tornadoes , ~~and~~ hurricanes and other severe windstorms. *Storm shelters* ~~may~~ shall be constructed as either separate~~,~~ detached buildings or rooms or spaces ~~and areas~~ within new or existing buildings. *Storm shelters* designed and constructed to this standard shall be designated as *hurricane shelters*, *tornado shelters* or combined hurricane and *tornado shelters*. Design of facilities for use as emergency shelters after the storm is outside the scope of this standard.

(IS-STM 01-02-18 AM)
101.3 Requirements not included. Where requirements are not provided by this standard, the applicable provisions of the ~~construction~~ *applicable codes* adopted by the *authority having jurisdiction* shall apply to the *storm shelter*.

(IS-STM 05-13-18 AFM)
~~**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.~~

101.4 ~~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

(IS-STM 03-04-18 AM/AMPC)

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.

(IS-STM 10-07-18 AM)

103.2 Figures. Unless specifically stated, figures included herein are provided for informational purposes only and are not considered part of the standard.

SECTION 104
OCCUPANCY

(IS-STM 01-02-18 AM)

104.1 Storm shelters within *host buildings* ~~**Rooms or spaces within other uses.**~~ Where designated storm shelters are constructed as a room or space within a *host building* that 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~~ required by ICC 500.

(IS-STM 01-02-18 AM/AMPC; IS-STM 05-18-18 AM/AMPC)

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

Exceptions:

1. Where the facility has ~~an occupant load~~ a *design occupant capacity* 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.*
2. Where the facility is a *residential storm shelter*, the designated occupancy shall be the Group R occupancy served as defined by the *International Building Code* or the facility shall comply with the *International Residential Code*, as applicable.

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.

(IS-STM 03-09-18 AM/AMPC)

104.4 *Storm shelters in the Northwest and South Pacific Oceans and in Alaska*. *Storm shelters* located in Guam, the Northern Mariana Islands, American Samoa and Alaska shall be designed and constructed using the requirements for hurricane shelters.

(IS-STM 01-02-18 AM)

SECTION 105
APPLICABLE ~~BUILDING~~ CODE

(IS-STM 01-02-18 AM /AMPC)

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

(IS-STM 01-27-18 – AS; IS-STM 01-21-18 AM)

SECTION ~~107~~ 106
~~CONSTRUCTION~~ SUBMITTAL DOCUMENTS

(IS-STM 01-14-18 – AM/AMPC; IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM; IS-STM 01-15-18 AM/AMPC; IS-STM 01-21-18 AM)

~~107.1~~ 106.1 General. ~~Where required by the authority having jurisdiction, construction~~ Submittal documents consisting of construction documents and other documentation shall be prepared and submitted to the *authority having jurisdiction* with each permit application. Such documents shall contain information as required by the *applicable* ~~building~~ *code* and this ~~section~~ standard. Storm shelter construction documents, including the design information listed in Section, 106.2.1 shall be prepared and sealed by a registered design professional.

Exception: Where the following items are *listed* and *labeled* to indicate compliance with ICC 500, construction documents for those items are not required to be prepared and sealed by a registered design professional:

1. Residential storm shelters.
2. Structural components and *impact-protective systems* installed in residential storm shelters.

(IS-STM 01-27-18 – AS)

~~107.2~~ 106.2 Information required. The following information applicable to construction and operation of the *storm shelter* shall be supplied as part of the construction documents.

(IS-STM 01-16-18 – AS/AMPC Item 2, 16, 17 & 18; IS-STM 01-17-18 – AS, Item 3; IS-STM 01-18-18 – AS, Item 20; IS-STM 01-27-18 – AS, relocate; IS-STM 04-09-18-AS/AMPC, Item 11 and 15; IS-STM 10-05-18 AM, Item 5 & 11; IS-STM 01-19-18 AM Item 21; IS-STM 01-29-18 AS, Item 1, 2, 4, 10, 11, 12, 15, 16, 18, 19; IS-STM 05-18-18 AM Item 16; **IS-STM 03-11-18 AM Item 9, 10 and 12; IS-STM 08-22-18 Part 1 and 3 AM/AMPC Item 12; IS-STM 05-03-18 AM/AMPC, Item 17; IS-STM 04-10-18 Part 1 & 2 AM/AMPC/AFMPC – Items 10 & 11)**

~~107.2.1~~ 106.2.1 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 *storm shelter*: Residential or community tornado, hurricane or a combination of both.
2. Use of *community storm shelter*: use by the general public, building occupants or a combination of both.

~~2.~~3. A statement that the ~~wind~~ design conforms to the provisions of the ICC 500 ~~/NSSA~~ *Standard for the Design and Construction of Storm Shelters*, with the edition year specified.

~~3.~~4. The *storm shelter design wind speed*, V, mph (m/s).

~~4.~~5. The wind exposure category (indicate all ~~if~~ where more than one is used).

~~5.~~6. The internal pressure coefficient, GC*pi*.

~~6.~~7. The topographic factor, *Kzt*.

~~7.~~8. The directionality factor, *Kd*.

~~8.~~9. *Design wind pressures* and their applicable zones with dimensions needed for the specification of the components and cladding of the *storm shelter envelope*, psf (kN/m^2).

~~8.~~10. Where subject to the requirements of Section 402.1, a statement that the *storm shelter* has~~/~~ or has not been constructed ~~within an area susceptible to flooding~~ in accordance with Chapter 4 ~~of this standard~~.

~~9.~~11. Where subject to the requirements of Section 402.1, the minimum elevation of the lowest floor required by the *authority having jurisdiction* for the location where the *storm shelter* is installed; ~~Design Flood Elevation,~~ ~~and~~ the *base flood elevation*, *500-year flood elevation* and *storm surge flood elevation* where applicable; and the *storm shelter* floor elevation ~~for the site (if applicable).~~ Where National Hurricane Center's *Sea, Lake and Overland Surges from Hurricanes* (SLOSH) or other *approved* source is utilized for data, the construction documents shall include documentation of the version, date and the source of the maps.

~~10.~~12. Documentation showing that components of the *storm shelter envelope* will meet the static and cyclic pressure and ~~missile~~ impact test requirements identified in Chapters 3 and 8 ~~of this standard~~.

~~11.~~13. 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.

~~12.~~14. A *storm shelter* section or elevation indicating the height of the *storm shelter* relative to the finished grade, finished floor, and the *host building*, where applicable.

~~13.~~15. The lowest *storm shelter* floor elevation and corresponding datum, except for *residential tornado shelters* outside of special *flood hazard area*s.

~~14.~~16. The ~~occupant load of the *storm shelter*~~ *design occupant capacity*.

~~15.~~17. Calculations for the *usable* ~~*storm shelter*~~ *floor area*, ft^2 (m^2).

~~16.~~18. Calculations for the venting area, in^2 (mm^2) ~~(square inches)~~ provided and locations in the *storm shelter*.

~~17.~~19. Calculations for the number of sanitation facilities for *community storm shelters*.

~~18.~~20. Minimum foundation capacity requirements including foundation thickness, steel reinforcement, and concrete cover.

~~19.~~21. Storm shelter installation requirements, including anchor location, minimum edge and end distance and minimum required capacity for all post-installed anchors ~~each anchor~~.

~~20.~~22. For *hurricane shelters*, the rainfall rate of the roof primary drainage system.

~~21.~~23. For *hurricane shelters*, the rainfall rate of the roof secondary (overflow) drainage system where required.

~~22.~~24. For *hurricane shelters*, the rainwater drainage design rainfall rate for facilities subject to rainwater impoundment.

(IS-STM 01-16-18 – AS/AMPC)

106.2.2 Design information documentation. Design information listed in Section 106.2.1 and instructions listed in Section 106.2.6 shall be documented or explicitly referenced on a single sheet within the construction documents.

(IS-STM 01-27-18 – AS, IS-STM 10-04-18 AS) IS-STM 01-29-18 AS

~~**107.2.2**~~ **106.2.3 Enclosure.** ~~When~~ Where a *storm shelter* is to be constructed as a portion of a *host building*, the walls and floors enclosing the *storm shelter* shall be clearly indicated on the drawings.

(IS-STM 01-27-18 – AS)

~~**107.2.3**~~ **106.2.4 Signage.** The type and location of signs required by this standard shall be indicated on the floor plans.

(IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM; IS-STM 01-14-18 – AM/AMPC; IS-STM 01-20-18 AS/AMPC)

~~**107.2.4 Inspections.** Where any special details are utilized in the design of the structure, or where any special investigations are required in addition 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.~~

(IS-STM 01-27-18 – AS/AMPC; IS-STM 01-20-18 AS/AMPC)

~~**107.2.5**~~ **106.2.5** ~~**Special**~~ **Storm shelter details.** The construction documents shall provide or include any ~~special~~ manufacturer's details or installation instructions for systems or equipment designed for the protection and operation of the *storm shelter*.

(IS-STM 01-20-18- AS/AMPC, IS-STM 01-27-18 – AS; IS-STM 01-29-18 AS

~~**107.2.6**~~ **106.2.6** ~~**Special**~~ **Storm shelter instructions.** The construction documents shall provide or include any ~~special~~ details or ~~special~~ instructions required for the functional operation of the *storm shelter*, such as:

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

2 Specifications for any alarm system to be installed.

3 Instructions for the installation or deployment of any ~~special protection equipment~~ *impact-protective systems* such as shutters, screens, ~~special latching or locking of~~ doors or windows,

4 Instructions for the installation, activation or deployment of any ~~equipment or switching for~~

mechanical, electrical and plumbing equipment.

(IS-STM 01-21-18 AM)

SECTION 107
QUALITY ASSURANCE PLAN

(IS-STM 01-27-18 – AS; IS-STM 01-29-18 AS; IS-STM 01-21-18 AM)

107.1 ~~107.3~~ Quality assurance plan. The construction documents for *community storm shelters* shall contain a quality assurance plan in accordance with Sections ~~107.3.1~~ 107.2 through ~~107.3.3~~ 107.4.

(IS-STM 01-27-18 – AS; IS-STM 01-29-18 AS; IS-STM 01-21-18 AM/AMPC; IS-STM 08-22-18 Part 3 AM/AMPC)

107.2 ~~107.3.1~~ Detailed requirements. A quality assurance plan shall be provided for the following:

1. Roof cladding, soffits 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 that are part of wall assemblies, roof assemblies or *impact-protective systems* of the *storm shelter envelope* required to meet ~~missile~~ impact or static or cyclic pressure test requirements of Chapter 3 such us window assembly, door assembly, shutter assembly or louver.
7. Wall cladding and wall cladding connections.
8. Corrosion resistance or protection of exposed metal connectors providing load path continuity.
9. *Critical support systems* and connections and ~~debris~~ impact protection of the components and connections.
10. Foundation design.
11. Prefabricated *storm shelter* installation requirements, including anchor location and minimum required capacity for each type of anchor.
12. Prefabricated *storm shelter* minimum foundation capacity requirements.

(IS-STM 01-27-18 – AS; IS-STM 01-21-18 AM/AMPC)

107.3 ~~107.3.2~~ Quality assurance plan preparation. A quality assurance plan prepared by a registered design professional shall be provided for each main wind-force resisting system and ~~each~~ wind-resisting ~~component~~ components and cladding.

The quality assurance plan shall identify the following:

1. The main wind-force resisting systems and wind-resisting components and cladding.
2. The *special inspections* and testing to be required in accordance with Section ~~106.2~~ 110.1.
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~~ 111.1.
6. The required distribution, type and frequency of reports of test, inspections and structural observations.

(IS-STM 01-27-18 – AS; IS-STM 10-06-18 AM; IS-STM 01-02-18 AM; IS-STM 01-21-18 AM/AMPC)

107.4 ~~107.3.3~~ ~~Contractor~~ Contractor's statement of responsibility. Each contractor responsible for the construction, fabrication or installation of a main wind-force resisting system, *impact-protective 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: A written statement of responsibility shall not be required for the fabrication of *storm shelter* components that have been inspected and *labeled* by an *approved agency* as meeting the requirements of the *applicable* ~~building~~ *code* and this standard.

(IS-STM 01-21-18 AM)

SECTION ~~109~~ 108

OWNER'S RESPONSIBILITY.

(IS-STM 01-21-18 AM)

108.1 Owner's statement of responsibility. For each *community storm shelter* the owner shall submit to the *authority having jurisdiction* a written statement of responsibility acknowledging the owner's responsibilities regarding shelter operation and maintenance with the application for a construction permit.

(IS-STM 01-21-18 AM/AMPC)

108.2 Preparedness and emergency operations plan. For each *community storm shelter* the owner shall submit to the *authority having jurisdiction* a written preparedness and emergency operations plan for the *storm shelter* prior to approval of the certificate of occupancy.

(IS-STM 01-27-18 – AS, IS-STM 01-28-18 AM)

SECTION 109
PEER REVIEW

(IS-STM 01-27-18 – AS, IS-STM 01-28-18 AM)

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

(IS-STM 01-28-18- AM/ Part 1 AMPC; IS-STM 05-18-18 AM; IS-STM 10-09-18 AS)
109.1 Storm shelters requiring *peer review*. A *peer review* shall be conducted for the following *storm shelter* types:

1. *Community storm shelters* with *a design occupant capacity* of 50 or greater.
2. *Storm shelters* in elementary schools, secondary schools and day care facilities with *a design occupant capacity* greater than 16.
3. *Storm shelters* for buildings and structures assigned to Risk Category IV (essential facilities) as defined in Table 1604.5 in the *International Building Code.*

(IS-STM 01-28-18- AM Part 1 AMPC)
109.2 *Peer review*. The owner or the owner's authorized agent, other than the registered design professionals for the project, shall employ independent registered design professionals to conduct a *peer review* for compliance with the requirements of Sections 106, 107, 110 and 111 and Chapters 3, 4, 5, 6 and 7.

Exception: A registered design professional for the project is permitted to employ the peer reviewer where the registered design professional for the project is also the owner.

(IS-STM 01-28-18- AM Part 1 AMPC)
109.3 Peer reviewer disclosure. The peer reviewer shall disclose to the *authority having jurisdiction* and the owner or the owner's authorized agent any possible conflicts of interest, financial or otherwise.

(IS-STM 01-28-18- AM Part 1 AMPC)
109.4 Peer reviewer qualifications. The peer reviewers shall provide written documentation to the owner or owner's authorized agent, demonstrating relevant experience and training in the specific areas of practice being peer reviewed and for projects similar in complexity to the type of *storm shelter* design under review.

(IS-STM 01-27-18 – AS, IS-STM 01-28-18 AM/ Part 2 AMPC)
109.5 ~~106.1.2~~ Peer review report. ~~Where a peer review is required by Section 106.1.1, a~~ A signed and sealed report shall be submitted to the owner or owner's authorized agent and to the *authority having jurisdiction* with the construction documents ~~identified in Section 107~~ prior to the issuance of a permit for construction. The report shall describe the items reviewed, provide an explanation of non-compliant issues, and recommend acceptance or rejection of the items reviewed ~~their compliance or noncompliance with *applicable codes* and standards, and recommend acceptance or rejection of the storm shelter design or modifications to render the design acceptable~~.

(IS-STM 01-28-18 AM/ AMPC Part 2)

> **109.5.1 Changes**. The registered design professional in responsible charge shall submit to the peer reviewer changes to the main wind force resistance system or components and cladding that occur after the peer review report, that are related to the requirements of Section 109.1 and occur before the issuance of permits for construction. If determined to be needed by the authority having jurisdiction, an amended peer review report shall be submitted before such design changes are implemented.

(IS-STM 01-27-18 – AS)

SECTION ~~106~~ 110
SPECIAL INSPECTIONS ~~AND STRUCTURAL OBSERVATIONS~~

(IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM)

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

(IS-STM 01-11-18 – AS; IS-STM 01-12-18 AM; IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM)
110.1 ~~106.2~~ *Special inspections*. *Special inspections* shall be provided in accordance with this section, in addition to those ~~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~~. One statement of *special inspections* shall be permitted to apply to both *host building* and *storm shelter* construction.

(IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM; IS-STM 08-22-18 Part 3 AM/AMPC)
110.1.1 ~~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*.

(IS-STM 01-11-18 – AS; IS-STM 01-27-18 – AS; IS-STM 10-04-AS; IS-STM 01-29-18 AS)
110.1.2 ~~106.3~~ Special cases. *Special inspections* shall be provided for proposed work comprised of the following:

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~~ where used for anchorage of *storm shelter* components forming a part of the *storm shelter* enclosure or for anchorage of the *storm shelter* structure to foundations shall be in accordance with Section ~~106.3.1~~ 110.1.2.1.

(IS-STM 01-11-18 – AS; IS-STM 01-27-18 – AS; IS-STM 01-29-18 AS)

110.1.2.1 ~~106.3.1~~ *Special inspections* to verify anchor installation. A *special inspection* shall be provided to verify the post-installed anchor installation and capacity in accordance with Section ~~107.2.1~~ 106.2.1. For post-installed anchorage to foundations, *special inspection* shall be provided to verify foundation adequacy in accordance with Sections ~~107.2.1~~ 106.2.1 and 307 ~~308~~.

Exception: For *residential storm shelters*, where the *authority having jurisdiction* verifies that the anchorage and, where required, the foundation complies with the requirements of the *storm shelter* design as provided in documentation required by Section ~~107~~ 106, *special inspection* is permitted to be waived by the *authority having jurisdiction*.

(IS-STM 01-27-18 – AS)

SECTION ~~109~~ 111
STRUCTURAL OBSERVATIONS

(IS-STM 01-11-18 – AS; IS-STM 01-27-18 – AS; IS-STM 01-02-18 AM; IS-STM 01-29-18 AS)

111.1 ~~106.4~~ Structural observations. During construction of *community storm 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.

(IS-STM 05-09-18 AM; IS-STM 01-25-18 AM)

SECTION ~~108~~ 112
~~DESIGN INFORMATION SIGNAGE AND~~ LISTING AND LABELING

(IS-STM 05-09-18 AM; IS-STM 10-06-18 AM; IS-STM 01-22-18 AM) – relocate to 508.2)

~~**108.1 508.2 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.~~

(IS-STM 10-04-18 AS; IS-STM 01-25-18 AM)

112.1 ~~108.2~~ Listing and labeling. *Impact-protective systems* shall be *listed* and *labeled* denoting compliance with this standard. ~~Other than impact protective systems, products, materials or systems shall be labeled by an approved agency when required by the applicable code or jurisdiction.~~

(IS-STM 01-25-18 AM)

112.1.1 ~~108.2.1~~ Marking. The following function and performance characteristics shall be provided on the *label* for each *impact-protective system* tested:

1. Manufacturer's identification reference or listing number for the assembly
2. Type of *impact-protective system,* such as window assembly, door assembly, shutter assembly or louver.
3. Hazard: hurricane, tornado or both.
4. Missile weight and speed.
5. *Design wind pressure*.
6. Edition of ICC 500.

(IS-STM 01-13-18 AM)

SECTION 113
EVALUATION, MAINTENANCE AND REPAIRS

(IS-STM 01-13-18 AM/AMPC)

113.1 General. Community shelters shall be evaluated and maintained in accordance with Sections 113.2 through 113.4.

(IS-STM 01-13-18 AM/AMPC)

113.2 Evaluation. The owner or owner's representative shall evaluate the storm shelter annually and when requested by the authority having jurisdiction. The evaluation of the storm shelter shall include the following:

1. The storm shelter envelope shall be evaluated through visual observation to assess whether the walls and roofs are intact and undamaged.
2. *Impact-protective systems* shall be evaluated for compliance with the manufacturer's operational and maintenance requirements.

(IS-STM 01-13-18 AM)

113.3 Maintenance and Repairs. Storm shelters shall be maintained in an operable condition at all times. All structural and operational elements shall be repaired or replaced where damaged or found to be inoperable.

(IS-STM 01-13-18 AM/AMPC; IS-STM 03-04-18 AM/AMPC)

113.3.1 Damaged or missing components. Storm shelters shall be maintained so that walls and roofs are intact and undamaged. Any damage to the storm shelter or its *impact-protective systems* that impair its functionality shall be repaired or replaced. Damaged or missing components shall be replaced with components that are specified within the tested or listed assembly.

(IS-STM 01-13-18 AM)

113.3.2 Replacement assemblies and systems. Where it is necessary to replace certified or listed *impact-protective systems*, replacements shall comply with applicable ICC 500 requirements, and shall be tested and installed as required by this standard for new installations or construction.

(IS-STM 01-13-18 AM/AMPC)

113.4 Recordkeeping. A record of the evaluations shall be maintained by the owner or owner's representative. A record of the evaluations, and any other tests, repairs or replacements, and other operations and maintenance shall be kept on the premises or other *approved* location and consist of all changes to the original *storm shelter envelope* or *impact-protective systems*. Records shall include the date and person conducting the evaluations and maintenance or repairs.

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.

(IS-STM 10-06-18 AM)
201.3 Interchangeability. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

SECTION 202
DEFINITIONS

(IS-STM 04-10-18 AS/AFMPC reconsideration)
500-YEAR FLOOD. The flood having a 0.2 percent chance of being equaled or exceed in any given year.

(IS-STM 04-10-18 AS/AFMPC reconsideration)
500-YEAR FLOOD ELEVATION. The elevation of the *500-year flood*, including wave height.

(IS-STM 04-10-18 AS/AFMPC reconsideration)
500-YEAR FLOOD HAZARD AREA. The area subject to the *500-year flood*.

(IS-STM 02-10-18 AM)
ALCOVE STORM **SHELTER ENTRY SYSTEM.** See the definition of "Entry System, Alcove or Baffled Storm Shelter."

(IS-STM 01-02-18 AM) (IS-STM 02-10-18 AM)
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 *storm shelter*.

(IS-STM 03-04-18 AM/AMPC)

APPROVED. Acceptable to the authority having jurisdiction.

(IS-STM 02-01-18 AM/DPC; IS-STM 03-04-18 AM/AMPC; IS-STM 05-06-18 AM/AMPC- CC with 03-04)

APPROVED AGENCY. An established and recognized agency that is regularly engaged in conducting tests, furnishing inspection services or furnishing product certification, where such agency has been *approved*.

AREAS OF CONCENTRATED FURNISHINGS. The areas of a *storm shelter* with furniture or fixtures that cannot be moved easily, including areas such as bathrooms, locker rooms and rooms with fixed seating or fixed tables.

AREAS OF UNCONCENTRATED FURNISHINGS. The areas of a *storm shelter* with furniture or fixtures that can be moved easily, including areas such as classrooms and offices.

AREAS OF OPEN PLAN FURNISHINGS. The areas of a *storm shelter* that are generally free of furniture or fixtures that cannot be moved easily and of interior partitions or other features that block movement through, or otherwise subdivide, the space.

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

(IS-STM 02-10-18 AM)
BAFFLED STORM **SHELTER ENTRY SYSTEM.** See the definition of "Entry System, Alcove or Baffled Storm Shelter."

(IS-STM 04-10-18 AS/AFMPC reconsideration)
BASE FLOOD. The flood having a 1-percent chance of being equaled or exceeded in any given year.

(IS-STM 04-10-18 AS/AFMPC reconsideration)
BASE FLOOD ELEVATION. The elevation of the *base flood*, including wave height,

(IS-STM 04-08-18 AS/AMPC)
COASTAL A ZONE. Area within a special *flood hazard area*, landward of a V zone or landward of an open coast without mapped *coastal high-hazard areas*. In a coastal A zone, the principal source of flooding is astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During the base flood conditions, the potential for breaking wave height is greater than or equal to 1-1/2 feet (457 mm). The inland limit of the coastal A zone is one of the following:

1. The Limit of Moderate Wave Action if delineated on a FIRM.
2. Designated by the *authority having jurisdiction*.

(IS-STM 04-08-18 AS)
COASTAL HIGH-HAZARD AREA. Area within the special *flood hazard area* extending from offshore to the inland limit of a primary dune along an open coast and any other area that is subject to high-velocity wave action from storms or seismic sources, and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as velocity Zone V, VO, VE or V1-30.

(IS-STM 03-12-18 AM/AMPC)
~~**COLLAPSE HAZARDS.** See "Hazards, Collapse."~~

(IS-STM 02-02-18-AS; IS-STM 07-01-18 AM)
CRITICAL SUPPORT SYSTEMS, STORM SHELTER. ~~Structures,~~ Systems and components required to ensure the health, safety and well-being of shelter occupants. Critical support systems include~~, but are not limited to,~~ potable and waste water systems, ~~electrical~~ emergency and standby power and lighting systems~~, life safety systems~~ and ~~HVAC~~ ventilation systems.

(IS-STM 05-18-18 AM)

DESIGN OCCUPANT CAPACITY. The number of occupants for which the storm shelter is designed.

(IS-STM 02-10-18 AM)
DESIGN WIND PRESSURE. The wind pressure on a specific location of the *storm shelter envelope*, as determined in accordance with Section 304, Wind Loads, which controls the design of components and cladding (C & C) of the *storm shelter envelope* or the main wind-force resisting system (MWFRS) for the *storm shelter*.

(IS-STM 02-10-18 AM/AMPC; IS-STM 03-11-18 AM)
~~**STORM SHELTER**~~ **DESIGN WIND SPEED (V).** The maximum wind speed for which the *storm shelter* has been designed. Values shall be the nominal 3-second gust wind speed in miles per hour (~~km/h~~ m/s) at 33 feet (10 m) above ground for open terrain (Exposure C).

(IS-STM 02-10-18 AM/AMPC; IS-STM 08-22-18 AM/AMPC Part 4)

~~**SHELTER**~~ **ENTRY SYSTEM, ALCOVE OR BAFFLED** STORM **SHELTER.** An entry system that uses walls and passageways to allow access to and egress ~~to the *shelter* interior~~ from the protected occupant area while providing shielding from wind-borne debris ~~in accordance with Section 306.5~~.

(IS-STM 02-08-18-AM; IS-STM 02-10-18 AM/AMPC; IS-STM 08-22-18 (Part 2 & 3) AM/AMPC)

~~**SHELTER**~~ **ENVELOPE,** STORM SHELTER**.** The ~~protective~~ roofs, walls and floors and the *impact-protective systems* that ~~doors and other protected openings that are designed to meet the requirements of Chapter 3 to~~ provide protection to occupants during a severe windstorm and meet the requirements of Chapter 3.

(IS-STM 02-10-18 AM)
~~**SHELTER ENTRY SYSTEM, BAFFLED** See the definition of "Shelter Entry System, Alcove."~~

(IS-STM 03-12-18 AM/AMPC)
FALLING DEBRIS HAZARDS. See Hazards, Falling debris."

(IS-STM 02-10-18 AM)
FIRE BARRIER. A fire-resistance-rated ~~vertical~~ wall assembly of materials designed to restrict the spread of fire in which ~~openings are protected~~ continuity is maintained.

(IS-STM 04-10-18 AS/AFMPC reconsideration)

FLOOD ELEVATION. The *base flood elevation, 500-year flood elevation* or *storm surge flood elevation* applicable for the design and construction of a storm shelter.

(IS-STM 04-09-18-AS)
FLOOD ELEVATION STUDY. An examination, evaluation and determination of flood hazard and, where appropriate, corresponding water surface elevations, or an examination, evaluation and determination of storm surge inundation, including coastal wave effects, associated with the maximum intensity hurricane.

(IS-STM 04-09-18-AS; IS-STM 04-10-18 AS/AFMPC reconsideration)
FLOOD HAZARD AREA. The greater of the following two areas:

1. The area in a floodplain subject to the base flood.
2. The area designated as a *flood hazard area* on a community's flood hazard map, or otherwise legally designated.

(IS-STM 02-10-18 AM)
FURNISHINGS. See AREAS OF CONCENTRATED FURNISHINGS, AREAS OF UNCONCENTRATED FURNISHINGS and AREAS OF OPEN PLAN FURNISHINGS

(IS-STM 10-05-18 AM; IS-STM 02-10-18 AM; IS-STM 03-12-18 AM/AMPC)
HAZARDS.

Coastal. See definition for Coastal High-Hazard Area.

~~**Collapse**~~ **Falling debris.** ~~Debris from wind damage to adjacent, taller structures that could fall onto the shelter.~~ Exterior components, cladding, and appurtenances, such as parapet walls, masonry cladding, or rooftop equipment, that could fall onto the roof of a storm shelter from wind damage to adjacent, taller buildings or taller sections of a host building.

Flood. See definition for Flood Hazard Area.

Laydown. Adjacent building elements, other structures and natural objects ~~Nearby structures such as towers or large trees~~, that could fall onto the roof of a storm shelter~~, if the shelter is within the laydown radius of the structure~~, such as exterior walls of adjacent single story structures, self-supporting towers, poles or large trees.

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

(IS-STM 02-10-18 AM)

HORIZONTAL ASSEMBLY. A fire-resistance-rated floor or *roof assembly* of materials designed to restrict the spread of fire in which continuity is maintained.

HOST BUILDING. A building that is not designed or constructed as a *storm shelter* that totally or partially encloses, or is connected to, a *storm shelter*.

(IS-STM 02-10-18 AM/AMPC)
HURRICANE SHELTER. A *storm shelter* specifically for use to protect occupants during hurricanes.

(IS-STM 02-08-18-AFM) (IS-STM 08-16-18 AS) *deleted from Section 802.2* **(IS-STM 08-17-18 AS/AMPC) (IS-STM 02-10-18 AM) (IS-STM 08-22-18 AM/AMPC)**
IMPACT-PROTECTIVE SYSTEM. ~~A system~~ An assembly or device, subject to static or cyclic pressure and impact testing as detailed in this standard, installed to protect an opening in a roof, wall or floor of the *storm shelter envelope* ~~that is capable of withstanding pressure and impact testing as detailed in this standard~~.

(IS-STM 02-10-18 AM, coord with *IS-STM 08-07-18)*
~~**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*.

(IS-STM 02-04-18 AS) – this section already had the proposed text.
LABELED. Equipment, materials or products to which has been affixed a *label*, seal, symbol or other identifying mark of a nationally recognized testing laboratory, *approved agency* or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LAYDOWN HAZARDS. See “Hazards, Laydown.”

(IS-STM 05-06-18 AM/AMPC; IS-STM 03-04-18 AM/AMPC)
LISTED. Equipment, materials, products or services included in a list published by an *approved* organization and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

(IS-STM 04-14-18 AS)
~~**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.

(IS-STM 02-10-18 AM; IS-STM 05-18-18 AM)
~~**STORM SHELTER OCCUPANT LOAD.** The occupant load intended for a room or space when that space is in use as a *storm shelter.*~~

(IS-STM 07-13-18 – AM/AMPC; IS-STM 02-10-18 AM)
OCCUPANT SUPPORT AREAS. ~~The areas~~ Areas within the *storm shelter envelope* required to ~~ensure~~ serve the health, safety and well-being of occupants~~. *Occupant support areas* include,~~ including, but ~~are~~ not limited to, *storm*

shelter management, food preparation, ~~water and food~~ storage, electrical and mechanical rooms, toilet and other sanitation rooms and first-aid stations.

(IS-STM 05-03-18 AM; IS-STM 02-10-18 AM; IS-STM 070-13-18 AM/AMPC)
OCCUPIED STORM **SHELTER AREAS.** The designated *storm shelter* area within the *storm shelter envelope*.

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.

(IS-STM 01-28-18 AM, Part 1 AMPC; IS-STM 10-06-18 AM)
~~PEER REVIEW.~~ ~~A review of the *storm shelter* in accordance with Section 106.1.1 by a registered design professional(s) independent from the registered design professional(s) in responsible charge of the storm shelter design. The peer review includes checking the construction documents, calculations and quality assurance plan for the storm shelter design.~~

(IS-STM 02-10-18 AM)
PROTECTED OCCUPANT AREA. The portions of the *storm shelter* area that are protected from intrusion of storm debris ~~by *alcove or baffled entry systems* in accordance with Section 804.9.7.~~

(IS-STM 02-10-18 AM; IS-STM 02-08-18-AM/AMPC; IS-STM 02-09-18 AM/AMPC)
REBOUND IMPACT. The ~~rebound~~ impact by a test missile, or fragments thereof, on a portion of the *storm shelter* ~~protective~~ *envelope* after the test missile has impacted another surface of the *storm shelter* ~~protective~~ *envelope*.

(IS-STM 08-19-18 AM/AMPC)
ROLLING DOOR ASSEMBLY. A vertically operating coiling door made of a curtain consisting of formed metal slats interlocking together, supported by a barrel assembly at the top of the opening, operating by means of door guides at the jambs.

(IS-STM 03-12-18 AM/AMPC)
~~**ROLLOVER HAZARDS.** See "Hazards, Rollover."~~

(IS-STM 08-19-18 AM)
SECTIONAL DOOR ASSEMBLY. A vertically operating door made of two or more horizontal sections hinged together, operating by means of tracks and track rollers at the jambs.

(IS-STM 02-08-18-AM/AMPC) (IS-STM 02-10-18 AM)

SHELTER ENVELOPE (relocated)

(IS-STM 03-04-18 AM/AMPC)
SPECIAL INSPECTION. Inspection of construction requiring the expertise of an ~~*approved*~~ *special inspector* in order to ensure compliance with this standard and the *approved* construction documents.

(IS-STM 03-04-18 AM/AMPC)
SPECIAL INSPECTOR. A qualified person employed or retained by an *approved agency* and *approved* ~~by the building official~~ as having the competence necessary to inspect a particular type of construction requiring *special inspection*.

(IS-STM 08-16-18 AS/AMPC, *relocated from 802.2)*
SPECIMEN. The entire assembled unit submitted for testing, including but not limited to anchorage devices with to which the product is to be mounted.

(IS-STM 10-06-18 AM; IS-STM 10-03-18 AM; IS-STM 01-16-18 AS/AMPC; **IS-STM 02-10-18 AM/AMPC;** IS-STM 05-18-18 AM)
STORM SHELTER. A building, structure or portion~~(s)~~ thereof, constructed in accordance with this standard, designated for use during a severe wind storm event such as a hurricane or tornado.

Community Storm Shelter. Any *storm shelter* not defined as a *residential storm shelter*. This includes storm shelters intended for use by the general public, by building occupants or a combination of both.

Residential Storm Shelter. A *storm shelter* serving occupants of dwelling units and having ~~an occupant load~~ a *design occupant capacity* not exceeding 16 persons.

(IS-STM 04-10-18 AS/AFMPC reconsideration)
STORM SURGE FLOOD. The flooding associated with the maximum storm surge inundation associated with the maximum intensity hurricane modeled using an *approved* source such as the National Hurricane Center's Sea, Lake and Overland Surges from Hurricanes (SLOSH).

(IS-STM 04-10-18 AS/AFMPC reconsideration)
STORM SURGE FLOOD ELEVATION. The elevation corresponding to the *storm surge flood*, including coastal wave effects

(IS-STM 04-10-18 AS/AFMPC reconsideration)
STORM SURGE FLOOD HAZARD AREA. The area subject to the *storm surge flood*

(IS-STM 08-16-18 AS, *relocated from 802.2)*
TEST CHAMBER. An airtight enclosure of sufficient depth to allow unobstructed deflection of the *specimen* during pressure cycling, including ports for air supply and removal, and equipped with instruments to measure test pressure differentials.

(IS-STM 02-09-18 AM/AMPC; IS-STM 08-22-18 AM/AMPC)

TEST LABORATORY. A testing agency accredited to conduct missile impact and static and cyclic pressure testing as required in Chapter 8.

(IS-STM 02-10-18 AM/AMPC)
TORNADO SHELTER. A *storm shelter* specifically for use to protect occupants during tornados.

(IS-STM 05-03-18 AMAMPC; IS-STM 02-10-18 AM; IS-STM 05-18-18 AM)
USABLE FLOOR AREAS. The portions of the floor area within the *storm shelter envelope* not including *occupant support areas*, used to determine the *design occupant capacity of the storm shelter*.

(IS-STM 02-10-18 AM)
WIND PRESSURE. See the definition for Design Wind Pressure.

(IS-STM 02-10-18 AM/AMPC)
WIND SPEED. See the definition for Design Wind Speed.

(IS-STM 02-10-18 AM; IS STM 03-09-18 AM/AMPC; IS-STM 03-11-18 AM/AMPC)

SECTION 203
SYMBOLS AND NOMENCLATURE

D = Dead load.

F_{aH} = Flood Load on hurricane shelters in accordance with Section 304.5
GC_{pi} – internal pressure coefficient

L = uniform live load for floors in hurricane shelters in accordance with the applicable code for the normal use of the space

L_T = uniform live for floors in tornado shelters in accordance with Section 303.2

L_{rH} = Roof live load for hurricane shelters in accordance with Section 303.3 and 305.3

L_{rT} = Roof live load for tornado shelters in accordance with Section 303.3 and 305.3
LRFD – load and resistance factor design
K_d – directionality factor

K_{zt} – topographic factor
MWFRS – main wind-force resisting system

R_H = Rain load for hurricane shelters in accordance with Section 303.1.1.

R = Rain load for tornado shelters in accordance with the applicable code.
V_H – Design wind speed for Hurricanes
V_T – Design wind speed for Tornadoes

W_H = Load due to wind pressure for hurricane force winds

W_T = Load due to wind pressure for tornado force winds

(IS-STM 03-01-18 – AM)

CHAPTER 3

STRUCTURAL DESIGN AND TESTING CRITERIA

SECTION 301
GENERAL

(IS-STM 03-01-18 – AM; **IS-STM 01-02-18 AM)**

301.1 Scope. The requirements of this chapter shall govern the structural design and testing criteria of *storm shelters*. ~~Loads and load combinations shall be determined in accordance with ASCE 7 unless otherwise noted. Structural elements of the *storm shelter* shall be designed in accordance with the appropriate material design standard specified in the *applicable* building *code* to sustain the loads prescribed in ASCE 7, as modified by this chapter, and combined in accordance with the load combinations of ASCE 7, as modified by Section 302.~~

(IS-STM 03-01-18 – AM; **IS-STM 01-02-18 AM; IS-STM 03-11-18 AM/AMPC)**

301.2 General design requirements. *Storm shelters* shall be designed to resist the loads and load combinations as prescribed by this chapter in addition to the loads and load combinations prescribed in the applicable code.

(IS-STM 03-01-18 – AM) **(IS-STM 01-02-18 AM)**

~~**301.1.1 Design or testing.** Where the strength requirements cannot be determined by engineering calculations in accordance with appropriate material design standards referenced by the applicable building code, roof and wall assemblies shall meet the pressure requirements of Section 805.~~

(IS-STM 03-01-18 – AM, IS-STM 03-02-18 - AM)

~~**301.1.2 Anchor calculations—doors, windows and shutters.** Where anchorage of door, window or shutter framing to the shelter structure is required by means other than those provided in the manufacturer's listing or installation instructions in accordance with Section 107, alternate anchorage shall be designed for pull-out and shear and the anchor placement detailed in accordance with accepted engineering practice. The alternate anchorage details and calculations shall be provided as part of the construction documents.~~

(IS-STM 03-01-18 – AM)

301.3 General testing requirements. Where the capacity of *storm shelter envelope* components cannot be determined by engineering calculations in accordance with Section 301.2, it shall be determined through testing in accordance with Section 306.

SECTION 302
LOAD COMBINATIONS

(IS-STM 03-11-18 AM/AMPC)

302.1 General. The storm shelter shall be designed to resist the load combinations specified in Section 302.2 or 302.3. Storm shelters that are designed as combination tornado and hurricane shelters shall comply with requirements for both sets of load combinations using either Section 302.2 or 303.2.

(IS-STM 02-10-18 AM/AMPC; IS-STM 03-11-18 AM/AMPC)

302.2 ~~**302.1**~~ **Strength design.** ~~For strength design or load and resistance factor design (LRFD), use the load combinations stated in ASCE 7, Section 2.3 with W_i determined in accordance with Section 304 of this standard. Exception 1 to ASCE 7 Section 2.3.2 shall not apply.~~ Where strength design or load and resistance factor design (LRFD) is used, storm shelters and portions thereof shall be designed to resist the most critical effects resulting from the following combinations of factored loads. Each load combination shall also be investigated with one or more of the variable loads set to zero.

For Tornado Shelters:

$1.4D$ (Equation 3-1)

$1.2D + 1.6L_T + 0.5L_{rT}$ (Equation 3-2)

$1.2D + 1.6L_{rT} + (L_T \text{ or } 0.5W_T)$ (Equation 3-3)

$1.2D + 1.0W_T + L_T + 0.5L_{rT}$ (Equation 3-4)

$0.9D + 1.0W_T$ (Equation 3-5)

For Hurricane Shelters

$1.4D$ (Equation 3-6)

$1.2D + 1.6L + 0.5(L_{rH} \text{ or } R_H)$ (Equation 3-7)

$1.2D + 1.6(L_{rH} \text{ or } R_H) + (L \text{ or } 0.5W_H)$ (Equation 3-8)

$1.2D + 1.0W_H + L + 0.5(L_{rH} \text{ or } R_H)$ (Equation 3-9)

$0.9D + 1.0W_H$ (Equation 3-10)

In addition, for Hurricane Shelters subject to the requirements of Section 402.1 and located in:

Coastal high-hazard areas or a *Coastal A Zone:*

$1.2D + 1.0W_H + 2.0F_{aH} + L + 0.5(L_{rH} \text{ or } R_H)$ (Equation 3-11)

$0.9D + 1.0W_H + 2.0F_{aH}$ (Equation 3-12)

All other locations:

$1.2D + 0.5W_H + 1.0F_{aH} + L + 0.5(L_{rH} \text{ or } R_H)$ (Equation 3-13)

$0.9D + 0.5W_H + 1.0F_{aH}$ (Equation 3-14)

(IS-STM 02-10-18 AM/AMPC; IS-STM 03-11-18 AM/AMPC)

302.3 ~~**302.2**~~ **Allowable stress design.** ~~For allowable stress design (ASD), use the load combinations stated in ASCE 7, Section 2.4 with W determined in accordance with Section 304 of this standard.~~ Where allowable stress design (ASD, working stress design) is used, storm shelters and portions thereof shall be designed to resist the most critical effects resulting from the following combinations of loads. Each load combination shall also be investigated with one or more of the variable loads set to zero.

For Tornado Shelters:

$D + L_T$ (Equation 3-15)

$D + (L_{rT})$ (Equation 3-16)

$D + 0.75L_T + 0.75(L_{rT})$ (Equation 3-17)

$D + 0.6W_T$ (Equation 3-18)

$D + 0.75L_T + 0.75(0.6W_T) + 0.75(L_{rT})$ (Equation 3-19)

$0.6D + 0.6W_T$ (Equation 3-20)

For Hurricane Shelters:

$D + L$ (Equation 3-21)

$D + (L_{rH} \text{ or } R_H)$ (Equation 3-22)

$D + 0.75L + 0.75(L_{rH} \text{ or } R_H)$ (Equation 3-23)

$D + 0.6W_H$ (Equation 3-24)

$D + 0.75L + 0.75(0.6W_H) + 0.75(L_{rH} \text{ or } R_H)$ (Equation 3-25)

$0.6D + 0.6W_H$ (Equation 3-26)

In addition, for Hurricane Shelters subject to the requirements of Section 402.1 and located in:

Coastal high-hazard areas or a *Coastal A Zone:*

$D + 0.6W_H + 1.5F_{aH}$ (Equation 3-27)

$D + 0.75L + 0.75(0.6W_H) + 0.75(L_{rH}) + 1.5F_{aH}$ (Equation 3-28)

$0.6D + 0.6W_H + 1.5F_{aH}$ (Equation 3-29)

All other locations:

$D + 0.75L + 0.75(0.6W_H) + 0.75(L_{rH} \text{ or } R_H) + 0.75F_{aH}$ (Equation 3-30)

$0.6D + 0.6W_H + 0.75F_{aH}$ (Equation 3-31)

SECTION 303
LOADS

(IS-STM 03-11-18 AM/AMPC)

303.1 Rain loads. Rain loads shall be determined in accordance with the applicable code ~~ASCE 7~~. ~~Rainfall rates for *hurricane shelter* roofs shall meet the following requirements:~~

(IS-STM 03-04-18-AFM; IS-STM 03-11-18 AM/AMPC)

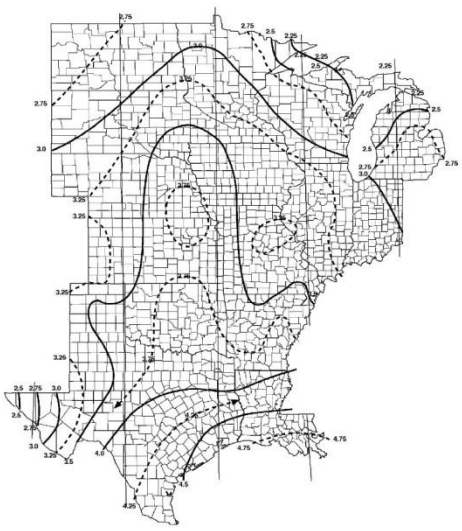
303.1.1. Rainfall rate. For *hurricane shelter* roofs The rainfall rate shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the 100-year, 1-hour rainfall rate. The 100-year, 1 hour rainfall rate shall be determined from Figure ~~303.2~~ 303.1.1 or *approved* local weather data.

(IS-STM 03-04-18-AFM)

For SI: 1 inch = 25.4 mm.

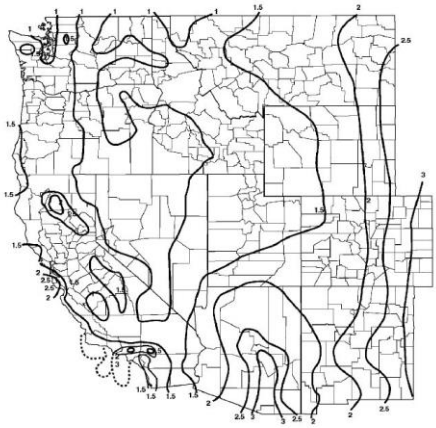
FIGURE ~~303.2~~ 303.1.1

100-YEAR, 1-HOUR RAINFALL (INCHES), EASTERN/CENTRAL UNITED STATES



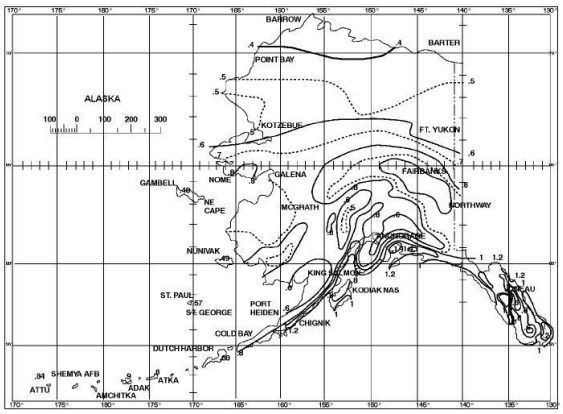
For SI: 1 inch = 25.4 mm.

FIGURE ~~303.2~~ 303.1.1**—continued**
100-YEAR, 1-HOUR RAINFALL (INCHES), CENTRAL UNITED STATES



For SI: 1 inch = 25.4 mm.
Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

FIGURE 303.1.1**—continued**
100-YEAR, 1-HOUR RAINFALL (INCHES), WESTERN UNITED STATES



For SI: 1 inch = 25.4 mm.
Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, DC.

FIGURE 303.1.1**—continued**
100-YEAR, 1-HOUR RAINFALL (INCHES), ALASKA

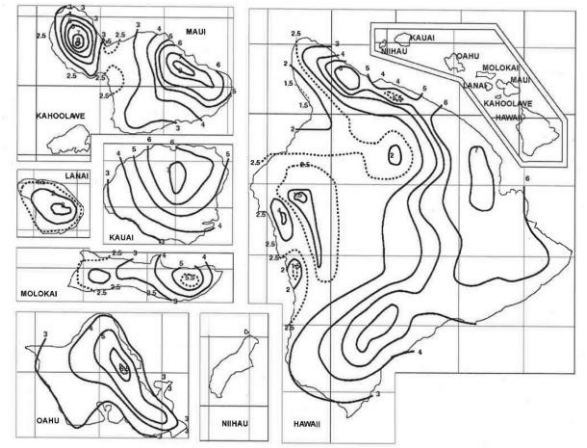


FIGURE 303.1.1**—continued**
100-YEAR, 1-HOUR RAINFALL (INCHES), HAWAII

(IS-STM 03-11-18 AM/AMPC Part 1)

303.2 Floor live loads. Community tornado shelters floors shall be designed for not less than the minimum uniform live loads for assembly occupancies in accordance with the applicable codes. Community hurricane shelter floors shall be designed for not less than the minimum uniform live for the normal occupancy of the space.

(IS-STM 03-11-18 AM/AMPC Part 2)

303.3 ~~**303.2**~~ **Roof live loads.** *Storm shelter* roofs shall be designed for minimum live loads specified in the applicable code ~~ASCE 7~~, but not less than the following:

Tornado shelters: 100 pounds per square foot (4.8 kN/m^2)
Hurricane shelters: 50 pounds per square foot (2.4 kN/m^2)

Where a storm shelter roof is subject to laydown or falling debris hazards, roof live loads shall also comply with Section 305.3.

(IS-STM 03-12-18 AM)

303.3.1 Wheel loads. Storm shelters subject to vehicle loads shall be designed for vehicle loads in accordance with the International Building Code Section 1607, the International Residential Code Section R301.5, or ASCE 7 Section 4.10 as applicable.

303.4 ~~**303.3**~~ **Hydrostatic loads.** Underground portions of *storm shelters* shall be designed for buoyancy forces and hydrostatic loads assuming that the ground water level is at the surface of the ground at the entrance to the *storm shelter*, unless adequate drainage is available to justify designing for a lower ground water level.

(IS-STM 04-09-18-AS; IS-STM 03-29-18 AS; IS-STM 03-11-18 AM/AMPC Part 2 & reconsideration)
303.5 ~~**303.4**~~ **Flood loads.** Where subject to the requirements of Section 402.1, flood loads, including wave action, shall be determined ~~in accordance with~~ ~~in accordance with~~ ~~ASCE 7. The~~ ~~design~~ using a flood elevation ~~shall equal or exceed~~ not less than the minimum floor elevation ~~as specified~~ required in Section 402.6 ~~401~~ ~~of this standard~~.

SECTION 304
WIND LOADS

(IS-STM 02-10-18 AM; IS-STM 03-11-18 AM/AMPC Part 2)
304.1 General. Hurricane wind loads, W_H, and tornado wind loads, W_T, and *design wind pressure* shall be determined ~~using~~ in accordance with ASCE 7, Chapters 26 through 31, except as modified by this section.

(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)
304.2 Design wind speed. For *tornado shelters*, the *design wind speed*, V_T, shall be in accordance with Figure 304.2(1). For *hurricane shelters*, the *design wind speed*, V_H, shall be in accordance with Figure 304.2(2). For *storm shelters* in Alaska the *design wind speed*, V_H, shall be in accordance with Figure 304.2(3).

(IS-STM 03-08-18 AM; IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)

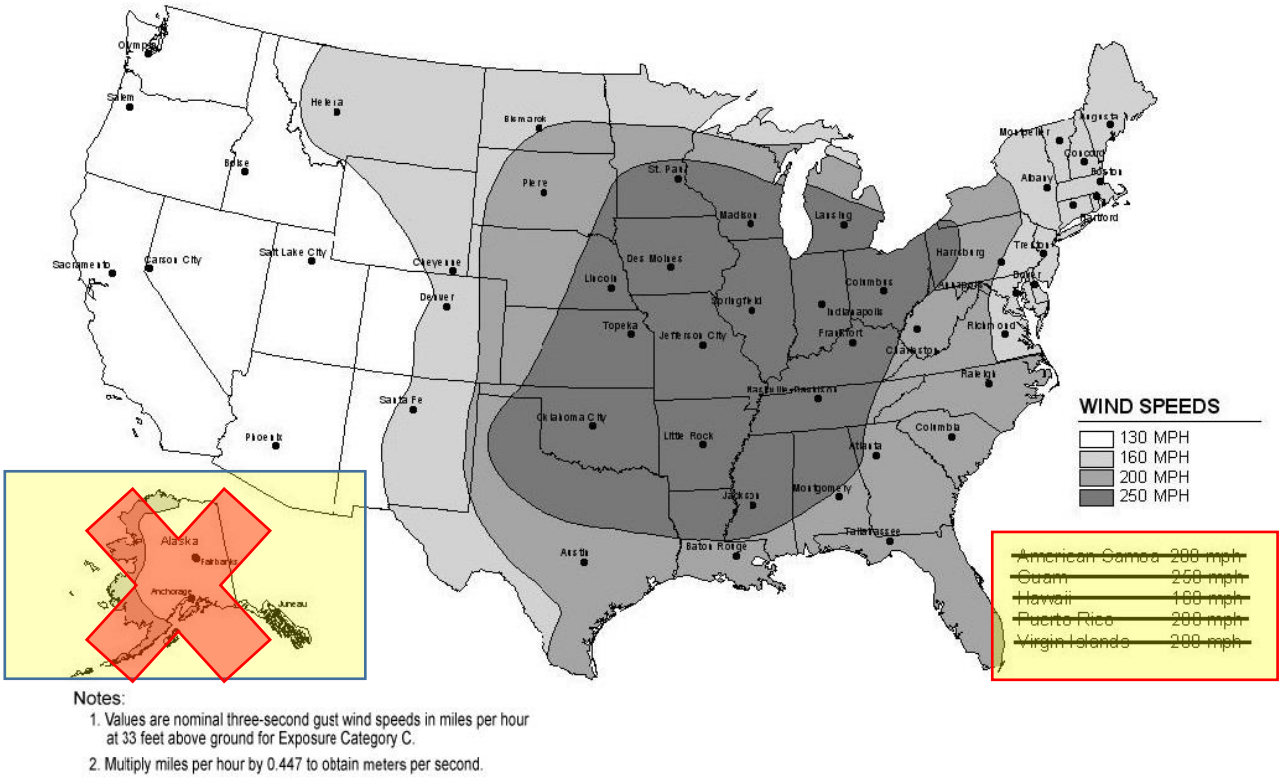
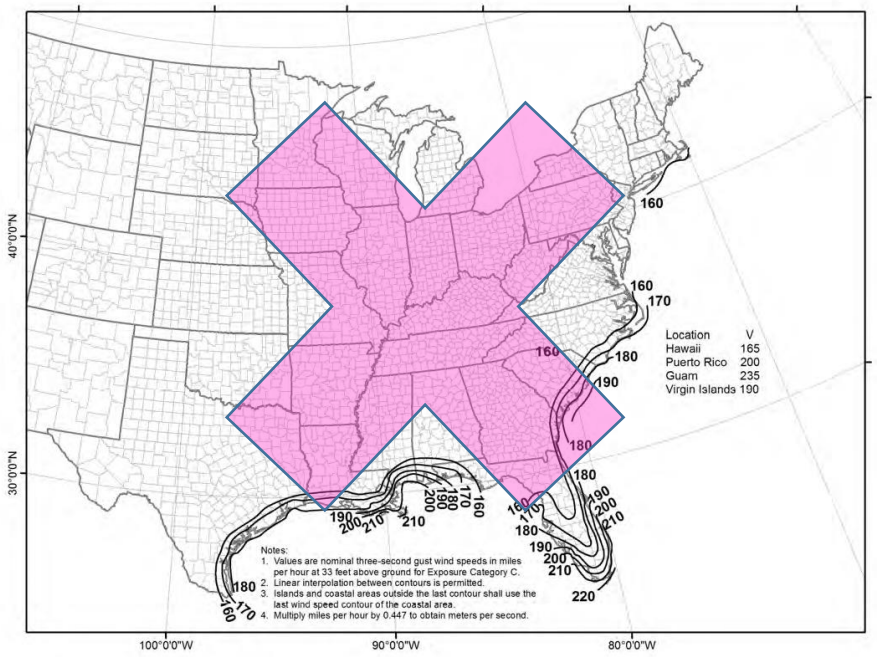
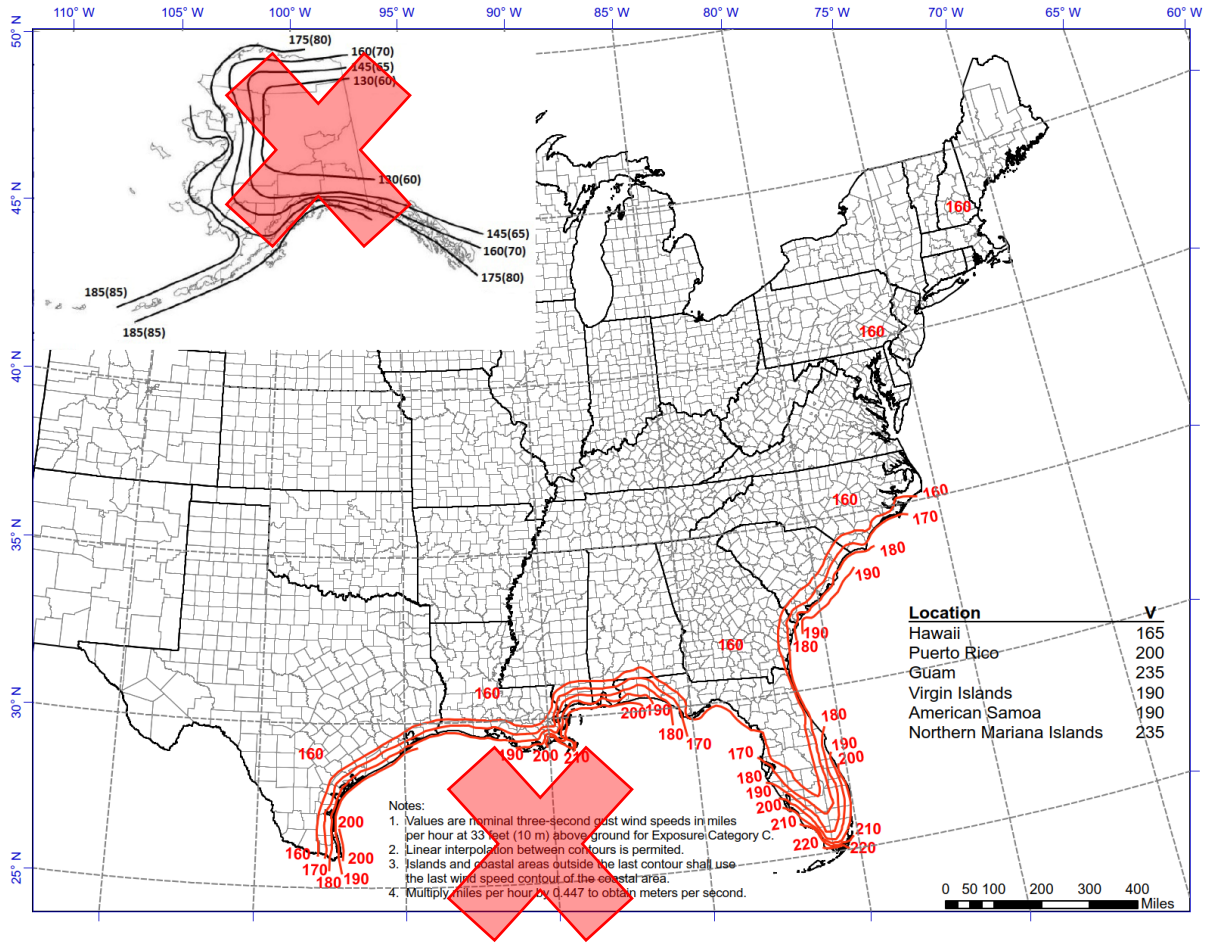


Figure 304.2(1) ~~*SHELTER*~~ *DESIGN WIND SPEEDS,* ~~*V*~~ V_T, FOR TORNADOES
Notes:
1. Values or nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C.
2. Multiple miles per hour by 0.047 to obtain meter per second.
3. Location-specific storm shelter design wind speeds shall be permitted to be determined using the ATC Hazards by Location web site https://hazards.atcouncil.org/.

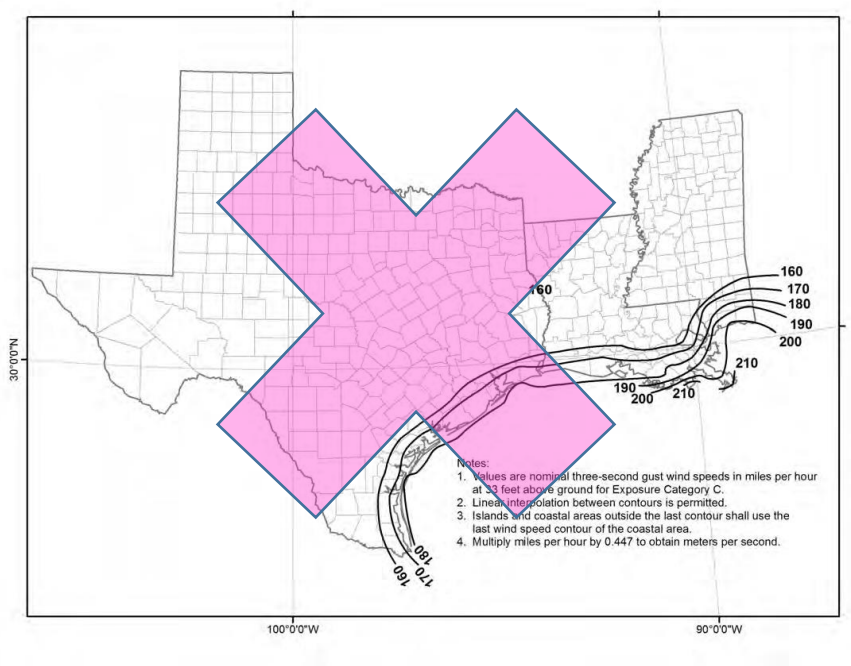
(IS-STM 03-09-18 AM) *revised figures for hurricane maps;* **IS-STM 03-09-18 AM/AMPC) remove Alaska**

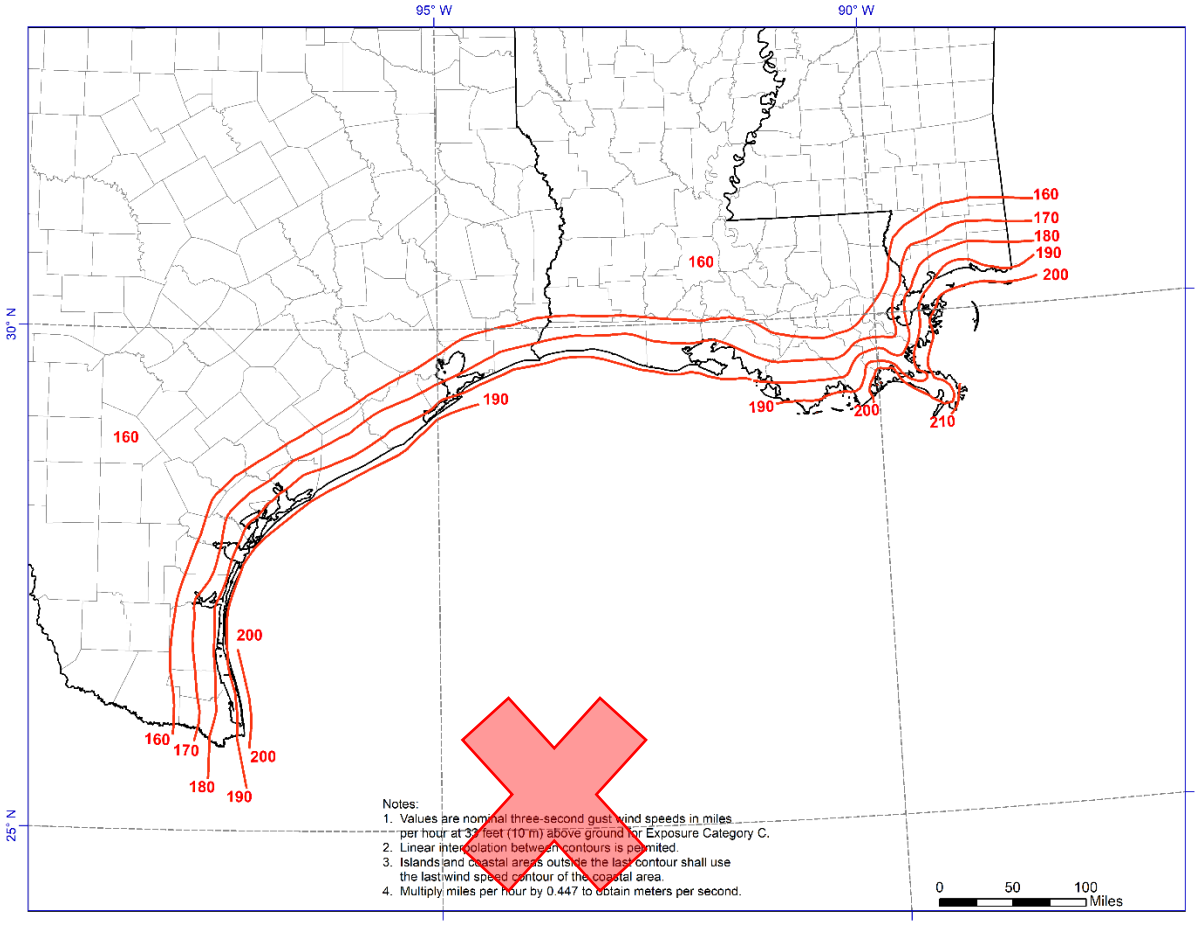




(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)
FIGURE 304.2(2)
***~~SHELTER~~ DESIGN WIND SPEEDS, V_H* FOR HURRICANES**
Notes:
1. Values or nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C.
2. Liner interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed countour of the coastal area.
4. Multiply miles per hour by 0.047 to obtain meter per second.
5. Location-specific storm shelter design wind speeds shall be permitted to be determined using the ATC Hazards by Location web site **https://hazards.atcouncil.org/**.

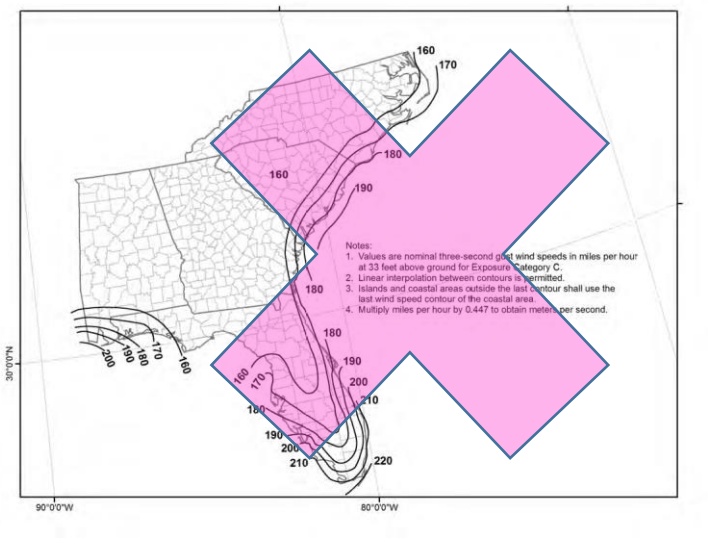
(IS-STM 03-09-18 AM) *revised figures for hurricane maps*

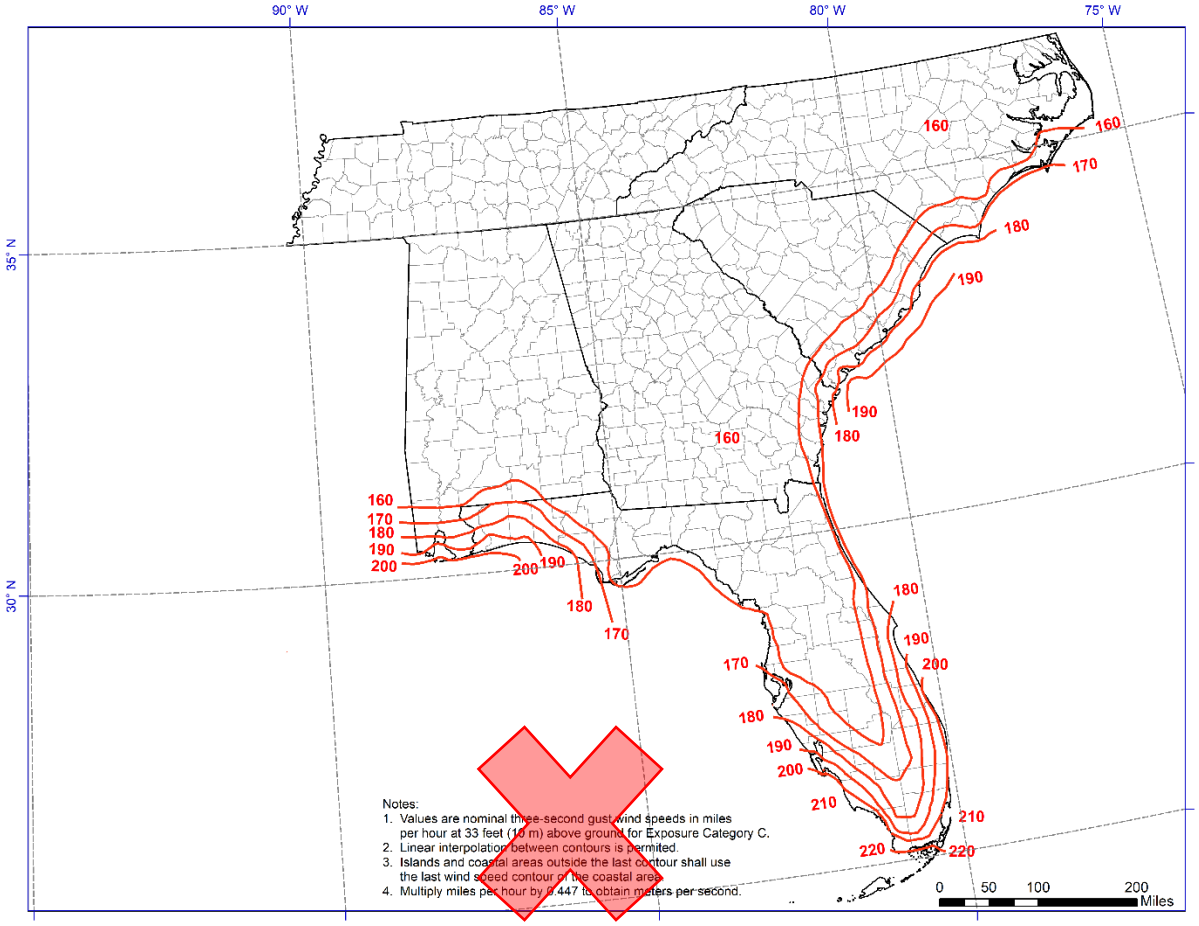




(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)
FIGURE 304.2(2)—continued
***~~SHELTER~~ DESIGN WIND SPEEDS*, V_H FOR HURRICANES —WESTERN GULF OF MEXICO**
Notes:
1. Values or nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C.
2. Liner interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed countour of the coastal area.
4. Multiply miles per hour by 0.047 to obtain meter per second.
5. Location-specific storm shelter design wind speeds shall be permitted to be determined using the ATC Hazards by Location web site **https://hazards.atcouncil.org/**.

(IS-STM 03-09-18 AM) *revised figures for hurricane maps*





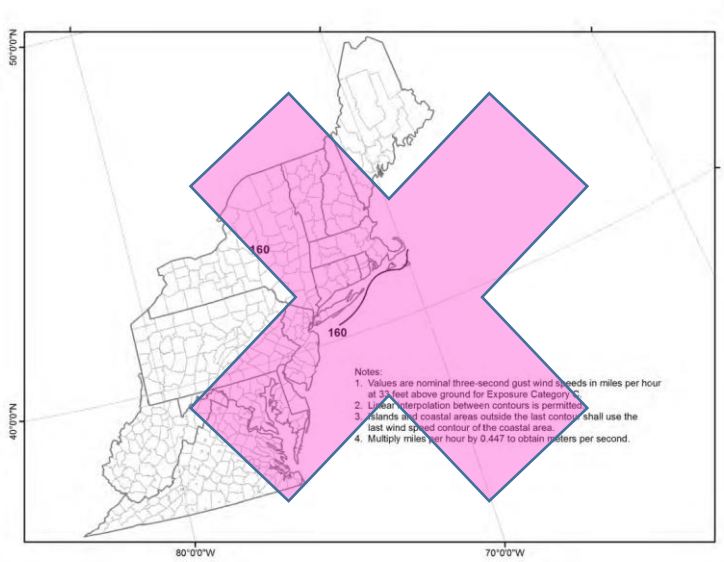
(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)
FIGURE 304.2(2)—continued
~~SHELTER~~ DESIGN WIND SPEEDS, V_H FOR HURRICANES — EASTERN GULF OF MEXICO AND SOUTHERN ATLANTIC

Notes:

1. Values or nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C.
2. Liner interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed countour of the coastal area.

4. Multiply miles per hour by 0.047 to obtain meter per second.
5. Location-specific storm shelter design wind speeds shall be permitted to be determined using the ATC Hazards by Location web site **https://hazards.atcouncil.org/**.

(IS-STM 03-09-18 AM) *revised figures for hurricane maps*



(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM)
~~**FIGURE 304.2(2)—continued**~~
~~*SHELTER DESIGN WIND SPEEDS,* FOR HURRICANES—MID-NORTHERN ATLANTIC~~

(IS-STM 03-09-18 AM) *new figure for Alaska;* **IS-STM 02-10-18 AM/AMPC; IS-STM 03-09-18 AM/AMPC)**

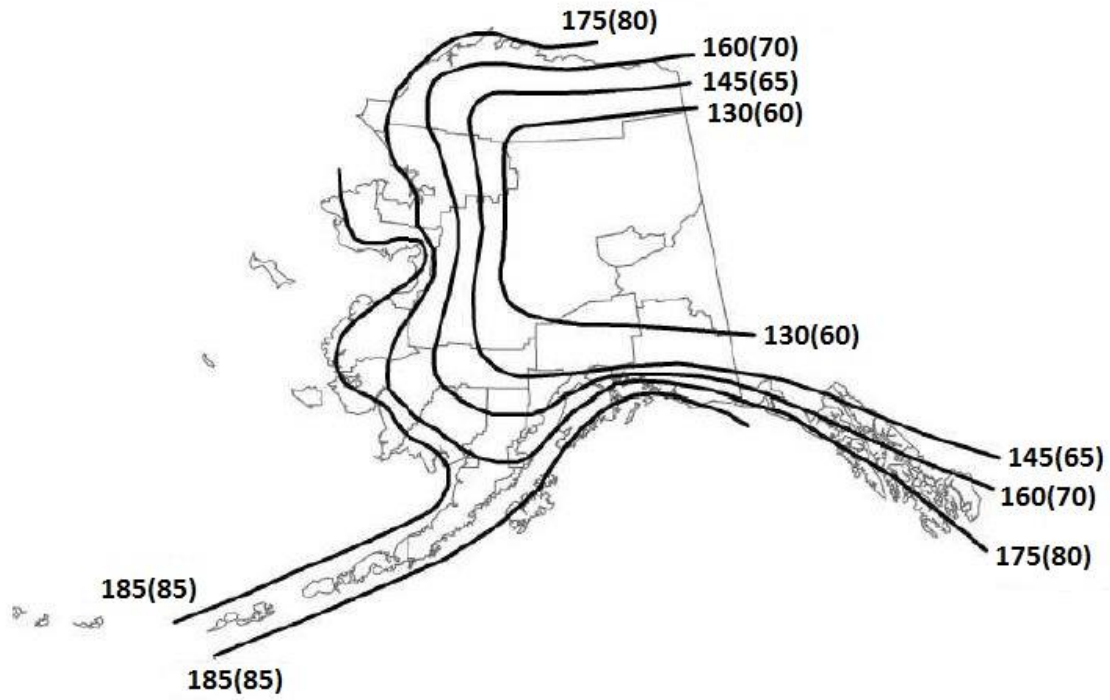


FIGURE 304.2(3) —continued
***DESIGN WIND SPEEDS, V_H,* FOR - ALASKA**
Notes:

1. Values or nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C.
2. Liner interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed countour of the coastal area.
4. Multiply miles per hour by 0.047 to obtain meter per second.
5. Location-specific storm shelter design wind speeds shall be permitted to be determined using the ATC Hazards by Location web site **https://hazards.atcouncil.org/**.

304.3 Wind directionality factor. The directionality factor shall be taken as K_d = 1.0.

304.4 Exposure category. For *tornado shelters*, wind loads shall be based on exposure category C. For *hurricane shelters*, use of exposure category B is not permitted.

Exception: For *hurricane shelters*, wind loads for the main wind-force resisting system (MWFRS) only shall be permitted to be based on exposure category B, where exposure category B exists for all wind directions and is likely to remain exposure category B after a hurricane with wind speeds as determined from Section 304.2.

304.5 Topographic effects. For *tornado shelters*, the topographic factor K_{zt} need not exceed 1.0.

(IS-STM 03-10-18 – AM/AMPC; IS-STM 08-18-18 AS/AMPC) – May 25 meeting, use 08-18-18
304.6 Enclosure classifications. Enclosure classifications for *storm shelters* shall be determined in accordance with ASCE 7, ~~Section 6.2~~ Chapter 26. For determining the enclosure classification for *community storm shelters*, the largest ~~door or window~~ opening protected by an *impact-protective system* on a wall that receives positive external pressure shall be considered as an opening.

(IS-STM 10-04-18 AS; IS-STM 03-28-18 AS; IS-STM 03-11-18 AM)
304.7 Atmospheric Pressure Change (APC). For *tornado shelters* classified as enclosed buildings, the additional internal pressures caused by atmospheric pressure change shall be considered. The internal pressure coefficient, GC_{pi}, shall be taken as ±0.18 ~~when~~ where APC venting area of 1 square foot (0.0929 m^2) per 1,000 cubic feet (28.3 m^3) of interior *storm shelter* volume is provided. APC venting shall consist of openings in the *storm shelter* roof having a pitch ~~not greater than~~ 10 degrees or less from the horizontal or openings divided equally (within 10 percent of one another) on opposite walls. A combination of APC venting meeting the above requirements is permitted.

Exception: Calculation of venting area to relieve APC is not required for *tornado shelters* classified as partially enclosed buildings. An internal pressure coefficient of GC_{pi} = ±0.55 shall be used for *tornado shelters* where APC venting meeting the requirements of Section 304.7 is not provided, or where APC venting area requirements are not calculated.

(IS-STM 03-28-18 AS; IS-STM 03-11-18 AM/AMPC)
304.8 Shielding of *storm shelters* by host and adjacent buildings. *Storm shelters* enclosed in, partially enclosed in or adjacent to *host buildings* or adjacent to other buildings not designed for wind loads for the load requirements of Chapter 3 shall be designed considering the *host building* and adjacent buildings to be destroyed and the *storm shelter* to be fully exposed.

(IS-STM 03-28-18 AS)
304.9 *Storm shelters* connected to *host buildings*. Where an element or component of the *host building* is connected to a *storm shelter*, the *storm shelter* shall be designed to resist the maximum force that could be transmitted to the *storm shelter* equal to the ultimate failure strength of the connection or element being connected, whichever is lower, concurrent with the other wind loads on the *storm shelter* required by Chapter 3.

SECTION 305
DEBRIS HAZARDS

(IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)
305.1 Wind-borne debris. All *storm shelters* shall be designed for the impact loads of wind-borne debris in accordance with ~~this section~~ Section 305.1.1 through 305.2.2.

(IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)
305.1.1 Missile criteria for *tornado shelters*. The ~~debris impact test~~ missile testing for all components of the *storm shelter envelope* of *tornado shelters* shall be a 15-pound (6.8 kg) sawn lumber 2 by 4 traveling at the speeds shown in Table 305.1.1.

(IS-STM 03-28-18 AS; **IS-STM 08-22-18 Part 3 AM/AMPC)**

TABLE 305.1.1
~~SPEEDS FOR 15-lb SAWN LUMBER 2 x 4~~ MISSILE SPEED FOR *TORNADO SHELTERS*

DESIGN WIND SPEED	MISSILE SPEED AND ~~SHELTER~~ IMPACT SURFACE
130 mph	80 mph Vertical Surfaces 53 mph Horizontal Surfaces
160 mph	84 mph Vertical Surfaces 56 mph Horizontal Surfaces
200 mph	90 mph Vertical Surfaces 60 mph Horizontal Surfaces
250 mph	100 mph Vertical Surfaces 67 mph Horizontal Surfaces

For SI: 1 mile per hour = 0.447 m/s.

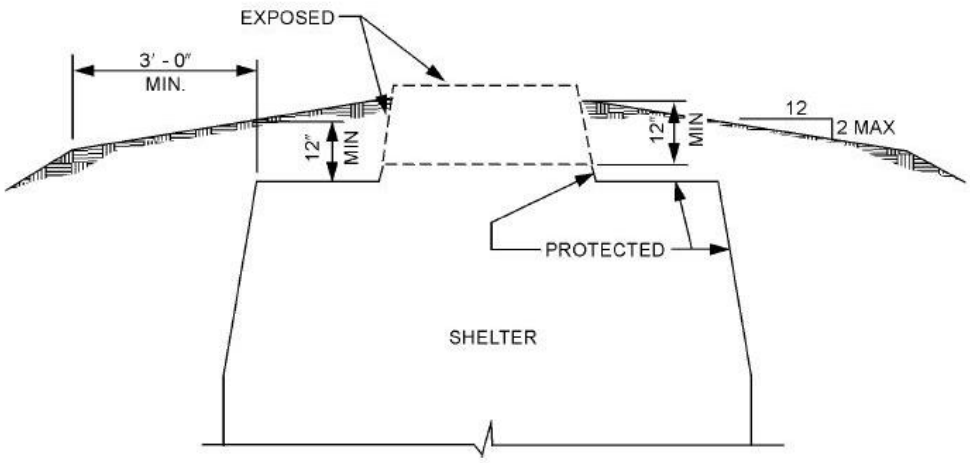
(IS-STM 03-28-18 AS; IS-STM 02-10-18 AM/AMPC; IS-STM 08-22-18 Part 3 AM/AMPC)
305.1.2 Missile criteria for *hurricane shelters*. The ~~debris impact~~ test missile for all components of the *storm shelter envelope* of *hurricane shelters* shall be a 9-pound (4.1 kg) sawn lumber 2 by 4. The speed of the test missile impacting vertical *storm shelter* surfaces shall be a minimum of 0.50 times the ~~*shelter*~~ *design wind speed*. The speed of the test missile impacting horizontal surfaces shall be 0.10 times the ~~*shelter*~~ *design wind speed*.

(IS-STM 03-17-19 AM; IS-STM 03-28-18 AS)
305.2 Testing for missile impacts. ~~Testing for missile impact of all components of the shelter envelope~~ All components of the *storm shelter envelope* shall be tested for missile impact ~~shall be~~ in accordance with Section ~~305~~ 306 following the test procedures of Section 803 ~~804~~.

Exception: Floors of the *storm shelter envelope* are not required to be tested for missile impact.

(IS-STM 03-17-19 AM; IS-STM 03-28-18 AS)
305.2.1 ~~Vertical or horizontal~~ Inclined surfaces. ~~Walls, doors and other~~ *Storm shelter envelope* surfaces inclined 30 degrees (.52 rad) or more from the horizontal shall be considered vertical surfaces. *Storm shelter envelope* surfaces inclined less than 30 degrees (.52 rad) from the horizontal shall be ~~treated as~~ considered horizontal surfaces.

(IS-STM 03-28-18 AS; IS-STM 10-07-18 AM)
305.2.2 Soil-covered portions of *storm shelters*. Portions of soil-covered *storm shelters*, with less than 12 inches (304.8 mm) of soil cover protecting *storm shelter* horizontal surfaces, or with less than 36 inches (914.4 mm) of soil cover protecting *storm shelter* vertical surfaces, shall be tested for resistance to missile perforation as though the surfaces were exposed. To qualify for shielding from soil cover, the soil surfaces shall slope away from the entrance walls or other near-grade enclosure surfaces of underground *storm shelters* at a slope of not more than 2 inches per foot for a horizontal distance of not less than 3 feet (914 mm) from the exposed portions of the *storm shelter* or unexposed portions deemed to be protected by soil cover. See Figure 305.2.2 for an example.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

(IS-STM 03-28-18 AS)
FIGURE 305.2.2
UNDERGROUND *STORM* ***SHELTER*****S**

(IS-STM 03-28-18 AS; IS-STM 03-12-18 AM)
305.3 Laydown and falling debris hazards. ~~Lay down, rollover and collapse hazards shall be considered by the design professional when determining the location of shelters on the site.~~ Where the roof of the storm shelter is within the laydown radius of a *laydown hazard* or the fall radius of a *falling debris hazard*, the storm shelter shall be designed to resist the impact loads from such hazards.

(IS-STM 03-12-18 AM/AMPC)
305.3.1 Laydown radius. The laydown radius shall be taken as the horizontal distance equal to the height of the *laydown hazard*.

(IS-STM 03-12-18 AM/AMPC)
305.3.2 Fall radius. The fall radius shall be taken as the horizontal distance equal to half the difference between the height of the *falling debris hazard* and the height of the roof of the storm shelter but need not exceed 30 ft (9.1 m).

(IS-STM 03-12-18 AM)
305.3.3 Impact loads. Impact loads from laydown and falling debris hazards shall be determined using a minimum impact factor of 2.0 times the estimated weight of the debris hazard. Each laydown and falling debris hazard load shall be considered one at a time, applied simultaneously with the uniform live loads on the roof of the shelter in accordance with Section 303.2.

(IS-STM 03-14-18-AM; IS-STM 03-28-18 AS)

SECTION 306
STORM ***SHELTER ENVELOPE*** **COMPONENT ~~DESIGN AND~~ TESTING AND DESIGN**

(IS-STM 03-28-18 AS; IS-STM 03-30-18 AS/AMPC; IS-STM 08-22-18 Part 3 AM/AMPC)
306.1 *Storm* ***Shelters*** **meeting tornado impact test requirements.** *Storm shelter envelope* components meeting ~~missile~~ impact test requirements for *tornado shelters* 250 mph *design wind speed* in accordance with Section 305.1.1 shall be considered acceptable for the impact test requirements for *hurricane shelters* provided ~~they~~ the components meet structural design load requirements for *hurricane shelters*.

(IS-STM 06-04-18 AM/AMPC)

306.2 Fire-resistance-rating. The storm shelter envelope shall be fire-resistance-rated in accordance with Section 603 and the applicable code.

(IS-STM 08-22-18 (Part 2 & 3) AM/AMPC)
306.3 ~~306.2~~ Roof and wall assemblies. Roof and wall assemblies shall meet the ~~missile~~ impact criteria of Section 305.1, and the *design wind pressure* ~~requirements of~~ in accordance with Section ~~304.1~~ 304.

(IS-STM 03-15-18-AS) (IS STM 08-13-18 AM; **IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 4 AM/AMPC)**
306.4 ~~306.3~~ Wall and roof openings. All openings in the *storm shelter envelope* shall be protected in accordance with Sections 306.4.1 through 306.4.3, as applicable. ~~by doors complying with Section 306.3.1, windows complying with Section 306.3.2, other impact-protective systems complying with Section 306.4 or baffled to prevent wind-borne debris from entering the shelter protected occupant area in accordance with Section 306.5.~~ Any changes to listed *impact-protective system*s, such as a change of glazing, shall require evaluation by the listing agency or retesting of the entire assembly.

(IS-STM 08-22-18 Part 4 AM/AMPC)
306.4.1 Impact-protective systems. *Impact-protective systems* for use in the *storm shelter envelope* shall be tested for impact in accordance with Section 803 and static and cyclic pressure in accordance with Section 804 and 805.

Exceptions:
1. Window assemblies and other glazed openings where the opening is protected on the exterior side by an *impact-protective system* are not required to be tested for impact
2. Window assemblies and other glazed openings where the opening is protected on the interior side by an *impact-protective system* are not required to be tested for impact and static and cyclic pressure.
3. Nonoperable, permanently affixed shields or cowlings designed to resist the *design wind pressures* are not required to be tested for static and cyclic pressure in accordance with Sections 804 and 805.

(Deleted by IS-STM 08-22-18 AM/AMPC)
(IS-STM 08-18-18 AS; IS-STM 08-19-18 AM)
~~**306.3.1 Testing of *shelter* door assemblies.** Door assemblies for use in the *shelter envelope* shall be tested in accordance with missile impact and pressure test procedures described in Chapter 8.~~

(IS-STM 03-15-18-AS; **IS-STM 03-17-18 AM; IS-STM 08-18-18 AS; IS-STM 05-14-18 AM/AFM)**

306.4.1.1 ~~306.7~~ Door undercut. Door ~~or shutter~~ assemblies for use in the *storm shelter envelope* with a threshold at the level of exit discharge shall be limited to a 3/4-inch (19.1 mm) maximum undercut. ~~A weather seal at the door undercut where doors are exposed to weather.~~

(IS-STM 03-16-18 AM; IS-STM 03-28-18 AS; IS-STM 08-22-18 AM/AMPC)
306.4.1.2 ~~306.4.1~~ *Impact-protective systems* in *tornado shelters*. *Impact-protective systems* in *tornado shelters* shall be permanently affixed. All operable *impact-protective systems* shall ~~be manually operable~~ include manual, non-powered operation capabilities from inside the *storm shelter*.

(IS-STM 03-02-18- AM/AMPC; IS-STM 03-15-18-AS; IS-STM 03-17-18-AM; IS-STM 03-28-18 AS; IS-STM 03-11-18 AM; IS-STM 08-22-18 Part 3 & 4 AM/AMPC)
306.4.1.3 ~~306.6~~ Anchorage ~~of doors, windows and shutters~~ for *impact-protective systems*. Where anchorage of ~~door, window or shutter framing~~ *impact-protective systems* to the *storm shelter* structure is required by means other than those provided in the manufacturer's listing ~~or installation instructions~~ in accordance with Section ~~107~~ 112, ~~alternate~~ anchorage shall be designed for pull-out and shear to resist the wind loads in accordance with Section 304. ~~and the anchor placement detailed in accordance with accepted engineering practice. The alternate anchorage details and calculations shall be provided as part of the construction documents~~.

(IS-STM 05-19-18 AS/AMPC; IS-STM 08-22-18 Part 4 AM/AMPC)

306.4.1.4 Installation. *Impact-protective systems* shall be installed in accordance with the manufacturer's *listing* and installation instructions.

(Deleted by IS-STM 08-22-18 AM/AMPC)

~~**306.3.2 Testing of window assemblies and other glazed openings.** Operable and nonoperable windows and other glazed openings including skylights, side lights and transoms, shall be tested for missile impact in accordance with Section 804 and cyclic pressure in accordance with Section 805.~~

~~**Exceptions:**~~

~~1. Missile impact testing shall not be required for window assemblies and other glazed openings where the opening is protected by a device conforming to Section 306.4 306.4.3 located on the exterior side of the opening.~~

~~2. Missile impact testing and pressure testing shall not be required for window assemblies and other glazed openings where the opening is protected by a device conforming to Section 306.4 306.4.3 located on the interior side of the opening.~~

(Deleted by IS-STM 08-22-18 AM/AMPC)

~~**306.3.2.1 Window and skylight assemblies for *tornado shelters*.** Window and skylight assemblies for use in *tornado shelters* shall comply with the missile impact requirements of Section 305.1.1 and *pressure* requirements of Section 304. Window and skylight assemblies for use in *tornado shelters* shall be tested for missile impact in accordance with Section 804 and pressure in accordance with Sections 805.3 and 805.4.~~

(Deleted by IS-STM 08-22-18 AM/AMPC)

~~**306.3.2.2 Window and skylight assemblies for *hurricane shelters*.** Window and skylight assemblies for use in *hurricane shelters* shall comply with the missile impact requirements of Section 305.1.2 and the pressure requirements of Section 304. Window and skylight assemblies for use in *hurricane shelters* shall be tested for missile impact in accordance with Section 804 and cyclic pressure in accordance with Section 805.4.~~

(Deleted by IS-STM 08-22-18 AM/AMPC)

(IS-STM 03-15-18-AS/AMPC**)**

~~**306.4 *Impact-protective systems*.** *Impact-protective systems* shall be tested for missile impact pressure in accordance with Chapter 8.~~

~~**Exception:** Nonoperable, permanently affixed shields or cowlings are excluded from pressure testing requirements of Section 806.5.~~

(IS-STM 03-15-18-AS; IS-STM 10-04-18 AS; **IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-22-18 Part 1-4 AM/AMPC)**

306.4.2 ~~306.5~~ Testing of *alcove or baffled* *storm shelter* *entry systems*. All protective elements of *alcove or baffled* *storm shelter* *entry systems* shall be tested for impact in accordance with Section 803.9.7 ~~designed to meet the wind load requirements of Section 304 and the debris impact test requirements of Section 305. Where a door is employed as part of the protection in such an entry system, the door shall meet the debris impact test requirements of Section 804.9.7 and the pressure testing requirements of Sections 805 and 806.6. The enclosure classification for *shelters* with baffled or *alcove* entries shall be determined in accordance with Section 304.6.~~

~~**Exception:** When the entry system for a *residential shelter* is equipped with a door assembly that meets the pressure requirements of Section 304, the enclosure classification shall remain unchanged by the *alcove or baffled entry system*.~~

(IS-STM 03-15-18-AS)

~~**306.7 Door undercut.**~~ **(relocated)**

(IS-STM 03-15-18-AS; IS-STM 03-19-18 AM/AMPC; IS-STM 03-20-18 AM; IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 3 & 4 AM/AMPC)

306.4.3 ~~306.8~~ Joints, gaps or voids in *storm shelter envelope*. Joints, gaps or voids in a *storm shelter envelope* that opens into the *protected occupant area* similar to masonry control joints, expansion joints, opening protective device shim spaces, air louver blades, grates, grilles, screens or precast panel joints shall be considered openings and shall be protected in accordance with Sections ~~306.3 and 306.4~~ 306.4.1.

Exceptions:

1. Masonry control joints~~,~~ and masonry or concrete expansion joints ~~or precast concrete panel joints~~ $3/8$-inch (9.5 mm) or less in width, sealed with joint material in accordance with TMS 602 for masonry or ASTM C920 for concrete.

2. Precast concrete panel joints in accordance with one of the following:

2.1. For wall panels 6-inches (152 mm) in thickness or greater where the joint is a maximum of 3/4-inches (19 mm) in width and sealed with joint material on each face in accordance ASTM C920. The panel thickness shall be measured perpendicular to the joint and at 1-inch or less from the joint center.

2.2. For roof panels 4-inches (102 mm) in thickness or greater where the joint is a maximum of 3/4-inches (19 mm) and sealed with joint material in accordance ASTM C920. The panel thickness shall be measured perpendicular to the joint and at 1-inch or less from the joint center.

3.~~2.~~ Joints, gaps or voids that will not allow a direct debris path through the *storm shelter envelope* into the *protected occupant area*. Debris particles shall impact at least two surfaces meeting the ~~missile~~ impact criteria of Section 305.1 prior to arriving at the *protected occupant area*. Straight missile paths and elastic impacts are assumed in determining missile trajectories.

(IS-STM 03-21-18 AM (relocated and split); IS-STM 03-22-18 AM coordination)

~~**SECTION 307**~~

~~**WEATHER PROTECTION**~~

(IS-STM 03-21-18 AM) (IS-STM 01-02-18 AM)

~~**307.1 Exterior cladding of hurricane shelters.** All exposed components and cladding assemblies and roof coverings of hurricane shelters shall be designed to resist rainwater penetration during the design windstorm and shall be designed and installed to meet the wind load requirements of Section 304.~~

~~**Exception:** Residential shelters that are fully enclosed in a host building constructed in compliance with the local building *code*.~~

(IS-STM 03-22-18 AM)

~~**307.2 Electrical grounding of shelters.** Exposed metal interior surfaces of shelters that are electrically grounded and electrical fixtures within shelters shall be grounded only to the host building external grounding system.~~

SECTION 307 ~~308~~
CONNECTION OF *STORM SHELTERS* TO FOUNDATIONS OR SLABS

(IS-STM 03-27 AM/AMPC; **IS-STM 03-28-18 AS; IS-STM 03-14-18 AM/AMPC)**

307.1 ~~308.1~~ Connections of storm shelters to foundations ~~or slabs~~ systems. Storm shelters shall be designed to resist all loads specified in Chapter 3 and to transfer the resultant forces ~~into the ground~~ from their point of origin through the structure to the foundation system. Foundations shall be designed to transmit the resulting loads to the supporting soil. Anchorage to concrete foundation systems shall be in accordance with ACI 318.

(IS-STM 10-08-18 AS**;** IS-STM 03-27 AM; **IS-STM 03-28-18 AS; IS-STM 03-11-18 AM)**

307.1.1 ~~308.1.1~~ Calculation of resistance. Structural stability of *storm shelters* shall be determined by engineering calculations for design wind loads ~~pressures determined in accordance with Section 304~~. Where *storm shelters* are anchored to foundation systems ~~foundations or slabs on grade whose~~ and such top surfaces ~~extending~~ extend outward from the *storm shelter* walls are at grade, the top surfaces of the foundation systems ~~foundations or slabs~~ shall not be considered to have wind uplift forces acting on them.

(IS-STM 03-27 AM; **IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC; IS-STM 03-11-18 AM/AMPC)**

307.1.2 ~~308.1.1.3~~ Elevated *storm shelter* ~~foundations~~ foundation systems. Where *storm shelters* are constructed with the top of the supporting foundation ~~structure~~ system located at an elevation higher than the surrounding finished grade level, the structural stability of the *storm shelter* and elevated supporting foundation ~~structure~~ system shall be computed assuming that both are fully exposed to the *storm shelter* design wind and

flood ~~forces~~ loads. Where applicable, and in accordance with ~~ASCE 7~~ the applicable code, the impacts of ~~wind-borne and~~ flood-borne debris on stability of the foundation system shall be considered.

(IS-STM 03-27 AM; IS-STM 03-23-18 AM)

~~**308.1.1.1 Slabs-on-grade.** New or existing slabs-on-grade shall be designed for the applicable loads in accordance with Section 301; however, The minimum thickness shall be 3-1/2 inches (88.9 mm) and the minimum steel reinforcement for slabs-on-grade resisting forces on the *storm shelter* shall be 6 × 6 – W1.4 × W1.4 welded wire reinforcement over the required area of slab or No. 4 bars, at a maximum spacing of 18 inches (457 mm) on center, in two perpendicular directions.~~

~~**Exception:** Concrete and concrete masonry *storm shelters* shall be permitted to be constructed within existing one- and two-family dwellings on existing slabs-on-grade without a foundation, under the following conditions:~~

1. ~~Calculated soil pressure under the slabs-on-grade supporting the *storm shelter* walls shall not exceed 2000 psf (95.8 kN/m^2) for design loading conditions other than design *storm shelter* events and 3000 psf (143.7 kN/m^2) for design *storm shelter* events.~~
2. ~~The *storm shelter* is anchored at a minimum to the slab-on-grade at each corner of the structure and on each side of the doorway opening.~~
3. ~~Reinforcing in the slab-on-grade shall not be required where the dead load of the slab is no t required to resist overturning.~~

(IS-STM 03-27 AM/AMPC; IS-STM 01-02-18 AM-CC)

307.2 ~~308.2~~ Slabs-on-ground. Where slabs-on-ground are serving as part of the foundation system for the storm shelter, the slabs-on-ground shall be designed in accordance with ACI 318 to resist all loads specified in Chapter 3 and to transfer the resultant forces into the ground.

Exceptions:

1. Slabs-on-ground within a storm shelter not utilized to transfer wind forces acting on the storm shelter to the ground or to a foundation system supporting the storm shelter shall be designed in accordance with the applicable code.
2. Slabs-on-ground within a one- or two-family dwelling and supporting a *residential storm shelter* shall be designed in accordance with ACI 318 or ACI 332.

(IS-STM 03-27 AM)

307.2.1 ~~308.1.1.2~~ Joints in concrete slabs-on- ground ~~grade~~. Design calculations for concrete slabs-on-ground ~~grade supporting *storm shelters*~~ shall include the effect of expansion joints, contraction joints or construction joints where such slabs-on- ground ~~grade~~ are utilized to resist ~~tensile and shear~~ loads from the supported *storm shelters*.

(IS-STM 03-27 AM/AMPC)

307.3 Existing slabs-on-ground supporting storm shelters. Replacement or strengthening of existing slabs-on-ground where a storm shelter is to be installed shall not be required where all of the following conditions apply:

1. Community storm shelters that are a single story in height with a footprint of 64 ft^2 (5.95 m^2) or less or residential storm shelters.
2. The storm shelter is constructed out of concrete or concrete masonry.
3. Calculated soil pressure under the slabs-on-ground supporting the storm shelter walls does not exceed 2000 psf (95.8 kN/m^2) for design loading conditions other than design storm events and 3000 psf (143.7 kN/m^2) for design storm events.
4. The storm shelter is anchored at a minimum to the slab-on-ground at each corner of the structure and on each side of door openings in the shelter envelope.

SECTION 308 ~~309~~
PENETRATIONS OF *STORM SHELTER ENVELOPE* BY SYSTEMS AND UTILITIES

(IS-STM 03-24-18 AS; IS-ST 03-25-18-AS; IS-STM 01-02-18 AM; IS-STM 03-28-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)

308.1 ~~309.1~~ Penetrations of *storm shelter envelope* by mechanical, electrical and plumbing systems. Penetrations through the *storm shelter envelope* of mechanical, electrical and plumbing systems, including piping and utility lines, larger than $3^1/_2$ square inches (2258 mm^2) in area for rectangular penetrations or ~~2 1/16~~ 2-1/2 inches (~~52.38~~ 63.5 mm)in diameter for circular penetrations, shall be considered openings and shall be protected in accordance with Section ~~306.3~~ 306.4. Penetrations of the *storm shelter envelope* shall not degrade the structural integrity of the *storm shelter* and ~~missile~~ impact resistance of the *storm shelter envelope*.

Penetrations of the *storm shelter envelope* by hazardous gas or liquid lines shall have automatic shutoffs to protect against leakage due to movement of the utility line. The threshold movements for shutoff shall be as defined by the *applicable codes* and standards governing such utility lines.

CHAPTER 4

SITING

(IS-STM 04-12-18-AS)

SECTION 401
GENERAL

(IS-STM 04-12-18-AS)
401.1 Scope. The requirements of this chapter shall govern the siting, elevation and travel distance for *storm shelters*.

(IS-STM 04-09-18-AS)

SECTION 402 ~~401~~
FLOOD ~~ELEVATION~~ CRITERIA

(IS-STM 04-09-18-AS/AMPC; IS-STM 04-13-18-AS; IS-STM 04-10-18 AM/AFMPC reconsideration)
402.1 General. Flood criteria shall apply to storm shelters in accordance with Table 402.1. *Storm shelters* shall be sited and elevated in accordance with Section 402.2 through 402.6.4 and shall be designed and constructed to resist the effects of flood hazards and flood loads in accordance with Section 303.5.

(IS-STM 04-10-18 AS/AFMPC reconsideration)

Table 402.1

STORM SHELTERS REQUIRED TO COMPLY WITH SECTION 402.

Type of Shelter	Location of Shelter		
	Flood hazard area	500-year flood hazard area	Storm surge flood hazard area
Community tornado shelter	All	Risk Category IV facilities or serving Risk Category IV facilities [a]	NA
Community hurricane shelter	All	All	All
Residential tornado shelter	All	NA	NA
Residential hurricane shelter	All	All [b]	All

NA = not applicable

a. Risk categories are determined in accordance with Table 1604.5 of the International Building Code.

b. Where the *500-year flood hazard area* is mapped and the *500-year flood elevation* is available in the *flood elevation study* adopted by the authority having jurisdiction.

(IS-STM 04-10-18 AS)
~~**401.1 Minimum floor elevation of storm shelters.**~~ (relocated)

(IS-STM 04-10-18 AS)
~~**401.1.1 Minimum floor elevation of community shelters.**~~ (relocated and split)

(IS-STM 04-10-18 AS)
~~401.1.2 Minimum floor elevation of residential shelters.~~ (relocated and split).

(IS-STM 04-05-18-AS; IS-STM 04-09-18-AS; IS-STM 04-10-18 AM/AFMPC reconsideration)
402.2 ~~401.2~~ Design criteria. The design and construction of *storm shelters* or portions thereof ~~subject to flooding~~ located in the areas indicated in Table 402.1, including *coastal high-hazard areas* and *coastal A zones* ~~shall be designed~~ in accordance with the provisions of this chapter, ~~ASCE 7, Section 5~~ and ASCE 24 except for the floor elevations for *storm shelters* required in Section 402.6.

(IS-STM 04-09-18-AS)
402.3 Determining flood elevations and floodway. The flood elevation and floodway shall be determined using the flood hazard map adopted by the applicable governing authority. Where flood elevations and floodway are not included in the flood hazard map, or where a *flood elevation study* is not adopted by the applicable governing authority, the flood elevation and floodway shall be determined in accordance with one of the following:

1. Utilize a flood elevation and floodway data available from federal, state or other *approved* source.
2. Determine the flood elevation and floodway in accordance with the accepted hydrologic and hydraulic engineering practices used to prepare a *flood elevation study*. Determination shall be undertaken by a registered design professional who shall document that the technical methods used reflect currently accepted engineering practice.

(IS-STM 04-09-18-AS)
402.4 Flood Information. Flood information shall be provided on the construction documents in accordance with Section 106.2.1.

(IS-STM 04-08-18-AS; IS-STM 04-13-18-AS; IS-STM 04-10-18 AS/AFMPC reconsideration)
402.5 ~~404.1~~ ~~Community~~ Storm shelter siting. ~~*Community*~~ *Storm shelters* shall be located outside of the following high-risk ~~*flood hazard*~~ areas:

1. ~~Flood hazard areas subject to high-velocity wave action (V zones).~~ *Coastal high-hazard areas* and *coastal A zones*.
2. Floodways.

Exception: ~~*Community*~~ *Storm shelters* shall be permitted in ~~flood hazard areas subject to high-velocity wave action (V zones)~~ *coastal high-hazard areas* and *coastal A zones* where permitted by the Board of Appeals in accordance with the provisions of the *International Building Code* or *International Residential Code*.

(IS-STM 04-10-18 AS/AMPC reconsideration)
402.6 ~~401.1~~ Minimum floor elevation of *storm shelters*. Where *storm shelters* are located in the areas indicated in Table 402.1, the minimum floor elevations of *storm shelters* shall be determined in accordance with Section ~~401.1.1 or 401.1.2~~ 402.6.1, 402.6.2, 402.6.3, 402.6.4, as applicable.

(IS-STM 04-10-18 AS/AMPC Part 2, 3 and 4/ AFMPC reconsideration; **IS-STM 04-13-18-AS)**
402.6.1 ~~401.1.1~~ Minimum floor elevation of *community tornado shelters*. The lowest floor used for the *occupied storm shelter areas* and *occupant support areas* of a *community tornado shelter* shall be elevated to or above the ~~higher~~ highest of the elevations determined by all of the following:

1.~~4.~~ The minimum elevation of the lowest floor required by the *authority having jurisdiction* ~~for the location where the *shelter* is installed; or~~.
2.~~5.~~ ~~Two feet (610 mm)~~ One foot (305 mm) above the *base flood elevation* ~~having a 1 percent annual chance of being equaled or exceeded in any given year~~.
3.~~1.~~ For *storm shelters* that are Risk Category IV facilities or serving Risk Category IV facilities:
   3.1 The *500-year flood elevation*, ~~including coastal wave effects, having an 0.2-percent annual chance of being equaled or exceeded in any given year); or~~.
   3.2 Two feet (6610 mm) above the *base flood elevation*.

~~2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or~~
~~3. The maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or~~

~~Exception~~ Exceptions: ~~Items 1 and 3 shall not apply to shelters designed, constructed, designated and used only as tornado shelters.~~

1. A *community tornado shelter* is not required to be elevated to the level required by Items 1 through 4 where all of the following are met:
   - 1.1 The host building or the shelter is dry floodproofed in accordance ASCE 24 to the elevation prescribed in Items 1 through 4.
   - 1.2 The shelter has at least one door, emergency escape opening or hatch complying with Chapter 5 that has the bottom of the opening located above the dry floodproofing elevation.
   - 1.3 The elevation of the floor of the *storm shelter* is not more than 36 inches below the elevation required by Items 1 through 4.

2. Where a *community tornado shelter* is constructed within an existing host building, only item 1 shall apply.

(IS-STM 04-10-18 AS/Part 1 AMPC/ AFMPC reconsideration; IS-STM 10-05-18 AM; **IS-STM 04-13-18-AS)**

402.6.2 ~~401.1.1~~ Minimum floor elevation of *community hurricane shelters*. The lowest floor used for the *occupied storm shelter areas* and *occupant support areas* of a *community hurricane shelter* shall be elevated to or above the ~~higher~~ highest of the elevations determined by all of the following:

1. ~~4.~~ The minimum elevation of the lowest floor required by the *authority having jurisdiction* for the location where the *community hurricane shelter* is installed~~; or~~.
2. ~~5.~~ Two feet (610 mm) above the base flood elevation (flood having a 1 percent annual chance of being equaled or exceeded in any given year), including coastal wave effects.
3. ~~1.~~ The 500-year flood elevation~~, including coastal wave effects~~, (flood having an 0.2-percent annual chance of being equaled or exceeded in any given year), including coastal wave effects.~~; or~~.

~~2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or~~

4. ~~3.~~ The *storm surge flood elevation* ~~maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or~~

~~**Exception:** Items 1 and 3 shall not apply to shelters designed, constructed, designated and used only as tornado shelters.~~

(IS-STM 04-10-18 AS/Part 1 & 4 AMPC/ AFMPC reconsideration; IS-STM 10-05-18 AM; **IS-STM 04-13-18-AS)**

402.6.3 ~~401.1.2~~ Minimum floor elevation of *residential tornado shelters*. The lowest floor ~~used for the occupied shelter area~~ of a *residential tornado shelter* shall be elevated to or above the ~~higher~~ highest of the elevations determined by all of the following:

~~1. The flood elevation, including coastal wave effects, having an 0.2-percent annual chance of being equaled or exceeded in any given year; or~~

~~2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or~~

~~3. The maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or~~

1. ~~4.~~ The minimum elevation of the lowest floor required by the *authority having jurisdiction* ~~for the location where the *shelter* is installed.~~
2. One foot (305 mm) above the *base flood elevation*.

Exception: ~~Items 1 and 3 shall not apply to shelters designed, constructed, designated and used only as tornado shelters.~~ Where a *residential tornado shelter* is constructed within an existing host building only Item 1 shall apply.

(IS-STM 04-10-18 AS/Part 1 AMPC/ AFMPC reconsideration; **IS-STM 04-13-18-AS)**

402.6.4 ~~401.1.2~~ Minimum floor elevation of *residential hurricane shelters*. The lowest floor ~~used for the occupied shelter area~~ of a *residential hurricane shelter* shall be elevated to or above the ~~higher~~ highest of the elevations determined by all of the following:

1. ~~4.~~ The minimum elevation of the lowest floor required by the *authority having jurisdiction* ~~for the location where the *shelter* is installed~~.
2. ~~1.~~ The 500-year flood elevation~~, including coastal wave effects, having an 0.2-percent annual chance of being equaled or exceeded in any given year; or~~.

~~2. The flood elevation corresponding to the highest recorded flood elevation if a flood hazard study has not been conducted for the area; or~~

3. The *storm surge flood elevation.* ~~maximum flood elevation associated with any modeled hurricane category, including coastal wave effects; or~~

~~**Exception:** Items 1 and 3 shall not apply to shelters designed, constructed, designated and used only as tornado shelters.~~

(IS-STM 04-14-18 AS)

~~**SECTION 402**~~
~~**HAZARDOUS MATERIALS**~~

(IS-STM 04-14-18 AS)

~~**402.1 Proximity to hazardous materials.** Occupants of *community shelters* that are located within a precautionary zone that includes facilities that manufacture, use or store hazardous materials shall be provided with protection from hazardous materials releases as deemed necessary by the *local emergency planning committee* and the *authority having jurisdiction*.~~

(IS-SM 04-11-18-AS; IS-SM 04-12-18-AS)

SECTION 403
~~SITING PROXIMITY~~ MAXIMUM TRAVEL DISTANCE FOR ~~*RESIDENTIAL*~~ *TORNADO SHELTERS*

(IS-SM 04-12-18-AS)

403.1 C*ommunity tornado shelters* in schools. Where required by the *International Building Code*, *community tornado shelters* that serve educational occupancies shall comply with the maximum travel distance to the tornado shelter entrance.

(IS-SM 04-11-18-AS; IS-SM 04-12-18-AS)

403.2 ~~403.1 Residential shelter siting~~ *Residential tornado shelters*. *Residential tornado shelters* shall be located within the residence that shelter is intended to serve, or shall be located on the site such that the maximum travel distance of at least one travel path from an access opening on the shelter to an exterior door of any residences that the shelter is intended to serve does not exceed 150 feet (45 720 mm).

(IS-STM 04-08-18 AS)

~~**SECTION 404**~~
~~**SITING FOR COMMUNITY SHELTERS**~~

(IS-STM 04-08-18 AS)

~~**404.1 Community shelter siting.**~~ (relocated)

(IS-STM 05-19-18 AS/AMPC)

CHAPTER 5

~~OCCUPANCY,~~ OCCUPANT DENSITY, ~~MEANS OF EGRESS,~~ ACCESS, ~~AND~~ ACCESSIBILITY, EGRESS AND SIGNAGE

(IS-STM 05-19-18 AS)

SECTION 501
GENERAL

(IS-STM 05-19-18 AS/AMPC)

501.1 Scope. The requirements of this chapter shall govern the occupant density, access, accessibility, egress, and signage for storm shelters.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

SECTION ~~501~~ 502
OCCUPANCY DENSITY IN COMMUNITY STORM SHELTERS

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

502.1 ~~501.1~~ General. A community storm shelter shall comply with the requirements ~~of this section~~ of Section 502.2 through 502.4. ~~A residential shelter shall comply with the requirements of Section 502.~~

(IS-STM 05-18-18 AM/AMPC)

502.2 Design occupant capacity. The *design occupant capacity* served by the storm shelter shall be determined based upon the needs of the storm shelter as determined by the authority having jurisdiction and the designer.

(IS-STM 05-17-18 AM; **IS-STM 05-19-18 AS/AMPC; IS-STM 05-03-18 AM/AMPC;** IS-STM 05-18-18 AM/AMPC)

502.3 ~~501.1.1~~ Occupant density. The minimum required ~~shelter~~ *usable floor area* per occupant for community storm shelters shall be determined in accordance with Table ~~501.1.1~~ 502.3 ~~and this section~~. ~~The number of standing, seated, wheelchair or bedridden spaces shall be determined based upon the needs of the shelter determined by the applicable authority having jurisdiction and the designer.~~

~~**501.1.3 Wheelchair spaces.**~~ Each storm shelter shall be sized to accommodate a minimum of one wheelchair space for every 200 storm shelter occupants or portion thereof.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS; IS-STM 05-03-18 AM/AMPC)

Table 502.2 ~~501.1.1~~

OCCUPANT DENSITY – COMMUNITY STORM SHELTERS

~~TYPE OF SHELTER~~ TYPE OF OCCUPANTS	MINIMUM REQUIRED *USABLE ~~SHELTER~~ FLOOR AREA*[a] IN SQUARE FEET PER OCCUPANT
Tornado	
Occupants who are Standing or seated	5
Occupants using a Wheelchair	10

Occupants who are relocated in a bed or stretcher ~~Bedridden~~	30
Hurricane	
Occupants who are Standing or seated	20
Occupants using a Wheelchair	20
Occupants who are relocated in a bed or stretcher ~~Bedridden~~	40

For SI: 1 square foot = 0.0929 m^2.

~~a. See Section 501.1.2 for requirements for minimum required usable shelter floor area.~~

(IS-STM 05-01-18 AM; IS-STM 05-19-18 AS; IS-STM 05-03-18 AM/AMPC; IS-STM 05-18-18 AM/AMPC)

502.4 ~~501.1.2~~ *Usable ~~storm shelter~~ floor area*. The *usable ~~storm shelter~~ floor area* shall be determined by Section ~~501.1.2.1 or 501.1.2.2~~ 502.3.1, 502.3.2 or a combination of these methods. The useable floor area shall meet or exceed the square footage required for the occupant density.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS; IS-STM 05-03-18 AM/AMPC)

502.4.1 ~~501.1.2.1~~ Calculation of *usable floor area*. The *usable ~~shelter~~ floor area* shall be determined by using the following percentages:

1. Reducing the gross floor area of *storm shelter* areas with *areas of concentrated furnishings* or fixed seating by a minimum of 50 percent.
2. Reducing the gross floor area of *storm shelter* areas with *areas of unconcentrated furnishings* and without fixed seating by a minimum of 35 percent.
3. Reducing the gross floor area of *storm shelter* areas with *areas of open plan furnishings* and without fixed seating by a minimum of 15 percent.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS; IS-STM 05-03-18 AM/AMPC)

502.4.2 ~~501.1.2.2~~ Alternative calculation of usable floor area. The *usable ~~shelter~~ floor area* shall be determined by subtracting from the gross floor area, the floor area partitions and walls, columns, fixed or movable objects, furniture, equipment or other features that under probable conditions cannot be removed.

(IS-STM 05-03-18 AM/AMPC; **IS-STM 05-17-18 AM;** IS-STM 05-19-18 AS)

502.5 *Tornado Shelter* Usable floor area. In *community tornado shelters* the following *occupant support areas* shall be permitted to be considered *usable floor area*;

1. The entire *storm shelter* is a single occupant toilet room area~~.~~
2. The *storm shelter* includes multi-stall toilet rooms, the toilet room area other than the toilet stalls and temporary water closet privacy areas.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

SECTION 503 ~~502~~
OCCUPANT DENSITY IN RESIDENTIAL STORM SHELTERS

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

503.1 ~~502.1~~ General. A *residential storm shelter* shall comply with the requirements ~~of this section~~ of Section 503.1 through 503.3 . ~~A community shelter shall comply with the requirements of Section 501.~~

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS/AMPC; **IS-STM 05-03-18 AM/AMPC;** IS-STM 05-18-18 AM/AMPC)

503.2 ~~**502.4**~~ **Occupant density.** The minimum required *usable* ~~*shelter*~~ *floor area* per occupant for *residential storm shelters* shall be determined in accordance with Table ~~502.4~~ 503.2.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS; IS-STM 05-03-18 AM/AMPC)

TABLE 503.2 ~~502.4~~
OCCUPANT DENSITY—*RESIDENTIAL STORM SHELTERS*

~~TYPE OF SHELTER~~ TYPE OF OCCUPANTS	MINIMUM REQUIRED *USABLE* ~~*SHELTER*~~ *FLOOR AREA* IN SQUARE FEET PER OCCUPANT
Tornado	
One- and two-family dwelling	3
Other residential	5
Hurricane	
One- and two-family dwelling	7
Other residential	10

For SI: 1 square foot = 0.0929 m^2.

(IS-STM 10-05-18 AM; IS-STM 05-19-18 AS/AMPC; **IS-STM 05-03-18 AM/AMPC;** IS-STM 05-18-18 AM/AMPC)

503.3 ~~**502.4.1**~~ **Usable** ~~**tornado**~~ ~~**shelter**~~ **floor area.** The *usable* ~~tornado~~ ~~*shelter*~~ *floor area* shall be ~~the gross floor area, minus the area of sanitary facilities, if any, and shall include the protected occupant area between the shelter walls at the level of fixed seating, where fixed seating exists~~ determined by subtracting from the gross floor area, the floor area of partitions and walls, columns, fixed or movable objects, furniture, equipment or other features that under probable conditions cannot be removed. The useable floor area shall meet or exceed the square footage required for the occupant density.

(IS-STM 05-19-18 AS/AMPC)

SECTION 504
ACCESS AND EGRESS IN COMMUNITY SHELTERS

(IS-STM 05-19-18 AS; IS-STM 06-04-18 AM/AMPC)

504.1 General. A community storm shelter shall comply with the access and egress requirements of Section 504.2 through 504.6. Community storm shelters shall also comply with the additional egress requirements in Section 603 as applicable.

(IS-STM 05-19-18 AS/AMPC ; IS-STM 08-22 AM/AMPC Part 4)

504.2 Wall and roof openings. All access openings, means of egress doors, emergency escape openings and overhead hatches in the *storm shelter envelope* shall be considered openings and shall be protected in accordance with n Section 306.4.

IS-STM 05-17-18 AM; IS-STM 05-19-18 AS/AMPC)

504.3 ~~**501.6 Accessibility Accessible route.**~~ Buildings and space used as community storm shelters shall be accessible in accordance with the applicable code. ~~Shelters shall be provided with an accessible route in accordance with ICC A117.1.~~

(IS-STM 01-02-18 AM; IS-STM 05-05-18 AM; **IS-STM 05-17-18 AM; IS-STM 05-18-18 AM; IS-STM 05-19-18 AS/AMPC; IS-STM 06-04-18 AM)**

504.4 ~~501.2~~ ~~Number of~~ Egress Doors. The ~~number of~~ means of egress doors ~~from a space~~ in the storm shelter envelope shall be determined based upon the occupant load for the normal occupancy of the space in accordance with the *applicable* ~~building~~ *code*. ~~For facilities used solely for *shelters*, the number of doors shall be determined in accordance with the *applicable* building *code* based upon the occupant load as calculated in Section 501.1.~~ The number of doors shall also comply with Section 603.

Where the *applicable* ~~building~~ *code* requires only one means of egress door from the storm shelter, the storm shelter shall also provide an emergency escape opening ~~shall be provided~~ in accordance with Section ~~501.4~~ 504.5 or an overhead hatch accessed by an emergency stair, ladder or alternating tread device in accordance with Section 506.

Exception: *Storm shelters* having an ~~occupant load~~ *design occupant capacity* not exceeding 16 are not required to have an emergency escape opening or an overhead hatch.

(IS-STM 05-06-18 AM; IS-STM 01-02-18 AM; **IS-STM 05-19-18 AS/AMPC – delete section)**

~~**501.3 Direction of swing.** The direction of the swing of doors shall be as required by the *applicable* building *code* for the normal occupancy of the space.~~

(IS-STM 05-19-18 AS/AMPC – delete section)

~~**501.5 Door operation.** Means of egress doors shall be operable from the inside without the use of keys or special knowledge or effort.~~

(IS-STM 05-19-18 AS)

504.5 ~~501.4~~ Emergency escape opening. The emergency escape opening shall be an additional door or an opening that ~~is~~ complies with the following:

1. Have a minimum net clear opening of 5.7 square feet (0.530 m^2) ~~in area~~.
2. ~~Such opening shall~~ Have a minimum net clear opening height of 24 inches (610 mm) and a minimum net clear opening width of 20 inches (508 mm).
3. ~~The emergency escape opening~~ Shall be operable from the inside without the use of tools or special knowledge.
4. Where the bottom of the clear ~~emergency escape~~ opening is located more than 44 inches (1117.6 mm) above the ~~finished~~ floor ~~level~~, vertical access to the opening shall be provided by ~~a~~ an emergency stair complying with Section ~~502.3.1~~ 506.2 or a ladder complying with Section ~~502.3.2~~ 506.3, or an alternating tread device complying with Section ~~502.3.3~~ 506.4.
   ~~The emergency escape opening shall be located away from the means of egress door by a minimum distance of one-third of the length of the maximum overall diagonal dimension of the area to be served.~~

   Exception: The minimum net clear opening shall be permitted to be 5 square feet where the bottom of the emergency escape opening is not more than 44 inches (1118 mm) above or below finished grade.

(IS-STM 10-04-18 AS; IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

~~**501.4.1 Ladders for *community shelters*.** Ladders for *community shelter*, which are required for access to emergency escape openings above the level of normal egress, shall comply with the requirements of Section 502.3.2. When the access opening is located on a vertical surface (see Section 305.2.1), the height of the opening shall be not less than 30 inches (762 mm).~~

(IS-STM 05-05-18 AM; IS-STM 05-19-18 AS/AMPC)

504.6 Multi-story shelter. *Storm* shelters with multiple stories shall be required to have one emergency means of vertical access and egress provided within the storm shelter to a level of exit discharge provided by a ~~stairway~~ emergency stair complying with Section ~~502.3.1~~ 506.2 or a ladder complying with Section ~~502.3.2~~ 506.3, or an alternating tread device complying with Section ~~502.3.3~~ 506.4.

Exception: Provide an emergency escape opening or overhead hatch to allow for emergency vertical access and egress to the roof.

(IS-STM 05-19-18 AS/AMPC)

SECTION 505
ACCESS AND EGRESS IN RESIDENTIAL STORM SHELTERS

(IS-STM 05-19-18 AS)
505.1 General. A residential storm shelter shall comply with the access and egress requirements of Section 505.2 through 505.4.

(IS-STM 05-19-18 AS/AMPC ; IS-STM 08-22 AM/AMPC Part 4)

505.2 Wall and roof openings. All access and egress openings, means of egress doors and overhead hatches in *the storm shelter envelope* shall be considered openings and shall be protected in accordance with Section 306.4.

(IS-STM 05-19-18 AS/AMPC)
505.3 Access and egress. The residential storm shelter shall be provided with a method of access and egress by a means of egress door, an access and egress opening complying with Section 505.3.1 or an overhead hatch complying with Section 506.5.

(IS-STM 05-19-18 AS/AMPC – delete section)
~~**502.5 Door operation.** Means of egress doors shall be operable from the inside without the use of keys or special knowledge or effort.~~

(IS-STM 05-19-18 AS/AMPC; IS-STM 05-17-18 AM)
~~502.2~~ 505.3.1 Access and egress openings. ~~All residential shelters~~ Access and egress openings shall be ~~provided with a method of entry and egress with minimum~~ a clear opening ~~dimensions~~ of 24 inches by 30 inches (610 mm by 762 mm) minimum.

(IS-STM 05-19-18 AS/AMPC; IS-STM 05-17-18 AM)
505.4 ~~502.3~~ Vertical access and egress. Where ~~required~~ provided, vertical access and egress to a residential storm shelter shall be by an emergency stair complying with Section ~~502.3.1~~ 506.2, or by a ladder complying with Section ~~502.3.2~~ 506.3, or an alternating tread device complying with Section ~~502.3.3~~ 506.4.

(IS-STM 05-19-18 AS/AMPC)

SECTION 506
VERTICAL ACCESS AND EGRESS

(IS-STM 05-19-18 AS)
506.1 General. Where stairways are required for means of egress for normal use of the space, they shall comply with the applicable code. An emergency stair shall comply with Section 506.2. A ladder shall comply with Section 506.3, An alternating tread device shall comply with Section 506.4. Overhead hatches shall comply with Section 506.5.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)
506.2 ~~502.3.1~~ Emergency stairs ~~for *residential shelters*~~. Emergency stairs shall comply with all of the following:

1. Treads shall have a minimum depth of 8 inches (203 mm).
2. Treads shall not be required to have a nosing.
3. Surfaces or treads shall be slip resistant.
4. The maximum height of risers shall be $9^{9}/_{16}$ inches (243 mm).
5. The minimum width of the emergency stairs shall be 22 inches (559 mm).
6. The angle of the emergency stair from horizontal shall be a maximum of 50 degrees (0.87 rad).

~~Treads for emergency stairs in *residential shelters* shall have a minimum depth of 8 inches (203 mm). The maximum height of risers shall be $9^{9}/_{16}$ inches (243 mm). Surfaces of steps shall be slip resistant. The minimum width of stairs shall be 22 inches (559 mm). The angle of the stairway from horizontal shall be a maximum of 50 degrees (0.87 rad). Stairs shall be constructed such that a foot is prevented from sliding off either side of the stairway. Stair Treads shall not be required to have a nosing.~~

Exception: ~~The maximum height of risers~~ For *residential* *storm shelters*, which have a ~~maximum~~ rise between the *storm shelter* floor level and *storm shelter* entrance level of 70 inches (1778 mm) maximum, the maximum height of risers shall be 10 inches (254 mm) ~~for 8-inch (203 mm) stair treads~~.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

506.2.1 ~~502.3.1.1~~ ~~Overhead clearance~~ Headroom. The minimum headroom clearance ~~above any stair tread to an overhead obstruction~~ shall be ~~6 feet 8~~ 80 inches (2032 mm), measured vertically ~~above the leading edge of the tread~~ from a line connecting the edge of the nosing.

Exceptions:

1. The minimum ~~overhead~~ headroom clearance is permitted to be reduced to ~~5 feet~~ 60 inches (1524 mm) where signage is provided at the top and bottom of the emergency stair conspicuously warning the user of low headroom.
2. Entrances that are entered by persons seated on the entrance threshold and that are not high enough for a person to enter standing erect shall not be required to provide minimum headroom clearance provided that there is no more than two ~~stair~~ risers leading into the *storm shelter*.

(IS-STM 05-19-18 AS)

506.2.2 ~~502.3.1.2~~ ~~Stair~~ Handrails. A continuous handrail shall be located on one side of ~~a stairway~~ an emergency stair having more than three risers. Handrail extensions are not required.

(IS-STM 05-08-18 AS; IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

506.3 ~~502.3.2~~ Ladders ~~for residential shelters~~. Ladders shall comply with the all of following:

1. The clear width between rails shall be not less than 16 inches (406 mm).
2. Rungs shall be a minimum of 3/4 inch (19 mm) in diameter.
3. Rungs or treads shall be capable of withstanding a 300 pound (136 kg) load.
4. Rungs or treads shall be spaced uniformly at not greater than 12 inches (305 mm).
5. The minimum clearance between the centerline of the rungs or treads to the nearest permanent object in back of the ladder on the toe side shall be no less than 7 inches (178 mm).
6. Ladders shall have a maximum slope of 90 degrees (1.57 rad) from horizontal and a minimum slope of 75 degrees (1.31 rad) from horizontal where measured on the toe side of the ladder.

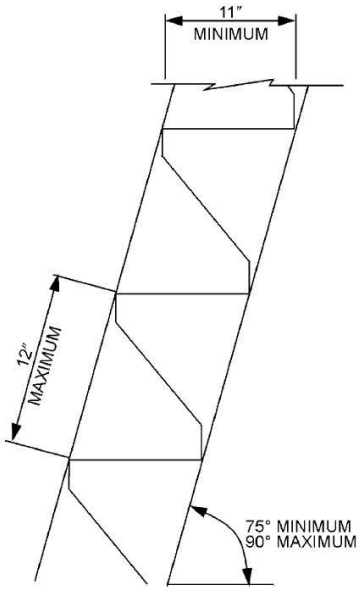
~~The clear length of rungs for ladders shall be not less than 16 inches (406 mm). Rungs shall be constructed such that a foot cannot slide off the end of the rung. Ladder rungs shall be a minimum of 3/4 inch (19 mm) in diameter and shall be spaced uniformly at not greater than 12 inches (305 mm).~~

~~Ladder wells or cages shall have a minimum of 15 inches (381 mm) clear on either side of the centerline of the ladder and a minimum of 27 inches (686 mm) clear from the centerline of the rungs to a ladder well or cage on the climbing side of the ladder. Where obstructions occur in the ladder well, this distance shall be increased to 30 inches (762 mm).~~

~~The distance between the centerline of the rungs or steps to the nearest permanent object in back of the ladder (on the toe side) shall be no less than 7 inches (178 mm). Ladders shall have a maximum slope of 90 degrees (1.57 rad) from horizontal and a minimum slope of 75 degrees (1.31 rad) from horizontal where measured on the toe side of the ladder.~~

Exception: ~~No~~ A minimum clearance is not required on the back side of the ladder where there is no obstruction on the climbing side of the ladder, and where ladder ~~steps~~ treads of 11 inches (279 mm) or greater in ~~width~~ depth are molded or fabricated in a continuous series of treads and risers ~~in which the foot can neither slip through the riser nor be trapped by the riser or next higher ladder stair tread~~. ~~The maximum slope shall be 90 degrees (1.57 rad) from horizontal and the minimum slope shall be 75 degrees (1.31 rad) from horizontal. See~~ as detailed in Figure ~~502.3.2~~ 505.3.

(IS-STM 05-08-18 AS; **IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)**



For SI: 1 inch = 25.4 mm, 1 degree = 0.0174 rad.

FIGURE ~~502.3.2~~ 505.3

Alternative for a ladder in a *storm* *shelter*

(IS-STM 05-19-18 AS)

506.3.1 ~~502.3.2.1~~ Ladder ~~Cages or~~ wells. Ladder ~~cages or ladder~~ wells, ~~shall be~~ where provided ~~for vertical climbs extending more than 8 feet (2438 mm).~~ shall have a minimum of 15 inches (381 mm) clear on either side of the centerline of the ladder and a minimum of 27 inches (686 mm) clear from the centerline of the rungs to a ladder well or obstruction on the climbing side of the ladder.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

506.4 ~~502.3.3~~ Alternating tread devices ~~for residential shelters.~~ Alternating tread devices ~~for residential shelters~~ shall comply with the applicable requirements listed in the ~~*International Building Code*~~ applicable code.

(IS-STM 05-19-18 AS)

~~**502.3.3.1 Overhead clearance.** The minimum clearance requirements for stairs including exceptions) listed in Section 502.3.1.1 shall also apply to alternating tread devices.~~

(IS-STM 05-19-18 AS)

506.5 ~~502.3.2.2~~ Overhead hatches. Where provided, hatches at the tops of emergency stairs, ladders or alternating tread devices shall ~~have~~ comply with the following:

1. A minimum clear dimensions of 24 inches by 30 inches (610 mm by 762 mm).
2. A clear opening of 24 inches (610 mm) minimum from the ~~centerline~~ the face of the top tread or rung of the emergency stairs, ladders or alternating tread devices on the climbing side ~~of the ladder~~ and
3. A minimum of 15 inches (372 mm) on either side of the centerline of the top tread or rungs ~~shall be provided.~~
4. Where the access opening is located on a vertical surface in accordance with Section 305.2, the height of the opening shall be 30 inches (762 mm) minimum.
5. Hatches shall open a minimum of 60 degrees (1.04 rad) from the closed position.
6. Hatches shall be counterweighted or otherwise held in the open position when opened.

(IS-STM 05-19-18 AS)

SECTION 507 ~~503~~
~~LOCKS AND~~ LATCHING

(IS-STM 05-19-18 AS)

507.1 ~~503.1~~ Latching mechanisms. Latching mechanisms for *impact-protective systems* shall be permanently mounted on the assembly. Such mechanisms shall require no tools to be engaged in the latched position. Devices such as pins shall be permanently secured to the assembly through the use of chains or wires that must be of corrosion-resistant material.

(IS-STM 05-17-18 AM; IS-STM 05-19-18 AS)

~~503.3 Door latches.~~ ~~Door~~ Latching ~~hardware~~ mechanism necessary for ~~the~~ *impact-protective systems* ~~door assembly~~ to perform as designed for the *storm shelter* shall ~~either~~ comply with either of the following:

1. Automatically engage ~~when~~ where the ~~door~~ *impact-protective system* is in a closed position and shall not be capable of being disabled~~, or~~.
2. Be capable of being engaged by an occupant. Signage shall be provided with instructions for latching the ~~door~~ *impact-protective systems* for ~~emergency~~ *storm shelter* use.

(IS-STM 05-19-18 AS/AMPC)

507.2 ~~503.2~~ Multi-latching systems. Impact-protective systems utilizing multi-latching systems ~~Multi-latching systems that are not categorized as a means of egress/escape and are provided~~ with more than one single-action latching mechanism shall be provided with permanently posted instructions on the latching.

(IS-STM 05-19-18 AS/AMPC)

507.3 Operating hardware on the unprotected side. Where operating hardware of an *impact-protective system* is located on the unprotected side of the storm shelter envelope, after the latching mechanism is engaged in accordance with Section 507.1, such operating hardware on the non-egress side shall be locked, disabled, or inactive and shall not be susceptible to unintentional unlatching by debris impact.

(IS-STM 05-09-18 AM; IS-STM 05-19-18 AS)

SECTION 508 ~~504~~
SIGNAGE ~~FOR *COMMUNITY SHELTERS*~~

(IS-STM 05-09-18 AM/AMPC; IS-STM 05-19-18 AS)

508.1 ~~504.1~~ Signage requirements. ~~*Community storm shelter* areas shall be marked by signage in accordance with this section~~. All storm shelters shall be marked with design information in accordance with Section 508.2. ~~Signage is required within a facility to direct occupants to storm shelter areas.~~ *Community storm shelter* areas shall be marked by signage in accordance with Sections 508.3 through 508.7, as applicable. All signs shall comply with the visual character requirements of ICC A117.1.

(IS-STM 05-09-18 AM/AMPC; IS-STM 01-22-18 AM/AMPC – relocated from 108.1**; IS-STM 05-17-18 AM;** IS-STM 02-10-18 AM/AMPC)

508.2 Design information. All *storm shelters* shall have a sign on or within the *storm shelter* with all of the following:

1. The *design occupant capacity*.
2. The storm type.
3. The *design wind speed*.
4. The edition of the ICC 500 used for the design.

5. The name of the manufacturer or builder of the *storm shelter*.

(IS-STM 05-09-18 AM; IS-STM 10-06-18 AM)

~~**504.1.2 Identifying sign.** A sign depicting the general location of storm shelter area(s) and accessways shall be displayed in all of the following locations:~~

~~1. Adjacent to access doors on the inside of the storm shelter;~~

~~2. In the office of the facility manager, where provided; and~~

~~3. In the designated shelter manager's area within the storm shelter, where provided.~~

(IS-STM 05-09-18 AM)

~~**504.1.2.1 Location of identifying sign.** The identifying sign shall be posted in a prominent location 60 inches (1524 mm) above the finished floor to the centerline of the sign.~~

(IS-STM 05-09-18 AM/AMPC; **IS-STM 05-17-18 AM)**

508.3 Exterior directional signs. Where the storm shelter serves the general public, exterior directional signage is required to direct intended occupants to the *storm shelter*.

(IS-STM 05-15-19 AM; IS-STM 05-17-18 AM)

508.4 *Storm* ***shelter*** **directional signage for a multi building site.** Where a *storm shelter* serves multiple buildings, directional signage is required to direct intended occupants to the *storm shelter*.

(IS-STM 05-15-19 AM; IS-STM 05-17-18 AM)

508.5 *Storm* ***shelter*** **directional signage within a *host building*.** Where a *storm shelter* is within a *host building*, directional signage is required within the *host building* to direct intended occupants to the *storm shelter*. The path of travel to the *storm shelter* shall be clearly marked to indicate the direction of travel in cases where the path of travel is not immediately visible to the intended occupants.

(IS-STM 05-09-18 AM/AMPC; **IS-STM 05-17-18 AM)**

508.6 ~~**504.1.1**~~ **Shelter entry sign** ~~**Signage location**~~**.** ~~At every entrance to a storm shelter, signage~~ Signage indicating "Tornado Shelter," or "Hurricane Shelter," ~~or~~ and appropriate symbols as applicable, shall be installed outside the *storm shelter*, adjacent to every door or *alcove or baffled storm shelter entry system* intended to provide entry into the *storm shelter*. ~~The signs shall comply with the applicable requirements of ICC A117.1.~~

(IS-STM 05-09-18 AM/AMPC; **IS-STM 05-17-18 AM)**

508.7 *Storm* ***shelter*** **perimeter sign.** Signage indicating "Notice: Now leaving the Tornado Shelter," or "Notice: Now leaving the Hurricane Shelter," shall be installed inside of the *storm shelter*, adjacent to every door or *alcove or baffled storm shelter entry system* which access non-protected areas located outside of the *storm shelter*.

CHAPTER 6
FIRE SAFETY

(IS-STM 06-07-18 AS)

SECTION 601
GENERAL

(IS-STM 06-07-18 AS)
601.1 Scope. The requirements of this chapter shall govern the fire safety of *community storm shelters*.

(IS-STM 07-01-18 AM)

SECTION 602
FIRE PROTECTION SYSTEMS

(IS-STM 07-01-18 AM/AMPC; IS-STM 08-22-18 Part 2 & 3 AM/AMPC)
602.1 Fire protection system. Fire protection systems shall be provided within the storm shelter where required by the applicable code for the normal use of the space. These systems are not required to remain functional for the design storm event and minimum period of shelter occupancy (24 hours for hurricane shelters, 2 hours for tornado shelters) or to be protected from the wind load and impact requirements of Chapter 3 or the flood-resistance requirements of Chapter 4.

(IS-STM 06-04-18 AM/AMPC)

SECTION ~~601~~ 603
FIRE-RESISTANT-RATED CONSTRUCTION

(IS-STM 06-04-18 AM) **(IS-STM 01-02-18 AM)**
~~**601.1 Fire separation.** *Fire barriers* and horizontal assemblies separating spaces or areas designated as *storm shelters* from other building areas shall have a minimum fire-resistance rating of 2 hours and shall be constructed in accordance with the *applicable* building *code*.~~

~~**Exception:** Fire separation assemblies are not required for *residential shelters*.~~

(IS-STM 06-04-18 AM/AMPC; **IS-STM 01-02-18 AM-CC; IS-STM 05-18-18 AM-CC; IS-STM 10-09-18 AS)**

603.1 Fire separation. Walls or horizontal assemblies between *community storm shelters* and other host building areas shall be *fire barriers* or *horizontal assemblies* with a minimum fire-resistance rating of 2 hours constructed in accordance with the applicable code.

Exceptions: Walls and horizontal assemblies are not required to be fire-resistance rated with any of the following configurations:

1. The *design occupant capacity* of 16 or fewer.
2. The storm shelter is located in the basement or underground, the *design occupant capacity* is less than 50, at least two egress doors are provided and the egress doors are separated by a minimum horizontal distance equal to 1/3 of the overall diagonal dimension of the storm shelter.
3. The *design occupant capacity* is less than 50 and an additional egress door, overhead hatch or emergency escape opening opens directly to the exterior of the building.
4. The means of egress is designed in accordance with the applicable code for the *design occupant capacity*, the storm shelter has at least two egress doors and at least at 50 percent of the total required capacity for the means of egress from the storm shelter is directly to the exterior of the building.

(IS-STM 06-04-18 AM/AMPC)

603.1.1 Doors and shutters. Fire-rated doors and shutters located in fire-resistance rated walls required by Section 603.1 are not required to be self or automatic closing.

SECTION 604 ~~602~~
FIRE EXTINGUISHERS

(IS-STM 05-05-18 AM)
604.1 ~~602.1~~ General. A fire extinguisher shall be required within each story of all *community storm shelter*s.

(IS-STM 08-22-18 Part 3 AM/AMPC)
604.2 ~~602.2~~ Requirements. Fire extinguishers shall meet the requirements of NFPA 10. Installation of fire extinguishers shall not compromise the structural or ~~missile~~ impact performance of the exterior *storm shelter envelope*.

(IS-STM 07-18-18 AS)

CHAPTER 7

STORM SHELTER ESSENTIAL FEATURES AND ACCESSORIES

SECTION 701
GENERAL

(IS-STM 07-08-18 AM/Part 1 AMPC)
701.1 Scope. The requirements of this chapter shall govern the essential features and accessories for *storm shelters*.

(IS-STM 07-02-18 – AM/D; IS-STM 07-01-18 AM; IS-STM 07-18-18 AS; IS-STM 08-22-18 Part 2 & 3 AM/AMPC)
701.2 ~~701.1~~ Protection of *storm shelter* critical support systems. *Storm shelter critical support systems* shall remain functional for the design storm event and minimum period of *storm shelter* occupancy (24 hours for *hurricane shelters*, 2 hours for *tornado shelters*). *Storm shelter critical support systems* located outside of the *storm shelter* areas shall be protected by a means that meets the wind ~~pressure~~ load and ~~missile~~ impact requirements of Chapter 3, and, as applicable, the flood-resistance requirements of Chapter 4.

SECTION 702
TORNADO SHELTERS

(IS-STM 07-08-18 AS/Part 1 AMPC)

702.1 General. *Tornado shelters* shall comply with the requirements of Section 702.2 through 702.9.

(IS-STM 03-21-18 AM; IS-STM 07-19-18 AS; IS-STM 01-02-18 AM-CC)
702.2 Exterior weather protection. All exposed components and cladding assemblies and roof coverings of *tornado shelters* shall meet the requirements of the applicable code.

(IS-STM 05-14-19 AM/AFM)

702.2.1 Door Weather Seal. Doors in the shelter envelope that are also exterior doors to the building shall have a weather seal provided at the undercut.

(IS-STM 07-08-18 – AS/Part 1 AMPC; IS-STM 07-18-18 AS)
~~**702.2 Sanitation facilities.** Toilet and hand-washing facilities shall be located within the tornado shelter area and provided in the minimum number shown in Table 702.2.~~

702.3 Minimum number water closets and lavatories. Water closets and lavatories shall be located within the *tornado shelter* and provided in the minimum number indicated in Table 702.3.

***(IS-STM 07-08-18 – AS/Part 1 AMPC;* IS-STM 07-09-18-AM; IS-STM 07-18-18 AS; IS-STM 10-09-18 AS)**
TABLE ~~702.2~~ 702.3
REQUIRED WATER CLOSETS AND LAVATORIES ~~FACILITIES~~, FOR *TORNADO SHELTERS*

~~STORM~~ *TORNADO SHELTER* TYPE	WATER CLOSETS ~~TOILET FACILITIES~~	LAVATORIES ~~HAND-WASHING FACILITIES~~
Residential, one- and two-family dwellings	Not Required	Not Required
Residential, other	1	Not Required

Community, *design occupant capacity* <50 ~~(≤50 occupants)~~	1	Not Required
Community, *design occupant capacity* >=50 ~~(>50 occupants)~~	~~2 minimum~~ 1 per 250 for the first 500 occupants and 1 additional per 500 occupants or portions thereof >500 occupants	1 per 1000 occupants

(IS-STM 07-08-18 – AS/Part 1 AMPC; IS-STM 07-18-18 AS)

~~**702.2.1**~~ **702.3.1** ~~**Required toilets and hand-washing facilities.**~~ **Water closets or lavatories.** ~~Plumbing fixtures.~~ Water closet or lavatories shall be either permanent plumbing fixtures installed within the tornado shelter, or temporary water closets or lavatories, such as chemical toilets or other means approved by the authority having jurisdiction. ~~Sanitation facilities provided for the normal occupancy installed within the *shelter* shall be included in the overall *shelter* sanitation facility count.~~

(IS-STM 07-08-18 – AS/Part 1 AMPC; IS-STM 07-10-18 AS; IS-STM 07-18-18 AS; IS-STM 03-04-18 AM/AMPC)

~~**702.2.2 Additional facilities for storm *shelters*.** Where the required number of sanitation facilities for the *tornado shelter* exceeds the number of facilities provided for the normal occupancy of the space, the additional facilities shall be permitted to be temporary sanitary fixtures, chemical toilets or other *approved* means.~~

(IS-STM 07-09-18 AM)

~~**702.2.3**~~ **702.3.2 Urinals.** Urinals shall be permitted to be substituted for water closets in accordance with the International Plumbing Code Section 424.

(IS-STM 07-09-18 AM/AMPC; IS-STM 07-08-18 AM/AMCP Part 2)

~~**702.2.4**~~ **702.3.3Fixture calculations.** The number of water closets and lavatories shall be allocated in accordance with the International Plumbing Code Section 403.1.1.

(IS-STM 05-03-18 AM; IS-STM 07-19-18 AS; IS-STM 07-08-18 AM/AMCP Part 2)

702.3.4 Water closet privacy. Each water closet shall occupy a separate compartment with walls, partitions, curtains or equivalent that enclose the water closet to ensure privacy.

(IS-STM 07-08-18 – AS/Part 1 AMPC; IS-STM 07-19-18 AS; IS-STM 07-11-18 D/AMPC)

~~**702.2.3 Sanitation facilities support systems.** Support systems for the sanitation facilities (e.g., bladders, storage tanks or vessels, etc.) shall be capable of supplying water and containing waste for the design capacity of the *tornado shelter*.~~

(IS-STM 07-19-18 AS; IS-STM 07-08-18 – AS/Part 1 AMPC)

~~**702.2.4 Conversion of plumbing systems.** Plumbing and valve systems of fixtures located within the *tornado shelter* shall be permitted to be designed for conversion to emergency operation to meet the required demand.~~

(IS-STM 07-19-18 AS; IS-STM 07-03-18 AM)

702.4 ~~**702.1**~~ **Ventilation.** Occupied space in *tornado shelters* shall be ~~ventilated by natural means~~ provided with *natural ventilation* in accordance with Section ~~702.1.1~~ 702.4.1 or ~~by~~ with mechanical ventilation in accordance with Section ~~702.1.2~~ 702.4.2. Openings used for atmospheric pressure change (APC) are permitted to be counted as ventilation for the purposes of this section. Ventilation openings for natural and mechanical ventilation shall comply with Section 702.4.3 and 702.4.4.

(IS-STM 07-17-18 AM; IS-STM 07-19-18 AS)

~~**702.1.1**~~ **702.4.1** ***Natural ventilation*.** *Tornado shelters* that rely on *natural ventilation* shall be provided with the minimum ventilation area in accordance with Table ~~702.1.1~~ 702.4.1.

(IS-STM 07-17-18 AM; IS-STM 07-19-18 AS; IS-STM 10-09-18 AS; 07-08-18 AMPC Part 1)

TABLE ~~702.1.1~~ 702.4.1
VENTING AREA REQUIRED FOR *TORNADO SHELTERS*

***TORNADO SHELTER* TYPE**	**VENTING AREA (PER OCCUPANT)**
Residential	2* square inches
Community, *design occupant capacity* <50 ~~(≤50 occupants)~~	5 square inches
Community, *design occupant capacity* >=50 ~~(>50 occupants)~~	6 square inches

* See exception to Section ~~702.1.1.1~~ 702.4.1.1.
For SI: 1 square inch = 645.2 mm^2.

(IS-STM 07-17-18 AM; IS-STM 07-04-18 AM; IS-STM 05-05-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)

~~702.1.1.1~~ 702.4.1.1 Location of ventilation openings. Configuration of *natural ventilation* openings required for *tornado shelters* shall be such that a minimum of 25 percent of the required area is located within 46 inches (2581 mm) of the floor, or in the lower one-half of the height of the tornado shelter, whichever is less, with the balance, but not less than 50 percent of the required area located a minimum of 72 inches (1829 mm) above the floor, or in the upper one-fourth of the height of the tornado shelter, whichever is greater. Lower and upper openings shall be ~~horizontally~~ dispersed and located on ~~an opposite wall~~ walls or ~~the~~ roof ~~surface~~ surfaces to provide cross ventilation of the *tornado shelter.* For tornado shelters with multiple stories, *natural ventilation* openings shall be provided for the occupants served for each story.

Exception: Air intake openings for *residential tornado shelters* shall be permitted to be located entirely in the upper half of the tornado shelter provided that the venting area is increased to 4 square inches (1290 mm^2) per tornado shelter occupant.

(IS-STM 07-17-18 AM; IS-STM 07-19-18 AS)

702.4.1.2 ~~702.1.6~~ Mechanical vents. Mechanical vents, louvers or dampers used to close *natural ventilation* openings shall be connected to a standby power system.

(IS-STM 07-03-18 – AM; IS-STM 07-13-18 – AM; IS-STM 07-17-18 AM; IS-STM 01-02-18 AM; IS-STM 07-05-18 AM; IS-STM 07-19-18 AS; IS-STM 01-22-18 AM/AMPC)

702.4.2 ~~702.1.2~~ Mechanical ventilation. *Tornado shelters* that rely on mechanical ventilation shall be provided with the minimum mechanical ventilation rate of required outdoor air at a minimum rate of 5 cubic feet per minute per occupant for the *design occupant capacity* ~~in accordance with the *applicable* building *code* provisions for the normal use of the space~~. The mechanical ventilation system shall be connected to ~~an emergency~~ a standby power system.

(IS-STM 07-06-18 – AM; IS-STM 07-17-18 AM; IS-STM 07-19-18 AS)

702.4.3 ~~702.1.3~~ Intake openings. Outside air intake openings ~~located in the same wall~~ shall be ~~located~~ separated a minimum of 10 feet (3048 mm) horizontally ~~and separated~~ from any hazardous or noxious contaminant, such as ~~emergency or back-up~~ generator vents or exhaust, fuel storage tank vents and containers, maintenance or custodial storage facilities.

(IS-STM 07-17-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS; IS-STM 06-04-18 AM; IS-STM 08-22-18 AM/AMPC Part 4)

702.4.4 ~~702.1.4~~ ~~Exhaust or intake~~ opening protection. Air exhaust or intake openings that terminate outside of *occupied storm shelter areas* and *occupant support areas* shall be considered openings and shall be protected in accordance with ~~comply with the provisions of~~ Section ~~306.3~~ 306.4 ~~for exterior wall and roof *impact-protective systems*~~. Ventilation openings that penetrate the *storm shelter envelope* between the host building and *storm shelter* shall also comply with the provisions of Section 603.

(IS-STM 07-13-18 AM; IS-STM 07-18-18 AS CC; IS-STM 07-19-18 AS)

702.5 Standby power. Where required by Section 702.4 or 702.8, *community tornado shelters* shall be provided with a standby power system. The standby power system shall support *occupied storm shelter areas* and *occupant support areas*.

(IS-STM 07-13-18 AM; IS-STM 07-17-19 AM; IS-STM 07-19-18 AS)
702.5.1 ~~702.3.1~~ Capacity. The ~~emergency electrical~~ standby power system shall have adequate capacity and rating to supply all required systems and circuits for standby lighting and any mechanical ventilation systems intended to be operated at one time.

(IS-STM 07-13-18 AM; IS-STM 07-17-19 AM; IS-STM 07-19-18 AS)
702.5.2 ~~702.3.2~~ Duration. The ~~emergency electrical~~ standby power system shall be designed to provide continuously the required output capacity for a minimum of 2 hours.

~~**Exception:** Personal-use flashlights shall be permitted for the emergency lighting system requirement for tornado shelters with an occupant load of less than or equal to 50, when provided at a quantity not less than one (1) flashlight per 10 occupants. Personal-use flashlights shall be a minimum of two "D" cell size or equivalent light output, and readily accessible from within the occupied shelter areas or immediately adjacent occupant support areas.~~

(IS-STM 07-17-18 AM; IS-STM 07-19-18 AS)
702.5.3 ~~702.5.3~~ Protection of components. Standby power supply, transformers, distribution panels, cabling, fuel supply storage tanks, fuel lines and power supply to *critical support system* components shall be protected in accordance with Section 701.1.

(IS-STM 03-22-18 AM; IS-STM 07-19-18 AS)
702.6 Electrical grounding and bonding of *tornado shelters*. Exposed metal surfaces within *tornado shelters* shall be electrically bonded and grounded where required by Article 250 of NFPA 70 or by the *authority having jurisdiction*.

(IS-STM 07-17-18 AFM; IS-STM 07-19-18 AS)
702.7 ~~702.3~~ Exit signs and emergency lighting. In *community tornado shelters*, in the event of a power supply failure, an emergency power system shall supply power for the exit signs and the emergency exit lighting in accordance with the International Building Code.

(IS-STM 07-13-18 AM/AMPC; IS-STM 07-17-18 AM; IS-STM 05-18-18 AM; **IS-STM 07-19-18 AS; IS-STM 07-18-18 AS)**
~~702.3~~ 702.8 ~~Emergency~~ Standby lighting. *Community tornado shelters* shall be provided with ~~an emergency~~ a standby lighting system. The ~~emergency~~ standby lighting system shall provide ~~an average~~ illumination levels of not less than 1 foot-candle (11 lux) ~~of illumination~~ at the walking surface in *occupied storm shelter areas*~~,~~ and *occupant support areas*~~, required corridors, passageways and means of egress~~. The standby lighting system shall be connected to a standby power system.

Exception: Personal-use lighting devices such as flashlights with a minimum of 150 lumens or approved equivalent lighting devices shall be permitted for tornado shelters with a *design occupant capacity* of less than 50. Lighting devices, shall be provided at a quantity not less than one (1) per 10 occupants and readily available within the *storm shelter*.

(IS-STM 07-12-18 AM/AMPC; IS-STM 07-19-18 AS)
~~702.4~~ 702.9 First aid kit. A Class A first aid kit complying with ANSI/ISEAI Z308.1 shall be supplied in all *community tornado shelters* ~~with a shelter occupant load of greater than 50~~.

SECTION 703
HURRICANE *SHELTERS*

(IS-STM 07-08-18 AS/Part 1 AMPC)

703.1 General. *Hurricane shelters* shall comply with the requirements of Section 703.2 through 703.11.

(IS-STM 03-21-18 AM; IS-STM 07-19-18 AS; IS-STM 02-08-18-AM/AMPC; **IS-STM 07-08-18 AS/Part 1 AMPC)**
703.2 Exterior weather protection. All exposed components and cladding assemblies and roof coverings of *hurricane shelters* shall be designed to resist rainwater penetration during the hurricane and shall be designed and installed to meet the wind load requirements of Section 304.

(IS-STM 05-14-19 AM/AFM)

703.2.1 Door Weather Seal. Doors in the shelter envelope that are also exterior doors to the building shall have a weather seal provided at the undercut.

(IS-STM 07-08-18 AS/Part 1 AMPC; IS-STM 07-18-18 AS CC)
~~**703.2 Sanitation facilities.** Toilet and hand-washing facilities shall be located within the storm shelter area and provided in the minimum number shown in Table 703.2.~~

703.3 Minimum number water closets and lavatories. Water closets and lavatories shall be located within the *hurricane shelter* and provided in the minimum number indicated in Table 703.3.

(IS-STM 07-08-18 AS/Part 1 AMPC; **IS-STM 07-18-18 AS; IS-STM 10-09-18 AS)**

TABLE ~~703.2~~ 703.3
REQUIRED WATER CLOSETS AND LAVATORIES ~~SANITATION FACILITIES~~ FOR *HURRICANE SHELTERS*

***HURRICANE SHELTER* TYPE**	**WATER CLOSETS ~~TOILET FACILITIES~~**	**LAVATORIES ~~HAND-WASHING FACILITIES~~**
Residential, one-and two-family dwellings	Not Required	Not Required
Residential, other	1	Not Required
Community, *design occupant capacity* <50 ~~shelters (≤50 occupants)~~	1	Not Required
Community, *design occupant capacity* >=50 ~~shelters (>50 occupants)~~	1 per 50 occupants	1 per 100 occupants

(IS-STM 07-08-18 AS/Part 1 AMPC)

703.3.1 Water closets or lavatories. Water closet or lavatories shall be either permanent plumbing fixtures installed within the hurricane shelter, or temporary water closets or lavatories, such as chemical toilets or other means approved by the authority having jurisdiction.

(IS-STM 07-08-18 AS/Part 1 AMPC; **IS-STM 07-18-18 AS)**
~~**703.2.1 Required toilets and hand-washing facilities.** Sanitation facilities provided for the normal occupancy installed within the *shelter* shall be included in the overall *shelter* sanitation facility count.~~

(IS-STM 07-08-18 AS/Part 1 AMPC; **IS-STM 07-18-18 AS; IS-STM 03-04-18 AM/AMPC)**
~~**703.2.2 Additional facilities for storm *shelters*.** Where the required sanitation facilities for the *hurricane shelter* exceed the required number of facilities provided for the normal occupancy of the space, the additional facilities shall be permitted to be temporary sanitary fixtures, chemical toilets or other means that are deemed acceptable by the *authority having jurisdiction*.~~

(IS-STM 07-09-18 AM)
703.3.2 Urinals. Urinals shall be permitted to be substituted for water closets in accordance with the International Plumbing Code Section 424.

(IS-STM 07-09-18 AM/AMPC; IS-STM 07-08-18 AM/AMCP Part 2)

703.3.3 Water closet and lavatory calculations. The number of water closets and lavatories shall be allocated in accordance with the International Plumbing Code Section 403.1.1.

(IS-STM 05-03-18 AM; IS-STM 07-19-18 AS; IS-STM 07-08-18 AM/AMCP Part 2)

703.3.4 Water closet privacy. Each water closet shall occupy a separate compartment with walls, partitions, curtains or equivalent that enclose the water closet to ensure privacy.

(IS-STM 07-08-18 AS/Part 1 & Part 2 AMPC; **IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)**

703.3.5 ~~703.2.3~~ Sanitation ~~facilities~~ support ~~systems~~ method. A sanitation support ~~systems~~ method for the ~~sanitation facilities~~ water closets or lavatories ~~(e.g., bladders, storage tanks or vessels, etc.)~~ shall be capable of supplying water and containing waste for the *design occupant capacity* of the ~~storm~~ *hurricane shelter.*

(IS-STM 07-08-18 AS/Part 1 & Part 2 AMPC)

~~703.3~~ **703.3.5.1 Storage capacity for Water supply and waste water ~~storage~~.** In community shelters with a *design occupant capacity* of 50 or greater, the capacity of plumbing and waste disposal systems to supply ~~potable~~ water and contain or dispose of waste water or solid wastes shall be ~~determined in accordance with Table 703.3~~ 1 gallon per occupant of supply water in addition to the drinking water required in Section 703.4 and 1.5 gallons per occupant for waste water.

Exception: Where temporary water closets or lavatories are provided that do not require water, the requirement for supply and waste water storage shall be permitted to be reduced proportional to the total required water closets and lavatories.

(IS-STM 07-18-18 AS; IS-STM 10-09-18 AS; IS-STM 07-08-18 AS/Part 2 AMPC)

~~**TABLE** 703.3~~
~~**WATER SUPPLY AND WASTE WATER STORAGE *HURRICANE SHELTERS***~~

~~**STORM *SHELTER* TYPE**~~	~~**POTABLE WATER**~~	~~**WASTE WATER**~~
~~Residential, one- and two-family dwellings~~	~~Not Required~~	~~Not Required~~
~~Residential, other~~	~~Not Required~~	~~Not Required~~
~~Community (≤50 occupants)~~	~~Not Required~~	~~Not Required~~
~~Community (>50 occupants)~~	~~1 gallon per occupant~~	~~1.5 gallons per occupant~~

~~For SI: 1 gallon = 3.785 L.~~

(IS-STM 07-08-18 AS/Part 2 AMPC)

703.4 Drinking water. For *community hurricane shelters* at least 1 gallon of drinking water shall be provided for each occupant.

(IS-STM 07-19-18 AS)

703.5 ~~703.8~~ Rainwater drainage for *hurricane shelter* facilities.

(IS-STM 03-04-18-AFM; IS-STM 07-19-18 AS)

703.5.1 ~~703.8.1~~ Rainfall rate for the primary roof drainage system. Rainfall rate for the primary roof drainage system of a *hurricane shelter* shall be determined by adding 3 inches (76.2 mm) of rainfall per hour to the 100-year, 1-hour rainfall rate. The 100-year, 1 hour rainfall rate shall be determined from Figure ~~303.2~~ 303.1.1 or *approved* local weather data.

(IS-STM 03-04-18-AFM; IS-STM 07-19-18 AS)

703.5.2 ~~703.8.2~~ Rainfall rate for the secondary (overflow) drainage systems. The rainfall rate for the secondary (overflow) drainage systems shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to

the 100-year, 1-hour rainfall rate. The 100-year, 1 hour rainfall rate shall be determined from Figure ~~303.2~~ 303.1.1 or *approved* local weather data.

(IS-STM 03-04-18-AFM; IS-STM 07-16-18 AS; IS-STM 10-05-18 AM; IS-STM 07-01-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)
703.5.3 ~~703.8.3~~ Rainwater drainage for *hurricane shelter* facilities. Rainwater drainage shall be provided for *hurricane shelter* facilities where ~~it is possible~~ that rainwater will be impounded and flood *occupied storm shelter areas*, occupant support areas and *storm shelter critical support systems* or access routes. The rainfall rate shall be determined by adding 6 inches (152.4 mm) per hour to the 100-year, 1-hour rainfall rate. The 100-year, 1 hour rainfall rate shall be determined from Figure ~~303.2~~ 303.1.1 or *approved* local weather data.

(IS-STM 07-03-18 – AM/AMPC; IS-STM 07-17-18 AM; IS-STM 05-18-18 AM; **IS-STM 07-19-18 AS)**
703.6 ~~703.1~~ Ventilation. Occupied spaces in *hurricane shelters* shall be provided with *natural ventilation* in accordance with Section 703.5.1. ~~Every occupied~~ Occupied space in *community hurricane shelters* with ~~an occupant load~~ a *design occupant capacity* of 50 or greater ~~than 50~~ shall be ventilated by mechanical means in accordance with Section ~~703.1.1~~ 703.5.2. ~~All *hurricane shelters* shall be provided with *natural ventilation* in accordance with Section 703.1.2.~~ Ventilation openings for natural and mechanical ventilation shall comply with Section 703.5.3 and 703.5.4.

(IS-STM 07-03-18 – AM; IS-STM 07-19-18 AS)
~~**703.1.1 Mechanical ventilation.**~~ (relocated)

(IS-STM 07-03-18 – AM/AMPC; IS-STM 07-17-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)
703.6.1 ~~703.1.2~~ *Natural ventilation*. All *hurricane shelters* shall be provided with openings to facilitate minimum *natural ventilation* in accordance with this section. The area of ventilation openings shall comply with Table ~~703.1~~ 703.6.1 ~~and the location of openings shall be in accordance with Section 703~~. Where *hurricane shelters* are also designed as *tornado shelters*, openings provided to relieve internal pressure for atmospheric pressure change (APC) per Section 304.7 shall be permitted to be counted as *natural ventilation* openings.

(IS-STM 07-03-18 – AM; IS-STM 07-19-18 AS; IS-STM 10-09-18 AS; IS-STM 07-08-18 AS/Part 1 AMPC)

TABLE ~~703.1~~ 703.6.1
VENTING AREA REQUIREMENTS FOR *HURRICANE SHELTERS*

SHELTER TYPE	VENTING AREA (PER OCCUPANT)
Residential	4 square inches
Community, *design occupant capacity* <50 (~~≤50 occupants~~)	8 square inches
Community, *design occupant capacity* >=50 (~~>50 occupants~~)	12 square inches

For SI: 1 square inch = 645.2 mm^2.

(IS-STM 07-03-18 – AM; IS-STM 07-04-18 AM; IS-STM 05-05-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)
~~703.1.3~~ 703.6.1.1 Location of ventilation openings. Configuration of *natural ventilation* openings required for *hurricane shelters* shall be such that a minimum of 25 percent of the required area is located within 46 inches (1168 mm) of the floor, or in the lower one-half of the height of the hurricane shelter, whichever is less, with the balance, but not less than 50 percent of the required area, located a minimum of 72 inches (1829 mm) above the floor, or in the upper one-fourth of the height of the hurricane shelter, whichever is greater. Lower and upper openings shall be ~~horizontally~~ dispersed and located on ~~an opposite wall~~ walls or the roof ~~surface~~ surfaces to provide cross ventilation of the *hurricane shelter.* For hurricane shelters with multiple stories, *natural ventilation* openings shall be provided for the occupants served for each story.

(IS-STM 07-17-AM; IS-STM 07-19-18 AS)
703.6.1.2 Mechanical vents. Mechanical vents, louvers or dampers used to close *natural ventilation* openings shall be connected to a standby power system.

(IS-STM 07-03-18 – AM; IS-STM 07-13-18 AM; IS-STM 01-02-18 AM; IS-STM 07-04-18 AM; IS-STM 07-19-18 AS; IS-STM 01-22-18 AM/AMPC)

703.6.2 ~~**703.1.1**~~ **Mechanical ventilation.** The minimum mechanical ventilation rate of required outdoor air shall be determined at a minimum rate of 5 cubic feet per minute per occupant for the *design occupant capacity* ~~in accordance with the *applicable* building *code* provisions for the normal use of the space~~. The mechanical ventilation system shall be connected to a standby power system.

(IS-STM 07-03-18 – AM; IS-STM 07-06-18 AM; IS-STM 07-19-18 AS)

703.6.3 ~~**703.1.4**~~ **Intake openings.** Outside air intake openings ~~located in the same wall~~ shall be ~~located~~ separated a minimum of 10 feet (3048 mm) horizontally and separated from any hazardous or noxious contaminant, such as ~~emergency or back-up~~ generator vents or exhaust, fuel storage tank vents and containers, maintenance or custodial storage facilities.

(IS-STM 07-03-18 – AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS; IS-STM 06-04-18 AM; IS-STM 08-22-18 AM/AMPC Part 4)

703.6.4 ~~**703.1.5**~~ ~~**Exhaust or intake**~~ **opening protection.** Air exhaust or intake openings that terminate outside of *occupied storm shelter areas* and *occupant support areas* shall be considered openings and shall be protected in accordance with ~~comply with the provisions of~~ Section 306.4 ~~for exterior wall and roof *impact-protective system*~~. *s*. Ventilation openings that penetrate the *storm shelter envelope* between the host building and *storm shelter* shall also comply with the provisions of Section 603.

(IS-STM 07-13-18 AM; IS-STM 07-01-18 AM; IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)

~~**703.6**~~ **703.7 Standby power.** Where required by Sections 703.5 or 703.9, *Community hurricane shelters* ~~with a shelter occupant load greater than 50~~ shall be provided with a standby ~~electrical~~ power system. The standby ~~electrical~~ power system shall support occupied ~~hurricane~~ *storm shelter* areas~~,~~ and *occupant support areas* ~~and critical support systems~~. ~~At a minimum, the standby electrical power system shall supply power to life safety systems and critical branch lighting circuits. Where required by the authority having jurisdiction, the standby electrical power system shall also supply power to selected HVAC circuits.~~

(IS-STM 07-13-18 AM)

~~**703.6.1**~~ **703.7.1 Capacity.** The standby ~~electrical~~ power system shall have adequate capacity and rating to supply all required systems and circuits for standby lighting and any mechanical ventilation systems intended to be operated at one time.

(IS-STM 07-13-18 AM)

~~**703.6.2**~~ **703.7.2 Duration.** The standby ~~electrical~~ power system shall be designed to provide continuously the required output capacity for a minimum of 24 hours.

(IS-STM 07-13-18 AM)

~~**703.6.3**~~ **703.7.3 Independence.** The standby ~~electrical~~ power supply shall be located *on-site*, and shall be independent of off-site sources of fuel or water.

(IS-STM 07-13-18 AM; IS-STM 07-14-18-AM)

~~**703.6.4**~~ **703.7.4 Protection of components.** Standby ~~electrical~~ power supply, transformers, distribution panels, cabling, fuel supply storage tanks, fuel lines and power supply to ~~other~~ *critical support system* components shall be protected ~~from design event conditions~~ in accordance with Section 701.1.

(IS-STM 07-13-18 AM)

~~**703.6.5**~~ **703.7.5 Location.** Standby ~~electrical~~ power supply shall be accessible by a protected access route. The access route shall be located within the *hurricane shelter* or shall meet the provisions for exterior wall and roof *impact-protective systems* in accordance with this standard.

(IS-STM 03-22-18 AM; IS-STM 07-19-18 AS)

703.8 Electrical grounding and bonding of *hurricane shelters*. Exposed metal surfaces within *hurricane shelters* shall be electrically bonded and grounded where required by Article 250 of NFPA 70 or by the authority having jurisdiction.

(IS-STM 07-17-18 AFM; IS-STM 07-19-18 AS)
703.9 Exit signs and emergency lighting. In *community hurricane shelters*, in the event of a power supply failure, an emergency power system shall supply power for the exit signs and the emergency exit lighting in accordance with the *International Building Code*.

(IS-STM 07-13-18 AM/AMPC; IS-STM 07-17-18 AM; IS-STM 05-18-18 AM; **IS-STM 07-18-18 AS; IS-STM 07-19-18 AS)**
~~**703.4**~~ **703.10** ~~**Emergency**~~ **Standby lighting.** *Community hurricane shelters* shall be provided with ~~an~~ ~~emergency~~ a standby lighting system. The ~~emergency~~ standby lighting system shall provide ~~an average~~ illumination levels of not less than 1 foot-candle ~~of illumination~~ (11 lux) at the walking surface in *occupied storm shelter areas*~~,~~ and *occupant support areas*~~,~~ ~~required corridors, passageways and means of egress~~. The standby lighting system shall be connected to a standby power system.

Exception: Personal-use lighting devices such as flashlights with a minimum of 150 lumens or approved equivalent lighting devices shall be permitted ~~for the standby lighting system requirement~~ for ~~*tornado*~~ *hurricane shelters* with ~~an occupant load~~ a *design occupant capacity* less than ~~or equal to~~ 50. Lighting devices, ~~when~~ shall be provided at a quantity not less than one (1) ~~flashlight~~ per 10 occupants. ~~Personal-use flashlights shall be a minimum of two "D" cell size or an equivalent light output~~, and readily available ~~accessible from~~ within the ~~*occupied*~~ *storm shelter* ~~*areas* or immediately adjacent *occupant support areas*~~.

(IS-STM 07-13-18 AM)
~~**703.5 Standby lighting.** Community hurricane shelters with a shelter occupant load greater than 50 shall be provided with a standby lighting system. The standby lighting system shall provide an average of 10 footcandles illumination (110 lux) in occupied shelter areas, occupant support areas, required corridors, passageways and means of egress.~~

(IS-STM 07-12-18 AM/AMPC; IS-STM 07-19-18 AS)
~~**703.7**~~ **703.11 First aid kit.** A Class A first aid kit complying with ANSI/ISEAI Z308.1 shall be supplied in all *community hurricane shelters*.

Exception: A first aid kit is not required where equivalent first aid supplies are located in the building.

CHAPTER 8

TEST METHODS FOR IMPACT AND PRESSURE TESTING

SECTION 801
GENERAL

(IS-STM 08-20-18 AM; IS-STM 08-22-18 Part 1 and 3 AM/AMPC)
801.1 Scope. This testing protocol covers procedures for conducting impact and static and cyclic pressure testing of components of the *storm shelter envelope* required to meet ~~wind-borne debris~~ impact provisions, as detailed in Section 305 ~~of this standard~~.

(IS-STM 08-16-18 AS)

~~SECTION 802~~
~~TERMINOLOGY~~

(IS-STM 08-16-18 AS)
~~**802.1 General terminology.** General terminology of building construction used in this test method is defined in ASTM E631.~~

(IS-STM 08-16-18 AS)
~~**802.2 Definitions of terms specific to this test method.**~~

(IS-STM 08-16-18 AS) *(deleted in favor or definition in Section 202)*
~~**IMPACT-PROTECTIVE SYSTEM.** A system or device such as a shutter, door or other device mounted on the inside or outside of the exterior wall of a *shelter* that has been demonstrated by testing to be capable of withstanding the impact of test missiles as detailed in this standard.~~

(IS-STM 08-16-18 AS) ***(relocated to 202)***
~~**SPECIMEN.** The entire assembled unit submitted for test, including but not limited to anchorage devices and structure to which product is to be mounted.~~

(IS-STM 08-16-18 AS) ***(relocated to 202)***
~~**TEST CHAMBER.** An airtight enclosure of sufficient depth to allow unobstructed deflection of the specimen during pressure cycling, including ports for air supply and removal, and equipped with instruments to measure test pressure differentials.~~

SECTION 802 ~~803~~
TEST SPECIMENS

(IS-STM 08-01-18 AM, IS-STM 08-02-18 AS, IS-STM 08-03-18 AS, IS-STM 10-04-18 AS; IS-STM 08-18-18 AS; IS-STM 08-22-18 Part 1 and 3 AM/AMPC; IS-STM 08-23-18 AS/AMPC)

802.1 ~~803.1~~ Test assembly. All parts of the test *specimen* shall be full size, using the same materials, details, methods of construction and methods of attachment as proposed for actual use. Testing of components consisting of wall assemblies, roof assemblies, ~~door or window assemblies~~ or *impact-protective systems* shall be allowed in lieu of testing entire *storm shelters*.

Where failure of framing members controls the impact performance, wall and roof ~~sections~~ assemblies subjected to impact ~~pressure~~ testing ~~and wall sections where impact resistance may be controlled by framing members~~ shall be a minimum of 4 feet (1219 mm) wide and the full length of the span of the wall or roof section from support to support. ~~Except~~ Where failure of framing members ~~may~~ has been shown through testing to not control the impact performance, wall and roof sections subjected to ~~debris~~ impact testing shall be a minimum of 4 feet (1219 mm) wide by 4 feet (1219 mm) high unless dimensions of the actual assembly are less than these dimensions.

~~Doors, windows and~~ *Impact-protective systems* ~~are to~~ shall be impact tested and cyclic pressure tested where applicable, ~~tested~~ at the maximum and minimum size listed for use. Static pressure testing shall be conducted on the maximum size listed for use. Operable ~~doors or windows~~ door assemblies and window assemblies shall be tested for the conditions of swing and latching including inward or outward swing separately as specified for use of the product. *Impact-protective systems* shall be static pressure tested in both directions unless a clear worst-case direction is determined by the *test laboratory*. Paired doors and their latching hardware shall be tested independently from single doors. The *specimen* shall consist of the entire assembled unit and shall, ~~when~~ where practical, be mounted as it will be installed in a *storm shelter*, and shall contain all devices used to resist wind forces and wind-borne debris. ~~When~~ Where it is not practical to install for testing ~~a doors or windows~~ door assemblies and window assemblies as it will be mounted in a *storm shelter*, then the unit or assembly shall be mounted in a test buck to connect the *specimen* to the test ~~frame/stand/chamber~~ frame, stand or *test chamber*. Details of the mounting shall be described in the test report.

(IS-STM 08-22-18 AM/AMPC)
802.2 ~~803.2~~ Number of test *specimen*s. Where ~~both~~ static pressure and impact ~~tests~~ testing are required, ~~testing of a single *specimen* subjected separately to each effect or two *specimens*, one subject to each load effect,~~ each test shall be permitted on a separate *specimen*. Where required, cyclic pressure testing shall be on the same *specimen* as the impact testing.

802.3 ~~803.3~~ *Specimen* conditioning. Samples shall be conditioned at ambient temperature [59º to 95º F (15º to 35º C)] for a minimum of 2 hours prior to testing.

(IS-STM 02-09-18 AM; IS-STM 08-20-18 AM)
802.4 ~~803.4~~ Specifications~~/~~ and drawings. The manufacturer or constructor shall provide the *test laboratory* with applicable product specifications and~~/or~~ drawings detailing materials of construction and applicable installation details. The ~~testing agency~~ *test laboratory* shall verify conformance of the test *specimen* to the product specifications and~~/or~~ drawings.

(IS-STM 06-04-18 AM/AMPC; **IS-STM 08-22-18 AM/AMPC Part 1)**

802.5 Testing for Fire- resistance-rating. Materials, elements or assemblies required to have testing for compliance with the fire-resistance ratings or fire-protection ratings required by Section 603, and pressure and impact testing in accordance with Chapter 8, shall be subjected to fire testing separately from the pressure and impact testing. Fire testing shall be permitted on separate *specimens* from the pressure and impact testing.

SECTION 803 ~~804~~
MISSILE IMPACT TESTING

(IS-STM 02-09-18 AM; IS-STM 03-04-18 AM/AMPC; IS-STM 08-22-18 Part 3 AM/AMPC)

803.1 ~~804.1~~ Apparatus. The general description of the apparatus for performing the ~~missile~~ impact testing requirements of this standard is detailed in Section 6 of ASTM E1886. Any equipment, properly accredited to ~~certified, calibrated and approved by~~ a ~~qualified lab~~ *test laboratory* capable of performing this test within the allowable tolerance is permitted.

803.2 ~~804.2~~ Calibration. Calibration of the speed measuring system shall be performed per the procedure detailed in Section 9 of ASTM E1886.

(IS-STM 08-22-18 Part 3 AM/AMPC)
803.3 ~~804.3~~ Missile impact procedure. Test *specimen*s shall be impact tested with test missiles of size and speed as specified in Section 305 ~~of this standard~~. Impact testing procedure shall be performed as detailed in Sections 11.1 through 11.3 of ASTM E1886. The minimum number of impact locations shall be as detailed in Section 803.9 ~~804.9~~.

803.4 ~~804.4~~ Missile properties. The test missile weight shall be selected to meet the requirements of Section 305 ~~of this standard~~ and shall comply with Sections 803.4.1 ~~804.4.1~~ through 803.4.3 ~~804.4.3.~~

803.4.1. ~~804.4.1~~ Wood species. Any common softwood lumber species as defined by DOC PS 20 shall be permitted to be used provided it meets length tolerances detailed below. The lumber shall be grade stamped No. 2 or better and be free of splits, checks, wane or other significant defects. The 2 by 4s used shall be straight such that any bow or warp measured by stretching a string or wire on the side of the board from end to end is within 0.5 inch of the 2 by 4s surface over its entire length.

(IS-STM 08-04-18 AM, IS-STM 10-04-18 AS)

803.4.2 ~~804.4.2~~ Missile length and weight tolerance. The wood density, including moisture content, shall be such that the required 15 ± 0.25 pound (6.8 ± 0.11 kg) weight is met with a length ~~of 13.5 and the 9 ± 0.25 pound (4.1 + 0.11 kg) weight is met with a length of 8 feet ± 4 inches (2438 mm ± 102 mm).~~ between 10 feet (3048 mm) and 15 feet (4572 mm). The 9 ± 0.25 pound (4.1 + 0.11 kg) weight is met with a length between 6 feet (1829 mm) and 10 feet (3048 mm). The sabot and attachment screws shall be included in the missile weight ~~when~~ where it is permanently attached. Missile weights shall be confirmed within 2 hours prior to their use.

803.4.3 ~~804.4.3~~ Conditioning. The test missile shall be conditioned at ambient temperature [59°F to 95°F (15°C to 35°C)] for a minimum of 2 hours prior to testing.

803.5 ~~804.5~~ Sabot size and weight. Where the missile launching system requires the use of a sabot for the effective launching of the missile, the sabot shall weigh no more than $^1/_2$ pound (0.226 kg), and shall be included in the weight of the missile, unless it is stripped away during flight prior to impact.

803.6 ~~804.6~~ Missile speed. Missile speed measurement and speed tolerances shall be in accordance with the following:

803.6.1 ~~804.6.1~~ Missile speed measurement. The missile speed shall be measured by a device capable of measuring the missile velocity to within ± 1 foot per second (0.305 m/s).

803.6.2 ~~804.6.2~~ Missile speed tolerance. The missile test speed tolerance is 4 mph above and 0 mph below the missile speed prescribed in Section 305.

803.7 ~~804.7~~ Impact angle. Missile impacts shall be within 5 degrees of normal to the primary plane of the test *specimen*. This requirement is deemed to be met when the barrel of the cannon is aligned within ± 2 degrees of perpendicular in the horizontal plane and between level and a 3-degree upward incline in the vertical plane.

803.8 ~~804.8~~ Testing temperature. The testing shall be conducted at ambient temperature in the range of [59°F to 95° F (15°C to 35°C)].

(IS-STM 08-17-18 AS; IS-STM 08-19-18 AM)

803.9 ~~804.9~~ Impact locations and the number of impacts. For purposes of testing *impact-protective systems*, impact ~~are to be located~~ locations and quantities shall be as indicated in ~~in the following sections~~ Sections 803.9.1 through 803.9.7.3, as applicable. The tolerance for impact locations shall be within a 2-1/2 inch (64 mm) radius circle, with the center of the circle located as indicated in Sections ~~804.9.1 through 804.9.7.3~~ 803.9.1 through 803.9.7.3, as applicable.

(IS-STM 10-04-18 AS; IS-STM 08-18-18 AS; IS-STM 08-21-18 AM; IS-STM 10-01-18 AM-CC)

803.9.1 ~~804.9.1~~ Panel or framed ~~walls/roofs~~ wall assemblies and roof assemblies. Sections of Panel or framed wall assemblies and roof assemblies ~~sections~~ shall be impacted in the center of the ~~wall/roof~~ section, and at one interface corner as detailed in Figures 803.9.1 ~~804.9.1~~ (1) and 803.9.1 ~~804.9.1~~ (2).

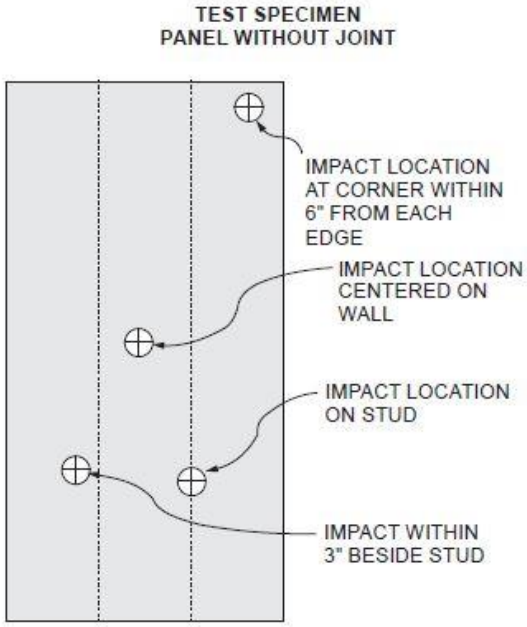
~~When~~ Where an interior stud or support is present, additional impacts shall be performed near the stud~~/~~ or support, and directly on the stud support, as detailed in Figures 803.9.1 ~~804.9.1~~ (1) and 803.9.1 ~~804.9.1~~ (2).

Interface joints used for attachment or joining at corners, at panel-to-panel sections, or at panel-to-roof shall be impacted directly on the interface joints as detailed in Figure 803.9.1 ~~804.9.1~~ (2) for each type of joint.

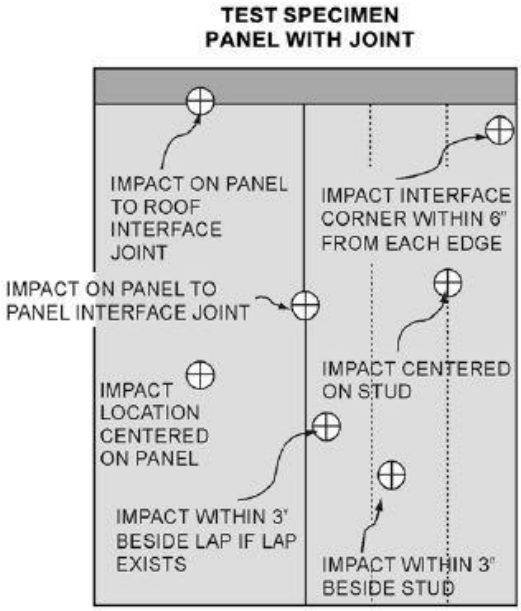
~~When~~ Where a section contains lapped materials, the centered impact shall be adjusted to strike the center of any lap, and an additional impact shall be performed beside the lap on the panel that laps behind the seam as detailed in Figure 803.9.1 ~~804.9.1~~ (2).

No more than three impacts shall be made on one *specimen*. Where more than three impacts are required, multiple identical test *specimen*s shall be provided.

Exception: More than three impacts ~~may~~ shall be permitted to be made on a test *specimen* by mutual consent of ~~owner~~ test sponsor and *test laboratory*.



For SI: 1 inch = 25.4 mm.



For SI: 1 inch = 25.4 mm.

(IS-STM 08-18-18 AS)
FIGURE 803.9.1 ~~804.9.1~~ (1)
PANEL OR FRAMED ~~WALLS/ROOF~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES

(IS-STM 08-18-18 AS)
FIGURE 803.9.1 ~~804.9.1~~ (2)
PANEL OR FRAMED ~~WALLS/ROOF~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES

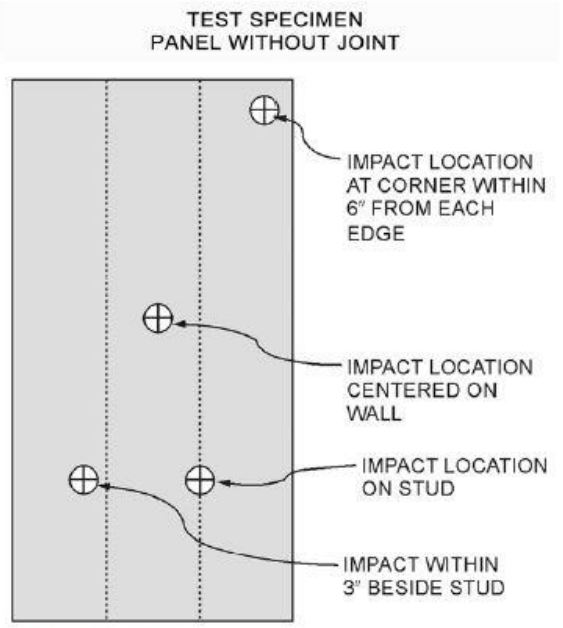
(IS-STM 10-01-18 AM; IS-STM 10-04-18 AS; IS-STM 08-18-18 AS; IS-STM 08-21-18 AM)

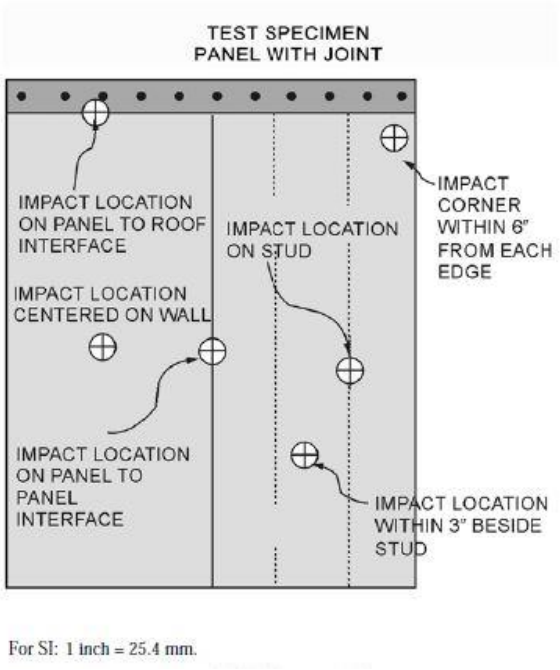
803.9.2 ~~804.9.2~~ Solid wall assemblies and roof assemblies ~~walls/roofs sections~~ of concrete or other materials. Sections of Wall assemblies and roof assemblies ~~sections~~ of solid concrete or other solid material shall be impacted in the center of the ~~wall/roof~~ section, and at one interface corner as detailed in Figures 803.9.2 ~~804.9.2~~ (1) and 803.9.2 ~~804.9.2~~ (2). ~~When~~ Where interface joints are used for joining at corners or panel-to-panel joints, an additional section shall be impacted directly on the interface joints as detailed in Figure 803.9.2 ~~804.9.2~~ (2).

Where an interior stud or support is present, additional impacts shall be performed within 3 inches (76.2 mm) of the stud~~/~~ and support, and directly on the stud support as detailed in Figures 803.9.2 ~~804.9.2~~ (1) and 803.9.2 ~~804.9.2~~ (2).

No more than three impacts shall be made on one *specimen*. Where more than three impacts are required, multiple identical test *specimen*s shall be provided.

Exception: More than three impacts ~~may~~ shall be permitted to be made on a test *specimen* by mutual consent of ~~owner~~ test sponsor and *test laboratory*.





(IS-STM 08-18-18 AS)
FIGURE 803.9.2 ~~804.9.2~~ (1)
SOLID ~~WALLS/ROOF SECTION~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES OF CONCRETE OR OTHER MATERIALS

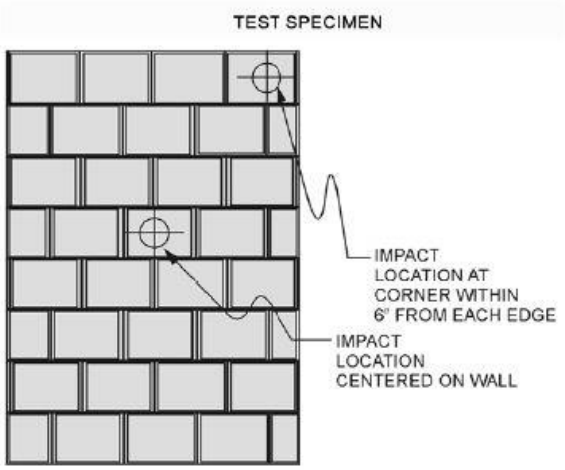
(IS-STM 08-18-18 AS)
FIGURE 803.9.2 ~~804.9.2~~ (2)
SOLID ~~WALLS/ROOF SECTION~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES OF CONCRETE OR OTHER MATERIALS

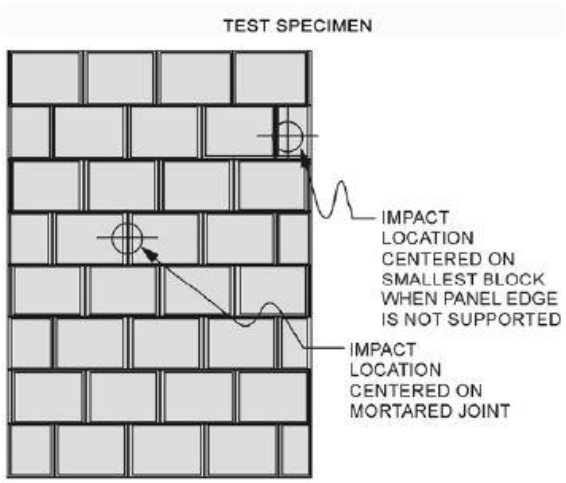
(IS-STM 10-01-18 AM; IS-STM 08-18-18 AS; IS-STM 08-21-18 AM)

803.9.3 ~~804.9.3~~ Masonry unit ~~walls/roofs~~ wall assemblies and roof assemblies. ~~Walls and roof sections~~ Section of wall assemblies and roof assemblies constructed of masonry units shall be impacted in the center of the ~~wall/roof~~ section, and at one interface corner or joint as detailed in Figure 803.9.3 ~~804.9.3~~ (1). Mortared joints shall be impacted directly on the interface joints as detailed in Figure 803.9.3 ~~804.9.3~~ (2).

No more than three impacts shall be made on one *specimen* or specimen panel. Where more than three impacts are required, multiple identical test *specimens* shall be provided.

Exception: More than three impacts ~~may~~ shall be permitted to be made on a test *specimen* by mutual consent of ~~owner~~ test sponsor and *test laboratory*.





For SI: 1 inch = 25.4 mm.

(IS-STM 08-18-18 AS)
FIGURE 803.9.3 ~~804.9.3~~ (1)
MASONRY UNIT ~~WALLS/ROOFS~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES

(IS-STM 08-18-18 AS)
FIGURE 803.9.3 ~~804.9.3~~ (2)
MASONRY UNIT ~~WALLS/ROOFS~~ WALL ASSEMBLIES AND ROOF ASSEMBLIES

(IS-STM 08-19-18 AM)
~~804.9.5~~ 803.9.4 Door assemblies. Door assemblies shall comply with Section ~~804.9.5.1, 804.9.5.2 or 804.9.5.3~~ 803.9.4.1, 803.9.4.2 or 803.9.4.3, as applicable. Glazed openings in doors shall comply with Section ~~804.9.5.4~~ 803.9.4.4.

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-19-18 AM; IS-STM 08-21-18 AM/AMPC)
803.9.4.1 ~~804.9.5 Doors or other entry/egress systems~~ Side-swinging door assemblies. ~~All~~ Side-swinging door assemblies ~~and other entry/egress systems~~ shall be impacted within 6 inches (152.4 mm) of an interface hinge joint, within 6 inches (152.4 mm) of an upper latch point and within 6 inches (152.4 mm) of center primary latches or operators as shown in Figure 803.9.4.1(1) ~~804.9.5(1)~~.

~~For double door assemblies, a single door leaf shall receive three impacts as shown in Figure 804.9.5(2) plus an additional impact on a center meeting point or mullion.~~

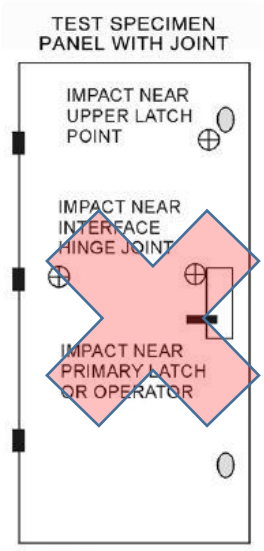
For double door assemblies with each door leaf containing identical hardware, ~~a single~~ one door leaf shall receive the same three impacts as a single door leaf ~~as shown in Figure 804.9.5(2)~~ plus an additional impact on a center meeting point or mullion as shown in Figure 803.9.4.1(2).

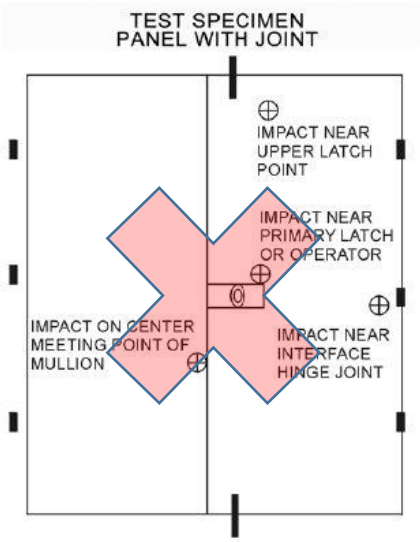
For double door assemblies where one or more hardware components differ between door leaves, each door leaf shall receive the same three impacts as a single door and an additional impact on a center meeting point or mullion as shown in Figure 803.9.4.1(2). No more than four impacts shall be made on one *specimen*. Where more than four impacts are required, multiple identical test *specimens* shall be utilized. Impacts shown on the same leaf in Figure 803.9.4.1(2), shall occur on the same test specimen.

Exception: More than four impacts shall be permitted to be made on a single *specimen* with mutual consent of the test sponsor and test laboratory.

~~Where the door contains glazed openings with a size less than or equal to 12 inches (305 mm) by 12 inches (305 mm), an additional sample shall be impacted in the center of the glazed opening. Where glazed openings have a dimension greater than 12 inches (305 mm), the glazed opening shall be treated as a window and tested in accordance with Section 804.9.4 of this standard.~~

(IS-STM 08-21-18 AM)





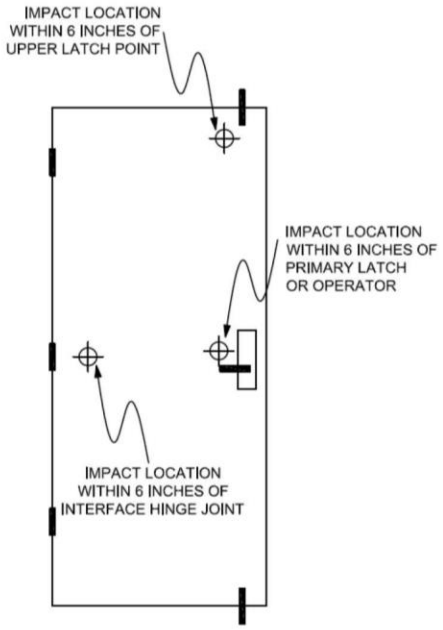


FIGURE 804.9.5(1) – SINGLE DOOR TEST SPECIMEN

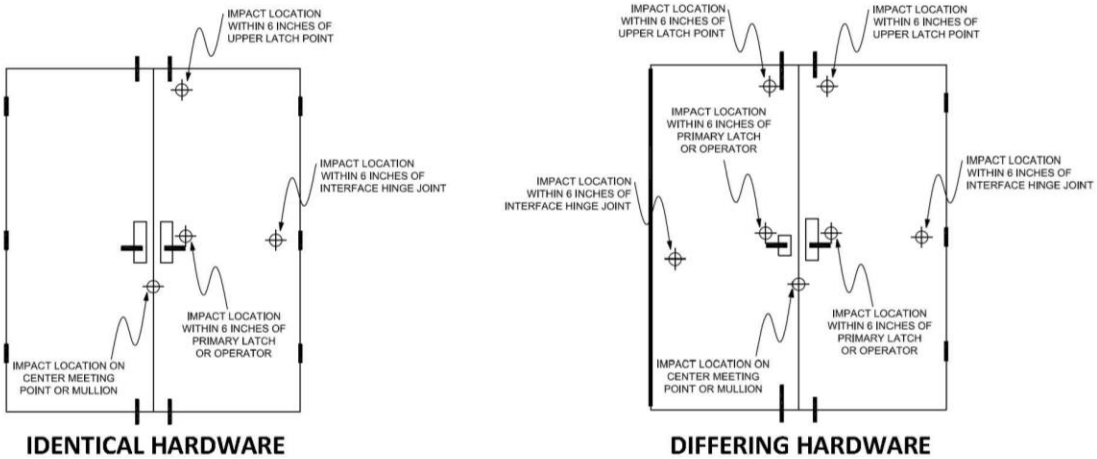


FIGURE 804.9.5(2) – DOUBLE DOOR TEST SPECIMEN

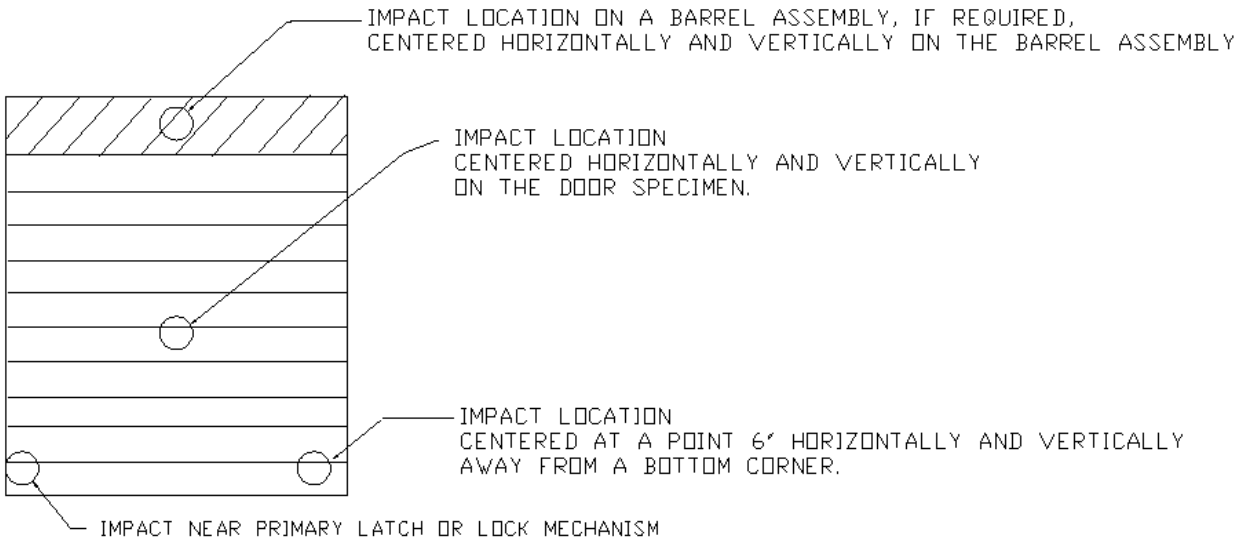
(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-19-18 AM; IS-STM 08-21-18 AM)
FIGURE 803.9.4.1(1) ~~804.9.5(1)~~.
SINGLE ~~**DOORS**~~ **DOOR ASSEMBLIES** ~~**AND OTHER ENTRY/EGRESS SYSTEMS**~~

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-19-18 AM; IS-STM 08-21-18 AM)
FIGURE 803.9.4.1(2) ~~804.9.5(2)~~
DOUBLE ~~**DOORS**~~ **DOOR ASSEMBLIES** ~~**AND OTHER ENTRY/ EGRESS SYSTEMS**~~

(IS-STM 08-19-18 AM/AMPC)

803.9.4.2 Rolling door assemblies. For rolling door assemblies, the door shall be impacted at the center of the door, at one bottom corner and within 6 inches (152.4 mm) of primary latch or lock mechanism, plus an additional impact centered on a barrel assembly as shown in Figure 803.9.4.2.

Exception: The barrel assembly is not subject to the additional impact where the entire barrel assembly is protected by the shelter envelope.

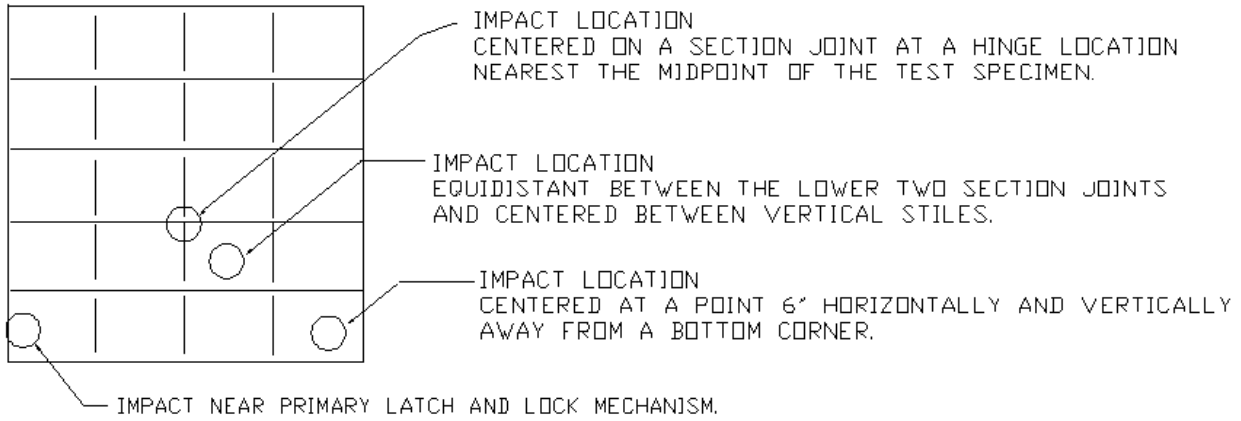


(IS-STM 08-19-18 AM)

FIGURE 803.9.4.2
ROLLING DOOR ASSEMBLIES

(IS-STM 08-19-18 AM/AMPC)

803.9.4.3 Sectional door assemblies. For sectional door assemblies, the door shall be impacted at the sectional joint nearest to the center of the door, within the lower two section joints and centered between two vertical stiles, at one bottom corner, and within 6 inches (152 mm) of the primary latch and lock mechanism as shown in Figure 803.9.4.3.



(IS-STM 08-19-18 AM)

FIGURE 803.9.4.3
SECTIONAL DOOR ASSEMBLIES

(IS-STM 08-19-18 AM/AMPC)

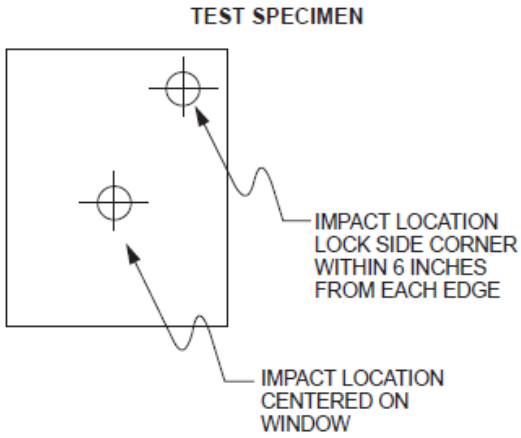
803.9.4.4 Glazed openings in doors. Where the door contains glazed openings with a height of 12 inches (305 mm) or less and a width of 12 inches (305 mm) or less, an additional sample shall be impacted in the center of the glazed opening. Where the door contains glazed openings with a height or width greater than 12 inches (305 mm), the glazed opening shall be treated as a window and tested in accordance with Section 803.9.5.

(IS-STM 10-01-18 AM; IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-21-18 AM)

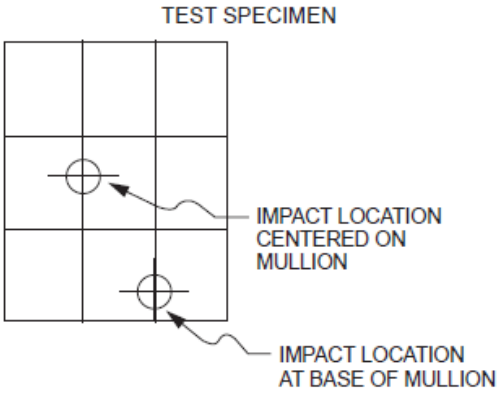
803.9.5 ~~804.9.4~~ ~~Windows~~ Window assemblies and other glazed openings. All window assemblies and other glazed openings shall be impacted in the center of the smallest glazed section, and at one interface corner as detailed in Figure 803.9.5 ~~804.9.4~~ (1). Where interior mullions or other glazed section joints ~~and/~~or latches are present, additional impacts shall be applied on these features as shown in Figure 803.9.5 ~~804.9.4~~ (2).

No more than two impacts shall be made on one *specimen*. Where more than two impacts are required, multiple identical test *specimen*s shall be provided.

Exception: More than two impacts ~~may~~ shall be permitted to be made on a test *specimen* by mutual consent of ~~owner~~ test sponsor and *test laboratory*.



For SI: 1 inch = 25.4 mm.



For SI: 1 inch = 25.4 mm.

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS)

FIGURE 803.9.5 ~~804.9.4~~ (1)

~~WINDOWS~~ WINDOW ASSEMBLIES AND OTHER GLAZED OPENINGS

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS)

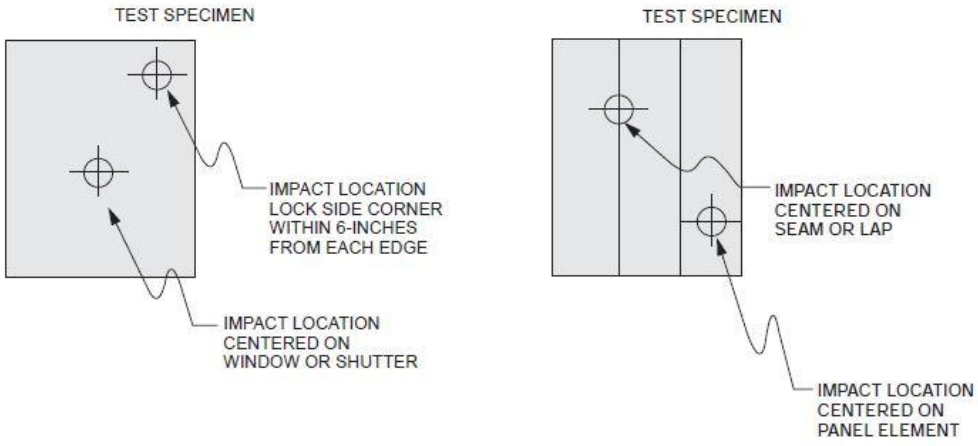
803.9.5 ~~804.9.4~~ (2)

~~WINDOWS~~ WINDOW ASSEMBLIES AND OTHER GLAZED OPENINGS

(IS-STM 08-06-18 AS; IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)

803.9.6 ~~804.9.6~~ Other *Impact-protective systems*. All ~~shutter assemblies and~~ other *impact-protective systems* shall be impacted in the center of the closed opening, and at one interface corner as detailed in Figure 803.9.6 ~~804.9.6~~ (1). Panels and interface joints shall be additionally impacted onto the same unit as shown in Figure 803.9.6 ~~804.9.6~~ (2).Interface hinge joints and primary latches, where present, shall be impacted as shown in Figure 803.9.4 ~~804.9.5~~(2) on an additional *specimen*. All ~~shutter assemblies and~~ *impact-~~protection~~ protective systems* that include swinging door assemblies with latching hardware shall be tested in accordance with Section 803.9.4 ~~804.9.5~~.

Where an interior stud or support is present, additional impacts onto the same unit shall be performed within 3 inches (76.2 mm) of the ~~stud~~ and support, and directly on the stud support, as detailed in Figure 803.9.2 ~~804.9.2~~(1) or 803.9.2 ~~804.9.2~~ (2).



For SI: 1 inch = 25.4 mm.

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)

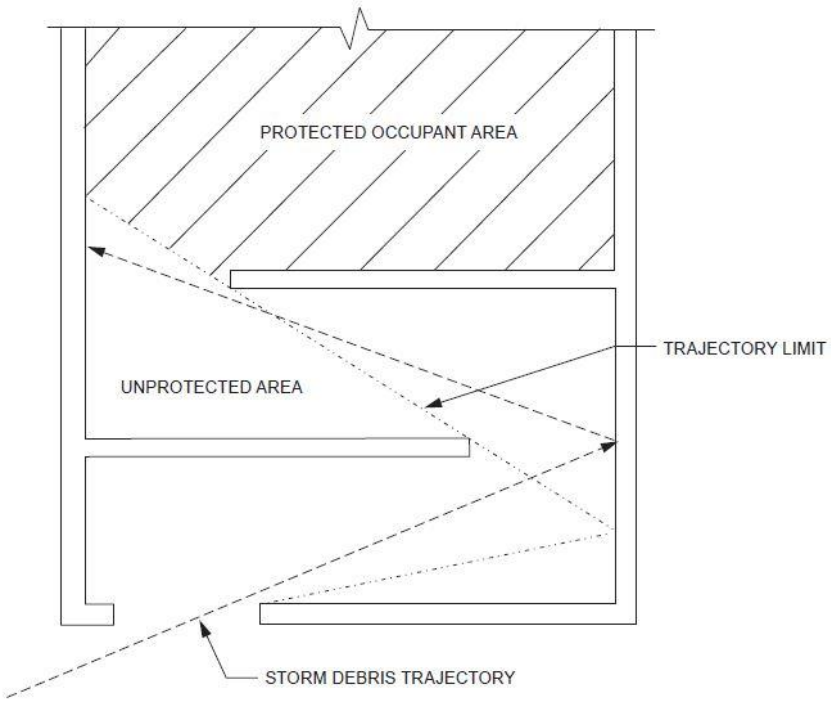
FIGURE 803.9.6 ~~804.9.6~~ (1)
~~SHUTTERS OR~~ OTHER IMPACT-~~PROTECTION~~ PROTECTIVE SYSTEMS

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 08-22-18 Part 3 AM/AMPC)
FIGURE 803.9.6 ~~804.9.6~~ (2)
~~SHUTTERS OR~~ OTHER IMPACT-~~PROTECTION~~ PROTECTIVE SYSTEMS

(IS-STM 08-18-18 AS; IS-STM 10-07-18 AM; IS-STM 06-04-18 AM; IS-STM 08-22-18 Part 3 AM/AMPC)

803.9.7 ~~804.9.7~~ *Alcove or baffled storm shelter entry systems.* ~~Debris~~ impact testing described in this section required for *alcove/ or baffled* ~~access/egress~~ *storm shelter entry systems* ~~meeting~~ shall meet the requirements of Sections 304 and 305. See Figure 803.9.7 ~~804.9.7~~ ~~illustrates~~ for an example of an *alcove/ or baffle storm shelter entry system*. ~~Debris~~ impact test requirements are presented for systems ~~for which~~ that comply with one of the following:

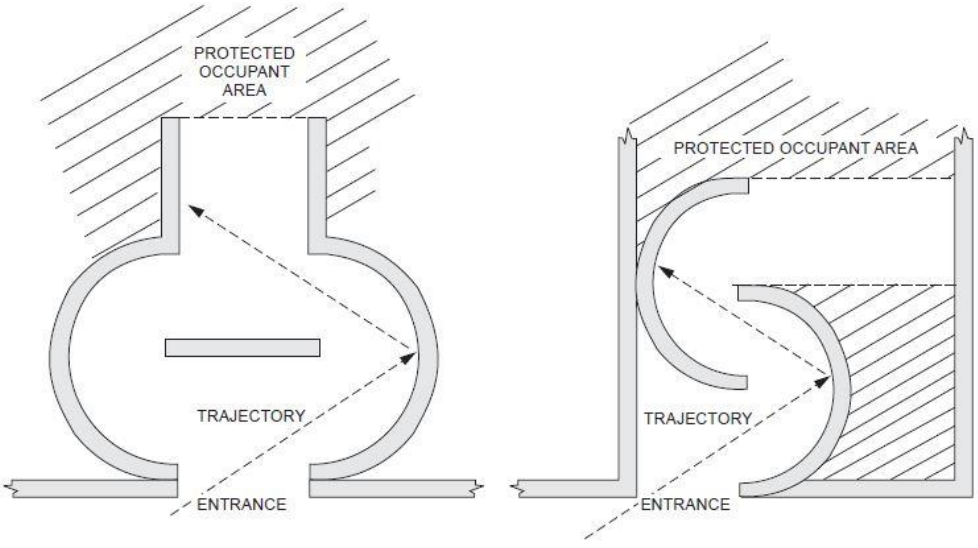
1. ~~Storm debris~~ The missile impacts at least two *impact-protective systems* meeting the requirements of Section **306.3** ~~**306.2**~~prior to entering the *protected occupant area*. Straight missile paths and elastic impacts are assumed in determining missile trajectories. Test requirements for this type of system are presented in Section 803.9.7.1 ~~804.9.7.1~~. Examples of this type of system are shown in Figure 803.9.7.1 ~~804.9.7.1~~. The boundary between the *protected occupant area* and the unprotected occupant area shall be clearly marked on the floor and walls of the *storm shelter*.
2. ~~Storm debris~~ The missile impacts initially an *impact-protective system* meeting the requirements of Section **306.3** ~~**306.2**~~and possibly rebounds to impact ~~an entry door~~ a door assembly. Straight missile paths and elastic impacts are assumed in determining missile trajectories. The ~~debris~~ impact test requirements for this type of system are presented in Section 803.9.7.2 ~~804.9.7.2~~. Examples of this type of system are shown in Figures 803.9.7.1 ~~804.9.7.1~~and 803.9.7.2 ~~804.9.7.2~~.
3. ~~Storm debris~~ The missile impact on ~~an entry door~~ a door assembly is limited to an angle less than 90 degrees (1.57 rad) by *impact-protective systems*. The ~~debris~~ impact test requirements for this type of system are presented in Section 803.9.7.3 ~~804.9.7.3~~. Examples of this type of system are shown in Figure 803.9.7.3 ~~804.9.7.3~~.



(IS-STM 08-18-18 AS)
FIGURE 803.9.7 ~~804.9.7~~
ALCOVE/ OR BAFFLED STORM SHELTER ENTRY SYSTEM

(IS-STM 10-04-18 AS; IS-STM 08-18-18 AS; IS-STM 10-07-18 AM; IS-STM 06-04-18 AM; IS-STM 08-22-18 Part 3 AM/AMPC)

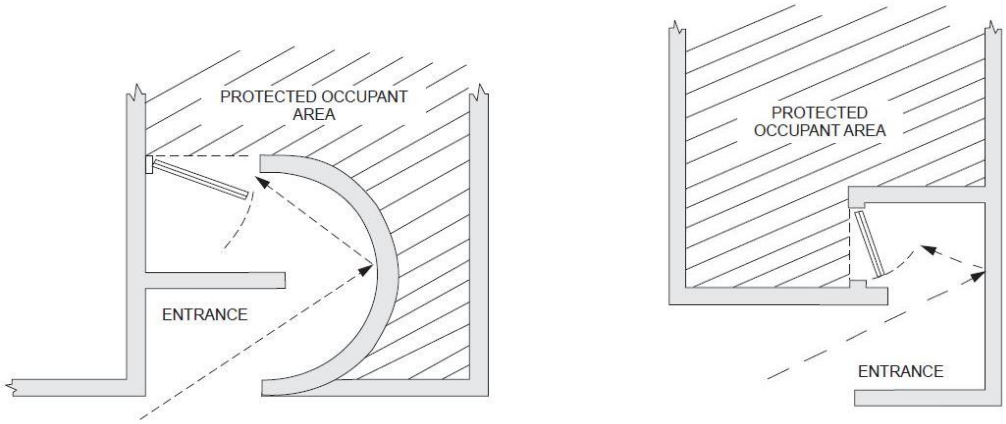
803.9.7.1 ~~804.9.7.1~~*Alcove/ or baffled storm shelter entry systems* for which no testing is required. *Storm shelter* entrances, whether provided with a door assembly or not, that are protected by an *alcove or baffled storm shelter entry system* that require missiles to impact at least two surfaces meeting the requirements of Section 306.3 ~~306.2~~ prior to arriving at the *protected occupant area* shall not be required to undergo ~~debris~~ impact testing. See Figure 803.9.7.1 ~~804.9.7.1~~ for an example. ~~When~~ Where a solid door assembly is installed as a closure for this type of entry system or to meet the fire-resistance requirements in Section 603, the door assembly need not meet the wind load requirements of Section 304.



(IS-STM 08-18-18 AS; IS-STM 06-04-18 AM-CC)
FIGURE 803.9.7.1 ~~804.9.7.1~~
***ALCOVE/ OR BAFFLED STORM SHELTER ENTRY SYSTEMS* FOR WHICH NO ~~DOOR~~ TESTING IS RE-QUIRED**

(IS-STM 08-18-18 AS; IS-STM 10-07-18 AM; IS-STM 08-22-18 Part 3 AM/AMPC)

803.9.7.2 ~~804.9.7.2~~Door assembly subject to *rebound impact*. Where the *alcove or baffled storm shelter entry system* prevents a first impact of the ~~design~~ missile on the door assembly but the door assembly is subject to a ~~rebounded~~ *rebound impact* of the ~~design~~ missile after it has impacted one surface meeting the requirements of Section **306.3 ~~306.2~~** (see Figure 803.9.7.2 ~~804.9.7.2~~ for an example), then a door assembly shall meet the wind load requirements of Section 304 and the ~~debris~~ impact requirements of Section 305 except that the missile shall be, at a minimum, a 9-pound (4.1 kg) sawn lumber 2 by 4 traveling at 50 feet per second (15.2 m/s). Entry systems having ~~doors~~ door assemblies that are protected from the initial and first ~~rebounded~~ *rebound impacts* of ~~debris~~ missile shall comply with the requirements of Section 803.9.7.1 ~~804.9.7.1~~.



(IS-STM 08-18-18 AS)
FIGURE 803.9.7.2 ~~804.9.7.2~~
~~DOORS~~ DOOR ASSEMBLIES SUBJECT TO REBOUND IMPACT

(IS-STM 08-18-18 AS; IS-STM 10-07-18 AM; IS-STM 06-04-18 AM; IS-STM 08-24-18 AS)

803.9.7.3 ~~804.9.7.3~~ Door assemblies subject to first impact. ~~If~~ Where a first-strike angle missile will impact on the door assembly ~~is possible~~ (see Figure 803.9.7.3 ~~804.9.7.3~~ for an example) ~~then the door is deemed suitable if~~ the door assembly ~~meets~~ shall meet the wind load requirements ~~of Section 304~~, the fire-resistance requirements of Section 603, and ~~the door assembly~~ meets one of the following debris impact criteria:

1. The door assembly withstands the impact of a missile ~~specified in Section 305~~ striking the door assembly at an angle closest to perpendicular to the plane of the door ~~that the missile might strike in the *shelter* application; or~~.
2. The door assembly ~~is tested following procedures specified in Section 305 or a door assembly is selected that~~ has withstood missile impacts by the design missile striking perpendicular to the surface with speed equal to or greater than the *storm shelter* design missile's velocity component perpendicular to the door assembly for the most critical angle that can occur in the application.

The minimum debris impact criterion for the door assembly shall be an impact perpendicular to the door assembly of a 9-pound sawn lumber 2 by 4 traveling at 50 feet per second [34 mph (15.2 m/s)].

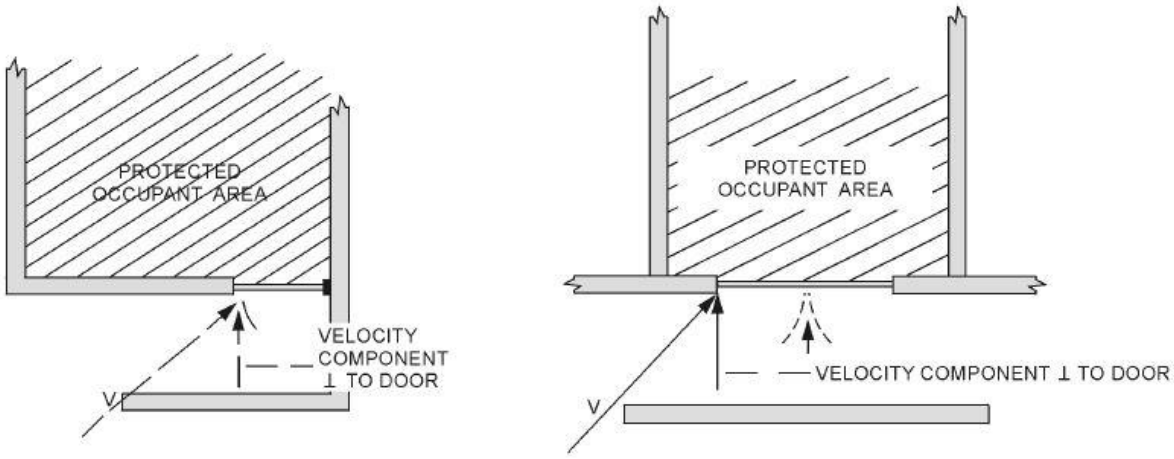


FIGURE 803.9.7.3 ~~804.9.7.3~~
~~DOORS~~ DOOR ASSEMBLY SUBJECT TO FIRST IMPACT

(IS-STM 08-20-18 AM; IS-STM 08-22-18 Part 3 AM/AMPC)
803.10 ~~804.10~~ Pass~~/~~ or fail. The pass~~/~~ or fail criteria for missile impact testing shall be in accordance with ~~this section~~ Section 803.10.1 through 803.10.4.

(IS-STM 08-20-18 AM)
803.10.1 ~~804.10.1~~ Perforation. Any perforation of the interior surface of the tested component of the *storm shelter envelope* by the design missile shall constitute a failure. For *impact-protective systems*, perforation or deflection that would result in impact of the protected component constitutes a failure.

(IS-STM 08-07-18 AM; IS-STM 02-09-18 AM/AMPC)

803.10.2 ~~804.10.2~~ Dislodgment and disengagement. *Specimens* and load-bearing fasteners, where used, shall not become disengaged or dislodged during the test procedures so as to endanger occupants. Disengagement or dislodgement that occurs in a test shall be demonstrated to not endanger occupants ~~be harmless~~ by failing to perforate a #70 unbleached kraft paper witness screen. The ~~with its~~ surface of the witness screen shall be secured in place on a rigid frame installed ~~within~~ not more than 5 inches (127 mm) ~~of the interior surface of the shelter~~ from the innermost component deemed by the ~~testing agency~~ *test laboratory* to be most susceptible to disengagement or dislodgement. The rigid frame shall maintain tautness of the kraft paper and shall have continuous supports in one direction at intervals not greater than 3 feet (914 mm).

(IS-STM 08-07-18 AM; IS-STM 02-09-18 AM/AMPC)

803.10.3 ~~804.10.3~~ Spall. Excessive spall shall not be released from the interior surface of any *specimen* during the test procedures so as to endanger occupants. Excessive spall is defined as that which perforates a #70 unbleached kraft paper witness screen ~~with its~~. The surface of the witness screen shall be secured in place on a rigid frame installed not more than 5 inches (127 mm) from the ~~interior~~ innermost surface of the test *specimen* deemed by the ~~testing agency~~ *test laboratory* to be most susceptible to spalling. The ~~witness screen~~ rigid frame shall maintain tautness of the kraft paper and shall have continuous supports in one direction at intervals not greater than 3 feet (914 mm).

~~**Exception:** Where warnings are to be provided marking the protected occupant area beyond the 5-inch (127 mm) limit defined above, the witness screen is permitted to be positioned at the boundary of the protected area, and excessive spall defined as that which will perforate the witness screen in this position.~~

803.10.4 ~~804.10.4~~ Permanent deformation. Permanent deformation of an interior surface of the test *specimen* shall be determined by measuring the distance from a straight edge held between two undeformed points on the

specimen. The maximum permanent deformation shall be measured to the nearest $^1/_8$ inch (3.2 mm) and shall not exceed 3 inches (76.2 mm).

(IS-STM 08-22-18 AM/AMPC Part 1)
SECTION 804 ~~805~~
STATIC AND CYCLIC PRESSURE TESTING

(IS-STM 03-04-18 AM/AMPC; IS-STM 02-09-18 AM/AMPC; IS-STM 08-22-18 AM/AMPC Part 1)
804.1 ~~805.1~~ Apparatus. The general description of the apparatus for performing the static and cyclic pressure testing requirements of this standard is detailed in Section 6 of ASTM E330 when performing the static pressure test, or ASTM E1886 when performing the cyclic pressure test. Any equipment, properly accredited to ~~certified, calibrated and approved by~~ a ~~qualified lab~~ test laboratory, capable of performing this test, within the allowable tolerance, is permitted.

804.2 ~~805.2~~ Calibration. Calibration of the pressure measuring system shall be performed in accordance with the procedure detailed in Section 9 of ASTM E330 or ASTM E1886.

(IS-STM 08-08-18 AM; IS-STM 08-09-18 AM; IS-STM 08-10-18 AM; IS-STM 08-15-18 AS; IS-STM 03-11-18 AM; IS-STM 08-22-18 AM/AMPC Part 1)
804.3 ~~805.3~~ Cyclic pressure testing after impact. Test *specimen*s requiring cyclic pressure testing ~~to establish the ability to meet the wind pressure requirements set forth in Section 304 of this standard~~ shall be cyclic tested in accordance with ASTM E1886 using the loading sequence detailed in Table 1 of ASTM E1886 ~~specified~~ to the *design wind pressure* ~~as defined in Section 304.1~~. The test *specimen*s used shall be the same test *specimen*s that received impact testing in accordance with Section 803. Cyclic pressure ~~Pressure~~ testing procedures shall be performed
in accordance with the Air Pressure Cycling criteria as detailed in ~~Sections 11.1 through 11.2.11 of~~ ASTM E1886.

Exception: The maximum allowable cycle time for *specimen*s over 75 square feet (7 m^2) in area shall be permitted to be calculated using the following equation:
Maximum allowable cycle time in seconds = (area of *specimen* in sq. ft. – 75) x 0.06 + 3
In no case shall the maximum cycle time exceed 10 seconds.

804.4 ~~805.4~~ Testing temperature. The testing shall be conducted at room temperature in the range of 59°F (15°C) to 95°F (35°C).

(IS-STM 08-22-18 AM/AMPC Part 1)
SECTION 805 ~~806~~
STATIC AND CYCLIC PRESSURE TESTING PROCEDURES

(IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; IS-STM 03-11-18 AM; IS-STM 08-22-18 AM/AMPC Part 1)
805.1 ~~806.1~~ **Pressure testing procedures.** ~~Procedures for pressure testing~~ Wall assemblies, roof assemblies, ~~door assemblies, window assemblies~~ and *impact-protective systems* ~~requiring~~ that are components of the storm shelter envelope shall be static or cyclic pressure ~~testing~~ ~~are presented~~ tested in accordance with ~~in this section~~ in Sections 805.2 through 805.5, as applicable. *Design wind pressure*s used for static or cyclic pressure testing of the *storm shelter envelope* shall be in accordance with Section 304.

(IS-STM 10-04-18 AS; IS-STM 08-18-18 AS; IS-STM 03-11-18 AM; IS-STM 08-11-18 AM; IS-STM 08-22-18 AM/AMPC)
805.2 ~~806.2~~ ~~Roof and~~ wall assemblies and roof assemblies. ~~When~~ Where testing of wall assemblies and roof ~~and wall~~ assemblies is required, ~~they~~ such assemblies shall be static pressure tested in the as-supplied condition. Static pressure testing of roof assemblies shall be conducted in accordance with FM 4474, ASTM E1592, UL1897 or ASTM E330, whichever is applicable, to a static pressure times the *design wind pressure* or greater. ~~Required~~ Static pressure testing of wall assemblies shall be ~~done as detailed in~~ conducted in accordance with ASTM E330 to ~~a pressure equal to or higher than~~ 1.2 times the ~~pressures specified in Section 304~~ *design wind pressure* or greater.

(IS-STM 08-22-18 AM/AMPC Part 1)

Delete all of Section 805.3 through 805.6 and replace as follows:

(IS-STM 08-22-18 AM/AMPC Part 1)
805.3 Impact-protective systems. Testing of *impact-protective systems* shall be conducted in the as-supplied condition as specified in Sections 805.3.1 or 805.3.2.

(IS-STM 08-22-18 AM/AMPC Part 1)
805.3.1 Hurricane shelters. Impact protective systems for use in *hurricane shelters* shall be static pressure tested to a pressure of 1.2 times the *design wind pressure* or greater in accordance with ASTM E330 and subjected to cyclic pressure testing in accordance with ASTM E1886. Cyclic pressure testing shall follow the impact testing required in Section 803.

Exception: Cyclic pressure testing is not required for door assemblies without glazing where such assemblies are static pressure tested to a pressure of 1.5 times the *design wind pressure* or greater in accordance with ASTM E330.

(IS-STM 08-22-18 AM/AMPC Part 1)
805.3.2 Tornado shelters. *Impact-protective systems* for use in *tornado shelters* shall be tested for static pressure to a pressure of 1.2 times the *design wind pressure* or greater in accordance with ASTM E330.

(IS-STM 10-04-18 AS) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)
~~**805.3 806.3 Door assemblies.** Door assemblies shall be pressure tested in the as-supplied condition and, when where required, they shall be static pressure tested or cyclically tested as specified in the the following sections: Sections 805.3.1 through 805.3.2.2.~~

(IS-STM 08-18-18 AS) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)
~~**805.3.1 806.3.1 Door assemblies without glazing.** Door assemblies without glazing that require testing to meet the qualification of Section 306.3 306.4 shall be pressure tested according to procedures specified in this section Sections 805.3.1.1 and 805.3.1.2~~.

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)
~~**805.3.1.1 806.3.1.1 Door assemblies without glazing for *tornado shelters*.** Door assemblies without glazing for use in *tornado shelters* shall be static pressure tested away from the door stops to a pressure of at least 1.2 times the pressures specified in Section 304 *design wind pressure* or greater. Pressure tests are permitted to be conducted separately from missile impact tests.~~

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)
~~**805.3.1.2 806.3.1.2 Door assemblies without glazing for *hurricane shelters*.** Door assemblies without glazing for use in *hurricane shelters* shall be static pressure proof tested away from the door stops to a pressure of at least 1.2 times the *design wind pressure* or greater, then subjected to required debris impact tests, and then to cyclic pressure tests following procedures of ASTM E1886.~~

~~Alternatively, door assemblies without glazing for *hurricane shelters* shall be statically pressure tested away from the door stops to a pressure of 1.5 times the *design wind pressure* or greater before impact tests and then to required debris impact tests. Cyclic pressure testing after impact tests is not required for these door assemblies that have been pressure tested to pressures equal to or greater than 1.5 times the *design wind pressure* or greater.~~

(IS-STM 08-12-18 AM) (IS-STM 08-18-18 AS) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)
~~**805.3.2 806.3.2 Door assemblies with glazing, sidelights or transoms.** Door assemblies with glazing, sidelights or transoms shall be pressure tested according to procedures specified in this section Sections 805.3.2.1 806.3.2.1 and 805.3.2.2. Where glazed openings are present, with a size of less than or equal to 12 inches by 12 inches (304.8 mm by 304.8 mm), an additional sample shall be impacted in the center of the glazed opening in accordance with Section 804 and cyclic pressure tested as detailed in Section 805.3. Where glazed openings have a dimension greater than 12 inches (304.8 mm), the glazed opening shall be treated as a window and tested in accordance with Section 806.5 of this standard.~~

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.3.2.1 806.3.2.1 Door assemblies with glazing, sidelights or transoms for *tornado shelters*. Door assemblies with glazing, sidelights or transoms for *tornado shelters* shall be static pressure tested away from the door stops following procedures of ASTM E330 to a pressure of at least 1.2 times the pressures specified in Section 304 *design wind pressure* or greater. Pressure tests are permitted to be conducted separately from debris impact tests.

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.3.2.2 806.3.2.2 Door assemblies with glazing, sidelights or transoms for *hurricane shelters*. Door assemblies with glazing, sidelights or transoms for *hurricane shelters* shall be static pressure proof tested away from the door stops to a pressure of at least 1.2 times the *design wind pressure* or greater. Any required debris impact tests shall follow pressure proof testing. After impact tests the door assembly shall be subjected to cyclic pressure tests following procedures of ASTM E1886.

(IS-STM 08-18-18 AS) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.4 806.4 Window assemblies and other glazed openings. Window assemblies and other glazed openings shall be pressure tested according to procedures specified in this section Sections 805.4.1 and 805.4.2.

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.4.1 806.4.1 Window assemblies and other glazed openings for *tornado shelters*. Window assemblies and other glazed openings for *tornado shelters* shall be static pressure tested away from stops to a pressure of at least 1.2 times the *design wind pressure* or greater following procedures detailed in ASTM E330. Pressure tests are allowed to be conducted separately from debris impact tests.

(IS-STM 08-22-18 AM) (IS-STM 03-11-18 AM) (Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.4.2 806.4.2 Window assemblies and other glazed openings for *hurricane shelters*. Window assemblies and other glazed openings for *hurricane shelters* shall be static pressure tested away from stops to a pressure of at least 1.2 times the *design wind pressure* or greater. Any required debris impact tests shall follow pressure proof testing. After impact tests the window assembly shall be subjected to cyclic pressure tests following procedures of ASTM E1886.

(IS-STM 10-04-18 AS; IS-STM 10-05-18 AM; IS-STM 10-08-18 AS**; IS-STM 08-14-18 AM/AMPC; IS-STM 08-17-18 AS; Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)**

805.5 806.5 Other *impact-protective systems*. Where installed, other external *impact-protective systems* shall be tested for the ability to withstand prescribed pressures if where withstanding pressure is critical to their function when installed. Where the only function of devices such as nonoperable, permanently affixed shields or cowlings, whose only function is to protect against debris intrusion, such devices need not be static or cyclic pressure tested when where the shields or cowlings have been designed and anchored to resist the design loads as determined in this standard.

(IS-STM 10-04-18 AS; IS-STM 10-08-18 AS; IS-STM 08-17-18 AS; IS-STM 03-11-18 AM; Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.5.1 806.5.1 Other *Impact-protective systems* for *tornado shelters*. Where installed, other **e**xternal *impact-protective systems* for *tornado shelters*, where the whose ability to withstand wind-induced pressure when installed is critical to their function, such systems shall be static pressure tested following procedures specified in ASTM E330 to a pressure of at least 1.2 times the *design wind pressures* or greater specified in Section 304. Debris impact tests and pressure tests are permitted to be conducted separately.

Exception: *Impact-protective systems* with a jamb or stop need to be tested with pressure only away from the stop.

(IS-STM 10-08-18 AS; IS-STM 08-17-18 AS; Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

805.5.2 806.5.2 Opening Other *impact-protective systems* devices for *hurricane shelters*. Where installed, other external *impact-protective systems* devices for *hurricane shelters*, where the whose ability to withstand wind-induced pressure when installed is critical to their function, such devices shall be static pressure tested to a pressure of at least 1.2 times the *hurricane shelter design wind pressures* specified in Section 304 following the procedures specified in ASTM E330. Cyclic pressure tests conducted in accordance with Section 805.5 shall be conducted after debris impact tests.

(IS-STM 10-08-18 AS; IS-STM 08-17-18 AS; IS-STM 08-18-18 AS; Section deleted - IS-STM 08-22-18 AM/AMPC Part 1)

~~**805.6 806.6 *Alcove or baffled storm shelter entry systems*.** Any element of the *alcove or baffled storm shelter entry system* whose with the ability to resist wind-induced pressure that is critical to the function of the *alcove or baffled storm shelter entry system* shall be designed to meet the requirements of Section 304 or shall be pressure tested in accordance with Section 805 806.~~

CHAPTER 9

REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard.

(IS-STM 03-27-18 AM/AMPC)

ACI

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331

Standard reference number	Title	Referenced in code section number
ACI 318-19: Building Code Requirements for Structural Concrete		307.2
ACI 332—19	Residential Code Requirements for Structural Concrete	307.2

(IS-STM 09-01-18 AM; IS-STM 09-02-18 AS)

ASCE

American Society of Civil Engineers
Structural Engineering Institute
1801 Alexander Bell Drive
Reston, VA 20191-4400

Standard reference number	Title	Referenced in code section number
7—~~10~~ 16	Minimum Design Loads for Buildings and Other Structures ~~with Supplement No. 1~~	301.1, 302.1, 302.2, 303.1, 303.2, 304.1, 304.7
24—~~05~~ 14	Flood Resistant Design and Construction	401.3

(IS-STM 09-01-18 AM/AMPC; IS-STM 09-03-18 AS; IS-STM 08-11-18 AM)

ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

Standard reference number	Title	Referenced in code section number
C920—~~08~~ 18	Standard Specification for Elastomeric Joint Sealants	
E330/E330M—~~02~~ 14	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference	805.1, 805.2, 806.2, 806.3.2.1, 806.4.1, 806.5.1, 806.5.2
~~E631—06~~	~~Terminology of Building Constructions~~	802.1
E1592-05 (Reapproved 2017)	Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference	
E1886—~~05~~ 19	Standard Test Method for the Performance of Exterior Windows, Curtain Walls, Doors	

and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials 805.1, 805.2, 805.3, 806.3.1.2, 806.3.2.2, 806.4.2

Note: The reference to this standard was deleted in from the 2008 edition. It is not referenced in the 2014 edition, so this is an erratum and will be deleted.

~~E1996—12 14a Specification for Performance of Exterior Windows, Curtains Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricane~~ ..... ~~306.3.2~~

(IS-STM 09-01-18 AM/AMPC)

DOC

U.S. Department of Commerce
National Institute of Standards and Technology
100 Bureau Drive Stop 3460
Gaithersburg, MD 20899

Standard reference number	Title	Referenced in code section number
PS 20—~~10~~ 20	American Softwood Lumber Standard	804.4.1

(IS-STM 08-11-18 AM)

FM

FM Approvals
Headquarters Office
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

Standard reference number	Title	Referenced in code section number
4474—2011: American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures		

(IS-STM 09-01-18 AM)

ICC

International Code Council, Inc.
500 New Jersey Ave, NW
6th Floor
Washington, D.C. 20001

Standard reference number	Title	Referenced in code section number
IBC—~~15~~ 21	International Building Code®	501.6
ICC A117.1—~~09~~ 17	Accessible and Usable Buildings and Facilities	504.1.1

(IS-STM 07-12-18 AM)

ISEA

International Safety Equipment Association
1901 North Moore Street, Suite 808,
Arlington, Virginia 22209

Standard reference number	Title	Referenced in code section number
ANSI/ISEA Z308.1-2015	Minimum Requirements for Workplace First Aid Kits and Supplies	

(IS-STM 09-01-18 AM/AMPC; IS-STM 03-22-18 AM)

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269-9101

Standard reference number	Title	Referenced in code section number
NFPA-10—~~13~~18	Portable Fire Extinguishers	602.2
NFPA-70-17	National Electrical Code	702.5, 703.9

(IS-STM 09-01-18 AM; IS-STM 09-02-18 AS; IS-STM 09-03-18 AS)

TMS

The Masonry Society
105 South Sunset Street, Suite Q
Longmont, CO 80501

Standard reference number	Title	Referenced in code section number
602—~~2011~~ 2016	Specification for Masonry Structures	

(IS-STM 08-11-18 AM)

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062.2096

Standard reference number	Title	Referenced in code section number
UL1897- 15	Standard for Safety for Uplift Tests for Roof Covering Systems	