ICC 500-2013 edition
Committee Actions
September 27, 2012
2008 ICC 500 Standard Revision Proposals

IS-STM1-11/12
Section 101.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

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

Reason: The purpose of this proposal is to provide editorial revisions to the scope. The one notable change is to specify “extreme high winds”, lest a user decide that a safe room or storm shelter is needed for protection against a garden-variety thunderstorm or because they live on a hill, ridge or escarpment subject to “high winds” from topographic effects.

Committee Action: Accept in principle

Modified Motion:

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

Committee Reason:
Section 104.1 and 104.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

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

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

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

Reason: The purpose of this proposal is to revise the occupancy requirements of ICC 500. Clarifications are provided to Section 104.1. An exception to the required Assembly Group A-3 designation is added to Section 104.2. This exception effectively points to and brings ICC 500 in line with the provision of Section 303.1.1 of the 2012 IBC that allows a building or structure used for assembly purposes but having an occupant load less than 50 persons to be designated as a Group B Occupancy rather than a Group A Occupancy.

Group A Occupancies are subject to more stringent provisions than Group B Occupancies, such as wall and ceiling finish requirements in corridors, number of plumbing fixtures in restrooms and bathrooms, and slope and handrail requirements for means of egress. These other occupancy-based requirements impose design constraints and increase the cost of constructing a storm shelter over and above what is simply needed to meet the structural requirements. Reducing those additional non-structural costs by allowing a small shelter to be re-classified as permitted by the IBC for any other small assembly space would remove a potential barrier to an owner choosing to provide a designated shelter facility on his site.

The same goes for a designated shelter room or area constructed within a larger building. The IBC permits mixed occupancies within a building and allows certain accessory rooms within a larger building (e.g. small assembly spaces accessory to another occupancy) to have a different – and possibly less stringent – occupancy classification than the larger building. ICC 500 should not override the standard IBC rules unless absolutely necessary to insure the performance of the shelter.

Committee Action: Accept in principle

Committee Reason:
IS-STM3-11/12
Section 106.2

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

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

Reason: The building official or authority having jurisdiction has the authority to require the preparation of construction documents for storm shelters (See SECTION 107 CONSTRUCTION DOCUMENTS, 107.1 General).

The authority having jurisdiction has the authority to require special inspections based on 1. and 2. of Section 106.3 Special cases.

The 2009 IBC, SECTION 1704 SPECIAL INSPECTIONS, permits the authority having jurisdiction to determine whether special inspections are warranted.

Committee Action: Accept in principle

Committee Reason:
IS-STM4-11/12
Section 106.1.1


Revise as follows:

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

Reason: By reducing the number of occupants required for peer review to 50 occupants from 300 occupants, more storm shelters will have a peer review performed and designers will be able to find and resolve inadequacies in their plans more easily.

Furthermore, many crucial facilities, such as schools, police and fire stations, and emergency operation centers have storm shelters that are intended to hold less than 300 occupants. For example, the Amory, MS community shelters shown in 2011 Tornado Outbreak Mitigation Assessment Team (MAT) Report Figure 8-29 and below were designed to hold less than 300 occupants. Therefore, providing an occupancy threshold of 300 for peer review for a community shelter allows for many of these critical facilities to bypass a peer review when their storm shelter is being designed.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornadoes, it was found that several residential and community pre-fabricated shelters lacked the adequate anchoring systems. Although the shelters would still provide a level of safety to the occupants, the inadequate designs is a concern when the goal of a shelter is to provide life safety. Additionally, observations made during design of safe rooms receiving FEMA grant funds showed a lack of proper oversight during the design phase. Products and design details were specified in the construction drawings that did not fully comply with ICC 500, such as opening protection, usable areas vs. occupancy requirements as well as other code related issues (2011 Tornado Outbreak, MAT Report, Sections 9.5.1 and 9.5.2). In addition, the Smithville, MS shelter shown below and found as Figure 8-28 in the MAT Report is lacking proper opening protection (door and ventilation system). Therefore, a higher level of scrutiny is required during the design and construction shelters.
Committee Action: Hold for further study
Task group AS
Committee 7/10
Committee Reason:

Amory, MS community shelters (2011 Tornado Outbreak MAT Report, Figure 8-29)

Smithville, MS community shelter (Figure 8-28 in 2011 Tornado Outbreak MAT Report). The door appears inadequate for debris impact and there is inadequate protection of the ventilation system (shown here covered as a result of damage in the storm).

Source: Mitigation Assessment Team (MAT) Report, 2011 Tornado Outbreak
IS-STM5-11/12
Section 106.1.1


Revise as follows:

106.1.1 **Peer review.** Construction documents for community shelters designed for greater than 300 occupants shall undergo a peer review by an independent registered design professional for compliance with the requirements of Chapter 3, Chapter 5 and Chapter 7.

**IS-STM5a:** add Chapter 6 Committee AS 10-0

Reason: Currently the peer review only includes the structural design criteria found in Chapter 3, and by reference the test methods for impact and pressure testing. The criteria found in Chapters 5 and 7 are equally important to provide the desired level of protection. Currently the peer review does not include the non-structural requirements found in Chapters 5 and 7. FEMA’s publication 361, 2nd edition, requires peer reviews of the structural and non-structural components of a safe room. This change will bring the standard into line with FEMA’s recommended practice. The attached is the appropriate section from FEMA 361.

3 DESIGN CRITERIA FOR TORNADO AND HURRICANE SAFE ROOMS DESIGN AND CONSTRUCTION GUIDANCE FOR COMMUNITY SAFE ROOMS SECOND Edition Deficiencies should 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 should submit to the AHJ a written statement that the site visits have been made and identify any reported deficiencies that, to the best of the structural observer’s knowledge, have not been resolved.

3.8.3 Peer Review
Construction documents for community safe rooms designed for more than 50 occupants should undergo a peer review by an independent registered design professional for conformance with the design criteria of this chapter. This peer review should focus on the structural and non-structural design of elements that provide life-safety protection for the occupants of the safe room. The design professional performing the peer review may be the same design professional who provides design oversight as recommended in Section 3.8.2.

3.9 Construction Documents, Signage Criteria, and Labeling
This section provides the criteria that should be adhered to when documenting the design criteria on project plans or within the safe room itself. The location of the safe room, the design criteria for the safe room, the product testing information, and similar information should be clearly identified on the project plans or construction documents. In addition, all safe rooms should have a label clearly identifying it as a safe room designed to provide life-safety...
protection to its occupants at a specified performance level; this is referred to as signage.

3.9.1 Construction Documents
Although not all jurisdictions require detailed construction documents, compliance with the FEMA criteria presented in this publication requires that construction documents should be prepared and maintained. Such documents should contain information as required by the applicable building code, the authority having jurisdiction, and this section.

Committee Action: 

Accept in principle

Committee Reason:
IS-STM6-11/12
Section 106.1.1


Revise as follows:

106.1.1 Peer review. Construction documents for community shelters designed for greater than 300 occupants shall undergo a peer review by an independent registered design professional for compliance with the requirements of Chapter 3. The peer review shall be submitted to the authority having jurisdiction with the construction documents identified in Section 107.

Reason: The standard requires the completion of a peer review, the review is not required to be submitted with the construction documents, or for review/consideration by the code official. The proposed change will require submission of the peer review to the code official.

Committee Action: Accept in principle

Committee Reason:
IS-STM7-11/12
Section 106.1.1


Revise as follows:

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

Reason: I do not believe the peer reviews are fulfilling the intended objective, which is a review by an outside party to determine compliance with the standard. Since the release of the ICC 500-2008 standard, staff with FEMA Region VII has reviewed approximately 120 community safe room projects. The purpose of the review is to determine eligibility for financial assistance from FEMA. The review considers the recommendations found in FEMA publication 361, and by reference, the ICC 500-2008 standard. The review occurs before the project is bid, or concurrent with the bid period.

Submitted with the construction documents are peer reviews covering structural and non-structural components of the safe room. Note that FEMA’s recommendations include non-structural components, so multiple peer reviews are provided. A minimum of two reviews are received, one from a professional engineer, and another from a registered architect. The two reviews cover different areas of practice; a review from a structural engineer for structural aspects, and a review from an architect for architectural aspects. Project constructed in Missouri also include one (or more) from the engineer(s) for the MEP components of the project. The current standard will allow a registered architect to review the structural aspects of the proposed storm shelter. I do not believe this is the intent of Section 106.1.1. The peer review should be completed by a design professional with experience in the specific area of practice under review.

As mentioned, FEMA Region VII requires the submittal of the peer reviews with the construction documents. All peer reviews state the proposed project is in compliance with the provisions of the ICC 500 and FEMA 361. However, the experience in FEMA Region VII is 50% of the reviewed projects fail to comply with one or more requirements of the ICC 500 and FEMA 361. Frequent omissions include an inadequate or missing opening protective for utility or system penetrations, inadequate door specification (citation of superseded criteria), missing design information in the construction documents, and inadequate protection of support equipment located outside the primary envelope of the shelter. I’ll also mention that almost all of the proposed projects do not include documentation showing components of the shelter envelope will meet the pressure and missile impact test requirements identified in Chapters 3 and 8.

If the peer reviews were functioning as intended then most proposed projects would not have omissions. Clearly the peer reviews are not achieving the desired result. Adopting the suggested change may partially address the problem. However, even with the change a design professional with no or little experience in safe room design can complete a peer review. The development of a commentary to expand on the intent of the standard may provide another information both the design team and the individuals completing the peer reviews.

Committee Action: Disapproved
Pass, 9 - 2

Committee Reason:
IS-STM8-11/12
Section 106.1.1.1


Add new text as follows:

106.1.1.1 Peer review for essential facilities. Construction documents for storm shelters in Risk Category IV (essential facilities) as defined in Table 1604.5 in the International Building Code as well as elementary schools, secondary schools, and day care facilities with an occupant load greater than 16, shall undergo a peer review by an independent registered design professional for compliance with the requirements of Chapter 3.

7/10 Committee: AM (in red) – AIP intent to make for day care with OL greater than 16

Section title??
Section Number – should not be subordinate
Storm shelters --
Reason: Many critical facilities, such as schools, day care centers, police and fire stations, and emergency operation centers and hospitals have storm shelters that are intended to hold less than 300 occupants, which is the current level of occupancy to trigger a peer review in ICC 500. However, critical and essential facilities often provide shelter for first responders who need to be able to get out to the surrounding areas immediately after an event. Schools and day care centers need to be able to provide protection for their vulnerable population. Therefore it is important to make sure designers pay special attention to storm shelters for ANY critical/essential facility in order to ensure that it is properly designed and will allow for the intended operations to continue after the event has passed. This requirement should be applicable to any storm shelter installed in a critical facility regardless of size or number of occupants. The figure below shows damages at Alberta Elementary School in Tuscaloosa, AL. The school did not have a shelter, but fortunately students had already been sent home at the time of the tornado. This photograph and a description of the damages at the school can be found in Section 8.3.2.1 of the 2011 Tornado Outbreak Mitigation Assessment Team (MAT) Report.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornados, it was found that several residential and community prefabricated shelters lacked the adequate anchoring systems, including the residential shelter shown below and described in Section 8.4.1.2 of the 2011 Tornado Outbreak MAT Report. Although the shelters would still provide a level of safety to the occupants, the inadequate designs is a concern when the goal of a shelter is to provide life during the design phase. Products and design details were specified in the construction drawings that did not fully comply with ICC 500, such as opening protection, usable areas vs. occupancy requirements as well as other code related issues. Also shown in the figure below is a lack of adequate opening protection, with an untested door system. Therefore, a higher level of scrutiny is required during the design and construction of shelters.

Additionally, local governments are already starting to require shelters in certain buildings. For example, the State of Alabama requires that all new K-12 schools have a shelter.
Committee Action: Hold for further discussion

Committee Reason:
Section 106.1.2


Add new text as follows:

106.1.2 Design evaluation. Prefabricated storm shelter units for residential application and community shelters with greater than 50 occupants should be reviewed in accordance with ICC 500 by the ICC-Evaluation Service.

Reason: The proposed addition of Section 106.1.2 serves to strengthen the quality assurance process for storm shelters. Under this provision, manufacturers of prefabricated shelter unit would be encouraged to have products reviewed by ICC-ES before distribution. Additionally, plan review for any community shelter with greater than 50 occupants by an organization capable of providing consistent review based on a detailed knowledge of the standard should be promoted. A significant trend in the production and installation of prefabricated units (which can be processed through one review for a specific design and then mass-distributed) and larger community storm shelters that will serve to protect larger amounts of occupants in schools and other critical facilities is prudent. In order to effectively integrate a plan review and evaluation service, the organization would need to be consulted to determine the appropriate language to correspond with their capability and responsibility. ICC-ES does not perform plan review, but ICC does offer plan review services. In order to avoid monopolization of this service, the language should not be implemented in a manner that reduces market competition of plan review and product evaluation services. However, developing a procedure for storm shelters to be consistently evaluated by large and capable plan and product evaluation services would strengthen the industry and provide greater confidence to consumers.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornados, it was found that several residential and community prefabricated shelters lacked the adequate anchoring systems, including the residential shelter shown below and described in Section 8.4.1.2 of the 2011 Tornado Outbreak Mitigation Assessment Team Report. Although the shelters would still provide a level of safety to the occupants, the inadequate designs is a concern when the goal of a shelter is to provide life safety. Additionally, observations made during design of safe rooms receiving FEMA grant funds showed a lack of proper oversight during the design phase. Products and design details were specified in the construction drawings that did not fully comply with ICC 500, such as opening protection, usable areas vs. occupancy requirements as well as other code related issues. Also shown in the figure below is a lack of adequate opening protection, with an untested door system. Therefore, a higher level of scrutiny is required during the design and construction shelters.
Smithville, MS – Above ground prefabricated shelter lacking any anchoring system and proper opening protection. (Figure 8.26 in Mitigation Assessment Team Report)

Source:
Chapter 8, 2011 Tornado Outbreak Mitigation Assessment Team Report
Section 9.5.1 and 9.5.2, Mitigation Assessment Team Report, 2011 Tornado Outbreak

Committee Action: Disapproved
Pass, 11 - 0

Committee Reason:
IS-STM10-11/12
Section 106.3


Revise as follows:

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

1. Construction materials and systems that are alternatives to traditional materials and systems prescribed by the applicable code.
2. Unusual design and construction applications.
3. Pre-fabricated shelter anchorage and foundation design.

TASK GROUP:

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

1. Construction materials and systems that are alternatives to traditional materials and systems prescribed by the applicable code.
2. Unusual design and construction applications.
3. Pre-fabricated shelter anchorage and foundation design.

Reason: As more storm shelters and safe rooms are constructed, FEMA has noted that one area where enforcement and responsibility is lacking is the installation of prefabricated storm shelters and safe rooms. Prefabricated units are the predominant choice for residential storm shelters and therefore would not be considered alternates to traditional materials or consist of unusual design and construction applications. ICC 500 should provide language to strengthen the contractor responsibility, making it clear that the contractor is responsible for properly installing a prefabricated shelter. This requires that the capacity of the foundation be evaluated and strengthened if needed, and that the connections between the prefabricated unit and the foundation be sufficient to meet the criteria in ICC 500. Based on the existing language and observations in the field, contractors are not being held to these criteria, and many prefabricated units are not properly connected to their foundations or properly account for the soil pressures and hydrodynamic forces. As shown in the figure below and discussed in Section 8.5.1.2 in the 2011 Tornado Outbreak Mitigation Assessment Team Report, the residential shelter in Smithville, MS has been subject to uplift since its installation.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornadoes, it was found that several residential and community pre-fabricated shelters lacked the adequate anchoring systems. Although the safe rooms would still provide a level of safety to the occupants, the inconsistent use of anchors resulted in a lack of confidence by the potential users. Such an anchoring system can be seen in the figures below and in Section 8.4.1.2 of the 2011 Tornado Outbreak Mitigation Assessment Team Report. Special inspections on the anchoring methodology and foundation design for pre-fabricated shelters will help ensure proper design to withstand the potential uplift and overturning.
Smithville, MS shelter subject to uplift (Figure 8-31 in 2011 Tornado Outbreak NAT Report)

Durant Police Station, Holmes County, Community Safe Room

Manufactured anchors and straps used to secure the safe room.
Smithville, MS – Above ground prefabricated shelter lacking any anchoring system. (Figure 8-26 in Mitigation Assessment Team Report)

Committee Action: Hold for further discussion

Committee Reason:
IS-STM11-11/12
Section 107.2.1

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

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

1. Type of shelter: tornado, hurricane or a combination of both.
2. A statement that the wind design conforms to the provisions of the ICC/NSSA Standard for the Design and Construction of Storm Shelters, with the edition year specified.
3. The shelter design wind speed, mph.
4. The importance factor, I.
5. The wind exposure category (indicate all if more than one is used.)
6. The internal pressure coefficient, GCpi
7. The topographic factor Kzt
8. The directionality factor Kd
9. A statement that the shelter has/has not been constructed within an area susceptible to flooding in accordance with Chapter 4 of this standard.
10. The Design Flood Elevation and Base Flood Elevation for the site (if applicable)
11. Documentation showing that components of the shelter envelope will meet the pressure and missile impact test requirements identified in Chapters 3 and 8 of this standard.
12. A floor plan drawing or image indicating location of the storm shelter on a site or within a building or facility; including drawing or image indicating the entire facility.
13. 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.
14. The lowest shelter floor elevation and corresponding datum, except for residential shelters outside of special flood hazard areas.
15. The occupant load of the storm shelter.
16. The usable storm shelter floor area.
17. Venting area (sq.in.) provided and locations in the shelter.

Reason: The height of the storm shelter is an essential piece of information for the design of the shelter for wind forces. The design wind pressures are based on the height of the storm shelter.

A review by the authority having jurisdiction would not be complete without the AHJ knowing the height of the storm shelter and its vertical elevation relative to the finished grade, finished floor elevation, or cross section of the host building, where applicable.

Committee Action: Accept in principle

Committee Reason:
IS-STM12-11/12
Section 107.2

Proponent: Robert Franke representing Department of Homeland Security,
Federal Emergency Management Agency

Add new text as follows:

107.2.7 Safe Room Design Information Sheet. The design information
described Section 107.2 shall be supplied on a single sheet.

Exception:

1. The documentation for 107.2.1 item 11 may be included in the project
   manual or an attachment to the single sheet.

Reason: Frequently the design information is found throughout the construction documents.
Placing the information on one sheet will facilitate the review of the storm shelter design. The
exception is to accommodate the documentation, typically in the form of multi-page test reports,
showing compliance with the pressure and missile impact tests.

Committee Action: Hold for further study
Committee Reason:
IS-STM13-11/12
Section 107.2.1


Revise as follows:

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

1. Type of shelter: tornado, hurricane or a combination of both.
2. A statement that the wind design conforms to the provisions of the ICC/NSSA Standard for the Design and Construction of Storm Shelters, with the edition year specified.
3. The shelter design wind speed, mph.
4. The importance factor, I.
5. The wind exposure category (indicate all if more than one is used.)
6. The internal pressure coefficient, GCpi
7. The topographic factor Kzi
8. The directionality factor Kd
9. A statement that the shelter has/has not been constructed within an area susceptible to flooding in accordance with Chapter 4 of this standard.
10. The Design Flood Elevation and Base Flood Elevation for the site (if applicable)
11. Documentation showing that components of the shelter envelope will meet the pressure and missile impact test requirements identified in Chapters 3 and 8 of this standard.
12. A floor plan drawing or image indicating location of the storm shelter on a site or within a building or facility; including drawing or image indicating the entire facility.
13. The lowest shelter floor elevation and corresponding datum, except for residential shelters outside of special flood hazard areas.
14. The occupant load of the storm shelter.
15. The usable storm shelter floor area.
16. Venting area (sq.in.) provided and locations in the shelter.
17. Pre-fabricated shelter minimum foundation capacity requirements.
18. Pre-fabricated shelter installation requirements including anchor location and minimum required capacity for each anchor.
19. For pre-fabricated shelters, at least one prescriptive foundation design.
**Reason:** As more storm shelters and safe rooms are constructed, FEMA has noted that one area where enforcement and responsibility is lacking is the installation of prefabricated storm shelters and safe rooms. Prefabricated units are the predominant choice for residential storm shelters. ICC 500 should provide language to strengthen the specifications provided to contractors, thereby facilitating installations that meet the design criteria. Based on the existing language and observations in the field, contractors and inspectors are not being held to these criteria, and many prefabricated units are not properly connected to their foundations and are at risk of overturning.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornadoes, it was found that several residential and community prefabricated shelters lacked the adequate anchoring systems. Such an anchoring system can be seen in the figures below and in Section 8.4.1.2 of the 2011 Tornado Outbreak Mitigation Assessment Team Report.

The proposed language serves to strengthen the enforcement of proper installation of prefabricated shelters. Items 17 and 18 are design criteria developed by the manufacturer that would be required as part of the design information for the pre-fabricated unit and its foundation connections and capacity. Providing this information will help the contractor to understand the design assumptions and ensure an adequate solution is implemented. Item 19 requires manufacturers to develop at least one prescriptive solution for the foundation design of prefabricated units. This item is essential. If a prescriptive foundation design is available for a contractor to implement, and if the existing or new foundation will meet the prescriptive design, a much higher assurance that the unit will be properly installed to meet the design criteria of ICC-500 is provided. However, if the existing or new foundation that the unit will be installed on does not meet the prescriptive design, the contractor should not make assumptions on the capacity of an “ad-hoc” or abnormal foundation. Since the consultation of a design, this proposal will give manufacturers the incentive to develop prescriptive solutions that cover the majority of foundations proper anchoring of shelters on foundations with sufficient capacity, and manufacturers will keep total shelter costs down while still efficiently meeting the criteria in ICC 500. If consultation is required between the manufacturer and contractor in some instances with foundations not covered by prescriptive solutions, items 17 and 18 will help to facilitate the contractor to install the unit in an acceptable manner, which will help to minimize the costs incurred as they develop an adequate solution. A proposal to require the contractor to install a pre-fabricated shelter only to specifications developed by the manufacturer has been provided for Section 107.3.3.
Durant Police Station, Holmes County, Community Safe Room

Manufactured anchors and straps used to secure the safe room.
Committee Action: Accept in principle

Committee Reason:
IS-STM14-11/12
Section 107.2 and 107.3

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

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

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.

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

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

107.3 Quality assurance plan. The construction documents for community shelters shall contain a quality assurance plan in accordance with Sections 107.3.1 through 107.3.3.

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

(No changes to Items 1 through 6.)

7. Requirements for components and cladding including soffits.
8. Corrosion resistance or protection of metal connectors providing load path continuity and exposed to the elements that provide load path continuity.
9. Requirements for critical support systems and connections and debris impact protection of the components and connections.

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

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

1. (No changes.)
2. (No changes.)
3. (No changes.)
4. (No changes.)

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

**Reason:** The purpose of this proposal is to provide editorial clarifications to the requirements for construction documents and quality assurance plans. The notable changes are as follows:

107.2 – “On the construction documents” implies that “construction documents” = drawings. “As part of” includes specifications, certification letters, calculations, product data sheets and other elements of a submitted design package.

107.2.5 – While both details and installation requirements can be “provided” on a drawing, there may be manufacturer installation instructions that are best “included” with the overall submittal package.

107.3.1 – I can inspect a “component” or a “system”, but I can’t inspect a “requirement”.

107.3.2 – As written this section appears to require a QA plan for the design process of certain elements. While it’s certainly not a bad idea for a structural engineering firm to have an internal QA/QC process, I think the intent was to have a QA plan for the construction of the MWFRS and wind-resistant C&C elements.

107.3.3 – The exception is clarified to specify that it is the shelter components that need to be labeled as meeting the building code, not the inspecting agency.

**Committee Action:** Accept in principle

**Committee Reason:**
IS-STM15-11/12
Section 107.3.1


Revise as follows:

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

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

Reason: As more storm shelters and safe rooms are constructed, FEMA has noted that one area where enforcement and responsibility is lacking is the installation of prefabricated storm shelters and safe rooms. Prefabricated units are the predominant choice for residential storm shelters. ICC 500 should provide language to strengthen the contractor responsibility, making it clear that the contractor is responsible for properly installing a prefabricated unit. This requires that the capacity of the foundation be evaluated and strengthened if needed, and that the connections between the prefabricated unit and the foundation be sufficient to meet the criteria in ICC 500. Based on the existing language and observations in the field, contractors are not being held to these criteria, and many prefabricated units are not properly connected to their foundations.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornadoes, it was found that several residential and community pre-fabricated shelters lacked the adequate anchoring systems, including the residential shelter shown below and described in Section 8.4.1.2 of the 2011 Tornado Outbreak Mitigation Assessment Team Report. Although the safe rooms would still provide an level of safety to the occupants, the inconsistent use of anchors resulted in a lack of confidence by the potential users. Such an anchoring system can be seen in the figures below.
Durant Police Station, Holmes County, Community Safe Room
Manufactured anchors and straps used to secure the safe room.
Smithville, MS – Above ground prefabricated shelter lacking any anchoring system. (Figure 8-26 in Mitigation Assessment Team Report)

Source:
Chapter 8, 2011 Tornado Outbreak Mitigation Assessment Team Report
Section 9.5.1 and 9.5.2, Mitigation Assessment Team Report, 2011 Tornado Outbreak

Committee Action: Accept in principle

Committee Reason:

Revise as follows:

**107.3.3 Contractor responsibility.** Each contractor responsible for the construction of a main wind force resisting system or any component listed in the quality assurance plan shall submit a written statement of responsibility to the authority having jurisdiction, the responsible design professional, and 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 conformance 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.
5. For pre-fabricated storm shelters, ensuring proper installation and foundation construction as specified by the manufacturer.

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

Reason: As more storm shelters and safe rooms are constructed, FEMA has noted that one area where enforcement and responsibility is lacking is the installation of prefabricated storm shelters and safe rooms. Prefabricated units are the predominant choice for residential storm shelters, and the existing language in Section 107.3.3 provides an exception for contractors with regard to their responsibilities. While contractors should not be held responsible for the testing and Approved of pre-fabricated units, they must be held responsible for proper installation of those units. ICC 500 should provide language to strengthen the section for contractor responsibility, making it clear that the contractor is responsible for properly installing a prefabricated unit. This requires that the capacity of the foundation be strengthened if needed, and that the connections between the prefabricated unit and the foundation be sufficient to meet the criteria in ICC 500. Based on the existing language and observations in the field, contractors are not being held to these criteria, and many prefabricated units are not properly connected to their foundations. The most effective method of ensuring that pre-fabricated units are properly installed is to force the manufacturer to provide the appropriate installation guidance to the contractor. Therefore, the manufacturer must provide installation instructions and the contractor must follow them. In cases in which the instructions do not apply to an existing foundation, the manufacturer should provide guidance to the contractor for an acceptable solution to be implemented.

Based on the results of the FEMA Mitigation Assessment Team efforts after the 2011 Spring tornados and the 2010 MS Tornados, it was found that several residential and community pre-fabricated shelters lacked the adequate anchoring systems. Although the safe rooms would still provide a level of safety to the occupants, the inconsistent use of anchors resulted in a lack of confidence by the potential users. Such an anchoring system can be seen in the figures below and, in the case of the Smithville, MS shelter, described in Section 8.4.1.2 of the 2011 Tornado Outbreak Mitigation Assessment Team Report. An example of improper installation/anchoring resulting in uplift of an underground shelter is shown in the figure below of the underground safe room from Smithville, MS.
Committee Action: Accept in principle

Modified Motion:

107.3.3 Contractor responsibility. Each contractor responsible for the construction of a main wind force resisting system or any component listed in the quality assurance plan shall submit a written statement of responsibility to the authority having jurisdiction, the responsible design professional, and 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.

Smithville, MS – Above ground prefabricated shelter lacking any anchoring system. (Figure 8-26 in Mitigation Assessment Team Report).

Smithville, MS shelter subject to uplift (Figure 8-31 in 2011 Tornado Outbreak MAT Report)
2. Acknowledgement that control will be exercised to obtain conformance 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.
5. For pre-fabricated storm shelters, ensuring proper installation and foundation construction as specified by the manufacturer.

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

Committee Reason:
IS-STM17-11/12
Section 108.1

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

108.1 Design information. All shelters except for non-prefabricated shelters constructed as part of a one- or two-family dwelling 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. For non-prefabricated shelters constructed as part of a one- or two-family dwelling, the design information shall be provided as part of the homeowner's manual.

Reason: The purpose of this proposal is to provide an exception to placing a visible sign on or in a site-built shelter constructed as part of a one- or two-family dwelling. Often, such shelters may serve other purposes such as a walk-in closet, storage room, or bathroom. The average homeowner, even in “Tornado Alley”, is probably not going to want the permanently-affixed sign mandated by this provision and is likely to either remove or paint it over. The requirement also specifies the sign shall remain visible. Does this mean if the homeowner hangs clothing in front of the sign (or a mirror, or a shoe tree) that he has violated the standard? One also wonders if having the builder's information so prominently displayed would increase the chances of the homeowner calling them to resolve minor issues not related to the shelter or placing a claim when otherwise they might take of care the problem themselves. This proposal replaces the signage requirement for a shelter built into a dwelling with a requirement to provide the requested information as a part of the homeowner's manual, warranties, etc. provided when the dwelling is turned over to the homeowner.

Committee Action: Disapproved
Pass, 10 - 1

Committee Reason:
IS-STM18-11/12
Section 202

Proponent: James Bell, representing ASSA ABLOY

Add new text as follows:

SECTION 202
DEFINITIONS

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

DOOR, WINDOW, AND SHUTTER ANCHOR CALCULATION. When listing alternate anchoring of door, window, and shutter framing to the shelter other than what was actually tested, the use of standard accepted engineering practices for calculating pull out and sheer loads and anchor placement shall be accomplished by an independent engineer for each type of alternate anchoring.

Reason: Each different type of anchor has different holding abilities when used in different substrates and along with the safety factors required by engineers in evaluating anchor placement and load baring capabilities is invaluable to the safety of the occupants of the shelter during an event.

Committee Action: Accept in principle

Committee Reason: Does not belong in definition.

9/27 Committee – HFS__Kurt Roeper to re-cast as language in reg text elsewhere
Add new text as follows:

SECTION 202
DEFINITIONS

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

An independent certification and permanent label applied on a product that contains the name of the manufacturer or the manufacturer's unique identification, the performance characteristics of the product or material and the name and identification of the Approved agency, and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency.

Reason: For doors, windows, and shutters there is a need to show that test were completed on all components of the approved assembly and since there can be varying levels of pressures and impacts to relay that information to inspectors and users of those products.

Committee Action: Accept in principle
Committee Reason: Does not belong in a definition.

9/27 – revision in legislative format

#19

Label. An identification applied on a product by the manufacturer. An independent certification and permanent label applied on a product that contains the name of the manufacturer or the manufacturer's unique identification, the function and performance characteristics of the product or material and the name and identification of the Approved agency, and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency.

9/27 Committee AS 8-0
IS-STM20-11/12
Section 302.1, 302.2, 304.1, 306.3, 306.4, 702.1.4, 703.1.5, 703.6.5, 804.9.6, 804.9.7, 804.10.1, 806.1, 806.5 and 806.5.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

302.1 Strength design. For Strength Design or Load and Resistance Factor Design (LRFD), use the load combinations stated in ASCE 7, Section 2.3.2 with the following additional load combinations being based on Section 304:

1. In load combination 3, replace 0.5W 0.8W with 0.3W 0.5W
2. In load combinations 4 and 6, replace 1.0W 1.6W with 0.6W 1.0W
3. Exception 1 shall not apply

302.2 Allowable stress design. For Allowable Stress Design (ASD), use the load combinations stated in ASCE 7, Section 2.4.1 with the following additional load combinations with W in these additional load combinations being based on Section 304:

1. In load combinations 5, 6, and 7, replace 0.6W with 0.4W 0.6W

304.1 General. Design wind pressures shall be determined using Chapter 27, Part I or Chapter 28, Part 1 Method 2, Analytical Procedure from Section 6 of ASCE 7 except as modified by this section.

306.3 Wall and roof openings. All openings in the shelter envelope shall be protected by doors complying with Section 306.3.1, windows complying with Section 306.3.2, other impact-protective system opening protective device complying with Section 306.4, or baffled to prevent windborne debris from entering the shelter protected occupant area in accordance with Section 306.5.

306.4 Opening Protective Devices. Impact-protective systems. Opening protective devices. Impact-protective systems such as shutters and protective screens shall be tested for missile impact in accordance with Chapter 8.

Exception: Non-operable, permanently affixed shields or cowlings are excluded from pressure testing requirements of Section 806.5.

306.4.1 Opening Protective Devices in tornado shelters. Impact-protective systems. Opening protective devices in tornado shelters shall be permanently affixed, and manually operable from inside the shelter.
702.1.4 Exhaust or intake opening protection. Air exhaust or intake openings that terminate outside of occupied shelter areas and occupant support areas shall comply with the provisions of Section 306.3 for exterior wall and roof impact-protective systems opening protectives.

703.1.5 Exhaust or intake opening protection. Air exhaust or intake openings that terminate outside of occupied shelter areas and occupant support areas shall comply with the provisions of Section 306.3 for exterior wall and roof impact-protective systems opening protectives.

703.6.5 Location. Emergency 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 opening protectives in accordance with this standard.

Opening Protective Device—Shutter, door or other device mounted on the inside or outside of the exterior wall of a shelter.

Impact-Protective System—System or device such as a shutter, door, or other device mounted on the inside or outside of the exterior wall of a shelter and which has been demonstrated by testing to be capable of withstanding the impact of test missiles as detailed in this standard.

804.9.6 Opening Protective Devices. Impact-protective systems. All shutter assemblies and other Impact Protective Protection Systems shall be impacted in the center of the closed opening, and at one interface corner as detailed in Figure 804.9.6-1. Panels and interface joints shall be impacted as shown in Figure 804.9.6-2. Interface hinge joints and primary latches, where present, shall be impacted as shown in Figure 804.9.5-2 on an additional specimen.

804.9.7 Alcove or Baffled Entry Systems. Debris impact testing described in this section is required for alcove/baffled access/egress systems meeting the requirements of Sections 304 and 305. Figure 804.9.7 illustrates an alcove/baffle system. Debris impact test requirements are presented for systems for which:

1. Storm debris impacts at least two impact-protective systems shelter protective elements meeting the requirements of Section 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 804.9.7.1. Examples of this type of system are shown in Figure 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 shelter.

2. Storm debris impacts initially a impact-protective systems shelter protective elements meeting the requirements of Section 306.2 and possibly rebounds to impact an entry door. Straight missile paths and elastic
impacts are assumed in determining missile trajectories. The debris test requirements for this type of system are presented in Section 804.8.7.2. Examples of this type of system are shown in Figure 804.9.7.2-1 and Figure 804.9.7-2-2.

3. Storm debris impact on an entry door is limited to an angle less than 90 degrees by impact-protective systems protective elements. The debris test requirements for this type of system are presented in Section 804.8.7.3. Examples of this type of system are shown in Figure 804.9.7.3.

804.10.1 Perforation. Any perforation of the interior surface of the tested component of the shelter envelope by the design missile shall constitute a failure. For impact-protective systems opening protective devices, perforation or deflection that would result in impact of the protected component constitutes a failure.

806.1 Pressure Testing Procedures. Procedures for pressure testing wall assemblies, roof assemblies, door assemblies, window assemblies, and impact-protective systems opening protective devices requiring pressure testing are presented in this section.

806.5 Opening Protective Devices. Impact-protective systems. External impact-protective systems opening protective devices such as shutters and protective screens shall be tested for ability to withstand prescribed pressures if withstand pressure is critical to their function when installed. Devices such as non-operable, permanently affixed shields or cowlings whose only function is to protect against debris intrusion need not be pressure tested.

806.5.1 Opening Protective Devices. Impact-protective systems. for Tornado Shelters. External impact-protective systems protective devices for tornado shelters whose ability to withstand wind-induced pressure when installed is critical to their function shall be static pressure tested following procedures specified in ASTM E330 to a pressure of at least 1.2 times the pressures specified in Section 304. Debris impact tests and pressure tests are permitted to be conducted separately.

Exception: Impact-protective systems Protective devices with a jamb or stop need be tested only with pressure away from the stop.

806.5.2 Opening Protective Devices for Hurricane Shelters. External impact-protective systems protective devices for hurricane shelters whose ability to withstand wind-induced pressure when installed is critical to their function shall be static pressure tested to a pressure of at least 1.2 times the shelter design wind pressures specified in Section 304 following the procedures specified in ASTM E330. Cyclic pressure tests conducted according to Section 805.5 shall be conducted after debris impact tests.
Reason: The purpose of this proposal is to provide coordination with ASCE 7-10. The latest version of ASCE 7 changed the wind maps from an allowable stress to a strength design basis and adjusted the load factors accordingly. The 1.6W for strength design is now 1.0W, and the 1.0W for allowable stress design is now 0.6W. Hence the ICC-500 load combinations need to be revised (divided by 1.6) to reflect the change. Also, the wind chapters were reorganized, with Chapter 6 now split into Chapters 26 through 31. The “all-heights” (directional) analytical method is now in Chapter 27; the “low-rise” (envelope) analytical method is now in Chapter 28. The reason Part I is specified for each chapter is to exclude the simplified low-rise method which was Method 1 under ASCE 7-05 and is now Part II of Chapter 28, and to similarly exclude the new 160-ft “simplified” method which is Part II of Chapter 27.

Finally, the term “impact protective system” is now used in the wind-borne debris section to refer to shutters or other opening protection other than impact-resistant glazing.

Committee Action: Accept in principle
Formula changes proposed in 302.1 must be tailored to ASCE7-10
Committee Reason:

9/27 – SEE GARY EHRLICH FILE -- Accept in Principle

Revised proposal 9/27:

IS-STM20-11/12
Section 302.1, 302.2, 304.1, 306.3, 306.4, 702.1.4, 703.1.5, 703.6.5, 804.9.6, 804.9.7, 804.10.1, 806.1, 806.5 and 806.5.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Proposal revised 9/13/2012 per TG-2 discussions. This proposal replaces the originally-submitted version of IS-STM20 in its entirety.

Add new definition to Section 202 as follows:

Impact-Protective System. System or device such as a shutter, door, or other device mounted on the inside or outside of the exterior wall of a shelter and which has been demonstrated by testing to be capable of withstanding the impact of test missiles as detailed in this standard.

Revise as follows:

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 determined in accordance with Section 304 of this standard. Exception 1 to ASCE 7 Section 2.3.2 shall not apply. 2.3.2 with the following additional load combinations with W in these additional load combinations being based on Section 304.
1. In load combination 3, replace 0.8W with 0.5W

2. In load combinations 4 and 6, replace 1.6W with 1.0W

3. Exception 1 shall not apply

302.2 Allowable stress design. For Allowable Stress Design (ASD), use the load combinations stated in ASCE 7, Section 2.4.4, with W determined in accordance with Section 304 of this standard, with the following additional load combinations with W in these additional load combinations being based on Section 304:

1. In load combinations 5, 6, and 7, replace W with 0.6W

306.3 Wall and roof openings. All openings in the shelter envelope shall be protected by doors complying with Section 306.3.1, windows complying with Section 306.3.2, other impact-protective systems—opening protective device complying with Section 306.4, or baffled to prevent windborne debris from entering the shelter protected occupant area in accordance with Section 306.5.

306.4 Opening Protective Devices. Impact-protective systems. Opening protective devices Impact-protective systems such as shutters and protective screens shall be tested for missile impact in accordance with Chapter 8.

Exception: Non-operable, permanently affixed shields or cowlings are excluded from pressure testing requirements of Section 806.5.

306.4.1 Opening protective devices Impact-protective systems in tornado shelters. Impact-protective systems—Opening protective devices in tornado shelters shall be permanently affixed, and manually operable from inside the shelter.

702.1.4 Exhaust or intake opening protection. Air exhaust or intake openings that terminate outside of occupied shelter areas and occupant support areas shall comply with the provisions of Section 306.3 for exterior wall and roof impact-protective systems opening protectives.

703.1.5 Exhaust or intake opening protection. Air exhaust or intake openings that terminate outside of occupied shelter areas and occupant support areas shall comply with the provisions of Section 306.3 for exterior wall and roof impact-protective systems opening protectives.

703.6.5 Location. Emergency 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 opening protectives in accordance with this standard.
804.9.6 Opening Protective Devices. Impact-protective systems. All shutter assemblies and other Impact Protective Protection Systems shall be impacted in the center of the closed opening, and at one interface corner as detailed in Figure 804.9.6-1. Panels and interface joints shall be impacted as shown in Figure 804.9.6-2. Interface hinge joints and primary latches, where present, shall be impacted as shown in Figure 804.9.5-2 on an additional specimen.

804.9.7 Alcove or Baffled Entry Systems. Debris impact testing described in this section is required for alcove/baffled access/egress systems meeting the requirements of Sections 304 and 305. Figure 804.9.7 illustrates an alcove/baffle system. Debris impact test requirements are presented for systems for which:

4. Storm debris impacts at least two impact-protective system shelter protective elements meeting the requirements of Section 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 804.9.7.1. Examples of this type of system are shown in Figure 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 shelter.

5. Storm debris impacts initially an impact-protective system shelter protective elements meeting the requirements of Section 306.2 and possibly rebounds to impact an entry door. Straight missile paths and elastic impacts are assumed in determining missile trajectories. The debris test requirements for this type of system are presented in Section 804.8.7.2. Examples of this type of system are shown in Figure 804.9.7.2-1 and Figure 804.9.7-2-2.

6. Storm debris impact on an entry door is limited to an angle less than 90 degrees by an impact-protective system protective elements. The debris test requirements for this type of system are presented in Section 804.8.7.3. Examples of this type of system are shown in Figure 804.9.7.3.

804.10.1 Perforation. Any perforation of the interior surface of the tested component of the shelter envelope by the design missile shall constitute a failure. For impact-protective systems opening protective devices, perforation or deflection that would result in impact of the protected component constitutes a failure.

806.1 Pressure Testing Procedures. Procedures for pressure testing wall assemblies, roof assemblies, door assemblies, window assemblies, and impact-protective systems opening protective devices requiring pressure testing are presented in this section.
806.5 Opening Protective Devices. Impact-protective systems. External impact-protective systems opening protective devices such as shutters and protective screens shall be tested for ability to withstand prescribed pressures if withstanding pressure is critical to their function when installed. Devices such as non-operable, permanently affixed shields or cowlings whose only function is to protect against debris intrusion need not be pressure tested.

806.5.1 Opening Protective Devices. Impact-protective systems for Tornado Shelters. External impact-protective systems protective devices for tornado shelters whose ability to withstand wind-induced pressure when installed is critical to their function shall be static pressure tested following procedures specified in ASTM E330 to a pressure of at least 1.2 times the pressures specified in Section 304. Debris impact tests and pressure tests are permitted to be conducted separately.

**Exception:** Impact-protective systems Protective devices with a jamb or stop need be tested only with pressure away from the stop.

806.5.2 Opening Protective Devices. Impact-protective systems for Hurricane Shelters. External impact-protective systems protective devices for hurricane shelters whose ability to withstand wind-induced pressure when installed is critical to their function shall be static pressure tested to a pressure of at least 1.2 times the shelter design wind pressures specified in Section 304 following the procedures specified in ASTM E330. Cyclic pressure tests conducted according to Section 805.5 shall be conducted after debris impact tests.

Dennis Graber to check loads

**9/27 – Dennis Graber check OK—AS per revised proposal 9/27**
IS-STM21-11/12
Section 305.1.2


Revise as follows:

305.1.2 Missile criteria for hurricane shelters. The debris impact test missile for all components of the shelter envelope of hurricane shelters shall be a 9 pound (4.1 kg) sawn lumber 2x4. The speed of the test missile impacting vertical shelter surfaces shall be a minimum of 0.40 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.

Reason: A change from the value of 0.4 to 0.5 times the shelter design wind speed is the most conservative approach to meeting the needs of the shelter occupants and designers. Based on Lin and Home’s 2007 paper published in the ASCE Journal which considered the trajectories of rod type wind borne debris in horizontal winds, it is determined that the speed of the wind born debris is a function of the relationship between the aerodynamic force and the gravity force, or the Tachikawa number. If we assume a wind speed of 60 m/s (134 mph) and a standard 2x4 missile, the speed of the test missile is approximately 0.4 at 5 m (16 ft), 0.5 at 10 m (32 ft), 0.6 at 20 m (65 ft) and 0.7 at 40 m (131 ft).

In addition, changing the 0.4 factor to 0.5 will bring ICC 500 more in-line with FEMA’s guidance. Resolving the difference between ICC 500 and FEMA 361 on this issue will be beneficial for designers and manufacturers of storm shelters by removing the discrepancy between the two documents.

Durant Police Station, Holmes County, Community Safe Room

Manufactured anchors and straps used to secure the safe room.
Committee Action: Hold for further discussion

Committee Reason: 9/27 Committee AS 9-0
Section 306.3.2

**Proponent:** Gary J. Ehrlich, P.E. NAHB

**Revise as follows:**

306.3.2 Testing of window assemblies and other glazed openings. Operable and non-operable window assemblies (operable and non-operable) 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 and with cyclic pressures in accordance with ASTM E 1996.

**Reason:** The purpose of this proposal is to clarify the glazing test requirements. An editorial change is made to remove text in parenthesis, which is considered commentary. The reference to “cyclic pressures in accordance with ASTM E 1996” is deleted as it is incorrect. E 1996 just specifies impact testing requirements. The cyclic pressure test is detailed in ASTM E 1886. Since Section 805.3 points directly to the cyclic pressure test requirements in E 1886, an additional pointer is not necessary in 306.3.2.

**Committee Action:** Approved

**Committee Reason:**

Pass, 12 - 0
IS-STM23-11/12
Section 306.4.1

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

306.4.1 Opening protective devices in tornado shelters. Opening protective devices in tornado shelters shall be permanently affixed to the exterior of the shelter. Devices shall be, and manually operable from inside the shelter or provided with a switch, remote control, or other automated means of moving the device into place.

Reason: The purpose of this proposal is to clarify the opening protection requirements. One assumes the impact protective system would be affixed to the outside of the shelter, but the language does not clearly say that. Also, the operation requirement is amended to indicate that switches, remote controls or other automatic means of moving devices into place are permitted. Otherwise, the requirement could be taken to imply that only a hand crank, slider, winch, or other literally hand-operated means are allowed.

Committee Action: Accept in principle

Modified Motion:

306.4.1 Opening protective devices in tornado shelters. Opening protective devices in tornado shelters shall be permanently affixed to the exterior of the shelter. Devices shall be, and manually operable from inside the shelter or provided with a switch, remote control, or other automated means of moving the device into place, as well as permitted.

Structural task group recommendation 9/11:

306.4.1 Opening protective devices in tornado shelters. Opening protective devices in tornado shelters shall be permanently affixed to the exterior of the shelter. Devices shall be, and manually operable from inside the shelter, or provided with a switch, remote control, or other automated means of moving the device into place. In addition, automated means of moving the device into place are permitted.

Committee Reason:

9/27 Committee: Motion D Task group rec: Pass 8-0
9/27 Committee: Motion D on proposal : (Return back to original text): Pass 7-1
Section 307.1

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

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.

Exceptions:

1. Residential shelters which are fully enclosed in a Host Building constructed in compliance with the local building code.
2. Non-public community shelters which are fully enclosed in a Host Building constructed in compliance with the local building code and having a shelter occupancy of 50 or less persons.

Reason: Residential shelters in Host Buildings are typically protected from rainwater penetration before the peak wind forces of a hurricane occur and are not typically occupied after a hurricane has passed. Therefore, the duration of exposure to rainwater penetrating the shelter exterior cladding or assemblies of an interior hurricane shelter would be limited to the time required for storm winds exceeding the design winds for the Host Building to pass. Imposing the requirement on construction of residential shelters would discourage rather than promote hurricane shelter construction.

Requiring all community shelters to meet this standard imposes an unnecessarily expensive requirement on hurricane shelter construction which is not essential to protection for the forces and debris from a hurricane and which will result in the discouragement of small residential facilities owners to construct hurricane shelters complying with section 307.1 for protection of tenants. It was known to the IS-STM Committee that the American Red Cross desired that the consensus committee require that public (community) hurricane shelters resist rainwater penetration during the peak design wind due to prior bad experiences with rainwater intrusion in large ARC storm shelters. However, no rationale was presented to the committee for requiring homeowners and smaller, non-public residential building owners to pay such a premium for protecting tenants. The requirement for Section 307.1 should have an exception which provides for small, non-public residential shelters constructed entirely within Host Buildings and for shelters constructed entirely within Host Buildings and intended for such non-public applications as hurricane protection of personnel working in essential facilities where personnel are required to remain at the facility during a hurricane.

Committee Action: Hold for further study

Committee Reason:

9/27 Committee: AM – Waller/2Ehrlich: Split question

Exception 1 Pass 8-0
Exception 2 Fail 4-4
IS-STM25-11/12
Section 308.1.1

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

308.1.1 Stability. In addition to structural stability requirements of Section 309, structural stability of a storm shelter shall also be determined for the building code design wind speeds (wind speeds which are below the shelter design wind speeds) where the host building or components thereof could transmit forces in connections to the storm shelter that are equal to 1.5 times the nominal strength of the connections.

Reason: Changing wind speeds to wind speed (singular) is consistent with the singular “storm shelter” subject.

The NSSA has received numerous questions regarding the meaning of connections between the host building and the storm shelter. The proposed revisions are intended to clarify that certain interior components of a host building such as partitions may be connected to the storm shelter for architectural reasons. For example, a non-load bearing partition of an adjacent room may connect to the vertical face of a storm shelter within the host building. Or, a load bearing partition of the host building may bear on the roof of a storm shelter. In either case, the storm shelter must be able to remain structurally stable while carrying the forces of any attached host building components with the connection of these components assumed to be applying 1.5 times the nominal strength of the connections of these components to the storm shelter in shear and tension.

It is assumed that any components of the host building, connected to a storm shelter, which are exposed to design wind speeds for the host building (90 mph, for example) will remain attached to the storm shelter. It is also assumed that connections of these components to the storm shelter will not fail until the wind speed reaches a higher wind speed than the design wind speed for the host building, but less than the storm shelter design wind speed. Regardless, Section 308.1.1, as revised, assures that connections of host building components to the storm shelter will not result in forces being transmitted to the storm shelter at any wind speed which will result in instability of the storm shelter.

Committee Action: Accept in principle

Committee Reason:
IS-STM26-11/12
Section 309.1.1 and 309.1.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

309.1.1 Structural stability of storm shelter foundations. Foundations and slabs other than host buildings designed in accordance with Section 308.1.1, foundations and slabs that provide structural stability for storm shelters shall be designed to resist the combined uplift and lateral forces on the shelter that are calculated for the storm shelter design wind speed assuming the host building is totally destroyed by the windstorm.

Exception: Where the host building is designed in accordance with Section 308.1.1, the design of foundations and slabs shall not be required to assume the host building is totally destroyed by the windstorm.

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

309.1.2.1. Slabs on grade. Slabs on grade shall be designed for the applicable loads in accordance with Section 301. Where a slab on grade is being used to resist loads, 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 x 6 – W1.4 x W1.4 or No. 4 bars, 18 inches on center in either direction.

Exception: Concrete and concrete masonry storm shelters shall be permitted to be constructed within existing one & 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 does not exceed 2000 psf (95.8 kN/m²) for design loading conditions other than design storm shelter events and 3000 psf (143.7 kN/m²) 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 The reinforcement requirements in the slab on grade shall not be required where the are waived if dead load of the slab is not required to resist overturning.

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

Reason: The purpose of this proposal is to provide editorial revisions and clarifications to the provisions for the design of storm shelter connections to foundations and slabs-on-grade. The significant changes are as follows:

309.1.1 – The alternative for buildings constructed to the additional requirements of Section 308 is more cleanly as an exception.

309.1.2 – The intent of the requirement for consideration of wind uplift forces on foundations and slabs is not clear. An editorial revision is suggested to clarify the intent as we read it.

309.1.2.2 – Editorial revision so the section does not read as if the expansion, contraction and construction joints are what is being used to resist the uplift loads on the storm shelter and slab-on-grade.

Committee Action: Accept in principle

Committee Reason:
SECTION 310
PENETRATIONS OF STORM SHELTER ENVELOPE BY SYSTEMS AND UTILITIES

310.1 Penetrations of storm shelter envelope by systems and utilities. Penetrations or openings through the storm shelter envelope larger than 3 ½ square inches (2258 mm²) or 2 1/16 inches (52.38 mm) for systems and utilities installed for any purpose, shall be considered openings and shall be protected in accordance with Section 306.3. Penetrations or openings through the storm shelter envelope shall not degrade the structural integrity of the storm shelter and missile impact resistance of the storm shelter envelope. This gap will allow smaller airborne debris to enter the shelter, and potentially result in injuries to shelter occupants.

Reason: Section 310 is applicable to penetrations for systems and utilities. It does not seem to apply to other openings. For example, I recently observed a gap between the floor and the bottom of the door on a manufactured storm shelter. The gap was between 2 and 2 ¼ inches in height, and between 72 and 81 square inches in area. The opening does not seem to be necessary for ventilation because sufficient ventilation is provided by protected openings. Since this opening was not related to a system, utility or ventilation, it appears to be permissible per the current standard.

A severe wind event generates debris in all shapes and sizes. The 2nd photo shows the crushed stone that surrounds the shelters, which is a potential source of debris. Following the Joplin tornado, a photo (Joplin Globe, June 3, 2001) shows a piece of lumber that has pierced a concrete curb. The unprotected openings illustrated in the photos, and similar openings, will allow debris to enter the shelter and have potential for injuries. The proposed change will address all openings.

Committee Action: Accept in principle

Committee Reason:
9/27 HFS – wait task group recommendation 27, 28, 49
IS-STM28-11/12
Section 310.1

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

310.1 Penetrations of storm shelter envelope by mechanical, electrical and plumbing systems and utilities. 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 mm²) in area for rectangular penetrations or 2-1/16 inches (52.38 mm) in diameter for systems and utilities installed for any purpose, shall be considered openings and shall be protected in accordance with Section 306.3. 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 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 codes and standards governing such utility lines.

Reason: The purpose of this proposal is to provide editorial clarifications. It appears the intent is to limit penetration size to 3.5 square inches in area or 2-1/16 inches in diameter. It is noted the latter works out to 3.34 square inches in area. “Hazardous” appears not to be necessary and is deleted. It is noted that otherwise the 2nd paragraph could be considered as only limiting lines carrying hazardous liquids. In reality, it seems like even a standard water line should have a shutoff.

Committee Action: Accept in Principle

Committee Reason:

9/27 HFS – wait task group recommendation 27, 28, 49
IS-STM29-11/12
Section 410.1.2

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be determined by:

1. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
2. One foot (304.8 mm) above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or in a mapped nonparticipating community.

Exception: Residential shelters constructed within an existing one- or two-family dwelling shall not be required to comply with the requirements of this section.

Reason: The purpose of this proposal is to add an exception to the floodplain requirements, in particular the one foot requirement in a non-flood-hazard area, for a new shelter built in an existing dwelling. This provision could create a disincentive for a homeowner to retrofit a safe room within their home. The one foot requirement is likely to conflict with the lower ceiling heights provided in older homes and make it technically infeasible to provide a shelter inside the home.

Committee Action: Disapproved

Pass, 5 - 3

Committee Reason: This provision is consistent with FEMA requirements for storm shelter location. Flooding is a concern for storm shelter occupants, especially in coastal areas.
IS-STM30-11/12
Section 404.1.1, 401.1.2


Revise as follows:

401.1.1 Minimum floor elevation of community and residential shelters. The lowest floor used for the occupied shelter and occupant support areas of a community and residential shelter shall be elevated to the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2% annual chance of being equaled or exceeded in any given year; or
2. Two feet above the flood elevation having a 1% annual chance of being equaled or exceeded in any given year; or
3. Two feet above the flood elevation corresponding to the highest recorded flood elevation if the area is not in a mapped special flood hazard area; or
4. The maximum flood inundation elevation associated with a Category 5 hurricane event, including coastal wave effects. In areas where Category 5 flood elevations have not been established, the elevation associated with the highest established hurricane category shall apply; or in an area subject to storm surge inundation.
5. The minimum elevation of the lowest floor required by the authority having jurisdiction.

Exception: Item no. 1 shall not apply to tornado shelters.

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be determined by:

1. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
2. One foot above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or in a mapped non-participating community.

Reason: The proposal seeks to eliminate 401.1.2 and make the requirements for residential shelters identical to those for community shelters – treating community and residential shelters the same (residential and community shelters should provide the same level of protection regardless of the intended occupants).

The proposed revisions to Section 401.1 seek to clarify the minimum floor elevation requirements for community storm shelters:
• Items 2 and 5 bring ICC-500 more in line with the provision of ASCE 24-05, which require Category IV structures to be elevated to the higher of the Design Flood Elevation (DFE) or BFE + freeboard. The next edition of ASCE 24 is being developed now, and may call for the elevation of Category IV structures above the 0.2-percent annual chance flood elevation (item 1).

• Item 3 has been modified to remove the freeboard that was added to the highest recorded flood elevation – unless the highest recorded elevation is low, item 1, 2, 4 or 5 will govern. If Item 3 governs, it is not believed reasonable to add freeboard to the record flood. Item 23 has also been revised so that the historical flood criterion applies to areas outside and inside the SFHA if this eliminates the strong possibility that shelter elevation requirements will be higher outside the SFHA than inside.

• Item 4 has been modified to add coastal wave effects, which can be significant in hurricane surge inundation areas; and to make clear that if Category 5 hurricane flood elevations have not been established, the flood associated with the highest established hurricane category shall be used (New England, for example, only establishes inundation for Category 4 hurricanes).

• Note that item 2 should be applied to areas outside the special flood hazard area where the ground elevation is below the BFE + 2 ft elevation. AHJs typically enforce freeboard only inside the SFHA, but in this case it should also apply to areas outside – the location of the SFHA boundary relative to the shelter should not alter the elevation requirement of item 2.

Committee Action: Hold for further study

Committee Reason:

Committee Action: 7/10/2012 AM
Modify proposal to read as follows:

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be determined by:

1. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
2. One foot (304.8 mm) above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or is in a mapped non-participating community, a flood hazard study has not been conducted for the area; or
3. The flood elevation, including coastal wave effects, having a 0.2-percent annual chance of being equaled or exceeded in any given year; or
4. The maximum flood elevation associated with a Category 5 hurricane event, including coastal wave effects. In areas where Category 5 flood elevations have not been established, the elevation associated with the highest established hurricane category shall apply.

Exception: Items 3 and 4 shall not apply to shelters designed, constructed, designated, and used only as tornado shelters.

Committee Reason:
IS-STM31-11/12
Section 404.1.1, 401.1.2


Revise as follows:

401.1.1 Minimum floor elevation of community and residential shelters. The lowest floor used for the occupied shelter and occupant support areas of a community and residential shelter shall be elevated to the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2% annual chance of being equaled or exceeded in any given year; or
2. Two feet above the flood elevation having a 1% annual chance of being equaled or exceeded in any given year; or
3. Two feet above the flood elevation corresponding to the highest recorded flood elevation if the area is not in a mapped special flood hazard area; or
4. The maximum flood inundation elevation associated with a Category 5 hurricane event, including coastal wave effects. In areas where Category 5 flood elevations have not been established, the elevation associated with the highest established hurricane category shall apply; or in an area subject to storm surge inundation.
5. The minimum elevation of the lowest floor required by the authority having jurisdiction.

Exception: Items no. 1, 2, 3 and 4 shall not apply to shelters designed, constructed, designated and used only as residential tornado shelters located outside of the hurricane-prone region.

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be determined by:

1. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
2. One foot above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or in a mapped non-participating community.

Reason: The proposal seeks to eliminate 401.1.2 and make the requirements for residential shelters identical to those for community shelters – treating community and residential shelters the same (residential and community shelters should provide the same level of protection regardless of the intended occupants).

The proposed revisions to Section 401.1 seek to clarify the minimum floor elevation requirements for community storm shelters:
- Items 2 and 5 bring ICC-500 more in line with the provision of ASCE 24-05, which require Category IV structures to be elevated to the higher of the Design Flood Elevation (DFE) or BFE + freeboard. The next edition of ASCE 24 is being developed now, and may call for the elevation of Category IV structures above the 0.2-percent annual chance flood elevation (item 1).

- Item 3 has been modified to remove the freeboard that was added to the highest recorded flood elevation — unless the highest recorded elevation is low, item 1, 2, 4 or 5 will govern. If item 3 governs, it is not believed reasonable to add freeboard to the record flood. Item 23 has also been revised so that the historical flood criterion applies to areas outside and inside the SFHA 0 this eliminates the strong possibility that shelter elevation requirements will be higher outside the SFHA than inside.

- Item 4 has been modified to add coastal wave effects, which can be significant in hurricane surge inundation areas; and to make clear that if Category 5 hurricane flood elevations have not been established, the flood associated with the highest established hurricane category shall be used (New England, for example, only establishes inundation for Category 4 hurricanes).

- The exception has been revised to clarify that residential shelters outside of hurricane prone regions as detailed in ASCE 7 intended for use only during tornados need only comply with the minimum elevation requirements otherwise pertaining to the structure (item 5).

- Note that item 2 should be applied to areas outside the special flood hazard area where the ground elevation is below the BFE + 2 ft elevation. AHJs typically enforce freeboard only inside the SFHA, but in this case it should also apply to areas outside — the location of the SFHA boundary relative to the shelter should not alter the elevation requirement of item 2.

Committee Action: See #32 Hold for further study

Committee Reason:
Section 404.1.1, 401.1.2


Revise as follows:

401.1.1 Minimum floor elevation of community and residential shelters. The lowest floor used for the occupied shelter and occupant support areas of a community and residential shelter shall be elevated to the higher of the elevations determined by:

1. The flood elevation, including coastal wave effects, having a 0.2% annual chance of being equaled or exceeded in any given year; or
2. Two feet above the flood elevation having a 1% annual chance of being equaled or exceeded in any given year; or
3. Two feet above The flood elevation corresponding to the highest recorded flood elevation if the area is not in a mapped special flood hazard area; or
4. The maximum flood inundation elevation associated with a Category 5 hurricane event, including coastal wave effects. In areas where Category 5 flood elevations have not been established, the elevation associated with the highest established hurricane category shall apply; or in an area subject to storm surge inundation.
5. The minimum elevation of the lowest floor required by the authority having jurisdiction.

Exception: Items no. 1, 2, 3 and 4 shall not apply to shelters designed, constructed, designated and used only as residential tornado shelters.

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be determined by:

1. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
2. One foot above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or in a mapped non-participating community.

Reason: The proposal seeks to eliminate 401.1.2 and make the requirements for residential shelters identical to those for community shelters – treating community and residential shelters the same (residential and community shelters should provide the same level of protection regardless of the intended occupants).

The proposed revisions to Section 401.1 seek to clarify the minimum floor elevation requirements for community storm shelters:
• Items 2 and 5 bring ICC-500 more in line with the provision of ASCE 24-05, which require Category IV structures to be elevated to the higher of the Design Flood Elevation (DFE) or BFE + freeboard. The next edition of ASCE 24 is being developed now, and may call for the elevation of Category IV structures above the 0.2-percent annual chance flood elevation (item 1).

• Item 3 has been modified to remove the freeboard that was added to the highest recorded flood elevation – unless the highest recorded elevation is low, item 1, 2, 4 or 5 will govern. If item 3 governs, it is not believed reasonable to add freeboard to the recorded flood. Item 23 has also been revised so that the historical flood criterion applies to areas outside and inside the SFHA 0 this eliminates the strong possibility that shelter elevation requirements will be higher outside the SFHA than inside.

• Item 4 has been modified to add coastal wave effects, which can be significant in hurricane surge inundation areas; and to make clear that if Category 5 hurricane flood elevations have not been established, the flood associated with the highest established hurricane category shall be used (New England, for example, only establishes inundation for Category 4 hurricanes).

• The exception has been revised to clarify that residential shelters outside of hurricane prone regions as detailed in ASCE 7 intended for use only during tornados need only comply with the minimum elevation requirements otherwise pertaining to the structure (item 5).

• Note that item 2 should be applied to areas outside the special flood hazard area where the ground elevation is below the BFE + 2 ft elevation. AHJs typically enforce freeboard only inside the SFHA, but in this case it should also apply to areas outside – the location of the SFHA boundary relative to the shelter should not alter the elevation requirement of item 2.

Committee Action: 7/10: AM
Replace proposal with the following

Option 2: One section for residential shelter elevation criteria with an exception for tornado-only shelters

401.1.2 Minimum floor elevation of residential shelters. The lowest floor used for the occupied shelter area of a residential shelter shall be elevated to the higher of the elevations determined by:

5. The minimum elevation of the lowest floor required by the floodplain ordinance of the community; or
6. One foot (304.8 mm) above the flood elevation corresponding to the highest recorded elevation if the area is not in a mapped special flood hazard area or is in a mapped non-participating community, a flood hazard study has not been conducted for the area; or
7. The flood elevation, including coastal wave effects, having a 0.2-percent annual chance of being equaled or exceeded in any given year; or
8. The maximum flood elevation associated with a Category 5 hurricane event, including coastal wave effects. In areas where Category 5 flood elevations have not been established, the elevation associated with the highest established hurricane category shall apply.

Exception: Items 3 and 4 shall not apply to shelters designed, constructed, designated, and used only as tornado shelters.
Section 403.1

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

403.1 Residential shelter siting. Residential tornado shelters shall be located within the residence that the shelter is intended to serve, or shall be located on the site such that the maximum travel distance from the access opening for the shelter to the furthest exterior door of within 150 feet (45 720 mm) of the residence or residences that the shelter is intended to serve does not exceed 150 feet (45 720 mm).

Reason: The purpose of this proposal is to clarify and improve the siting requirement for residential shelters. As written, it was not clear if all of the elements of the shelter including the edges of footings or other projecting elements, needed to be within 150 feet of the residence served. Also, no guidance was given as to where the 150 feet was measured from. Is it OK if the shelter is plopped down 150 feet from any random wall regardless of where the exits from the house are? The provision as written would allow the shelter to be placed 150 feet from the opposite side or end of the house from the one the egress door is on. Is that maximizing the utility of the shelter? It seems travel distance would be a better measure, even if that might require a bit more work to properly locate the shelter.

Committee Action: Accept in principle

Committee Reason:
IS-STM34-11/12
Section 404


Add new text as follows:

SECTION 404
SITING PROXIMITY TO FLOOD HAZARD AREAS

404.1 Community shelter siting. Community shelters shall be located outside of the following high-risk flood hazard areas:

1. The Coastal High Hazard Area (VE zones) or other areas known to be subject to high-velocity wave action; or
2. Areas seaward of the Limit of Moderate Wave Action (LiMWA) where mapped, also referred to as the Coastal A Zone in ASCE 24; or
3. Floodways.

Exception: In special circumstances, where consultation between local and state emergency management officials and the authority having jurisdiction concludes there is no other feasible option, community shelters shall be permitted in High Risk Flood Hazard Areas.

Reason: The proposed new Section 404 would provide community shelter siting requirements consistent with FEMA 361. This would require shelter construction outside of High Risk Flood Hazard Areas. At the time of the development of the ICC 500, flood siting information and guidance for life safety as provide in FEMA 361 (Second Edition, 2008). Based on the overall goal of a shelter to provide life safety from multiple hazards, restricting construction of community shelter is high risk flood hazard areas is not advisable.

Committee Action:
Modify proposal by replacing with the following:

404.1 Community Shelter Siting. Community 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), The Coastal High Hazard Area (VE zones) or other areas known to be subject to high-velocity wave action; or
2. Areas seaward of the Limit of Moderate Wave Action (LiMWA) where mapped, also known as the Coastal A Zone in ASCE 24; or

Exception: Community shelters shall be permitted in flood hazard areas subject to high-velocity wave action (V zones) coastal High Risk Flood Hazard Areas where permitted by the Board of Appeals in accordance with the provisions of the International Building Code.
404.1 Commentary. New community shelter buildings, and new community shelters constructed within, adjacent or attached to existing buildings, should not be located in coastal high risk flood hazard areas unless the Board of Appeals determines that there is no feasible alternative. The Board of Appeals should consider the following items in making its determination: 1) the fraction of the community within coastal high risk flood hazard areas, and whether it is feasible to locate community shelters outside these areas, 2) whether the shelter will be used for critical government purposes, and whether it will house first responders or other government officials who should stay behind in the event of an evacuation, and 3) whether the AHJ or other responsible government entity can issue evacuation orders in time to evacuate the affected population to designated public shelters or other safe havens.

Section 404 is not intended to preclude the continued use of existing community shelters that have been constructed prior to the effective date of this Standard, as long as those existing community shelters are not substantially damaged by a coastal flood and event.
IS-STM35-11/12
Section 202 and 501.1.2.1

Proponent: Gary J. Ehrlich, P.E. NAHB

1. Add new text as follows:

SECTION 202
DEFINITIONS

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

AREAS OF CONCENTRATED FURNISHINGS. The areas of a storm shelter or safe room with furniture or fixtures which cannot be easily moved, 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 or safe room with furniture or fixtures which can be easily moved, including areas such as classrooms and offices.

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

2. Revise as follows:

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

Reason: The purpose of this proposal is to clarify the calculation of usable floor area. How does the architect, shelter designer, or building official decide what constitutes "concentrated furnishings", "unconcentrated furnishings" or "open plan furnishings". Is this a case of "I know it when I see it"? What if the designer and the authority having jurisdiction disagree? What reference standard or other guidance document can they consult to resolve the dispute? Three
definitions are proposed. The first two are based on FEMA’s *Supplement to the Benefit-Cost Analysis Reference Guide*; the third is of our own devising but phrased to be consistent with the Reference Guide definitions.

Committee Action: Accept in principle

Committee Reason:
IS-STM36-11/12
Section 501.2

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

501.2 Number of doors. The number of means of egress doors from a space 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.

Where the applicable building code requires only one means of egress door, an emergency escape opening shall be provided in accordance with Section 501.4.

Exception: Shelters having 50 or less occupants whose floors are located at the level of exit discharge and having a maximum of 25 feet travel distance to the shelter exit door.

TASK GROUP:
501.2 Number of doors. The number of means of egress doors from a space 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.

Where the applicable building code requires only one means of egress door, an emergency escape opening shall be provided in accordance with Section 501.4.

Exception: Shelters having 50 or less occupants whose floors are located at the level of exit discharge and having a maximum of 25 feet travel distance to the shelter exit door are not required to have an emergency escape opening.

COMMITTEE: FURTHER MODIFY -- (SEE HIGHLIGHT):
Reason: Section 501.2 Number of doors, states that "The number of means of egress doors from a space 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 second paragraph of Section 501.2 states "Where the applicable building code requires only one means of egress door, an emergency escape opening shall be provided as calculated in accordance with Section 501.4. Section 501.4, Emergency escape opening, states "The emergency escape opening shall be an additional door or an opening that is a minimum of 5.7 square feet (0.530 m^2) in area." This provision presumes that the requirement should override the judgment of the AUTHORITY HAVING JURISDICTION in interpreting 2009 IBC, Section 1019.2.
Buildings with one exit, which for A, B, E, F, M, and U occupancies of one story, having 49 or less occupants and a maximum of 75 feet travel distance to an exit door, requires only one door not less than 32 inches clear width (Table 1016.1).

The proposer of this exception recommends “50 or less occupants” as the break point for requiring multiple doors or doors with emergency escape openings for the following reasons.

a. Community shelters will require a 3'-0” egress door whose width exceeds the width requirement of 2009 IBC, Section 1019.2.

b. The proposer is proposing a maximum of 25 feet (rather than 75 feet) travel distance to the exit door.

c. ICC-500 Table 702.1.1, TABLE 702.2, TABLE 703.1, TABLE 703.2, and TABLE 703.3 use the break point of “≤ 50 occupants”.

d. Section 501.2 allows no exceptions by the building official based on the applicable building code for unique shelter or Host Building conditions, occupancy, or conditions of the surrounding landscape. (See End Notes.)

e. Section 501.2 adds inordinate cost to small shelters which will discourage entities from constructing storm shelters meeting the requirements of section 501.2 within the premises of manufacturing facilities, businesses, hospitals, schools, government facilities, and the like.

END NOTES

1. 2009 IBC, Section 104 Duties and Powers of Building Official

Section 104.1 “The building official shall have the authority to render interpretations of this code and adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.”

   Section 104.3 “The building official shall issue all necessary notices or orders to ensure compliance with this code.

2. 2009 IBC, Section 102 Applicability

Section 102.4 Referenced codes and standards. “Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.


“The safe room should comply with the fire protection and life-safety requirements of the model building code, the state code, or the local code governing construction in the jurisdiction where the safe room is constructed.

Committee Action: Hold for further study

Committee Reason:
IS-STM37-11/12
Section 503.1

Proponent: Gary J. Ehrlich, P.E. NAHB

Revise as follows:

503.1 Locks and latching mechanisms. Locking and other latching mechanisms shall be permanently mounted on the assembly. Such mechanisms shall require no tools to be engaged in the locked position. Devices such as pins shall be permanently secured to the assembly through the use of chains or wires which must be of corrosion resistant material.

Reason: The purpose of this proposal is to coordinate terms. During the original development process, this section used “specimen” in two places where “assembly” was the more appropriate term. A ballot comment led to the change being made in one place but the second occurrence was missed.

Committee Action: Approved
Pass, 8 - 0

Committee Reason:
IS-STM38-11/12
Section 503.1, 503.2 and 503.3 (new)

Proponent: John Woestman, representing Builders Hardware Manufacturers Association (BHMA)

Revise as follows:

503.1 Locks and latching mechanism. Locking and other latching mechanisms shall be permanently mounted on the assembly. Such mechanisms shall require no tools to be engaged in the locked-latched position. Devices such as pins shall be permanently secured to the specimen through the use of chains or wires which must be corrosion-resistant material.

503.2 Multi-latching systems. Products that are not categorized as means of egress/escape and are provided with more than one single-action locking latching mechanism shall be provided with permanently posted instruction on latching.

503.3 Door latches. Door latching hardware necessary for the door assembly to perform as designed for the storm shelter shall either:

1. Automatically engage when the door is in a closed position and shall not be capable of being disabled, or
2. Be capable of being engaged by any occupant without the use of special tools or special knowledge.

Reason: The proposed modifications to 503.1 and 503.2 recommend “latched” and “latching” instead of “locked” and “locking”. A locked door implies passage through the door is prevented in at least one direction – and this standard should not imply occupants are locked in, or locked out, of a storm shelter.

The added language of 503.3 addresses an omission in ICC 500. Some commercial door hardware components have the ability for the door latching mechanism(s) to be held in the non-latching position. When a building is occupied (or intended to be occupied) keeping the latches retracted allows for easier entry and exit through the doors, reduces the noise of the door’s operation, and reduces wear and tear on the door and door hardware.

The proposed language is intended to assure that doors are latched or may be easily latched by the shelter’s occupants when needed to perform as part of the storm shelter.

Committee Action: Accept in principle

Committee Reason:
IS-STM39-11/12
Section 504.1.1

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

504.1.1 Signage location. At every entrance to a storm shelter, signage indicating “Tornado Shelter”, or “Hurricane Shelter”, or appropriate symbols as applicable, shall be installed. The sign shall be both tactile and visual, meeting the requirements of ICC A117.1. The sign shall be no smaller than 8.5 inches by 11 inches (216 mm by 279 mm). The sign shall be mounted on or adjacent to the door, located in accordance with ICC A117.1.

Reason: It is inconceivable that a visually or mobility impaired person seeking access to a storm shelter would be alone in his/her effort to enter a storm shelter. In the case of public community storm shelters or large residential building community shelters, it is not conceivable that visually unimpaired persons would not be available during a windstorm event to assist visually impaired persons in safely entering a storm shelter. In the case of facilities dedicated to care and housing of visually or mobility impaired persons, it is not conceivable that at least one visually unimpaired staff member would not be available during a windstorm event to assist visually impaired persons in safely entering the storm shelter. In the latter case, rehearsals of storm shelter entry and occupancy would most likely have taken place which would familiarize visually impaired persons as to where and how to enter and occupy the storm shelter.

Tactile storm shelter signs are not standard signs and are extremely expensive to purchase if a manufacturer can be found. High costs of a shelter accessory of questionable necessity will discourage rather than promote the construction of storm shelters.

The purpose of ICC A117.1 is to create an environment which facilitates unassisted mobility of visually and mobility impaired persons in the built environment under normal circumstances. Entry into a storm shelter for protection is not a normal circumstance.

The flow of traffic into a tornado shelter during an impending tornado event would probably be accelerated by the desire or need to rapidly seek entry to the shelter. A delay at the entrance door by a visually impaired person attempting to read a tactile sign could create a hazard to the visually impaired person standing near the door or doorway and others trying to enter the tornado shelter.
Efforts of a visually impaired person seeking the location of an appropriate entrance door of a storm shelter by means of a tactile sign would be excessive, considering the certain assistance available from non-visually impaired persons entering or having entered the shelter.

Committee Action: Accept in principle
Input from accessibility experts will be sought.
Committee Reason:

9/27 Committee Disapprove comment

Committee modified the language further:

504.1.1 Signage location. At every entrance to a storm shelter, signage indicating “Tornado Shelter”, or “Hurricane Shelter”, or appropriate symbols as applicable, shall be installed. The sign shall be both tactile and visual, meeting the requirements of ICC A117.1. The sign shall be no smaller than 8.5 inches by 11 inches (216 mm by 279 mm). The sign shall be mounted on or adjacent to the door, located in accordance with ICC A117.1. The sign shall comply with the applicable requirements of ICC A117.1.

Committee Reason: The need for signage to assist site challenged people has always intended to include signage for emergency purposes. The International Building Code, for instance, requires signage in a building to point to areas of refuge. The signage often provides a sight challenged person the ability to familiarize herself or himself with the available shelters and areas of refuge in the building during times when there is not an emergency.
Section 601.1
Fire Resistant Construction

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 as required by the applicable building code. Shelter construction, including ducts and vent openings for mechanical or natural ventilation for the shelter shall be non-combustible construction.

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

Reason:
1. The requirement for a 2 hour fire separation is in conflict with the ventilation requirements of 702.1 Ventilation and 703.1 Ventilation (Host Building). The ventilation for a shelter is typically provided by passive intake/exhaust vents. If a 2 hour separation is required these vents would require dampers which eliminate the passive ventilation when the power fails. While powered ventilation could be used, a protected generator would have to be provided which could place an undue economic burden on the owner. The economic burden could cause fewer shelters to be built which is in conflict with the overall purpose of the shelter (protecting the health, safety and welfare during a storm event).

2. If the shelter’s primary use is for other purposes (non-shelter related, i.e. a classroom that is also a shelter), the shelter must meet the code requirement of this purpose (i.e. classroom) only. Requiring the shelter to have a 2 hour separation is in conflict with this requirement if the shelter’s primary purpose does not require a 2 hour separation.

3. 2009 IBC Section 701.1 Scope, is limited to safeguarding against the spread of fire and smoke within a building and the spread of fire to or from buildings. The scope does not include the requirement for providing ventilation to occupants within a building during a fire. The primary requirements embodied in life safety codes and egress provisions of building codes involve providing safe means of egress from a building in the event of a fire or suppression of fire where egress is hampered. For example, 2009 IBC, Section 903.2.1.2 requires fire sprinkler systems for Group A-3 occupancies where:
   a. The fire area exceeds 12,000 square feet.
   b. The fire area has an occupied load of 300 or more.
   c. The fire area is located on a floor other than the level of exit discharge.

4. ICC-500, Section 501.2 Number of doors, states “The number of means of egress doors from a space shall be determined based upon the occupant load for the normal occupancy of the space 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.” This is consistent with the 2009 IBC (End Notes 2 and 3 and FEMA 361 (End Note 4). [Emphasis added]

The second paragraph of Section 500.1.2 states “Where the applicable building code requires only one means of egress door, an emergency escape opening shall be provided as calculated in accordance with Section 501.4.” Section 501.4, Emergency escape opening, states “The emergency escape opening shall be an additional door or an opening that is a
minimum of 5.7 square feet (0.530 m²) in area.” This requirement is clearly intended to assure rapid egress from a storm shelter after a storm, unimpeded by storm debris blocking a single egress door. In conjunction with the requirement to base the minimum number of doors on occupancy as a storm shelter in accordance with the applicable building code, the emphasis is clearly on insuring that occupants can quickly exit the storm shelter after the storm event. Therefore, providing protection of shelter occupants from a fire outside the shelter should not be a requirement for storm shelter construction.

End Notes

1. FOREWORD of ICC-500, 2008, Introduction
   The scope of the standard is to provide minimum design and construction requirements for storm shelters that provide a safe refuge from storms that produce high winds, hurricanes and tornadoes.

2. 2009 IBC, Section 104 Duties and Powers of Building Officials
   Section 104.1 “The building official shall have the authority to render interpretations of this code and adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

3. 2009 IBC, Section 102 Applicability
   Section 102.4 Referenced codes and standards. “Where differences occur between provision of this code and referenced codes and standards, the provisions of this code shall apply.

   “The safe room should comply with the fire protection and life-safety requirements of the model building code, the state code, or the local code governing construction in the jurisdiction where the safe room is constructed.

Committee Action: Hold for further Study

Committee Reason:

9/27 Committee HFS – Task group assigned to look into issues on 40, 41, 42
IS-STM41-11/12

Section 601.1

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Revise as follows:

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, as required by the applicable building code. Shelter construction, including ducts and vent openings for mechanical or natural ventilation for the shelter shall be non-combustible construction.

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

Reason: The requirement for a 2 hour fire separation of ICC-500, section 601.1 Fire Separation is mutually exclusive with the requirements of ICC-500, section 702.1 Ventilation and section 703.1 Ventilation for any storm shelter enclosed in a Host Building as permitted by ICC-500, Section 303 SHELTERS ENCLOSED OR PARTIALLY ENCLOSED IN A HOST BUILDING. Compliance with Section 601 precludes compliance with Sections 702.1 and 703.1 for storm shelters enclosed in a Host Building for the following reasons:

- Through wall and through roof venting of storm shelters is required by sections 702.1 and 703.1. Required ventilation must have intake/exhaust openings which are external to the Occupied Shelter Areas. Intake/exhaust openings for a storm shelter enclosed in a Host Building typically open to the interior of the Host Building. Alternately, intake/exhaust openings for a storm shelter enclosed in a Host Building can be exterior to the Host Building. Section 703.6.4 Protection of Components requires that such ducts “…be protected from design event conditions.” Fire dampers on intake/exhaust openings would not comply with the requirements of ICC-500, sections 702.1 and 703.1.

- ICC-500, section 702.1.1.1 Location of ventilation openings and section 703.1.3 Location of ventilation openings specify proportions of natural ventilation which much be located in the lower portion of the shelter and in the upper portion of the shelter. Protection of numerous dispersed ventilation intake/exhaust openings is impracticable and not economically feasible.

- Ventilation exhaust and intake openings on the outside of storm shelters are required by ICC-500, section 702.1.4 Exhaust or intake opening protection and 703.1.5 Exhaust or intake opening protection to meet the design and impact testing requirements of ICC-500, section 306.3 Wall and roof openings which requires compliance with section 306.4 Opening protective devices.

- ICC-500, section 702.1.3 Intake openings and section 703.1.4 Intake openings specify the minimum separation of intake openings “…from any hazardous or noxious contaminant….” Smoke generated by a fire within a Host Building must be construed as a hazardous or noxious contaminant which is omnipresent within the Host Building.

- Alcove/baffled entry systems for storm shelters, as shown in ICC-500, Figure 804.7 and Figure 804.7.1, would not be permitted by section 601.1 within a Host Building. Alcove/baffled entry systems within Host Buildings are particularly appropriate for interior facilities such as restrooms and dedicated storm shelters where unrestricted
public access is required by the Authority Having Jurisdiction or the owner for safety or liability reasons.

The provisions of ICC-500, section 601.1 Fire Separation, preclude practicable and economical construction of storm shelters enclosed in a Host Building for the reasons presented herein. Exclusion of storm shelters in Host Buildings will adversely affect the storm shelter industry and discourage entities from providing storm shelters meeting the requirements of ICC-500 within the premises of manufacturing facilities, businesses, hospitals, schools, government facilities, and the like. The requirement to protect storm shelter occupants from fire simultaneously with a windstorm event is inconsistent with the scope of ICC-500 as stated in FOREWORD of the standard (see End Note 1).

2009 IBC, section 603 Combustible Material in Type II and III Construction, Table 601, does not require fire resistance ratings for Type IIB or IIB construction except for exterior walls of Type IIIIB construction. Table 601 also permits approved sprinkler systems complying with Section 903.3.1.1 to be substituted for 1-hour fire resistance rated construction for Type IIA and IIIA construction. ICC-500, section 601.1, provides no exceptions for fire sprinkler systems in buildings for storm shelters or for waivers of construction from the building official based on the applicable building code or unique Host Building conditions or occupancy.

2009 IBC, section 701.1 Scope, is limited to safeguarding against the spread of fire and smoke within a building and the spread of fire to or from buildings. The scope does not include the requirement for providing ventilation to occupants within a building during a fire. The primary requirements embodied in life safety codes and egress provisions of building codes involve providing safe means of egress from a building in the event of a fire or suppression of fire where egress is hampered. For example, 2009 IBC, section 903.2.1.2 requires fire sprinkler systems for Group A-3 occupancies where:

a. the fire area exceeds 12,000 square feet
b. the fire area has an occupant load of 300 or more
c. the fire area is located on a floor other than the level of exit discharge

ICC-500, section 501.2 Number of doors, states that “The number of means of egress doors from a space 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.” This is consistent with the 2009 IBC (End Notes 2 and 3 and FEMA 361 (End Note 4). [Emphasis added.]

The second paragraph of section 501.2 states “Where the applicable building code requires only one means of egress door, an emergency escape opening shall be provided as calculated in accordance with section 501.4.” Section 501.4, Emergency escape opening, states “The emergency escape opening shall be an additional door or an opening that is a minimum of 5.7 square feet (0.530 m²) in area.” This requirement is clearly intended to assure rapid egress from a storm shelter after a storm, unimpeded by storm debris blocking a single egress door. In conjunction with the requirement to base the minimum number of doors on occupancy as a storm shelter in accordance with the applicable building code, the emphasis is clearly on insuring that occupants can quickly exit the storm shelter after the storm event. Therefore, providing protection of shelter occupants from a fire outside the shelter should not be a requirement for storm shelter construction.

End Notes

Foreword of ICC-500, 2008, Introduction
The scope of the standard is to provide minimum design and construction requirements for storm shelters that provide a safe refuge from storms that produce high winds, hurricanes and tornadoes.
2009 IBC, Section 104 Duties and Powers of Building Official
Section 104.1 “The building official shall have the authority to render interpretations of this code and adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.”

Section 104.3 “The building official shall issue all necessary notices or orders to ensure compliance with this code.

2009 IBC, Section 102 Applicability
Section 102.4 Referenced codes and standards. “Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

“The safe room should comply with the fire protection and life-safety requirements of the model building code, the state code, or the local code governing construction in the jurisdiction where the safe room is constructed.

Committee Action: Hold for further Study
Committee Reason:

9/27 Waller offered replacement proposal

9/27 Committee HFS –Task group assigned to look into issues on 40, 41, 42

Waller replacement proposal as follows:

IS-STM __________

Section 601 Fire Resistant Construction – Proposed Amendments – Jim Waller

601.1 Fire separation. Fire barriers and fire-rated 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. are not required for storm shelters.

Exception: Fire Separation assemblies are not required for residential shelters.

Reasons for proposed amendment to Section 601.1:

1. Experts in the field of post-hurricane and post-tornado damage assessment will testify to the IS-STM Committee that the probability of fire resulting directly from these severe windstorms is extremely small, perhaps below the de minimis value. Evidence will be presented to the Committee that the risk of death or injury...
due to fire occurring after severe windstorms relative to the risk of death or injury
due to the forces and debris impacts of the storms is also very small, also perhaps
below the de minimis value.
2. Fire resistance is currently not required for storm shelters which are not located
within host buildings or for residential shelters.
3. The fire resistance of the host building is governed by the IBC based on building
construction type and occupancy. A storm shelter contained within the host
building is afforded the same protection as that required by the host building.
Storage and mechanical occupancies are required to have fire resistance. Under
normal conditions the storm shelter is protected from fire to the same degree as
the host building. If the building is destroyed by the windstorm, the storm shelter
may not have this fire protection, but the shelter occupants will have had the
benefit of protection from the storm wind forces and debris resulting from the
storm.
4. The ventilation requirements of Sections 702.1.1 Natural ventilation and 703.1.2
Natural ventilation prescribe distribution of ventilation openings for natural
ventilation between the upper and lower halves of the shelter and the minimum
spacing of ventilation openings on the same wall which make compliance with the
requirements for natural ventilation and fire separation extremely expensive, if
not mutually exclusive. This will certainly discourage construction of storm
shelters in host buildings which offer the safest opportunity for storm-threatened
persons to access.

Add new section as follows:

Section 601.2. Permitted host building occupancies. Storm shelters shall be
permitted to be constructed within host buildings having occupancies except High-
Hazard Group H and Storage Group S.

Reasons for proposed amendment to add Section 601.2:

1. Occupancies H and S are significantly more subject to fire than other
occupancies. This restriction will lessen risk of fire in a permitted occupancy
where a storm shelter is constructed.
2. This restriction will attenuate potential anxiety of fire codes officials regarding
the proposed amendment to Section 601.1
IS-STM42-11/12
Section 601.2 (new)

Proponent: James E. Waller, PE, representing NSSA Standards Committee

Add new text as follows:

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.

601.2 Fire resistant materials. Storm shelter components and interior finishes and furnishings shall not be constructed of, or contain highly flammable materials.

Reason: The purpose for the proposed revision of section 601.2 is to prevent the use of highly flammable materials for finishes and furnishings in storm shelters. Such materials include pyroxylin plastic or similarly hazardous base materials. It would be prudent to establish a firm definition of what is highly flammable based on definitions in the NFPA or other standards. The criteria could be included in section 601.2 or in the Commentary. It would not impose an economic hardship to limit wall and ceiling finishes to Class A, for example. Decorative materials in storm shelters should comply with NFPA 701.

Committee Action: Accept in principle

Committee Reason:

9/27 Committee HFS – Task group assigned to look into issues on 40, 41, 42
IS-STM43-11/12
Section 803.1

Proponent: James Bell, representing ASSA ABLOY

Revise as follows:

803.1 Test Specimen. 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, roof, door, or window assemblies shall be allowed in lieu of testing entire shelters. Except where failure of framing members may control the impact performance, wall and roof sections subjected to debris impact testing shall be a minimum of 4-feet (1219mm) wide by 4-feet (1219 mm) high unless dimensions of the actual assembly are less than these dimensions. Wall and roof sections subjected to 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 section from support to support.

Doors and windows shall be tested at the maximum size proposed for use. Opening protective devices (shutters) are to be tested at the maximum and minimum size proposed for use. Operable doors or windows shall be tested for the conditions of swing and latching as specified for use of the product. The specimen shall consist of the entire assembled unit and shall, when practical, be mounted as it will be installed in a shelter, and shall contain all devices used to resist wind forces and windborne debris. When it is not practical to install for testing a door or window frame as it will be mounted in a shelter, then the unit or assembly shall be mounted in a test buck to connect the specimen to the test frame/stand/chamber. Details of the mounting shall be described in the test report.

Reason: As opening for shutters get smaller the impact locations get closer together adding additional stress at latching points. Smaller surface areas on shutters increases the pressure loading on latches during static load testing.

Committee Action: Accept in principle

Committee Reason:
IS-STM44-11/12
Section 804.11, 805.5 and 806.7

Proponent: Joseph R. Hetzel, P.E., Technical Director, representing Door & Access Systems Manufacturers Association (DASMA) International

Add new text as follows:

804
MISSILE IMPACT TESTING

804.11 Garage doors and rolling doors. Garage doors and rolling doors may meet the applicable door related requirements of Sections 804.1 through 804.10 through missile impact testing procedures in accordance with ANSI/DASMA 115.

805
PRESSURE TESTING

805.5 Garage doors and rolling doors. Garage doors and rolling doors may meet the applicable door related requirements of Sections 805.1 through 805.4 through static pressure testing procedures in accordance with ANSI/DASMA 108 and cyclic testing procedures in accordance with ANSI/DASMA 115. For static pressure testing, garage doors and rolling doors shall meet the acceptance criteria of ANSI/DASMA 108.

806
PRESSURE TESTING PROCEDURES

806.7 Garage doors and rolling doors. Garage doors and rolling doors may meet the applicable door related requirements of Sections 806.1 through 806.3 through static pressure testing procedures in accordance with ANSI/DASMA 108 and cyclic testing procedures in accordance with ANSI/DASMA 115. For static pressure testing, garage doors and rolling doors shall meet the acceptance criteria of ANSI/DASMA 108.

Add new standards as follows:

CHAPTER 9
REFERENCED STANDARDS

ANSI/DASMA 115-03, Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure

Reason: ANSI/DASMA 108 and ANSI/DASMA 115 are test methods referenced in the International Building Code as applicable to garage doors and rolling doors, and referenced in the International Residential Code as applicable to garage doors.

Committee Action: Hold for further study

Committee Reason:

9/27 – Testing task group will review this and advise.
IS-STM45-11/12
Section 806.4.1

**Proponent:** Andrew Herseth and Tom Reynolds representing Department of Homeland Security, Federal Emergency Management Agency and URS Corporation representing FEMA

**Revise as follows:**

**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 following procedures detailed in sections ASTM E 330 to the pressures specified in Section 304. Pressure tests are allowed to be conducted separately from debris impact tests.

**Reason:** The proposed revision corrects a typographical omission in Section 806.4.1 that did not include requiring the pressure to be increased by 20% for the pressure test.

**Committee Action:** In Favor of the proposed change, with a vote of 10 to 0. Approved.

**Committee Reason:**
IS-STM46-11/12
Section 502.3.1

Proponent: James E. Waller, PE Chairman, NSSA Standards Committee

Revise as follows:

502.3.1. Stairs for residential shelters. Limits on residential storm shelter maximum riser height.

Exception: The maximum height of risers for residential shelters which have a maximum rise between shelter floor level and shelter entrance level of 70 inches shall be 10 inches for 8 inch stair treads.


Upon review of the current OSHA - ICC/NSSA criteria and personal inspection of an under-floor storm shelter, it is the opinion of the undersigned that the stairs of a shallow under-floor or underground shelter such as shown in Photo 1 (attached), which have minimum 8 inch treads and not more than seven 10 inch risers for a total rise of 70 inches, are safe and acceptable for shelter ingress/egress. The rise angle, 51.3 degrees, is 2.7% greater than OSHA permits for unlimited numbers of risers in an industrial environment. This exception for shallow under-floor storm shelters is deemed by the undersigned to be acceptable and will have a positive effect on the manufacture of shallow underground/under-floor storm shelters.

It is recommended to Committee ICC-STM that this change to the ICC-500, 2013 edition standard, Section 502.3.1 Stairs for residential shelters, be approved so that the maximum rise angle may be 51.3 degrees (8 inch tread and 10 inch riser) for stairs of residential shelters which have a maximum stair rise between floors of 70 inches. This change will not compromise the safety of occupants entering or exiting a shelter, provided all other requirements of ICC-500, Section 502.3.1 Stairs for residential shelters are adhered to.

Committee Action: Accept in principle

Committee Reason:
Proponent: James E. Waller, PE Chairman, NSSA Standards Committee

Add new definition as follows:

**PEER REVIEW.** A review of the storm shelter design by a registered design professional who is not in the same firm as the registered design professional who designed the storm shelter. The peer review includes checking the construction documents including the design criteria, applicable codes and standards, design references, calculations, construction drawings, shop drawings, and quality assurance plan for the storm shelter design.

Reason:

Committee Action: Accept in principle

Committee Reason:
IS-STM48-11/12
Section 106.1.1

Proponent: James E. Waller, PE Chairman, NSSA Standards Committee

Add at the end of the present Section 106.1.1:

A signed and sealed report, fully describing the items reviewed, their compliance or non-compliance with applicable codes and standards, and recommendation of acceptance or rejection of the storm shelter design, or modifications to render the design acceptable, shall be submitted to the authority having jurisdiction prior to issuance of a permit for construction.

Reason:

Committee Action: Accept in principle

Committee Reason:
IS-STM49-11/12

Section 310

Proponent: Corey Shultz

Revise as follows:

SECTION 310
PENETRATIONS OF STORM SHELTER ENVELOPE BY SYSTEMS AND UTILITIES

310.2 Penetration of storm shelter envelope shall have a maximum width dimension of \( \frac{3}{4}'' \). Any penetration larger than \( \frac{3}{4}'' \) in width shall be considered an opening and shall be protected in accordance with Section 306.3.

Reason: Shelters have many openings that can exceed 3.5 square inches that are not for systems and utilities including but not limited to shim space around doors and windows, under cut on doors, masonry control joints, expansion joints, and joints between precast concrete wall panels which typically are \( \frac{1}{4}'' \), \( \frac{5}{8}'' \) (excluding threshold), \( \frac{3}{8}'' \), \( 1'' \)-\( 2'' \) typical, and \( 1'' \) respectively. At some width, these openings need to be addressed. I’m suggesting \( 3/4'' \) maximum which would eliminate most of the openings associated with doors/windows and masonry, but would require protection of expansion and pre-cast joints.

As a point of reference, a typical \( 1/4'' \) shim space around a shelter window that is 4’X6’ is equal to 60 square inches of opening. A 1’ joint, 20’ tall in a precast concrete panel is equal to 240 square inches.

Committee Action: No action. Item introduced to committee for first time.
9/27 HFS – wait task group recommendation 27, 28, 49

Committee Reason:
Add the following to the end of the paragraph:

….or in the upper one-fourth of the height of the shelter, whichever is greater. **Lower and upper openings shall be horizontally located at least 2/3 the diagonal distance of the shelter apart on opposite wall or the roof surface.**

**Reason:** The intent of the natural ventilation option is to get cross ventilation in the shelter. The way it is currently written, I have seen many shelters where the high and low ventilation is located on the same wall and some stacked one directly above the other which will not allow for cross ventilation.

**Committee Action:** Accept in principle

**Committee Reason:**
IS-STM51-11/12
Section Table 702.2

Proponent: Corey Shultz

Revise wording for Toilet Facilities-Community (>50) to read:

2 minimum for the first 500 occupants and 1 additional per 500 occupants or portions thereof > 500 occupants.

Reason: I believe this was the original intent of the committee. I have seen several jurisdictions that as currently written interpretations are that for a shelter of 50, 1 toilet is required but at 51, 3 is required (2 minimum plus 1 per 500 occupants or portions thereof, 51 being a portion of 500). As I recall, the 2 minimum was to cover the first 500 occupants then adding 1 for each portion of 500 beyond 500 occupants.

Committee Action: Approved 10-0

Committee Reason:
IS-STM52-11/12
Section 703.1.3

Proponent: Corey Shultz

Add the following to the end of the paragraph:

…..or in the upper one-fourth of the height of the shelter, whichever is greater. Lower and upper openings shall be horizontally located at least 2/3 the diagonal distance of the shelter apart on opposite wall or the roof surface.

**Reason:** The intent of the natural ventilation option is to get cross ventilation in the shelter. The way it is currently written, the high and low ventilation can be located on the same wall and may be stacked one directly above the other which will not allow for cross ventilation.

Committee Action: Accept in principle

Committee Reason:
IS-STM53-11/12
Chapter 8

Proponent: Corey Shultz

Revise as follows:

??

Reason: In the past couple of years, we have been seeing open screens and mechanical louvers being tested for tornado shelters. From my understanding, the same protocol is being used to test these items as is for solid specimens like walls, doors, and windows. Open screens and mechanical louvers allow air to flow through them freely where the solid specimens do not. The same shard of glass that may spall off the back of a window specimen and penetrate the witness paper may be carried in the air stream of the free flowing air passing through the screen or louver that would damage the same witness paper. However, this is not a part of the protocol.

My concern is these items being used in a shelter wall and an occupant being directly behind this device and being "sand blasted" by small shards of glass (up to 1/2" in some cases) that are passing through the device freely. It may stop the 15 lb 2X4 but what about the other small debris that could be harmful? It appears that the Standard is more stringent for solid materials than those that are open. Should a different protocol be considered and created for these types of protective devices?

Below is a schematic of two different louvers directly from the manufacturer’s website. Please note the open areas above and below the louver blades.

9/27—Corey Schultz advised that this may get resolved via items #27, 28, 49.
Committee Action:
Hold for further Study

Committee Reason:
IS-STM54-11/12
Section 303

Proponent: Danny J. Kilcollins

Revise as follows:

303.1.1 Rainfall rate. For hurricane shelters, rainfall rate shall be determined by adding a rate of 3 inches (76.2 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

303.1.1.1 Secondary (emergency) drain rainfall rate. Where required, rainfall rate for secondary drains or scuppers shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

303.1.1.2 Rainfall rate for vertical wall or barrier enclosed areas. Rainfall drainage shall be provided where perimeter wall construction or barrier extends above the floor or grade of a structure or courtyard in such a manner that rainwater will be entrapped and flood occupied shelter areas, critical support systems or access routes. Where required, rainfall rate shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

107.2.1 Design Information.

#. For hurricane shelters, the design 1-hour rainfall rate.

Reason: The purpose of this revision is to increase the design rainfall rate to be more consistent with a 1,000-year recurrence interval1. The current ICC 500 uses wind design maps that are based on a 1,000-year recurrence interval. This revision will better harmonize the rainfall rate with the wind speed map recurrence interval. The revision will also ensure that the rainfall rate is applied not only where ponding loads are a hazard (e.g., roof tops with drainage confining parapets), but also to locations where rainwater accumulation flooding could affect the shelter areas or their critical support systems and access routes (e.g., screen roofed mechanical and generator enclosures and courtyards).

1 – Statistics of extremes and estimation of extreme rainfall; II. Empirical investigation of long rainfall records; Demetrius Koutsoyiannis; 2004

References:
NOAA HMR 51; Probable Maximum Precipitation Estimates, United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1978
NOAA HMR 52; Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1982

Committee Action: Accept in principle

Committee Reason:
IS-STM55-11/12
Section 308.1.1

Proponent: Gary Ehrlich, NAHB

Delete and substitute and follows:

308.1.1 Stability. In addition to structural stability requirements of Section 309, structural stability of a storm shelter shall also be determined for building code design wind speeds (wind speeds which are below the shelter design wind speeds) where the host building could transmit forces in connections to the storm shelter that are equal to 1.5 times the nominal strength of the connections.

308.1.1 Stability. Where an element or component of the host building is attached to or supported on an element or component of a storm shelter, the structural stability of the storm shelter under the loads imparted by the attached or supported element shall be evaluated, in addition to the structural stability requirements of Section 309. The design wind loads per the applicable building code for the connections between the elements or components of the host building and the storm shelter shall be increased by a factor of 1.5.

Reason: The existing language of Section 308.1.1 is confusing and makes it difficult for a user to understand the intent of the section. The reason statement for James’s proposal IS-STM25 states the intent of this section is to increase the loads imposed by an element or component of the host building supported on or attached to a shelter by 50% and use that magnified load to perform an additional structural stability check on the storm shelter. We agree with this intent, and suggest the committee propose this revised language which can hopefully be better understood by the user.

Committee Action: Hold for further study SEE #59

Committee Reason:

IS-STM54-11/12
Section 303

Proponent: Danny J. Kilcollins

Revise as follows:

303.1.1 Rainfall rate. For hurricane shelters, rainfall rate shall be determined by adding a rate of 3 inches (76.2 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.
303.1.1.1 Secondary (emergency) drain rainfall rate. Where required, rainfall rate for secondary drains or scuppers shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

303.1.1.2 Rainfall rate for vertical wall or barrier enclosed areas. Rainfall drainage shall be provided where perimeter wall construction or barrier extends above the floor or grade of a structure or courtyard in such a manner that rainwater will be entrapped and flood occupied shelter areas, critical support systems or access routes. Where required, rainfall rate shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

107.2.1 Design Information.

# For hurricane shelters, the design 1-hour rainfall rate.

Reason: The purpose of this revision is to increase the design rainfall rate to be more consistent with a 10,000-year recurrence interval. The current ICC 500 uses wind design maps that are based on a 10,000-year recurrence interval. This revision will better harmonize the rainfall rate with the wind speed map recurrence interval. The revision will also ensure that the rainfall rate is applied not only where ponding loads are a hazard (e.g., roof tops with drainage confining parapets), but also to locations where rainwater accumulation flooding could affect the shelter areas or their critical support systems and access routes (e.g., screen roofed mechanical and generator enclosures and courtyards).

Task group 8/28: 303.1.1.2 in the wrong place. Chapter 7

References:
NOAA HMR 51; Probable Maximum Precipitation Estimates, United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1978
NOAA HMR 52; Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1982

Committee Action: Accept in principle

Task group 8/28: 303.1.1.2 in the wrong place. Chapter 7
Also Section 303.1.1.1 needs some tweaking. Marc will discuss with Danny K.

Committee Reason:

Replace the proposal as follows:

IS-STM54-11/12
Section 303
Proponent: Danny J. Kilcollins
Revise as follows:
303.1 Rainfall loads. Rain loads shall be determined in accordance with ASCE 7.
Rainfall rates for hurricane shelter roofs shall meet the following:
303.1.1 Rainfall rate for the primary drainage system. Rainfall rate for the primary drainage system shall be determined by adding 3 inches (76.2 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

303.1.2 Rainfall rate for the secondary (overflow) drainage system. Where required, the rainfall rate for the secondary drainage system shall be determined by adding 6 inches (152.4 mm) of rainfall per hour to the rainfall rate established from Figure 303.2.

107.2.1 Design Information.

# For hurricane shelters, the rainfall rate of the roof primary drainage system.
# For hurricane shelters, the rainfall rate of the roof secondary (overflow) drainage system where required.

Reason: The purpose of this proposed revision is to increase the design rainfall rate of the secondary (overflow) roof drainage system to be more consistent with a 10,000-year recurrence interval. The current ICC 500 uses wind speed design maps that are based on a 10,000-year recurrence interval. This revision will better harmonize the roof drainage rainfall rate with the wind speed map recurrence interval. The proposal purposely gives separate rainfall rates for the primary and secondary (overflow) roof drains. The use of two separate rainfall rate design values for the roof drainage systems are to reduce/eliminate an increase in cost while still significantly improving drainage capacity in an extreme event (i.e., increased recurrence interval event). The 6-inch, one-hour rainfall rate increase only applies to the secondary (overflow) drain system, which is generally composed of perimeter scuppers, weirs or similar overflow openings. Anecdotally, designers and constructors of record have indicated that increases in size of secondary overflow components of up to 12-inches per hour total overflow capacity have negligible impact on construction costs. However, the cost impact on primary roof drainage systems of buildings with large horizontal projected areas can be significant due to increased size of field drains, conductors, collector pipes and discharge structures. It should also be noted that the highest one-hour rainfall rate recorded in the National Climate Data Center for tropical cyclones or remnants between 1981 and 2005 is 6.08-inches (Tropical Storm Allison, 2001); though there are higher hourly rates shown in Table 21, HMR 52. Therefore, the ICC 500 first edition’s 3-inch increase in rainfall rate per hour above the 100-year, 1-hour map (Figure 5, NWS Hydro 35; Figure 303.2, ICC 500) gives design values that appear to be adequate for severe but not necessarily extreme events.

The 6-inches added to the secondary drainage system is intended to increase the one-hour design rainfall rate to approximate a 10,000-year recurrence interval. The higher recurrence interval values are related to Probable Maximum Precipitation (PMP; HMR 51 and 52) for a point/site (1 square mile), and US and world records. The method of calculation is as follows: assume 16.5-inch one-hour rainfall rate (Figure A.2.1, WMO 332) is 100,000-year recurrence; using a graphical log table method, input the known 100-year and 100,000-year recurrence values and solve for 10,000-year recurrence; the result is that about 10 inch to 11 inch rainfall rate is a 10,000-year recurrence for Florida and gulf and southeast Atlantic coasts. The further north the site/point is located, the 10,000-year recurrence design value is expected to drop (Figure 24, HMR 52). The 100-year hourly values also drop (from 4- to 5-inches along gulf coast to 2-inches in New
England). Therefore, adding a constant value (6-inches) to the relatively small range of 100-year hourly rainfall design values is consistent with PMP maps.

References:
NOAA HMR 51; Probable Maximum Precipitation Estimates, United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1978
NOAA HMR 52; Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1982
WMO 332; Manual for Estimation of Probable Maximum Precipitation World Meteorological Organization; 1986
NOAA Tech Memo NWS Hydro 35; Five to 60-Minute Precipitation Frequency for Eastern and Central United States; 1977

IS-STM54-11/12 (Continued)
(New) Section 405
Proponent: Danny J. Kilcollins
Add as follows:

Section 405

405.1 Rainwater drainage for hurricane shelter facilities with open or perforated screen roof. Rainwater drainage shall be provided for facilities with open or screen roof and perimeter walls or barriers that extend above the floor or grade in such a manner that where it is possible that rainwater will be impounded and flood occupied shelter areas, critical support systems or access routes. Where required, the rainfall rate shall be determined by adding 6 inches (152.4 mm) per hour to the rainfall rate established in Figure 303.2.

107.2.1 Design Information.

For hurricane shelters, the rainwater drainage design rainfall rate for open-air or screen roof facilities subject to rainwater impoundment.

Reason: The current ICC 500 doesn’t explicitly require that open or screen roofed essential ancillary facilities, such as mechanical, electrical and plumbing equipment enclosures and yards, that are subject to rainwater impoundment are provided with adequate rainwater drainage. This proposal will require rainwater drainage be applied not only to rain-tight enclosed roofs where ponding loads are a hazard (e.g., roof tops with drainage confining parapets), but also to facilities where floor level rainwater accumulation flooding could impact shelter areas or their critical support systems and access routes. The proposed 6-inch increase in rainfall rate above Figure 303.2 will improve rainwater drainage system performance to be more consistent with a 10,000-year recurrence interval. The current ICC 500 uses wind speed design maps that are based on a 10,000-year recurrence interval. This requirement will better harmonize the rainwater drainage rainfall rate with the wind speed map recurrence interval. The higher recurrence interval values are related to Probable Maximum Precipitation (PMP; HMR 51 and 52) for a point/site (1 square mile), and US and world records. The method of calculation is as follows: assume 16.5-inch one-hour rainfall rate (Figure A.2.1, WMO 332) is 100,000-year recurrence; using a graphical log table method, input the known 100-year and 100,000-year recurrence values and solve for 10,000-year recurrence; the result is that
about 10 inch to 11 inch rainfall rate is a 10,000-year recurrence for Florida and gulf and southeast Atlantic coasts. The further north the site/point is located, the 10,000-year recurrence design value is expected to drop (Figure 24, HMR 52). The 100-year hourly values also drop (from 4- to 5-inches along gulf coast to 2-inches in New England). Therefore, adding a constant value (6-inches) to the relatively small range of 100-year hourly rainfall design values is consistent with PMP maps.

References:
NOAA HMR 51; Probable Maximum Precipitation Estimates, United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1978
NOAA HMR 52; Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian; NOAA/US Dept. of the Army, Corps of Engineers; 1982
WMO 332; Manual for Estimation of Probable Maximum Precipitation World Meteorological Organization; 1986
NOAA Tech Memo NWS Hydro 35; Five to 60-Minute Precipitation Frequency for Eastern and Central United States; 1977
9/27 Committee : AS 9-0
IS-STM55-11/12
Section 308.1.1

Proponent: Gary Ehrlich, NAHB

Delete and substitute and follows:

308.1.1 Stability. In addition to structural stability requirements of Section 309, structural stability of a storm shelter shall also be determined for building code design wind speeds (wind speeds which are below the shelter design wind speeds) where the host building could transmit forces in connections to the storm shelter that are equal to 1.5 times the nominal strength of the connections.

308.1.1 Stability. Where an element or component of the host building is attached to or supported on an element or component of a storm shelter, the structural stability of the storm shelter under the loads imparted by the attached or supported element shall be evaluated, in addition to the structural stability requirements of Section 309. The design wind loads per the applicable building code for the connections between the elements or components of the host building and the storm shelter shall be increased by a factor of 1.5.

Reason: The existing language of Section 308.1.1 is confusing and makes it difficult for a user to understand the intent of the section. The reason statement for James’s proposal IS-STM25 states the intent of this section is to increase the loads imposed by an element or component of the host building supported on or attached to a shelter by 50% and use that magnified load to perform an additional structural stability check on the storm shelter. We agree with this intent, and suggest the committee propose this revised language which can hopefully be better understood by the user.

Committee Action: Hold for further study

Committee Reason

Items to be added to Proposed Changes:
9/27/2012

IS-STM57-11/12

Section 303.4 Flood Loads. Flood loads shall be determined in accordance with ASCE 7 using the flood elevations as specified in Section 401 of this standard.

9/27 Motion AS – 8-0

IS-STM58-11/12
proposals to fix problems with Section 304 and update for ASCE 7-10.
08/29/12 version
Marc Levitan

SECTION 304
WIND LOADS

304.1 General. Wind loads shall be determined using ASCE 7 except as modified by this section.

304.2 Design wind speed. For tornado shelters, the design wind speed shall be in accordance with Figure 304.2(1). For hurricane shelters, the design wind speed shall be in accordance with Figure 304.2(2).

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

304.5 Exposure category. For tornado shelters, wind loads shall be based on exposure category C. For hurricane shelters, use of exposure category B is permitted.

Exception: For hurricane shelters, wind loads for the Main Wind Force Resisting System (MWFRS) only shall be permitted to be based upon exposure category B when exposure category B exists for all wind directions and is likely to remain exposure category B after a hurricane with a wind speed determined from Section 304.2.

304.6 Topographic effects. For tornado shelters, the topographic factor $Kzt$ need not exceed 1.0.

304.7 Enclosure classifications. Enclosure classifications for storm shelters shall be determined in accordance with ASCE 7, Section 6.2. For determining the enclosure classification for community storm shelters, the largest door or window on a wall that receives positive external pressure shall be considered as an opening.

304.8 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, $G_{Cpi}$, shall be taken as $\pm 0.18$ when APC venting area of 1 square foot (0.0929 m$^2$) per 1,000 cubic feet (28.3 m$^3$) of interior shelter volume is provided. APC venting shall consist of openings in the shelter roof having a pitch not greater than 10 degrees from the horizontal or openings divided equally (within 10% 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. An internal pressure coefficient of $G_{Cpi} = \pm 0.55$ shall be used for tornado shelters where APC venting meeting the requirements of Section 304.8 is not provided, or where APC venting area requirements are not calculated.

Rationale

304.1 General. The existing provision restricting wind loads to be determined from method 2 analytical procedure is unnecessarily restrictive. We are ruling out wind tunnel testing as an alternative, which was never the intent – that was an oversight in how we wrote the original language.

The original rationale for excluding simplified procedures was that the Method 1 simplified procedure was only applicable to enclosed buildings. However, some of the shelters designed by ICC 500 might well be defined as enclosed buildings, e.g., residential hurricane shelters. We provide information on how to determine enclosure in ICC 500, and ASCE 7-10 clearly indicates which of the several wind load methods apply to enclosed buildings, partially enclosed buildings, and open buildings. There is no reason for us to introduce any additional restrictions. If we ever write commentary or user guide, it should make note of the fact that if the shelter is partially enclosed, that several of the simplified procedures are not applicable.

“wind pressures” was changed to “wind loads” in the first sentence, to account for loads on rooftop equipment or other elements where wind forces rather than pressures are determined in ASCE 7.
304.4 Importance factor  Deleted, importance factor no longer exists for wind

304.5 Exposure.  Due to changes in ASCE 7-10, the ICC 500 treatment of exposure is now unconservative for hurricane shelters.  ASCE 7-10 brought back exposure D in hurricane prone regions (ASCE 7-05 treated water bodies in the hurricane zone as exposure C).  The proposed change removes the prescription of exposure C for hurricane shelters, so that it defaults back to basic ASCE 7 procedures, and provides additional clarification of when the exception for use of exposure B for MWFRS loads is applicable.  For example, if your hurricane shelter is in a manufactured home park, and those buildings are what define the surface roughness leading to definition of exposure B, it won’t continue to have that same roughness and exposure after the Cat 4 or 5 hurricane passes through.  However, if the surface roughness comes form being located in a dense urban ocation with multistory buildings all around, those buildings may be damaged by the design level hurricane but frames will still be in place providing the roughness needed to maintain exposure B.

304.8 Atmospheric pressure change (APC).  Remove the erroneous reference to hurricane shelters in the exception.  The first sentence of Section 304.8 makes it clear that APC is only for torn

9/27 Committee:  AS 8-0

Andrew Herseth and Tom Reynolds

309.1.2.1 Slabs on grade.  Slabs on grade shall be designed for the applicable loads in accordance with Section 301.  Where a slab on grade is being used to resist loads, the minimum thickness shall be 3 ½ inches (88.9 mm) and the minimum steel reinforcement for slabs on grade resisting forces on the storm shelter shall be 6 by 6 – W1.4 by W1.4 or No. 4 bars, 18 inches on center in either direction.

309.1.2.1.1 Existing slabs on grade.  Shelters may be installed on existing slabs if the post-installed anchors are installed under special inspection and the slab has been tested or evaluated and found to have the minimum thickness and steel reinforcement requirements detailed in Section 309.1.2.1 or analyzed and found to be structurally capable to resist the