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What is the Latest?

ICC 500 2020

BRW ARCHITECTS

Anne Hildenbrand, AIA, ALEP, LEED AP BD+C

BRW ARCHITECTS

Associate Principal

ASSOCIATE PRINCIPAL of the K12 Studio

25+ years experience in managing the planning, programing, and design of education facilities

Currently serving as Past President of the A4LE North Texas Chapter

Past Texas Society of Architects (TxA) Codes and Standards Committee

Currently serving on the TxA Government Affairs Steering Committee

Past Texas Society of Architects (TxA) Codes and Standards Committee

Developed BRW's Storm Shelter Standards

AIA CONTINUING EDUCATION

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This course is approved for 1 LU|HSW AIA CES credit.

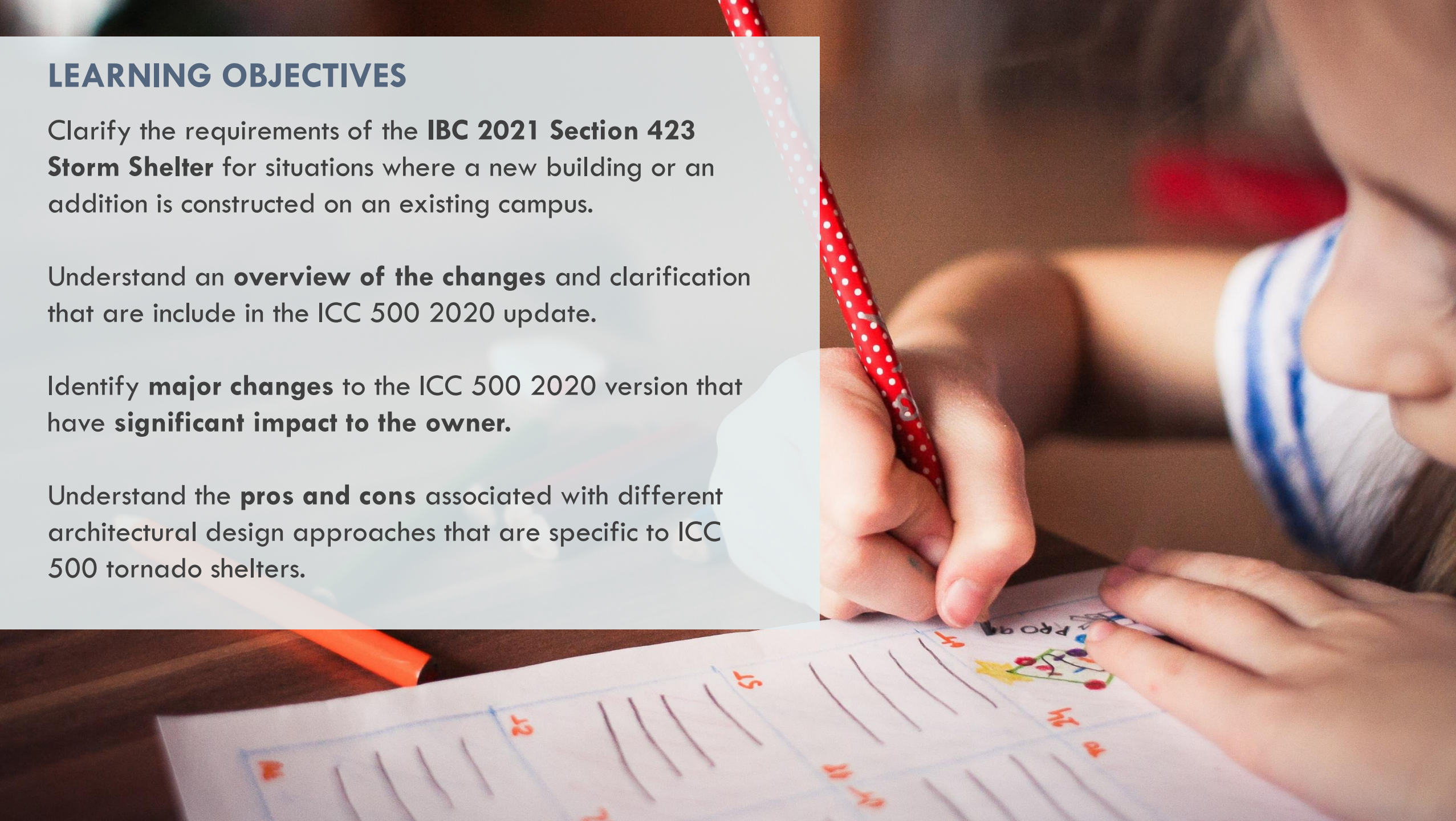
LEARNING OBJECTIVES

Clarify the requirements of the **IBC 2021 Section 423 Storm Shelter** for situations where a new building or an addition is constructed on an existing campus.

Understand an **overview of the changes** and clarification that are include in the ICC 500 2020 update.

Identify **major changes** to the ICC 500 2020 version that have **significant impact to the owner.**

Understand the **pros and cons** associated with different architectural design approaches that are specific to ICC 500 tornado shelters.

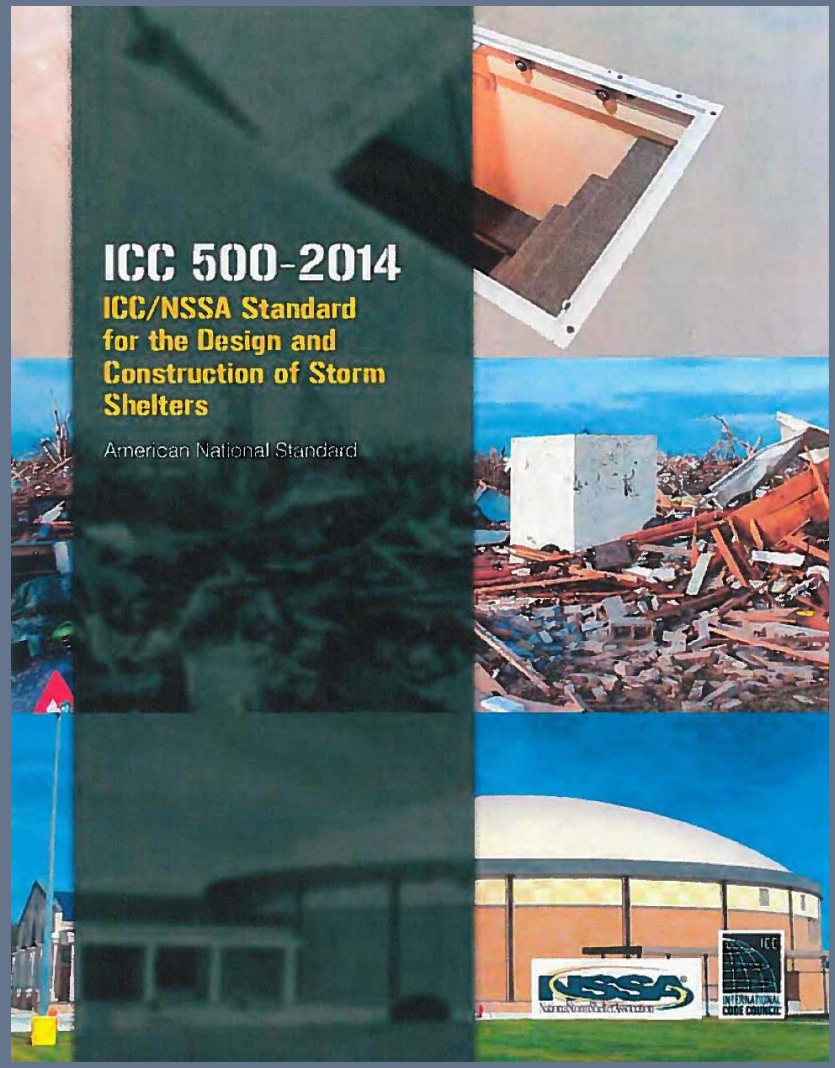


01

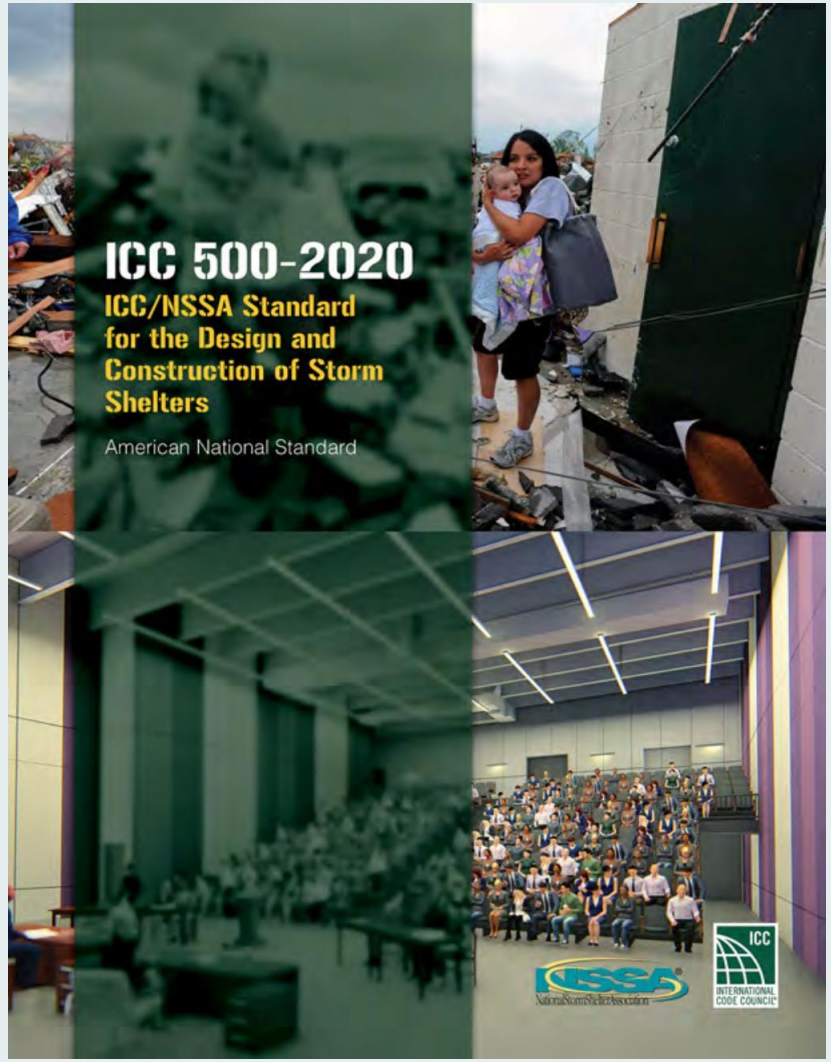
WHEN IS A ICC 500 STORM SHELTER REQUIRED?

Understand IBC 2021 Clarifications for Additions on an Existing Campus.

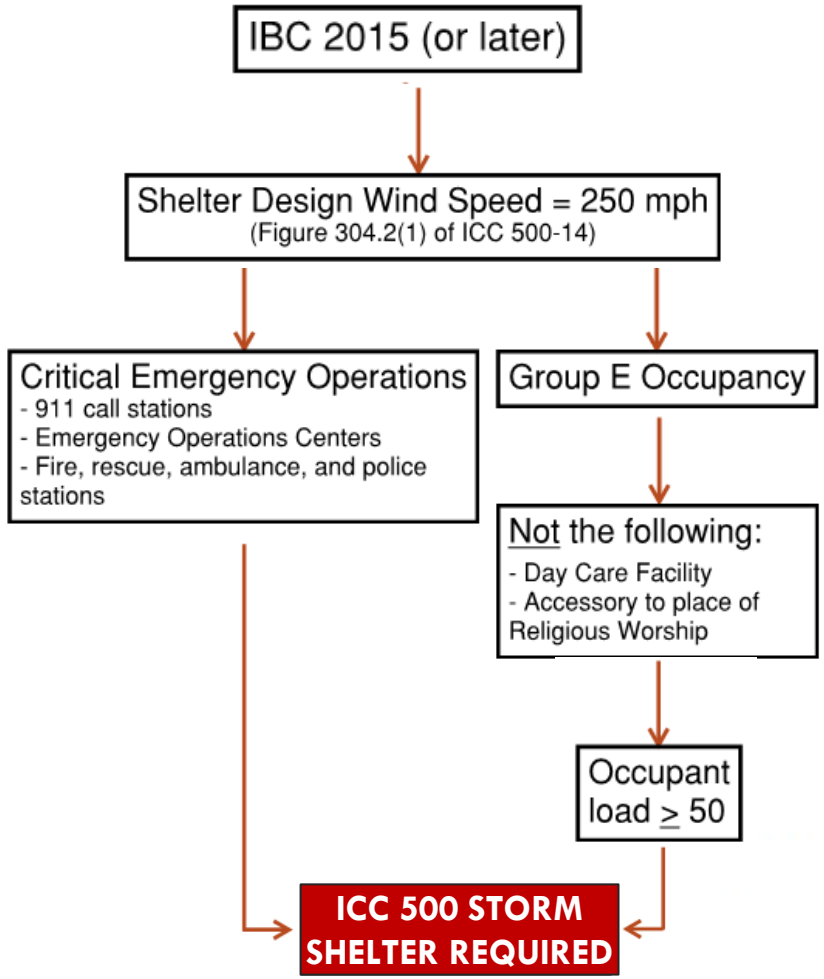
ICC 500



FIRST ADOPTED BY THE 2015 IBC



ADOPTED BY THE 2021 IBC



Flowchart based on IBC Section 423

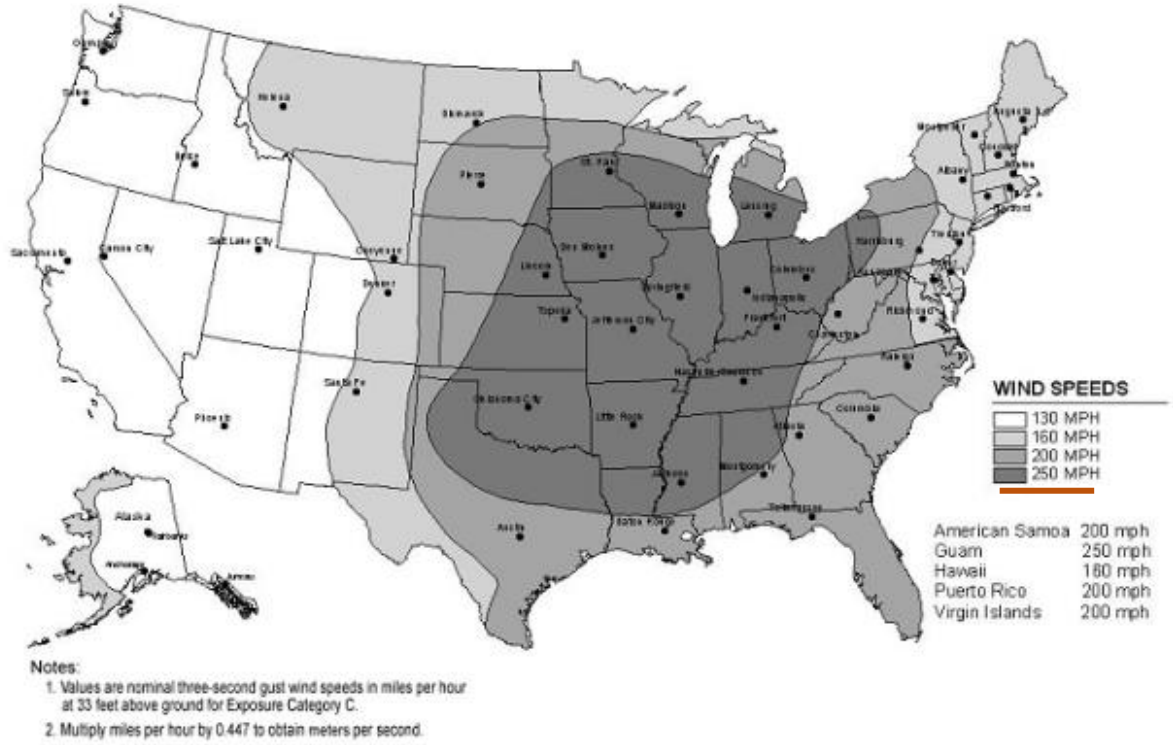
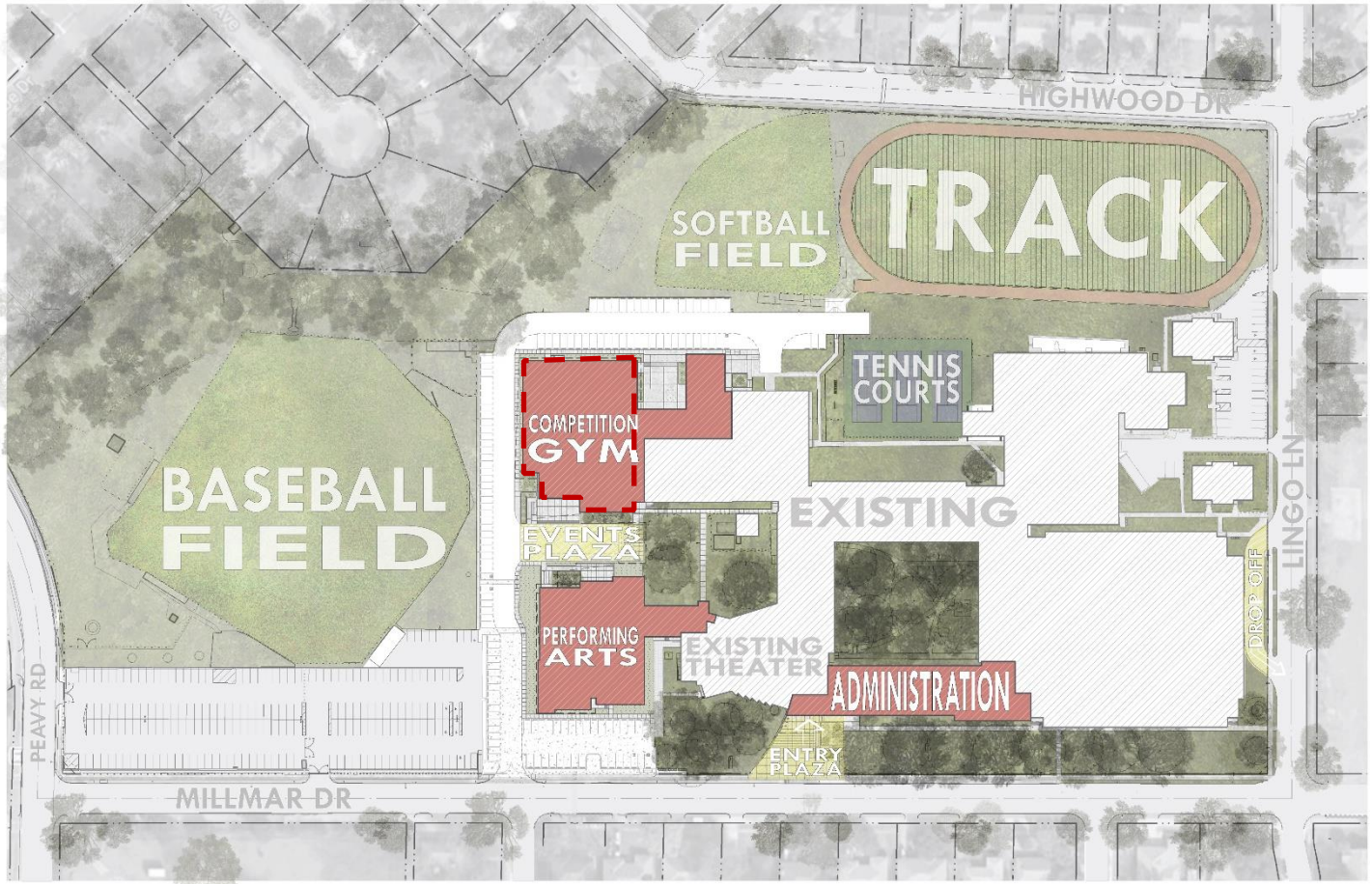


FIGURE 304.2(1)
SHELTER DESIGN WIND SPEEDS FOR TORNADOES

WHEN IS THE **ICC 500 STORM** SHELTER REQUIRED?



IBC 2021 CLARIFICATIONS

MEET EARLY WITH YOUR AHJ

1. DETERMINE OCCUPANCY CAPACITY
   Which is larger?
   - Total occupant load of classrooms vocational rooms and office in the Group E occupancy
   - OR Largest assembly space
2. STORM SHELTER WITIHIN 1,000'
3. ADDITIONS
   - Will the size of the addition accommodate the required capacity of the storm shelter for the entire campus?
   - Clarifies at min accommodate required occupant capacity of the Addition

02

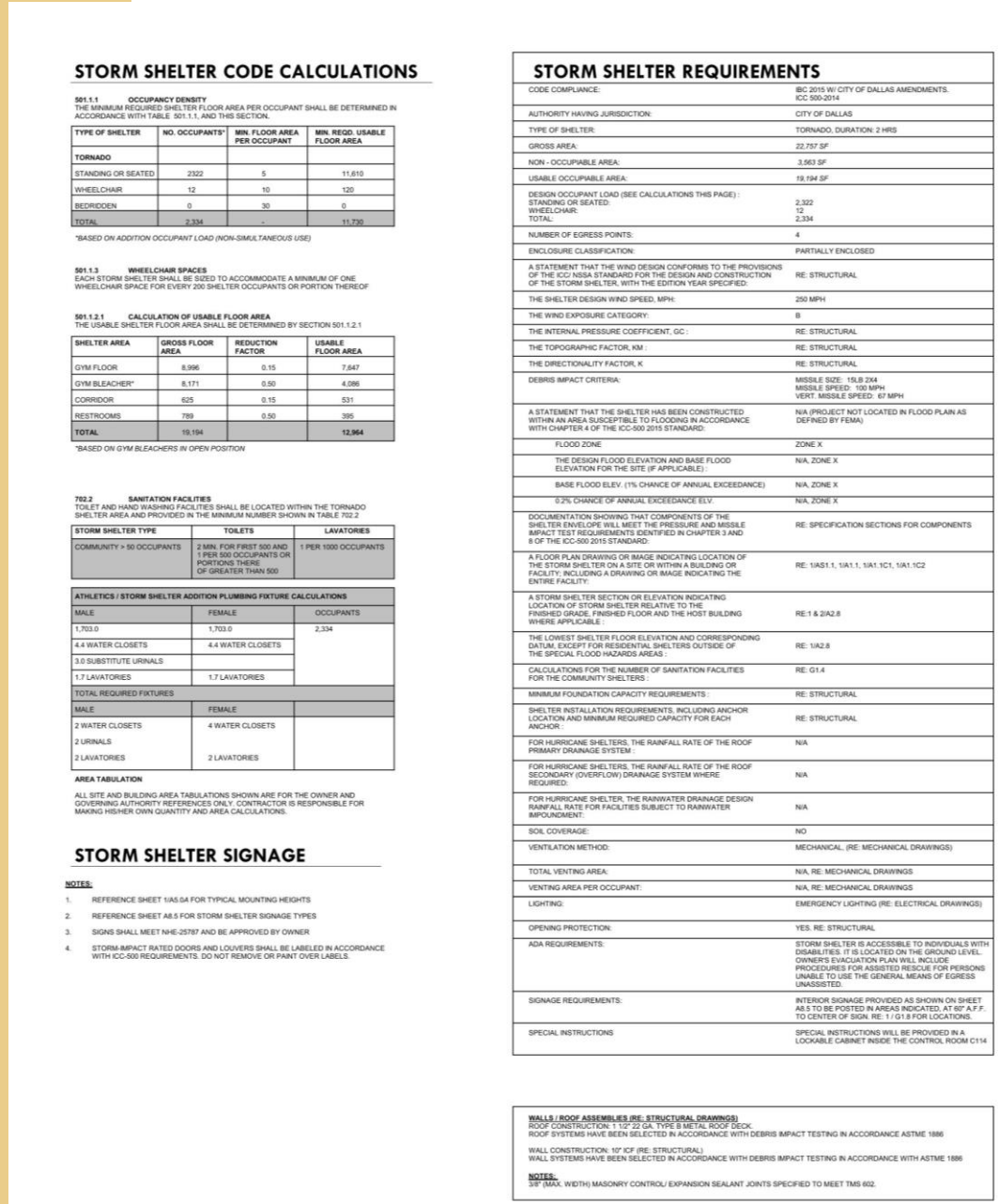
HIGHLIGHT OF ICC 500 2020 UPDATES

Summary of major changes, highlighting those changes with significant impact to Owner.

CHAPTER 1 (APPLICATION AND ADMINISTRATION)

- **SECTION 106.2.2 Design information documentation.**
  - Basic shelter info from all disciplines must be included or referenced on one sheet within drawings (not split across various disciplines)

ICC 500-2020 HIGHLIGHTS



STORM SHELTER CODE CALCULATIONS

501.1.1 OCCUPANCY DENSITY
THE MINIMUM REQUIRED SHELTER FLOOR AREA PER OCCUPANT SHALL BE DETERMINED IN ACCORDANCE WITH TABLE 501.1.1, AND THIS SECTION.

TYPE OF SHELTER	NO. OCCUPANTS*	MIN. FLOOR AREA PER OCCUPANT	MIN. REQD. USABLE FLOOR AREA
TORNADO			
STANDING OR SEATED	2322	5	11,610
WHEELCHAIR	12	10	120
BEDRIDDEN	0	30	0
TOTAL	2,334	-	11,730

*BASED ON ADDITION OCCUPANT LOAD (NON-SIMULTANEOUS USE)

501.1.3 WHEELCHAIR SPACES
EACH STORM SHELTER SHALL BE SIZED TO ACCOMMODATE A MINIMUM OF ONE WHEELCHAIR SPACE FOR EVERY 200 SHELTER OCCUPANTS OR PORTION THEREOF

501.1.2.1 CALCULATION OF USABLE FLOOR AREA
THE USABLE SHELTER FLOOR AREA SHALL BE DETERMINED BY SECTION 501.1.2.1

SHELTER AREA	GROSS FLOOR AREA	REDUCTION FACTOR	USABLE FLOOR AREA
GYM FLOOR	8,996	0.15	7,647
GYM BLEACHER*	8,171	0.50	4,086
CORRIDOR	625	0.15	531
RESTROOMS	789	0.50	395
TOTAL	19,194		12,964

*BASED ON GYM BLEACHERS IN OPEN POSITION

702.2 SANITATION FACILITIES
TOILET AND HAND WASHING FACILITIES SHALL BE LOCATED WITHIN THE TORNADO SHELTER AREA AND PROVIDED IN THE MINIMUM NUMBER SHOWN IN TABLE 702.2

STORM SHELTER TYPE	TOILETS	LAVATORIES
COMMUNITY > 50 OCCUPANTS	2 MIN. FOR FIRST 500 AND 1 PER 500 OCCUPANTS OR PORTIONS THERE OF GREATER THAN 500	1 PER 1000 OCCUPANTS

ATHLETICS / STORM SHELTER ADDITION PLUMBING FIXTURE CALCULATIONS		
MALE	FEMALE	OCCUPANTS
1,703.0	1,703.0	2,334
4.4 WATER CLOSETS	4.4 WATER CLOSETS	
3.0 SUBSTITUTE URINALS		
1.7 LAVATORIES	1.7 LAVATORIES	
TOTAL REQUIRED FIXTURES		
MALE	FEMALE	
2 WATER CLOSETS	4 WATER CLOSETS	
2 URINALS		
2 LAVATORIES	2 LAVATORIES	

AREA TABULATION

ALL SITE AND BUILDING AREA TABULATIONS SHOWN ARE FOR THE OWNER AND GOVERNING AUTHORITY REFERENCES ONLY. CONTRACTOR IS RESPONSIBLE FOR MAKING HIS/HER OWN QUANTITY AND AREA CALCULATIONS.

STORM SHELTER SIGNAGE

NOTES:

1. REFERENCE SHEET 1/A5.0A FOR TYPICAL MOUNTING HEIGHTS
2. REFERENCE SHEET A8.5 FOR STORM SHELTER SIGNAGE TYPES
3. SIGNS SHALL MEET NHE-25787 AND BE APPROVED BY OWNER
4. STORM-IMPACT RATED DOORS AND LOUVERS SHALL BE LABELED IN ACCORDANCE WITH ICC-500 REQUIREMENTS. DO NOT REMOVE OR PAINT OVER LABELS.

STORM SHELTER REQUIREMENTS

CODE COMPLIANCE:	IBC 2015 W/ CITY OF DALLAS AMENDMENTS. ICC 500-2014
AUTHORITY HAVING JURISDICTION:	CITY OF DALLAS
TYPE OF SHELTER:	TORNADO, DURATION: 2 HRS
GROSS AREA:	22,757 SF
NON - OCCUPIABLE AREA:	3,563 SF
USABLE OCCUPIABLE AREA:	19,194 SF
DESIGN OCCUPANT LOAD (SEE CALCULATIONS THIS PAGE) : STANDING OR SEATED: WHEELCHAIR: TOTAL:	2,322 12 2,334
NUMBER OF EGRESS POINTS:	4
ENCLOSURE CLASSIFICATION:	PARTIALLY ENCLOSED
A STATEMENT THAT THE WIND DESIGN CONFORMS TO THE PROVISIONS OF THE ICC/ NSSA STANDARD FOR THE DESIGN AND CONSTRUCTION OF THE STORM SHELTER, WITH THE EDITION YEAR SPECIFIED:	RE: STRUCTURAL
THE SHELTER DESIGN WIND SPEED, MPH:	250 MPH
THE WIND EXPOSURE CATEGORY:	B
THE INTERNAL PRESSURE COEFFICIENT, GC :	RE: STRUCTURAL
THE TOPOGRAPHIC FACTOR, Kzt :	RE: STRUCTURAL
THE DIRECTIONALITY FACTOR, K	RE: STRUCTURAL
DEBRIS IMPACT CRITERIA:	MISSILE SIZE: 15LB 2X4 MISSILE SPEED: 100 MPH VERT. MISSILE SPEED: 67 MPH
A STATEMENT THAT THE SHELTER HAS BEEN CONSTRUCTED WITHIN AN AREA SUSCEPTIBLE TO FLOODING IN ACCORDANCE WITH CHAPTER 4 OF THE ICC-500 2015 STANDARD:	N/A (PROJECT NOT LOCATED IN FLOOD PLAIN AS DEFINED BY FEMA)
FLOOD ZONE:	ZONE X
THE DESIGN FLOOD ELEVATION AND BASE FLOOD ELEVATION FOR THE SITE (IF APPLICABLE) :	N/A, ZONE X
BASE FLOOD ELEV. (1% CHANCE OF ANNUAL EXCEEDANCE)	N/A, ZONE X
0.2% CHANCE OF ANNUAL EXCEEDANCE ELV.	N/A, ZONE X
DOCUMENTATION SHOWING THAT COMPONENTS OF THE SHELTER ENVELOPE WILL MEET THE PRESSURE AND MISSILE IMPACT TEST REQUIREMENTS IDENTIFIED IN CHAPTER 3 AND 8 OF THE ICC-500 2015 STANDARD:	RE: SPECIFICATION SECTIONS FOR COMPONENTS
A FLOOR PLAN DRAWING OR IMAGE INDICATING LOCATION OF THE STORM SHELTER ON A SITE OR WITHIN A BUILDING OR FACILITY, INCLUDING A DRAWING OR IMAGE INDICATING THE ENTIRE FACILITY:	RE: 1/AS1.1, 1/A1.1, 1/A1.1C1, 1/A1.1C2
A STORM SHELTER SECTION OR ELEVATION INDICATING LOCATION OF STORM SHELTER RELATIVE TO THE FINISHED GRADE, FINISHED FLOOR AND THE HOST BUILDING WHERE APPLICABLE :	RE:1 & 2/A2.8
THE LOWEST SHELTER FLOOR ELEVATION AND CORRESPONDING DATUM, EXCEPT FOR RESIDENTIAL SHELTERS OUTSIDE OF THE SPECIAL FLOOD HAZARDS AREAS :	RE: 1/A2.8
CALCULATIONS FOR THE NUMBER OF SANITATION FACILITIES FOR THE COMMUNITY SHELTERS :	RE: G1.4
MINIMUM FOUNDATION CAPACITY REQUIREMENTS :	RE: STRUCTURAL
SHELTER INSTALLATION REQUIREMENTS, INCLUDING ANCHOR LOCATION AND MINIMUM REQUIRED CAPACITY FOR EACH ANCHOR :	RE: STRUCTURAL
FOR HURRICANE SHELTERS, THE RAINFALL RATE OF THE ROOF PRIMARY DRAINAGE SYSTEM :	N/A
FOR HURRICANE SHELTERS, THE RAINFALL RATE OF THE ROOF SECONDARY (OVERFLOW) DRAINAGE SYSTEM WHERE REQUIRED:	N/A
FOR HURRICANE SHELTER, THE RAINWATER DRAINAGE DESIGN RAINFALL RATE FOR FACILITIES SUBJECT TO RAINWATER IMPOUNDMENT:	N/A
SOIL COVERAGE:	NO
VENTILATION METHOD:	MECHANICAL, (RE: MECHANICAL DRAWINGS)
TOTAL VENTING AREA:	N/A, RE: MECHANICAL DRAWINGS
VENTING AREA PER OCCUPANT:	N/A, RE: MECHANICAL DRAWINGS
LIGHTING:	EMERGENCY LIGHTING (RE: ELECTRICAL DRAWINGS)
OPENING PROTECTION:	YES, RE: STRUCTURAL
ADA REQUIREMENTS:	STORM SHELTER IS ACCESSIBLE TO INDIVIDUALS WITH DISABILITIES. IT IS LOCATED ON THE GROUND LEVEL. OWNER'S EVACUATION PLAN WILL INCLUDE PROCEDURES FOR ASSISTED RESCUE FOR PERSONS UNABLE TO USE THE GENERAL MEANS OF EGRESS UNASSISTED.
SIGNAGE REQUIREMENTS:	INTERIOR SIGNAGE PROVIDED AS SHOWN ON SHEET A8.5 TO BE POSTED IN AREAS INDICATED, AT 60" A.F.F. TO CENTER OF SIGN. RE: 1 / G1.8 FOR LOCATIONS.
SPECIAL INSTRUCTIONS	SPECIAL INSTRUCTIONS WILL BE PROVIDED IN A LOCKABLE CABINET INSIDE THE CONTROL ROOM C114

WALLS / ROOF ASSEMBLIES (RE: STRUCTURAL DRAWINGS)
ROOF CONSTRUCTION: 1 1/2" 22 GA. TYPE B METAL ROOF DECK.
ROOF SYSTEMS HAVE BEEN SELECTED IN ACCORDANCE WITH DEBRIS IMPACT TESTING IN ACCORDANCE ASTME 1886

WALL CONSTRUCTION: 10" ICF (RE: STRUCTURAL)
WALL SYSTEMS HAVE BEEN SELECTED IN ACCORDANCE WITH DEBRIS IMPACT TESTING IN ACCORDANCE WITH ASTME 1886

NOTES:
3/8" (MAX. WIDTH) MASONRY CONTROL/ EXPANSION SEALANT JOINTS SPECIFIED TO MEET TMS 602.

CHAPTER 1 (APPLICATION AND ADMINISTRATION)

- **SECTION 108 OWNER'S RESPONSIBILITY has been added.**
  - The owner must submit an Owner's statement of responsibility with the application for a construction permit. It acknowledges their responsibility regarding shelter operation and maintenance.
  - The owner must submit a Storm Shelter Preparedness and Emergency Operation Plan (SSPEOP) to the AHJ prior to the approval of the certificate of occupancy.

Added an Appendix A – Storm Shelter Preparedness and Emergency Operation Plan (SSPEOP). This serves as a template for the Owner when preparing their SSPEOP.

ICC 500-2020 UPDATED HIGHLIGHTS

5. Identify who the intended occupants are, for example:
   5.1. *Host building*.
   5.2. Within a campus, defined property or boundary.
   5.3. General public.
6. Days and hours when the shelter will be operational for intended occupants including expectation of storm shelter use during off-hours, where applicable.

A104.4 Floor plans and site plans. The SSPEOP shall include floor plans for the *storm shelter*, and additional information for the *host building* and site where applicable.

A104.4.1 Storm shelter floor plans. A storm shelter floor plan shall be provided. The plan shall indicate the following:

1. Access and means of egress doors.
2. Emergency escape openings, where provided.
3. *Impact-protective systems* that need to be secured in place.
4. Layout and function of *occupant support areas*.
5. Mechanical vents or mechanical ventilation systems that need to be activated, where provided.
6. Water closet and lavatory locations, including locations for set up of temporary water closets and lavatories, where provided.
7. Standby power supply, where provided.
8. Storage of required supplies such as first aid kits and flashlights.
9. Location of fire extinguishers.

A104.4.2 Hurricane storm shelter floor plans. In addition to the items listed in Section A104.4.1, a hurricane storm shelter floor plan shall indicate the following:

1. Sample layout for sleeping accommodations.
2. Storage location for drinking water and food provisions.

A104.4.3 Host building plans. Where the *storm shelter* is located within or adjacent to a *host building*, a plan of the *host building* shall be provided. The *host building* plan shall identify the following:

1. The route from the building entrance to the storm shelter entrance.
2. Primary and secondary evacuation routes from the *storm shelter* after the storm.
3. A list of major fire hazards associated with the normal use and occupancy of the premises, if applicable.

A104.4.4 Site plans. Where any portion of the storm shelter's intended occupant population is anticipated to travel from off-site to the *storm shelter*, a site plan shall be provided. The site plan shall indicate the following:

1. Site arrival points for shelter occupants.
2. Traffic pattern and parking plans.
3. Exterior routes from the parking to the building entrance.

A104.5 Registration of location. Where a storm shelter registry is maintained by the *authority having jurisdiction* or local emergency responders, the owner, owner's representative or entity responsible for operating the *storm shelter* shall register the location of the *storm shelter*. The SSPEOP shall indicate the name and contact information of the group that maintains the registry and the date that the *storm shelter* was registered, as applicable.

SECTION A105
SSPEOP PREPAREDNESS REQUIREMENTS

A105.1 General. An *approved* SSPEOP shall include preparedness requirements as required in Sections A105.2 through 105.6.4.1. The purpose of the plan's preparedness components is to verify that the *storm shelter* is ready and maintained for use and will be fully operational during the storm.

A105.2 Storm shelter management team. The SSPEOP shall include *storm shelter management team* roles and duties. At a minimum, the roles of storm shelter manager, storm shelter assistant manager and general staff shall be identified. The SSPEOP shall identify the primary individual currently assigned to each role and shall identify back-up staff for management roles and for general staff roles that are assigned duties considered critical to shelter emergency operations.

A105.2.1 Contact information. Current contact information for all identified primary and back-up shelter management team roles shall include phone numbers and email addresses. Contact information shall be updated no less than one time per year or as needed.

A105.2.2 Duties. The SSPEOP shall identify the *storm shelter management team* primary and back-up roles charged with the following critical duties:

1. Authorization to issue an order to activate the *storm shelter*.
2. Authorization to issue an all clear for *storm shelter* deactivation.
3. Unlocking the *storm shelter*, where applicable, and
4. Securing and locking down all *impact-protective systems* prior to the storm.

A105.2.3 Specialized personnel. The *storm shelter management team* shall include specialized personnel where required by Sections A105.2.3.1 through A105.2.3.3.

A105.2.3.1 Security personnel. Where the *storm shelter* is open to the general public and *storm shelter design occupant capacity* is greater than 500 or where required by the *authority having jurisdiction*, security personnel shall be designated in the SSPEOP.

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APPENDIX A—STORM SHELTER PREPAREDNESS AND EMERGENCY OPERATIONS PLAN (SSPEOP)

A105.2.3.1.1 Duties. The duties of security personnel shall include:

1. Conduct an inspection of the *storm shelter* area and identify and address any occupant safety concerns.
2. Direct and assist the shelter occupants into the *storm shelter* at activation and for evacuation at deactivation.
3. Assist emergency response personnel where requested.

A105.2.3.2 Health care personnel. Where required by the *authority having jurisdiction,* health care personnel shall be designated in the SSPEOP to provide first aid as needed and attend to health care needs of storm shelter occupants.

A105.2.3.2.1 Duties. The duties of designated storm shelter health care personnel shall include:

1. Identify and assign medical support or first aid personnel.
2. Maintain first aid and medical support supplies for use during shelter activation.
3. Maintain confidential information provided by intended occupants who have indicated special medical needs and coordinate indicated accommodations where practicable during shelter activation.
4. Designate isolation areas for occupants who arrive with indications of communicable illnesses and provide direction to the isolation areas; provide personal protective equipment, such as masks or gloves, as appropriate.

A105.2.3.3 Fire watch personnel. Where required by the *authority having jurisdiction*, fire watch personnel shall be designated in the SSPEOP. Fire watch personnel shall remain on duty while the *storm shelter* is activated for use.

A105.2.3.3.1 Duties. On-duty fire watch personnel shall have the following responsibilities:

1. Conduct an inspection of the storm shelter area to identify and mitigate any fire hazards.
2. Keep diligent watch for fires, obstructions to *means of egress* and other hazards.
3. Take prompt measures for remediation of hazards and extinguishment of fires that occur.
4. Take prompt measures to assist in the evacuation from the *storm shelter*.

A105.2.4 Team training and team drills. Where required by the *authority having jurisdiction, storm shelter management team* members and their backups shall be trained periodically. The purpose of staff training is to provide members with current information on their duties and responsibilities under the SSPEOP and to provide an opportunity to practice execution of their duties with other team members through team-only or intended occupant drills.

A105.3 Community outreach and notification. The SSPEOP shall include the methods and procedures chosen to contact, notify and update the intended occupants of the *storm shelter* regarding the following information:

1. Days and hours when the *storm shelter* will be operational, including expectation of *storm shelter* use during off-hours, where applicable.
2. Activation signals and drills. The preferred and any alternative means of notifying the general public or intended occupants of the need to move to the *storm shelter*. The notification methods shall be distinct from other hazard warning signals. Where provided, a description of the emergency voice/alarm communication system alert tone and preprogrammed voice messages shall be included.
3. Accessing the *storm shelter,* including location of entrances and parking where applicable.
4. Policies and procedures regarding:
   4.1. Public health and infectious disease.
   4.2. Pets.
   4.3. Occupancy.
   4.4. Deactivation.
5. Shelter contact information.

A105.3.1 Recordkeeping. The SSEOP shall include or reference the location of records including the dates that notifications occurred and the method of outreach implemented.

A105.4 Intended occupant drills. Where required by the *authority having jurisdiction*, intended occupant drills shall involve the movement of intended storm shelter occupants to the *storm shelter*. Unless more frequent drilling is required by the *authority having jurisdiction*, no less than one intended occupant drill shall occur yearly.

A105.4.1 Recordkeeping. The SSEOP shall include or reference the location of records on required storm shelter drills. The records shall include the following information:

1. Date and time of the drill.
2. Notification method used.
3. Identity of the person conducting the drill, staff on duty and staff participating.
4. Number of occupants relocated to the *storm shelter*.
5. Special conditions simulated.
6. Weather conditions when occupants were evacuated from the *storm shelter*.
7. Time required to accomplish complete movement of intended occupants to the *storm shelter*.
8. Problems encountered.

A105.4.2 Notification. Where required by the *authority having jurisdiction*, prior notification of shelter activation drills shall be given to the *authority having jurisdiction*.

A105.5 Communication. The SSPEOP shall identify at least one means of communication other than landline telephone or

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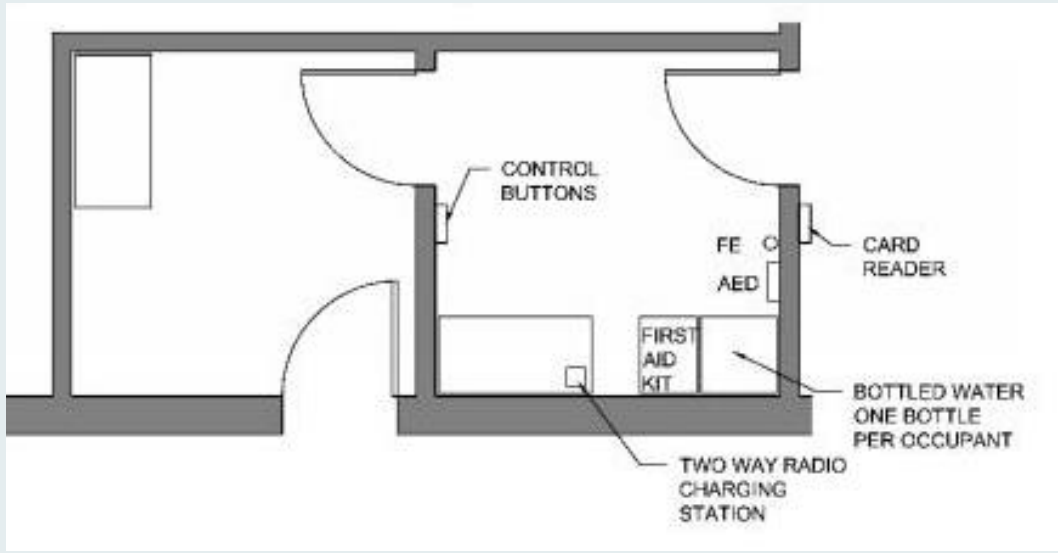
APPENDIX A SSPEOP



Source: DISD TDG Control Room Diagram

CONTROL ROOM

- Designated Area within the tornado shelter
- Control buttons for emergency operation of Doors, Shutters and emergency power
- Reset button
- First Aid Kit
- Drinking Water
- Fire Extinguisher
- AED
- Instruction for Emergency Operations

APPLICATION OF THE SSPEOP

Source: Dallas ISD

Pre-Construction Checklist

- Local controls for overhead doors enclosing the shelter
- Hold-opens for interior doors leading from campus
- 4 receptacles on back-up power for phone and radio charging
- Card reader for control room
- Include sign for design capacity of storm shelter
- Include sequence of event instructions in control room
- Owner's Emergency Manager to observe Storm Shelter drill
- Owner's Emergency Manager to observe training of on-site staff

APPLICATION OF THE SSPEOP

APPENDIX A SSPEOP

JQ: City of Dallas Fire Station #41 (October 2019)

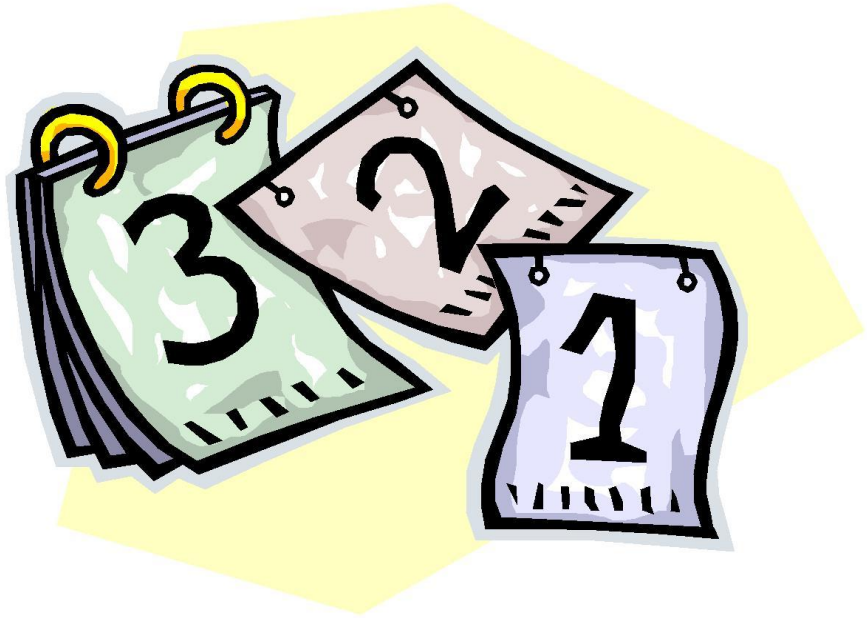
CHAPTER 1 (APPLICATION AND ADMINISTRATION)

- **SECTION 109 PEER REVIEW.**
  - Clarifies that the owner, not the registered design professionals for the project, shall employ an independent registered design professional to conduct a peer review.
  - Requires that the Peer reviewer provides qualifications demonstrating their relevant experience and training for projects similar in complexity.

ICC 500-2020 UPDATE HIGHLIGHTS

- Owner may not understand their responsibility related to hiring peer reviewer
- Not all peer reviewers are created equally
- Signed peer review report is required for permit
- High potential to affect project schedule

PEER REVIEW CHALLENGES



- Coordinate peer review requirements with Owner early
- Peer reviewer must interpret ICC 500 in similar manner as the design team
- Consider early coordination meeting with peer reviewer(s)
- Expect at least 2 rounds of reviews
  - Estimate ~2-3 weeks for each review
  - Peer reviews at 50% CD and 90% CD
- Design team should design/coordinate shelter early so drawings are complete enough for effective peer reviews

PEER REVIEW AND THE SCHEDULE

CHAPTER 1 (APPLICATION AND ADMINISTRATION)

- **SECTION 113 EVALUATION, MAINTENANCE AND REPAIRS has been added.**
  - Owner must conduct an annual visual observation and assessment of the shelter
  - Owner must maintain the shelter in an operational condition at all times and repair all structural and operational damages.
  - Owner must keep a record of evaluations, maintenance, and repairs and make it available to AHJ.

TABLE 502.3
OCCUPANT DENSITY—COMMUNITY STORM SHELTERS

TYPE OF OCCUPANTS	MINIMUM REQUIRED USABLE FLOOR AREA IN SQUARE FEET PER OCCUPANT
Tornado	
Occupants who are standing or seated	5
Occupants using a wheelchair	10
Occupants who are relocated in a bed or stretcher	30
Hurricane	
Occupants who are standing or seated	20
Occupants using a wheelchair	20
Occupants who are relocated in a bed or stretcher	40

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

CHAPTER 5 (OCCUPANT DENSITY, ACCESS, ACCESSIBILITY, EGRESS AND SIGNAGE)

- Section 502 OCCUPANCY DENSITY IN COMMUNITY STORM SHELTER. Clarifies that the design occupant capacity of the storm shelter shall be determined based upon the needs of the storm shelter as determined by the owner and the designer and approved by the AHJ **or** calculated as prescribed Table 502.3.

SECTION 508 SIGNAGE.

Clarifies Signage requirements as follows:

1. Information (what)
2. Directional (where)
3. Entry (how do I get in)
4. Perimeter (how do I get out)

INFORMATION (What) SIGNAGE

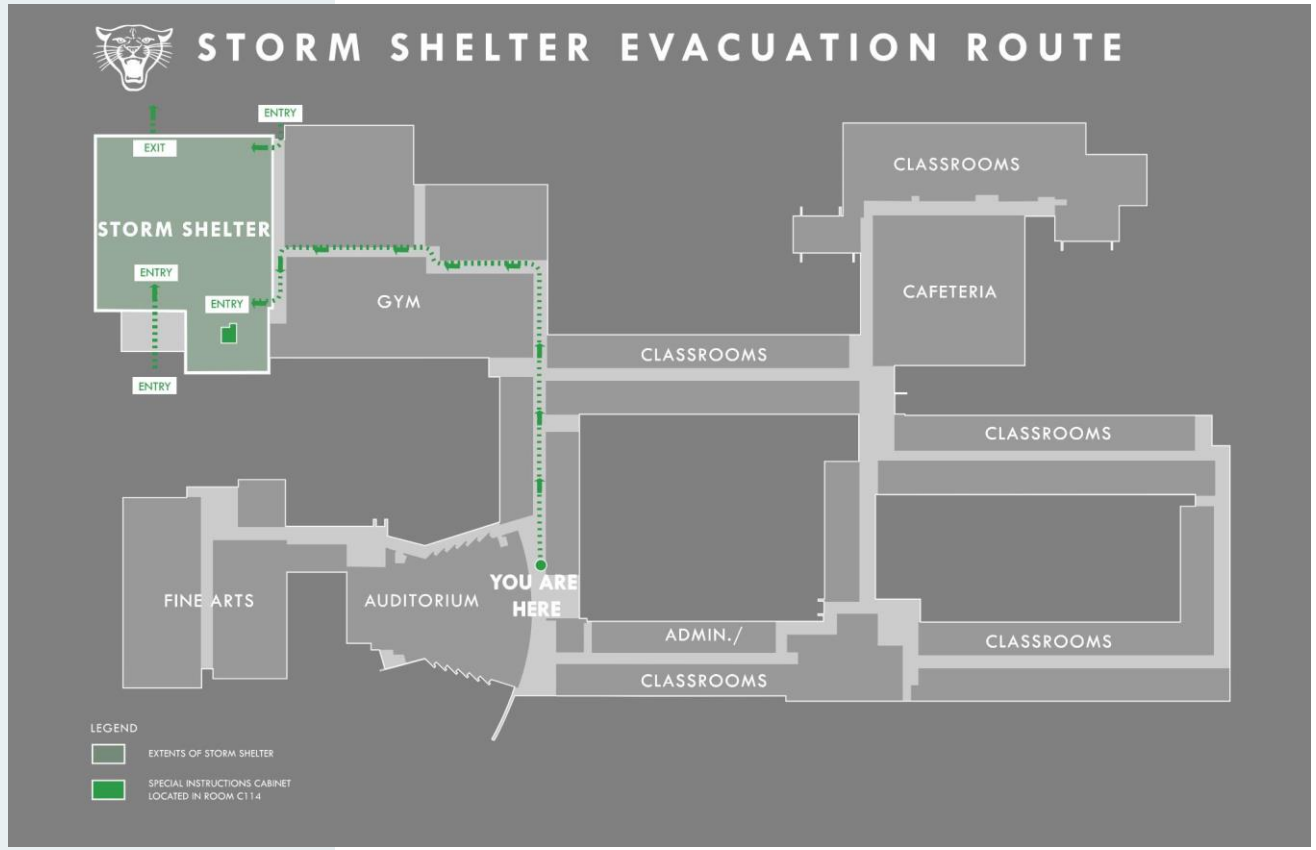
- Design Information Sign to include the
  - Design occupant capacity
  - Storm type
  - Design wind speed
  - Edition of the ICC 500
  - Name of the storm shelter manufacturer/builder
- Located on or within the storm shelter.

SIGNAGE UPDATES

SIGNAGE UPDATES

DIRECTIONAL (where) SIGNAGE

- Exterior directional signs only where the storm shelter serves the general public.
- Storm shelter directional signage within a host building and for a multi-building site to direct intended occupants to the storm shelter.



ENTRY (*HOW DO I GET IN*) SIGNAGE

- Shelter entry sign indicating Tornado Shelter.
- Located outside every intended storm shelter entrance.

SIGNAGE UPDATES

PERIMETER (*HOW DO I GET OUT*) SIGNAGE

- Storm shelter perimeter sign

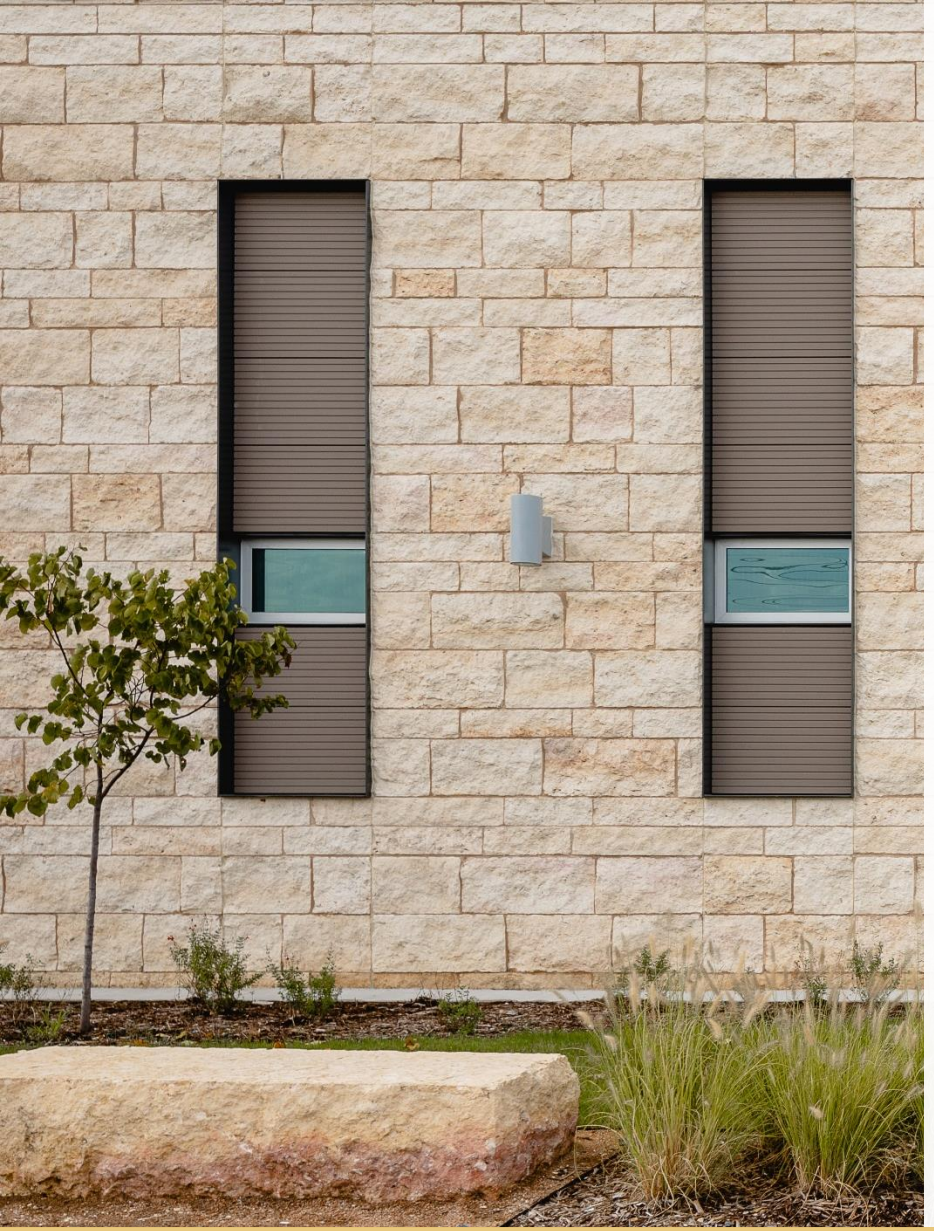
  "NOTICE: NOW LEAVING THE TORNADO SHELTER".

- Located inside of every storm shelter entry.

SIGNAGE UPDATES

SECTION 602 FIRE PROTECTION SYSTEMS SECTION

- Clarifies that the fire protection systems provided within the storm shelter required by code for normal use of the space are not required to remain functional during the design storm event.



SECTION 702 TORNADO

- The requirement for the Sanitation facility support system has been removed. Water/wastewater storage not required in a tornado shelter.
- All Standby power systems shall be protected

03

ARCHITECTURAL CHALLENGES

Review best practices for construction administration, pros and cons of major architectural elements, and conclude with major cost implications of the various design elements of a tornado shelter.

SPECIFICATIONS

- Pre-install meeting
- Storm shelter submittal requirements
- Addresses contractor's statement of responsibility
- Storm shelter submittal requirements
- Testing and inspection requirements
- Mock-ups

QUALITY ASSURANCE PLAN

SECTION 01 81 33 - STORM SHELTER QUALITY ASSURANCE PLAN

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
1. Quality Assurance Plan for ICC-500 Storm Shelters. Refer also to notes and additional information in Drawings.
2. Contractor's responsibilities for Storm Shelter quality control.

B. Related Sections include the following:
1. Divisions 03 and 05, as applicable for structural shell.
2. Division 07, Penetration Firestopping.
3. Division 07, Expansion Control, for joint covers for structural isolation joints.
4. Division 08, storm rated protective systems for openings through storm rated structure.
5. Division 10, Signage, for required signage for storm shelters.
6. Division 10, Fire Protection Specialties.
7. Division 22, for plumbing system requirements for storm shelters.
8. Division 23, for ventilation for storm shelters.
9. Division 26, for lighting and electrical requirements for storm shelters.
10. Requirements noted in the Drawings and other sections related to storm shelters.

1.03 REFERENCES

A. ICC-500: ICC/NSSA Standard for the Design and Construction of Storm Shelters, most current version, or version currently in force by authorities having jurisdiction.

1.04 DEFINITIONS

A. Authority having jurisdiction: The organization, political subdivision, office, or individual charged with the responsibility for administering and enforcing the provisions of the ICC-500 design standard.

B. ICC: International Code Council.

C. NSSA: National Storm Shelter Association.

1.05 SUBMITTALS

A. Product Data and Shop Drawings: Information as required for compliance with the Storm Shelter Quality Assurance Plan for each type of material or system specified that is tested and labeled by a qualified testing agency meeting the requirements of the ICC-500 design standard. Submit as required by authorities having jurisdiction.

Require minimum two storm shelter pre-installation meetings with agenda

- 1st meeting to include owner's agent, general contractor, architect, MEP consultant, structural engineer, AHJ, testing agency
- 2nd meeting to add subcontractors

PRE-INSTALLATION MEETINGS

- Requirement for contractor's statement of responsibility
- Coordination with testing and inspection agency
- Review required submittals
- Review impact resisting systems requirements
- Review MEP life support system requirements
- Review storm shelter quality assurance plan
- Review shop submittal unresolved comments

PRE-INSTALLATION AGENDA

TESTED ASSEMBLIES

ICC 500-2014

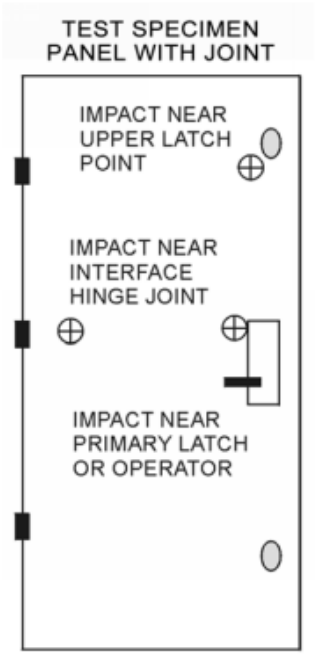


FIGURE 804.9.5(1)
DOORS AND OTHER ENTRY/EGRESS SYSTEMS

ICC 500-2020

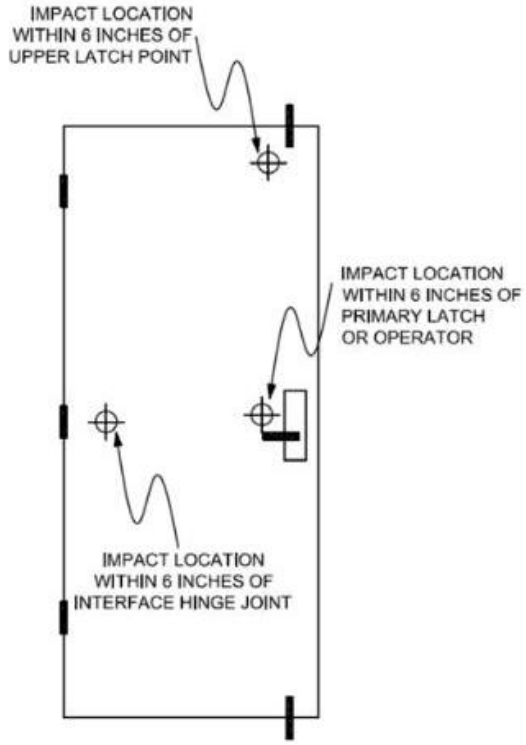
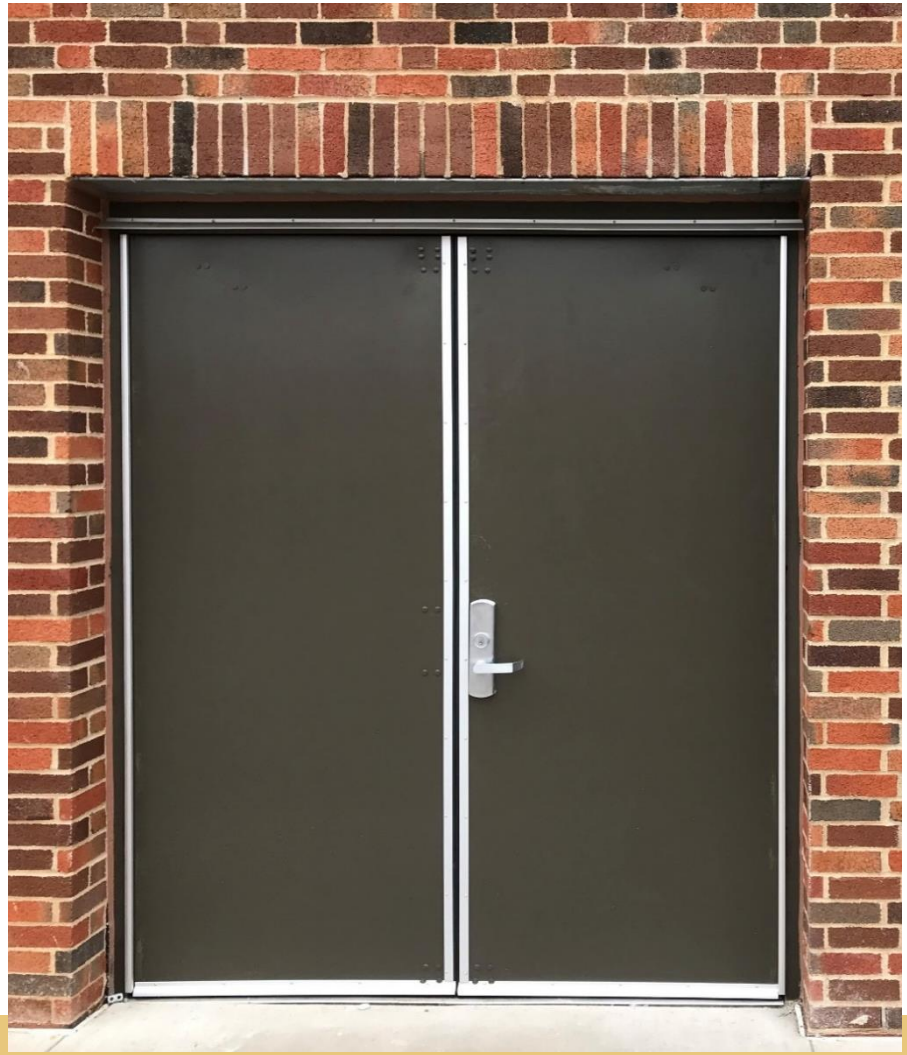


FIGURE 803.9.4.1(1)
SINGLE DOOR TEST SPECIMEN

Texas Tech University: Example of debris impact test at TTU Wind Science and Engineering Research Center

Door	Shutter
No special operation required to open or close the doors	Manual override required Monitoring of doors required
Allows emergency egress	Does not allow emergency egress
Less costly	More costly
No overhead clearance issues	No TAS clearance issues at openings
No unsightly housing to conceal	Conceal housing or leave exposed

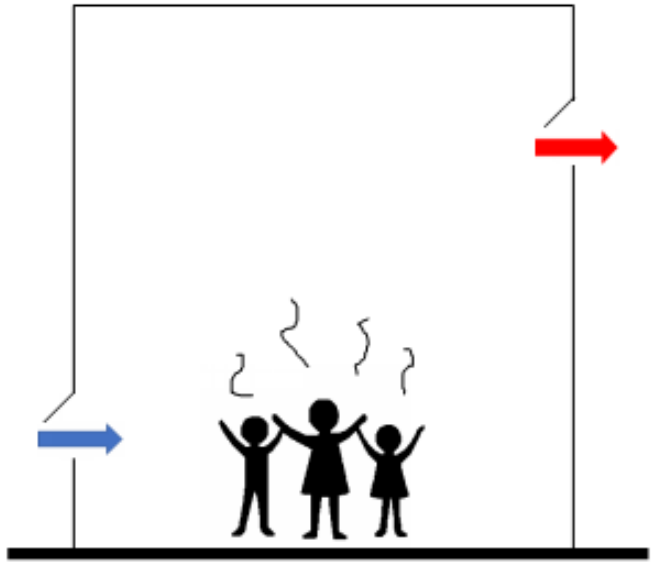


DOOR VERSUS SHUTTER

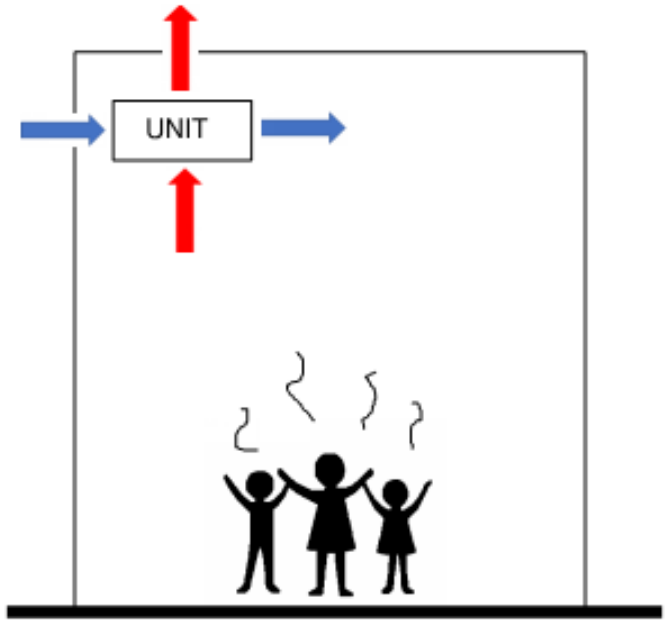
Window	Shutter
No special operation required to open or close windows	Manual override required
Opening limitations	Allows larger openings
Less costly	More costly
No overhead clearance issues	Address clearance requirements of housing
Glazing is polycarbonate and has slight distortion	Glass matches. No distortion.
No unsightly housing to conceal	Conceal housing or leave exposed

WINDOW VERSUS **SHUTTER**

WINDOW VERSUS **SHUTTER**

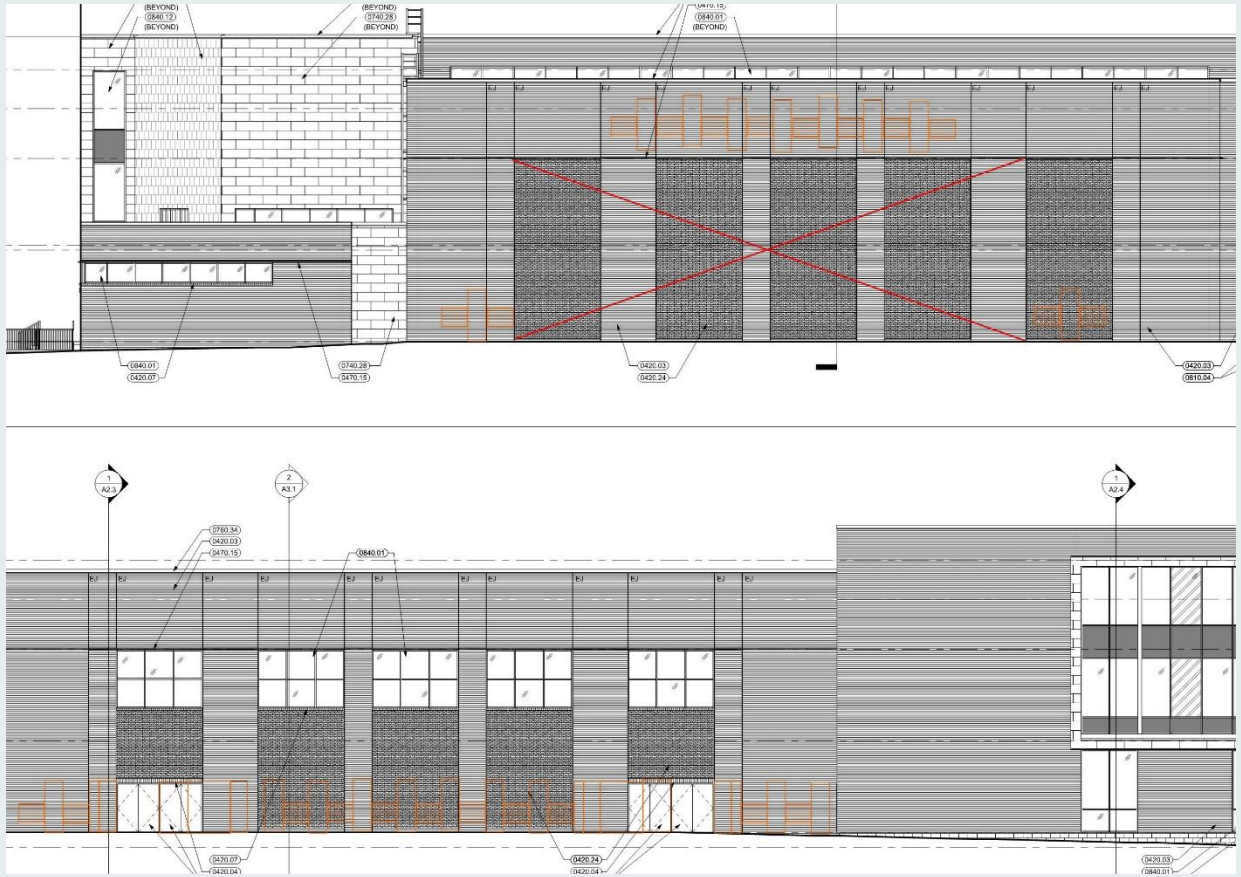


NATURAL VENTILATION



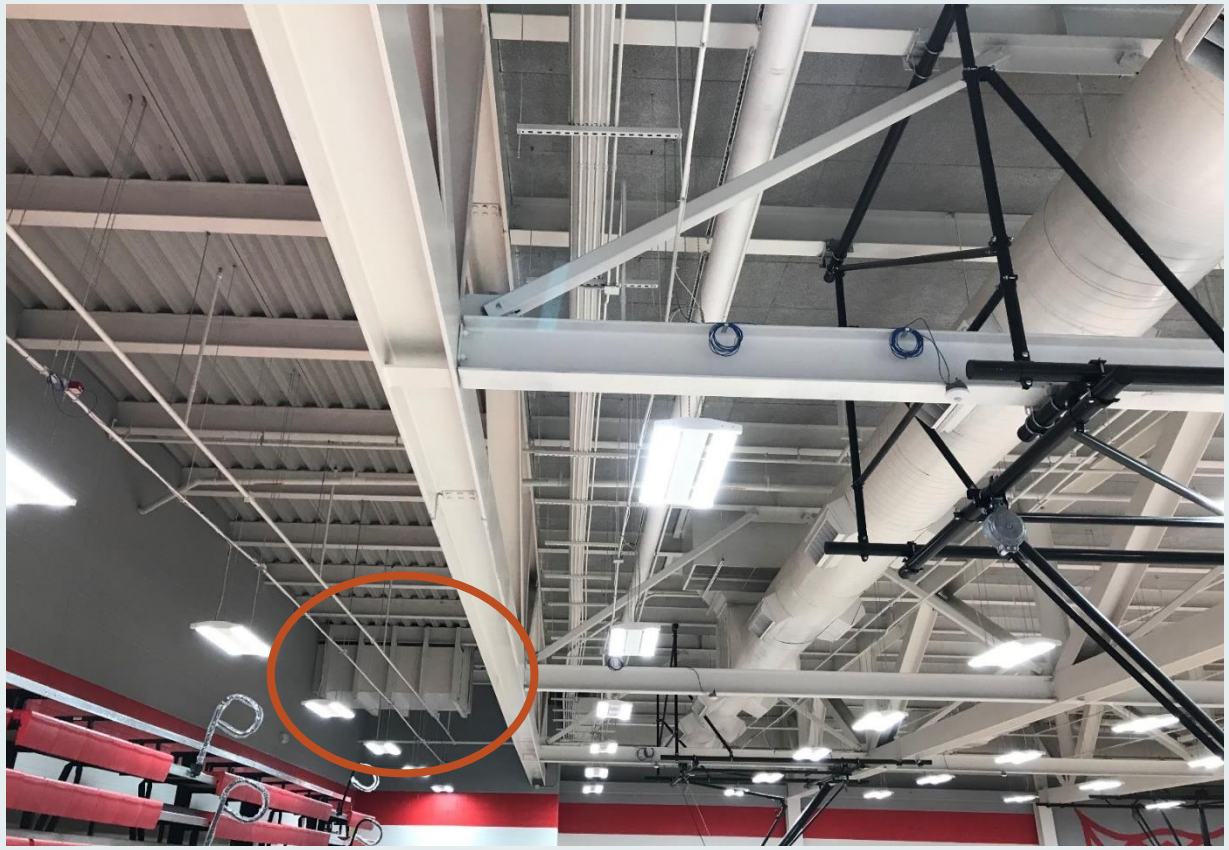
MECHANICAL VENTILATION

ICC 500 PERMITED **MECHANICAL SYSTEMS**



- Coordinate with your mechanical engineer to determine sizes of louvers
- Coordinate with your structural engineer to determine max size and location
- Natural ventilation = more openings

NATURAL OR MECHANICAL VENTILATION



- Baffles at RTU openings
- Conduits to minimize surface run
- Coordinate with structural engineer
- Roof drain openings: Encase in wall

PROTECTION OF MEP OPENINGS

- 2-hour wall construction of separation wall
- Building EJ at separation wall
- Additional SF to house back-up power generation and possible control room
- Premium for missile impact door and window assemblies

ARCHITECTURAL COST IMPLICATIONS

- Thicker/heavier structural walls
- 12” fully grouted CMU
- Concrete walls
- Thicker/heavier roof systems
- Concrete over metal deck
- Precast concrete
- Increased rebar in walls and roofs
- Increased structural steel tonnage at roofs
- More robust foundations
- Additional structural testing and inspections

STRUCTURAL COST IMPLICATIONS

- Protection of mechanical equipment openings
- Emergency ventilation
- Emergency lighting
- Back-up power

MEP COST IMPLICATIONS

COMMENTS + QUESTIONS?

BRW ARCHITECTS

REFERENCES

- International Building Code 2015
- International Building Code 2018
- International Building Code 2021
- ICC 500-2014 “ICC/NSSA Standard for the Design and Construction of Storm Shelters
- ICC 500-2020 “ICC/NSSA Standard for the Design and Construction of Storm Shelters

BRW ARCHITECTS

THANK YOU