

# STORM SHELTER DESIGN

*Midwest Facility Masters Conference*

October 31, 2023



**30 Locations**  
*World-wide*

**1300+**  
*Employee-owners*



UNITED STATES

**80%**  
*Repeat Clients*



CHINA

*11 offices in tornado alley*



UNITED ARAB EMIRATES

# Presentation Team

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**Brandon Spoehr**  
Senior Associate  
Senior Project Architect  
12 yrs



**Aaron Gahwiler**  
Associate  
Structural Leader  
7 yrs



**Matt Strasser**  
Senior Associate  
Mechanical Leader  
17 yrs



**Dangelo Gayle**  
Principal  
Electrical Leader  
40 yrs

# Agenda

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**01** Background  
(AG)

**02** Regulatory  
Requirements  
(AG/BS)

**03** Sizing and Siting  
(BS)

**04** Architectural  
(BS)

**05** Structural  
(AG)

**06** Mechanical  
(MS)

**07** Electrical  
(DG)

**08** Additional  
Requirements

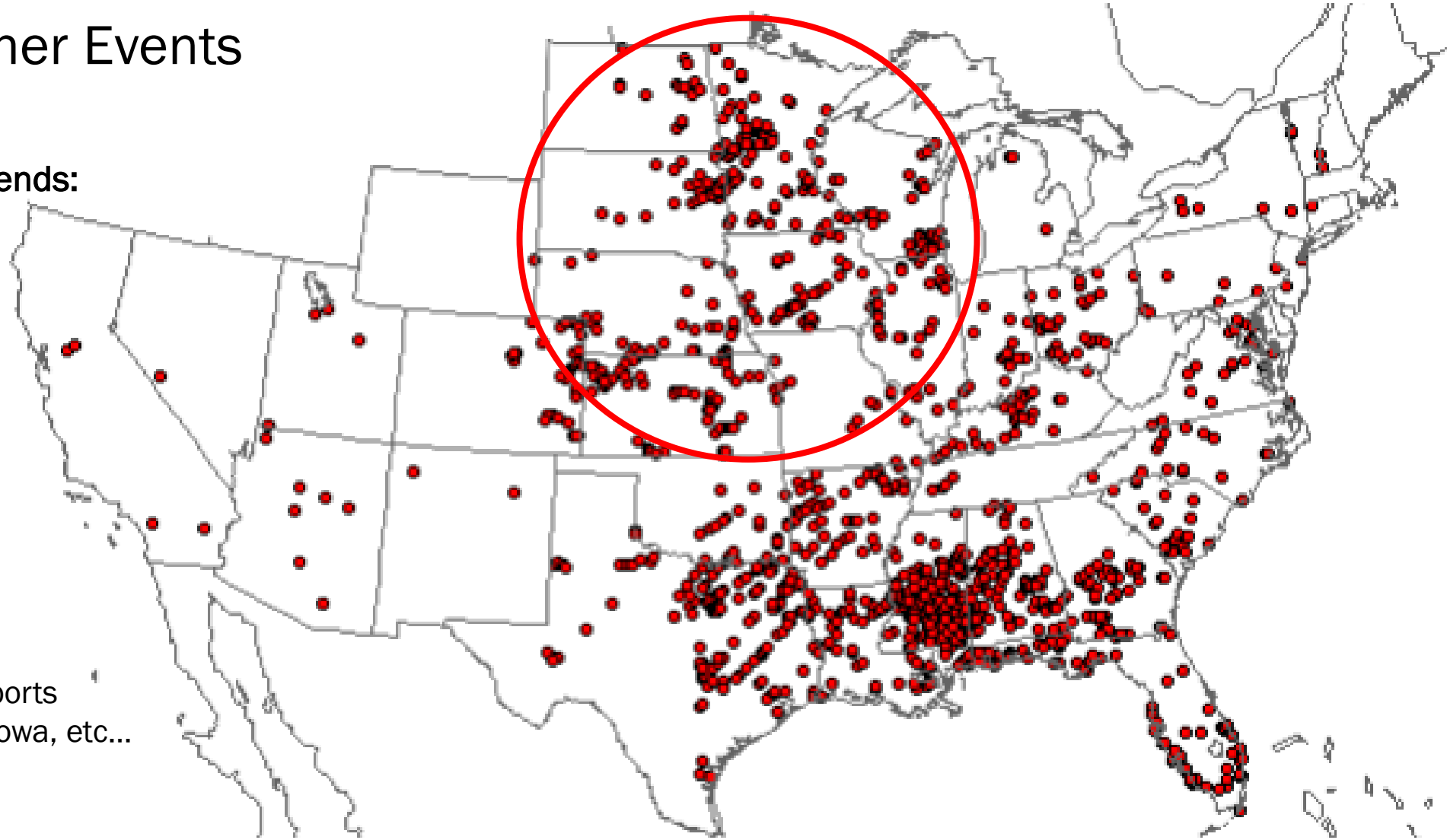
**09** Q&A



# Extreme Weather Events

## 2022 Midwest Tornado Trends:

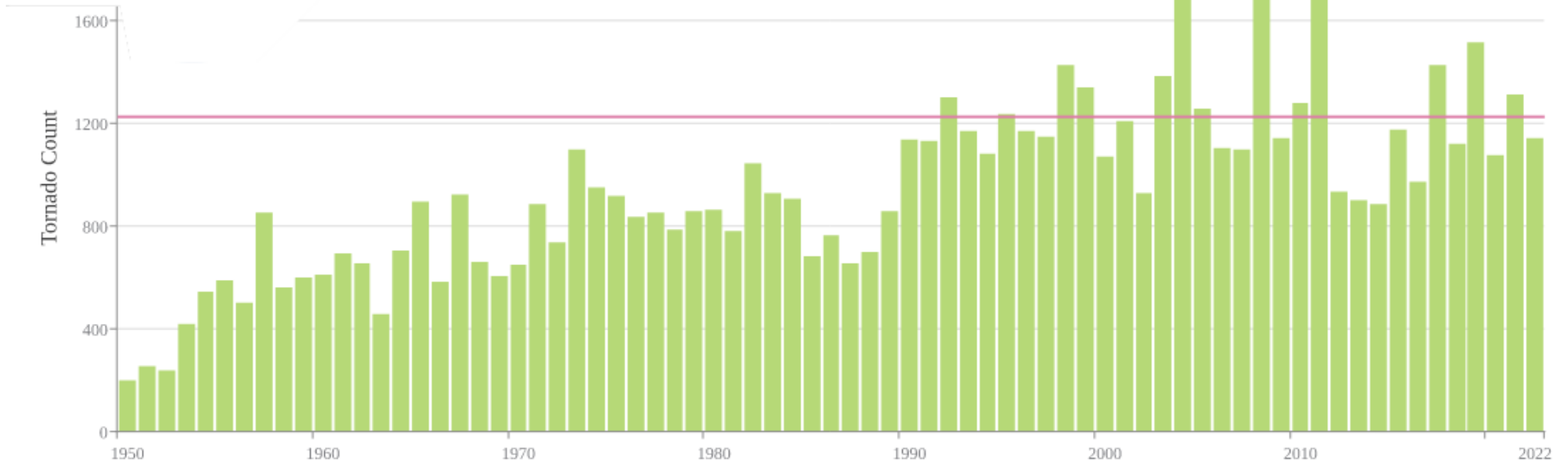
- During April 2022, there were 60 tornado reports in Nebraska, Minnesota, Iowa, etc...
- During May 2022, there were 118 tornado reports in Nebraska, Minnesota, Iowa, etc...
- During June 2022, there were 68 tornado reports in Nebraska, Minnesota, Iowa, etc...



# Extreme Weather Events

## US Tornado Trends:

- During 2022, there were 1,329 tornado reports, with March, April, May, June and November having each 100+ tornado reports.



1991-2020 Average: 1,225.1 Tornadoes

Source: [Storm Prediction Center \(SPC\)](#)

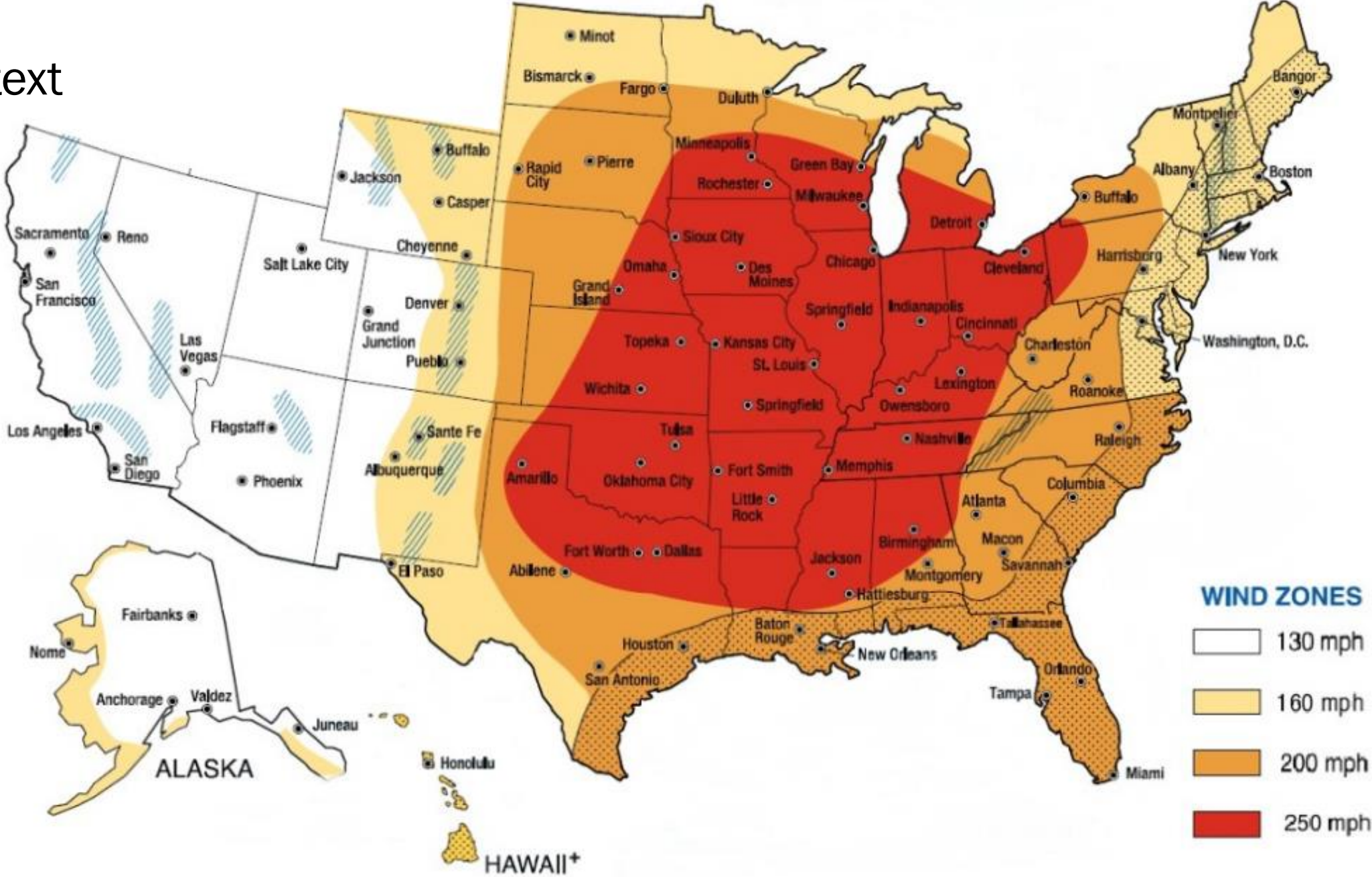
# Code Context

Governing Code:

- 2014 ICC 500

Exceptions\*:

- Exception by county and AHJ





# Code Context

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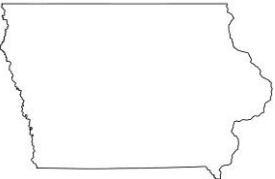
**Minnesota: IBC 2018**  
Required to the full extent defined in IBC 2018



**Wisconsin:**  
Not Required While Wisconsin adopts the IBC 2015, the state code SPS 362.0423 specifically excludes IBC 423.3 and 423.4 relating to storm shelters.



**Michigan: Michigan Building Code 2015 (amended IBC 2015)**  
Not Required (yet)



**Iowa: IBC 2015 with amendments**  
Not Required While Iowa adopts the IBC 2015, the state code 301.3(13) specifically deletes chapter 423 in its entirety. It does replace with 2 clauses defining storm shelters, but does not require them.



**Ohio: Ohio Building Code 2017 (amended IBC 2015)**  
Not Required. Ohio adopted the 2024 Ohio Building Code and it will go into effect next year. It is anticipated that section 423 that relates to storm shelters will be excluded.



**Missouri:**  
It depends...



**Illinois: IBC 2015 with amendments**  
Required for New Construction or additions that increase the size of the remaining building by 50% or more. Illinois General Assembly Part 180 adopts IBC 2015, it replaces 423 with less stringent requirements for additions to an existing school.

# Code Context

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## Existing Site And New Building Triggers\*:

- Additions, with more than 50 occupants, to Group E occupancy

## New Site And New Building Triggers\*:

- Group E occupancy with more than 50 occupants

## Key Requirements:

- The required occupant capacity depends on occupant loads

## Exceptions\*:

- Exception by county and AHJ



# Why Storm Shelters?

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- Long Range Facility Planning
- Meeting code requirements for New construction / Additions
- Future code changes for other facility types
- Community perspective



# Siting the Shelter

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**FREE STANDING**



**FREE STANDING W/  
CONNECTION**



**ABUTTED  
(EXTERIOR)**



**CONJOINED**



**ABUTTED  
(INTERIOR)**



**SURROUNDED**

Things to consider:

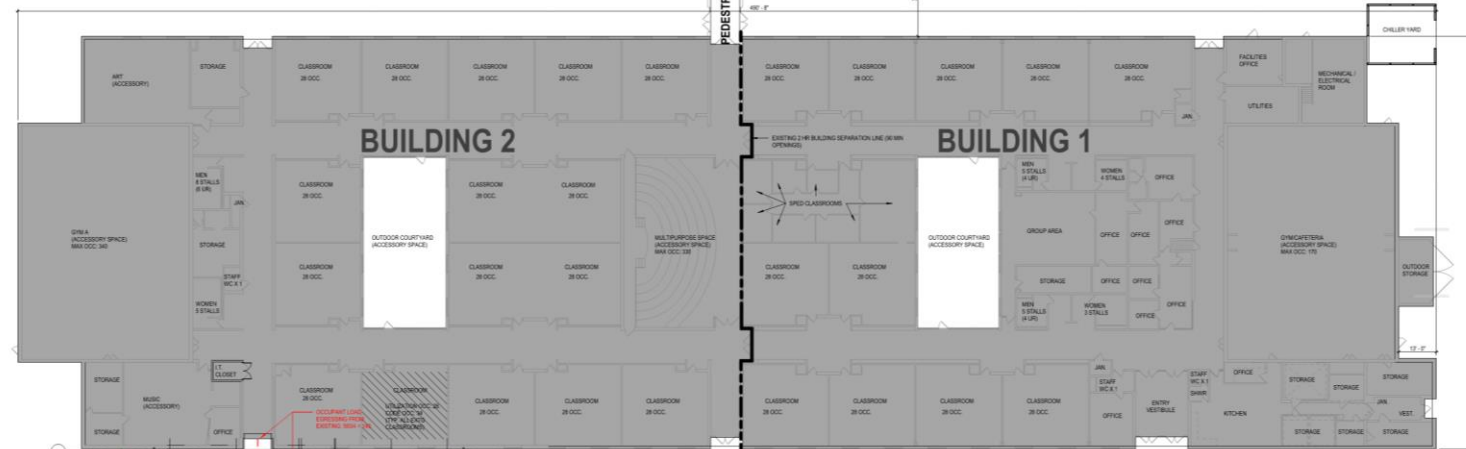
1. Constructability
2. Structural + fire separation
3. Normal use functions
4. Direct Exiting
5. Primary site access
6. Topography

# Siting and Sizing

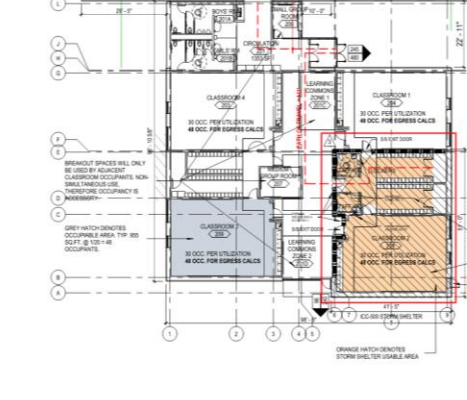
**BUILDING 3 - EXISTING**  
**CONSTRUCTION TYPE II-B**  
 GROUP: E  
 ONE STORY = 5,104 SF  
 OCCUPANT LOAD = 30 (all accessory)  
 SPRINKLERED (250' MAX. TRAVEL DISTANCE)

**BUILDING 2 - EXISTING**  
**CONSTRUCTION TYPE II-B**  
 GROUP: E  
 (16 CLASSROOMS)  
 ONE STORY = 32,600 SF  
 OCCUPANT LOADS:  
 E-USE UTILIZATION: 384  
 CODE OCCUP. FOR EGRESS = 593 (including accessory)  
 SPRINKLERED (250' MAX. TRAVEL DISTANCE)

**BUILDING 1 - EXISTING**  
**CONSTRUCTION TYPE II-B**  
 GROUP: E  
 (12 CLASSROOMS)  
 ONE STORY = 30,900 SF  
 OCCUPANT LOADS:  
 E-USE UTILIZATION: 288  
 CODE OCCUP. FOR EGRESS = 444 (including accessory)  
 SPRINKLERED (250' MAX. TRAVEL DISTANCE)



**BUILDING 2 ADDITION**  
**CONSTRUCTION TYPE II-B**  
 GROUP: E  
 (4 CLASSROOMS)  
 ONE STORY = 8,700 SF  
 OCCUPANT LOADS:  
 E-USE UTILIZATION = 120 (including accessory\*)  
 SPRINKLERED (250' MAX. TRAVEL DISTANCE)



**APPLICABLE CODES**  
 200 MINNESOTA BUILDING CODE (IBC 2018 WITH MIN AMENDMENTS)  
 200 MINNESOTA FIRE CODE (FC 2018 AS AMENDED)  
 200 MINNESOTA PUBLIC WORKS CODE (PWC 2018 AS AMENDED)  
 200 MINNESOTA ACCESSIBILITY CODE (2018 AS AMENDED)  
 200 MINNESOTA ELECTRICAL CODE (NEC 2017 AS AMENDED)  
 200 MINNESOTA MECHANICAL CODE (MCC 2018 AS AMENDED)  
 200 MINNESOTA PLUMBING CODE (MPC 2018 AS AMENDED)

**CODE ANALYSIS NOTES**  
 EXISTING BUILDING CONSTRUCTION TYPE II-B FULLY SPRINKLERED  
 ALLOWABLE BUILDING AREA PER FLOOR (A/B/F) (F.5.1)  
 EXISTING BUILDING AREAS:  
 Building 1: 5,104 SF (existing)  
 Building 2: 32,600 SF (existing)  
 Building 3: 30,900 SF (existing)  
 EXISTING BUILDING PERMITTED:  
 Building 1: 5,104 SF (existing)  
 Building 2: 32,600 SF (existing)  
 Building 3: 30,900 SF (existing)

**EGRESS DISTANCES**  
 MAX TRAVEL DISTANCE: 250 FT  
 MAX CORRIDOR LENGTH: 30 FT  
 MAX DEAD-END CORRIDOR LENGTH: 30 FT  
 EXISTING CLASSROOM OCCUPANCY: 30 PER CLASSROOM (UNLESS OTHERWISE NOTED)  
 (UNLESS OTHERWISE NOTED)  
 STUDENT OCCUPANCY (ACCESSORY USE)  
 STUDENT OCCUPANCY WITH ADDED CLASSROOMS: 30 PER CLASSROOM (UNLESS OTHERWISE NOTED)

**PLUMBING FIXTURE ANALYSIS**  
**STUDENT OCCUPANCY FOR PLUMBING FIXTURES**  
 NEW STUDENT OCCUPANCY SPILT AT BME:  
 MEN: 30  
 WOMEN: 30  
 EXISTING RESTROOM COUNT:  
 MEN: 18 STALLS (4 URINALS)  
 WOMEN: 18 STALLS  
 (VALUERS FOR CLASS SIZE INCREASE ON FUTURE EXPANSION)

**STUDENT RESTROOM ANALYSIS** MEETS CODE  
 OCCUPANCY (M/F): 30 (30 OCCUPANTS POSTED)  
 ADDITIONAL STUDENT RESTROOMS REQUIRED: 2 MEN, 2 WOMEN  
**ADDITIONAL RESTROOMS ADDED: 4 MEN, 4 WOMEN**  
 (VALUERS FOR CLASS SIZE INCREASE ON FUTURE EXPANSION)

**ASSEMBLY OCCUPANCY (WHEN NOT ACCESSORY USE)**  
 CATERING (A-3) (15 OCCUPANTS POSTED)  
 SPECIAL MEALS (A-3) (30 OCCUPANTS POSTED)  
 TOTAL ASSEMBLY OCCUPANCY: 45  
 OCCUPANCY (M/F): 45 (45 OCCUPANTS)  
 OCCUPANCY (M/F): 45 (45 OCCUPANTS)  
**ASSEMBLY USE FIXTURES REQUIRED: (17) SINKS, 180 FEMALE, 180 MALE FIXTURES**  
**ASSEMBLY RESTROOM ANALYSIS** MEETS CODE  
 CATERING (A-3) (15 OCCUPANTS POSTED)  
 SPECIAL MEALS (A-3) (30 OCCUPANTS POSTED)  
 TOTAL ASSEMBLY OCCUPANCY: 45  
 OCCUPANCY (M/F): 45 (45 OCCUPANTS)  
 OCCUPANCY (M/F): 45 (45 OCCUPANTS)  
**ASSEMBLY USE FIXTURES REQUIRED: (17) SINKS, 180 FEMALE, 180 MALE FIXTURES**

**SYMBOL LEGEND**  
 OCCUPANCY LOAD  
 ACCESSORY USE AREA  
 OCCUPANCY LOAD IS NOT INCLUDED IN LOADS BEYOND THIS ROOM  
 COMBINED OCCUPANCY LOAD AT A GIVEN DOOR OR STAIR  
 TOTAL EXIT CAPACITY OF DOOR OR STAIR  
 THE CAPACITY OF DOORS ARE DETERMINED AS FOLLOWS  
 CLASSIFIED BY ROOM IN INCHES SHOWN BY 1/2"  
 THE CAPACITY OF STAIRS ARE DETERMINED AS FOLLOWS  
 WIDTH IN INCHES SHOWN BY 1/2"  
 COMBINED OCCUPANCY LOAD AT A GIVEN DOOR (SUM OF THESE EQUALS TOTAL OCCUPANCY LOAD)  
 THE CAPACITY OF DOORS ARE DETERMINED AS FOLLOWS  
 CLASSIFIED BY ROOM IN INCHES SHOWN BY 1/2"  
 F-RACK DEVICE  
 30 MIN - DOOR-FIRE RATING

**WALL SEPARATION LEGEND**  
 WALL SEPARATION TYPE  
 1 - 1 HOUR  
 2 - 2 HOUR  
 3 - 3 HOUR  
 4 - 4 HOUR  
 5 - 5 HOUR  
 6 - 6 HOUR  
 7 - 7 HOUR  
 8 - 8 HOUR  
 9 - 9 HOUR  
 10 - 10 HOUR  
 11 - 11 HOUR  
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 100 - 100 HOUR



**TORNADO STORM SHELTER**  
 20 MPH STORM SHELTER DESIGN WIND SPEED (3-SECOND GUST)  
 MINIMUM WIND RESISTANCE  
 15 LB. 2M @ 8' HIGH HORIZONTAL SURFACE  
 15 LB. 2M @ 8' HIGH VERTICAL SURFACE  
 BRADLER CONTRACTORS NAME  
 NOTE: ALL SIGN INFORMATION TO BE PROVIDED IN SMALLER PER ADA/AS STANDARDS  
 NOTE: LOCATE AT 8" ABOVE FINISH FLOOR, MEASURED TO THE CENTERLINE OF THE SIGN PER ICC 508.2014



**TORNADO STORM SHELTER OCCUPIABLE AREA**  
 NOTE: LOCATE AT 8" ABOVE FINISH FLOOR, MEASURED TO THE CENTERLINE OF THE SIGN PER ICC 508.2014

CODE PLAN, LEVEL 1  
 SCALE: 1/8" = 1'-0"

STORM SHELTER SIGNAGE A  
 SCALE: 1/8" = 1'-0"

STORM SHELTER SIGNAGE B  
 SCALE: 1/8" = 1'-0"

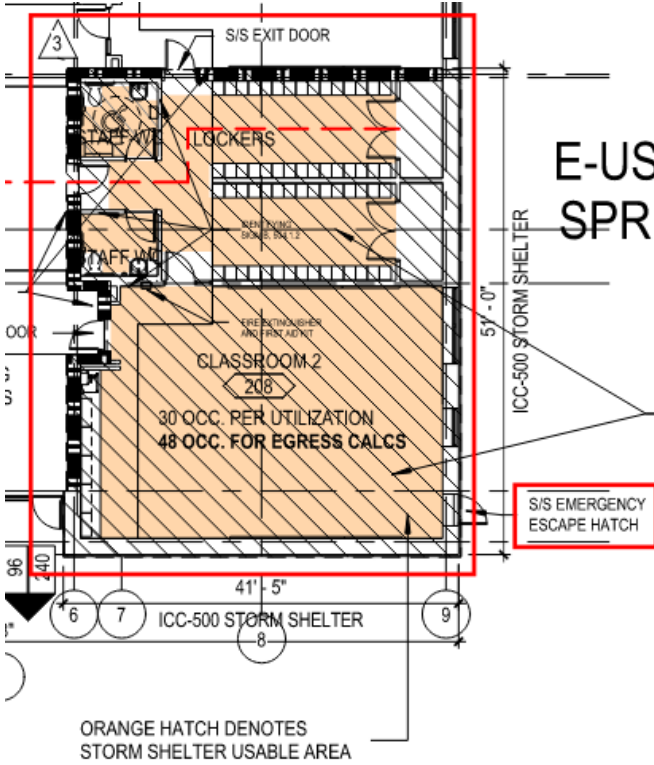
# Sizing

## GROUP E (4 CLASSROOMS)

ONE STORY = 8,700 SF

OCCUPANT LOADS:

E-USE UTILIZATION = 120 (including accessory\*)  
 SPRINKLERED (250' MAX. TRAVEL DISTANCE)



\* ACCESSORY USE AREAS NOT SIMULTANEOUSLY OCCUPIED

**ICC 500 COMMUNITY TORNADO SHELTER:**  
 OCCUPANT LOAD: 120

Per Table 501.1.1 and 501.1.2.1:  
 CLASSROOM: 65% OF 935 SF FLOOR AREA @ 1/5 SF = 120 (incl. 1 @10sf for ADA).

LOCKER ROOM: 65% OF 406 SF OPEN FLOOR AREA @ 1/5 SF = 50.

TOILET ROOMS: 65% OF 91 SF OPEN FLOOR AREA @ 1/5 SF = 11.

TOTAL OCCUPANT CAPACITY: 181.

- ICC-500 TORNADO SHELTER NOTES:**
1. EMERGENCY ESCAPE HATCH MEETS 501.4 REQUIREMENTS IN SIZE AND POSITIONING ON EXTERIOR WALL.
  2. MECHANICAL / ELECTRICAL SYSTEMS SWITCH TO EMERGENCY MODE AUTOMATICALLY, PER 702.
  3. PLUMBING SYSTEMS ARE SET UP PER 702.2 TO RUN FROM WATER STORAGE TANK IN NON-EMERGENCY MODE, SO SWITCHING MODES NOT REQUIRED IN A STORM EMERGENCY.
  4. STORM SHELTER IS MECHANICALLY VENTILATED PER 702.1.2 USING STORM SHELTER POWER SUPPLY. SEE PLANS AND ELEVATIONS FOR WALL LOUVER LOCATIONS.
  5. ALL EXHAUST AND INTAKE OPENINGS AND PLUMBING PENETRATIONS AT ROOF LEVEL ARE PROTECTED FROM TORNADO PROJECTILES PER 702.1.4.
  6. POWER TO ALL UTILITIES DURING AN EMERGENCY PER 702.3 IS PROVIDED BY INDEPENDENT POWER SUPPLY IN STORM SHELTER ELECTRICAL CLOSET.
  7. STORM SHELTER PERIMETER DOORS/HARDWARE ASSEMBLIES AND WINDOWS ARE ICC-500 / FEMA TESTED AND COMPLIANT FOR TORNADO CONDITIONS. DOOR OPERATIONS ARE PER 502.5.
  8. FIRE EXTINGUISHER PER 602.1, AND FIRST AID KIT PER 702.4 IS INCLUDED IN STORM SHELTER.
  9. FIRST AID KIT PER 702.4 IS INCLUDED IN STORM SHELTER.
  10. REFER TO STRUCTURAL SHEETS FOR TORNADO SHELTER LOAD CONDITIONS.

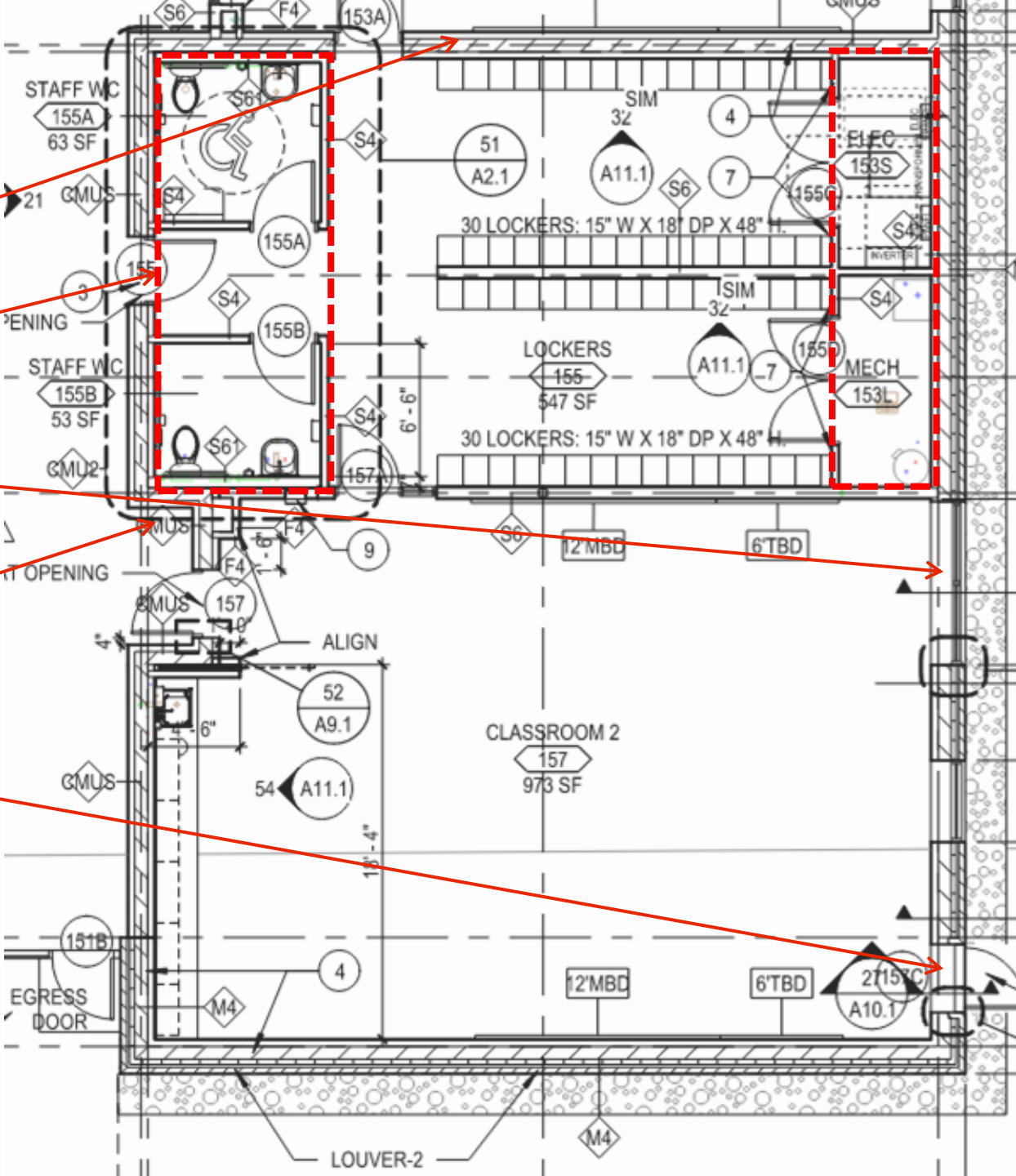
# Design requires Careful Planning

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# Tornado Shelter Features

- 2-hr Fire Separation
- Opening Protection
- Restroom
- Emergency Utilities for 2 hrs
- Fire Extinguisher & First Aid
- Emergency Exit Hatch
- Signage





# Opening Protectives

Glazed openings aren't impossible, and they look almost as good as the normal stuff:

1. Insulgard windows for punched openings
2. Insulgard Storm-Rated Storefront for larger glazed areas
3. Storm-Rated HM doors are nearly indistinguishable from typical HM doors
4. Storm-rated louvers
5. MEP Penetration protectives



**STORMDEFEND TTH600**  
**TORNADO & HURRICANE STORM**  
**SHELTER THERMAL WINDOW SYSTEM**

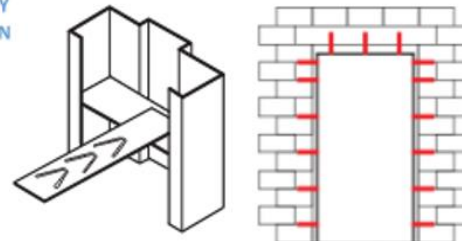


Innovative window solutions for tornado and hurricane protection.

**PRODUCT DESCRIPTION**

THIS WINDOW SYSTEM IS DESIGNED AND CERTIFIED FOR USE IN TORNADO AND HURRICANE SAFE ROOMS/STORM SHELTERS MEETING **FEMA P361-15** AND **ICC 500-2014** STANDARDS. IT IS CRITICAL THIS SYSTEM BE USED IN CONJUNCTION WITH EQUIVALENT PERFORMANCE SUBSTRATE/ WALL AREAS.

FIG. 16 – MASONRY T IN JAMBS SHOWN WITH 4" FACE IN LINE WITH BLOCK COURSING

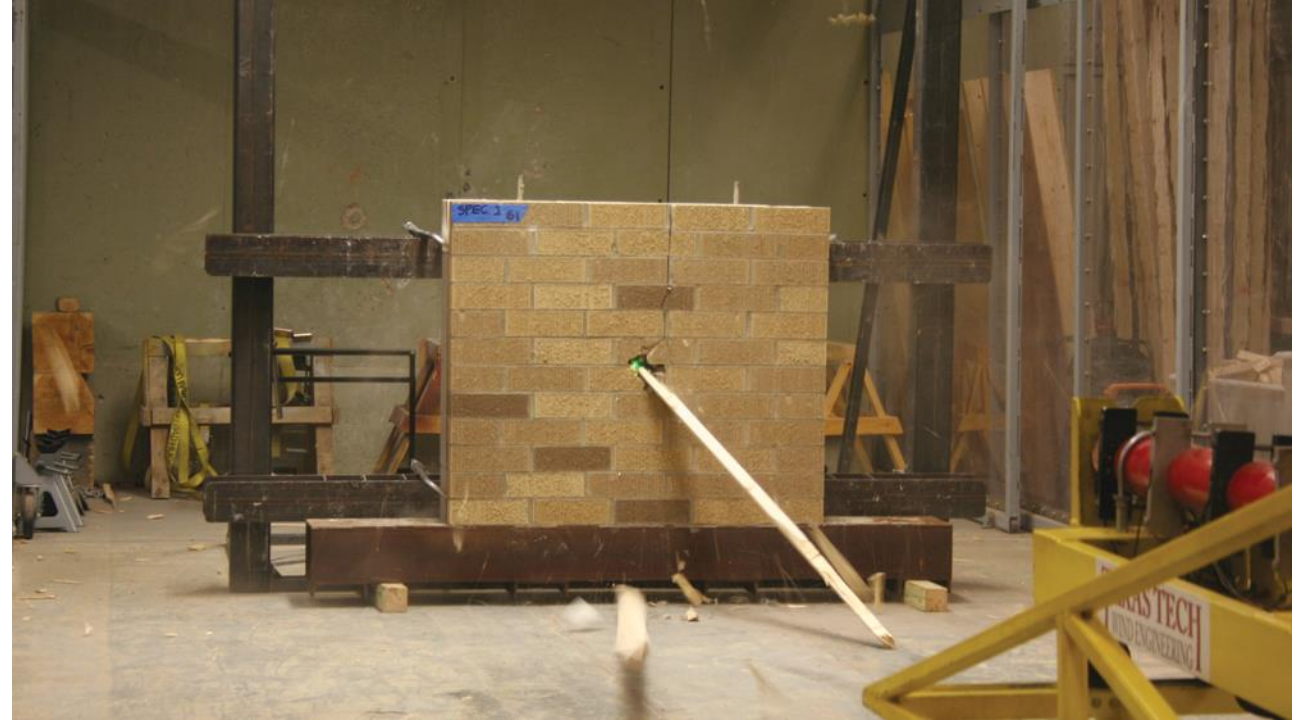


# Assembly Testing

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1. Texas Tech NWI was the home to debris impact testing. (Transitioning to UL and Intertek)
2. The cannon shoots 8' 2x4's at over 100 MPH and is used to evaluate multiple strikes at specific locations in a test assembly

**These are not 2 x 4s -  
they are missiles**



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# Structural

## Constraints And Performance:

- ASCE 7 Risk Category IV

**Table 1.3-1 Target Reliability (Annual Probability of Failure,  $P_F$ ) and Associated Reliability Indices ( $\beta$ )<sup>1</sup> for Load Conditions That Do Not Include Earthquake, Tsunami, or Extraordinary Events<sup>2</sup>**

Basis	Risk Category			
	I	II	III	IV
Failure that is not sudden and does not lead to widespread progression of damage	$P_F = 1.25 \times 10^{-4} / \text{yr}$ $\beta = 2.5$	$P_F = 3.0 \times 10^{-5} / \text{yr}$ $\beta = 3.0$	$P_F = 1.25 \times 10^{-5} / \text{yr}$ $\beta = 3.25$	$P_F = 5.0 \times 10^{-6} / \text{yr}$ $\beta = 3.5$
Failure that is either sudden or leads to widespread progression of damage	$P_F = 3.0 \times 10^{-5} / \text{yr}$ $\beta = 3.0$	$P_F = 5.0 \times 10^{-6} / \text{yr}$ $\beta = 3.5$	$P_F = 2.0 \times 10^{-6} / \text{yr}$ $\beta = 3.75$	$P_F = 7.0 \times 10^{-7} / \text{yr}$ $\beta = 4.0$
Failure that is sudden and results in widespread progression of damage	$P_F = 5.0 \times 10^{-6} / \text{yr}$ $\beta = 3.5$	$P_F = 7.0 \times 10^{-7} / \text{yr}$ $\beta = 4.0$	$P_F = 2.5 \times 10^{-7} / \text{yr}$ $\beta = 4.25$	$P_F = 1.0 \times 10^{-7} / \text{yr}$ $\beta = 4.5$

<sup>1</sup>The target reliability indices are provided for a 50-year reference period, and the probabilities of failure have been annualized. The equations presented in Section 2.3.6 are based on reliability indices for 50 years because the load combination requirements in Section 2.3.2 are based on the maximum loads for the 50-year reference period.

<sup>2</sup>Commentary to Section 2.5 includes references to publications that describe the historic development of these target reliabilities.

# Structural

## Increases In Snow, Ice, Seismic And Roof Live Loading:

- Increases in ASCE 7 Importance Factors
- Increases in ASCE 7 Minimum Roof Live Loads

**Table 1.5-2 Importance Factors by Risk Category of Buildings and Other Structures for Snow, Ice, and Earthquake Loads**

Risk Category from Table 1.5-1	Snow Importance Factor, $I_s$	Ice Importance Factor—Thickness, $I_i$	Ice Importance Factor—Wind, $I_w$	Seismic Importance Factor, $I_e$
I	0.80	0.80	1.00	1.00
II	1.00	1.00	1.00	1.00
III	1.10	1.15	1.00	1.25
IV	1.20	1.25	1.00	1.50

Note: The component importance factor,  $I_p$ , applicable to earthquake loads, is not included in this table because it depends on the importance of the individual component rather than that of the building as a whole, or its occupancy. Refer to Section 13.1.3.

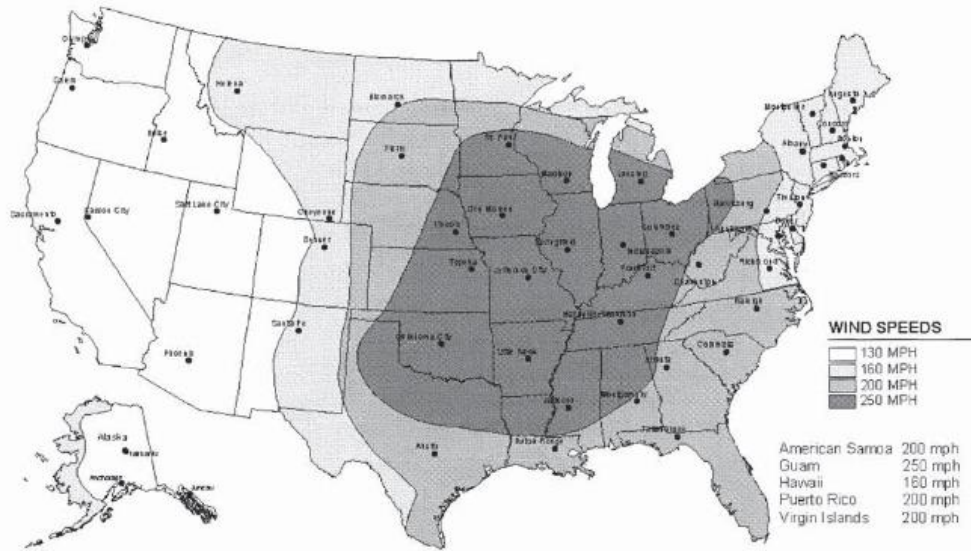
**303.2 Roof live loads.** Storm shelter roofs shall be designed for minimum live loads specified in ASCE 7, but not less than the following:

Tornado shelters: 100 pounds per square foot (4.8 kN/m<sup>2</sup>)

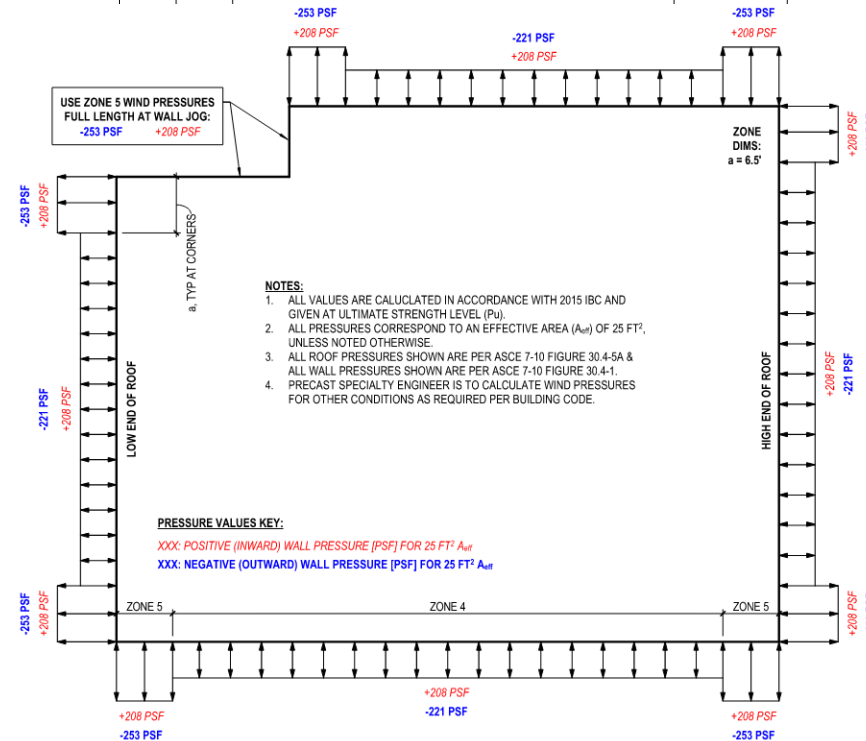
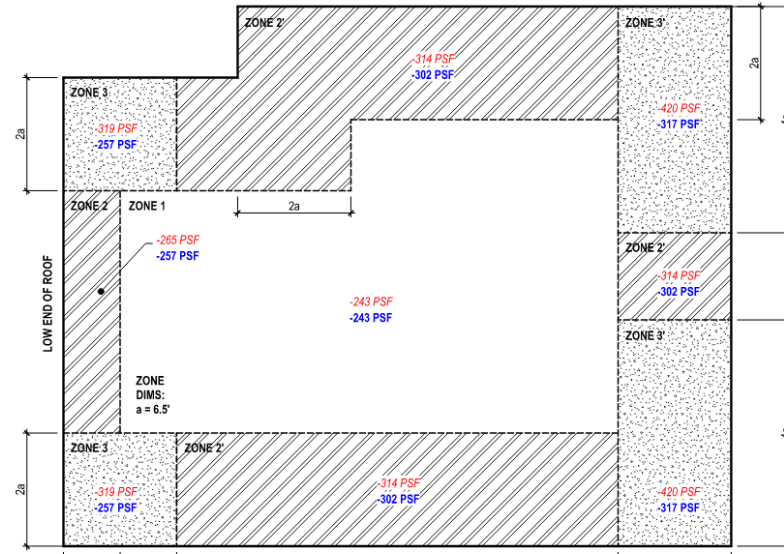
# Structural

## Increases In Wind Loading:

- Increases in ASCE 7 Basic Wind Speeds
- Increases in ASCE 7 Exposure Coefficients



- Notes:
1. Values are nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure Category C.
  2. Multiply miles per hour by 0.447 to obtain meters per second.





# Plumbing

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## Key Requirements:

- Toilets and handwash required
  - Potable water not required
  - Qty based on shelter occupancy
  - Chemical toilets allowed
- Water supply required for fixtures
  - 2 hour duration
    - Qty/person not stated
    - 2/3 pint/person based on hurricanes
  - Separate service
  - Storage/bladder tanks
- Fixture type matters for sizing storage
  - 15 psig for flush tank, manual faucets
  - 25 psig for flush valve

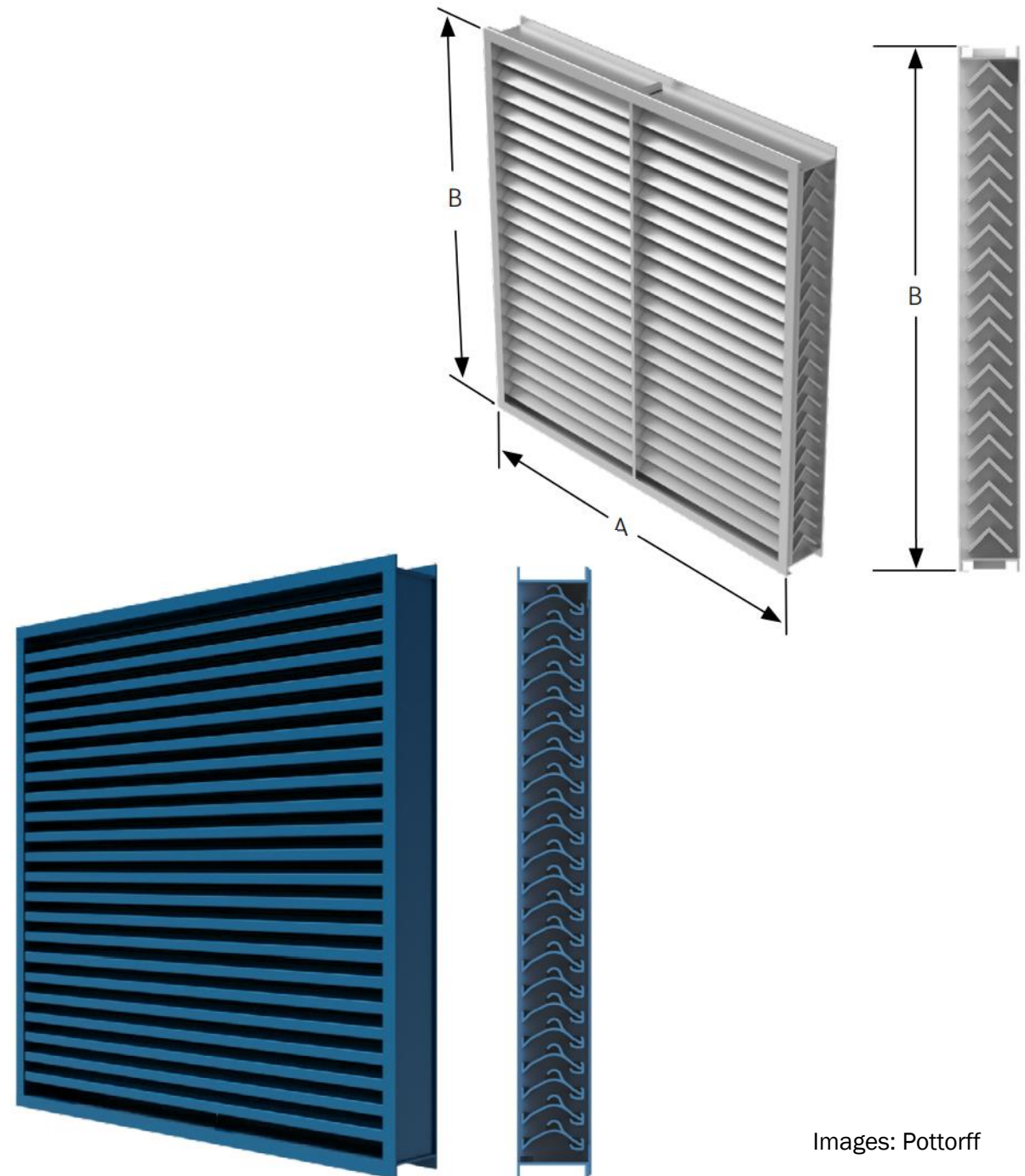




# Mechanical

## Key Requirements:

- Don't need to heat or cool
- Natural Ventilation
  - 6 square inches per person, split high and low
  - Potential cold/hot spots
- Mechanical Ventilation
  - 2014 – Ventilate at normal rate
  - 2020 – 5 CFM/person (may be larger rate)
  - Back up power for 2 hours
  - Ducted distribution, exhaust possible
- Louvers
  - Chevron – protects against missiles, not rain
    - May need secondary louver
  - Wind driven rain
  - ICC 500 is not FEMA 361 or Miami/Dade



# MEP Openings

## Key Requirements:

- Any opening more than 3.5 square inches or 2.06" diameter
- 2 points of impact
- Tested and labeled



CYCLONE WALL SHROUDS

Images: Roof Penetration Housing



# Backup Power

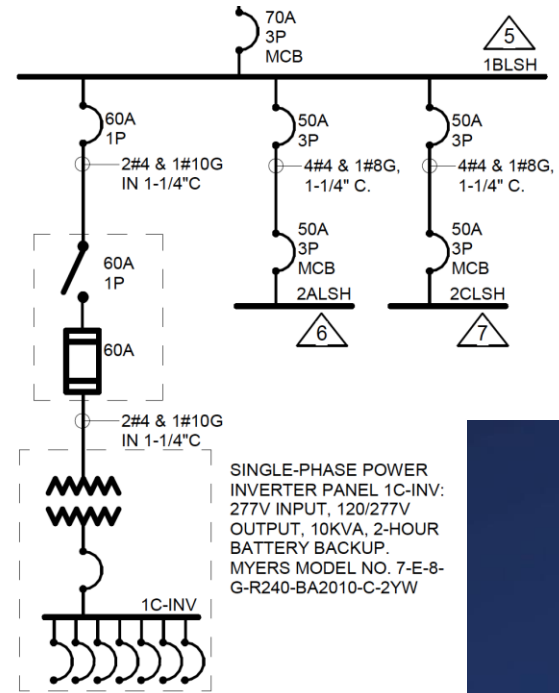
## Requirements:

Backup power is required for a minimum of 2hrs

- Lighting
- Active Mechanical Systems
- Sanitary/ Domestic water Pumps (as required)

## System Options:

- Backup Generator
  - Required to be within storm shelter, or within its own storm-rated vault
- Large Battery Bank with inverter
- Emergency Battery located within fixture



# Peer Review

Item #	Project Sheet #	Code Section #	Code Verbiage	Item Correct?	Revised/ Corrected?
			Comment		
4		107.2.2	<b>Enclosure.</b> When a storm shelter is to be constructed as a portion of a host building, the walls and floors enclosing the shelter shall be clearly indicated on the drawings.	Yes	
		CP1.2	<i>Shelter envelope is denoted on the drawings.</i>		
5	Arch Mech Plumb Elect	107.2.6	<p><b>Special instructions.</b> The construction documents shall provide or include any special details or special instructions required for the functional operation of the storm shelter, such as:</p> <ol style="list-style-type: none"> <li>1. Type and location of equipment and amenities required within the shelter, including water supply, sanitary facilities, fire extinguishers, batteries, flashlights, special emergency lighting equipment or any other equipment required to be installed in the shelter.</li> <li>2. Specifications for any alarm system to be installed.</li> <li>3. Instructions for the installation or deployment of any special protection equipment such as shutters, screens, special latching of doors or windows, any equipment or switching for mechanical, electrical and plumbing equipment.</li> </ol>	No	No
			<p><i>Instructions for using/converting the water closets from the public water supply to the water storage tank shall be include in the drawings. Denote instructions for handwashing for the shelter use if the storage water supply is non-potable. Denote the shutters and doors shall be shut locked and latched in the event of a high wind storm. Denote any instructions for operating the mechanical system for the shelter use. Denote any shut offs as required for water lines penetrating the shelter.</i></p> <p><i>Plumbing drawings denote the location of the emergency water supply, but do not denote instructions for use. The intent of the instructions is to let the end user know what is required of them for any active systems in the shelter. Does the occupant know they need to shut off the water valve? Do they know which water valve? The instructions for using the active systems in the shelter shall be located on sheet CP1.2 with all other storm shelter information. Sheet P1.2 denotes the emergency water storage is for water closet usage, how is handwashing handled?</i></p>		

## Key Requirements:

- Architectural and Structural **peer review is required**
- Both professional licenses must be valid in the state the storm shelter is **BUILT**, not designed
- There are some individuals who perform both Structural and Architectural peer reviews – one stop shopping
- Similar in nature to a permit review process where comments are made, logged and responded to with a narrative response and drawing updates as required
- Report from peer review must be submitted with permit application docs

# Testing and Inspections

Technical (2)		Description (3)	Type of Inspector (4)	Specific Report Frequency (5)
Section	Article			
31	2000	SOILS, IBC TABLE 1705.6	PER ITA	MONTHLY
3	3000/4000	CONC, IBC TABLE 1705.3	PER ITA	MONTHLY
4	2000	MASONRY (LEVEL B&C)	PER ITA	MONTHLY
		TMS 402-11 TBL 1.19.2/3		
5	1200	STEEL, IBC TBL 1705.2.1	PER ITA	MONTHLY
5	3000	DECK, IBC SEC 1705.2.2	PER ITA	MONTHLY
5	2000	JOISTS, IBC 1705.11	PER ITA	MONTHLY
3	4000	ANCHORS, IBC 106.3.1	PER ITA	MONTHLY
7	8100	SPRAY FIREPROOFING	PER ITA	PROJECT END
5	5000	SHELTER PENETRATIONS IBC SEC 106.3	PER ITA	MONTHLY

## Testing & Inspections During Construction

### Testing Requirements:

1. Typical construction phase soils and materials testing also required at storm shelter
2. Storm shelter may require additional testing based on assemblies within shelter and these assemblies may have different compliance metrics than remainder of building

### Special Inspections

1. Special Inspections of storm shelter components are required by ICC-500
2. Special Inspections must be completed by 3<sup>rd</sup> Party Reviewer certified to complete inspections, and must be contracted by Owner. Architect to aid in procurement of reviewer similar to materials testing and called inspections agencies
3. Special inspections include inspections as required by AHJ and observation of fabrication and installation of structural components of shelter.
4. These inspections are in addition to inspections/testing required for school buildings

### Additional Contractor Responsibilities

1. Phasing: In general, once construction on a component or assembly is started on a jobsite, work on this component/assembly must continue until complete.
2. Written Statement of Responsibility: each contractor responsible for construction of any component/assembly in a storm shelter must submit a Written Statement of Responsibility acknowledge awareness and identify procedures for the completion that component/assembly.

Q & A

