

2018 MBC Public Hearing  
Part 4. Building Code (ORR# 2019-125 LR)  
September 24, 2020 9:00 am

**The Michigan Masonry Coalition (MMC) is in support of Section 423 Storm Shelters in the 2018 IBC. We are in support of keeping the mandate for storm shelters in new school construction (or striking the portion of the proposed rules that currently exempts schools). There is a growing awareness in this country in designing and constructing resilient buildings. Resiliency is needed when natural and man-made disasters occur with high wind events spurred on by tornadoes.**

Good morning! I'm Dan Zechmeister and I'm speaking as a citizen, as a professional engineer and on behalf of the Michigan Masonry Coalition. The storm shelter mandate should not be excluded for K-12 schools in the 250-mph design wind speed area of Michigan **because numerous tornados have happened in Michigan and more tornados will continue to happen in Michigan.**

- a. Per a former school superintendent comment last year, "The #1 concern for parents is their kids safety and getting their kids home safely at the end of the day."
- b. There have been 1,029 total tornados since 1950 in the state of Michigan.
- c. Significant structural damage from EF3, EF4 and EF5 tornados will occur to all structures including schools.
- d. The wind speed ranges for tornados are:
  - i. For EF3: 136-165 mph
  - ii. For EF4: 166-200 mph
  - iii. For EF5: > 200 mph
- e. Here are total numbers of (EF3, EF4 and EF5) tornados including deaths and injuries.
  - i. 58 – (EF3, EF4 and EF5) tornados in Michigan from 1950 through 2017.
  - ii. With 2,510 injuries
  - iii. With 195 deaths
- f. There is a map of tornado tracks and intensities. That map led to a 'design' wind speed map for establishing the mandate. The mandate area is mapped that way for a reason – **because tornados have occurred and will occur in that region – including the southern portion of Michigan.**
- g. In June 1953, the Flint-Beecher EF5 tornado stood as one of nations worst for decades (with 116 deaths and 844 injuries). In May of 1953 (just two and half weeks prior), the St. Clair County and Port Huron EF4 tornado resulted in 2 deaths and 68 injuries.
- h. More recently, Michigan has averaged 14 tornados per year for the last 14 years and has averaged almost one significant EF3 or EF4 or EF5 tornado per year since 1950.
- i. We need to protect our children and teachers in schools, from fire (with sprinklers, fire-rated walls and fire-rated floors and doors...) and other dangers that rarely happen, shouldn't we also protect them from tornados?

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**THIS COULD BE BAD!**

The Federal Emergency Management Agency (FEMA) maintains records for federal natural disaster declarations since 1953. Beginning in 1996, yearly declarations have generally doubled over previous years.

One of the nation's most devastating natural disasters occurred in the Flint, Michigan's Beecher district on Monday, June 8th, 1953, resulting in 116 deaths and injuring 844. To date, this F5 intensity tornado was the last one in the United States to result in over 100 fatalities. In a 2000 National Weather Service poll, both the general public, and area "weather experts" voted the Flint-Beecher Tornado as the worst natural disaster in the state of Michigan in the 20th century. In fact, two and half weeks prior on May 21, 1953, an F4 intensity tornado roared through St. Clair County and the Port Huron area, killing 2 and injuring 68. In the state of Michigan since 1951, there have been 1049 tornadoes (2-F5s, 21-F4s, 46-F3s, 218-F2s, 418-F1s and 344-F0s) with a total of 302 fatalities, and 4099 injuries. ([www.tornadohistoryproject.com/tornado/Michigan/table](http://www.tornadohistoryproject.com/tornado/Michigan/table))

According to the National Weather Service, National Oceanic and Atmospheric Administration, (<https://www.weather.gov/oun/efscale>), the Enhanced Fujita Scale or EF Scale, became operational on February 1, 2007, is used to assign a tornado a 'rating' based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DIs) and Degrees of Damage (DoD) which help estimate better the range of wind speeds the tornado likely produced. From that, a rating (from EF0 to EF5) is assigned.

EF SCALE	
EF Rating	3 Second Gust (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

Buildings in Michigan excluding storm shelters are typically design for an ultimate wind speed of 120 mph. Let us now take a look at the DoDs (degree of damages) for three school types listed by the National Weather Service.

15. Elementary School

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	65	47	80
2	Loss of roof covering (<20%)	79	66	99
3	Broken windows	87	71	106
4	Exterior door failures	99	85	118
5	Uplift of some roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	101	82	121
6	Damage to or loss of wall cladding	108	92	127
7	Uplift or collapse of roof structure	125	108	148
8	Collapse of non-bearing walls	139	117	162
9	Collapse of load-bearing walls	153	130	180
10	Total destruction of a large section of building or entire building	176	152	203

\* Degree of Damage

16. Junior or Senior High School

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	68	55	83
2	Loss of roof covering (<20%)	79	66	99
3	Broken windows	87	71	106
4	Exterior door failures	101	83	121
5	Uplift of metal roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	101	85	119
6	Damage to or loss of wall cladding	108	92	127
7	Collapse of tall masonry walls at gym, cafeteria or auditorium	114	94	136
8	Uplift or collapse of light steel roof structure	125	108	148
9	Collapse of exterior walls in top floor	139	121	153
10	Most interior walls of top floor collapsed	158	133	186
11	Complete destruction of all or a large section of building	192	163	224

17. Low Rise Buildings (1 – 4 Stories)

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	68	55	83
2	Loss of roof covering (<20%)	80	67	103
3	Uplift of metal roof decking at eaves and roof corners; significant loss of roofing material (>20%)	101	83	120
4	Broken glass in windows, entryways or atriums	101	83	122
5	Uplift of lightweight roof structure	133	114	157
6	Significant damage to exterior walls and some interior walls	143	122	167
7	Complete destruction of all or a large section of building	188	161	221

\* Degree of Damage

## **EXISTING SCHOOL DESIGN DOESN'T PROTECT!**

As you can see, current IBC-compliant facilities are susceptible to significant building damage and disruption if struck by strong or violent EF3, EF4 and EF5 tornadoes (as shown with the previous three school examples). Since 1951, there have been 21 – F4s and 46 – F3s for a total of 67 tornadoes with 146 fatalities and 2462 injuries in the state of Michigan. Michigan has averaged 14 tornadoes per year over the last 20 years and has averaged almost one significant (EF3, EF4 or EF5) tornado per year since 1950.

Due to unpredictable and often very short tornado warning time, there are many events where it is unfeasible to evacuate schools. Field studies of the Spring 2001 Southern US tornadoes revealed extensive damage to schools (including safe refuge areas) built to current codes. Several other schools evaluated for damage by FEMA Mitigation Assessment Team (MAT) deployed following the Spring 2011 tornado outbreak all showed substantial damage when exposed to a tornado. The consequences of the inability of a school to withstand a tornado event coupled with the lack of an ICC 500-compliant safe room could lead to devastating consequences, including loss of life. The inability of a school to withstand a tornado event not only is damaging for the walls but also damaging for the roofs, windows and doors. Tornadoes create flying projectiles which can easily penetrate many conventional wall, window and door construction types. A saferoom provides near absolute protection for this vulnerable population, our children.

Based on the current IBC Section 423 language, the storm shelter requirements would only apply to new construction (buildings or additions) with occupant loads of 50 or more located in the 250-mph shelter design wind speed (lower half of Lower Peninsula). Storm shelters are not required when doing renovations and upgrades or even for additions or new buildings with occupant loads less than 50 persons.

FEMA technical and policy guidance on safe rooms recommends only having a 5-minute travel time (0.5-mile distance) to seek shelter from a tornado. It is oftentimes imperative therefore, that students are able to shelter at their schools. In order for the students to be given near-absolute protection from a tornado, the safe rooms in schools need to be constructed to meet ICC 500-2008 standards, as is proposed by the addition of Section 423.

Incorporating storm shelters and community shelters into the design of buildings located in high wind regions enhances the living environment for the occupants. These shelters become havens for protecting people from injury or death due to structural collapse and windborne debris. Additional benefits are enhanced life safety, security and occupant comfort; potentially less demand on community resources required for emergency response and healthcare; and allowing facilities to be more readily adapted for re-use if there is a change of occupancy in the future.

# PROPOSED RULE/CODE CHANGE REQUEST

Michigan Department of Licensing and Regulatory Affairs  
Bureau of Construction Codes/Administrative Services Division

Attn: Amanda Johnson  
PO Box 30254, Lansing, MI 48909  
Phone (517) 241-9303  
Fax (517) 241-0130  
Email: johnsona39@michigan.gov

ACTION:

DATE:			
NAME:		REPRESENTING:	
ADDRESS:		CITY:	STATE: ZIP:
PHONE:	FAX:	EMAIL:	

**RULE/CODE SECTIONS/TABLES/FIGURES PROPOSED FOR REVISION (Note: If the proposal is for a new section, indicate "new")**

**PROPOSED LANGUAGE:** Show proposed text in accordance with the following format: ~~Strikeout~~/**Bold & underline proposed added text**

**REASON:** Thoroughly explain the need and reason for the proposed change to include the following:

- Identify the problem.
- Explain the rationale for the proposed change.
- Describe the environmental impact.
- Is the proposed change comparable to federal rules or national or regional standards in similarly situated states, based upon geographic location, topography, natural resources, commonalities, or economic similarities? If the proposed change exceeds standards in those states, explain why and specify costs and benefits.
- Identify individuals and groups affected by the proposed change and the impact on these groups.
- Are there any reasonable alternatives to the proposed change? If so, please provide those alternatives.
- What is the fiscal impact for the proposed change? Provide a cost/benefit analysis.
- Estimate the actual statewide compliance costs of the proposed rule.
- What are the primary and direct benefits of the rule?
- Estimate any cost increases or reductions to businesses, individuals, groups, or governmental units as a result of the rule.

As well as any other information appropriate to assist with a clear understanding of the issue. During the rulemaking process, the need and reasoning of all proposed rule changes should be identified. By including a detailed explanation, the general public will gain a better understanding on all aspects of the proposal. Providing an explanation on the need and rationale for the proposal is optional; however, MCL 24.245 requires the department to provide proper justification for each proposal. Without this important information, the department may not be able to document appropriate justification and merit for a proposal. For further information, please refer to the Administrative Procedures Act of 1969.

**Back Up/Graphic Material Included**

There is a subset of occupancies that are required to install an automatic sprinkler system in 903.2, and other occupancies that choose to voluntarily install an automatic sprinkler system, that are not required to install a fire alarm system by 907.2. Those occupancies can meet the requirement of 901.6 by installing the required supervisory service with the use of a dedicated function fire alarm, a term that is used in the referenced standard NFPA 72 – National Fire Alarm Code. The dedicated function fire alarm provides the required monitoring of the automatic sprinkler system without the additional expense of adding occupant notification throughout the building. This is consistent with a previous Formal Interpretation (09-53) of the Construction Code Commission.

Some jurisdictions are requiring occupancies that install sprinkler supervisory service, to also install occupant notification systems, effectively extending the requirements of 907.2 to occupancies not required by 907.2. This results in additional expenditure for plan review, labor, materials and inspections to add audible and visual notification appliances to occupancies that are not required by 907.2 to provide a fire alarm system. Providing a sprinkler system lowers the risks associated with a fire, and should not be the basis for requiring occupant notification that otherwise would not be required.

The proposed change involves defining a dedicated function fire alarm system, and adding language to 901.6 identifying that dedicated function fire alarm systems do not provide occupant notification and are permitted to meet the requirements of this section.

No environmental impact is anticipated from the proposed change.

The proposed change is consistent with the Construction Code Commission Formal Interpretation 90-53, and is consistent with how other states using the ICC Building Code apply these requirements.

The individual or groups affected by the proposed change would be those building owners who have provided automatic sprinkler systems and are not required by 907.2 to provide a fire alarm system. The impact on these owners would be a financial savings in not being required to invest in additional fire alarm equipment to notify building occupants that the sprinkler system was activated.

The proposed change is to clarify the requirements of 901.6. Most jurisdictions, including the Bureau of Construction Codes, apply the code as written so there would be need for an alternative method. The change would help standardize the application of the code throughout the State, to the benefit of owners and contractors alike.

The fiscal impact is difficult to assess, as there are a limited number of jurisdictions that are interpreting 901.6 to require a fire alarm system with occupant notification. However, in those affected jurisdictions the costs to the owner for the additional requirements can range from about a thousand dollars for a small facility to hundreds of thousands of dollars for a large F-1 occupancy.

In terms of a cost/benefit analysis, theoretically there should be no additional cost, no additional benefit, as the proposed change seeks to align certain jurisdictional requirements with the existing requirements of the code.

The statewide compliance costs would be a negative cost, or a cost savings, for those affected building owners that are not required to provide systems above and beyond what is required by the Michigan Building Code.

The primary and direct benefits of the rule is standardization of the application of the code among the various jurisdictions in Michigan that have adopted and are enforcing the Michigan Building Code. This provides a benefit for building owners who have facilities in multiple jurisdictions, of not having to meet different requirements in different jurisdictions. This provides a benefit to engineers and system designers of consistency in the code requirements, so they are not faced with unexpected costs from a jurisdiction applying their own costly interpretation of the code.

There would be cost reduction to certain building owners as noted above.

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The statewide compliance costs would be a negative cost, or a cost savings, for those affected building owners that are not required to provide systems above and beyond what is required by the Michigan Building Code.

The primary and direct benefits of the rule is standardization of the application of the code among the various jurisdictions in Michigan that have adopted and are enforcing the Michigan Building Code. This provides a benefit for building owners who have facilities in multiple jurisdictions, of not having to meet different requirements in different jurisdictions. This provides a benefit to engineers and system designers of consistency in the code requirements, so they are not faced with unexpected costs from a jurisdiction applying their own costly interpretation of the code.

There would be cost reduction to certain building owners as noted above.

My name is William Hordyk. I am a registered Building inspector and plans examiner in the State of Michigan. I also hold 11 national certifications with the International Code Council including Residential and Commercial Inspector, Residential and Commercial Plans Examiner and Building Code Specialist. I come to you duly elected by the Metro Building Inspectors Association of Greater of Grand Rapids to speak on their behalf regarding this mater. The Metro association is a group of over 130 registered building officials and inspectors performing their duties for over 70 delegated authorities in the state of Michigan.

In review of the proposed rule changes, I would like to raise an objection to the deletion of substantial portions of the administrative section (chapter 1) of the Building Code. These sections identified for deletion have existing in the model code and MI versions of that code since the promulgation of the 2000 codes. Similar language has also been a part of the MI adopted codes from the formation of PA 230 of 1972 without being modified by administrative rules. Why is it now that the director has determined to throw out 50 years of precedence and claim that these sections of code are in contradiction to the Act?

Apart from the objection to the letter of the proposed rule changes, I raise objection to the stated reasoning for these administrative changes. In the Bureau's Rules Impact Statement, it is claimed that the proposed changes are intended to bring the rules "...in line with actual practices." I present to you that, as a representative of over 130 registered code officials, the proposed changes at best indifferent to actual practices at more likely in direct contradiction to actual practices of those who daily serve to protect the people of this great state from a hazardous built environment.

I ask the director to respond with reasoning for the deletions, and specific reasoning for each of the following sections identified for deletion from the 2018 International Building Code indicating what specific language of PA 230 is purported to be contradicted.

Section:

104.2  
104.3  
104.5  
104.7  
104.8  
104.10  
105.3  
105.3.1  
105.3.2  
105.6  
109.1  
109.2  
109.3  
109.4  
109.5  
109.6  
110.3.9  
111.1  
111.2  
111.3  
113.2

113.3

114.1

114.2

114.3

114.4

115.1

115.2

115.3

I also request substantiation for the proposed amending of

**101.3**

**103.3**

**104.6**

**107.5**

**1203.1**

And to the Deletion of the definition of

**“Agricultural Building”**

**“Recreational Vehicle”**

I also ask for explanation and substantiation of rule 415a which appears to add, modify, duplicate and delete definitions of words within the code beyond the enacting language of rule 401, including the redefining of “Occupiable space” which alone will have an unimaginable impact to the enforcement of all the construction codes

Thank you for your time today.

**William Hordyk**

**Plans Examiner**

City of Grand Rapids

1120 Monroe Ave, NW

Grand Rapids, MI 49503

(616) 456-3134



To whom it may concern,

My name Michael E. Vandervennet.

I am the Business Manager/ Financial Secretary for the International Union of Elevator Constructors, Local 36, Detroit, MI.

The current Chair of the State of Michigan Elevator Safety Board.

I have held an Elevator Journey Person's License for the State of Michigan and City of Detroit for over thirty years.

I ask the Director to explain under R408.30458 the reason for rescinding Section 3001.2 (Other devices) including 3001.2.1 (Conveyors) and 3001.2.2 (Automotive Lifts). If these are removed, what code or standard will these devices covered under? If there is no standard applied for the technicians who install, service and maintain. Endangering the technicians and all who use such devices.

Regarding, 1109.8. Lifts. Platform (wheelchair) lifts may be a part of a required accessible route in new construction where indicated in items 1 to 10. Platform (wheelchair) lifts shall be installed in accordance with the Michigan elevator code, R 408.7001 to R 408.8695.

If the above reference will remain and it is agreed it makes reference to *MI Administrative Code(s) for Licensing and Regulatory Affairs - Bureau of Construction Codes* then the reference is to Michigan Elevator Rules. Please consider the following revision.

Regarding 1109.8. Lifts. Platform (wheelchair) lifts may be a part of a required accessible route in new construction where indicated in items 1 to 10. Platform (wheelchair) lifts shall be installed in accordance with the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

*Rationale: To ensure details of any legally enforceable document accurately make reference to the jurisdictions rules.*

Regarding, ~~3001.4~~**3001.5**. Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from 1 freight class to another freight class shall comply with the requirements of the Michigan elevator code, R 408.7001 to R 408.8695.

If the above reference will remain and it is agreed, it makes reference to *MI Administrative Code(s) for Licensing and Regulatory Affairs - Bureau of Construction Codes* then the reference is to Michigan Elevator Rules. Please consider the following revision.

~~3001.4.3001.5.~~ **3001.5.** Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from ~~1~~ one freight class to another freight class shall comply with the requirements of the ~~Michigan elevator code~~ Michigan Elevator Rules, R 408.7001 to R 408.8695. If a building or structure is re-purposed and/or occupancy classification altered resulting in a freight elevator found to be used by practice as a freight elevator permitted to carry passengers or a passenger elevator this is considered an alteration and shall comply with the applicable requirements in Michigan Elevator Rules, R 408.7001 to R 408.8695

*Rationale: As buildings and structures age in our communities and the resources available to AHJs dwindle due to fiscal problems the end enforcers of codes and standards have reported multiple times to witness a freight elevator being used to carry passengers which is contraindicated and therefore should be prohibited. The language proposed provides both the building official and authorities such as but not limited to accessibility, elevator oversight to enforce a safer use and configuration of the conveyances covered here. Changing the “1” to a “one” is reads better in my opinion.*

Regarding, ~~3001.4.3001.5.~~ **3001.5.** Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from 1 freight class to another freight class shall comply with the requirements of the Michigan elevator code, R 408.7001 to R 408.8695.

If the above reference will remain and it is agreed, it makes reference to *MI Administrative Code(s) for Licensing and Regulatory Affairs - Bureau of Construction Codes* then the reference is to Michigan Elevator Rules. Please consider the following revision.

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Regarding, ~~3002.6. Prohibited doors. Doors, other than hoistway doors and the elevator car door, shall be prohibited at the point of access to an elevator car.~~

3002.6. Prohibited doors. Doors, other than hoistway doors and the elevator car door, shall be prohibited at the point of access to an elevator car. Exception: access doors and panels allowing partial or full bodily entry shall comply with Michigan Elevator Rules, R 408.7001 to R 408.8695 or be subject to a variance hearing with Michigan' Elevator Safety board in accordance with Act 227, 408.808(c). Access doors and panels are further subject to compliance with 29 CFR 1910, 29 CFR 1926.

*Rationale: Current configurations of elevators (machine-room-less) are being driven in a non-codified vehicle and a substantial list of hazards are being presented that are not covered prescriptively by any code, standard, law or rule set. At code developing bodies it has been reported that these configurations have been allowed beyond what codes can safely provide oversight. All of the parts, assemblies, systems that fall into this concern may be mitigated or eliminated through an effective variance process as found to be present in Michigan's elevator Safety Board. The factors guiding this access fall under but are not limited to safety codes, standards, and the States Osha Plan. I do reference OSHA in my proposal and please forgive me as I am not versed in what may be a better nomenclature to indicate Michigan's State Plan.*

Regarding, Rule 458. Sections 3001.1, ~~3001.2, 3001.4,~~**3001.5**, 3002.5, ~~3002.6~~, 3003.1, and 3003.2, of the code are amended, sections 3001.2.1, 3001.2.2 are being deleted, and 3003.1.5 and 3004.5 are added to the code to read as follows:

3001.1. Scope. The design, construction, installation, alteration, and repair of elevators and conveying systems and their equipment shall conform with the requirements of the Michigan elevator laws and rules, **including** 1967 PA 227, MCL 408.801 to 408.824; 1976 PA 333, MCL 338.2151 to 338.2160;; ~~and~~ R 408.7001 to R 408.8695; and this chapter. Installation or construction in flood hazard areas established in section 1612.3 shall comply with ASCE 24 listed in chapter 35.

Rule 458. Sections 3001.1, 3001.2, 3001.4,**3001.5**, 3002.5, 3002.6, 3003.1, and 3003.2, of the code are amended, sections 3001.2.1, 3001.2.2 are being deleted, and 3003.1.5 and 3004.5 are added to the code to read as follows:

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*Rationale: Revise editorially the technical aspect of my other public comments.*

Regarding, R 408.30499 Adoption of standards by reference; referenced codes. Please consider the following revision.

Rule 499. Chapter 35 of the code is amended to add the following referenced codes, which are available for inspection and purchase from the Michigan Department of Licensing and Regulatory Affairs, Bureau of Construction Codes, ~~2501 Woodlake Circle, Okemos, Michigan 48864~~ **611 W. Ottawa, Lansing, Michigan 48933**, at a cost as of the time of adoption of these rules of: **Michigan Electrical Code \$122.00, Michigan Mechanical Code \$83.00, Michigan Plumbing Code \$83.00, Michigan Uniform Energy Code \$48.00, ~~Michigan Elevator Code~~ [Michigan Elevator Rules](#) \$89.50, and Michigan Boiler Code \$100.00 each.**

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

Regarding, R 408.30499 Adoption of standards by reference; referenced codes.

...

(a) Michigan Electrical Code R 408.30801 to R 408.30880 of the Michigan Administrative Code.

(b) Michigan Mechanical Code R 408.30901 to R 408.30998 of the Michigan Administrative Code.

(c) Michigan Plumbing Code R 408.30701 to R 408.30796 of the Michigan Administrative Code.

(d) Michigan Uniform Energy Code R 408.31001 to R 408.31086 of the Michigan Administrative Code.

(e) ~~Michigan elevator code~~ R 408.7001 to R 408.8695 of the ~~Michigan elevator cod~~ [Michigan Elevator Rules. Michigan Elevator Rules](#)

(f) Michigan Boiler Code R 408.4001 to R 408.5609 of the Michigan Administrative Code.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law. Right Title and capitalization.*

Regarding, R 408.30427 Barrier free design for buildings, structures, and improved areas.

Rule 427. Sections ~~1101.2~~ **1102.1** and 1109.8 of the code are amended and section 1103.2.15 is added to the code to read as follows:

~~1101.2.1102.1~~. Design. Buildings and facilities shall be designed and constructed to be accessible in accordance with 1966 PA 1, MCL 125.1351 to 125.1356, this code, and ICC/ANSI A 117.1, except sections 611 and 707.

1103.2.15. Military, fire service, and police facilities. Housing, bathing, toilet, training, and storage areas intended for use and occupancy exclusively by military, fire service, police, or security personnel required to be physically agile are not required to be accessible.

1109.8. Lifts. Platform (wheelchair) lifts may be a part of a required accessible route in new construction where indicated in items 1 to 10. Platform (wheelchair) lifts shall be installed in accordance with the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

1. An accessible route to a performing area and speakers' platforms.
2. An accessible route to wheelchair spaces required to comply with the wheelchair space dispersion requirements of sections 1108.2.2 to 1108.2.6.
3. An accessible route to spaces that are not open to the general public with an occupant load of not more than 5.
4. An accessible route within a dwelling or sleeping unit.
5. An accessible route to jury boxes and witness stands; raised courtroom stations including judges' benches, clerks' stations, bailiffs' stations, deputy clerks' stations and court reporters' stations; and to depressed areas such as the well of the court.
6. An accessible route to load and unload areas serving amusement rides.
7. An accessible route to play components or self-contained play structures.
8. An accessible route to team or player seating areas serving areas of sport activity.
9. An accessible route instead of gangways serving recreational boating facilities and fishing piers and platforms.
10. An accessible route where existing exterior site constraints make use of a ramp or elevator infeasible.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

Regarding, 3002.5. Emergency doors. Where an elevator is installed in a single blind hoistway or on the outside of a building, there shall be installed in the blind portion of the hoistway or blank

face of the building, an emergency door in accordance with the requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

3003.2 ~~Fire fighters'~~ [Firefighters'](#) emergency operation. Elevators shall be provided with phase I emergency recall operation and phase II emergency in-car operation in accordance with the requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law. If referring to an A17.1, Section 2.27 configuration the word firefighters' is not hyphenated.*

R 408. 30459 Elevators.

Rule 459. Sections 1009.4 and ~~1607.9.1~~ **1607.10.1.** of the code are amended to read as follows:

1009.4. Elevators. To be considered part of an accessible means of egress, an elevator shall be in compliance with the emergency operation and signaling device requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

~~1607.9.1~~ **1607.10.1.** Elevators. Elevator loads shall be increased by 100% for impact and the structural supports shall be designed within the limits of deflection prescribed by the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

Proposal:

3004.x Network Connected Conveyances and Associated Equipment Any conveyance connected to a network shall be equipped with a Network Disconnect Switch to physically disconnect a conveyance connected to a network by disconnecting the network connection. This Network Disconnect Switch is provided to provide persons the ability to protect affected persons and buildings through isolation as they determine necessary. Network connected equipment shall comply with 3004.x.x through 3004.x.x

3004.x.x The Network Disconnect Switch contacts shall be physically and positively opened and closed manually, terminate all transmitting and receiving of signals once opened, terminate all power over ethernet connections once opened. No portion of a part, assembly, device, and/or its required and connected circuit and/or parts used for this switching is and/or has any parallel provision may reside in part or completely as a solid-state entity. Software enabling and disabling is prohibited. Bypassing the Network Disconnect Switch is prohibited.

3004.x.x The Network Disconnect Switch shall be located inside of a room accessed with key(s) for that room and not used to open any other lock in the building or structure shall not be used to lock or unlock the room. Keys to the room containing the Network Disconnect Switch shall be kept on the premises in a location readily accessible to qualified persons only. A log showing

access to the room containing the Network Disconnect Switch shall be maintained with the building owner. The log shall contain date, time accessed, name of person, name of company or organization, purpose for access.

3004.x.x The Network Disconnect shall be permanently marked “NETWORK DISCONNECT SWITCH [insert equipment identification here]”. The marking shall be on the Network Disconnect Switch assembly and shall be readily visible. Letters used shall be block type and at least 13 mm (1/2 in.) in height

3004.x.x The Network Disconnect Switch shall be provided with markings to indicate the open or closed position.

3004.x.x The Network Disconnect Switch shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed

3004.x.x The Network Disconnect Switch shall be permitted to open automatically to isolate the equipment from a network.

3004.x.x The Network Disconnect Switch shall not be closed by a control circuit type device.

3004.x.x The installation of a Network Disconnect Switch shall be required on new and existing equipment connected to a network.

3004.x.x The Network Disconnect Switch shall be installed on all network connection configurations including wireless connections.

3004.x.x Peripherals attached temporarily such as service tools, laptops etc. are considered an external entity and would be subject to the Network Disconnect Switch. Exception: qualified persons employed to interact with the equipment while at the equipment shall be permitted to access the equipment even while the Network Disconnect Switch is off. The connection a qualified person uses will be connected on the equipment side.

Rationale: A network being understood and perhaps defined in an industry currently using microprocessor where two or more computers that are linked in order to share resources, exchange files, or allow electronic communications comprise a network. A network can be an intranet or internet. The computers on a network may be linked through discrete (wired) or wireless communication, wireless signals derived from any signal on the electromagnetic spectrum. For years equipment manufacturers have created equipment that can be and are connected to networks for use to sell their products and services, but no provision has been made to provide the protection to an affected person and/or building from the hazards associated with an entity affecting a conveyance connected to a network. This concern is increased with the increased practices of utilizing networks to monitor and/or interact with conveyances. The hazards of network connections include but are not limited to struck by, caught between, falls, electrocution, improper operation due to changes made to a system incorrectly via a network as well as privacy and contract abuse concerns. Public welfare in the form of financial loss to building owners is happening and will continue to occur. If left unaddressed as it currently is hazards and danger exist to a building and its personnel.

Please confirm this public comment has successfully been submitted.

Michael E. Vandervennet  
BM/FS IUEC Local 36  
1640 Porter, Detroit, MI. 48216  
(313)961-0717 Office, (313)515-6894

Greetings,

I am submitting this comment for use in your proposed rule set (2019-125 LR) will adopt by reference the 2018 International Building Code (IBC) with amendments, deletions, and additions deemed necessary for use in Michigan.

**Comment regarding 2018 International Building Code (IBC) with amendments:**

Regarding, 1109.8. Lifts. Platform (wheelchair) lifts may be a part of a required accessible route in new construction where indicated in items 1 to 10. Platform (wheelchair) lifts shall be installed in accordance with the Michigan elevator code, R 408.7001 to R 408.8695.

If the above reference will remain and it is agreed it makes reference to *MI Administrative Code(s) for Licensing and Regulatory Affairs - Bureau of Construction Codes* then the reference is to Michigan Elevator Rules. Please consider the following revision.

Regarding 1109.8. Lifts. Platform (wheelchair) lifts may be a part of a required accessible route in new construction where indicated in items 1 to 10. Platform (wheelchair) lifts shall be installed in accordance with the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

*Rationale: To ensure details of any legally enforceable document accurately make reference to the jurisdictions rules.*

*Please confirm this public comment has successfully been submitted.*

Regarding, ~~3001.4.3001.5~~. Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from 1 freight class to another freight class shall comply with the requirements of the Michigan elevator code, R 408.7001 to R 408.8695.

If the above reference will remain and it is agreed, it makes reference to *MI Administrative Code(s) for Licensing and Regulatory Affairs - Bureau of Construction Codes* then the reference is to Michigan Elevator Rules. Please consider the following revision.

~~3001.4.3001.5~~. Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from ~~1~~ one freight class to another freight class shall comply with the requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695. If a building or structure is re-purposed and/or occupancy classification altered resulting in a freight elevator found to be used by practice as a freight elevator permitted to carry passengers or a passenger elevator this is considered an alteration and shall comply with the applicable requirements in Michigan Elevator Rules, R 408.7001 to R 408.8695

*Rationale: As buildings and structures age in our communities and the resources available to AHJs dwindle due to fiscal problems the end enforcers of codes and standards have reported multiple times to witness a freight elevator being used to carry passengers which is*

*contraindicated and therefore should be prohibited. The language proposed provides both the building official and authorities such as but not limited to accessibility, elevator oversight to enforce a safer use and configuration of the conveyances covered here. Changing the “1” to a “one” is reads better in my opinion.*

Regarding, ~~3001.2. Other devices. Other devices shall conform to the requirements of sections 3001.2.1 and 3001.2.2 of the code.~~

~~—3001.2.1. Conveyors. Conveyors and related equipment shall conform to the requirements of ASME B20.1 listed in chapter 35.~~

~~—3001.2.2. Automotive lifts. Automotive lifts shall conform to the requirements of ALI ALCTV listed in chapter 35.~~

Please consider the following revision.

[3001.2. Other devices. Other devices shall conform to the requirements of sections 3001.2.1 and 3001.2.2 of the code.](#)

[3001.2.1. Conveyors. Conveyors and related equipment shall conform to the requirements of ASME B20.1 listed in chapter 35.](#)

[3001.2.2. Automotive lifts. Automotive lifts shall conform to the requirements of ALI ALCTV listed in chapter 35.](#)

*Rationale: Conveyors referenced being struck are installed in buildings and structures and introduce hazards and dangers to affected persons. The standards referenced affect conveyances being installed in building under the purview of the IBC. For more substantive reporting on the examples contact me and I would provide such a presentation publicly. The references provide oversight in two major areas. First any applicable safety provision that supports a safer culture and derived from Michigan’s final adopted building code. Secondly accurately refers users to the appropriate referenced standard to ensure the appropriate enforcement. Looking at the proposed deletion I see safety being removed but not an equivalence provided.*

Regarding, Rule 458. Sections 3001.1, ~~3001.2, 3001.4,~~**3001.5**, 3002.5, ~~3002.6,~~ 3003.1, and 3003.2, of the code are amended, sections 3001.2.1, 3001.2.2 are being deleted, and 3003.1.5 and 3004.5 are added to the code to read as follows:

3001.1. Scope. The design, construction, installation, alteration, and repair of elevators and conveying systems and their equipment shall conform with the requirements of the Michigan elevator laws and rules, **including** 1967 PA 227, MCL 408.801 to 408.824; 1976 PA 333, MCL 338.2151 to 338.2160; ~~and~~ R 408.7001 to R 408.8695; and this chapter. Installation or construction in flood hazard areas established in section 1612.3 shall comply with ASCE 24 listed in chapter 35.

Please consider the following revision.

Rule 458. Sections 3001.1, [3001.2, 3001.4,](#)**3001.5**, 3002.5, [3002.6,](#) 3003.1, and 3003.2, of the code are amended, sections 3001.2.1, 3001.2.2 are being deleted, and 3003.1.5 and 3004.5 are added to the code to read as follows:

3001.1. Scope. The design, construction, installation, alteration, and repair of elevators and conveying systems and their equipment shall conform with the requirements of the Michigan elevator laws and rules, **including** 1967 PA 227, MCL 408.801 to 408.824; 1976 PA 333, MCL 338.2151 to 338.2160; ~~and~~ R 408.7001 to R 408.8695; and this chapter. Installation or construction in flood hazard areas established in section 1612.3 shall comply with ASCE 24 listed in chapter 35.

*Rationale: Revise editorially the technical aspect of my other public comments.*

Regarding, ~~3002.6. Prohibited doors. Doors, other than hoistway doors and the elevator car door, shall be prohibited at the point of access to an elevator car.~~

Please consider the following revision.

[3002.6. Prohibited doors. Doors, other than hoistway doors and the elevator car door, shall be prohibited at the point of access to an elevator car. Exception: access doors and panels allowing partial or full bodily entry shall comply with Michigan Elevator Rules, R 408.7001 to R 408.8695 or be subject to a variance hearing with Michigan' Elevator Safety board in accordance with Act 227, 408.808\(c\). Access doors and panels are further subject to compliance with 29 CFR 1910, 29 CFR 1926.](#)

*Rationale: Current configurations of elevators (machine-room-less) are being driven in a non-codified vehicle and a substantial list of hazards are being presented that are not covered prescriptively by any code, standard, law or rule set. At code developing bodies it has been reported that these configurations have been allowed beyond what codes can safely provide oversight. All of the parts, assemblies, systems that fall into this concern may be mitigated or eliminated through an effective variance process as found to be present in Michigan's elevator Safety Board. The factors guiding this access fall under but are not limited to safety codes, standards, and the States Osha Plan. I do reference OSHA in my proposal and please forgive me as I am not versed in what may be a better nomenclature to indicate Michigan's State Plan.*

Regarding, R 408.30499 Adoption of standards by reference; referenced codes. Please consider the following revision.

Rule 499. Chapter 35 of the code is amended to add the following referenced codes, which are available for inspection and purchase from the Michigan Department of Licensing and Regulatory Affairs, Bureau of Construction Codes, ~~2501 Woodlake Circle, Okemos, Michigan 48864~~ **611 W. Ottawa, Lansing, Michigan 48933, at a cost as of the time of adoption of these rules of: Michigan Electrical Code \$122.00, Michigan Mechanical Code \$83.00, Michigan Plumbing Code \$83.00, Michigan Uniform Energy Code \$48.00, ~~Michigan Elevator Code~~ Michigan Elevator Rules \$89.50, and Michigan Boiler Code \$100.00 each.**

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

Regarding, R 408.30499 Adoption of standards by reference; referenced codes.

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- (a) Michigan Electrical Code R 408.30801 to R 408.30880 of the Michigan Administrative Code.
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- (e) ~~Michigan elevator code~~ R 408.7001 to R 408.8695 of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#).
- (f) Michigan Boiler Code R 408.4001 to R 408.5609 of the Michigan Administrative Code.

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Rule 427. Sections ~~1101.2~~**1102.1** and 1109.8 of the code are amended and section 1103.2.15 is added to the code to read as follows:

~~1101.2~~**1102.1**. Design. Buildings and facilities shall be designed and constructed to be accessible in accordance with 1966 PA 1, MCL 125.1351 to 125.1356, this code, and ICC/ANSI A 117.1, except sections 611 and 707.

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6. An accessible route to load and unload areas serving amusement rides.
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9. An accessible route instead of gangways serving recreational boating facilities and fishing piers and platforms.

10. An accessible route where existing exterior site constraints make use of a ramp or elevator infeasible.

*Rationale: To ensure details of any legally enforceable document accurately refer to the jurisdiction's rules. I get it, I just think the terms should be consistent with the law.*

Regarding, 3002.5. Emergency doors. Where an elevator is installed in a single blind hoistway or on the outside of a building, there shall be installed in the blind portion of the hoistway or blank face of the building, an emergency door in accordance with the requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

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R 408. 30459 Elevators.

Rule 459. Sections 1009.4 and ~~1607.9.1~~ **1607.10.1.** of the code are amended to read as follows:

1009.4. Elevators. To be considered part of an accessible means of egress, an elevator shall be in compliance with the emergency operation and signaling device requirements of the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

~~1607.9.1~~ **1607.10.1.** Elevators. Elevator loads shall be increased by 100% for impact and the structural supports shall be designed within the limits of deflection prescribed by the ~~Michigan elevator code~~ [Michigan Elevator Rules](#), R 408.7001 to R 408.8695.

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**Proposal:**

[3004.x Network Connected Conveyances and Associated Equipment Any conveyance connected to a network shall be equipped with a Network Disconnect Switch to physically disconnect a conveyance connected to a network by disconnecting the network connection. This Network Disconnect Switch is provided to provide persons the ability to protect affected persons and buildings through isolation as they determine necessary. Network connected equipment shall comply with 3004.x.x through 3004.x.x](#)

3004.x.x The Network Disconnect Switch contacts shall be physically and positively opened and closed manually, terminate all transmitting and receiving of signals once opened, terminate all power over ethernet connections once opened. No portion of a part, assembly, device, and/or its required and connected circuit and/or parts used for this switching is and/or has any parallel provision may reside in part or completely as a solid-state entity. Software enabling and disabling is prohibited. Bypassing the Network Disconnect Switch is prohibited.

3004.x.x The Network Disconnect Switch shall be located inside of a room accessed with key(s) for that room and not used to open any other lock in the building or structure shall not be used to lock or unlock the room. Keys to the room containing the Network Disconnect Switch shall be kept on the premises in a location readily accessible to qualified persons only. A log showing access to the room containing the Network Disconnect Switch shall be maintained with the building owner. The log shall contain date, time accessed, name of person, name of company or organization, purpose for access.

3004.x.x The Network Disconnect shall be permanently marked “NETWORK DISCONNECT SWITCH [insert equipment identification here]”. The marking shall be on the Network Disconnect Switch assembly and shall be readily visible. Letters used shall be block type and at least 13 mm (1/2 in.) in height

3004.x.x The Network Disconnect Switch shall be provided with markings to indicate the open or closed position.

3004.x.x The Network Disconnect Switch shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed

3004.x.x The Network Disconnect Switch shall be permitted to open automatically to isolate the equipment from a network.

3004.x.x The Network Disconnect Switch shall not be closed by a control circuit type device.

3004.x.x The installation of a Network Disconnect Switch shall be required on new and existing equipment connected to a network.

3004.x.x The Network Disconnect Switch shall be installed on all network connection configurations including wireless connections.

3004.x.x Peripherals attached temporarily such as service tools, laptops etc. are considered an external entity and would be subject to the Network Disconnect Switch. Exception: qualified persons employed to interact with the equipment while at the equipment shall be permitted to access the equipment even while the Network Disconnect Switch is off. The connection a qualified person uses will be connected on the equipment side.

*Rationale: A network being understood and perhaps defined in an industry currently using microprocessor where two or more computers that are linked in order to share resources, exchange files, or allow electronic communications comprise a network. A network can be an intranet or internet. The computers on a network may be linked through discrete (wired) or wireless communication, wireless signals derived from any signal on the electromagnetic spectrum. For years equipment manufacturers have created equipment that can be and are connected to networks for use to sell their products and services, but no provision has been made to provide the protection to an affected person and/or building from the hazards associated with an entity affecting a conveyance connected to a network. This concern is increased with the increased practices of utilizing networks to monitor and/or interact with conveyances. The hazards of network connections include but are not limited to struck by, caught between, falls, electrocution, improper operation due to changes made to a system incorrectly via a network as*

*well as privacy and contract abuse concerns. Public welfare in the form of financial loss to building owners is happening and will continue to occur. If left unaddressed as it currently is hazards and danger exist to a building and its personnel.*

**Proposal:**

**1104.3 Connected spaces.** Where a building or portion of a building is required to be *accessible*, at least one *accessible route* shall be provided to each portion of the building, to *accessible* building entrances connecting *accessible* pedestrian walkways and to the *public way*.

[1104.3.x Elevators comprising a part of an accessible route where two or more elevators \(a group\) called from a hall call station shall provide car call controls to and serve all the floors available to any one elevator in the group to facilitate persons can access all floors served by any elevator in the group.](#)

*Rationale: Currently elevators are being installed at times where they are called by a single hall call button, yet one or more elevators do not provide accessible routing to every floor. As an example two elevators connected to one hall button have been found to have only one of the two elevators serve a given floor and the other could not, thus the elevator that would not provide service to the floor but will answer the single call fails to provide accessibility. This example can be drawn out to larger elevator groups and still poses an problem. Caution is advised to ensure floors that need be accessed which is generally derived at the point of permit, plan submittal under the scrutiny of an accessibility professional. The solution is in the proposed language to ensure*

*R. Scott Hultstrom*

*National Coordinator*

*Elevator Industry Work Preservation Fund*

*6919 South Valley Stream Drive, Tucson, Arizona 85757 USA*

*Office: +1 520-308-5133, Cell: +1 520-300-1039*

# Should We Shelter?

## STUDENT TORNADO SHELTERS IN THE NEXT MBC... OR NOT?

Presented by Scott W. Walkowicz, PE, FTMS, NCEES

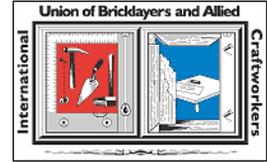
On behalf of the Michigan Structural Masonry Coalition



# Michigan Masonry Coalition 2020



**MCE**  
Michigan Council of  
Employers of  
Bricklayers and Allied  
Craftworkers



**Accessory Suppliers  
Stone & Block Suppliers**



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# Learning Objectives

---

After the seminar attendees will:

- Understand the basics of Tornado Sheltering and the IBC Mandate.
- Have been exposed to prior and current MBC actions on Tornado Sheltering for Schools .
- Better recognize the impact of Tornado Sheltering on school projects.



# Outline

---

Not really a masonry session... but masonry is interested!

Where do Tornado Sheltering requirements Come From?

What are the basics of Tornado Sheltering Requirements?

What about Michigan

Sheltering Solutions

Open Discussion... Should New Schools Shelter?



# Where do Sheltering Requirements Come From?

WHAT SHOULD WE BE TALKING ABOUT AND WHY?

Risk? IBC 2015 (and later) – ICC 500 (...and - FEMA P361 )



How many are familiar with ICC 500? FEMA P361?  
Has anyone designed a tornado shelter? Using ICC 500?

# The Basis for Tornado Sheltering

Where???

What???

EF3 - EF5

When???

1950 - 2013

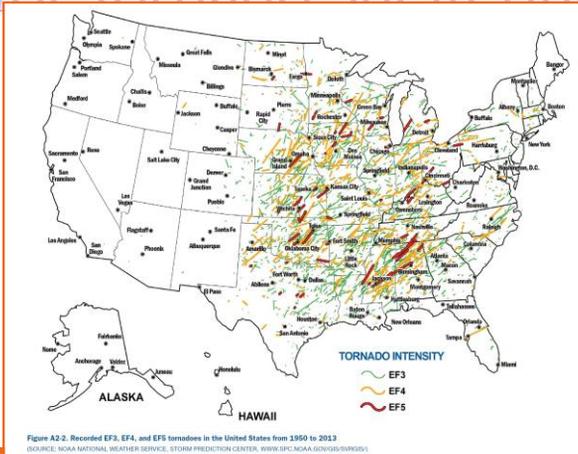


Figure A2.2. Recorded EF3, EF4, and EF5 tornadoes in the United States from 1950 to 2013.  
(SOURCE: NOAA NATIONAL WEATHER SERVICE, STORM PREDICTION CENTER, WWW.SPC.NOAIA.GOV/GIS/STORMS)



Mandatory for certain projects within darkest gray shaded area – 250 mph design wind speed!

# The Basis for Tornado Sheltering

Where???

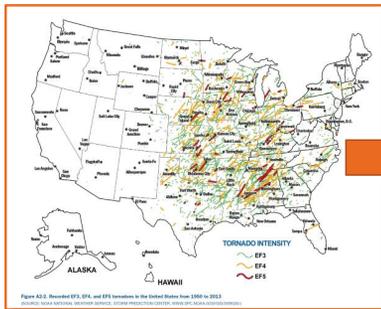
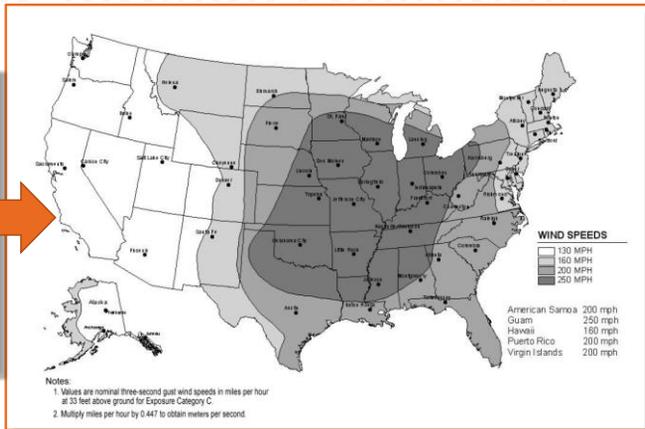


Figure A2.2. Recorded EF1, EF2, and EF3 tornadoes in the United States from 1980 to 2017.



Mandatory for certain projects within darkest gray shaded area – 250 mph design wind speed!

I've been told that the tornado design wind speed map isn't necessarily or fully probabilistic...

# Are School Structures Good Enough?



Why???



Best Available???



Photo Credits: FEMA P-361 2014, Typ UNO

Figure 1. Destroyed tornado refuge area at Kelley Elementary School, Moore, Oklahoma (1999)

Figure 2. Destroyed tornado refuge area at Enterprise High School, Enterprise, Alabama (2007)



Why do we need specifically designed shelter spaces with well defined loads?  
History shows that areas previously thought to be 'safe' were not necessarily safe...  
The concept was good, but not sufficient to resist tornado wind loads, especially EF3 and greater....

No fatalities at Kelley Elementary School – school was out, but the refuge area was destroyed....

Eight fatalities in Enterprise High School – in area of refuge

# Are School Structures Good Enough?

## MEASURING TORNADO INTENSITY

EF Number	Wind Speed (3 second gust)
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

Source: NOAA,  
[www.spc.noaa.gov/efscale/ef-scale.html](http://www.spc.noaa.gov/efscale/ef-scale.html)  
EF = Enhanced Fujita  
mph = miles per hour

School Design Wind Speed: 120 mph

- EF2 Tornado Wind Speeds can exceed design wind speeds – over-stress conditions (47 psf vs. 37 psf)
- EF3 Tornado Wind Speeds exceed design wind speed by 36.5% - minor damage due to 89% higher wind pressure (70 psf vs. 37 psf)
- EF4 Tornado Wind Speeds exceed design wind speed by 66.7% - moderate damage due to 175% higher wind pressure (102 psf vs. 37 psf)
- EF5 Tornado Wind Speeds exceed design wind speed by 100% or more – significant damage to failure due to 332% higher wind pressure (160 psf vs. 37 psf)
- Missiles???



Based on Occupancy Risk Category III

# Why Shelter for Tornadoes?

Why???



Figure B1-4. Safe room with items stored inside; such items take up space and reduce occupant capacity (Joplin, MO)



Figure A4-1. Example of a multi-purpose safe room also used as a gymnasium



NOT to save golf clubs.... Unless this is Phil Mickelson's club shelter....  
DEFINITELY to save occupants....

# Shelter Standards - History

## FEMA (Federal Emergency Management Agency) Activities

- Respond to catastrophic events – tornados and hurricanes
- Support communities
- Study structures and their performance
- Many documents and studies
- 1973 through today



Current FEMA P-361 supersedes 'National Performance Criteria for Tornado Shelters'...

# Shelter Standards - History

## FEMA P-361 'Safe Rooms for Tornados and Hurricanes'

Government's response to losses of life due to tornados and hurricanes...

- First Edition – July, 2000
- Second Edition – August, 2008
- Third Edition – March, 2015

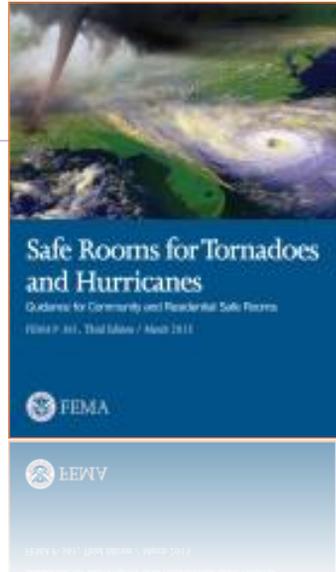


Third edition included 6 additional years of data regarding storms and building performance.

Including shelters that were directly impacted by events....

# FEMA P-361 2015

- Considers ICC 500-14
- ICC 500 codified P-361 through consensus process
- P-361 Part B recommendations required for projects with FEMA grant funds
- Part A = Guidance for planning, designing and operating safe rooms
- Part B = Comparative presentation of P-361 and ICC 500 including differences
- Some P-361 content more conservative



ICC 500 = code = life safety minimums

P-361 = government recommendations = sometimes more conservative

P-361 required when FEMA grant money is used....

# Shelter Standards - History

## ICC 500 'Standard for the Design and Construction of Storm Shelters'

- May, 2002 initiated joint project with NSSA (National Storm Shelter Association)
- First Edition – 2008
- Second Edition - 2014



Considered many sources including P-361  
Consensus standard intended for adoption through building codes

# ICC 500-2014

- Codified shelter design requirements
- Consensus basis
- (Hurricanes and/or) Tornadoes
  - Wind
  - Projectiles
- Stand-alone shelters
- Shelters within buildings



First mandated within IBC 2015!

## SECTION 423 STORM SHELTERS

**423.1 General.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500.



# Tornado Sheltering Basics

## AN OVERVIEW OF KEY SHELTER REQUIREMENTS

Building Type, Location, Occupancy and Construction



Focus on tornados (some provisions different for hurricanes...)

# IBC 2015

The first code to mandate shelters for tornados

New Construction

Tornado Design Wind Speed  $\geq$  250 mph

Critical Emergency Operations

Primary Schools

- Occupant Load  $\geq$  50
- Does not specifically address additions
- Must house the total Group E Occupant Load

## SECTION 423 STORM SHELTERS

**423.1 General.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500.

**423.3 Critical emergency operations.** In areas where the shelter design wind speed for tornados in accordance with Figure 304.2(1) of ICC 500 is 250 MPH, 911 call stations, emergency operation centers and fire, rescue, ambulance and police stations shall have a storm shelter constructed in accordance with ICC 500.

**Exception:** Buildings meeting the requirements for shelter design in ICC 500.

**423.4 Group E occupancies.** In areas where the shelter design wind speed for tornados is 250 MPH in accordance with Figure 304.2(1) of ICC 500, all Group E occupancies with an aggregate occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500. The shelter shall be capable of housing the total occupant load of the Group E occupancy.

**Exceptions:**

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.
3. Buildings meeting the requirements for shelter design in ICC 500.



# IBC 2018

**423.2 Construction.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500. Buildings or structures that are also designated as emergency shelters shall also comply with Table 1604.5 as Risk Category IV structures.

## The second code to mandate shelters for tornados

- Still a New Construction Code!
- Tornado Design Wind Speed  $\geq$  250 mph
- Critical Emergency Operations
- Primary Schools
  - Occupant Load  $\geq$  50
  - Clarified Additions and Shelter Occupant Load
    - Aggregate occupant load of classrooms, vocational rooms, and offices
    - OR largest gathering space occupancy
  - Specified Location / Travel Distance



Generally interpreted as the occupant load of the entire building when additions are being constructed....

# IBC 2018

**423.2 Construction.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500. Buildings or structures that are also designated as emergency shelters shall also comply with Table 1604.5 as Risk Category IV structures.

**423.4 Group E occupancies.** In areas where the shelter design wind speed for tornados is 250 mph in accordance with Figure 304.2(1) of ICC 500, all Group E occupancies with an occupant load of 50 or more shall have a storm shelter constructed in accordance with ICC 500.

**Exceptions:**

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.
3. Buildings meeting the requirements for shelter design in ICC 500.

**423.4.1 Required occupant capacity.** The required occupant capacity of the storm shelter shall include all of the buildings on the site and shall be the greater of the following:

1. The total occupant load of the classrooms, vocational rooms and offices in the Group E occupancy.
2. The occupant load of any indoor assembly space that is associated with the Group E occupancy.

**Exceptions:**

1. Where a new building is being added on an existing Group E site, and where the new

building is not of sufficient size to accommodate the required occupant capacity of the storm shelter for all of the buildings on the site, the storm shelter shall at a minimum accommodate the required occupant capacity for the new building.

2. Where approved by the code official, the required occupant capacity of the shelter shall be permitted to be reduced by the occupant capacity of any existing storm shelters on the site.

**423.4.2 Location.** Storm shelters shall be located within the buildings they serve or shall be located where the maximum distance of travel from not fewer than one exterior door of each building to a door of the shelter serving that building does not exceed 1,000 feet (305 m).



New building on a site... is that an addition or literally a new building?  
Golden ticket if not shelter full occupancy of a site...  
It doesn't cost that much extra to build small additions as full shelter...

# IEBC and MRC

**423.2 Construction.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500. Buildings or structures that are also designated as emergency shelters shall also comply with Table 1604.5 as Risk Category IV structures.

2015 Michigan Renovation Code (MRC)

Based on 2015 International Existing Building Code (IEBC)

Level 1, 2 and 3 alterations **DO NOT** require tornado shelters

**IF** 30% (MRC criteria) of total floor and roof structure being changed, then the lateral load resisting system **MUST** be upgraded to resist **current wind and seismic loads**

- Basic Design Wind Speed
- **NOT TORNADO LOADS** (Tornado Design Wind Speed)



30% is a MRC requirement – not in IEBC...

# IEBC and MRC

**423.2 Construction.** In addition to other applicable requirements in this code, storm shelters shall be constructed in accordance with ICC 500. Buildings or structures that are also designated as emergency shelters shall also comply with Table 1604.5 as Risk Category IV structures.

2015 Michigan Renovation Code is the latest

There is a 2018 IEBC

- Level 1, 2 and 3 alterations DO NOT require tornado shelters
- Not require shelters for occupancy change
- Only require wind and seismic upgrades if 'substantial' structural changes are performed (no 30% - that's MRC)



The 2018 IEBC also does not contain language that requires shelters to be added for changes of occupancy, ie. a commercial space being converted into a school or classrooms. There have been national level discussions related to this provision and adding the requirement has been rejected at different forums and it has not been added to the IEBC. It has been reported that some building officials have been requiring this independently of the code....



# General Design Content

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Design Documentation and Content

Quality Assurance Plan

Peer Review (School Shelter with > 16 occupants)

- Structural
- Occupancy, Means of Egress, Access and Accessibility
- Fire Safety
- Shelter Essential Features and Accessories
- Report required prior to issuance of permit



# General Design Content

---

Special Inspection

Structural Observation



# Architectural Design Content

## Floor area

- 5 SF for seated or standing occupants
- 10 SF for wheelchair occupants (minimum 1 space per 200)
- 30 SF for bedridden occupants
- Reduce for obstructions
  - Materials stored
  - Furniture (fixed or not, concentrated...)



So if 1400 students at a school – need  $1400/200 = 7$  spaces at 10 SF = 70 SF PLUS  
1393 spaces at 5 SF = 6965 SF Total = 7035 SF  
Or, about 85' x 85'

Higher required areas for hurricane shelters due to longer duration of storm event....

# Architectural Design Content

## Doors and Egress

- Number per occupancy load
- Pressure and Impact Tested assembly, or
- Alcove or baffle protected for debris
- Possible emergency exit required...
  - If only one door required based on occupant load
  - Exempted if occupant load not greater than 16
- Swing per applicable building code
  - In the direction of egress but also consider ingress
- No keys, special knowledge or effort...



Figure B8-1. Metal door breached by wind-borne debris (this door was not designed to resist debris).  
(Tuscaloosa, AL, 2011 tornado)  
(SOURCE: FEMA P-608)



Pressure and also missile impact

Missile Test = specified strikes with 15 lb. 2x4 at 100 mph....

Multiple locking pins, latches, etc... to resist pressure and impact

New standard says must test largest and smallest variants – smaller = less energy dissipation at impact.

See FEMA site for up to date tested assemblies

Ingress consideration – occupant volume, corridor sizes, door sizes, etc... think about an emergency situation.

# Architectural Design Content

## Windows

- Impact resistance and pressure resistant, or
- Protected
  - Pressure resistant glazing with missile resistant protective element
  - Full protective element



Figure A4-5. Interior operated safe room shutters in multi-purpose classroom/safe room. Image on left is normal usage; image on right shows shutters in 'lock down' position where they are closed and latched



# Door and Window Assemblies

Rated and Labeled by an approved testing lab

National Wind Institute

Home About Us Research Facilities News & Events

## Debris Impact Facility

**ACCREDITED**  
Cert. No. 29-01

**For Information on Debris Impact Testing:**  
Terry Pines, Office Manager  
• Phone: (505) 834-8004  
• Email: [terry.pines@ttu.edu](mailto:terry.pines@ttu.edu)

Larry Tanner, Manager  
• Phone: (505) 834-2329  
• Email: [larry.tanner@ttu.edu](mailto:larry.tanner@ttu.edu)

**Frequently Asked Questions**

**Tested Shelters, Doors & Components:**

- [Above ground Shelters](#)
- [Below ground Shelters](#)
- [Commercial Doors](#)

<https://www.depts.ttu.edu/nwi/research/Debrisimpact/index.php>



# Architectural Design Content

---

## Ventilation

- Natural ventilation
  - Size per occupant
  - Location and distribution
  - Protection / Baffling
  - Can use Atmospheric Pressure Change openings
- Mechanical
  - Ventilation rate per applicable code
  - Protect equipment and intake/exhaust openings
  - Emergency power required...



# Architectural Design Content

---

## Sanitation Facilities

- Toilets
  - Minimum 1 for shelters with  $\leq 50$  occupants
  - For shelters with  $> 50$  occupants: 2 minimum for first 500, then 1 per 500 occupants or part of 500 occupants
- Hand Washing
  - Not required for less than 50 occupants
  - 1 per 1000 occupants
  - **Additional fixtures, beyond those for normal use of space, may be chemical or other means...**
- Within the shelter envelope!



# Architectural Design Content

---

## Other items

- Signage
- Joints must be protected, or
- Maximum 3/8" wide joints at concrete and masonry
  - With sealant per material standards
  - Or if no direct path to shelter space...
- Door undercuts
- ...?



# Structural Design Content

---

## Components and Cladding Wind Pressure:

- Directionality Factor,  $K_d = 1.0$
- Exposure Category = C
- Topographic Factor,  $K_{zt} \leq 1.0$
- Enclosure Classification:
  - Based on openings
  - 0.55 Partially enclosed factor recommended by FEMA P-361
  - 0.18 Enclosed factor
    - If APC (Atmospheric Pressure Change) venting provided
    - Require 1 SF of vent per 1000 CF of volume
  - Required to treat the largest door/window on positive pressure side as an opening



# Structural Design Content

---

## Missiles:

- 15 pound 2x4
- Walls: 100 mph
- Roof/horizontal surfaces: 67 mph

## Other loads:

- Roof Live Load: 100 psf
- Local lay-down, roll-over and collapse loads



# Structural Design Content

## Missile resistance

Figure B8-4. Large debris: Steel beam that blew into a school (Greensburg, KS, 2007 tornado)



Figure B8-11. Refrigerator pierced by a 2x6. The portion of the 2x6 that is visible was 4 feet 8 inches long. It went several inches into the freezer compartment. (Oklahoma City, OK, 1999 tornado) (SOURCE: FEMA P-342)

Must test for performance....



Missiles are a real and significant danger....

Must be tested to show resistance – wall and roof assemblies, doors, shutters, etc....

# Construction Phase Content

## Special Inspections

- Per appropriate building code and the Quality Assurance Plan
- Special systems or components
- Post installed anchors in concrete or masonry that are part of shelter or anchor the shelters
- Fabricators of components or shelters unless inspected and labeled...

## Structural Observations

- Structural systems for general conformance



Remember that Engineer of Record typically must prepare Statement of Special Inspection – requirement for permit

Special Inspections already required by IBC – it is the premise that the code allowables are based on! Nothing new here...

Some exceptions on inspections for residential construction

Structural observations – more importance than items by inspectors – looking at it from engineer's eye....

# Construction Phase Content

---

## Quality Assurance Plan (QAP)

- Address all components, systems and assemblies for shelter
  - Cladding
  - Missile resistance
  - Anchorage at roof and foundation
  - Much more...
- For each main windforce resisting system and wind resisting component
  - Includes Special Inspection
  - Also Structural Observation
  - Reporting requirements
- By a registered design professional



# Construction Phase Content

## Contractor Responsibilities

- EACH contractor
  - working on main wind force resisting system, or
  - ANY component listed in the QAP
  - Must submit a written statement of responsibility
    - Understanding
    - Compliance intended with appropriate control
    - Intended actions to verify
    - Person providing control and their qualifications
- Except when work is inspected and labeled



Masonry industry is working on a storm shelter certification for mason contractors

# What About Michigan

## WHERE WE ARE AND MIGHT BE HEADING

Do we now require shelters? Should we require shelters in school projects?



# What is Michigan's Tornado History?

Michigan Tornadoes (1950-2017)			
Magnitude	Quantity	Injuries	Fatalities
EF0:	347	12	0
EF1:	414	127	5
EF2:	210	346	16
EF3:	41	312	12
EF4:	15	1062	50
EF5:	2	1136	133
<b>Totals:</b>	<b>1029</b>	<b>2995</b>	<b>216</b>
<b>Totals (EF3-EF5):</b>	<b>58</b>	<b>2510</b>	<b>195</b>

Per [www.spc.noaa.gov/wcm/#data](http://www.spc.noaa.gov/wcm/#data)

MEASURING TORNADO INTENSITY	
EF Number	Wind Speed (3 second gust)
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

Source: NOAA,  
[www.spc.noaa.gov/efscale/ef-scale.html](http://www.spc.noaa.gov/efscale/ef-scale.html)  
 EF = Enhanced Fujita  
 mph = miles per hour



# 1953: F5 Flint-Beecher Tornado



<https://www.Wikipedia.org>



<https://www.extremeplanet.me>



June 8, 1953 at 8:30 p.m.

116 people killed

\$19 million total damage in 1953 (about \$180 million today)

27 miles long and up to 800 yards wide

# 1953: F5 Flint-Beecher Tornado

<https://www.mlive.com>



Beecher School, Pride of District, Was Directly in Twister's Path and Is Left



<https://www.beecherbucs.org>



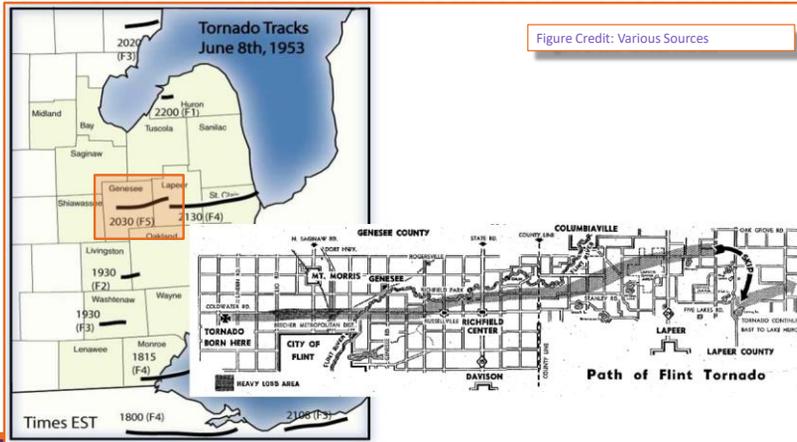
Should We Shelter? Student Tornado Shelters in the Next MBC... or Not?

2020

43

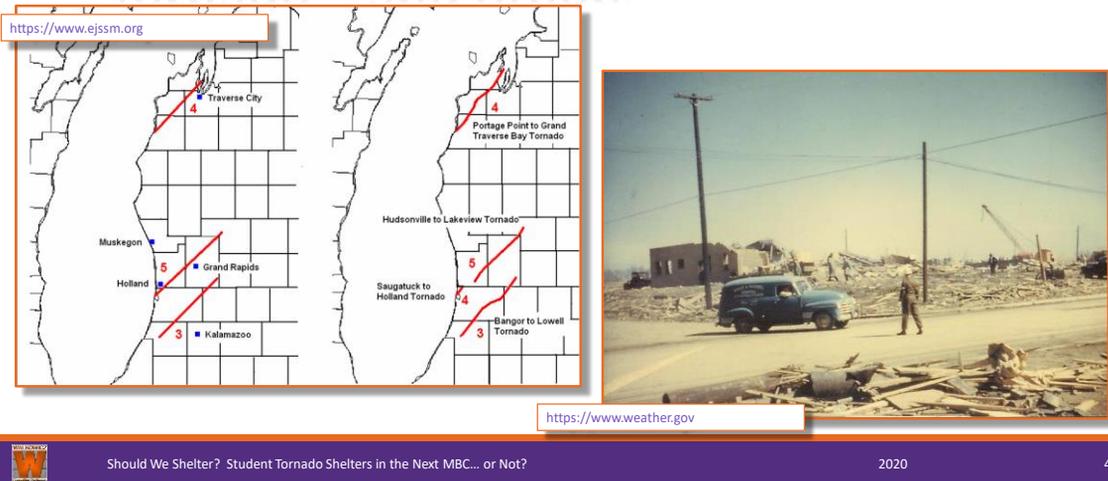
June 8, 1953 at 8:30 p.m.  
Beecher School was severely damaged...

# 1953: F5 Flint-Beecher Tornado





# 1956: F5 Hudsonville-Standale Tornado... and others



April 3, 1956 around 6:30 p.m.  
17 people died  
\$13 million in damages  
48 miles long, up to 400 yards wide



# Michigan State Building Code

IBC 2015 Adopted April 20, 2017 – With Shelter Requirements

## Designers Were Surprised...?

- Over 250 schools without shelter space submitted after rules became effective
- Designs had been completed, would require revision
- Construction funded by bonds, millage – time required

## Rules stayed for 6 months on June 13, 2017

- New effective date for designs October 20, 2017 (?) or December 13, 2017
- Saved 2017 summer construction starts....

## Then excluded permanently... November 6, 2017

- Timing of bonds and design documents was one stated concern
- Cost of shelters was the other primary concern



# 2018 MBC – Proposed Rules

In process for 2020 adoption

Sheltering was in...

One informal public hearing

Collaborative shelter meeting to discuss concerns and options

Filed with the Secretary of State on  
These rules take effect 120 days after filing with the Secretary of State

(By authority conferred on the director of the department of licensing and regulatory affairs by section 4 of 1972 PA 230, MCL 125.1504, and Executive Reorganization Order Nos. 2003-1, 2008-4 and 2011-4, MCL 445.2011, 445.2025, and 445.2030)

R of the Michigan Administrative Code are amended and R are rescinded as follows:

## PART 4. BUILDING CODE

R 408.30401 Applicable code.

Rule 401. The provisions of the international building code, ~~2015~~2018 edition, including appendices F, G, and H, except for sections **104.2, 104.3, 104.5, 104.7, 104.8, 104.9, 104.10, 104.11.1, 104.11.2, 105.1.1, 105.1.2, 105.3, 105.3.1, 105.3.2, 105.6, 107.2.5, 109.1, 109.2 to 109.6, 110.3.9, 111.1, 111.2, 111.3, 113.2, 113.3, 114.1, 114.2, 114.3, 114.4, 115.1 to 115.3, 415.9.1.2 to 415.9.1.9, 415-7.4, 903.2.8.4., 2902 to 2902.6, Table 2902.1, 3005.5, the definition of "agricultural building" in section 202, the definition of "recreational vehicle" in Appendix G and, IECC-2015, IEBC-2015, IMC-2015, IPC-2015, IPSDC-2015, NFPA 70-2014, listed in chapter 35, govern the construction, alteration, relocation, demolition, use, and occupancy of buildings and structures, and, with exceptions noted, the international building code is adopted by reference in these rules. All references to the International Building Code, International**



Proposed rules did not exclude section 423 in general or any portion related schools

# 2018 MBC – Proposed Rules

In process for 2020 adoption

Sheltering was in...

One informal public hearing

Collaborative shelter meeting

**Governor directed exclusion of school shelters again...**

Filed with the secretary of state on

These rules take effect 120 days after filing with the secretary of state.

(By authority conferred on the director of the department of licensing and regulatory affairs by section 4 of the **Stille-DeRossett-Hale single state construction code act**, 1972 PA 230, MCL 125.1504, and Executive Reorganization Order Nos. 2003-1, 2008-4, and 2011-4, MCL 445.2011, 445.2025, and 445.2030)

R 408.30401, R 408.30401a, R 408.30402, R 408.30403, R 408.30404, R 408.30409, R 408.30414, R 408.30415a, R 408.30418, R 408.30419, R 408.30427, R 408.30428, R 408.30441, R 408.30442, R 408.30446, R 408.30448d, R 408.30458, R 408.30459, and R 408.30499 of the Michigan Administrative Code are amended, R 408.30406, R 408.30415, R 408.30417, and R 408.30422 are added, and R 408.30408, R 408.30410, R 408.30411, R 408.30412, and R 408.30443 are rescinded, as follows:

## PART 4. BUILDING CODE

R 408.30401 Applicable code.

Rule 401. The provisions of the international building code, ~~2015~~**2018** edition, including appendices F, G, and H, except for sections **104.2, 104.3, 104.5, 104.7, 104.8, 104.10, 105.3, 105.3.1, 105.3.2, 105.6, 109.1, 109.2 to 109.6, 110.3.9, 111.1, 111.2, 111.3, 113.2, 113.3, 114.1, 114.2, 114.3, 114.4, 115.1 to 115.3, 415.9.1.2 to 415.9.1.9, 423.2.4, 423.4, 423.4.1, 403.2.8.4, 2902 to 2902.6, Table 2902.1, 3005.5, the definition of "agricultural building" in section 202, the definition of "recreational vehicle" in Appendix G, and IEBC-2015, IEBC-2015, IMC-2015, IPC-2015, IPSDC-2015, and NFPA 70-2014, listed in chapter 35, govern the construction, alteration, relocation, demolition, use, and occupancy of buildings and structures, and, with**



New Proposed rules now do exclude sections 423.4 and 423.4.1 (shelters for E Use Group)

# Michigan Mandate

## No Shelter Mandate

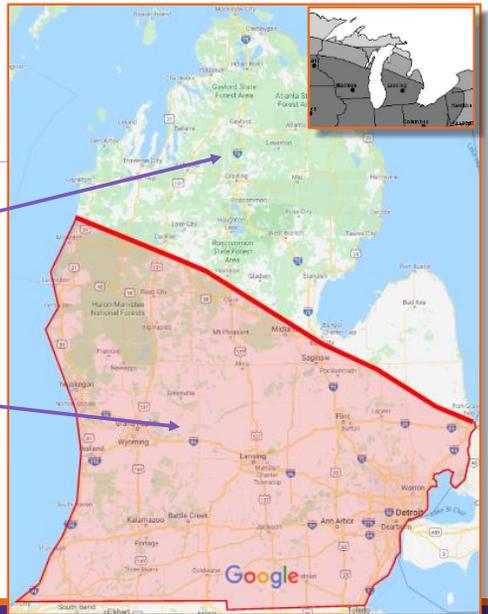
Shelter Design Wind Speed < 250 mph

## Shelter Mandate –

Shelter Design Wind Speed ≥ 250 mph

**New Construction Only**

**50 or more occupants**



# 2018 IBC

## Exception for Additions:

- Minimum shelter for occupants of addition
- Deduct existing shelter capacity with code official approval

**423.4.1 Required occupant capacity.** The required occupant capacity of the storm shelter shall include all of the buildings on the site and shall be the greater of the following:

1. The total occupant load of the classrooms, vocational rooms and offices in the Group E occupancy.
2. The occupant load of any indoor assembly space that is associated with the Group E occupancy.

### Exceptions:

1. Where a new building is being added on an existing Group E site, and where the new building is not of sufficient size to accommodate the required occupant capacity of the storm shelter for all of the buildings on the site, the storm shelter shall at a minimum accommodate the required occupant capacity for the new building.
2. Where approved by the code official, the required occupant capacity of the shelter shall be permitted to be reduced by the occupant capacity of any existing storm shelters on the site.



This was to clarify intent that had led to concerns with the 2015 IBC mandate.... Golden Ticket issue if don't shelter for all occupants...

# 2018 MBC – Proposed Rules

## One informal public hearing

- School Boards and School Superintendents and Administrators opposed based on poor information/understanding:
  - Don't want to impact projects 'on the boards...'
  - All school projects required shelters (renovations, paving, etc...)
  - Communities cannot afford shelters
  - Cannot compare to other states since Michigan is the only one that doesn't provide funding for school construction
  - Believe that current school design is sufficient for resisting tornados
- Michigan Masonry Coalition presented sheltering data and refuted most of concerns

## State asked groups to meet and reach a collaborative solution



Concerns were stated along the lines of 'If we add a vestibule, we need to add a shelter..., if we pave a parking lot, we need to add a shelter...'

# 2018 MBC – Proposed Rules

## Collaborative shelter meeting discussion points

- ~~Don't want to impact projects 'on the boards...'~~
- **Simple date of funding implementation...**
- ~~All school projects required shelters (renovations, paving, etc...)~~
- **New construction only, 50 or more total occupants or invoke exception to shelter only addition occupants, or make the whole addition a shelter, not renovations...**
- ~~Communities cannot afford shelters~~
- **Premium costs likely less than \$200k for small up to \$1 million for larger ones – 1-2% of project total cost... Just upgrade the structural capacity. Premium around \$40/SF**
- **Can use natural ventilation and closure OR protected mechanical and entrances**
- **Can use chemical or portable plumbing if not required for space already**
- **Can use battery or other lighting**
- **Cannot afford to have an occupied school hit by a tornado**



One person valued at \$6mil (DOT, FAA) to \$9.1mil (EPA)

# 2018 MBC – Proposed Rules

## Collaborative shelter meeting discussion points

- ~~Cannot compare to other states since Michigan is the only one that doesn't provide funding for school construction~~
- **23 States affected by mandate – 17 States with 2015 or later IBC**
- **7 states with full mandate, 5 states too small of an area, 3 states exempted (MI, WI, OH)**
- **MN now includes full mandate for counties within the mandate area**
- **States with full and modified mandates fund from 0% (LA and MO) to 8% (IL) to 61% (IA and KS)**
- **FEMA grants are available... but take time and planning and extra design**



# 2018 MBC – Proposed Rules

## Collaborative shelter meeting discussion points

- ~~◦ Believe that current school design is sufficient for resisting tornadoes~~
- **Michigan has had an average of 14 tornadoes per year for the last 20 years and averaged about one significant tornado (EF3-EF5) per year for last 50 years**
- **Significant structural damage and collapse can result at EF3-EF5 with standard school design and construction**
- **No protection against 'missiles' in standard construction**



Proposed rules did not exclude section 423 in general or any portion related schools

# 2018 MBC – Proposed Rules

Progress was being made but schools groups withdrew from process, then...

## **Governor directed LARA to exclude school shelters from MBC... again... reportedly...**

- Unknown what prompted unilateral action by Governor
- Based on summary data from Informal Public Hearing?

Working to understand and promote inclusion of sheltering provisions in new rules – options include:

- Formal Public Hearing
- Legislative Committee and Full Votes



# Tornado Sheltering Solutions

IF WE CHOOSE TO SHELTER, THEN WHAT?

What do tornado shelters require and how do we manage the cost?



# Masonry Shelter Cost Evaluation

Quincy Public Schools – Quincy, IL (Southwest IL)

New Elementary School

Located in seismically active area (occupancy demand higher than MI)

Gymnasium and Locker Rooms, Generator Room Shelter Areas

2016 Study, 2017-18 construction



# Masonry Shelter Cost Evaluation

Foundations included

Exterior walls with insulation and veneer included

Sheltered areas included

Partitions included

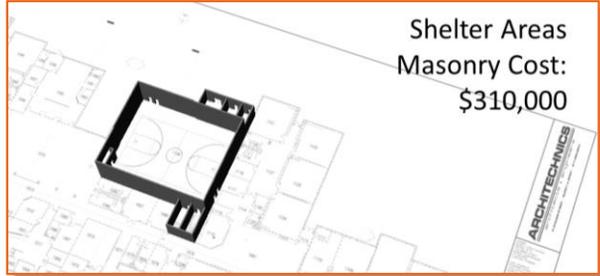


# Masonry Shelter Cost Evaluation

Sheltered areas have been designed to meet the requirements

Gym reinforced using a 12" cmu w/(2) #8 @ 8" o.c. bond beam at top and over openings

Bathroom and generator reinforced using 12" cmu w/(2) #7 @ 24" o.c.



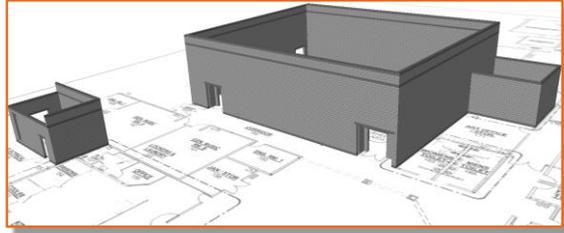
Shelter Areas  
Masonry Cost:  
\$310,000



# Masonry Shelter Cost Evaluation

## Shelter Areas Masonry Cost Premium

Difference between the shelter (solid grout with double bars @ 8" o.c.) vs. more typical (partially grouted with single bars @ 32" o.c.)



**\$65,000**



# Masonry Shelter Cost Evaluation

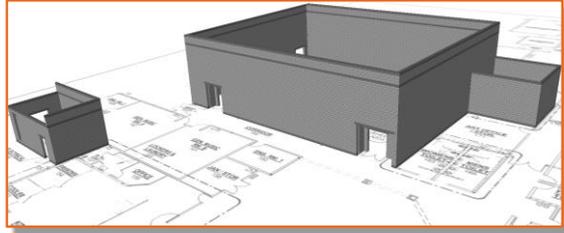
## Shelter Areas Masonry Cost Premium

Kansas Schools:

Non-Shelter Cost: \$275/SF

Shelter Cost: \$315/SF

Premium: \$40/SF



# Other Shelter Structure

Roof: 100 psf (or more?)

- Double Tees for long-span
- Plank for shorter spans
- Concrete on metal deck on beams or trusses
- Design for Live Load AND Net Uplift



Uplift of roof and even at base of walls is significant  
Sliding can be significant – use lots of shear wall or walls  
Be careful with internal pressure coefficients  
Connectivity is key

# Other Shelter Structure

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## Connections from Roof to Walls

- Vertical loads
- Diaphragm loads

## Connections from Walls to Foundation

## Foundations



Uplift of roof and even at base of walls is significant  
Sliding can be significant – use lots of shear wall or walls  
Be careful with internal pressure coefficients  
Connectivity is key

# Masonry Shelter Cost Evaluation

## Shelter Areas Masonry Cost Premium

Kansas Schools – Total Building Cost Comparison:

Non-Shelter Cost: \$275/SF => 4000 SF = \$1.100 mil

Shelter Cost: \$315/SF => 4000 SF = \$1.260 mil

Premium: \$40/SF => \$160,000 or about 15%

Premium cost percentage goes down compared to total project cost when building shelter space within larger additions or new schools....



Lower end standard school construction cost can be more like \$265/SF, so premium = \$50/SF and 4000 SF addition premium would be \$200,000... still manageable when looking at bond/millage costs to shelter as many people as that would cover....

# Questions

---

Scott Walkowicz, PE, FTMS, NCEES  
Walkowicz Consulting Engineers  
(517) 648-9319  
[scott@walkowiczce.com](mailto:scott@walkowiczce.com)



# Discussion...? Should New Schools Shelter???

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- Shelters are justified?
  - Cost?
  - Safety?
  - Timing?
- Shelters can be constructed cost effectively?
- Should school shelters be exempted from the next MBC?
- Will you support including shelters?
- What other information would be helpful?





PUBLIC HEARING - PART 4 BUILDING CODE (ORR# 2019-125 LR)

SUMMARY OF CONTENT

By

SCOTT W. WALKOWICZ

PE<sub>AL/CA/CO/FL/GA/IN/LA/MI/MS/NC/NY/OH/SC/TX/VA/WA/WI</sub>, SE<sub>UT</sub>, FTMS, NCEES  
Owner/WCE

1. Good morning! I'm Scott Walkowicz and I'm speaking as a citizen, as a professional engineer and on behalf of the Michigan Masonry Coalition. The storm shelter mandate should not be excluded for primary education facilities – E Use Group Buildings - in the IBC mandated area of Michigan ***because storm shelter spaces can be designed and constructed effectively and cost efficiently.***
  - a. First, let me say that we cannot afford not to begin to build shelters into schools now! Shelter design and construction must be proactive, not reactive... if you build it after the tornado hits, it's too late!
  - b. And, how much is the life of a student or a teacher or other staff person worth? Your son or daughter, niece or nephew? Brother, sister, friend, neighbor? For a modest cost, we can protect them from tornados as we do for fire and other hazards.
  - c. We ***can*** do this and other states ***are*** doing it....
    - i. There are 23 total states affected by the mandate zone.
    - ii. Some states use older codes or aren't largely within the mandate zone.
    - iii. That leaves 12 states of interest.
    - iv. 7 of those states, including Minnesota, utilize the full IBC school shelter mandate.
    - v. 2 others keep the shelter provisions but not the mandate.
    - vi. Only MI, OH and WI have exempted primary education facilities from the requirements.
    - vii. Also, states with mandates build shelters with low to modest state funding - as low as 0% and as high as 61%....
    - viii. And there are FEMA grants available!
  - d. What we need to talk about is the modest '***premium***' cost to build shelter space – ***not*** the total cost of the space! You're just upgrading the already planned space! And it doesn't cost that much extra!

- e. For example, Kansas regularly builds shelter spaces in schools:
  - i. Common school construction cost is about \$275 per square foot.
  - ii. School shelter construction cost is about \$315 per square foot.
  - iii. That's a \$40 per square foot premium to build shelter space.
  - iv. For a small, four-room addition, say 4,000 SF – typical construction cost would be around \$1.100 mil; shelter construction cost would be about \$1.260 mil. That's \$160,000 extra to build the whole addition as a shelter and to shelter several hundred kids, maybe enough to shelter the whole existing school occupancy...  
***who wouldn't vote to support that on a millage??? A 15% premium - and the percentage goes down when doing shelters within larger additions or new schools....***
- f. And, think about this - an occupied Oklahoma school that was hit by a tornado with student deaths was sued for not having a shelter... before the mandate existed. They were sued with no mandate, should we really go against the recommendations of the International Building Code writers and their tornado shelter mandate???
- g. I'll close with this:
  - i. We can design and build cost effective storm shelters!
  - ii. And, we can deal with design dates and bond funding dates through the code adoption language....
- h. Thank you!



### **When would 'Storm Sheltering' required in the 2018 MBC?**

A summary document prepared on behalf of the Michigan Masonry Coalition.

#### **General Notes:**

1. Storm shelters may be voluntarily designed as part of any project.
2. Storm shelters are mandated for inclusion in certain buildings in certain area within the 2018 International Building Code (IBC). That building code follows the precedent set in the 2015 IBC regarding a storm shelter mandate.
3. Michigan adopted, with modifications, the 2015 IBC and eventually excluded the storm shelter mandate for the duration of the 2015 Michigan Building Code (MBC).
4. Michigan is currently working through the adoption process to implement the 2018 IBC with modifications as the 2018 MBC.

**Simple Summary:** The intent of the International Building Code and the International Existing Building Code and codes based on them (Michigan Building Code and Michigan Rehabilitation Code, respectively) are that storm (tornado) shelters are required only for new buildings or additions when: the occupant load equals or exceeds 50 and the building is located in the 250 mph tornado shelter wind region as shown on a map, with some exclusionary exceptions. Shelters are not intended to be required for additions with no or small occupancies or for buildings undergoing any type of alterations or renovations. Such interpretations are outside the intent of the code language and standard practice in areas already implementing the storm shelter provisions.

Following are notes regarding when shelters are required for what types of buildings. The focus of these notes is new building construction, including additions, that would be designed under the 2018 MBC (IBC, if not modified). Section 1, below, includes discussion related to these provisions. We have not focused on building alterations since the next edition Michigan Rehabilitation Code is not yet being evaluated. There was, however, some discussion related to this and possibly some clarity would be helpful on the requirements within the International Existing Building Code (IEBC) and the Michigan Rehabilitation Code (MRC). Section 2, below, includes information related to both of these documents.

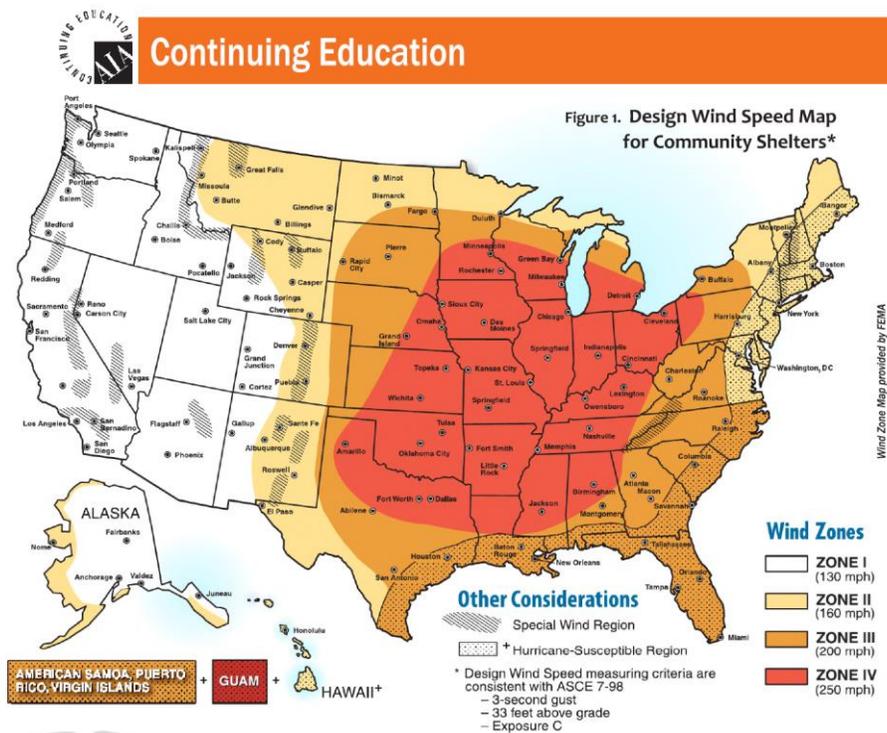
1. Storm shelter design and the 'mandate' for certain building types under certain conditions exist in Chapter 4, Section 423. The 'mandate' criteria for when a shelter is required is in the IBC and the technical provisions for design and construction are in ICC 500. Following are IBC 2018 code provisions that direct and limit storm shelter design and construction, with emphasis on Group E uses:

- 1.1. Storm shelters, when designed, constructed and designated for such purpose, shall be constructed per ICC 500 (2014). (Section 423.2) *So, IF you are going to designate a structure or some part of a structure as a Storm (Tornado) Shelter, then you must design it and construct it per ICC 500.*
- 1.2. For **Group E (K-12 Education) occupancies**: (Section 423.4)
  - 1.2.1. Required when the building is located in an area where the ‘shelter design wind speed’ for tornadoes is 250 mph or greater. *This is the first qualifying criteria – location. See the included map – Note that the mandate is only required for the lower half or so of the Lower Peninsula based on this map and the map is ‘shelter design wind speed’ not the ‘basic design wind speeds’ included in maps within IBC/MBC that were taken from ASCE 7.*
  - 1.2.2. ONLY required when the occupant load equals or exceeds 50. *This is a key point as many additions may not have a designated occupancy requirement or may fall below the 50-occupant threshold and a shelter would not be required under the 2018 IBC/MBC. It appears that the ‘occupant load’ is intended to include the occupants of both the addition and the original facility but not necessarily separate buildings on the same site.*
  - 1.2.3. Other uses excluded from mandated storm shelter:
    - 1.2.3.1. Group E daycare facilities.
    - 1.2.3.2. Group E occupancies accessory to places of worship.
    - 1.2.3.3. If the entire building is designed as a storm shelter.
  - 1.2.4. Occupancy required shall be the greater of: (Section 423.4.1)
    - 1.2.4.1. (Section 423.4.1) **Total of classrooms, vocational rooms and offices** in the Group E occupancy, or... *Another key clarifying point – only the occupancy of these spaces must be considered and then compared to the occupancy load of ANY indoor assembly space (see following criteria point...). You would size any required shelter (>50 occupants) based on the greater occupant load for either this combined occupancy load or that of the largest indoor assembly space of the new building or addition.*
    - 1.2.4.2. (Section 423.4.1.2) The occupant load of any **indoor assembly space** associated with the Group E occupancy. *The key clarifier here is the use of the word ‘any’ rather than ‘all’ or ‘cumulative’ – you compare the occupant load of the combined classrooms, vocational rooms and offices with the largest indoor assembly space of the new building or addition. A secondary clarifying point is the word ‘indoor’ – you would not use an outdoor assembly space to determine any shelter occupancy load.*
    - 1.2.4.3. (Section 423.4.1, Exception 1) Exception: for a new addition to an existing building and when the new building addition is not of sufficient size to accommodate the required occupant capacity for a storm shelter for all the buildings on site, then the storm shelter shall accommodate at least the occupant load capacity for the new building addition. *Note that this language was revised in the 2018 IBC, specifically in response to concerns and mis-interpretations of intent in the 2015 IBC. The intent is not to require an addition to shelter the*

*entire occupancy load of an existing building or buildings on a site. The language is, however, still somewhat vague, in our opinion, related to one particular point and that is that it may be interpreted to require the addition or some part of it to be designed as a full-site shelter if it can provide the appropriate space for all the required occupancy on a site. So, large additions may be required to be, or to provide within them, full shelter occupancy for the building or site if the occupant load fits.*

1.2.4.4. (Section 423.4.1, Exception 2) May also reduce the storm shelter size by the capacity provided by an existing storm shelters on site with the building official’s permission.

1.2.5. Must be located within the buildings they serve or such that maximum travel distance from one or more doors in each building served does not exceed 1000 feet. (Section 423.4.2)



## Tornado Shelters CODE REVISIONS IN THE 2015 IBC

Corey Schultz, AIA, LEED AP BD+C

Figure 1: Tornado Design Wind Speed Map - Mandated Shelters within Zone IV where wind speed = 250 mph or more. (credit Corey Schultz)

## 2. IEBC and MRC

2.1. 2018 IEBC does not contain provisions that require storm shelters to be added under Level 1, 2 or 3 Alterations. Wind and seismic upgrades must be implemented if ‘substantial structural alterations’ are being performed. This is

specific to the whole building lateral system and is not related to storm shelter design nor does it invoke storm shelter requirements.

2.2. 2015 MRC – note that there is not a newer, 2018 MRC yet and (to our knowledge) is not yet being developed or proposed provisions are not yet published.

2.2.1. There are three levels of alterations covered:

**2.2.1.1.** ‘Level 1 [alterations](#) include the removal and replacement or the covering of existing materials, elements, equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose.’ Specific requirements for Level 1 alterations are covered in Chapter 7. Structural requirements are in Section 707. **Storm sheltering is not required for projects involving Level 1 alterations.**

2.2.1.2. ‘Level 2 [alterations](#) include the reconfiguration of space, the [addition](#) or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional equipment.’ Specific requirements for Level 2 alterations are covered in Chapter 8. Structural requirements are in Section 807. Minor structural provisions are included when changing the weight on structure related to re-roofing or replacement of equipment only. Minor provisions related to modifying structural systems or loads are included in Level 2 alterations. **Storm sheltering is not required for projects involving Level 2 alterations.**

2.2.1.3. ‘Level 3 [alterations](#) apply where the [work area](#) exceeds 50 percent of the *building area*.’ Specific requirements for Level 3 alterations are covered in Chapter 9. Structural requirements are in Section 907. **It is our opinion, and that of others significantly involved in storm shelter design and peer review, that storm sheltering is not required for projects involving Level 3 alterations under IEBC and subsequently under MRC language as written and as intended.** *The MRC, Section 907.4.2 on ‘Substantial structural alteration’ notes that when 30% or more of the total floor and roof areas have been or are proposed to be involved in STRUCTURAL ALTERATION, then the altered BUILDING lateral load system must comply with the current code for WIND and REDUCED SEISMIC forces. The 30% criteria was added by MRC compared to the IEBC since the IEBC only used the undefined term ‘substantial structural alteration.’ The wind mentioned is specifically related to the basic design wind speed, not the shelter design wind speed and the maps are totally different. Based on this language, sheltering would not be required under the MRC unless there is some formal state interpretation contrary to the code language which invokes it. We are communicating with the State on this point and will provide further commentary when we’ve received their response. Note that the only place that sheltering is invoked in the IEBC is for additions and that the 2015 did not include the sheltering requirement for additions....*



Jennifer Smith, Director, MASB  
Via email: [jsmith@masb.org](mailto:jsmith@masb.org)  
Peter Spadafore, Director, MASA  
Via email: [pspadafore@gomasa.org](mailto:pspadafore@gomasa.org)

September 12, 2019

RE: Proposed Language for 2018 MBC Regarding Storm Shelters

Dear Jennifer and Peter:

I am writing to you on behalf of the Michigan Masonry Coalition. Subsequent to our initial meeting, we met and talked amongst ourselves and with design experts for storm shelters from states that have adopted these provisions. The outcome is the following preliminary recommendation: Include unmodified storm shelter provisions per Section 423 of the 2018 IBC rather than trying to carve out just the 'structural' shell and include an implementation date relating compliance to funding approval beginning with the date of the 2018 MBC implementation. We have included trial language and rationale related to this for your consideration prior to the September 13, 2019 date that Tony Snyder shared. We would like the opportunity to discuss this with you and see if we can reach consensus during the early portion of the rules development process and before the public hearing. Please consider the following information and then let us know your thoughts. Thank you.

Proposed Language:

#### **SECTION 423 STORM SHELTERS**

**423.4 Group E occupancies.** In areas where the shelter design wind speed for tornadoes is 250 mph in accordance with Figure 304.2(1) of ICC 500, all Group E occupancies with an occupant load of 50 or more, ***and a school bond election approval date on or after the effective date of the 2018 MBC,*** shall have a storm shelter constructed in accordance with ICC 500. *(Note: we can fine tune the language or include an actual date of the MBC adoption if that is better, or we could add an exception for all projects with bond elections approved prior to the code adoption date.)*

Rationale:

1. This language (or something crafted for this intent) would clearly limit the implementation to projects funded after the code adoption.
2. Based on the current IBC Section 423 language, the storm shelter requirements would only apply to new construction (buildings or additions) with occupant

■ Specialists in Masonry and Structures ■

It appears that 'occupant load' is intended to refer to the total occupant load of the composite building, not just the addition, although there is an exception for additions that are not large enough to shelter the full building's occupants.

- loads of 50 or more located in the 250-mph shelter design wind speed (lower half of Lower Peninsula). Storm shelters are not required when doing renovations and upgrades or even for additions or new buildings with occupant loads less than 50 persons.
3. There are many good reasons to keep the lighting, ventilation and plumbing requirements for occupant comfort during traumatic events. We can itemize and/or discuss these at greater length if that would be helpful.
  4. Storm shelter construction adds a very modest 1-2 percent premium to a project's total cost when included in the design process from the beginning. (FEMA p-361, page A3-3) Storm shelter construction generally doesn't require additional space being created within a project but, instead, utilizes existing space(s) so there is only a modest premium to harden the envelope and provide basic ventilation, lighting and plumbing facilities.
  5. Michigan's lack of state level funding is not significantly different than in other states within the storm shelter mandate zone. States which have mandated storm shelter requirements and fund school construction do so at a rate as low as 8% (IL) to as high as 61% (IA and KS) and states such as Louisiana and Missouri provide no funding for mandated shelters, all based on 2010 data reporting.
  6. Federal funding is available (FEMA) for shelter construction premium costs through a grant process accessible to all Michigan school districts.
  7. Michigan has averaged 14 tornados per year over the last 20 years and has averaged almost one significant (EF3, 4 or 5) tornado per year since 1950. An EF 3 or higher tornado is expected to produce significant structural damage to, or collapse of, schools designed only to the basic building code wind design requirements.
  8. Tornados create flying projectiles which can easily penetrate many conventional wall construction types and tested walls and opening closures provide proper occupant protection. Please see the videos at the following link and attached to the distribution email: Clemson University Testing – 50 mph 2x4 (half the velocity of ICC 500 test: <https://www.youtube.com/watch?v=fDk0QKEc02Q>; International Masonry Institute and others - 100 mph 2x4 test per ICC 500 and referenced standards: please see the video file attached to the transmittal email.

Sincerely,



Scott W. Walkowicz

PE<sub>(AL/CA/CO/FL/IN/LA/MI/MS/NC/NY/OH/SC/TX/VA/WA/WI)</sub>, SE<sub>(UT)</sub>, FTMS, NCEES  
Owner/WCE

CC: Maria Alvaro, AIA, LEED AP BD+C, International Masonry Institute  
Dan Zechmeister, PE, Masonry Institute of Michigan  
Chuck Kukawka, Bricklayers and Allied Craftworkers, Local 2, MI  
Phil Ledent, PE, SE, Fishbeck, Thompson, Carr & Huber, Inc.

The following email is in response to the recent discussion regarding storm shelter design in Michigan Public School Buildings:

I have been intimately involved in K-12 design and construction projects in Michigan over the last 30 years. The proposed requirement to create separate storm shelter facilities would create a financial burden on already cash-strapped districts and it is not necessary to provide the level of safety that is appropriate during a storm event.

The unintended consequences of providing these facilities involves providing separate HVAC systems, additional structural requirements and separate plumbing facilities. With minor modifications to existing code requirements, these types of spaces could be combined within existing construction to provide an equivalent level of life safety. Creating separate spaces for this highly unlikely scenario is a waste of resources.

It would be prudent to bring together a wider variety of design and construction professionals to discuss this issue further along with the long-term consequences. I am happy to discuss this further if you are interested.

Sincerely,  
Steven H. Hoekzema

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**Steven H. Hoekzema**  
AIA, NCARB, CPTED

Director of K12 Education, Principal

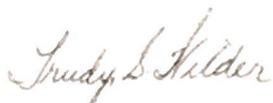
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TO: LARA-BCC-Rules @michigan.gov

RE: Hearing on Administrative Rules Part 4      date: 9-24-2020

Attn: Amanda Johnson

Trudy Wilder, Building Official from the City of St. Joseph concurs with the statements of Bill Hordyk from Grand Rapids against the proposed deletions.



**Trudy S. Wilder**

Building Official

Certified Residential Building Inspector

ICC/AACE Property Maintenance Housing Inspector

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Troy Gano, Building Official from St. Joseph Charter Township concurs with the statements of Bill Hordyk from Grand Rapids against the proposed deletions.



BERRIEN COUNTY

"A Full Service Community"

**Troy Gano**

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