KOMA

ARCHITECTS | DESIGNERS | ENGINEERS

STORM SHELTER REQUIREMENTS FOR MINNESOTA K-12 SCHOOLS

Understanding current building codes and the requirements needed to provide safety and comfort during emergencies

MAY 2023

OVERVIEW

With the adoption of the current Minnesota Building Code (2020 MNSBC), storm shelters became a required component for many Minnesota K-12 school buildings and critical emergency operations facilities.

The primary goal of the code is to protect building inhabitants against wind and flood damage or collapse from tornadoes and hurricanes. Storms shelters are required to be constructed in accordance with ICC 500-2014.

WHAT IS A STORM SHELTER?

A storm shelter is a building, structure, or portion thereof designated for use during tornadoes and other severe windstorms. A reliable storm shelter is engineered to provide safety and comfort during emergencies and is compliant with code requirements.

WHO IS IMPACTED?

Storm shelters are required for:

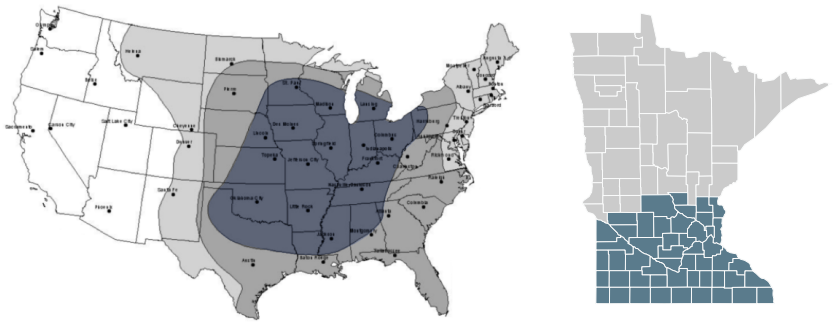
- The southern third of Minnesota where the tornado shelter design wind speed is 250 mph
- Newly constructed schools with an occupant load of 50+
- All newly constructed critical emergency operations facilities
- Additions with an occupant load of 50+ made to an existing school or critical emergency facility

Group E day care facilities and Group E occupancies accessory to places of worship are exempted.

KEY REQUIREMENTS

Areas that need oversight to meet storm shelter standards may include:

- Structural steel
- Structural concrete
- Plumbing
- Electrical
- Heating, Ventilation, and AC
- Fire protection systems
- Communication systems



Storm shelters are required in these regions

CASE STUDY

HOPE Community Academy
St. Paul, Minnesota

HOPE Community Academy in St. Paul predominantly serves the Hmong community in the metro area. Its early success as an elementary-level charter school created the need for a major expansion to accommodate students through 12th grade. In early 2020, KOMA and its broader team took on the challenge to develop a three-story addition to the school's existing building (on a very tight site) including middle and high school classrooms, a two-story media center, and new main offices. The addition included a full gymnasium which was also designed as a storm shelter to keep the school population safe and meet the 2020 MNSBC and ICC 500-2014 code requirements.

Early in the design process, it was important to engage the broader project team—including city officials—to determine the code requirements and implications of the design and costs.

The final result was one of the first approved and constructed storm shelters in St. Paul.

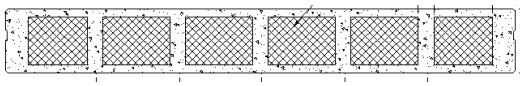
KEY FEATURES

1. **Storm shelter capacity:** KOMA was able to provide storm shelter capacity for the entire staff and student body of the school within the gymnasium addition.

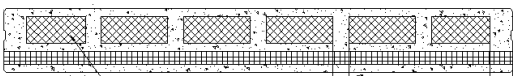
2. **Designed to survive the destruction of the host building:** A double wall was constructed where the storm shelter abuts the host building. This allowed the gymnasium to serve as the storm shelter and remain structurally intact in the event the host building collapses from storm impact.

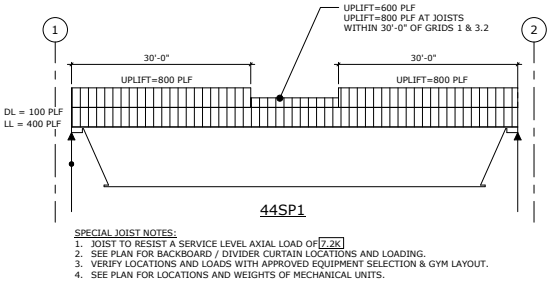
3 **Structurally hardened shell:** It was determined that the best solution for the storm shelter was to harden the structure around the gymnasium. The building was constructed using precast concrete wall panels with a steel bar joist and metal deck roof. Joist spacing was reduced and the roof diaphragm required enhanced roof deck attachment.

Storm Shelter PreCast Walls – Steel Form 12" Versacore



Standard PreCast Walls – Steel Form Sandwich Panel

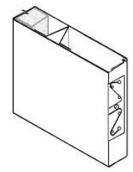




4 **Impact-protected openings:** Doors, windows, and other openings in the shelter envelope were detailed to be protected against missile impact and wind pressure. Hollow metal doors were a cost-effective solution to protect most openings.

STEELCRAFT

TORNADO RESISTANT OPENING SYSTEMS **PW-SERIES**

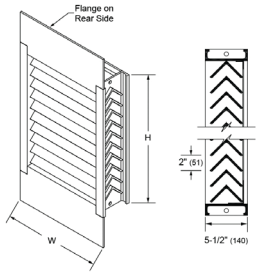


Premium Edge Construction - STANDARD

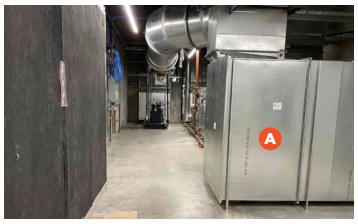
- Beveled hinge & lock edges
- Full height mechanical interlock with adhesive
- Seamless welded edge seam standard
- Lock edge with 12 gage (0.093") channel

Rigid End Channel Construction - STANDARD

- Top and bottom edges are closed with inverted 14 gage (0.067") welded channels.
- Top channel includes an additional 12 gage [0.093"] flush top channel.



5 **Dedicated air handling unit:** A dedicated air handling unit for the gymnasium was housed on a mechanical mezzanine above the locker rooms (A). Gas service with a meter immediately outside the space was protected by a precast wing wall. Mechanical penetrations were protected and hazardous gas or liquid lines were fitted with automatic shutoffs to protect against leakage due to movement of the utility line during a storm event (B).



The mechanical mezzanine contains the mechanical unit and backup power.

CYCLONE® Submittal
ROOF CRV Series

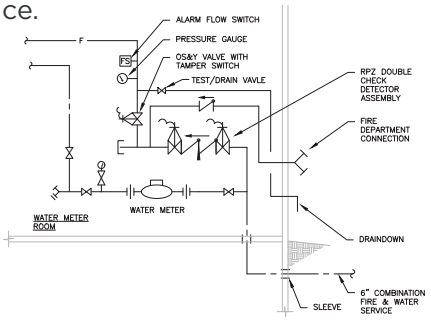
CYCLONE
Roof Penetration Housings, LLC

Specifications:

- All sizes between smallest and largest are 3rd-party tested to meet ICC-500 2014/ FEMA P-361 missile impact rating 250+ mph for Safe Room/Storm Shelter applications
- ISO 9001:2015 certified
- For all pipe, conduits, or duct work installations
- Available in sizes from 22"X10"X16" to 48"X48"X48"all sizes are custom
- All sizes are custom

6 **Backup power:** A natural gas-powered generator to provide backup power was located on the mechanical mezzanine served by its own dedicated gas service.

7 **Restroom facilities:** A second water service for the gymnasium was installed to serve both domestic and fire protection needs. Restroom facilities were designed to meet the requirements for sanitation facilities for a community shelter.



CHANGES AHEAD

The current version of ICC 500 (2014) has been updated (2020) and will be reviewed for adoption with the next cycle of the Minnesota Building Code.

Some highlights of changes include:

- The building owner will be responsible to maintain shelters and ensure they are in working order.
- Annual evaluations of the storm shelter envelope and impact-protective systems will be required.
- A third-party peer review of all components of the design of the storm shelter will be required.
- Fire protection systems will not be required to be protected from the storm shelter design event.
- Precast concrete panel joints with maximum widths up to 3/4 inch for minimum 6-inch-thick wall panels or 4-inch-thick roof panels will be allowed.
- The threshold for circular penetrations in the storm shelter envelope will increase to 2-1/2 inches to allow commonly sized plumbing vent pipes to be used without protection.
- Given the practical considerations involving cost and relatively short design storm events, the requirements for tornado shelter sanitation support methods have been removed from ICC 500-2020. Tornado shelters will no longer be required to provide a sanitation support method capable of supplying water and containing waste. Mechanical vents required to operate ventilation openings must be connected to standby power.
- First aid kits that comply with ANSI/ISEA Z308 are required to be in the shelter.

ABOUT KOMA

Established in 1985, KOMA is a versatile architecture, structural engineering, and interior design firm that serves a wide variety of clients and industries. We believe in making space both intentional and meaningful and developing engaged partnerships with our clients helps yield completed projects that balance beauty, performance, and distinction.

As municipalities and school districts seek to provide safe and code compliant buildings that are ready for weather emergency events, the KOMA team's knowledge and experience with storm shelter design makes for an effective partnership. Contact us for more information:

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Sources:

Storm Shelter Design: Overview of IBC and ICC-500 Requirements. https://www.ccaps.umn.edu/documents/cpe-conferences/structural/2021StructuralHandouts1.26.pdf

"Highlights of ICC 500-2020," FEMA, August 2021. "Structural Changes in the 2020 Edition of ICC 500 – Standard for the Design and Construction of Storm Shelters," Jeffrey D. Viano, Connor J. Bruns, STRUCTURE Magazine, March 2023.