

FREQUENTLY ASKED QUESTIONS



TORNADO REFUGE AREAS IN EXISTING INDIANA K-12 SCHOOLS

*This is intended to be a resource for school safety specialists and school administrators in Indiana K-12 schools in identifying tornado refuge areas. Specifically, there are suggestions for locating / improving / utilizing the “**best available refuge areas**” from tornados in existing buildings.*

This document has been prepared by The American Institute of Architects Indiana (AIA), Indiana School Safety Task Force, with assistance from members of the Indiana Department of Education. These materials are designed and intended solely to provide general information with regard to the subject matters covered herein and should not be used as a substitute for professional service in specific situations or as to specific buildings or facilities. Please seek out the services of an AIA architect or professional structural engineer for professional advice or other expert assistance.



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GENERAL INFORMATION

What is a TORNADO REFUGE AREA?

There are three important definitions and distinctions that describe areas in buildings for protection in Tornado events in this guide:

- **Best Available Tornado Refuge Area** – an area in an existing building or school (as identified by a registered architect or engineer) that offers a higher degree of protection than other areas in the building.
- **Tornado Safe Rooms** – are buildings or portions thereof that comply with FEMA 361 (a federal standard).
- **Tornado Safe Shelters** – are buildings or portions thereof that comply with INTERNATIONAL CODE COUNCIL (ICC) ICC-500.

'Safe Rooms – FEMA 361' and 'Safe Shelters-ICC-500' establish criteria for design and apply primarily to new construction. Because of the thousands of existing school buildings in Indiana without designated refuge areas, these FAQs focus primarily on "Best Available Refuge Area".

Are public schools required to provide tornado refuges, safe rooms or safe shelters?

Tornado refuge, safe rooms or shelters are **NOT REQUIRED** by the Indiana Building Code or the Indiana Department of Education or any other state agency. However, the 2012 edition of the Indiana Building Code when adopted likely will allow the use of ICC-500 as a code compliant option for school districts that choose to incorporate them in their new projects.

Who is responsible for determining the need and level of protection from tornadoes in our schools?

Ultimately, the local school board of education, elected and supported by the community, must establish the level of protection against the risk of tornado damage. The board and administration must weigh the additional costs necessary to pay for improvements in existing spaces or to require refuge or safe areas in new buildings.



GENERAL INFORMATION

Regarding tornado preparedness and safety in public schools – what does the state require?

Every Indiana school corporation must have a certified school safety specialist who has completed five days of Basic Training and completed two days of advanced training each school year. Each school must have a safety plan and must conduct a minimum of one tornado preparedness drill per semester.

Does the Department of Education have a standard preparedness plan that we can adopt for all the schools in our district?

The state provides the school safety specialist with access to sample protocols and plans for various emergencies including tornado and severe weather. However, these sample plans should be customized by the corporation's school safety specialist to best fit the unique needs of each school. The key to an effective tornado preparedness plan is an understanding of the building structure and the staff's reaction to the weather situation as it unfolds.

Are there any grant opportunities to help fund tornado preparedness initiatives?

Though grant funding is not always available, check with the director of your local Emergency Management Agency (EMA) who may be aware of new funding opportunities.

A complete list of EMA districts and directors is available online: www.in.gov/dhs/2797.htm.

The state Department of Education also posts funding opportunities at: www.doe.in.gov/student-services/safety



INFORMATION ABOUT 'BEST AVAILABLE REFUGE AREAS'

What are the fundamental attributes of a best available refuge area within a school?

Although not specifically designed to protect occupants during a tornado, a registered architect or engineer may identify the best available refuge area(s) in existing buildings by considering the following general recommendations:

1. General recommendations are to stay in a basement (if available), or low roof, first floor, interior spaces that are away from glass. Ideally the walls surrounding this area would be masonry. There should be some type of mechanical fastener between the roof structure and the surrounding walls of the refuge area. The refuge area should have short structural spans. Avoid long roof spans and large volume open areas such as gymnasiums, auditoriums and cafeterias.
2. Because of their proximity to classrooms or due to lack of better alternatives, corridors may offer the best available tornado refuge area, but should be selected with care because of the potential for wind tunnel effects.

Straight shot corridors with exterior doors or glass at the end(s) should be avoided. Interior corridors with 90-degree turns and/or fire doors offer enhanced protection. If the refuge area is a corridor with lockers, the lockers should be secured to walls. Remove hazards in the refuge area such as hanging pictures, plaques and display cases. Once the occupants are in the assigned space, close all doors leading to the refuge area.

3. Confirm that the space is not next to a higher volume space where the tall adjacent wall or chimney could collapse on the lower roof area. Also review the site to identify any exterior hazards that could fall on the building such as large trees, antennas, satellite dishes, etc. Additionally, locations of roof top mechanical equipment should be identified and areas under this equipment avoided as a refuge area.

The refuge areas should be located near classrooms so the evacuation area is close to where the students are generally located. Additional refuge areas near the cafeteria and gymnasium should also be identified. The identified areas must be large enough to contain all students and staff.



4. It is recommended that a registered design professional (architect or structural engineer) study the facility's layout and the massing of the building and understand the materials used in constructing the school. Existing drawings of the facility would be very helpful if they are available.

A recommendation for a refuge area can then be made after this assessment that is best suited for the specific facility. Additionally, suggestions may be made that describe how to make specific areas less vulnerable to damage and safer for students and staff. This description also would identify the cost impact for the suggested enhancements. The building owner should avoid cookie-cutter plans, even if offered at no charge, as each school tornado refuge plan must be developed for the specific facility in order to maximize the effectiveness.

Once identified by the architect or engineer, it is recommended that a permanent sign be installed to identify the space which states "Tornado Refuge Area." The sign should have a footnote indicating the date it was posted.

How do we go about identifying the best available areas of refuge in our schools?

Because every building is different structurally and spatially, only architects and engineers are qualified and trained to understand the complex array of factors that can affect the protective qualities of a building. Even then, their recommendations are not a guarantee of safety from all possible tornado events. It is only their professional opinions that the area(s) identified are the best available refuge areas.



INFORMATION ABOUT 'BEST AVAILABLE REFUGE AREAS'

Are newer areas of buildings or recent additions safer than older areas?

A new structure is not necessarily safer than an older structure. One of the biggest determining factors is the type of construction and materials used, regardless of age. Many older structures were built with heavy, strong materials that can withstand severe storms while newer structures may have been built with lighter building materials that could be more susceptible to damage. Conversely, new buildings are generally designed to more stringent wind load criteria than older buildings. Again, the main factors in determining the best available locations are stated above and should be determined by a design professional.

What areas should be avoided as a tornado refuge?

This may be the most important question to ask. Here are places to avoid:

- **Gymnasiums, auditoriums and cafeterias.** While these areas may be convenient, because of the large number of seating capacity and ease of access for a larger number of people. However, these spaces are especially vulnerable to high wind events due to typically high walling conditions and wide open areas that make it subject to collapse in a wind event faster than other areas.
- **Areas with large expanses of glass and skylights.** Areas at the exterior of the building with large expanses of glass or interior spaces with large skylights are exceptionally vulnerable to flying objects and the glass shards becoming deadly projectiles.
- **Corridors that allow straight access to exterior doors and glass.** Corridors in this configuration can concentrate storm energy with wind tunnel effects and should be avoided.
- **Mechanical rooms, power rooms and areas under heavy equipment.** Areas that are concentrated with heavy equipment above and/or large concentrations of utilities within the space, such as mechanical rooms and power rooms and areas under large roof top equipment such as chillers, rooftop heating systems and chimneys should be avoided.
- **Athletic locker rooms.** Sometimes areas that appear to be good protection areas can be misleading. An example of this would be locker rooms, which many may assume they would offer protection, because of large concentrations of internal walls, short spans structurally and no windows in the internal spaces. However, these areas often are located around gymnasiums or areas of high walls that could create a collapse situation on top of the locker areas.



INFORMATION ABOUT 'BEST AVAILABLE REFUGE AREAS'

How are people injured from tornados?

There is no limit to the potential injuries that are possible in a tornado, up to and including death. These occur mainly from projectile objects or building collapses.

What are some of the specific hazards that areas of refuge help protect against?

Areas of refuge are intended to protect against flying glass and other projectile items, rooftop mechanical equipment that could fall through the roof along with antennas, utility towers, power poles and trees that could fall on the building. Additionally, a properly positioned refuge area should be located away from high walls such as around gymnasiums and auditoriums as these walls could collapse onto an adjacent low roof area in a tornado event.

What about classroom doors with glass located in areas of refuge?

Because alternative areas for refuge may not be available, sections of corridors may still offer the best available tornado refuge area even though there are small areas of glass in or adjacent to the doors to the classrooms. According to the Indiana Building Code, the glass in and/or next to doors (called side light) must be safety glass that will not shatter into shards. However, large side lights or glass transoms above the door would disqualify the corridor as a refuge area.

(It should be noted that the glass in doors or the sidelights provides a deterrent against other safety concerns such as "behind closed door" activities and/or false accusations of same.)

Are hallways with lockers good areas of refuge?

Corridors with lockers may be used as areas of refuge, however the lockers should be secured to the adjacent walls. Also, any hanging pictures, plaques, etc. should either be removed or permanently fastened to the walls.

Can we assume that a corridor or the restrooms are spaces with short span structure over head?

Corridors or restroom areas often have short structural spans that would maximize a protection area. It is vitally important for an architect or engineer to determine the structural system and spans before determining the best area of refuge.



GENERAL TORNADO PREPAREDNESS PLANNING ISSUES

How much time do we have to respond to a warning of imminent tornado threat? How much time does the National Weather Service give?

Today's weather radars typically provide an average of 11 minutes lead time, according to the National Severe Storm Laboratory that works with the National Weather Service. Other sources reported — from an historical perspective — that in 2000, the lead times averaged 6 minutes, while in 2012, the average lead time was 18.5 minutes.

Should we post signs in tornado refuge area?

Yes. Once an area of refuge is identified by a professional architect or engineer, it is recommended that a permanent sign be installed which states: "Tornado Refuge Area." The sign should include the date the area was last assessed because, over the years, modifications may adversely affect the suitability of the space for tornado refuge. The date will validate the relevance of the designation.



PROFESSIONAL ASSISTANCE INFORMATION

Can any employee or non-professional assess a school to determine an area of refuge?

Because of the many variables and contributing factors, it is essential that a registered architect or structural engineer (experienced in refuge issues) conduct an assessment and identify the best available areas of refuge and make recommendations that could provide significant improvements to the level of protection offered.

Who can we contact to receive professional advice and guidance to identify the best available refuge area in our facilities?

Contact a registered architect or structural engineer to identify these areas. A good resource is the American Institute of Architects Indiana. Call 317-634-6993 or go to the organization online at www.aiaindiana.org.

How do I locate and contact an architect or engineer that is capable and knowledgeable in this specialized area of practice?

Registered architects and engineers specialized in K-12 building types are located throughout the state. If you need assistance in identifying potential companies in your area, please contact AIA Indiana at 317-634-6993.

What kind of arrangement for these services, or agreement might I expect?

Options may range from a simple purchase order issued by the school to a letter proposal drafted by the professional that outlines services, to a full owner-architect (or engineer) agreement.

When developing an agreement, consider requesting these activities be performed by your professional:

- Tour every facility in person.
- Study all existing building drawings.
- Develop a drawing and narrative that indicates the best available refuge areas.
- Identify if there are any refuge area deficiencies.
- Recommend additional upgrades to address deficiencies.
- Develop project costs associated with addressing each deficiency.



REFERENCE MATERIALS

What reference materials are available that might have additional and more detailed information?

THE CHANGING ROLE OF ARCHITECTS IN DISASTER RESPONSE

[Original Document \(Webpage\)](#)

www.aia.org/about/initiatives/AIAS075272

The American Institute of Architects Staff (Undated). "The Changing Role of Architects in Disaster Response ". The American Institute of Architects. Retrieved 2012-07-12.

CRITICAL FACILITIES LOCATED IN TORNADO-PRONE REGIONS: RECOMMENDATIONS FOR FACILITY OWNERS

[Original Document \(PDF\)](#)

www.fema.gov/library/file.jsessionid=6D0FD7E0ED6728A668B9994FAC9480CE.Worker2Library?type=publishedFile&file=ra5_2011_recommendations.pdf&fileid=c7d4d580-b3bd-11e0-aa19-001cc4568fb6

FEMA Staff (July 2011). "Tornado Recovery Advisory RA5: Critical Facilities Located in Tornado-Prone Regions: Recommendations for Facility Owners". U.S. Department of Homeland Security, Federal Emergency Management Agency. Retrieved 2012-07-12.

CRITICAL FACILITIES LOCATED IN TORNADO-PRONE REGIONS: RECOMMENDATIONS FOR ARCHITECTS AND ENGINEERS

[Original Document \(PDF\)](#)

www.fema.gov/library/file.jsessionid=6D0FD7E0ED6728A668B9994FAC9480CE.Worker2Library?type=publishedFile&file=ra6_2011_critical_facilities.pdf&fileid=c5301240-d4a1-11e0-a1f9-001cc4568fb6

FEMA Staff (August 2011). "Tornado Recovery Advisory RA6: Critical Facilities Located in Tornado-Prone Regions: Recommendations for Architects and Engineers". U.S. Department of Homeland Security, Federal Emergency Management Agency. Retrieved 2012-07-12.

TORNADO PREPAREDNESS TIPS FOR SCHOOL ADMINISTRATORS

www.spc.noaa.gov/faq/tornado/school.html

By Roger Edwards, Storm Prediction Center, Norman, Oklahoma

THE FIRST 30 SECONDS

www.safehavensinternational.org/resources/safetopics/thefirst30seconds

By Michael S. Dorn, Safe Havens International. This brochure or CD can be ordered at the above website.

