PBK

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SHELTER IN PLACE

BEST PRACTICES

New Shelter in Place Requirements

Will have substantial cost implications for new school construction

Due to the requirements of the 2015 International Building Code's (IBC) requirements for Shelter in Place spaces, new school designs will need to be more innovative. Creative solutions for these spaces in schools will be required to accommodate a shelter that has both the required functional requirements and the criteria to meet the standards for protection. These shelter in place areas will be required for all new schools, as well as additions to existing schools, and will have both design and cost ramifications.

Careful planning for these spaces to find opportunities where shelters can be utilized for something other than only a shelter is extremely important. Proper and efficient design of shelters related to building systems, materials and construction details will be required to both find the appropriate location and use for the space as well to minimize the escalated cost resulting in the criteria to accomplish a space that can meet the IBC's guidelines.

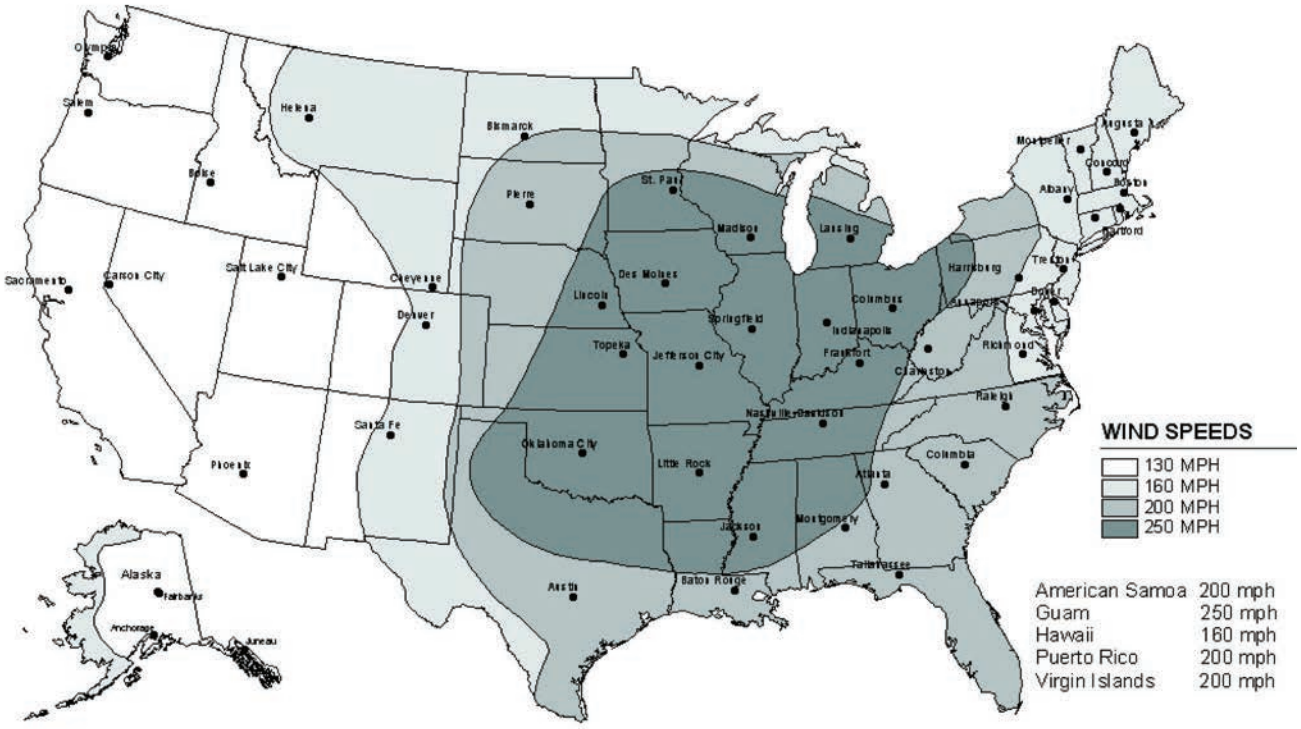

FIGURE 304.2(1)
SHELTER DESIGN WIND SPEEDS FOR TORNADOES

THE DALLAS/FORT WORTH REGION FALLS WITHIN THE 250 MPH ZONE, AS IDENTIFIED ABOVE.

WHAT DOES THIS MEAN FOR SCHOOL CONSTRUCTION BUDGETS?

As a result, all new construction must conform to the minimum design requirements regarding a shelter to meet the 2015 IBC code requirements. These requirements are outlined by the following:

1. The shelter must be built to withstand missile impact as follows:
   a. *Walls must withstand a 15 pound 2x4 wood stud shot at 100 mph*
   b. *Roof must withstand a 15 pound 2x4 wood stud shot at 67 mph*
2. All wall and roof openings (windows and skylights) must be protected with elements complying with the missile-impact testing requirements.
3. The building's structure must be designed to withstand additional wind force.
4. The shelter must have a dedicated ventilation system.
5. All mechanical penetrations greater than 3-1/2" must be covered with impact protection.
6. The shelter must contain an emergency lighting system that is active for a minimum of two hours.
7. All critical support systems must remain operational for a minimum of two hours.
8. Toilet and hand wash facilities are required.

When starting to plan and design for shelter-in-place facilities, there are some basic issues that need to be considered, such as:

LONG RANGE PLANNING

During the long range planning process, a district must consider the location and placement of the building/ expansion on the site. Given the number of students, the appropriate-sized building has to be programmed along with a realistic budget that includes escalation factors. If it is an addition to an existing campus there are a variety of options that might be considered.

The shelter could possibly be combined with other functions, such as a multi-use facility, gym, classroom space, parking garage or another type of space on campus.

Recent similar facilities indicate that there is a cost premium in the range of 30% associated with upgrading from a design with the requirements of 90 MPH to a shelter-in-place facility that can meet the 250 MPH IBC design requirements.

SINGLE-USE VS. MULTI-USE SPACE

A single-use space used specifically as a shelter will cost less per square foot than a space that must accommodate other uses. The increased cost related to multi-use spaces is usually due to space components, finishes, furnishings and other occupancy requirements that are driven by design parameters. However if a reasonable use for the space can be identified that is a program requirement for the school, then the net effective cost of a shelter can be somewhat mitigated.

THE SIMPLER THE SPACE, THE MORE COST-EFFECTIVE

Shelters with short walls, short roof spans, minimal interior partitions as opposed to high walls, long–span roof assemblies, etc. will be more cost effective. Therefore a gymnasium will generally be an expensive space to make as a shelter-in-place facility, even though functionally will make a great deal of sense.

IMPACT-RESISTANCE CONSTRUCTION CAN BE COSTLY

Most common building materials are not “debris impact resistant” to meet the IBC’s 250 MPH design requirements. Therefore, the costs to meet these requirements are higher than standard construction costs. Costs for shelter in place facilities can be somewhat mitigated by minimizing the number of fenestration elements (doors, windows, vents, etc.) into the space. These are elements that due to the design requirements can be substantially more expensive than standard products.

Once planning commences for a shelter-in-place facility for your school, you need to estimate the size of the shelter based on the students that will be accommodated in the space. For example, for a facility to accommodate a student occupancy of 900 students would need to be based on the following criteria:

- Overall unencumbered space of 4,500 SF, based on a requirement of 5 SF per occupant.
- An additional 20% of the space or 900 SF for MEP system and toilets
- Therefore the total SF for a 900 student shelter would be 5,400 SF.
- Within this facility you will be required to construct:
  - *Restroom facility*
  - *2 entry/exits with a minimum width in exiting capacity*
  - *An Independent lighting system and HVAC power supply*

Related to construction cost, the estimated cost in 2018 dollars for an average standalone educational facility of 5,400 SF would be in the range of $1,512,000, calculated based on a cost of $280 per SF. To build a shelter-in-place facility to meet the requirements of Section 423.4 of the IBC of the same size, you could estimate a cost of $1,965,600 SF or $364 per SF. Therefore there could be a 30% additional cost for meeting Section 423.4 of the IBC. However, a space such as a gymnasium or a multi-use space that does not include furniture is functionally more efficient and can accommodate more students on a per square feet basis.

OTHER REQUIREMENTS

Other requirements per code that must be considered in the overall program for a shelter in place facility include:

- The design must be peer-reviewed by an independent registered engineer
- The construction must have special inspections on all structural components
- All walls and roof elements must be protected with elements complying with the missile-impacting testing requirements
- All MEP penetrations greater that 3 ½ square inches must be covered with an impact protection system in case the duct or pipe is ripped out of the opening during a storm.
- A dedicated ventilation system that is properly sized for full occupancy is required
- Critical systems must be designed to remain operational for a two-hour period
- Interior emergency lighting must be designed for a two-hour period
- Walls of below grade shelters must be designed to resist hydrostatic load from ground water at the main floor level
- In basement-level shelters, if the structure above the shelter is not designed to resist tornado speeds, then it must be designed to support the load of the potential of a collapsed structure above.

SUMMARY

Educational facilities will be require to make a number of changes due to the requirements of the 2015 IBC related to shelters. The new requirement for a shelter space to meet the requirement of the impact of a projectile at 250 MPH has an impact on design, construction and cost. The following items will need to be addressed to meet these new code requirements:

- A shelter space to accommodate occupants of the new facility based on a minimum SF per person.
- A design that provides ample ingress/egress, toilets, MEP systems to meet the requirements of the code.
- Materials, systems and construction details for a shelter in place space that meets the standards to resist the impact of a 250 MPH projectile.

All of these requirements will need to be balanced with finding the appropriate location on the campus or in the school, a space that preferably can be multi-functional, and a design that is the most cost effective solution.

QUESTIONS?

If you have specific questions or would like more information on this topic, please contact:

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