" Can You Storm Proof Your Station?"

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The recent devastation of much of the Gulf Coast by Hurricane Katrina has caused many, including those in the fire services industry, to reconsider how their current or planned facility would fair in a similar storm. Major storm damage in the Southeastern United States usually comes in the form of hurricanes or tornados. It is important, though, to understand that the immediate, intense structural stresses caused by strong tornados are typically more catastrophic than those caused by extended hurricane loads. Many of the issues we will consider in this article will apply to both types of storms, but we will discuss these issues as they usually relate to hurricanes.

While the following issues should wisely be addressed in fire station design where storm events are anticipated, everyone understands that only underground bunkers are capable of withstanding the worst possible storms. And an underground bunker typically doesn't perform that well when floods accompany the storm! Not to mention that you probably can't afford an underground bunker the size of a fire station.

Site Considerations

Most coastal areas affected by hurricanes have very flat topography. That is the major reason that flooding is so prevalent before, during and after the storm. Proper location for ISO purposes cannot be the only consideration for the hurricane-prone station site selection. If you can identify the property that satisfies your response time *and* is at an elevation above the desired flood level then you have likely solved the majority of your future station flooding problems. Just because the property is free, inexpensive, or available doesn't mean it is the best location.

If the best available property is only a few feet below the high flood elevation, you should seriously consider the option of building up the site with structural fill. You will simply have to weigh the cost benefit of making sure you are above the "high water mark".

Also to consider are any onsite or nearby elements that could become missiles during high wind conditions. A poorly constructed, four-story hotel is not what you want to be next to when 150mph winds come through. You may end up with building materials from the adjacent structure penetrating portions of your facility. While no one would advocate clear-cutting all significant trees from a site, you must understand what damage can be done by a tree falling onto your building or blocking the apparatus driveway.

(insert a photo of TOHH #7 station here with caption, "Station #7 site for the Town of Hilton Head Island was selected and designed so that the floor elevation would be above the flood line".)

Building Structure

The applicable building code will certainly outline the minimum design loads that the building must withstand. As an *essential facility* most codes will require a fire station to meet a higher level of structural stability than a normal commercial building. Often times, the department desires to have the structure designed to withstand greater storm loads than the minimum required by code. For each 10mph or so increment in wind resistance added to the structure, substantial costs of construction can be expected. The costs of such structural upgrades have to be balanced against the received benefits.

Exterior Building Skin

This issue relates mostly to two issues: walls and roofs. It is advisable to use exterior wall materials that are capable of withstanding considerable wind and impact loads. Masonry walls, even if only veneer, when properly designed can serve as an extremely durable and impact resistant surface. Cracked masonry joints caused by substantial wind loads are easy to tolerate compared to wall systems that have been penetrated by flying objects.

Historically, roof panels or materials are often the first items to "fly away" during a storm's strong winds. Extreme care must be taken when specifying and constructing the roof system. There are several roof systems that can be specified to withstand wind loads in excess of 130mph. Careful observation and verification of the construction methods should accompany the design of these systems.

In the past, the problem with wall or roof sections coming off during the storm has been the pressurization of the building envelope. Once the first section comes off, the difference in inside versus outside pressure causes the entire envelope to weaken and quickly disintegrate. One remedy to this problem is to design the entire structure as a *partially enclosed* structure instead of an *enclosed* structure. It does add to the cost of construction, but will result in the building withstanding the adverse pressures even if the envelope is violated.

(insert rendering of North Port, Fla station and caption, "The new North Port, Fla substation is design using the 'partially enclosed' structural classification".)

Doors and Windows

The most obvious building elements that you probably have seen "storm-protected" are the doors and windows. There are more products or systems made to protect these openings than can be individually mentioned here.

You will want your overhead doors to be of such material and design that it can withstand impacts and wind loads. Most overhead door companies can up-fit many of their doors with wind bracing packages that greatly enhances wind load capability. The bi-fold, apparatus doors are generally designed to withstand far greater wind loads than the

normal overhead door. But the bi-fold door comes with a much higher price tag. One of our coastal clients use glass, overhead doors to show off the apparatus…typically thought a no-no when considering hurricane winds. But they also put a second, steel-coiling door on the outside of the glass door to be used only in the event of a storm. Very nice, but very expensive.

You really do have a huge selection of choices when it comes to wind protection for windows. From channel-held steel panel shutters manually installed, to heavy steel-mesh screens that look like darker insect screens, to accordion-style metal covers, all the way to impact resistant glass with no shutters. Your budget and ease of deployment are all that limits you on your choice of storm, window protection.

Hardened Rooms

Several storm-prone clients have taken advantage of small rooms that are hardened for the worst-case storm. You may not be able to afford building the entire station as a concrete bunker, but you can probably afford to make one of the interior rooms capable of protecting life in a category 5. The theory is that by making a support room, such as the shop, gear room, or decontamination room with concrete walls and ceilings, the entire building could come down around it while it still stands. Obviously, this does nothing to protect the apparatus, but apparatus can be replaced.

(insert photo of Morehead City Fire and caption, "The Morehead City substation includes a concrete enclosed radio/room that serves as the hardened room".)

Emergency Back-up Power

Most essential facilities will want full-building or partial-building emergency back-up power even if they're not in a storm prone area. Since most large generators are outside, keep in mind several of the previously discussed means of protection against wind and water. This includes making sure that the generator, like the building elevation, is above the flood line. By the way, it doesn't make a lot of sense to provide back-up power for HVAC if your mechanical yards or condenser units are not above the flood line as well.

Each department has their own preference for diesel versus natural gas/LP generators. Each has its pros and cons. You need to consider which fuel source will most likely be uninterrupted following a storm. Often the deciding factor is the rule of thumb that natural gas/LP generators are usually twice the price of diesel generators.

Temporary Residents

If you've designed well, constructed well…or maybe you're just lucky…and your station survives the big-one, you may very well be housing occupants that you don't house on a normal basis. Many departments or municipalities think ahead to be able to use the station training room as a temporary EOC. Careful consideration to electrical outlet,

data-box and TV cable boxes will provide the EOC occupants with the ease of use they need.

Before, during, and after the storm, a higher number of people than usual may find themselves living in the station. Having the ability to set up cots in small or large rooms will prove beneficial. You may be able to separate citizen sleepers from public safety sleepers if you plan ahead.

Conclusion

It is impossible to plan, design, and construct for every devastating storm. But if you can do just a few things to modify your existing station or plan your new facility considering the occasional storm, it only makes sense to do so.