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Steps to Reduce the Risk of Tornado Damage in Commercial Structures

About 1,000 tornadoes occur each year in the United States, causing an average of \$1.1 billion in property damage and 80 deaths. These storms vary in intensity and the accompanying damage can result in everything from minor repairs to complete destruction with little warning. Most tornadoes are relatively weak, and therefore, primarily damage roofs, windows and trees. While only two percent of tornadoes achieve the most violent and damaging classification, one quarter of tornadoes are powerful enough to cause 90 percent of the damage and two-thirds of the deaths.

In an effort to gain a better understanding of who is most at risk from these destructive forces, the Insurance Institute for Business & Home Safety (IBHS) conducted a regional analysis of tornadoes of F2 or greater strength that were reported during the 50-year period beginning in 1957 through 2006. This analysis, coupled with the construction guidance included below, is intended to better define which areas are most likely to be affected by tornadoes and to suggest methods for mitigating property risks.

The analysis used tornado records from a period of time when the older Fujita Scale classification F0 through F5 was being used. Since 2006, tornadoes have been classified by the Enhanced Fujita Scale using EF0 through EF5. Both scale classifications are based on damage observed after a tornado strikes. The EF scale, which provides a larger number of damage indicators for different

types of buildings, attempts to recognize the difference between poorly constructed and well constructed buildings and results in lower estimates of wind speeds for the most intense storms, which are classified using the highest number on the F or EF scales. Efforts to re-classify the older F-Scale tornadoes using the EF-Scale are very labor intensive and subject to judgment because it requires a review of old damage reports, many of which will not have pictures of the damage. The simple approach, which is reasonable and probably slightly conservative, is to simply use the new wind speed estimates with the older classifications.

In creating the map on page 4, IBHS used a grid of 100-square-mile cells in the analysis. This is a smaller cell size than used by most other analyses. The advantage is a finer resolution of tornado risks at the expense of greater variability between adjacent cells.

The effects of this potential limitation were reduced by employing a process to smooth out differences in tornado frequencies between nearby cells.

Tornadoes have a unique destructive power among wind-related natural disasters because they concentrate a massive amount of energy in a relatively small area. The strongest category of tornadoes can generate maximum wind speeds of greater than 250 mph, which is enough to destroy most buildings and structures in their path. These maximum wind speeds generate forces that are about twice as large as those generated by the strongest hurricanes.

Only a few specialty buildings are designed to withstand the direct impact of a severe tornado. However, well engineered, large and tall commercial structures are not likely to suffer structural collapse. For smaller commercial structures, good construction choices can give added protection and increase the likelihood that at least part of the structure will remain standing to provide shelter. Buildings that have been strengthened in critical areas and particularly at connection points, such as between the roof and walls and walls and foundation, would have a good chance of surviving intact or with minor cosmetic damage if subjected to the outer edges of a tornado.

Despite the annual tornado exposure, many walls and roofs of businesses in inland areas of the United States are typically built to resist gravity loads and have little resistance to uplift and lateral loads. Construction where all parts of the building are well connected is more common in hurricane-prone areas, but should also be considered by anyone who wants to increase their property's protection from other severe windstorms, according to the building science experts at IBHS.

A checklist for mitigating tornado risks

While there is no way to eliminate all the damage of a direct hit from a violent tornado, businesses in tornado-prone areas can implement a variety of affordable measures which, for the majority of tornadoes, will effectively minimize damages to facilities, injuries to employees and the losses associated with business disruptions.

While the measures below focus specifically on tornado risks, many also will help protect businesses from other types of high wind and thunderstorm-related weather risks outside of tornado-prone regions.

Assess the likelihood of a tornado striking your business

Is the area where you live and work prone to tornadoes? Look at the map on page 4 to identify areas with the highest risk of tornadoes. Knowing what tornado risks are present is essential for choosing the appropriate mix of measures to protect your business. Businesses located in areas with a heightened tornado risk should take the following steps to minimize their risk of tornado damage:

Protect your employees

- Prepare and disseminate an emergency plan describing what supervisors and employees should do as a tornado threatens. Practice these procedures through tornado drills.
- Purchase a weather radio with local discrimination capability. Monitor weather conditions so employees can be moved to secure locations when necessary:
 - Have an adequate source of weather information, such as a tone alert weather radio, to keep abreast of weather conditions.

- Have someone monitor local radar and warning information during a tornado watch and especially if a tornado warning has been issued for the area.

Watches and Warnings:

- A tornado watch is a caution indicating a high probability of tornadoes within an area approximately 250 miles long and 120 miles wide.
- A tornado warning means that a tornado has been spotted on the ground in your county or moving toward your county, or that weather radar indicates a high probability of a tornado existing.
- Keep exterior doors and windows closed to minimize rain and flying debris. Closing interior doors will also help to compartmentalize the building and provide more barriers between your employees and the storm.
- Select the best protective area for employees to seek shelter if there is a tornado:
 - Basements are usually considered a good area, as are corridors and small interior rooms on the first floor of a structure.
 - Never shelter employees in rooms where there is an outside wall, particularly those with glass windows, or where the ceiling or roof has a span between supports of more than 40 feet.
 - If your building does not provide adequate protection and you are located in a tornado prone area, work with a contractor to harden a section of your facility or build a safe room.
 - Safe Rooms: The Federal Emergency Management Agency (FEMA) and International Code Council (ICC) offer shelter guidelines.
 - If you have 10 or fewer employees, a small size room designed according to the requirements and guidance published in FEMA 320 or ICC 500 for residential shelters may be sufficient.
 - For larger safe rooms, use FEMA 361 or ICC 500 guidance for community shelters.

- For additional information on safe rooms, see “Creating A Safe Room” in the Tornado section of the IBHS website www.DisasterSafety.org.

Make provisions to shelter employees working in portable out buildings and those operating trucks and other vehicles.

Protect your property

Wind-resistant construction can be cost effective and minimize the risk of structural damage for the majority of tornadoes, particularly damage from weak to moderate tornadoes, hail and wind associated with thunderstorms, and even to buildings on the edge of strong or violent tornadoes:

For new construction in a tornado prone area:

- Work with an architect or contractor to incorporate wind mitigation techniques and high-wind-rated products when constructing your building, including safe areas for personnel.
- These techniques provide state-of-the art solutions to minimize structural risks by withstanding pressures created by specified high winds, strengthening roof and wall connections, roof systems, walls and wall covering, windows, doors, and skylights.
- It is less costly and more effective to harden buildings during design and construction rather than later.

For existing structures, not built to wind mitigation standards:

- Consider retrofitting, especially when remodeling or replacing building components.
- Retrofitting may include:
 - Bracing and strapping the roof.
 - Adding recommended fasteners, ties, reinforcements, roof covering and anchors as building components are modified and maintained.

- Making entry doors and overhead doors more wind-resistant.
- Building a safe room to protect against tornadoes.

For additional information on protection for existing buildings, see "Protecting Commercial Property" in the Tornado section of our website www.DisasterSafety.org.

Minimize the threats from wind-borne debris:

- Identify and remove trees and branches that could fall on the building walls or roof, or on power lines.

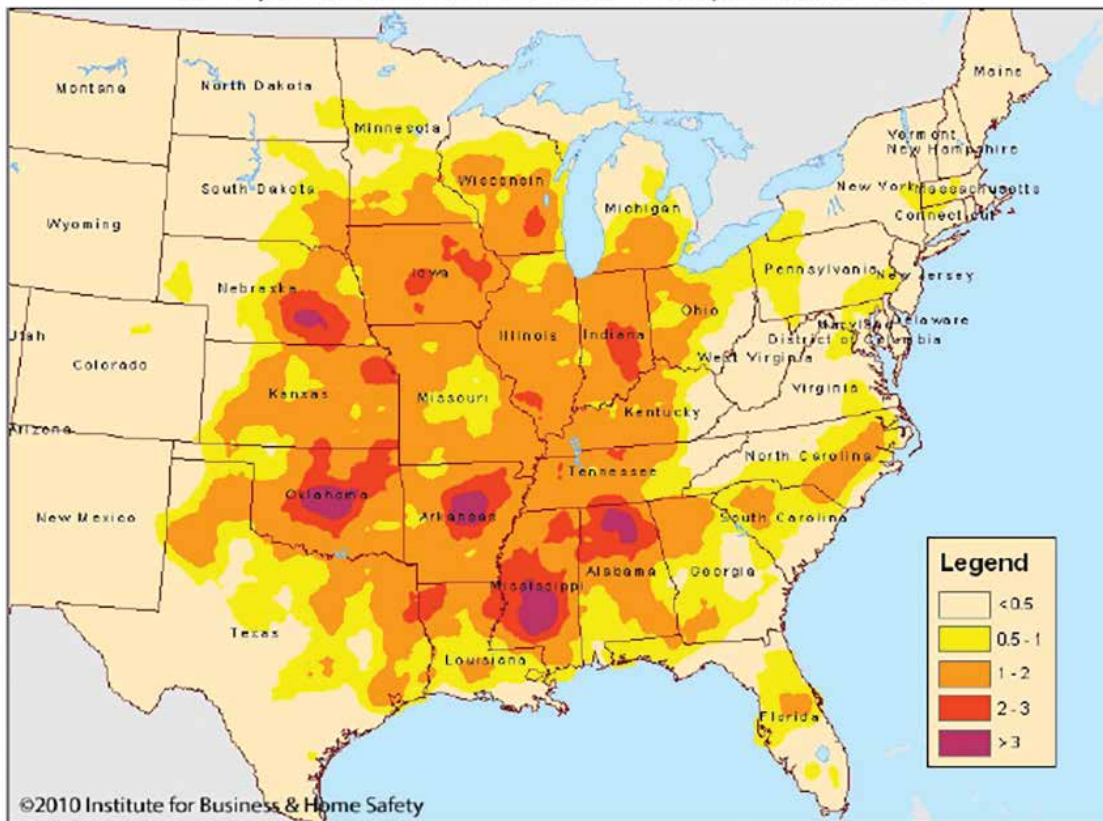
- Inspect and repair loose or damaged building components such as siding, soffit and fascia, shingles and roofing, brickwork, and brick chimneys.
- Avoid using built-up roofs with aggregate or pavers on the surface.

Visit www.DisasterSafety.org/tornado to find additional details and how-to instruction for many of these projects.

▶ To learn more about Hanover Risk Solutions, visit hanoverrisksolutions.com

Tornado Activity in the United States

Summary of Recorded F2, F3, F4, F5 Tornadoes Per 100 Square Miles (1957-2006)



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