

**BUILDERS RISK
GUIDE TO LOSS PREVENTION**

PART THREE: WIND-RELATED EXPOSURES

Prepared by IMUA's

Loss Control and Claims Committee

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INTRODUCTION

Every year windstorms cause tremendous damage to buildings under construction in all geographic regions of the United States. In fact, the number of wind losses to buildings under construction is nearly equal to fire casualties. Whether it is a hurricane along the Southeast and/or Gulf Coast, a nor'easter in Middle Atlantic States and New England or a tornado in the country's heartland there are precautions that can be taken to reduce the exposure.

According to ISO (Insurance Services Office) statistics for the most recent five year period (2007-2011), damage from wind accounts for more than 13 percent of loss dollars (\$281 million) and over 17 percent of losses to all building types.

BACKGROUND

Windstorms can take a number of forms. A tropical storm is a tropical disturbance or cyclone that has sustained wind speeds of greater than 39 mph. Similarly, hurricanes have wind speeds of greater than 74 mph. They can strike Eastern United States along the Atlantic or Gulf Coasts. They can also strike California and Hawaii. Damage in the form of high winds, storm surge, torrential rain and flooding is common to the coastal areas at initial impact. In the recent past, yet commercial buildings and residences under construction have been affected hundreds of miles inland. According to natural catastrophe modeling results, this trend of longer duration, but less severe, coastal storms moving further inland is expected to continue.

Nor'easters are similar to tropical storms that strike in the winter months, but generally lack a defined eye and other characteristics of a tropical cyclone. They are known to brandish strong winds and heavy snows.

Tornadoes typically occur in the "Alley" that runs north from Texas through eastern Nebraska and northeast to Indiana. Kansas, Oklahoma and Texas experience the most "twisters" but these unpredictable and dangerous storms can strike almost anywhere in the United States.

Most of the damage at construction sites involves masonry walls, framework, forms and roof coverings. High winds can cause roofs and walls to collapse even when normal bracing is in place. Unprotected or unsecured building materials, such as lumber, plywood, metal or plastic panels, as well as equipment and tools become projectiles that can cause further damage. In addition, windstorms are often accompanied by rain or hail that can damage interior sections already finished, erode exposed grounds and foundations and can result in mudslides. (Part Two of IMUA's Builders Risk Guide to Loss Control focuses exclusively on water and the exposures it presents.)

METEOROLOGICAL DATA

Windstorms come in a variety of forms. According to the Saffir-Simpson Scale, the five major classifications of windstorms and their definitions are:

- Hurricanes - cyclonic storms arising in the tropical waters of both the Atlantic and Pacific Oceans are termed “hurricanes” when their sustained wind speed exceeds seventy-three miles per hour (73 mph).
- Tropical Storms - weather disturbances of similar origin as the aforementioned hurricanes but with less wind velocities.
- Gales - sustained winds exceeding thirty-nine miles per hour (39 mph). These winds do not have to be directly associated with a storm. A derecho is a widespread and long-lived windstorm associated with thunder storms.
- Tornadoes - rapidly spinning funnels of air associated with the passing of two storm fronts. Wind speeds in the center have been estimated to reach between 200-300 miles per hour.

When a violent windstorm occurs it is often difficult to differentiate between a tornado and a microburst, especially when a funnel has not been sighted. While a tornado involves swirling winds, a microburst is principally a downdraft occurrence. The pattern of tree damage will generally indicate what caused the destruction. A tornado leaves trees scattered about the “strike zone” whereas trees felled in one direction is a sign of a microburst.

- Squalls- sudden violent, gusty winds associated with the same type of storm front that spawns tornadoes. Wind gusts can peak at up to ninety miles per hour (90 mph).

Using meteorological data, such as local prevailing winds, unusual occurrences and known losses, a meteorological history of an area can be determined. For additional details such as basic wind speed, tornado maps, and other weather related perils, refer to the following Inland Marine Underwriters Association publications:

- Weather Related Perils and Natural Disasters
- Tornado: A Hazard Not To Be Overlooked
- Hurricanes

BUILDING STRUCTURES/TYPES

High rise structures, defined as in excess of 70 feet, are exposed to different wind conditions than lower buildings, and many have distinctive designs with newer materials and untested structural systems.

Even low winds can cause damage to partially completed structures. Framing, unsupported masonry, tilt-up construction and unsecured materials and tools are particularly vulnerable.

Large structures such as arenas, shopping malls and some regular mercantile buildings and hotels have long span supports and unique roof systems, are always a concern due to collapse potential during windstorms.

Condominiums and apartments have load limitations and special temporary bracing or shoring requirements. .

While all building types are susceptible to damage from wind, pre-engineered metal buildings with large flat roof areas, have been found to be highly prone to damage.

BUILDING COMPONENTS

All building components should be designed to withstand the anticipated wind velocities and wind loads that may strike a certain area. Some cities and counties have established their own set of wind resistant building codes, standards and test materials. Obviously, the design, especially the wind resistance, of building components must conform to the relevant local regulations. For example, Miami-Dade and Broward counties in Florida have enacted some of the most stringent requirements.

The components of most concern in the Builders Risk sector are the framework of the structure and the roof although in later stages of construction, windows and wall openings must also be considered.

Framework:

Concrete block, brick walls, concrete tilt-up construction as well as structural steel framework can be damaged under certain conditions. Therefore, efforts must be made to understand and plan for their protection during each stage of construction.

Construction should be planned so that framing is adequately braced and walls are anchored to the structure's framework as soon as they are erected. If this cannot be accomplished, temporary shoring is required. Construction forms should also be adequately secured. Steelwork should be bolted and guy wired with enough tension to withstand severe winds.

All structural steel and masonry work should be secured at the end of each working day, or in the event of impending severe weather.

Roof:

During construction, building elements such as edge flashings, and roof coverings are susceptible to wind action until permanently constructed or attached.

Wind damage to roof structures can quickly lead to further and more costly losses. Rain and wind may gain access to the exposed interior resulting in extensive damage to contents. Roof shingles, tiles and ballast can also be propelled into adjacent buildings. Proper methods of roof application are critical, particularly insulated steel deck roofs.

Most commercial roofs have a low slope and the most common coverings are single-ply membranes, built-up roofs and spray-applied polyurethane foams. Single-ply membranes are made in factories, shipped to the site “as is” and held in place with adhesives, rocks (also known as ballast), gravel, or metal fasteners. Bitumen roofs are constructed at the job site by pouring the covering material over a prepared surface.

The roof decking should be permanently installed as soon as it is laid into place. In addition, all vapor barriers, insulation and roofing materials should be attached to the roof decking as they are applied.

Roofs that are unfinished should be properly secured, weighed down or otherwise protected at the close of the work day to prevent damage and blockage of roof drains that may contribute to collapse.

Roof perimeter flashing acts as a weather closure between the building wall and the roof covering. The edge of the roof covering is protected from wind and rain by the flashing. In some cases the covering is installed long before the flashing and winds can roll back the now unprotected edge. To minimize wind damage to roof coverings, the perimeter flashing assembly should be installed as soon as practical. If the edge of the insulation and covering has to be exposed for short periods of time, weigh down all temporary edges with closely spaced concrete blocks, temporary nailing or equivalent, until the flashing is completed.

There are a number of existing standards for wind-resistance of roof coverings such as those developed and published by FM Global, Underwriters Laboratories and the American Society for Testing and Materials.

Windows and Glass Doors:

Protecting the exterior glass during construction is critical as this protection can minimize damage to the interior of the building from water leaks. Equally important, exterior glass can serve to prevent internal pressurization, a phenomenon that can result in additional loads on the interior walls and lifting up of the roof. When wind is allowed to enter the building envelope unimpeded, it can literally “tear the building apart” from the inside. Buildings and their structural components, designed to withstand external forces, can be quickly and destructively overloaded from within.

Obviously, in-place windows and glass doors need to be protected. Large openings in the building envelope, awaiting the installation of these items, should be eliminated. Studies have concluded that wood structural panels, 7/16-inch, or better, plywood or OSB (Oriented Strand Board) fastened with pre-installed anchors are effective in protecting these areas. Some building plans, especially low-rise commercial, call for the addition of storm shutters. While these can offer viable protection they are not always operationally practical.

The use of impact-resistant glass is also suggested for protection against wind-blown debris especially in areas prone to high winds. The typical window and door glass found in commercial structures is either plate or tempered. These will break when hit by flying debris. Laminated glass, consisting of two (2) layers of glass with a plastic liner, tends to hold the glass in place when broken. This also helps minimize exposure from the building envelope being open.

MATERIALS & EQUIPMENT

Movable structures, office trailers, scaffolding, tool sheds and the like should be properly anchored by attaching them to substantial structural members of the building being constructed or to ground anchors. Storing smaller portable pieces can best be handled by simply putting them inside or under cover, if that protection is available. The practice of suspending smaller pieces of equipment from cranes, for example compressors, is not recommended. While this is a recognized theft deterrent, in impending windstorms this can be a cause of damage to the site and/or equipment.

Larger, mobile items such as cranes and other handling equipment should sometimes be anchored. Often the Original Equipment Manufacturer (OEM) will supply appropriate tie-down points and procedures. In the case of mobile cranes, they should be tied down when the boom cannot be lowered to the ground. They should not be allowed to swing and vane as they are on the ground and do not have the freedom to spin without hitting something. On the other hand, tower cranes must weathervane. If not permitted to weathervane a tower crane is subject to possible collapse in high wind...

Roof-mounted equipment should be well anchored to the structure as soon as it is installed. Finally, remove or adequately secure all loose equipment, tools, building components, debris and other materials that can become airborne during windstorms and do damage.

BRACING

Bracing, whether it is rigid or temporary guy cables, should be designed and approved by qualified engineers to secure frames and walls of buildings under construction.

- Several types of buildings are particularly vulnerable during construction, potentially more so during windstorms. Shopping centers and mercantile

establishments are generally characterized by large span areas. Condominiums and apartments require special temporary bracing or supports.

- Some construction techniques may also be more susceptible to collapse if hit by excessive wind forces. In tilt-up and pre-cast buildings, until the roof is in place, the walls must be properly braced. It is preferable that this bracing be on both sides. These concrete forms should be braced with struts placed between the ground (or floor) level and the form itself thus ensuring both vertical alignment and stability. Pre-cast and tilt-up type wall panels are supported at the bottom on the foundation wall and at the top by the structural roof.
- Each panel needs temporary shoring as it is erected until the roof is completed and the panel secured to it. Steel pipe braces have been used to support these panels but care must be taken to ensure that the diameter of steel pipe braces is substantial enough to support the load. As the length of the pipe brace increases so too must the diameter of the pipe otherwise, the brace can fail. Designing the bracing member according to existing specifications, such as those standardized by the American Institute of Steel Construction (AISC), can minimize or reduce buckling or other failure.

Building materials are also unique in how they are to be braced.

- According to both Occupational Safety and Health Act (OSHA) and American National Standards Institute (ANSI) recognized standards, freestanding masonry walls over eight (8) feet high should be braced until permanently tied into the structure. In areas exposed to high winds, these walls should not be built higher than ten times their thickness unless they are adequately braced or provisions have been made to install permanent bracing either at the floor or roof level. Bracing is normally done by placing two by tens (2" x 10") against the wall butting up against a similarly sized strut running from the wall to the floor at defined intervals.
- Reinforced concrete requires temporary support while curing until it reaches its full strength. The forms must also be braced and the concrete may need to be re-supported after the form has been stripped. This reshoring is important during subsequent phases of construction as new floors, equipment and personnel are added.
- Non-reinforced hollow masonry units such as concrete block can be blown over by even moderate winds if left without lateral support. If the concrete is part of a design incorporating a steel framework, then the concrete should be attached to the frame with steel straps.

Since hollow masonry can be composed of different materials: sand, stone aggregate or even cinders and slag, this must be considered when determining the type of bracing needed. Cinders and slag are relatively lightweight and have less

built-in stability. Therefore, bracing must begin at lower heights than when heavier aggregate is used.

The bracing must be designed to withstand winds that can reasonably be expected for this location given the time of the year but the design should also factor in unexpected high winds that could be encountered. Vertical bracing should also be placed closer together as the nominal wall thickness decreases and the maximum anticipated wind speeds increase. For example, an eight-inch thick wall in a location expecting 50 miles per hour (mph) winds or six-inch thick wall in a 40-mph area should be braced about the same, roughly every 16 feet.

- Steel in the course of construction also needs some sort of temporary support. The bracing to support this material is usually multi-directional guying (wire rope or cable connecting the steel framing with stationary objects) in order to provide added stability and protection against wind force from any side.

Structural beam-to-column connections are frequently secured by a single bolt or two during erection. This method allows some movement between the two structural members and makes it easier to plumb at a later time. However, until the other bolts are added and sufficiently tensioned, the connections do not possess enough rigidity to withstand strong winds and are liable to be damaged unless they are properly braced.

- Bracing for frame construction is typically accomplished by nailing two by fours (2" x 4") to the floor to support framed-out walls until the walls are tied together.

WEATHER FORECASTING & PLANNING

The builder's Emergency Plan must include a section on how to react to severe weather conditions. The builder must develop, implement and maintain an Emergency Plan covering all major construction projects. While there are so many variables that can preclude using an off-the-shelf plan, the IMUA paper entitled "Evaluating Emergency Plans" can be consulted as a reference in assessing the viability of the final document.

The first active step in the face of inclement weather should be to devise an effective means to monitor the conditions. The National Weather Service will give regular updates on the radio and television. Private weather service companies can also be contracted with to custom tailor reports to your particular equipment and needs. Regardless of the method decided upon, there should be a means of regular monitoring of weather to identify the need to install additional bracing or supports and provide better protection for equipment or materials vulnerable to windstorm damage. The frequency of this weather watch will depend on the size of the job site and its susceptibility to damage, usually based on the stage of construction. However, at the minimum, a weather watch should take place daily.

A plan to monitor weather forecasts on a continual basis should be established so that personnel can be alerted to even fast developing storms. They can then install extra bracing and perform other actions that will increase the overall level of protection for the site.

SUMMARY

The following are some recommended actions designed to address this exposure:

- Determine the meteorological history of the area including any known losses related to windstorms.
- As part of this meteorological study, check for local prevailing winds and speed, remembering that gusts can be twice as strong, and any unique characteristics of the wind. You should be aware that even relatively low winds could cause damage to partially completed structures, especially framing, unsupported masonry and tilt-up construction. Unprotected and unsecured building materials and equipment are likely targets of wind.
- Ensure that the building design and various components are consistent with the anticipated wind velocities and loads. Some cities or counties have established their own sets of weather-resistance building standards and test methods. Structures built to meet the current building codes for high wind regions are designed to withstand the effects of windstorms much better than conventional structures. One such reference has been developed by the International Code Council. Also, Florida has established a stronger statewide building code with respect to wind that is regularly updated. This will mean that with a few exceptions most commercial buildings in the state will have to be built stronger or have windborne debris protection.
- Anticipate the exposures to the structure being built taking into consideration any unique features and put appropriate loss prevention and control measures in place.
- Eliminate large openings in the building envelop; this can occur during the normal course of construction or when windows or doors are blown away
- Provide adequate bracing to wall panels and scaffolding to prevent collapse during all stages of construction. This bracing should be inspected on a continuous basis so that necessary adjustments can be made in a timely manner.
- Establish a plan to monitor weather forecasts on a continual basis to be alert to install extra bracing or support and provide a higher level of protection.
- Remove loose equipment, tools, building components, debris and items that can become airborne during windstorms and be damaged or do damage to other property.

APPENDIX

IMUA Reports Available on WWW.IMUA.ORG

Evaluating Emergency Plans

Weather Related Perils and Natural Disasters

Tornado: A Hazard Not to be Overlooked

Hurricanes

Pertinent Websites

ANSI Online

American National Standards Institute (ANSI) web site offers up-to-date resources on national and international standards activities.

<http://www.ansi.org/>

FM Global

The FM Global website for risk management is an online community for risk managers, insurance and business professionals, and others. The website publishes information about standards and data sheets relating to wind-resistance. Of particular interest is FMDS 1-28 “Wind Damage.”

<http://www.fmglobal.com/>

Institute for Business and Home Safety (IBHS)

The IBHS is an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters. The website includes building code information, land use planning, specified natural disaster particulars and reference material.

<http://www.ibhs.org>

International Code Council (ICC) at <http://http://www.sbcci.org>

A member-focused association. ICC is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, affordable and resilient structures.

Occupational Safety and Health Administration (OSHA)

OSHA offers an extensive website as well as interactive software advisors to help employers and employees better understand how to comply with OSHA standards.

<http://www.osha.gov/>

Techstreet - Standards & Technical Books

Techstreet provides standards and technical books from more than 300 organizations, including the American National Standards Institute.

www.techstreet.com

Underwriters Laboratories

A safety consulting and certification company. UL provides safety-related certification, validation, testing, inspection, auditing, advising and training services.

<http://www.ul.com/global/eng/pages/solutions/standards/>