



Protecting Roofing Systems Against Windstorm Damage





In recent years, there have been a number of hurricanes, typhoons and cyclones that have raised awareness about the significant damage they can cause. It is important to realize that all windstorms wreak havoc—especially in areas of the world unaccustomed to them.

Most industrial building structures can withstand high winds, but the roofing system—which acts like an envelope protecting the interior of a building—can be susceptible to damage. Once the roof is compromised, the entire contents of a building become vulnerable to water and wind.

FM Global-insured wind losses averaged US\$650 million per year over a recent 10-year history, with 80% of the loss dollars related to roofing system failures. In fact, since 2007, approximately 2,492 roof-related wind losses were reported to FM Global, totaling nearly US\$3.25 billion.*

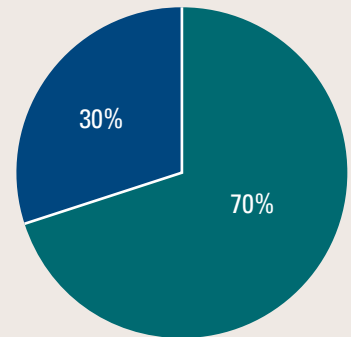
Protecting commercial roofing systems is the single most effective way to reduce windstorm loss. In fact, one of the most cost-effective ways to economically upgrade a roofing system is to attach additional fasteners to only the small edge areas of the roof.

* Indexed to 2019 dollars.

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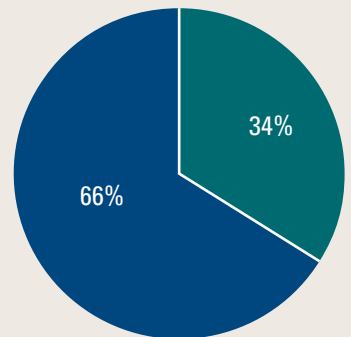
Wind Losses Since 2000*

Number of losses



- Severe windstorms (hurricanes, typhoons or cyclones)
- Other windstorms

Gross loss dollars



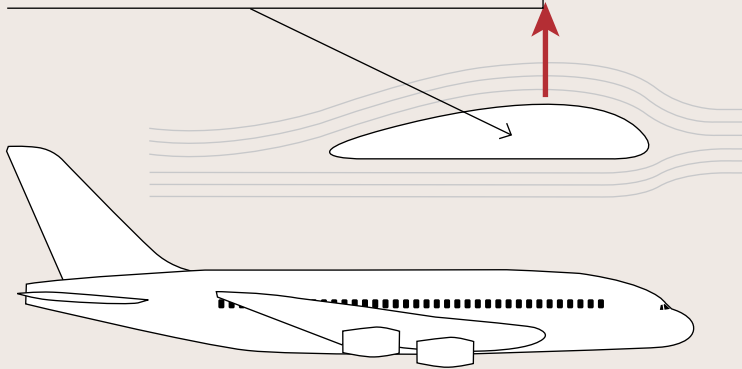
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- Other windstorms

* These percentages represent net wind losses for FM Global clients, 2000-2019.

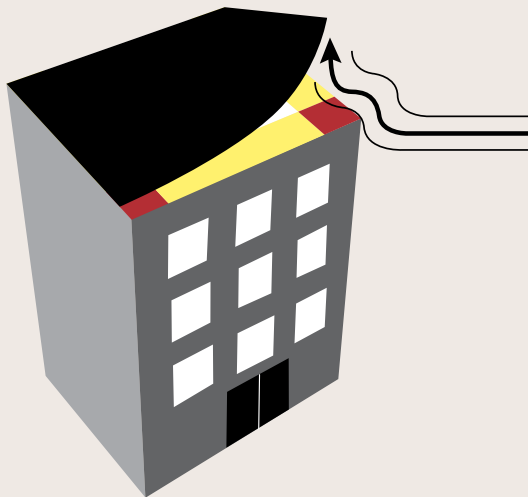
The Wind-Roof Connection

To best protect your commercial roofing system from windstorm hazards, it is important to understand the wind-roof connection.

Wind forces on a building create an action similar to that of wind passing over an aircraft wing.



A change in the wind's direction as it passes over and around the building results in uplift or suction forces. These forces vary dramatically in magnitude on different parts of the roof—with forces much greater along the roof edges than in the main interior or "field" of the roof.



In the corners (shown in red), the wind force can be more than two-and-one-half times the uplift in the main interior (field) of the roof. At the perimeter edges of the roof (shown in yellow), the uplift force can be more than one-and-one-half times that in the main interior of the roof.

Know the hazard

The most important component of a roofing system is the metal-edge flashing, which secures the roof cover to the edge of the building. If high wind loosens perimeter flashing, further damage to the rest of the roof—roof covering and insulation—is inevitable, even if properly secured. Inadequately designed and installed flashing will likely lead to additional damage from water leakage.

Loose flashing can be re-secured fairly inexpensively with appropriate weather-resistant fasteners with washers.

Also important to the roofing system is the roof itself, which acts as an envelope protecting the contents of the building. If the roof becomes detached, the interior of the building becomes exposed to rain and wind.

In many cases, the main interior (field) of commercial roofing systems is adequately secured, but the corners and perimeter are not. This occurs mostly because roofs tend to be uniformly attached. The higher uplift forces at the corners and perimeter can overload the fasteners that keep the roof attached to the building. The damaged corner or perimeter then allows the wind to act on loose edges of roof cover, and a large area of the roof can peel off. Fortunately, adding fasteners to these small areas of the roof is relatively inexpensive.

Don't Be Complacent Because Your Facility "Survived" a Hurricane...

...And Don't Underestimate the Power of Lesser Wind Speeds

So, your building is still standing despite the Category 4 hurricane that swept through your area. You're feeling pretty good. But are you absolutely sure the wind speeds that passed over your facility were actually of Category 4 magnitude? Hurricane wind speeds vary dramatically with the most severe wind occurring in a relatively small area near the eye wall. Your facility may have experienced Category 1 or 2 wind speeds even though the hurricane was a Category 4 at landfall. Minor differences in wind speeds result in much greater uplift forces on the roof because wind uplift pressures increase exponentially with wind velocity. Doubling wind velocity quadruples its pressure. For example, a 140-mph (63-m/s) wind exerts twice the uplift pressure of a 100-mph (45-m/s) wind. Depending on the type of roof, these forces can wreak havoc on areas that are particularly vulnerable to damage, such as the flashing, perimeters and corners.

Conversely, loss experience has proven that even wind of less velocity is capable of causing considerable damage when roofing design, installation or maintenance is deficient. For example, insulation boards adhered with hot asphalt directly to steel decks are not recommended for use at any time because, historically, hot asphalt used for securing the insulation boards to the steel deck has been applied improperly. This traditionally poor installation is what makes this type of roofing system susceptible to even minor wind velocity. FM Global engineers have found clay and concrete roof tiles that were fastened improperly. In other cases, facilities used only mortar without any fasteners, and loosely or inadequately attached tiles had been blown off the roof, becoming missiles that broke windows and damaged wall surfaces. Depending on the quality of the roofing design, installation and maintenance, a roofing system may or may not withstand lesser wind speeds.

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Hurricane damage to this roof is concentrated at the corners and perimeter, where the uplift pressure is higher.

Properly designed windows and doors can help protect the roof from damage in a storm. If windows and doors break from wind pressure or windborne debris, the uplift pressure in the building can increase by 10 to 30%, blowing off the roof.

Additionally, rooftop equipment not properly secured can be blown loose, tumble across the roof, and slice open the roof covering. And, metal panels pulled through their fasteners

and gravel blown off the roof can mar building surfaces and break windows or door glazing.

Know the Solution

Ensuring the integrity of your commercial roofing system can be simple and inexpensive. In many cases, only the small perimeter and corner areas need to be reinforced. Most of the time, reinforcement can cost less than US\$5,000.

FM Global is available to help you design the proper roof for your location, using the right combination of FM Approved material. If your existing roof needs more uplift resistance, FM Global can identify vulnerable areas, low-cost solutions and possibly, ways to improve uplift resistance. Call your FM Global client service representative today.

Be Sure to Inspect Your Roof

You can conduct a preliminary inspection of your roof to determine if there are major deficiencies.



Is your flashing secure?

If you suspect your flashing is loose, have it inspected — and secured — by trained personnel.



Is your roof in good condition?

If it looks bad, it is bad, and won't hold up in a hurricane. If it feels like it's coming apart, chances are it will come apart when you need it most.



Is the roof covering over your steel deck roof secure?

Look for fasteners. If none are visible, your roof is probably deficient. If fasteners are visible, contact FM Global for an analysis of the securement.



Are windows and other openings secured?

Be sure all building openings (even skylights) are impact-resistant or protected by shutters, as needed.

Additional Resources

FM Global offers access to a wide range of educational material designed to increase property protection awareness and understanding. These resources include publications, learning kits, videos and FM Global Property Loss Prevention Data Sheets—engineering guidelines written to help reduce the chance of property loss due to fire, weather conditions and failure of electrical or mechanical equipment.

For more information, visit our online catalog at fmglobalcatalog.com.

The following is a partial list of resources available to help you protect your roofing system against windstorm damage:

FM Global Property Loss Prevention Data Sheets

- 1-28, *Wind Design*
- 1-28R/1-29R, *Roof Systems*
- 1-29, *Roof Deck Securement and Above-Deck Roof Components*
- 1-30, *Repair of Wind-Damaged Single- and Multi-Ply Roof Systems*
- 1-31, *Panel Roof Systems*
- 1-32, *Inspection and Maintenance of Roof Assemblies*
- 1-33, *Safeguarding Torch-Applied Roof Installations*
- 1-34, *Hail Damage*
- 1-35, *Green Roof Systems*
- 1-49, *Perimeter Flashing*
- 1-52, *Field Verification of Roof Uplift Resistance*
- 1-54, *Roof Loads for New Construction*

Our data sheets are available at no cost at fmglobaldatasheets.com. Register today!

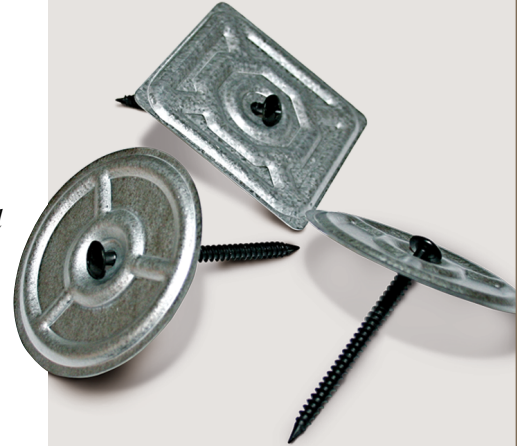
Publications

- *Protecting Your Facility Against Major Windstorms* (P9811)
- *Emergency Checklist: Wind* (P9308)

Online training

- *Preparing Your Facility for Wind*, available at training.fmglobal.com

Simple Security



Sometimes all it takes to prevent a catastrophic property loss are a few well-placed screws. It sounds ridiculously simple, but it's true.

Applying additional fasteners at the perimeter and corners of a roof—where it's most vulnerable—can prevent it from detaching and peeling back, exposing the building's interior contents to wind and water.

This is the most cost-effective way to economically upgrade a roofing system. For more information about this and other ways to protect your roofing system, contact your FM Global client service team.



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