# Roof Design & Protection

**HIGHLY PROTECTED RISK (HPR) ASSET PROTECTION "STARTS ON THE ROOF"**

## Overview

The roof is a buildings most critical and yet most vulnerable asset. They serve the purpose of completing the building envelope along with the walls and floor and carry the bulk of the load of a buildings weatherproofing purpose. Once constructed, the roof is often one of the least maintained portions of a building. The symptoms of a failing roof are rarely evident until the process is well underway or the stresses of severe weather allow it to fail. This guideline is intended to draw attention to best practices for roof design, re-roofing and routine maintenance of roofs.

*Roof failure has catastrophic consequences*

## Purpose

Without a roof, all of the assets within a facility become exposed to hazards without vital protection. From a risk assessment standpoint, a buildings roof is a single point failure mode potential. Utilizing the approach outlined in this technical resource will equip the user to build a firm foundation for critical asset protection and business continuity.

When considering new construction, major renovations, roof replacement or updating your risk management plan, follow the TMA HPR Loss Control "**WIND"** advice as a best practice.

*Hurricanes are among the many causes of severe winds*

- **W**herever your facility is located, all new important structures should be designed to meet applicable standards
- **I**nvestigate all existing important structures for conformance to appropriate standards
- **N**ecessary retrofit upgrades should be strategically considered following the advice of your Account Team
- **D**ecide in advance to meet these guidelines by inclusion in corporate design specifications

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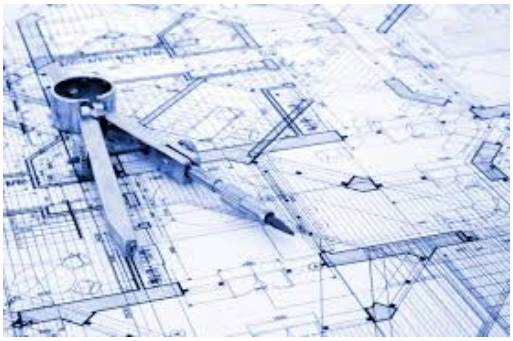
## Design & Construction

Tokio Marine America (TMA) HPR Property Loss Control windstorm guidelines adhere to the technical advice detailed in the referenced FM datasheets and follow the FM 'RoofNav #' approval methodology for new construction and re-roofing. Achieving full approval requires careful planning and coordination both prior to and during construction to ensure all aspects of the standards are met. An approved roof consists of components, fastening and installation methods that merge to form a system summarized using a 'RoofNav #'. This identification number is utilized to verify that the desired combustibility, windstorm resistance and other natural hazard protection goals desired such as external fire resistance and hail are met.

*A new roof is a major investment, ensure it is well designed.*

The required windstorm design is based upon building height, base wind speed determined by geographical location and a 'ground roughness' factor. The required design is summarized by a numerical code (e.g. 1-90). The "1" in this code identifies the construction as meeting Class 1 combustibility standards while the '90' indicates the relative windstorm rating. The lowest windstorm rating is 60 and the higher the number, the more windstorm resistance the system provides. While indirectly related to uplift pressure, this number should not be directly confused with the required uplift pressure. The RoofNav # chosen should be listed to meet or exceed the required windstorm design. All roofs meeting these guidelines require fastening enhancements at perimeter and corner areas that are more vulnerable to uplift.



*TMA HPR Loss Control Plan Review services are available to assist with your project*

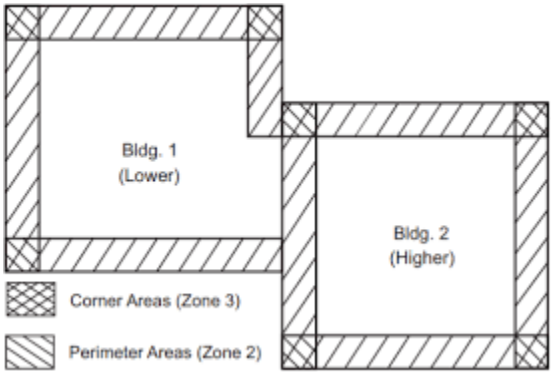
## Retrofitting for better protection

An existing deficient roof or roof cover cannot easily be upgraded to meet applicable guidelines without a complete replacement. This fact may result in decisions to improve protection being deferred for decades until major construction or re-roofing occurs. However, there are retrofit options that will *permit targeted risk improvement* to enhance windstorm resistance. While such retrofits cannot always meet all aspects of the guidelines such as hail resistance or combustibility, retrofits may still be valuable to protect existing facilities from windstorm events that often strike with little to no warning.

- **Flashing Securement** – A perimeter flashing system meeting applicable guidelines with a continuous 'cleat' or 'hook strip' offers the best protection along the edges of a roof where many wind uplift events originate. It is notable that a roof cover meeting these guidelines may fail due to unsecured or defective flashing. Conversely, a roof that does not fully meet these guidelines will perform better when flashing is secured.
    - Secure loose, single piece or disconnected sections of continuous cleat flashing using minimum No. 8 screws with neoprene washers spaced minimum 1 ft. on center.
    - Space the fasteners 6 in. on center within 12 ft. of the corners for added protection.
    - Replace retrofitted flashing with an approved flashing system at the next re-roofing.

- **Increase Perimeter & Corner Fastening** – All roofs and roof covers that meet referenced guidelines are provided with additional fastening in the corner and perimeter areas of the roof. This is because the perimeter of a roof is subject to approximately 1.7 times the 'field' or center of the roof uplift pressure while corners are subject to 2.6 times the field uplift pressure. Many pre-engineered metal building roofs and various types of roof covers that do not meet applicable guidelines typically lack sufficient perimeter or corner fastening enhancements. Standing seam metal roofs cannot be easily retrofitted due to the need for additional purlins to act as fastening points; however, other roofs may be able to be easily retrofitted with additional fastening.

    - Through fastened or lap seam, metal roofs are easily retrofitted by driving additional fasteners through the metal deck into the existing purlins. Standard fastening for this type of roof is 1 ft. on center. As a general rule, perimeter areas should receive one additional fastener in between each existing fastener. Corner areas should receive two additional fasteners equally spaced.
    - Roof covers such as built up, modified bitumen and all single ply types may be similarly retrofitted in perimeter and corner areas.




    - The retrofit fastening plan depends upon the building height, wind speed exposure, ground roughness, the presence of 3 ft. or higher masonry parapet walls and the fastening the current system utilizes.
    - Retrofit fastening in most cases may be completed by driving fasteners with an appropriate fastener plate directly through the existing roof cover into the roof deck.
    - Single ply and modified bitumen retrofits may be sealed using strips of new roofing material applied directly over the retrofitted fasteners.
    - A qualified roofer should be utilized to complete fastening retrofits to ensure appropriate repairs to the roof cover areas affected are completed.
    - Corner and Perimeter areas are defined in the reference document "Wind Design" and include peak areas of pitched gable structures and some areas where adjacent buildings intersect.

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## Summary of the risk

The risk of damage to your facility during a windstorm is significant and may result from many factors. The damage resulting from a windstorm has the potential to severely interrupt business for extended periods of time due to significant damage to equipment, stock and utilities. To best protect the assets located within your facility, begin outside on the roof with a windstorm risk engineering assessment. Then, take the necessary steps during new construction, re-roofing and on a retrofit basis to ensure your investments are well protected when nature strikes.

## Reference Documents

FM Data Sheet 1-28 “Wind Design”

FM Data Sheet 1-29 “Roof Deck Securement and Above Deck Roof Components”

FM Data Sheet 1-31 “Panel Roof Systems”

FM Data Sheet 1-9 “Roof Anchorage for Older, Wood-Roofed Buildings”

FM Data Sheet 1-30 “Repair of Wind-Damaged Single- and Multi-Ply Roof Systems”

FM Data Sheet 1-32 “Inspection and Maintenance of Roof Assemblies”

FM Data Sheet 1-34 “Hail Damage”

FM Data Sheet 1-35 “Vegetative Roof Systems”

FM Data Sheet 1-49 “Perimeter Flashing”

FM Data Sheet 1-52 “Field Verification of Roof Wind Uplift Resistance”