Rooftop Equipment Securement Guidelines

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

Overview

The roof is a building's most critical and yet most vulnerable asset. When the wind begins to blow, all elements of the roof must perform uniformly including equipment that is installed on the roof. Similar to how seatbelts function in a car, well designed rooftop equipment securement will prevent equipment movement up to the limits of the *structure's* design. When subjected to high winds, inadequately secured rooftop equipment may be dislodged, resulting in severe damage to the roof cover and structure making the building more vulnerable to the ongoing wind threat.

Exhaust fan with no base fasteners

Purpose

Split HVAC unit not secured to its curb

This guideline is intended to draw attention to typical rooftop equipment installation practices and deficiencies. Despite close attention being paid to windstorm resistance for roof structures and roof covers, some rooftop equipment is commonly installed without any means for securement other than weight. In addition, often there is less rigorous control over the methods used to secure equipment that is installed in between new construction or re-roofing projects. If rooftop equipment is not well secured, it may become detached leaving the roof and all of the assets within the facility more vulnerable. From a risk assessment standpoint, severe damage to a building's roof can be a single point failure mode potential for the facility as a whole. Utilizing the approach outlined in this technical resource will equip the user to address rooftop equipment securement in both construction and retrofit circumstances.

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Rooftop Equipment Securement Best Practices

Tokio Marine America (TMA) HPR Property Loss Control recommends following Factory Mutual (FM) datasheets for best protection against Natural Hazards. These windstorm guidelines adhere to the technical advice detailed in the referenced documents. Whether considering new construction, major renovations, maintenance related roof replacement or repairs or updating your risk management plan, follow the TMA HPR Loss Control "**WIND"** advice as a best practice.

- **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

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

Equipment installed on the roof needs to be secured to the structure in a manner equivalent to or exceeding the strength of the structure itself. Equipment could become dislodged and damage the roof cover or leave large holes where the equipment was located. This may also cause a premature failure of the roof cover or structure during high wind exposure. Securing rooftop equipment protects the building, roof cover and its contents from unexpected additional damage that would otherwise not occur if the equipment were adequately secured.

During construction or major re-roofing, plan to evaluate new and existing equipment securement methods using a proven engineering method to meet the anticipated wind uplift forces. However, in lower wind speed zones ($\leq$ 110 mph) the prescriptive approach outlined in this document offers an alternative that is best applied for existing equipment. Applying the best practices outlined in this document will help to assure that rooftop equipment will remain secured to the structure during a storm.

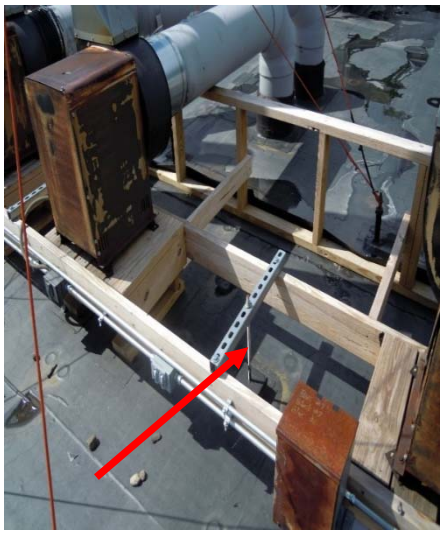
Rooftop Equipment Securement - Prescriptive Approach

There are a variety of sizes and types of rooftop equipment typically found on the roof. Larger equipment is typically mounted on steel framing that is merely an extension of the buildings structural framing. Other equipment such as packaged HVAC units and most exhaust fans are mounted on curbs that outline the perimeter of a hole in the roof deck used to permit ductwork and utility penetration. Curb construction typically utilizes wood framing secured to the roof structure and installation should follow referenced guidelines to ensure adequate resistance to wind uplift. Lastly, some equipment may be installed on sleepers without any mechanical securement to the roof at all. Ideally, all equipment should be secured mechanically to the building structure to ensure success of the entire roof assembly.

- **Exhaust Fans on curbs** – Secure the base to the curb using minimum No. 12 screws with neoprene washers on all four sides spaced maximum 1 ft. on center or based upon referenced standards.

- **Fan Cowlings** – The motor covers on top of many exhaust fans may become loose over time due to routine usage. Loose cowlings should be secured using cable or strapping fastened utilizing minimum No. 12 screws. The strapping should be run across the top of the cowling and secured on the opposing side of the fan base. This method is recommended using two cables arranged perpendicular to each other in all cases when base wind speed is 110 mph or more.

- **Sleeper Mounted Equipment** – Equipment such as split HVAC condensing units, horizontally arranged exhaust fans, condensers, ductwork and other equipment such as satellite dishes may often be installed on wood, plastic or metal sleepers that elevate the equipment above the roof surface. Sleepers are often not secured to the roof deck and is very vulnerable to wind uplift.



Sleeper mounted equipment secured with iron rods via pitch pockets

o The use of sleepers should be avoided for all new equipment installations on existing roofs or new construction.

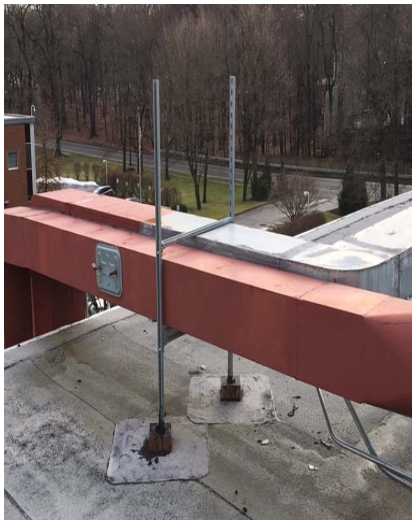
o Re-roofing specifications should indicate that existing sleepers be replaced with curbs.

o Alternatively, this equipment should be secured to properly installed curbs that are secured to the structure.

Well secured curb mounted exhaust fan; use two straps in high wind zones

- When re-roofing is not scheduled for the near future, consider installing iron rods secured to the structure via pitch pockets. Next, secure the equipment to the rods using rigid metal brackets and/or cables. The equipment should be well secured to the sleepers. *NOTE*: This method is anticipated to be effective only for inland, lower wind speed locations until re-roofing permits equipment to be reinstalled using curbs.

- Where existing equipment is installed on sleepers in coastal, high wind speed zone (i.e., ≥ 110 mph) locations, curbs should be retrofitted and the equipment reinstalled and secured to the curbs.



Ductwork secured using brackets via pitch pockets

- **Packaged HVAC Units** – This common equipment is installed on curbs positioned over a large opening in the roof where ductwork and utilities pass into the building. This equipment is typically installed without mechanical securement to the structure but is typically larger and heavier. In some cases, roof mounted ductwork or filter sections may be connected and installed unsecured to the structure. Utilize engineered solutions as outlined in applicable guidelines to ensure adequate securement methods are prescribed. This method is recommended for new locations where the base wind speed is ≥ 120 mph or ≥ 110 mph within 1 mile of the coast. However, in lower wind speed locations, existing equipment may be secured by adding cable ties and/or strapping. This will provide enhanced securement that in combination with the weight of the equipment will be effective in these lower wind speed zones:

Packaged HVAC unit secured to curb using angle iron & cable ties

  - Metal strapping attached to the curbing on opposing sides of the unit using two minimum # 12 screws on each side.
  - Alternatively, install thick (¼ in.) angle iron with an eyelet in its top flange. Attach the angle iron using two minimum ¼ in. bolts or screws to the curbing.
  - Utilize minimum ¼ in. cable to connect the angle iron via the eyelet to all rigging points of the unit, typically in all four corners. Additional cable ties may be needed for larger, particularly long equipment.
  - In 90 mph, inland wind zones, two cable ties in opposing corners may be considered when equipment is protected such as behind a substantial parapet wall.

Rooftop Equipment Securement Guidelines

- **Equipment mounted to steel framing** – This equipment is commonly secured using beam clamps, welding, bolts or screws. Unlike packaged HVAC units on curbs, which are typically unsecured, equipment mounted on steel framing is typically secured to the framing. The most common error is using inadequately sized screws or bolts or installing equipment that is not rated for the applicable wind zone. Another common pitfall is not replacing rusted or broken fasteners as time passes. Use larger bolts (½ - 1 in.) for larger equipment and check or replace them periodically.

Even larger, heavier equipment may be blown off the roof when securement is deficient.

Summary of the risk

The risk of damage to your facility during a windstorm is significant and may result from many factors. One of the most commonly overlooked factors is securement of rooftop equipment. When rooftop equipment securement is not as strong as the roof or roof cover, the equipment can become dislodged during the worst part of the storm. The ensuing damage to the roof cover and building may result in business interruption, and damage equipment and inventory. To protect 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 the facility is well protected when nature strikes.

Reference Documents

FM Data Sheet 1-28 “Wind Design”

FM Data Sheet 1-15 “Roof Mounted Solar PV Panels”

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

FEMA Document “Attachment of Rooftop Equipment in High-Wind Regions”

Revised 4/28/2021