Risktopics

ZURICH

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Guide to securing rooftop equipment in hurricane-prone regions

Introduction

Surviving a hurricane with minimal property loss begins with maintaining the integrity of the building envelope. Any failure of the roof, glazing or cladding will allow storm water to enter the building. Zurich experience shows that once water gets in, the potential for severe property damage and lengthy business interruption begins.

Time taken to evaluate and improve the securement of rooftop equipment is time well spent. This applies to both the design of new buildings and the upgrade of existing buildings. Failure of rooftop equipment is a common outcome of high-wind events. Rooftop equipment failure will open points for water entry into the building and will become a major source of wind-bourn debris that can cause further damage to the building envelope.

Concerns

Rooftop equipment often forms an integral part of the building envelope. Air intakes and exhaust fans cover large openings in the building envelope. If forced from their curbs, the unprotected opening that remains can allow significant quantities of to water enter.

Figure 1. Wind damage to rooftop equipment
Source – FEMA

Figure 2. Roof cover damage from equipment
Source – FEMA

Equipment dislodged by wind also becomes wind-bourn debris that can damage the roof cover, skylights, or other building envelope features.

Satellite dishes, lightning protection systems, electrical conduit, and piping can also become significant sources of damage to the roof cover and other building envelope features.

Guidance

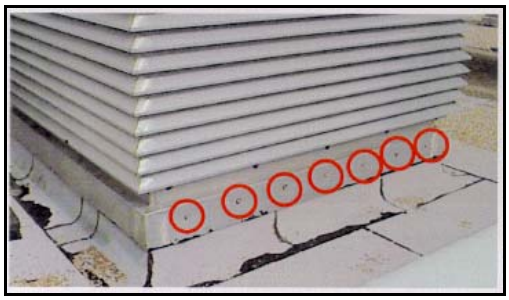
Evaluate each piece and section of rooftop equipment to verify that adequate securement is provided against wind loads. For new buildings or new equipment on existing buildings, plans should be prepared that provide specific guidance for the appropriate securement of equipment. Where connections are engineered, follow the guidelines of ASCE 7-05 (see references). Consult with Zurich for guidance on the selected Basic Design Wind Speed, and always apply an Importance Factor of 1.15 to building envelope features. Ultimately, for property insurance purposes, the securement of rooftop equipment should follow at least the minimum guidance provided in this document.

1. Small rooftop equipment – securing equipment to curbs

Secure small roof top equipment such as stacks, exhaust fans and air intakes to resist the wind loads in accordance with one of the following:

a. ASCE 7-05 using the appropriate basic design wind speed and an Importance Factor of 1.15
b. FEEM guide "Attachment of Rooftop Equipment in High-Wind Regions"
c. As a minimum, provide corrosion resistant fasteners (e.g. stainless steel or hot dipped galvanized #14 screws) not exceeding 6" on centers between the equipment, transition pieces, and the roof curb

Inadequate securement
Source – FEMA



Adequate securement
Source - FEMA

2. Small rooftop equipment – securing exhaust fan cowlings

Secure exhaust fan cowlings with wire rope to the roof deck or the equipment curb.

Wind damaged fan and cowling

Secured fan and cowling
Source - FEMA

3. Goose-necks

Secure goose-neck relief air hoods to resist the wind loads in accordance with one of the following:

a. ASCE 7-05 using the appropriate basic design wind speed and an Importance Factor of 1.15

b. FEEM guide "Attachment of Rooftop Equipment in High-Wind Regions"

c. As a minimum, provide corrosion resistant fasteners (e.g. stainless steel or hot dipped galvanized #14 screws) not exceeding 6" on centers between the equipment, transition pieces, and the roof curb

This goose-neck was secured with two screws.
Failure lead to significant water entry into the building
Source - FEMA

4. Air conditioning condensers

Air conditioning condensers and similar equipment should be secured with straps fastened to the stand, curb, or roof deck.

Limited attachment to unsecured wood blocking

Limited attachment to stand

Well secured with straps, 2 screws desirable per strap connection

Source – FEMA

5. Rooftop ductwork

Avoid exposed rooftop ductwork. Locate ductwork within the building, mechanical penthouse, or within reinforced concrete or reinforced CMU enclosures.

Exposed rooftop ductwork

Ductwork installed under roof cover

6. Lightning protection systems

Arrange lightning protection systems in accordance with the FEMA guide "Rooftop Attachment of Lightning Protection Systems in High-Wind Regions" available at http://www.fema.gov/rebuild/mat/mat_katrina.shtm.

Air terminal penetrating roof cover (source FEMA)

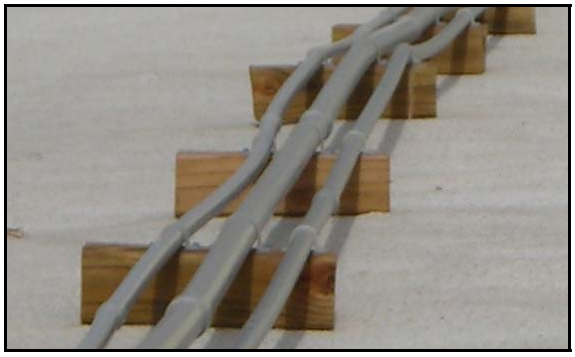
Air terminal screwed to wood nailer

Conductor secured with clip adhered to cover

Conductor separated from clip after high wind
Source – FEMA

7. Pipe and conduit

Fasten piping and conduit to the building walls or to stands attached to the building roof deck or building frame in accordance with the Florida Building Code.



Conduit on unsecured wood blocking

Pipe supported on stands anchored to concrete deck

8. Satellite dishes

Satellite dishes typically have a maximum design wind speed rating of 125 mph. In hurricane prone regions, hurricane emergency action plans should be expanded to include relocating satellite dishes inside before the hurricane. If the satellite dish frame is not secured to the building, it should be relocated inside with the dish.

Before high wind exposure

After high wind exposure
Source – FEMA

9. Large rooftop equipment

Engineer the connections for large equipment. Secure large rooftop equipment such as chillers, cooling towers, and HVAC units to resist the anticipated wind loads per ASCE 7-05 using the appropriate Basic Design Wind speed and an Importance Factor of 1.15.

Example of a non-engineered connection anticipated to fail under high winds

18,000 lb HVAC unit secured to curb with 16 straps, one screw per strap. Wind speed 85-90 mph
Source - FEMA

10. Vibration isolators

Where rooftop equipment uses vibration isolators, verify that isolators include uplift securement.

Vibration isolator with threaded rod for upward travel limit

Conclusion

For either new buildings in the design phase or occupied buildings with existing or planned rooftop equipment, take the time now to evaluate the anchorage of each and every rooftop feature.

When rooftop equipment stays in place during high-winds, a major challenge to the integrity of the building envelope and a major source of water entry into the building is eliminated.

Remember, once water gets in, the potential for severe property damage and lengthy business interruption begins.

References

Minimum Design Loads for Buildings and Other Structures. American Society of Civil Engineers, 2005.

Tom Smith, AIA, TLSmith Consulting Inc., "Wind Safety of the Building Envelope"
http://www.wbdg.org/resources/env_wind.php

FEMA, "Attachment of Rooftop Equipment in High-Wind Regions"
http://www.fema.gov/rebuild/mat/mat_katrina.shtm.

FEMA, "Rooftop Attachment of Lightning Protection Systems in High-Wind Regions"
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