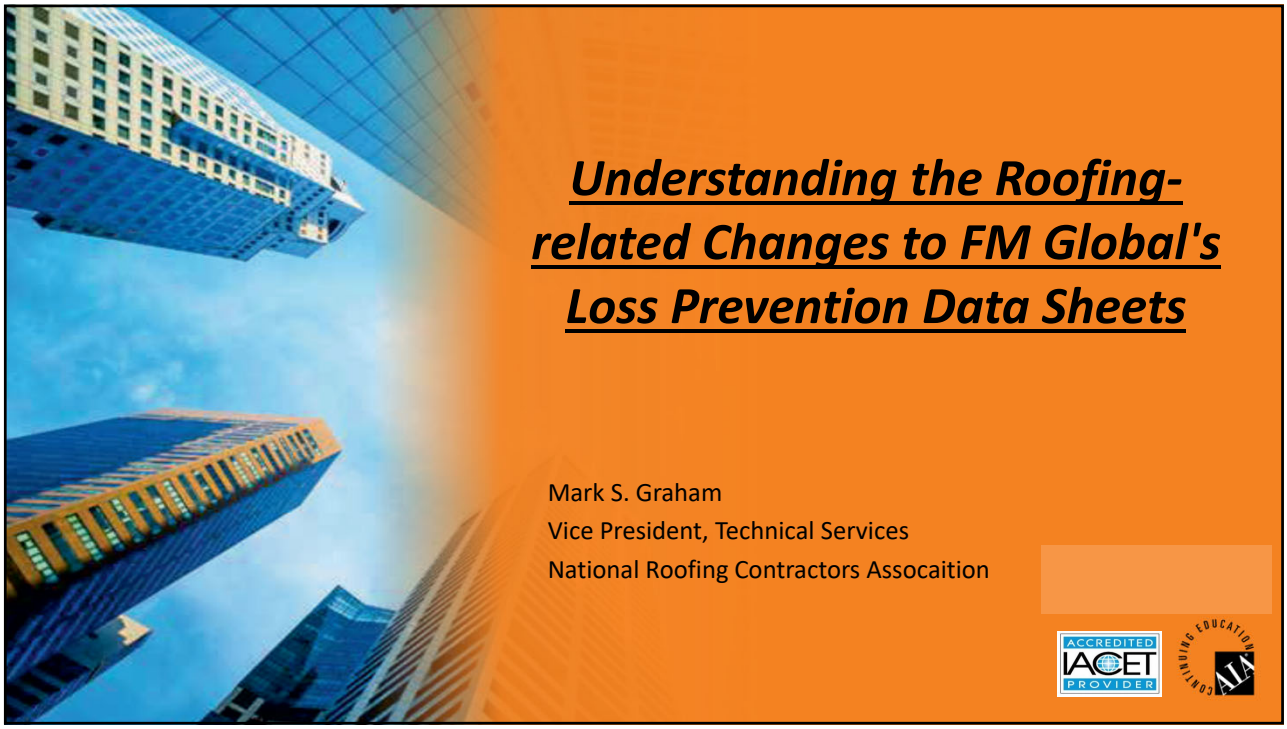


1

Learning Objectives

1. Identify the roles FM Global and FM Approvals play in the roofing industry.
2. Assess the aspects of changes FM Global has made to their roofing-related Property Loss Prevention Data Sheets.
3. Review examples explaining the impacts these changes can have on roof system designs.
4. Explore how designers of roof systems can implement FM Global's changes.

2

Credit earned on completion of this course will be reported to AIA CES for AIA members.

To receive a Certificate of Completion you must complete and pass the 10-question quiz at continuingeducation.bnpmedia.com following this presentation with an 80% or higher, then a certificate of completion will be available for immediate download.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

3

Link

4

How the roofing industry will adapt to ASCE 7-16 remains to be seen….

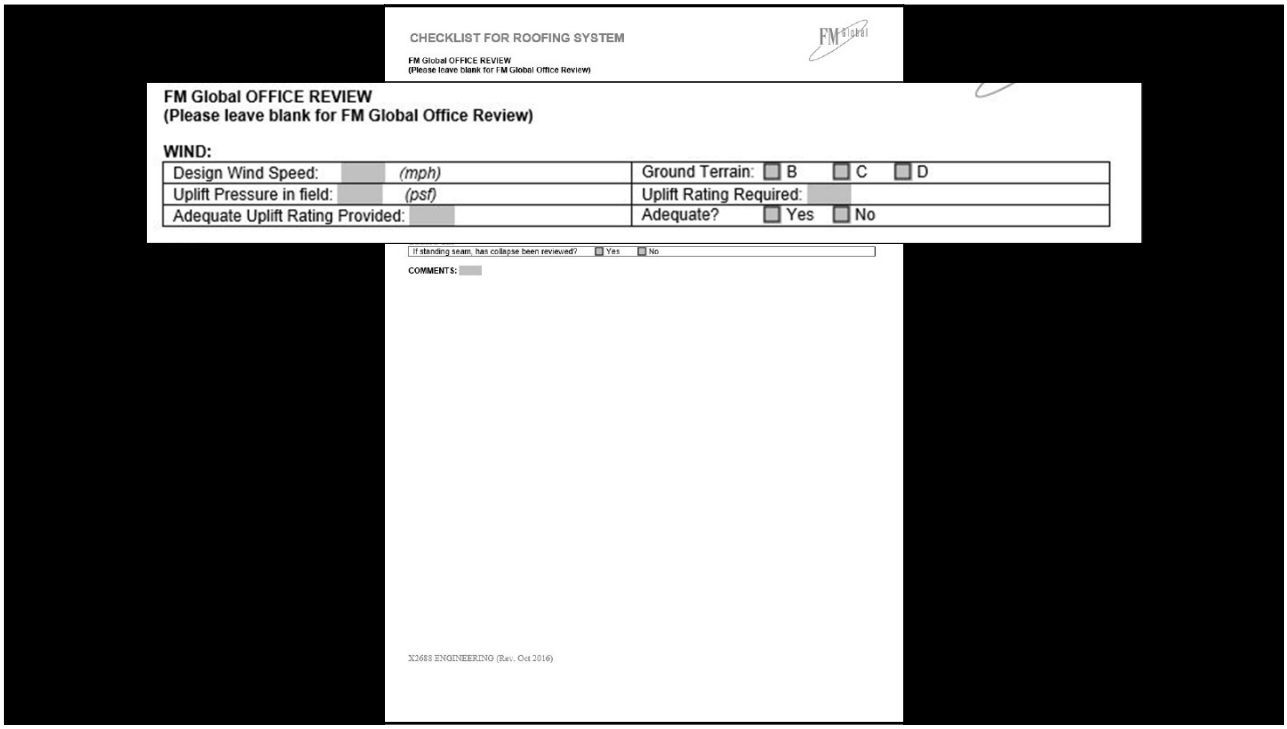
FM Global has indicated they will update their FM 1-28 to be based on ASCE 7-16 (with modifications) in Oct. 2019.

5

Who is Factory Mutual?

- FM Approvals
  - A standards development organization (e.g., FM 4474)
  - A code-approved testing agency (e.g., 1-60, 1-90, etc.)
  - A subsidiary of FM Global
- FM Global
  - A mutually-owned insurance company (i.e., highly-protected risk)
  - Property Loss Prevention Data Sheets (e.g., FM 1-28)
  - Form X2688, "Checklist for Roofing System"

6



CHECKLIST FOR ROOFING SYSTEM

FM Global OFFICE REVIEW
(Please leave blank for FM Global Office Review)

FM Global OFFICE REVIEW
(Please leave blank for FM Global Office Review)

WIND:

Design Wind Speed: *(mph)*	Ground Terrain: ☐ B ☐ C ☐ D
Uplift Pressure in field: *(psf)*	Uplift Rating Required:
Adequate Uplift Rating Provided:	Adequate? ☐ Yes ☐ No

If standing seam, has collapse been reviewed? ☐ Yes ☐ No

COMMENTS:

X2688 ENGINEERING (Rev. Oct 2016)

7

February 26, 2020

Publication date… and implementation date

March 5, 2020

Roofing industry FM coalition meeting

8

New FM Global Loss Prevention Data Sheets

February 26, 2020 – Accessible at www.fmglobaldatasheets.com

- FM 1-15, "Roof-Mounted Solar Photovoltaic Panels
- FM 1-28, "Wind Design"
- FM 1-29, "Roof Deck Securement and Above-deck Roof Components"
- FM 1-30, "Repair of Wind-damaged Single- and Multi-ply Roof Systems
- FM 1-31, "Roof Panel Systems"
- FM 1-34, "Hail Damage"
- FM 1-35, "Vegetative Roof Systems
- FM 1-49, "Perimeter Flashing"
- FM 1-52, "Field Verification of Roof Wind Uplift Resistance"

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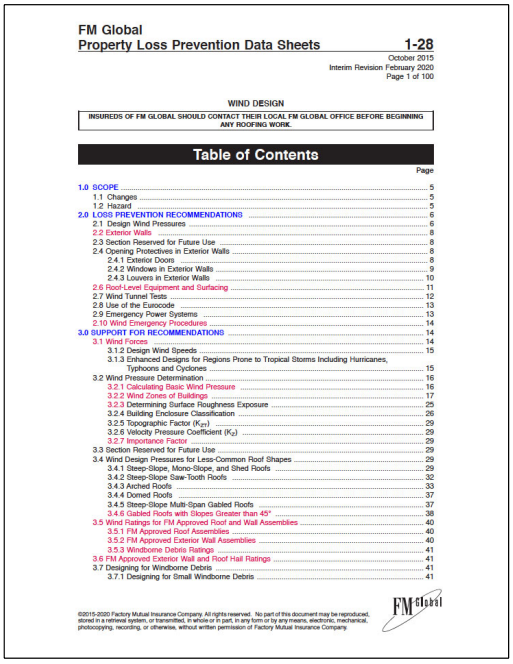

FM Global
Property Loss Prevention Data Sheets 1-28

October 2015
Interim Revision February 2020
Page 1 of 100

WIND DESIGN

INSUREDS OF FM GLOBAL SHOULD CONTACT THEIR LOCAL FM GLOBAL OFFICE BEFORE BEGINNING ANY ROOFING WORK.

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FM 1-28
October 2015
Interim Revision February 2020

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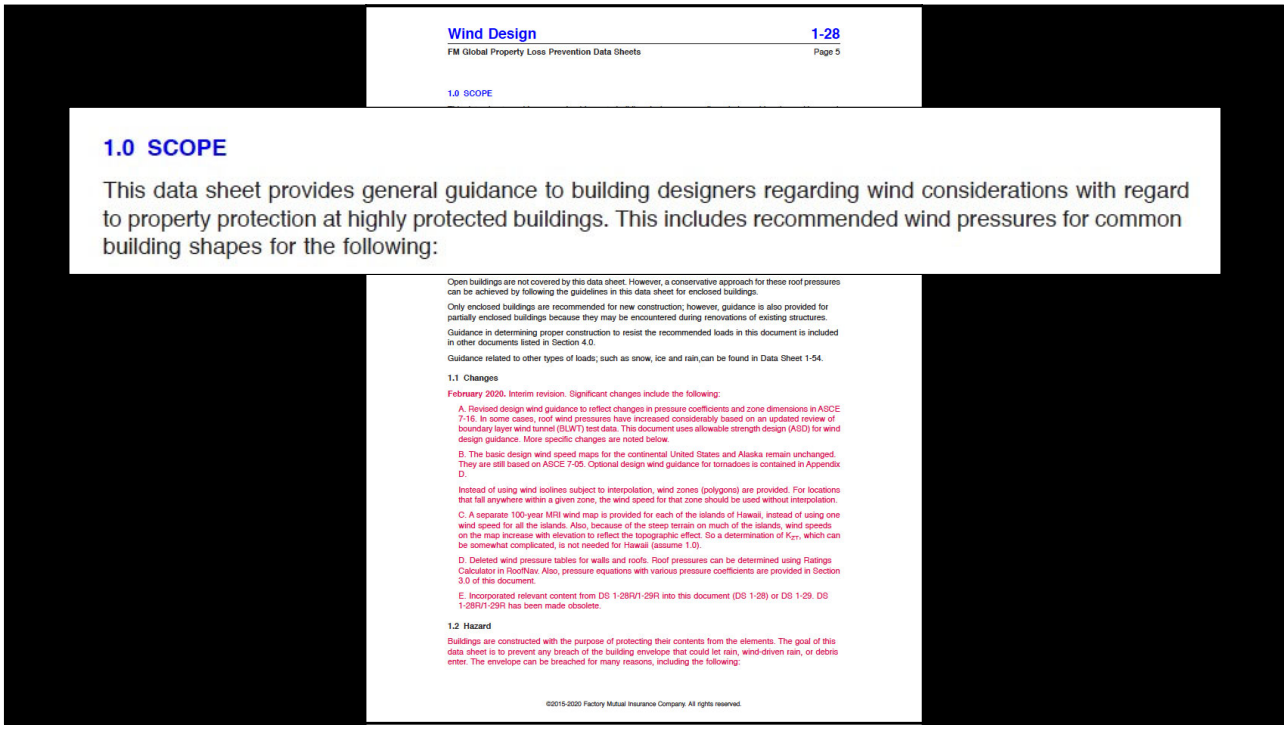

Wind Design 1-28
FM Global Property Loss Prevention Data Sheets Page 5

1.0 SCOPE

1.0 SCOPE

This data sheet provides general guidance to building designers regarding wind considerations with regard to property protection at highly protected buildings. This includes recommended wind pressures for common building shapes for the following:

Open buildings are not covered by this data sheet. However, a conservative approach for these roof pressures can be achieved by following the guidelines in this data sheet for enclosed buildings.

Only enclosed buildings are recommended for new construction; however, guidance is also provided for partially enclosed buildings because they may be encountered during renovations of existing structures.

Guidance in determining proper construction to resist the recommended loads in this document is included in other documents listed in Section 4.0.

Guidance related to other types of loads; such as snow, ice and rain,can be found in Data Sheet 1-54.

1.1 Changes

February 2020. Interim revision. Significant changes include the following:

A. Revised design wind guidance to reflect changes in pressure coefficients and zone dimensions in ASCE 7-16. In some cases, roof wind pressures have increased considerably based on an updated review of boundary layer wind tunnel (BLWT) test data. This document uses allowable strength design (ASD) for wind design guidance. More specific changes are noted below.

B. The basic design wind speed maps for the continental United States and Alaska remain unchanged. They are still based on ASCE 7-05. Optional design wind guidance for tornadoes is contained in Appendix D.

Instead of using wind isolines subject to interpolation, wind zones (polygons) are provided. For locations that fall anywhere within a given zone, the wind speed for that zone should be used without interpolation.

C. A separate 100-year MRI wind map is provided for each of the islands of Hawaii, instead of using one wind speed for all the islands. Also, because of the steep terrain on much of the islands, wind speeds on the map increase with elevation to reflect the topographic effect. So a determination of K_{zt}, which can be somewhat complicated, is not needed for Hawaii (assume 1.0).

D. Deleted wind pressure tables for walls and roofs. Roof pressures can be determined using Ratings Calculator in RoofNav. Also, pressure equations with various pressure coefficients are provided in Section 3.0 of this document.

E. Incorporated relevant content from DS 1-28R/1-29R into this document (DS 1-28) or DS 1-29. DS 1-28R/1-29R has been made obsolete.

1.2 Hazard

Buildings are constructed with the purpose of protecting their contents from the elements. The goal of this data sheet is to prevent any breach of the building envelope that could let rain, wind-driven rain, or debris enter. The envelope can be breached for many reasons, including the following:

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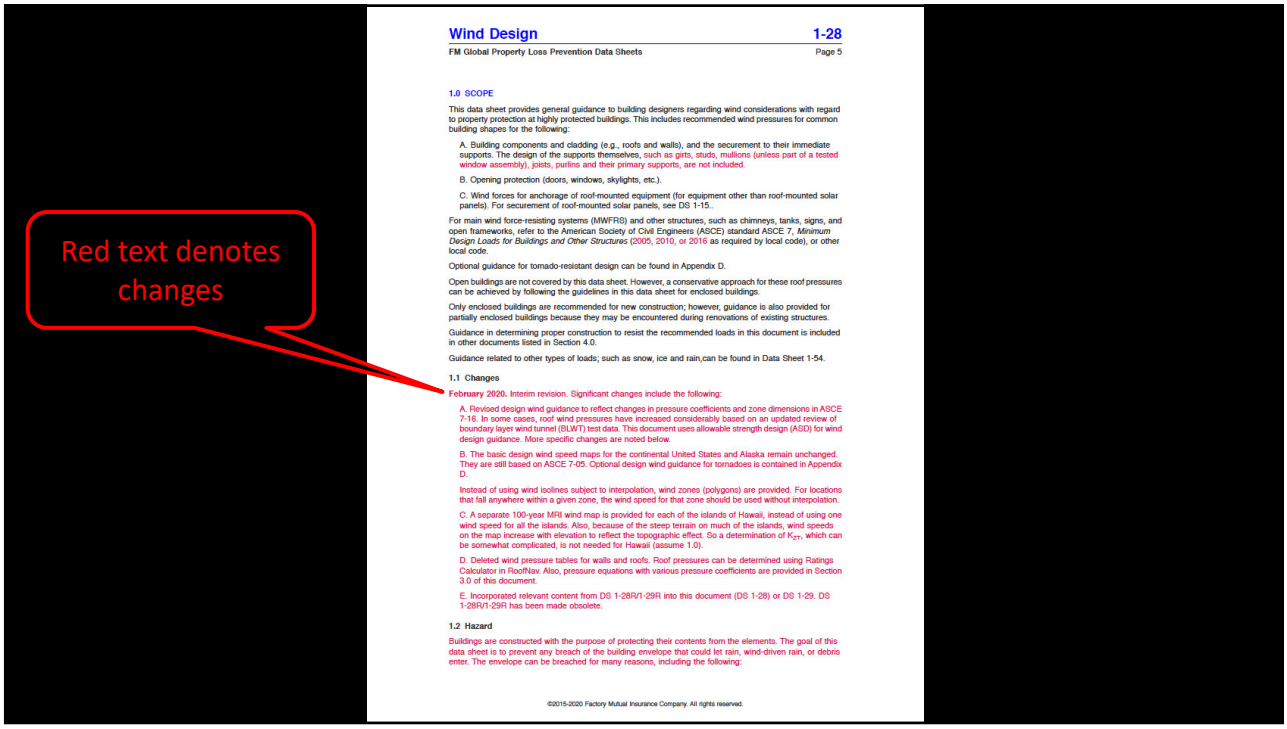

Wind Design 1-28
FM Global Property Loss Prevention Data Sheets Page 5

1.0 SCOPE

This data sheet provides general guidance to building designers regarding wind considerations with regard to property protection at highly protected buildings. This includes recommended wind pressures for common building shapes for the following:

A. Building components and cladding (e.g., roofs and walls), and the securement to their immediate supports. The design of the supports themselves, such as girts, studs, mullions (unless part of a tested window assembly), joists, purlins and their primary supports, are not included.

B. Opening protection (doors, windows, skylights, etc.).

C. Wind forces for anchorage of roof-mounted equipment (for equipment other than roof-mounted solar panels). For securement of roof-mounted solar panels, see DS 1-15.

For main wind force-resisting systems (MWFRS) and other structures, such as chimneys, tanks, signs, and open frameworks, refer to the American Society of Civil Engineers (ASCE) standard ASCE 7, *Minimum Design Loads for Buildings and Other Structures* (2005, 2010, or 2016 as required by local code), or other local code.

Optional guidance for tornado-resistant design can be found in Appendix D.

Open buildings are not covered by this data sheet. However, a conservative approach for these roof pressures can be achieved by following the guidelines in this data sheet for enclosed buildings.

Only enclosed buildings are recommended for new construction; however, guidance is also provided for partially enclosed buildings because they may be encountered during renovations of existing structures.

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Significant changes in FM 1-28, Feb. 2020

- Wind load determination tables have been removed from FM 1-28; now use the ratings calculator in RoofNav

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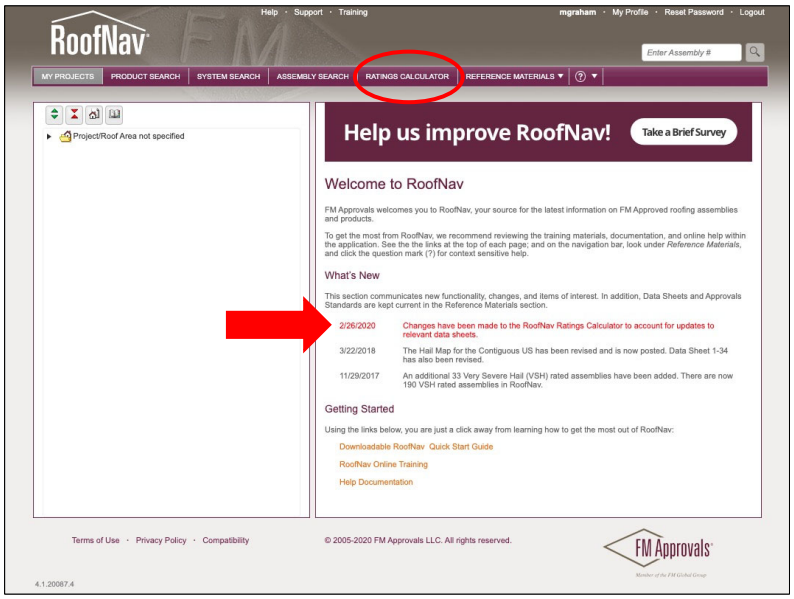
FM Approvals' RoofNav

www.roofnav.com



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Significant changes in FM 1-28, Feb. 2020

- Wind load determination tables have been removed from FM 1-28; now use the ratings calculator in RoofNav
- FM 1-28 now uses ASCE 7-16's pressure coefficients and zones
- FM 1-28 still uses ASCE 7-05's 100-year MRI maps
- FM 1-28 still uses ASCE 7-05's allowable strength design (ASD)
- FM 1-28 uses (adds) an Importance Factor of 1.15 from ASCE 7-05

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What impacts do these changes have?

An example calculation using the Ratings Calculator:

Example: A low-rise office building (Risk Category II) is located in Chicago, IL. The building is an enclosed structure with a mean roof height of 60 ft. The building is located in an open terrain area that can be categorized as Exposure Category C.

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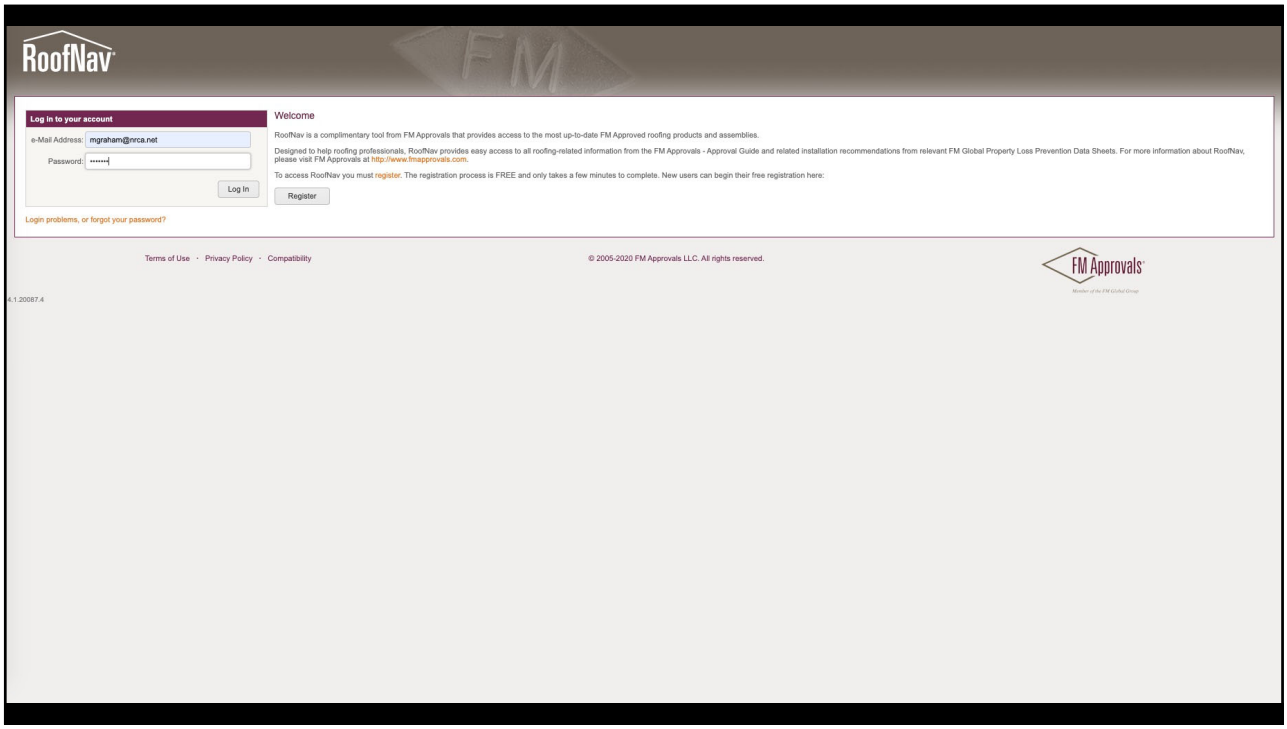
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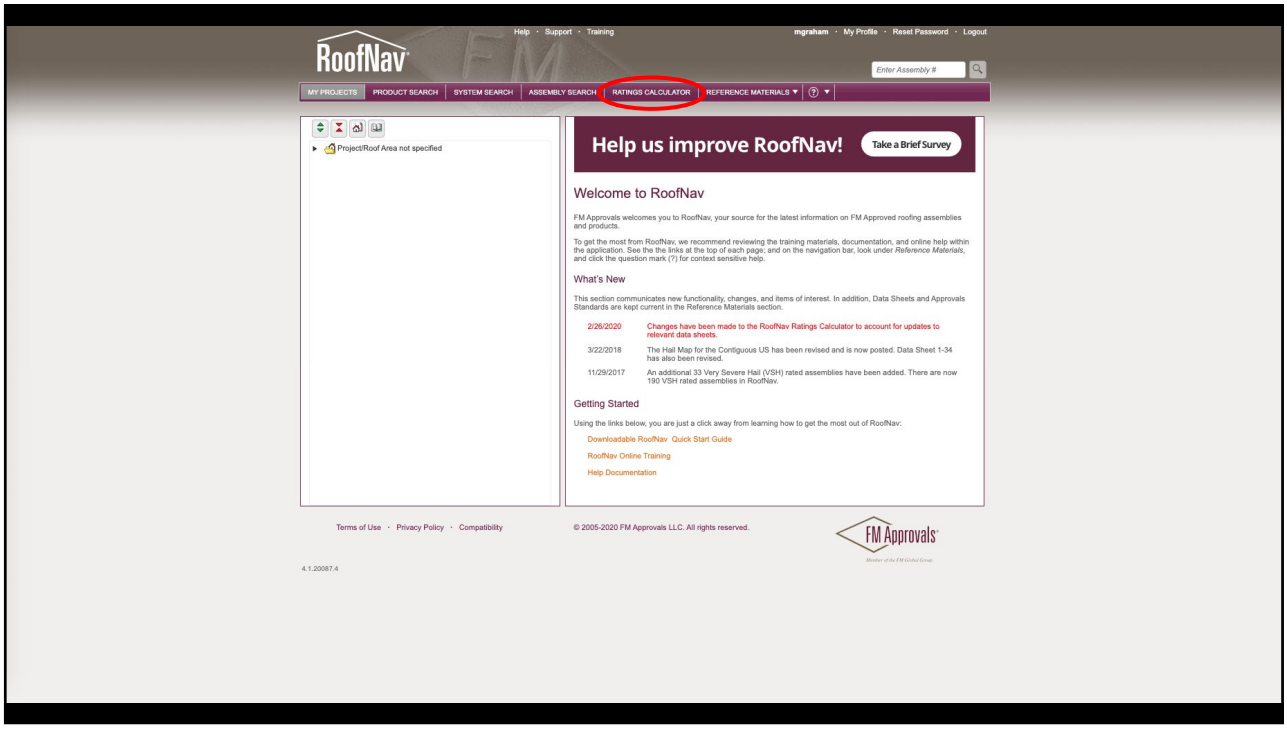
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FM Approvals welcomes you to RoofNav, your source for the latest information on FM Approved roofing assemblies and products.
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What's New
This section communicates new functionality, changes, and items of interest. In addition, Data Sheets and Approvals Standards are kept current in the Reference Materials section.
2/26/2020 Changes have been made to the RoofNav Ratings Calculator to account for updates to relevant data sheets.
3/22/2018 The Hail Map for the Contiguous US has been revised and is now posted. Data Sheet 1-34 has also been revised.
11/29/2017 An additional 33 Very Severe Hail (VSH) rated assemblies have been added. There are now 190 VSH rated assemblies in RoofNav.
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RoofNav Online Training
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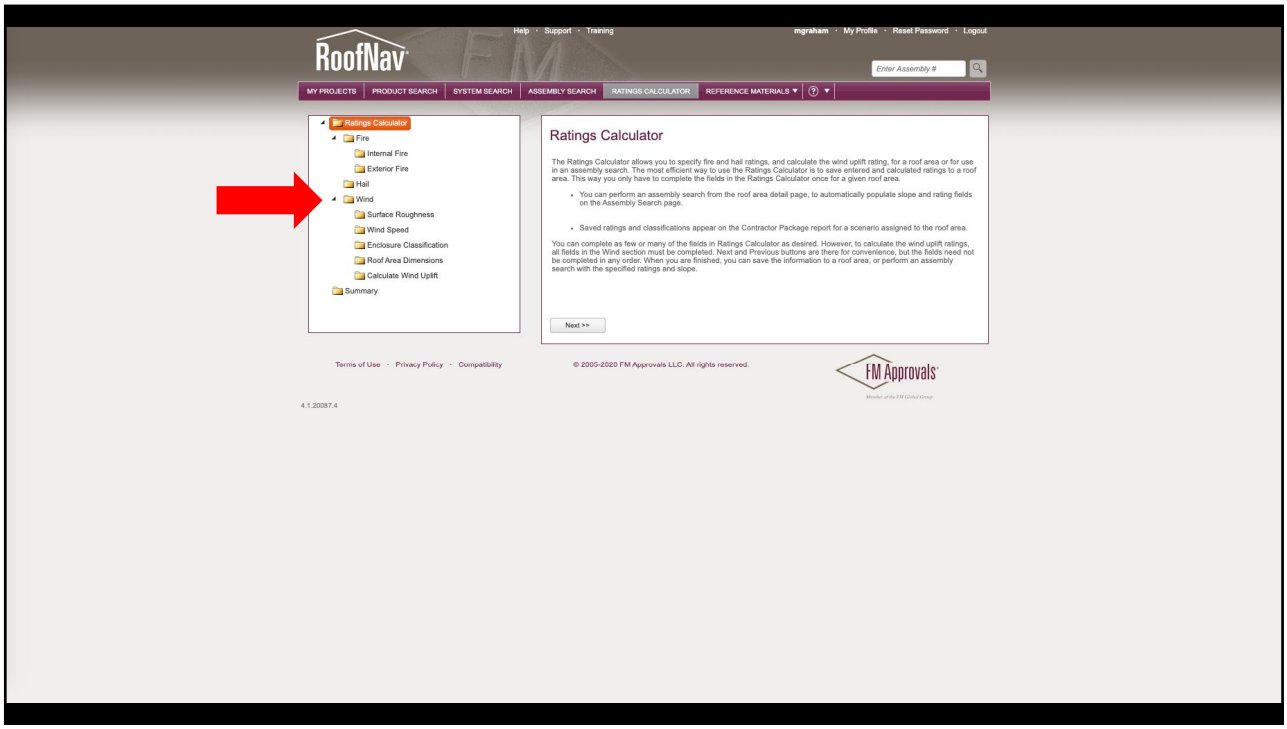
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REFERENCE MATERIALS
Ratings Calculator
Fire
Internal Fire
Exterior Fire
Hail
Wind
Surface Roughness
Wind Speed
Enclosure Classification
Roof Area Dimensions
Calculate Wind Uplift
Summary
Ratings Calculator
The Ratings Calculator allows you to specify fire and hail ratings, and calculate the wind uplift rating, for a roof area or for use in an assembly search. The most efficient way to use the Ratings Calculator is to save entered and calculated ratings to a roof area. This way you only have to complete the fields in the Ratings Calculator once for a given roof area.
You can perform an assembly search from the roof area detail page, to automatically populate slope and rating fields on the Assembly Search page.
Saved ratings and classifications appear on the Contractor Package report for a scenario assigned to the roof area.
You can complete as few or many of the fields in Ratings Calculator as desired. However, to calculate the wind uplift ratings, all fields in the Wind section must be completed. Next and Previous buttons are there for convenience, but the fields need not be completed in any order. When you are finished, you can save the information to a roof area, or perform an assembly search with the specified ratings and slope.
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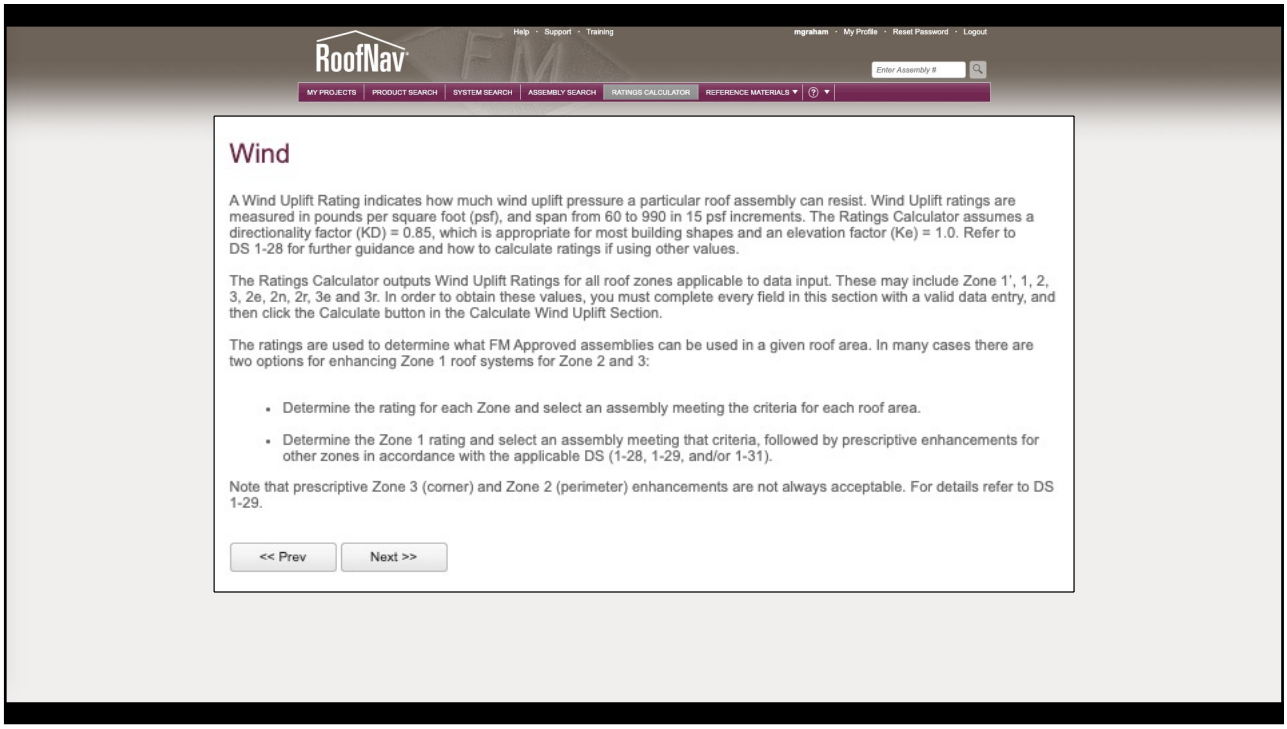
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Wind
A Wind Uplift Rating indicates how much wind uplift pressure a particular roof assembly can resist. Wind Uplift ratings are measured in pounds per square foot (psf), and span from 60 to 990 in 15 psf increments. The Ratings Calculator assumes a directionality factor (KD) = 0.85, which is appropriate for most building shapes and an elevation factor (Ke) = 1.0. Refer to DS 1-28 for further guidance and how to calculate ratings if using other values.
The Ratings Calculator outputs Wind Uplift Ratings for all roof zones applicable to data input. These may include Zone 1', 1, 2, 3, 2e, 2n, 2r, 3e and 3r. In order to obtain these values, you must complete every field in this section with a valid data entry, and then click the Calculate button in the Calculate Wind Uplift Section.
The ratings are used to determine what FM Approved assemblies can be used in a given roof area. In many cases there are two options for enhancing Zone 1 roof systems for Zone 2 and 3:
Determine the rating for each Zone and select an assembly meeting the criteria for each roof area.
Determine the Zone 1 rating and select an assembly meeting that criteria, followed by prescriptive enhancements for other zones in accordance with the applicable DS (1-28, 1-29, and/or 1-31).
Note that prescriptive Zone 3 (corner) and Zone 2 (perimeter) enhancements are not always acceptable. For details refer to DS 1-29.
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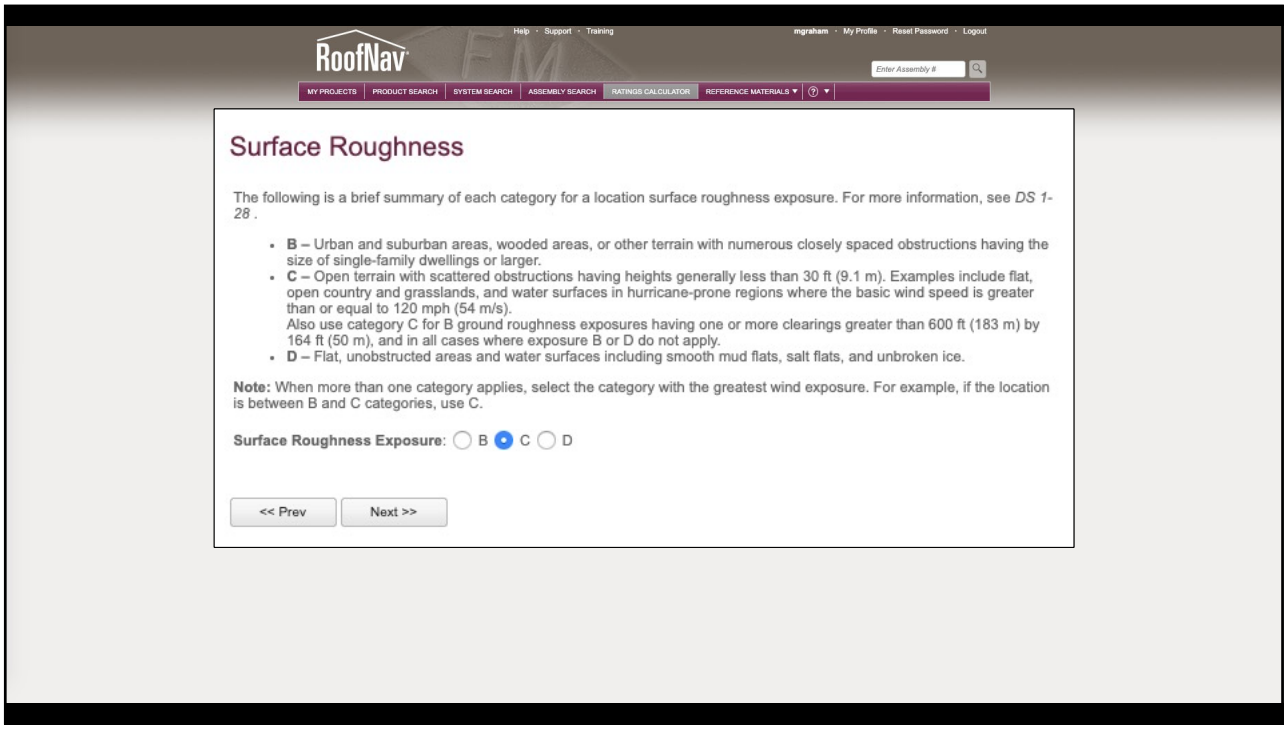
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Surface Roughness
The following is a brief summary of each category for a location surface roughness exposure. For more information, see DS 1-28 .
B – Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.
C – Open terrain with scattered obstructions having heights generally less than 30 ft (9.1 m). Examples include flat, open country and grasslands, and water surfaces in hurricane-prone regions where the basic wind speed is greater than or equal to 120 mph (54 m/s).
Also use category C for B ground roughness exposures having one or more clearings greater than 600 ft (183 m) by 164 ft (50 m), and in all cases where exposure B or D do not apply.
D – Flat, unobstructed areas and water surfaces including smooth mud flats, salt flats, and unbroken ice.
Note: When more than one category applies, select the category with the greatest wind exposure. For example, if the location is between B and C categories, use C.
Surface Roughness Exposure: B C D
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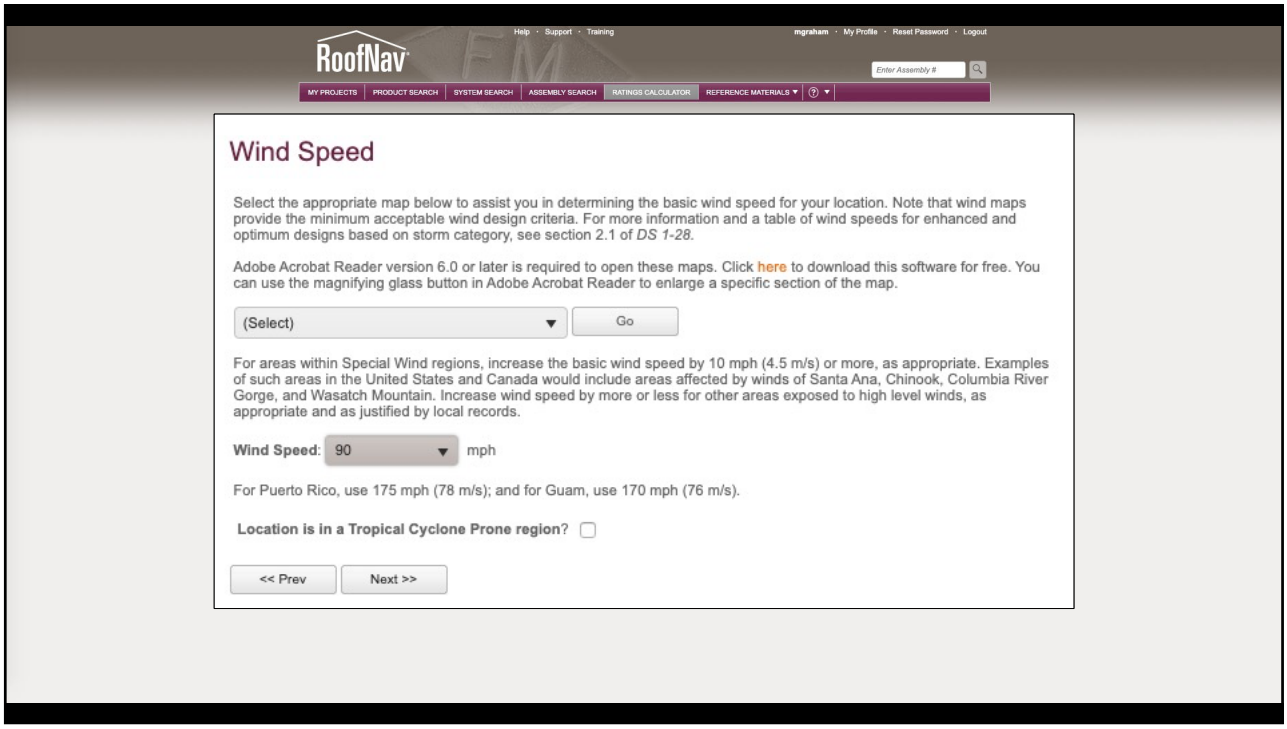
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Wind Speed
Select the appropriate map below to assist you in determining the basic wind speed for your location. Note that wind maps provide the minimum acceptable wind design criteria. For more information and a table of wind speeds for enhanced and optimum designs based on storm category, see section 2.1 of DS 1-28.
Adobe Acrobat Reader version 6.0 or later is required to open these maps. Click here to download this software for free. You can use the magnifying glass button in Adobe Acrobat Reader to enlarge a specific section of the map.
(Select)
Go
For areas within Special Wind regions, increase the basic wind speed by 10 mph (4.5 m/s) or more, as appropriate. Examples of such areas in the United States and Canada would include areas affected by winds of Santa Ana, Chinook, Columbia River Gorge, and Wasatch Mountain. Increase wind speed by more or less for other areas exposed to high level winds, as appropriate and as justified by local records.
Wind Speed: 90 mph
For Puerto Rico, use 175 mph (78 m/s); and for Guam, use 170 mph (76 m/s).
Location is in a Tropical Cyclone Prone region?
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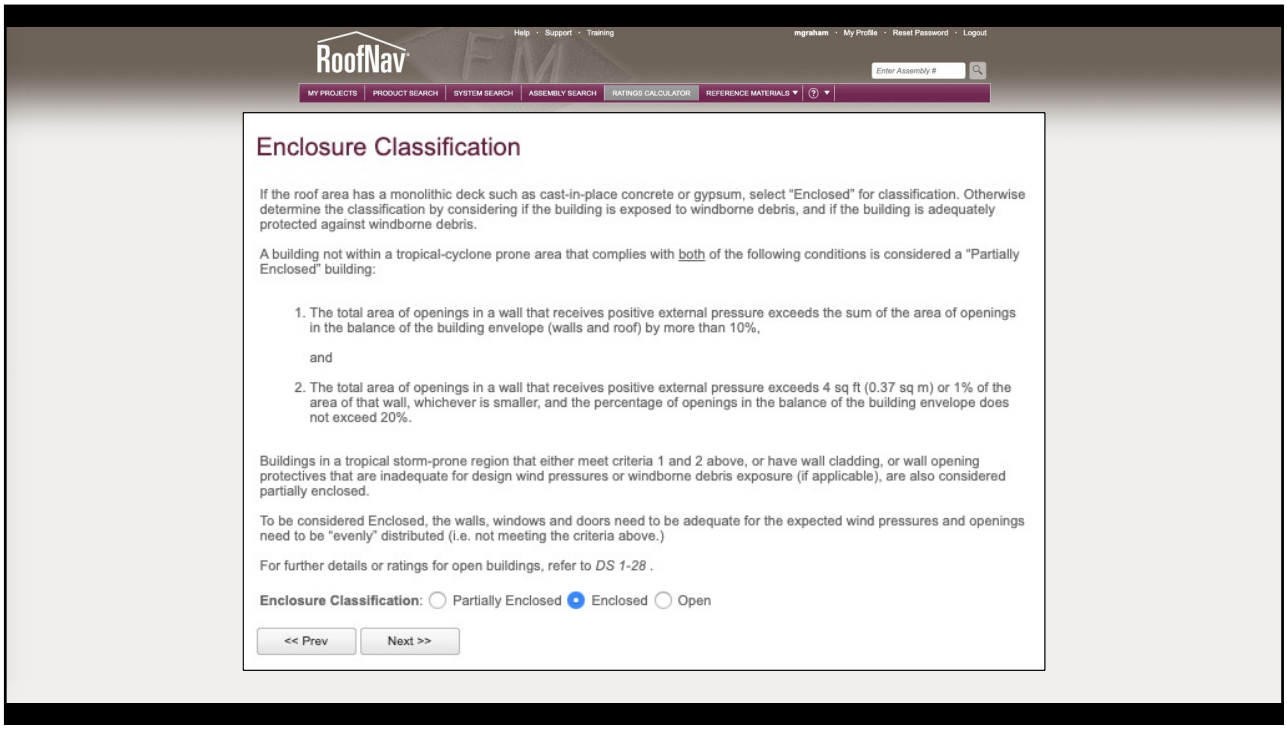
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Enclosure Classification
If the roof area has a monolithic deck such as cast-in-place concrete or gypsum, select "Enclosed" for classification. Otherwise determine the classification by considering if the building is exposed to windborne debris, and if the building is adequately protected against windborne debris.
A building not within a tropical-cyclone prone area that complies with both of the following conditions is considered a "Partially Enclosed" building:
1. The total area of openings in a wall that receives positive external pressure exceeds the sum of the area of openings in the balance of the building envelope (walls and roof) by more than 10%,
and
2. The total area of openings in a wall that receives positive external pressure exceeds 4 sq ft (0.37 sq m) or 1% of the area of that wall, whichever is smaller, and the percentage of openings in the balance of the building envelope does not exceed 20%.
Buildings in a tropical storm-prone region that either meet criteria 1 and 2 above, or have wall cladding, or wall opening protectives that are inadequate for design wind pressures or windborne debris exposure (if applicable), are also considered partially enclosed.
To be considered Enclosed, the walls, windows and doors need to be adequate for the expected wind pressures and openings need to be "evenly" distributed (i.e. not meeting the criteria above.)
For further details or ratings for open buildings, refer to DS 1-28 .
Enclosure Classification: Partially Enclosed Enclosed Open
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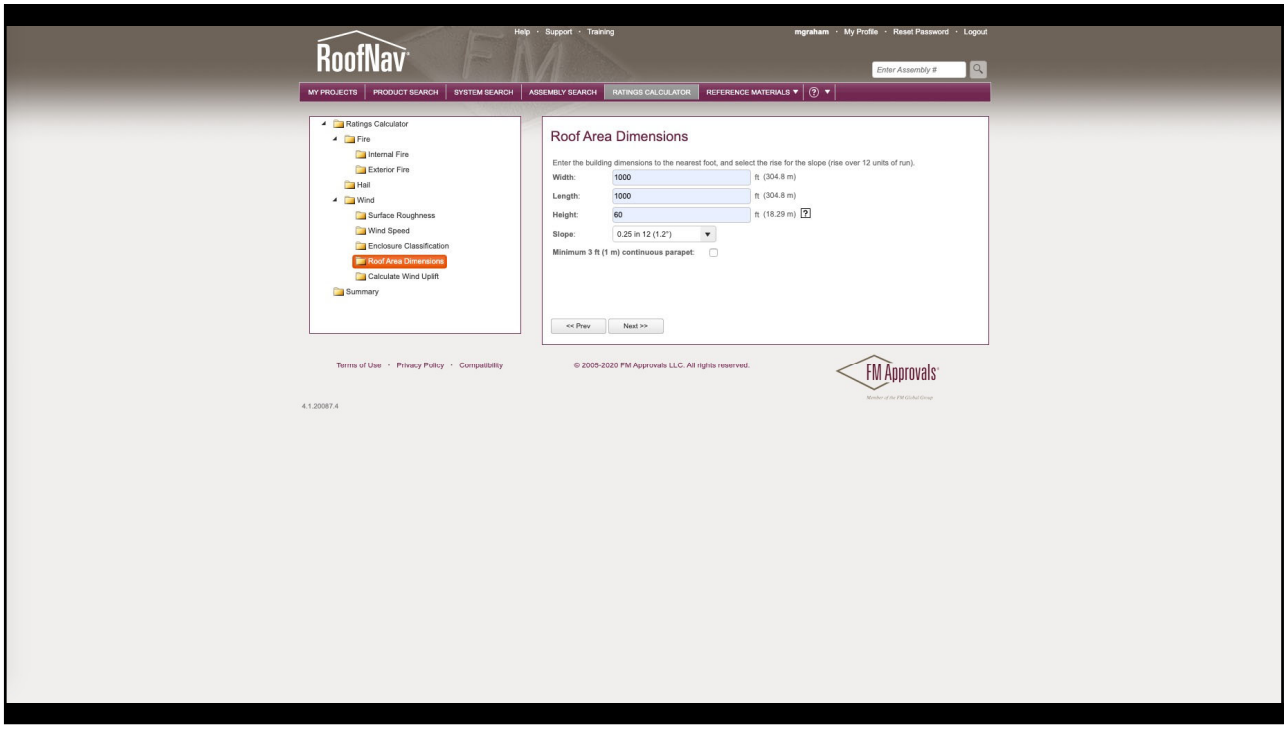
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REFERENCE MATERIALS
Ratings Calculator
Fire
Internal Fire
Exterior Fire
Hail
Wind
Surface Roughness
Wind Speed
Enclosure Classification
Roof Area Dimensions
Calculate Wind Uplift
Summary
Roof Area Dimensions
Enter the building dimensions to the nearest foot, and select the rise for the slope (rise over 12 units of run).
Width: 1000 ft (304.8 m)
Length: 1000 ft (304.8 m)
Height: 60 ft (18.29 m)
Slope: 0.25 in 12 (1.2°)
Minimum 3 ft (1 m) continuous parapet:
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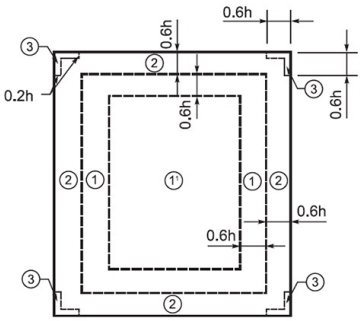
Calculate Wind Uplift

Roof Area Properties	Dimensions	1000 x 1000 ft (304.8 x 304.8 m)
	Height	60 ft (18.29 m)
	Slope	0.25 in 12 (1.2°)
	Min 3 ft (1 m) continuous parapet	N
Site Properties	Surface Roughness	C
	Wind Speed	90 mph
	In a Tropical Cyclone Prone region	N
	Enclosure Classification	Enclosed
Wind Pressures	Zone 1 Prime	24 psf (1.1 kPa)
	Zone 1	43 psf (2.1 kPa)
	Zone 2	57 psf (2.7 kPa)
	Zone 3	77 psf (3.7 kPa)
Wind Uplift Ratings	Zone 1 Prime	60 psf
	Zone 1	90 psf
	Zone 2	120 psf
	Zone 3	165 psf



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Comparing ASCE 7-05, FM 1-28, ASCE 7-10 and ASCE 7-16

Example: A low-rise office building (Risk Category II) is located in Chicago, IL. The building is an enclosed structure with a mean roof height of 60 ft. The building is located in an open terrain area that can be categorized as Exposure Category C.

Document	Basic wind speed (mph)	Design wind pressure (psf)			
		Zone 1' (Center)	Zone 1 (Field)	Zone 2 (Perimeter)	Zone 3 (Corners)
ASCE 7-05	V_{ASD} = 90	--	24	40	58
FM 1-28 (old)	V_{ASD} = 90	--	27	46	69

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Comparing ASCE 7-05, FM 1-28, ASCE 7-10 and ASCE 7-16

Example: A low-rise office building (Risk Category II) is located in Chicago, IL. The building is an enclosed structure with a mean roof height of 60 ft. The building is located in an open terrain area that can be categorized as Exposure Category C.

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		Zone 1' (Center)	Zone 1 (Field)	Zone 2 (Perimeter)	Zone 3 (Corners)
ASCE 7-05	V_{ASD} = 90	--	24	40	58
FM 1-28 (old)	V_{ASD} = 90	--	27	46	69
FM 1-28 (new)	V_{ASD} = 90	24	43	57	77

A 59% increase

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Comparing ASCE 7-05, FM 1-28, ASCE 7-10 and ASCE 7-16

Example: A low-rise office building (Risk Category II) is located in Chicago, IL. The building is an enclosed structure with a mean roof height of 60 ft. The building is located in an open terrain area that can be categorized as Exposure Category C.

Document	Basic wind speed (mph)	Design wind pressure (psf)			
		Zone 1' (Center)	Zone 1 (Field)	Zone 2 (Perimeter)	Zone 3 (Corners)
ASCE 7-05	V_{ASD} = 90	--	24	40	58
FM 1-28 (old)	V_{ASD} = 90	--	27	FM 1-60	69
FM 1-28 (new)	V_{ASD} = 90	24	43	FM 1-90	77
ASCE 7-10 Ult.	V_{ULT} = 115	--	39	65	97
ASCE 7-10 ASD	V_{ASD} = 90	--	23	39	58
ASCE 7-16 Ult.	V_{ULT} = 105	30	51	67	92
ASCE 7-16 ASD	V_{ASD} = 90	18	31	FM 1-75	55

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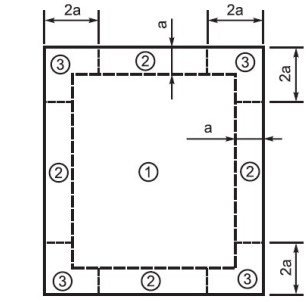
Calculate Wind Uplift

Roof Area Properties	Dimensions	1000 x 1000 ft (304.8 x 304.8 m)
	Height	150 ft (45.72 m)
	Slope	0.25 in 12 (1.2°)
	Min 3 ft (1 m) continuous parapet	N
Site Properties	Surface Roughness	C
	Wind Speed	90 mph
	In a Tropical Cyclone Prone region	N
	Enclosure Classification	Enclosed
Wind Pressures	Zone 1	44 psf (2.1 kPa)
	Zone 2	69 psf (3.3 kPa)
	Zone 3	94 psf (4.5 kPa)
Wind Uplift Ratings	Zone 1	90 psf
	Zone 2	150 psf
	Zone 3	195 psf



a = 10% of the lesser horizontal dimension, but not less than 3ft. (0.9m)

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Comparing ASCE 7-05, FM 1-28, ASCE 7-10 and ASCE 7-16

Example: A high-rise office building (Risk Category II) is located in Chicago, IL. The building is an enclosed structure with a mean roof height of 150 ft. The building is located in an open terrain area that can be categorized as Exposure Category C.

Document	Basic wind speed (mph)	Design wind pressure (psf)			
		Zone 1' (Center)	Zone 1 (Field)	Zone 2 (Perimeter)	Zone 3 (Corners)
ASCE 7-05	V_{ASD} = 90	--	38	60	82
FM 1-28 (old)	V_{ASD} = 90	--	44	69	94
FM 1-28 (new)	V_{ASD} = 90	--	44	FM 1-90	94
ASCE 7-10 (Ult.)	V_{ULT} = 115	--	63	98	134
ASCE 7-10 ASD	V_{ASD} = 90	--	38	59	80
ASCE 7-16 Ult.	V_{ULT} = 105	--	52	82	112
ASCE 7-16 ASD	V_{ASD} = 90	--	31	49	67

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The values derived from FM 1-28 are not consistent with ASCE 7-16's ASD values (IBC 2018). Using FM 1-28 typically results in higher design wind loads.

Complying with the code is a minimum legal requirement.

- Where FM 1-28's values are lower, use of the code's required wind loads is recommended
- Where FM 1-28's values are higher, these may be a project-specific contract requirement

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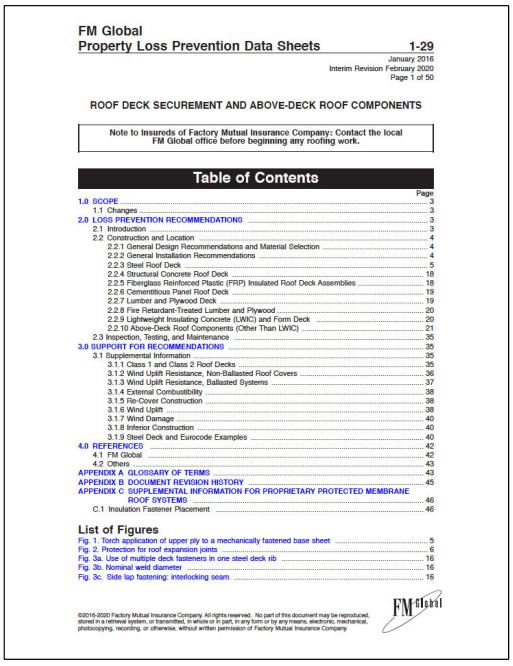

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ROOF DECK SECUREMENT AND ABOVE-DECK ROOF COMPONENTS

Note to Insureds of Factory Mutual Insurance Company: Contact the local FM Global office before beginning any roofing work.

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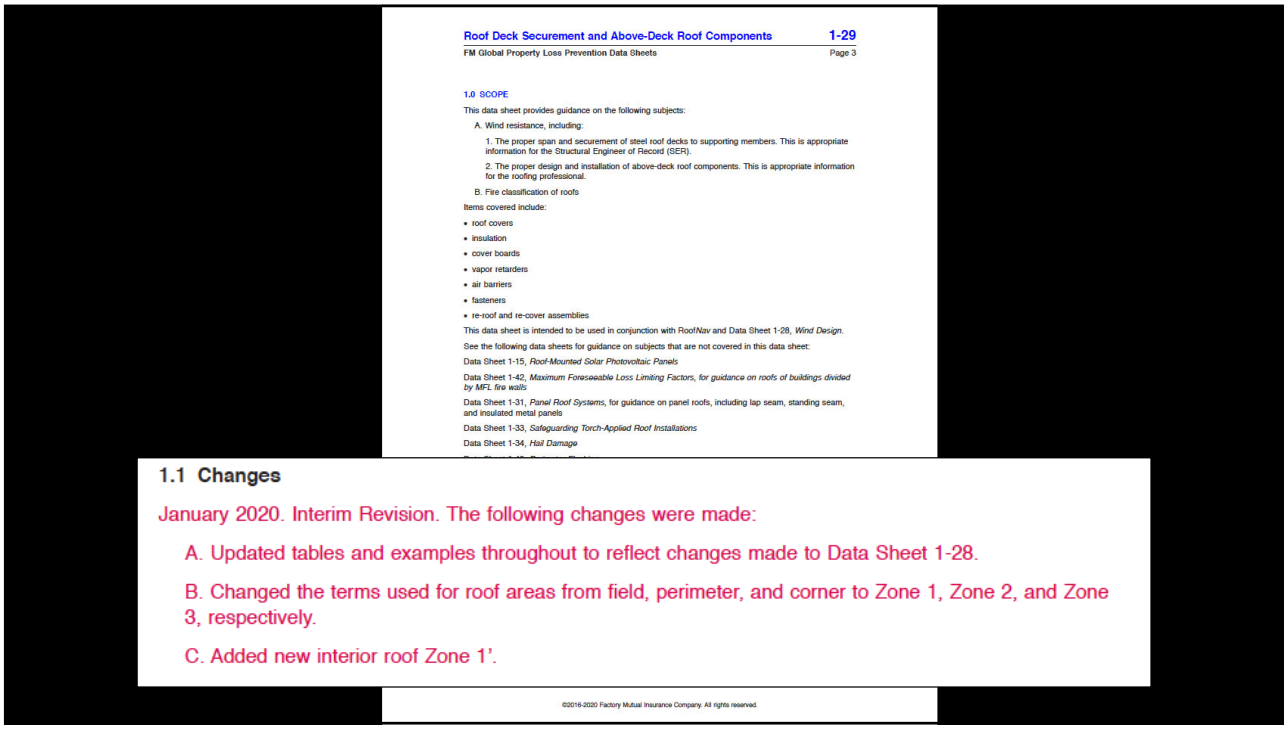

Roof Deck Securement and Above-Deck Roof Components 1-29

FM Global Property Loss Prevention Data Sheets Page 3

1.0 SCOPE

This data sheet provides guidance on the following subjects:

A. Wind resistance, including:

1. The proper span and securement of steel roof decks to supporting members. This is appropriate information for the Structural Engineer of Record (SER).

2. The proper design and installation of above-deck roof components. This is appropriate information for the roofing professional.

B. Fire classification of roofs

Items covered include:

- roof covers
- insulation
- cover boards
- vapor retarders
- air barriers
- fasteners
- re-roof and re-cover assemblies

This data sheet is intended to be used in conjunction with RoofNav and Data Sheet 1-28, *Wind Design*.

See the following data sheets for guidance on subjects that are not covered in this data sheet:

Data Sheet 1-15, *Roof-Mounted Solar Photovoltaic Panels*

Data Sheet 1-42, *Maximum Foreseeable Loss Limiting Factors, for guidance on roofs of buildings divided by MFL fire walls*

Data Sheet 1-31, *Panel Roof Systems*, for guidance on panel roofs, including lap seam, standing seam, and insulated metal panels

Data Sheet 1-33, *Safeguarding Torch-Applied Roof Installations*

Data Sheet 1-34, *Hail Damage*

1.1 Changes

January 2020. Interim Revision. The following changes were made:

A. Updated tables and examples throughout to reflect changes made to Data Sheet 1-28.

B. Changed the terms used for roof areas from field, perimeter, and corner to Zone 1, Zone 2, and Zone 3, respectively.

C. Added new interior roof Zone 1'.

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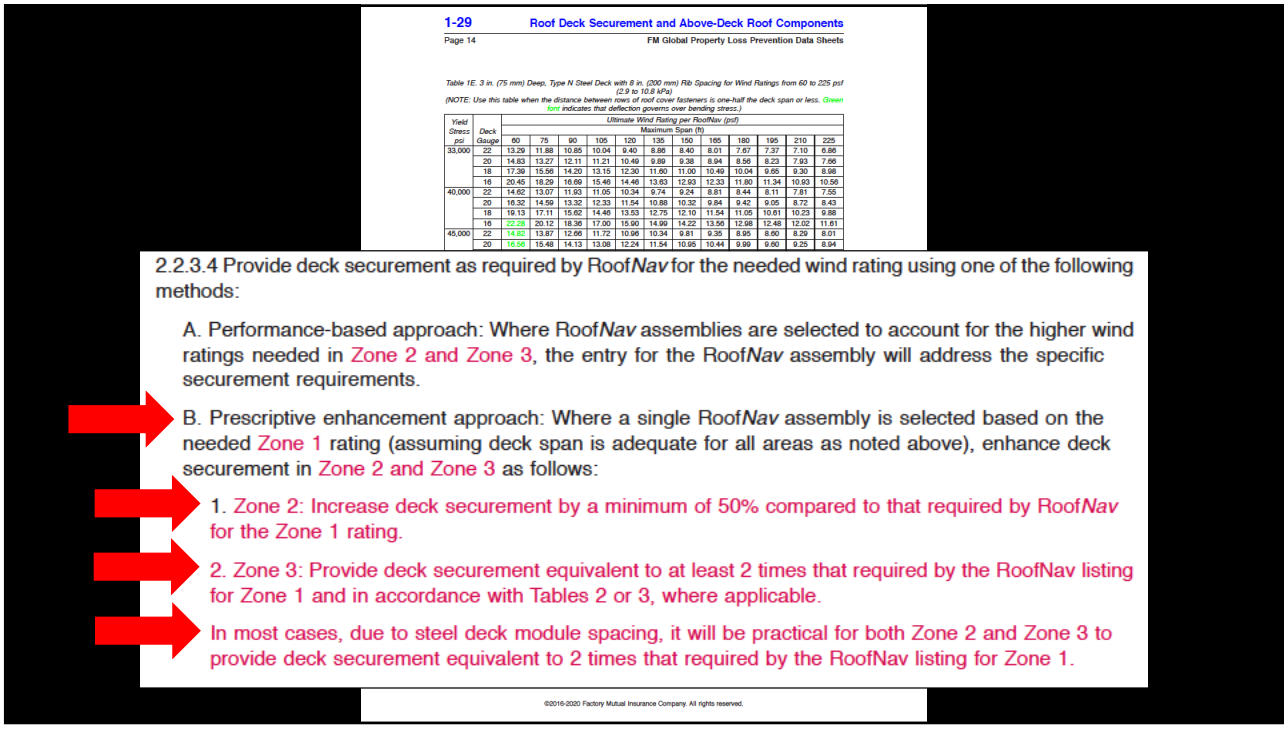

1-29 Roof Deck Securement and Above-Deck Roof Components

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Table 1E. 3 in. (75 mm) Deep, Type N Steel Deck with 8 in. (200 mm) Rib Spacing for Wind Ratings from 60 to 225 psf (2.9 to 10.8 kPa)

(NOTE: Use this table when the distance between rows of roof cover fasteners is one-half the deck span or less. Green font indicates that deflection governs over bending stress.)

Yield Stress psi	Deck Gauge	Ultimate Wind Rating per RoofNav (psf) Maximum Span (ft)											
		60	75	90	105	120	135	150	165	180	195	210	225
33,000	22	13.29	11.88	10.85	10.04	9.40	8.86	8.40	8.01	7.67	7.37	7.10	6.86
	20	14.83	13.27	12.11	11.21	10.49	9.89	9.38	8.94	8.56	8.23	7.93	7.66
	18	17.39	15.56	14.20	13.15	12.30	11.60	11.00	10.49	10.04	9.65	9.30	8.98
	16	20.45	18.29	16.69	15.46	14.46	13.63	12.93	12.33	11.80	11.34	10.93	10.56
40,000	22	14.62	13.07	11.93	11.05	10.34	9.74	9.24	8.81	8.44	8.11	7.81	7.55
	20	16.32	14.59	13.32	12.33	11.54	10.88	10.32	9.84	9.42	9.05	8.72	8.43
	18	19.13	17.11	15.62	14.46	13.53	12.75	12.10	11.54	11.05	10.61	10.23	9.88
	16	22.28	20.12	18.36	17.00	15.90	14.99	14.22	13.56	12.98	12.48	12.02	11.61
45,000	22	14.62	13.87	12.66	11.72	10.96	10.34	9.81	9.35	8.95	8.60	8.29	8.01
	20	16.56	15.48	14.13	13.08	12.24	11.54	10.95	10.44	9.99	9.60	9.25	8.94

2.2.3.4 Provide deck securement as required by Roof*Nav* for the needed wind rating using one of the following methods:

A. Performance-based approach: Where Roof*Nav* assemblies are selected to account for the higher wind ratings needed in Zone 2 and Zone 3, the entry for the Roof*Nav* assembly will address the specific securement requirements.

B. Prescriptive enhancement approach: Where a single Roof*Nav* assembly is selected based on the needed Zone 1 rating (assuming deck span is adequate for all areas as noted above), enhance deck securement in Zone 2 and Zone 3 as follows:

1. Zone 2: Increase deck securement by a minimum of 50% compared to that required by Roof*Nav* for the Zone 1 rating.

2. Zone 3: Provide deck securement equivalent to at least 2 times that required by the RoofNav listing for Zone 1 and in accordance with Tables 2 or 3, where applicable.

In most cases, due to steel deck module spacing, it will be practical for both Zone 2 and Zone 3 to provide deck securement equivalent to 2 times that required by the RoofNav listing for Zone 1.

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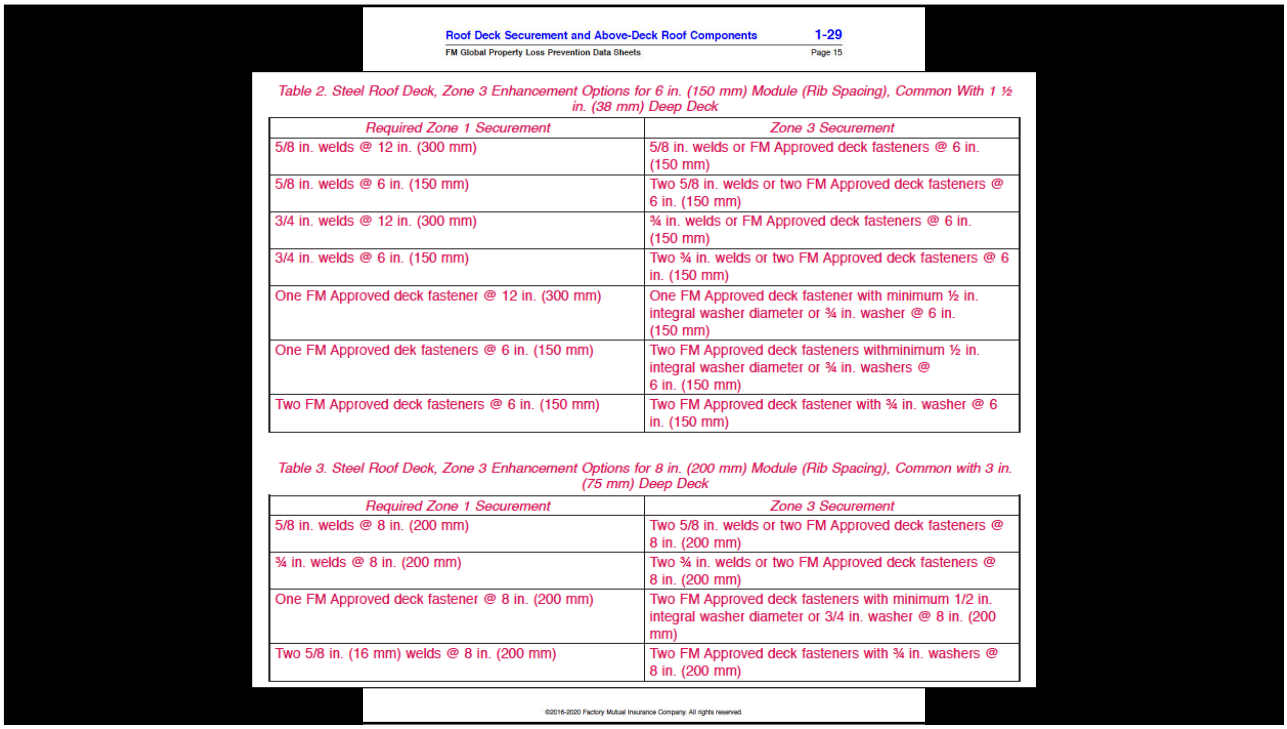

Roof Deck Securement and Above-Deck Roof Components 1-29
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Table 2. Steel Roof Deck, Zone 3 Enhancement Options for 6 in. (150 mm) Module (Rib Spacing), Common With 1 ½ in. (38 mm) Deep Deck

Required Zone 1 Securement	*Zone 3 Securement*
5/8 in. welds @ 12 in. (300 mm)	5/8 in. welds or FM Approved deck fasteners @ 6 in. (150 mm)
5/8 in. welds @ 6 in. (150 mm)	Two 5/8 in. welds or two FM Approved deck fasteners @ 6 in. (150 mm)
3/4 in. welds @ 12 in. (300 mm)	¾ in. welds or FM Approved deck fasteners @ 6 in. (150 mm)
3/4 in. welds @ 6 in. (150 mm)	Two ¾ in. welds or two FM Approved deck fasteners @ 6 in. (150 mm)
One FM Approved deck fastener @ 12 in. (300 mm)	One FM Approved deck fastener with minimum ½ in. integral washer diameter or ¾ in. washer @ 6 in. (150 mm)
One FM Approved dek fasteners @ 6 in. (150 mm)	Two FM Approved deck fasteners withminimum ½ in. integral washer diameter or ¾ in. washers @ 6 in. (150 mm)
Two FM Approved deck fasteners @ 6 in. (150 mm)	Two FM Approved deck fastener with ¾ in. washer @ 6 in. (150 mm)

Table 3. Steel Roof Deck, Zone 3 Enhancement Options for 8 in. (200 mm) Module (Rib Spacing), Common with 3 in. (75 mm) Deep Deck

Required Zone 1 Securement	*Zone 3 Securement*
5/8 in. welds @ 8 in. (200 mm)	Two 5/8 in. welds or two FM Approved deck fasteners @ 8 in. (200 mm)
¾ in. welds @ 8 in. (200 mm)	Two ¾ in. welds or two FM Approved deck fasteners @ 8 in. (200 mm)
One FM Approved deck fastener @ 8 in. (200 mm)	Two FM Approved deck fasteners with minimum 1/2 in. integral washer diameter or 3/4 in. washer @ 8 in. (200 mm)
Two 5/8 in. (16 mm) welds @ 8 in. (200 mm)	Two FM Approved deck fasteners with ¾ in. washers @ 8 in. (200 mm)

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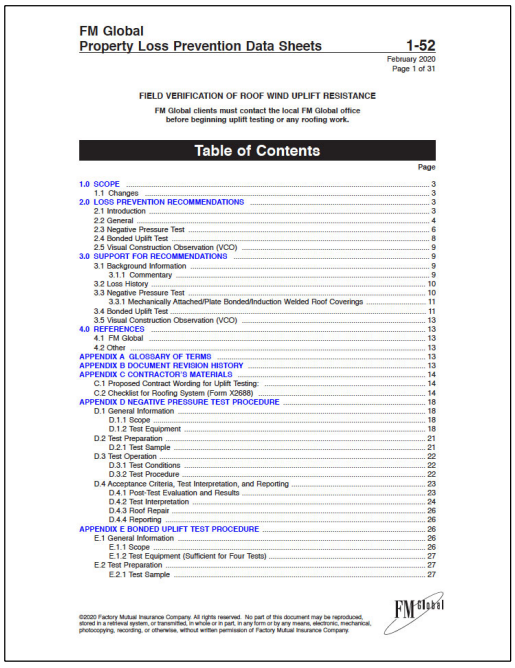

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FIELD VERIFICATION OF ROOF WIND UPLIFT RESISTANCE

FM Global clients must contact the local FM Global office before beginning uplift testing or any roofing work.

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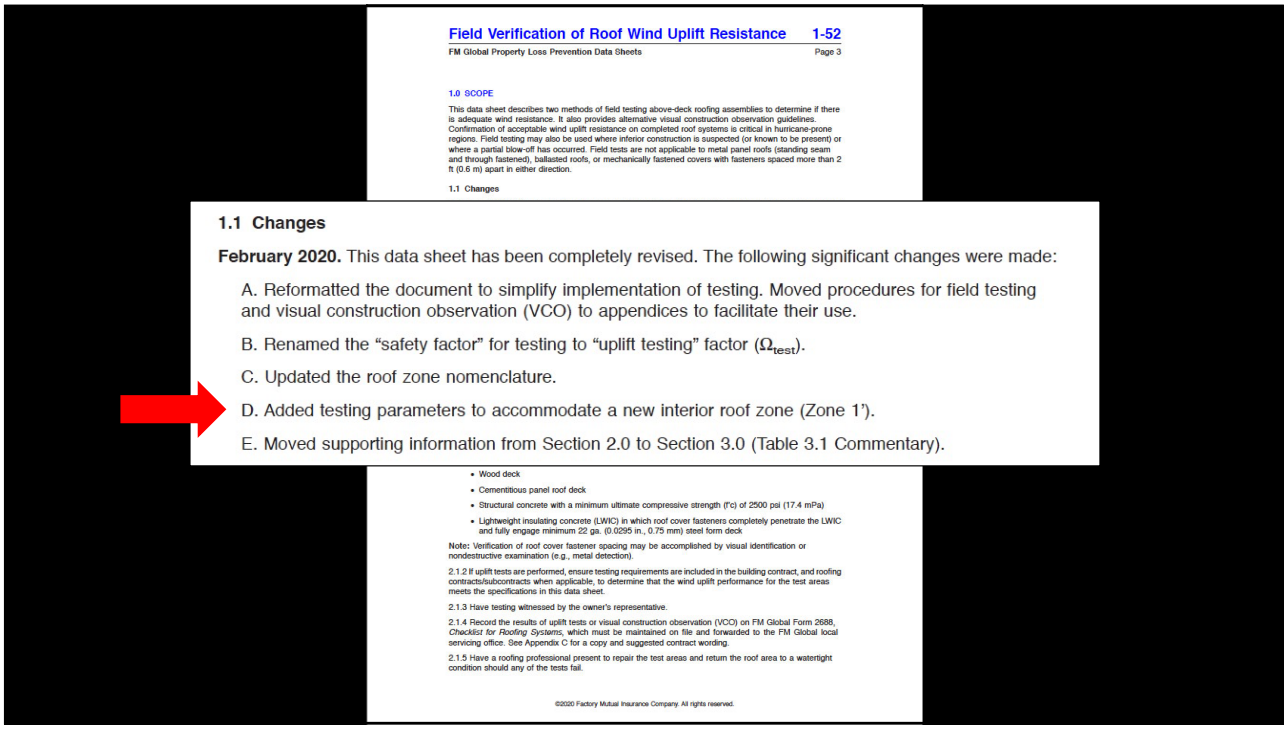

Field Verification of Roof Wind Uplift Resistance 1-52
FM Global Property Loss Prevention Data Sheets Page 3

1.0 SCOPE

This data sheet describes two methods of field testing above-deck roofing assemblies to determine if there is adequate wind resistance. It also provides alternative visual construction observation guidelines. Confirmation of acceptable wind uplift resistance on completed roof systems is critical in hurricane-prone regions. Field testing may also be used where inferior construction is suspected (or known to be present) or where a partial blow-off has occurred. Field tests are not applicable to metal panel roofs (standing seam and through fastened), ballasted roofs, or mechanically fastened covers with fasteners spaced more than 2 ft (0.6 m) apart in either direction.

1.1 Changes

1.1 Changes

February 2020. This data sheet has been completely revised. The following significant changes were made:

A. Reformatted the document to simplify implementation of testing. Moved procedures for field testing and visual construction observation (VCO) to appendices to facilitate their use.

B. Renamed the "safety factor" for testing to "uplift testing" factor (Ω_{test}).

C. Updated the roof zone nomenclature.

D. Added testing parameters to accommodate a new interior roof zone (Zone 1').

E. Moved supporting information from Section 2.0 to Section 3.0 (Table 3.1 Commentary).

- Wood deck
- Cementitious panel roof deck
- Structural concrete with a minimum ultimate compressive strength (f'c) of 2500 psi (17.4 mPa)
- Lightweight insulating concrete (LWIC) in which roof cover fasteners completely penetrate the LWIC and fully engage minimum 22 ga. (0.0295 in., 0.75 mm) steel form deck

Note: Verification of roof cover fastener spacing may be accomplished by visual identification or nondestructive examination (e.g., metal detection).

2.1.2 If uplift tests are performed, ensure testing requirements are included in the building contract, and roofing contracts/subcontracts when applicable, to determine that the wind uplift performance for the test areas meets the specifications in this data sheet.

2.1.3 Have testing witnessed by the owner's representative.

2.1.4 Record the results of uplift tests or visual construction observation (VCO) on FM Global Form 2688, *Checklist for Roofing Systems*, which must be maintained on file and forwarded to the FM Global local servicing office. See Appendix C for a copy and suggested contract wording.

2.1.5 Have a roofing professional present to repair the test areas and return the roof area to a watertight condition should any of the tests fail.

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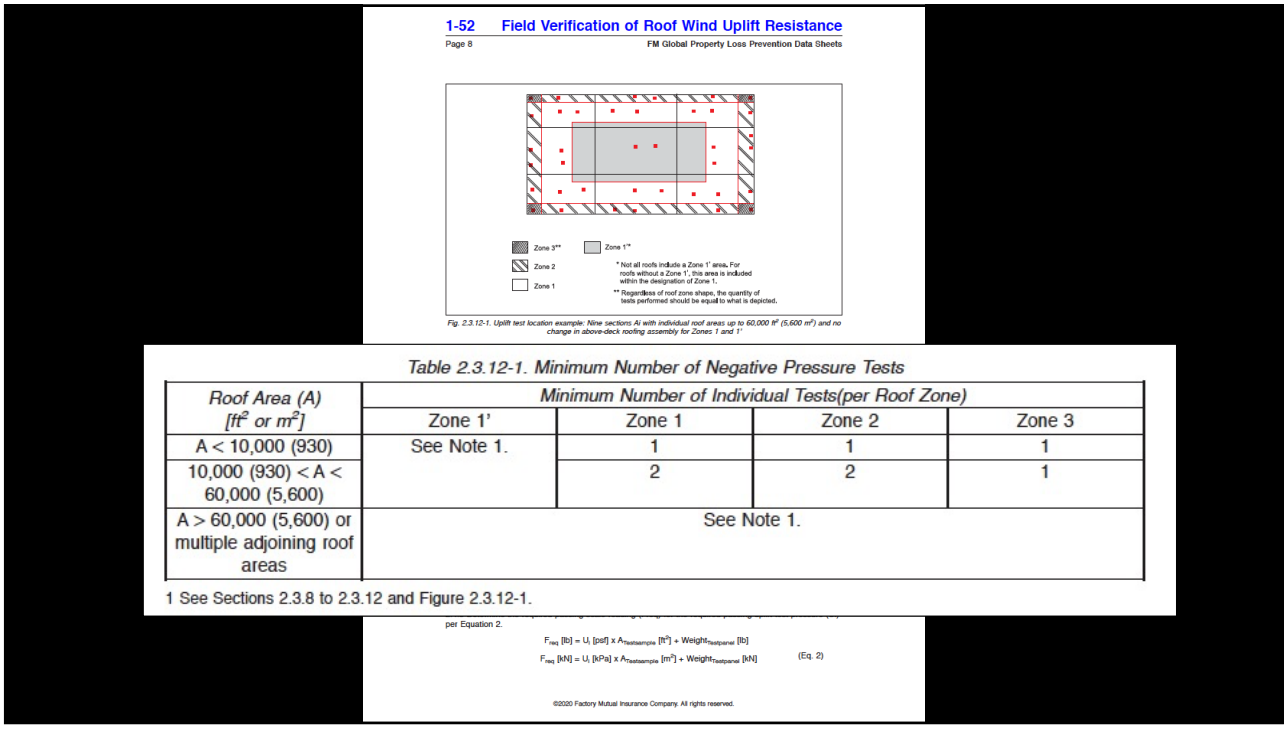

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Fig. 2.3.12-1. Uplift test location example. Nine sections Ai with individual roof areas up to 60,000 ft² (5,600 m²) and no change in above-deck roofing assembly for Zones 1 and 1'

Table 2.3.12-1. Minimum Number of Negative Pressure Tests

Roof Area (A) [ft² or m²]	*Minimum Number of Individual Tests(per Roof Zone)*			
	Zone 1'	Zone 1	Zone 2	Zone 3
A < 10,000 (930)	See Note 1.	1	1	1
10,000 (930) < A < 60,000 (5,600)		2	2	1
A > 60,000 (5,600) or multiple adjoining roof areas	See Note 1.			

1 See Sections 2.3.8 to 2.3.12 and Figure 2.3.12-1.

per Equation 2.

$$F_{req}\ [lb] = U_i\ [psf] \times A_{testsample}\ [ft^2] + Weight_{testpanel}\ [lb]$$
$$F_{req}\ [kN] = U_i\ [kPa] \times A_{testsample}\ [m^2] + Weight_{testpanel}\ [kN] \quad \text{(Eq. 2)}$$

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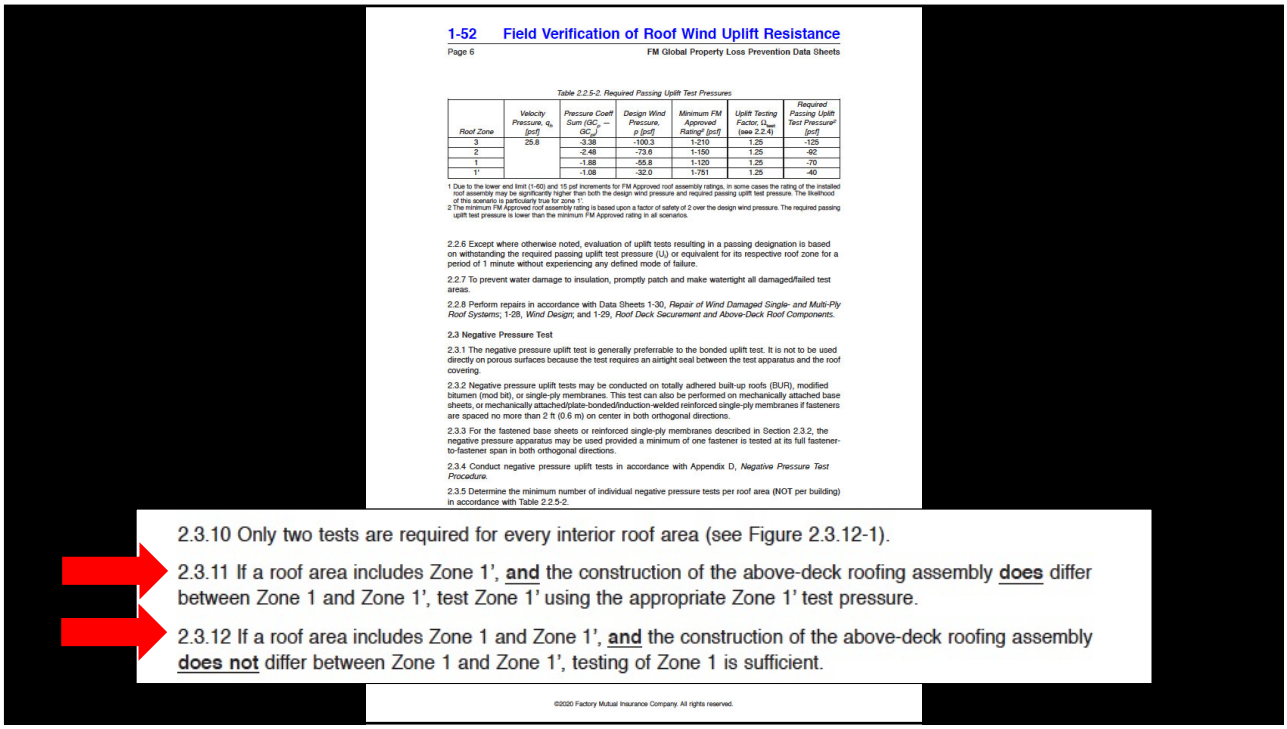

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Table 2.2.5-2. Required Passing Uplift Test Pressures

Roof Zone	Velocity Pressure, q_h [psf]	Pressure Coeff Sum ($GC_p - GC_{pi}$)[1]	Design Wind Pressure, p [psf]	Minimum FM Approved Rating[2] [psf]	Uplift Testing Factor, Ω_{test} (see 2.2.4)	Required Passing Uplift Test Pressure[2] [psf]
3	25.8	-3.38	-100.3	1-210	1.25	-125
2		-2.48	-73.6	1-150	1.25	-92
1		-1.88	-55.8	1-120	1.25	-70
1'		-1.08	-32.0	1-751	1.25	-40

1 Due to the lower end limit (1-60) and 15 psf increments for FM Approved roof assembly ratings, in some cases the rating of the installed roof assembly may be significantly higher than both the design wind pressure and required passing uplift test pressure. The likelihood of this scenario is particularly true for zone 1'.
2 The minimum FM Approved roof assembly rating is based upon a factor of safety of 2 over the design wind pressure. The required passing uplift test pressure is lower than the minimum FM Approved rating in all scenarios.

2.2.6 Except where otherwise noted, evaluation of uplift tests resulting in a passing designation is based on withstanding the required passing uplift test pressure (U_t) or equivalent for its respective roof zone for a period of 1 minute without experiencing any defined mode of failure.

2.2.7 To prevent water damage to insulation, promptly patch and make watertight all damaged/failed test areas.

2.2.8 Perform repairs in accordance with Data Sheets 1-30, *Repair of Wind Damaged Single- and Multi-Ply Roof Systems*; 1-28, *Wind Design*; and 1-29, *Roof Deck Securement and Above-Deck Roof Components*.

2.3 Negative Pressure Test

2.3.1 The negative pressure uplift test is generally preferrable to the bonded uplift test. It is not to be used directly on porous surfaces because the test requires an airtight seal between the test apparatus and the roof covering.

2.3.2 Negative pressure uplift tests may be conducted on totally adhered built-up roofs (BUR), modified bitumen (mod bit), or single-ply membranes. This test can also be performed on mechanically attached base sheets, or mechanically attached/plate-bonded/induction-welded reinforced single-ply membranes if fasteners are spaced no more than 2 ft (0.6 m) on center in both orthogonal directions.

2.3.3 For the fastened base sheets or reinforced single-ply membranes described in Section 2.3.2, the negative pressure apparatus may be used provided a minimum of one fastener is tested at its full fastener-to-fastener span in both orthogonal directions.

2.3.4 Conduct negative pressure uplift tests in accordance with Appendix D, *Negative Pressure Test Procedure*.

2.3.5 Determine the minimum number of individual negative pressure tests per roof area (NOT per building) in accordance with Table 2.2.5-2.

2.3.10 Only two tests are required for every interior roof area (see Figure 2.3.12-1).

2.3.11 If a roof area includes Zone 1', **and** the construction of the above-deck roofing assembly **does** differ between Zone 1 and Zone 1', test Zone 1' using the appropriate Zone 1' test pressure.

2.3.12 If a roof area includes Zone 1 and Zone 1', **and** the construction of the above-deck roofing assembly **does not** differ between Zone 1 and Zone 1', testing of Zone 1 is sufficient.

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FM Global intends these new guidelines to be effective as of February 26, 2020 (date of publication)

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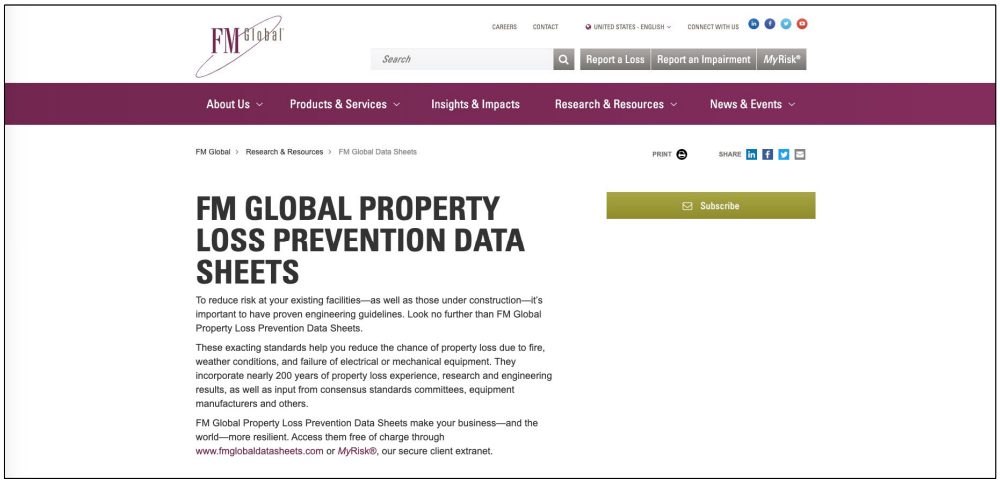

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Conclusions

- FM Global's LPDS are design guides intended for FM Global-insured buildings
- FM 1-28 (new) generally results in higher wind loads than FM 1-28 (old) and ASCE 7-16
- Different roof system attachment patterns may apply to Zone 1' and Zone 1
- Be aware of steel roof deck attachment requirements (by Zone)
- Be aware FM Global's effective date may present issues with current projects

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