



Roofing Issues: Decks to Dockets  
September 6-8, 2018 – Napa, CA

***Contractors Beware: Technical Issues  
Posing Liability Risks***

presented by

**Mark S. Graham**

Vice President, Technical Services  
National Roofing Contractors Association (NRCA)

**Topics**

- Moisture in concrete roof decks (an update)
- Steel roof deck concerns
- An NFPA 70 (National Electrical Code) issue
- New 2018 I-codes
  - ASCE 7-16 wind design
- Roof drain concerns
- FM's very severe hail (VSH) classification
- Attic ventilation
- "Fully" adhered misnomer
- Questions.... and additional topics

## Moisture in concrete roof decks

## NRCA Industry Issue Update, August 2013



**INDUSTRY ISSUE UPDATE**  
NRCA Member Benefit

### Moisture in Lightweight Structural Concrete Roof Decks

Concrete Moisture Presents Challenges for Roofing Contractors

**NRCA** Technical Services Section is receiving an increasing number of inquiries relating to the application of roof systems over concrete roof decks. These inquiries can be separated into two general questions: When is a concrete roof deck dry enough to apply a roof covering? And why is a roof system applied over a concrete roof deck showing signs of moisture infiltration when the roof covering isn't leaking?

**CONCRETE BASICS**  
There are three general types of concrete: normal-weight structural concrete, lightweight structural concrete and lightweight insulating concrete.

Normal-weight structural concrete is what most people think of as concrete. It has a density of about 150 pounds per cubic foot (pcf). Lightweight structural concrete has structural load-carrying capabilities similar to normal-weight structural concrete. It has a density in the range of 85 to 130 pcf. Lightweight insulating concrete, which many roofing professionals are familiar with as an insulating, slope-in-place deck topping, typically has a density in the range from 20 to 40 pcf.

Structural concrete—normal-weight structural concrete and lightweight structural concrete—is produced by mixing large and small aggregates, Portland cement, water and, in some instances, admixtures such as fly ash or various chemical additives. Admixtures can add strength and/or reduce concrete's curing, retain concrete's excess moisture and/or lengthen concrete's finishing time. Use of admixtures typically is not visually identifiable in the field; microscopic analysis usually is needed for post-application identification of admixtures.

The primary difference in the composition of normal-weight structural concrete and lightweight structural concrete is the large aggregate type. Normal-weight structural concrete contains normal-weight aggregate such as stone or crushed gravel, which are dense and typically will absorb no more moisture than about 2 percent by weight. Lightweight structural concrete uses lightweight,

porous aggregates such as expanded shale, which will absorb about 5 to 25 percent moisture by weight. Lightweight aggregate needs to be saturated with moisture—its often stored in ponds—before mixing. As a result, lightweight structural concrete inherently contains much more water than normal-weight structural concrete.

Lightweight structural concrete is used in roofing-related applications for cast-in-place concrete roof decks using removable form composite roof decks where a metal form deck remains in place and as a deck topping material, such as a concrete topping surface over precast concrete planks or slabs.

Once poured, lightweight structural concrete typically cures more slowly than normal-weight structural concrete.

Visual identification is possible using magnification, typically a microscope used by a trained technician.


**REPORTED PROBLEMS**  
The problems reported in NRCA associated with lightweight structural concrete roof decks include the following:

- **Moisture accumulation.** Excessive moisture from a concrete deck can be pressure-differential driven into and condensed within a roof system.
- **Adhesive loss.** The presence of moisture can result in deterioration of moisture-sensitive roofing materials and adhesive bond lines between adjacent material layers.
- **Adhesive issues with non-solvent and low-solvent epoxies compounds.** Excessive moisture can affect adhesive curing and drying rate. Also, moisture can result in adhesive "bleeding," resulting in bond strength loss.
- **Metal and fastener corrosion.** Excessive moisture can contribute to and accelerate metal component corrosion, including fastener corrosion.
- **Insulation R-value loss.** The accumulation and presence of moisture in most insulation products will result in reduced thermal performance (lower effective R-value).
- **Microbial growth.** The presence of prolonged high-moisture

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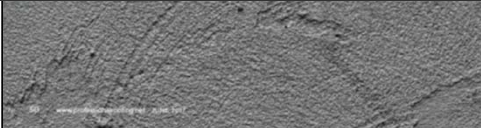
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June 2017





ASTM E96 calculated perm					
		Lightweight structural concrete		Normal weight concrete	
Age	Wet cup	Dry cup	Wet cup	Dry cup	
28 days	1.48	0.78	3.42	1.05	
60 days	1.45	0.47	2.03	1.13	

The figure shows results of ASTM E96 water vapor transmission testing. Note the lightweight structural concrete has about half of the permeability of regular weight concrete. Considering lightweight structural concrete arrives with more than twice the evaporable water of regular weight concrete, this explains why lightweight structural concrete retains moisture for so long.



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## Moisture on concrete roof decks

**Moisture in concrete roof decks**  
Normal-weight and lightweight structural concrete cause some concern  
by Mark S. Givens

**N**ORCA continues to receive a significant number of reports of moisture-related problems associated with concrete roof decks. Following years of research and numerous best practices recommendations for addressing the issue, we've reported:

The issue of moisture in concrete roof decks is not new. Since 2006, NORCA has received numerous reports of moisture-related problems with roof systems installed on concrete roof decks. Such lightweight structural and normal weight structural concrete. Reported problems include roof system moisture accumulation, adhesive delamination issues with water-based and the evaporation of organic solvents, mold and bacteria growth, moisture to cause delamination of joints.

Since the 2005 publication of the NORCA Best Practice Waterproofing Manual, PPH-2005, NORCA no longer considers the plastic sheet use method as a viable assessment to determine a concrete roof deck dry, moisture-free system application. Also, there is little to no correlation between concrete DR dry-cup/perm and to the "dryness"

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**Moisture vapor reduction admixtures (MVRAs)**

Some examples:

- Barrier One
- ISE Logik MVRA 9000
- SPG VaporLock

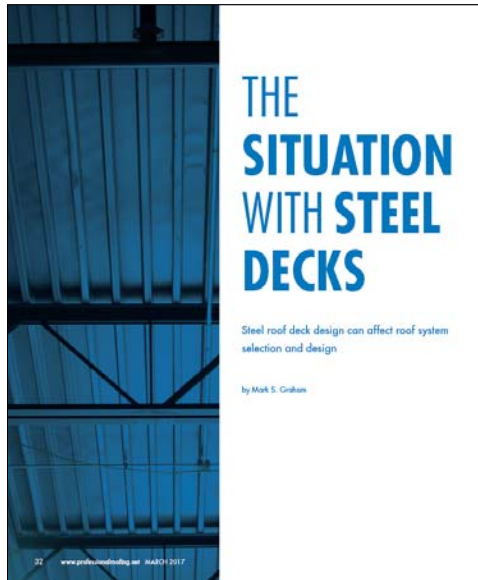
*NRCA has still not seen an MVRA perform  
successfully in concrete roof deck applications*

*The roofing industry needs to re-think  
the concept of concrete roof deck “acceptance”*

**NRLRC's Contract Provisions, Vol. III**

“Roofing Contractor’s commencement of the roof installation indicates only that the Roofing Contractor has visually inspected the surface of the roof deck for visible defects and has accepted the surface of the roof deck. Roofing Contractor is not responsible for the construction, structural sufficiency, durability, fastening, moisture content, suitability, or physical properties of the roof deck or other trades’ work or design. Roofing Contractor is not responsible to test or assess moisture content of the deck or substrate.”

**Steel roof deck concerns**



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## **Issues**

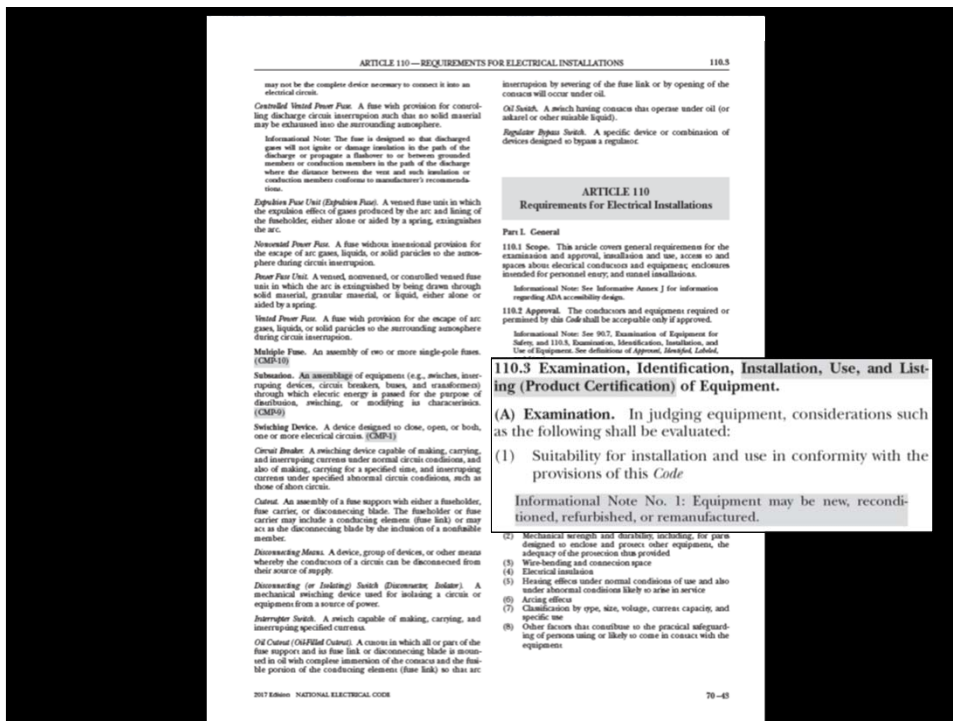
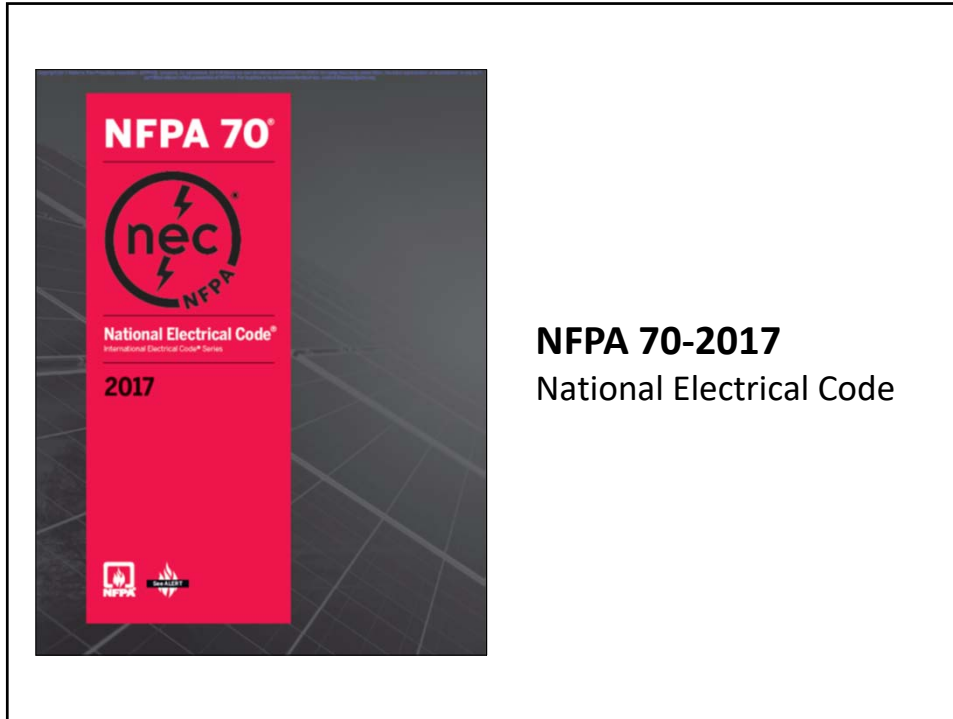
Steel roof deck concerns

- Steel roof decks are typically designed for 30 psf uplift
  - Roof systems rated higher than FM I-60 are problematic
- Steel roof decks are typically designed for uniform loading
  - Adhered systems result in uniform loading; seam-fastened, mechanically-attached systems result in concentrated loading
- Most steel roof decks have a 33 ksi design yield strength
  - Most seam-fasten, mechanically-attached systems' classifications are based upon 80 ksi steel deck
- Wide seam spacing-sheet systems results in excessive deck shear and moment
  - Sheet seam spacing wider than deck support spacing is problematic

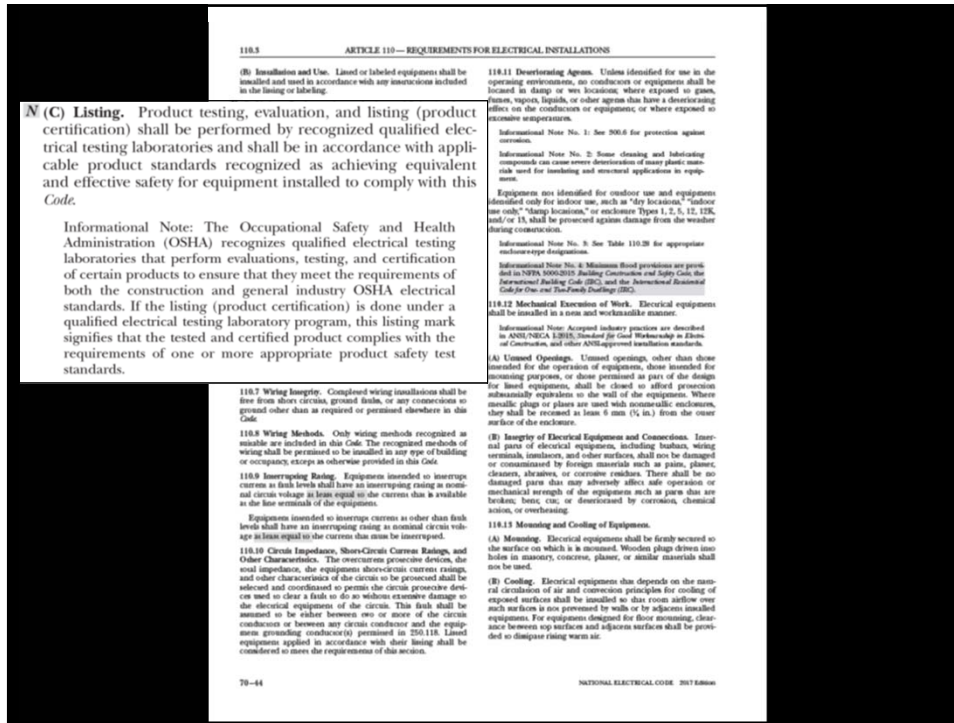
*Be aware of steel roof deck-related problems (and potential liability) associated with seam-fastened, mechanically-attached membrane systems*

**An NFPA 70 issue**

National Electrical Code







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The Heritage Resort & Spa Napa, CA

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**NRLRC News**

OSHA issues memorandum outlining enforcement of silica standard

Contract provision to provide roofing contractor with opportunity to appeal dispute resolution decision issued by "decision maker" designated by contract

[\[ More news \]](#)




### Contract provision obligating manufacturer and seller of equipment to roofing contractor to furnish equipment that is code-compliant

When purchasing a new piece of equipment, roofing contractors should beware of signing a seller's or manufacturer's standard purchase order agreement or agreeing to a seller's or manufacturer's standard terms and conditions. This agreement could include an express disclaimer of Uniform Commercial Code warranties of merchantability and fitness and will seek to limit the liability of the seller and the remedies available to the buyer in the event of a defect or problem with the product. Prior to making a purchase, the roofing contractor should obtain written assurance the equipment or product the contractor is purchasing complies with all codes, standards and regulations applicable to that equipment or product and its installation. Roofing contractors should be certain to include a provision to that effect in the purchase agreement.

For example, if your roofing company is in the market to purchase a sheet metal folding machine, it's important the sales agreement contain a provision such as the one above that obligates the seller to furnish a machine that will comply with all applicable codes and standards pertaining to the machine in the locality where you intend to install the machine. Such a provision is especially critical considering the 2017 edition of the NFPA 70, National Electrical Code (NEC), which jurisdictions could adopt as of Jan. 1. Article 110 of the 2017 NEC contains a new provision that has been interpreted as requiring all electrical equipment installed or used in a building undergo product testing, evaluation and listing (product certification) by a recognized qualified electrical testing laboratory in accordance with applicable product safety standards recognized by the NEC. If your business is in one of the states, cities, counties or towns throughout the U.S. that has adopted the 2017 edition of the NEC, in the absence of proof your new sheet metal folding machine complies with the NEC, code officials may not permit the newly purchased machine to be used. To

**Equipment and product purchase agreement:** The Seller and Manufacturer warrant to the Roofing Contractor that the equipment and product manufactured by Manufacturer and sold by Seller to Roofing Contractor will comply with all codes, standards and regulations applicable to the equipment and product in the jurisdiction where the equipment and product are delivered and intended for use, including the applicable electrical code and OSHA standards. No disclaimer or limitation of warranties of merchantability or fitness or other warranties by Seller or Manufacturer and no term or condition in the sales agreement shall cause or be interpreted to void, disclaim or reduce the obligation of the Seller and Manufacturer to furnish equipment and products that are in compliance with applicable codes, standards and regulations.

7/31/2018
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### Field Evaluations of Electrical Equipment

Are you struggling with the local authority? Has the local electrical inspector, or other Authority Having Jurisdiction (AHJ) "red-tagged" your equipment without a mark of compliance to electrical safety standards? Intertek's experts can be onsite within 24 hours in response to a red-tag event. What's more, our experts are on hand to answer your questions.

- Need an Intertek expert on site within 24 hours? Call 1-800 WORLD LAB and ask for Field Labeling help.
- Need advice on how to handle a red-tag event? Call 1-800 WORLD LAB and ask for a Field Labeling expert.
- Want to learn about the fastest Field Labeling team in North America? [Download a free copy of our fact sheet.](#)

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## New 2018 I-codes



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### roofwinddesign

ASCE 7-16, ASCE 7-10 and ASCE 7-16

Roof Wind Designer is intended to provide users with an easy-to-use means for determining roof systems' design wind loads for buildings that are subject to building code compliance.

Roof Wind Designer is derived using the American Society of Civil Engineers (ASCE) Standard ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," (ASCE 7-16). This standard is a widely recognized consensus standard and is referenced in and serves as the technical basis for the International Building Code and NFPA 5000: Building Construction and Safety Code. Roof Wind Designer allows users to choose from three methods of design: ASCE 7-16's Method 1—Simplified Method, ASCE 7-10's Envelope Procedure, and ASCE 7-16's Envelope Procedure, Part 2: Low-rise Buildings (Simplified) of Chapter 30, and Part 2: Low-rise Buildings (Simplified) of Chapter 30, and Part 2: Low-rise Buildings (Simplified) of Chapter 30, and Part 2: Low-rise Buildings (Simplified) of Chapter 30.

**ASCE 7-16**  
Increased design wind-uplift loads may present challenges  
by Mark S. Graham


In June 2017, the American Society of Civil Engineers (ASCE) published an updated edition of ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," (ASCE 7-16). Because ASCE 7-16 is referenced in the International Building Code, ASCE 7-16's design wind-uplift loads for roof assemblies typically are determined using ASCE 7-16's Chapter 30 Wind Loads, Components and Cladding.

Chapter 30 provides three methods—referred to as "Parts"—for wind load determination. Part 1 applies to low-rise, enclosed or partially enclosed buildings. Part 2 is a simplified approach applicable to low-rise, enclosed buildings. Part 3 applies to enclosed or partially enclosed buildings.

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**Keeping an eye on I-CODES: Part one**

**Keeping an eye on I-CODES: Part two**

**Changes to the 2018 codes affect roof assemblies**

**Professional Roofing, December 2017**  
[Link to access this article](#)

**Professional Roofing, January 2018**  
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## Roof drain concerns

## Roof drainage

### SECTION 1502 ROOF DRAINAGE

[P] 1502.1 **General.** Design and installation of roof drainage systems shall comply with Section 1502 of this code and Sections 1106 and 1108, as applicable, of the *International Plumbing Code*.

[P] 1502.2 **Secondary (emergency overflow) drains or scuppers.** Where roof drains are required, secondary (emergency overflow) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. The installation and sizing of secondary emergency overflow drains, leaders and conductors shall comply with Sections 1106 and 1108, as applicable, of the *International Plumbing Code*.

1502.3 **Scuppers.** Where scuppers are used for secondary (emergency overflow) roof drainage, the quantity, size, location and inlet elevation of the scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1611.1. Scuppers shall not have an opening dimension of less than 4 inches (102 mm). The flow through the primary system shall not be considered when locating and sizing scuppers.

1502.4 **Gutters.** Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or not less than Schedule 40 plastic pipe.

### CHAPTER 11 STORM DRAINAGE

Over note:  
About this chapter: Detailed roof building must be reviewed and checked to ensure that an appropriate storm water Chapter 11 code flow the design needed exist for the program area and provide sizing methods for piping and gutter systems to remove the storm water away from the building. Included in this chapter are regulations for piping materials and related drainage systems.

### SECTION 1105 ROOF DRAINS

1105.1 **General.** Roof drains shall be installed in accordance with the manufacturer's instructions. The inside opening for the roof drain shall not be obstructed by the roofing membrane material.

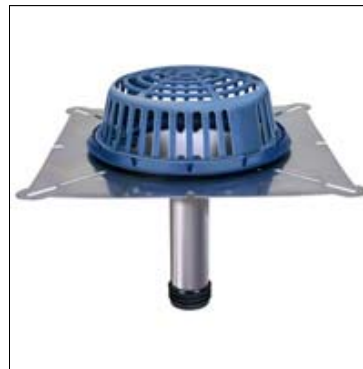
1105.2 **Roof drain flow rate.** The published roof drain flow rate, based on the head of water above the roof drain, shall be used to size the storm drainage system in accordance with Section 1106. The flow rate used for sizing the storm drainage piping shall be based on the maximum anticipated ponding at the roof drain.

### SECTION 1106 SIZE OF CONDUCTORS, LEADERS AND STORM DRAINS

1106.1 **General.** The size of the vertical conductors and leaders, building storm drains, building storm sewers and any horizontal branches of such drains or sewers shall be based on the 100-year hourly rainfall rate indicated in Figure 1106.1 or on other rainfall rates determined from approved local weather data.



Primary roof drain



Retrofit roof drain insert


### **NRCA's interim recommendations**

Roof drainage concerns

- Be cautious of roof drain issues, particularly in reroofing situations
  - IBC 2009 adds secondary drainage
  - IBC 2015 provides exception
  - IPC 2015 and IPC 2018 changes
- Assure membrane opening is larger than drain outlet/piping opening
- Be cautious of retrofit drain inserts
- Consider proposal/contract language

### **FM's very severe hail (VSH) classifications**

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**Understanding FM VSH**  
 FM has implemented a new impact-resistance classification  
 by Mark S. Graham

**Commercial and industrial owners** FM Global and its endorser, testing agency Intertek, FM Approvals, have implemented a Very Severe Hail (VSH) impact resistance classification that could affect some of the work you do.

**FM Global guidelines**  
 FM Global traditionally has recommended its insured building owners use minimum hail (50) and severe hail (20) classified roof systems for buildings located in areas FM Global considers to be susceptible to moderate or severe hail impacts. FM Loss Prevention Data Sheet 1-34 (FM 1-34), "Hail Damage," provides some clarifying information.


In recent years, the U.S. insurance industry has experienced increases in losses from hail in terms of the number of claims reported and costs of those claims. A majority of the hail damage occurs in rural settings and often results in crop damage.

In the latest version of FM 1-34, dated October 2016, FM Global has identified a new VSH region, encompassing Oklahoma, Kansas and some southern counties in Texas. FM 1-34 Table 1 identifies the specific southern Texas counties.

To access FM Global Data Sheets, including FM 1-34, "Hail Damage," go to [www.professionroofing.net](http://www.professionroofing.net)

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**Designing for hail resistance**  
 Did you know FM Global has updated its hail design guidance?  
 by Mark S. Graham

**As March, property and building loss insurer** FM Global updated its Property Loss Prevention Data Sheet 1-34, "Hail Damage" (FM 1-34). If you work on building interiors FM Global, you should be aware of its latest hail resistance guidelines and the effects they may have on roof system selection and design.

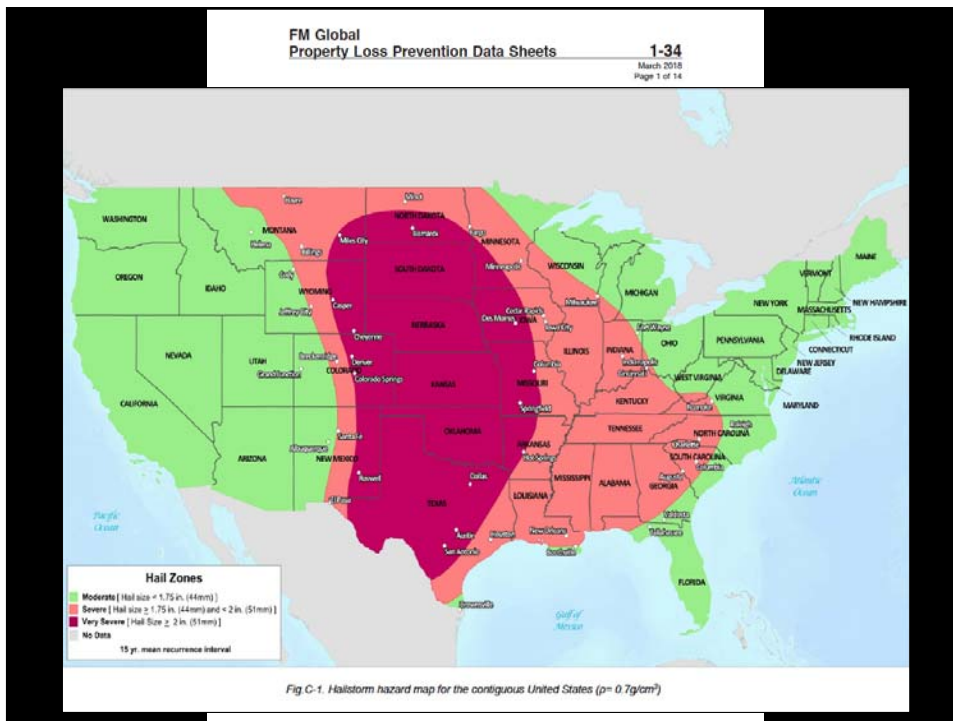
**FM 1-34**  
 FM 1-34 provides loss prevention guidelines to minimize the potential for hail damage to buildings and associated equipment and other outdoor equipment. FM Global intends FM 1-34 and its other Property Loss Prevention Data Sheets to apply to the insured building. However, some designers use the Property Loss Prevention Data Sheets as design guidelines for buildings (and not systems) other than those insured by FM Global.

FM Global routinely holds seminars a worldwide basis offering many areas of the world that are severely damaged buildings' and systems, including HVAC units and skylights. Cooling towers and exposed glass and plastic components of outdoor equipment also can be

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Of the 893,384 roof assemblies in FM's RoofNav,  
only 291 have a VSH classification

As of Sept. 4, 2018

**Attic ventilation**



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**Clearing the air**  
Considerations for attic ventilation  
by Mark S. Graham

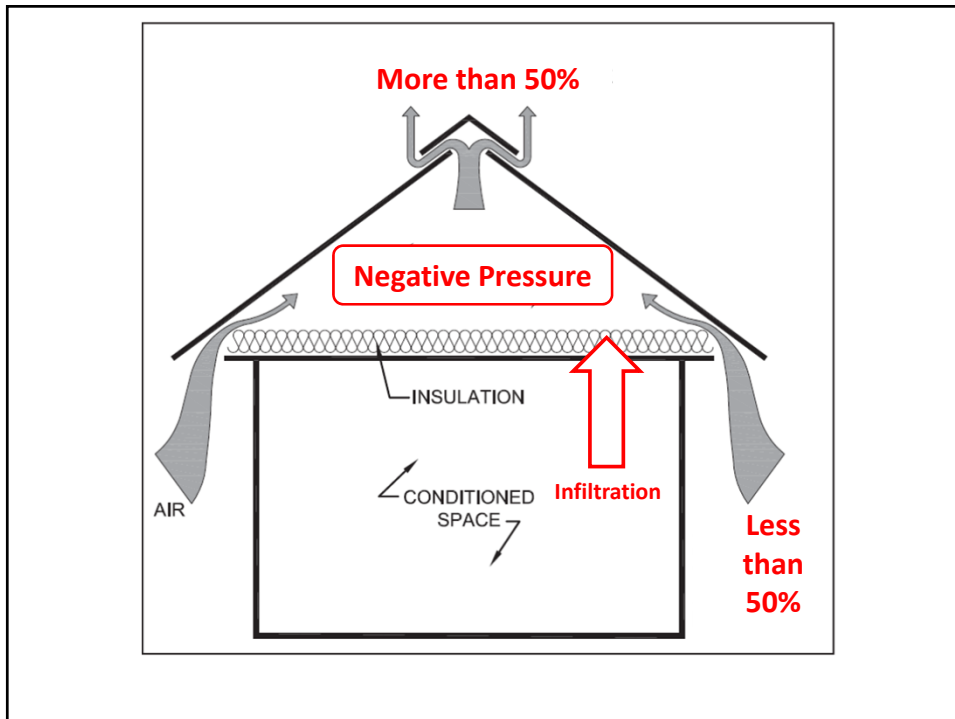
**P**roper attic ventilation can be an important consideration when specifying high-performance, energy-efficient roof assemblies. For example, with some asphalt-shingle products, proper attic ventilation may be a warranty requirement. Following is a review of code requirements and NRCA guidelines for attic ventilation in energy-efficient roof assemblies.

**Code requirements**  
Code requirements for attic ventilation have varied between the International Building Code® (IBC) and International Residential Code® (IRC) and have changed with each edition up to the 2018 editions. Beginning with the IBC and IRC's 2015 editions, both codes require the net free ventilating area (NFVA) to be at least a 1:300 ratio of the space being vented. Any blocking or hanging in attic must not interfere with air movement, and an air space of at least 1 inch must be provided between the bottom of the roof deck and any insulation. Vent openings must protect against the entrance of rain and snow and be installed according to manufacturer's installation instructions.

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*Be careful not to install excess amounts of ridge  
vents.... It can have undesirable consequences*

**The “fully” adhered misnomer**



**The fully adhered misnomer**  
 Terminology can create unrealistic expectations within the roofing industry  
 by Mark S. Graham

**NRCA**  
recommends  
the term "fully  
adhered" be  
avoided

defined, the  
to 100 percent  
to or essential.

professionals  
system adhere  
to an angle-  
rigid board  
fully cannot be

one, complete  
membrane and  
one to improve  
membrane  
with joints.  
to installation  
time needs to be  
U.S. product  
installation,  
verification  
acceptance  
removes a board  
to and creating  
to stick in depth  
acceptance  
to. Because  
ions tend to lap  
roof membrane  
to and remain  
optimal integra-  
tibility.

Irregular, non-smooth roof deck surfaces  
create similar situations. Because board type  
insulation is relatively rigid, it generally will  
not readily conform to irregularities in roof  
deck substrates. Individual rigid boards tend  
to rest on the high points in a roof deck's flu-  
ished surface and span the low points.  
As a result, rigid board insulation seldom

is completely adhered to roof deck substrates.  
It generally is adhered at the relative high  
points in the roof deck's surface and may  
be partially or marginally adhered and even  
unadhered at the relative low points. Specifying  
single membrane board sizes (4 by 4 feet  
instead of 4 by 8 feet) generally is suggested  
to minimize rigid insulation board spans from  
spanning substrate low-point irregularities.

In practice

The concept of lacking 100 percent, com-  
plete adhesion between two adhered surfaces  
is not new to the roofing industry; it has long  
been recognized in the application of built-  
up roof membranes where weak between-  
ply joints occur. To address this, NRCA's  
Quality Control Guidelines for the Applica-  
tion of Built-up Roofing indicates interply  
overlapping are intended to be continuous;  
however, weak or limited size are permitted  
provided overlapping weak do not occur  
between two or more plys. NRCA has main-  
tained this position since the late 1970s, and  
it has become well-accepted by the roofing  
industry.

As it applies to adhering rigid board insu-  
lation to continuously applied adhesive appli-  
cations, actual adhesion rates of about 60 to  
70 percent are common (even less in some  
specific instances) in successfully performing  
adhered roof systems.

On this basis, NRCA recommends the  
term "fully adhered" be avoided and suggests  
the term "adhered" for field applications  
because it is more realistic. ■■■

MARK S. GRAHAM is NRCA's vice president of  
technical services.

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**January 2017**

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**Questions... and other topics**

NRLRC Conference - Roofing Issues: Decks to Dockets

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