



**2018 MiRCA Annual Convention**

July 26-29, 2018

Treetops Resort – Gaylord, MI

## **Roofing industry technical issues**

presented by

**Mark S. Graham**

Vice President, Technical Services  
National Roofing Contractors Association



## **Topics**

- Moisture in concrete roof decks
- Wind uplift concerns with steel roof decks
- ASCE 7-16
- “Fully” adhered
- Field wind uplift testing
- Metal stud walls & perimeter membrane attachment
- NRCA programs

**Moisture in concrete roof decks**







### Some terminology

- **Structural concrete (normal weight)**
  - 150 lbs/ft<sup>3</sup>
- **Lightweight structural concrete**
  - 85–120 lbs/ft<sup>3</sup>
- ~~**Lightweight insulating concrete**~~
  - 20–40 lbs/ft<sup>3</sup>

### **Concrete mix design**

- Aggregate:
  - Large aggregate
  - Fine (small) aggregate
- Portland cement
- Water
- Admixtures:
  - Fly ash
  - Air entrainment
  - Curing compounds
  - Etc.

### **Concrete Aggregates**

60-80% of Concrete Mix Design

- Normal-weight aggregates (stone):
  - Dense
  - Absorb about 2% by weight
- Light-weight aggregates (expanded shale):
  - Porous
  - Absorbs from 5 - 25% by weight

***Lightweight structural concrete  
inherently contains more moisture***

### **An up-close look**



### **Uses for lightweight structural concrete**

- Cast-in-place roof decks (removable forms)
- Composite roof decks (metal form deck stays in-place)
- Deck topping (e.g., topping over precast concrete)

## What is the appeal?



Water Tower Place (1975)  
Chicago, IL  
859 feet tall

- Reduced weight:
  - Transportation
  - Pumping
  - Placement
  - In-place (Dead load)
- Similar strength
- Similar workability:
  - Begin finishing earlier
- Sustainability credit:
  - LEED

## Reported roofing-related problems

- Moisture within the roof system
- Loss of adhesion
- Insulation facer delamination
- Adhesive curing issues
- Mold growth
- Fastener/metal corrosion
- R-value loss

## **When is it OK to roof?**

Historical guidelines

- After 28 days
- Application of hot bitumen
- Plastic film test
  - ASTM D4263, “Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method”

***These guidelines are not appropriate for current generations of concrete mixes***

## **Flooring industry**

ASTM Committee F06—Resilient Floor Coverings

- ASTM F1869, “Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride”
- ASTM F2170, “Standard Test Method for Determining Humidity in Concrete Floor Slabs Using In-situ Probes”



### ASTM F2170 apparatus

Measure relative humidity (RH %) and temperature

### Trial ASTM F2170 tests

Existing lightweight structural concrete roof decks

	Roof 1	Roof 2	Roof 3
Roof age (yrs)	4	7	7
Area (ft <sup>2</sup> )	13,200	23,840	14,760
Thickness (in.)	6.5	7.5	7.3
No. of readings	13	10	8
High reading	99% RH	99% RH	99% RH
Low reading	63% RH	96% RH	84% RH
Median reading	97% RH	99% RH	99% RH
Mean reading	89% RH	99% RH	95% RH

*Values of 65-85% RH are considered acceptable in the flooring industry depending upon the specific floor covering type.*

## Concrete Floors and Moisture, 2<sup>nd</sup> Edition

Howard M. Kanare, CTL Group

75% internal RH can be achieved:

- Normal weight structural concrete
  - Less than 90 days
- Lightweight structural concrete
  - Almost 6 months

## 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 water content, 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 aggregates 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.** Excessive moisture can affect adhesive curing and drying time. Also, moisture can result in adhesive "bleeding," resulting in bond strength loss.
- **Moist and faster 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

### Conclusions

- Concrete roof decks – normal weight and light-weight structural – present challenging moisture-related considerations.
- Further complicated by the use of admixtures and method of finishing.
- NRCA does not support the 28-day drying period or the plastic sheet test


### Conclusions - continued

- Roofing contractors can only visually assess the dryness of the concrete's top surface
- Roofing contractors cannot readily assess any remaining free moisture within concrete or its likely release

***Roofing contractors are not privy to and may not be knowledgeable about the information necessary to make "...when to roof..." decisions***

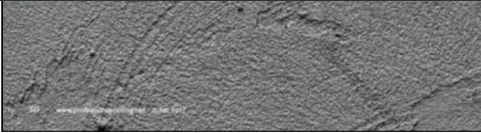
## Professional Roofing

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.



## Moisture on concrete roof decks

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

**N**ISCA continues to receive a significant number of reports of moisture-related problems associated with concrete roof decks. Following a recent background investigation and NISCA board recommendations for addressing the issue.

**What's happened?**  
The issue of moisture in concrete roof decks is not new. Since 2000, NISCA 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, excessive heat, delamination with water-based and the evaporation of organic solvents, mold and bacteria growth, moisture in vapor barrier and structural joints.

Since the 2005 publication of the NISCA Building Waterproofing Manual, Fifth Edition, NISCA no longer considers the plastic sheet use method as a viable approach to distribute a concrete roof deck dry. moisture and vapor application. Also, there is still no correlation between concrete 28-day curing period and the "dryness"

20 www.professionalroofing.net SEPT/NOV 2017

**Professional Roofing,**  
Sept. 2017

**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.”

**Wind uplift concerns with steel roof decks**

### **Steel roof deck design**

- SDI Design Manual
- AISI S100, “Specifications for the Design of Cold-formed Steel structural Members”
- ANSI/SDI RD1.0-2006, “Standard for Steel Roof Deck”
- ANSI/SDI RD-2010, “Standard for Steel Roof Deck”
- *SDI Roof Deck Design Manual, First Edition* (Nov. 2012)


### **Steel roof deck design**

Wind uplift resistance

- Minimum 30 psf uplift (uniform loading)
- Minimum 45 psf uplift (uniform loading) at roof overhangs

## SDI bulletin

2009



**STEEL DECK INSTITUTE**  
Position Statement

**ATTACHMENT OF ROOFING MEMBRANES TO STEEL DECK**

This document has been published by the Steel Deck Institute (SDI) as a position paper in response to discussions taking place in the roofing community about the screw attachment of roofing membranes to steel deck following line patterns with large spacing. The impetus for this paper is in response to testing carried out by the Special Interest Group for Dynamic Evaluation of Roofing Systems (SIGEDRS) at the Institute for Research in Construction, National Research Council of Canada. The mandate of the SIGEDRS joint research program is to carry out generic, peer competitive research on the performance of flat roofing systems subjected to dynamic wind loading. The objective is to develop improved roofing systems and design methods.

The SIGEDRS research is looking at roofing systems that incorporate wide membrane sheets attached to the steel deck following line patterns spaced at up to 12 ft (3.66 m). While the membrane itself has the performance characteristics to accommodate this size of tributary loading, the existing design methods for steel deck under wind uplift are typically based on the uniform application of the wind suction to the deck. The large majority of the steel roof deck used for commercial buildings in North America is profiled with 1 1/4" DB metal flutes, with the structural supports usually spaced between 5' 0" (1.52 m) and 6' 0" (2.03 m). Under uplift conditions, the attachment of the roofing membrane along lines with large spacing could produce localized loads that can exceed the capacity of the deck, whereas those same loads applied uniformly on the surface of the deck would be acceptable.

The strength of screwed connection between the membrane and the steel deck, as well as the strength of screwed, nailed, or welded attachment of the steel deck to the structural supports can be computed according to the North American Specification for the Design of Cold-Formed Steel Structural Members. These design values are based on the specified minimum mechanical properties (i.e. base steel thickness and yield strength) specified for the steel sheet roof deck, and should be lower than the strength determined by field testing. The use of field test results for properties such as the pull-out strength of a screw into a steel deck needs to recognize that the properties of the steel deck can be higher than the minimum limits required by the steel specifications. Therefore, field testing results must be adjusted accordingly to account for the difference between the actual properties of the deck and the minimum properties of the steel according to the material specification used in design.

The screw fastening of wide roofing membranes (up to 12 ft) and the corresponding spacing of the lines of screws holding the membrane on the deck, will have a very different effect on the deck and structural supports than a membrane that is adhered over its entire surface. The screws will produce a line load along the deck instead of a uniform load of the entire deck surface. The line loads can be perpendicular or parallel to the deck flutes depending on the orientation of the membrane; each condition can have different implications of the loading that is applied to the deck.

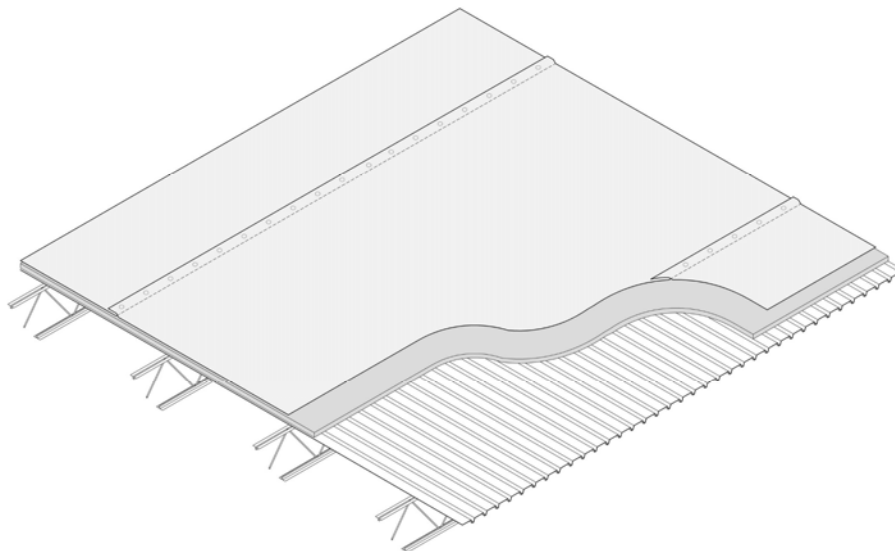
If the roofing membrane seam is perpendicular to the flutes of the deck, as illustrated in Figure 1, there are two special conditions that need to be considered:

1. If the membrane seam occurs at the mid-span of the steel deck; and
2. If the membrane seam occurs at the structural support (joist).

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- Decks designed for joist spacing between 5' and 6' 8" o.c.
- Decks designed for uniform loading
- Seam-fastened single-ply membranes are a concern

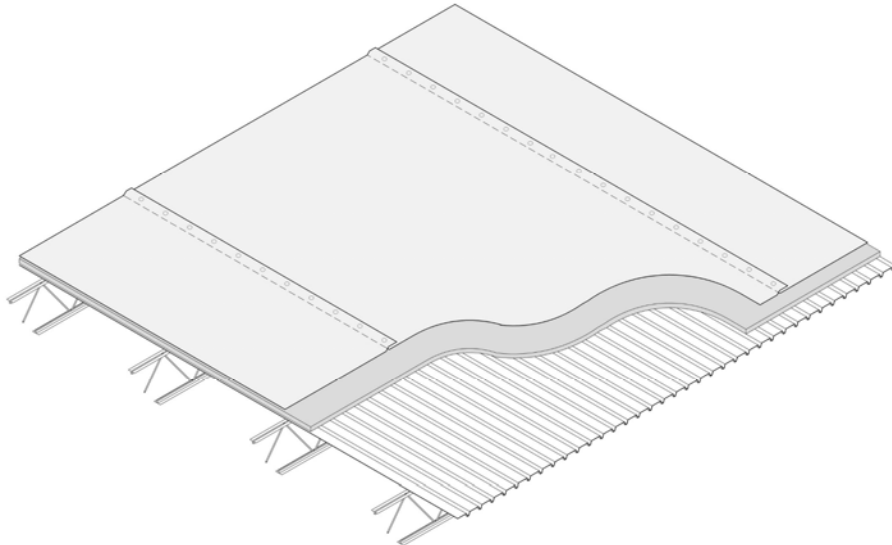
### Membrane seams across deck flutes



SDI: 3.8 X moment (deck); 2 X load (joists)



**Membrane seams in deck flute direction**



SDI: 12 X bending moment and shear (deck)

**SDI bulletin -- Conclusion**

“...SDI does not recommend the use of roofing membranes attached to the steel deck using line patterns with large spacing unless a structural engineer has reviewed the adequacy of the steel deck and the structural supports to resist to wind uplift loads transmitted along the lines of attachment. Those lines of attachment shall only be perpendicular to the flutes of the deck.”

## FM's guidelines

- FM 4451, 1978 edition (Steel roof deck)
- FM 4451, June 2012 edition (Steel roof deck)
  - Incorporates AISI S100-07
- FM 4470, June 2012 edition (Roof systems)



### Changes reduce some FM classifications

FM 4470 has been revised, resulting in different uplift resistance criteria

by Mark S. Graham

FM Approvals has revised its criteria for determining the uplift resistance of membrane and liquid-applied roof assemblies. Because many roofing professionals rely on FM Approvals' classifications when designing and specifying low-slope roof assemblies, you should be aware of the change made and their effect on specific roof assembly classifications.

**FM 4470**  
 FM 4470, "Approved Standard for Single-Ply, Polymer-Modified Bitumen Sheets, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction," is the basis for FM Approvals' determination of 1-60, 1-90, 1-120, etc., classifications used for low-slope membrane and liquid-applied roof assemblies.

In June 2012, FM Approvals revised FM 4470; the effective date of the new standard was Dec. 31, 2012. The revisions include adding NFPA 276, "Standard Method for the Test for Determining the Fire Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components," to determine combustibility below the roof deck; changes to the conditions of acceptance for wind uplift and damage resistance testing; and adding an alternative test method for determining fastener corrosion resistance.

One of the most significant changes to FM 4470 is how and roof decks are evaluated. With the revised standard, roof deck characteristics exceed the allowable stresses provided for in AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members." The maximum allowable deflection for steel roof decks is based on a 200-pound point load per square foot, and 300-pound point load was used. Also, minimum design of roof deck steel now are based on

a minimum 57-ounce-thick (slightly less than 22-gauge), 33-ksi yield strength steel. Previously, minimum 6.75-ounce-thick (22-gauge) steel complying with the ASTM International specification was used for evaluation.

The method of analyzing attachment of roof decks also has been revised. Check fasteners now are used for fastener "pull-out" (pull strength) of the deck material. Also, some calculations are performed on both steel decks and fastener heads, and the lower of the two values is used as the basis for classification.

FM 4470 also now includes additional provisions allowing for optional testing for dynamic pressure resistance of roof coverings, noncombustible core for roof insulation and solar reflectance of roof surfaces.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements. Products FM Approvals already approved under previous editions of FM 4470 also need to comply with the current edition by the effective date or fabric classification.

**What this means**  
 If a specific classified assembly meets in an unmodified steel roof deck, FM Approvals has, upon consultation with the manufacturer, either changed the assembly parameters to compensate for the deck increase or reduced the assembly wind rating to a level where the deck no longer is overstressed. Assembly parameters likely changed include reducing the deck span and/or increasing the deck's roof thickness and/or yield strength (from 33 ksi to 60 ksi).

For assemblies where the wind rating has been reduced, the manufacturer's previous Roof-Nor numbers have been withdrawn and new Roof-Nor numbers issued to avoid confusion.

If you use the new version of FM 4470 for an allowed roof assembly applied to a 160-ounce-thick, 22-gauge steel deck as a 6-foot maximum span, FM Approvals has indicated minimum classifications are limited to 1-105 when using a 33-ksi steel deck and 1-300 when using a 60-ksi steel deck. For non-vented mechanically attached single-ply membrane assemblies, classifications will vary based on assembly parameters and span for new roof spacing, but generally classifications will be noticeably lower than with FM 4470's previous version.

**Proceed cautiously**  
 Roof system designers and specifiers need to be aware of FM 4470's revision and its effect on assembly parameters, uplift ratings and Roof-Nor numbers for membrane and liquid-applied roof assemblies using steel decks.

For roofing projects designed before the implementation date but that will be installed after the implementation date, classification needs to be sought regarding which version of FM 4470 applies. If the current version applies, changes to the roof assembly specification may be necessary and affect a project's permitting and design team.

For more information, contact your local FM Approvals office or visit [www.fmaprovals.com](http://www.fmaprovals.com).

**MARK S. GRAHAM** is FM Approvals' executive director of technical services.

## Professional Roofing

January 2013

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## FM's guidelines

- FM 4451, 1978 edition (Steel roof deck)
- FM 4451, June 2012 edition (Steel roof deck)
  - Incorporates AISI S100-07
- FM 4470, June 2012 edition (Roof systems)
- FM 1-29, January/April 2016 (Securement)

## FM 1-29 updated

[www.fmglobalsdatasheets.com](http://www.fmglobalsdatasheets.com)

FM Global Property Loss Prevention Data Sheets		1-29
		January 2016
		Version: Revision April 2016
		Page 1 of 40
<b>ROOF DECK SECUREMENT AND ABOVE-DECK ROOF COMPONENTS</b>		
Note to Insuree of Factory Mutual Insurance Company: Contact the local FM Global office before beginning any roofing work.		
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### New criteria for steel roof deck uplift:

- Uniformly-distributed loading
- Concentrated loading

### **An example**

Hypothetical analysis using FM 1-29

- Adhered (uniform loading) roof system:
  - 6 ft. joist spacing → Class 165
- Seam-fastened (nonuniform, linear load) roof system:
  - 6 ft. seam spacing → Class 90 (33 ksi steel deck)
  - 9.5 ft. seam spacing → Class 90 (80 ksi steel deck)
  - 6 ft. seam spacing → Class 165 (80 ksi steel deck)

***Seam spacing wider than joist spacing begins to get problematic***

### **NRCA's recommendations**

Uniformly-loaded vs. non-uniform, linear pattern loaded steel roof decks

New construction:

- Structural engineer awareness of roof system design
  - Note load pattern and steel's yield strength on structural drawings and shop drawings
- Roof system designer awareness of steel roof deck design

### **NRCA's recommendations – cont.**

Uniformly-loaded vs. non-uniform, linear pattern loaded steel roof decks

#### Reroofing:

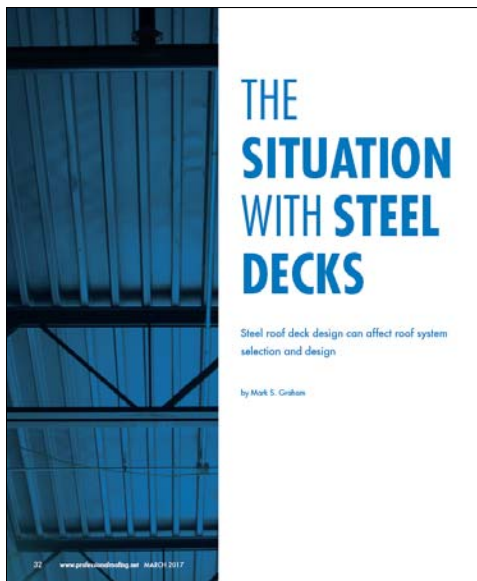
- Realize steel roof decks are not likely designed to current SDI, FM Global and FM Approvals' standards
- If steel deck design cannot be verified:
  - Use narrow fastener row/seam spacing (rows/seams  $\leq$  joist spacing)
  - Use a uniform uplift loading roof system (BUR, MB, adhered single ply)

### **Fastener pull-out tests...**

*There is little correlation between fastener pull-out resistance and a steel roof deck's yield strength and uplift (bending) strength*

*Although roofing contractors sometimes are given the responsibility of inspecting and accepting steel roof decks to receive a new roof system, determining a roof deck's design adequacy is beyond the expertise of most roofing contractors.*

*This determination is best made during a project's design phase.*



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March 2017  
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**CONSTRUCTION ISSUES**

discussion of construction issues and techniques

**Are Your Roof Members Overstressed?**

By James M. Fisher, Ph.D., PE, DNS, M.ASCE and Thomas Shaw, Ph.D., PE, S.E., FASCE

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30 March 2017

**M**embrane roof systems installed on steel roof decks traditionally result in a uniform transfer of wind (uplift) loads from the roof membrane to the steel roof deck and underlying supporting structure (e.g., steel joist). For example, in a built-up membrane roof system — which has been used commonly in the U.S. roofing industry for more than 125 years — the built-up membrane is continuously adhered to rigid roof insulation. The rigid roof insulation, which is used to span the steel deck's flutes, is mechanically attached to the steel roof deck in a closely-spaced pattern (e.g., 1 fanner per every 2 square feet), resulting in a near uniform uplift load path. Polymer-modified bitumen roof systems and adhered single-ply membrane roof systems are installed in similar configurations and result in a similar uniform uplift load path.

In the 1960s, single-ply membrane roof systems were first introduced into the U.S. roofing market. By the late 1970s, the seam-fanned, mechanically attached method of installation was first introduced. With this membrane method, the single-ply membrane sheet is mechanically attached along its outer edges into the roof deck, which results in a larger arbitrary uplift load per fanner and placement of fans in an linear, non-uniform loading configurations of the roof deck and underlying supporting structure. When first introduced, membrane sheet widths in seam-fanned single-ply membrane roof systems typically were five feet wide, resulting in rows of mechanical fasteners spaced at six feet on-center. Since the early 2000s, single-ply membrane sheet widths have become wide, with 16-foot-wide sheets now commonplace — resulting in rows of mechanical fasteners spaced at 16 feet on-center.

Currently, single-ply membrane roof systems have clearly overtaken conventional built-up and polymer-modified bitumen membrane systems in market share. The seam-fanned, mechanically attached method of installation also has overtaken traditionally adhered methods of application. The National Roofing Contractors Association (NRCA) annual market survey shows seam-fanned, mechanically attached single-ply membrane roof systems make up the majority of all membrane roof systems currently installed.

With the present emphasis on wind resistance in design, a closer look at how seam-fanned mechanically attached single-ply membrane roof systems interact with steel roof deck and joint construction is in order.

A common method of single-ply membrane sheet layout is shown in Figure 1. A common placement of mechanical fasteners is shown in Figure 2. These concentrated line loads can

severely overstress the steel deck and may also cause the steel joint below the deck to be overstressed under uplift loading. The behavior of such fastening systems, when the roof system is subjected to uplift loading, is shown in Figure 3. The current trend to accommodate for the membrane installer to mechanically fasten the membrane to the deck only along the edge of the sheet rolls to speed up the roof installation, thereby lowering installation costs. Unfortunately, the Structural Engineers of Record, and the steel deck and joint supplier, are usually unaware of the concentrated load pattern of the roof membrane attachment. In fact, the architect of record may not be aware of the ramifications of such attachments. The Architectural roofing specifications may simply state that the roof membrane shall be installed per manufacturer recommendations. The roofing install foreman is the one who generally decides on the exact layout of the membrane sheet on the roof. This decision is made based on what layout can be installed in the fastest and least expensive

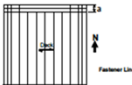


Figure 1. Typical membrane layout by rolls.

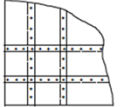


Figure 2. Seam-fanned layout of a membrane sheet.

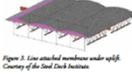


Figure 3. Line attached membrane under uplift. Courtesy of the Steel Deck Institute.

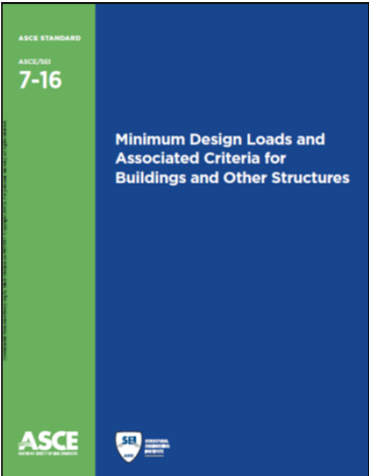
**Structure magazine**

March 2017

[www.structuremag.org](http://www.structuremag.org)

## New wind design method

ASCE 7-16



- Published in June 2017
- Referenced in IBC 2018
- Beginning to be implemented

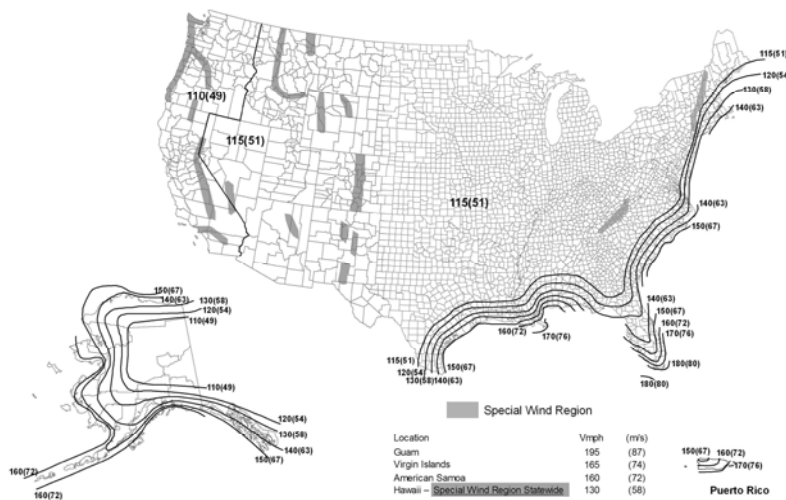
## ASCE 7-16's changes

- Revised basic wind speed map
- Changes (and new) pressure coefficients
- Revised perimeter and corner zones

*Expect higher field, perimeter and corner uplift pressures*

## ASCE 7-10 basic wind speed map

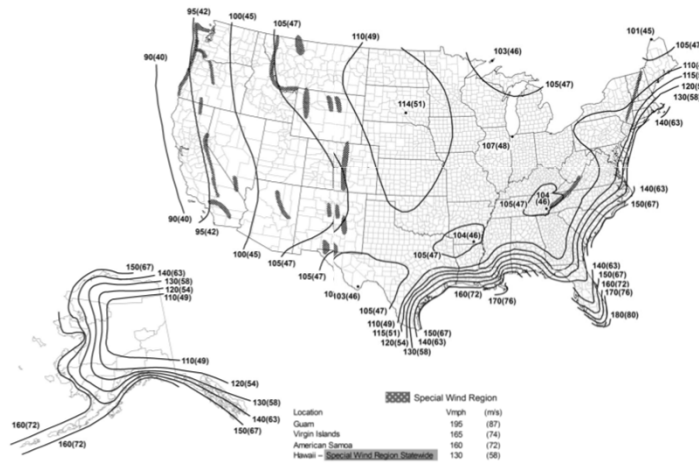
Fig. 1607A-- $V_{ult}$  for Risk Category II Buildings





## ASCE 7-16 (draft) basic wind speed map

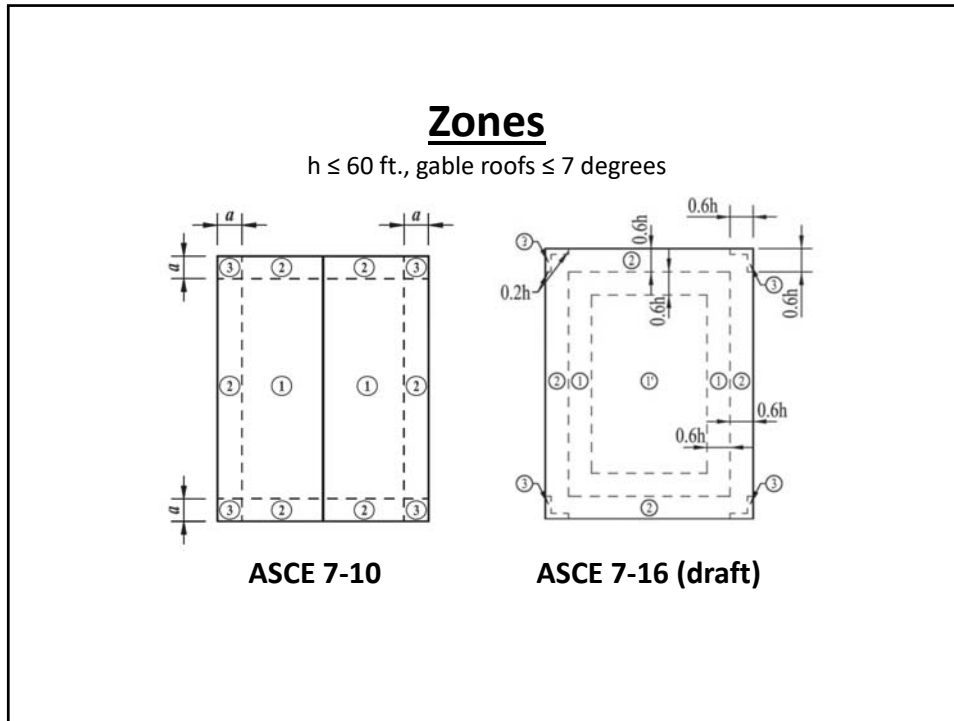
Risk Category II Buildings



## GC<sub>p</sub> pressure coefficients

h ≤ 60 ft., gable roofs ≤ 7 degrees

Zone	ASCE 7-10	ASCE 7-16 (draft)
1 (field)	-1.0	-1.7
1'	--	-0.9
2 (perimeter)	-1.8	-2.3
3 (corners)	-2.8	-3.2




### Comparing ASCE 7-05, ASCE 7-10 and ASCE 7-16

Example: A manufacturing building is located in Lansing, MI. The building is an enclosed structure with a low-slope roof system and a roof height of 40 ft. The building is located in an area that is 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	90	--	21.8	36.4	54.8
ASCE 7-10 Strength design	115	--	35.5	59.5	89.5
ASCE 7-10 ASD	89	--	21.3	35.7	53.4
ASCE 7-16 Strength design	110	29.7	51.7	68.1	92.8
ASCE 7-16 ASD	85	17.8	31.8	40.9	55.7

*Proper wind design (which is oftentimes avoided) is getting even more complicated.*

**“Fully” adhered**


TECH TODAY

### 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** 100 percent or more.

**professionals** apply adhesive in a single rigid board fully cannot be

**one, complete** membrane and use to improve membrane seal joints.

**in insulation** film needs to be U.S. product insulation, verification requirements require a board to be installed in such a depth accuracy.

**to become** ions tend to lap roof membrane to and remain captured completely.

**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 finished 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 smaller insulation board sizes (4 by 4 feet instead of 4 by 8 feet) generally is suggested to minimize rigid insulation boards from spanning substrate low-point irregularities.

**In practice**

The concept of lacking 100 percent, complete 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-plies can occur. To address this, NRCA's Quality Control Guidelines for the Application of Built-up Roofing indicates interply overlapping joints should be continuous; however, weak joints are permitted provided overlapping joints do not occur between two or more plies. NRCA has maintained this position since the late 1970s, and it has become well-accepted by the roofing industry.

**As it applies to adhering rigid board insulation** to continuously applied adhesive applications, 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.

## Professional Roofing,

### January 2017

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[www.professionroofing.net](http://www.professionroofing.net) JANUARY 2017

# Field uplift testing

## Field uplift testing

- ASTM E907, “Standard Test Method for Field Testing Uplift Resistance for Adhered membrane Roofing Systems”
- FM 1-52, “Field Verification of Roof Wind Uplift Resistance”



INDUSTRY ISSUE UPDATE

NRCA Member Benefits

### Field-uplift testing

ASTM E907 and FM 1-52 tests continue to be problematic

June 2015

**N**RCAs continue to receive a significant number of requests from roofing contractors, manufacturers and designers regarding the use of and problems associated with field uplift tests to pre-qualify quality assurance measures for membrane roof systems. NRCA has addressed these testing issues a number of times during the year, following a consensus of NRCA's previous discussions, as well as updated information and recommendations.

**ASTM E907/FM 1-52**

There are two recognized field test methods for determining adhered membrane roof system uplift resistance: ASTM E907, "Standard Test Method for Field Testing Uplift Resistance of Adhered Membrane Roofing Systems," and FM Global Loss Prevention Division 1-52, FM 1-52, "Field Verification of Roof Wind Uplift Resistance."

Both test methods are similar and provide for affixing a 3- by 3-foot diameter chamber to a roof surface's top edge and applying a defined negative uplift pressure inside the chamber to the roof system's exterior side surface using a vacuum pump (see photo).

During the test, membrane surface deflection inside the chamber is visually measured and recorded to determine whether a roof system passes or is "suspect."

Using ASTM E907, a roof system is considered to be suspect if the deflection measured during the test is 25 mm (about 1 inch) or greater. During FM 1-52 testing, a roof system is suspect if the measured deflection is between 1/4 of an inch and 3/4 of an inch, depending

on the maximum test pressure, 1 inch when a thin trapping board (over board) is used or 2 inches when a thin over-board or flexible, mechanically attached insulation is used.

If an ASTM E907 or FM 1-52 test yields a suspect result, a test cut should be taken in the test area to determine whether failure has occurred and the specific failure mode.

ASTM E907 and FM 1-52 differ mainly in their test cycles and maximum test pressures for determining roof system deflection and whether a roof system passes or is suspect. ASTM E907 testing is conducted in 15 pounds per square foot (psf) pressure intervals up to the calculated design wind uplift pressure for the specific roof system being evaluated. FM 1-52 testing is conducted using an initial 15 psf test pressure followed by 7 1/2 psf test increments up to a maximum test pressure of 120 times the design uplift pressure for the specific roof system being evaluated.

Considering maximum test loading and allowable test deflection in combination, FM 1-52 requires 25 percent higher test loads, yet only allows as little as 1/4 the test deflection of ASTM E907. The fact FM 1-52 is a significantly more stringent test than ASTM E907, ASTM E907 originally was published as a recognized consensus standard in 1993, and it was revised in 1996. In 2013, ASTM withdrew ASTM E907 because a consensus could not be reached regarding necessary revisions – most significantly, defining the test methods' position and test frequency. ASTM E907 will be available for use and can be obtained directly from ASTM's website, [www.astm.org](http://www.astm.org).

FM 1-52 is an FM Global-proprietary evaluation method and not a recognized industry consensus test standard. FM 1-52's scope indicates it only is intended to confirm acceptable wind-uplift resistance on completed roof systems in hurricane-prone regions, where a partial blow-off has occurred or where interior roof system construction is required or known to be present.

FM 1-52 originally was published by FM Global in October 1976. The negative pressure uplift test was added in August 1988 and has been revised several times. The current edition is dated July 2012 and includes an option for "visual construction observation (VCS)" as an alternative to negative pressure uplift testing. VCS provides for full-time, third-party monitoring of a roof system application to verify roof system installation in accordance with contract documents.

## NRCA “Industry Issue Update,” June 2015

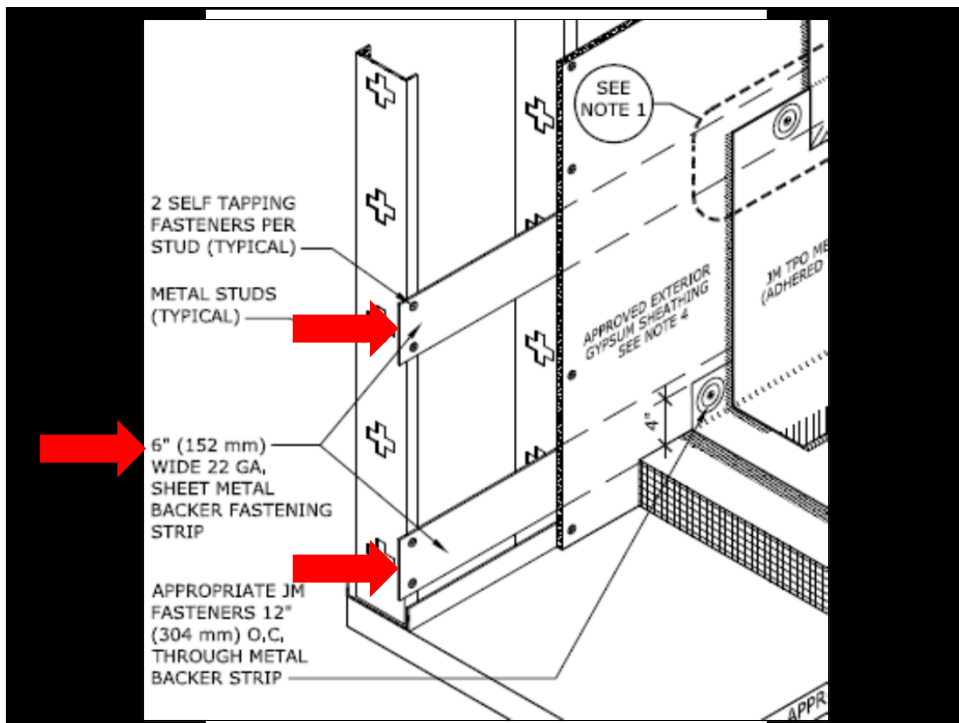
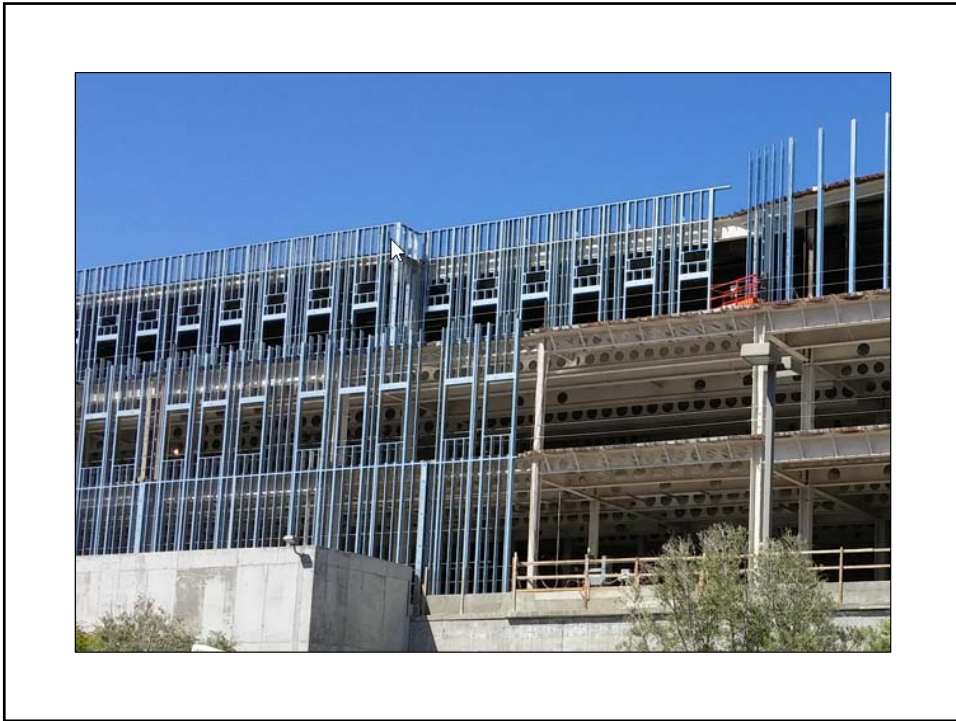
### NRCA's experience:

- Most tests not conducted in accordance with ASTM E907 or FM 1-52.
- No correlation between field test vs. lab. results/classifications
- NRCA survey: 55% passing

**The latest...**

Designers specifying roof systems designs that have not been FM tested/classified, but require the contractor to pass FM 1-52 to receive payment

**Metal stud walls and perimeter  
membrane attachment**



*Applicators need more guidance  
on base termination/attachment details*



Recognition of expertise level of field workers

Launch in November 2018

[www.nrca.net/NRCA-ProCertification](http://www.nrca.net/NRCA-ProCertification)





April 3-4, 2019  
Hyatt Regency Washington on Capitol Hill  
Washington, DC



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