Estimators and Submittals Engineers
Oglebay Resort, Wheeling, WV
October 3, 2018

Wind-uplift design and technical issues update

Mark S. Graham
Vice President, Technical Services
National Roofing Contractors Association
Rosemont, Illinois

About NRCA

- Not-for-profit trade association founded in 1886
- Rosemont, IL and Washington , DC
- More than 3,500 members:
  - Roofing contractors and affiliate members
  - All 50 states and 53 counties
  - 97 local, state and regional affiliates organizations
  - Less than $1 M to large companies
  - Both residential and commercial work
  - One-third in business for more than 50 years
- Information, education, technology and advocacy

About me

- Grew up in a three-generation family construction business
- Degree in Architectural Engineering
- Roof contracting business
- Consulting engineer
- NRCA…for the last 25 years

Today's topics

- Wind-uplift design
  - ASCE 7-16
  - Roof Wind Designer
- Moisture in concrete roof decks
- Steel roof deck concerns
- Roof drain concerns
- "Fully" adhered
- Installation instructions
- Metal stud parapet walls
- Questions… and other topics

Wind-uplift design

Specifying a wind speed warranty,
in itself, is not proper wind design…

…in fact, it is usually evidence of
incomplete, inadequate or improper design

Reference documents – "the acronyms"

Wind design

American Society of Civil Engineers (ASCE)

- ASCE 7, "Minimum Design Loads for Buildings and Other Structures"

International Code Council (ICC):

- *International Building Code* (IBC)

FM Global:

- Loss Prevention Data Sheet 1-28, "Design Wind Loads"
- Loss Prevention Data Sheet 1-29, "Roof Deck Securement and Above-deck Roof Components"

Reference documents -- continued

Wind design

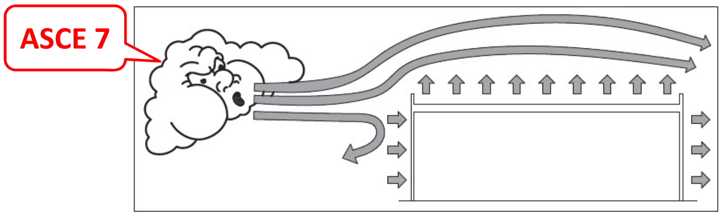
FM Approvals (a subsidiary of FM Global)

- Approval classifications: 1-60, 1-90, 1-120, etc.
- RoofNav (www.roofnav.com)

Underwriters Laboratories (UL):

- Fire classifications: Class A, Class B and Class C
- Wind classifications: Class 30, Class 60, Class 90
- Impact (hail) classifications: Class I to IV
- Online certifications directory (www.ul.com)

The fundamental concept



Wind creates pressures/forces
on building elements

Fundamental pressure equation

ASCE 7-10, Equation 30.3-1

$$q_h = 0.00256\,(K_z)\,(K_{zt})\,(K_d)\,(V^2)$$

Where:

K_d = wind directionality factor

K_z = velocity pressure exposure coefficient

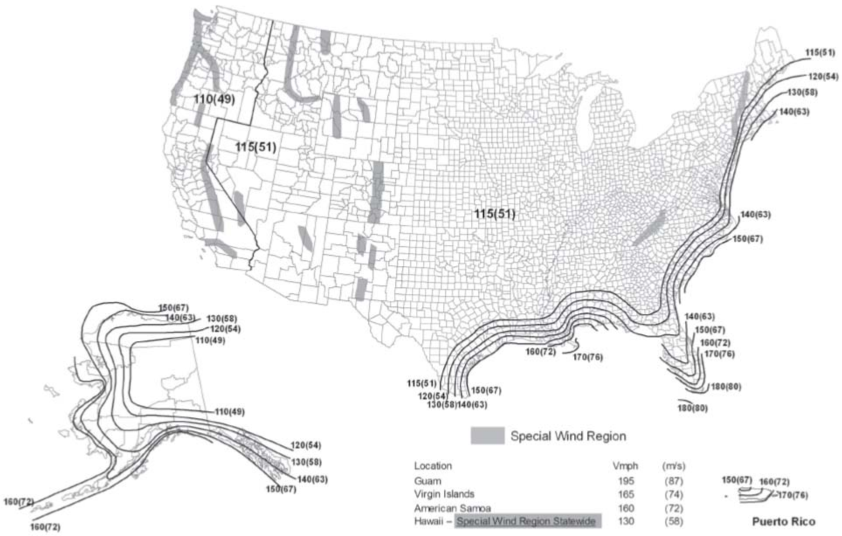
K_{zt} = topographic factor

V = wind speed (mph)

q_h = velocity pressure (psf)

Basic wind speed

ASCE 7-10, Occupancy Category II Buildings



Fundamental concept -- continued

Adhesion or attachment ≥ Uplift pressure

- FM rating
- UL classification ≥ ASCE 7
- Engineering

Pressure coefficients (GC_p)

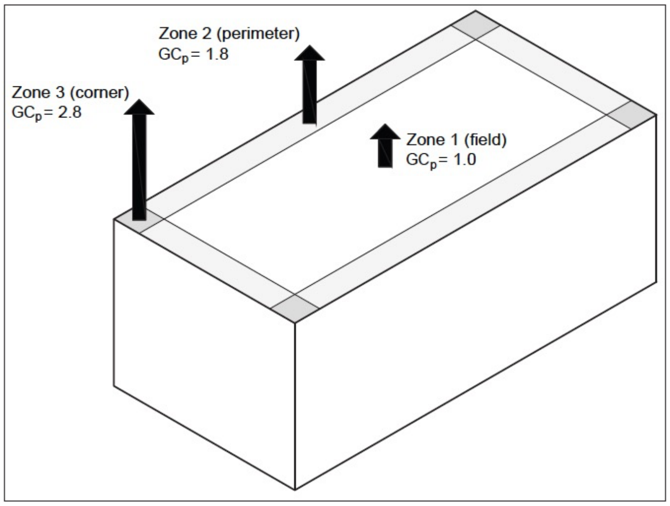


Illustration based upon ASCE 7-10, Fig. 30.4-2A ($\theta \le 7°$); Effective wind area = 10 ft^2

Safety factor

A factor of safety is intended to address possible variances in load determination and normally anticipated variances in materials, including material aging and deterioration, and in application.

Designation: D6630/D6630M – 16

**Standard Guide for
Low Slope Insulated Roof Membrane Assembly Performance**[1]

This standard is issued under the fixed designation D6630/D6630M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide lists test methods intended to establish a minimum level of performance for insulated roof membrane assemblies, and lists pertinent design guidelines and installation methods in a unified manner. Material tests and evaluations are included with and without roof insulation.

1.2 It is not possible to establish a precise correlation between laboratory tests on roof assemblies and natural weathering due to variations in geographical climate, design, mate-

7.3.7 Wind uplift forces should be determined according to ASCE-7. Roof system wind uplift resistance shall have a minimum 2.0 factor of safety. For ballasted single ply roofs use ANSI/SPRI RP-4 for determining their wind uplift resistance.

priate safety and health practices and determine the applicability of regulatory requirements prior to use.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
D450/D450M Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing
D1079 Terminology Relating to Roofing and Waterproofing
D2523 Practice for Testing Load-Strain Properties of Roofing Membranes
D4434/D4434M Specification for Poly(Vinyl Chloride) Sheet Roofing
D4637/D4637M Specification for EPDM Sheet Used In Single-Ply Roof Membrane
D4798/D4798M Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)
D4799/D4799M Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials
D5635/D5635M Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens
D5849/D5849M Test Method for Evaluating Resistance of Modified Bituminous Roofing Membrane to Cyclic Fatigue (Joint Displacement)
D6754/D6754M Specification for Ketone Ethylene Ester Based Sheet Roofing
D6878/D6878M Specification for Thermoplastic Polyolefin Based Sheet Roofing
E96/E96M Test Methods for Water Vapor Transmission of Materials
E631 Terminology of Building Constructions

2.2 *ASCE Standard:*

ASCE-7 Minimum Design Loads for Buildings and Other Structures[4]

[1] This guide is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.20 on Roofing Membrane Systems.

Current edition approved July 1, 2016. Published August 2016. Originally approved in 2001. Last previous edition approved in 2008 as D6630 – 08. DOI: 10.1520/D6630_D6630M-16.

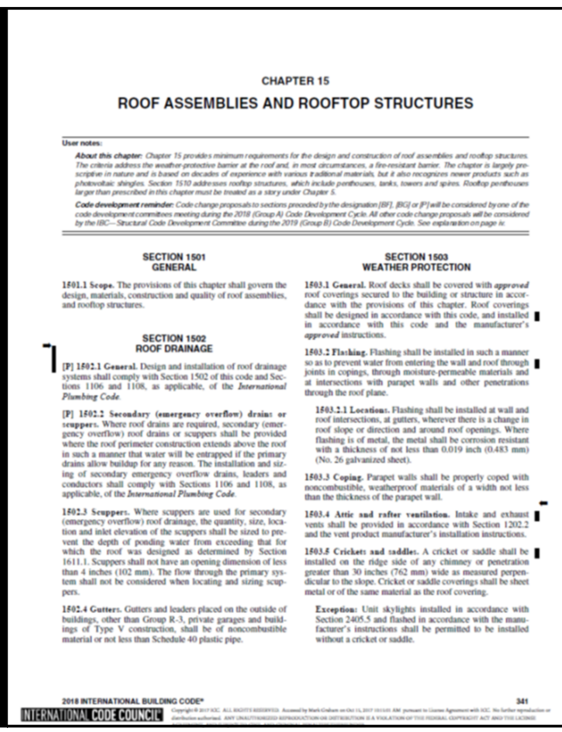
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

With IBC 2018 and ASCE 7-16, proper wind design as we have known it (or not known it) has fundamentally changed…

International Building Code, 2018 Edition



CHAPTER 15

ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

User notes:

About this chapter: *Chapter 15 provides minimum requirements for the design and construction of roof assemblies and rooftop structures. The criteria address the weather-protective barrier at the roof and, in most circumstances, a fire-resistant barrier. The chapter is largely prescriptive in nature and is based on decades of experience with various traditional materials, but it also recognizes newer products such as photovoltaic shingles. Section 1510 addresses rooftop structures, which include penthouses, tanks, towers and spires. Rooftop penthouses larger than prescribed in this chapter must be treated as a story under Chapter 5.*

Code development reminder: *Code change proposals to sections preceded by the designation [BF], [BG] or [P] will be considered by one of the code development committees meeting during the 2018 (Group A) Code Development Cycle. All other code change proposals will be considered by the IBC—Structural Code Development Committee during the 2019 (Group B) Code Development Cycle. See explanation on page iv.*

SECTION 1501
GENERAL

1501.1 Scope. The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies, and rooftop structures.

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.

SECTION 1503
WEATHER PROTECTION

1503.1 General. Roof decks shall be covered with ***approved*** roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof coverings shall be designed in accordance with this code, and installed in accordance with this code and the manufacturer's ***approved*** instructions.

1503.2 Flashing. Flashing shall be installed in such a manner so as to prevent water from entering the wall and roof through joints in copings, through moisture-permeable materials and at intersections with parapet walls and other penetrations through the roof plane.

1503.2.1 Locations. Flashing shall be installed at wall and roof intersections, at gutters, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than 0.019 inch (0.483 mm) (No. 26 galvanized sheet).

1503.3 Coping. Parapet walls shall be properly coped with noncombustible, weatherproof materials of a width not less than the thickness of the parapet wall.

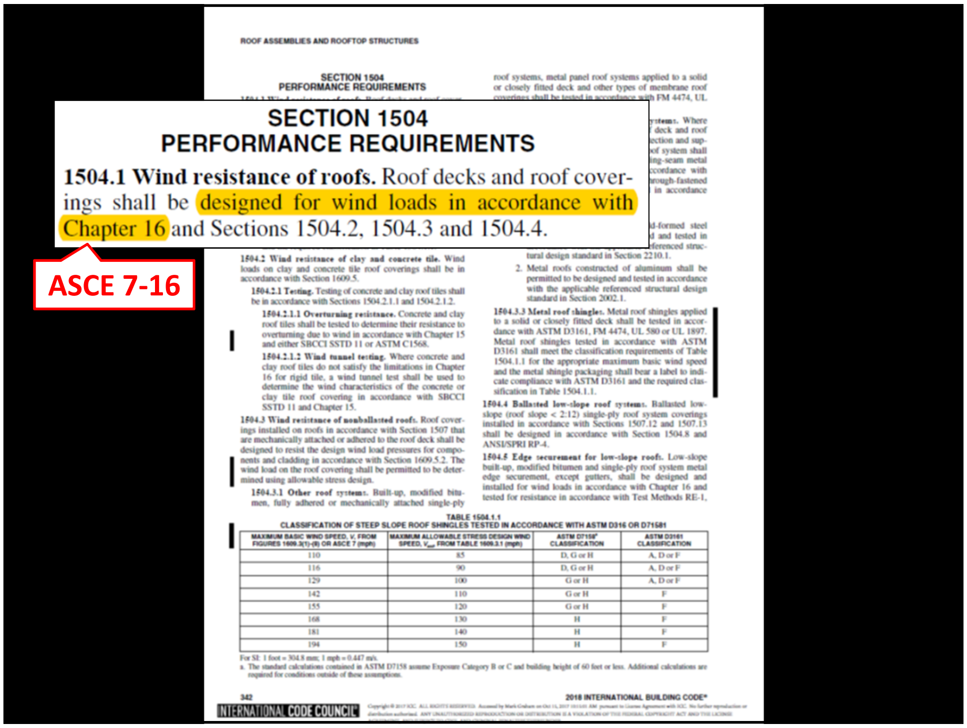
1503.4 Attic and rafter ventilation. Intake and exhaust vents shall be provided in accordance with Section 1202.2 and the vent product manufacturer's installation instructions.

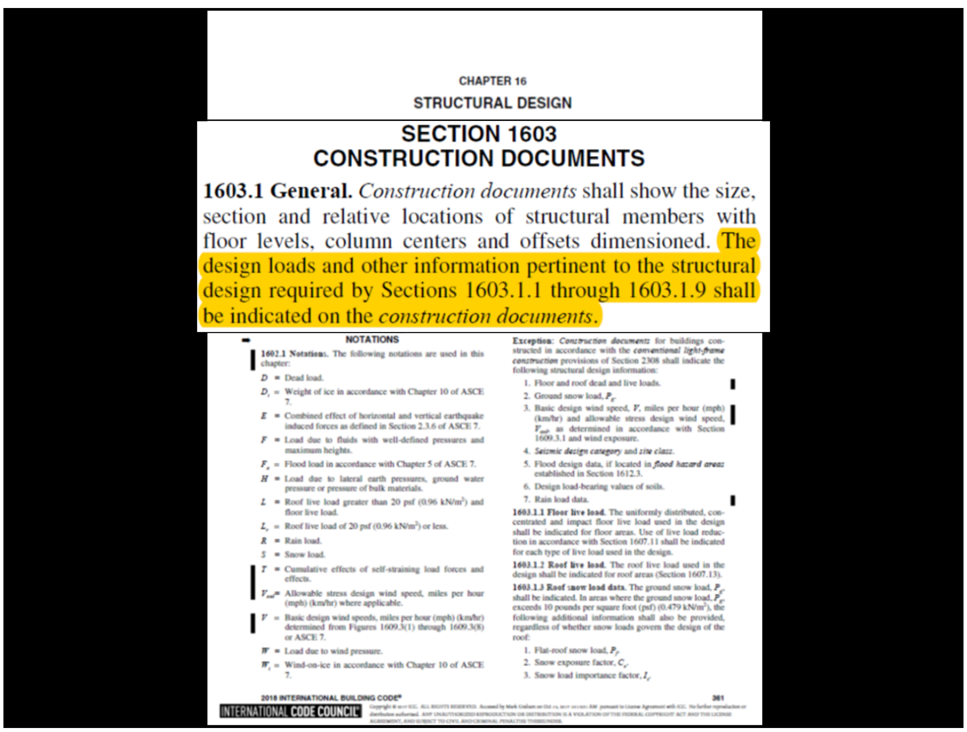
1503.5 Crickets and saddles. A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

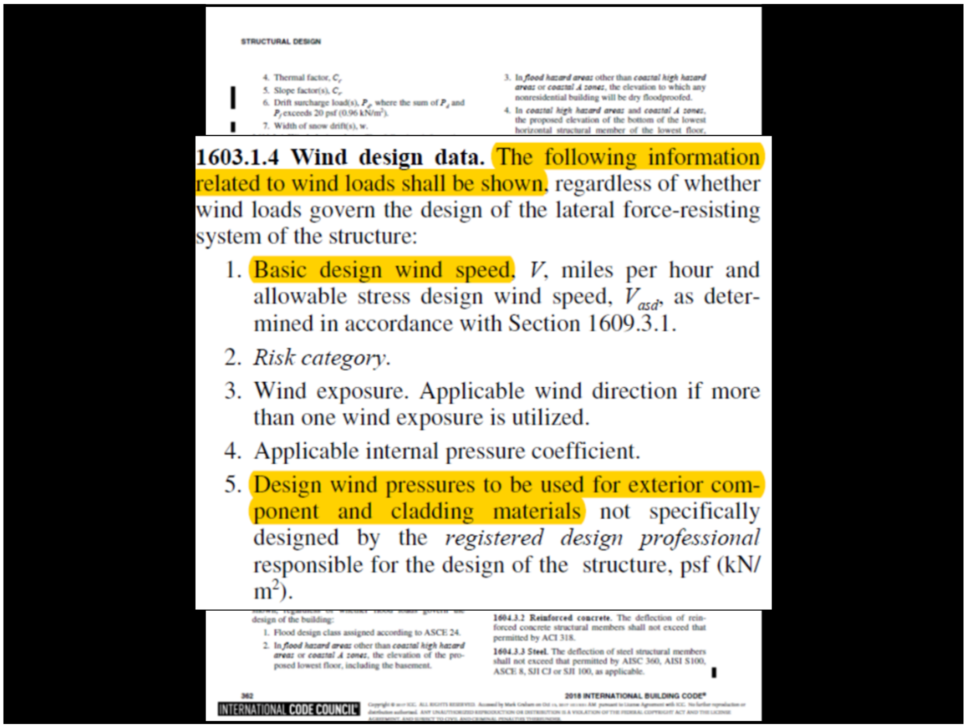
Exception: Unit skylights installed in accordance with Section 2405.5 and flashed in accordance with the manufacturer's instructions shall be permitted to be installed without a cricket or saddle.

2018 INTERNATIONAL BUILDING CODE® 341

INTERNATIONAL CODE COUNCIL®


SECTION 1504
PERFORMANCE REQUIREMENTS
1504.1 Wind resistance of roofs. Roof decks and roof coverings shall be designed for wind loads in accordance with Chapter 16 and Sections 1504.2, 1504.3 and 1504.4.
ASCE 7-16
2018 INTERNATIONAL BUILDING CODE
INTERNATIONAL CODE COUNCIL


CHAPTER 16
STRUCTURAL DESIGN
SECTION 1603
CONSTRUCTION DOCUMENTS
1603.1 General. Construction documents shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.9 shall be indicated on the construction documents.
NOTATIONS
2018 INTERNATIONAL BUILDING CODE
INTERNATIONAL CODE COUNCIL



STRUCTURAL DESIGN

4. Thermal factor, C_t
5. Slope factor(s), C_s
6. Drift surcharge load(s), P_d, where the sum of P_d and P_f exceeds 20 psf (0.96 kN/m²).
7. Width of snow drift(s), w.

3. In *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*, the elevation to which any nonresidential building will be dry floodproofed.
4. In *coastal high hazard areas* and *coastal A zones*, the proposed elevation of the bottom of the lowest horizontal structural member of the lowest floor,

1603.1.4 Wind design data. The following information related to wind loads shall be shown, regardless of whether wind loads govern the design of the lateral force-resisting system of the structure:

1. Basic design wind speed, *V*, miles per hour and allowable stress design wind speed, V_{asd}, as determined in accordance with Section 1609.3.1.
2. *Risk category*.
3. Wind exposure. Applicable wind direction if more than one wind exposure is utilized.
4. Applicable internal pressure coefficient.
5. Design wind pressures to be used for exterior component and cladding materials not specifically designed by the *registered design professional* responsible for the design of the structure, psf (kN/m²).

design of the building:

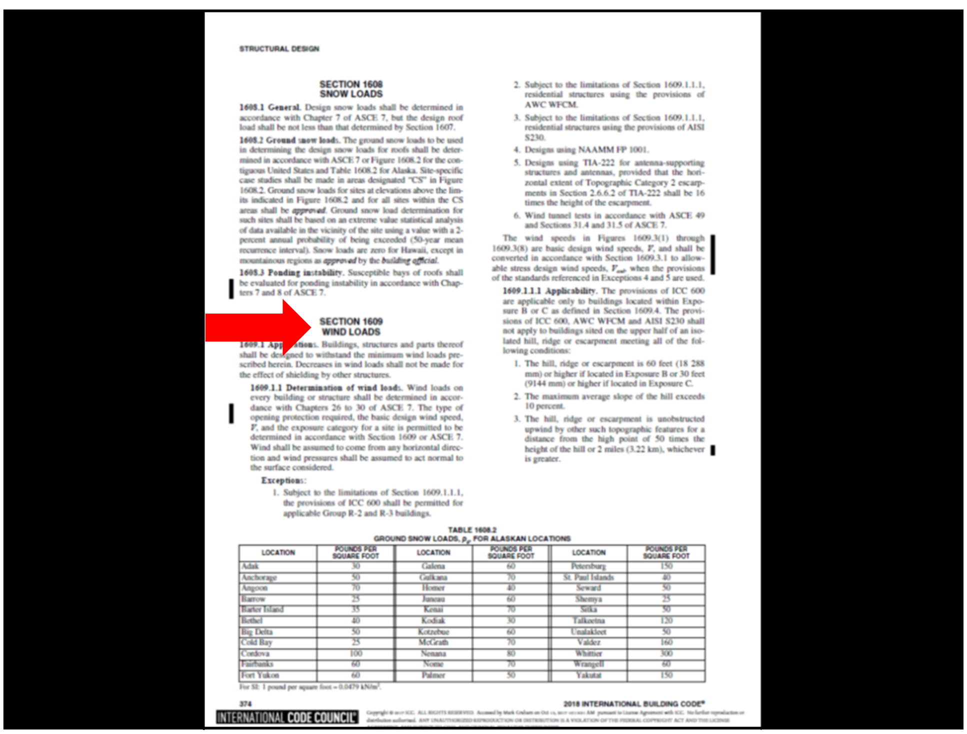
1. Flood design class assigned according to ASCE 24.
2. In *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*, the elevation of the proposed lowest floor, including the basement.

1604.3.2 Reinforced concrete. The deflection of reinforced concrete structural members shall not exceed that permitted by ACI 318.

1604.3.3 Steel. The deflection of steel structural members shall not exceed that permitted by AISC 360, AISI S100, ASCE 8, SJI CJ or SJI 100, as applicable.

362 2018 INTERNATIONAL BUILDING CODE®

INTERNATIONAL CODE COUNCIL®



STRUCTURAL DESIGN

SECTION 1608
SNOW LOADS

1608.1 General. Design snow loads shall be determined in accordance with Chapter 7 of ASCE 7, but the design roof load shall be not less than that determined by Section 1607.

1608.2 Ground snow loads. The ground snow loads to be used in determining the design snow loads for roofs shall be determined in accordance with ASCE 7 or Figure 1608.2 for the contiguous United States and Table 1608.2 for Alaska. Site-specific case studies shall be made in areas designated "CS" in Figure 1608.2. Ground snow loads for sites at elevations above the limits indicated in Figure 1608.2 and for all sites within the CS areas shall be *approved*. Ground snow load determination for such sites shall be based on an extreme value statistical analysis of data available in the vicinity of the site using a value with a 2-percent annual probability of being exceeded (50-year mean recurrence interval). Snow loads are zero for Hawaii, except in mountainous regions as *approved* by the *building official*.

1608.3 Ponding instability. Susceptible bays of roofs shall be evaluated for ponding instability in accordance with Chapters 7 and 8 of ASCE 7.

SECTION 1609
WIND LOADS

1609.1 Applications. Buildings, structures and parts thereof shall be designed to withstand the minimum wind loads prescribed herein. Decreases in wind loads shall not be made for the effect of shielding by other structures.

1609.1.1 Determination of wind loads. Wind loads on every building or structure shall be determined in accordance with Chapters 26 to 30 of ASCE 7. The type of opening protection required, the basic design wind speed, *V*, and the exposure category for a site is permitted to be determined in accordance with Section 1609 or ASCE 7. Wind shall be assumed to come from any horizontal direction and wind pressures shall be assumed to act normal to the surface considered.

Exceptions:

1. Subject to the limitations of Section 1609.1.1.1, the provisions of ICC 600 shall be permitted for applicable Group R-2 and R-3 buildings.
2. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AWC WFCM.
3. Subject to the limitations of Section 1609.1.1.1, residential structures using the provisions of AISI S230.
4. Designs using NAAMM FP 1001.
5. Designs using TIA-222 for antenna-supporting structures and antennas, provided that the horizontal extent of Topographic Category 2 escarpments in Section 2.6.6.2 of TIA-222 shall be 16 times the height of the escarpment.
6. Wind tunnel tests in accordance with ASCE 49 and Sections 31.4 and 31.5 of ASCE 7.

The wind speeds in Figures 1609.3(1) through 1609.3(8) are basic design wind speeds, *V*, and shall be converted in accordance with Section 1609.3.1 to allowable stress design wind speeds, V_{asd}, when the provisions of the standards referenced in Exceptions 4 and 5 are used.

1609.1.1.1 Applicability. The provisions of ICC 600 are applicable only to buildings located within Exposure B or C as defined in Section 1609.4. The provisions of ICC 600, AWC WFCM and AISI S230 shall not apply to buildings sited on the upper half of an isolated hill, ridge or escarpment meeting all of the following conditions:

1. The hill, ridge or escarpment is 60 feet (18 288 mm) or higher if located in Exposure B or 30 feet (9144 mm) or higher if located in Exposure C.
2. The maximum average slope of the hill exceeds 10 percent.
3. The hill, ridge or escarpment is unobstructed upwind by other such topographic features for a distance from the high point of 50 times the height of the hill or 2 miles (3.22 km), whichever is greater.

TABLE 1608.2
GROUND SNOW LOADS, p_g, FOR ALASKAN LOCATIONS

LOCATION	POUNDS PER SQUARE FOOT	LOCATION	POUNDS PER SQUARE FOOT	LOCATION	POUNDS PER SQUARE FOOT
Adak	30	Galena	60	Petersburg	150
Anchorage	50	Gulkana	70	St. Paul Islands	40
Angoon	70	Homer	40	Seward	50
Barrow	25	Juneau	60	Shemya	25
Barter Island	35	Kenai	70	Sitka	50
Bethel	40	Kodiak	30	Talkeetna	120
Big Delta	50	Kotzebue	60	Unalakleet	50
Cold Bay	25	McGrath	70	Valdez	160
Cordova	100	Nenana	80	Whittier	300
Fairbanks	60	Nome	70	Wrangell	60
Fort Yukon	60	Palmer	50	Yakutat	150

For SI: 1 pound per square foot = 0.0479 kN/m².

374 2018 INTERNATIONAL BUILDING CODE®

INTERNATIONAL CODE COUNCIL®

STRUCTURAL DESIGN

1609.3(4) and 1609.3(8). The basic design wind speed, V, for the special wind regions indicated near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. The basic design wind speeds, V, determined by the local jurisdiction shall be in accordance with Chapter 26 of ASCE 7.

In nonhurricane-prone regions, when the basic design wind speed, V, is estimated from regional climatic data, the basic design wind speed, V, shall be determined in accordance with Chapter 26 of ASCE 7.

1609.3.1 Wind speed conversion. Where required, the basic design wind speeds of Figures 1609.3(1) through 1609.3(8) shall be converted to allowable stress design wind speeds, V_{asd}, using Table 1609.3.1 or Equation 16-33.

$$V_{asd} = V\sqrt{0.6} \quad \textbf{(Equation 16-33)}$$

where:

V_{asd} = Allowable stress design wind speed applicable to methods specified in Exceptions 4 and 5 of Section 1609.1.1.

V = Basic design wind speeds determined from Figures 1609.3(1) through 1609.3(8).

1609.4 Exposure category. For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities shall be determined for the site at which the building or structure is to be constructed. Account shall be taken of variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features.

1609.4.1 Wind directions and sectors. For each selected wind direction at which the wind loads are to be evaluated, the exposure of the building or structure shall be determined for the two upwind sectors extending 45 degrees (0.79 rad) either side of the selected wind direction. The exposures in these two sectors shall be determined in accordance with Sections 1609.4.2 and 1609.4.3 and the exposure resulting in the highest wind loads shall be used to represent winds from that direction.

1609.4.2 Surface roughness categories. A ground surface roughness within each 45-degree (0.79 rad) sector shall be determined for a distance upwind of the site as defined in Section 1609.4.3 from the following categories, for the purpose of assigning an exposure category as defined in Section 1609.4.3.

Surface Roughness B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

Surface Roughness C. Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat open country, and grasslands.

Surface Roughness D. Flat, unobstructed areas and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.

1609.4.3 Exposure categories. An exposure category shall be determined in accordance with the following:

Exposure B. For buildings with a mean roof height of less than or equal to 30 feet (9144 mm), Exposure B shall apply where the ground surface roughness, as defined by Surface Roughness B, prevails in the upwind direction for a distance of not less than 1,500 feet (457 m). For buildings with a mean roof height

1609.5 Roof systems. Roof systems shall be designed and constructed in accordance with Sections 1609.5.1 through 1609.5.3, as applicable.

1609.5.1 Roof deck. The roof deck shall be designed to withstand the wind pressures determined in accordance with ASCE 7.

1609.5.2 Roof coverings. Roof coverings shall comply with Section 1609.5.1.

Exception: Rigid tile roof coverings that are air permeable and installed over a roof deck complying with Section 1609.5.1 are permitted to be designed in accordance with Section 1609.5.3.

Asphalt shingles installed over a roof deck complying with Section 1609.5.1 shall comply with the wind-resistance requirements of Section 1504.1.1.

able and installed over a roof deck complying with Section 1609.5.1 are permitted to be designed in accordance with Section 1609.5.3.

Asphalt shingles installed over a roof deck complying with Section 1609.5.1 shall comply with the wind-resistance requirements of Section 1504.1.1.

TABLE 1609.3.1
WIND SPEED CONVERSIONS[a, b, c]

V	100	110	120	130	140	150	160	170	180	190	200
V_{asd}	78	85	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.44 m/s.
a. Linear interpolation is permitted.
b. V_{asd} = allowable stress design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.
c. V = basic design wind speeds determined from Figures 1609.3(1) through 1609.3(8).

378 2018 INTERNATIONAL BUILDING CODE®

INTERNATIONAL CODE COUNCIL®

TECH TODAY

Specifying wind design

Many roof system designers inadequately address wind loads in contract documents

by Mark S. Graham

Code requirements

ANSI/SPRI ES-1

Responsibilities

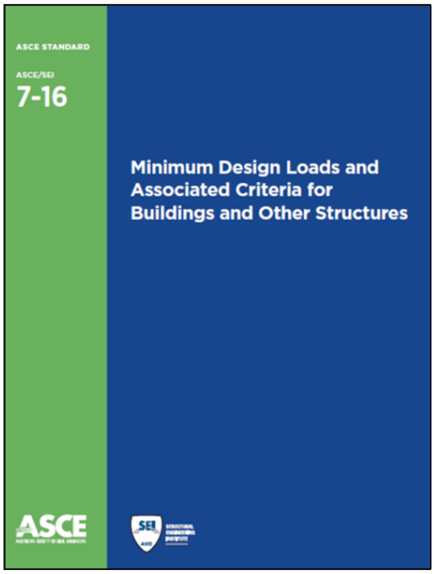
Specifying wind speed warranties is not a substitute for code-required wind design data

MARK S. GRAHAM is NRCA's associate executive director of technical services.

16 www.professionalroofing.net MARCH 2014

Link

Professional Roofing
March 2014



American Society of Civil Engineers Standard 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures" (ASCE 7-16)

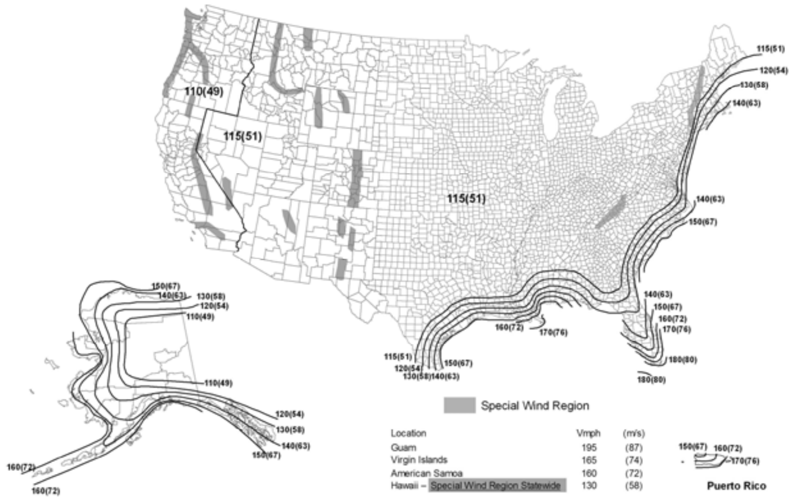
Noteworthy changes in ASCE 7-16

Compared to ASCE 7-10

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

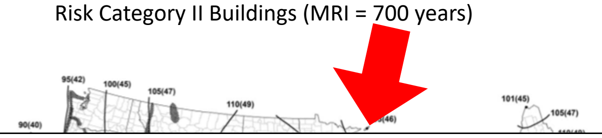
ASCE 7-10 basic wind speed map

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



ASCE 7-16 basic wind speed map

Risk Category II Buildings (MRI = 700 years)



MRI		
Risk Category	**ASCE 7-10**	**ASCE 7-16**
I (Low)	300 yrs.	300 yrs.
II (not I, II or IV)	700 yrs.	700 yrs.
Category III (High risk)	1,700 yrs.	1,700 yrs.
Category IV (Essential)	1,700 yrs.	3,000 yrs.

Selection of the correct Risk Category/map (i.e., wind speed) is essential

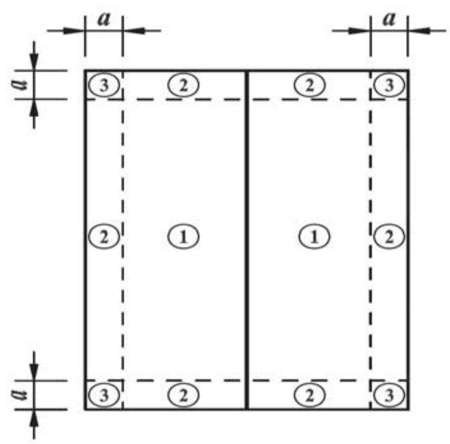
Comparing GC_p pressure coefficients

h ≤ 60 ft., gable roofs ≤ 7 degrees

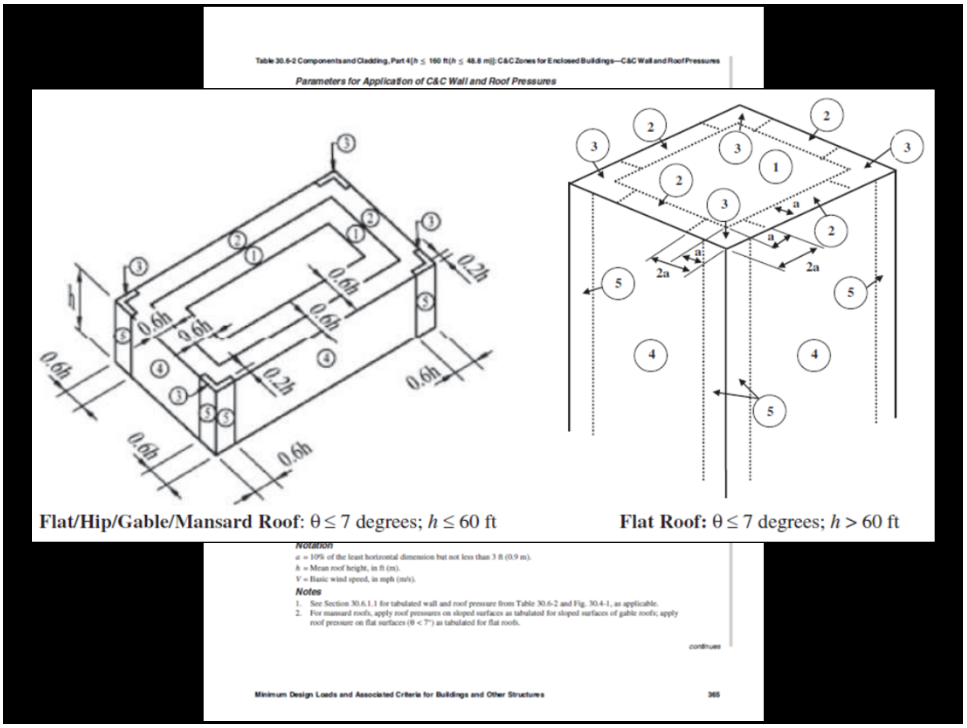
Zone	ASCE 7-10	ASCE 7-16	Change
1’	n/a	0.9	-10%
1 (field)	-1.0	-1.7	+70%
2 (perimeter)	-1.8	-2.3	+28%
3 (corners)	-2.8	-3.2	+14%

Zones

h ≤ 60 ft., gable roofs ≤ 7 degrees



ASCE 7-10



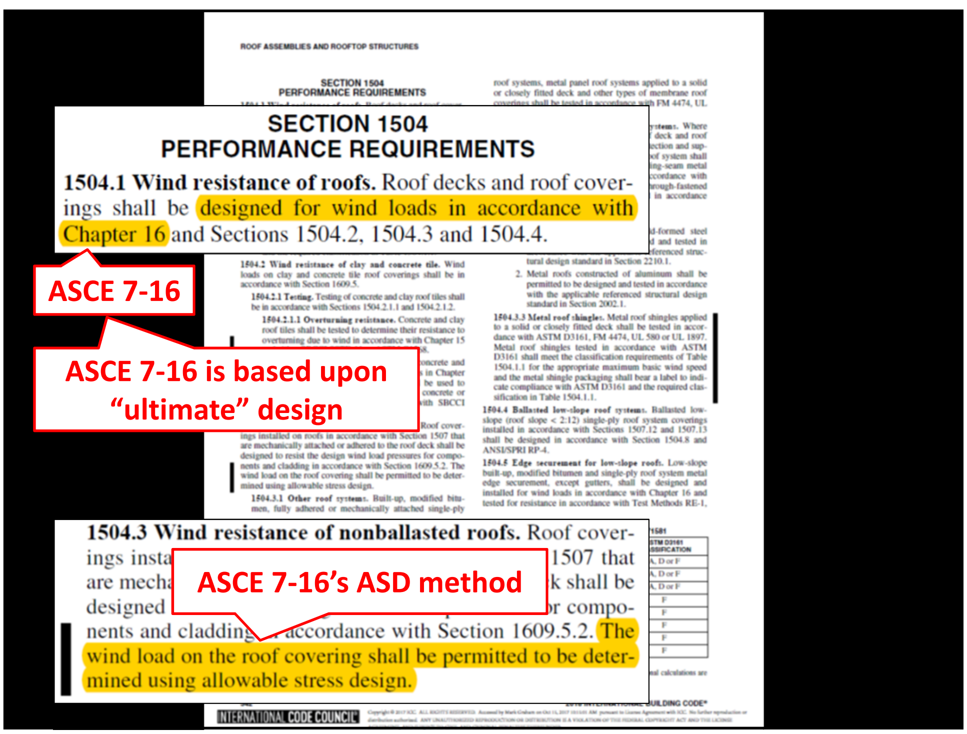
Noteworthy changes in ASCE 7-16

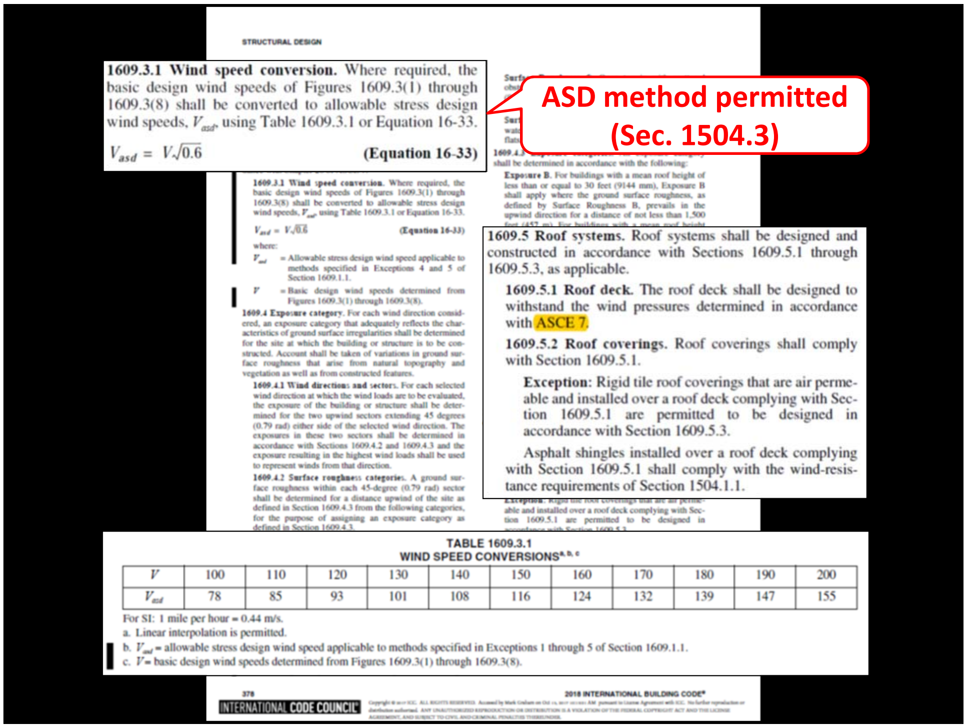
Compared to ASCE 7-10

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

While center field pressures may be slightly lower, field, perimeter and corner uplift pressures will generally be greater

International Building Code, 2018 Edition





STRUCTURAL DESIGN

1609.3.1 Wind speed conversion. Where required, the basic design wind speeds of Figures 1609.3(1) through 1609.3(8) shall be converted to allowable stress design wind speeds, V_{asd}, using Table 1609.3.1 or Equation 16-33.

$$V_{asd} = V\sqrt{0.6} \qquad \text{(Equation 16-33)}$$

1609.5 Roof systems. Roof systems shall be designed and constructed in accordance with Sections 1609.5.1 through 1609.5.3, as applicable.

1609.5.1 Roof deck. The roof deck shall be designed to withstand the wind pressures determined in accordance with ASCE 7.

1609.5.2 Roof coverings. Roof coverings shall comply with Section 1609.5.1.

Exception: Rigid tile roof coverings that are air permeable and installed over a roof deck complying with Section 1609.5.1 are permitted to be designed in accordance with Section 1609.5.3.

Asphalt shingles installed over a roof deck complying with Section 1609.5.1 shall comply with the wind-resistance requirements of Section 1504.1.1.

TABLE 1609.3.1
WIND SPEED CONVERSIONS[a, b, c]

V	100	110	120	130	140	150	160	170	180	190	200
V_{asd}	78	85	93	101	108	116	124	132	139	147	155

For SI: 1 mile per hour = 0.44 m/s.
a. Linear interpolation is permitted.
b. V_{asd} = allowable stress design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.
c. V = basic design wind speeds determined from Figures 1609.3(1) through 1609.3(8).

378 2018 INTERNATIONAL BUILDING CODE®

INTERNATIONAL CODE COUNCIL®

It is important to differentiate between "ultimate" strength design and "allowable stress design" (ASD) wind loads…

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 mid-2019.

roofwinddesigner.com

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

Home | Contact Us | FAQ

Welcome: Mark Graham | My Projects | Profile | Logout | Administration

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

Roof Wind Designer has been updated based upon ASCE 7-16:

- **Part 2: Low-rise Buildings (Simplified) [h ≤ 60 ft.]**
- **Part 4: Buildings with 60 ft. < h ≤ 160 ft. (Simplified)***

* Does not include hip and gable roofs h > 60 ft. and all roof slopes over 7 degrees (about 1.5:12)

To register for a new account click here. If you already have an account, click here to login.

NRCA
National Roofing Contractors Association

An example…

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

Example: A office building (Risk Category II) is located in Omaha, Nebraska. The building is an enclosed structure with a mean roof height of 40 ft. The building is located in an open terrain area that can be categorized as Exposure Category C. An adhered, membrane roof systems is to be installed.

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 Ult.	115	--	35.5	59.5	89.5
ASCE 7-10 ASD	89	--	21.3	35.7	53.4
ASCE 7-16 Ult.	110	29.7	51.7	68.1	92.8
ASCE 7-16 ASD	85	17.8	31.8	40.9	55.7

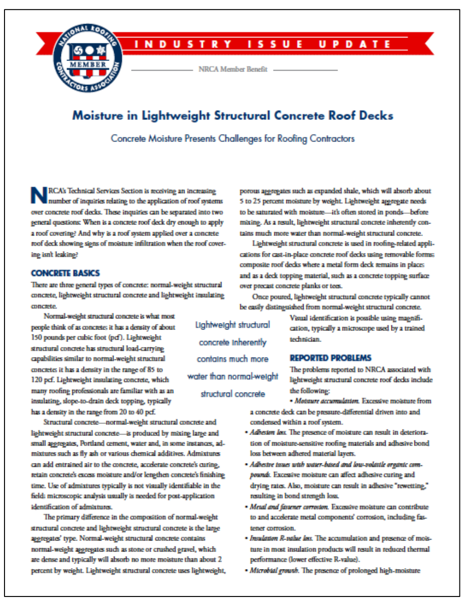
This comparison illustrates why it is important for Designers to include wind design loads in their Construction Documents (per IBC Sec. 1603.1)…

…It also illustrates why specifying a wind warrantee can create an uneven playing field. Unless the Designer indicates the wind design loads, which design method will the manufacturer use (e.g., in a competitive environment)?

Technical issues update

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's 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 120 pcf. Lightweight insulating concrete, which many roofing professionals are familiar with as an insulating, slope-to-drain deck topping, typically has a density in the range from 20 to 40 pcf.

Lightweight structural concrete inherently contains much more water than normal-weight structural concrete

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 entrained air to the concrete, accelerate 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 aggregates' 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—it's 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 forms; 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 tees.

Once poured, lightweight structural concrete typically cannot be easily distinguished from normal-weight structural concrete. Visual identification is possible using magnification, typically a microscope used by a trained technician.

REPORTED PROBLEMS

The problems reported to 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.
- *Adhesion loss.* The presence of moisture can result in deterioration of moisture-sensitive roofing materials and adhesive bond loss between adhered material layers.
- *Adhesive issues with water-based and low-volatile organic compounds.* Excessive moisture can affect adhesive curing and drying rates. Also, moisture can result in adhesive "rewetting," resulting in bond strength loss.
- *Metal and fastener corrosion.* Excessive moisture can contribute to and accelerate metal components' 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

Link

Concrete Floors and Moisture, 2nd 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

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

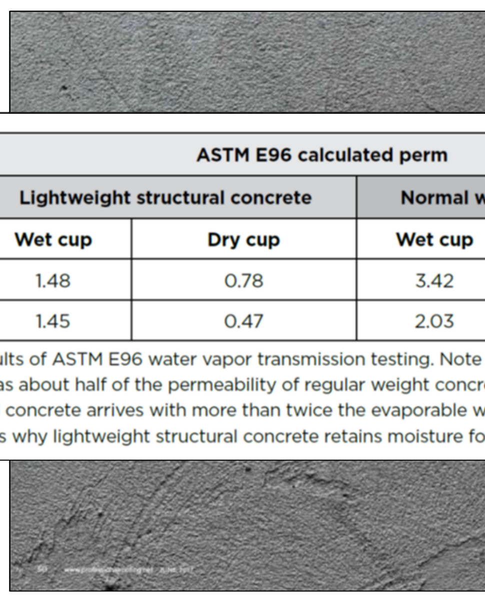
Conclusions - continued

- 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.

Link

Moisture on concrete roof decks

Link

Professional Roofing,
Sept. 2017

Moisture vapor reduction admixtures (MVRAs)

Some examples:

- Barrier One
- ISE Logik MVRA 9000
- SPG VaporLock

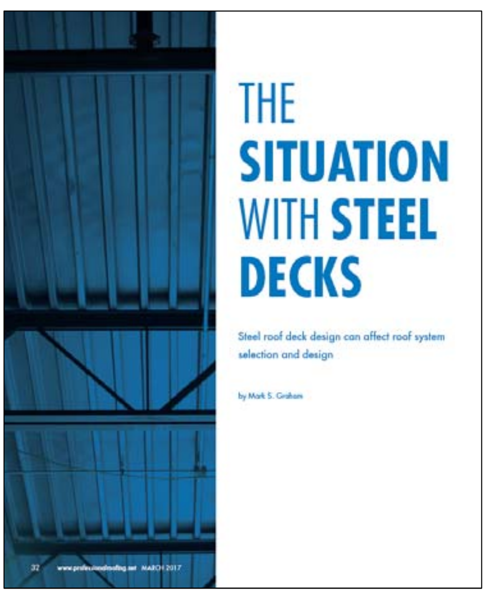
NRCA has still not seen an MVRA perform successfully in concrete roof deck applications

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."

Steel roof deck concerns

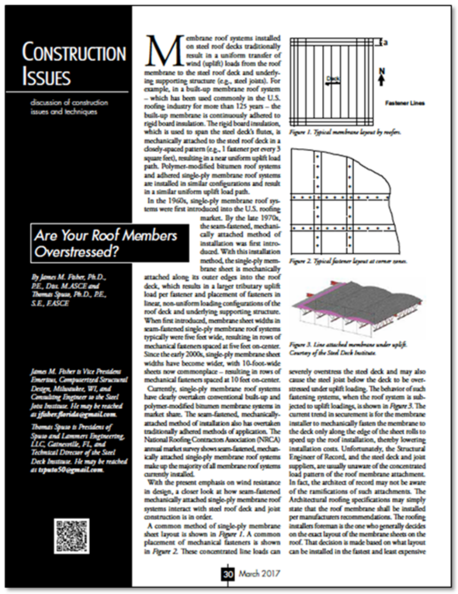

THE SITUATION WITH STEEL DECKS

Steel roof deck design can affect roof system selection and design

by Mark S. Graham

32 www.professionalroofing.net MARCH 2017

Professional Roofing
March 2017
www.professionalroofing.net



CONSTRUCTION ISSUES

discussion of construction issues and techniques

Are Your Roof Members Overstressed?

By James M. Fisher, Ph.D., P.E., Dist. M.ASCE and Thomas Sputo, Ph.D., P.E., S.E., F.ASCE

Membrane 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 joists). 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 board insulation. The rigid board 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 fastener per every 3 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-fastened, mechanically attached method of installation was first introduced. With this installation method, the single-ply membrane sheet is mechanically attached along its outer edges into the roof deck, which results in a larger tributary uplift load per fastener and placement of fasteners in linear, non-uniform loading configurations of the roof deck and underlying supporting structure. When first introduced, membrane sheet widths in seam-fastened single-ply membrane roof systems typically were five feet wide, resulting in rows of mechanical fasteners spaced at five feet on-center. Since the early 2000s, single-ply membrane sheet widths have become wider, with 10-foot-wide sheets now commonplace – resulting in rows of mechanical fasteners spaced at 10 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-fastened, mechanically-attached method of installation also has overtaken traditionally adhered methods of application. The National Roofing Contractors Association (NRCA) annual market survey shows seam-fastened, 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-fastened mechanically attached single-ply membrane roof systems interact with steel roof deck and joist 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 joist below the deck to be overstressed under uplift loading. The behavior of such fastening systems, when the roof system is subjected to uplift loadings, is shown in *Figure 3*. The current trend in securement is 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 Engineer of Record, and the steel deck and joist suppliers, 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 manufacturers recommendations. The roofing installers foreman is the one who generally decides on the exact layout of the membrane sheets on the roof. That decision is made based on what layout can be installed in the fastest and least expensive

Figure 1. Typical membrane layout by roofers.

Figure 2. Typical fastener layout at corner zones.

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

James M. Fisher is Vice President Emeritus, Computerized Structural Design, Milwaukee, WI, and Consulting Engineer to the Steel Joist Institute. He may be reached at jfisher.florida@gmail.com.

Thomas Sputo is President of Sputo and Lammers Engineering, LLC, Gainesville, FL, and Technical Director of the Steel Deck Institute. He may be reached at tsputo50@gmail.com.

30 March 2017

***Structure* magazine**

March 2017

www.structuremag.org

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)

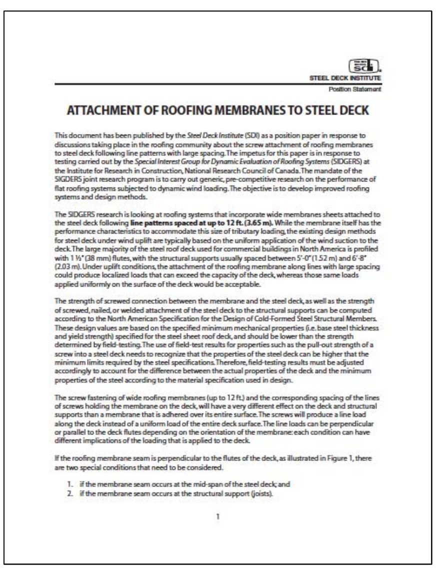
Steel roof deck design

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* (SIDGERS) at the Institute for Research in Construction, National Research Council of Canada. The mandate of the SIGDERS joint research program is to carry out generic, pre-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 SIDGERS research is looking at roofing systems that incorporate wide membranes sheets attached to the steel deck following **line patterns spaced at up to 12 ft. (3.65 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 ½" (38 mm) flutes, with the structural supports usually spaced between 5'-0" (1.52 m) and 6'-8" (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 that 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.

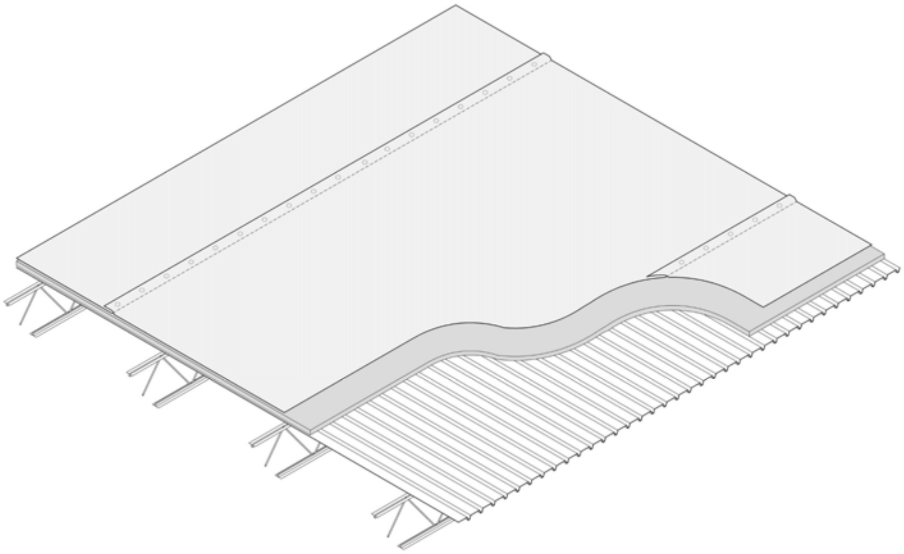
If the roofing membrane seam is perpendicular to the flutes of the deck, as illustrated in Figure 1, there are two special conditions that need to be considered.

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 (joists).

1

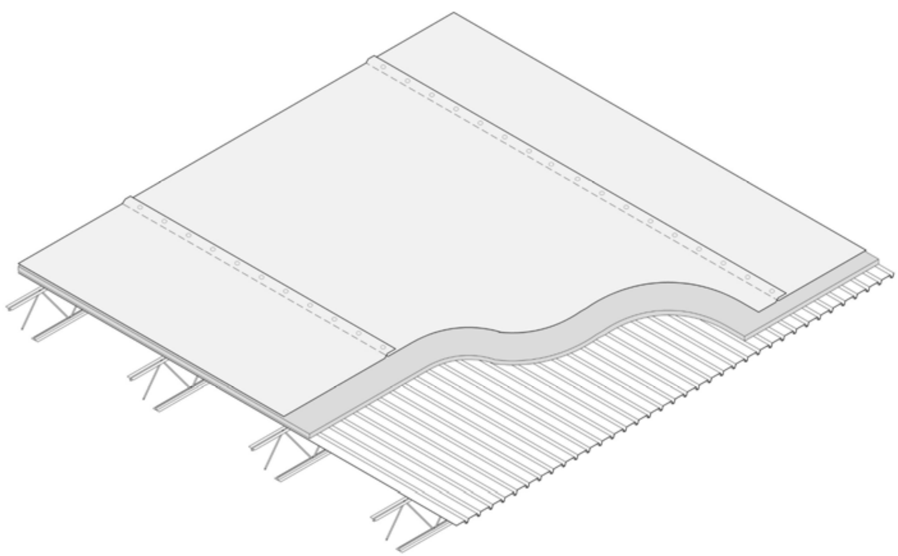
- Decks designed for joist spacing between 5' and 6' 8" o.c.
- Decks designed for uniform loading
- Seam-fastened single-ply membranes are a concern

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)

TECH TODAY

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 resistances 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 changes made and their effects on specific roof assembly classifications.

FM 4470

FM 4470, "Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, 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 Fire Tests for Determining the Heat 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 hail damage resistance testing; and adding an alternative test method for determining fasteners' corrosion resistances.

One of the more significant changes to FM 4470 is how steel roof decks are evaluated. With the revised standard, steel roof decks cannot 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; previously, a 300-pound point load was used. Also, minimum designs of steel roof decks now are based on a minimum 0.7-mm-thick (slightly less than 22-gauge), 33-ksi yield strength steel. Previously, minimum 0.75-mm-thick (22-gauge) steel complying with the ASTM International specification was used for evaluation.

The method of analyzing attachment of steel decks also has been revised. Deck fasteners now are tested for fastener "pull over" (pull through) of the deck material. Also, stress 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 ratings for dynamic puncture 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 forfeit classification.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements

What this means

If a specific classified assembly results in an overstressed steel roof deck, FM Approvals has, upon consultation with the manufacturer, either changed the assembly's parameters to compensate for the deck overstress or reduced the assembly's 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 steel thickness and/or yield strength (from 33 ksi to 80 ksi).

For assemblies where the wind rating has been reduced, the assemblies' previous RoofNav numbers have been withdrawn and new RoofNav numbers issued to avoid confusion.

If you use the new version of FM 4470 for an adhered roof assembly applied to a 1½-inch-thick, 22-gauge steel deck at a 6-foot maximum span, FM Approvals has indicated maximum classifications are limited to 1-165 when using a 33-ksi steel deck and 1-300 when using an 80-ksi steel deck. For seam-fastened mechanically attached single-ply membrane assemblies, classifications will vary based on assembly parameters and seam fastener row 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 RoofNav numbers for membrane and liquid-applied roof assemblies using steel roof decks.

For roofing projects designed before the implementation date but that will be installed after the implementation date, clarification 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 cost.

I encourage roof system designers and specifiers and roofing contractors to work closely with manufacturers when determining changes to specific assembly parameters, uplift ratings and RoofNav numbers.

MARK S. GRAHAM is NRCA's associate executive director of technical services.

12 www.professionalroofing.net JANUARY 2013

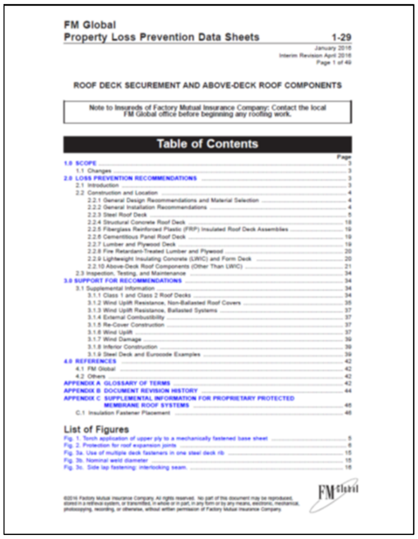
Professional Roofing
January 2013
www.professionalroofing.net

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.fmglobaldatasheets.com



FM Global
Property Loss Prevention Data Sheets 1-29
January 2016
Interim Revision April 2016
Page 1 of 49

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.

Table of Contents

List of Figures

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 is 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 ≤ 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.

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

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.

INTERNATIONAL CODE COUNCIL


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

"Fully" adhered


TECH TODAY

The fully adhered misnomer

Terminology can create unrealistic expectations within the roofing industry

by Mark S. Graham

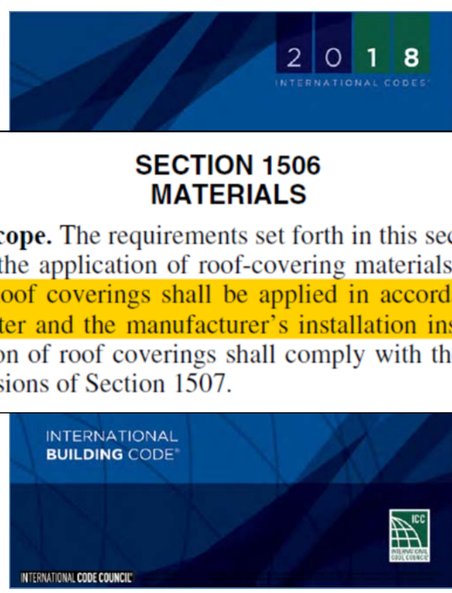
NRCA recommends the term "fully adhered" be avoided

Professional Roofing, January 2017

Manufacturer's installation instructions

Building code requirements

International Building Code, 2018 Edition (previous editions similar)



SECTION 1506
MATERIALS

1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. Roof coverings shall be applied in accordance with this chapter and the manufacturer's installation instructions. Installation of roof coverings shall comply with the applicable provisions of Section 1507.

TECH TODAY

A quest for clarity

A new NRCA task force is reviewing manufacturers' installation instructions

by Mark S. Graham

Instructions for some products are not written at a level appropriate for intended users

Instructional variance

NRCA review task force

Code requirements

Professional Roofing

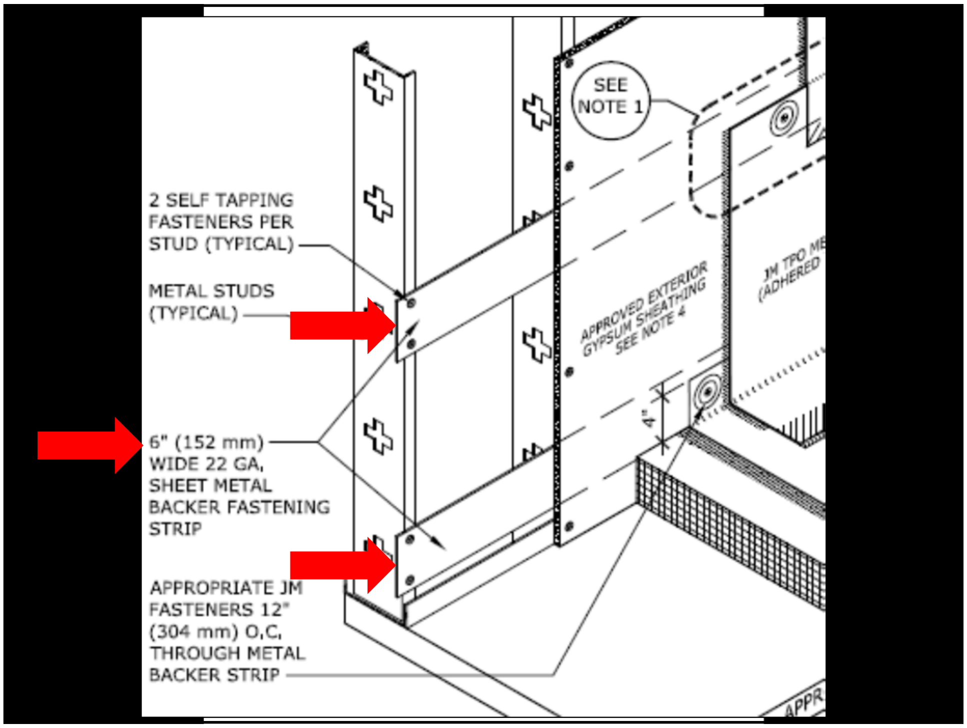
October 2014

Recommendations

Manufacturer's Installation Instructions

- Access and review on a project-by-project basis
- Include in project file
- Document any variations

Metal stud-framed parapet walls

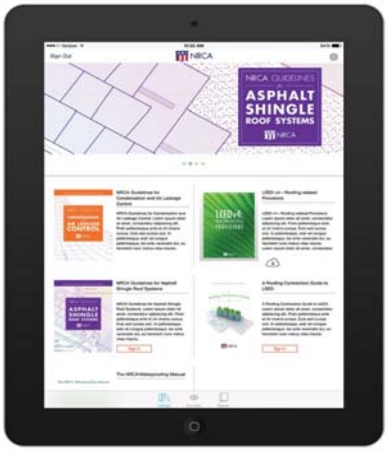


Applicators need more guidance on base termination/attachment details

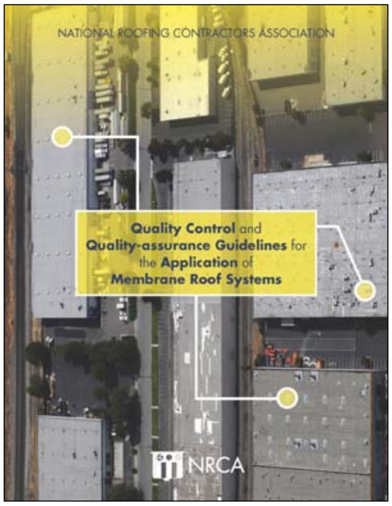
Using NRCA's resources…

The NRCA Roofing Manual - 2018

NRCA App



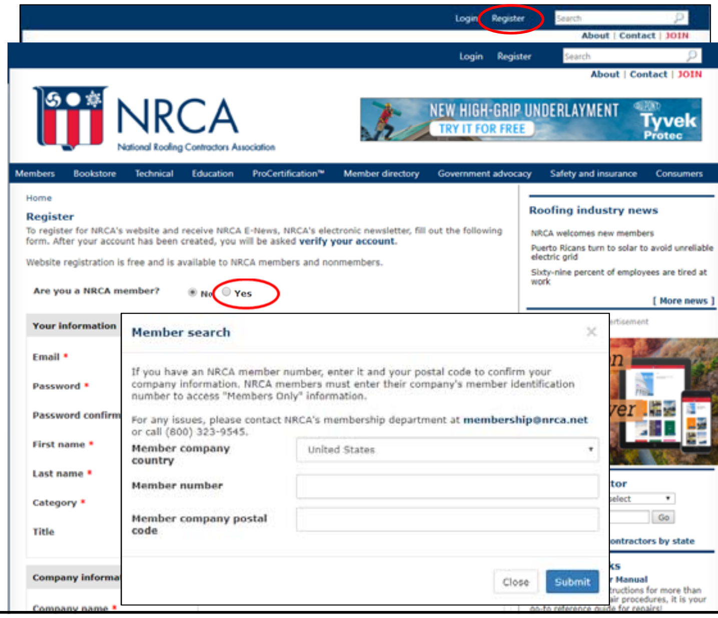
- NRCA App available on the Apple Store and Google Play Store for tablets
- iPhone App also available
- Register within App as being an NRCA member
- The NRCA Roofing Manual is viewable to NRCA members
- Favorite and send pages features



Quality Control and Quality-assurance Guidelines for the Application of Membrane Roof Systems

NRCA website

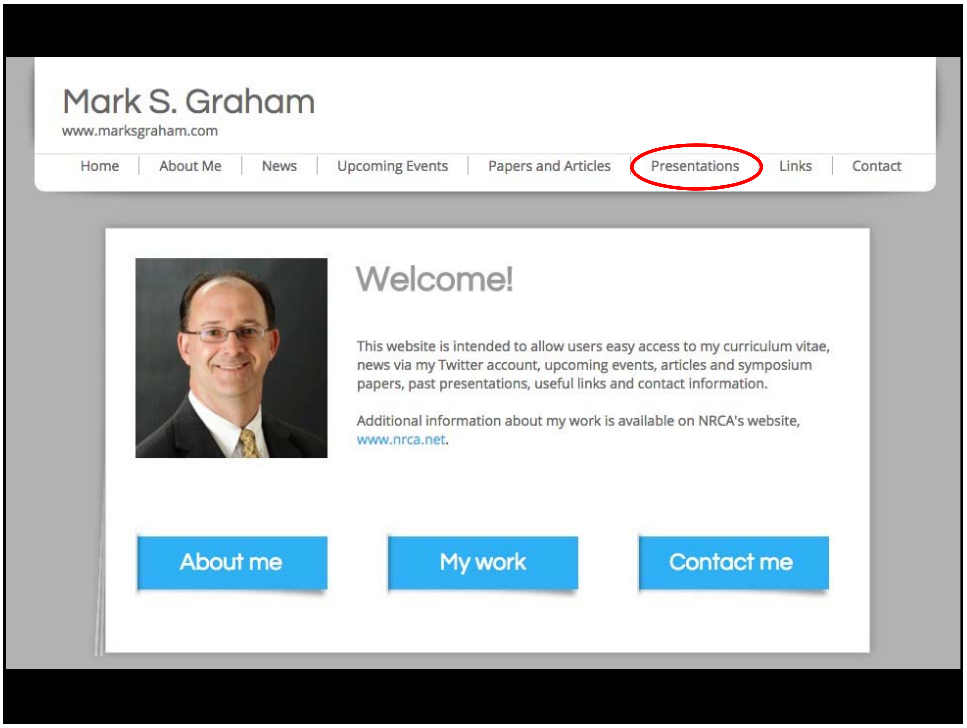
www.nrca.net



Mark S. Graham
Vice President, Technical Services
National Roofing Contractors Association
10255 West Higgins Road, 600
Rosemont, Illinois 60018-5607

(847) 299-9070
mgraham@nrca.net
www.nrca.net

Twitter: @MarkGrahamNRCA
Personal website: www.MarkGrahamNRCA.com


Mark S. Graham
www.marksgraham.com
Home | About Me | News | Upcoming Events | Papers and Articles | Presentations | Links | Contact
Welcome!
This website is intended to allow users easy access to my curriculum vitae, news via my Twitter account, upcoming events, articles and symposium papers, past presentations, useful links and contact information.
Additional information about my work is available on NRCA's website, www.nrca.net.
About me
My work
Contact me