



NRCA

NRCA University Webinar
July 28, 2016

Roofing Industry Technical Update


presented by

Mark S. Graham

Vice President, Technical Services
National Roofing Contractors Association

Moisture in concrete roof decks

2


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 meeting an increasing number of requests relating to the application of roof systems over concrete roof decks. These requests 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 but has a density in the range of 90 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.

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 to the concrete, accelerate concrete's curing, retain concrete's excess moisture and/or lengthen concrete's handling time. Use of admixtures typically is not readily 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

aggregates such as expanded shale, which will absorb about 5 to 25 percent moisture by weight. Lightweight aggregates need 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 formwork composite roof decks where a metal form deck remains in place and so a deck topping material, such as a concrete topping surface over precast concrete slabs or pans.

One problem, 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 present differential down 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 loss between adhered material layers.
- **Adhesive issues with water-based and low-solids organic compounds.** Excessive moisture can affect adhesive curing and drying rates. Also, moisture can result in adhesive "swelling," resulting in bond strength loss.
- **Blister and delamination formation.** 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).
- **Structural growth.** The presence of prolonged high-moisture

NRCA “Industry Issue Update,” August 2013:

- Reported problems
- Deck dryness tests:
 - Conventional dryness tests are no longer reliable
 - Suggested using ASTM F2170
- NRCA recommendations:
 - Contractors should not determine deck dryness
 - Don't use lightweight structural concrete
 - Remedial repair suggestions

Concrete roof deck moisture research

- NRCA
- Chicago Roofing Contractors Association
- Chicagoland Roofing Council
- Several manufacturers

4

Concrete deck moisture research

Concrete pour: Monday, July 11, 2016

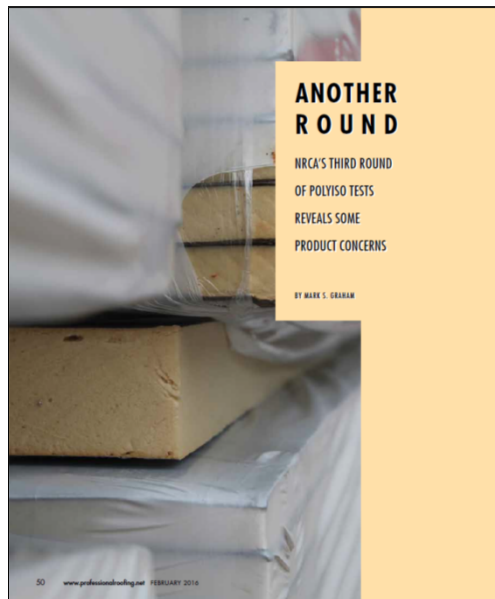


We expect to have some preliminary results
after the first of the year...

...look for a status report at the 2017 IRE

Polyisocyanurate insulation issues

7



Professional Roofing,
February 2016

8

PIMA PERFORMANCE BULLETIN

Measuring the R-value of Polyiso Roof Insulation


BACKGROUND: The 2016 edition of the *Roofing Manual of the National Roofing Contractors Association (NRCA)* includes a recommendation for the use of an arbitrary unit R-value of 5.0 for all thicknesses and configurations of polyiso roof insulation. In lieu of current ASTM C-1288 Long-Term Thermal Resistance (LTR) values as published by polyiso insulation manufacturers. After reviewing the NRCA manual and related documents and presentations, the Polyisocyanurate Insulation Manufacturers Association (PIMA) has developed this Performance Bulletin to provide additional information to support and validate the use of PIMA member published LTR values as the most reliable measure of polyiso thermal value for building owners, designers, specifiers, and contractors.

The North American Standard for R-value Measurement of Polyiso Roof Insulation
 The R-value recommendation and underlying data published by NRCA differ from the long-established Long-Term Thermal Resistance (LTR) data published by PIMA members for over a decade. Based on years of research and development, LTR:

- Remains the most reliable and relevant measure of long-term polyiso roof insulation R-value for the building designer, specifier and roofing contractor.
- Is supported by years of scientific study conducted by leading research organizations, including Oak Ridge National Laboratory (ORNL) and the National Research Council of Canada (NRC-CNRC).
- Has been established as a reliable national consensus standard both in the United States (ASTM C1288) and Canada (CANULC C-708) and is incorporated within all North American building codes as the designated measure of polyiso roof insulation performance.

Third-party Certified for Over Ten Years
 Polyiso roof insulation LTR values are further supported by PIMA's QualityMark™ program, a voluntary program that allows participating polyiso manufacturers to certify LTR values through an independent third party.

- QualityMark covers over 30 participating plants across North America, and each facility must submit to an annual verification of LTR product values.
- During verification, an independent third-party representative visits each manufacturing facility and randomly selects a minimum of five boards for testing.
- Each selected board is sent to an approved testing laboratory, and the overall verification process is administered by FM Global, a leading independent construction testing and standards organization.
- The QualityMark program is supported by over 2,000 polyiso insulation samples tested over the past ten years, and the ultimate evidence of the success of the program is that all participating manufacturing facilities have maintained continuous certification since the program's inception.



PIMA bulletin

www.polyiso.org

9

TECH TODAY

PIMA disagrees

PIMA's performance bulletin disputes NRCA's design R-value recommendation

by Mark S. Graham

In April, the Polyisocyanurate Insulation Manufacturers Association (PIMA) issued a performance bulletin titled "Measuring the R-value of Polyiso Roof Insulation," which attempts to refute NRCA's recommendation that designers use an average R-value of 5.0 per inch when specifying polyisocyanurate insulation.

NRCA stands by its current R-value recommendation

PIMA's position PIMA's performance bulletin aligns with NRCA's recommendation as "... an arbitrary unit R-value of 5.0." "The bulletin goes on to briefly explain long-term thermal resistance (LTR) testing. PIMA's QualityMark™ LTR certification program and the results of recent QualityMark verification testing. The bulletin reports results of PIMA's 2015 QualityMark verification testing as an average LTR per inch of 5.78 for 1-inch-thick product, 5.74 for 2-inch-thick product, 5.85 for 3-inch-thick product and 5.95 for 4-inch-thick product.

The PIMA bulletin also indicates "... It should be noted the LTR testing conducted under the QualityMark program uses a more severe conditioning procedure than the standard R-value test used by NRCA as a basis for its recommendation. ... Given the difference in NRCA's recommendation and PIMA's QualityMark program testing results, PIMA suggests that this difference may be attributed to a smaller testing sample size used by NRCA to support its recommendation and a possible lack of experimental controls regarding how NRCA insulation samples were procured and selected. ..."

NRCA's recommendation

With the January publication of an interim update to *The NRCA Roofing Manual: Advanced Roof System—2015*, NRCA revised its design in-service R-value recommendation to 5.0 per inch thickness for polyisocyanurate insulation used in roof systems.

NRCA explained the rationale for this change in its *Industry Issue Update*, "New polyisocyanurate R-values" that was distributed to NRCA members in January.

Although PIMA's bulletin appears to dispute only NRCA's R-value testing, it is important to note NRCA's R-value test results have been explained by research published in a 2013 report by Building Science Corp., Watford, Mass., and research published in a 2014 report by BDI Building Engineering Ltd., Vancouver, British Columbia. Also, since NRCA announced its revised R-value recommendation in January, the association has learned of an insulation manufacturer that has replicated NRCA's R-value test results.

"When reviewing the results of PIMA's 2015 QualityMark verification testing, it should be noted the reported LTR values are average values, not the minimum or lower end of the values tested. These average results range from only 0.04 to 0.08 greater than manufacturers' minimum published LTR values. Unlike the range of verification testing data is extremely narrow, which is unlikely. QualityMark's data likely show some tested LTR values less than the manufacturers' minimum published LTR values.

The distinction

"When considering the variations between the QualityMark LTR values and NRCA's cited R-values, it is important to understand the concepts themselves are somewhat different.

LTR is an accelerated thermal resistance conditioning and testing method conducted under controlled laboratory conditions intended to provide an estimate of a product's R-value at an age of five years; this value corresponds closely to an estimate of the product's average R-value during its first 15 years of service life.

Conversely, NRCA's R-value test results are representative of product's R-value at the time of testing. The products tested were new (unused, uninstalled) at the time of testing. In NRCA's case, one also takes into account and would conditioning the tested products experienced during shipment and storage, such as changing ambient temperature and humidity exposure conditions.

Although PIMA's bulletin suggests the difference between PIMA's QualityMark's values and NRCA's test results may be attributable to NRCA's limited test sample size, sample procurement and selection, it is far more logical and likely the laboratory conditioning contained in the QualityMark procedure is not truly representative of the actual exposure conditions polyisocyanurate insulation typically experiences.

After reviewing PIMA's performance bulletin and the additional R-value test data made available, NRCA stands by its results and current R-value recommendations for polyisocyanurate insulation. ●●●

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

Professional Roofing,

June 2016

10

PIMA/NRCA TOC meeting

July 12, 2016

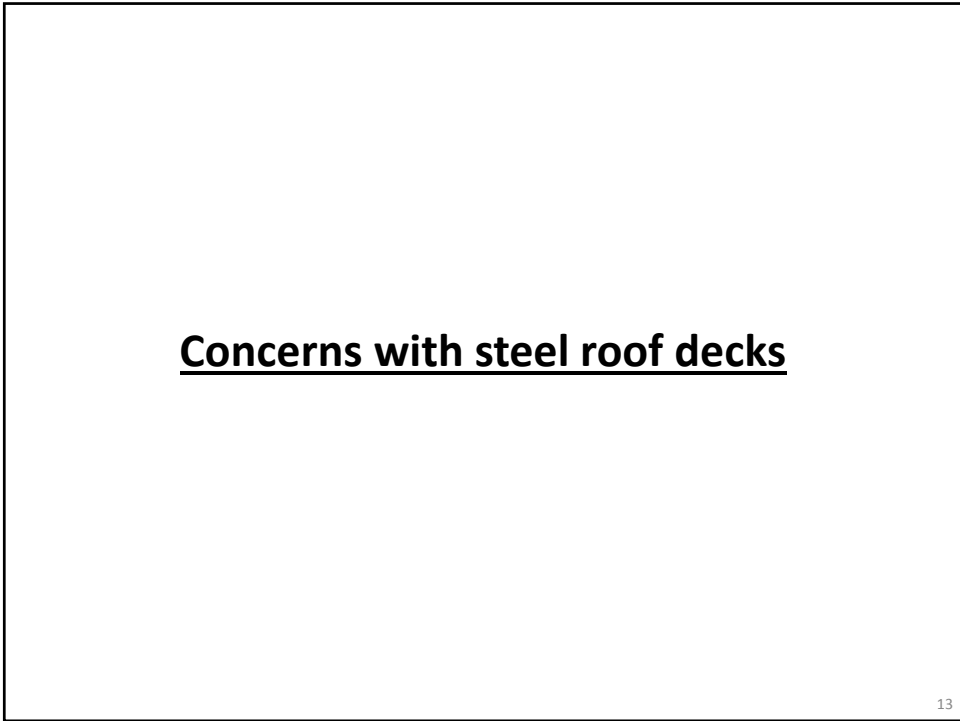
Outcomes:

- PIMA R-value research
 - Results to NRCA by the end of the year
- Facer sheet descriptions
- Knit line criteria
- Review storage/covering criteria

11

Stay tuned...

12



Concerns with steel roof decks

TECH TODAY

Concerns with steel roof decks

Seam-fastened single-ply membrane systems may be problematic

by Mark S. Graham

Steel roof decks are the most popular roof deck type used in the U.S. However, inconsistencies between design methods and for steel roof decks and roof systems can cause for concern.

SDI guidelines

Steel roof decks typically are designed using guidelines developed by the Steel Deck Institute (SDI).

Historically, SDI's design guidelines for steel roof decks have been published in various editions of SDI's Design Manual for Composite Decks, Form Decks and Roof Decks. SDI has revised and updated its manual a number of times during the years. For example, the 2007 edition is referred to as "Publication No. 315."

Beginning in 2006, SDI published its design specifications for steel roof decks as ANSISD/RDI-2006, "Standard for Steel Roof Decks." The 2010 edition, ANSISD/RDI-2010, is the current edition.

Before the 2006 edition of the International Building Code (IBC), design guidelines were not specifically referenced in model building codes. ANSISD/RDI-2006 was referenced as a requirement in the International Building Code, 2006 Edition (IBC 2006). ANSISD/RDI-2010 is referenced in IBC 2012 and IBC 2015.

SDI design manual and ANSISD/RDI-2006 provide for roof decks to be designed for a 30-pound-per-square-foot (psf) uplift and a 45-psf uplift or roof overhang. ANSISD/RDI-D-2006 also allows

a roof deck's dead load to be deducted from the prescribed design uplift load.

ANSISD/RDI-2010 explains roof decks must "... be anchored to resist the required net uplift forces, but not less than ... 30 psf and 45 psf for roof overhangs."

Also, in 2009, SDI issued a position statement, "Mechanisms of Sealing Membranes to Roof Decks." In this statement, SDI indicates its design methods are based on uniform loading of roof decks, such as that provided by adhered built-up, polymer-modified bitumen or single-ply membrane roof systems.

SDI's statement further explains with design uplift loading conditions, attachment of seam-fastened mechanically attached single-ply membrane roof systems with wide seam spacing could result in localized loads that exceed roof deck capacity. These same loads applied uniformly on a deck's surface would be acceptable.

NRCA's analysis

When buildings are designed, the design team's structural engineer typically will be responsible for the design of the roof structure and roof deck. If SDI's guidelines are used, steel roof decks must likely be designed for a 30-psf uniform uplift capacity with little or no consideration of the roof system type being installed.

Roof system designers typically have site-specific knowledge of steel deck design. Many roof system designers rely on FM Approvals' classification for designing and specifying roof system uplift, which likely results in widely different design uplift capacities between roof systems and steel roof decks.

For example, a roof system with an FM 1-3000 Class 90 uplift classification is intended to resist a 45-psf uplift load in the roof

field and higher uplift loads in the roof eave perimeter and corners. If this roof system is designed to be installed on a steel roof deck using SDI's guidelines for a 30-psf uplift, the steel deck has a design uplift capacity of only about one-third the load that the roof system. In this case, attachment of the roof deck to the steel structure is of specific concern.

Similarly, with seam-fastened mechanically attached membrane roof systems where the roof membrane's seam spacing exceeds the spacing of the roof deck's structural supports, the steel roof deck likely has a design uplift capacity low (and significantly lower) than the roof system. Roof deck loading under uplift loading, attachment of the roof deck to the steel structure and, in some instances, localized corner uplift loading of the steel structure are of concern.

In many instances, steel roof decks are fabricated from steel stock with yield strengths in excess of those prescribed in ANSISD/RDI-2010. This results in steel roof decks being somewhat stronger than what SDI prescribes for uplift design purposes. However, roof system designers should not unknowingly rely on any capacity in excess of steel roof deck design properties.

Clearly, dialogue is necessary between steel roof deck designers and roof system designers. Additional dialogue between the roofing and steel deck industries also is needed.

Additional information about steel roof decks is contained in the steel decks section of The NRCA Roofing Manual: Membrane Roof Systems, which is available by accessing designcenter.nrca.com or calling (800) ANS-NRCA (275-4722). ■■■

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

Professional Roofing, January 2015

- SDI guidelines vs. FM guidelines
- Uniformly-distributed loading vs. concentrated loading

12 www.professionroofing.com JANUARY 2015

14

NRCA Webinar

7

NRCA has arranged a meeting with
AISI, SDI, SJI to discuss the issue(s)
and possible solutions

15

FM document updates

16

FM 1-28 has been updated

www.fmglobaldatasheets.com

FM Global
Property Loss Prevention Data Sheets **1-28**
October 2016
Page 1 of 100

WIND DESIGN

PROVIDER OF FM GLOBAL SHOULD CONSULT LOCAL CODES BEFORE BEGINNING ANY ROOFING WORK.

Table of Contents

	Page
1.6 SCOPE	6
1.7 Changes	6
2.0 LOSS PREVENTION RECOMMENDATIONS	6
2.1 Design Wind Parameters	6
2.2 Minimum Wind Rating for FM Approved Roof System	7
2.2.1 Design Pressure	7
2.2.2 Roof Overhang	7
2.2.3 Wind of Parallel and Corner Zones	8
2.3 Exposed Walls	8
2.4 Opening Penetrations in Exterior Walls	9
2.4.1 Penetrations in Gables	9
2.4.2 Joists in Exterior Walls	11
2.4.3 Penetrations in Parapets	11
2.4.4 Joists in Exterior Walls	11
2.4.5 Penetrations in Parapets	11
2.4.6 Penetrations in Parapets	11
2.4.7 Penetrations in Parapets	11
2.4.8 Penetrations in Parapets	11
2.4.9 Penetrations in Parapets	11
2.4.10 Penetrations in Parapets	11
2.4.11 Penetrations in Parapets	11
2.4.12 Penetrations in Parapets	11
2.4.13 Penetrations in Parapets	11
2.4.14 Penetrations in Parapets	11
2.4.15 Penetrations in Parapets	11
2.4.16 Penetrations in Parapets	11
2.4.17 Penetrations in Parapets	11
2.4.18 Penetrations in Parapets	11
2.4.19 Penetrations in Parapets	11
2.4.20 Penetrations in Parapets	11
2.4.21 Penetrations in Parapets	11
2.4.22 Penetrations in Parapets	11
2.4.23 Penetrations in Parapets	11
2.4.24 Penetrations in Parapets	11
2.4.25 Penetrations in Parapets	11
2.4.26 Penetrations in Parapets	11
2.4.27 Penetrations in Parapets	11
2.4.28 Penetrations in Parapets	11
2.4.29 Penetrations in Parapets	11
2.4.30 Penetrations in Parapets	11
2.4.31 Penetrations in Parapets	11
2.4.32 Penetrations in Parapets	11
2.4.33 Penetrations in Parapets	11
2.4.34 Penetrations in Parapets	11
2.4.35 Penetrations in Parapets	11
2.4.36 Penetrations in Parapets	11
2.4.37 Penetrations in Parapets	11
2.4.38 Penetrations in Parapets	11
2.4.39 Penetrations in Parapets	11
2.4.40 Penetrations in Parapets	11
2.4.41 Penetrations in Parapets	11
2.4.42 Penetrations in Parapets	11
2.4.43 Penetrations in Parapets	11
2.4.44 Penetrations in Parapets	11
2.4.45 Penetrations in Parapets	11
2.4.46 Penetrations in Parapets	11
2.4.47 Penetrations in Parapets	11
2.4.48 Penetrations in Parapets	11
2.4.49 Penetrations in Parapets	11
2.4.50 Penetrations in Parapets	11
2.4.51 Penetrations in Parapets	11
2.4.52 Penetrations in Parapets	11
2.4.53 Penetrations in Parapets	11
2.4.54 Penetrations in Parapets	11
2.4.55 Penetrations in Parapets	11
2.4.56 Penetrations in Parapets	11
2.4.57 Penetrations in Parapets	11
2.4.58 Penetrations in Parapets	11
2.4.59 Penetrations in Parapets	11
2.4.60 Penetrations in Parapets	11
2.4.61 Penetrations in Parapets	11
2.4.62 Penetrations in Parapets	11
2.4.63 Penetrations in Parapets	11
2.4.64 Penetrations in Parapets	11
2.4.65 Penetrations in Parapets	11
2.4.66 Penetrations in Parapets	11
2.4.67 Penetrations in Parapets	11
2.4.68 Penetrations in Parapets	11
2.4.69 Penetrations in Parapets	11
2.4.70 Penetrations in Parapets	11
2.4.71 Penetrations in Parapets	11
2.4.72 Penetrations in Parapets	11
2.4.73 Penetrations in Parapets	11
2.4.74 Penetrations in Parapets	11
2.4.75 Penetrations in Parapets	11
2.4.76 Penetrations in Parapets	11
2.4.77 Penetrations in Parapets	11
2.4.78 Penetrations in Parapets	11
2.4.79 Penetrations in Parapets	11
2.4.80 Penetrations in Parapets	11
2.4.81 Penetrations in Parapets	11
2.4.82 Penetrations in Parapets	11
2.4.83 Penetrations in Parapets	11
2.4.84 Penetrations in Parapets	11
2.4.85 Penetrations in Parapets	11
2.4.86 Penetrations in Parapets	11
2.4.87 Penetrations in Parapets	11
2.4.88 Penetrations in Parapets	11
2.4.89 Penetrations in Parapets	11
2.4.90 Penetrations in Parapets	11
2.4.91 Penetrations in Parapets	11
2.4.92 Penetrations in Parapets	11
2.4.93 Penetrations in Parapets	11
2.4.94 Penetrations in Parapets	11
2.4.95 Penetrations in Parapets	11
2.4.96 Penetrations in Parapets	11
2.4.97 Penetrations in Parapets	11
2.4.98 Penetrations in Parapets	11
2.4.99 Penetrations in Parapets	11
2.4.100 Penetrations in Parapets	11

Minor Changes Made to Previous Edition: © 2016 FM Global. No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of FM Global.

- Use RoofNav’s ratings calculator
- Apply a 2.0 safety factor
- Roof overhang factors (Table 7)
- Windborne debris separation distances
- Roof-mounted equipment (ASCE 7-10)
- Tornado-resistant design (Appendix)

A new consideration

FM 1-28 has been updated, further complicating wind designs

by Mark S. Graham

FM 1-28 typically results in higher design wind pressures and recommended resistance ratings

For buildings and other structures, although FM 1-28 contains some adjustments that typically result in higher design wind pressures and recommended resistance ratings. Conversely, the 2012 and 2015 editions of the International Building Code (IBC) reference ASCE 7-10, which can result in notably different design wind loads from those listed in FM 1-28.

FM 1-28 recommends the use of a 2.0 safety factor and recommended resistance ratings for roof overhangs have been increased, and some roof overhang factors (Table 7) have been increased, which will result in higher design wind pressures at roof overhangs with roof slopes of 1:12 and greater.

FM 1-28, Section 7.7.4, stipulating for Windborne Debris includes a specific calculation procedure for determining separation distances between buildings in locations prone to tropical storms where aggregate roof surfacings are used.

FM 1-28, Section 7.8, Roof-mounted Equipment adds guidance on determining resistance to uplift, sliding and overturning in high winds for roof-mounted equipment. The guidelines for roof-mounted equipment generally are consistent with ASCE 7-10.

FM 1-28, Appendix D (Optional Guidance for Tornado-Resistant Design and Construction) provides optional guidance for locations

that may warrant additional property protection in locations subject to tornadoes.

FM 1-28 and ASCE 7-10

FM 1-28 includes a discussion and example comparison of the differences in design wind pressures using FM 1-28 and ASCE 7-10 as well as IBC 2012 and IBC 2015.

FM 1-28 uses basic wind speeds based on a 50-year mean recurrence interval (MRI) and upwind of a 100-year MRI along coastal areas, as well as an importance factor of 1.15 and recommended safety factor of 2.0. Conversely, ASCE 7-10, except design method for components and claddings, uses ultimate wind speeds based on 30-, 50- and 1,000-year MRIs.

FM 1-28 also provides a method for assessing strength design method results to alternate stress design (ASD) method values, which are more compatible to FM 1-28's methods.

FM 1-28 typically results in higher resistance and recommended resistance ratings than those defined using ASCE 7-10's strength design or ASD methods.

Closing Thoughts

The revision of FM 1-28 has resulted in changes to FM Global's recommendations to designers of highly protected buildings, issued by FM Global.

Designers using FM 1-28 need to realize it typically results in higher design wind pressures and recommended resistance ratings than when using ASCE 7-10, IBC 2012 and IBC 2015. ■■■

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

Professional Roofing,

March 2016

FM 1-29 has just been 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 readers of Factory Mutual Insurance Company: Contact the local FM Global office before beginning any roofing work.

Table of Contents	
	Page
1.0 Objectives	1
2.0 LOSS PREVENTION RECOMMENDATIONS	2
2.1 Installation	2
2.2 Construction and Location	4
2.2.1 General Design Recommendations and Material Selection	4
2.2.2 General Insulation Recommendations	4
2.2.3 Steel Roof Deck	6
2.2.4 Structural Composite Roof Deck	10
2.2.5 Fiberglass Reinforced Plastic (FRP) Insulated Roof Deck Assemblies	10
2.2.6 Composite Panel Roof Deck	10
2.2.7 Lumber and Plywood Deck	10
2.2.8 Fire Retardant Treated Lumber and Plywood	10
2.2.9 Lightweight Insulating Concrete (LWIC) and Foam Deck	11
2.2.10 Reinforcing Steel Concrete (Other Than LWIC)	11
2.3 Inspection, Testing and Maintenance	11
3.0 SUPPORT FOR RECOMMENDATIONS	14
3.1 Supplemental Information	14
3.1.1 Class 1 and Class 2 Roof Decks	14
3.1.2 Wind Uplift Resistance, Non-Adhesive Roof Covers	15
3.1.3 Wind Uplift Resistance, Adhesive Systems	17
3.1.4 External Combustibility	17
3.1.5 Fire Check Construction	17
3.1.6 Wind Uplift	17
3.1.7 Wind Damage	17
3.1.8 Interior Contamination	17
3.1.9 Snow Deck and Corrosive Compounds	17
3.1.10 Snow Deck	17
3.1.11 Fire Spread	17
4.0 REFERENCES	42
4.1 Fire Spread	42
4.2 Other	42
APPENDIX A: SUMMARY OF TERMS	42
APPENDIX B: DOCUMENT REVISION HISTORY	44
APPENDIX C: SUPPLEMENTAL INFORMATION FOR PROPRIETARY PROTECTED MECHANICAL ROOF SYSTEMS	45
C.1 Insulation Placement	45
List of Figures	
Fig. 1. Deck assembly of upper ply to a mechanically fastened base sheet	6
Fig. 2. Protection for roof support joists	6
Fig. 3a. Use of multiple deck fasteners in one steel deck rib	10
Fig. 3b. Insulation and separator	10
Fig. 3c. Deck toe fastening interlocking seam	10

- Revised/nor criteria:
- Steel roof decks:
 - Uniformly-distributed loading
 - Concentrated loading
 - Lightweight structural concrete

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

2.2.3.2 When designing the steel deck, give consideration to the needed wind rating, and how the load is applied (concentrated vs. uniformly distributed) from the above-deck components to the deck. Where the distance between rows of roof cover fasteners is greater than half the deck span, treat as a concentrated load.

As an alternative to using Tables 1A or 1B for concentrated loads, a performance-based approach may be used if calculations are conducted by a licensed S.E. or P.E. in structural engineering. This applies to situations where the distance between rows of roof cover fasteners is greater than one-half the deck span. Make the following assumptions:

- Assume a 3-span structural condition.
- Assume the first row of roof cover fasteners is located at mid-point of the first deck span.
- Assume maximum allowable stresses are determined using allowable strength design (ASD) in accordance with AISI S100-2012, or comparable standard outside the United States

Due to the more brittle nature of higher grade steels, the maximum yield stress used in the analysis is 60,000 psi (414 MPa), even for 80,000 psi (552 MPa) yield stress steel. Use Tables 1A through 1E as follows to facilitate deck selection:

Table 1A. Use for roof covers or base plies that are mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is more than half the deck span and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with a minimum yield stress of 33,000 psi (228 MPa).

Table 1B. Use for roof covers or base plies that are mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is more than half the deck span and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with a minimum yield stress of 60,000 psi (414 MPa).

Note: Where the minimum specified yield stress is between 33,000 psi (228 MPa) and 60,000 psi (414 MPa), it is reasonably accurate to interpolate the maximum deck span linearly based on Tables 1A and 1B.

Table 1C. Use for roof covers or base plies that are adhered to insulation or cover board, or mechanically fastened to the steel deck when the distance between rows of roof cover fasteners is one-half the deck span or less and the deck is 1-1/2 in. (38 mm) deep, wide rib (Type B) with minimum yield stresses of 33,000 psi (228 MPa) and ultimate wind ratings of from 60 to 225 psf (2.9 to 10.8 kPa).

20

**FM Global
Property Loss Prevention Data Sheets** 1-29
January 2016
Interim Revision April 2016

Table 1C. Maximum Steel Deck Span (ft) for 1½ in. (38 mm) Deep, Wide Rib (Type B) Steel Deck with an Adhered Roof Cover, for Wind Ratings from 60 to 225 psf (2.9 to 10.8 kPa)
(NOTE: Use this table when the distance between rows of roof cover fasteners is one-half the deck span or less. **Green font** indicates that deflection governs over bending stress.)

Yield Stress psi	Deck Gauge	Ultimate Wind Rating per RoofNav (psf)												
		Maximum Span (ft)												
		60	75	90	105	120	135	150	165	180	195	210	225	
33,000	22	7.10	7.10	7.10	7.10	7.07	6.67	6.33	6.03	5.78	5.55	5.35	5.17	
	20	7.78	7.78	7.78	7.78	7.78	7.43	7.05	6.72	6.44	6.18	5.96	5.76	
	18	9.08	9.08	9.08	9.08	9.08	8.66	8.22	7.84	7.50	7.21	6.95	6.71	
	16	10.36	10.36	10.36	10.36	10.36	9.89	9.38	8.94	8.56	8.23	7.93	7.66	
40,000	22	7.10	7.10	7.10	7.10	7.10	7.10	6.96	6.64	6.35	6.10	5.88	5.68	
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	
45,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	
50,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	
55,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	
60,000 +	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	

Green font indicates that deflection governs over bending stress.

21

**FM Global
Property Loss Prevention Data Sheets** 1-29
January 2016
Interim Revision April 2016

Table 1A. Maximum Steel Deck Span (ft) for 1½ in. (38 mm) Deep, 33,000 psi (228 MPa) Yield Stress with a Mechanically Fastened Roof Cover (continued)
(Note: Use this table when the distance between rows of roof cover fasteners is more than one-half the deck span.)

Max Deck Spans By Wind Rating/Fastener Spacing, Sheet Gauge for 33 ksi, 1½ in. Deep Wide Rib Deck

Roof Cover Fastener Row Spacing (ft)	Gauge	Wind Rating [psf]																		
		330	315	300	285	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60
8	18	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5.5	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	6
8.5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	6
9	18	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5
9.5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4.5	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
10	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	4.5
10.5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5
11	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5
11.5	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
12	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Roof Cover Fastener Row Spacing	Gauge	330	315	300	285	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60

Green font indicates that deflection governs over bending stress.

22

FM Global
Property Loss Prevention Data Sheets 1-29

January 2016
Interim Revision April 2016
Page 1 of 40

2.2.4.2 Lightweight Structural Concrete (LWSC) Roof Deck

2.2.4.2.1 Where the structure will not safely support normal-weight concrete and therefore lightweight structural concrete (90-115 pcf [1440/1840 kg/m³]) must be used (e.g., to provide required fire-resistance ratings), design the concrete and its reinforcement as a noncomposite type and pour the LWSC over removable forms.

Lightweight aggregate retains a great deal of moisture that will be released for several months after the concrete has hardened and will be absorbed by abovedeck components. This will damage and weaken those components, resulting in damage from winds below design speeds, or premature deterioration requiring replacement.

2.2.4.2.2 Where the use of removable forms is not practical, take the following precautions to prevent moisture damage to above-deck roof components:

A. Use the lowest reasonable water-to-cement (w/c) ratio in the concrete mix. "Water reducers" may be used in the concrete mix; however, do not use water-reducing admixtures that contain calcium chloride or other chloride salts that are corrosive to the steel form deck.

In addition, do one of the following (B or C):

B. Use an FM Approved assembly consisting of a mechanically fastened modified bitumen base sheet directly over a concrete deck followed by adhered components above, or

C. Ensure the concrete roof deck is dry before installing the above-deck components. In some cases, this could take months. Perform a test to ensure the moisture migration has been reduced to a level where damage to above-deck components is unlikely based on the product manufacturer's recommendations (note: neither the Plastic Sheet Method Test [ASTM D4263] nor the Calcium Chloride Test [ASTM F1869] are recommended for this purpose). The test procedures and acceptance criteria must first be agreed upon by all stakeholders.

Note: The following are NOT considered substitutes for the above recommendations:

- The use of a vented steel form deck alone (without one of the above alternatives) because it will have limited impact on moisture reduction.
- The use of above-deck components that are resistant to moisture.

23

Updated guidelines

FM 1-29's revisions affect many roof deck designs

by Mark S. Graham

A roof deck that complies with FM's guidelines is essential

FM Global [FM] has updated its Loss Prevention Data Sheet 1-29, "Steel Deck, Noncomposite and Above-Deck Roof Components," which provides general design guidance regarding wind resistance for noncomposite roof assemblies on highly pressurized buildings (inspired by the company).

FM 1-29's revisions

A revised edition of FM 1-29 was published in January and an updated version containing some editorial changes was published in April. The document's previous edition was published in September 2010.

With the latest changes, FM 1-29 has been completely reorganized, revised and expanded. The revised scope of the data sheet includes providing guidance to structural engineers for determining the proper spans and spacings of roof decks to supporting members to provide wind resistance. The data sheet also provides roofing professionals with guidance regarding the proper design and installation of above-deck roof components for wind resistance and fire classification.

FM 1-29's Sec. 2.2.2 contains new guidelines for designing roof decks. It includes a structural engineer needs to consider the necessary wind rating and how uniformly distributed or concentrated loads from above-deck components are applied to roof decks. When the distance between several consecutive above-deck components is greater than half

the deck span (mechanically fastened mechanically attached single-ply membrane roof systems), the deck design for wind uplift should be based on concentrated loads.

New tables provide maximum deck spans for 16-, 20- and 22-gauge steel roof decks used with mechanically attached roof systems, resulting in concentrated loads. Table 1A applies to steel roof decks with 33-kg-per-square-foot (ft²) yield strengths, and Table 1B applies to steel roof decks with 40-kg or greater yield strengths. For calculation purposes, FM allows only a maximum 60-kg load to be used for higher-yield (60-kg) yield grade metals because of their much more brittle nature.

As an alternative to using Tables 1A or 1B, FM allows a performance-based design approach if calculations are conducted by a licensed professional engineer or structural engineer. These calculations should be based on assuming a three-span deck condition, the five uses of roof form factors should occur at the five deck span midpoints, and maximum allowable stresses should be determined using the allowable strength design method from AISI S100-12, "North American Specification for the Design of Cold-Formed Steel Structural Members."

New Tables 1C, 1D and 1E provide maximum deck spans for 16-inch Type 9 and 3-inch Type N steel decks used in uniformly distributed loading (adhered roof coverings) situations.

Also, FM's guidelines for enhanced deck attachments to steel structural steel members are provided in Tables 2 and 3. FM 1-29's previous editions provided narrative guidelines for enhanced deck attachments. FM 1-29's Sec. 2.2.2.2 provides new guidelines for lightweight structural concrete

Professional Roofing, July 2016

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

12 www.professionalroofing.com JULY 2016

NRCA Webinar

12

NRCA technical program/document updates

25

Roof Wind Designer update

www.roofwinddesinger.com

$q_w = 0.00256(K_z)(K_d)(K_e)(V^2)(I)$

Home | Contact Us | FAQ login

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.

Design-wind loads are derived using the American Society of Civil Engineers (ASCE) Standard ASCE 7, "Minimum Design Loads for Buildings and Other Structures." This standard is a widely recognized consensus standard and is referenced in and serves as the technical basis for wind load determination in the International Building Code and NFPA 5000: Building Construction and Safety Code. Roof Wind Designer allows users to choose between the 2005 or 2010 editions of ASCE 7. Roof Wind Designer uses Method 1—Simplified Method, 2005 edition, and the Envelope Procedure, Part 2: Low-rise Buildings (Simplified) of Chapter 30, 2010 edition. For a more detailed explanation of the two editions, please [click here](#).

Also, Roof Wind Designer determines roof systems' minimum recommended design wind-resistance loads, which are derived from the building's design wind loads, taking into consideration a safety factor in reliance of ASTM D6630, "Standard Guide for Low Slope Insulated Roof Membrane Assembly Performance." Using these minimum recommended design wind-resistance loads, users can select appropriate wind resistance classified roof systems and edge-metal flashing systems.

Roof Wind Designer has been developed and is maintained by the National Roofing Contractors Association (NRCA), with the support of the Midwest Roofing Contractors Association (MRCA) and the North/East Roofing Contractors Association (NERCA). Currently, this application is available at no cost.

Questions regarding Roof Wind Designer can be directed to the [Contact Us](#) page.

To register for a new account [click here](#). If you already have an account, [click here](#) to login.


  

© Copyright 2016 National Roofing Contractors Association

26

EnergyWise Roof Calculator update

energywise.nrca.net



NRCA

EnergyWise Roof Calculator

[Log in](#) | [Register](#)

Home Contact Help FAQ Log in

Welcome to EnergyWise Roof Calculator

EnergyWise Roof Calculator Online is a Web-based application that provides a graphical method of constructing roof assemblies to evaluate thermal performance and estimated energy costs under normal operating conditions.


This application also provides minimum insulation requirements as stipulated in the following codes and standards:

- International Energy Conservation Code (IECC), versions 2006, 2009, 2012 and 2015
- International Green Construction Code (IgCC), versions 2012 and 2015
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 90.1, "Energy Standard for Buildings Except Low-rise Residential Buildings," versions 1999 (2001), 2004, 2007, 2010 and 2013
- ASHRAE Standard 189.1, "Standard for the Design of High-Performance Green Buildings," versions 2009 and 2011

[Click here](#) for additional information about IECC, IgCC, ASHRAE 90.1 and ASHRAE 189.1

Because this application is intended to be a simplified guide, complex energy calculations, such as solar heat gain and exterior shading considerations, have intentionally not been included. For complex energy evaluation calculations, including evaluations of the entire building envelope, building usage, or changes to heating and air-conditioning equipment, consult the ASHRAE Fundamentals Handbook or an experienced mechanical engineer.


This application determines "Annual Energy Cost" values, which is useful when comparing the energy costs and savings associated with various roof assemblies' designs. This value should not be confused with the building owner's overall energy costs, which in most instances will be somewhat larger than the "Annual Energy Cost" that is attributable to the roof assembly only. For a detailed financial analysis of the long-term costs and potential savings of an energy-efficient roof system, consult an experienced accountant.



Related sites


NRCA
Professional Roofing
Alliance for Progress

In partnership with




27

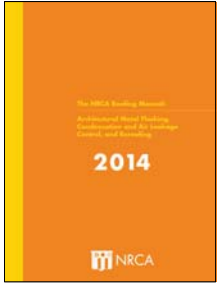
The NRCA Roofing Manual




2016



2015



2014



2013

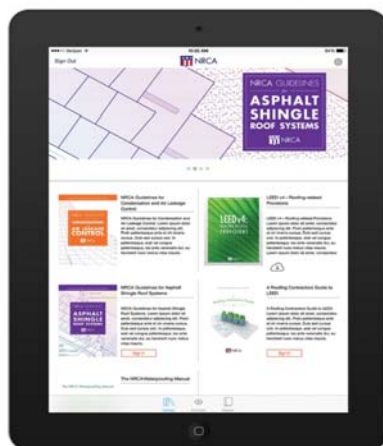
Manual online

www.nrca.net



- Available to all NRCA member registered users (multiple users per member company)
- “Members only” section, click on “My account”, the “Electronic file”
- View, download and print

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



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