NORTH TEXAS ROOFING CONTRACTORS ASSOCIATION
who's on your roof?

Wednesday, May 8, 2024
Texas Star Golf Course
Euless, TX

Technical issues update

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

1

RESEARCH+TECH

Plywood or OSB?

Moisture-related concerns exist with wood structural panels

by Mark S. Graham

NRCA's technical services staff continues to hear from roofing contractors experiencing moisture-related dimensional stability problems with plywood and oriented strand board structural panel sheathing used with steep-slope roof systems. Following is a brief discussion of moisture mechanics, linear expansion and thickness swell testing, and NRCA's recommendations for plywood and OSB structural panel sheathing roof decks.

Moisture mechanics

Plywood and OSB sheathing, similar to all wood products, are hygroscopic, meaning they tend to absorb and release moisture from their surroundings.

When not exposed to direct wetting, structural panel sheathing's moisture content is a function of its environment's relative humidity and temperature. During construction and its service life, panels may be exposed to direct moisture. When exposed to direct wetting, structural panel sheathing's moisture content is influenced by wetting time and panel variables that affect capillarity, such as veneer species of plywood and wax additives in OSB.

24 professionalroofing.net APRIL 2021

Professional Roofing
April 2021

Link

2

Standards for wood structural panels

International Residential Code, 2021 Edition

Plywood:

- U.S. Department of Commerce PS-1, “Structural Plywood”
- CSA Group O325, “Construction Sheathing”

Oriented-strand board (OSB):

- U.S. Department of Commerce PS-2, “Performance Standard for Wood-based Structural-use Panels”
- CSA Group O437, “Standards for OSB and Waferboard”

3

Common, but not referenced in the Code

Plywood and OSB:

- APA-The Engineered Wood Association Standard PRP-108, “Performance Standards and Policies for Structural-Use Panels”

4

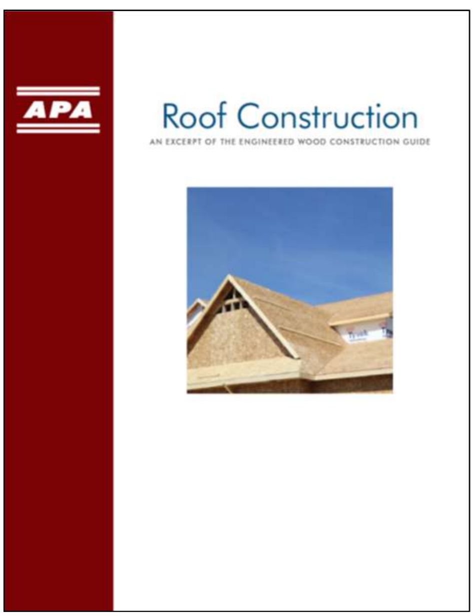
Roof sheathing attachment

IRC 2021 Table 602.3(1), Rows 31-33 (minimum attachment)

ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER[a, b, c]	SPACING OF FASTENERS	
			Edges[h] (inches)	Intermediate supports[c, e] (inches)
Wood structural panels, subfloor, roof and interior wall sheathing to framing and particleboard wall sheathing to framing [see Table R602.3(3) for wood structural panel exterior wall sheathing to wall framing]				
31	3/8″ – 1/2″	6d common or deformed (2″ × 0.113″ × 0.266″ head); or 2 3/8″ × 0.113″ × 0.266″ head nail (subfloor, wall)[i]	6	6[f]
		8d common (2 1/2″ × 0.131″) nail (roof); or RSRS-01 (2 3/8″ × 0.113″) nail (roof)[b]	6	6[f]
32	19/32″ – 3/4″	8d common (2-2 1/2″ × 0.131″) nail (subfloor, wall)	6	12
		8d common (2 1/2″ × 0.131″) nail (roof); or RSRS-01; (2 3/8″ × 0.113″) nail (roof)[b]	6	6[f]
		Deformed 2 3/8″ × 0.113″ × 0.266″ head (wall or subfloor)	6	12
33	7/8″ – 1 1/4″	10d common (3″ × 0.148″) nail; or (2 1/2″ × 0.131 × 0.281″ head) deformed nail	6	12

f. For wood structural panel roof sheathing attached to gable end roof framing and to intermediate supports within 48 inches of roof edges and ridges, nails shall be spaced at 4 inches on center where the ultimate design wind speed is greater than 130 mph in Exposure B or greater than 110 mph in Exposure C.

5



Link

APA Form E30, "Roof Construction"

--Roofing-specific excerpts from APA's *Engineered Wood Construction Guide* (102 pages)

6

A Not-So-Perfect Storm:
The Convergence of Large Buildings, Wood Decks, and Mechanically Attached Low-Slope, Single-Ply Roofing Systems

ABSTRACT

Recent indicators suggest the potential need for additional design considerations when installing mechanically attached, low-slope, single-ply roof systems over oriented strand board (OSB) decking in large warehouse applications. Specifically, sustained wind uplift forces, building pressurization, or a combination of the two can sometimes coincide to subject the roof system to excessive stress. This, in turn, may cause the mechanical fasteners securing the roof to loosen or withdraw.

To gain a deeper understanding of the potential concerns associated with employing standard fastening patterns in such systems, we conducted a limited sampling of cyclic and dynamic testing. This limited sampling allowed us to formulate prospective conclusions on the potential effects of wind uplift and building pressurization on mechanical fastener pullout values.

This white paper is dedicated to exploring the potential performance of in-seam mechanical fastening patterns in OSB decking systems within large warehouse building environments when they are exposed to a variety of environmental conditions. Furthermore, we aim to provide suggestions for design professionals to consider when choosing to use a mechanically fastened single-ply roofing system over an OSB deck in large warehouse applications.

LEARNING OBJECTIVES

- Identify wind uplift and building pressurization issues with wood decks on large warehouse and industrial structures and the resulting effects on mechanically attached, single-ply roofing systems.
- Describe wind and pressure-related failures of single-ply roof systems on distribution centers in the western United States.
- Recognize variability in wood decking materials as well as the effect of pressure, cycling, and eccentric uplift forces in the acceleration of roof system failures.
- Explain design and installation best practices along with repair recommendations to reinforce roof system reliability.

SPEAKERS

Richard Gustin
Johns Manville, Denver, Colorado

Rick Gustin started his career as a roofing contractor before coming to Johns Manville (JM) in 1998, where he served as a field technical representative. He then held various roles, including technical services specialist, Six Sigma Black Belt, and application engineer before assuming responsibility as manager of Guarantee Services. In 2013, he became the EPDM product manager focusing on developing JM's offering. Today, Rick is the Owner Services Technical Manager responsible for large claims and technical marketing support. He holds a degree in mechanical engineering from Rensselaer Polytechnic Institute.

22 | GUSTIN & HUGHES The IIBEC International Convention and Trade Show

Link

2024 IIBEC Convention Proceedings

March 8-11, 2024

7

Considerations

Lumber, plywood and OSB

- Be extra cautious of plywood and OSB roof decks
- Limit your deck acceptance responsibilities
- Consider more proactive plywood and OSB deck replacement
- Consider pull tests for plywood and OSB roof decks when using mechanically-attached membrane systems

8

Nailbase insulation considerations

9

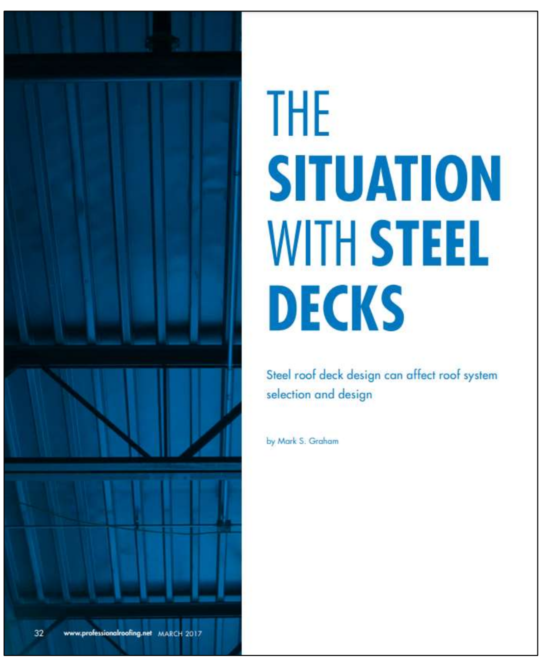
Nailbase insulation considerations

- Double layer design and application
- Taped joints can control vapor leaks/underlayment wrinkling at board joints
- Pressure-tested and FRT nailbase are not good ideas for nailbase

10

Continuing concerns with steel roof decks

11



Link

Professional Roofing
March 2017

12

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

*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 Lammert Engineering, LLC, Gainesville, FL, and Technical Director of the Steel Deck Institute. He may be reached at **tsputo50@gmail.com**.*

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

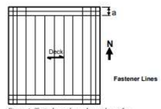


Figure 1. Typical membrane layout by roofers.

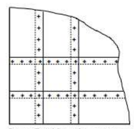


Figure 2. Typical fastener layout at corner zones.

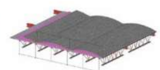


Figure 3. Line attached membrane under uplift. Courtesy of the Steel Deck Institute.

Structure magazine

March 2017

Link

13

FM Global
Property Loss Prevention Data Sheets **1-29**

January 2016
Interim Revision July 2022
Page1 of 50

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

Page
1.0 SCOPE ... 3
1.1 Changes ... 3
2.0 LOSS PREVENTION RECOMMENDATIONS ... 3
2.1 Introduction ... 3
2.2 Construction and Location ... 4
2.2.1 General Design Recommendations and Material Selection ... 4
2.2.2 General Installation Recommendations ... 5
2.2.3 Steel Roof Deck ... 6
2.2.4 Structural Concrete Roof Deck ... 18
2.2.5 Fiberglass Reinforced Plastic (FRP) Insulated Roof Deck Assemblies ... 19
2.2.6 Cementitious Panel Roof Deck ... 19
2.2.7 Lumber and Plywood Deck ... 19
2.2.8 Fire Retardant-Treated Lumber and Plywood ... 20
2.2.9 Lightweight Insulating Concrete (LWIC) and Form Deck ... 20
2.2.10 Above-Deck Roof Components (Other Than LWIC) ... 21
2.3 Inspection, Testing, and Maintenance ... 35
3.0 SUPPORT FOR RECOMMENDATIONS ... 35
3.1 Supplemental Information ... 35
3.1.1 Class 1 and Class 2 Roof Decks ... 35
3.1.2 Wind Uplift Resistance, Non-Ballasted Roof Covers ... 36
3.1.3 Wind Uplift Resistance, Ballasted Systems ... 37
3.1.4 External Combustibility ... 38
3.1.5 Re-Cover Construction ... 38
3.1.6 Wind Uplift ... 38
3.1.7 Wind Damage ... 40
3.1.8 Inferior Construction ... 40
3.1.9 Steel Deck and Eurocode Examples ... 40
4.0 REFERENCES ... 42
4.1 FM Global ... 42
4.2 Others ... 43
APPENDIX A GLOSSARY OF TERMS ... 43
APPENDIX B DOCUMENT REVISION HISTORY ... 45
APPENDIX C SUPPLEMENTAL INFORMATION FOR PROPRIETARY PROTECTED MEMBRANE ROOF SYSTEMS ... 46
C.1 Insulation Fastener Placement ... 46

List of Figures

Fig. 1. Torch application of upper ply to a mechanically fastened base sheet ... 5
Fig. 2. Protection for roof expansion joints ... 6
Fig. 3a. Use of multiple deck fasteners in one steel deck rib ... 16
Fig. 3b. Nominal weld diameter ... 16
Fig. 3c. Side lap fastening: interlocking seam. ... 16

FM Global

14

14

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

Page 6 FM Global Property Loss Prevention Data Sheets

2.2.2.5 Prevent over-stressing of the roof deck due to possible high concentrated loads during construction. This includes rolls of membrane and gravel carts. When the weight of individual rolls of single-ply membrane exceeds 1100 lb (500 kg), use precautions such as plywood sheets over steel deck to reduce point loads.

2.2.2.6 Protect roof expansion joints by filling the space between nailers with noncombustible, compressible insulation, such as mineral wool. Cover the expansion joint with flashing made of galvanized steel, zinc-aluminum-coated steel, or stainless steel secured in accordance with Data Sheet 1-49. An example is shown in Figure 2. Similar details can be found in the *NRCA Roofing Manual: Membrane Roof Systems.*

2.2.2.7 Provide adequate separation and/or noncombustible insulation between hot exhaust stacks and combustible roof components. See DS 1-13, *Chimneys*, for details.

2.2.2.8 Ensure all above-deck components are dry and surfaces are free of debris or dirt prior to adhering roof covers to them. This will help ensure complete adhesion of the cover to its substrate.

2.2.2.9 In locations that are prone to tropical cyclones, plan roof installations that use cold-process adhesives to ensure adequate curing time prior to potential exposure from a tropical cyclone. Also, see Section 3.1.2.2.

2.2.2.10 Apply adhesives in accordance with the manufacturer's temperature limitations.

2.2.3 Steel Roof Deck

2.2.3.1 Select a Roof*Nav* assembly after determining the needed wind, hail, and interior and exterior fire ratings. Use the center-to-center spacing of supports to determine the deck span.

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:

A. Assume a 3-span structural condition.

B. Assume the first row of roof cover fasteners is located at mid-point of the first deck span.

C. Assume maximum allowable strength is determined using allowable strength design (ASD) in accordance with AISI S100-2016, 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:

15

15

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

FM Global Property Loss Prevention Data Sheets Page 7

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).

Table 1D. 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 240 to 405 psf (11.5 to 19.4 kPa).

Table 1E. 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 3 in. (75 mm) deep, with an 8 in. (200 mm) rib spacing (Type N) 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).

NOTE for Tables 1A through 1E: Maximum spans may vary slightly depending on the exact section properties for the specific deck.

16

16

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	7.76	7.40	7.08	6.80	6.56	6.33
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.04	8.62	8.25	7.93	7.64	7.38
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.32	9.84	9.42	9.05	8.72	8.43
45,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.04	6.74	6.48	6.24	6.03
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.51	7.22	6.95	6.72
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	8.76	8.41	8.11	7.83
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	9.99	9.60	9.25	8.94
50,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	6.93	6.66	6.42	6.20
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.72	7.42	7.15	6.91
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.00	8.65	8.33	8.05
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.28	9.87	9.51	9.19
55,000	22	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	6.90	6.67
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.69	7.43
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	8.97	8.66
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.24	9.89
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	6.97
	20	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.77
	18	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.08	9.06
	16	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.34

Green font indicates that deflection governs over bending stress.

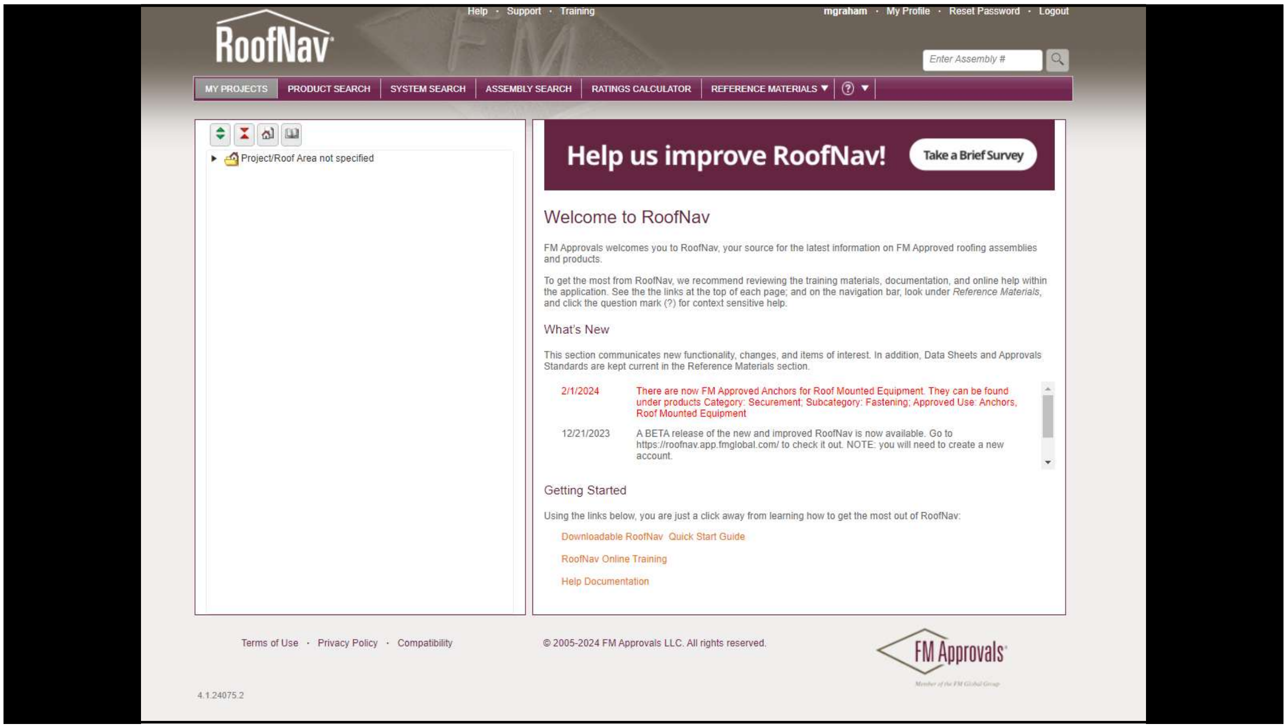
17

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

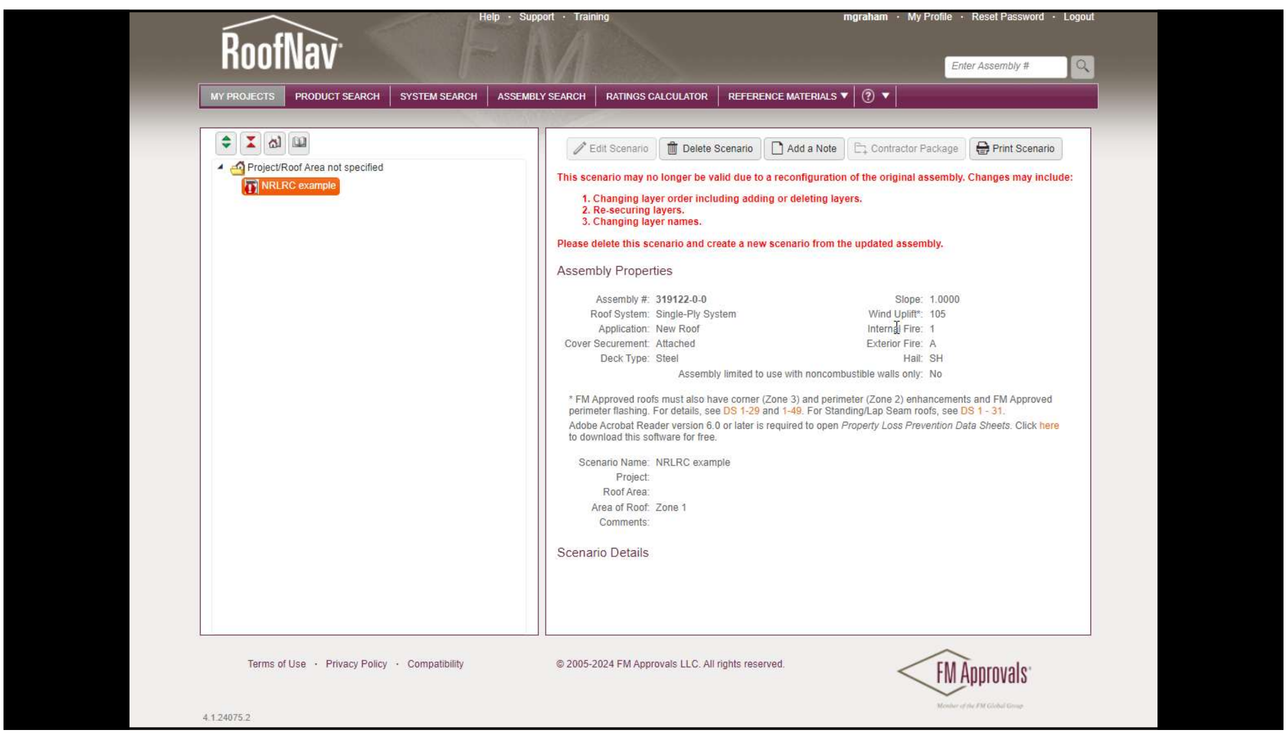
Table 1B. Maximum Steel Deck Span (ft) for 1½ in. (38 mm) Deep, Yield Stress ≥ 60,000 psi (414 MPa) with a mechanically fastened Roof Cover (continued)
(Note: Use this table when the distance between rows of roof cover fasteners is more than one-half the deck span.)

Max Deck Spans By Wind Rating/Fastener Spacing, Sheet Gauge for 80 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
8.5	18	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	4	4	4.5	5.5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6
9	18	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6
9.5	18	-	-	-	-	-	-	4	4	4	4.5	5	5.5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
10	18	-	-	-	-	-	-	-	4	4	4.5	4.5	5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	4	4.5	4.5	5.5	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5.5	6	6
10.5	18	-	-	-	-	-	-	-	4	4	4.5	4.5	5	5.5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	4	4	4.5	5	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6
11	18	-	-	-	-	-	-	-	-	4	4	4.5	5	5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6
11.5	18	-	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6
12	18	-	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	5.5	6
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
		Wind Rating [psf]																		

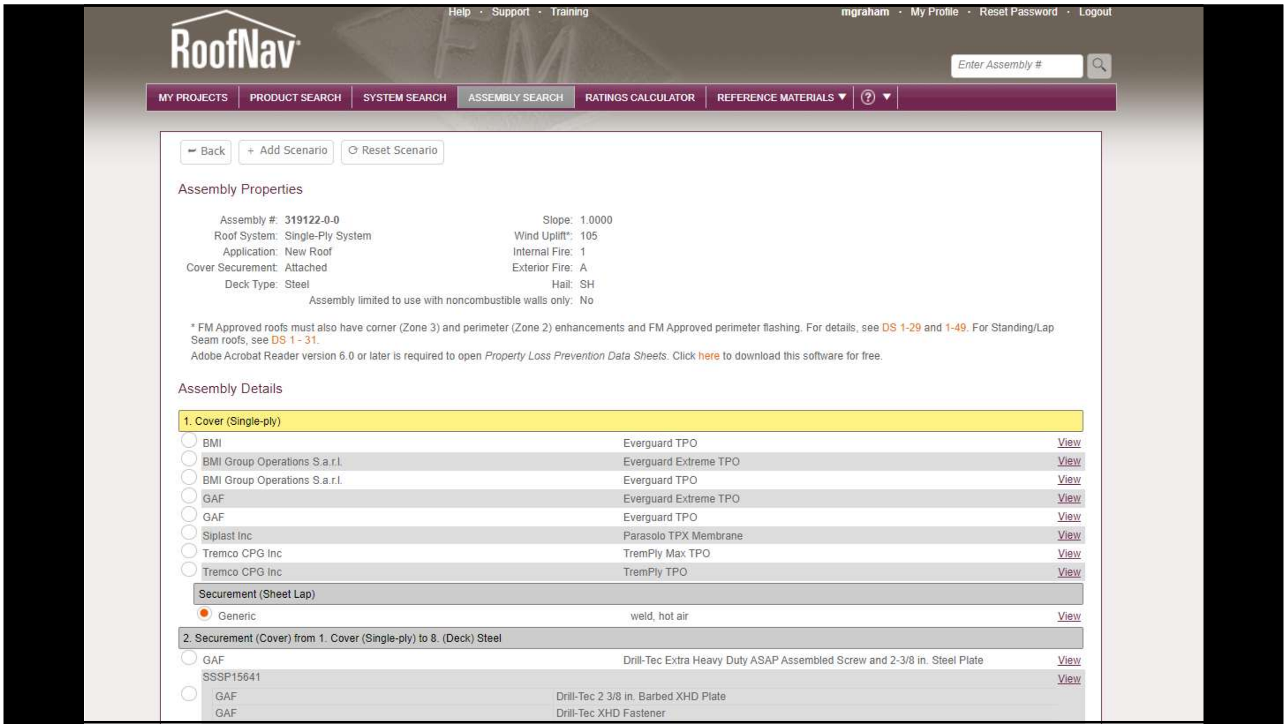
18


Help · Support · Training
mgraham · My Profile · Reset Password · Logout
RoofNav
Enter Assembly #
MY PROJECTS
PRODUCT SEARCH
SYSTEM SEARCH
ASSEMBLY SEARCH
RATINGS CALCULATOR
REFERENCE MATERIALS
Project/Roof Area not specified
Help us improve RoofNav!
Take a Brief Survey
Welcome to RoofNav
FM Approvals welcomes you to RoofNav, your source for the latest information on FM Approved roofing assemblies and products.
To get the most from RoofNav, we recommend reviewing the training materials, documentation, and online help within the application. See the the links at the top of each page; and on the navigation bar, look under Reference Materials, and click the question mark (?) for context sensitive help.
What's New
This section communicates new functionality, changes, and items of interest. In addition, Data Sheets and Approvals Standards are kept current in the Reference Materials section.
2/1/2024
There are now FM Approved Anchors for Roof Mounted Equipment. They can be found under products Category: Securement; Subcategory: Fastening; Approved Use: Anchors, Roof Mounted Equipment
12/21/2023
A BETA release of the new and improved RoofNav is now available. Go to https://roofnav.app.fmglobal.com/ to check it out. NOTE: you will need to create a new account.
Getting Started
Using the links below, you are just a click away from learning how to get the most out of RoofNav:
Downloadable RoofNav Quick Start Guide
RoofNav Online Training
Help Documentation
Terms of Use · Privacy Policy · Compatibility
© 2005-2024 FM Approvals LLC. All rights reserved.
FM Approvals
4.1.24075.2

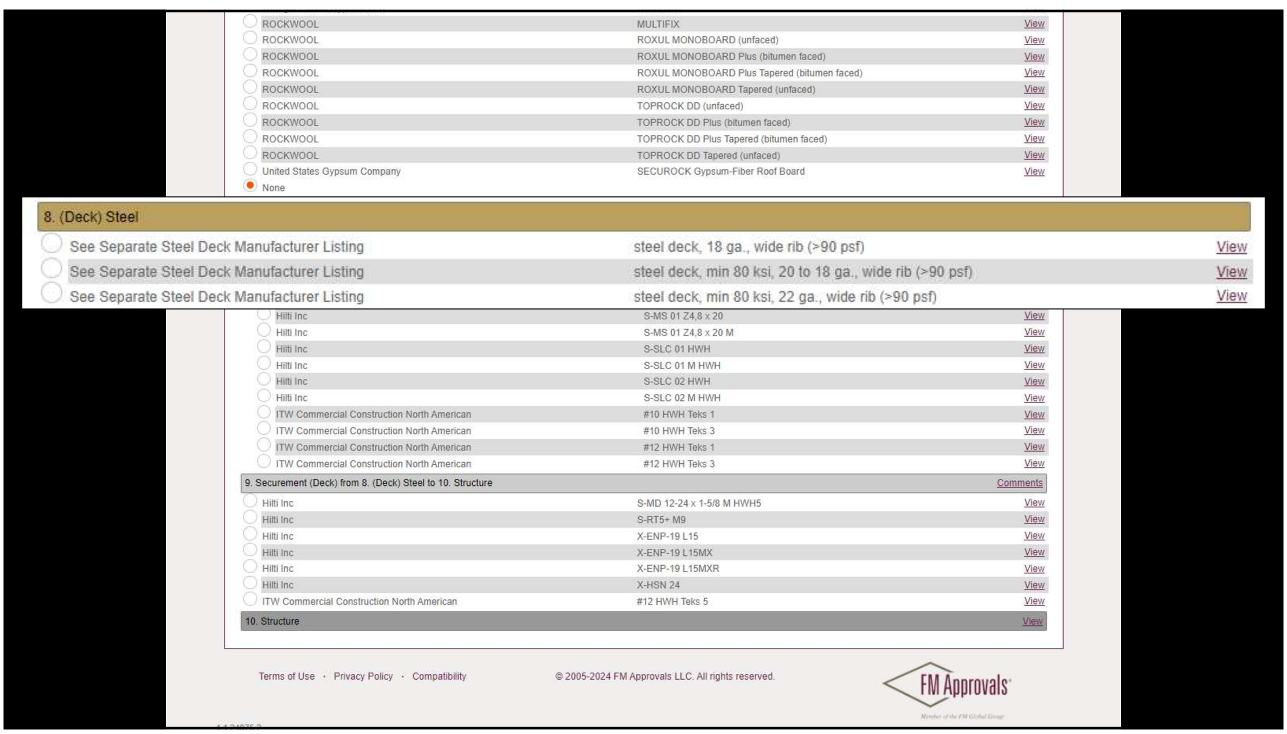
19


Help · Support · Training
mgraham · My Profile · Reset Password · Logout
RoofNav
Enter Assembly #
MY PROJECTS
PRODUCT SEARCH
SYSTEM SEARCH
ASSEMBLY SEARCH
RATINGS CALCULATOR
REFERENCE MATERIALS
Project/Roof Area not specified
NRLRC example
Edit Scenario
Delete Scenario
Add a Note
Contractor Package
Print Scenario
This scenario may no longer be valid due to a reconfiguration of the original assembly. Changes may include:
1. Changing layer order including adding or deleting layers.
2. Re-securing layers.
3. Changing layer names.
Please delete this scenario and create a new scenario from the updated assembly.
Assembly Properties
Assembly #: 319122-0-0
Roof System: Single-Ply System
Application: New Roof
Cover Securement: Attached
Deck Type: Steel
Slope: 1.0000
Wind Uplift*: 105
Internal Fire: 1
Exterior Fire: A
Hail: SH
Assembly limited to use with noncombustible walls only: No
* FM Approved roofs must also have corner (Zone 3) and perimeter (Zone 2) enhancements and FM Approved perimeter flashing. For details, see DS 1-29 and 1-49. For Standing/Lap Seam roofs, see DS 1 - 31.
Adobe Acrobat Reader version 6.0 or later is required to open Property Loss Prevention Data Sheets. Click here to download this software for free.
Scenario Name: NRLRC example
Project:
Roof Area:
Area of Roof: Zone 1
Comments:
Scenario Details
Terms of Use · Privacy Policy · Compatibility
© 2005-2024 FM Approvals LLC. All rights reserved.
FM Approvals
4.1.24075.2

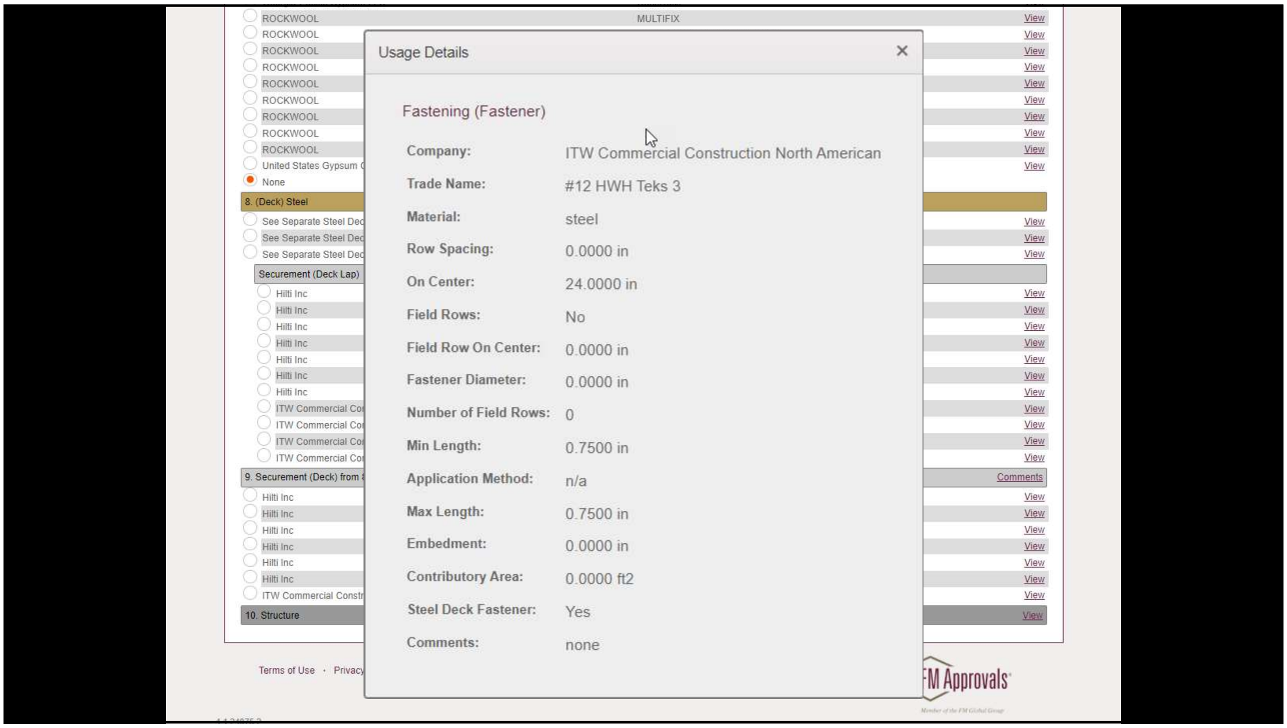
20


Help · Support · Training
mgraham · My Profile · Reset Password · Logout
RoofNav
Enter Assembly #
MY PROJECTS
PRODUCT SEARCH
SYSTEM SEARCH
ASSEMBLY SEARCH
RATINGS CALCULATOR
REFERENCE MATERIALS
Back
+ Add Scenario
Reset Scenario
Assembly Properties
Assembly #: 319122-0-0
Roof System: Single-Ply System
Application: New Roof
Cover Securement: Attached
Deck Type: Steel
Slope: 1.0000
Wind Uplift*: 105
Internal Fire: 1
Exterior Fire: A
Hail: SH
Assembly limited to use with noncombustible walls only: No
* FM Approved roofs must also have corner (Zone 3) and perimeter (Zone 2) enhancements and FM Approved perimeter flashing. For details, see DS 1-29 and 1-49. For Standing/Lap Seam roofs, see DS 1 - 31.
Adobe Acrobat Reader version 6.0 or later is required to open Property Loss Prevention Data Sheets. Click here to download this software for free.
Assembly Details
1. Cover (Single-ply)
BMI Everguard TPO View
BMI Group Operations S.a.r.l. Everguard Extreme TPO View
BMI Group Operations S.a.r.l. Everguard TPO View
GAF Everguard Extreme TPO View
GAF Everguard TPO View
Siplast Inc Parasolo TPX Membrane View
Tremco CPG Inc TremPly Max TPO View
Tremco CPG Inc TremPly TPO View
Securement (Sheet Lap)
Generic weld, hot air View
2. Securement (Cover) from 1. Cover (Single-ply) to 8. (Deck) Steel
GAF Drill-Tec Extra Heavy Duty ASAP Assembled Screw and 2-3/8 in. Steel Plate View
SSSP15641 View
GAF Drill-Tec 2 3/8 in. Barbed XHD Plate
GAF Drill-Tec XHD Fastener

21


ROCKWOOL MULTIFIX View
ROCKWOOL ROXUL MONOBOARD (unfaced) View
ROCKWOOL ROXUL MONOBOARD Plus (bitumen faced) View
ROCKWOOL ROXUL MONOBOARD Plus Tapered (bitumen faced) View
ROCKWOOL ROXUL MONOBOARD Tapered (unfaced) View
ROCKWOOL TOPROCK DD (unfaced) View
ROCKWOOL TOPROCK DD Plus (bitumen faced) View
ROCKWOOL TOPROCK DD Plus Tapered (bitumen faced) View
ROCKWOOL TOPROCK DD Tapered (unfaced) View
United States Gypsum Company SECUROCK Gypsum-Fiber Roof Board View
None
8. (Deck) Steel
See Separate Steel Deck Manufacturer Listing steel deck, 18 ga., wide rib (>90 psf) View
See Separate Steel Deck Manufacturer Listing steel deck, min 80 ksi, 20 to 18 ga., wide rib (>90 psf) View
See Separate Steel Deck Manufacturer Listing steel deck, min 80 ksi, 22 ga., wide rib (>90 psf) View
Hilti Inc S-MS 01 Z4,8 x 20 View
Hilti Inc S-MS 01 Z4,8 x 20 M View
Hilti Inc S-SLC 01 HWH View
Hilti Inc S-SLC 01 M HWH View
Hilti Inc S-SLC 02 HWH View
Hilti Inc S-SLC 02 M HWH View
ITW Commercial Construction North American #10 HWH Teks 1 View
ITW Commercial Construction North American #10 HWH Teks 3 View
ITW Commercial Construction North American #12 HWH Teks 1 View
ITW Commercial Construction North American #12 HWH Teks 3 View
9. Securement (Deck) from 8. (Deck) Steel to 10. Structure Comments
Hilti Inc S-MD 12-24 x 1-5/8 M HWH5 View
Hilti Inc S-RT5+ M9 View
Hilti Inc X-ENP-19 L15 View
Hilti Inc X-ENP-19 L15MX View
Hilti Inc X-ENP-19 L15MXR View
Hilti Inc X-HSN 24 View
ITW Commercial Construction North American #12 HWH Teks 5 View
10. Structure View
Terms of Use · Privacy Policy · Compatibility
© 2005-2024 FM Approvals LLC. All rights reserved.
FM Approvals

22



23

Steel roof deck considerations

- Be cautious of deck overstress with using mechanically-attachment membrane systems
  - Thicker deck
  - Reduced deck spans
  - Higher yield strength steel
- Roof deck to structure (e.g., joists) attachment is dictated by the roof assembly's wind uplift classification
  - Many classifications require specific mechanical fasteners
- Be cautious of "acceptance" of steel roof decks

24

Updates to FM Global datasheets

www.FMGlobalDataSheets.com

- FM 1-15, “Roof-mounted Solar Photovoltaic Panels”
- FM 1-28, “Wind Design”
- FM 1-54, “Roof Loads and Drainage”

25

Wind Design **1-28**

FM Global Property Loss Prevention Data Sheets Page 5

1.0 SCOPE

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

1.1 Changes

January 2024. Interim revision. The following changes were made:

A. The tornado guidance formerly in Appendix D has been transferred to new Sections 2.11 and 3.12, and to existing Section 4.2. All tables, figures and equations have been re-numbered to the new sections. Appendix D has been deleted in its entirety.

B. Guidance on FM Approved Roof Anchors was added to Sections 2.6 and 3.8. FM Approved Roof Anchors are now available and can be used to provide additional securement for roof mounted equipment to prevent overturning.

C. Modifications were made to the pressure coefficient for the vertical force equation in Section 2.6. Conditions where the ratio of the distance of elevated roof mounted equipment from the roof surface to the bottom of the equipment in relation to the mean roof height for the building (C/H) is ≥ 0.03 allows for a lower pressure coefficient.

D. The map in Figure 11-b “Basic wind speeds for areas in Canada in a tropical cyclone prone region” was added and replaces certain select cities in Canada within the Canadian Maritimes.

- Windows, doors, and lightweight wall cladding can be broken by windborne debris, such as tree branches, parts of wood-framed structures, and roof tiles or gravel from nearby roofs.
- Windows and doors and lightweight wall cladding can be blown in or out by the pressures exerted on the building.
- Roofing and roof deck materials can be torn and/or peeled off structures.
- Inadequately secured roof-mounted equipment can be blown out of place, damaging the roof cover.

26

Wind Design 1-28

FM Global Property Loss Prevention Data Sheets Page 13

2.8.5 One of the following may be done to account for the higher wind pressures in the perimeter and corner areas:

A. Use wind design pressures for the field, perimeter and corner areas based on the Eurocode, or

B. Use wind design pressures for the field-of-roof as determined by the Eurocode and provide prescriptive enhancements for the securement of above-deck roof components and metal deck securement for the perimeter and corner areas per DS 1-29 or DS 1-31.

2.8.6 Do not credit parapets for reducing roof design uplift pressures unless the parapet height (h_p) is at least 3 ft (0.9 m). In addition, use design pressures based on the Eurocode that are at least equal to that required for an h_p/h ratio of 0.025, regardless of the actual ratio.

2.8.7 Use Figure 30.3-7 of ASCE 7-16 for external pressure coefficients (GC_p) for domed roofs with an EWA of 10 ft^2 or 1 m^2 (CPE,1).

2.8.8 Design all structural framing, including beams, columns, trusses, purlins, and girts, using load factors and capacity-reduction factors specified in the Eurocode.

2.8.9 Use Eurocode factors that are modified by National Annexes only if they make the design more conservative.

2.11 Tornadoes

2.11.1 The following section provides guidance for building owners or occupants who have important facilities that warrant additional protection to reduce potential property damage and business interruption as a result of a tornado.

The tornado guidance in this standard should be applied to locations with tornado wind speeds ≥ 140 mph (63 m/s) as defined by the wind contours in the tornado wind speed map in Figure 2.11.1.

Design the building envelope, including walls, doors, windows, skylights, roof-mounted equipment and roofs to resist tornado wind speeds in accordance with Figure 2.11.1 and Section 3.0. Higher design wind speeds may also be used if desired.

Note for Figure 2.11.1: Hawaii, Alaska, Puerto Rico and Guam have a very low probability of tornado occurrence. The non-tornado design wind speeds exceed 100 mph (45 m/s) for all of Hawaii, Puerto Rico and Guam, and much of Alaska. One difference is that Hawaii, Puerto Rico and Guam are prone to tropical storms and should normally be designed for windborne debris, which is not true for Alaska.

27

Wind Design 1-28

Page 14 FM Global Property Loss Prevention Data Sheets

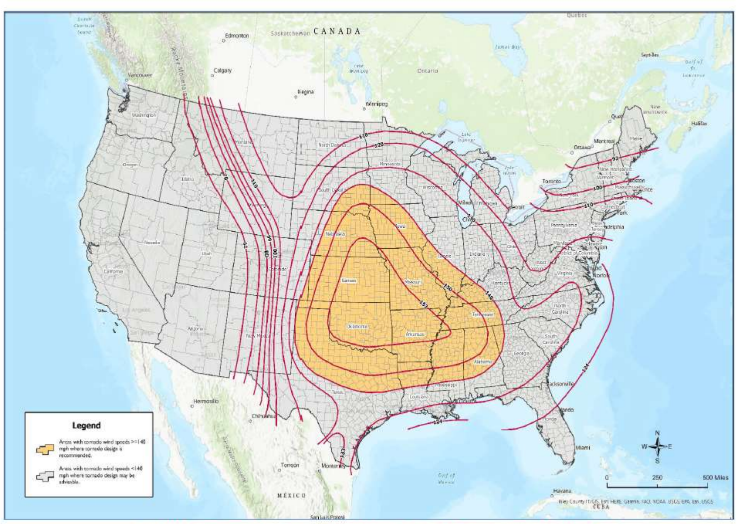


Fig. 2.11.1. Tornado speed based on ASCE 7-22 for 10,000-year MRI with effective plan area of 1,000,000 ft^2 (92,903 m^2)

28

Wind Design **1-28**
FM Global Property Loss Prevention Data Sheets Page 47

3.12.4.8 Building Materials Used for Roof Construction

Wind loss experience has been more favorable with structural concrete roof decks than with steel decks. Steel deck may be used, but should be designed for higher pressures. This design could involve the use of any or all of the following:

- Shorter deck spans
- Stiffer (deeper, thicker, etc.) deck
- Increased securement to joists/purlins

Experience has also shown that steel joists may buckle due to the transfer of lateral loads to them, or from compressive stresses that develop in their lower chords while uplift pressures are applied to the roof deck. This buckling could be resolved by enhancing the joist resistance, improving the joist bridging and/or adding lower chord extensions.

Insulated roof assemblies with very high wind resistance can be found in RoofNav®, a publication of FM Approvals. Some assemblies, including those using insulated steel deck, have wind uplift ratings up to approximately 465 psf (22 kPa). These assemblies provide a cost-effective design for higher wind speeds associated with tornados, including the application of pressure coefficients to reflect areas of the roof with higher wind pressures, and a reasonable safety factor.

FM Approval Standard 4431, *Approval Standard for Skylights*

Note: The cost increase to change from a 90 mph (40 m/s) design wind speed (as is the case with the majority of the central United States) to a higher tornado wind design will vary, depending on geography, the specific design criteria, percentage of windows, etc. Increased construction costs for components and cladding are expected in areas not normally designed for increased wind speeds. This cost increase could be as high as 50%.

29

FEMA/NIST Design Guide

Design Guide for New Tornado Load Requirements in ASCE 7-22

This instructional guidance is for design professionals and building officials to help them determine when a building or other structure is required to be designed to minimum tornado loads and how to calculate design tornado forces. This guide is in accordance with the updated requirements of the American Society of Civil Engineers (ASCE) / Structural Engineering Institute (SEI) standard ASCE 7-22, ***Minimum Design Loads and Associated Criteria for Buildings and Other Structures.***[1]

This Design Guide is intended for users with a basic understanding of ASCE 7 and who know how to determine wind loads using ASCE 7 methodology, as presented in Chapters 26 through 31.

Introduction and Background

Tornadoes have historically killed more people in the United States than hurricanes and earthquakes combined (NWS, 2020; USGS, 2015). According to the Insurance Information Institute, Inc. (2020), the average annual insured catastrophe losses for events involving tornadoes exceeded those for both hurricanes and tropical storms combined, for the period of 1997–2016. The 2011 Joplin tornado disaster was the deadliest and costliest tornado in the U.S. since 1950 and was one of the primary drivers for the addition of tornado load provisions in ASCE 7 (NIST, 2022). With the publication of ASCE 7-22 (ASCE; 2021), tornado load requirements are now considered as a minimum design load in conventional building design when buildings are located in tornado-prone areas. The new ASCE 7 tornado load provisions do not apply to storm shelters or safe rooms. The ASCE 7 tornado load requirements will be included in the 2024 International Building Code (IBC), the 2024 National Fire Protection Association (NFPA) 5000 Building Construction and Safety Code, and the 2023 Florida Building Code. The adoption of the ASCE 7 tornado load provisions by the State of Florida is an example of local Authorities Having Jurisdiction incorporating the most current design guidance prior to their inclusion in the model building codes.

Storm shelters and safe rooms are specifically designed for life safety protection during the most extreme wind events and require more extreme design hazard intensities than conventional buildings. Buildings and other structures designed per Chapter 32 of ASCE 7 do not meet the requirements for storm shelters or safe rooms.

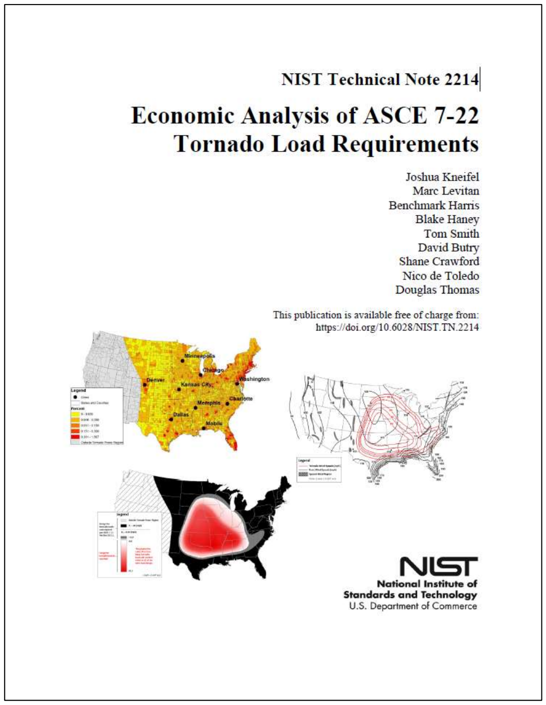
[1] The references to ASCE 7 within the design guide represent references to ASCE 7-22.

FEMA NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY U.S. DEPARTMENT OF COMMERCE

January 2023 - 1

Link

30



NIST Technical Note 2214

Economic Analysis of ASCE 7-22 Tornado Load Requirements

Joshua Kneifel
Marc Levitan
Benchmark Harris
Blake Haney
Tom Smith
David Butry
Shane Crawford
Nico de Toledo
Douglas Thomas

This publication is available free of charge from:
https://doi.org/10.6028/NIST.TN.2214

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

[Link]

31

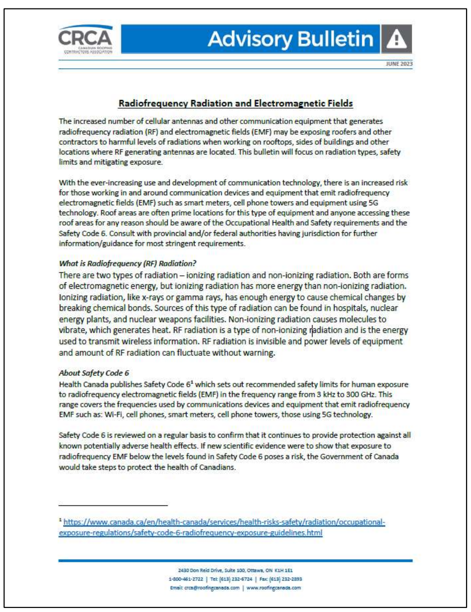
Look for more information from NRCA on tornado design in the near future…

32

Radio frequency radiation

Rooftop cell phone transmitters

33



CRCA Advisory Bulletin

JUNE 2023

Radiofrequency Radiation and Electromagnetic Fields

The increased number of cellular antennas and other communication equipment that generates radiofrequency radiation (RF) and electromagnetic fields (EMF) may be exposing roofers and other contractors to harmful levels of radiations when working on rooftops, sides of buildings and other locations where RF generating antennas are located. This bulletin will focus on radiation types, safety limits and mitigating exposure.

With the ever-increasing use and development of communication technology, there is an increased risk for those working in and around communication devices and equipment that emit radiofrequency electromagnetic fields (EMF) such as smart meters, cell phone towers and equipment using 5G technology. Roof areas are often prime locations for this type of equipment and anyone accessing these roof areas for any reason should be aware of the Occupational Health and Safety requirements and the Safety Code 6. Consult with provincial and/or federal authorities having jurisdiction for further information/guidance for most stringent requirements.

What is Radiofrequency (RF) Radiation?

There are two types of radiation – ionizing radiation and non-ionizing radiation. Both are forms of electromagnetic energy, but ionizing radiation has more energy than non-ionizing radiation. Ionizing radiation, like x-rays or gamma rays, has enough energy to cause chemical changes by breaking chemical bonds. Sources of this type of radiation can be found in hospitals, nuclear energy plants, and nuclear weapons facilities. Non-ionizing radiation causes molecules to vibrate, which generates heat. RF radiation is a type of non-ionizing radiation and is the energy used to transmit wireless information. RF radiation is invisible and power levels of equipment and amount of RF radiation can fluctuate without warning.

About Safety Code 6

Health Canada publishes Safety Code 6[1] which sets out recommended safety limits for human exposure to radiofrequency electromagnetic fields (EMF) in the frequency range from 3 kHz to 300 GHz. This range covers the frequencies used by communications devices and equipment that emit radiofrequency EMF such as: Wi-Fi, cell phones, smart meters, cell phone towers, those using 5G technology.

Safety Code 6 is reviewed on a regular basis to confirm that it continues to provide protection against all known potentially adverse health effects. If new scientific evidence were to show that exposure to radiofrequency EMF below the levels found in Safety Code 6 poses a risk, the Government of Canada would take steps to protect the health of Canadians.

[1] https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/occupational-exposure-regulations/safety-code-6-radiofrequency-exposure-guidelines.html

2430 Don Reid Drive, Suite 100, Ottawa, ON K1H 1E1
1-800-461-2722 | Tel: (613) 232-6724 | Fax: (613) 232-2893
Email: crca@roofingcanada.com | www.roofingcanada.com

Link

CRCA Advisory Bulletin

June 2023

34

CRCA

How protect yourself from RF radiation
The risks associated with RF radiation increases with the number of devices present, the closer a worker is to the equipment/device(s), and the more time that is spent in the area. Workers can protect themselves by the following:

How protect yourself from RF radiation

The risks associated with RF radiation increases with the number of devices present, the closer a worker is to the equipment/device(s), and the more time that is spent in the area. Workers can protect themselves by the following:

- Complete a visual assessment of the area to determine if cellular antennas or other RF radiation generating antennas are present. If you are not sure, ask your supervisor, the building owner, or the property manager if RF-generating antennas are present where you need to work. The building owner or property manager should have the information, or know whom to contact for information about antennas, their locations, and the RF radiation levels.
- Look for warning signs posted near RF antennas; the signs should identify the hazard and tell you where to get more information.
- Contact the building owner/manager and the antenna licensee to have the equipment temporarily powered down or moved.

The opinions expressed herein are those of the CRCA National Technical Committee. This Advisory Bulletin is circulated for the purpose of bringing roofing information to the attention of the reader. The data, commentary, opinions and conclusions, if any, are not intended to provide the reader with conclusive technical advice and the reader should not act only on the roofing information contained in this Advisory Bulletin without seeking specific professional, engineering or architectural advice. Neither the CRCA nor any of its officers, directors, members or employees assumes any responsibility for any of the roofing information contained herein or the consequences of any interpretation which the reader may take from such information.

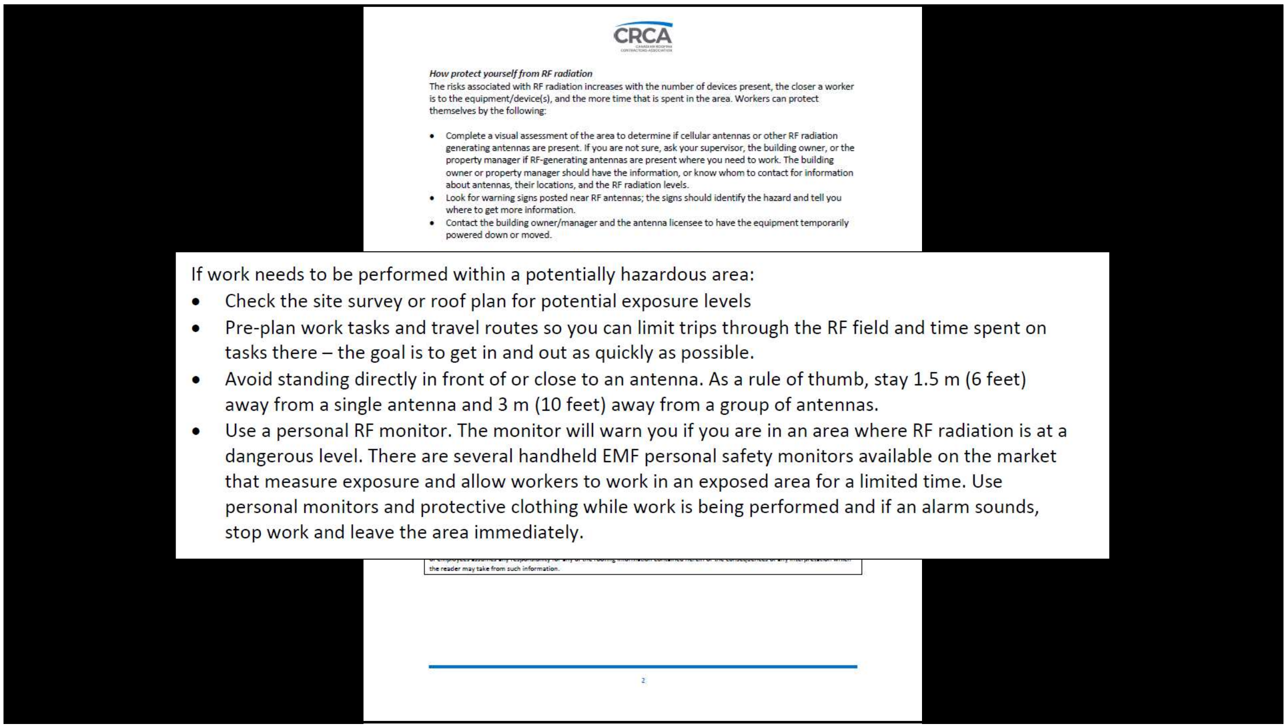
2

35

Recognize the signage

Photos courtesy of Peter Shackford—Hettrick, Cyr & Associates, Inc.

36



CRCA

How protect yourself from RF radiation

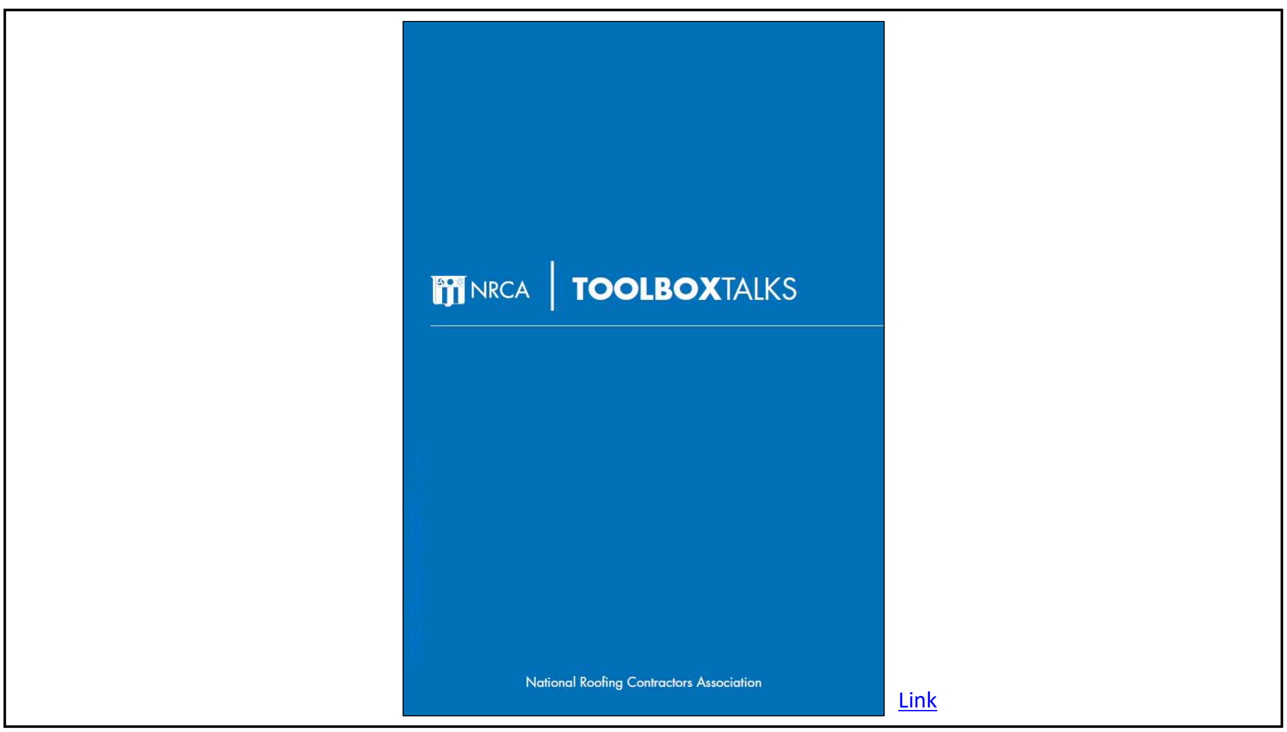
The risks associated with RF radiation increases with the number of devices present, the closer a worker is to the equipment/device(s), and the more time that is spent in the area. Workers can protect themselves by the following:

- Complete a visual assessment of the area to determine if cellular antennas or other RF radiation generating antennas are present. If you are not sure, ask your supervisor, the building owner, or the property manager if RF-generating antennas are present where you need to work. The building owner or property manager should have the information, or know whom to contact for information about antennas, their locations, and the RF radiation levels.
- Look for warning signs posted near RF antennas; the signs should identify the hazard and tell you where to get more information.
- Contact the building owner/manager and the antenna licensee to have the equipment temporarily powered down or moved.

If work needs to be performed within a potentially hazardous area:

- Check the site survey or roof plan for potential exposure levels
- Pre-plan work tasks and travel routes so you can limit trips through the RF field and time spent on tasks there – the goal is to get in and out as quickly as possible.
- Avoid standing directly in front of or close to an antenna. As a rule of thumb, stay 1.5 m (6 feet) away from a single antenna and 3 m (10 feet) away from a group of antennas.
- Use a personal RF monitor. The monitor will warn you if you are in an area where RF radiation is at a dangerous level. There are several handheld EMF personal safety monitors available on the market that measure exposure and allow workers to work in an exposed area for a limited time. Use personal monitors and protective clothing while work is being performed and if an alarm sounds, stop work and leave the area immediately.

37



38

TOOLBOXTALKS

Radio frequency (RF) hazards

According to the Federal Communications Commission (FCC), radio waves and microwaves emitted by transmitting antennae are one form of electromagnetic energy that harm people. Harm from RF exposure will vary according to power levels, length of exposure time and distance from the antennae. Sources of RF energy on a rooftop often are not obvious and usually are not properly marked or defined as danger zones by warning signs. In many cases, antennae are hidden by building elements so workers may not be aware of their presence. Here are some important facts about RF energy and things that you can do to avoid it:

- High levels of RF may heat body tissue and increase body temperature, causing tissue damage because the body cannot cool quickly enough to prevent damage. This is called RF's thermal effects, and your eyes are the most vulnerable part of your body. Actual contact may cause a shock or burn.
- At lower, nonthermal levels of RF exposure, nervous system and immune system problems, kidney damage, neurological disorders and even some cancers may occur.
- Become familiar with what RF transmitters or antennae look like and the dangers of working near them. Be aware that warning signs for RF transmitters may not always be present on a roof.
- Your employer must inquire as to the presence of RF equipment and whether it may be shut down or shielded or other barrier device installed for the duration of the work period roofing workers will be in proximity to the transmitter.
- Symptoms of RF exposure often seem the same as physical exertion and can become heat exhaustion or heat stroke. Removing a worker from the area and cooling the body is important. Trained, professional medical care of the symptoms is critical.

National Roofing Contractors Association TOOLBOXTALKS www.nrca.net 219

39

Some useful references

- CRCA Advisory Bulletin (Link)
- Health Canada's Safety Code 6 (Link)
- Federal Communications Commission (Link)
- Center for Construction Research and Training (Link)

40

Roof deck loading considerations

41

Some examples of roof loading

- Pallet of asphalt shingles (42 bundles): 2,500 to 4,200 lbs.
- Pallet of TPO membrane rolls: 1,400 to 3,450 lbs.
- Pallet of MB cap sheet (20 rolls): About 2,500 lbs.
- Pallet of glass-faced gypsum board (4 x 4): 1,600 to 2,400 lbs.
- Pallet of bonding adhesive (45 pails): 1,800 lbs.
- Bundle of polyiso. (4 x 8): 250 to 500 lbs.

42

Some initial considerations

Roof deck loading concerns

- Roofing operations may exceed live load capacity
- Note joist/framing orientation
- Consider avoiding adjacent load placement
- Position loads across joists/framing
- Consider added dunnage across framing
- Also consider rooftop equipment weight

43

"Moisture" meter concerns


44

These meters do not read moisture…
…they are reading relative conductivity, which can be correlated to specific materials in specific conditions when properly calibrated.

45

Considerations

"Moisture" meters

- Read/understand the instruction manual
- Understand device sensitivity
- Understand proper operating conditions
- Proper calibration/recalibration is critical
- Don't overstate the meter's capability
- Verify job-specific results with gravimetric analysis

46

Questions… and other topics

47

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

Personal website: www.MarkGrahamNRCA.com
LinkedIn: linkedin.com/in/MarkGrahamNRCA

48