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NRCA Technical Operations Committee:
Technical programs and issues

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Topics

- Committee members and staff
- New publications
- Some issues
- Concrete roof deck moisture research (Matt Dupuis)
- Steel roof decks and wind uplift
- Questions... and other topics

Technical Services section staff

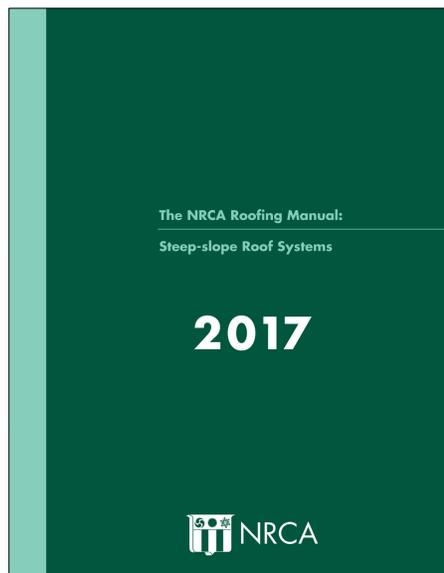
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Other technical committees and task forces

- Manual Update Committee
- Manufacturers Spec Review Task Force
- QA/QC Guidelines Task Force
- Repair Manual Task Force
- Vegetative Roof Manual Task Force



***The NRCA Roofing Manual:
Steep-slope Roof Systems-2017***



Steep-slope update

The 2017 volume of The NRCA Roofing Manual updates and expands NRCA's steep-slope guidelines
by Mark S. Graham

There are a number of changes incorporated into the 2017 volume

Each section is further divided into the following chapters: Chapter 1—Roof System Configurations; Chapter 2—Roof Details; Chapter 3—Underlayment; Chapter 4, which addresses the primary roof covering type for that section; Chapter 5—Roofing; and Chapter 6—Construction Details.

Notable changes

Although NRCA's best practice guidelines for steep-slope roof assemblies have been well established since 1981, there are a number of changes incorporated into the 2017 volume. New "how-to" guidelines have been added at the beginning of each section to show users how to best use the manual's content. NRCA recognizes in manual is more commonly used as a reference document, and the current volume has been reformatted accordingly. Roof system configuration descriptions have been moved from Chapter 4 within each roof system-specific section

of the 2013 manual to Chapter 1—Roof System Configurations in each section of the 2017 volume. The roof system configurations serve somewhat as a table of contents or index to information specific to each roof system type.

The roof system configurations for new construction or roof system replacement and roof recovery are now consolidated in Chapter 1. Additional roof system configuration descriptions have been added for multi-layer underlayment configurations.

New information has been added to each roof system-specific section addressing underlayment attachment in high-wind areas. The International Building Code, 2015 Edition and International Residential Code, 2015 Edition contain new (and somewhat differing) attachment requirements for underlayment in high-wind regions. Where applicable, NRCA recommends compliance with these code requirements.

Chapter 5 in each section of the 2017 volume has been expanded to address guidelines applicable to reroofing. Chapter 5—Roofing provides new guidelines for evaluating existing roof systems, information about building code requirements for reroofing, and guidelines for roof decks and proper roof re-cover and roof replacement design for each roof system type.

Appendix 1—Roof Accessories has been expanded to better address flashing roofing, rack-mounted photovoltaic (PV) systems supports. NRCA recommends PV support systems flashing have a flanged base, similar to what NRCA recommends for other roof penetration flashings. (This is illustrated in the volume's detail ASFH-15-Vent Pipe Penetration.) Additional information applicable to rooftop-mounted PV installations is provided in NRCA's *Guidelines for Rooftop-mounted Photovoltaic Systems*.

Appendix 2—Radiant Barriers provides new considerations and building code requirements for radiant barriers used in attics and roof assembly components. Because of the potential accelerated aging effect radiant barriers can have on roofing materials, NRCA does not recommend the use of radiant barriers in attics or roof assembly components.

Appendix 3—Insects Updates has been added as a placeholder reserved for providing brief overviews of future insects changes to the electronic versions of the manual.

Get it!

The 2017 volume is available for purchase in hardcover and electronic formats and as part of The NRCA Roofing Manual—2017 Bundle Set. NRCA members can access the manual electronically for free via NRCA's online bookstore, shop.nrca.net, and on the NRCA app.

The construction details from The NRCA Roofing Manual are available in an AutoCAD-compatible format as The NRCA Construction Details CAD Files—2017 and can be purchased at shop.nrca.net. NRCA members also can access the CAD files of the construction details free of charge via shop.nrca.net.

Encourage you to update your library with these best practice guidelines. **▶▶▶**

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

Professional Roofing

February 2017

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The NRCA Roofing Manual - 2017



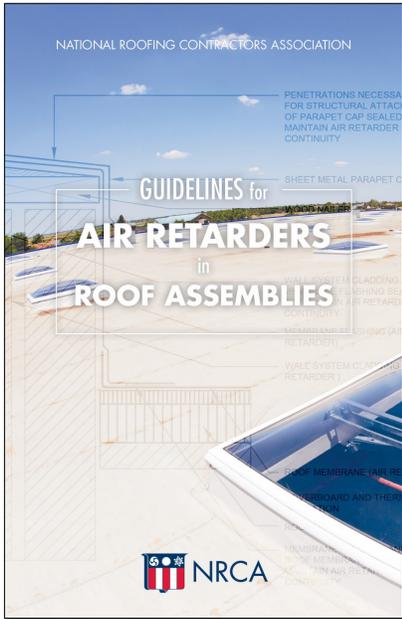
Manual online

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



The image shows the cover of a technical publication titled "GUIDELINES for AIR RETARDERS in ROOF ASSEMBLIES" published by the NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA). The cover features a technical cutaway diagram of a roof assembly with various components labeled, such as "PENETRATIONS NECESSARY FOR STRUCTURAL ATTACHMENT OF PARAPET GAP SEALED TO MAINTAIN AIR RETARDER'S CONTINUITY", "SHEET METAL PARAPET", "CLADDING SYSTEM", "FLASHING SYSTEM", "MEMBRANE SYSTEM", "WALL SYSTEM OF AIR RETARDER", and "ROOF MEMBRANE (AIR RETARDER)". The NRCA logo is visible at the bottom left of the cover.

Guidelines for Air Retarders in Roof Assemblies

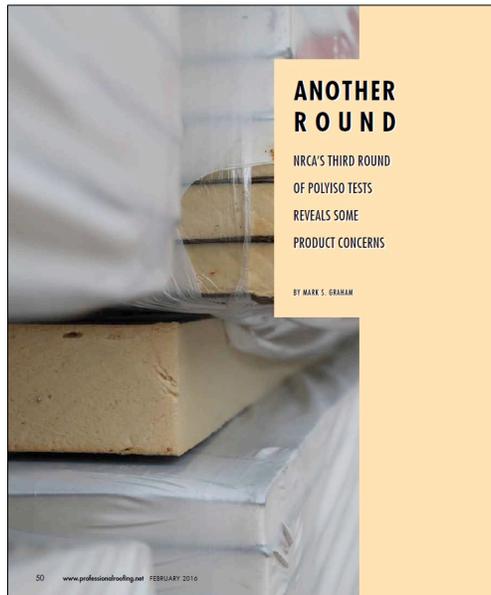
- Ch. 1: IECC and ASHRAE
- Ch. 2: Industry research
- Ch. 3: Recommendations

Some key points...

- Building and roof system designers are responsible for proper design....
- Construction Documents should clearly denote locations, materials, application methods and details
- NRCA considers a continuous, air-impermeable roof membrane to function as an air retarder
 - Built-up roof system
 - Polymer-modified bitumen roof system
 - Single-ply membrane roof system

Polyisocyanurate insulation

Knit line, thickness and dimensional stability concerns



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Knit lines



Knit lines -- continued





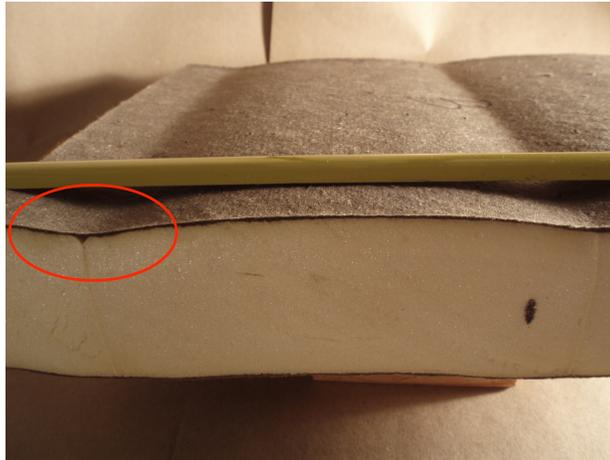
Photo from manufacturer's product literature

Thickness and knit lines



As delivered by manufacturer.

Knit lines -- continued



After conditioning: 158 ± 4 F and $97 \pm 3\%$ RH for 7 days

Knit lines -- continued



Knit line and V-groove close-up (after conditioning)

“NRCA recommends the use of a suitable cover board layer over polyisocyanurate insulation before the installation of roof membrane.”

-The NRCA Roofing Manual: Membrane Roof Systems-2015

Additional interim recommendations

Polyiso. knit line, thickness and dimensional stability concerns

- Measure polyiso. thickness upon delivery
- Look for knit lines and board unevenness
- Contact manufacturer and NRCA if you see any issues

Concrete Roof Decks and Moisture

Matt Dupuis PhD PE
Structural Research, Inc.
Middleton, Wisconsin

Topics

- Problem Statement(s)
- Research Sponsors
- Research Goals
- Research Plan
- Research Progress
- Recommendations
- Questions

Problem Statements

- The roofing industry has seen a dramatic increase in moisture related failures from roofing over concrete roof decks, both new construction and reroofs.
 - The compressed schedules in new construction have seen General Contractors direct the installation over green concrete, only days old.
- The roofing industry has little to no guidance on the acceptance of the concrete substrate as suitable to begin installing a roof system.
 - The guidance that does exist for indirect testing of roof decks is typically legacy specification language tracing its origin to WWII

Research Sponsors



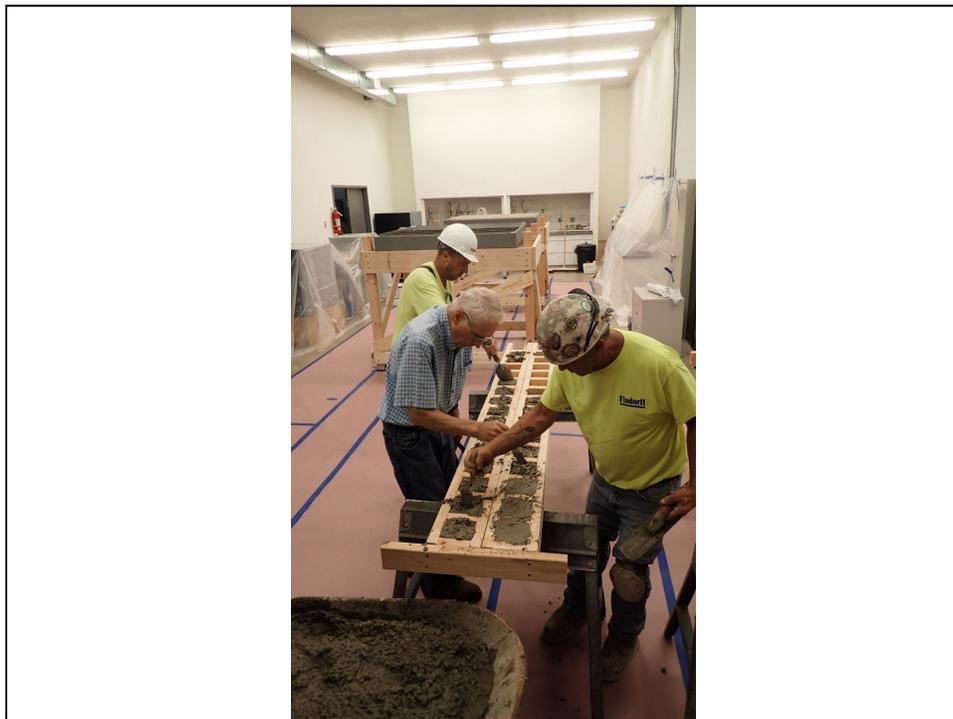
Research Goals

- Primary Goal
 - Determine what moisture level in concrete decks is appropriate for roofing operations
 - New construction and reroof
- Secondary Goals
 - Study instrumentation capabilities for speed and accuracy in the determination of moisture levels in concrete roof decks
 - Study impact of weather and the phenomena of “rewetting” on moisture levels in concrete roof decks

Research Plan

- 4 Phases of the study
- Began preparation and planning Spring 2016
- Concrete pours occurred July 11, 2016
- Study is ongoing
 - New information learned reshapes hypotheses and direction of research







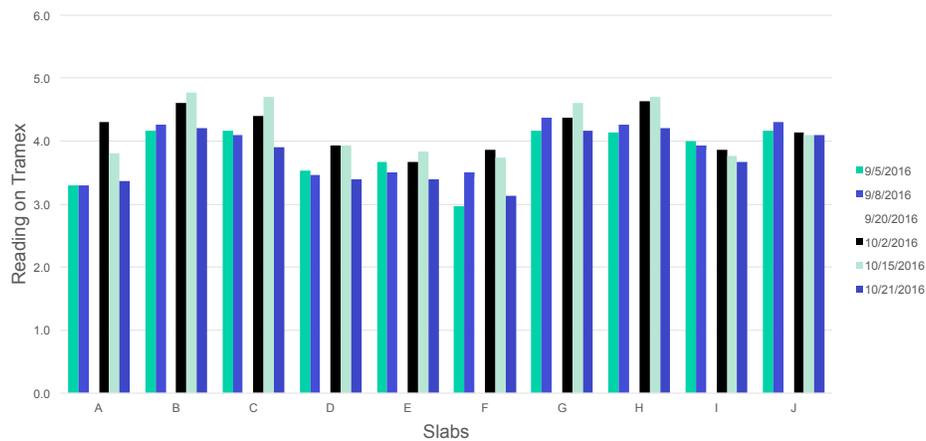


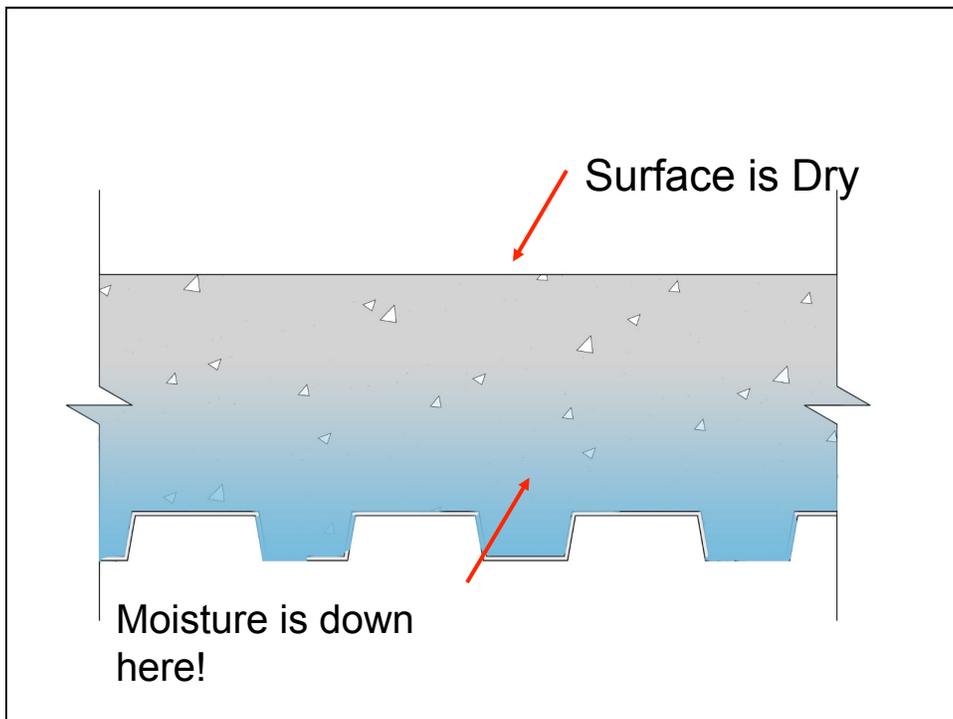
Research Progress

- Phase 1 Full scale concrete weathering farm and lab samples
 - Received 20.43 inches of rain during the 16 week period
 - Tramex CMEX II - Concrete Moisture Meter used
 - No discernable difference between inside, outside, normal weight, light weight
 - Only was an indicator of recent rain

Research Progress

Tramex CMEX II - Concrete Moisture Meter Readings





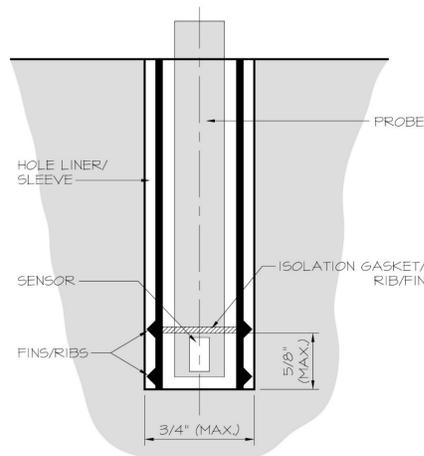
Research Progress

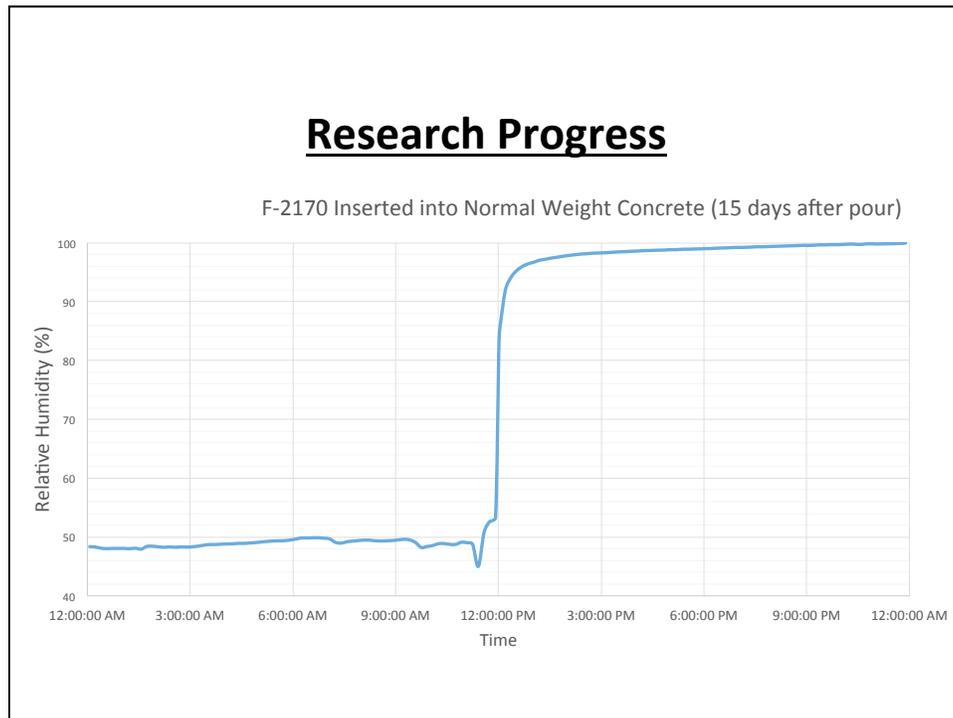
- Phase 1
 - Use of F-2170 probes
 - Wagner Meters in Rogue River, Oregon provided hundreds of probes and accessories for this study.
 - Calibrated before use
 - Readings typically taken 1,2,3,6, and 24 hours after placement weekly
 - Pans
 - Slabs
 - Replicates
 - Exterior pans brought in lab and probe again
 - Thousands of readings with confounding variables
 - Promising data need more time to study



Research Progress

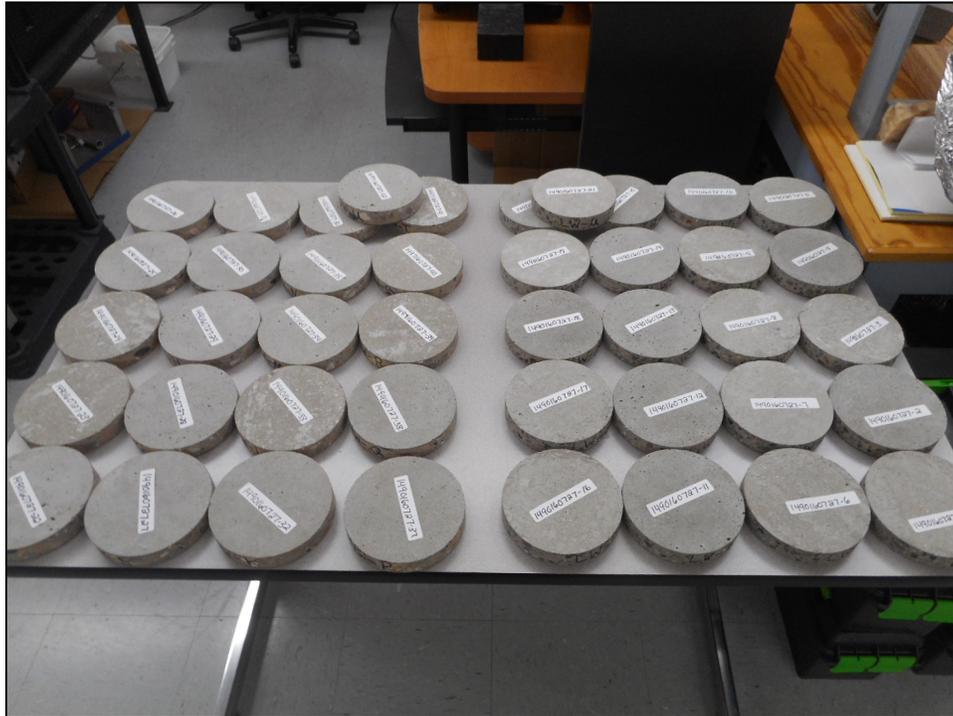
ASTM F2170-11





Research Progress

- Phase 2 Hygrothermal characterization of concrete
 - E96 Vapor Permeability
 - C1794 Water Absorption Coefficient
 - C1498 Hygroscopic Isotherm
 - C1699 Moisture Retention



Research Progress

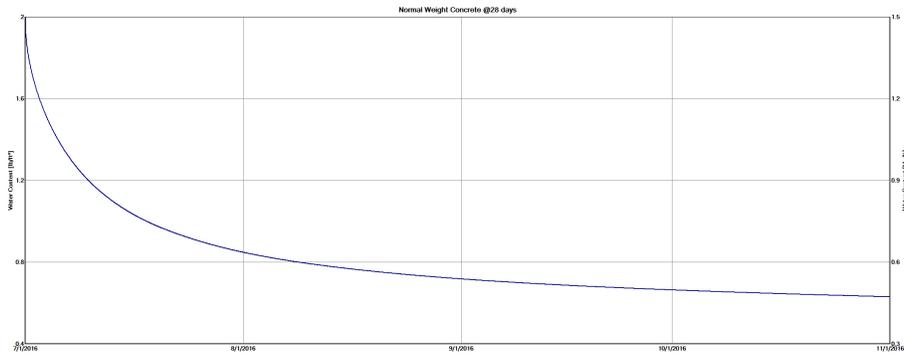
- Phase 2 Hygrothermal characterization of concrete

ASTM E96 calculated Perm·in				
Light Weight Structural Concrete			Normal Weight Concrete	
Age	Wet Cup	Dry Cup	Wet Cup	Dry Cup
28 Day	1.48	0.78	3.42	1.05
60 Day	1.45	0.47	2.03	1.13

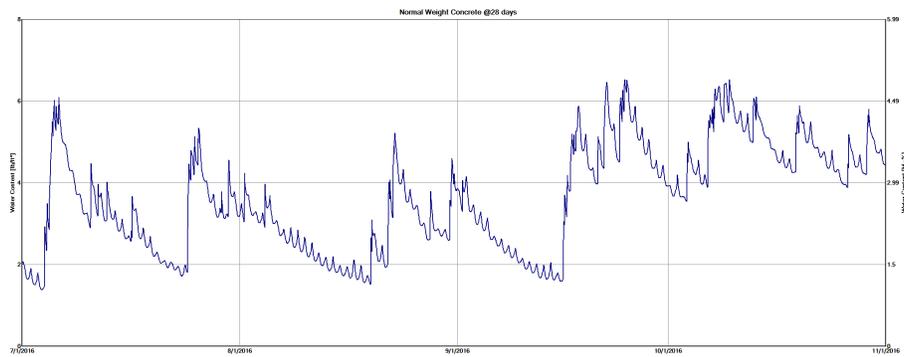
Research Progress

- Phase 3 Hygrothermal modeling
 - WUFI 5.3 Pro Hygrothermal program utilized
- Consulting with justSmartSolutions the U.S. partner of the German software vendor
- The data output from the modeling has been validated with Phase 1 data
- Let us look at some of the thing we can opine from just the simple graphs!

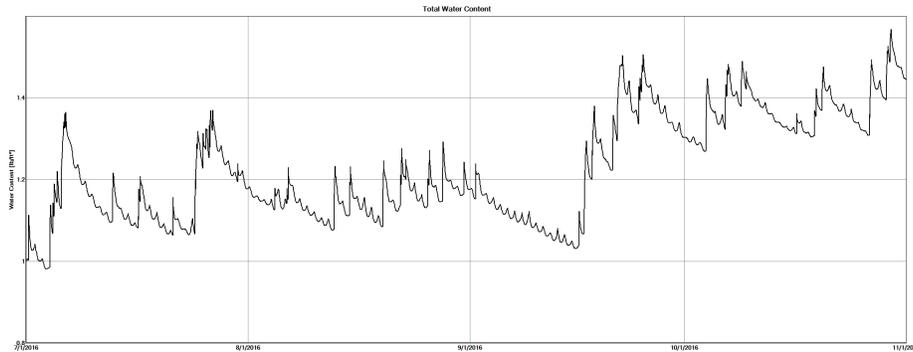
Normal Weight Concrete – Lab Dry Down
(4 Months)
Top 1 inch of slab



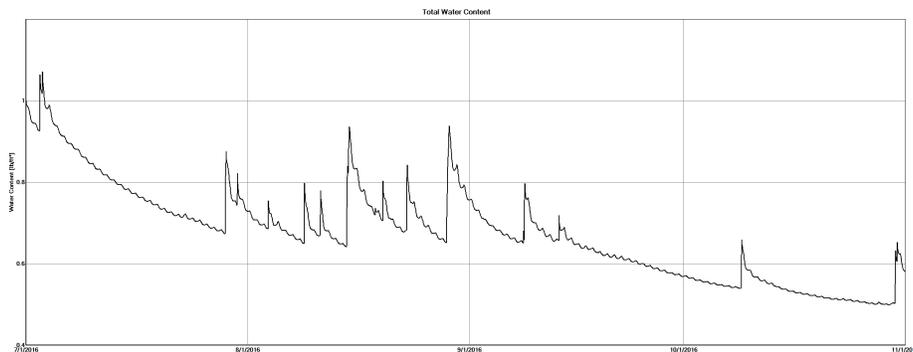
Normal Weight Concrete – Outdoor Dry Down
(4 Months)
Top 1 inch of slab



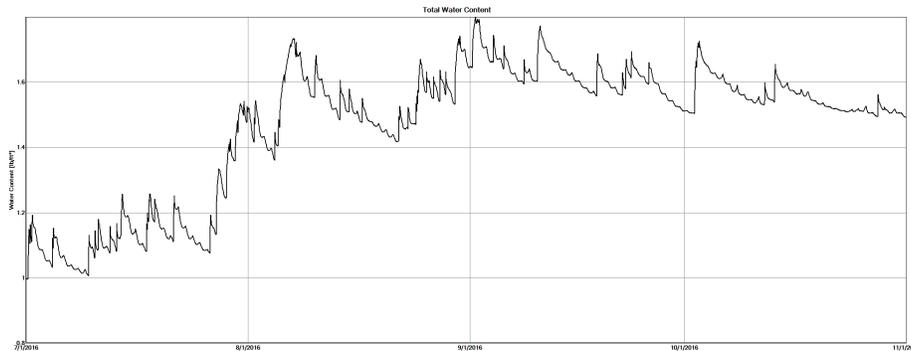
Total Water Content per Ft² of slab
Regular Weight Concrete Chicago, IL (4 Mo.)



Total Water Content per Ft² of slab
Regular Weight Concrete Phoenix, AZ
(4 Mo.)



Total Water Content per Ft² of slab
Regular Weight Concrete Edmonton, CAN
(4 Mo.)

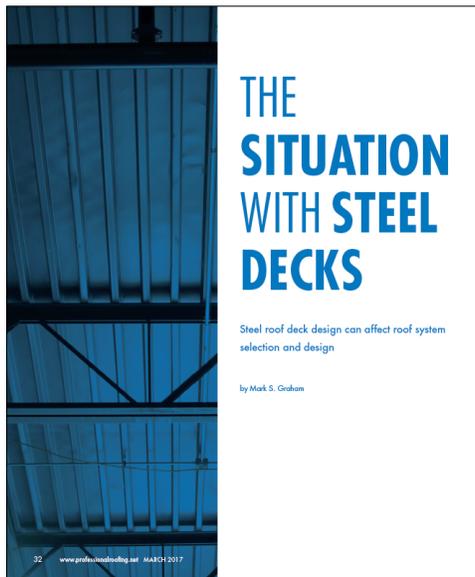


Recommendations

- Preliminary findings of concrete research program point to a distinct issue with slabs in northern and humid climates.
- Work on hygrothermal simulations and their validation is ongoing.
- But given the currently available research data and observations from it, this researcher is recommending that:
 - **Unless the Designer of Record approves in writing otherwise, a vapor retarder of less than 0.01 perm is necessary over new concrete roof decks.**
- The impact of rewetting on existing concrete decks (reroof) and moisture laden roof systems is being determined.

Thank You

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mdupuis@sri-engineering.com



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Steel roof deck design

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

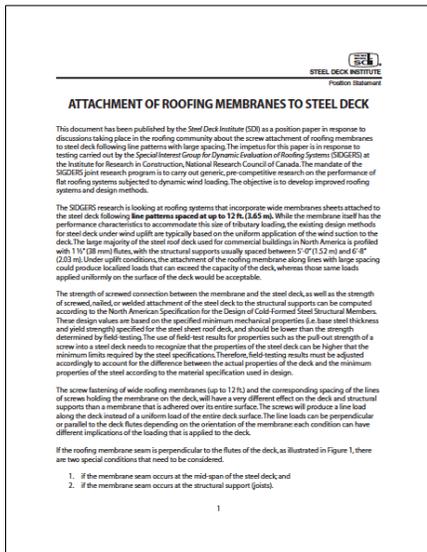
Steel roof deck design

Wind uplift resistance

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

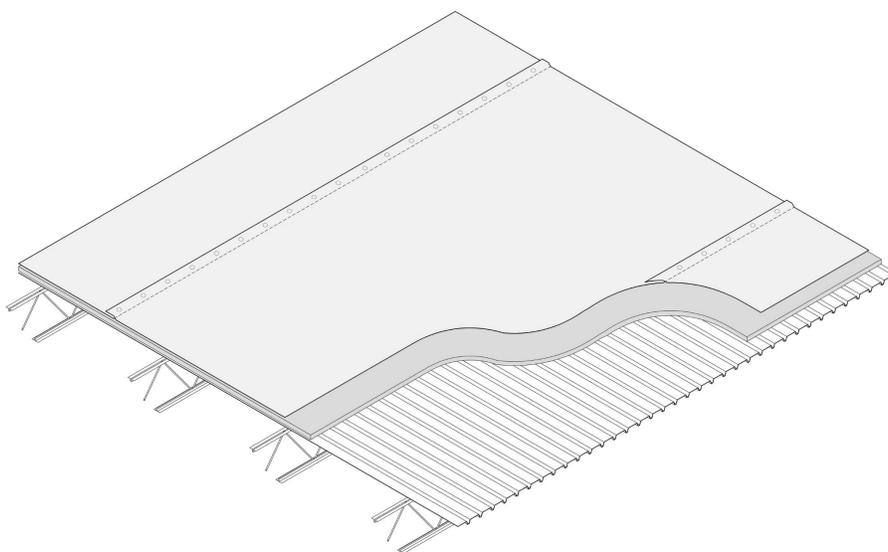
SDI bulletin

2009



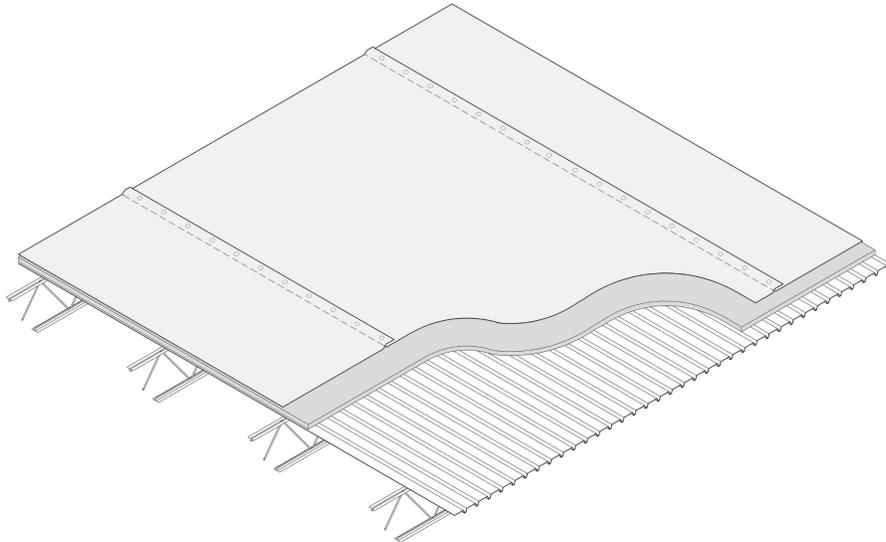
- Decks designed for joist spacing between 5' and 6' 8" o.c.
- Deck designed for uniform loading
- Seam-fastened single-ply membranes are a concern

Membrane seams across deck flutes



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

Membrane seams in deck flute direction



SDI: 12 X bending moment and shear (deck)

SDI bulletin -- Conclusion

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

FM 1-29 has been updated

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ROOF DECK SECUREMENT AND ABOVE-DECK ROOF COMPONENTS

Note to Insurers of Factory Mutual Insurance Company: Contact the local FM Global office before beginning any roofing work.

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Revised/now criteria:

- Steel roof decks:
 - Uniformly-distributed loading
 - Concentrated loading
- Lightweight structural concrete

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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 stresses are determined using allowable strength design (ASD) in accordance with AISI S 100-2012, 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 80,000 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 80 to 225 psf (2.9 to 10.8 kPa).

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Table 1C. Maximum Steel Deck Span (ft) for 1 1/2 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)												
33,000	22	7.10	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	7.78	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	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	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	6.67	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.

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Table 1A. Maximum Steel Deck Span (ft) for 1 1/2 in. (38 mm) Deep, 33,000 psi (228 MPa) Yield Stress with a Mechanically Fastened Roof Cover
(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, 1 1/2 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
3.5	18	4.5	5.5	5.5	5.5	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	4	4	4.5	4.5	4.5	5	5.5	5.5	5.5	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	4	4	4.5	4.5	4.5	5.5	5.5	5.5	6	6	6	6	6	6
4	18	4.5	4.5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	4	4.5	4.5	5	5	5.5	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	4	4.5	5	5	6	6	6	6	6	6	6
4.5	18	-	4	4	4.5	5	5	5.5	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	4	4	4	5	5	5.5	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6
5	18	-	-	-	4	4	4.5	5	5	5.5	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6
5.5	18	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5	6	6	6	6	6
6	18	-	-	-	-	-	-	-	-	-	4	5	5.5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5	6	6	6
6.5	18	-	-	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	5.5	6	6
7	18	-	-	-	-	-	-	-	-	-	-	-	4	5.5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	6	6	6
7.5	18	-	-	-	-	-	-	-	-	-	-	-	-	4	5.5	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	6	6

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Table 1B. Maximum Steel Deck Span (ft) for 1 1/2 in. (38 mm) Deep, Yield Stress \geq 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, 1 1/2 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
	20	-	-	-	-	-	-	-	-	-	4	4	4.5	5.5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	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	6
	22	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	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	6
	22	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6	6
10	18	-	-	-	-	-	-	4	4	4	4.5	4.5	5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	4	4.5	4.5	5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	4	4.5	4.5	5.5	6	6	6	6	6
10.5	18	-	-	-	-	-	-	4	4	4.5	4.5	5	5.5	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	4	4	4.5	5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	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	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6
11.5	18	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6
12	18	-	-	-	-	-	-	-	-	4	4	4.5	5	5.5	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	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

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Table 1B. Maximum Steel Deck Span (ft) for 1 1/2 in. (38 mm) Deep, Yield Stress \geq 60,000 psi (414 MPa) with a mechanically fastened Roof Cover
(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, 1 1/2 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
3.5	18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	5.5	5.5	5.5	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6
4	18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	4.5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
4.5	18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	4	4	4.5	5	5	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6
5	18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	4.5	5	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	-	-	4	4	4.5	4.5	5	5.5	6	6	6	6	6	6	6	6	6	6	6
5.5	18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	4	4.5	4.5	5	5.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6	6	6
6	18	5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6	6
6.5	18	4.5	5	5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	4	4.5	5	5.5	6	6	6	6	6	6	6	6	6
7	18	-	4	4	4.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	4	4	4.5	5.5	6	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6	6	6	6	6	6
7.5	18	-	-	-	4	4.5	4.5	5.5	6	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6	6	6	6	6
8	18	-	-	-	-	4	4	4.5	5	6	6	6	6	6	6	6	6	6	6	6
	20	-	-	-	-	-	-	-	4	4.5	5.5	6	6	6	6	6	6	6	6	6
	22	-	-	-	-	-	-	-	-	4	4.5	5	6	6	6	6	6	6	6	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

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NRCA's recommendations

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

New construction:

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

NRCA's recommendations – cont.

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

Reroofing:

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

Fastener pull-out tests...

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

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

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

Closing thoughts....

Some numbers...

- Average life of a commercial roof: 17.4 years
- IRS allowable roof depreciation: 39.5 years

*We need to be manufacturing, designing,
installing and maintaining well beyond “average”*

Some (more) numbers...

- UL certified roofing products: 65,000+
- FM Approvals approved assemblies: 931,500+



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