




NRCA University Webinar
December 17, 2015

Technical Roofing Industry Update

presented by

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National Roofing Contractors Association



Moisture in Lightweight Structural Concrete Roof Decks
Concrete Moisture Presents Challenges for Roofing Contractors

NRCA Technical Services Section is receiving an increasing number of inquiries relating to the application of roof systems over concrete roof decks. These inquiries can be separated into two general questions: "When is a concrete roof deck dry enough to apply a roof covering?" And "Why is a roof system applied over a concrete roof deck showing signs of moisture infiltration when the roof covering isn't leaking?"

CONCRETE BASICS
There are three general types of concrete: normal-weight structural concrete, lightweight structural concrete and lightweight insulating concrete.

Normal-weight structural concrete is what most people think of as concrete. It has a density of about 150 pounds per cubic foot (pcf). Lightweight structural concrete has structural load-carrying capabilities similar to normal-weight structural concrete. It has a density in the range of 85 to 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 water moisture and/or lighten concrete's finishing time. Use of admixtures typically is not visually identifiable in the field; microscopic analysis usually is needed for post-application identification of admixtures.

The primary difference in the composition of normal-weight structural concrete and lightweight structural concrete is the large aggregate type. Normal-weight structural concrete contains normal-weight aggregate 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

process aggregates such as expanded shale, which will absorb about 5 to 25 percent moisture by weight. Lightweight aggregates usually are 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 as a deck topping material, such as a concrete topping surface over precast concrete slabs or joists.


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 pressure-differential driven into and condensed within a roof system.
- Adhesive loss. The presence of moisture can result in deterioration of moisture-resistant roofing materials and adhesive bond loss between adjacent material layers.
- Adhesive issues with water-based and low-solids organic compounds. Excessive moisture can offset adhesive curing and drying rates. Also, moisture can result in adhesive "swelling," resulting in bond strength loss.
- Mold and fungus concerns. Excessive moisture can contribute to and accelerate mold components' corrosion, including faster corrosion.
- Insulation & vapor loss. The accumulation and presence of moisture in most insulation products will result in reduced thermal performance (lower R-value or R-value).
- Microbial 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



An up-close look



Concrete Floors and Moisture, 2nd Edition

Howard M. Kanare, CTL Group

75% internal RH can be achieved:

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



Barrier One

 <p>BARRIER ONE INTERNATIONAL MOISTURE VAPOR REDUCTION ADMIXTURE</p>	<p>Phone: 877.224.5850 Fax: 904.584.1440 522 S. Hunt Club Blvd., #203 Apelak, Florida, 32713</p> <p>Email: info@barrierone.com Website: www.barrierone.com</p> <p>Effective Date:</p>
<p>General Contractor Attn: Project Manager info@barrierone.com P. XXX, XX XXXX 123 Main Street Any Town, USA 12345</p>	
<p>Subj: BARRIER ONE PROJECT MOISTURE LETTER Re: Project Name, address, city, state, zip</p>	
<p>PM,</p> <p>Our Barrier One Concrete Admixture was used in the above named project. We obtained cylinders of the Barrier One placed concrete throughout the project for our quality control and testing processes and have completed the hydraulic conductivity testing on those samples using ASTM D 5584. The test results reveal the concrete of your project to be non-hygroscopic and relatively impermeable to moisture vapor emission from the concrete itself. No further field moisture testing is required by Barrier One prior to flooring installation, but if conducted, Barrier One warrants up to 100% relative humidity (per ASTM C1710) within 20 pounds of moisture (per ASTM F 155).</p> <p>When our admixture is used, the associated warranty against moisture related flooring failure for exceeds that which is offered within the adhesive and flooring manufacturer's standard warranties and completely removes the liability for moisture vapor emission from everyone involved. Installation of the flooring can begin upon receipt assuming the site conditions are suitable and being sure to follow the flooring manufacturer's installation guidelines with the instruction of field moisture and pH testing. Should the installed flooring later fail due to moisture vapor emission from the slab, the responsibility to address would rest with Barrier One, and not with flooring contractor, adhesive manufacturer, flooring manufacturer, your firm or the project's owner. This warranty is in effect for the <u>life of the concrete</u> and covers identification of failed areas/areas, typical remediation of the corresponding slab, and new material and labor for the installation of the same flooring material.</p> <p>Please refer any questions you might have directly to your Barrier One Regional Manager or me at info@barrierone.com.</p> <p>Sincerely,</p> <p>Principal Barrier One, Inc.</p> <p style="font-size: small;">Copyright 2013 by Barrier One Inc. All Rights Reserved. Duplication without permission is prohibited.</p>	

“...moisture vapor reduction admixture (water-based concrete admixture). A nano scale, chemical formation of micro calcium silicate hydrate molecules that blocks moisture vapor transmission through the capillary system of cementitious structural concrete.”



Conclusions

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



Conclusions - continued

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

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



NRLRC's Contract Provisions, Vol. III

"Roofing Contractor's commencement of the roof installation indicates only that the Roofing Contractor has visually inspected the surface of the roof deck for visible defects and has accepted the surface of the roof deck. Roofing Contractor is not responsible for the construction, structural sufficiency, durability, fastening, moisture content, suitability, or physical properties of the roof deck or other trades' work or design. Roofing Contractor is not responsible to test or assess moisture content of the deck or substrate."



Insulation R-values



Insulation R-values

International Energy Conservation Code, 2015 Edition

C303.1.4 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission R-value rule (CFR Title 16, Part 460) in units of $\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$ at a mean temperature of 75°F (24°C).



Long-term thermal resistance (LTTR)

- ASTM C1303
- ULC-S 770

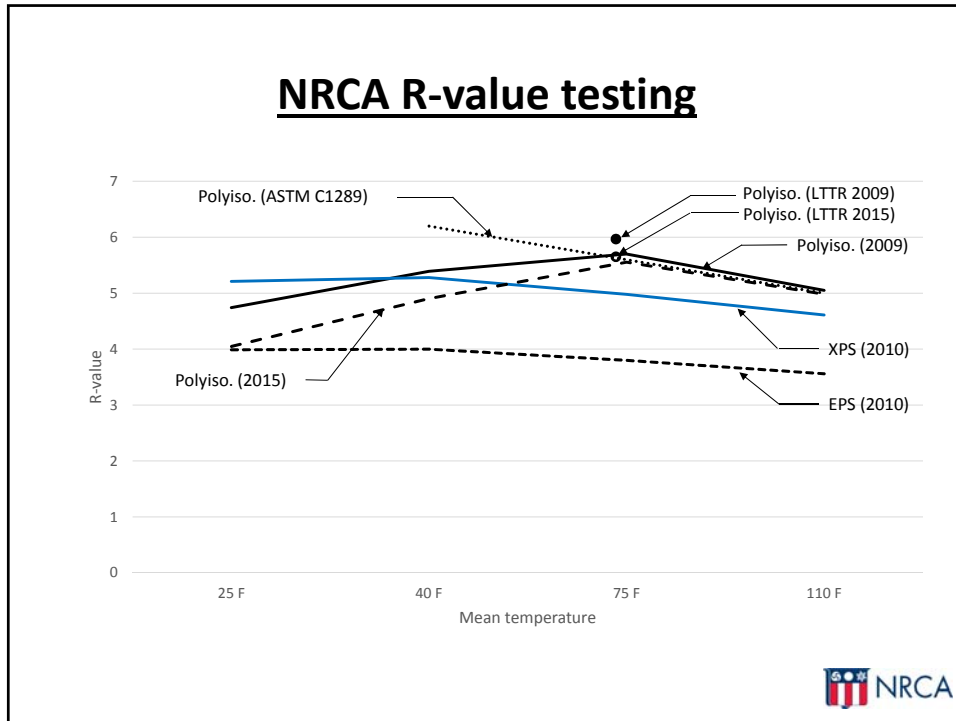
LTTR is intended to represent the R-values of specimens tested after five years of aging when stored in a controlled laboratory environment. This five-year figure corresponds closely to a predicted 15-year, time weighted average of R-values.



NRCA R-values testing

- Polyisocyanurate (2009 and previous)
- Expanded polystyrene (2010)
- Extruded polystyrene (2010)
- Polyisocyanurate (2015)





NRCA's design, in-service R-value recommendation

Polyisocyanurate insulation

1986-2011:

- R = 5.6 per inch thickness

2012-2015:

- R = 5.6 per inch thickness (cooling climates)
- R = 5.0 per inch thickness (heating climates)

Beginning in 2016:

- R = 5.0 per inch thickness



NRCA recommendation

In contract documents, identify insulation by its thickness, not its LTTR or R-value.



High-density polyiso. coverboards

Professional Roofing, "Tech today," December 2015



Manufacturer	ASTM C1289, Type II, Class 4		
	Grade 1 (80 psi)	Grade 2 (110 psi)	Grade 3 (140 psi)
Atlas Roofing Corp.	ACFOAM®-HS Coverboard	—	—
	ACFOAM-III HD Coverboard	—	—
Firestone Building Products Co.	—	ISOGARD HD Cover Board	—
GAF	EnergyGuard® HD Cover Board	EnergyGuard HD Plus Cover Board	—
Hunter Panels	H-Shield HD	—	—
Johns Manville	—	—	Invinsa Roof Board
	—	—	Invinsa FR
Rmax	—	—	—

Johns Manville — — — Invinsa Roof Board
 — — — Invinsa FR
 Rmax — — —
 Roof, high-density polyisocyanurate insulation cover boards.
 14 www.professionroofing.net OCTOBER 2015

Copyright © 2015
 Review of polyisocyanurate
 insulation manufacturers' product literature reveals fire
 resistance. ©©©
 MARK S. GRAHAM is NRCA's vice president of technical services.

Additional issues...

High-density polyiso coverboards

- Facer sheet delamination
- Boards being shipped wet
 - Manufacturer recommending boards be laid-out to air dry



Proper wind design

- Determine wind loads
 - IBC Ch. 16-Structural Design
 - ASCE 7-10, “Minimum Design Loads for Buildings and Other Structures”
- Design for resistance
 - FM 4474
 - UL 580 or UL 1897

IBC requires (Sec. 1603) design wind loads to be shown in the Contract Documents



*Specifying a wind warrantee,
in itself, is not proper wind design*



Design wind load determination

www.roofwinddesigner.com



FM 1-28 has been updated

www.fmglobalsdatasheets.com


FM Global
Property Loss Prevention Data Sheets **1-28**
October 2015
Page 1 of 102

WIND DESIGN
NEEDED BY FM GLOBAL. SHOULD CONTACT THEIR LOCAL FM GLOBAL OFFICE BEFORE BEGINNING ANY ROOFING WORK.

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- October 2015 update
- Based upon ASCE 7-05 with enhancements
- Reformatted
- Be cautious of FM-insured projects
- NRCA will review and publish a summary of changes



ASCE 7-16 (public review draft)

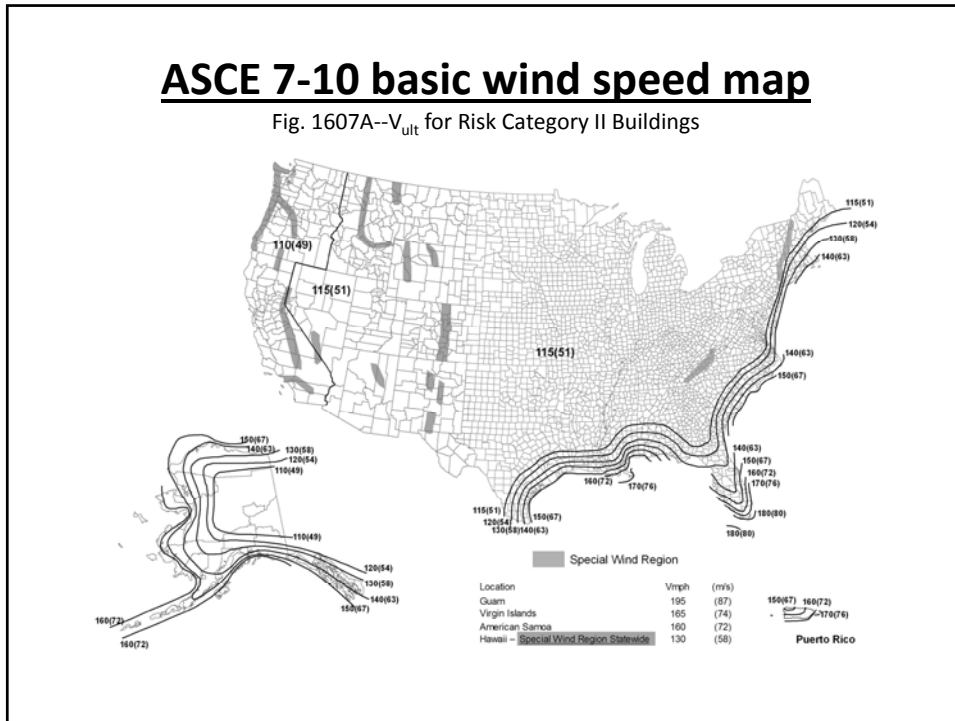
- Revised basic wind speed map
- Changes (and new) pressure coefficients
- Revised perimeter and corner zones

Expect higher field, perimeter and corner uplift pressures



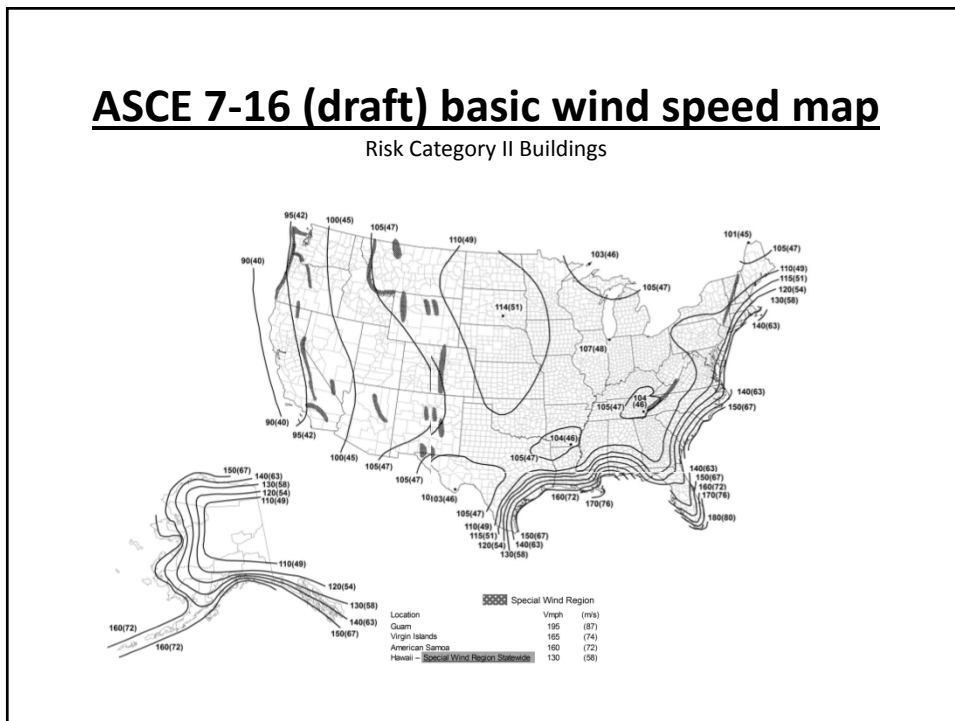
ASCE 7-10 basic wind speed map

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



ASCE 7-16 (draft) basic wind speed map

Risk Category II Buildings



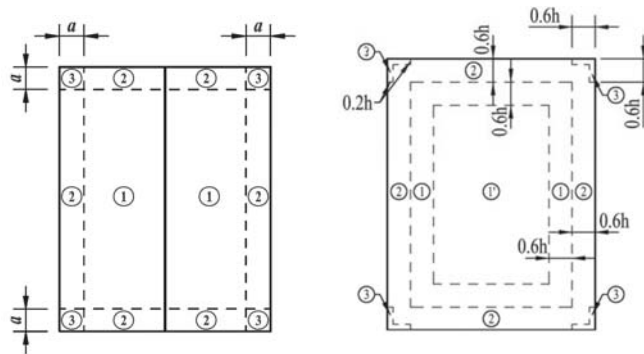
GC_p pressure coefficients

$h \leq 60$ ft., gable roofs ≤ 7 degrees

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

Zones

$h \leq 60$ ft., gable roofs ≤ 7 degrees



ASCE 7-10

ASCE 7-16 (draft)

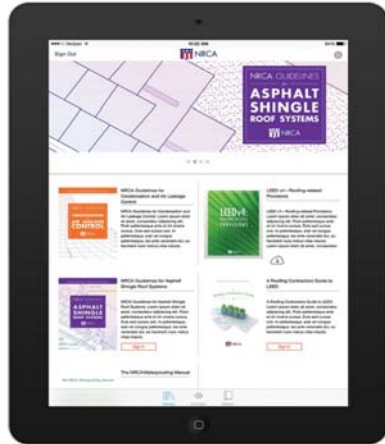
*Proper wind design is oftentimes avoided...
and it is getting more complicated*



The NRCA Roofing Manual



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



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





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