



The Shortcomings of Using Prescriptive Specifications with Emerging Roofing Technologies

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Implementation of emerging technologies into time-tested, proven roof systems can result in some unintended consequences

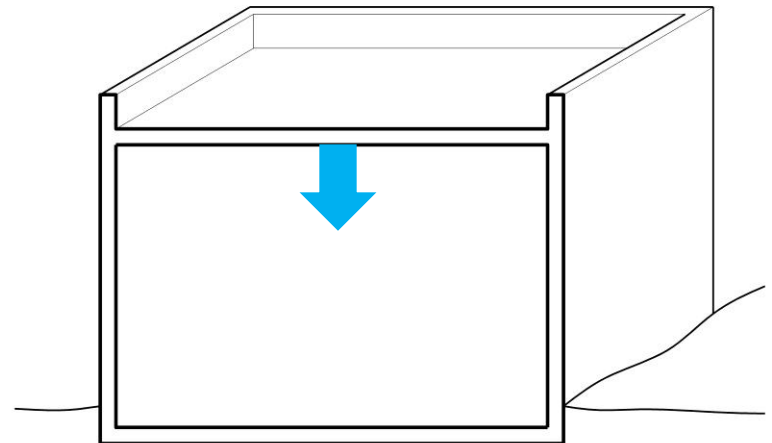
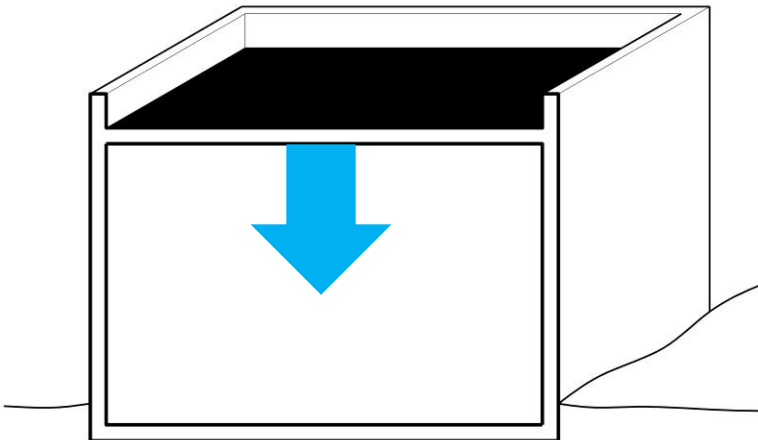


Problems observed

- Moisture migration from the buildings' interiors
- Condensation forming within roof systems
- Loss of adhesion within roof systems
- In Northern climates, ice formation underneath roof membranes

Research

Bill Rose, “The White Roof Problem in the U.S. Desert Southwest,” Thermal Performance of Exterior Envelopes of Whole Buildings X, December 2007, Clearwater Beach, FL



Research

Anthony Nicaastro and Kenneth Klein,
“Moisture Problems Overhead:
Lightweight Concrete in Roofing and
Waterproofing Systems,”
The Construction Specifier,
September 2009, pages 34-41



Water Tower Place (1975)
Chicago, IL
859 feet tall

Concrete types:

- Structural concrete
 - 150 lbs/ft³
- Lightweight structural concrete
 - 85–120 lbs/ft³
- Lightweight insulating concrete
 - 20-40 lbs/ft³

Concrete Aggregates

60-80% of Concrete Mix Design

- Normal-weight aggregates (stone):
 - Dense
 - Absorb about 2% by weight
- Light-weight aggregates (expanded shale):
 - Porous
 - Absorbs from 5 - 25% by weight

**Lightweight structural concrete
inherently contains more moisture**

When is it OK to roof?

Historical guidelines

- After 28 days
- Plastic film test
 - ASTM D4263, “Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method”
- Application of hot bitumen

**These are not appropriate for
current generations of concrete**

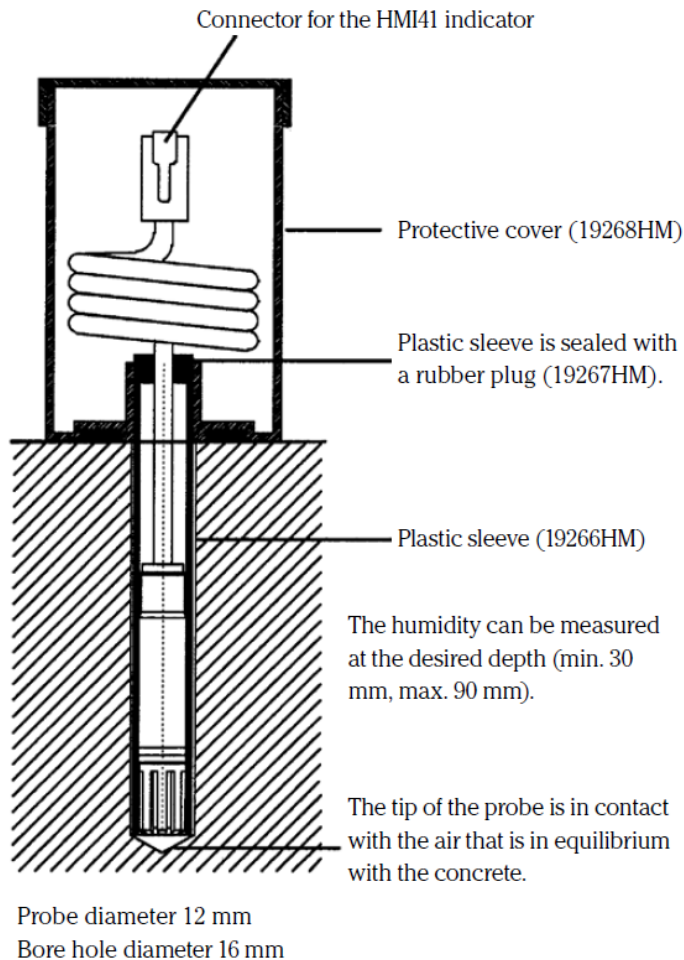
Flooring industry

ASTM Committee F06—Resilient Floor Coverings

- ASTM F1869, “Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride”
- ASTM F2170, “Standard Test Method for Determining Humidity in Concrete Floor Slabs Using In-situ Probes”

ASTM F2170 apparatus

Measure relative humidity (RH %) and temperature



Trial ASTM F2170 tests

Existing lightweight structural concrete roof decks

	Roof 1	Roof 2	Roof 3
Roof age (yrs)	4	7	7
Area (ft ²)	13,200	23,840	14,760
Thickness (in.)	6.5	7.5	7.3
No. of readings	13	10	8
High reading	99% RH	99% RH	99% RH
Low reading	63% RH	96% RH	84% RH
Median reading	97% RH	99% RH	99% RH
Mean reading	89% RH	99% RH	95% RH

Values of 65-85% RH are considered acceptable in the flooring industry depending upon the specific floor covering type.

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

Acceptable values for roof systems?

Aren't currently known









Conclusions

- Adapting emerging technologies can present some unexpected challenges
- Controlling moisture and its movement are increased concerns
- Concrete presents unique challenges
- We currently don't have all the answers

Recommendations

- Using ASTM F2170 for concrete roof decks appears reasonable... but roofing-specific criteria needs to be developed.

Recommendations – cont.

“...when in doubt, we better figure it out...”

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Questions?