



NRCA University Webinar
July 18, 2013

Problems and Risks Posed by Lightweight Structural Concrete Roof Decks

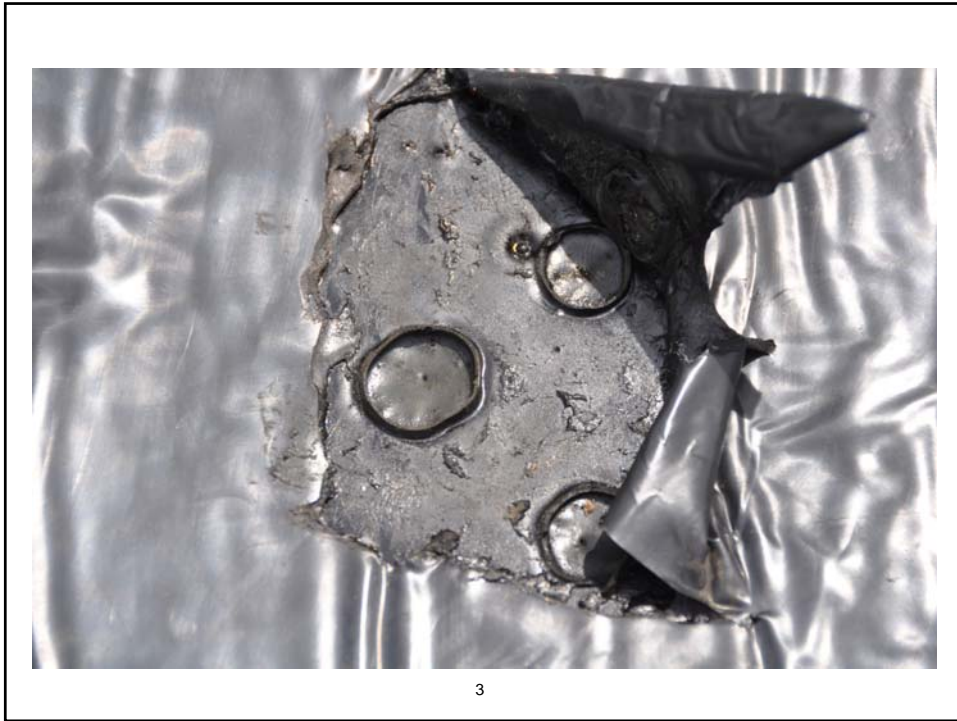
presented by

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Some terminology

- **Structural concrete (normal weight)**
 - 150 lbs/ft³
- **Lightweight structural concrete**
 - 85–120 lbs/ft³
- ~~Lightweight insulating concrete~~
 - 20–40 lbs/ft³

Concrete mix design

- Aggregate:
 - Large aggregate
 - Fine (small) aggregate
- Portland cement
- Water
- Admixtures:
 - Fly ash
 - Air entrainment
 - Curing compounds
 - Etc.

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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**

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An up-close look



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Uses for lightweight structural concrete

- Cast-in-place roof decks (removable forms)
- Composite roof decks (metal form deck stays in-place)
- Deck topping (e.g., topping over precast concrete)

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What is the appeal?



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

- Reduced weight:
 - Transportation
 - Pumping
 - Placement
 - In-place (Dead load)
- Similar strength
- Similar workability:
 - Begin finishing earlier
- Sustainability credit:
 - LEED

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Reported roofing-related problems

- Moisture within the roof system
- Loss of adhesion
- Insulation facer delamination
- Adhesive curing issues
- Mold growth
- Fastener/metal corrosion
- R-value loss

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When is it OK to roof?

Historical guidelines

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

These are not appropriate for current generations of concrete mixes

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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”

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ASTM F2170 apparatus

Measure relative humidity (RH %) and temperature

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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.

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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

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Some conclusions

- Lightweight structural concrete presents challenges
- Historical “when to roof” parameters are no longer appropriate
- Roofing contractors do not have the information – and may not have the expertise – to make determinations
- Alternative designs need to be considered

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Interim recommendations

In new construction:

- NRCA recommends lightweight structural concrete not be used for roof deck construction.
- If lightweight structural concrete is used, the Designer should specifically identify concrete drying parameters/when to apply roofing

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Interim recommendations – cont.

Existing concrete roof decks (known to be lightweight structural concrete or where moisture-related problems are evident):

- Above-deck venting design (e.g., venting base sheet)
- Adhered vapor retarder (e.g., two-part epoxy 12-15 mils)

Adhered or loosely-laid, ballasted roof systems

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The issues associated with moisture in concrete roof decks illustrate why roofing professionals may need to rethink their company's liability for roofing-related technical issues.

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Concrete Roof Decks: What Should Roofing Contractors Do To Reduce Legal Liability Due To Moisture in Concrete Decks?

- ▶ Be Proactive
- ▶ Be Knowledgeable
- ▶ Be Communicative

“To Be Forewarned Is To Be Forearmed”

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Learn About the Deck

At the earliest possible opportunity, whether new construction or re-roofing, determine if there is a concrete deck and if it's a lightweight structural concrete deck.

If so, communicate promptly to others involved in the project the risk posed to the roofing assembly due to retained moisture in the concrete deck.

- Pre-bid conference on public projects and communication to other parties
- On private jobs, explicitly exclude deck conditions that can adversely affect roof performance.

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Concrete decks pose major technical and liability problems for the roofing contractor.

- Manufacturer's disclaim liability for any condition due to the deck.
- Owner and Architect naturally look to the roofing contractor when there is a roof problem and expect the "roofing people" to know what conditions are suitable for roof installation.

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Contract and specification language increases roofing contractor liability

- Roofing contractor's commencement of work is commonly viewed as roofing contractor's acceptance of the deck and there is quite often an express provision in the contract documents to this effect.
- Project specifications often include express and explicit requirements regarding the roofing contractor's determination that the deck is satisfactory and acceptable.

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Acceptance of the Deck = Liability to Roofing Contractor

Formerly, it was commonplace for roofing contractors to “accept” the roof deck by commencing work. Project specifications routinely include such a provision. Historically, prudent contractors would seek to limit acceptance of the deck to acceptance of the **surface** of the deck. Today, more explicit language is needed by roofing contractors.

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New Construction or Re-roofing?

- o Problem not limited to new construction.
- o Moisture in lightweight structural concrete decks can adversely affect not only the original roof, but also affect the replacement roof, if the moisture has remained in the lightweight structural concrete deck and can only escape upwards.

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Why Problem Now?

Traditional concrete decks, using hot-applied asphalt to adhere insulation and a roof membrane, provided a roof assembly that performed satisfactorily.

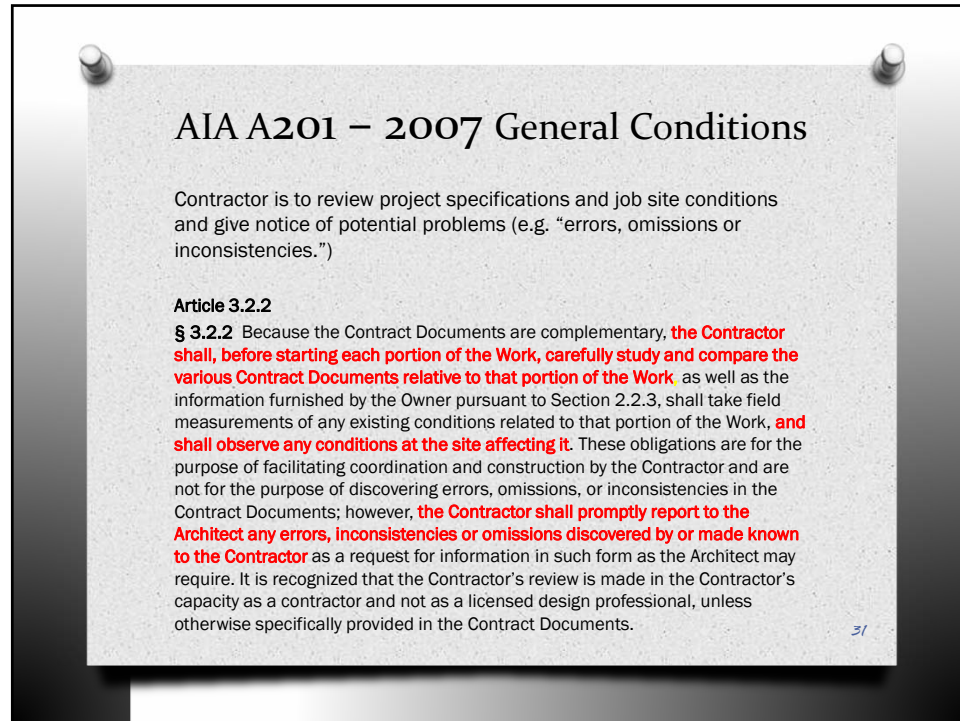
Roof systems installed in recent years over concrete decks, particularly lightweight structural concrete decks, where cold, foam and water based adhesives have been applied to the concrete deck, have been problematic.

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Notification by Roofing Contractor

Roofing contractor should provide notification and warning to all parties of potential problems posed by concrete decks at the earliest possible opportunity and do so repeatedly

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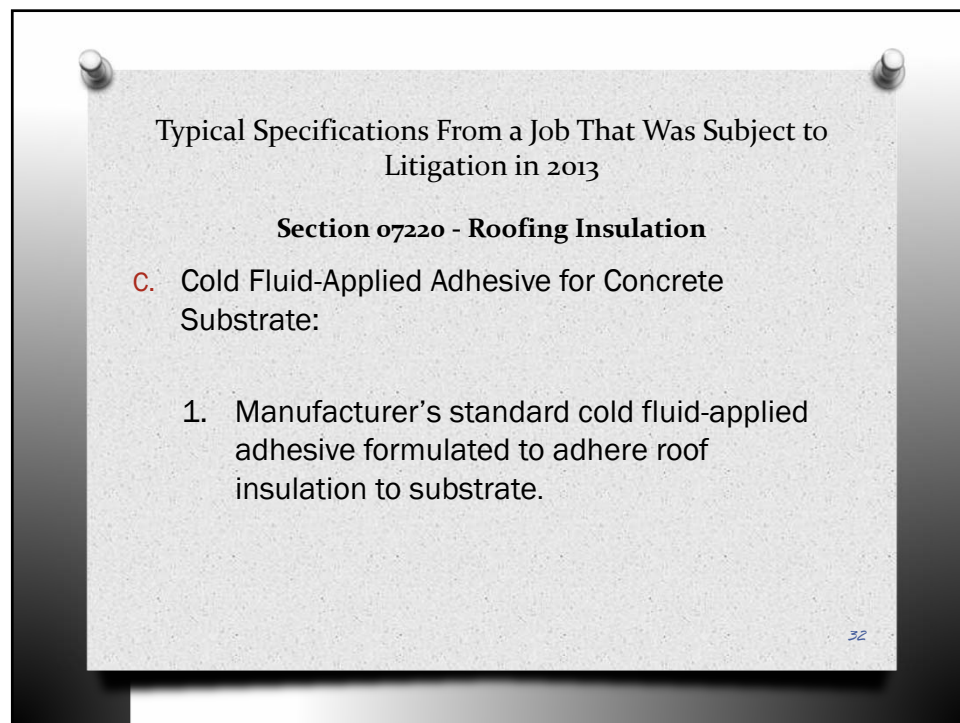
AIA A201 – 2007 General Conditions

Contractor is to review project specifications and job site conditions and give notice of potential problems (e.g. “errors, omissions or inconsistencies.”)

Article 3.2.2

§ 3.2.2 Because the Contract Documents are complementary, **the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work**, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, **and shall observe any conditions at the site affecting it**. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, **the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor** as a request for information in such form as the Architect may require. It is recognized that the Contractor’s review is made in the Contractor’s capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

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Typical Specifications From a Job That Was Subject to Litigation in 2013

Section 07220 - Roofing Insulation

C. Cold Fluid-Applied Adhesive for Concrete Substrate:

1. Manufacturer’s standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

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Section 07220 - Roofing Insulation

3.2 Preparation

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.
 - 1. Surfaces to which insulation is to be applied shall be even, smooth, sound, thoroughly clean and dry, and free from all defects that might affect the application.

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Section 07220 - Roofing Insulation

- D. Adhered Insulation:
 - 1. Install each layer of insulation and adhere to substrate as follows:
 - a) Prime surface of concrete deck with asphalt primer and allow primer to dry.
 - b) Set each layer of insulation in a cold fluid-applied adhesive.

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Section 07532
Adhered EPDM Membrane Roofing Language

1.3 PERFORMANCE REQUIREMENTS

B. Material Compatibility

1. Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

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Section 07532
Adhered EPDM Membrane Roofing Language

1.5 QUALITY ASSURANCE

D. Preinstallation Conference:

3. Review methods and procedures related to roofing system including, but not limited to, the following:

a) Meet with Owner, Owner's insurer if applicable; testing and inspecting agency representative; roofing installer; roofing system manufacturer's representative; deck installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

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Section 07532
Adhered EPDM Membrane Roofing Language

1.5 QUALITY ASSURANCE

- b) Review methods and procedures related to roofing installation, including manufacturer's written instructions.
- d) Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

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Section 07532
Adhered EPDM Membrane Roofing Language

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 5. Verify that concrete substrate is visibly dry and free of moisture.
 - a) Test for capillary moisture by plastic sheet method according to ASTM D 4263.

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Section 07532
Adhered EPDM Membrane Roofing Language

3.1 EXAMINATION

6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

7. Proceed with installation only after unsatisfactory conditions have been corrected.

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Section 07532
Adhered EPDM Membrane Roofing Language

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

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Typical Manufacturer's Warranty:



FIRESTONE WARRANTY EXCLUSIONS

Firestone shall have no obligation under this Limited Warranty, or any other liability, now or in the future of a leak or damage is caused by:

- o Condensation or infiltration in, through, or around the walls, copings, rooftop, hardware or equipment, building structure or underlying or surrounding materials
- o The architecture, engineering, construction or design of the roof, roofing systems, or building.

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Examples of Proposal/Contract Language the Roofing Contractor Should Consider:

DECK CONDITIONS

- o Customer warrants that structures on which XYZ Roofing personnel are to work are in sound condition and capable of withstanding roofing construction, equipment and operations.
- o Commencement of roof installation indicates only that XYZ Roofing has visually inspected the surface of the roof deck for visible defects.

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Examples of Proposal/Contract Language the Roofing Contractor Should Consider:

DECK CONDITIONS

- XYZ Roofing is not responsible for the structural sufficiency, quality of construction (including compliance with FMG criteria), undulations, fastening or moisture content of the roof deck or other trades' work or design.

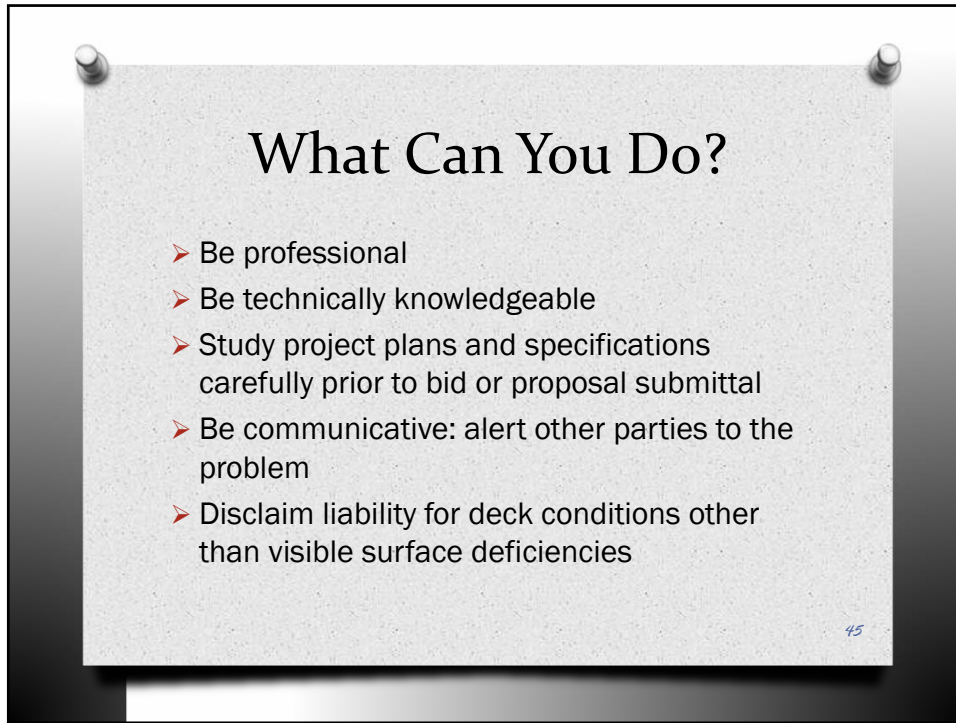
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Examples of Proposal/Contract Language the Roofing Contractor Should Consider:

CONCRETE DECKS

- In the event that roofing is to be installed over a concrete or other wet deck or substrate, the determination as to when the concrete or wet substrate is sufficiently cured and dried so that roofing materials can be installed without potential future adverse effect shall be made by the General Contractor in consultation with the concrete subcontractor, concrete manufacturer and design professional.
- XYZ Roofing is not responsible to test or assess moisture content of the deck or substrate or for the effects of moisture emitted from the deck.

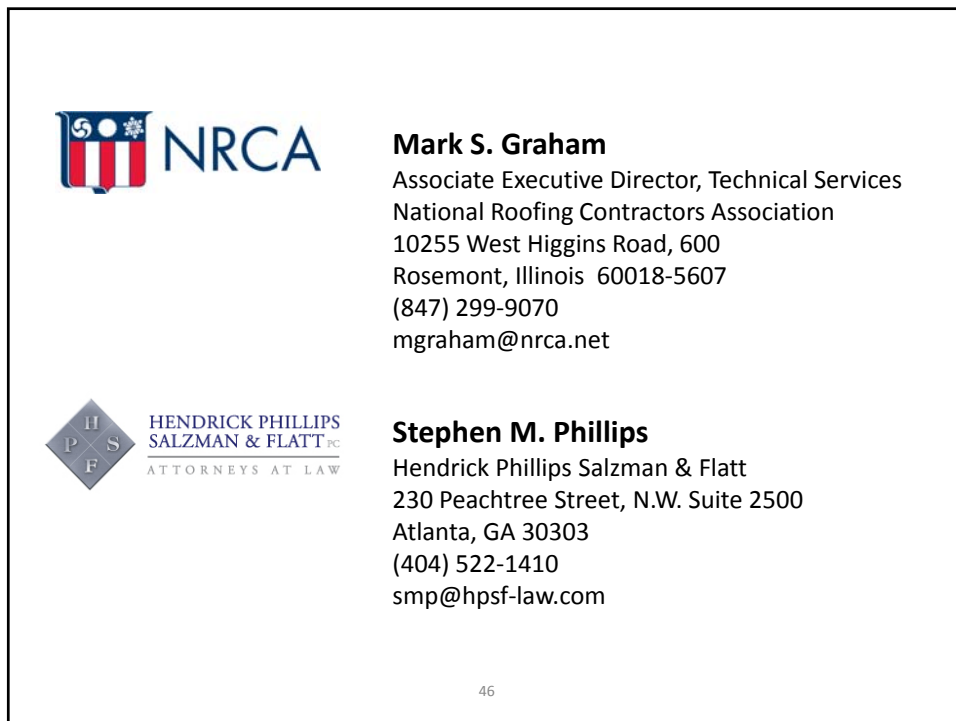
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What Can You Do?

- Be professional
- Be technically knowledgeable
- Study project plans and specifications carefully prior to bid or proposal submittal
- Be communicative: alert other parties to the problem
- Disclaim liability for deck conditions other than visible surface deficiencies

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