

Lightweight Structural Concrete Problems and Risks

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On July 18, the National Roofing Contractors Association (NRCA) hosted a webinar entitled “Problems and Risks Posed by Lightweight Structural Concrete Roof Decks.” The webinar was hosted by Mark Graham, associate executive director of technical services of NRCA, and Stephen Phillips, an attorney with Hendrick, Phillips, Salzman & Flatt, a construction law firm located in Atlanta, Georgia.

Graham began the webinar by showing photos demonstrating the problems that can occur when lightweight structural concrete is used for the roof deck. The photos included a deck application of hot liquid asphalt, a peel-and-stick membrane, a black adhered membrane, and a white single-ply membrane over glass-faced gypsum board. In all cases, the roof deck was composed of lightweight structural concrete. The photos illustrated blistering and membranes that were no longer adhered and were taken two days to 15 months after the roof coverings were installed. They demonstrated that all types, colors, and ages of roof coverings are susceptible to problems when installed over lightweight structural concrete.

Normal-weight structural concrete has

a density of roughly 150 lbs./ft.³, where lightweight structural concrete has a density of 85-120 lbs./ft.³. Lightweight structural concrete should not be confused with lightweight insulating concrete, which is nonstructural and has a density of 20-40 lbs./ft.³.

Concrete is composed of three materials: aggregate, which varies in size from large to fine (sand); Portland cement, which is used as a binder; and water. Admixtures such as fly ash, air entrainment, and curing compounds may be added to the mix. The aggregate constitutes 60-80% of the mix. Normal-weight aggregate has an absorption rate of about 2% by weight, whereas the aggregate used in lightweight structural concrete has a rate of 5-25% by weight. The aggregate used in lightweight structural concrete is saturated with moisture prior to adding it to the concrete mix to prevent the aggregate from absorbing the water added to the mix for hydration of the concrete. Saturating the aggregate means the lightweight structural concrete contains much more water when it is placed than does normal-weight concrete.

Lightweight structural concrete can be used for cast-in-place roof decks, composite roof decks, and roof topping. Some of the advantages of using lightweight struc-

tural concrete are ease of transportation, pumping, and placement; similar strength and workability to normal-weight concrete; and sustainability credits from LEED®. The problems reported with lightweight structural concrete include moisture within the roof system, loss of adhesion, insulation facer delamination, adhesive curing issues, mold growth, fastener/metal corrosion, and loss of R-values.

Historically, the industry standard has been to cover the roof deck after 28 days; however, this standard evolved because the concrete has developed sufficient strength at 28 days, not because of its moisture content. One of the methods used to determine if the roof deck is ready for covering is the plastic film test per ASTM D4263, *Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method*. This test method assumes that the deck is the same temperature on its top as on its bottom. With lightweight structural concrete, this appears not to be the case. On a hot day, the vapor is driven from the outside down into the deck and can result in false readings when conducting the plastic film test.

The flooring industry has been aware of the moisture problems associated with lightweight structural concrete and devel-

oped several test methods to help determine when the floor is ready for covering. ASTM F2170, *Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes*, requires drilling and placing probes in the deck. After 48-72 hours, temperature and humidity readings are observed. Relative humidity readings of 65-85% are considered acceptable to cover the floor. In tests conducted by NRCA, roof slabs had readings of 89-99% up to seven years after installation.


In conclusion, Graham stated that lightweight structural concrete presents challenges to the contractor and building owner. The parameters that have been used to determine when to install a roof system don't appear to work with lightweight structural concrete. Further, contractors don't have the information, knowledge, or expertise to determine this. For these reasons, NRCA recommends considering alternative designs. As an interim suggestion, NRCA recommends that lightweight structural concrete should not be used for roof decks. If lightweight structural concrete is used,

the designer should identify the drying parameter for the concrete before the roof is covered. For existing decks (if it is known to be lightweight structural concrete), consider above-deck venting with a venting base sheet or applying an adhered vapor retarder. The vapor retarder should be a two-part epoxy 12-15 mils in thickness.

The last half of the webinar was hosted by Steve Phillips, who spoke on reducing liability. Most of the comments were directed at contractors, but many can be useful for consultants as well.

1. Determine if the deck is lightweight structural concrete.
2. If so, communicate that to everyone involved with the project.
 - a. Have a prebid conference if it is a public job.
 - b. Exclude from the contract the deck conditions that can adversely affect the roof performance.
3. Require written notification from the designer that it is acceptable to commence work on the deck.

4. Clean the substrate.
5. Prime the surface with asphalt primer.
6. Set each layer of insulation in a cold, fluid-applied adhesive.
7. Make sure materials are compatible.
8. Require a preinstallation conference.
9. Pay attention to quality assurance.
 - a. Review methods and procedures with the manufacturers.
 - b. Examine the substrate.
 - c. Specify a minimum drying period or moisture content.
 - d. Test by the plastic sheet method.
 - e. Verify that concrete-curing compounds will not be detrimental.
 - f. Beware of warranty exclusions.

For those interested in viewing the presentation, it has been uploaded by NRCA to <http://www.nrca.net/store/detail/nrca-university-webinar-recording-problems-and-risks-posed-by-lightweight-structural-concrete-roof-decks-video-file/1207>. 



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