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Finishing Lightweight Concrete Floors

by the Expanded Shale, Clay & Slate Institute (ESCSI)

Over the past 80 years, more than five hundred thousand (500,000) floors have been constructed with structural lightweight concrete made with Expanded, Shale, Clay and Slate Lightweight Aggregate. The satisfactory performance record of these floors is accepted and well known.

In the past few years delamination issues have been reported on both normalweight and lightweight concrete floors when a riding trowel with float pans has been used.

The purpose of this paper is to offer a better understanding of the construction, finishing and use of lightweight concrete floors.

First National Bank Tower, Omaha, NE

General

Designers specify lightweight concrete floors because they are cost effective and environmentally efficient. Lightweight concrete has compressive strength comparable to normalweight concrete, but it is typically 25% to 35% lighter. Lightweight concrete floors offer design flexibility and substantial cost savings by providing less dead load, improved seismic structural response, longer spans, better fire ratings, thinner sections, smaller size structural members, less reinforcing steel, and lower foundation costs.

Building codes mandate the requirements for fire rated floor assemblies and are explicit with regard to the use of structural lightweight concrete. The concrete used in the floor assembly, and tested in accordance with ASTM E 119, must meet the specified physical properties of density (unit weight) and air content. For UL fire rated lightweight concrete floor assemblies, entrained air contents are specified in the concrete property criteria.

By definition, lightweight concrete is lighter than normalweight concrete. This is made possible by replacing heavy, ordinary aggregate with expanded shale, clay or slate lightweight aggregate, and by maintaining entrained air at approximately 6%. Air entrainment in concrete improves durability and

workability, reduces bleeding, and is recommended for lightweight concrete by both ACI 211.2 and ACI 302. For workability and weight reduction, ESCSI recommends 4 to 7 percent air entrainment.

The typical lightweight suspended floor is used with floor coverings for foot traffic in office, commercial, multi-unit residential and institutional buildings. ACI 302 calls this type of floor a Class 2 Floor with a flat and level slab suitable for applied coverings, and having a "light" steel-troweled finish. The floor flatness/levelness tolerances for this floor are F_F25/F_L20. On some occasions, flatness/levelness tolerances are higher to meet specific design requirements. The "light" steel-troweled finish is not the same as a "normal" or "hard" steel-troweled finish recommended by ACI 302 for commercial or industrial floors subject to vehicular traffic.

Worker making first pass over lightweight concrete with walk-behind power trowel.

Concrete Finishing

The increasing call for faster construction and flatter tolerances has increased the use and development of ride-on power trowels with float pans. This equipment is capable of providing flat floors with a minimal amount of labor, and has been used extensively on non-air entrained slab-on-grade concrete. It is now being used successfully on many elevated floors which are usually constructed with lightweight concrete. The user of this equipment needs to recognize and adapt to the fact that lightweight concrete is always air entrained at about 6%, and often has a different timing sequence during finishing.

Bank of America Corporate Center, Charlotte, NC

Ride-on power trowels with pan floats impart more energy to the concrete surface at an earlier age than walk-behind power trowels. All power trowels with pan floats exert much lower surface pressures, thereby allowing the contractor to commence finishing sooner with this equipment. This fact is a major contributor to delamination issues.

Concrete Construction, March 1998, pp. 277-283, reported surface pressures of 0.36 to 0.98 psi for walk-behinds and ride-on power trowels equipped with blades, 0.16 to 0.42 psi for pan floats, and 3.3 to 6.0 psi surface pressure for a person walking on the concrete. ACI 302 recommends that machine floating be started when the concrete will support a finisher on foot without more than a 1/8 to a 1/4 inch indentation. As a general rule, ACI 302 also recommends that when flatness tolerances are not high, power floating should be started as late as possible. This is indicated when a foot print is barely perceptible.

Problems develop when the floor is power floated prematurely and consequently over worked. This is not a new development. For many decades, delamination has been known to apply to inappropriately timed hand troweling.

Manny Mattos of D&M Concrete Floor Company, Fall River, MA, still relies on the time-tested rules of thumb for finishing concrete and knowing when to start power floating: (1) When the top surface allows a footprint indentation no deeper than 1/8", or in some cases 1/4"; (2) When no bleed water sheen is visible on the surface. "We finished a lot of lightweight air entrained concrete floors without blistering or delamination problems. We always start our power floating operation on a lightweight floor using a 36" walk-behind machine with a float pan. This ensures we are not on the floor too soon, because the heel (footprint) test is fool-proof. After the first power float, we then use a ride-on power trowel with float pans."

Awareness of surrounding weather conditions must also be taken into consideration. Sun, wind and broad changes in temperature and humidity during the placing and finishing operation will play a big part in crusting, blistering and delamination issues. These conditions need to be part of the discussion at a pre-slab construction meeting.

Air-entrained structural lightweight concrete can be successfully incorporated in construction of suspended floor slabs, and has a long history of successful use. Structural and fire rating considerations require that the air entrainment be maintained in the structural lightweight concrete. It can be finished with modern finishing equipment and techniques, as long as proper procedures are used.

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