Concrete Slabs: Surface Prep & Moisture Tests

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Providing compete construction specifications documentation, systems and performance descriptions, and risk and quality advisory services.

Conspectus's Tech Tips received the national Communications Award from CSI.

ABSTRACT:
The appearance and performance of floor finishing materials depends upon the quality of the concrete substrate to which they will be applied. The preparation of and the moisture content of concrete are key to achieving the desired appearance and performance of the finished floor. This article discusses the standards which govern surface preparation and moisture testing of concrete slabs.

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KEYWORDS:
Concrete Surface Preparation, Concrete Slab Moisture Testing, Slab on Grade, Cast-in-Place Concrete.

REFERENCES:
ASTM D 4258 - Standard Practice for Surface Cleaning Concrete for Coating.
ASTM D 4259 - Standard Practice for Abrading Concrete.
ASTM F 1869 - Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous CaCl2.
ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.
ICRI Technical Bulletin No. 03732 "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays"

Floor Finishes

Many floor finishing materials, particularly those that rely on adhesion to a substrate, depend upon the texture and moisture content of that substrate to look and perform properly.
Such flooring materials include, but are not limited to, wood flooring, resilient flooring, terrazzo, fluid-applied flooring, carpeting, and paints. Each type of material and each manufacturer will have different requirements. Consult the finish floor product manufacturer for those requirements before preparing or testing the concrete slab.
For floor finishes being applied to existing concrete slabs, the primary concern is the cleanliness and texture of the concrete. Dust, dirt, oils, waxes, and coatings all conspire to prevent new finishes from adhering to concrete. These materials must be completely removed from existing concrete. The degree or level of the concrete's texture is also critical. The concrete surface must have enough texture for the adhesive or finish to "grab" onto, but should not have so much texture that it telegraphs through the finish.
For floor finishes applied to new concrete slabs, the primary concern is moisture content of the slab. Concrete is installed wet and develops an initial cure over a 28 day period. However, concrete continues to give up moisture as hydration continues which extends far beyond 28 days. Note that admixtures can also affect the rate of hydration.
If moisture above specific levels is still emanating from the slab after a floor finish has been installed, then that finish could lose its adhesion to the slab. This can cause carpet tiles and VCT to come loose. Other finishes could blister and peel.

Surface Preparation

After concrete has cured for a minimum of 28 days, preparations for installing finishes may begin. First test the concrete to verify that its moisture content is less than the maximum allowed by the manufacture of the finish to be installed. See Testing Slabs for Moisture below. The surface should also be checked to verify it complies with tolerances for level, flatness, and smoothness. All conditions which do not meet requirements should be repaired prior to preparation work.

Surface Preparation Methods

ASTM D 4259: Abrasive (e. g. sand blast) and shot blasting techniques are effective methods for preparing concrete slabs. These methods provide a low risk of introducing micro-cracking in concrete surface. Other more aggressive mechanical cleaning methods are available, but pose a greater risk of surface cracking. Abrasive and shot blasting are not recommended for removing resilient coatings, uncured coatings or adhesives, and tar-based materials. Consult ICRI Technical Bulletin No. 03732 for additional recommendations.

ICRI defines various levels of surface texture preparation as CSP (Concrete Surface Profiles) ranging from CSP 1 (finest profile) CSP 9 (coarsest profile).

CSP Profile Recommendations:

- CSP 3 for thin film, paint finishes.
- CSP 3 to 5 for high build paint finishes.
- CSP 4 to 6 for thin self leveling floor finishes.
- CSP 5 to 9 for polymer overlay floor finishes.

Dust Control Recommendations:

- CSP 2, 3, and 4 can be produced using an abrasive blast where uncontrolled dust will not pose problems.
- CSP 3 through 8 can be produced using shot blast where dust control is important, especially for projects with adjacent occupied spaces.

Acceptable substrate surfaces will be free of laitance, oil, grease, flooring adhesive, paint, and other surface contaminates capable of affecting bond of specified floor finishes to concrete substrate.
After abrasive cleaning, surface irregularities should be repaired. Bugholes, spalls, cracks, deteriorated joints and other surface damage should be filled to produce a surface flush with adjacent surfaces Once repairs are complete and just prior to finish installation, the concrete surfaces should be dry broom or vacuum cleaned in accordance with ASTM D 4258 to remove loose materials on the substrate surface.

Moisture Testing

Once the slab has been poured and allowed to cure, there are two tests established to determine whether the moisture content of the slab is acceptable for the installation or application of a finish:

1. ASTM F 1869 Calcium Chloride Test.
2. ASTM F 2170 Relative Humidity Test.

The Calcium Chloride test measures the rate of moisture vapor emission from the surface of a concrete slab, whereas the Relative Humidity test measures the relative humidity within the concrete slab.
ASTM F 1869; Calcium Chloride Test: This test involves sealing a container of calcium chloride to the concrete slab for between 60 - 72 hours and measuring the weight gained by the calcium chloride from absorbed moisture to determine the amount of moisture emitted by the concrete slab.
ASTM F 2170; Relative Humidity Test: This method involves drilling holes into the slab and using an instrument to measure the temperature and relative humidity of the slab by direct contact near the center of the slab. Test holes are sleeved and capped for a minimum of 72 hours to permit the test hole to acclimate before measurements are taken.
The flooring industry has adopted the calcium chloride test as the standard most commonly referenced. However, test results may be questionable. 60 - 72 hours is a long time for a test on a construction site to remain undisturbed. This test requires carefully controlled and monitored conditions to ensure meaningful results.

Verify with the manufacturer for each finish flooring material to be used as to which test is recommended. To assure performance, it may be necessary to conduct both of these tests on the same area of slab.
Most flooring manufacturers require maximum water vapor emission rates of 3.0 lbs/1000 sf/24 hours, a maximum relative humidity of 75%, and a maximum 9.0 pH. Achieving these conditions without treating the concrete surfaces is difficult.
Untreated concrete can be expected to have water vapor emission rates greater than 5 lbs/1000 sf/24 hours and a 12 pH.
Verify maximum surface humidity requirements for each finish material and adhesive to be installed on the slab with the manufacture of each product. Finish materials and adhesives should not be installed until humidity levels in the slab are less than the maximum allowed for the specific finish to be used.

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