The Very Beginning: Understanding the Concrete You're Coating

By Chris O'Brien, President and CEO of Rock-Tred Corporation on 5/1/2017 3:54 PM

Photos courtesy of Rock-Tred

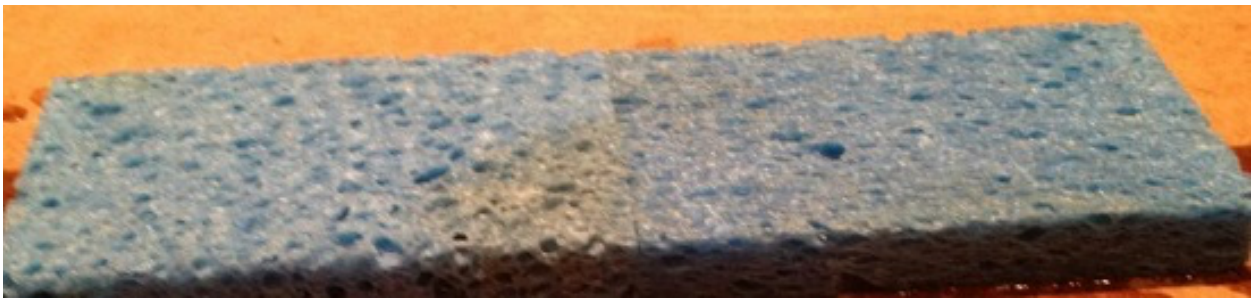
How many times have flooring contractors installed a rigid resinous polymer flooring system just to get a call back months later stating that the floor has cracked? The rule governing this behavior is the "who touched it last" rule, which means — "if you coated it, you accepted it!"

Crack issues can be a common experience in the flooring business. So what information should be gathered and documented to keep the responsibility where it belongs and what information should be collected to demonstrate who is really responsible when a crack appears after the coating or overlay has been installed?

Concrete Cracks

Concrete is by far the most common structural substrate on which resinous flooring materials are applied. Concrete, in its most basic description, is a mixture of cement, various grades and sizes of aggregate, and water. While the makeup of concrete is basic in design, the proper placement, curing, and drying of concrete is an extremely complex process requiring a high degree of expertise.

There are many different mix designs that are used to modify the performance and physical characteristics of concrete. Each of these designs have pros and cons, but as a general rule, factors that contribute to the amount of concrete cracking include add-mixtures, weather conditions, proper grade selection and compaction, water-to-cement ratios, moisture barriers, proper curing and drying of the concrete, proper layout and cutting of contraction joints (often referred to as control joints), and overloading the slab. The fact is, there is no way to absolutely predict when and exactly where the concrete will crack. So what can a flooring contractor do to avoid problems with the concrete cracking?



Know Thy Cracks!

Concrete cracks for many reasons. Some of the most common reasons are as follows:

1. **Cracking Due to Corrosion.** The corrosion of reinforcing rebar and other embedded metals is a major cause of cracking in concrete. As reinforcing steel corrodes, it expands. That creates internal forces that eventually overcome the tensile strength of the concrete, resulting in cracking and other concrete surface failures. Often rust can be seen at the surface and can be a help in quickly identifying this type of cracking.
2. **Expansion Cracks.** As with many materials, concrete will expand exponentially as it gets hotter. This expansion can cause immense stress on a concrete floor. As the concrete expands, it pushes against all obstacles in its way. When it comes against an unmovable object, such as another concrete floor, the weaker of the two obstacles will be forced to crack. Designers plan for this by placing expansion joint material, such as foam, asphalt, and cork, at the interface between the concrete floor and walls, columns, and other structural components.
3. **Loss of Subbase Support.** This is most often caused when the subbase is washed-out or settles from its original compacted state, causing an implosion of the concrete slab. Although it is most commonly seen in older slabs, it can be seen in new construction when the concrete form work has been removed too early in the curing stage.
4. **Thermal Cracks.** Thermal cracks are caused when the temperature increases in the interior portions of the concrete, causing it to expand, while the outside surface of the concrete is cooling, causing it to contract. When the temperature differential between the interior and exterior is too great, consequential tensile stresses can cause thermal cracks at the surface. This kind of cracking is usually

seen when concrete is in mass, but it can also be found in thicker concrete floor pours.

5. **Crazing Cracks.** Crazing cracks are very common and exhibit themselves as small pattern cracks occurring in a floor slab surface. They are caused when the surface of the concrete floor dries earlier than the underlying concrete. These cracks are usually smaller than 1/8–1/4-inch (3.2–6.4 mm) deep and are usually not detrimental to the performance of the concrete.

6. **Plastic Shrinkage Cracks.** Plastic shrinkage cracks are caused when moisture evaporates faster from the surface of newly poured concrete, and then bleed water comes to the surface to replace the evaporated water. Low humidity, elevated temperatures, and high winds can all play a part in drying out the top of a concrete slab. As the top of the slab dries, it begins to shrink. The underlying concrete, still wet, restrains this shrinkage, causing tensile stress to develop in the weak uppermost part of the concrete surface. This results in shallow cracks of varying depths. These cracks usually run parallel with each other about 1–3 feet (30.5–91.4 cm) apart and can be fairly wide at the surface. Normally, they are a cosmetic defect, and if repaired, they are not detrimental to the performance of the concrete floor.

7. **Drying Shrinkage Cracks.** Concrete, in its plastic state, gains volume due to the exothermic hydration reaction of cement and the reaction of calcium sulfate and calcium aluminate to form calcium sulfoaluminate. This gain in volume occurs within the first few hours after mixing with water. As the concrete loses moisture and begins to harden, it loses volume and acts much like a wet sponge as it dries (see figures 1 and 2). When shrinkage is restrained by its contact with the subbase, surrounding structural components, such as walls, columns, steel reinforcement within the concrete, and piping in and through the concrete, tensile stress is developed within the concrete itself. Concrete, while being strong in compressive strengths, is weak in tensile strength (approximately 10 percent of its compressive strength) and this weakness is greatly tested as the concrete shrinks and literally pulls itself apart. The result is cracking of the concrete at its weakest points. Designers plan for this by specifying contraction joints at intervals spaced at distances equal to 24 to 30 times the slab thickness and in areas such as re-entrant corners. To be effective in controlling shrinkage cracks, joints must be troweled into the plastic concrete, or cut to a minimum depth of 25 percent of the actual slab thickness before the concrete has already cracked. Usually, this is as soon as it can be walked on without damaging the finish and almost always before 24 hours of placement. Failure to properly weaken the plane at the proper time can result in cracking alongside the planned joint or at random locations.

Information Is Key

The first step in protecting your bottom line is to do your homework. ACI 302 and ACI360R-10:*Guide to Design of Slabs-on-Ground* provide a plethora of information and outline the most current recommendations for constructing concrete floors and slabs. These documents most likely governed the placement of the concrete that you have been hired to coat. Understanding what should and should not have been done when the concrete was placed is extremely important to your success.

This is the first article from Chris O'Brien regarding concrete repair and coatings. To read the second article, called "Cracking the Code on Concrete Repair" click here.

About the Author:

Chris O'Brien, president and CEO of Rock-Tred Corporation, has worked with specification writers, architects, building consultants, general contractors, facility managers, and business owners over the past 25 years to design and execute coating and overlay projects that beautify and protect.

Cracking the Code on Concrete Repair

By Chris O'Brien, President and CEO of Rock-Tred Corporation on 6/5/2017 2:33 PM

Photos courtesy of Rock-Tred

Failing to spot and document mistakes in concrete before applying a coating system may result in losses for your coating contracting company. It is not enough to have 20 years of experience with coatings. If you don't understand the concrete you are applying coatings on, experience won't help.

New Concrete

There are many benefits to working on a new construction site. The history of the concrete pour has most likely been documented. Weather reports, batch tickets, and other concrete testing results are usually available. Specifications, drawings, and the concrete contractor or general contractor are usually available as references.

Asking questions, keeping good notes, taking pictures, and performing tests are all critical to both the success of the flooring project and, ultimately, your protection. Some critical information includes:

- The specification section(s) covering the mix design, slab thickness, subbase, compaction, steel reinforcement, and moisture barrier/retarder for the specified area to be coated.
- The specification covering the flooring system to be installed.
- The soil report for the worksite.
- A copy of the submittal for any required moisture barrier or retarder.
- Identification of contraction, construction, expansions, joints, etc.
- Verification that the contraction joint plan was followed.
- Repair requirements for cracks (don't assume this is your work).
- Noted time lapse between the concrete pour and troweling or cutting the joints.
- Depth measurements of the joints.
- Sounding at the side of joints, re-entrant corners, and slab ends to detect areas where the slab is not in contact with the subbase.
- Approved flooring material submittals and detailed installation instructions.

Old Concrete

Obtaining design information on older concrete slabs can be difficult for the simple reason that the data may have been lost over time. When most or all of the contract documents are missing, visual inspection and testing become critical.

You should consider taking these additional steps:

- Core drilling over a crack and joint to ascertain the type of crack(s) exhibited, to learn the thickness of the slab, to see if a vapor barrier/retarder was installed, and to see the subbase and construction practice employed.

- Sending the cores out for testing if contaminants are known or suspected or if the concrete feels punky or chalky. The joints are often the place where contaminants first show themselves when a floor is finished.

- Random testing with a rebound hammer to spot check the compressive strength of the existing concrete. This will also help detect areas where the concrete is not in contact with the subbase, as a hollow sound with low compressive numbers will result.

In all cases, take pictures and create detailed drawings of the joints and cracks that are visible, as well as those areas where a hollow sound was detected. If this step is not completed, the coating contractor will probably take the blame for any new crack that appears, for not having properly addressed the cracks prior to over-coating the floor. This process is time consuming, but it will help ensure protection against repairing new cracks for free.

Follow the Contractual Chain

Once the information is gathered and thoroughly examined, you should present your findings in a clear, concise document to the proper authority in the contractual chain. This document should contain areas of concern, such as where the specification is silent or fails to address the issues that you discovered while gathering the information.

Concerns relating to joint and crack repair and any defective areas that will negatively affect the performance of the flooring system and/or warranty should also be included in this document. For example, if the concrete floor was specified to receive two coats of a water-borne epoxy sealer with a total system of 3–5 mils (76.2–127.0 microns) dry film thickness (DFT) and the majority of the floor is covered with crazing cracks, it would be imperative for you to express that the specified system will most likely not hide the crazing cracks.

If asked by the owner or owner’s representative what should be done to correct the issue(s) at hand, you should speak from expertise only! Recommending a solution that fails to resolve the matter or exacerbates the issue may result in liability and losses both financially and to your credibility. If the specification is in contradiction to the approved

manufacturer's repair instructions, you should involve the manufacturer and always make sure to submit a written RFI (Request for Information) through the proper contractual channels. Lastly, do not start work until you have received a written response to your RFI.

When You Get the Call

If you have been in the business long enough, you will eventually get a call stating that your flooring has cracked and needs to be repaired immediately. Before you react, it is important you do the following:

- Listen to the complaint in detail and don't get defensive!
- Ask preliminary questions and write down the answers.
- Schedule a site visit and bring the flooring manufacturer representative.
- Take your file with you to the jobsite and compare your notes with the location of the failed area(s).
- Examine the crack(s). Carefully cut across the crack(s) with a thin, sharp blade to see if the crack originates in the concrete. If it does, see if the crack contains patching material and determine whether it was repaired previously by your crew or is new. (See photo).
- Consult an expert if you are not sure what caused the crack.

Once you are convinced as to why the crack occurred, take the time to answer true or false to the following questions:

1. The cause of the crack was completely outside of my control.
2. I followed the specification and manufacturer's directions completely.
3. The workmanship was performed correctly.
4. The material was stored, mixed, and used per the manufacturer's guidelines.
5. I did not write the specification.
6. I did not design, place, cure, or dry the concrete slab.
7. There was nothing I could do to prevent the crack.

If you answered true to all of the above questions, then you most likely are not responsible for the repair. If you answered false to one or more of the above, then you may have some degree of responsibility.

Crack the Code

Cracks remain a challenge to the resinous flooring industry and can steal profits when they are not addressed and documented properly. The quality of the concrete is most always outside of the coating contractor's control. Historically, coating contractors have been blamed unfairly when new cracks develop after the coating has been installed.

You and your crew have a responsibility to know your profession and to perform your work per established best practices, specifications, and manufacturer's installation guides. But you don't design the concrete mix, place the concrete, control the layout for saw cutting or cut the contraction joints, control the water/cement ratio, control the curing mechanism or quality of curing, or control the drying process. These facts must be communicated and documented or it is likely that you will be held responsible for the cracks that appear even when they are not due to your defective labor or material.

For far too long coatings contractors have been making free repairs for cracked concrete over which they had no control. By taking the time to understand, document, and communicate the condition of cracks to the customer before coatings are installed, the resinous flooring contractor will not only keep more of his profits but will do a great service to the resinous flooring industry.

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