

## Golden Rules of Industrial Floor Repair

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Plant Engineering and Maintenance (PE&M) Departments are often charged to repair or upgrade facility floors without benefit of outside engineering services. In operations where corrosion resistance or sanitation are required, PE&M is usually fairly adept at flooring rehabilitation, because production is impacted by down-time caused by faulty or failing applications. Many times in plants without such demands, need for floor remediation is infrequent and the challenge to effect floor repairs suffers a low priority in both desire and expertise. In each case, however, PE&M tends to rely upon outside assistance from manufacturers or contractors for these repairs.

- **Golden Rule #1** – There is no one cure-all. No single product will be correct for every job.
- **Golden Rule #2** – No single manufacturer has the best product for every need.
- **Golden Rule #3** – No single contractor can do it better than any other contractor in every case.

Some manufacturers, sales representatives and contractors like to give one-dimensional answers to complicated questions. PE&M must question, investigate, verify and confirm the best answer to the flooring recommendation riddle. Regardless of any warranty, when the job is done, the sales representative, manufacturer and contractor leave the plant. PE&M stays and lives with the result—whatever it may be. Manufacturers have favorite products. Sales Representatives have favorite products. Contractors have favorite products. PE&M's favorite product should be the one or ones that work. Investigate. Take nothing for granted.

PE&M may favor some manufacturers and contractors over others. That is their right and prerogative. Sometimes relationships between the plant and these vendors have high value, especially if obligations are honored after the work is done. These relationships, however, must focus on the goal of providing the plant with just rewards—trouble-free floors. If problems do occur, just rewards are reaped only after the job has been completed.

- **Golden Rule #4** – Concrete doesn't stick to itself very well.
- **Golden Rule #5** – Thin concrete breaks, especially at edges.
- **Golden Rule #6** – The bond of any repair material increases as substrate profile increases—the rougher, the better.
- **Golden Rule #7** – The bond of any repair material increases as substrate cleanliness increases.

The fact that concrete is so familiar to most people, may lead some to conclude that repairing it is no big deal. It is not, if done properly. Unfortunately, most people—even those in the business—either do not know how, or just do not do it correctly. PE&M often awards concrete repair projects to concrete contractors. Concrete repair methods, however, are very different from procedures for casting large concrete flatwork.

As a general rule, sawcut the perimeter of the repair area to create minimum ½ in (131-mm) shoulders. Make sure the field of the patch is “roughened.” Clean the dust and dirt that has settled on the substrate—vacuums work best.

Repair materials don't stick to oil or grease, either. Any and all contaminants must be removed—dirt, dust, oil, grease—get rid of them.

The adhesive strength of concrete is ~10% of its compressive strength, usually in the vicinity of only 300 – 350 psi (2.1 to 2.4 MPa)—not very much. Repair areas need “shoulders” to which the repair material can abut and a clean profile to gain maximum adhesion. Figure 1 illustrates the type of preparation that is needed to repair a deteriorated concrete area with polymer-modified cementitious materials. Figure 2 shows how the edges are locked at the “shoulders,” with no exposed edges.

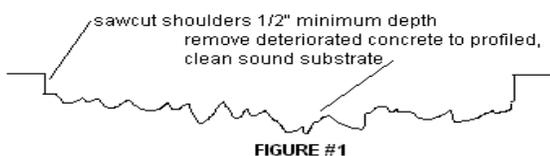


FIGURE #1

**Proper preparation for repair of deteriorated concrete**

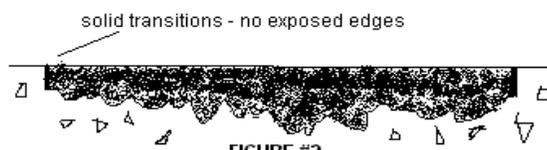


FIGURE #2

**Completed repair. Edges are locked at shoulders**

Field-mixed concrete can be used for patching, but extra precautions must be taken. Procedures will be discussed in Golden Rule #9.

- **Golden Rule #8** -- Do not use gypsum-based cementitious repair materials for industrial floor repairs.

Repair materials are generally classified as cementitious (cement), polymer-cementitious (latex or microsilica) or polymeric (epoxy, novolac epoxy, polyester, vinyl ester, methyl methacrylate, modified urethane, etc). All these products have their places and will function well if installed with good practices just described.

Gypsum-based repair materials, however, are a different story. Installed meticulously, they will still fail in an industrial flooring environment. Although attractive because they cure fast and are user-friendly, water and moisture will degrade the material. Depending upon the degree of moisture exposure, the installation will fail 1 month to 3 years after installation. The patch will eventually absorb moisture, either from the top or bottom. The best protective coating applied over the top cannot protect the patch from moisture vapor ingress from the bottom.

- **Golden Rule #9:** Cementitious and Polymer Cementitious repair materials (applied without an epoxy bonding agent) should be applied over a Surface Saturated Dry (SSD) substrate.

SSD means the concrete substrate is pre-soaked or pre-saturated with water for 20 min to 2 h before the repair material is applied. Standing water should be swept off prior to application. Adhesion of cementitious materials will greatly increase as the substrate moisture will act as a conduit for the repair material to gain chemical bond. Also, the repair material will not lose moisture it needs to cure correctly.

Field-mixed repair concrete, typically two parts sand, one part cement and two to three parts peastone, requires a good SSD substrate, soaked for at least 1 h. In addition, several other pre-requisites are in order: shoulders and patches should  $\leq 2$ -in. thick and a “slurry” of cement and water should be scrubbed into the SSD substrate just prior to application.

Over-watering the mix will drastically reduce strength. Just add enough water to your dry mix so it is workable, but not soupy. If the mixed material can hold a slope without slumping down, the mix should be about right. While the slurry is still wet, fill the patch with concrete, consolidating it with a vibrator or with the trowel itself. After the material is consolidated, trowel the patch until the surface is closed, keeping the height of the patch  $\sim 1/16$  in. (0.2 cm) above the adjacent concrete, as the material will shrink down as it hydrates.

Place wet burlap over the patch after it will support some weight, then cover it with polyethylene (PE) for 3 days, keeping the patch wet under the polyethylene. After 3 days, pull the coverings, let it air dry for another 4 days before returning it to traffic.

- **Golden Rule #10:** Verify the credentials of your prospective applicators.

Applicator selection is difficult. If contractors are available who specialize in industrial flooring repair and installation are available, the task is a bit easier. Unless PE&M is familiar with any contractor’s performance, however, the prospective applicator should be interrogated in detail about selected products. Perhaps the applicator has installed that product or something like it, but that doesn’t mean it was installed properly. Many specialty flooring contractors who prosper in the industrial sector consistently install sub-standard work. Repairs are made incorrectly every day, and contractors are getting paid to do them wrong—either because they do not know the right way themselves, or they are taking shortcuts

- **Golden Rule #11:** Cold temperatures generally slow down or stop cure times of most repair materials.

Most data sheets show cure rates  $\sim 72^\circ\text{F}$  ( $22^\circ\text{C}$ ). Colder temperatures tend to lengthen cure times while warmer temperatures tend to shorten them. Substrate and ambient temperatures can significantly impact material selection and turn-around times. If PE&M is charged with executing work in a certain time frame, it is imperative these factors be understood and taken into account.

Data sheets should be checked to ensure the applicator understands cure times. Contractors have a tendency to focus only on how long it takes to install materials, not how long materials take to cure. After finding cure times on the data sheet, have an idea when the contractor should have the repair materials installed so the cure rates meet PE&M’s completion targets. Then, make certain the contractor understands the schedule and executes accordingly.

- **Golden Rule #12** -- Regardless of repair material type, long term repair success rates will increase if the basic preparation repair procedures described earlier are followed.

Epoxy mortars will bond to the substrate, even when flashed down to “nothing.” Also, some epoxies bond well to damp substrates. If traffic continually runs over flashed epoxy edges, however, the edges will eventually break just like cementitious

repair materials. Also, if some “moisture tolerant” epoxies stick well to damp surfaces, they will stick better to dry, clean, profiled ones.

- **Golden Rule #13** -- Prime the substrate with epoxy primer before epoxy mortar application.

A few manufacturers will promote their epoxy mortar to be self-priming. Priming, however, ensures good adhesion by satisfying substrate porosity. The mortar retains its resins, rather than allowing them to leach down into an unprimed substrate. “Resin-starved” mortars are dry and weak.

- **Golden Rule #14** -- Flooring epoxy cures faster in a thick mass than in a thin layer.

Flooring epoxies today are generally 100% solids or near that. If mixed epoxy is left in the mixing bucket longer than it should be, it may not come out. Check the data sheet for pot life. PE&M is probably fairly familiar with behavior of epoxy paints, which can remain in the pail for an hour or two. Flooring epoxies don't behave the same way.

- **Golden Rule #15** -- Do not fill a moving crack with hard, inflexible material.

Moving cracks are really expansion or control joints. This may be the result of either poor design or installation during construction.

If it is uncertain whether the crack is moving or non-moving, treat it as a moving. Hard fillers in moving cracks will cause some grief. Moving cracks can be “V” grooved then filled with sealant (caulk).

Cutting the cracks  $\sim\frac{1}{2}$  in. deep by  $\frac{1}{4}$  in. wide (13 by 6 mm) is a better method. Place foam backer rod into the prepared crack followed by sealant. The is to bond to both sides of the crack but not to the bottom. If appearance is important, tape both adjacent sides of the prepared crack before applying sealant. Apply the sealant and slick it off. Pull the tape before the sealant cures.

- **Golden Rule #16** -- Unsealed control or expansion joints will break away at a much faster rate than caulked or sealed joints.

One or both sides of a joint will break away or “ravel” over time, if the joint is not filled. Significant separation normally occurs under lift truck or heavy wheeled traffic. Sealant helps to support the “open” side of a joint when placed under compression. Generally, sealant thickness should be  $\frac{1}{2}$  the width of the joint (Figure 3).

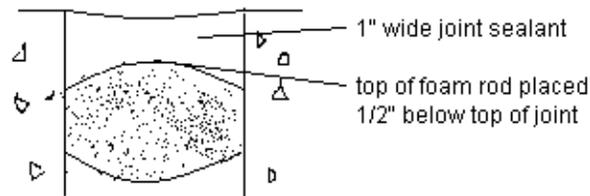


FIGURE #3

**Proper sealing of an expansion joint or moving crack**

- **Golden Rule #17** -- Resloping an existing floor is more difficult than it first appears.

Average acceptable slope is  $\sim\frac{1}{8}$  in./ft (1.1 cm/m). Chemical plants, pharmaceuticals, dairies and others may need  $\frac{3}{16}$  to  $\frac{1}{4}$  in. (4.8 to 6.4 mm). Running a slope  $< \frac{1}{8}$  in. (3.2 mm) tends to result in puddles or low spots, especially in long runs. Unless a low spot is within a sloping run, filling a low spot normally moves a puddle from one undesired place to another.

Needless to say, re-pitching a floor is an exercise in cause and effect. Most applications are not easy from a design standpoint, and solving one problem can create other problems elsewhere. Unless PE&M is extremely familiar with re-pitching existing areas, seek experienced outside assistance.

- **Golden Rule #18** -- If a manufacturer or contractor cannot or will not give you a generic description of the product, do not use it.

Beware of the words “special” and “proprietary”—they usually mean “more expensive.” Industrial floor surfacings are not magical. There are scientific and chemical reasons why surfacings will work or not. People who do not describe what a

product is are hiding something. Chances are, their product is the same as the competition's. Forthright, upstanding people are not reluctant to be specific about their product..

- **Golden Rule #19** -- No floor surfacing will hold a building together.
- **Golden Rule #20** -- If concrete or structural problems are not addressed and solved as a separate issue, sooner or later any surfacing treatment will eventually highlight the problem below it.
- **Golden Rule #21** -- Correctly chosen and installed floor surfacings will maximize life of a solid concrete substrate.

Applying floor surfacings over unsound substrates is a major cause of failure. It does not work, regardless how much money is spent. If the substrate is deteriorated from long-term chemical or oil exposure or is structurally cracked, no surfacing will resolve the problem. Deteriorated concrete must be removed and replaced. Before installing any flooring system, understand and resolve any structural cracking or movement problems.

- **Golden Rule #22** -- Unless a floor surfacing is going to be installed in the Plant Engineering Office, Plant Engineering should not select final texture.

Finished texture is best chosen by committee. Production, quality control, safety and sanitation all have different ideas of "correct texture." PE&M can facilitate the process by requiring texture samples from the supplier, then having the samples installed on the floor for final selection.

- **Golden Rule #23** -- pH readings alone are insufficient information to produce a floor surfacing recommendation.

PH readings will reveal whether a reagent is very acidic or very caustic or somewhere between—similar to saying the outside temperature is hot or cold. Chemical resistant floor surfacings recommendations should not be taken lightly. Problems that can occur with non-chemical exposures are compounded by attack by chemical reagents. Thorough information is essential in finding appropriate flooring systems.

- **Golden Rule #24** -- Qualified Inspection of a contractor's work will increase quality in every case.

Quality assurance and quality control of floor surfacing installations in plant environments is poor. In-process applications are rarely checked or monitored by PE&M. If PE&M does not have qualified inspectors, then outside inspection should be contracted. Poor contractors fear qualified inspection. Good contractors welcome qualified inspection, because it helps them to provide a good installation.

Qualified inspection increases the initial cost of a project, but decreases the overall costs by increasing the rate of success. Well-planned and correctly executed industrial flooring installations function well for a long period of time. Downtime as a result of failure is expensive. Re-doing a floor is expensive. Those costs are far greater than the cost of inspection.

Space-age materials may have evolved from rocket science, but correct installation procedures remain unchanged. Proper preparation, selection and installation is not rocket science; it is common sense. Some avoid the common sense approach because it may seem to require more initial work. In the long run, however, common sense saves time and money.