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June 2019

concrete solutions®

(After many requests, CalPortland is bringing back our quarterly newsletter. This is our second issue. Each issue will contain information that will be useful for everyone involved with ready mix concrete. Consider saving the issues for future reference.)

COMMON SLAB DEFECTS: CAUSE AND EFFECT

Fortunately, concrete slab/flatwork problems are the exception and not the rule. Since concrete is placed and finished under several varying site and environmental conditions and by various finishers using different techniques, there are no flatwork jobs that are the same. This can also mean that there can potentially be numerous problems with flatwork. This article will look at some of the more common flatwork problems, examine their causes and suggest ways to avoid their re-occurrences.

DUSTING

Dusting is the development of a fine, powdery material that easily rubs off the surface of hardened concrete. Dusting is the result of a thin, weak surface layer called laitance which is composed of water, cement and fine aggregate particles. Dusting is caused by 1. finishing concrete with bleed water on the surface, 2. the application of water to the surface during the finishing operation (sometime referred to blessing the slab), 3. exposure to rainfall during the finishing process, 4. spreading dry cement over the surface to accelerate finishing time or absorb surface water, 5. a high water/cement ratio from too much mix water, 6. the lack of proper curing, 7. carbonation during winter concreting caused by unvented heaters or 8. freezing of the concrete surface after the finishing process and before the concrete has had time to develop sufficient strength to resist damage. To prevent dusting, do not begin finishing operations until all free water has evaporated from the surface, but do not allow the surface to dry out. Do not add additional water to the surface (this includes protection from rain). If heaters are used, be sure to vent exhaust fumes to the outside and provide adequate ventilation. The exhaust gases can react with the plastic concrete surface causing carbonation of the surface and dusting. Protect the concrete from freezing until sufficient strength is reached.

BLISTERS

Blisters are surface bubbles of entrapped air or water that rise through the unhardened concrete. To avoid blisters, use proper vibration and compaction techniques. Also, avoid using magnesium floats on the first pass. Mag floats tend to close the surface very tightly which prevents bleed water from getting to the surface. The water can become trapped just below the concrete surface forming a blister. Instead, use wood floats to allow bleed water to freely get the surface and evaporate. Avoid overworking the surface. Beware of

concrete that is placed directly over a plastic vapor barrier. If possible, place a moist layer of sand directly over the vapor barrier first. If a sand layer on top of a vapor barrier is fully saturated by rainwater, this excess water will need to migrate to the top of the concrete surface creating the possibility of blisters and lowering the water/cement ration of the surface resulting in lower surface strengths. Concrete subject to moisture sensitive floor coverings typically is placed directly on a vapor barrier.

PLASTIC SHRINKAGE CRACKS

Plastic shrinkage cracks are a network pattern of fine cracks, often three pronged in appearance. These cracks do not penetrate much below the concrete surface and are rarely seen near the edge of the concrete. The cracks are not structural in nature but are unsightly and should be avoided if possible. They are created when moisture loss from the surface of plastic concrete occurs at a greater rate than it can be replaced by normal bleed water coming to the surface from below. Low humidity, high air temperatures, hot sun or drying wind either separately or in any combination can cause rapid surface drying and the possibility of plastic shrinkage cracking. Prevention can be achieved using fog sprays or chemical surface evaporation retarders after the initial screeding of the surface. The evaporation retarders are monomolecular films that have the advantage of maintaining the water/cement ratio at the surface. To be the most effective, these evaporation retarders should be re-applied after each finishing operation.

CURLING

Concrete curling is evidenced by a distortion of the slab's corners and edges due to differences in moisture content or temperature. It is analogous to a wet sponge being left to dry. The top dries faster than the middle or bottom. The sponge assumes a curved shape since the drier top gets smaller in relation to the middle and bottom and the ends and corners are pulled up. To avoid curling, use the lowest water/cement ratio possible to place the concrete. Order mixes with the largest coarse aggregate particle consistent with the slab thickness. Avoid a higher than necessary cement content. Using fly ash or slag will help maintain the water/cement ratio without too much cement. Proper curing and a tighter joint spacing will also help reduce curling.

DISCOLORATION

Discoloration is defined as a non-uniform appearance of the slab surface. Some variance in color and appearance should always be expected. Overall consistency is a key to avoiding major discoloration. Uniformity of the subgrade, slump, placing, finishing and curing operations will help reduce the chances for color variations. When

placing concrete in cooler temperatures and a set accelerator is desired, always specify a non-chloride accelerator. Calcium chloride can cause discoloration. When placing a slab over a period of time, be sure to order the same mix and inform the dispatcher when you last placed concrete at that job. That way they can insure that you get the same mix from the same plant with the same materials. Different forming materials will produce different color variations on vertical surfaces. To have the most consistent color for your vertical surfaces, use the same type of forming material throughout the project.

POP OUTS

A pop out is a conical fragment that breaks out of the surface of the concrete leaving a hole that may vary in size. The cause of a popout may be a piece of poor-quality rock under the surface which breaks down quickly or caused by reactive aggregates. Also, recently placed concrete exposed to freezing conditions may have small areas directly above a coarse aggregate particle that

expand and pop out. These may show in the first 72 hours after placing. Generally, most pop outs appear within the first year after placement. Pop outs are usually considered a cosmetic detraction and may not affect the service life of the concrete. However, pop outs on an industrial floor are not acceptable and need to be eliminated. To avoid pop outs, concrete should be made with durable aggregates that are minimally absorptive. Using a lower water/cement ratio increases durability. Proper curing will also help to increase water tightness and surface durability.

SCALING

Scaling is the general loss of surface mortar on concrete exposed to repeated cycles of freezing and thawing. The aggregate is usually exposed and often stands out from the surface. Scaling is primarily a physical action caused by pressure from within the concrete when water expands from liquid to solid when it freezes. One major protection for concrete scaling when exposed to cycles of freezing and thawing is to incorporate an air entraining admixture in the mix design. In cooler temperatures the concrete must be protected from freezing until a minimum strength of 500 psi is reached. This generally means using insulated curing blankets for a minimum of three days after placement. Ideally, fresh concrete should not be exposed to freeze/thaw cycles until it reaches a compressive strength of 3,500 psi. Proper curing will also strengthen the surface giving it greater resistance to scaling.

CONCLUSION

Since concrete is placed and finished under several varying site and environmental conditions, by various finishers using different techniques, there are no flatwork jobs that are the same. Fortunately, concrete slab/flatwork problems are the exception and not the rule. Always plan ahead to avoid problems.

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CONCRETE TIPS….

Concrete curing is defined as the process of maintaining moisture and temperature conditions during the initial, intermediate and final stages of concrete placement and finishing.

Curing concrete serves two main purposes.

- It retains moisture in the concrete, so it will continue to gain strength.
- It delays drying shrinkage until the concrete is strong enough to resist shrinkage cracking

Properly curing concrete improves strength, durability, water tightness and wear resistance.

CURING METHODS

Water Cure: the concrete is flooded, ponded or mist sprayed. This is the most effective curing method for preventing mix water evaporation.

Water Retaining Methods: use coverings such as sand, canvas, burlap or straw that are kept continuously wet.

Waterproof Paper or Plastic Film: applied as soon as the concrete is hard enough to resist damage. Plastic films may cause discoloration of the concrete surface and should not be applied where appearance is important.

Chemical Membranes: applied at the manufacturer's recommended rate as soon as the concrete is finished. Note that curing compounds may affect adherence of resilient flooring. Consult with the flooring contractor and/or chemical membrane manufacturer.

All desirable properties of concrete are improved by proper curing.

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