baltimore

Felt Tips

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IMPROVING DURABILITY OF CONCRETE PAVING

Concrete pavements, curbs, and similar horizontal exterior concrete work are often subjected to frequent cycles of freezing and thawing, wetting and drying, excessive use of de-icing agents, and extreme variations in temperature. These conditions of severe exposure contribute to surface scaling and disintegration.

Careful attention to the use of quality materials properly mixed and placed will result in greater durability and extended service life of concrete work exposed to the elements. Observation of some basic principles of design and placement will provide rewarding results.

Resistance to scaling and greater durability can be achieved by use of properly proportioned concrete mixes of low water-cement ratios, low total water content, air entrainment, and with proper mixing, placing, finishing, curing, and protection during curing.

Compliance with ASTM Standards will be an indication of the level of quality of the materials used in the mix. Some of the commonly used standards for materials are:

C-33	Specification for Concrete Aggregates
C-150	Specification for Portland Cement
C-260	Air-Entraining Admixtures for Concrete
C-494	Chemical Admixtures for Concrete

Coarse aggregate with a high percentage of unsound particles will contribute to "pop-outs" and scaling. Hot cement or cement failing to meet the specifications for false or flash setting tendencies can contribute to scaling and early disintegration.

Where durability is a prime consideration, use a high strength concrete even though a relatively low strength concrete may meet the structural requirements. Since the placement costs are the same and the cost of material is nominal, the greater durability obtained from the higher strength concrete is a bargain.

The size of the coarse aggregate affects the amount of air entrainment suggested for introduction into the mix. With 1-1/2 inch maximum size aggregate, use 5 to 6 percent air entrainment. With 3/4-inch maximum size aggregate, use 6 to 7 percent air entrainment. Adequate air entrainment combined with quality materials, good workmanship, and attention to detail will assure durability.

Do not permit the addition of "extra" water. Adding water to a workable concrete mix lowers strength and increases absorption, thereby increasing the likelihood of scaling.

If a more fluid, free flowing mix is required, provide for it by specifying the formulation to be used at the batching plant to provide the required consistency.

Proper placing and finishing are essential companions of good design and quality materials. Concrete should be placed and finished in a manner to a homogeneity of material composition throughout the slab, including the surface. Excessive or premature finishing contributes to bleeding and reduces air content in the concrete. These effects can be minimized if smooth or swirled surfaces are achieved by using hand floats or trowels after the concrete has stiffened.

Proper hydration and maximum strength are obtained by keeping concrete moist and at an adequate temperature for as long as possible. Curing compounds may be used in place of the traditional water method. Keep concrete continuously moist during the entire curing period. Alternate wetting and drying during the early age of concrete will cause crazing and increase the possibility of scaling.

Impermeable coatings and pore-filling materials, such as linseed oil solutions, increase the resistance to scaling. Moisture trapped beneath the sealer can aggravate scaling. Concrete that is less than one year old is very susceptible to scaling due to the presence of de-icing agents either applied to the surface or drippings from automobiles.

Tests show that improper curing can easily cut the strength of even the best concrete by 50%. Curing simply means keeping the water in the concrete where it can do its job of chemically combining with the cement and turning into a strong "glue" that will help make strong, durable concrete. Good curing means keeping the concrete damp and at about 70F until the concrete is strong enough to do its job. Recommended practice calls for a minimum of 7 days of curing for ambient temperatures above 40F or the time necessary to attain 70 percent of the specified compressive or flexural strength, whichever period is less.

All concrete must be cured to get the maximum strength of the concrete. Correctly cured concrete is best from every standpoint: it shrinks less, cracks less and dusts less. It is stronger, more durable and has a more wear-resistant surface.

Start curing the concrete as soon as possible after it has hardened. Early drying - especially during hot, windy weather - must be prevented or the concrete will not attain its full potential quality. Refer to ACI Standard Recommended Practice for Hot Weather Concreting (ACI-305.)

Water spray is a good curing method if the concrete is kept continuously damp. Do not allow the concrete surface to dry between sprinklings.

Waterproof paper holds moisture in the concrete by preventing evaporation. First, water spray the concrete surface, then cover with a non-staining waterproof paper. Overlap edges and seal with waterproof tape. This method works better for slabs than for walls or irregular surfaces.

Damp burlap is effective and easy to handle. Spread burlap over the concrete surface and keep damp with water spray to replace water lost through evaporation.

Membrane curing compounds seal moisture in the concrete. Easy to spray or brush on. Low in cost and only one application needed. Effective for slabs, vertical walls or irregular surfaces. For flat work, cover the dried curing compound with scuff-proof building paper to protect the surface from marring by other trades until the curing is complete.

Concrete strength develops more slowly at lower temperatures, requiring a longer curing period. Refer to ACI-306 for cold weather concreting.