Driveways: What to Expect, What to Require

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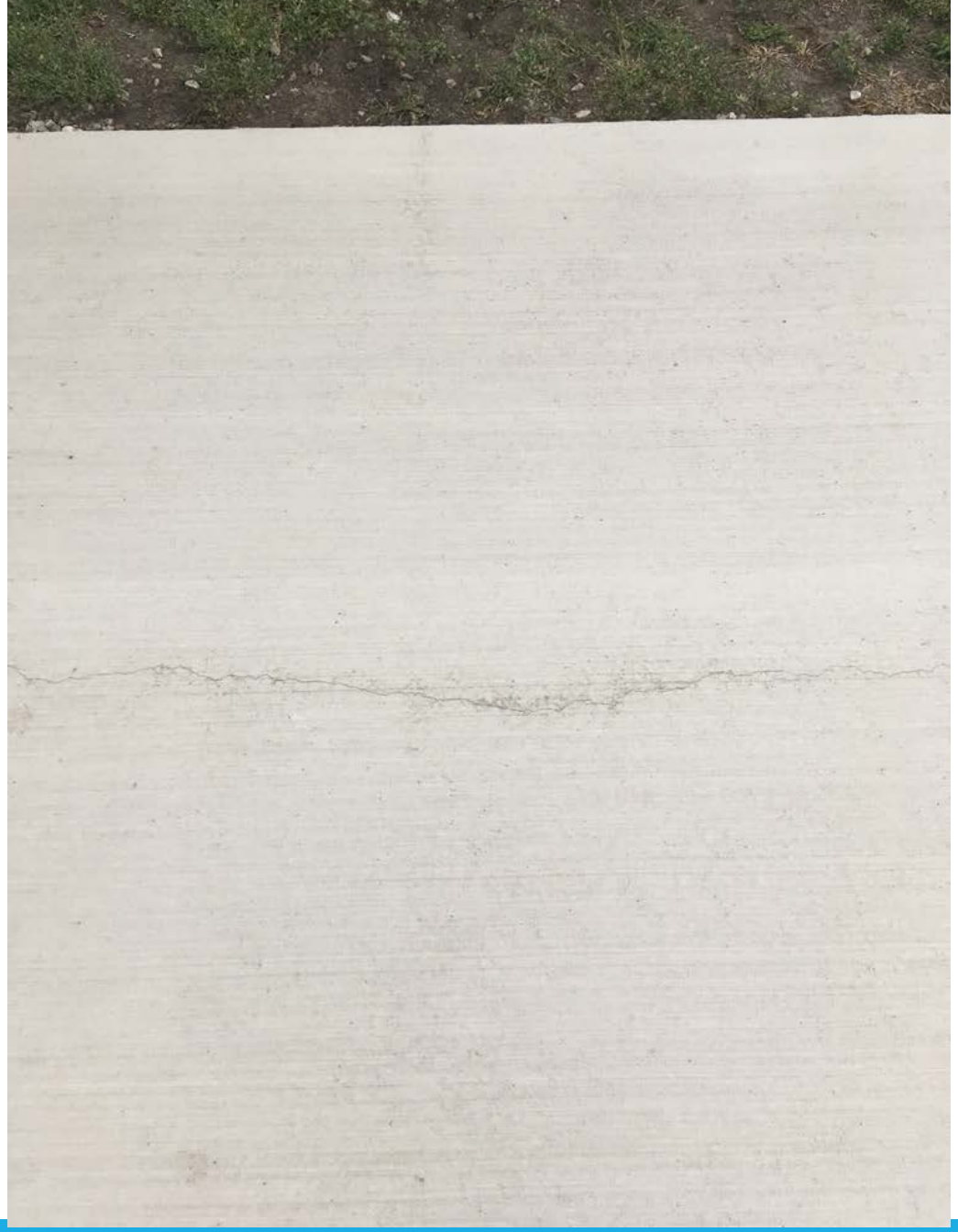

Discussion


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Drying Shrinkage

Drying shrinkage occurs as the moisture content and temperature of concrete is reduced which results in the volume of concrete decreasing.

Prevention of Drying Shrinkage

For normal concrete, drying shrinkage can not be prevented but can be controlled through proper jointing

Reduce or eliminate things that restrain concrete

Can use shrinkage compensating cement in some specialty applications

Some macro fibers have shown success in controlling cracking

Note: Reinforcing steel does not prevent cracking

ACI 302: Concrete Floor and Slab Construction

Maximum [joint] spacing should be about 24 to 36 times the thickness of the slab up to a maximum of 18 feet

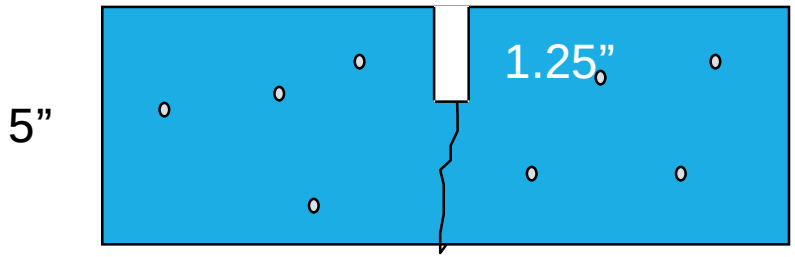
About 0 to 3% of panels should expect random cracking

ACI 330: Parking lots

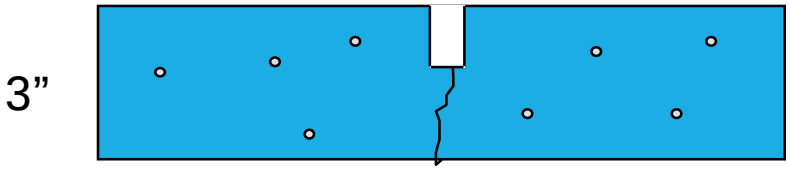
"…maximum [joint] spacing should be about 30 times the thickness of the slab up to a maximum of 15 feet."

Industry recommendations for controlling cracks

Joints should be a minimum of 1/4 the depth of the slab (minimum of 1 inch) for floors and 1/3 depth for pavements unless early entry saws are used then 1-1/4 inch depth



5” x 1/4 = 1.25”



3” x 1/4 = 3/4” = 1”

Plastic Shrinkage

Cracks that occur in the surface of fresh concrete soon after its placed that are usually relatively shallow and appear 1 to 3 feet apart. Usually they are not interconnected.

Causes of Plastic Shrinkage

- Rapid loss of water (evaporation) at the surface of the concrete before it has set
- Reduced bleed water caused by high cementitious content, high fines content, reduced water content, air entrainment, high concrete temperatures, and thinner sections of concrete.
- Factors that delay the setting of concrete such as cool weather or subgrade temperatures, high water content, lower cement content, retarders and some water reducers, supplementary cementitious materials
- Conditions that contribute to plastic shrinkage are:
  - Wind velocity in excess of 5 mph
  - Low relative humidity
  - High ambient and/or concrete temperature

Crazing

Crazing is the development of a network of fine random cracks rarely more than 1/8 inch deep and 3/8 to 1-1/2 inch apart on the surface caused by shrinkage of the surface layer

Causes of Crazing

Inadequate curing

Too wet a mix

Finishing while bleed water is present

Sprinkling cement on the surface

Scaling / Mortar Flaking

Scaling is local flaking or peeling of a finished concrete surface as a result of exposure to freezing and thawing usually to a depth of up to 1/8 to 3/8 inch. Mortar flaking is where the mortar pop offs over the coarse aggregate.

Causes of Scaling / Mortar Flaking

No or too little air-entrainment in the concrete

Overworking the concrete or finishing while bleed water is still present

Insufficient curing

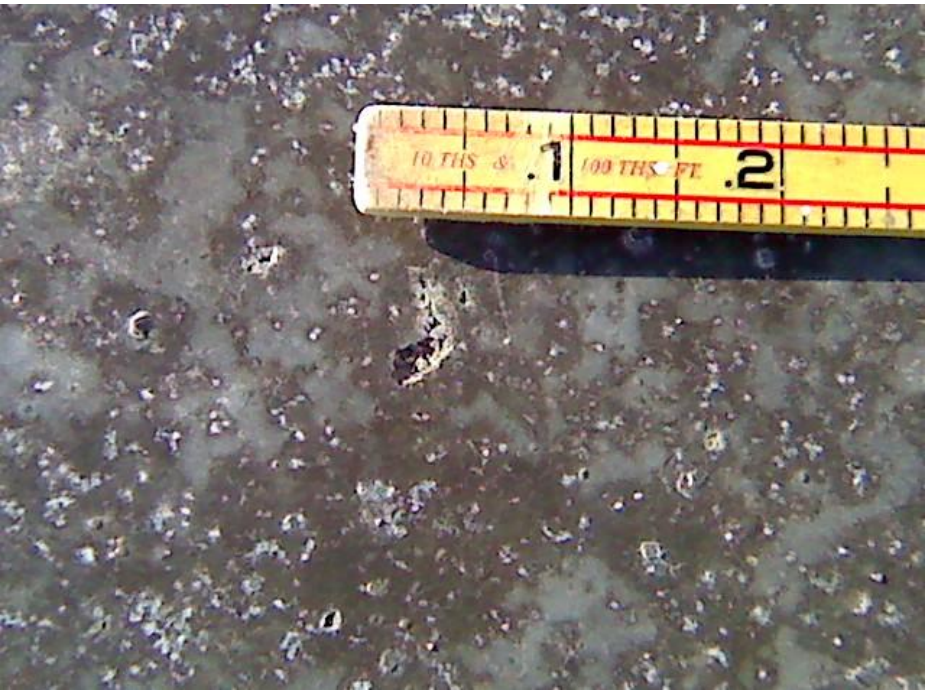
Applying deicers especially during the first year after the concrete is placed

Chemicals in some deicers and fertilizers can physically eat the cement paste (Magnesium chloride, ammonium sulfate, and ammonium nitrate)

Mortar flaking is caused be the mortar drying out over the coarse aggregate particle

Popouts

Popouts are a small generally cone-shaped cavity in the concrete surface left after a near-surface aggregate particle has expanded and fractured.



Causes of Popouts

The aggregate particle expands and fractures as a result of either a physical or chemical reaction

Physical reaction caused by freezing of water absorbed in the aggregate or the aggregate swelling

Chemical reactions resulting from alkalis in cement and other sources reacting with silica to form an Alkali-Silica reaction gel which forms a gel which absorbs water and expands

Discoloration

Surface discoloration is the non-uniformity of color or hue on the surface of a single concrete placement. For our purposes it does not include stains caused by foreign materials coming in contact with the concrete

Causes of Discoloration

Changes in formwork

Changes in mixture proportions

Admixtures variations

Amount of water in a mix

Amount of mixing time

Improper timing of finishing operations

Use of calcium chloride

Delayed hydration of the cement paste

Inadequate or inappropriate curing

The End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