Concrete Tech Tip # 25

Mortar Flaking

1. WHAT is Mortar Flaking?

Mortar flaking is the dislodging of small sections of surface concrete, usually smaller than a dime, directly above coarse aggregate particles. Mortar flaking is typically very shallow in depth and consists of distinct delaminations (flakes) that occur directly over the coarse aggregate particles located near the surface of the concrete. It is most common in exterior concrete exposed to freeze/thaw conditions but can occur any time rapid evaporation has occurred immediately after finishing.

Mortar flaking can be distinguished from pop outs (see CCT-17) - a similar looking surface blemish - by examining the nature of the aggregate particle exposed by the loss of surface mortar. If the aggregate particle is substantially intact, the problem is defined as mortar flaking and is indicative of poor curing practices. If the aggregate particle is fragmented with a portion remaining in the concrete and a fragment imbedded in the lost surface mortar, then the defect is a pop out and is a result of susceptible aggregate in the mix. Each has its own cause and must be treated as two different phenomena.

2. WHY Does Mortar Flaking Occur?

The delamination of small sections of the surface mortar from the coarse aggregate particles is due to drying of the surface before the normal bond forces were developed between the mortar and the stones. Bleed water rising within in the mix is forced to travel around such particles so that the mortar above is not replenished with moisture from below. The mortar over these stones dries out, undergoes normal drying shrinkage, fails to develop bond and flakes off as a result. Insufficient finishing allowing large aggregate particles to remain close to the surface with minimal cover will also contribute and increase the likelihood of the surface mortar drying too quickly.

3. HOW to Prevent Mortar Flaking.

Mortar flaking typically occurs in concrete that was not properly cured. All concrete requires time in order for the chemical reaction to occur between the batch water and the cementitious materials. This process known as hydration permits the mix to develop the strength and durability. Physical curing techniques that trap water inside the concrete for a week or more, like covering concrete with polyethylene sheeting or wet burlap, maintain continuous moisture at the exposed surface allowing time for the batch water and cementitious materials in the concrete to react. While continuous wet curing provides the best results, often the most practical curing method for exterior flatwork involves the application of a liquid membrane forming curing compound. Be certain to apply any curing compound at the manufacturer's specified rate. Using less is false economy since a complete coating of the surface will not be achieved.

Curing must start as soon as possible which, for exterior textured surfaces, means as soon as the broom finish or other final texture has been applied. Doing so will ensure that the top surface is not permitted to dry out forming a weak a layer that is likely to flake. Returning the next day or later to apply curing will not reduce the risk of mortar flaking.

References:

1. Concrete Tech Tip # 11 *Curing In-Place Concrete*, Alberta Ready Mixed Concrete Association, Edmonton, AB, Canada.
2. Concrete Tech Tip # 14 *Finishing Concrete Flatwork*, Alberta Ready Mixed Concrete Association, Edmonton, AB, Canada.
3. Concrete Tech Tip # 17 *Aggregate Pop outs*, Alberta Ready Mixed Concrete Association, Edmonton, AB, Canada.
4. CSA A23.1-14 *Concrete Materials and Methods of Concrete Construction*, The CSA Group, Mississauga, On, Canada.
5. *Design and Control of Concrete Mixtures 8th Edition, 2011*, Cement Association of Canada, Ottawa.
6. Reviewed and Revised 2016.

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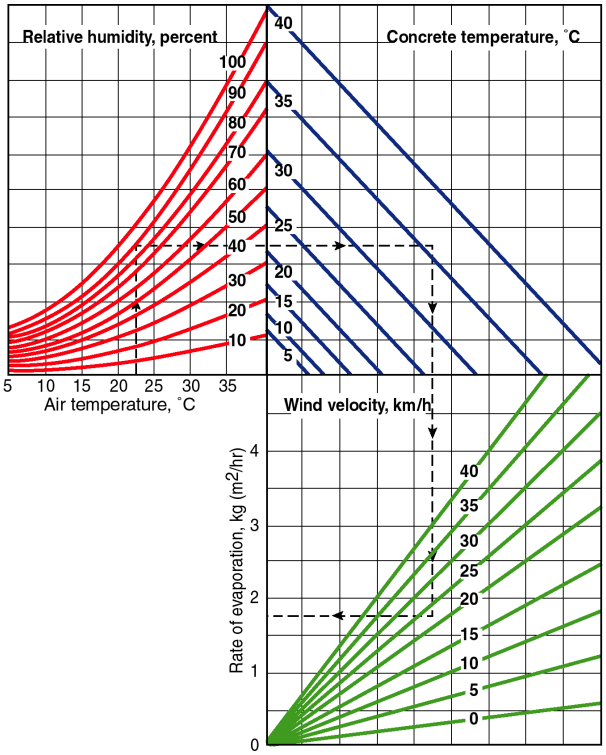

For flatwork that is to be hard troweled, such as industrial floors, the hours-long waiting period between stages of the finishing procedure puts the concrete surface at risk of surface defects associated with evaporation such as plastic shrinkage cracking or mortar flaking. CSA A23.1 stipulates that when pouring concrete flatwork when the rate of evaporation from a concrete surface exceeds 0.5 kg/m^3 (see chart), precautionary measures are required. The concrete finisher should consider fogging the slab or applying mono-molecular spray film such as Con-Film or Sure-Film, between operations, to compensate for any differences in bleed and evaporation rates prior to the final finish and the immediate application of a curing compound.

To use this chart::
1. Enter with air temperature; move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind velocity.
4. Move left: read approximate rate of evaporation..

Wind velocity is measured 500 mm above the evaporating surface. Air Temperature and Relative Humidity should be measured at a level approximately 1.2-1.8 m above the evaporating surface on its windward side shielded from the sun's rays (Menzel 1954).

Follow These Rules to Help Avoid Mortar Flaking

1. Select the proper mix to match placing conditions.
2. When floating the concrete, ensure all coarse aggregate particles are set sufficiently below the concrete surface without bringing excess fines and paste to the surface. Refer to Concrete Tech Tip #14 for proper finishing of concrete flatwork.
3. Cure the concrete as soon as all finishing is completed and the water sheen has left the surface. Some methods of curing include: liquid curing compounds applied immediately after final finishing; plastic sheeting to cover the concrete; ponding; continuous sprinkling; continuously wet burlap; non-woven geotextile. For more information consult Concrete Tech Tip # 11.
4. For exterior flatwork exposed to freeze-thaw and de-icer salts, seal the surface of the concrete following a 30 day drying period after curing is completed. For interior slabs not subject to freeze-thaw, seal the concrete as soon as the curing period is complete. In both instances, follow the sealer manufacturer's directions for any surface preparation that may be required before applying a sealer.

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