



AVR, INC.
Ready-Mixed Concrete

Minneapolis/St. Paul, Serving the Seven County Metro Area



Mortar Flaking

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 in 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 - 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.

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.

How to prevent mortar flaking

All concrete requires curing in order that the chemical reaction between the batch water and the cementitious materials can occur. This permits the mix to develop the strength and durability it is capable of. Curing techniques are those that trap water inside the concrete for a week or more or, like poly or wet burlap, that trap water against the exposed surface. While wet curing provides the best curing conditions, most exterior concrete surfaces are more practically cured by spraying on a liquid curing compound – sometimes called cure and seal liquids - especially formulated for the purpose. Be certain to apply the correct dosage – usually 200 to 400 square feet per gallon.

Curing must start as soon as possible which, for exterior textured surfaces, means as soon as the broom finish or other texture has been applied. Returning the next day or later to apply curing will not reduce the risk of mortar flaking.

The prevention of mortar flaking and other surface failure issues has been a topic of research for many years. While a few unanswered questions still exist, most of the potential issues can be prevented by following 6 easy rules for durable concrete.

1. Use properly air entrained concrete ($6.5 \pm 1.5\%$)
2. Concrete should have a water/cement ratio of < 0.45
3. Do not over finish or finish with bleed-water present
4. Provide sufficient and timely curing
5. Avoid late season placement – Concrete needs a minimum of 30 days before being subjected to deicing salts
6. Use a penetrating sealer (silane or siloxane)

"I did everything right but my concrete still mortar flaked!"

New deicing chemicals have the potential to create significant damage and deterioration to even the best built concrete structures. However, there are a number of strategies that can be employed to help minimize their deleterious effects. These strategies are described in the following chart.

Summary of strategies to minimize effects of chemical deicers

Strategy

Recommended Activities

Durable Mix Design

GOAL: Preparation of dense, impermeable mix to resist deicing chemicals

- Inclusion of supplementary cementitious materials (SCM) to decrease permeability
- Low w/cm (0.45 max) to decrease permeability if protection from corrosion is sought
- Durable aggregates not reactive or susceptible to freeze-thaw
- Establishment of adequate air-void system targeted to severity of environmental exposure

Effective Construction

GOAL: Construction of well-consolidated concrete free of plastic shrinkage cracks

- Avoid construction under extreme weather conditions
- Perform adequate consolidation to remove entrapped air.
- Ensure bleed water has disappeared before finishing, and avoid overworking surface.
- Provide adequate curing using an effective curing compound.
- Employ a 30-day "drying period" before applying deicing chemicals to new concrete.

Post-Construction Mitigation

GOAL: Minimize deleterious effects of deicing chemicals on concrete structures

- Minimize the application of deicing chemicals and maximize effectiveness of each application.
- Use deicing chemicals at lowest possible concentration levels.
- Consider increased use of sodium chloride wherever possible.
- Employ surface sealers (particularly the use of siloxanes or possibly silanes) in areas of heavy deicing applications to reduce ingress of chemicals.