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Aggregate Pop outs

1. WHAT is a Pop Out?

A pop out is a relatively small conical shaped cavity left after a near-surface aggregate particle has expanded and fractured. Generally, part of the fractured aggregate particle will be found at the bottom of the cavity with a part of the aggregate still bonded to the point of the pop out cone. Pop outs general vary size from 6 to 50 mm in diameter.

A pop out is a small fragment of concrete surface that broke away due to internal pressure, leaving a shallow, typically conical, depression.

2. WHY do Pop Outs Occur?

Physical Pop outs are usually caused by the expansion of porous low density aggregate particles having a high rate of absorption. As the offending aggregate absorbs moisture or freezes under moist conditions, its swelling creates internal pressures sufficient to rupture the particle and the overlying concrete surface. Ironstone, coal, shale and soft fine grained limestone are the commonly observed source causes of physical pop outs.

Most physical pop outs occur within the first year of concrete placement. Moisture induced swelling may occur shortly after placement due to moisture absorption from the plastic concrete, or they may not occur until after prolonged rainy weather or the first winter. Pop outs are generally considered a cosmetic flaw primarily affecting the concrete appearance and usually do not affect the service life of the concrete.

The cause of a pop out due to a chemical reaction is often related to alkali silica reaction (ASR). Alkalis from cement or another source cause an environment of high pH which causes the breakdown of silica and the formation of an ASR gel which absorbs water and expands removing a small portion of the surface mortar with it. These are called ASR pop outs. Some alkali silica reaction pop outs can occur within days of concrete placement.

References

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3. How to Repair Pop Outs.

Surfaces with pop outs can be repaired. A small patch can be made by drilling out the spalled particle and filling the void with a damp pack mortar, epoxy mortar, or other appropriate patching material. If pop outs are too numerous to patch individually, a thin bonded overlay or surface grinding may be used to restore serviceability.

For additional information on pop outs, refer to: *Concrete Slab Surface Defects: Causes, Prevention, Repair*, IS177, Portland Cement Association, Skokie, IL

Follow These Steps to Minimize the Potential for Pop outs

1. Use durable aggregate from a proven source. A limit of 1% deleterious material by mass of dry aggregate has been found to minimize difficulties with pop outs. In some parts of Alberta, the available natural gravels contain some particles that are likely to result in pop outs. Due to the unavailability of economic alternate aggregate sources, the occurrence of pop outs on sidewalk and pavements is an accepted, albeit undesirable, likelihood in those locations.

2. Use concrete with the lowest water content and slump possible for the application. This will reduce concrete permeability minimizing the potential for water to migrate to undesirable aggregates and to increase the resistance to swelling forces.

3. Use SCMs to reduce concrete permeability.

4. Provide proper curing for exterior concrete flatwork as this will strengthen the concrete paste fraction and reduce permeability which will restrict the access of moisture to porous particles.

5. To reduce potential of Chemical Pop outs, use low alkali cement, non-reactive aggregates or replace cement with effective SCM sources at levels proven appropriate to mitigate ASR Pop outs.

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