HAHN READY MIX

Shrinkage, Curling, & Extended Joint Spacing

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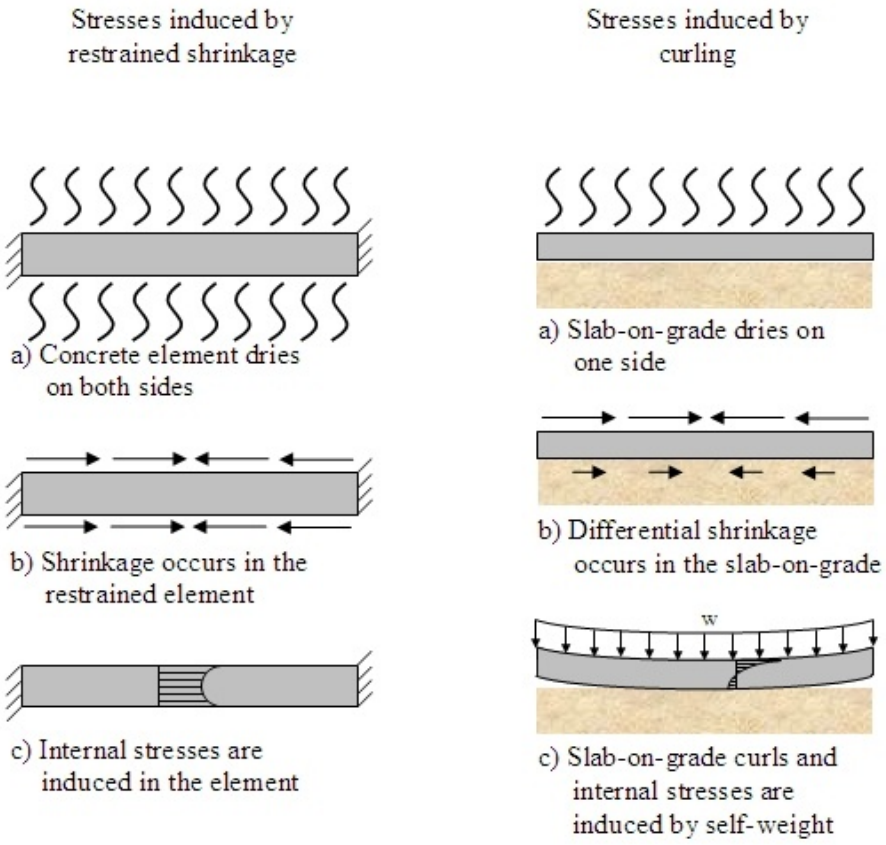
Curling

Today we are going to discuss curling and shrinkage in interior concrete floors. Curling is the effect where the edges and corners of a concrete slab warp (typically upwards). This phenomenon results in a non-flat floor and a much higher potential for cracking where the concrete has curled and is no longer supported by the base material.



Curling occurs most often when concrete shrinks at different rates in the top of the slab vs the bottom of the slab. There's a couple ways to address this: First, try to make sure the slab dries out evenly, and second, try to reduce the total shrinkage potential of the entire slab. To achieve the first objective of even shrinkage, we should make sure the concrete is poured on a damp, absorptive base. This allows the concrete to bleed in two directions. If curling is a concern, we should not use a vapor barrier as this will force all the bleed water up. Finally, proper curing operations will help ensure the top of the concrete does not dry out too quickly.

Shrinkage

Perhaps the most effective way to eliminate curling is to manage the shrinkage potential of the concrete as a whole. Some of the effective measures to combat shrinkage include:

- - Use the largest feasible coarse aggregate, and the highest feasible proportion of coarse aggregate to fine aggregate.
- - Reduce paste content by using the minimum cementitious content needed to achieve the necessary strengths.
- - Use SCM's such as fly ash and slag to replace a portion of the cement.
- - Reduce the water content as much as possible by utilizing water reducing admixtures.
- - In extreme cases, shrinkage reducing admixtures can be an effective, if expensive, way to reduce the shrinkage potential of a mix design.

Other measures to mitigate curling

In addition to the strategies listed above, there are a few other tricks that can help mitigate curling:

- - Use a joint spacing that is no more than 24 times the thickness of the slab. This doesn't change the shrinkage, but it ensures the curling that does occur is more evenly spaced out.

- - Thicken the slab or even just thicken the edge of the slab.
- - Properly designed reinforcement, including load transfer dowels, can mitigate or eliminate curling.
- - Some concrete coatings are designed to help mitigate curling by preventing differential moisture contents in the top and bottom of a slab.

What if my slab has already curled?

Luckily there are a couple methods to attempt to mitigate curling in floors without a complete remove and replace. One method includes ponding a slab with water to reduce the curl and then sawing additional joints to spread the curling effect out over more joints. This method may return a slab to serviceability but will not result in a completely flat floor.

Another method is to inject a grout fill where the slabs have curled to connect the slabs back to the base material and then grind the curled areas to the desired elevation. This method is effective but results in an aesthetic difference to the slab surfaces that have been ground.

Extended Joint Floors

Dramatically extended joint spacings in warehouse floors have become quite the rage in recent years. Owners like these type of slabs because when done correctly, there is less wear and tear on forklifts, improved flatness, and less downtime for joint repair. There are a number of ways to achieve these floors, but none are cheap.

Floor System - A patented floor system such as Ductilcrete by GCP or PrimX, can reduce slab joints by 75% or more. The Ductilcrete system uses specialty admixtures, macrofibers, and a unique two-lift process to reduce shrinkage. The PrimX system utilizes steel fibers with specialty admixtures. The systems have to be placed by a franchised and licensed contractor.

Continuous Heavy Rebar - One way to completely eliminate joints is to use continuous heavy rebar in a slab. Now, it's important to know that this method does not eliminate cracking… it just controls that the crack will not widen and the the slabs cannot heave on either side of the crack.

Post Tensioning - In some cases, post tensioning can be used to put the concrete in compression and prevent shrinkage. This creates a bunch of constructability challenges, and the slab must be allowed to move horizontally, but this can be an effective way to prevent shrinkage.

Shrinkage Compensating Cement - One very effective method is to use an expansive cement (type K) or expansive cement additive, such as Komponent. These products are designed to expand at the same degree that the concrete shrinks, effectively neutralizing the shrinkage potential. There are logistical challenges to this method in concrete production and the mixes with these expansive cements can be unforgiving.

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