

## Type K Cement can help Produce Slabs with Minimal Jointing, Cracking, Curling, and Rebar

Glacier Northwest offers shrinkage compensating cement products from CTS Cement. The most economical approach to using these cements is the Komponent®, a concentrated version of Type K cement where the cement replacement is only 15%. A 15% replacement reduces the cost of freight and therefore reduces the overall cost of Type K cement concrete. While the Komponent has been used for over 20 years, CTS has recently introduced System-K™, which includes Komponent® and CTS K-Fiber™. This system allows non-structural steel to be eliminated from slabs on grade.

The quantity of water required to place concrete is far in excess on the quantity required to hydrate the Portland cement and it is this excess water that causes shrinkage and leads to a number of surface problems. Concrete made with Type K shrinkage-compensating cement can eliminate most of these typical issues with slabs. Type K cements have been used in the United States for over 40 years for hundreds of millions of square feet of slabs. Locally, Fred Meyer has used Type K on numerous projects over the last decade; they are currently using Komponent® for their distribution center addition in Chehalis, Washington.

### How Type K Cement Works

For the first seven days after placement, Type K concrete will expand slightly. Most of the potential expansion is restrained by the reinforcement. This restraint puts the reinforcement into tension and the concrete into compression, which is where these two

materials work best. After seven days as the concrete dries, it merely shrinks the little bit that it had expanded and relieves the stresses in the reinforcement and concrete. The concrete ends up the same size as when it was placed and in a neutral stress condition.

As stated in section 1.2 of ACI 223-98 Standard Practice for the Use of Shrinkage-Compensating Concrete: "...expansion will induce tension in the reinforcement and compression in the concrete. On subsequent drying, the shrinkage merely relieves the expansive strains..." Section 3.4.5 says, "...contraction joints are eliminated..." Figure 1 depicts how this mechanism works.

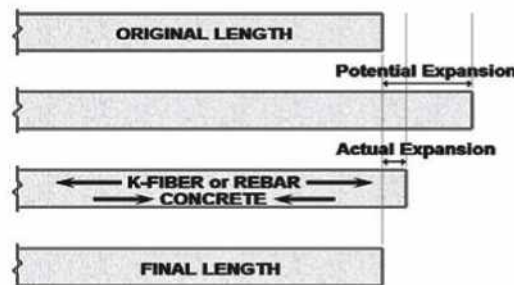


Figure 1

Traditionally, the restraint to keep the concrete from expanding has come from rebars, welded wire fabric, or steel fibers. The System-K™ which includes specially manufactured CTS K-Fiber™ may eliminate the need for steel. The fibers restrains the potential expansion, which places the fibers into tension and the concrete into compression. Figure 2 shows the initial testing done with System-K™. The sections were 50" by 6" by 6", far exceeding the ACI recommendation of 2:1 maximum.

This testing shows that the System-K™ with CTS K-Fiber™ is dramatically better than regular Portland cement concrete with rebar and slightly better than Type K

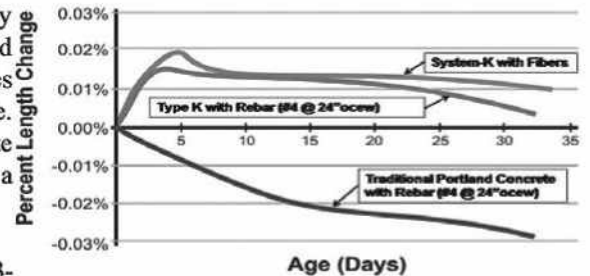


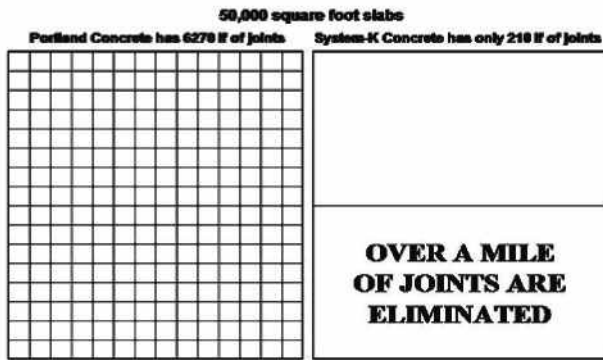
Figure 2

concrete with rebar. After a year the Portland cement section had the usual drying shrinkage cracks, but there were no cracks in the System-K™ Concrete.

Besides the expansion, the other major factor that makes Type K concrete work is that much more water is tied up. Although concrete is typically placed with a .45 to .50 water/cement ratio (w/c), Portland cement only needs a .25 w/c for full hydration. The remaining water, known as water of convenience, is just there to help the contractor place the concrete and all that excess water has to come back out of the concrete. One cubic yard of a typical 3000 psi Portland concrete mix with a .50 w/c has an extra two cubic feet of water. There are only 27 cubic feet in a cubic yard and 2 of them must come back out. This leads to shrinkage, curling and various types of cracking. Type K cement requires a higher w/c for full hydration, so there is less excess water. A smaller volume change means less shrinkage.

### Slab Benefits

Very large placements of 20,000 to 50,000 square feet without control joints are common with System-K™. Figure 3 shows a 50,000 square foot slab (about the size of an average grocery store). In this example there would be one joint instead of 28 and the only reason that there is even one construction joint in the System-K™ slab is that most



**Figure 3**

contractors don't want to place and finish over 50,000 square feet in one day. The end result is that over a mile of joints are eliminated by using System-K™. Eliminating joints saves the costs associated with load transfer devices such as dowel baskets, sawing costs, joint filling and maintenance cost for the life of the building. On-going maintenance costs are reduced. In a recent survey published in *Concrete International* 92% of facilities managers said that joints were their number one repair concerns.

With System-K™ concrete there is virtually no curling because the concrete tries to lift up in the middle rather than at the edges. But the weight of the slab prevents that so the slab stays very flat. As stated in section 3.4.2 of ACI 223-98 "...restrained expansive strains are greater at the top surface than at the bottom, so reversed curling conditions develop... counterbalanced by the dead weight of the slab itself." System-K™ concrete is flat initially and stays flat over time. Our first System-K™ job had an initial FF 98.8 and still had an astounding FF 98.6 five weeks later.

days instead of 28 days or more. This time savings can make a very big impact on a tight construction schedule.

### Wall Benefits

Another good application for Type K Cements can be in walls such as water treatment plants. The joint spacing for flat walls can be increased significantly and no joints are required for round tanks.

Fewer joints mean savings on water stops, labor, and construction time. Temperature steel can be eliminated on some projects, since it isn't required in tank walls when Type K is used. On some projects the thickness of the walls is determined by the cover required for the rebar and without the temperature steel, the walls can actually be made thinner.

### Tilt-up Benefits

As stated in section 3.5.1 of ACI 551R-92 Tilt-Up Concrete Structures: "Panels are normally cast on the floor slab and any imperfections in the slab will be reflected in the panel finish." And section 3.5.1.1 states "Locate crack control joints to minimize unsightly lines being transferred to the panel. These lines will always be visible." Tilt-up panels that are cast on a floor slab that is very flat and has no joints or cracks will not reflect any defects and they tend to be flatter since curling is minimized. This is particularly true if the panel will be sand-blasted.

### Benefits of of System-K™

System-K™ helps you get better concrete slabs without the joints, cracks, curl, and rebar. These factors can lead to significant savings in both initial and life-cycle costs. Please contact your Glacier Northwest sales representative to find out which Type K mixes can work for you.