



Florida Department of Transportation Research Simulation of Prepackaged Grout Bleed under Field Conditions BDK75-977-59

Post-tensioning (PT) is a method of compensating for concrete's weakness under tension by adding steel. Tubes (ducts) are cast into concrete components; after the concrete sets, high-strength steel cables (tendons or strand) are run through the ducts, secured at both ends, and tensioned by powerful jacks. The ducts are then filled with PT grout, which hardens, preventing corrosion and bonding the cables to the concrete.

PT is a very successful and widely used method. However, its durability depends on the quality of the grout and its installation. Since grouting is a blind operation, some problems with grout only become apparent years later – as soon as two years in some cases. Voids or other irregularities in grout distribution or setting can lead to corrosion, which can lead to failure of the concrete component. In this report, University of Florida researchers focused on a problem which has been found in several bridges in Florida, soft grout – grout which has not hardened after many years and is often associated with corrosion.

The research involved many tasks and subtasks organized in three phases: first, determine the cause of soft grout and reproduce this effect; second, study the effect of low-reactivity fillers on production of soft grout in a variety of grout formulations; and third, determine the shelf life of commercial grouts. Grout should harden quickly, and in this report, soft grout refers to grout that has not hardened after 24 hours.

To determine the cause of soft grout, the researchers developed the Modified inclined tube test (MITT), based on Euronorm test EN445. MITT offered a lab-scale configuration for simulating grout bleed and segregation during full-scale mixing and injection. The tube's change in elevation created water separating from grout (bleed) at the tube base to flow upward along the tube length. However, no prepackaged grout tested with MITT produced bleed or soft grout when the grout was used according to



A worker places post tensioning strands in the ducts cast into this bridge component.

manufacturer's recommendations and tested well before the expiration date printed on the bag. To induce soft grout production, variations that occur in field conditions, such as varying mixing water ratios, were simulated and tested with MITT.

The second phase focused on the effect of low-reactivity fillers on production of soft grout in plain grout formulations of Portland cement, ground calcium carbonate, and high-range water reducer. Mixtures with 45% and 35% additional filler generated more soft grout than mixtures with no extra filler at any water-to-solids ratio.

In the third phase, preliminary testing indicated that lengthy storage made prepackaged grout more susceptible to forming soft grout using MITT. PT grout manufacturers place expiration dates on their product, yet no standards or rational process for determining this date were found. Grouts were tested under three temperature-humidity regimes.

Fortunately, PT grout problems have never led to catastrophic failure in the U.S., but they have led to expensive repairs. Establishing standards for storage times and methods that lead to consistent field production of reliable grout will increase the integrity of Florida transportation structures and reduce long-term maintenance costs.