Florida Department of Transportation Research

Evaluation of Techniques to Remove Defective Grout from Post-Tensioning Tendons

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Current Situation

Concrete bridge girders in the U.S. are often built using multistrand post-tensioned (PT) tendons. The tendon is a tube (the duct) that carries a bundle of steel cables. The duct is backfilled with grout to exclude air and moisture and to provide an alkaline environment. The grout should harden completely, but segregated and unhardened grout with free moisture has been found in some tendons. This "soft grout" can cause corrosion of prestressing strands, which can require expensive repairs, especially for tendons internal to the concrete. Alternative repair methods can save time and expense.

Removing the top of the PVC duct and chiseling away the soft grout exposes the steel strands of a post-tensioning tendon.

Research Objectives

University of Florida researchers tested two methods of remediating soft grout: use of high pressure water to remove defective grout and a method of drying defective grout. Corrosion potential during the tendon-drying process was also evaluated.

Project Activities

The researchers first used hydrodemolition, which is the use of high pressure water to break up and remove soft grout. However, in a series of tests, hydrodemolition failed to completely remove soft grout, and it was concluded that the technique did not warrant further investigation.

To study drying as a remediation for soft grout, the researchers built two types of PT tendon mockups and filled them with layers of grout of varying quality. Grout was dried in place by passing dehumidified air through the tendon to remove moisture. Mockups containing normal grout dried in 167 days, and the mockup containing only soft grout dried in 117 days. Moisture content of dried layers of soft grout was consistently below 1%, indicating that drying had effectively removed moisture from the soft grout. Dried specimens, however, exhibited strand corrosion in several locations, which did not occur in the control specimens.

To better understand this corrosion, corrosion tests were conducted by drying small tendons with a single prestressing strand. Consistency and layering of grout were varied in these specimens, and in some, the grout was contaminated with chloride. Drying was terminated when the inlet relative humidity (RH) was indistinguishable from the outlet. During and after drying, corrosion potential was measured. After monitoring corrosion for a set time, specimens were dissected to evaluate grout moisture content and strand corrosion. Moderate corrosion was found, with the majority of the corrosion occurring in chloride-contaminated specimens.

Given the unknowns in the field application of this method and the fact that corrosion occurred during drying in laboratory conditions, the researchers recommended following grout drying with an immediate injection of corrosion inhibitor. For PT tendons with chloride-contaminated grout, the recommended procedure includes drying with an inert gas followed by injection with a corrosion inhibitor effective in high-chloride environments.

Project Benefits

The results of this project offer a promising new method for remediating soft grout in bridge girders that avoids costlier repairs or replacement.

For more information, please see dot.state.fl.us/research-center