Florida Department of Transportation Research

Develop Epoxy Grout Pourback Guidance and Test Methods to Eliminate Thermal/Shrinkage Cracking at Post-Tensioning Anchorages, Phase 2

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Current Situation

Florida bridges are often built using post tensioned concrete members. Duct cast into concrete components carries steel tendons that are stressed and anchored after the concrete has set. At the tendon anchorages, permanent grout caps are placed over the tendon ends and injected with a filler material. The anchorage cap is typically encapsulated by grout or concrete (termed a "pourback"), part of a multilevel system of protection against the ingress of contaminants into the anchorage, which can cause corrosion of the tendons, possibly leading to failure. However, some Florida bridges have been found to have thermal/shrinkage cracking of epoxy grout pourbacks, creating a pathway for moisture and contaminants to reach the tendon.

Serious cracking can be observed in this epoxy pourback, which encases a post tensioning anchorage (marked by the dark spot).

Research Objectives

In this study, Florida International University researchers studied epoxy grouts used for pourbacks. The work was undertaken to better understand failure mechanisms in epoxy grout pourbacks and to provide guidelines and methods for preventing them.

Project Activities

To prepare for field examination of epoxy grout pourbacks and further experimental work, the researchers first conducted a comprehensive literature review regarding the use of epoxy grout pourbacks for anchorage corrosion protection in Florida bridges. Field inspections were conducted at the LeRoy Selmon Crosstown Expressway in Tampa and the SR 826/836 Interchange Bridge #11 in Miami. The locations of cracks, especially points of origin, were observed and cataloged.

The full-scale test consisted of testing rectangular (R-type) and irregular (S-type) pourbacks with various V/S (volume to surface) ratios. The S-type pourback was modeled from the cracked pourback found at the LeRoy Selmon Crosstown Expressway. The full-scale specimens incorporated multiple thermocouples and a vibrating wire strain gauge to capture the temperature profile and localized strain, respectively.

Based on the literature review, manufacturer and contractor feedback, field investigation, and full-scale testing, potential factors affecting epoxy grout pourbacks were determined to be pourback size, shape (particularly shapes with obtuse corners), ambient conditions, and concrete substrate temperature.

Based on the full-scale test data and observation, full-depth cracks were found on specimens with V/S ratio of 0.37 ft and on the S-type specimen with V/S ratio of 0.32. The cracks appeared within the first 24 hours and concentrated in regions with high exothermic temperature, suggesting that these cracks were caused by exothermic temperature rather than shrinkage. A finite element analysis was used to perform a parametric study to clarify the cracking mechanism of epoxy grout pourback systems and the influence of V/S ratio. The model was calibrated and validated using full-scale test data. Behavior of the full-scale pourbacks and the simulated pourbacks was correlatable, showing a general correspondence. Study results led to recommendations for the design and construction of epoxy grout pourbacks.

Project Benefits

Appropriate use of epoxy pourbacks can result in better and more effective protection of post tensioning strands and can lead to a longer life for Florida bridges at lower lifetime maintenance costs, leading to increased reliability at significant cost savings. This project will benefit users of epoxy pourbacks as the findings shed new light on their behavior regarding thermal/shrinkage cracking. Recommendations are made from this study for appropriate use of epoxy pourbacks in order to avoid cracking.

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