Case Study

Market Application Focus

Concrete Repair & Protection

Project: Sunshine Skyway Bridge - Tampa Bay, FL
Owner: Florida D.O.T.
Engineer: SDR Engineering Consultants, Inc.
Contractor: Intron Technologies, Inc.
Year: November 2006 – September 2007

The Problem

The Sunshine Skyway Bridge is just as impressive from an engineering viewpoint as it is from an aesthetic one. At the time of construction, it was the world's longest bridge having a cable-stay main span with an overall length of 5-1/2 miles. The main span is 1,200 ft. and the vertical clearance is over 190 ft. Built at a cost of $244 million, it opened to traffic in 1987. The Sunshine Skyway Bridge is comprised of the main span, the high level approach, and the low level trestle spans. A total of 650 precast concrete girders support the northbound trestle spans and another 650 girders support the southbound span. AASHTO Type IV girders were used for a majority of the 100 foot long trestle spans. Shear cracking was observed during routine inspections of the trestle span girders of the Skyway Bridge. The history of the inspection indicated that the number of cracked beams had increased over time. Inclined shear cracking was much more prevalent in the exterior girders than the interior girders. For the southbound bridge, 97.7% of the exterior girders showed cracking while only 1.0% of the interior girders exhibited cracks. For the northbound bridge, 93.1% of the exterior girders were cracked while only 1.3% of the interior girders exhibited cracks. In addition to the deficient AASHTO girders, cracks were observed in numerous pier caps. In some cases, these cracks were very large and exhibited visible signs of water penetration and damage. This environment is classified as extremely aggressive due to the proximity of Tampa Bay and the Gulf of Mexico. Any cracks in the concrete girders could provide direct access for chlorides and moisture to the prestressed strands, many of which were classified as unshielded. Not only were the girders deficient in shear and torsion, but they were compromised from a durability standpoint. A repair was critical in order to guard against fatigue of the existing reinforcement.

The Sika Solution

Prior to the start of construction, load testing was performed on full-scale AASHTO Type IV precast girders in the FDOT Structures Lab in Tallahassee, FL. This testing confirmed the engineer's calculations that a CFRP upgrade would be the best solution for repairing the shear deficiency in the AASHTO girders. The use of a carbon fiber system was chosen to structurally repair the girders for a variety of reasons. A bi-directional carbon fiber fabric provided reinforcement in the 0/90 degree directions. The carbon fiber system was able to conform to the geometry of the AASHTO girders very easily. The light weight nature of the fabric was able to be installed very easily, despite having to be done from a man-lift off a barge under the bridge. The carbon fiber/epoxy system is extremely durable and not susceptible to corrosion, even in a marine environment. Lastly, the high tensile strength and modulus of elasticity of the carbon fibers made them suitable for the repairs on this bridge.

Sika's System Approach to Concrete Repair and Protection

Carbon Fiber Fabric for Structural Strengthening
SikaWrap® Hex 115C - a bi-directional, high strength, carbon fiber fabric. Material is field laminated using Sikadur 300 epoxy to form a carbon fiber reinforced polymer (CFRP) used to strengthen structural elements.

High-modulus, High-strength, Impregnating Resin
Sikadur® 300 **-** a two-component 100% solids, moisture-tolerant, high strength, high modulus epoxy and is used as a an impregnating resin with SikaWrap Structural Strengthening System.

High-modulus, High-strength, Impregnating Resin
Sikadur® 330 - two-component, solvent-free, moisture-tolerant, high strength, high modulus structural epoxy adhesive and is used as a an impregnating resin and primer with SikaWrap Structural Strengthening System.

High-strength Epoxy Grouting/Sealing/Binder Adhesive
Sikadur® 35, Hi-Mod LV - a 2-component, 100% solids, moisture-tolerant, low-viscosity, high-strength, multipurpose, epoxy resin adhesive. It conforms to the current ASTM C-881 and AASHTO M-235 specifications. It seals interior slabs and exterior above-grade slabs from water, chlorides, and mild chemical attack; also improves wearability.

High-modulus, High-strength, Structural, Epoxy Paste Adhesive
Sikadur® 31 Hi-Mod Gel - a 2-component, 100% solids, solvent-free, moisture-tolerant, high-modulus, high-strength, structural epoxy paste adhesive. It conforms to the current ASTM C-881 and AASHTO M-235 specifications.

High Performance Repair Mortar
SikaTop® 123 PLUS **-** is a two-component, polymer-modified, portland cement, fast-setting, non-sag mortar. It is a high performance repair mortar for vertical and overhead surfaces, and offers the additional benefit of Sika FerroGard 901, a penetrating corrosion inhibitor.

Anti-Carbonation Coatings
Sikagard® 670W - protect concrete from the damaging effects of carbon dioxide (carbonation), water and pollutants. Sikagard 670W, is a high-performance, protective coating, available in a variety of decorative colors.

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