

Pineda Causeway Bridge Rehabilitation

By R. Curtis White Jr.

The Pineda Causeway Bridge, located along Florida State Route 404, is one of three similar, high-rise bridges linking mainland Florida's east coast to the barrier islands on the Atlantic Coast, where the Kennedy Space Center and Patrick Air Force Base are located at Cape Canaveral. These bridges provide the only land access to this sensitive area that is home to a thriving tourist destination and important military and NASA facilities.

The Pineda Causeway Bridge also spans the Atlantic Intracoastal Waterway, which is maintained by the U.S. Army Corps of Engineers and administered by the U.S. Coast Guard. The waterway is a vital route for pleasure craft and



Pineda Causeway over the Indian River



One of the twin spans of the Pineda Causeway

commercial barge traffic wanting a protected north and south path along the entire east coast of the United States. Disruption to either land or watercraft would be a major issue for the federal agencies that oversee the waterway or the Florida Department of Transportation (FDOT), which is responsible for the highway traffic and maintenance of the bridge structure.

The bridge had experienced significant spalling and delamination of concrete at the waterline of the low-level pile caps since its construction in 1969. An earlier repair of the spalling was attempted using form-and-pump methods. It was a particularly difficult forming job because the piles were not positioned the same on any of the 84 lower pile caps being repaired. This meant that there was no repeatability in forming the repair, so all the forms were custom-built. In addition, the forms needed to be supported under the caps with no clearance from the water—except at low-tide water level—and then only 8 in. (203 mm) could be anticipated. So, in essence, the plan was to support the 84 custom-built forms with skyhooks and hope the repair concrete bonded upside down. This was not a recipe for success.

FDOT let a contract in 2004 to repair these low-water level caps. The repair contractor made a valiant, but ultimately unsuccessful, attempt to complete the repair. His bonding company took over the work and brought in another contractor to complete the contract. This effort, using the same techniques, was no more successful than the first, and the bonding company filed suit against the state to be released from its obligations. Rather than fight the lawsuit, FDOT cancelled the contract and rebid the job in March of 2006, using the same specifications for the work.

The successful bidder was 25% lower than the second bid. The low bidder suggested a value engineering change to the procedure from the beginning. His proposal was to change only the method of placement from form-and-pump to dry-mix shotcrete. Dry-mix shotcrete was proposed because of the access restrictions that required all work be done from watercraft with no highway traffic lane closures allowed. The relatively small quantities and long travel distance from the staging area to the work site precluded the efficient use of wet-mix shotcrete.

Additional “sweeteners” were added to the proposed value engineering change (other than actually being able to **do** the work) in the form of a reduced unit price for the repair work and, innovatively, a “no-crack” warranty. The original repair attempts had produced several caps that were “repaired.” These caps exhibited significant cracking and spalling after only 1 year of service. To further entice FDOT to consider shotcrete for this repair (FDOT already has shotcrete specs and a colorful history of use), the contractor proposed a 4-year “no-crack” warranty. After a thorough investigation of the proposed methods, pricing, and past history of application, FDOT approved replacing the form-and-pour method with shotcrete. Standard FDOT specifications for shotcrete were available for reference which added to the ease of changing from one method to another.

Now that means and methods were agreed to by both parties, the daily problems of accomplishing the work had to be addressed. While the Indian River is salt water, normal tides do not affect this portion of the waterway due to its distance from the nearest inlet. Wind direction and strength, however, have a significant effect on high and low water. Because the low water pile caps are submerged during high water, look-ahead schedules had to be created to avoid projected high water and take advantage of low water levels. Prevailing north winds during the winter months usually result in lower water. The contractor was able to take advantage of this effect and complete most of the low-level repairs during this period. When the water came up, efforts were shifted to the required column repairs.

To prove the effectiveness of the shotcrete repairs, FDOT required random bond strength tests. These tests were accomplished using ASTM C1583/1583M-04e1, “Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).” Pull-off tests of repairs on the footings resulted in failure in the old concrete substrate—generally at values above 200 psi (1 MPa). Any failure in the parent concrete is an indication of the successful bonding between the substrate and the repair material.

The repair material placed on this project was Gunitite 7001d, a single-component, modified silica-fume shotcrete material with 1/2 in. (13 mm) polypropylene fibers produced by U.S. Concrete Products of Baltimore, MD. Twenty-eight-day compressive strength test results were in excess of 7000 psi (48 MPa). These tests were conducted in accordance with ASTM C1140-03a, “Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels” and performed on cores taken from test panels made in



Pullout test showing core failure in substrate



Removal of spalled concrete from pile caps



Pile caps after chipping and ready for shotcreting

accordance with ACI 506.2-95, "Specification for Materials, Proportioning, and Application of Shotcrete." The work was accomplished by nozzlemen certified for ACI by ASA Examiners.

Whereas this project was ultimately completed to the satisfaction of the design engineer, the owner, and the contractor, it required all parties be amenable to alternate processes and approaches and concentrate on the **performance** aspects of the specifications and not on prescribing all the steps to be taken during construction. Using this manner of solving problems allowed the project to be completed early and under budget, whereas

previous efforts to rehabilitate this bridge had failed miserably. Without the cooperation between parties and innovative thinking by the contractor, this could have been one more project ending in litigation to the benefit of no one.



Shotcrete placement on low water pile caps



Dry-mix shotcrete can be placed slowly to reduce fallouts



R. Curtis White Jr. is President of Coastal Gunite Construction Company, a 30-year-old firm specializing in the repair and restoration of concrete structures using the shotcrete process. Coastal Gunite is active east of the Mississippi River

and completes shotcrete projects for new basement wall construction, sewer rehabilitation, bridge restoration, building rehabilitation, and seawall reconstruction. Coastal Gunite has won awards from ASA and the International Concrete Repair Institute (ICRI) for bridge repairs in the Florida Keys, tunnel restoration in West Virginia, and cooling tower rehabilitation in northern Florida. White is a long-time member of ACI Committees 506, Shotcreting, and C660, Shotcrete Nozzleman Certification, and ASTM International Committee C09.46, Shotcrete. He is one of the authors of the AASHTOAGC-ARTBA Task Force 37, "Guide Specification for Shotcrete Repair of Highway Bridges." White is a founding member of ASA and ICRI, and has been on the ASA Board of Direction since 2009.

Pineda Causeway Bridge, State Route 404 over the Indian River (Atlantic Intracoastal Waterway)

Location

Melbourne,
Brevard County, Florida

Shotcrete Contractor

Coastal Gunite Construction Company*

General Contractor

Coastal Gunite Construction Company*

Engineer

Kisinger Campo and Associates Corp.

Material Manufacturer

US Concrete Products, LLC*

Shotcrete Equipment

Allentown Shotcrete Technology, Inc.*
A Putzmeister America company

Project Owner

Florida Department of Transportation, District 5

*Corporate Member of the
American Shotcrete Association



Close-up of reinstalled chamfers



Completed low water pile caps