PROJECT

# New Jersey Route 52 Causeway

Ribbon-in-space design solves horizontal and vertical alignment challenges

by Maher (Mike) Sidani and Joseph Romano, Michael Baker Jr. Inc., and David Lambert and Frank Inverso, New Jersey Department of Transportation

On May 24, 2012, the mayors of Ocean City and Somers Point, N.J., hosted a grand opening ceremony for the new, 3-mile-long Route 52 Causeway that connects these seaside communities.

Somers Point is located on mainland New Jersey, while Ocean City, a major tourist destination, lies on a peninsula to the southeast. Great Egg Harbor Bay separates the two cities and includes several small islands and four channels, two of which are navigable.

The original Route 52 Causeway over the bay consisted of four bridges: two low-level causeway bridges in the middle and a drawbridge at each end. The New Jersey Department of Transportation (NJDOT) maintained these causeway bridges that were 1.1 miles long and in constant need of repair and in critical need of replacement.

Highway and marine traffic increased dramatically in the 70 years since the bridge was built. The narrow lanes and lack of shoulders contributed to frequent backups, more prevalent with the increase in drawbridge openings caused by a greater volume of marine traffic. A major safety concern was the potential of storm-driven waves to wash over the low causeways, making them impassable—a significant issue as Route 52 is designated a critical coastal evacuation route for the area.

## Project Split - Two Contracts

Due to the condition of the existing bridges, NJDOT split the scope of work into two staggered construction contracts. Contract A replaced the two deteriorated low level causeway bridges, while Contract B encompassed replacement of both drawbridges and

Overall view of the Route 52 Causeway from the Ocean City side, showing low level, high level, and curved alignments. All photos: Stokes Creative Group Inc.

profile

**NEW JERSEY ROUTE 52 CAUSEWAY** / OCEAN CITY AND SOMERS POINT, NEW JERSEY

**BRIDGE DESIGN ENGINEER:** Michael Baker Jr. Inc., Hamilton, N.J.

**PRIME CONTRACTOR (CONTRACT A1):** George Harms Construction Company, Howell, N.J.

**PRIME CONTRACTOR (CONTRACT B):** Route 52 Constructors: A Joint Venture of G.A. & F.C. Wagman Inc., York, Pa., and R.E. Pierson Construction Co. Inc., Pilesgrove, N.J.

**CAST-IN-PLACE CONCRETE SUPPLIER (CONTRACT A1):** Clayton Companies, Lakewood, N.J.

**CAST-IN-PLACE CONCRETE SUPPLIER (CONTRACT B):** Clayton Companies, Lakewood, N.J., and R.E. Pierson Construction Co. Inc., Pilesgrove, N.J.

**PRECASTER:** Bayshore Concrete Products Corp., Bay Charles, Va., a PCI-certified producer

improvements at the touchdowns at each bridge end, bringing the total project length to 3 miles. Dividing the project into two contracts was also necessary because of the $400 million price tag, which made the Route 52 Causeway Replacement one of the largest projects ever undertaken by NJDOT.

## Design Spurred Greater Competition

Originally, the bridge design called for precast concrete segmental boxes, which are faster to construct and require less access from underneath. However, only one fabricator in the region was ready to provide the specialized segmental boxes. Demand from the Gulf region following Hurricane Katrina depleted most-available concrete fabricators, resulting in higher than anticipated bids.

To increase competition, an alternative superstructure design was developed using precast, prestressed concrete I-girders. NJDOT re-advertised the revised Contract A1 in April 2006. The bids came in lower than expected making it possible to proceed with construction.

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Due to the harsh marine environment, durability of the bridge designed for a 75-year service life was a major consideration. Concrete was preferred over steel because of its exceptional durability, low maintenance requirements, and life-cycle cost advantages. The concrete elements utilized on the project included low-permeability, high-performance concrete.

Route 52 Construction of Contract A1, while maintaining traffic on existing causeway.

## Environmental Concerns Respected and Addressed

Environmental restrictions were one of the most significant construction-phase challenges. The project area is important to endangered species, protected birds, fish, shellfish, sea turtles, and plant life. Environmental permits limited the types, locations, and durations of certain construction activities.

From the start, NJDOT held regular interagency meetings to keep environmental agencies informed and demonstrate the team's commitment to protecting natural resources. Where feasible, the team developed plans for bioengineered shoreline stabilization and preserving nearby open space to help offset impacts. These efforts made environmental agencies more willing to discuss reasonable modifications to restrictions when needed. For example, in-water construction is not allowed from April 1 to June 30. Providing justification for a permit modification to install piles within watertight cofferdams during the restricted period gave the contractor more flexibility in the project schedule, which sped project completion.

## Distinct Technical Challenges Overcome

The coastal project location introduced plenty of technical challenges, including dealing with sandy, silty soil conditions. Soft soils were a particular concern under the 900-ft-long fill section on Rainbow Island. Vibro concrete columns, which had been used only once before in New Jersey, were used to stabilize the embankment rapidly and cost-effectively. Concrete columns, 18 in. in diameter that flare out at the top and bottom, were driven approximately 60 ft into the ground. Several layers of geotextile and compacted fill were placed across the tops of the columns to transfer the embankment load down to more stable soil layers.

The Route 52 Causeway consists of two, 12-ft-wide lanes in each direction, 5-ft-wide inside shoulders,

NEW JERSEY DEPARTMENT OF TRANSPORTATION, OWNER

**BRIDGE DESCRIPTION:** A dual bridge with lengths of 10,080 ft (contract B) and 7550 ft (contract A1) designed as simple span, precast, prestressed concrete girders made continuous for live load. Girders were 93.5-in.-deep precast, prestresesd concrete bulb-tees spaced 8 to 11.75 ft apart. The bridge deck consists of a 6-in.-thick, cast-in-place concrete deck placed on 3.5-in.-thick precast, prestressed concrete deck panels. Piers for contract B are single-column piers with pier cap and bowtie pier. Contract A1 piers are multicolumn and use an inverted-T pile cap.

**STRUCTURAL COMPONENTS:** Precast, prestressed concrete girders; precast, prestressed concrete deck panels; cast-in-place concrete deck slab; prestressed concrete piles; concrete pile caps, abutments, footings, pier columns, and pier caps

Route 52 Contract B: The prestressed bulb-tee beams are supported by the high level piers.

8-ft-wide outside shoulders, and a 10-ft-wide shared-use walkway along the southbound side of the roadway. The total useable width of the roadway section (including walkways) is 84 ft representing a significant increase from the 40 ft width of the existing causeway.

Thirty-inch-square, 5 ksi, precast, prestressed concrete piles were used for the pile foundation, with a maximum pile design length of 106 ft. A waterline cast-in-place, 4-ksi concrete pile cap was selected due to economic considerations.

The top of the in-water pile cap is 2.54 ft above the mean high water elevation and is visible to passing boaters at most times. The pier is composed of cast-in-place, 4 ksi concrete hammerhead pier caps supported by a single column cast-in-place bow-tie column cross-section with Y-shaped double pylons at the top. High-performance concrete (HPC) was used for the pile caps, the columns, and the pier caps due to the marine environment.

Route 52 Contract A1: The low level bridges with the fishing pier are visible.

The superstructure consists of nine lines of bulb-tee beams spaced at 10 ft 6 in. and a composite deck consisting of 3½-in.-thick precast concrete deck panels and 6-in-thick cast-in-place HPC. The total superstructure depth is 93.5 in. The simple span girders were made continuous for live load. Span lengths in the high level bridge vary from 137 to 166 ft. Specified design strength for the HPC used in the girders was 8.0 ksi. The girders were delivered to the site by barge from a pre-built main dock area. Epoxy-coated reinforcement was used for the entire structure.

## 'Ribbon in Space' an Aesthetic Delight

Typically in designing similar bridges over water, the challenge is determining how to cross a single major channel located in the middle of the waterway. The bridge profile slopes gradually up to a high point in the center, where the longest span of the bridge (166 ft) crosses the ship channel, providing visual focus of the project. With the Route 52 Causeway, there are two navigable channels located near each tie-in point of the bridge presenting a challenge to provide the required 55-ft-minimum vertical clearance for the waterways and to align the bridge horizontally with the connecting streets in Somers Point and Ocean City.

The design team carefully shaped the horizontal and vertical curves of the bridge to make the alignments as attractive as possible, giving the bridge a dynamic and sweeping "ribbon in space" appearance that conveys the speed and direction of the traffic across it.

**...giving the bridge a dynamic and sweeping "ribbon in space" appearance...**

Underside of the Route 52 Bridge over the beach thoroughfare next to Ocean City.

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*Maher (Mike) Sidani is vice president and Joseph Romano is the structures department manager for Michael Baker Jr. Inc., office in Hamilton, N.J. David Lambert is the state transportation engineer and Frank Inverso is a project manager with the New Jersey Department of Transportation, Trenton, N.J.*

**For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.**

### EDITOR'S NOTE

*The Route 52 Visitors Center Bridge, which is adjacent to the causeway, was described in the Summer 2012 issue of* ASPIRE™.