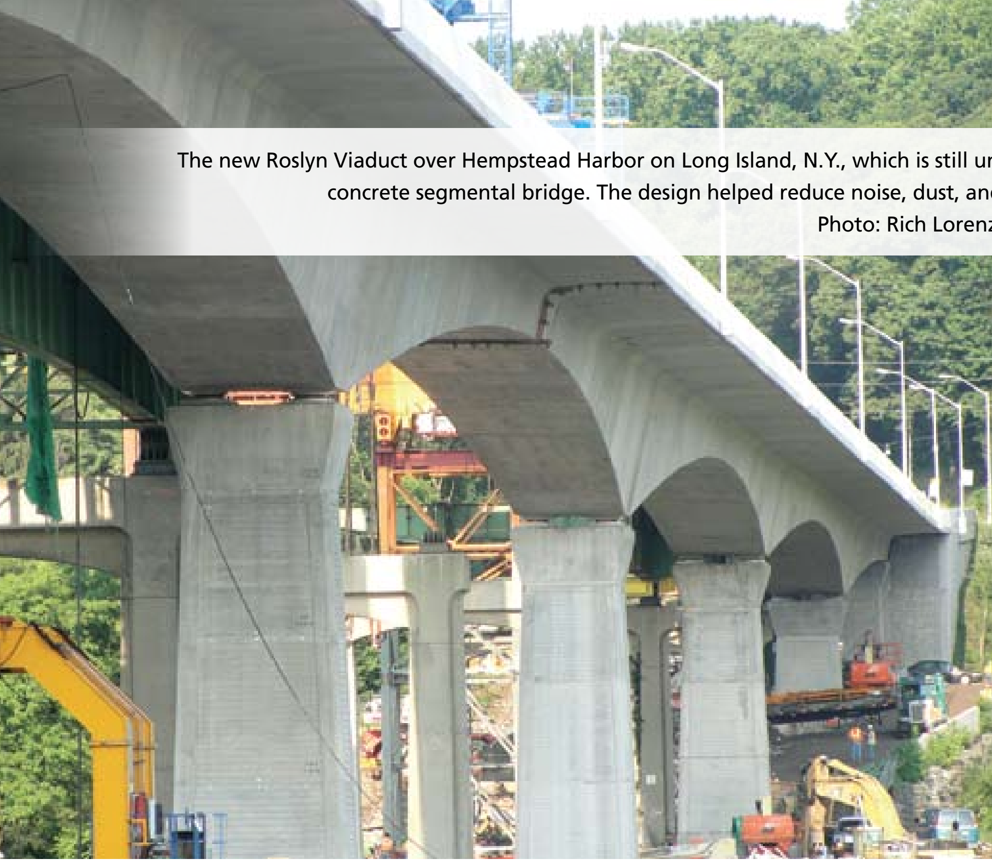


The new Roslyn Viaduct over Hempstead Harbor on Long Island, N.Y., which is still under construction, features the area's first precast concrete segmental bridge. The design helped reduce noise, dust, and vibration while providing an aesthetic solution. Photo: Rich Lorenzen. Rendering (below): Hardesty & Hanover LLP.

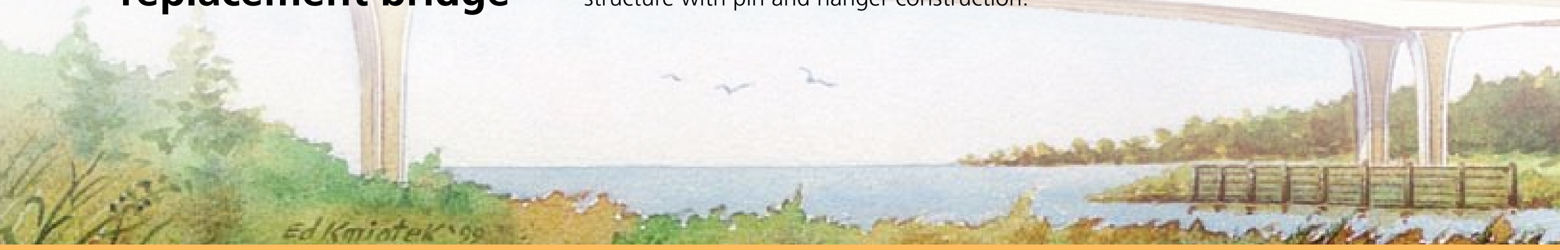
BUILDING A BRIDGE IN TIGHT QUARTERS

by Eileen Peters, New York State Department of Transporation

Haunched box girders made with high-performance concrete provides strong aesthetics and long service life for Long Island replacement bridge

The new Roslyn Viaduct Bridge on Route 25A over Hempstead Harbor, Long Island, N.Y., provides a wider, aesthetically pleasing and effective design that replaces a deteriorating 1949 steel bridge that could not handle the growing traffic volume. The new segmental precast concrete structure, featuring haunched box girders, provides a 75-year service life, minimizes impact to the public and its surroundings, and complements the area's many historical structures and characteristics. It also represents the first bridge of this type on Long Island.

The $127-million project is a key east-west roadway in Nassau County, carrying 38,000 vehicles each day. Significant challenges arose in designing the best alternative, as a replacement structure required demolishing the existing bridge while maintaining traffic flow. Rehabilitation was considered, but officials agreed that replacement was preferred, as the structure was an aging non-redundant two-girder structure with pin and hanger construction.



profile

ROSLYN VIADUCT / N.Y. ROUTE 25A OVER HEMPSTEAD HARBOR, NASSAU COUNTY, NEW YORK

ENGINEER: Hardesty & Hanover LLP, New York, N.Y.

CONSTRUCTION INSPECTION: STV Inc. / PB Americas Inc. Joint Venture, New York, N.Y.

PRIME CONTRACTOR: Tully Construction Co., Flushing, N.Y.

CONTRACTOR CONSTRUCTION ENGINEER: Weidlinger Associates Inc., Mountain Lakes, N.J., and HDR Inc., Newark, N.J.

CONSTRUCTABILITY REVIEWS: FIGG Bridge Engineers Inc., Exton, Pa.

PRECASTER: Bayshore Concrete Products Inc., Cape Charles, Va., a PCI-certified producer

AWARDS: *Named among "Top 10 Bridges in North America" in 2007 by* Roads & Bridges *magazine*

Self-consolidating, high-performance, 10,200 psi concrete was used for girders and abutments to ensure a 75-year service life.

Community Involved

As part of the development process, the New York State Department of Transportation (NYSDOT) undertook a partnering initiative with the community to ensure that the bridge was constructed in context with its surroundings and in keeping with the local vision for future needs. To ensure the process moved smoothly, a Bridge Task Force (BTF) was created, comprising public officials and their appointed representatives. Designers presented several concepts, including a cable-stayed design, a deck-arch bridge, a multigirder structure (of either steel or concrete), a box-girder bridge (of either steel or concrete), and a tunnel.

After considering the options and receiving local input, the BTF chose a segmental concrete bridge with haunched box girders, which could be designed to resemble the contours of the existing bridge. Key considerations were that this approach would limit dust and noise at the site, with most superstructure and column components fabricated off-site, as well as reduce construction time; thereby minimizing the amount of traffic impacted by the construction.

The nine-span bridge is 78.2 ft wide with two 11.8-ft-wide travel lanes and 7.9-ft-wide shoulders in each direction with a concrete median barrier. The bridge provides a pedestrian walkway on one side and widens to 84.2 ft at the east end to provide transitions for entrance and exit ramps. The nine spans vary in length, becoming shorter as they approach the ends to leave the center of the bridge more open. The lengths of the spans from west to east are 152.6, 252.6, 272.3, 292.0, 272.3, 272.3, 265.7, 215.4, and 120.9 ft. The cross section of the bridge consists of two single-cell box girders.

The bridge contains no horizontal curvature and only a slight vertical curve to the east end with gradient increases from east to west. It was designed to meet the existing approach roadways with an increase in elevation at the west end. Since the approaches could be raised only marginally to meet existing grades, the haunched box girders provided a workable solution.

Designers also chose 10,200 psi (70 MPa) high-performance, self-consolidating concrete for the girders and abutments to ensure a 75-year service life for the structure. The abutments were designed to contain interior hollow sections to store equipment needed to maintain the bridge and provide access to the interior for inspection and maintenance activities. Each abutment also includes two hydraulic dampers to address seismic concerns.

To protect the waterway near the site, precast concrete segments were barged from the precaster's plant in Cape Charles, Va., to a location several miles from the project and then hauled by specialized trailers to the site. Photo: Will Brown.

Design Addresses Key Challenges

A key challenge focused on the soil conditions at the site, which were of varying compositions, with layers of organic material at some strata levels. There also is high groundwater that had to be considered in the design. Drilled and grouted micropiles were used to transfer the high dead loads into the ground. Drilling the piles rather than driving them also minimized vibration to nearby historic buildings and structures and to several 100-year-old wells in close proximity. Vibration monitoring was provided throughout the site.

PRECAST CONCRETE HAUNCHED BOX-GIRDER BRIDGE / NEW YORK STATE DEPARTMENT OF TRANSPORTATION, OWNER

POST-TENSIONING CONTRACTOR: Freyssinet LLC, Sterling, Va.

GANTRY CRANE SUPPLIER: DEAL, Italy

TENDON GROUT SUPPLIER: Sika Corporation, Lyndhurst, N.J.

BRIDGE DESCRIPTION: Nine-span haunched segmental box-girder bridge with precast segments for the superstructure and columns

BRIDGE CONSTRUCTION COST: $127.4 million

Ironworkers align the couplers for the post tensioning bars as they set the precast concrete column cap segment at pier 7. Photo: Renata Magoc.

Another significant challenge arose with transporting the precast concrete segments to the site. The largest segments weighed close to 100 tons. Initially, the construction team planned to use the channel waterway, but the NYS Department of Environmental Conservation was concerned about protecting the aquatic natural habitat. Instead, the segments were barged from the precaster's plant in Cape Charles, Va., to a location several miles from the project and then hauled by specialized trailers to the site via ground-surface transportation routes. This approach required numerous contacts and discussions with local public agencies, residents and other stakeholders. The contractor obtained permits to use special multi-axle trailers to transport many of the bridge segments over the existing viaduct bridge.

Demolition of the existing bridge and construction of the new structure were coordinated to minimize traffic disruptions and required construction in two stages. Demolition of the northern third of the bridge came first. Then, new pier-column segments were installed and girder segments for the portion of the bridge east of the waterway erected. The column segments and many of the girder segments for the portion west of the waterway were transported over the existing viaduct during nighttime operations while the bridge was closed to traffic.

After the northern portion of the original bridge was demolished, NYSDOT used three travel lanes on the remaining southern portion, with the center lane accommodating traffic in peak periods by alternating flow direction. The traffic switches took place three times per day using three sets of lane-use signals. Two westbound lanes were used in the morning and early afternoon. Two eastbound lanes were used in the late afternoon and evening. One lane in each direction was used overnight. To prevent traffic backups, a manned tow truck was available at all times, and the bridge was monitored remotely with multiple cameras.

The majority of the precast concrete girder segments for the northern portion of the bridge were installed using a 700-ft-long gantry built on the site away from locations where it would impact travel. The northern approach roadways were completed first, in the fall of 2008. Once the northern half of the new bridge was finished, traffic switched to this new structure and the gantry shifted to the south to facilitate demolition of the southern portion of the existing structure. Construction on that portion then commenced. Self-consolidating concrete was used for cast-in-place closure placements, using a similar concrete mix to the one used for the column and girder segments.

The end segment is positioned on the west abutment bearings. Access to the inside of the structure will be from a stairway inside the abutment and the opening in the center of the segment. Photo: Rich Lorenzen.

Durability and Corrosion Protection

The post-tensioning tendons were provided with multiple layers of protection in accordance with AASHTO design standards. Provisions for future post-tensioning continuity tendons were provided within the bridge. In addition, epoxy-coated reinforcing bars were used in the cast-in-place pile caps and abutments throughout the project.

The designed combination of HPC with a 2-in.-thick silica fume concrete overlay will produce a highly durable bridge able to withstand 75 years of New York weather and de-icing salts. Several components were further designed to withstand the test of time with the use of stainless steel reinforcing bars. These components included light-pole pilasters, barrier walls, and closure placements. Stainless steel also was used for anchors and supports for the bridge's electrical components, as well as for the access doors, ladders, and platforms within the bridge columns.

The resulting bridge will provide a strong addition to the community. The haunched superstructure and long spans provide local residents and businesses with a more open view of the harbor, with the total number of piers reduced from 13 to 8. To blend into the surroundings, pier columns and faux columns at the abutments feature a ship-lap pattern in the concrete, while a New England dry-stack form liner along with the ship-lap pattern were used for the abutments and wing walls. This attention to detail ensures that residents will find their new bridge to be both functional and aesthetically pleasing for many decades to come.

The information in this article was compiled by Eileen Peters, the public information officer for the New York State Department of Transportation, Region 10 in Long Island, N.Y., and was supplied by NYSDOT construction and design personnel who worked on the project.

For more information on this or other projects, visit www.aspirebridge.org.

A completed cantilever section over pier 5. In the foreground, a straddlecarrier moves segments into position on the ground. Photo: Rich Lorenzen.

The Roslyn Viaduct was designed and built as a balanced cantilever bridge. The gantry crane moves segments 4 east and 4 west into position followed by stressing platforms at each end, which allow the workers to accomplish the post-tensioning. Photo: Rich Lorenzen.

After the north side of the bridge was constructed, the gantry crane was shifted to the south to remove the steel frame of the existing bridge. Photo: Rich Lorenzen.

The majority of the precast concrete girder segments for the northern portion of the bridge were installed using a 700-ft-long gantry.

Tapered pier columns create a new visual appeal for the Roslyn Viaduct. The near end will tie into the east abutment. Photo: Rich Lorenzen.

Concrete is placed at the closure pour at pier 7 using a crane and bucket while the gantry is positioned at piers 6 and 7. In the foreground are the pier 8 pier table and the east abutment. Photo: Rich Lorenzen.