The Connecticut DOT
makes quick work of its first-ever design-build project.

FAST Finish

BY THOMAS R. LALIBERTE, PE, JODI GREENE AND ANDREW CARDINALI, PE

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WITHIN 15 MONTHS from the notice to proceed for design, four bridge superstructures carrying Route 8 over Lindley Street and Capitol Avenue in Bridgeport, Conn., were fully replaced and open to the public.

The bridges were originally built in 1970 with prestressed concrete girders. These bulb tee girders experienced premature deterioration caused by alkali-silica reactivity, and the failed bridge joints created sub-

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structure spalls and bearing damage. The poor superstructure conditions are what prompted this rehabilitation project.

Hoping to complete the project within a shortened period, the Connecticut Department of Transportation (CTDOT) conducted a risk analysis that determined this project was appropriate for its first design-build endeavor. The design-build project delivery method allowed general contractor Manafort Brothers, Inc. (Manafort) and engineer WSP|Parsons Brinckerhoff (WSP|PB) to develop innovative design and construction solutions from the start of design through the end of construction. Design began in April 2015, girders were delivered to the site in October and all bridges were replaced and in service by July 2016.

Crossover

A significant portion of the project involved preparing for two 14-day crossover periods when the superstructures were replaced. Due to the geometry of the existing highway alignment, it was possible to shift both north- and southbound lanes onto the original northbound highway during the crossover period. This method was repeated in the opposite direction as well. When traffic was diverted to one side of the highway, demolition of the existing and construction of the new structures was performed on the opposite side. Various accelerated bridge construction (ABC) techniques were used to replace the superstructures in less than weeks, and one specific technique was the use of prefabricated bridge units (PBUs). The short construction schedule relieved highway users (the average daily traffic volume on the bridges is 89,300 vehicles) and the community of Bridgeport from long-term construction impacts.

The PBUs were designed to be constructed off-line, then erected during the crossover periods. They consisted of two steel plate girders and a concrete deck, and the magnitude of the units made transportation and erection challenging. The PBUs were up to 90 ft long by 17 ft wide and weighed up to 260 kips. Manafort assembled the units at a site less than one mile from the bridges, then they were transported to the project site with 16-axle highly specialized steerable and adjustable trailers, then finally tandem-picked into final position with 300-and 500-ton cranes.

➤ WSP | PB designed prefabricated bridge units for the Route 8 bridge project.

➤ Traffic was shifted to one bound during each crossover period. The two sides were replaced in under 14 days.

At the assembly area, temporary or "mock" abutments were constructed to match existing bridge substructures, which were reused for the new bridges. Each bridge span included four PBUs that were constructed together full width and length to ensure fit-up during erection. All steel members were erected prior to casting the deck, then the diaphragms between the PBUs at the closure joints were removed when it was time to transport the units. As a result, minimal adjustment occurred at the final site.

Switch to Steel

The bridge design focused on reducing the weight of the superstructures for both final condition and construction purposes. For this reason, steel girders were used instead of the concrete scheme of the original bridges. The overall superstructure weight reduction prevented the need for advanced geotechnical analysis on the existing abutments and piers, which were reused for the new bridges. The switch from concrete to steel girders resulted in lighter PBUs, ultimately saving on the costs associated with larger capacity cranes and transportation devices.

The design-build delivery method prompted innovative use of steel girders that resulted in benefits to safety, schedule and budget. The steel girder design reduced superstructure depths; at controlling locations, minimum vertical clearances increased from 14 ft, 5 in. to 15 ft, 11 in. for local roads below, improving safety to the traveling public. The design also allowed for an alteration that reduced the number of girders per span from twelve to eight, which decreased the number of PBUs and required cast-in-place deck closure pours. The ripple effect of this change saved both cost and time for the required materials, fabrication, erection and construction of each bridge superstructure.

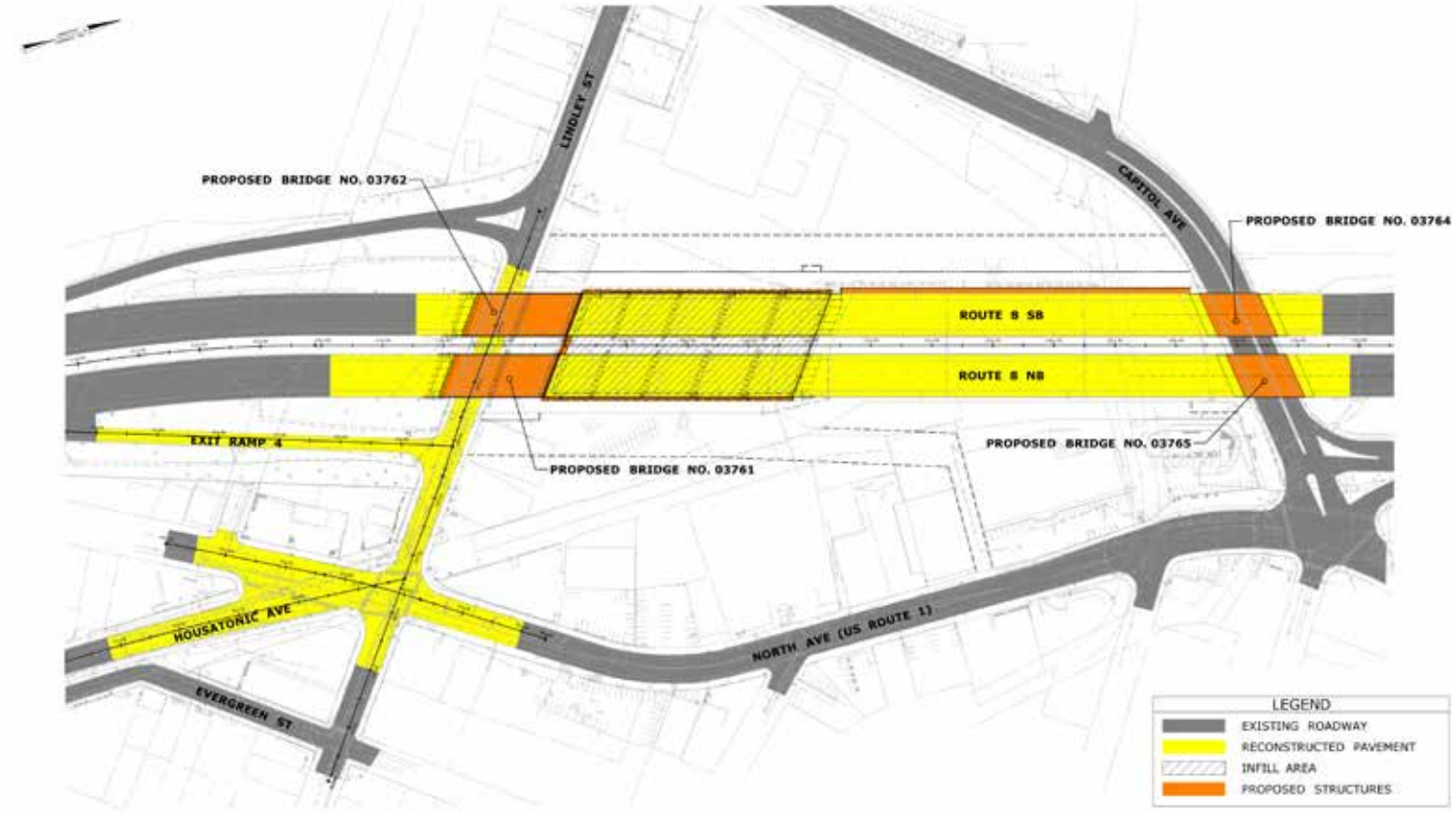
Reduced Maintenance

In the long term, the replacement project will reduce bridge maintenance. The existing bridges over Lindley St. consisted of seven spans, and the new configuration filled in five spans and replaced the final two, resulting in ten fewer spans to inspect and maintain; retaining walls were constructed alongside and below the existing bridge prior to the crossover period to accomplish this. The existing bridges were carefully demolished adjacent to these walls, and fill brought the grade up to match the elevation of the bridge approach.

In addition, the bridge superstructeres are built from weathering steel, which will eliminate the need for future painting. The design incorporates link slabs and semi-integral abutments, which will eliminate bridge joints and associated damage to bearings and concrete, a problem on the original bridge. The existing structures only served for 46 years, and CTDOT was keen on avoiding premature replacement in the future. The new bridges have an expected service life of 75 years.

▲ Highly specialized steerable and adjustable trailers were used to transport the PBUs on local roads to the bridge location.

▼ The PBUs were assembled about a mile from the final bridge locations.



- Seven spans of the existing bridge were demolished within hours of the start of crossover.
- Construction activities were schedule around the clock during the crossover periods.
- The bridge cross section was composed of four PBUs with closure pours between units.

▲ The design team produced visualizations for public information meetings to communicate the project sequencing to the community.

◀ An overhead view of the project layout.

The two crossover periods required round-the-clock construction activity, with more than 100 employees working to further accelerate the schedule. Manafort completed the closure periods a total of four days ahead of the 28-day schedule, and one local paper noted that the project was "likely the fastest bridge replacement project ever seen in Fairfield County." ■

Owner
Connecticut Department of Transportation

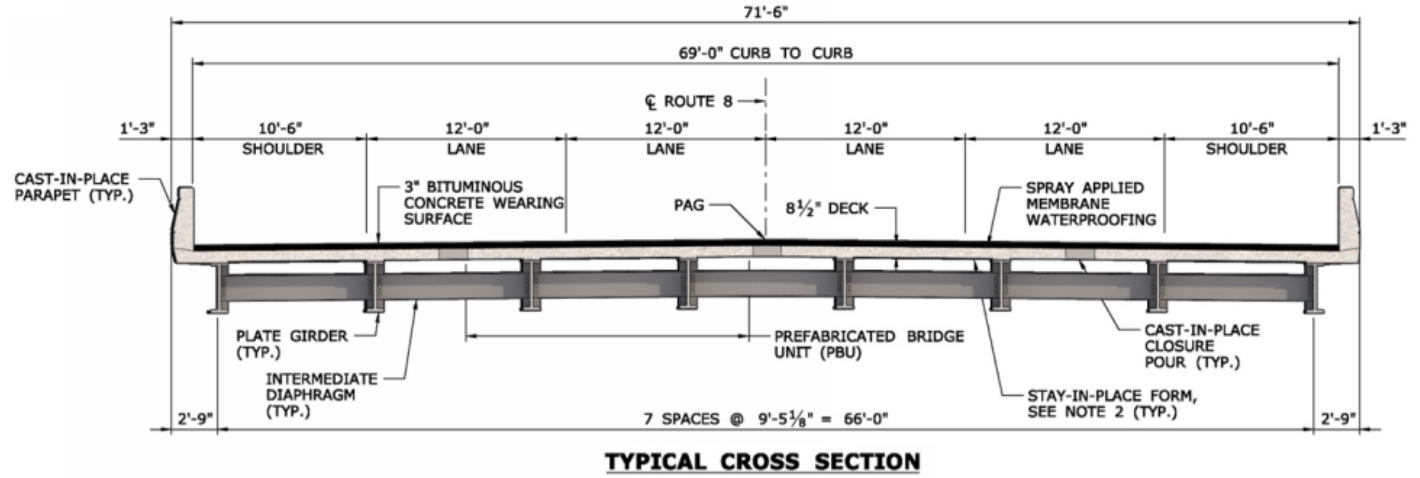
General Contractor
Manafort Brothers, Inc., Plainville, Conn.

Structural Engineer
WSP | Parsons Brinckerhoff, Glastonbury, Conn.

Steel Team

Fabricator
High Steel Structures, LLC, Lancaster, Pa.

Erector
Hartland Building and Restoration Co., East Granby, Conn.



TYPICAL CROSS SECTION