

## PROJECT

# I-84 BRIDGES OVER MARION AVENUE

An accelerated bridge construction success story in Southington, Conn.

by Andrew Lessard, Stantec



Completed project. All photos: Andrew Lessard, Stantec.

For the last few years, state transportation departments across the country have begun using accelerated bridge construction (ABC) to minimize the sometimes-lengthy disruption to the driving public that large construction projects can have. In 2014, the Connecticut Department of Transportation (CTDOT) realized it had an ideal opportunity to employ ABC on a large-scale construction project: the reconstruction of two structurally deficient highway bridges along Interstate 84 (I-84) in Southington, Conn. The resulting effort reconstructed the two heavily traveled bridges in just a single weekend, avoiding what would have been months—or even years—of construction and associated disruption to traffic.

### The Marion Avenue Bridges

The two bridges, which run parallel to each other on the eastbound and westbound sides of I-84, were built in 1963 and each carry three lanes

of traffic over Marion Avenue. The bridges consisted of a similar cross section but slightly different span lengths. In 2008, the state identified the bridges as structurally deficient due to a deteriorating superstructure and moved them into a priority position for reconstruction.

After determining that the substructure was still in good condition and suitable for reuse, the preferred scope of rehabilitation was to reuse the existing concrete abutments and bridge seats. A design plan was developed based on New England bulb-tree (NEBT) 1200 prestressed concrete beams supporting a cast-in-place concrete deck.

As the team got further into design, however, CTDOT began exploring the idea of using an ABC approach to reconstruct the bridges and minimize the significant impact that this type of project would have on traffic. The I-84 Bridges over Marion Avenue project

stood out as a good candidate for ABC thanks to two main factors: schedule and site.

### Schedule

Because all three lanes of traffic in each direction of I-84 would need to stay open during construction, traffic congestion became a major concern. With conventional construction, accommodating that requirement would have entailed an overbuild of the bridges and widening of the existing abutments through four stages of construction. Each stage would have been months long, with significant adverse effects to I-84. With ABC, that duration would be condensed into the period of a few days.

### Site

The bridges comprise the overpass component associated with a diamond interchange, meaning it would be relatively simple to route traffic around construction using the interchange off-

## profile

### I-84 BRIDGES OVER MARION AVENUE / SOUTHINGTON, CONNECTICUT

**OWNER'S LIAISON ENGINEER:** Close, Jensen and Miller P.C., Wethersfield, Conn.

**BRIDGE DESIGN ENGINEER:** Stantec Consulting Services Inc., New Haven, Conn.

**PRIME CONTRACTOR:** Northern Construction Service LLC, Weymouth and Palmer, Mass.

**HEAVY LIFT CONTRACTOR:** Marino Crane/Barnhart Northeast Inc., Middletown, Conn.

**PRECAST BEAM DESIGN:** Eriksson Technologies, Tampa, Fla.

**CONTRACTOR ENGINEERING:** Steere Engineering Inc., Warwick, R.I.

and on-ramps. This also meant that there was a large work area for the contractor to construct the new bridges offline with no impacts to mainline traffic.

### Moving to ABC

The switch to an ABC approach, however, meant the project team had to revise the design—which was now at more than 60% complete and tailored to conventional construction techniques—to ensure it was feasible, while maintaining the proposed project schedule. The original design included NEBT 1200 concrete beams supporting an 8.5-in.-thick, cast-in-place concrete deck with epoxy-coated reinforcement and a 3-in.-thick bituminous overlay. The deck concrete had a design compressive strength of 4 ksi, while the beam concrete was 8 ksi. The existing curb-to-curb width of each bridge was to be maintained at 52 ft 10 in. and the span lengths for the new structure were also the same as those for the existing bridge.

The NEBT 1200 beams were chosen as they allowed the existing vertical clearance over Marion Avenue to be retained without requiring adjustments to the crest vertical curve on I-84



Before construction began at the site of the I-84 Bridges over Marion Avenue.

where the bridges were located. The beams also allowed for reuse of the existing bridge pedestals. Because the abutments were to be reused, the existing curved horizontal alignment was also to be maintained, and was accommodated by varying the fascia overhangs.

Under the new plan, the contractor would remove both of the existing bridges and replace them with new, prebuilt structures using two sets of self-propelled modular transporters (SPMTs). The design team was able to maintain the original framing concept while adjusting the specifications and construction details to accommodate the necessary phasing. Some of the specific adjustments included the

following:

- Allowing more leeway in construction details and dimensions due to potential variations that could result from lifting the bridges using the SPMTs. For example, the interface between the bridge superstructure and abutment backwalls was revised to allow clearance for the lateral movement of the existing and proposed bridges.
- Incorporating the reconstruction of the in-line wingwalls, which required reconstruction to the current CTDOT standard shape, into the initial stages of the project. Concrete parapet closure placements using high-early strength concrete were also detailed to tie the bridge and wingwall parapets together after the new bridges were installed.
- Detailing precast concrete approach slabs with high-early-strength concrete closure placements to minimize the time needed for their installation.
- Ensuring that the site was suitable for the heavy movement patterns of the SPMTs supporting the bridges, and that equipment was available to perform the moves on the site.



Precast concrete approach slabs, cast-in-place concrete deck, and parapet closure placements being prepared for final paving for the I-84 Bridges over Marion Avenue.

### CONNECTICUT DEPARTMENT OF TRANSPORTATION, OWNER

**PRECASTER:** Northeast Precast Products LLC, Cressona, Pa.—a PCI-certified producer

**BRIDGE DESCRIPTION:** Twin 56.67-ft-wide, three-lane bridge structures composed of prestressed concrete beams supporting a cast-in-place concrete deck with an eastbound span of 102 ft and a westbound span of 103 ft.

**STRUCTURAL COMPONENTS:** Each bridge is comprised of 10 PCEF 47 prestressed concrete beams spaced at 5.67 ft on center, with a composite 8.5-in.-thick, cast-in-place concrete deck and 16.5-ft-long, precast concrete approach slabs

**BRIDGE CONSTRUCTION COST:** \$7 million (for both bridges)

- Ensuring each prefabricated bridge, which weighed over 2 million pounds, could withstand the structural loads resulting from being lifted via the SPMT approach. Additional reinforcement was added to the deck at the SPMT pick points to accommodate negative moment. The contractor also established a number of monitoring points and strain gauges in the prestressed beams to check for twisting, rotating, or other movement.
- Providing enough space to accommodate the large SPMT equipment. The revised specifications, therefore, detailed the gore areas between the highway and off ramps to ensure the SPMTs can get into and out of the project site and move around as needed.
- Developing regional and local detour routes that directed traffic away from the project site during the weekend closure.



Moving the new eastbound bridge into place.

**Extensive work was done by the contractor developing and improving upon the ABC concept.**

Once the project was awarded, extensive work was done by the contractor developing and improving upon the ABC concept. Due to timing and availability constraints, the contractor elected to substitute the nearly equal Prestressed

Concrete Committee for Economic Fabrication (PCEF) 47 beams in lieu of the NEBT 1200 beams. The contractor also developed a comprehensive work plan with working drawings including the following:

- SPMT design and configuration—two sets of SPMTs were used. One set was used on the eastbound side to remove the existing and install the new bridges, while the other set was used on the westbound side for new bridge installation only. The existing westbound bridge was

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demolished in place onto Marion Avenue. The design of the SMPT system was challenging due to the weight of the load, as well as the height at which the load was to be carried (30 ft above grade).

- Demolition and erection procedures.
- Temporary abutments to support the new bridges that were being constructed offline and for support of the existing eastbound bridge after its removal using SPMTs.
- Travel path and bridge staging area site improvements beyond what was envisioned on the design plans to ensure the ground would support the 3-million-pound weight of each SPMT loaded with the a new bridge.
- Three-dimensional, finite-element analysis of the bridges subjected to transport loadings.
- A comprehensive contingency plan, including provisions for maintaining backup equipment and staff on-site during the weekend closure.

## Innovation Success

With a plan in place, the contractor began construction of the new bridge superstructures in early 2014. All six lanes of traffic were maintained while the new superstructures were constructed off-line and the site was prepared for the move. By June 2014, the team was ready to make the move, settling into the weekend of June 28 and 29, 2014. In just under 46 hours—12 hours ahead of schedule—the two bridges were lifted into place and reopened to traffic with minor disturbances to the local flow of traffic.

As they were moved into place, traffic was managed through a combination of detour routes and bypass routes around the site. I-84 through traffic was rerouted well in advance of the project site to the east along preferred detour route of I-691 and I-91. I-84 traffic that did not use the detour was channeled to one lane on the existing Marion Avenue off-ramps and immediately back onto I-84 after bypassing the site. Local traffic on



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Marion Avenue was routed around the site as well. These proposed traffic pattern changes were heavily communicated to the public by the state weeks in advance, through such media as public websites, press releases and media coverage, traffic alerts, webcam videos, Intelligent Transportation System message boards, and detour signage.

**The ABC approach ultimately saved months of construction time, condensing major traffic impacts from what could have been years into a period of one weekend.**

The ABC approach ultimately saved months of on-site construction time, condensing major traffic impacts from what could have been years into a period of one weekend. What's more, this approach created a safer work

zone as traffic was entirely closed to the construction site. The state was thrilled with the results and now considers the I-84 Bridges over Marion Avenue project a model for continued ABC efforts across the state.

Perhaps most importantly, this project has allowed the state to make much needed improvements to critical infrastructure within a reasonable budget and schedule. These kinds of improvements create safer, more-reliable infrastructure to serve residents and the surrounding community without imposing the inconveniences of lengthy construction schedules. 

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*Andrew Lessard is a senior associate at Stantec in New Haven, Conn.*

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