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Acceler-8 I-90 Bridge Replacement Project

Southborough & Westborough, Massachusetts



AWARDS

2023 PCI DesignTransportation Award: Best Bridge with a Main Span Up to 75AwardsFeet

PROJECT TEAM

Owner:

Massachusetts Department of Transportation, Boston, Mass.

PCI-Certified Precast Concrete Producer:

JP Carrara & Sons Inc., Middlebury, Vt.

Engineer of Record:

Gill Engineering Associates, Needham, Mass.

AWARDS

General Contractor:

J.F. White Contracting Co., Framingham, Mass.

Project Cost:

\$55 million

Project Size:

Eight bridges with span lengths from 35 ft 6 in. to 70 ft 9 in.

KEY PROJECT ATTRIBUTES

- MassDOT bundled replacement projects for eight bridge structures over II-90 during the summer of 2021.
- Innovative construction techniques and precast concrete systems were used to upgrade the crossings between Worcester and Boston (which serve more than 100,000 drivers per day) while minimizing the project's impact on the traveling public and local residents.
- The use of a single-stem NEXT D beam was a distinctive aspect of the project and allowed for a more efficient cross-section design.

PROJECT/PRECAST SCOPE

- Replace eight bridges in eight weekends over the Massachusetts Turnpike (I-90).
- The six superstructure replacements and the two bridge replacements were completed over six weekends of traffic diversion. Bridge demolition and reconstruction took place over 55-hour weekend closures.
- Each bridge had five NEXT D beams and one single-stem NEXT D beam as well as precast concrete abutment caps, approach slabs, and moment slabs. In total, 48 NEXT D beams were used

Project Overview

The Acceler-8 Interstate 90 (I-90) bridge replacement project outside of Boston epitomized rapid bridge-replacement and bridge-bundling techniques. The challenge was to replace eight bridges in eight weekends during the summer of 2021. The use of precast concrete components was essential to the successful completion of every crossing.

Initially, the Massachusetts Department of Transportation (MassDOT) considered prefabricated bridge units (PBUs) composed of steel beams with a precast concrete deck. However, the final design used Northeast Extreme Tee Deck (NEXT D) beams as an alternative technical concept along with precast concrete approach slabs and abutment caps.

"We chose an innovative solution and selected precast, prestressed NEXT D beams. NEXT D beams were more economical than the proposed PBU option from the base technical concept, due to lower material and fabrication costs, including reduced handling. PBUs require fabrication in both steel and precast concrete plants, whereas NEXT D beams require fabrication in only a precasting plant," says Joseph Gill, PE, president, Gill Engineering.

The use of a single-stem NEXT D beam was a distinctive feature of this project and allowed for a more efficient cross-section design. However, stability of the beam during storage, transportation, and erection needed to be addressed. NEXT D beams are extremely robust. Their beefy stems can tolerate significant deterioration before structural integrity is compromised. The fabricator also used a high-performance, self-consolidating concrete (SCC) mixture, which typically achieves 28-day compressive strength of 10,000 psi. The NEXT D beams were designed for a compressive strength of 8000 psi, and the additional strength will improve the structure's service life. This same SCC mixture was used in the abutment caps, approach slab panels, and moment slabs, all of which were designed assuming a 4000-psi strength. The NEXT D beams will also reduce maintenance costs by eliminating the need to repaint steel beams in the future.

Long Summer Weekends

To prepare for the targeted weekend road closures, cast-in-place concrete micropile foundations, abutment stems, and wing walls were constructed and backfilled under the existing approach spans in the months before the planned closures. The six superstructure replacements and the two bridge replacements were completed over six weekends of traffic diversion. During each 55-hour weekend, all traffic was consolidated into one barrel of the roadway (eastbound or westbound), carrying two lanes in each direction. This traffic setup was implemented with crossovers and movable barriers. Typically, demotion would be completed by around 10:00 a.m. on Saturday, and after cleanup, precast concrete erection would begin around 12:00 noon and would be completed by approximately 6:00 p.m. Each completed bridge was reopened to traffic by 5:00 a.m. on Monday.

Each weekend project required 60 precast concrete pieces for the accelerated bridge construction. Some of the precast concrete pieces weighed more than 60,000 lb, so a heavy crane was required to hoist them into place. Trucks delivering precast concrete bridge components from the precast concrete producer's facility were dropped at a storage lot and

during the weekend were staged along I-90 and local roads.

"One challenge was addressing the beam camber," says Gill. Because the design used an 8in.-thick deck and no haunch, "all variations in the camber needed to be addressed with variable thickness of paving on the approaches and along the beams." The prestressed beams were surveyed after fabrication to determine the actual camber. The project team revised the seat elevations during construction by lowering the horizontal saw cuts in the rehabilitated abutments and lowering the seat elevations of the cast-in-place abutments, to ensure that the final beam position would properly conform to the roadway profiles. After final placement, additional surveying ensured that the asphalt pavement would meet the final roadway profile and provide a smooth ride.

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