

## PROJECT

# Northwest Corridor Express Lanes

by Alan Kite, Parsons Corporation

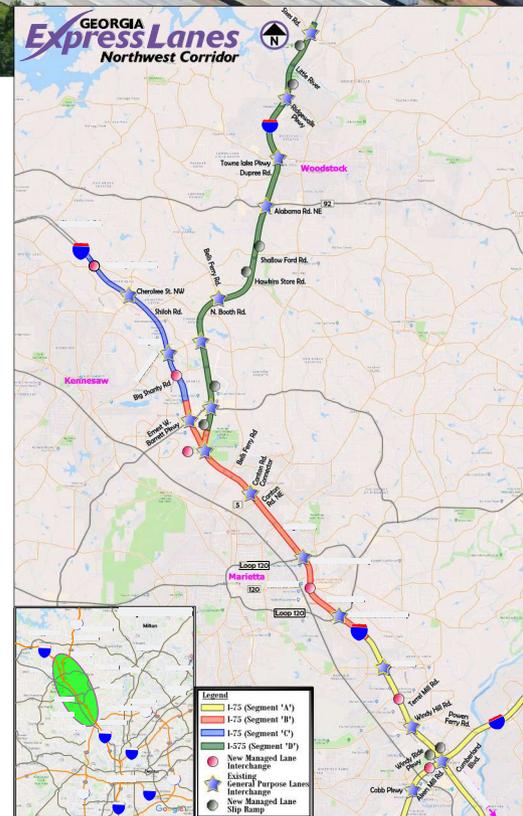
Aerial view of a mainline bridge. Bridge 25 parallels existing Interstate 75 southbound lanes and is over 1 mile long. Photo: Aerial Innovations of Georgia Inc.

The Interstate 75/Interstate 575 (I-75/I-575) corridor northwest of the Atlanta Beltway, or Interstate 285 (I-285), runs through a densely populated and rapidly growing section in the Atlanta, Ga., metropolitan area. This corridor currently accommodates 297,000 vehicles per day, which almost meets the traffic projection of 310,000 vehicles per day by 2035 per the project's environmental assessment. Several planning studies over the past 15 years have looked for economical alternatives to alleviate daily traffic congestion, increase traffic capacity, and provide a construction scheme with minimal impact on existing traffic. In the fall of 2013, a public-private partnership, design-build-finance contract was executed to construct reversible managed toll lanes that will allow drivers to choose to pay a dynamically priced toll to bypass congestion.

The project extended from the I-285 (Atlanta Beltway)/I-75 interchange

parallel to I-75 to Hickory Grove Road (approximately 17 miles) and from the I-75/I-575 interchange parallel to I-575 to Sixes Road (approximately 12 miles). The project scope included 39 bridges, two major interchanges, roadway, signing, tolling facilities, intelligent transportation systems, and all ancillary structures for the project. Flyover ramps within the I-75/I-285 interchange are up to 2827 ft long with span lengths up to 175 ft and pier heights up to 90 ft to cross numerous roadways, existing flyover ramps, and irregular terrain.

Prestressed concrete girders were used on several of the interchange bridges to construct cost-effective and low-maintenance structures. North of the I-75/I-575 interchange, mainline viaduct superstructures are 39.25 ft wide with four prestressed concrete bulb-tee beams, 72 to 74 in. deep, supported on single-column hammerhead piers. Bridge lengths range from 1298 to 5981 ft to span over existing local roads, railroads, streams, wetlands, and



Project location and vicinity map. All Figures: Parsons.

## profile

### NORTHWEST CORRIDOR EXPRESS LANES / MARIETTA, GEORGIA

**BRIDGE DESIGN ENGINEER:** Parsons, Peachtree Corners, Ga.

**OTHER BRIDGE CONSULTANT:** Heath & Lineback Engineers, Marietta, Ga.

**PRIME CONTRACTOR:** Northwest Express Roadbuilders, a joint venture of Archer Western and Hubbard Construction Company, Marietta, Ga.

**PRECASTER:** Standard Concrete Products, Atlanta, Ga.—a PCI-certified producer

**POST-TENSIONING CONTRACTOR:** Freyssinet Inc., Sterling, Va.

**OTHER MATERIAL SUPPLIERS:** Mechanically stabilized earth wall panel fabricator: Reinforced Earth Company, Atlanta, Ga.; noise barrier panel fabricator: Oldcastle Precast Inc., Newnan, Ga.—a PCI-certified producer

on/off ramps to I-75. Throughout the project corridor, smaller bridges were used to span over local roads and streams.

The \$654 million design-build-finance project required a fast-paced design schedule, with all bridge and structure design to be completed in 15 months. To meet this schedule, design teams were established in six Parsons offices (Atlanta, Ga.; Baltimore, Md.; Boston, Mass.; Chicago, Ill.; Orlando, Fla.; and Washington, D.C.) and the local office of Heath & Lineback Engineers to create the design and generate contract documents. Each office was assigned bridges with similar superstructure and substructure types and similar span arrangements to provide design consistency and an efficient design that met the design schedule. Another advantage of using multiple offices was that it allowed independent design checks on major bridge elements to be performed by engineers not directly involved in the initial design.

Prior to the start of design, a project-specific design criterion was written that included contract-specific requirements, Georgia Department of Transportation (GDOT) bridge standards, and contractor-preferred materials (for example, concrete strengths), where applicable.

Precast concrete girders were selected because rapid construction was critical to meeting the schedule, and because of their additional benefits of high durability, low maintenance, excellent quality, and low cost relative to other construction materials. In addition, standard details were established and provided to each bridge design team to ensure project-wide design and detailing consistencies. Weekly conference calls

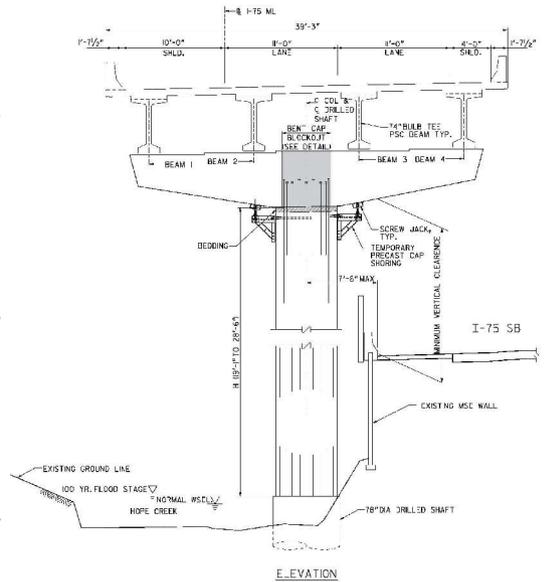
with all offices were held to discuss design issues, the use of similar details, and adherence to the design schedules.

### Precast Concrete Pier Caps

Numerous project challenges related to site conditions and economical construction methods had to be resolved at various locations along the alignment. At one project location, a proposed 3500-ft-long bridge would be adjacent to the existing I-75 roadway. A mechanically stabilized earth (MSE) wall supported the existing fill, with a stream and environmentally sensitive wetlands located at the bottom of the wall and running parallel to the interstate. Eighteen single-column piers along the proposed bridge were to be constructed in the narrow wetlands area between the stream and the wall.

During the early stages of the project, it was evident that access to the site, traffic maintenance, and minimizing impact on the wetlands would be a major challenge. Two alternatives were evaluated: building a conventional temporary work bridge, and using accelerated bridge construction methods with precast concrete pier elements. Ultimately, it was decided to perform all major construction activities from the existing southbound interstate shoulder with limited nighttime lane closures.

The piers are founded on 78-in.-diameter drilled mon shafts. Excavated spoil was contained with permanent casings that were installed with drilling equipment staged on the southbound I-75 shoulder. The maximum offset from the existing I-75 southbound curb to the centerline of the pier shaft was limited to 7.5 ft. This distance was dictated by the practical reach of the drilling rig as well as the maximum allowable surcharge



Cross section of a 3300-ft-long bridge adjacent and parallel to southbound Interstate 75, the existing retaining wall, and wetlands. Figure: Parsons.

pressure behind the existing MSE wall. This system minimized the impact on the environmentally sensitive wetlands area, remained within the required vertical and lateral structural loading capacities, and limited traffic interruptions.

Precast concrete caps were cast by the contractor at a yard located approximately 5 miles from the pier construction site. The precast concrete units were transported individually using a single specialized-permit vehicle. A rapid setup/takedown type of crane was used to erect the precast concrete caps onto a temporary support bracket attached to the top of the column. The temporary shoring bracket included screw jacks mounted on top of the pier column to support and provide geometry control to the precast concrete cap before the connection was cast.

A cast-in-place concrete bedding layer between the top of column and bottom of cap was used to provide

## GEORGIA DEPARTMENT OF TRANSPORTATION, OWNER

**BRIDGE DESCRIPTION:** The project included 39 bridges; mainline bridges were between 807 and 5981 ft long and 29 ft 3 in. to 39 ft 3 in. wide. Mainline bridge superstructures have a 7½ in. thick cast-in-place concrete deck and prestressed concrete girders.

**STRUCTURAL COMPONENTS:** Mainline bridges used BT72 and BT74 prestressed concrete bulb-tee girders supported on single-column hammerhead piers and drilled shafts or piles; precast concrete pier caps; and precast concrete post-tensioned straddle-beam piers

**BRIDGE CONSTRUCTION COST:** \$131 million

**AWARDS:** 2018 *Roads & Bridges* #1 Road; Georgia Engineering Excellence Award Winner in Transportation; Georgia Partnership for Transportation Quality Preconstruction Design Award Grand Prize Winner; Precast Concrete Institute 2019 Design Award Main Span More than 150 Feet



Erection of a precast concrete pier cap from the adjacent Interstate 75 shoulder. Photo: Northwest Express Roadbuilders.



Lifting the post-tensioned precast concrete portion of a straddle bent cap from the fill embankment. The top of the embankment was constructed at the same slope as the final cap geometry to control the geometry of the formwork and post-tensioning ducts. The bottom segment of the cap was cast on the ground and lifted into place after post-tensioning. The top portion of the cap was then cast in place. Photo: Northwest Express Roadbuilders.

construction tolerance and to position the precast concrete cap. The cap-column connection was established using a filleted rectangular blockout (with 7.375 in. chamfers at each corner) in the precast concrete cap. Headed dowels, confined by heavy transverse reinforcement, reinforced the connection zone.

The precast concrete cap reinforcement was detailed to avoid conflict with the headed dowels. The size and reinforcement detailing of the connection were designed to utilize standard strength concrete ( $f'_c = 4.5$  ksi). Constructing the pier column from the I-75 shoulder and using precast concrete elements efficiently minimized both traffic disruptions and the environmental impact of the project.

### Precast, Post-Tensioned Straddle Bent Caps

At a second site, an 806.5-ft-long, six-span bridge carries the I-75 express roadway over the existing I-75 southbound lanes. The roadway's horizontal alignment at the bridge is highly skewed with respect to the roadway below and consists of two reverse curves with a short tangent between the curves. The overall width of the bridge varies from 29 ft 3 in. to 35 ft 3 in.

Given these geometric constraints and the presence of existing roadways under

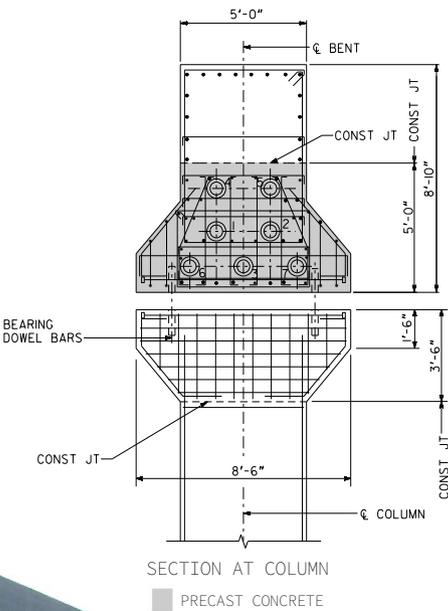
the bridge, three types of intermediate piers were used: conventional hammerhead on a single column, inverted-tee hammerhead on a single column, and inverted-tee straddle bent on two columns. The inverted-tee hammerhead pier caps were used in two of the intermediate bents to mitigate the limitations on the available vertical clearance under the bridge.

A straddle bent was selected primarily because of the sharp skew angle and to keep the maximum span lengths around 150 ft, which would make the best use of precast concrete girders. The location of the straddle bent was chosen to minimize its length and to balance loads from the adjacent spans.

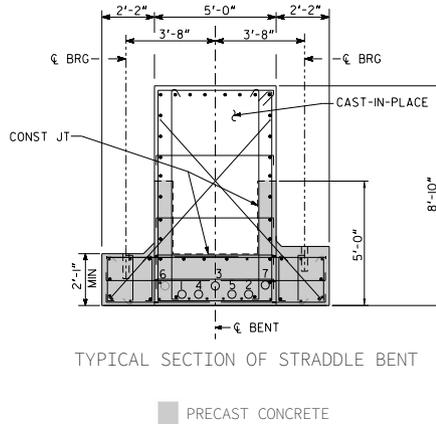
To make the straddle bent, a fill embankment with the same slope as the final slope of the precast concrete bent cap was constructed; this facilitated geometric control of the formwork and the post-tensioning ducts. The precast concrete bent cap was cast on site, adjacent to the final bent location, and post-tensioned and grouted while on the ground. The precast concrete cross section was a "U" shape to allow for seven ducts, each with nineteen 0.6-in.-diameter strands tensioned in a single-stage post-tensioning operation. The concrete for the cap was at least 14 days old and had reached a compressive strength of 7 ksi (which was also the 28-day

design strength) before tensioning. The "U" shape also minimized the lifting weight (210 kip) and provided part of the formwork for the cast-in-place concrete after the precast concrete member was erected on the columns. The prestressed beam seats were constructed as part of the precast concrete section, with 2-ft 2-in.-wide ledges on each side of the 5-ft-wide core precast concrete section. During a temporary nighttime (11:00 p.m. to 4:00 a.m.) shutdown of the existing southbound I-75, traffic was detoured to adjacent roadways and I-285. During this time, two 300-metric-ton mobile hydraulic cranes were used to lift the cap and place it on top of the columns. The formwork for the cast-in-place portion of the bent cap was then lifted and connected to the precast concrete section. The cast-in-place concrete was placed later with protection measures in place while traffic was maintained below.

The cast-in-place portion of the bent cap reached a minimum strength of 5 ksi before the prestressed concrete girders were erected. To maintain structural stability of the precast concrete section after erection on the columns, the top of the 5-ft-wide column was flared to 8 ft 6 in. wide in the longitudinal direction. The precast concrete cap width was similarly flared to 8 ft 6 in. to accommodate two bearings at each column.



Cross section of a straddle bent cap. The shaded area is the precast concrete section with seven post-tensioning ducts and longitudinal girder bearing seats. The cast-in-place concrete portion of the section was placed after cap erection and over traffic.

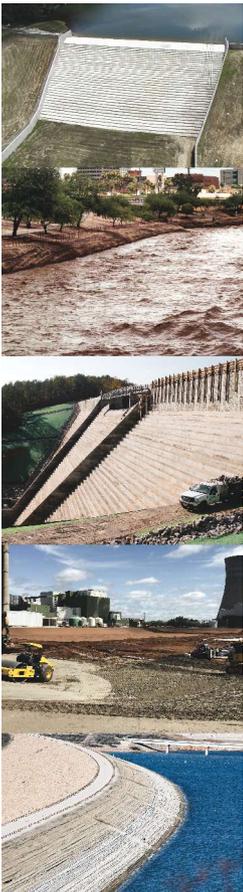


## Conclusion

The Northwest Corridor Express Lanes opened to traffic in September 2018 after 5 years of design and construction. During the first month of operation, more than 20,000 vehicles per day were using the express lanes, far exceeding initial projections. The 29.7-mile-long corridor is the longest installation in the Georgia express lane system and has received glowing reviews from the traveling public and GDOT, which noted that the project has set the bar for future mega-design-build project delivery within Georgia and around the country. 

*Alan Kite is a senior project manager with Parsons Corporation in Baltimore, Md., and was the lead structural engineer for the Northwest Corridor Express Lanes project.*

A straddle bent with flared ends to support two bearings at each end of the pier cap. Photo: Parsons.



**PCA**  Since 1916  
America's Cement Manufacturers™

## WATER RESOURCES

Concrete | Roller Compacted Concrete | Soil-Cement

- DAMS
- OVERTOPPING PROTECTION
- FLOOD CONTROL
- EMBANKMENT PROTECTION
- WATER SUPPLY
- LINERS

[www.cement.org/water](http://www.cement.org/water)

