Courtland Street Bridge Replacement Project—Tight Space, Tight Schedule

by Al Bowman, Michael Baker International, and Mike Nadolski, C.W. Matthews Contracting Company

The partnering approach taken by the Georgia Department of Transportation, Michael Baker International, and C.W. Matthews ensured that the Courtland Street Bridge project could be executed rapidly despite a constricted urban site. All Photos: Georgia Department of Transportation.

A vital lifeline in Atlanta, Ga., the Courtland Street Bridge provides access to the state capitol and Georgia State University. This bridge replacement project was contracted by the Georgia Department of Transportation (GDOT) as a design-build collaboration between Georgia firms C.W. Matthews Contracting Company and Michael Baker International.

Between May and October 2018, the project replaced the 110-year-old Courtland Street Bridge in downtown Atlanta in just 155 days. The design-build team used micropiles, precast concrete beams, high early-strength concrete, and innovative phased-design packages to meet this aggressive schedule. While replacing this historic bridge, the team resolved challenges involving extensive utilities, a severely constricted right-of-way, and multiple safety and stakeholder coordination issues.

Historical Background

At the start of the 20th century, the railroad system that was helping Atlanta grow also divided the city, inconveniencing residents and prompting calls for a viaduct on Washington Street to help with traffic flow. Rail companies also had a stake in developing a viaduct because they wanted to close a nearby crossing to modify their railyard operations. In 1906, after several years of debate, the Atlanta City Council approved construction of the Washington Street Viaduct (as the Courtland Street Bridge was then called).

The original 28-span bridge was 1546 ft long and approximate 58 ft wide, with 8-ft-wide sidewalks on both sides. The existing bridge had multiple configurations; it included steel spans over the railroad and to the south and used reinforced concrete spans from the approaches to the abutments. The project, which became Atlanta's longest viaduct, took roughly 18 months and

profile

COURTLAND STREET BRIDGE / ATLANTA, GEORGIA

DESIGN ENGINEER: Michael Baker International, Norcross, Ga.

PRIME CONTRACTOR: C.W. Matthews Contracting Company, Marietta, Ga.

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

OTHER BRIDGE CONSULTANTS: Bridge deck drainage: Aulick Engineering, Atlanta, Ga.; lighting: Key Engineering, Decatur, Ala.; micropiles: Hayward Baker, Hanover, Md.

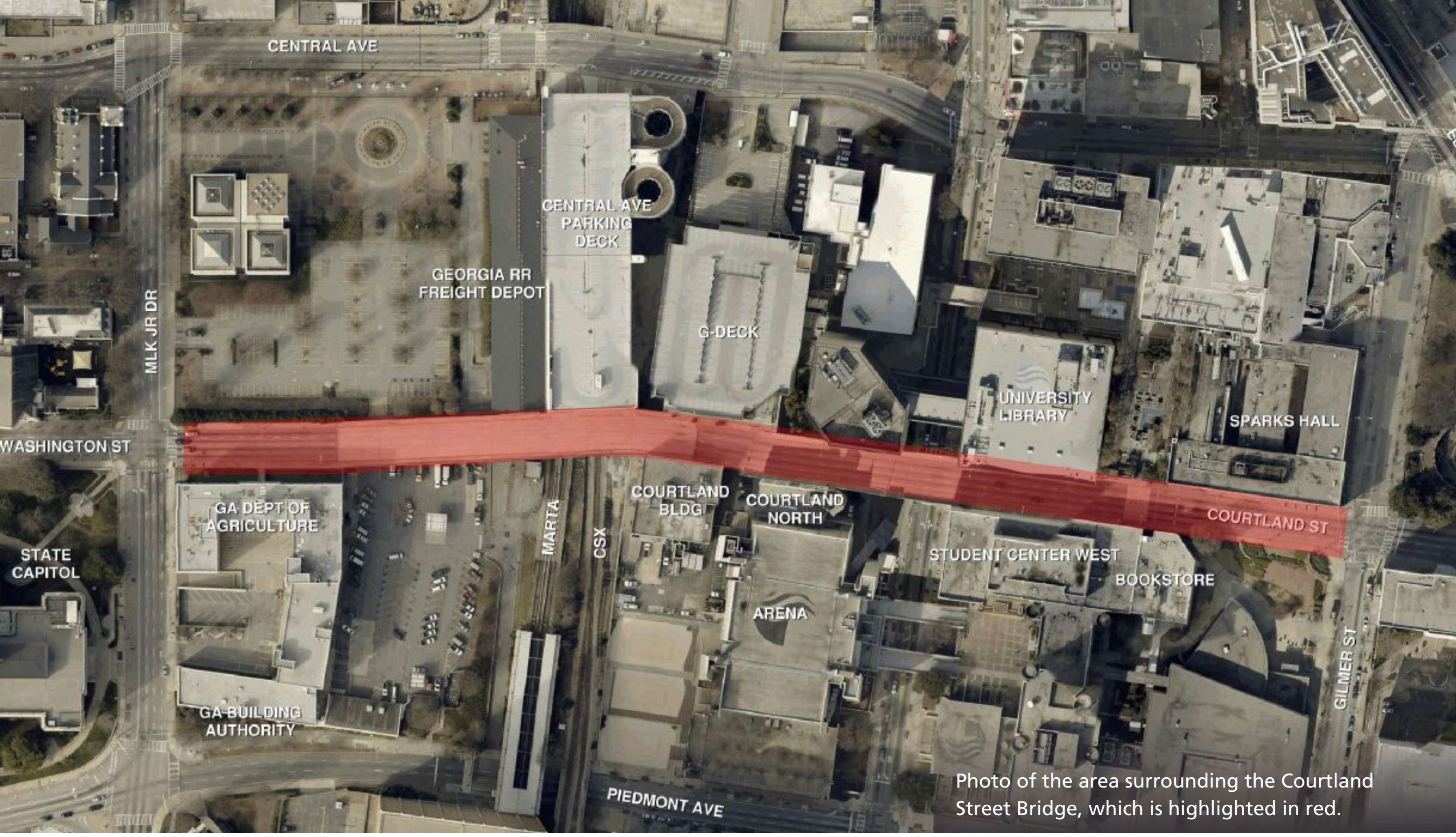


Photo of the area surrounding the Courtland Street Bridge, which is highlighted in red.

cost $126,180, with the railroads paying most costs and the city paying the rest.

The Washington Street Viaduct opened in September 1907. In 1909, the Auditorium and Armory was built nearby. This cultural facility, which hosted events such as the Metropolitan Opera's visits to Atlanta, helped make the thoroughfare a bustling center for Atlanta's social and business functions. In 1913, Georgia Tech (the predecessor to Georgia State University) established a presence next to the viaduct. Today, Georgia State University's urban campus is split by the Courtland Street Bridge; the Auditorium and Armory is now Georgia State's Dahlberg Hall.

Project Strategies

Before 2018, repair work on the Courtland Street Bridge had included reconstruction projects in 1950 and 1995. However, the increased volume and size of vehicles crossing the bridge prompted GDOT to seek a more permanent and lasting solution. To minimize the time the bridge would be out of service, GDOT opted to reconstruct the bridge using a design-build approach, including accelerated bridge construction (ABC) techniques.

From project inception, the design-build team recognized that utility conflicts and a restricted right-of-way posed major challenges. Conventional ABC techniques were not viable on this project due to the constricted right-of-way; therefore, the optimal way to meet project schedule goals was through an aggressive work schedule and innovative use of materials.

Using subsurface utility plans completed by GDOT, the team created

New bridge bents were constructed beneath the existing bridge while it remained open. This technique shaved several months off the road closure.

GEORGIA DEPARTMENT OF TRANSPORTATION, OWNER

BRIDGE DESCRIPTION: 1130-ft-long, 58-ft-wide, 12-span prestressed concrete girder bridge with cast-in-place concrete bents on micropile foundations

STRUCTURAL COMPONENTS: 142 micropiles, 13 concrete bents, 36 AASHTO-Type III beams totaling 2666 ft in length, 28 BT-54 beams totaling 2502 ft in length, eight BT-63 beams totaling 1015 ft in length, 14 BT-65 beams totaling 1871 ft in length, and an 8¼-in.-thick cast-in-place concrete deck

CONSTRUCTION COST: $21 million

AWARD: 2018 Georgia Partnership for Transportation Quality Preconstruction Award—Design-Build

Several prestressed concrete girders have been placed for the span in the foreground. Because of the confined site, the crane had to back out after all girders were set for a span so the cap for the next span could be constructed.

Prestressed concrete girders have been erected and forms set for placement of the deck.

The completed Courtland Street Bridge.

scaled-foundation cutouts from clear plastic stock to determine where and how foundations could be placed to avoid the most utilities and provide acceptable span lengths that could be accommodated by equipment and the limited access in the constrained workspace. In addition to the extensive utilities, a series of driveways and pedestrian access to two parking garages also had to be maintained.

Adding to the project's complexity, the existing Courtland Street Bridge had several different types of foundations that had been retrofitted over the years. Furthermore, while using ground-penetrating radar to determine the extents and types of foundations, the team discovered that a building had been constructed around one of the bridge's foundations.

To overcome the array of challenges, the team plotted all the driveways, utilities, and existing footings to determine the appropriate span lengths that would minimize site conflicts while allowing for material deliveries in the narrow right-of-way. This plan worked well, and all but five footings were built without conflicts to utilities and existing footings.

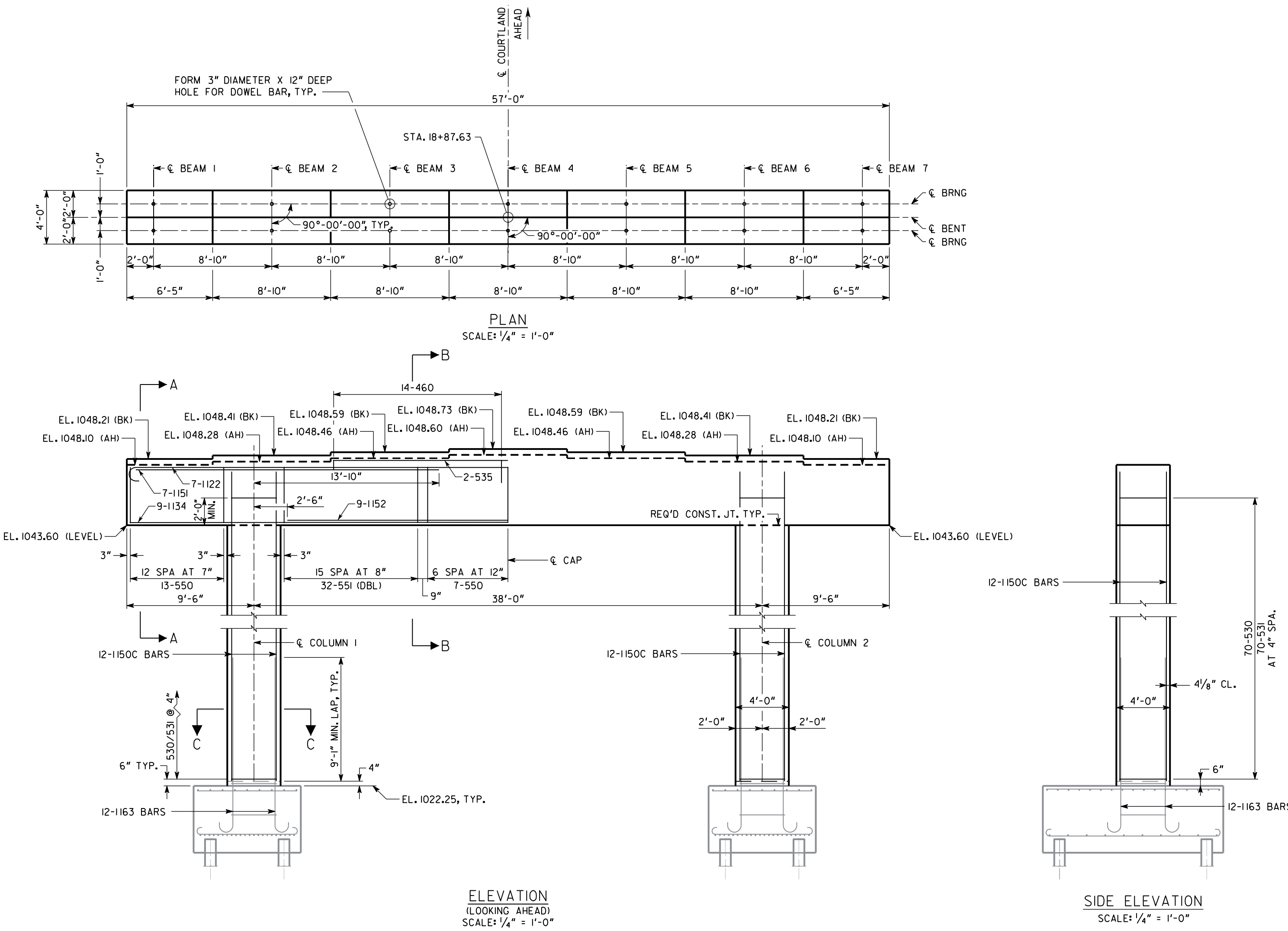
Micropile foundations were selected because they offered multiple advantages over other deep foundation types. First, they could be installed with low-overhead equipment beneath the existing bridge while it remained in service, which was important because the space between the ground and the old bridge was as low as 12 ft in some areas. Second, micropiles—with their drilled installation method—would not risk vibration damage to the surrounding structures. Third, micropiles generally have more capacity than traditional piles; therefore, fewer were needed, which helped to avoid utility conflicts.

The 9.625-in.-diameter micropiles were installed 80 to 90 ft deep in bedrock and bonded using high-strength grout. These piles carried a factored axial load of 555 kip downward and 125 kip in uplift. The uplift capacity allowed the designers to minimize the footing sizes, further aiding in the avoidance of utilities and other subsurface obstacles. Because of the constricted construction space, beam-erecting equipment had to be placed within the footprint of the project. This limited most spans to less than 90 ft in the vicinity of the Georgia State campus. Multiple types and sizes of prestressed concrete beams were used because they proved to be an economical solution. Once a span of beams was placed, the crane would back out of that span and the substructure cap of the next span would be formed and placed.

Given the aggressive project schedule, waiting the typical 10 or more days for concrete to reach its required strength was not a viable option. Working with a concrete supplier, the design-build team developed high-early-strength concrete that could achieve the required strength within 24 hours. Using precast concrete bridge piers with a grouted connection was considered, but this option was not selected because the proposed bridge was wide and would have required thick bridge caps, which would have been difficult to transport given the restricted project site.

Using prefabricated steel diaphragms at midspan is a common practice in Georgia; however, to expedite this project, the team took the unusual step of using a steel diaphragm at the end of each span. A Georgia first, the team's use of prefabricated steel k-frames at each end eliminated the labor needed to form the traditional cast-in-place concrete end diaphragms, thereby reducing the time needed for each span placement by one week. This innovative approach helped ensure that the project stayed on schedule.

An important project requirement was limiting closure of the bridge to six months. The construction team had a 24/7 presence on the project once the bridge was closed. To meet the aggressive project schedule, an innovative phased approach to the design, as well as the construction, was used. The team was given its notice to proceed in September 2017. The goal was to have the contractor installing foundations by January 1, 2018, and setting the thousands of feet of precast, prestressed concrete beams by May 2018. To that end, the designers worked with GDOT to gain approval of the foundation and beam designs before the drawings for the entire



Intermediate bent details for the Courtland Street Bridge. High-early-strength concrete was used to achieve the design concrete compressive strength within 24 hours. Figure: Michael Baker International.

bridge were completed. Early approval of these phased packages allowed construction of the project to progress on schedule while other, minor details were still being discussed.

Demolition Challenges

Demolition began in May 2018, coinciding with the end of the spring semester at Georgia State. The construction team deployed two demolition contractors, which worked in opposite directions (north and south) starting at the railroad tracks.

During demolition, stakeholder engagement and safety precautions were vital. In some places, only ½ in. of expansion material separated the demolition area from nearby buildings, which included one building that had historic preservation status. The university's summer session was also underway; therefore, in-depth stakeholder coordination was required to maintain safe egress zones around the construction site. Demolition over the Metropolitan Atlanta Rapid Transit Authority and CSX railway corridor posed even more challenges because work could only occur there for 90 minutes a night.

Conclusion

The new, 12-span Courtland Street Bridge is 1130 ft long and 58 ft wide with a cast-in-place deck, 86 prestressed concrete bulb-tee and AASHTO-Type III girders, and cast-in-place concrete bents supported on micropiles. Its structural components include 142 micropiles, 13 concrete bents, 36 Type III beams, 28 BT-54 beams, 8 BT-63 beams, and 14 BT-65 beams. The design-build team's expertise, GDOT's flexibility, and Georgia State University's cooperation were all essential to overcome the logistical challenges of rebuilding this important historical connection through the heart of Atlanta.

Al Bowman is the director of transportation for Michael Baker International in Norcross, Ga. Mike Nadolski is a project manager with C.W. Matthews Contracting Company in Marietta, Ga.