Fifth Street
Pedestrian Plaza Bridge

by Jim Aitken, ARCADIS U.S. Inc.; Mike Clements, Georgia DOT; and Tim Schmitz, formerly with ARCADIS U.S. Inc.

The newly constructed Fifth Street Bridge over I-75/I-85 provides a user-friendly environment with a roadway, traffic lanes, bicycle lanes, sidewalks, lawns, and planters. Photo: ARCADIS U.S. Inc.

Reconnecting Neighborhoods in Midtown, Atlanta

Original Fifth Street Bridge. Photo: Sunbelt Structures Inc.

Located in the heart of Midtown, the recently completed Fifth Street Bridge is quite unlike other bridges that cross the I-75/I-85 downtown connector in Atlanta, Georgia. At bridge level, it is difficult to tell that this is a bridge at all. It more closely resembles a small park with wide sidewalks, grassy lawns, shrubbery, and benches. Trees and a trellis provide shade from the intense summer sun that beats down on Atlanta.

The new Fifth Street Bridge reconnects neighborhoods that were once isolated from the downtown area by the 16 lanes of northbound and southbound traffic on I-75/I-85. It links the main Georgia Institute of Technology campus to the university's east campus at Technology Square, which was completed in 2003. Technology Square is home to a hotel and conference center; the College of Management; Georgia Tech Global Learning Center; Economic Development Institute; Center for Quality Growth and Regional Development; Georgia Tech Bookstore; and a host of restaurants, shops, and other businesses. The entire Midtown community is now unified by this inviting green span that provides a pedestrian-, bicycle-, and transit-friendly connection over the vehicular traffic that uses Atlanta's streets daily.

The original Fifth Street Bridge was constructed in the mid-1980s as a two-span, continuous steel-plate-girder

profile

FIFTH STREET PEDESTRIAN PLAZA BRIDGE / ATLANTA, GEORGIA

ENGINEER: ARCADIS U.S. Inc., Atlanta, Ga.

TIEBACK WALL ENGINEER: Hayward Baker Inc., Alpharetta, Ga.

ARCHITECT: Smallwood, Reynolds, Stewart, Stewart & Associates, Atlanta, Ga.

PRIME CONTRACTOR: Sunbelt Structures Inc., Tucker, Ga.

PRECASTER (BEAMS): Standard Concrete Products, Atlanta, Ga., a PCI-Certified Producer

PRECASTER (MSE AND MISCELLANEOUS PRECAST PANELS): MC Precast Inc., Atlanta, Ga.

AWARDS: *2007 PCI Bridge Design Award for the Best Non-Highway Bridge and Co-Winner of the Best Sustainable Design*

Precast, prestressed concrete beams were selected as the most economical solution.

bridge, 228 ft 4 in. long and 70 ft 5 in. wide. The roadway carried four 12-ft-wide lanes and two 8-ft-wide sidewalks. Concrete parapets with a chain link fence formed the railings on each side of the bridge. The end bents were constructed on retaining walls at each end, with a cast-in-place (CIP) wall at the west end and a tieback wall at the east end. During the construction of Technology Square, Fifth Street underwent a major renovation that featured wide sidewalks and special lighting, both on and off campus. To complete the renovation, Georgia Tech initiated a meeting with the Georgia Department of Transportation (GDOT) officials to discuss replacement of the Fifth Street Bridge.

The university wanted a signature bridge that would create approximately three-quarters of an acre of green space with 25-ft-wide sidewalks to match the sidewalks at the ends of the bridge, as well as planters, benches, decorative lighting, and a trellis to serve as a shaded area for the campus trolley stop. The walls and planters would be wide enough and high enough to obstruct the view of the interstate below the bridge. In addition, the original plan called for removal of the existing bridge and completion of the traffic lanes and sidewalks of the new bridge, without interruption to vehicular or pedestrian traffic, by the beginning of the 2006 football season. The total bridge width, including roadway, bicycle lanes, sidewalks, lawns, and planters, would be 250 ft 3 in. However, the Federal Highway Administration required that the proposed structure provide for future high-occupancy vehicle expansion of the downtown connector. Therefore, it was necessary to increase the bridge length to 256 ft 6 in. and reduce the bridge width to 223 ft 3 in.

A wide sidewalk and trellis were used on the south side of the plaza. Photo: ARCADIS U.S. Inc.

GDOT decided that the best way to meet the requirements of all parties involved was to award the project as a design-build project with an accelerated schedule. Ten design-build teams submitted Statements of Qualifications in November 2003, and a shortlist of five teams was released in February 2004. The project was advertised in April 2004 and awarded to the winning team of Sunbelt Structures Inc. (Sunbelt) and ARCADIS in June 2004. The entire process was greatly accelerated, especially in the planning stages. On average, a GDOT project of this size and nature takes approximately 10 years from the initial concept to the letting phase, whereas Fifth Street took just 10 months. Notice to Proceed was issued July 22, 2004.

ARCADIS served as the project designer and performed all roadway, drainage, electrical, and structural design, with the exception of the abutment at the east end of the bridge. Hayward Baker Inc. designed this abutment as a tieback wall abutment due to the presence of an existing tieback wall that complicated the design and construction. The contractor, Sunbelt, was responsible for construction of the entire project.

Planters were used on the north side of the bridge to hide the interstate. Photo: ARCADIS U.S. Inc.

The new Fifth Street Bridge is a two-span bridge with span lengths of 137 ft and 119 ft 6 in. Precast, prestressed concrete beams were selected by the design-build team during the prebid phase as the most economical solution for the new structure. The final design used twenty-eight 74-in.-deep modified AASHTO bulb-tee beams in span 1. The modifications consisted of increasing the depth of the bottom flange and width of the beam by 2 in. over the entire height of the beam to fit an additional strand per row in the bottom flange and web. Span 2 used twenty-six 74-in.-deep bulb-tee beams without the additional 2 in. width. The large dead loads associated with the landscaping, planters, and sidewalks necessitated the use of the deep beam and modified section. In addition, the beams were designed and constructed using high performance concrete with a 28-day specified compressive strength of 10,000 psi and 0.6-in.-diameter strands. Structural steel diaphragms made up of 6 x 6-in. angles were used instead of GDOT's typical CIP concrete diaphragms. These were installed more quickly and provided lateral support to the beams almost as soon as they were erected.

PRECAST, PRESTRESSED CONCRETE / GEORGIA DEPARTMENT OF TRANSPORTATION AND GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA, GA., OWNER

PRECAST SPECIALTY ENGINEER (MSE WALLS): Reinforced Earth Co., Norcross, Ga.

PRECAST SPECIALTY ENGINEER (PLANTER WALLS): Wolverton & Associates, Duluth, Ga.

BRIDGE DESCRIPTION: Two-span bridge with precast, prestressed concrete beams and cast-in-place concrete deck supporting unusual loads including planting areas up to 9-ft high

STRUCTURAL COMPONENTS: 74-in.-deep bulb tees, modified 74-in.-deep bulb tees, planter walls on bridge, mechanically stabilized earth wall panels, and cast-in-place concrete deck

BRIDGE COST: $10.12 million

The walls and plantings are the most important aesthetic feature of the new structure.

The exterior beams under the walls and landscaping had to be spaced closer together due to the effect the walls had on the dead load distribution. Photo: Sunbelt Structures Inc.

The planter walls also had to be considered in the design of the beams because of their effect on the distribution of the sustained dead load of the landscaping on the bridge. The density of normal landscape fill for plantings ranges from 110 pcf to 120 pcf. GDOT decided to use a special lightweight organic soil with a density of 90 pcf to help reduce weight, but the loading was still significant. ARCADIS was concerned that the effect of the deep wall sections would be to distribute a greater percentage of the dead load to the beams under the landscaping, particularly under the walls, instead of being evenly distributed to all of the beams in the cross section. This type of loading was not addressed by the project specifications, so ARCADIS verified the actual load distribution using a finite element model. The model used plate elements for the deck and beam elements modeled at the center of gravity of each precast girder. The steel diaphragms were also included. The girders were then analyzed using conventional methods (Leap's CONSPAN software) and verified with GDOT's in-house prestressed concrete beam design program. The results of the model confirmed that the planter loads would be distributed to the girders under the landscaping. Had this analysis not been performed, the girders immediately adjacent to the planters may have been under-designed.

Trellis on the south side of the bridge provides shade. Photo: ARCADIS U.S. Inc.

A pile bent and mechanically stabilized earth (MSE) wall system comprise the west end bent, while a tieback wall abutment supports the east end bent. The center wall pier of the existing bridge was widened, and the existing cap was modified to accommodate the new concrete beams. The design and construction of the east abutment were complicated by the presence of an existing tieback retaining wall and an existing CIP retaining wall just in front of the new wall. The abutment was constructed using secant-drilled shafts, supported by deep-tension micropiles. The shafts and tension micropiles were founded on bedrock. However, where the old foundation of the existing CIP wall interfered with shaft construction, the drilled shafts were founded on top of the old footing, and compression micropiles were drilled through the footing and founded in bedrock to support the shafts.

The final and, perhaps, most significant challenge was to complete the project without disrupting traffic on either the Fifth Street Bridge or the interstate over the entire two-year construction period. Lane shifts and closures were permitted on I-75/I-85 but were subject to time limits, as well as liquidated damages. Work-hour limitations were also in effect for special events in the area, such as sporting events, concerts, and festivals. Traffic on the Fifth Street Bridge itself was maintained by reducing the number of lanes to one in each direction. Using the staged construction scheme, the widened part of the structure was built first, and then traffic was shifted to the newly constructed portion of the bridge so the remainder of the bridge could be constructed.

The structure was completed and opened to traffic in December 2006, just 29 months after Notice to Proceed was issued.

Jim Aitken is the Structures Department Manager for ARCADIS' Atlanta office, Mike Clements is a Design Group Leader in the Office of Bridge Design at the Georgia Department of Transportation, and Tim Schmitz, formerly with ARCADIS, was the structural designer for the project.

For more information on this or other projects, visit www.aspirebridge.org.

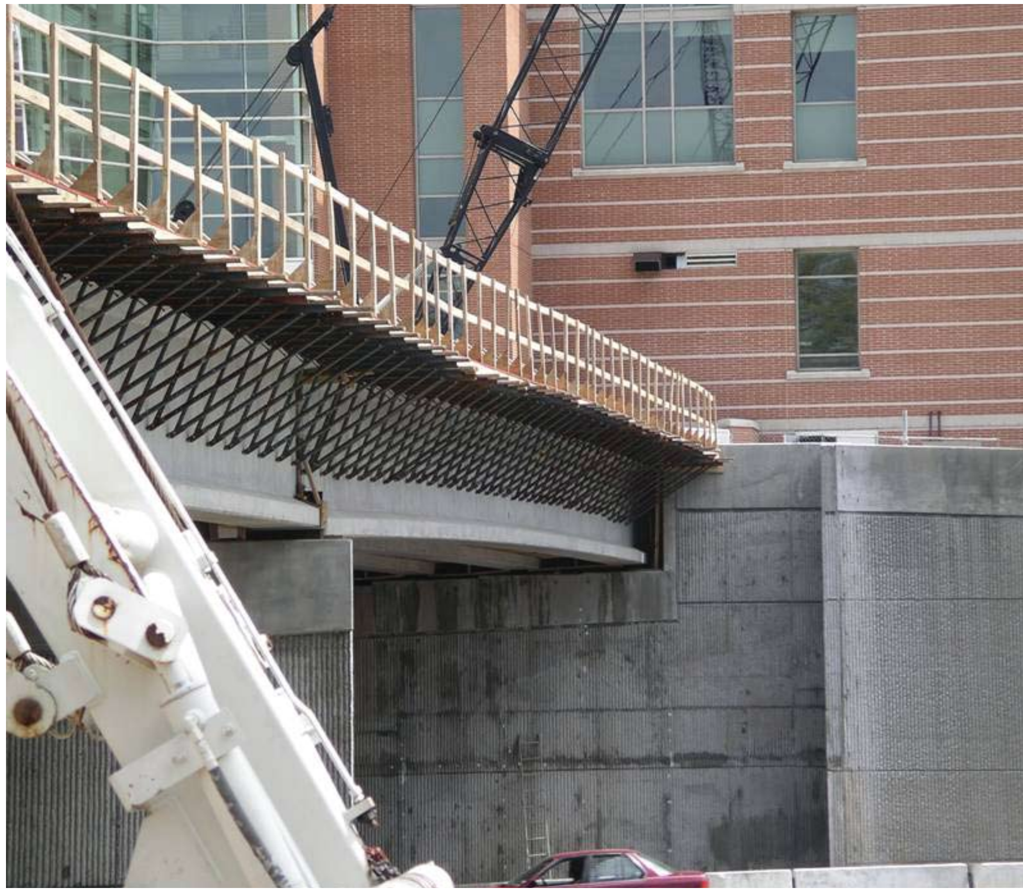
Providing a Pedestrian-Friendly Environment

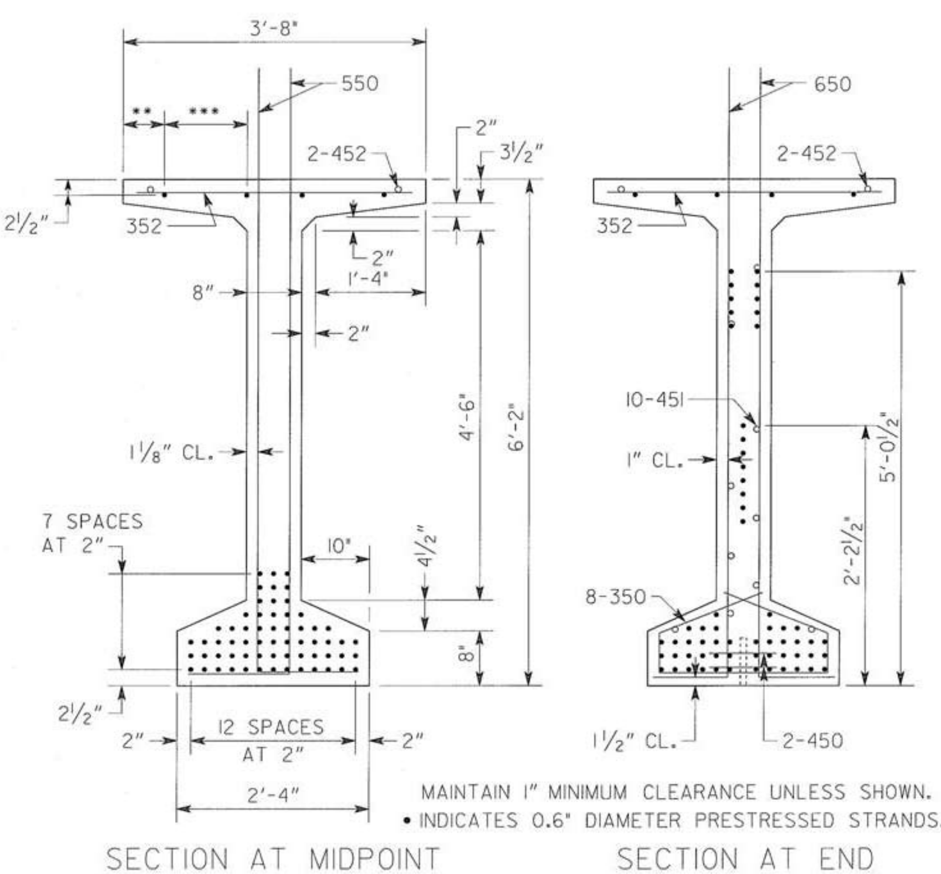
The new bridge provides a roadway that is 48 ft wide, the same width as the original structure. However, it carries only two lanes of vehicular traffic; the remaining width is dedicated to bicycle and turning lanes. Each side of the roadway has a 24-ft-wide sidewalk. While the total bridge width is 223 ft 3 in., more than 125 ft are landscaped areas, with 75 ft on the north side and more than 50 ft on the south side.

Benches for seating are provided on each side of the bridge. On the south side of the roadway, a trellis provides a bench with shade. On the north side, sloped walkways give pedestrians access to an area of lawn. Decorative lighting illuminates the sidewalks and landscaping on both sides of the bridge. Precast concrete walls separate each of the lawn and landscaped areas from the pedestrian and roadway areas.

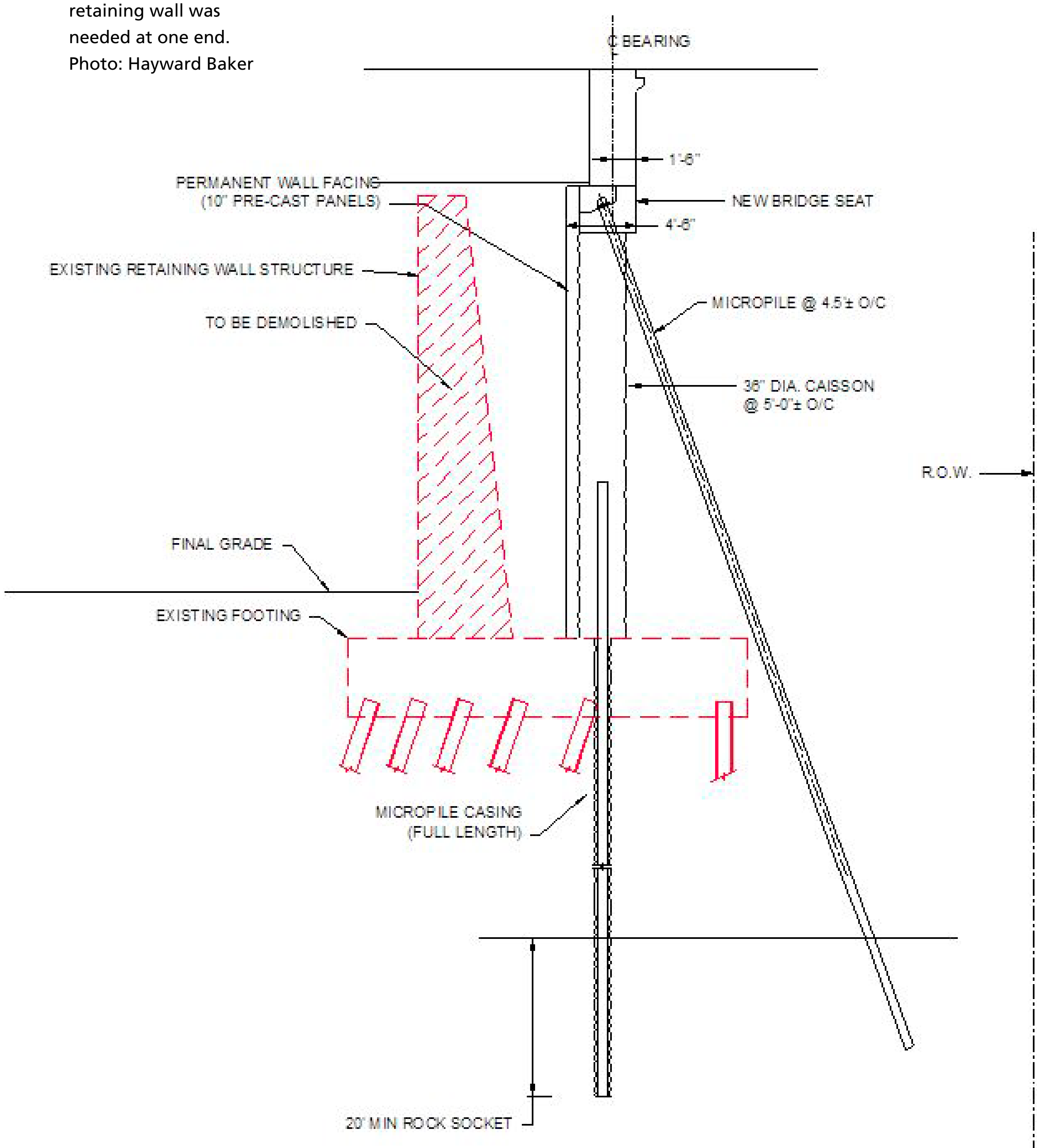
The planting plan included multi-tiered planting areas that range in height from 1 ft 6 in. to 9 ft. The walls and plantings are the most important aesthetic feature of the new structure and define the character and nature of the new space on Fifth Street. The design called for the walls to be CIP, but Sunbelt decided to precast the walls on site. Special counterforts were designed to replace the CIP system to support the walls.

The beams in Span 2 have not yet deflected into their final position.





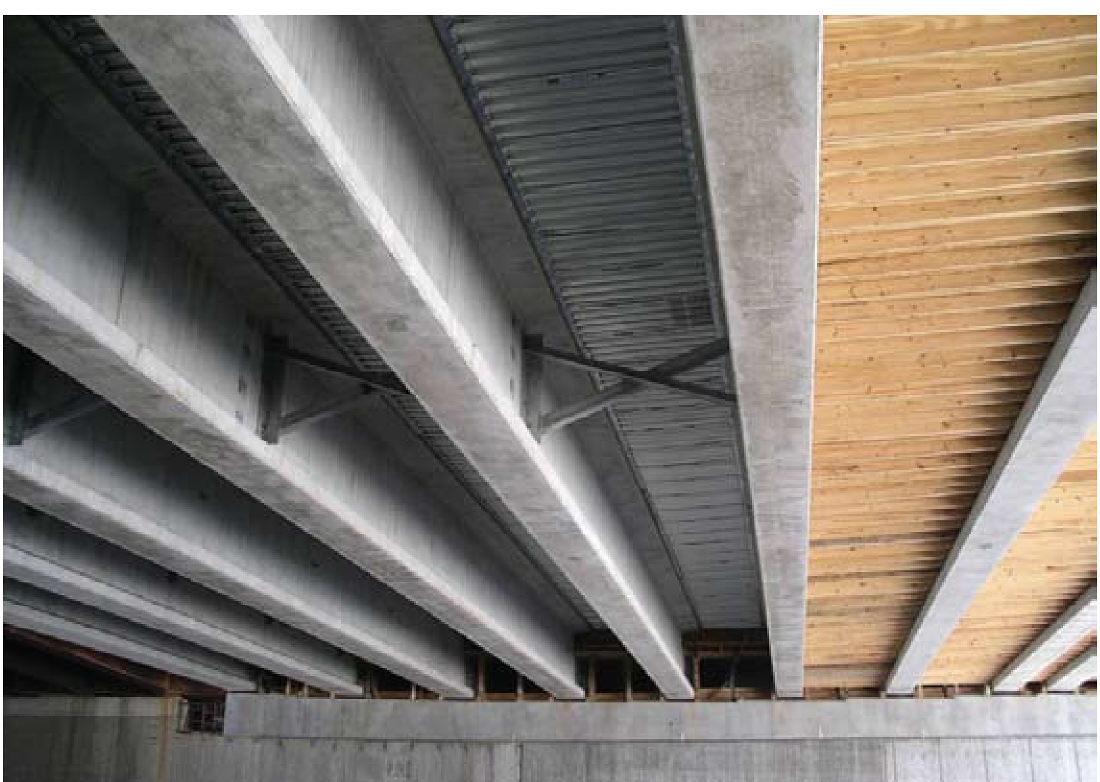
A bulb-tee cross section was modified to allow an extra line of strands in the web.



A new tieback retaining wall was needed at one end. Photo: Hayward Baker

Specially designed counterforts were used to support the 9-ft-high precast planter walls. Main Photo: GDOT

Inset Photo: Planter walls and trellis on the south side of the bridge. Photo: ARCADOS U.S. Inc.



Steel diaphragms were used to provide quick installation and lateral support to the beams.