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Design transcends function in first GDOT design-build project in Atlanta
Fifth Street Pedestrian Plaza Bridge Becomes Landmark at Georgia Tech

Sue McCraven

Georgia Institute of Technology (Georgia Tech), nestled in the heart of Atlanta, Ga., is ranked as the seventh best public university in the nation, and its College of Engineering is consistently ranked in the top five, according to the 2007 rankings by U.S. News & World Report. With more than 18,000 undergraduate and graduate students, the 400-acre (162 ha), 120-year-old university is a national and international leader in scientific and technological research and education. Many of the participants in the Fifth Street Pedestrian Plaza Bridge project, from designers to constructors, are Georgia Tech alumni who feel duly proud of the final result.

More than half of the bridge width is reserved for paved walkways and landscaped greenspace, making the Fifth Street Pedestrian Plaza Bridge a popular landmark structure for Georgia Institute of Technology's campus in midtown Atlanta, Ga. Courtesy of Georgia Institute of Technology.
Georgia Tech plans signature bridge

In 2003, when Georgia Tech expanded its campus across 15 lanes of the I-75/I-85 Downtown Connector, the new Technology Square development on the east side was connected to the older west-side campus by an old and unsightly bridge. A two-span, continuous, steel-plate-girder bridge, the old structure had concrete parapets, sidewalks, and chain-link fencing. End bents were constructed on retaining walls at either end with a cast-in-place (CIP) concrete cantilever wall at the west end and a tieback wall at the east abutment. The 8-ft-wide (2.4 m) sidewalks were immediately adjacent to the four lanes of bridge traffic, and there was no accommodation for bicycles. The bridge presented an uninviting, unsafe, and noisy pedestrian commute for Georgia Tech students and professors.

Georgia Tech’s master plan called for a signature bridge with expansive greenspace, 24-ft-wide (7 m) pedestrian pathways, planters, benches, decorative lighting, and a trellis for the campus trolley stop. Tall planter walls were envisioned to screen students from the view of...
heavy traffic below, and, equally important, to significantly reduce road noise from I-75/I-85. Initially, the proposed width of the new bridge was 250.25 ft (76 m), but the Federal Highway Administration (FHWA) required the design to accommodate two additional future high-occupancy vehicle lanes, and consequently the final bridge length was increased to 256.5 ft (78 m). As a consequence, the bridge width was reduced to 223.5 ft (68 m) due to budget constraints.

A typical bridge project for the Georgia Department of Transportation (GDOT) requires about five to six years from design concept to award of contract for construction. In this case, however, GDOT and Georgia Tech wanted an accelerated schedule, so the project was advertised in April 2004 as a design-build (D-B) contract. A remarkable achievement, the typical 6-year process was reduced to just 10 months for the Fifth Street Pedestrian Plaza Bridge project, through a dramatic reduction in the length of the planning stages, without compromising the quality of the project.

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

New bridge creates green space

The new Fifth Street Pedestrian Plaza Bridge is a two-span bridge. The first span is 137 ft (42 m) long, and the second span is 119.5 ft (36 m) long. The new bridge provides a roadway that is 48 ft (15 m) wide, the same roadway width as the original structure, and carries only two lanes of vehicular traffic. The remaining pavement width is dedicated to two bicycle lanes and one vehicular turning lane. Each side of the new roadway has a generous 24-ft-wide (7 m) sidewalk. While the total bridge width is 223.25 ft (68 m), more than 125 ft (38 m), or 55%, of this total expanse is landscaped greenspace.

Benches are provided on each side of the bridge, and the south side of the roadway has a white, tubular, steel trellis. On the north side, sloped walkways with dark-red concrete pavers provide a pedestrian access to an area of lawn. Decorative lighting illuminates the entire bridge. Precast concrete walls separate each of the lawn and landscaped areas from the pedestrian and roadway areas and further serve to block traffic noise from I-75/I-85.
Specially chosen landscaping is arranged in multi-tiered planting areas that range in height from 1.5 ft (0.5 m) to 9 ft (2.7 m). The landscape architect employed by Smallwood, Reynolds, Stewart, Stewart, & Assoc. (SRSSA) specified the bridge plantings that were reviewed by GDOT. 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 concrete, but the general contractor decided to fabricate precast concrete walls on-site, with the exception of CIP concrete counterforts, to add stability to the 9-ft-tall (2.7 m) outer walls located adjacent to the deck edges.

Precast, prestressed concrete beams were selected by the D-B team during the prebid phase as the most economical solution for the new structure. The final design used 28 modified, 74-in.-deep (1880 mm) American Association of State Highway and Transportation Officials (AASHTO) bulb-tee beams in span 1. The beams were modified by increasing the width and height of the standard 72 in. (1830 mm) bulb-tee beam by 2 in. (50 mm) over the entire length of the beam to accommodate an additional strand per row in the bottom flange and web. Span 2 used 26 standard, 74-in.-deep AASHTO bulb-tee beams.

Filled with trees, plants, and special soil, the planters and walls were considered in the design of the beams as composite dead load. The heavy dead loads associated with the landscaping and planters necessitated the use of the modified beam section in span 1. In addition, the beams were designed and constructed using high-performance concrete with a 28-day compressive strength of 10,000 psi (68.9 MPa) and 0.6-in.-diameter (15 mm) prestressing strands. Structural steel diaphragms made of 6 in. × 6 in. (150 mm × 150 mm) angles were used instead of GDOT’s typical CIP concrete diaphragms. This was because steel could be installed more quickly and provided support to the beams almost as soon as they were erected.

ARCADIS was concerned that the deep planter sections would distribute a greater percentage of the composite dead load to the beams under the grassed landscaping and sidewalk, instead of being evenly distributed on the beams directly under the section. This type
Bridge components

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
<th>Number</th>
<th>Strength, psi</th>
</tr>
</thead>
</table>
| Beams, Span 1  
Modified AASHTO 74 in. bulb-tee beam | 136.38 ft long  
(average) | 28 | \(f'_c = 8200\)  
\(f'_{ci} = 10,000\) |
| Beams, Span 2  
AASHTO 72 in. bulb-tee beam | 118.00 ft long  
(average) | 26 | \(f'_c = 7500\)  
\(f'_{ci} = 10,000\) |
| Walls | 1.5, 2.0, 4.0, 6.5, and 9.0 ft high | 189 |  |
| | 13,841 ft² | |  |
| MSE wall at Bent 1 | 6048 ft² | |  |

Note: \(f'_c\) = compressive strength of concrete; \(f'_{ci}\) = compressive strength of concrete at initial prestress; AASHTO = American Association of State Highway and Transportation Officials; MSE = mechanically stabilized earth.

The girder design was determined using conventional methods (Leapsoft’s Conspan software) and verified with GDOT’s in-house prestressed beam design program. The results of the model confirmed that the planter loads would be distributed to the girders under the grassed landscaping and sidewalk.

### Bridge details

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>256.5 ft</td>
</tr>
<tr>
<td>Overall width</td>
<td>223.25 ft</td>
</tr>
<tr>
<td>Total area of deck</td>
<td>57,264 ft²</td>
</tr>
<tr>
<td>Length of span 1</td>
<td>137.0 ft</td>
</tr>
<tr>
<td>Length of span 2</td>
<td>119.5 ft</td>
</tr>
</tbody>
</table>
| Support skew*                    | Bent 1 10°-28’-48”  
Bent 2 9°-53’-43”  
Bent 3 10°-08’-00” |
| Radius of horizontal skew        | n.a.                               |
| Predominant grade                | 0.3%                               |
| Two traffic lanes and one turn lane | 12.0 ft wide (each)            |
| Two bicycle lanes                | 6.0 ft wide (each)                 |
| Two sidewalks                    | 24.0 ft wide (each)                |
| Two landscaped areas (running the length of the bridge) | 76.1 ft wide and 51.1 ft wide, respectively |
| Total landscaped area            | 0.75 acre                          |

*Measured from a line normal to the bridge centerline.  
Note: n.a. = not applicable. 1 ft = 0.3048 m; 1 ft² = 0.09290 m²; 1 acre = 0.405 ha.
This Georgia Department of Transportation (GDOT) drawing shows dead load data for the Fifth Street Pedestrian Plaza Bridge in Atlanta, Ga. Significant dead loads of filled planter walls determined the spacing of precast concrete support beams. Note: 1" = 1 in. = 25.4 mm; 1' = 1 ft = 0.3048 m. Courtesy of GDOT.

Shown is a finite element analysis schematic for the Fifth Street Pedestrian Plaza Bridge in Atlanta. Note: 1 ft = 0.3048 m; 1 k = 1 kip = 4.448 kN. Courtesy of Tim Schmitz, Structural Engineering Solutions LLC.
Maintaining traffic flow the greatest challenge

Over the entire two-year construction period, the most significant challenge was to complete the project without disrupting traffic flow on the Fifth Street bridge, and particularly to avoid daytime affects on traffic on I-75/I-85. Lane shifts and closures were permitted on I-75/I-85 but were subject to stringent GDOT time limits as well as considerable liquidated damages. Longer weekend work periods were also frequently suspended for special venues in Atlanta, such as sporting events, concerts, and festivals. Traffic on the Fifth Street Pedestrian Plaza Bridge was maintained by reducing traffic to one lane in each direction. Using a staged-construction scheme, the widened part of the structure was built first, and traffic was subsequently shifted onto the newly constructed portion of the bridge as the remainder of the bridge was built.

In an interesting and humorous aside, early in the design process for the bridge, the installation of water fountains on either side of the bridge was considered. While water fountains may have been a good idea from

Three Georgia Institute of Technology (Georgia Tech) students were invited to express their impressions of the completed Fifth Street Pedestrian Plaza Bridge.

“The new bridge is an excellent way to connect Tech Square to the older part of campus,” says Lauren Miller, a senior in Business Management. “We have access to restaurants and shops in the newer [east] section of campus and the bridge’s location next to fraternity and sorority houses makes it a great place to meet, play Frisbee, and hang out.”

Brock Wester, a 2004 graduate in computer engineering who is working on a Ph.D. in biomedical engineering, agrees. “We needed to make the bridge more aesthetically appealing [than the old structure] to fulfill Georgia Tech’s master plan for connecting one side of campus to the other. Students use the bridge as a meeting place for events—the pregame tailgate parties are held there and the large grassy area is used for pick-up touch football.”

“It’s a fabulous entryway into Georgia Tech,” says Lindsay Sprung, a senior in economics and international affairs. “I have attended campus movies in the two or three years since the bridge was completed and you can hardly hear the traffic. It’s become a popular place for students to meet in a more intimate setting. It’s phenomenal!”
an aesthetic perspective, the nearby location of fraternity and sorority houses on the older west side of the bridge reminded GDOT engineers of their Georgia Tech experiences. While most of the diverse and well-attended student activities on the new pedestrian bridge are innocuous (see “Georgia Tech students call bridge a fabulous entryway,” p. 65), GDOT planners could envision the result of the addition of dish soap to water fountains by some of the more exuberant students. Soap in pressurized fountain sprays could result in a slick surface, not only on the bridge, but on the busy I-75/I-85 below, a situation that could not be allowed because it might adversely affect safe driving conditions or otherwise distract drivers.

GDOT also determined that types and sizes of plantings used in the bridge landscaping might inadvertently create unsafe conditions for bridge pedestrians by providing cover for would-be assailants. As a result of these concerns for public safety, GDOT specified the types, shapes, and maximum sizes of trees and other vegetation planned for the bridge landscaping, requiring that Georgia Tech remove trees that grow beyond a prescribed height.

**Planter wall design diminishes highway noise** Nine-foot-high (3 m) planter walls at the outer perimeter of the Fifth Street Pedestrian Plaza Bridge effectively minimize road noise from high-speed traffic running under the bridge. Students confirm that sounds from the freeway are greatly minimized compared with the loud and often windy conditions on the old bridge. Another more serious function of the planter walls is to screen student activities on the bridge from motorists traveling 55 mph (89 km/hr) on I-75/I-85 who may be easily distracted by campus-approved bridge activities, such as movies, group gatherings, and energetic tailgate celebrations prior to sporting events.
In referring to the waterproofing material for the precast concrete planter walls, Clements says, “Sunbelt wanted to use a spray-on product that was not on GDOT’s QPL [quality products list]. Even though only about 400 ft² of three-ply membrane waterproofing is needed on a typical bridge project, the unique design [at Fifth Street Pedestrian Plaza Bridge] required application to a much larger area. We require agency testing and/or independent lab testing for approval of any new material, and Sunbelt was under tight time and money constraints to finish the job.”

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“Even when everyone is on the same page, the precast concrete construction industry suffers from individual interpretation of commonly used terminology.”

“Prestressing’ and ‘post-tensioning’ are good examples. Is prestressing a form of post-tensioning or vice-versa?” Clements says. Most, but not all, industry professionals interpret “post-tensioning” to involve a jacking procedure on site; but if post-tensioning is done at the precast fabrication facility, does this make it “pretensioning”? The latter definition “was the case in Georgia in the 60s and 70s,” says Mike. “Girder’, ‘whaler’, and ‘beam’ are also terms that mean different things to different people [and] that can cause confusion. I think we can do a better job clarifying common terminology that we all use to clarify communication between all parties on projects.”

At an early stage of design, project architects had proposed light poles of heights ranging from 20 ft to 60 ft (6 m to 18 m) and illuminated with yellow and white lights. Again, GDOT had serious concerns regarding the public’s driving safety and did not approve any visual distraction in the bridge design that might lead to driver distractions, potentially unsafe road conditions, or both.

**Architects use a fresh streetscape approach** According to SRSSA of Atlanta, project architects for the streetscape design on the bridge, the greatest challenge was establishing an overall design objective that satisfied the various stakeholders’ (Georgia Tech, GDOT) interests. Opinions ranged from “let’s do the absolute minimum” to “let’s make this the iconic gateway to midtown Atlanta and Georgia Tech.” SRSSA developed several creative design ideas, many of which had substantial community and stakeholder support.

With so many project players involved, including the general contractor and precasters for the different bridge elements, the success of the project depended on clearly defined goals and terminology that all parties understood and supported. SRSSA said that it was particularly important to provide a spacious green lawn for students to use as an activity space that is easy to access. Most of the pedestrians crossing the connector are students, and the project architects understood that open greenspace was at a premium on campus. A parklike environment would be something that students would gravitate toward and enjoy.
Modified bulb-tee maximizes structural capacity

Standard Concrete Products of Atlanta fabricated the modified PCI bulb-tee beams for the Fifth Street Pedestrian Plaza Bridge in Atlanta, Ga., to the standard AASHTO bulb-tee beam. As a D-B project, this was the first time GDOT had allowed this modified bulb-tee girder for bridge construction. The girders were 2 in. (50 mm) taller and 2 in. wider than a standard AASHTO 72 in. (1830 mm) bulb-tee beam.

Standard Concrete Products economically modified its existing standard bulb-tee forms. Modifications involved using a readily available, wider, bottom form and elevating the side forms. The additional height was achieved with a structural tube spacer and by redesigning the under ties. Even though this is the first time that both modifications were used on a GDOT project, the 72 in. (1830 mm) beam with added depth was first used in Georgia about six years ago in a value-engineered project. It was an
effective method to use existing forms to obtain more structural capacity from the standard bulb-tee girder. The center wall pier of the existing bridge was widened, and the existing cap was modified to accommodate the new precast concrete beams.

Precasters were able to incorporate more prestressing into the modified beam because of its larger bottom flange. The additional height accommodated one more row of prestressing strand, and the additional width allowed one more strand per row. With the FHWA allowance of 0.6-in.-diameter (15 mm) strand and the more recent push for high-performance concrete, this modified beam has become a favorite with local bridge designers. An unusual detail incorporated in production of the modified beam is the method of harping, or draping, the prestressing strands, where harped strand groups are brought into the end of the beam at different elevations. This strand arrangement reduces stress concentrations and the potential for web cracking.

**Rigid tieback walls use micropiles**

Hayward Baker Inc. of Alpharetta, Ga., with design consultant AMEC Earth and Environmental, provided a D-B solution for the complex east abutment/retaining wall for the bridge. The design was complicated by the presence of an existing tieback retaining wall and an existing CIP concrete retaining wall located immediately in front of the new abutment. Hayward Baker designed a rigid tieback wall abutment for the east-end bent. The Reinforced Earth Company (RECo) designed and supplied the components for the mechanically stabilized embankment (MSE) wall, ARCADIS designed the pile bent, and Sunbelt Structures constructed both.

The east abutment was constructed using secant-drilled shafts supported by deep-tension micropiles. The drilled shafts were 36-in.- to 42-in.-diameter (915 mm to 1070 mm) openings into which full-length reinforcing steel cages were placed. Structural concrete was subsequently placed in the hole to form a vertical, cylindrical, reinforced concrete element. The shaft spacing in plan view was 6 ft (1.8 m) on center. The shafts and tension micropiles were founded on bedrock. Where the old foundation of the existing CIP concrete wall interfered with shaft construction, however, the drilled shafts were founded on the old footing, and compression micropiles were drilled through the footing and founded in bedrock to support the shafts.

The tension micropiles that support the abutment walls were attached to a reinforced-concrete cap beam that spans the top of the secant-drilled shaft wall. The micropiles consisted of 7-in.-diameter (180 mm) steel pipe that was drilled to the top of bedrock. A rock socket was then drilled into the rock, and a 2.5-in.-diameter (64 mm) high-strength steel bar was cement grouted into the bedrock to support the wall.
A reinforced concrete cap beam was used to transfer the tension micropile load to the top of the drilled shafts near the beam seat for the bridge. The tension micropiles thus acted to support the drilled shafts as they provided double-duty as the abutment foundation and the earth retention structure. The existing tieback retaining wall and the stem of the existing wall were demolished after the new abutment was placed. A CIP concrete facing was then placed in front of the new abutment. The abutment was about 30 ft (9 m) tall and encompassed about 8000 ft² (745 m²).

For bent 3, the footings in the existing abutment and the adjacent CIP concrete wall had many battered piles. Instead of removing them, Hayward-Baker opted to leave the existing footing in place to resist all lateral loads. To carry the vertical loads, however, the micropiles had to be drilled through the existing footing. Bent 2 was analyzed and found to have reserve load-carrying capacity as the original bridge was a continuous plate girder bridge designed by the allowable working stress method. Sunbelt removed the cap (top portion) and cast a new cap. The widened portion on both sides of the existing bent was new construction. Bent 3 was totally removed and replaced with an MSE wall with a pile bent.
MSE precast concrete panels provide schedule flexibility

MC Precast Inc. of Atlanta was retained by RECo to manufacture the fascia panels for the MSE wall. The reinforced earth wall, designed and manufactured by RECo and used on the bridge project, is stable, reliable, and quite easy to install. It gives the general contractor the needed flexibility to construct a project with minimal delays. Although MC Precast’s role on the bridge was small, it was important to the overall success of the project. Through good communication and strict compliance to project specifications, the MSE precaster was able to meet or exceed GDOT and Georgia Tech’s expectations.

New design creates tough construction challenges

New design and construction methods on the Fifth Street Pedestrian Plaza Bridge project included:

- galvanized structural steel diaphragms, used for the first time in Georgia (GDOT prefers concrete diaphragms because they are practically maintenance-free),
- precast concrete planter walls that the contractor fabricated on-site,
- tension-micropile-supported, drilled-shaft abutment.
Clockwise from top  Logistics for I-75/I-85 lane closure and equipment mobilization during night-time hours proved daunting for the general contractor while constructing the Fifth Street Pedestrian Plaza Bridge in Atlanta, Ga. Courtesy of Sunbelt Structures.

Restricted equipment and storage space and I-75/I-85 traffic nearby added to the contractor’s daily construction challenges. Courtesy of Sunbelt Structures.

Steel plate support design for trellis and planter walls allowed effective use of mechanical screed for deck finishing. Courtesy of Sunbelt Structures.

Because local precasters were busy with ongoing projects, Sunbelt Structures, general contractor for the Fifth Street Pedestrian Plaza Bridge, precast the concrete planter walls on-site. Courtesy of Sunbelt Structures.
Counterclockwise from top Pictured are nighttime screeding and finishing of the deck concrete. Courtesy of Sunbelt Structures.

Just-in-time delivery of precast concrete bridge beams for immediate night erection required careful planning and construction sequencing. Courtesy of Sunbelt Structures.

Both pedestrian and vehicular traffic on the Fifth Street Pedestrian Plaza Bridge could not be interrupted at any time during construction. Courtesy of Sunbelt Structures.

Precast concrete planters were filled with special lightweight organic soils. Courtesy of Sunbelt Structures.
Contractor works to keep I-75/I-85 open

When asked about their experience as general contractor on the project, David Culpepper, senior project manager and chief engineer, and Gene Boullain, project manager, of Sunbelt Structures Inc. of Tucker, Ga., said that foremost in their minds was the short time frame for completing the Fifth Street Pedestrian Plaza Bridge as significant liquidated damages were written into the GDOT specifications. Sunbelt was responsible for about 90% of the design and construction decisions. For each day of construction beyond the specified completion date, the general contractor would be fined thousands of dollars. Listed here are some of the many project challenges faced by the contractor:

- There was a clause in the construction documents for $10,000 per day liquidated damages for delay of the project completion date beyond that specified by GDOT.

- The Fifth Street Pedestrian Plaza Bridge was the first full D-B bridge project for GDOT and the first D-B government project for the general contractor in Atlanta.

- Approval of design drawings was delayed by the third-party review process.

- Five to six months of design work preceded the start of eighteen-month, real-time construction of bridge structural elements, shortening the erection schedule and eliminating float time.

- The contractor worked seven days per week, day and night, for almost 70 days.
The earliest time for which I-75/I-85 lane closures or lane shifts were approved by the specification and construction was 8:00 p.m., and all lanes had to be returned to traffic before rush hour at 5:00 a.m. from Monday through Friday.

Pedestrian and vehicle traffic on the bridge could not be closed at any time during construction.

Numerous professional sporting events in Atlanta prevented extended lane closures on the weekends.

A second contract specification for liquidated damages covered construction for the middle pier, an early component of the construction schedule.

Fifteen lanes of traffic run on I-75/I-85 under the Fifth Street Pedestrian Plaza Bridge, seven northbound and eight southbound.

**Lane-closure sequence affects construction efficiencies**

Before construction could begin, GDOT required that new highway signage be installed for both north and southbound lanes of I-75/I-85 to replace signage removed from the old bridge. GDOT permitted lane closures for I-75/I-85 beginning at 8:00 p.m. and specified four lanes as the maximum number of lanes that could be closed any time. Each successive lane closure, however, required about one hour for the contractor to implement. Because of the need to keep I-75/I-85 open in downtown Atlanta, the effective start time for bridge construction was about 11:00 p.m. With 5:00 a.m. established as the time that all lanes were to be fully open to rush-hour traffic, the contractor had to halt construction from I-75/I-85 and begin removing cranes, erection equipment, and crews at 3:00 a.m.

Saturdays and Sundays were days of the week during which the contractor could continue bridge erection and lane closures beyond 5:00 a.m.; however, this window of opportunity closed whenever a sporting event took place in Atlanta. Games for the city’s professional sports teams, including the Atlanta Braves (baseball), Falcons (football), and Thrashers (hockey), took precedence over construction to allow fans to drive to the stadiums and arenas downtown. Understandably, GDOT, Georgia Tech, and the City of Atlanta did not want to receive public complaints about travel delays to popular sporting venues.

Sunbelt Structures used large-capacity cranes for erection, including 660-ton (600 tonne) and 550-ton (500 tonne) Demag lattice-boom crawler cranes. Setup, rigging, dismantling, and movement of these large machines required time, and equipment logistics had to be synchronized carefully to maximize erection time between the daily scheduled lane closures and openings. All materials and erection equipment were hauled in and out of the I-75/I-85 lanes on a daily basis, limiting even further the permissible time for actual construction.

**Crews work seven days a week in restricted space**

Two to three crews were employed by the contractor on a daily basis, including a foreman, traffic control personnel, superintendent, and project manager. The number of workers at the bridge site at any given time...
during construction ranged from 10 to 15 people. Night-time work hours and the seven-day-per-week schedule continued for over 70 days straight to complete work at the bridge site by the contract completion date. Overtime and weekend wage rates increased costs significantly for the contractor. Photos clearly show the restricted space available to the contractor for equipment and material storage adjacent to the bridge.

Concrete planter walls precast on site Design drawings for the precast concrete planter walls were some of the last to be approved, in February and March of 2006, because these designs evolved over the course of construction on the bridge. Arriving late in the construction schedule, these finalized drawings negatively affected the contractor’s already tight schedule. Sunbelt Structures sent the planter drawings out for bids to precasters. Because the construction market was, and is, booming in Atlanta, all of the area precasters were busy with ongoing work in the spring of 2006 and were not prepared to commit to fabricating the precast concrete planter walls for the bridge.

Not willing to wait for a subcontract precaster bid and with the looming GDOT penalty for project completion delays, the contractor decided to precast the concrete planter walls on-site. Adding to the complexity of production for the planter walls was the vertical curve for the bridge. The bridge’s slope ran uphill to the west abutment at a 0.3% grade, and each successive planter wall exhibited different trapezoidal geometry. Forming for each planter wall was different.

Waterproofing poses difficulties Pedestrian bridge planter walls were a new design not only for the contractor but for GDOT. Consequently, the GDOT-approved product list did not include all of the available concrete waterproofing materials. Keeping abreast of rapidly evolving technologies and products in the precast concrete industry is a challenging and ongoing process for everyone, from code writers to designers and fabricators. While the contractor wanted to use a particular waterproofing product that was considered the best for planter wall application over roadways, it was not on the GDOT-approved list and the agency’s required independent testing and review and approval for a new product could have required an additional, unanticipated time delay.
As with projects across the country, transportation agencies are reluctant to relinquish authority over building-material selection to contractors, even on D-B projects. Already facing complicated planter wall forming and not prepared to face the costly delay for the preferred-product approval, the contractor used a waterproofing material on the existing GDOT-approved list, a coating that was typically applied to the earthen side of bridge abutment retaining walls.

While the contractor was able to complete the Fifth Street Pedestrian Plaza Bridge by the contract’s specified completion date and thereby avoid liquidation damages of $10,000 per day, subsequent leaks from the planter wall required costly repairs. GDOT’s concerns over leakage are taken seriously in Atlanta, where three to four days of freezing weather can be expected during the winter months and potential icing on I-75/I-85 below the bridge is not acceptable.

In the future, the contractor believes that the project problems resulting from waterproofing material selection and approval may be avoided by a more proactive approach, on the part of the contractor, in managing the design process. For D-B contracts, in particular, project goals are best served when the builder has the authority to choose the best available technologies. Because some of the elements of design on the Fifth Street Pedestrian Plaza Bridge were new to both GDOT and the contractor, some problematic issues could not be anticipated.

In the future, however, the contractor believes that a larger project contingency fund on D-B contracts involving new and untried designs may be appropriate to balance potential delays from mandatory agency material review and approval. The contractor credits GDOT’s Bridge Design Group Leader for facilitating the timely resolution of many difficult issues on the project. Despite the many challenges, the bridge took only 26 months to construct.
EOR describes project challenges

The project’s engineer of record (EOR), Tim Schmitz, P.E. (now president of Structural Engineering Solutions LLC in Smyrna, Ga.), reinforces the general contractor’s view that this was a tough job with an even tougher construction schedule and a long list of construction challenges. Although the Fifth Street Pedestrian Plaza Bridge was not a large project in terms of square footage, it had numerous construction-activity limitations that proved onerous.

First, due to the involvement and interest of so many non-traditional bridge design entities and non-traditional bridge items, each detail was reviewed and critiqued by the decision makers. For example, the details of the geometry of the bridge at Williams Street (east side) opened many discussions. If the typical section was maintained, significant drop-offs would occur at the extreme left and right of the bridge and vehicle-impact concerns increased. If the end of the bridge warped to William Street’s vertical profile, the bridge geometry and drainage became huge challenges.

Second, because this was the first D-B bridge project authorized by GDOT in Atlanta’s metropolitan area and the first government D-B contract for the contractor, many traditional (design and construction) specifications and work procedures were tested under this project delivery method.

Third, while the contractor builds from the bottom of the structure up, design must proceed from the top down. Many details needed to be finalized prior to moving to final design. Working through these details in a manner that is fair to the other bidders, meets the specifications, is structurally sound, and is within the contractor’s expectations and time constraints was a tedious process.

Fourth, the west end of the bridge, at the older section of Georgia Tech’s campus, presented a myriad of unknown and dated utility ductwork that proved difficult to work into the design.

Fifth, required clearances over I-75/I-85 (17 ft [5.2 m]) drove the bridge-profile design, calling for a 0.3% slope or vertical grade. The west end of the bridge is about 12 in. (300 mm) higher than the east abutment. All drainage flowed toward the west end where all the dated and unpredictable utilities lay. Drainage from the new planter walls was not part of any existing GDOT specification for bridge design and the drainage from the hydrated planter soils could not be permitted to reach the road surface of I-75/I-85 where moisture could create dangerous icing conditions.

Additional project conditions and requirements presented challenging logistics and construction procedures for the contractor. At the request of Georgia Tech campus officials, traffic and pedestrian access on the Fifth Street Pedestrian Plaza Bridge could not be closed at any time during construction. Fortunately, vehicular traffic on the bridge travels at a low speed, presenting a lower risk to workers and easier facilitation of lane shifts for construction.

Special reinforcement was used in the deck under the trellis column and planter wall locations. Steel plates with a smooth upper surface and shear studs below allowed the contractor to use a mechanical screed on the bridge deck without interference from reinforcing bars. Standard reinforcement at these locations would have required manual screeding of deck concrete, a time-consuming, labor-intensive process.
One of the suggestions for redesign from Wolverton & Assoc., the precast concrete specialty engineer for the planter walls, regarded the standard connection detail to the bridge deck. The original design specified that the no. 8 (25M) steel dowels cast in the deck be grouted in 3-in.-diameter (76 mm) ducts cast into the precast concrete planter walls. This original specification would have been difficult to construct in the field due to the need to precisely place the dowels in the deck and to support the no. 8 bars in a vertical position during the screeding of the deck. Wolverton’s redesign specified connections of the panels to the deck as welded connections with embedded plates in the deck and precast concrete panels. This connection system was forgiving of misalignment issues. Photos show how steel angles at the base of planter walls were welded to the steel plates set into the deck concrete and then grouted. The stability and solid attachment of the planter walls was a critical detail to ensure road safety because the 9-ft-high (2.7 m) walls are located directly above I-75/I-85. CIP concrete counterforts added the stability required for the tallest walls on the bridge.

Steel diaphragms were used beneath the bridge to stabilize the structure during construction and to ensure safety. While CIP concrete diaphragms are preferred by GDOT for minimal corrosion potential, the steel diaphragms were used because they provide immediate bracing capacity during deck construction. The specified galvanized steel diaphragms are quicker to install and time was a critical factor in completion of the bridge. After the deck was completed, the contractor welded the non-galvanized joints of the diaphragms and then applied a galvanized coating to meet specifications.

The bridge expansion joint is located at the west side, but the planter walls continue into the campus for about 40 ft (12 m) at the request of Georgia Tech.

**Fifth Street bridge transcends function**

Georgia Tech’s Fifth Street Pedestrian Plaza Bridge in midtown Atlanta meets more than the standard definition of a successful precast concrete construction project. It is a durable and economic structure that serves its intended purpose. GDOT stepped up to take advantage of new designs in an unprecedented acceleration of its planning timelines. The con-

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**Detailed Project Costs of the Fifth Street Pedestrian Plaza Bridge**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid price</td>
<td>$10,305,379.00</td>
</tr>
<tr>
<td>Supplemental</td>
<td>$380,113.00</td>
</tr>
<tr>
<td>Total</td>
<td>$10,685,492.00</td>
</tr>
<tr>
<td>Total cost of the bridge</td>
<td>$10,117,213.00</td>
</tr>
<tr>
<td>Cost/ft² of the bridge</td>
<td>$176.68/ft²</td>
</tr>
</tbody>
</table>

Note: $1/ft² = $11/m².
tractor faced costly penalties for construction delays and for any interference with traffic in a willingness to construct its first D-B bridge for GDOT with some untried elements. The architect created new planting walls and landscaping schemes that were received with open-mindedness by Georgia Tech in a mutual quest for an optimized, multifunction structure.

Strong interest in reconnecting neighborhoods with similar bridges in Georgia is already clear. The City of Atlanta has expressed an interest in several other sites along the Downtown Connector. Completed 26 months after GDOT’s notice to proceed at a cost of $10.3 million, Georgia Tech’s Fifth Street Pedestrian Plaza Bridge is an exceptional new urban landmark. A high-profile project, the bridge now serves as a popular collegiate gathering spot and functions as a vehicle/pedestrian span that offers a remarkably tranquil and green setting above the noisy rush of I-75/I-85.

Acknowledgments

The author thanks the following individuals for their help in providing information and graphics for this article: Paul V. Liles Jr., P.E., State Bridge and Structural Engineer and Marion “Mike” Clements III, P.E., Bridge Design Group Leader, GDOT, Office of Bridge and Structural Design; Jim Aitken, P.E., structural department manager, ARCADIS U.S. Inc.; Tim Schmitz, P.E., president, Structural Engineering Solutions LLC and former engineer of record, ARCADIS U.S. Inc; David Culpepper, P.E., senior project manager/chief engineer, and Gene Boullain, project manager, both of Sunbelt Structures Inc.; Richard Potts, P.E., vice president engineering manager, Standard Concrete Products, Georgia division; John R. Wolosick, P.E., director of engineering, Hayward Baker Inc.; Gil Garrison,
AIA, principal, and Lindsey Scheiblauer, both of Smallwood, Reynolds, Stewart, Stewart & Assoc. Inc.; Peter Libourel, precast general manager, MC Precast Inc.; Frank G. Lamia, Manager Construction Administration, project liaison, Georgia Tech Facilities Office of Design and Construction, Lisa Ray Grovenstein, director of client communications, Jennifer Tyner, digital imaging specialist, and Michael Hagearty, manager, campus communications, all of Georgia Institute of Technology; Greg Grant, P.E., director of structural engineering, and Mike Lewis, design engineer, both of Wolverton & Assoc. Inc.; Jack D. Stewart, P.E., division manager, SE division, The Reinforced Earth Co.; and Georgia Tech students Lauren Miller, Lindsay Sprung, and Brock Webster.

References

About the author

Sue McCraven is an engineer, freelance writer, and editor in Farmington Hills, Mich. She has worked as the engineering editor of the *PCI Journal* since 2002.

Synopsis

Few things provide more professional satisfaction to precast concrete engineers, architects, precasters, and contractors than to create an exciting landmark structure with untried new designs. In midtown Atlanta, Ga., the Georgia Institute of Technology’s (Georgia Tech’s) Fifth Street Pedestrian Plaza Bridge provides more than safe passage over the 15 busy lanes of the I-75/I-85 Downtown Connector. Using some bridge elements for the first time (including a modified PCI bulb-tee beam, planter walls, and a tension-micropile support abutment), the Georgia Department of Transportation (GDOT) compressed its usual 6-year planning schedule to an unprecedented 10 months for the Fifth Street Pedestrian Plaza Bridge project. Building a GDOT design-build bridge for the first time, the general contractor worked seven-day weeks to avoid project delays and traffic interruptions. Georgia Tech students testify to the success of the Fifth Street Pedestrian Plaza Bridge as more than a popular location for recreation and collegiate gatherings; the campus’ new signature bridge achieves remarkable noise abatement from I-75/I-85 while offering a tranquil, park-like setting and passage for pedestrians and vehicles.

Keywords

Accelerated schedules, bridges, design/build, design-build, GDOT, modified bulb-tee girders, on-site production, retaining walls, planter walls, tiebacks, waterproofing.

Reader comments

Please address any reader comments to *PCI Journal* editor-in-chief Emily Lorenz at elorenz@pci.org or Precast/Prestressed Concrete Institute, c/o *PCI Journal*, 209 W. Jackson Blvd., Suite 500, Chicago, IL 60606.
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