Jeff Danzer Bridge over the Little Scioto River Scioto County, Ohio

Top view of new Jeff Danzer Bridge over the Little Scioto River.

Side view of new Jeff Danzer Bridge over the Little Scioto River.

In this unique design-build project, spliced, precast concrete bulb-tee girders using semi-lightweight concrete and two-stage post-tensioning were designed to cross a river with a 200-ft-long (610 m) single-span structure.

Utilizing girders of this size and type is not common on single-span river crossings, and in this case the girders eliminated the need for construction of the substructure in the channel and the pursuant lengthy U. S. Army Corps of Engineers (USACOE) individual permit process.

The Jeff Danzer Bridge is situated in rural southern Ohio in the foothills of the Appalachian Mountains. Its precise location is Scioto County Road 15, Dixon Mill Road over the Little Scioto River. The site was surveyed in May 2003 and the bridge was completed in October 2006. The 201 ft 6 in.–long (61.4 m), two-lane, single-span, precast, prestressed concrete structure replaced a deteriorated, two-span, steel beam/steel truss bridge. The former steel bridge was functionally obsolete, posted for reduced loads, and in critical need of replacement.

Although it was obvious that a replacement bridge was urgently needed, funding for projects in rural areas such as Sci-

oto County is always a major challenge. Using money only from scarce county motor vehicle fuel tax dollars, it is impossible to complete sizeable road or bridge construction projects while meeting the other county needs; therefore, a great deal of imagination is needed to leverage the local portion of highway project costs with other resources.

This particular bridge was a challenge due to its relatively large size and cost to replace. Clyde Willis, P.E., P.S., Scioto County Engineer, is experienced in installing precast concrete deck-slab structures on small, cast-in-place concrete foundations using county crews to replace short-span bridges. Willis and his crew have replaced 114 bridges that were less than 30 ft (9.15 m) in length since 1990. He contracted 51 bridge replacements since that time. Other structures in the county over $100,000 but less than $500,000 are commonly funded 80%/20% with Ohio Issue 2 state bond money, which is earmarked for local governments and distributed on a regional basis.

At an estimated $1.2 million construction cost, replacement of this county bridge exceeded the maximum annual amount available of Issue 2 grant funds by a factor of three. The first challenge for the Dixon Mill bridge replacement project was getting the design and construction funded.

In spring of 2003, Willis hired a fiscal and managerial consultant, Mary Ellen Kimberlin, P.E., to help him develop funding options and manage the project development of the subject bridge and another similar bridge replacement project. Kimberlin proposed using the design-build project delivery system to get the bridge replaced quickly and with the added benefit of including the cost of design engineering with the construction bid price. Both design and construction costs are eligible for 80%/20% federal funding in a design-build job. In a traditional project using federal funds, the design must be paid fully by the local government before the construction is eligible for the 80%/20% funding. This decision created a direct savings of approximately $100,000.

Design-build project delivery guarantees collaboration of the designer and contractor that will result in the most efficient and effective project if carefully scoped and managed. The county was able to use toll revenue credits for a 15% local match, leaving its share as only 5%, and so the project was programmed. The use of a State Infrastructure Bank (SIB) loan repaid with federal funds was employed, along with early coordination and strong project management. The SIB loan was used to advance the project from its programmed sale date of July 2008. The final cost to the county to move up the sale date approximately 30 months was $24,724.

Old, deteriorated, steel-beam truss bridge over the Little Scioto River.

Swept ducts in girders prior to concrete placement.

End girder detail prior to placing concrete in the girder.

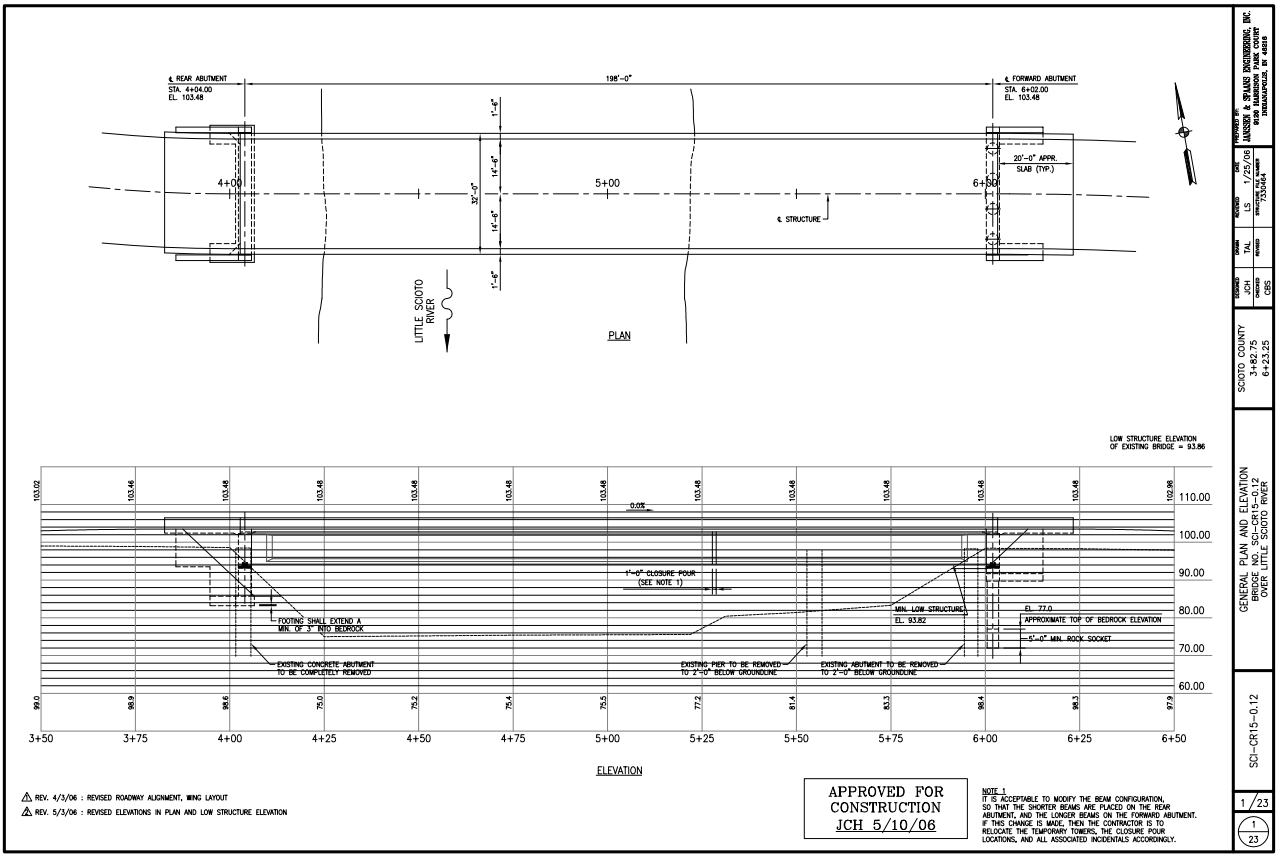
To move the project quickly through the traditionally bureaucratic, federally funded project development process, it was necessary for Scioto County, the owner, to make some decisions about the new bridge.

First, a single-span structure was chosen in order to apply for and receive a USACOE nationwide permit rather than endure the lengthy individual permit process.

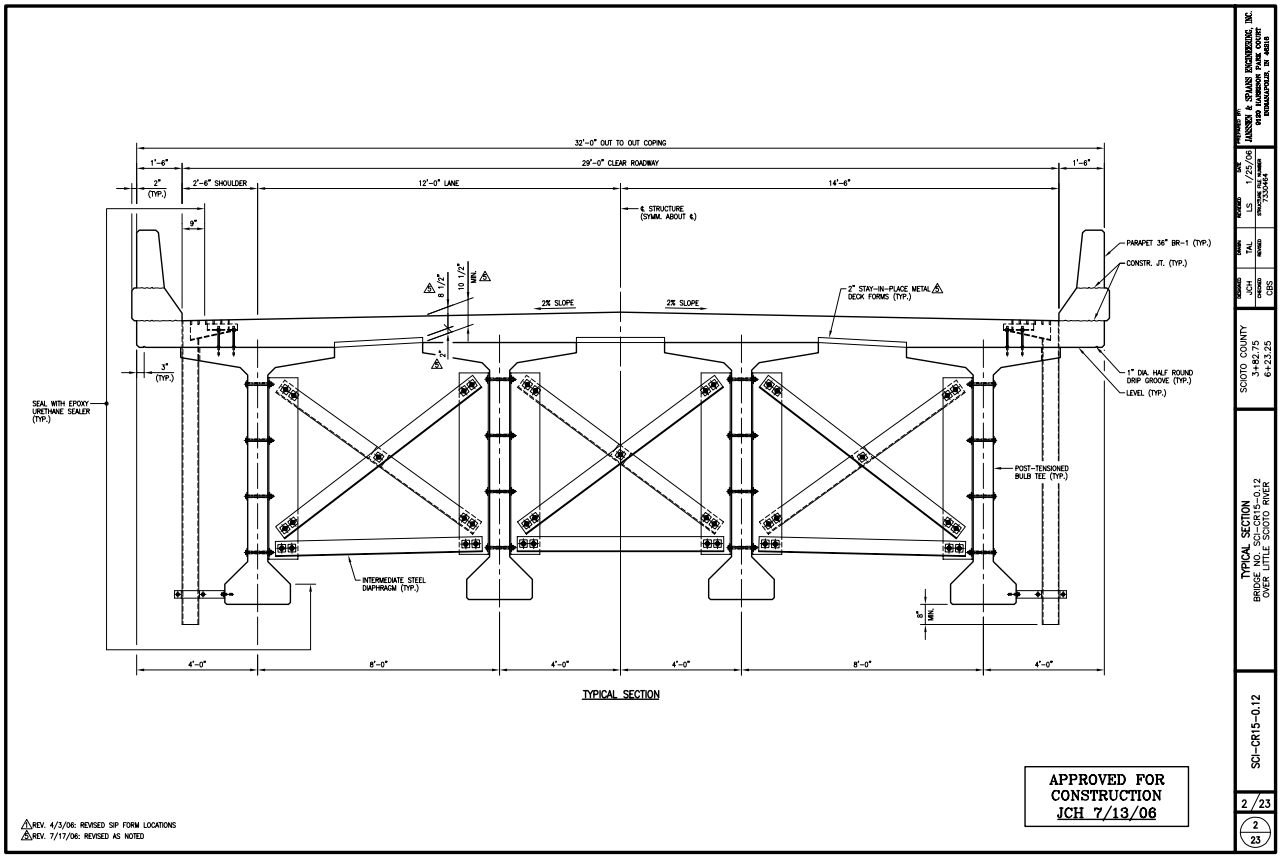
Second, the profile grade was raised approximately 10 ft (3 m) above existing grade to accommodate the deeper superstructure of a simple span. This enabled the owner to acquire property for right-of-way and relocate utilities prior to the design-build contract sale.

Third, the bridge type was limited to galvanized steel, cast-in-place concrete, or precast/prestressed concrete. Because of the poor past performance of weathering steel in the region and the county's desire to have a maintenance-free, long-life structure, steel was not chosen. These preliminary decisions presented some serious challenges to the design-build teams but framed the project well.

Willis prepared the conceptual site plan with his staff. The environmental assessment determined that the bridge



Plan and elevation of Jeff Danzer Bridge over the Little Scioto River.



Cross section of Jeff Danzer Bridge over the Little Scioto River.

was a level 1 categorical exclusion and the documentation was prepared by Ohio Department of Transportation (ODOT) District 9 planning staff. Right-of-way was acquired prior to sale using a task order consultant in compliance with U.S. Code of Regulations Title 23. Scioto County prepared the right-of-way plans in-house as well as the scope and bid documents following ODOT's procedures for design-build projects. To save additional time, the county used the local let process for local public agencies to advertise and sell the project rather than using ODOT's process.

The project description taken directly from the scope of work contract bid document reads as follows:

"Remove and dispose of existing bridge superstructure; remove existing pier and remove existing abutments. The proposed structure shall be a simple span. All removed materials are the responsibility and property of the DBT [design-build team]. Due to the environmentally sensitive nature of the project area, the structure type shall be limited to prestressed or cast-in-place concrete, or galvanized steel girders as approved by the Scioto County Engineer prior to award of the contract. The design criteria shall be HS20-44 with Alternate Military Loading. Utilize the profile line and grade as shown on the conceptual drawings as much as is practicable. Drawings are provided for conceptual information only. The pavement and geometric design shall be in accordance with ODOT Location and Design Manuals and any design exceptions shall be the responsibility of the DBT."

Two bids were submitted for this design-build project. One design-build team submitted a three-beam-line, simple-span, steel alternate, while the victorious team bid a prestressed concrete structure.

The successful bid used 8 ft 6 in.–deep (2.6 m), precast, prestressed concrete spliced bulb-tee girders with a 5 ft 1 in.–wide (1.6 m) top flange. Four girder lines at 8 ft (2.4 m) on center were used for a total of eight girders. Section lengths are 75 ft and 125 ft 6 in. (22.9 m and 38.3 m), with a 1-ft-wide (0.3 m) closure pour for a total span of 201 ft 6 in. (61.4 m). Two-stage post-tensioning is used for the splicing.

Adjoining precast concrete bulb-tee girder sections showing 1 ft (0.3 m) closure joint.


Newly installed, precast concrete bulb-tee girders.

The overall width of the bridge is 32 ft (9.8 m) out-to-out of the deck. This brings the total deck area to 201.5 × 32 = 6448 ft^2 (600 m^2). A plan, elevation, and cross section of the bridge are shown herein.

The winning design-build team comprised C. J. Mahan Construction Co. and Janssen & Spaans Engineering Inc. The successful bid for the project came in at $1.45 million for the bridge and roadway. The actual cost of the bridge was $1,328,500, which brought the cost per square foot of the bridge to $206 per ft^2. Prestress Services Industries LLC fabricated the girders at its plant in Columbus, Ohio. The girders were transported by tractor-trailer to the project site, a distance of about 90 miles (145 km).

The first design challenge was the mandatory simple-span length of 200 ft (60 m). A temporary bent was constructed on a concrete slab to support the beam sections prior to closure pour

Post-tensioning the precast concrete bulb-tee girder at bridge end.

Bridge surface ready for 8½-in.-thick (216 mm) deck slab.

and stressing. Some concern over the depth of the concrete girders was one factor in the selection of a spliced, post-tensioned, four-girder line concept. The higher-cost steel alternate was 93 in. deep (2400 mm) and was also spliced but had only three girder lines.

Because the weight of the girders was a concern, semi-lightweight concrete was specified. Spliced girders were designed so the sections could be transported and erected without difficulty. ODOT design requirements permit a minimum web thickness of 8 in. (200 mm), and the top flange needed to be wide for transportation stability, so the weight of traditional concrete posed a challenge. The concrete used had a density of 125 lb/ft^3 (3.5 kg/m^3).

Post-tensioning in two stages was the best approach for the spliced-girder design. The post-tensioning ducts were swept from the bottom flange of the girder up into the web. In the first stage of post-tensioning, most of the stressing was done prior to placing the deck concrete. After the deck concrete was placed, the final stage of post-tensioning brought the deflection of the girders to planned values. The swept ducts were challenging for the precast concrete producer, but they engineered custom reinforcing bar supports that helped ensure that the ductwork was correct.

Another feature of this bridge was the use of a simplified decking system. Galvanized steel, stay-in-place formwork was used, which is commonly employed in Ohio bridges. The innovation was in laying the formwork directly on the top flanges of the girders without any fillets.

Design of this project began in 2005 and lasted nine months. Construction took only 120 days, which fulfilled the contract requirement for road closure. The bridge was opened to traffic after a bridge-naming ceremony on October 27, 2006, and has been operating with total satisfaction of the public and the owner since then.

In summary, the precast, prestressed concrete alternate met the owner's specifications in terms of functionality, strength, and economics. From inception to project completion, only three years elapsed. The project was built on time, had no contract modifications, and met the budget. All parties (owner, designer, contractor, and precaster) agree that the bridge is a success.

It is expected that this bridge will have a long life with minimal maintenance. The use of semi-lightweight concrete is a new trend to reduce the weight of members, and the technique of splicing girders with post-tensioning is a proven method to increase span length. Also, the precast concrete bulb-tee girders with their wide top flanges will improve the stability of the structure.

The Jeff Danzer Bridge was named in honor of an outstanding Scioto County employee and serves as a monument to innovation. This bridge is the longest simple-span bridge in Ohio using prestressed concrete girders. It is hoped that it will serve as a prototype for single-span bridges in the future.

For further information on design and construction details of this type of bridge, see:

- PCI Bridges Committee. 2003. *PCI Bridge Design Manual*, 2nd ed. Chicago, IL: Precast/Prestressed Concrete Institute.
- Castrodale, R. W., and C. D. White. 2004. Extending Span Ranges of Precast Prestressed Concrete Girders. NCHRP Report 517, Washington, DC: Transportation Research Board.

CREDITS

Owner: Scioto County; Portsmouth, Ohio
Scioto County Engineer: Clyde S. Willis, P.E., P.S.; Portsmouth, Ohio
Managerial Consultant: Mary Ellen Kimberlin, P.E.; Consultant; Columbus, Ohio
Engineer of Record: Janssen & Spaans Engineering Inc.; Indianapolis, Ind.
Contractor: C. J. Mahan Construction Co.; Grove City, Ohio
Precaster: Prestress Services Industries LLC; Lexington, Ky.
Line drawings: Janssen & Spaans Engineering Inc.; Indianapolis, Ind.
Photographs: Prestress Services Industries LLC, Mary Ellen Kimberlin LLC, and Clyde S. Willis

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