Dodridge Street Bridge
Franklin County, Ohio

Three-span, post-tensioned concrete girder end-anchored superstructure bridge

by Jim Pajk, Franklin County, Ohio, and Rick Engel and Dave Traini, E.L. Robinson Engineering

Bridge profile (east end). The Dodridge Street Bridge has a main span of 200 ft and two hidden end spans of 20 ft 6 in. All photos: E.L. Robinson Engineering.

The Dodridge Street Bridge over the Olentangy River serves as a gateway into Olde North Columbus, one of the oldest neighborhoods in Columbus, Ohio. The project replaced a deteriorating bridge, corrected an existing deficient roadway alignment, and carries over 14,000 vehicles per day as well as pedestrians.

In addition, several thousand pedestrians and bicycle users travel daily along the Olentangy River Greenway (ORG), which is located underneath the bridge. The 13-mile-long ORG connects the north suburbs to downtown Columbus and travels through several parks and The Ohio State University campus area.

During design of the Dodridge Street Bridge, the Franklin County Engineer's Office (FCEO) identified the need to solicit design input from the surrounding community. These opinions, coupled with river hydraulics, ongoing river restoration, upstream protected wetlands, and the extensive use of the ORG, supported the desire to provide a long-span, aesthetically pleasing structure.

Background

The original 206-ft-long bridge, constructed in 1901, was a two-span, steel through girder bridge with a timber floor system. The bridge was rehabilitated in 1952. In 1967, the entire superstructure was replaced with precast, prestressed concrete adjacent box beams. In 2010, the bridge was determined to be in poor condition.

Project Development

Five design alternatives were considered for the Dodridge Street Bridge. The alternative that was favored best satisfied the following project criteria:

- No piers within the river banks
- West abutment location out of ordinary high water
- Open inviting appearance
- Significant headroom and trail width for ORG
- Minimal disruption to existing dwellings
- Reasonable cost
- Long structure life
- Minimal maintenance associated with a concrete structure

[The alternative] required the least construction time, largely due to the use of precast concrete beam construction.

The selected alternative of a three-span bridge minimized work within the river, where the water elevation can fluctuate greatly due to an upstream reservoir controlled by the Army Corps

profile

DODRIDGE STREET BRIDGE / FRANKLIN COUNTY, OHIO

BRIDGE DESIGN ENGINEER: E.L. Robinson Engineering, Columbus, Ohio, and Janssen & Spaans Engineering Inc., Indianapolis, Ind.

AESTHETIC ADVISOR: Frederick Gottemoeller, Columbia, Md.

PRIME CONTRACTOR: J. D. Williamson Construction Co. Inc., Tallmadge, Ohio

PRECASTER: Prestress Services LLC, Grove City, Ohio, a PCI-certified producer

POST-TENSIONING CONTRACTOR: VSL International Ltd., Hanover, Md.

READY-MIX CONCRETE SUPPLIERS: Anderson Concrete, Columbus, Ohio, and Central Ready Mix, Columbus, Ohio

Erection of the precast concrete segments and view of the abutment tie-downs.

of Engineers. It also required the least construction time, largely due to the use of precast concrete beam construction.

The presence of shallow bedrock meant that the design could use short end spans with high capacity tie-downs, and avoid the expenses and construction issues related to longer end spans, which would encroach on the apartment building to the east of the site. The 200-ft-long center span was considered the optimal, upper span limit for this bridge type and necessary to meet the previously outlined concerns. The 26-ft 6-in.-long hidden end spans also avoided the removal of the existing stone east wall abutment and reduced right-of-way issues.

Construction started in July 2011 and the project was opened to traffic by the end of October 2012. The project was able to accomplish the goal of replacing the bridge while incorporating many community- and stakeholder-requested elements during and after construction.

Improvements to the ORG trail included a wider, paved path underneath the bridge and an improved railing to protect the users. The proposed bridge roadway section provides additional bridge width to accommodate wider sidewalks, vehicular barriers between the roadway and sidewalk, and consideration for future bicycle lanes. Safe and efficient detours were critical during construction. Many individuals use the bridge and the ORG beneath it to get to work or education facilities. The FCEO worked with The Ohio State University, Central Ohio Transit Authority, City of Columbus Recreation and Parks, and bicycle advocates to address user concerns during construction.

Superstructure

The structure was designed in accordance with the *AASHTO LRFD Bridge Design Specifications*. The bridge has a main span of 200 ft and two hidden end spans of 26 ft 6 in. The superstructure consists of four variable-depth precast concrete U-beams at 18 ft centers for the main span and four constant-depth U-beams for the side spans. The main span beams vary in depth from 5 ft 6 in. at midspan to 10 ft at the intermediate piers. The beam width varies from 4 ft at the soffit to 8 ft at the underside of the deck. The

Public Opinion

The Franklin County Engineer's Office (FCEO) hosted numerous public involvement meetings on key project design issues, and over 12 stakeholder groups and numerous homeowners provided project design-related opinions. Public meetings offered the stakeholders a chance to voice opinions on sidewalks, path facilities, solutions to a safe trail detour, construction-related-activity concerns, potential environmental impacts to the river, flooding and conservation easement, mobility of current pedestrians along Dodridge Street and Olentangy River Greenway (ORG), structure type and choice of material, and the importance of bridge aesthetics.

Early in the development phase, ARC Industries, located adjacent to the bridge, indicated they had a relatively high volume of special-needs individuals who used public transportation and walked to their facility across the bridge from the bus stop on the east side. Along with the structural demands of the project, the needs of the users of these adjoining and affected public facilities, especially the ORG, were considered.

The design team used this input to develop five project design alternatives. The public then provided comments on the five proposed structure alternatives and various railing, lighting, and other aesthetic features. The selected alternative provides Ohio with a unique and aesthetically pleasing bridge type. This alternative is an economical solution that provides a slender single span, resulting in a feeling of openness along the river, inviting pedestrians and bikers to travel along the ORG to this destination site.

FRANKLIN COUNTY, OWNER

BRIDGE DESCRIPTION: A precast concrete U-beam bridge with a 200-ft-long main span and 26-ft 6-in.-long hidden end spans

STRUCTURAL COMPONENTS: Precast concrete U-beams; cast-in-place concrete abutments, piers, hidden end spans, and deck

BRIDGE CONSTRUCTION COST: $7.7 million web thickness varies from 9 to 12 in. The U-beams support an 11-in.-thick cast-in-place concrete deck with a total width of 75 ft 0 in.

The main-span concrete beams were precast in three sections, erected on falsework, and spliced with a closure pour. The end spans were cast-in-place extensions of the precast concrete main span beams. The main span and end span beams were post-tensioned together longitudinally to create a continuous structure from abutment to abutment.

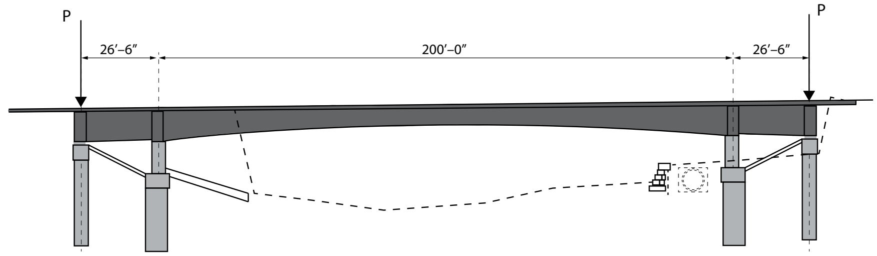
For the precast concrete beams, the specified concrete strength was 7 ksi. The use of high-performance concrete, epoxy-coated reinforcing steel, a soluble reactive silicate (SRS) sealer on the deck, and non-epoxy coating on exposed concrete surfaces, will provide a long lasting structure with minimal future maintenance needs.

Erection of the precast concrete segments on temporary towers.

Tie Downs

Tied-down end spans have been used successfully in Ohio on three bridges that have steel girder superstructures. For this project, the tied-down end spans, along with the haunching of the concrete girders at the piers, allow the middle of the center span to be relatively slender and improves the appearance of the bridge by making the bridge seem thinner and lighter. A 4-in. offset in the outer webs of the fascia girders creates a shadow line that enhances this slender visual effect.

The use of tied-down end spans for concrete girder superstructure designs presents a design challenge due to the relatively large dead load that must be resisted by the tied-down anchors. Each tied-down rock anchor located at the abutments consisted of twelve 0.6-in.-diameter, 270 ksi, prestressing monostrands placed in a conduit filled with grease. The tendons extend from the top of the abutment diaphragm to approximately 30 ft into bedrock. The tendon free length is 40 ft and the bond length is approximately 30 ft. The portion of the tendon that extends from the top of the abutment footing for a distance of 30 ft to the top of bedrock is centered in a 12-in.-diameter steel casing that allows the tendon to translate horizontally as the expansion and contraction movements of the superstructure occur.



Profile and bridge elevation view, where P is the force from twelve monostrands. Drawing: PCI.

Within the bedrock, the corrosion protection consisted of a grout-filled corrugated plastic casing placed around the bare strands. The design factored load for the 12 tied-down anchors at each abutment was 440 kips per anchor. The abutments and the piers were constructed of cast-in-place concrete in a continuous box configuration that was supported by drilled shafts socketed into bedrock.

The precast concrete beams used for the superstructure of the Dodridge Street Bridge are unique because their main structural component is the tied-down anchors located at the abutments of the two hidden end spans. These two hidden end spans were required to balance the effects of having a slender main span structure. The architectural geometry of this bridge required the smallest structural section where peak design demand occurred, posing a significant design challenge. To overcome this challenge, tied-down anchors were utilized to provide stability for the bridge which is otherwise unbalanced in its three-span configuration.

The beams were also post-tensioned in stages as dead load was applied to allow the girders to function as continuous beams, despite the appearance of a single-span gentle arch. The construction of this bridge required a careful sequencing of the post-tensioning and tied-down forces to ensure the beams were stable throughout all stages of construction and were at no time overstressed.

Aesthetic treatments to the substructure units. The end span is hidden behind the abutment.

This aesthetically pleasing structure will provide local residents with a beautiful gateway that can be enjoyed for decades. The use of a precast, post-tensioned concrete superstructure provided an economical solution and saved construction time, thus minimizing disruption to the community. The improvements made to the ORG will allow users to navigate along the trail while appreciating the bridge's aesthetic features.

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