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Unique bridge rising in Columbus

Finishing touches being put on west pier for an inclined arch bridge of Main Street over the Scioto River in Columbus

A state-of-the-art, signature bridge is beginning to take shape over the Scioto River in downtown Columbus. This showcase bridge will replace the aging Main Street Bridge built in 1937. The new bridge is referred to as an inclined arch. The main span will consist of a single steel arch situated on one side of the 40 ft wide vehicular roadway with an 18 ft - 7 in. wide pedestrian/bikeway on the other side of the arch. The 400 ft long, 10 degree leaning arch will support transverse steel floor beams which in turn will support the deck and pedestrian walkway using a combination of compression struts and tensioned hangar cables.

When completed in 2009, this will be one of only five such bridges ever constructed in the world and the first in the United States. The City of Columbus wanted a unique structure to showcase the downtown area and so they appointed Dr. Spiro Pollalis, professor at the Harvard University, Gradu-

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Unique bridge rising, Continued from page 1

Forming inclined face as pour progresses to assure full consolidation of concrete for pier footing

ate School of Design, to conceptualize the design. The Ohio Department of Transportation (ODOT), in partnership with the City of Columbus, chose the design team of DLZ Ohio, of Columbus, and HNTB Corporation, of Cleveland, for the final design.

The bridge is actually a three span structure. The main arch span is 400 ft long and has 131 ft - 6 in. spans on each end. The arch will rise from massive concrete piers at each end to a height of 80 ft. Even though it is a steel structure, there is plenty of cast-in-place concrete supporting it (about 19,000 yd^3). The abutments are founded on six 6 ft diameter drilled shafts 80 ft deep and the piers (which support the arch) are founded on nine 5 ft-6 in. diameter drilled shafts 80 ft deep into bedrock.

Each pier is resting on a footing on top of the drilled shafts. The piers were a forming challenge. The river sides of the piers have a curved vertical face (similar to the shape of a snow plow blade). The bank sides of the piers have a relatively flat incline which will blend in with the profile of the arch. The sides are inclined outward (wider at the top than at the bottom.) The two 14-ft thick monoliths are heavily reinforced with No.18 bars, and each required about 920 yd^3 of concrete. Due to the massive amount of concrete, tubes for cooling the fresh concrete with water pumped from the river, were incorporated into the pour.

For this project, cast-in-place concrete strength requirements range from 4,000 psi to 6,000 psi, depending on the specific element of the bridge. All concrete is specified to be QC/QA (Quality Control/Quality Assurance), meaning that the contractor/concrete producer can choose their own mix designs as long as the required strength, air content and permeability is met.

Bids for this project were opened in June of 2006 with a completion date of June 2009. Kokosing Construction Company Inc., of Fredericktown, OH, won the job with a bid of $45 million. ODOT District 6 is providing construction inspection and administration on the project. Other players on the team include Janssen & Spaans Engineering, of Indianapolis, who is the Construction Engineer, and Dick Corporation, of Cleveland, providing Construction Management services to ODOT. Concrete for the project is being supplied by Anderson Concrete Corp., of Columbus, with concrete testing performed by CTL Engineering, Inc., also of Columbus.

The single steel arch of Main Street Bridge will incline 10 degrees from vertical toward the viewer of this artist's rendering

200 foot, single span bridge with concrete girders

Casting a concrete girder in Columbus

Mr. Clyde Willis, PE, PS, the Scioto County Engineer, has now replaced two aging steel truss bridges without using another truss and without using piers in the stream. His solution was to build the new bridges with prestressed, spliced concrete girders, and cast in place concrete decks.

By his design, the bridge superstructure is made up of four prestressed, spliced concrete girders. The girders are actually 199 ft -6 in. long and are spaced at 8 ft centers. The girders are bulb tees 8 ft-7 in. deep with a 5 ft-1 in. wide top flange and a 2 ft- 2 in. wide bottom flange. Each is cast with 4 ducts to accommodate draped post-tensioning strands.

Each girder line is comprised of two girder sections which are spliced in the field after erection. One section is 122 ft -3 in. long and the other is 70 ft- 3 in. long. The girders are erected end-to-end and supported on temporary shoring at the splice point. A cast-in-place concrete closure pour is made and after necessary strength gain is achieved, the ends are post-tensioned together. After the girders are erected and tensioned, an 8 ½ in. thick reinforced concrete deck is cast on galvanized steel stay-in-place forms.

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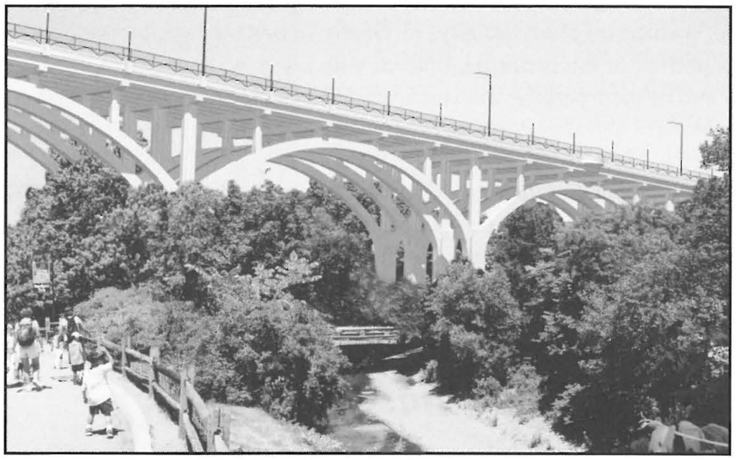
200 ft Single Span Bridge, Continued from Page 4

The latest project, County Road 48 (Arion Rd.) over Scioto Brush Creek, is also unique because the substructure is founded on 14 in.-square prestressed concrete piling. This was one of the first bridge projects in Ohio to utilize prestressed concrete piling. The advantage of the concrete piling over conventional steel piling is its availability from local precasters and the ability to install lengths up to 65 ft without splicing.

No piers in the stream required with 200 ft long spliced concrete girders

The Arion Road project was a design-build project with CJ Mahan Construction, of Grove City, OH, as the contractor and Janssen & Spaans Engineering, Inc., of Indianapolis, IN, as the designer. Ready mixed concrete for the girders was supplied by Anderson Concrete Corp., to the Prestress Services Industries yard in Columbus. Ready mixed concrete for the abutments and deck was supplied by Hanson Aggregates Davon, Inc. (Chattin Ready Mix) of Piketon OH.

High-tech concrete for a high bridge in Cleveland



Artist's rendering of Fulton Road Bridge from the Cuyahoga County Engineer's website www.cuyctyengineers.org

The Ohio Department of Transportation (ODOT) District 12 is currently administering construction of a 1,561 ft long, concrete arch bridge that will tower about 110 ft over the Cleveland Metroparks Zoo, and two active railroad lines. Aesthetically speaking, the new bridge will be a same-site replica of the open spandrel deck concrete arch bridge that had been admired by Zoo visitors since 1932. Major unseen differences are ongoing in the concrete technology being used to build the new structure.

The Cleveland office of Michael Baker Jr., Inc., designed the contemporary precast concrete arch structure that will be the new Fulton Road Bridge. With a deck width of 81 ft (four lanes of traffic, two bike lanes and two sidewalks), the new bridge is replacing a structurally deficient and functionally obsolete 75-year structure whose 63 ft wide deck had been reduced to two lanes of traffic due to safety concerns. The new structure will have eleven spans (six are arches) and four arch ribs per arch span. About 20,000 yd^3 of cast-in-place concrete will be required for the drilled shaft foundations, substructure and superstructure. That work will include high-strength, self-consolidating, mass concrete with maturity monitoring for the arch pier thrust blocks.

This is District 12's first project to use the ODOT Quality Control/Quality Assurance Supplemental Specification 898 *QC/QA Concrete for Structures*. Kokosing Construction Company, Fredericktown OH, is the project's general contractor. Concrete testing is being performed by the Cleveland office of Ohio-based, CTL Engineering, Inc., with CTL Group, of Skokie IL, as their subconsultant for mass concrete.

CTL Engineering is providing the quality control testing services for Kokosing, including: quality control plans for QC/QA, laboratory concrete testing and concrete maturity testing, concrete mix design verification, concrete maturity curve development, mass concrete thermal control plans and QC/QA concrete testing in the field.

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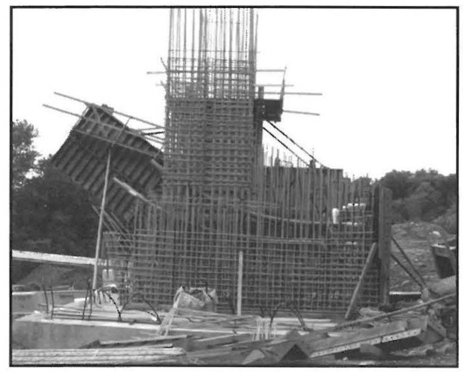

Each arch pier thrust block will require about 500 yd^3 of high strength self consolidating mass concrete.

High Tech Concrete, Continued from Page 5

For the mass concrete work, CTL Engineering performed specialized material testing (adiabatic temperature rise, thermal expansion, elastic modulus, compressive and split tensile strengths) used to develop the thermal control plans including performance-based temperature difference limits. CTL Group designed the thermal control system and wrote the thermal control plans.

Mass concrete is being used for the arch pier footings, the arch pier bases above the footings and the arch pier thrust blocks. The project's seven arch pier footings average over 500 yd^3 each of QSC1M, 4,000 psi mass concrete. Five of the arch piers have four pier bases each below the thrust blocks, one for each arch rib, averaging over 100 yd^3 each of QSC1M, 4,000 psi mass concrete. Each of the seven arch piers has four arch pier thrust blocks. Internally, the thrust blocks are highly congested structures, heavily reinforced with large diameter steel bars, plus post-tension tendon ducts, mass concrete cooling tubes and block-outs for intentional voids. Each thrust block averages over 90 yd^3 of QSC3MSCC, 7,000 psi self-consolidating (SCC) mass concrete.

The thermal control plans for mass concrete require that the internal and external concrete temperatures be monitored and controlled until the internal temperature is within a 35 degree temperature difference limit of ambient temperature. Pre-cooling of the fresh concrete and internal cooling of the hardened concrete is used to keep the internal temperature below a maximum 155° F and to reduce the temperature control period. A higher, performance-based, temperature difference limit can further reduce the temperature control period based on the actual strength of the concrete in-place. Maturity testing is being used to estimate the strength of the concrete in-place at any given time.

After the mass concrete work, there will be many small but critical closure placements for the arch segments, followed by the spandrel frames above the arches, and then the deck, to be of cast-in-place concrete. The precast, post-tensioned concrete arch segments for each of the six spans require sixteen arch closures of less than 2 yd^3 each of QSC3 concrete designed for 7,000 psi at 7 days of age. The arches require twelve struts for each of six spans with two closures for each strut for 144 closures of less than one yd^3 each of QSC2, 4,500 psi concrete. More than 50 placements of QSC2 concrete are needed for the spandrel frame between the arches and the deck, which along with the arches will give the bridge its open, airy appearance. Six placements will be required to complete the concrete deck, and will total 4,600 yd^3 of QSC2, 4,500 psi concrete. Finally, concrete sidewalks on both sides of the bridge with lookouts above the zoo, and ornamental fence and parapets, will complete the structure.

Congestion of reinforcing steel, post-tension tendon ducts and mass concrete cooling tubes made SCC a necessity for the thrust block pours on new Fulton Road Bridge

The bridge is expected to be completed and open to traffic by mid-December 2009.

SS 898 classes of concrete for the Fulton Road Bridge:

Class	Compressive Strength (28 day)	Permeability	Description
QSC1	4,000 psi	2000 coulombs	
QSC1M	4,000 psi	2000 coulombs	Mass Concrete
QSC2	4,500 psi	1500 coulombs	
QSC3	7,000 psi at 7 days	2000 coulombs	
QSC3MSCC	7,000 psi	2000 coulombs	Mass Concrete, SCC