Steel Bridge NEWS

NATIONAL STEEL BRIDGE ALLIANCE SEPTEMBER 2006

REPAIR AND RETROFIT

140-Year-Old Steel Suspension Bridge to Close for Repairs

Kentucky plans to close the historic 140-year-old John A. Roebling Suspension Bridge for repairs and maintenance in early October. The bridge, which crosses the Ohio River and connects Covington, Ky., with Cincinnati, Ohio, will undergo about $2.8 million in structural and electrical repairs as well as $6 to $8 million for repainting.

Structural repairs include work on the steel grid bridge deck as well as the supporting beams beneath the deck. About $500,000 of the cost will go toward upgrading electrical wiring that has been in place for 30-50 years. The work is expected to be completed within a year.

Designed by engineer John Roebling, the bridge was completed in 1866 after the Civil War ended. Roebling began work on the structure in 1856, when his crew laid the foundations for the massive towers that

anchor the thick steel cables supporting the deck. The Civil War drained resources from the project, delaying construction.

In 1866, the 1,057 ft main span was the longest in the world. It was first suspension bridge to use both vertical suspenders and diagonal stays fanning from either tower. Roebling also employed this advance on the Brooklyn Bridge, which statistically surpassed the Cincinnati bridge in 1883.

The Cincinnati bridge remains an important river crossing for thousands of cars and buses each day. Repairs are expected to extend the life of the bridge for at least another 50 or 60 years.

—Based on a news story in the Cincinnati Post by Greg Parth and on information from Cincinnati Transit.

A MESSAGE FROM THE

Executive Director

I have heard from many of you that there is concern and frustration that federal bridge replacement and highway construction funds that were authorized in SAFETEA-LU last year are not producing the anticipated increase in projects being put out to bid. The story I keep hearing from NSBA members is that states are blaming the Federal Highway Administration.

I have raised this concern with Federal Highway Administration (FHWA) officials and with Congress. Federal and congressional officials are pointing back to the states. As is so often the case, the answer lies somewhere in between.

Congress did indeed pass SAFETEA-LU and the bill was signed into law by President Bush last year. It set forth funding levels for highway and transit programs through 2009. In addition to laying out the funding formulas for highway and bridge programs in the federal highway system, it also identified several thousand "high priority" projects and authorized funding for them with a four-year distribution formula. The states received their formula funding allocations from FHWA, and have known for several months how much they will receive in the current fiscal year. So Congress and FHWA are right in saying that the states have the money.

From the state perspective, however, SAFETEA-LU ultimately authorized highway program funding at a level nearly $100 billion below what was identified as the need for the next five years. So while they know how much money they are scheduled to receive, it is less than what they need. Secondly, information about funding for "high priority" projects was delayed. This was because there were so many projects and it took the FHWA a long time to work through them all. Additionally, SAFETEA-LU spells out the level of funding that will be allocated for each of those projects over the life of the bill. Not only were the formula funds less than the need, but funding for a certain segment of the highway projects was slow to reach the states.

So, the states have a point, too.

But then, many states have an inventory of highway project needs that dwarf their ability to provide the state funding share, even if the federal government had provided all the funding they sought. This is why we are increasingly seeing states exploring new highway financing mechanisms like expanded toll authorities and the sale or leasing of highways.

From a NSBA perspective, we just want to see projects move forward. I will continue to push in Washington to help this process. We also are working closely with states to identify project opportunities and offer our design assistance to encourage the use of steel. Passage of SAFETEA-LU was a long time in coming, and we need to put those funds to work to begin addressing the backlog of projects that were deferred while Congress worked to finalize a bill.

Sincerely,
Conn Abnee
NSBA Executive Director

STANDING THE TEST OF TIME

Sixteenth Street Bridge

Combining the immutability of classic design with the longevity of structural steel, the Sixteenth Street Bridge in Pittsburgh, Pa., has the distinction of having had two lifetimes. The bridge originally stood as a wooden-covered structure with four arch trusses, and was destroyed by fire in April 1919. Years later, the bridge that currently stands astride the Allegheny River reopened on October 9, 1923.

The Sixteenth Street Bridge was engineered by H.G. Balcom of New York, and cost $1,250,000. It is four lanes wide with a pedestrian walkway on both sides of the deck, and a steel-trussed arch with three main spans through the arch. The bridge consists of latticed and riveted plate girders and a warren truss on the arches and cross bracing. The deck is suspended below the arches. The length of the center span is 437 ft. The length of the north arch span is 240 ft and the south span is 240 ft. The total length including the longest elevated ramp is 1996 ft.

The design of the bridge was the second of two submitted by New York architects Warren and Wetmore; the first design included a victory memorial with triumphal arches at each portal. The chosen design had bronze winged seahorses and armillary spheres, created by Leo Lentilli, a New York sculptor. Because the four groups—which includes four sets of horses—were too wide to be transported by rail, two arrived by truck and two via the river.

Just below the bronze sculptures, six fish are carved in a band approximately four ft. high encircling the top of each pylon. The pylons rise approximately 62 ft above the bridge deck. The pedestrian walkway passes through an arched opening in each pylon; above the arched passage are stone carvings of a woman and a bearded man. These same faces appear on opposite pylons at each end of the bridge.

The original lighting was attached to the vertical members by ornamental brackets; these lights have been removed and replaced by modern lamp fixtures. Whereas the original bridge was painted silver and green, currently all steel on the bridge is painted yellow.

References: USACE Allegheny River Nav. Charts; *Discovering Pittsburgh's Sculpture* by Gay and Evert; *Pittsburgh's Landmark Architecture* by Kidney; *The Pennsy in The Steel City* by Kobus and Consoli; www.pghbridges.com.

BIDDING

Recent Steel Bridge Bids Below Estimates

Low bids for the following noteworthy three steel bridges came in under the engineer's estimate:

- **Columbus, Ohio**—Kokosing Construction's low bid to replace the Main Street bridge over the Scioto River in downtown Columbus was $44.1 million, about $6 million less than the state engineer's estimate of about $50 million. A one-of-a-kind signature bridge with a slant arch design, the project is to be completed by June 2009. The deteriorating existing bridge, which has been closed since 2002, is scheduled to come down this year.
- **Bismarck, N.D.**—A steel box girder design won over segmental concrete in recent bids for construction to replace the Liberty Memorial Bridge over the Missouri River, connecting Bismarck with Mandan, ND. The winning bid by Lunda Construction of Black River Falls, WI, came in at $47.27 million, nearly $100,000 under the NDDOT engineer's estimate. Neither bidding contractor bid the concrete option, designed as a cast-in-place pre-stressed segmental concrete bridge with balanced cantilever construction.
- **Omaha, Neb.**— A low bid by Hawkins for a weathering steel 785.7-ft viaduct in southeast Omaha, Neb., came in at $7.37 million, or 6.4 percent under the engineer's estimate. The National Steel Bridge Alliance recommended cost-cutting measures during the viaduct's preliminary design stage. The new viaduct will connect 13th Street with Gibson Road, crossing the mainline tracks of the Burlington Northern Santa Fe railroad. From end to end, the viaduct elevation changes about 41 ft, while curving on a 450 ft radius, complicating construction. Construction started in August.

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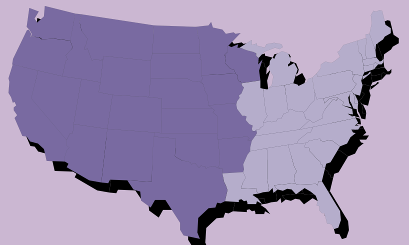


Steel Bridge Uses Simple-Span-Made-Continuous Construction

The Colorado DOT has designed and built its first new steel bridge using simple-span-made-continuous construction. Using this technique, workers connected in-line steel girders together at the piers. Conventionally, a welded or bolted steel splice of girder segments is located some distance out between piers, adding labor and construction complexity. CDOT engineering estimates indicated that this technique, combined with rolled steel beams, was especially cost-effective. In fact, the cost of the erected steel bridge superstructure was just $1.1 million. ($53.2/sq ft of deck or $.97/lb erected.)

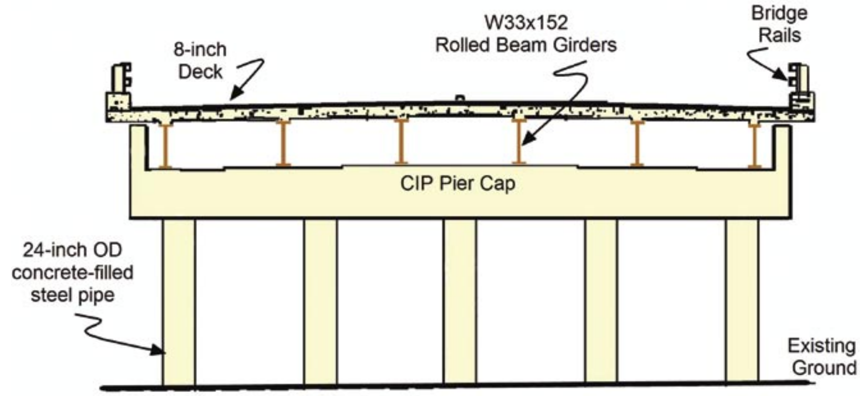
"The simple-span-made-continuous design is common with concrete beams," says Mark Leonard, State Bridge Engineer. "What we've done with this bridge is apply the same technique to structural steel, greatly simplifying design and construction. The end result is a steel bridge superstructure that's highly competitive with concrete beam alternatives," he says.

The new bridge crosses Box Elder Creek on U.S. Route 36 just east of Denver. For about four months during its construction, CDOT diverted all traffic to Interstate 70, which parallels U.S. 36 in this area. The new bridge replaces one built in 1930 and widened in 1950, but considered functionally obsolete.

Designer Teddy Meshesha, CDOT Structural Project Engineer, notes that the new 470-ft bridge is straight with six equal spans. "Its overall width is 44 ft, leaving 41 ft curb to curb for two 12 ft traffic lanes bordered by 8.5 ft shoulders," says Meshesha.

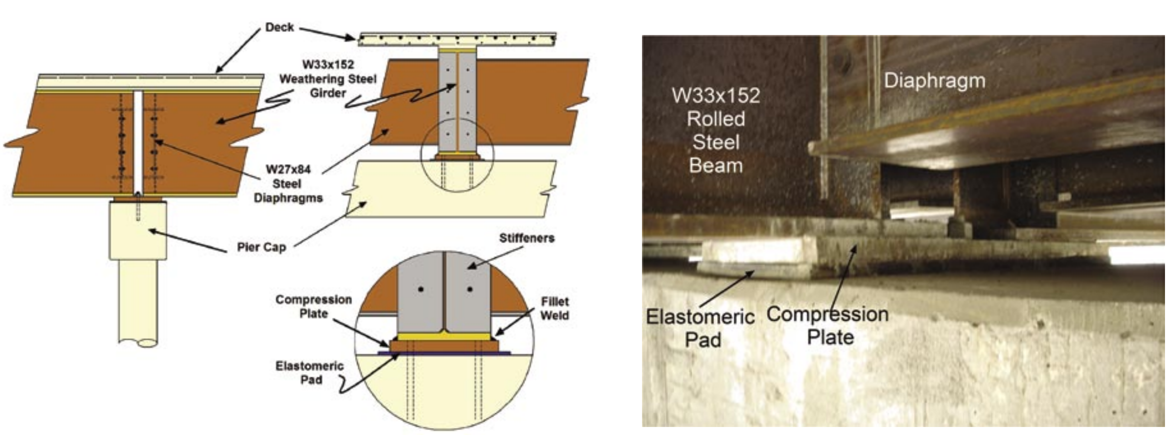
"Five 24-in. diameter steel pipe piles filled with concrete extend to a concrete cap to form the substructure for each pier and the abutments," he says. "The bridge has no expansion joints, which is a CDOT requirement for bridges of this size. The piers and abutments accommodate expansion and contraction of the superstructure."

During the design stage, Meshesha considered three possible superstructures: rolled steel beams, precast prestressed bulb-t (BT) concrete beams, and precast prestressed concrete box beams. "High-water restrictions eliminated the bulb-t beams," says Meshesha. "While Box Elder creek is generally dry, it can carry fast-moving water seasonally or after heavy rains. CDOT requires a 2 ft clearance between the high water and



Typical section of Box Elder Creek bridge.

Rolled beam girders and diaphragms form the steel superstructure for the bridge.



Workers weld the bottom flanges of in-line girders to a compression plate bolted to the pier, creating a continuous connection for live loads.

the bottom of the beams to permit passage of debris," he says. "The 42 in. depth of the concrete BT beams provided insufficient clearance." He adds that cost ruled out the precast concrete box superstructure. "By our estimate, the steel beam design came in 18 percent under the cost of concrete box beams," says Meshesha.

The depth of W33x152 rolled steel beam girders (33 in.) offered sufficient clearance from high water. The bridge has six lines of these grade 50 weathering steel girders across its width. Weathering steel eliminated the need for initial painting and minimized future maintenance. Each girder is about 77 ft long. The lateral spacing between girder centerlines is 7 ft 4 in.

Meshesha says that the steel superstructure follows LRFD guidelines. Making the girders continuous shares the live loads between spans, requiring a less robust girder section. The fabricator, Big R Manufacturing LLC in Greeley, CO, added a slight camber to the steel beams. "Big R supplied the girders to the site in pairs, connected by a series of W27x84 rolled steel diaphragms, for stability during erection," says Meshesha. During construction, a crane lifted a pair of girders, placing the girder ends on the piers."

The steel diaphragms that create a girder pair bolt to 0.5-in.-thick stiffeners. The diaphragms are spaced at 12 ft 8 in. for the two external girder pairs and about 19 ft for the internal pair. Similar diaphragms laterally connect the three pairs of girders at the piers.

The ends of two in-line girders are 6 in. apart and sit on a 30x14x1 in. steel compression plate bolted to the pier concrete cap. The cap has a 36-in.-wide cross section. A 0.75-in. elastomeric pad lies between the plate and the cap. To make the steel girders continuous, a worker welds the bottom flanges of the two girders to the compression plate. Tension rebar within the 8 in. concrete deck handles the tensile component of the negative moment load of the continuous connection.

Total project cost was $2.1 million, including removal of the old bridge, asphalt paving, new guardrails, fencing, striping, and seeding. The bridge opened for traffic in early July.

Design
Colorado Department of Transportation

Contractor
Structures, Inc., of Englewood, Colo.

Steel fabrication
Big R Manufacturing LLC (AISC and NSBA member), Greeley, Colo.