A Kentucky bridge makes a quick comeback after a ship takes out one of its spans.

Down but not Out

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Tom Roberts, Hall Construction

THE EGGNER FERRY BRIDGE took a knockout punch on January 26.

The MV Delta Mariner, an 8,200-ton cargo ship, struck and collapsed a 322-ft span of the 3,495-ft-long bridge, which carries U.S. Highway 68/KY 80 over Kentucky Lake in the western part of Kentucky. Fortunately no injuries or fatalities resulted from the collapse. However, the subsequent bridge closing cut off a vital link to the area and the western gateway to the Land Between the Lakes National Recreation Area. The detour around the bridge was almost 50 miles.

Immediately after the span collapse, Kentucky Transportation Cabinet (KYTC) investigated a number of options for replacing the span as quickly as possible. Coincidentally, at the time of the collapse, the final design of a replacement to the Eggner Ferry Bridge was already significantly under way. KYTC chose to look at short-term replacement strategies rather than alter the course of the proposed replacement crossing.

▲ The replacement section in place, less than four months after the collapse of the original section.

An engineering study was performed, giving consideration to multi-span concrete, steel or prefabricated superstructures using light piers in the lake, as well as single-span options without any additional piers. Concerns with putting piers in a potential barge navigation area, as well as preliminary design cost and construction schedule estimates, drove KYTC to choose a single-span steel parallel chord truss to be constructed on the existing piers. This solution would provide vertical clearance equal to or greater than the existing span. It also offered the best potential for KYTC's goal of having the bridge open to traffic on May 27, the day before Memorial Day. In fact, Hall Contracting of Kentucky, Inc., the general contractor, would face liquidated damages of $50,000 per day if it didn't finish the project on time.

Back in a Flash

Less than four months went by between the original span's demise and the new one opening to traffic.

January 26, 2012: The Delta Mariner strikes Eggner Ferry Bridge, collapsing a 322-ft span
February 27: Michael Baker Jr., Inc., (EOR) completes preliminary plans for a single-span steel truss
March 2: KYTC solicits RFQ, specifies open-to-traffic deadline of May 27
March 7: Bids open, Hall Construction awarded contract
March 9: Mill order placed for April rolling
March 14-April 3: Shop drawings completed and approved by Tensor Engineering
April 2: Gusset plate material arrives at United Steel's plant
April 16: Rolled beams arrive at Padgett's fabrication plant
April 24: Truss members begin to arrive at assembly site
May 6: Final truss members arrive at assembly site
May 8: Truss assembly completed
May 14: Truss and cranes loaded onto barges and floated to bridge site
May 15: Truss is set in place and secured on existing piers
May 20: Deck pour completed in one day
May 25: Bridge opens to traffic, two days before deadline

▲ The new section, shown here being lifted into place, weighs approximately 300 tons.

▲ The truss was assembled in less than four weeks on land adjacent to Kentucky Lake.

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▲ The truss is assembled on the lakeshore...

▲ ...floated to the site...

Saving Time

Luckily, there were several opportunities for time savings, from design to steel procurement and fabrication. For example, the preliminary design used three-plate welded H-sections for the truss members. However, the project's structural engineer, Michael Baker Jr., realized that using all rolled sections for the truss members along with the wide-flange sections (floor beams and stringers) already designed in the integral floor system, would significantly cut fabrication time; going this route effectively eliminated all shop welding. The truss was redesigned using HP16 members with fill plates. All gusset plates were ¾ in. thick, and no welding was necessary except for field studs on the stringers for the composite concrete deck.

The truss assembly also evolved from the initial design. While preliminary engineering showed the design efficiency of a parallel chord truss without verticals, the use of simplified and repetitive connections details, as well as common member sizes, trumped weight savings for the critical-path construction schedule. The team used MIDAS Civil, a 3D finite element analysis program, to model the truss and the integral floor system and composite concrete deck. Members were designed with in-house code checking spreadsheets and the final truss design was independently checked using the AASHTOWare Virtis software. HP16×183 sections were used for the top chord and end diagonals, HP16×121 sections were used for the bottom chord and HP16×88 sections were used for the remaining diagonals. The top bracing and struts all consisted of W12×40 sections, and the integral floor system was made up of W18×86 stringers and W24×103 floor beams. Therefore only six different rolled sections were used, which helped get the mill order accepted for an early April rolling. This, along with close coordination with the steel detailer (Tensor Engineering), allowed the shop drawings to be completed, reviewed and stamped in less than three weeks.

The tops of the W18 stringers were set below the bottom of the W24 floor beam flange, thus eliminating the need for coping, which also saved fabrication time. In addition, not one of the 13,000 bolt holes used to assemble the truss required reaming on-site, and fabrication was completed in less than three weeks.

Lakeside Assembly

Thanks to the MIDAS 3D model and using lift-off points proposed by Hall, the team determined that the entire steel truss (weighing about 300 tons) could be lifted without member overstress, and Hall elected to assemble the entire truss on land adjacent to the lake, approximately 29 miles from the bridge site. The truss was assembled in less than four weeks, as gusset plates and rolled members arrived at the assembly area, and was ready to be loaded onto a barge by May 8.

Encore

The Eggner Ferry Bridge replacement was actually the second cooperative effort between Michael Baker, Jr. and Hall Construction involving accelerated replacement or repair of a major structure. The first one, which took place just months before the Eggner Ferry Bridge was struck, was an emergency repair of the Sherman Minton Bridge, which was closed on September 9, 2011, due to detection of defects in the non-redundant tie girder of both main span tied arches. The Sherman Minton is a major crossing carrying Interstate 64 over the Ohio River between Louisville and New Albany, Ind., and consists of two double-deck steel tied arch structures, each approximately 800 ft long. Repairs involved the use of more than 1,200 tons of HPS70 steel plate and 287,000 high-strength bolts. That replacement project also opened ahead of schedule and was completed in 17 weeks.


Chou-Yu Yong, Michael Baker Jr., Inc.

▲ ...lifted into place...


Tom Roberts, Hall Construction

▲ ...and ready for action!

The barge, along with a deck barge for each of the two barge cranes needed to lift the truss onto the existing piers, arrived at the site on May 14. Deck overhang forms were installed on the barge to expedite construction, and the truss was lifted and secured in place on existing piers on May 15. Following the setting of the truss, the stay-in-place forms and studs were installed, and the concrete deck pour (with curing accelerator) was completed by May 20. The guardrail was then installed and the bridge open to traffic on Friday, May 25, two days ahead of an already aggressive schedule. MSC

Owner
Kentucky Transportation Cabinet

Structural Engineer
Michael Baker Jr., Inc., Louisville

General Contractor
Hall Contracting of Kentucky, Inc., Lousville

Steel Team

Fabricator
Padgett, Inc., New Albany, Ind. (AISC Member/NSBA Member/AISC Certified Fabricator)

Detailer
Tensor Engineering Co., Indian Harbour Beach, Fla. (AISC Member/NSBA Member)

▼ A Midas Civil model of the 322-ft-section.