NEW LIFE FOR AN OLD SPAN

A first-ever approach to pin-and-link replacement breathes new life into a veteran Mississippi River span.

At 75 years old, the original U.S. 84 Mississippi River Bridge, also known as the Natchez-Vidalia Bridge, was showing its age. The vital connector between Natchez, Mississippi, and Vidalia, Louisiana, was designed by HNTB when it was built in 1940. After decades of use, a routine, in-depth inspection found that a truss pin had begun to shift. A later inspection showed a second pin was shifting.

It became apparent that age was taking its toll. Two of its eight links and four corresponding pins needed replacing. The cost of doing nothing meant its potential loss. Replacing the bridge was cost-prohibitive.

After considering all options on the table, the job soon became an endeavor to repair the bridge for $3.8 million rather than replacing it with a new $250 million structure.

ASSESSING THE SITUATION

While the condition of the bridge posed no immediate risk, there was no way to create a warning system to alert officials if things deteriorated further. HNTB worked with MDOT and LADOTD to determine how to temporarily support the bridge to facilitate replacing the pins and links. While both states share the responsibility for the project, MDOT served as the lead and contracting agency.

The U.S. 84 bridge is a vital connector between the towns of Natchez, Mississippi, and Vidalia, Louisiana.

"One of the unique approaches we took with this project was that we sat down with officials and developed a risk matrix," said James Gregg, HNTB project manager. "There are a lot of unknowns when you take apart an old bridge. This matrix helped us understand what we were up against."

HNTB arrived at four options, which included:

- restrain and monitor: a low-cost, less-intrusive approach
- reset pins: a repeat of an earlier approach that was not successful
- replace pins: replace the pins, but not the links
- replace lower and upper pins and links: remove and replace existing pins with new pins and hexagonal recessed nuts

"This led us to agree as a team that we needed to replace the pins and the links that hold up the bridge," Gregg added. "Working with bridge experts from HNTB offices in Baton Rouge, Chicago, Kansas City and New Jersey, we developed a concept that would lock down the bridge and create a true bypass for any of the load that's on it."

Creating a bypass that locked the bridge down in all directions was a challenge. The piers are fixed, so that the pins and links on the truss accommodate expansion and rotation. The truss expands and contracts throughout the day. Fortunately, an analysis showed that the piers were flexible enough to take the force once the joints were restrained.

SURGICAL PRECISION

HNTB and MDOT collaborated to develop multiple bypasses and contingency plans to ensure redundancy. The bypasses needed to act as a failsafe, because the teams were embarking on a quest not unlike open-heart surgery.

"We were essentially going to open up the bridge, remove its old heart that was keeping it operational, then put in something new," Gregg said. "We had to make sure that there was nothing that could go awry. We spent a lot of time putting ourselves in the contractor's shoes, developed plans that were highly detailed and suggested a sequence of construction and methods on how to remove the pins and links.

"We wanted to demonstrate to the contractor an exact route that we believed would make this project successful. The contractor for this project, CEC, Inc., is very sophisticated and nearly always suggests ways to create more constructability within a project. In this case, CEC commented that we had gotten down to the actual nuts and bolts of the project and there was little to modify."

The reality was that this project was simple in concept, yet complicated in detail. This plan included instructions from the big picture down to how to remove every rivet.

"These plans took away any chance that we might have installed something wrong," said David Huval, Jr., president of CEC, Inc. "The backups to critical parts of the plans guided us with alternative ways to get things done, when needed."

FIRST TIME EVER

Unlike cardiac surgeons, designers and engineers working on the Natchez-Vidalia Bridge didn't have more than a century of proven procedures on which they could rely. In fact, they had no road map as this process had never been attempted before. Railroads have completed successful pin replacements on bridges, but they typically don't have as much dead load to temporarily support as long-span highway bridges do. The importance of this detail was reinforced during pre-bid meetings in that HNTB and MDOT wanted a partner, not just a contractor, to supplement and follow the plan.

"HNTB and MDOT determined that replacing pins of this size had never been done on vehicular bridges," said Justin Walker, MDOT director of structures. "We did find examples where sections of trusses had been removed, but those projects contained expensive

QUICK FACTS

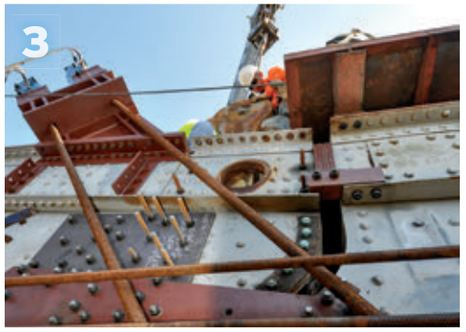
NAME
U.S. 84 Mississippi River Bridge
Works Progress Administration Project #1126

CONSTRUCTED IN
1940

BUILT FOR
City of Natchez, Mississippi

ORIGINAL CONSTRUCTION COST
$3.56 million

DESIGNED BY
Ash-Howard-Needles & Tammen (HNTB)



shoring systems, adding new structures to the bridge or shoring off certain parts of it.

"This was different. We left everything in place and bypassed the joint to replace links and pins in place. HNTB found several small jobs where this had been done, but not on this scale. One of the bigger challenges with this project is that we didn't have the opportunities to talk with peers and use their projects as historical examples. This is one reason why the many contingency plans were needed. We had to predict issues that might be detrimental to the project and design around them."

Another challenge the team faced was the loading situation. Thermal movement in a bridge this large can escalate the loading or shift it to unfamiliar positions. To alleviate thermal variations as much as possible, work took place in the middle of summer when temperatures are relatively constant.

View a video of the U.S. 84 Natchez-Vidalia Bridge pin-and-link replacement. www.youtube.com/watch?v=3pPF1CL4J3c

Video available for iPhone and iPad on the HNTB Publications App.

KEEP THE REGION MOVING

The U.S. 84 Mississippi River Bridge is critical to the economies of the Vidalia and Natchez communities. From agricultural and industrial products to daily commuters going to work on both sides of the river, a complete closure would create a detour of 60 to 70 miles roundtrip for those on both sides. Fortunately, a newer, parallel bridge was kept open and the original bridge closed during the pin-and-link replacement.

"One of the easiest contingencies we executed was to take traffic off the bridge," Walker said. "That way, if we did have issues, we wouldn't subject travelers to it. Plus, it made for greater contractor and driver safety, which gave us all peace of mind that we didn't put the traveling public at risk."

COOPERATION, COMMUNICATIONS SUPPORT GOAL

Despite all of the risks and unknowns of the replacement process, the team of HNTB, MDOT, LADOTD and CEC, Inc., attributes preparation and communications as the key to a well-run, successful project. Collectively, team members worked to add more years of service life to the bridge. Though coordinating activities between two state agencies is often a challenge, this job turned out to be the opposite.

"The process went smoothly," Walker said. "The project team gave us a lot of feedback. We considered many of the contractor's suggestions and applied a lot of them, particularly on issues such as thermal movement or monitoring.

"This is probably one of the better jobs we've had when it comes to communication. With all team members, and even the subcontractors, it was a very open atmosphere. Everybody listened to each other. We had to. None of us had any experience in doing work like this. Because we didn't have the luxury of doing the job before now, we had to talk and listen."

Listening paid off. Replacement of the upper and lower pins and links was a success and the bridge has a new lease on life.

"This project means a lot," Gregg said. "HNTB was part of this bridge in the beginning and here we are, 75 years later, still making sure it's serving the needs of the community. The bridge is at an age when we'd typically consider replacing it, but with current funding, there's no way to do that. The pin and link replacement was successful and will allow the structure to provide another 40 years of good service. It's an example of what cooperation, communication and technical excellence can achieve." ■

CONTACT:

JAMES GREGG, HNTB Project Manager
(225) 368-2815 ■ jgregg@hntb.com

A CLOSER LOOK AT THE REPLACEMENT PROCESS

The photos above show the steps that took place during the pin-and-link replacement process, which extended the life of the U.S. 84 Mississippi River Bridge another 40 years.

1—Employees from CEC, Inc., the contractor partner for the project, removed splice plate templates that were welded together so that holes could be drilled in the temporary splice plate, which was one inch thick. Fill plates were installed to ensure the splice plate was flush between the two gussets. More than 400 A490 bolts measuring 7/8 of an inch in diameter were used to fasten the temporary splice plate to the gussets. Horizontal post-tensioning bars were used to prevent the joint from moving.

2—The project team removed the 4,500-pound forged link from the bridge by cutting the upper and lower pins with a wire saw.

3—During removal of the U29 link, a diagonal bypass was used to temporarily support the bridge. A one-inch splice plate was used to lock the upper joint, as well as act as a secondary load path if the diagonal bypass failed.

4—To facilitate removal of the forged link from inside the truss, the upper diagonal bypass was positioned on the cantilever span side of the truss to support the suspended span side at the adjacent lower joint (L28-U29 and L48-U49).

5—A subcontractor, In-Place Machine Company from Milwaukee, Wisconsin, worked around the clock during the replacement to measure and line bore upper and lower pins simultaneously over a three-day period. The team spent 24 hours setting up and measuring before work began to ensure upper and lower pins were plumb and in line with each other.

6—A new hole was line bored for the existing gusset and new eyebars. Because the existing lower pin hole was oblong from wear and the upper pin was not plumb, the diameter of the new pins was increased up to 3/4 of an inch to ensure proper fit and provide a clean bearing surface.

7—The contractor team installed new upper pins, which were packed in dry ice and transported from the machine shop to the job site, where ice was removed. Grease was applied prior to installation, allowing the new pins to slide into the newly bored holes with ease.

8—The team worked to install new upper pins through the existing gusset and six new eyebars. Both upper and lower pins were turned down in the machine shop just hours prior to installation to ensure a correct fit.

9—The newly installed eyebars are shown in place and secured with a retainer plate to provide a more robust method to prevent the pins from rotating or moving transversely.

10—The completed U49 with new eyebars and retainer plates provides the structural support needed to extend the life of bridge.