

Threading a Needle

Rolling gantry system safely speeds installation of longest-ever precast concrete girders in Mississippi

by Sam Barnes, Barnes Media LLC



Because of the slope of the roadway and the skew of the bents, the self-propelled modular transporters needed to be repositioned each time a girder was set. Photo: Barnhart.

Key Constructors' megaproject on Interstate 20 (I-20) resembles Central Houston, Tex., more than the south side of Jackson, Miss., given the number of bridges, service roads, and on-ramps in the vicinity. The contractor is threading a needle as it replaces a deteriorated section of the I-20 eastbound bridge with a larger 14-span bridge at the confluence of I-20 with Interstate 55 (I-55) and U.S. Highway 51 (U.S. 51).

Much of the project team's early attention, however, was on the \$42.2 million project's biggest hurdle: the three-span section of bridge needed to cross a stretch of rail owned by CN railroad. Addressing this hurdle would eventually require the placement of the longest precast concrete girders in Mississippi's history, seven of them reaching 170 ft in length and weighing 200,000 lb each.

In November 2019, Key Constructors president Jason Henry asked Mike Cassibry, the sales manager for Barnhart Crane & Rigging, to visit the site and possibly find a workable solution. This proved to be a wise move. After a series of brainstorming sessions among Key, Barnhart, and engineering consulting firm Huval & Associates, the team developed an innovative rolling gantry system using self-propelled modular transporters (SPMTs) that could easily handle the massive girders while minimizing impacts on traffic and safely eliminating the need for a work trestle or shoring of existing bridges.

Same Equipment, Different Application

The use of SPMTs is nothing new. In fact, many states are beginning to plan accelerated bridge construction projects that will include SPMTs for a variety of uses. (see the Focus article in this issue of *ASPIRE*[®], where the use of SPMTs for the Lake Pontchartrain safety shoulder project is discussed).

At the I-20 site, however, the team came up with a decidedly different application. During girder erection in late 2020, Barnhart used two pairs of SPMTs to support twin gantry cranes across the new bridge site, situating two SPMTs on the existing I-20 westbound bridge and the other two on U.S. 51. The SPMTs moved longitudinally along the existing bridge decks to precise positions while spreading the girder loads to the bridges' superstructures below.

The SPMTs were also able to easily manage the varying elevation of the bridge decks caused by longitudinal and transverse changes in grade. Cassibry, now a Key Constructors project manager, says Barnhart engineers worked with Huval & Associates to model the operation and "performed some number crunching" to ensure it would meet structural capacity limitations of the existing bridges and provide adequate load stability.

Some tweaks were made along the way. The project team had originally planned to use supportive stands on the SPMT decks to achieve the necessary heights, but that method would not have provided adequate stability. "The

Barnhart R&D Department suggested that we integrate standard shipping containers into the system,” says John Engberg, Barnhart’s vice president of engineering. “By stacking the inexpensive containers on top of the SPMTs, we achieved the perfect height . . . and they’re 8 ft wide, so they’re very stable.”

The 20-ft-long cargo containers sat directly on top of the SPMT platforms and decking, and were secured by container corner beams (fabricated by Barnhart in Memphis, Tenn.) and ¼-in. chains.

“It’s a simple solution, for sure, but we’re not building rocket ships,” Engberg says. “We’re trying to come up with solutions that will do the job. That also allowed us to accommodate the uneven road surfaces. The road wasn’t flat, so as we were going from one span to the next the roadway was sloping up and down. That meant we had to move our system down each time we set a girder because of the way they were skewed.”

The team also chose to “decouple” the SPMT pairs so that they could reposition each pair independently. Not all of the massive bridge girders were the same length, so the spacing between the SPMTs had to be adjusted when going from one span to the next. “Originally, we had all four Goldhofers [SPMTs] tied together,” says Matt Scrip, Barnhart project manager. “I was a bit nervous about that, because it would have required a significant amount of coordination. If one started to outrun the other, it could have put a lot of torque into the system.”

The team left a lane open on U.S. 51 (which was shut down) so that girder delivery vehicles could park immediately adjacent to the SPMTs. “We would lift [girders] off of the trucks and start sliding them across to set them,” Scrip says. “It was critical for the girders to be delivered in the right orientation. They were so long, and the jobsite was so congested. . . . If they showed up in the wrong orientation, it would have been problematic to say the least.”

Barnhart field superintendent Rick Umfress coordinated closely with

Aerial view of the two pairs of self-propelled modular transporters (SPMTs) with gantry system, and the 170-ft-long, 200,000 lb girders. Using the SPMTs minimized lane closures. Photo: Barnhart.

Interstate 20 Flyover Bridge

by Natalie McCombs, HNTB

In February 2017, the Mississippi Department of Transportation (MDOT) hired HNTB to perform a value-engineering study on Interstate 20 eastbound bridge no. 44.9B at Interstate 55 (I-55) South in Jackson, Miss. At that time, the proposed plans showed a 1784-ft-long bridge with a maximum span of 360 ft. Steel welded-plate girders with web depths of 80 and 144 in. were proposed. HNTB’s study revealed two significant improvements that would save costs for the project. The first improvement was to reduce the 360 ft span over I-55 using cast-in-place concrete straddle bents at a few key locations along the alignment. The use of straddle bents allowed optimization of pier locations and 150 ft spans. The shorter spans made standard 78-in.-deep prestressed concrete Florida I-beams (FIB) sections a feasible option for most of the bridge. The second improvement was to reduce the 280 ft span over the railroad to 170 ft from center to center of pier. That span was now governed by a reduced horizontal clearance requirement established by CN railroad, which allowed a pier to be placed on the railroad right-of-way rather than requiring a clear span of the entire right-of-way.

Even with the shorter span, the standard FIB-78 beams would not be the best structural solution. Instead, 168-ft-long FIB-84 beams were used. They were the deepest and longest precast concrete beams used in Mississippi to date, and they weighed around 200,000 lb. The contractor used an innovative approach that involved self-propelled modular transporters to set these long, heavy beams over the railroad corridor. By implementing the improvements specified in the value-engineering study, the 1855-ft-long bridge costs were reduced by \$20 million and a durable concrete structure was provided for MDOT.





Engineers analyzed the existing bridges to ensure that they had sufficient structural capacity to support the self-propelled modular transporters and the massive girders during the erection operation. Photo: Key Constructors.

Key, the railroad, and other team members before and during the lifts, meeting with them at the beginning of each day to go over job safety and plans for the day.

Vital to the Critical Path

After only about a week and a half of setup, the team was erecting six girders a day, with each girder lifted directly off the transport vehicle, moved transversely, and set on the bearing pad within 30 minutes of delivery. In 10 days, all 21 prestressed concrete girders were placed and the rolling gantry system was moved to the laydown area for disassembly.

Trent Holbrook, the Mississippi Department of Transportation engineer who oversees projects in the area, says Barnhart's rolling gantry system was critical to keeping the project on track for October 2021 completion. It also alleviated traffic impacts by minimizing lane closures and disruptions.

Standard 8-ft-wide by 20-ft-long shipping containers were stacked on top of self-propelled modular transporters and secured by custom-fabricated container corner beams and ¼-in. chains to achieve the perfect height to erect the girders. Photo: Key Constructors.



The first 170-ft-long, 200,000 lb girder after it was erected over the railroad. Photo: Key Constructors.

“That area is tight,” Holbrook says. “And the railroad had lots of restrictions for working in the right-of-way, vibrations, etc. Otherwise, some rather large cranes would have been necessary to lift and place these 200,000 lb beams.”

Once complete, the new bridge will handle both east- and westbound I-20 traffic, and the existing I-20 West bridge will be used solely for I-55 traffic. The I-55/I-20 merger is also being moved farther to the east. “Essentially, we’re tearing down one I-20 span, and the other span will become part of I-55,” Holbrook says. “We’re on schedule and should finish with the deck placement in July, followed by the completion of the rails and asphalt approaches to the bridge.” [A](#)

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