Lift, Slide, Attach, Repeat

Novel erection scheme widens Huey P. Long cantilevered steel truss bridge.

BY JIM TALBOT

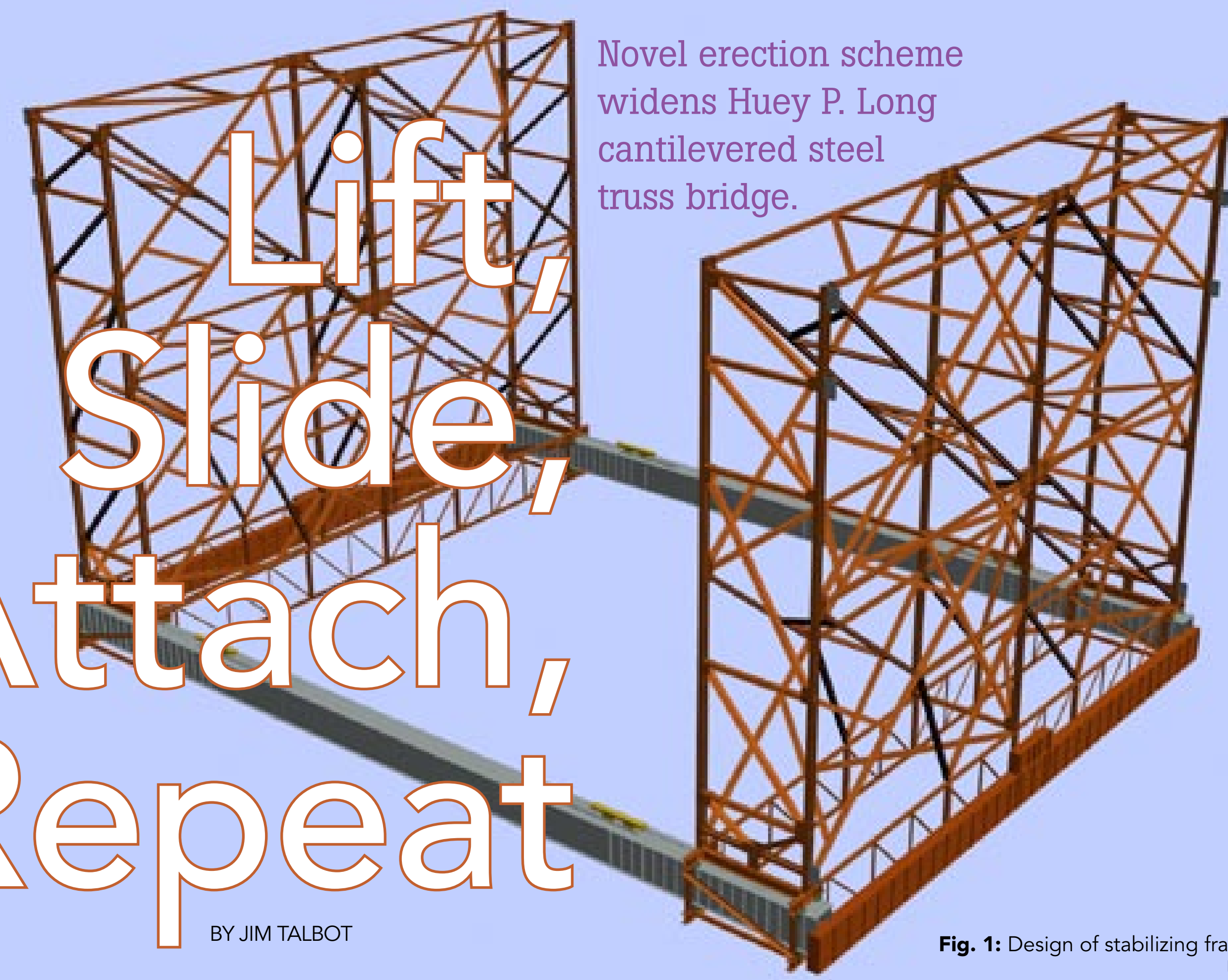

Fig. 1: Design of stabilizing frames.
HNTB

THE FIRST LIFT in an innovative erection plan for new steel trusses to widen the 2,380-ft Huey P. Long bridge in New Orleans proved successful in June. The plan calls for simultaneously lifting a pair of truss panels—one on each side of the bridge—for three of the four main spans. Two of these truss lifts must first clear the recently widened piers. Then each truss panel must move 13 ft laterally back over the pier before being set down on bearings. This combination of lifting and lateral movement for a large pair of truss panels had never before been tried.

Modjeski and Masters originally envisioned that the widening truss would be erected by a traditional stick-build erection method. MTI and HNTB had two primary concerns about the stick-build method that were the genesis of a modified plan. The risk of a ship impacting the required falsework was a huge concern. In addition, during construction some truss panel points were estimated to be as much as 11 in. higher or lower than the existing truss until they displaced into their final position. Fit up would have required many temporary slotted and rotational connections, complicating erection.

The span-by-span erection lift method solves both concerns. It avoids the falsework in the river plus the need to install 30-ft diameter massive dolphins in front of each in 100 ft of water. And it leads to less than 3 in. of differential displacement between the existing and widening trusses at any time. Once crews make the permanent secondary member connections between the existing and widening trusses, deflection differences fall to less than an inch.

Developing an Erection Plan

Completed in 1935, the Huey P. Long bridge is a three-span continuous cantilever truss plus an adjacent 530-ft simple-span through truss. Two rail tracks run between the two truss sides. Two cantilevered 9-ft lanes with no shoulders for road traffic sit outboard of the truss on each side. The bridge serves as one of three major Mississippi River crossings in the New Orleans metro area and has daily traffic counts of more than 50,000.

Its widening is being funded by the Louisiana Transportation Infrastructure Model for Economic Development Program (TIMED). Louisiana TIMED Managers (LTM), a consortium comprising three companies: Parsons Brinkerhoff, GEC Inc., and the LPA Group, administers contracts for the Louisiana Department of Transportation and Development, primarily on road and bridge projects. LTM handles such functions as RFI submittals, public outreach, quality assurance, changes, fabrication inspection, and other general construction management tasks.

> One of LTM's tasks has been to build community support for the project. That support was a big factor in the success of the first lift in June. Bridge closings, which typically are not well received, to that point had generated just a single public complaint.

According to Tim Todd, LTM resident engineer, the widening of the Huey P. Long bridge superstructure is the third phase of a four-phase project. The first two phases involved substructure and railroad modifications. The final phase involves infrastructure and approach work. Todd says that each direction of the widened bridge will have three 11-ft driving lanes along with an 8-ft outside

The next lift will be the center section over the main navigation channel, scheduled for this fall.

HNTB

Fig. 2: Erection of stabilizing frames and truss panels on barges north of the bridge.

MTI (Massman/Traylor/IHI)

shoulder and a 2-ft inside shoulder. The bridge widening project adds two new steel trusses to the existing superstructure to form an integrated four-plane truss system.

Contractor MTI—a joint venture of Massman Construction Co., Traylor Bros. Inc., and IHI Inc.—hired HNTB to devise the erection plan. "Taking this unique erection technique from concept to reality was a collaborative effort between MTI, HNTB, Mammoet, LTM and Modjeski and Masters," said HNTB's John P. Brestin, S.E., P.E. "It could not have happened without everyone on the team pulling in the same direction." Brestin and Sean T. Cooney, P.E., also with HNTB, described the plan in November 2009 in a presentation at the World Steel Bridge Symposium. Their paper is available as a free download at **www.aisc.org/wsbs**.

Widening a Cantilever Truss

The first step was widening the existing piers. "Essentially a new concrete jacket surrounds the original piers," Brestin said, "leaving a ledge near the top. A new steel pier truss sits on the ledge and widens the pier sufficiently to carry the new bridge truss panels." That configuration means that during lifting, the new truss panels have to clear the pier edges, and then move inward horizontally to their final position above the bearings.

Brestin said a key to successful lifts is the design of a lifting and stabilizing frame (see Figure 1). "The same stabilizing frames serve for all three truss lifts," Brestin said. "They basically consist of space frames mounted on two main floor beams. Lifting the truss panels from their bottom corners puts the top truss chords in compression. They would tend to buckle. The space frames provide the support necessary to prevent buckling during the lift."

Four frames—two on each side—take part in each lift. The frames themselves mount on floor beam sleeves. Hillman rollers, mounted to all four interior surfaces of the sleeve assembly, allow the frames and attached truss panels to ride along the floor beams laterally.

Once the whole system of lifting frames with truss panels reaches the desired height above and outside of the piers, horizontal jacks move the frames with truss panels toward each other until the panels are about 6 in. above their bearings. "This lateral movement problem is what we scratched our heads about for some time—figuring out how to move the panels horizontally while keeping them stable," Brestin said.

Lifting and Positioning the Truss Panels

For the first lift, MTI devised a platform of four barges (see Figure 2), connected by three sectional barges. MTI crews first

Jim Talbot is a freelance technical writer living in Ambler, Pa.

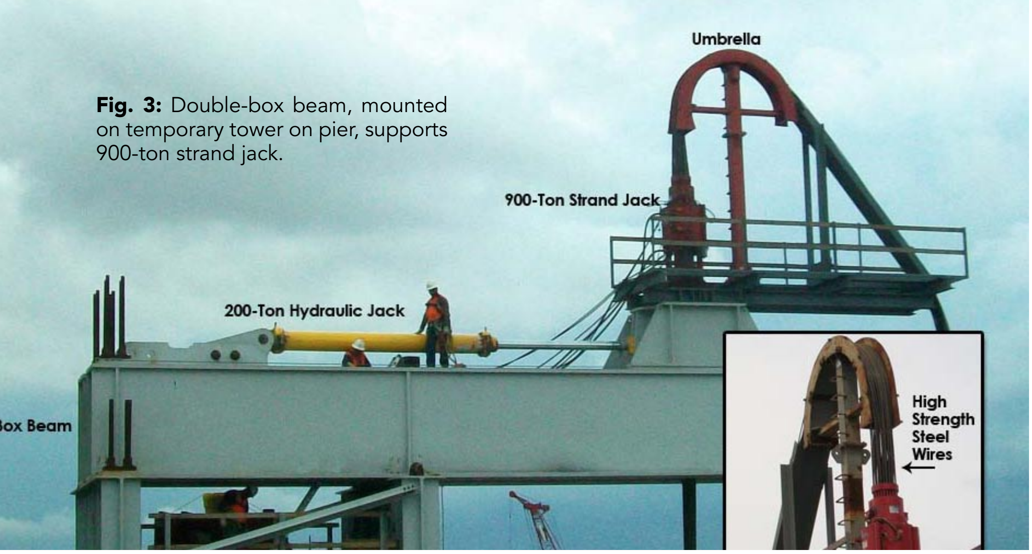

Fig. 3: Double-box beam, mounted on temporary tower on pier, supports 900-ton strand jack.

Fig. 4: Widened piers with temporary lift towers prior to lift.

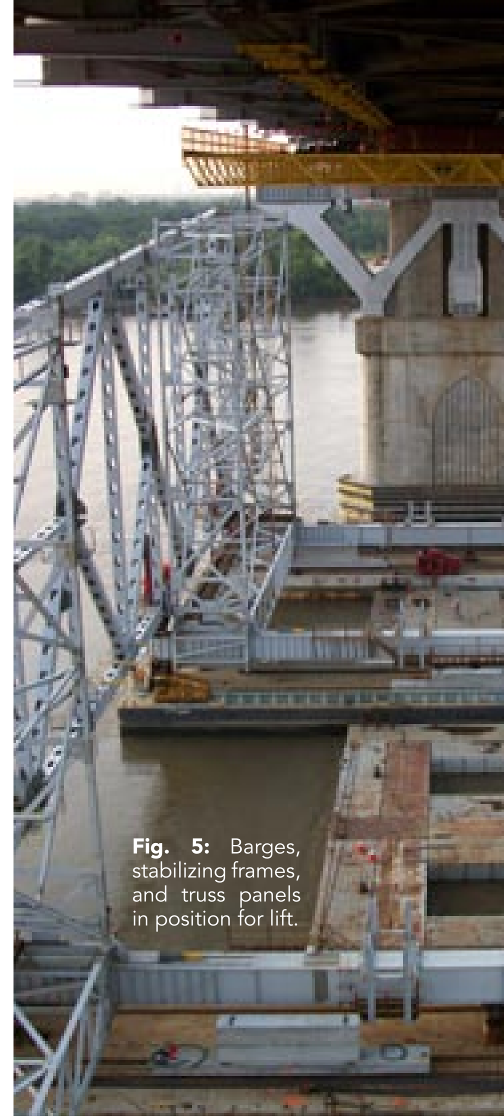

Fig. 5: Barges, stabilizing frames, and truss panels in position for lift.

erected the stabilizing frames on the barge assembly, which was moored north of the bridge. Then, using the stick-by-stick method, they erected the two widening truss panels, attaching them to the stabilizing frames for lateral support.

Meanwhile MTI erected temporary towers on the four edges of the permanent pier trusses (see Figure 3). Each tower supports a double box beam that cantilevers over the edge of the pier trusses. A strand jack mounted atop each beam provides the force to lift the truss panels from the four bottom panel corners along with the attached stabilizing frames.

The strand jacks are mounted on sleds that can move transversely. The sleds permit the truss panels to be jacked back horizontally into position over the bearings after the vertical lift clears the piers. Teflon surfaces and stainless steel lubricated with dish soap promote the sliding sled movement.

Preparations for the first span lift, for the east anchor span, were ready by early June. On Friday morning, June 18, the river was closed down for eight hours to position the barges and spans in the auxiliary channel where the lift occurred. At 5 p.m. the barges were in position and the adjacent main navigation channel was opened for river traffic. The roadway and train traffic were unaffected during all that time. The next morning at 5 a.m. the bridge was closed to the public for the weekend, except for emergency traffic on one side of the bridge.

"At that time the river was closed for four hours to prevent ship wakes from the main channel that might affect liftoff—a sensitive time" Brestin said. "By 9 a.m. the lifting frame and truss panels were clear of the barges, and we opened river traffic in the main navigation channel."

Applied Geomechanics Inc. (AGI), a consultant to MTI, set up a system of tilt meters and lasers to monitor any distortions of the truss panels during their lift and installation. Real-time monitoring helped to speed any adjustments necessary to keep the panels level and to check for indications of buckling. Mammoet could adjust the nominal 16-in. stroke of the strand jacks to compensate for any differences in lift heights at each corner. With each stroke the lifting properties of individual strand jacks became apparent so that the second half of the lift required virtually no adjustments.

Once the 2,600-ton assembly cleared the barges, the strand jacks raised the panel trusses 150 ft to an elevation about 6 in. above their final elevation. At that point, MTI braced the stability frames to the bottom chord of the existing truss.

"We planned to close down rail traffic to avoid vibrations while the truss panels were each moved 13 ft laterally over their bearings," Brestin said. "One train got through, shaking the panels and making us all a bit nervous."

Six horizontal jacks like that shown in Figure 7 moved each truss panel laterally, while the monitoring system helped keep them in a plane parallel to the existing truss. One control room controlled the jacks while another monitored the truss panels.

Once the panels rested on their bearings, crews attached temporary horn beams—pre-installed on the top of the existing truss—from panel to panel to stabilize them from the top chords. Then they braced the bottom chords against the existing truss. Once

Fig. 6: Lifting frame with new truss panels in mid-lift.

Fig. 7: Horizontal jack slides sled-mounted strand jack 13 feet, carrying truss panel over its bearing.

Photos by LA TIMED Managers/LaDOTD

these members were in place, MTI disconnected the stabilizing frame. Four strand jacks attached to each truss panel lowered the stabilizing frame back down to the barge."

The existing bridge was opened to road traffic by 9 p.m. Sunday, eight hours earlier than originally expected.

Lifting the Suspension Span

Brestin said the next lift will be the suspension span over the main navigation channel, scheduled for October or early November. "That lift is actually more critical because it's in the middle of the main navigation channel," he said. "We understand that the lift will affect just three deep draft vessels over the 48 hours of closure. MTI will have to brace the panels at the top quickly and then get out of the way—no breaks." Shallower draft vessels will still be able to use the auxiliary channel under the east anchor span.

MTI has already completed a modified stick build of the west anchor span and added a cantilevered arm for connection to the suspended span. Crews are building the corresponding cantilevered arm on the recently lifted east anchor span in the same manner, using cranes on barges in the river.

For the modified stick build, the arms contain all the primary truss members but only some of the secondary members, Brestin said. Once these cantilevered sections are in place, MTI can raise the suspended span. The stabilizing frames are being used for all three span lifts because lifted span lengths are all about 530 ft.

The truss panels for the lift of the suspension span do not have to clear piers. MTI will lift those panels straight up using four strand jacks mounted on the stick-built cantilevered arms of the anchor spans. Very little lateral adjustment will be necessary once the truss panels are up. The weight of the suspended span will cause the anchor spans to deflect upward, but strategically placed ballast will keep the anchor span deflections within an acceptable range.

The last span lift for the through truss section is expected in the spring of 2011. This lift will be similar to that of the first east anchor span. Contracts call for the widening of the bridge to be complete by early 2013. MSC

Owner
Louisiana Department of Transportation

Design
Modjeski and Masters, New Orleans (AISC Member)

Steel Fabricator
Industrial Steel Construction, Gary, Ind. (AISC and NSBA Member)

Contruction Manager
Louisiana TIMED Managers

Erection Engineer
HNTB, Kansas City, Mo. (AISC Member)

Contractor
MTI (consisting of Massman Construction Co., Kansas City, Mo. (AISC Member), Traylor Brothers, Inc., Evansville, Ind. (AISC Member), IHI Corporation)