Repairs to the Historic Tombigbee River Hwy 182 Bridge

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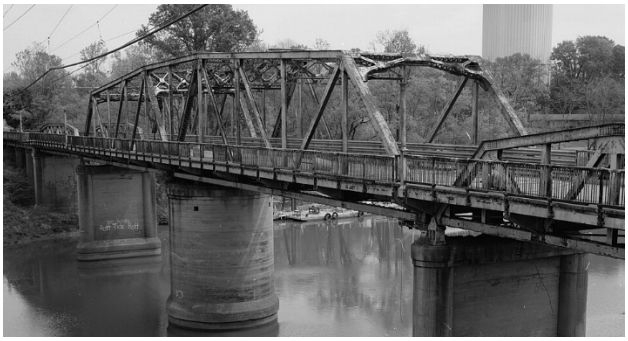
ABSTRACT: The historic Tombigbee River Bridge in Columbus, Mississippi, has encountered numerous challenges throughout its nearly 100-year history. In 2020, a runaway barge struck the eastern river pier, displacing it by 11 inches and jeopardizing the two supported truss spans. The City filed a maritime claim against the barge company, who ultimately settled for the entire sum needed to restore the historic bridge to its original appearance. Neel-Shaffer Engineering and Malouf Construction collaborated to devise an innovative repair method that temporarily supported the precariously positioned bridge spans, enabled the removal of the damaged pier and allowed for the construction of a new pier.

HWY 182 BRIDGE HISTORY

The historic Old Hwy. 182 bridge over the Tombigbee River (later renamed Tennessee-Tombigbee Waterway) was opened to traffic in 1927. The bridge consists of eight concrete T-beam approaches and four riveted steel truss river spans. The two center truss spans are continuous and were designed to rotate on the center pier to allow river traffic to pass through. The river piers are constructed on spread footings socketed in a chalk riverbed.



IMG 1 - Historic Photo

In 1988 the bridge was listed on the National Register of Historic Places. In 1989 the ownership of the bridge was transferred from the State to the county jurisdiction. An underwater inspection discovered scour under the center pier which prompted the construction of a new bridge upstream. The original bridge was eventually closed to traffic and regular maintenance was discontinued.

In 2011 the City of Columbus hired Neel-Schaffer to rehabilitate the bridge for pedestrian use. The work included repairing damaged railing, truss members and the center river pier scour, replacing the turn span's timber-asphalt deck with concrete, painting and adding lighting. The contractor selected for the work was Malouf Construction. The bridge was reopened in October of 2013.

In February of 2020, the bridge was closed again after a runaway barge struck one of the river piers, deflecting the top of the pier 11 inches toward the bank and separating the columns from the foundation. The limited rotation of the bearings on the truss span kept the pier from collapsing. The City of Columbus hired Neel-Schaffer to assess the damage and develop a repair. The primary challenges were:

- Not altering the appearance of the visible portion of the pier to preserve the historic character,
- Shoring the bridge during construction,
- Working with limited overhead clearance, and
- Installing a cofferdam system to allow the repairs to be constructed in the dry.

To work through these challenges, direct input from a contractor about available construction technologies was imperative. Therefore, Neel-Schaffer asked Malouf Construction to work as the design-build team to develop a practical and cost-effective repair.

IMG 2 - Damaged Pier

DESIGN

In addition to the column separation from the footing, the pier had only minor cracking in the web wall between the columns. Therefore, the first option considered was plumbing the existing pier and reattaching the columns to the footings. The water depth at the pier is approximately 20 feet and the repair would likely require a full cofferdam. Driving sheet piles in the stiff chalk foundation soils would not be practical. Instead, the sheet pile installation would require trenching and grouting the piles in place. Also, the internal cofferdam bracing would restrict the work area around the pier. Shoring the bridge on independent foundations would be required prior to beginning the cofferdam. This option was ruled out due to safety concerns over manipulating the existing pier and the cost of the cofferdam.

The design concept chosen was re-building the pier on new foundations outside of the existing footings. This design utilized four cased drilled shafts and precast caps at each end of the pier. The pile caps were attached to the shafts using grout pockets. Next, temporary shoring towers were installed on the precast caps near the outside edge eliminating the need for separate temporary

foundations. The temporary shoring tower/gantry system supported the ends of the two trusses that rested on the damaged pier. Once the bridge was supported and the existing pier demolished to the top of the footings, a precast riser that extended the construction above the water was installed near the inside edge of the pile caps. Again, grout pockets were used to attach the riser to the pile caps. For both the pile cap and riser installation, pipe pile coffer-cells were used over each grout pocket to minimize dewatering and allow for the addition of reinforcement between the precast elements and precise grout application. The remainder of the pier was constructed using conventional methods. All visible portions of the new pier above water were visually identical to the original pier.

IMG 3 - New Pier

TEMPORARY SUPPORTS

Malouf Construction partnered with Genesis Structures to assist with the project's construction and demolition engineering aspects. Barnhart Crane and Rigging, a specialty heavy lift and transport company, provided the temporary shoring towers and overhead gantry system to support the existing truss spans. The shoring towers came up approximately 60 feet from the newly constructed pier caps with a double W40 header beam spanning 55 feet from tower to tower. Four center-hole jacks with 1.75" threaded rods engaged the end floor beams of both trusses and lifted the trusses off the damaged pier. Each span required approximately 80,000 lbs of lift force per corner.

IMG 4 - Spans Supported by Falsework

CONSTRUCTION AND INSTALLATION OF NEW PIER

As the existing pier was demolished underneath the supported trusses, the custom precast riser was built approximately 1 river mile upstream of the bridge site. The conventionally reinforced precast riser is 46 feet long, 16 feet wide and 10 feet tall, weighing approximately 380,000 lbs. A work pad was constructed directly adjacent to the

river to construct the riser and allow for barge access to hoist the precast.

To hoist the 380,000 lb precast, a Shugart Pontoon barge with a custom Barnhart gantry lift system was used. The barge platform was 120 feet wide by 60 feet in length to allow the barge and precast riser to fit between the existing swing span pivot pier and the falsework towers supporting the spans. Barnhart's gantry system used four 20-foot pyramid shoring stands that elevated two 5-foot-deep box girders that supported four 70-ton strand jacks that cantilevered over the side of the barge 14 feet.

The Barnhart gantry lift system required a rear hold down to resist the overturning effect from the precast cantilevered hoist. A total of 300 kips of hold-down force was required to stabilize the gantry lift system. This was achieved by connecting an attachment frame through the pinhole connections of the Shugart barge to a reaction system under the pontoons. As the load in the strand jacks were systematically increased, a series of pontoons on the stern of the barge were filled with water as counterbalance. Approximately 100,000 gals or 800,000 lbs of water counterweight plus another 80,000 lbs of deck counterweight was used to counterbalance the system.

IMG 5 - Hoisted Precast Riser

Once the precast was freed from the bank line, the system was floated downstream to the project site. Extreme care had to be provided to ensure the precast would not impact the falsework towers during final positioning. A minimum of 12" of clearance between the precast and the shoring towers was maintained during the positioning. A spudded guide barge provided the initial rough alignment and positioning and then hand winches and wire lines in all 4 directions provided the fine movement control. The precast riser was lowered onto the pier caps, and the water ballast was removed from the barge as it continued to transfer its load to the piers.


IMG 6 - Tight Clearance

With the precast riser installed, conventional concrete construction continued the pier web wall and cap construction in 3 concrete lifts. The original bearings were reconditioned and reinstalled, and the bridge spans were set back down onto the new pier.

COMMUNITY IMPACT AND FINAL THOUGHTS

Restoring the Old Tombigbee River Bridge reignites a vibrant centerpiece to the Columbus Riverwalk that will benefit our citizens and local businesses for years to come. Development of this walkway provides citizens and visitors a unique opportunity to access the beautiful Tombigbee River that flows through the city. This historic and beautiful bridge provides

pedestrians with safe access to "The Island," our future Amphitheater, and the on-going renovation of our downtown area. This bridge is also becoming a popular attraction for community events such as yoga on the bridge, seasonal festivals, class reunions, and countless class pictures. The bridge has become an icon of the Columbus community, and we are glad this effort has restored it to the historical landmark it is and popular local attraction it has become.

With the Old Hwy 182 Bridge repairs complete, pedestrian traffic can now travel from the downtown area of Columbus, MS which includes eateries and numerous public and private activities to the outdoor Amphitheater across the river. This project is a great example of how a local Contractor (Malouf Construction) and a local Design Firm (Neel-Schaffer) bring their unique abilities and knowledge with a common goal of repairing a community icon.

IMG 7 - Completed Bridge