BRIDGES

Rochester Replaces Problematic Troup Howell Bridge

Rochester's new triple-arch bridge over the Genesee River not only replaces the problematic Troup Howell Bridge, which has cost the state $38 million in repairs, but also creates a signature bridge for the city. Its three arch ribs stand prominently over the eight-lane bridge deck, which will be able to accommodate approximately 100,000 vehicles daily.

The 50-year-old Troup Howell Bridge, in Rochester, New York, has been a thorn in the side of New York's Department of Transportation (DOT) ever since its construction. Burgeoning traffic on Interstate 490, which the bridge carries over the Genesee River, forced the DOT to open the bridge before its asphalt wearing surface had been placed. The severity of the winter weather that year caused deterioration problems that have never been resolved despite attempts at rehabilitation in 1960, 1971, 1984, and 1992 that together have cost more than $35 million. Now, finally, the city and the DOT are replacing the bridge as part of a larger project to rehabilitate the interstate, a heavily traveled corridor used by those commuting to and from downtown Rochester.

The replacement project gives the city an opportunity to create a more appealing structure. The original crossing, a simple 15-span steel multigirder bridge, carried six lanes and rested on reinforced-concrete piers. It was 365 m long and 29.9 m wide and in 1955 was serving approximately 16,000 vehicles per day—a figure that had climbed to 80,400 by 1993. In contrast, the new bridge will incorporate eight spans, the 132 m river span being a unique through arch structure comprising three parallel arch ribs that will rise above the deck and support it by means of a hanger assembly. Its eight lanes will be able to accommodate 100,000 vehicles per day, and the structure will be one of the first triple-arch bridges of its kind in the United States.

The DOT was considering several types of bridges, including a conventional continuous span bridge resting on piers. But city officials requested that the new crossing serve as an icon for the city. The result is a design in which aesthetics informs nearly every element, including approach spans, foundations, arch ribs, hangers, and floor beams.

The bridge's approach spans on both sides of the river extend over decommissioned railways and active city streets. The areas occupied by railways have been converted into a parking lot on the west side and into riverside trails along both sides. On each side, arch anchorages have been placed behind the existing river walls so that the new foundations can be constructed on land. These anchorages comprise massive concrete footings below angled concrete skewbacks. The concrete footers rest on a layer of solid rock located approximately 4 m underground. Workers have excavated 1.2 to 1.75 m into the rock so that the footings, fitting like keys into the rock, will
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resist the horizontal component of the arch ribs' thrust.

The three steel arch ribs are to be the most prominent feature of the bridge. Howard Ressel, P.E., a project manager for the DOT, says that typically four arch ribs support each direction of traffic, but in this case the lack of available right-of-way put a premium on space. Instead, there will be one large center arch 3 m deep and two outer arch ribs 1.78 m deep.

Originally the arch girders were to be shaped like trapezoids in cross section. But to minimize cost and facilitate construction, engineers with the local engineering firm Erdman Anthony & Associates, Inc., designed a square box girder that features a 1.43 m wide flange at its top and a 1.17 m wide flange at its bottom. Exterior steel stiffeners connect the outer edges of the top flanges to the outer edges of the bottom flanges to give the impression that the girder has the shape of a trapezoid. These stiffeners became structurally important once the engineers realized that they had to remove some interior stiffeners in the girder to provide access to maintenance workers near the hangers. Ressel says that the exterior stiffeners "provide the structure needed at the hanger points but also the aesthetics we want."

To brace the arch ribs laterally, 12 dog-bone-shaped Vierendeel braces—rigid box girders 19.9 m long by 1.74 m deep that flair at the ends—were placed between the arches. The architectural subconsultant, HGA, based in Philadelphia, and the engineers chose to use the braces instead of a cross brace arrangement so that the horizontal support system would be less obtrusive visually. The flanges on the braces range from 1.15 to 2.29 m.

Nineteen pairs of hangers arranged in a fan configuration hang from each arch. Each pair is designed to provide redundancy and facilitate replacement. The hangers connect to a pivot plate and a partially tensioned tie beam at the deck, which then connects to the floor beams. The floor beams are spaced 5.87 m apart along the bottom of the bridge.

Because the tie beams are not connected to the arch ribs, the fanned hanger arrangement forms a "cradle" for the bridge deck, says Ressel. The deck transfers longitudinal loads to the floor beams, then to the hanger system, and from there up to the arch ribs. This configuration makes it possible for the bridge to move and to distribute seismic loads more efficiently.

Aesthetics was considered in choosing the shape of the bridge's stringers and floor beams because these members will be visible from the riverside. To make the underside of the bridge more interesting, the engineers decided to vary the depth of the floor beams, the maximum depth, at midspan, tapering to a rounded "bullnose" at each end.

The bridge marks the end of the navigable portion of the Genesee River, for just beyond it is the Court Street Dam. Rather than demolish the original bridge's piers, it was decided to remove only the top and leave the rest of the piers standing just below the river's surface. A small navigation channel is being maintained near the west bank that will allow smaller maintenance vessels to travel to the dam as needed.

Edward Kraemer and Sons, of Plain, Wisconsin, the general contractor for the project, decided to construct the arch ribs from falsework towers braced against the original bridge deck. Each of the three ribs will require six falsework towers. Each tower will be supported on twin steel 900 mm diameter pipe piles socketed into the bedrock underlying the riverbed.

The bridge is to be completed by December 2006, exactly 51 years to the month after the opening of its predecessor. "I hope it's something that those in the future will want to preserve," says Ressel. At the very least, city and state officials and commuters expect the new bridge to be a marked improvement over the old one.

—Brutt Hansen