Through-Girder Bridge Offers Low Clearance

Lower profile that overcomes clearance problems made possible by combining precast panels with box girders for first time in Indiana

The old Sedley Bridge in Porter County, Ind., posed a dilemma for bridge designers, a quandary that had kept its replacement on hold for nearly a decade. The existing timber-trestle structure offered only 19 feet of clearance over the Norfolk/Southern/CSX railroad tracks and had outlived its usefulness. After several alternatives were rejected over the years, the ultimate solution was found in precast concrete "through girders," representing the first use of this technology in the state.

The original plan for the replacement bridge 10 years ago was to design a steel-girder option that would carry traffic not only over the railroad but also over Indiana State Highway 130, which runs parallel to the tracks. But that proposal immediately set up howls of protest, because it would have to span the two rights-of-way and then have its north approach run approximately a quarter of a mile to a north-south county highway to then carry traffic to the state highway.

Disapproval by the community and the Northern Indiana Regional Planning Commissioners led to a search for an alternative. The ultimate design created by Indianapolis engineering firm Butler, Fairman & Seufert produced the first-ever use in Indiana of two post-tensioned, precast concrete box girders combined with post-tensioned concrete deck panels.

The solution resulted from evaluations conducted by the team at BFS, headed by vice president Stephen Weintraut, which examined and rejected several other conventional girder designs. "We decided the only way we were going to accomplish what the Commissioners and local residents wanted was to build a through-girder bridge," says Weintraut.

The facts that swung the decision included the concrete system's ability to offer greater internal redundancy than a steel girder bridge, its higher resistance to damage from impact and its maintenance advantages. Also, its profile could be minimized — the distance from the top of the deck to its lowest point is only 14 inches, compared to 3½ feet for the originally proposed steel structure. This allows the road to span the tracks, providing the desired clearance, and still tie directly into the highway instead of needing the unwieldy county road to make that connection.

The through-girder approach offered greater internal redundancy and lower long-term maintenance needs.

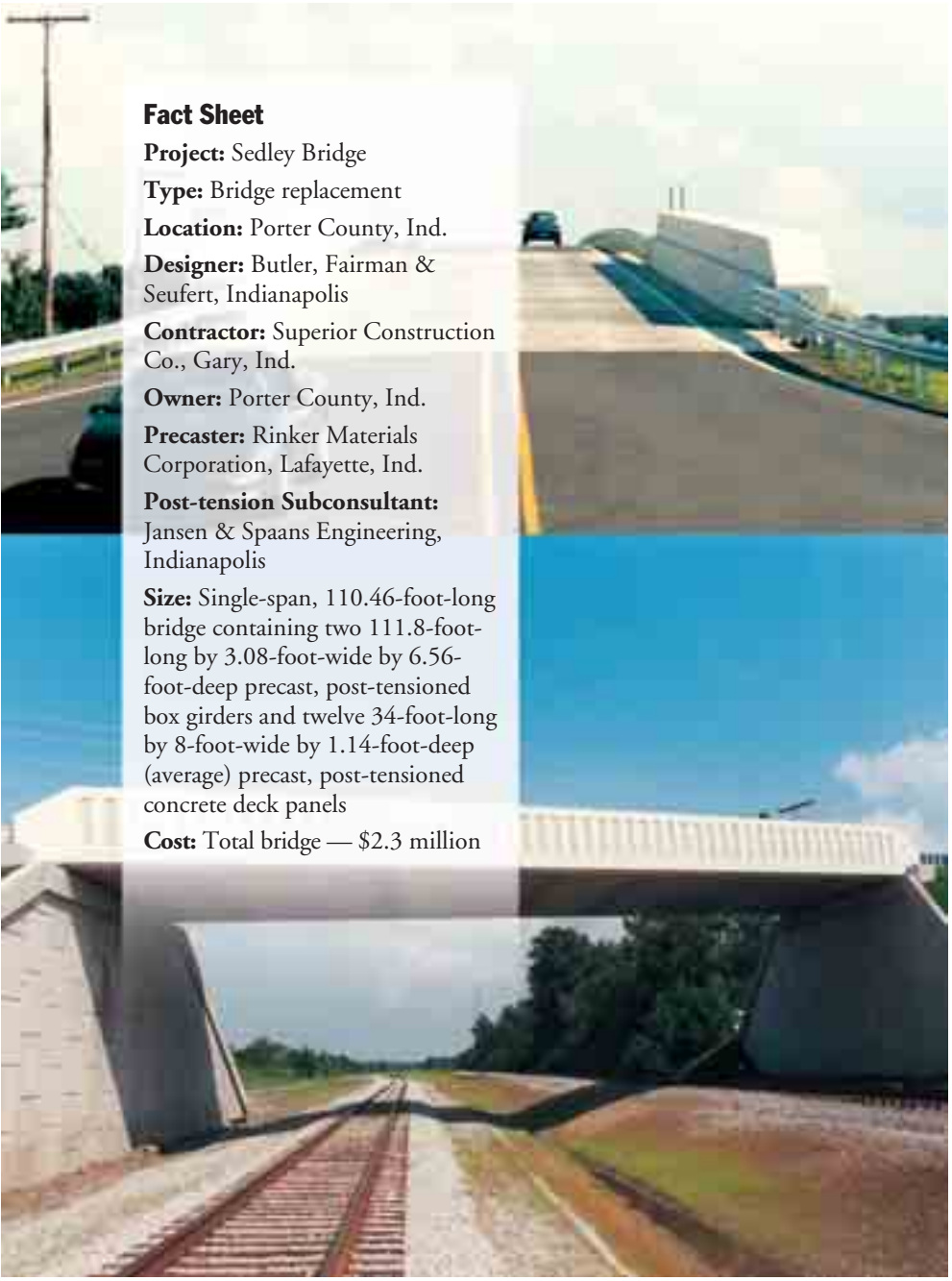
$1 Million Saved

Not only did the design solve the problems that had long delayed the building of the bridge, it also provided a significant cost savings. "The original estimate on the steel girder bridge was well over $3 million," says Weintraut. "The final cost of the bridge was around a million dollars less — approximately $2.3 million."

The cost savings resulted from a number of factors, Weintraut says. Not the least of these centered on the bridge approaches, which required less construction than the original design — the north approach alone was reduced in length by nearly a quarter mile. The bridge's concrete girders were only a third as long as the steel girders originally proposed. There also was a reduced environmental impact, and the

Deck panels, their post-tensioning ducts visible, arrive at the site.

Deck panels sit against shear keys at the bottom of the girders. After post-tensioning, grout will be used to close the gap between the edges of the panels and the girders.



Fact Sheet

Project: Sedley Bridge

Type: Bridge replacement

Location: Porter County, Ind.

Designer: Butler, Fairman & Seufert, Indianapolis

Contractor: Superior Construction Co., Gary, Ind.

Owner: Porter County, Ind.

Precaster: Rinker Materials Corporation, Lafayette, Ind.

Post-tension Subconsultant: Jansen & Spaans Engineering, Indianapolis

Size: Single-span, 110.46-foot-long bridge containing two 111.8-foot-long by 3.08-foot-wide by 6.56-foot-deep precast, post-tensioned box girders and twelve 34-foot-long by 8-foot-wide by 1.14-foot-deep (average) precast, post-tensioned concrete deck panels

Cost: Total bridge — $2.3 million

The two main considerations that led to the use of the concrete through girder system for the Sedley Bridge in Porter County, Ind., were the need to provide the required clearance for the railroad tracks below while lowering the bridge's overall profile.

Through-Girder Bridges Offer Strong Option

The new Sedley bridge in many ways echoes a similar structure built several years earlier in New York State, which earned the designers the Harry H. Edwards Industry Advancement Award sponsored by the Precast/Prestressed Concrete Institute.

The Carpenter Road Project, a precast, post-tensioned segmental bridge, also faced clearance problems over a railroad. The solution was to use match-cast "U" shaped segments post-tensioned together longitudinally to span 89' 6" with a width of 39' 11". The upturned legs of the "U" act as the traffic barriers at the edges, with the bottom of the U serving as the deck.

PCI's Design Awards Judges lauded the bridge for its innovative precast segmental system for new bridge construction. Like the Sedley Bridge, the East Fishkill Bridge is post-tensioned both longitudinally and transversely. Its low profile, assembly from above and scheduling advantages minimized disruption, hazards, road closing and detours.

The HHE award-winning design has been used a second time in New York, and the precaster sees further potential. "I feel that this system should be considered in replacing bridges where speed of construction and other issues, like traffic clearance, are critical," says Tony Mazzeo of Oldcastle/Spancrete, South Bethlehem, N.Y. As more designers nationwide become aware of the potential available, that likely will be a strong possibility.

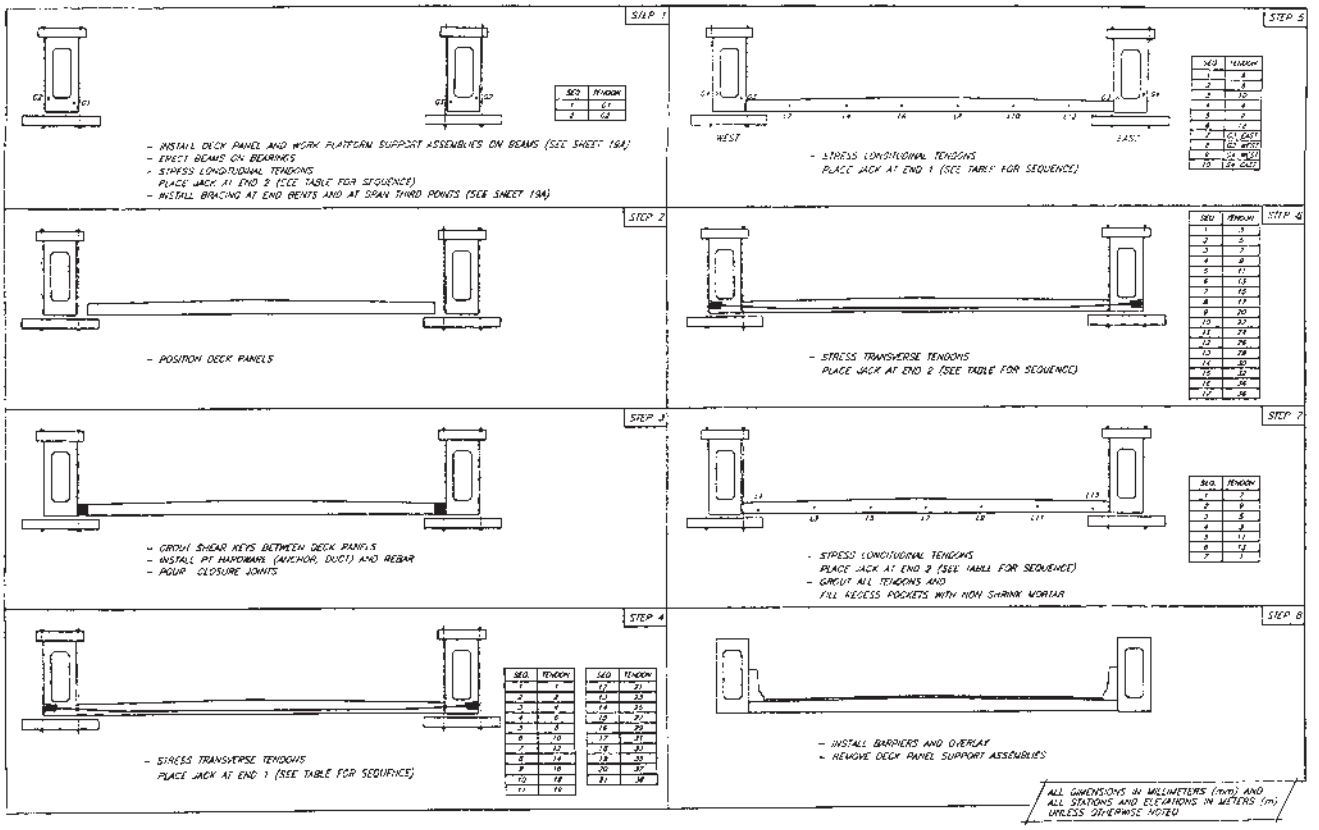
single-span construction of the bridge, with no false work required, maintained clearance for the railroad below throughout the construction sequence.

Shorter approaches saved a significant amount from the original cost.

"There were compromises made to meet the grade requirements of the railroad and also to keep the grade separation while bringing traffic down off the bridge to the county highway," notes Porter County engineer David Schelling, based in Valparaiso. "For example, unlike many bridges, the high point of the structure is not in the middle of the span. To make our transition to the highway, the high point of the structure is actually off the bridge."

The bridge itself is fairly simple in design and structure. It comprises two precast concrete box girders measuring 111.8 feet long, 3.08 feet wide and 6.56 feet deep plus 12 34-foot-long, 8-foot-wide concrete panels. The concrete panels average 1.14 feet in depth and are cast with a natural crown in the middle of the roadway. The concrete components were fabricated and transported to the bridge site by Rinker Materials Inc. in Lafayette, Ind.

The construction sequence involved first placing the girders on their abutments, attaching steel struts as temporary lateral supports at the abutments and performing the first stage post-tensioning. The concrete panels were placed on temporary wood shelves that were attached to the bottom of the girders



This construction sequence for the bridge shows how a through-girder design such as the one used on the Sedley Bridge is put into place.

using high-strength steel bars. Once all of the concrete panels were in place, concrete closure pours were made between the edges of the panels and the girders. The bridge then was post-tensioned both transversely and longitudinally.

"It always is a challenge to be the first to try a new design," say Bill Yoder, Rinker's plant manager at the time of the construction and now a consultant to the firm. "The clearance problems at the bridge precluded the use of a conventional I-beam. You could not have met the clearances required and still have provided for the 100-foot drop to the county road below."

Maintaining Grade Separation

There was also a safety factor involved, says Schelling. "We wanted to maintain a grade separation at the site, since that obviously is a much safer solution than a grade crossing of the railroad tracks would have been. It was apparent, however, that we needed to replace the old bridge."

Since the original bridge was only one lane wide, vehicles were frequently seen to meet in the middle of the structure, requiring one to back off the bridge to make way. During rush hours, traffic backups could involve literally hundreds of vehicles. "The new bridge solves these problems while meeting all of the objectives of the railroad, the planning commission, Indiana Department of Transportation and the Metropolitan Planning Organization." ■

— Wayne A. Endicott

Providing a low profile while maintaining clearance over railroad tracks was a major consideration of this bridge in East Fishkill, N.Y.

Web resources at www.pci.org

To learn about another short-span bridge, the U.S. Route 3A bridge, visit PCI's Web site and click on: Projects Showcases > Transportation > Bridges.

Additional resources are available at PCI's new Designer's Knowledge Bank, accessed by clicking on the DKB icon (pictured) at www.pci.org or your local precaster's own Web site. Free registration is required to access the material.