An HNTB-led project team used specialized design and construction techniques to minimize the new U.S. 20 bridge's impact on the sensitive Iowa River Greenbelt.

Passing the Test

First U.S. launched I-girder highway bridge nears successful completion

The first motorists to cross the new U.S. 20 Iowa River Bridge in north-central Iowa in late 2003 will be pleased that 15 miles and more than 30 minutes have been trimmed from their commute between Interstate 35 and Waterloo. Those who canoe under the structure will scarcely notice its existence. Those who orchestrated the carefully sequenced launch of 10 302-foot spans of structural steel will marvel at a bridge that pushed the limits of conventional structural engineering and construction technology.

HNTB, design and construction consultant for the project, worked closely with the Iowa Department of Transportation and the Federal Highway Administration to meet multiple objectives — and overcome significant challenges — in designing the bridge. The project is a major milestone in the state's program to upgrade U.S. 20 to four lanes.

"The only way we could be successful on this project was to form a true partnership among all parties involved," said Bob Younie, construction engineer for IaDOT's District 1. "The results exceeded my expectations."

Environmental sensitivity and economics were overriding design directives. The bridge site is located on 10 acres in the Iowa River Greenbelt. The woodland is a roosting habitat for bald eagles, and the river is home to three endangered or threatened species of freshwater mussels. Residents were vocal about their desire to preserve the site's natural resources.

"From an engineering standpoint, this project was not just a structural challenge," said HNTB project manager and project engineer Dave Rogowski. "It required innovative aesthetic, geotechnical, hydraulic and environmental solutions as well." ▶

Local construction and engineering contractors were instrumental in building the 1,630-foot steel I-girder bridge using the launch sequence HNTB developed.

The right design

HNTB developed six alternative structure types for IaDOT's review. The client's desire to build a bridge with minimal impact — visual and environmental — on the scenic area led to the selection of an incrementally launched, steel I-girder superstructure.

The steel I-girder design is slender and its appearance is much less dramatic than the other alternatives. Its longer spans reduce the number of piers needed, thus minimizing visual obstructions at river level, and its weathering steel blends with the natural surroundings and eliminates the need for future painting.

Erected as two parallel 39-foot-wide deck structures, the bridges consist of five equal spans of 302 feet and one 60-foot precast concrete jumpspan at each end of the bridge. The deck structures are supported on six cast-in-place reinforced concrete piers and two end abutments. A sealed drainage system collects stormwater landing on the bridge deck.

The bridge design, however, was not the only big decision to be made by client and consultant. The determination of how to construct the I-girder bridge in a valley that was steep, deep and environmentally protected required innovation from the designers and cooperation from all stakeholders.

The best solution

Anticipating limited construction equipment access to the river valley and expecting strict enforcement of environmental restrictions, HNTB engineers ruled out conventional steel erection from within the valley and decided on a launched erection sequence as the construction method. While it had never been employed for a steel I-girder system of this magnitude, the incremental launching technique had been successfully used for concrete box structures in Europe and steel box girders for railroad bridges in the United States.

"The concept was sound, but the challenge came in building this bridge type in a way that previously had not been proven," Rogowski said.

Contractor Jensen Construction of Des Moines, Iowa, was up to the challenge of constructing HNTB's design.

Jensen used the general erection sequence developed by HNTB and modified some roller and guidance systems to suit its schedule, available equipment and materials. A 15-foot-deep, 600-foot-long launching pit was constructed behind the east abutment. In it a number of temporary pile bents were constructed to allow sections of the I-girder superstructure to be assembled on rollers and later pushed incrementally across the piers.

Steel construction for the eastbound bridge began in June 2001. A temporary "launching nose" was attached to the front of the leading span to guide its placement and reduce the deflection of the 302-foot cantilever. Temporary roller bearings placed on the bridge piers assisted with the process of rolling sections across the valley. Launching of the westbound bridge began in late January.

The launch of the 10th and final span was completed in late March. In the end, the customized equipment pushed more structural steel (approximately 10 million pounds) than had ever been launched before.

A proven success

"The $20 million bridge will be complete this year, but paving of U.S. 20 on the bridge's east end will be ongoing through 2003," said HNTB's Mike LaViolette, resident construction engineer. At its opening to traffic in late 2003, the 1,630-foot bridge will be used by 13,000 motorists daily.

Iowa residents are eager. "I get more questions about when this segment will be open than about all other projects in District 1 combined," IaDOT's Younie said. "The bridge is the golden spike in a corridor project that has been under way since 1969."

HNTB engineers agree. "With the Iowa River Bridge, we pushed the limits of conventional construction techniques," Rogowski said. "We provided the client and the community with a bridge that was aesthetically pleasing, cost-effective and could be constructed without compromising the surrounding environment."

With pushing the limits — and succeeding — comes the knowledge that the practical application of incremental launching of a long-span steel I-girder bridge is now proven. It's a point that won't escape HNTB engineers as they take on the next site-constrained bridge design challenge.

In the meantime, Iowa drivers and environmentalists will enjoy the simple outcome of a complex but largely transparent engineering solution. ■

Left, center: Sections of the bridge superstructure were assembled in a launching pit outside the river valley and pushed incrementally across the bridge piers. Right: Rollers were used to help move the sections into place.