PROJECT

DWIGHT D. EISENHOWER VETERANS MEMORIAL BRIDGE

REPLACING AN URBAN GATEWAY IN INDIANA

by Jeffery Parke, Beam, Longest and Neff LLC

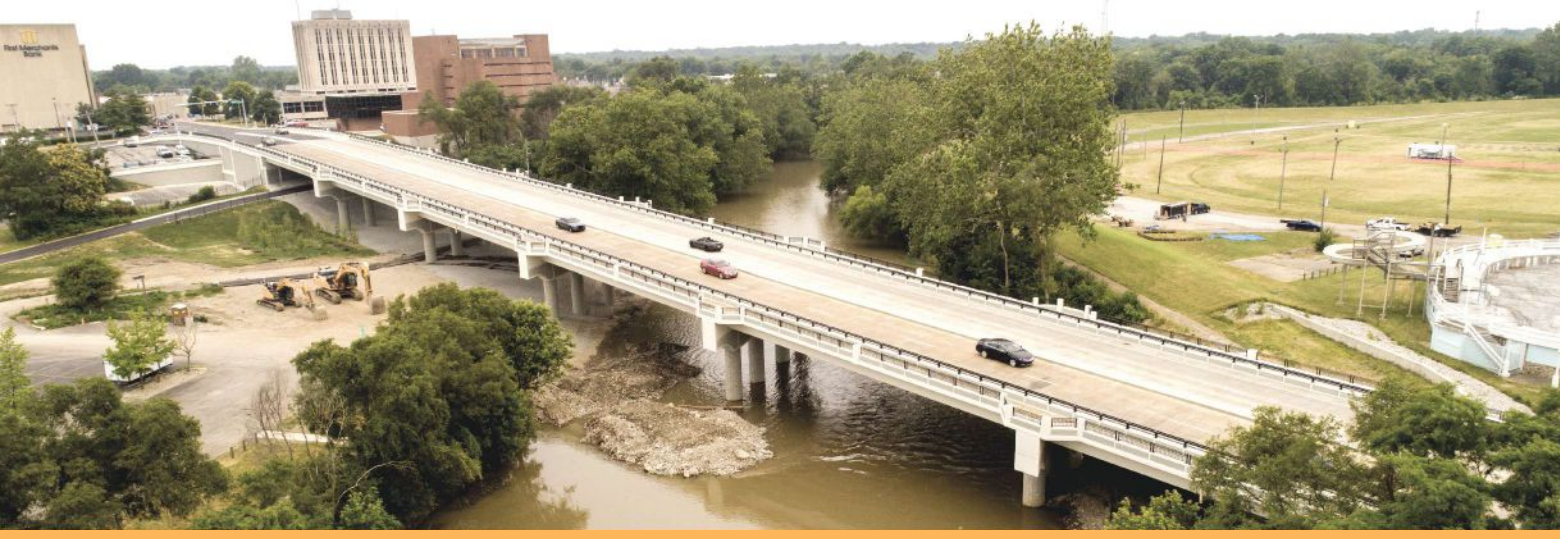
The Dwight D. Eisenhower Veterans Memorial Bridge in Anderson, Ind., carries Eighth Street over the White River. The most heavily traveled bridge in Madison County, it serves as the eastern gateway into downtown Anderson.

When the orginal Eisenhower bridge was built in the late 1960s, complex site conditions, including a railroad and utility building, led to the selection of a design with multiple skews, span lengths, beam depths, and substructure types. Unfortunately, some of these construction details eventually contributed to deterioration of structural elements at critical locations. In 2009, when the original bridge was about 40 years old, the owner, Madison County, initiated an alternatives analysis to determine the best course of action. The study found that the most cost-effective solution for the community was bridge replacement. Soon after, project development for the replacement bridge was initiated, with funding for construction secured in 2016 through the Transportation Investment Generating Economic Recovery grant program.

Project Specifications

The owner requested that the existing 729-ft-long, 10-span, continuous prestressed concrete I-beam bridge be replaced by a structure with an optimized span configuration; the owner also wanted to keep the existing cross-section geometry in a design that would be low maintenance and aesthetically pleasing. Additionally, permanent right-of-way acquisition was to be minimized while temporary right-of-way could be acquired for causeways used for beam placement or other construction activities.

The new Dwight D. Eisenhower Veterans Memorial Bridge over the White River. Debris walls for piers in the river were eliminated due to the lack of debris flow at this location. Photo: Beam, Longest and Neff LLC.



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DWIGHT D. EISENHOWER VETERANS MEMORIAL BRIDGE / ANDERSON, INDIANA

BRIDGE DESIGN ENGINEER: Beam, Longest and Neff LLC, Indianapolis, Ind.

PRIME CONTRACTOR: Primco Inc., Fort Wayne, Ind.

PRECASTER: Prestress Services Industries LLC, Decatur, Ind.—a PCI-certified producer

OTHER MATERIAL SUPPLIERS: Precast concrete panels and mechanically stabilized earth walls: SINE WALL, Wake Forest, N.C.

Epoxy-coated reinforcement was used in the 8-in.-thick deck. Photo: United Consulting.

The selected six-span bridge design was approximately 695-ft-long, with 114 ft 4 in. end spans and 115 ft 8 in. spans for the remainder of the bridge; all spans were constructed on a 30-degree skew, including the approaches and piers.

The designers eliminated the existing 34-ft-long span 1 on the west end of the bridge to lower the grade of Eighth Street by approximately 6 ft and shorten the bridge. Uniform span lengths were obtained by removing the final impediment, an abandoned utility building.

Much of the existing roadway geometry was maintained, except that on both sides an interior bridge railing was added to separate pedestrians from traffic and the sidewalks were widened to 6 ft. The selected cross section consisted of four 11-ft-wide travel lanes (two in each direction), 5-ft-wide outside shoulders, and 6-ft-wide flush sidewalks. A 4-ft-wide raised concrete median with 1-ft-wide flush offsets separates the eastbound and westbound traffic for an out-to-out coping width of 76 ft 8 in. Scenic overlooks were added at each pier, and ornamental streetlights were spaced along each coping.

The designers evaluated which superstructure materials and details would reduce future maintenance costs. Structural steel was eliminated because painted steel would require maintenance, and staining is associated with weathering steel. Traditional prestressed concrete I-beams and bulb-tee beams were eliminated because of the number of beams that would be required. However, 48-in.-deep, high-performance, high-strength (HPHS) prestressed concrete U-beams could be spaced at 13 ft and were selected because they would result in six beam lines and require minimal maintenance. The HPHS concrete allowed the spans and beam spacings to be increased, reducing project costs. For the precast, prestressed concrete U-beams, the HPHS concrete mixture proportions specified a water–cementitious materials ratio of 0.34 and silica fume to increase durability. The specified compressive strengths for the U-beams were 7000 psi at transfer and 9000 psi at 28 days.

Stay-in-place metal deck forms were used to form the 8-in-thick cast-in-place concrete deck, which used epoxy-coated reinforcement. Epoxy-coated reinforcement was also used in the barrier rails, moment slabs, approach slabs, and semi-integral abutments. Access hatches were placed at each end of every beam on the structure. The designer used semi-integral abutments and located the expansion

MADISON COUNTY, INDIANA, OWNER

BRIDGE DESCRIPTION: Six-span, 695-ft-long, continuous, prestressed concrete U-beam bridge with 114 ft 4 in. end spans and four 115 ft 8 in. interior spans, constructed on a 30-degree skew

STRUCTURAL COMPONENTS: Thirty-six 48-in.-deep prestressed concrete U-beams with stay-in-place metal deck forms and an 8-in.-thick cast-in-place concrete deck; cast-in-place concrete semi-integral end bents, pier caps, and columns founded on cast-in-place concrete foundations supported by steel H-piles

BRIDGE CONSTRUCTION COST: $13.8 million total; $10.1 million ($190/ft^2) for the bridge

Pier cap and footing construction. Photo: United Consulting.

joints at the ends of the reinforced concrete approach slabs because the 2009 analysis found that expansion joints located in the existing bridge had directly led to significant deterioration of the prestressed concrete beams and substructure. Cast-in-place concrete joint abutments were placed between the approach pavement and the approach slabs to support the expansion joints.

Minimalistic pier geometry was selected to reduce thermal load effects while also accommodating phased-construction requirements. The owner specified that the existing bridge could not be closed completely, so the design team developed a maintenance-of-traffic plan that reduced the existing eastbound traffic lanes to one across the existing bridge and through the project limits while detouring the westbound lanes around the construction site during phase 1 construction. Upon completion of phase 1, the eastbound traffic lane was diverted onto the newly constructed westbound portion of the structure while the westbound traffic continued to follow the established detour.

The pier consisted of a hammerhead cap on four 5-ft-diameter columns. The pier cap was designed using the strut-and-tie methodology, and an open joint was placed in the middle of the cap to reduce transverse thermal loads. Each of the columns was founded on a 4-ft-thick cast-in-place pile cap supported by steel H-piles.

Existing dissimilar span lengths between the westbound and eastbound lanes made it difficult to locate the substructure without conflicting with existing piling. The span arrangement was selected to minimize these conflicts; however, where conflicts did arise, specifications directed the contractor to remove the existing piles and backfill the remaining hole. All conflicting piles were successfully removed during construction.

Project Aesthetics

Because the bridge is the eastern gateway into Anderson, the owner stipulated that the bridge must have an appropriate, consistent aesthetic quality. The owner selected a concrete formliner to be used for all precast concrete wall panels and cast-in-place concrete pier columns. A different formliner was used for the cast-in-place concrete pier caps and bridge railing. A two-color (white/gray) palette was selected to be applied to all exposed concrete surfaces, including the U-beams, while metal portions of the bridge railing were painted black. Finally, black ornamental streetlights were selected to match similar units located throughout the city.

Project Challenges

Because of the project's location, numerous project challenges had to be overcome. The west end of the existing bridge was supported on a

On the west end of the structure, precast concrete panels were anchored to the existing retaining walls. The narrow 2 ft 6 in. gap between them was filled with lightweight cellular concrete fill to limit the additional load on the existing foundation. Photo: Beam, Longest and Neff LLC.

Prestressed concrete U-beams being erected at abutment number 1. The crane is sitting on crane pads within the mechanically stabilized earth fill. Photo: United Consulting.

full-faced concrete abutment with long, tall concrete retaining walls supporting Eighth Street. Given the limited right-of-way, precast concrete panels were anchored to the existing retaining walls, with a narrow 2 ft 6 in. gap between them. The gap was filled with lightweight cellular concrete fill to limit the additional load on the existing foundation. Railing and moment (overhanging) slabs were constructed on top of the wall panels without affecting the stability of the existing wall. The eliminated span was filled in and reconstructed using mechanically stabilized earth walls to support the abutment.

The Madison County Jail is located at the northwest quadrant of the project. Vibration monitoring was required during pile driving to decrease the likelihood of damage to the jail. Reports were prepared before and after the pile driving to document the condition of the facility. Pile driving was successfully completed without structural damage to the facility.

The numerous utilities located within the existing bridge and surrounding site required relocation. Fiber-optic lines were located on the bridge, and electrical lines were located underneath it. Also, 12-in.- and 24-in.-diameter water mains crossed under the bridge, river, and levee. The most significant utility relocation was the 24-in.-diameter water main, which was directionally bored beneath the river and levee. Coordination with the U.S. Army Corp of Engineers was required to develop construction details and specifications that would not endanger the stability of the levee during and after construction.

Relocating the thousands of copper and fiber-optic telecommunications lines located in both sidewalks of the existing bridge required significant coordination with the local utility. Relocation of all affected utilities was completed without delay to the project.

Finally, the existing bridge's flat and angular spaces were riddled with bird nests. These nests posed a health and safety hazard to bridge inspectors and residents who used the paths beneath the bridge. For the new bridge, prestressed concrete U-beams were selected in part because they do not have exposed bottom flanges or exterior diaphragms where birds can roost. Pier continuity diaphragms were detailed to the full pier cap width, further eliminating ledges. These design elements discourage birds nesting on the bridge.

Conclusion

From the in-depth alternative analysis through construction, clear and consistent communication among stakeholders was the key to success. The completed bridge, which was opened on time on June 18, 2019, will provide a safe gateway into downtown Anderson for years to come.

Jeffery Parke is a senior bridge engineer for Beam, Longest and Neff LLC, in Indianapolis, Ind.

Completed pier with architectural formliner. The open joint in the middle of the pier cap to reduce transverse thermal loads is barely visible. The clean lines beneath the bridge limit areas for birds to roost. Photo: Beam, Longest and Neff LLC.