The Other Side of the Tracks

SUBMITTED BY HDR ENGINEERING, INC.

A new viaduct provides motorists with an alternate route over multiple tracks in a western Iowa railroad town.

THE ORIGINAL STARTING POINT FOR THE TRANSCONTINENTAL RAILROAD, COUNCIL BLUFFS, IOWA, HAS TRULY BECOME A RAILROAD TOWN. The presence of multiple railroad companies in the city divides the community physically with tracks dissecting it in both the east-west and north-south directions.

This creates some life safety issues in the event that the only east-west railroad overpass becomes blocked or closed for any reason. It therefore became a priority for the city to construct a second viaduct over tracks of the Union Pacific (UP) Railroad and the Chicago Central and Pacific (CCP) Railroad.

The chosen location for the new railroad overpass is north of the primary central business district on an arterial route, the Avenue G corridor, through a primarily residential area of Council Bluffs. As Avenue G crosses the two railroad companies' tracks, it is also flanked by various industrial buildings and a school. The locations of these facilities, as well as numerous primary utilities in the tight Avenue G corridor, eventually led to a partially offset alignment for the overpass. To provide adequate offset to the adjoining buildings, the alignment of the bridge structure required reverse curvature.

Smooth Curves

The Avenue G Viaduct project incorporates a four-lane cross-section in its 54-ft clear roadway and includes a 10-ft wide trail on the south side. The 1,290-ft long bridge crosses two city streets, a three-track cluster of the CCP Railroad, two yard tracks and a proposed future yard track of the UP, and a separate five-track cluster of the UP. This five-track cluster includes the UP's two mainline tracks, an industrial lead track, and two additional yard tracks. The curving bridge alignment also passes within approximately 10 ft of an existing brick railroad maintenance building that was formerly a UP roundhouse, and within approximately 15 ft of an industrial building housing a furniture manufacturing facility. To minimize the required bridge length, the abutments at each end of the bridge are situated behind mechanically stabilized earth (MSE) walls.

Preliminary design of the viaduct presented several challenges including:

- Consideration of steel plate girder and prestressed concrete beam superstructures.
- Detailed cost estimates for each superstructure type.
- Minimization of MSE wall heights at the abutments because of settlement and stability constraints stemming from poor geotechnical conditions.
- Accommodation of the reversed curve alignment.
- Minimization of the required utility relocations for bridge substructures.
- Accommodation of vertical and lateral clearances to adjacent railroad tracks and city streets.

In addition, because of the curving bridge alignment, there was also a preference for providing constant bridge deck overhang widths and having the fascia of bridge girders follow the curved

The proximity of the bridge to adjacent industrial structures required a reverse-curve alignment.

alignment of the bridge rather than using chorded girders.

Decision Time

When weighing steel plate girder against concrete prestressed concrete beam alternatives, both standard Iowa Department of Transportation (IaDOT) bulb-T prestressed concrete beams and IaDOT's newer metric bulb-T beams were considered. These inventories of prestressed beams allowed a maximum span of approximately 140 ft using IaDOT's design criteria for providing structures that are considered continuous for live load. The prestressed beam structure type would have required a 12-span structure, given the constraints of pier placement that resulted from the locations of existing roads and railroad tracks. The limitation on the maximum span length also would have placed one pier within a 25-ft clearance envelope of a proposed future track for the UP. This constraint would have required approval from the UP as well as the addition of a crash wall to protect the pier. Furthermore, the reversed curve alignment would have prevented the desired uniformity in casting lengths for prestressed girders in a given span, which promotes efficiencies in this type of structure.

The steel plate girder structure type, on the other hand, would allow for longer span lengths of up to 180 ft within the same structure depth as required for the standard prestressed concrete bulb-T beams. These longer span lengths would provide a particular advantage for this bridge, considering the locations of the existing streets and railroad tracks. As a result, the steel plate girder option would require only an eight-span structure, thus saving three pier elements throughout the length of the bridge. Because the alignment of the bridge is on a reversed curve, the sweeping alignment crossed over the center line of the existing Avenue G corridor. This sweeping alignment would wreak havoc with the existing utility facilities in the corridor. Consequently, a reduction in the number of piers also translated into fewer utility conflicts.

Early On

IaDOT typically does not take alternate steel girder and prestressed beam bridge designs all the way through final design and letting. The agency's normal practice is to evaluate the different structure types in the preliminary design stage and to make a decision on the structure type at the conclusion of this design. Therefore, a detailed quantity and cost estimate was prepared for each alternative at the preliminary design stage. Substructure dimensions were estimated, and reinforcing densities were assumed based on past projects utilizing similar multi-column bents and abutment types. The number of piles per substructure element and pile lengths were also estimated. The number of girder lines could be determined and the structural steel quantities could be estimated based on preliminary girder designs for both the steel and prestressed beam alternatives. The bridge deck concrete quantities could be determined based on the assumed bridge cross section, and deck reinforcing quantities were estimated based on deck reinforcing densities from similar IaDOT projects. Finally, recent IaDOT average bid tab unit prices were applied to the appropriate quantities to establish base estimates for the steel girder and the prestressed concrete beam alternatives. These detailed estimates indicated that the steel alternative was slightly (approximately 2%) less expensive than the concrete alternative.

Because the cost estimates of the two structure types were very close, a decision matrix was also prepared to compare various parameters. The matrix indicated the advantages and disadvantages of the steel girder and prestressed concrete beam alternatives.

After consideration of the expected cost and functional advantages of the steel girder alternative, a decision was made to proceed with steel. The contract was awarded with an in-place bid price for fabricated structural steel of $1.13 per lb, which closely matched the unit price estimated in preliminary design. With an expected opening by late November of this year, the Avenue G Viaduct will provide a welcome alternative route over the tracks for Council Bluffs residents. MSC

Owner
The City of Council Bluffs, Iowa

Bridge Design
HDR Engineering, Inc., Omaha, Neb. (Subconsultant to HGM Associates, Inc., Council Bluffs)

Project Architect
RDG Planning & Design, Des Moines

General Contractor
Cramer & Associates, Des Moines

Steel Fabricator
PDM Bridge Wausau, Wis. (NSBA Member)

Engineering Software
STLBRIDGE, Bridgesoft, Inc.

Comparison Matrix of Steel and Prestressed Concrete Bridge Alternatives

	Advantages	Disadvantages
Steel Girder	✓ Slight cost advantage ✓ Longer spans/increased lateral railroad clearances ✓ Fewer piers/fewer potential utility conflicts ✓ Fewer pier footings next to UP roundhouse ✓ All piers outside of desirable 25-ft railroad clearance ✓ Better overall aesthetics (no chorded girders)	✗ Generally longer lead time on girder fabrication ✗ More field pieces to erect ✗ Potential staining of piers from weathering steel
Prestressed Beam	✓ Improved speed of erection ✓ Faster fabrication/delivery turnaround	✗ Slight cost disadvantage ✗ Chorded girders not as aesthetic ✗ Variable slab overhang more difficult to form ✗ Piers on both sides of UP mainline less than 25 ft clear ✗ More piers/more potential utility conflicts ✗ Span limitation doesn't allow for future UP railroad track ✗ Variation of beam lengths in curved sections