Unique Approaches to Erecting Long-Span Girders

by Dr. Keith Kaufman, Knife River Corporation

Improved materials, handling equipment, and shipping equipment continue to push the fabrication limits of precast, prestressed concrete girders. Concrete compressive strengths at transfer of prestress and at 28 days may exceed 7 and 10 ksi, respectively. Precast, prestressed concrete fabricators have constructed stressing beds capable of jacking over 3 million pounds. Many states or regions have adopted bulb-tee cross sections to receive the high prestressing loads and improve the response to handling, shipping, and erection stability.

Design engineers take advantage of these improvements to increase span lengths. The project environmentalist, biologist, and hydrologist restrict waterway construction and limit in-water activities such as work bridges and foundation construction. With these time and geometry restrictions, contractors find unique ways to erect these long spans.

Passing a girder between two cranes using a load triangle (inset). Photos: Knife River Corporation.

Single Pick

One approach to erect a long, heavy girder is to mobilize a large crane and utilize a single pick. Sling orientation limits, such as 60 degrees, and modifications to the lifting system are often required. The girder stability must also be evaluated for the additional horizontal compressive forces. Horizontal spreader beams can be used to eliminate the horizontal forces delivered to the girder. Bearing elevations that are different at each end of the girder can lead to challenges as the statics of the system change when one end of the girder rests on the support bearing before the other end does.

Decked bulb-tee being erected by a single pick. Photo: Morrison Structures Inc.

Passing Girders between Two Cranes

Another technique is to pass the girder from one crane to another crane located on the opposite bank of the crossing. The long girder is shipped using a rear steering unit and the front jeep or tractor. The steering unit is backed into the site and one crane lifts one end of the girder off the rear steering unit. The rear steering unit is then disconnected and moved out of the way. The other end of the girder remains securely attached to the front jeep or tractor. The crane rotates as the girder/truck assembly backs up, moving the girder toward the other bank.

As the first crane reaches its radius capacity, the load is transferred to a second crane located on the opposite bank. The first crane then swings into position to pick the other end of the beam off the truck. The two-crane pick completes the erection.

Load transfer between cranes may involve a load triangle with the two cranes attached to the top two corners of the triangle. The triangle rotates as the load is transferred to the second crane. It is important to not attempt to change the position

Single-span girder launching system where truck pushes girder across the launching girder. Photo: Knife River Corporation.

of the beam while both cranes share the load, that is, the position of the beam must be stationary as the load is transferred between cranes. This will minimize exceeding crane capacities if the load is accidently shifted between cranes.

Girder Launchers

Many bridge contractors own or have access to girder launchers. A launcher typically consists of a single-span structure with a mobile support system (cart) that can travel across the launcher. It is important that the girder restraint system be maintained to the truck and the trolley during this operation. Once the girder reaches the desired location, cranes are connected to the lifting points to complete the erection.

A unique launching system may include a multi-span launcher that includes a pair of mobilized beam launcher carts. This system allows all girders for the bridge to be delivered to one abutment and moved to the desired span. The shipping equipment is backed up to the abutment. A crane lifts the girder and places it on the cart located on the launcher. The truck continues to back into the site until the crane can lift the other end of the girder and place it on the second cart. At all times, the restraint of the girder is maintained at a minimum of one end of the girder. The girder is then moved along the launching girders until it reaches the appropriate span. The girder is then erected into its final position or into a temporary position until the launcher can be removed. Launchers are often supported on the new structure or on temporary bents that may be supported on the foundations from an existing structure that is being replaced.

Stability is Key

Erection of the girders is often the most exciting part of a project. This phase of the project presents the transition milestone between the substructure and superstructure. Several techniques have been discussed that can be used to erect large girders. In all situations, the girder stability must be evaluated and maintained. Costly equipment and teamwork are both required to complete this phase of the project.

A fully braced superstructure ready to receive the deck and rails is the goal before the end of the day. The creativity of a good bridge contractor often allows the bridge engineer to *aspire* to design these challenging structures.

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EDITOR'S NOTE

For more information, please consult the* Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders *published by PCI.