A Montana fabricator puts its rapid bridge construction system to the test on a fast-track replacement project.

product expert series

REFINING RAPID REPLACEMENT

BY PAT SOUTHWORTH

ABC—OR ACCELERATED BRIDGE CONSTRUCTION— has become more and more prevalent in the U.S. in recent years. Its overarching principle of reducing onsite construction time, whose goal is to reduce traffic impacts or complete new or replacement bridges within increasingly short closure windows, has been embraced by many in the bridge design and construction world and ardently endorsed by the Federal Highway Administration.

Of course, all stakeholders have an opportunity to contribute to the ABC process in their own way—not just in terms of participation but also via improvement upon the historical techniques and practices that seem to drag out what should be a simple bridge installation. One such idea is that of shipping steel bridge assemblies with deck already attached.

Topped at the Shop

Montana fabricator Allied Steel has delved into this concept and over the past couple of years has developed the Rapid Bridge System (patent pending), which is fabricated and built using steel girders—wide-flange, plate girder, truss, etc.—and topped with a concrete deck or wearing surface. The weight of what can be picked is limited only by what the chosen crane can safely pick, and the system is applicable for both the single- and multiple-span bridges and in any climate. The difference is in the application of the concrete deck. While deck is normally poured or assembled onsite following erection of the steel superstructure, we have developed a system where the deck is actually poured and attached to the steel at our facility, with the concrete completely cured before shipping the bridge to the site. The system incorporates the general goals of ABC: the use of superior materials for all aspects of a bridge, the capability to be efficiently installed in any climate and features that would save time and money on-site, such as eliminating field welding and field pouring of the deck (and in some cases the abutments and back walls).

Using this technique requires breaking the bridge down into sections or modules due for transportation, thanks to the added size and weight of the concrete; each module includes one or two girders with the concrete deck. While this increases the number of sections that need to be transported, the system's benefits are many. It allows for more rapid bridge erection; the concrete is completely cured in a controlled environment rather than on-site; the bridge site itself is more efficient and less crowded since the deck is already poured—which also means that it is ideal for tight construction sites; and site disruption, from both a time and a "wear and tear" perspective, is greatly reduced. The system is not limited by the depth of the slab, and with our cambering tolerance we are able to deliver a smooth riding surface from pier to pier without any additional overlays.

In addition, the system uses a tight keyway bolted connection (also patent pending) to align the longitudinal joints between each module while still holding the deck elevation. Typical concrete bridges use embedded angle clips with a plate that is field-welded approximately every 5 ft on center down the entire length of each longitudinal joint. Because of the variance in the camber from pretensioning the concrete structure, the bridge erector has to be crafty in their techniques to level the tops of the concrete structure to actually achieve this system. This puts tension in the direction perpendicular to the beams, making this option more

Allied's first project using its Rapid Bridge System: the Maxwell Coulee Bridge, about 20 miles east of Jordan, Mont.

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The Maxwell Coulee Bridge was engineered into six modules, each approximately 7 ft by 110 ft and comprised of one girder, with diaphragm bracing and an 8-in. concrete deck.

susceptible to deterioration. Current steel ABC systems use a field pour system where concrete is poured down the entire length of the longitudinal joints. This requires forming, inserts in the modular slab, threading and tying rebar and a field cast. Our system only requires a bolted connection approximately 20 ft on center and also incorporates an angle system that holds a piece of rebar down the center of the keyway for additional strength. Once the bolts are in place, all that is required is to pour a non-shrink epoxy grout into the keyways.

The Test Run

Our first project using the new system was for the Montana Department of Transportation: the Maxwell Coulee Bridge, about 20 miles east of Jordan, Mont. on Highway 200. This new bridge, which replaced an existing wooden span over a small ravine, or coulee, is 40 ft wide, 105 ft long and has a 35° skew. The structure was engineered into six modules, each approximately 7 ft by 110 ft and comprised of one girder—W36×182 with a 1½-in. reinforced bottom flange plate—with diaphragm bracing and an 8-in. concrete deck.

As this was our first "test" of the new system, there were lessons learned, which will be useful in improving the system. The most significant issue was the skew in conjunction with the camber points in the girder, which created problems with lining up the decks from module to module. We addressed this problem by making temporary steel abutments to set the girders in place, supporting the camber points and designing a new forming system. Despite this issue, the project was completed late last year within the allotted 45 days (the asphalt approaches will be completed this spring) and in harsh Montana winter conditions. The rapid bridge techniques proved themselves not only in the shop but also on the road. MSC