Precast Concrete *Solutions*

by Craig A. Shutt

Accelerated bridge construction (ABC) has become a watchword for many design teams, as owners look to shorten the design and construction process. Not only does faster construction reduce user costs and enhance community relations, but it increases safety by minimizing the time workers are exposed to hazardous conditions. A variety of methods can accelerate bridge construction based on the types of materials, conditions, and program goals.

Bridges that feature precast concrete components have found success using several new techniques. Design-build delivery methods, casting techniques, and design concepts in combination with precast concrete components can shorten construction times. Here are some examples.

Eight-Day Schedule

With the Mill Street Bridge over the Lamprey River in Epping, the New Hampshire Department of Transportation (NHDOT) officials used precast concrete components to finish erection of the 115-ft-long bridge in only eight days.

Seven precast, prestressed adjacent box beams were used, with five abutment and wingwall pieces on one end and six on the other, plus ten footing pieces. The precaster also supplied four precast concrete pilasters to add a decorative touch. This superstructure is supported by an all-precast concrete substructure, composed of full-height cantilevered abutments founded on spread footings.

The project was let using an approach somewhere between the traditional design-bid-build and the design-build process. Design control remained with NHDOT engineers but the specific method of bridge assembly was left to the contractor and precaster. They determined where joints within the substructure would be introduced and how the precast concrete bridge elements would be assembled.

Horizontal joints in the stems and between the stems and footings feature full moment connections with grouted splice sleeves. The splice sleeves were cast into the front and back faces of the stem elements to accept reinforcement extending from the bottom footing element.

The precast concrete components could be cast in advance and delivered for assembly when the site was ready. Savings realized on items such as the reduced rental time for a temporary bridge and elimination of the labor needed to mobilize around available construction windows compensated for the costs associated with the fabrication and delivery of the precast concrete.

Mill Street Bridge over the Lamprey River in Epping, N.H. Photo: New Hampshire Department of Transportation.

The new Route 70 Bridge over Manasquan River in New Jersey. Photo: Aurora & Associates.

Memorial Bridge

In replacing the Route 70 bridge over Manasquan River, the New Jersey Department of Transportation officials chose a method that reduced construction time by 25 months over more-typical designs.

Each 724-ft-long structure has two, three-span continuous superstructure units comprising precast concrete bulb-tee beams. The superstructures are supported on two abutments and five architecturally treated, in-water piers with pile foundations.

To minimize the duration of in-water construction, architectural piers were supported at the waterline on a simulated masonry-faced plinth. The piers have a pair of prismatic vertical columns near the bridge's centerline, as well as inclined tapered columns sloping outward towards the bridge fascias.

The pier structural system consists of precast concrete cofferdam shells, hollow precast concrete columns, and hollow precast, prestressed concrete cap beams connected with post-tensioning.

In Phase 1, the girders for the eastbound structure were set using the existing bridge as a working platform. Then the completed eastbound portion was used to set the westbound structure. The contractor operated on a six-day workweek and employed multiple crews, which moved from one pier location to the next, performing the same tasks for each pier in sequence. This allowed a production rate of 19 working days per pier on each half of the bridge. As a result, the project was substantially completed more than two years ahead of schedule.

This example shows that by providing flexibility and alternate provisions and allowing reasonable substitutions, engineers and owners empower (and challenge) contractors and fabricators to construct high-quality projects at a lower cost and faster pace. As engineers and contractors gain experience with precast concrete substructure construction, these techniques will be adopted for more conventional spans, realizing even greater efficiencies with lower costs and timely deliveries.

The South Maple Street Bridge in Enfield, Conn. Photo: Hoyle, Tanner & Associates Inc.


The State Highway 86 Bridge over Mitchell Gulch in Colorado.

South Maple Street Bridge

To complete the first, totally precast concrete bridge in the town of Enfield, Conn., town officials used ABC concepts to reduce user costs. As a result, the structure was erected in just 17 days.

The South Maple Street Bridge, which spans the Scantic River, was assembled from 71 precast concrete components. The concept used precast concrete adjacent box beams, with a continuous-length lip extending in front of the abutment panels to hide the horizontal joint. Additional components comprised footing blocks with threaded jacks to level them to grade after setting, 10 abutment walls, 12 wingwall pieces cast in decorative patterns, 4 cheek walls, and 12 pavement approach slabs.

The contractor cast an unreinforced "mud slab" at the abutment sites and set the footing blocks on them. The abutment walls and wingwalls then were set over the reinforcing bars and the dowel bar splice sleeves were grouted. The precast concrete abutment bridge seat was set onto the projecting reinforcing bars from the abutment walls, allowing the abutment pieces to act as one unit. Then the box beams were set on elastomeric bearing pads on the precast bridge seat. Following erection of the box beams, the precast concrete cheek walls and precast concrete approach slabs were erected.

Mitchell Gulch Bridge

Precast concrete abutments and pier caps offer a strong option for accelerated construction schedules. State Highway 86 Bridge over Mitchell Gulch in Colorado is another example of those benefits. The use of precast concrete abutments allowed the bridge to be constructed over the weekend and open only 46 hours after closure.

The original timber bridge was replaced with a 40-ft-long, 43-ft-wide, single-span precast concrete slab superstructure and precast, reinforced concrete abutments. The precast concrete abutments and wingwalls with embedded steel plates were erected by crane and welded to the steel H-piles and to each other, finishing in less than two days.

These projects present several innovative ways precast concrete components are being used to accelerate bridge construction while meeting a variety of needs for economy, aesthetics, and durability. By using easily designed techniques, the projects achieve their goals while also ensuring bridges are brought into service quickly. A

This is the first in a series of articles examining different approaches to Accelerated Bridge Construction and examples featuring those techniques. Details of these projects can be found in the issue archive at www.aspirebridge.org. They originally appeared in the Spring 2007 issue (Mill Street Bridge and Mitchell Gulch Bridge), Fall 2009 issue (Route 70 Bridge), and Summer 2011 issue (South Maple Street Bridge).

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.