Precast Concrete Bridge Approach Slabs Speed Construction

by George D. Nasser

An innovative application of post-tensioned precast concrete approach slabs reduces construction time, adds durability, and provides more user comfort

In the past five years, the use of precast, prestressed concrete pavement (PPCP) has been advancing rapidly. Completed projects in Texas, California, Missouri, and Iowa have shown that PPCP is not only viable and cost competitive, especially when life-cycle costs are considered, but also possesses some distinct advantages. A new project involving bridge approach slabs in Iowa shows the concept has even more versatility.

First and foremost among PPCP's benefits is speed of construction. Highways can be opened to traffic as soon as the panels are installed, without waiting for the concrete to reach its specified strength, as would be required for conventional cast-in-place construction. The installation also can be done at night and during nonpeak traffic hours, without having to rely on favorable weather conditions. Experience has shown that the construction season can be extended in northern states.

Prestressing Adds Benefits

Pretensioning the panels in the plant and post-tensioning on-site induces compression in the concrete, effectively preventing cracking. Prestressing also provides significantly thinner slab sections. A recent project in Texas used precast panels as thin as 8 in., compared to 14-in.-thick conventional cast-in-place concrete pavement.

The thinner sections require less material, which saves costs and permits "in-kind" replacement of existing pavement. Being lighter, the panels provide easier handling; being thinner, they reduce the overall thickness of the pavement sections, which provides greater clearances beneath underpasses. Prestressing also permits longer sections of pavement to be constructed between expansion joints, requiring fewer expansion and contraction joints overall.

Because the panels are fabricated under plant-controlled conditions, the products offer high quality, resulting in pavements that are strong, durable, long lasting, and virtually maintenance free. All these benefits combine to create a highly cost-effective project when costs are considered over the full life cycle. Although initial costs may be higher, the lifetime costs will be significantly lower.

The potential of PPCP has not gone unnoticed. The Federal Highway Administration (FHWA) has already funded four PPCP demonstration projects and several more are on the drawing boards. Also, the Precast/Prestressed Concrete Institute (PCI) has established a technical committee on PPCP. In October 2006, it conducted sessions on PPCP from the viewpoint of both the owner and the precaster at the PCI Convention in Grapevine, Texas.

Iowa Approach Slab Project Underway

The latest application of PPCP, which focuses on bridge approach slabs, is currently underway with the sponsorship of the FHWA and the Iowa Department of Transportation. Instrumentation and monitoring are being carried out by researchers at Iowa State University at the Bridge Engineering Center in Ames, Iowa. The project is one of several demonstration projects being conducted as part of the FHWA Concrete Pavement Technology Program.

profile

IOWA HIGHWAY 60 / O'Brien County, Iowa

SPONSORS: Federal Highway Administration, Washington, D.C.
Office of Bridges and Structures, Iowa Department of Transportation, Ames
Iowa Highway Research Board, Ames (instrumentation and monitoring)

RESEARCHER: Iowa State University Bridge Engineering Center, Ames

The demonstration project in O'Brien County, Iowa, uses precast, pretensioned and post-tensioned concrete approach slabs.

The precast approach slab system is intended for use in either new construction or rehabilitation/reconstruction applications. It can be installed in single lane widths to permit staged construction with minimal disruption to traffic.

One objective of the research is to eliminate the annoying "bump at the end of the bridge" that vehicle drivers often experience. This phenomenon is caused by pavement settlement from consolidation or erosion of the underlying embankment material and can be as much as several inches.

While precast concrete approach slabs will not prevent this settlement, they provide a rapid reconstruction solution for approach slabs that have failed due to settling. The Iowa DOT also is developing a tied connection between the approach pavement and the integral abutment bridge, as well as a detail for a prefabricated paving notch.

In the Iowa DOT project, a comparison will be made between the performance of an integral abutment using the precast, post-tensioned concrete system and conventional cast-in-place construction. Approximately 160 ft of approach slab has been constructed on a section of Highway 60 in O'Brien County near Sheldon, Iowa, using the precast system on the northbound lanes and cast-in-place pavement on the southbound lanes.

The precast bridge approach slab for the northbound lanes was attached directly to the abutments of a 300-ft-long, prestressed concrete I-beam bridge. Eight 12-in.-thick panels were placed at each end of the abutments for a total length of 160 ft at the roadway centerline. A bond breaker was provided between the precast slabs and the subbase. The two panels adjacent to each abutment were skewed at 30 degrees, and the six remaining panels were cast in 14- by 20-ft-rectangular sections. The panels were pretensioned transversely in the plant and post-tensioned both longitudinally and transversely in the field to a concrete compressive stress between 100 and 200 psi, using single 0.6-in.-diameter, 270 ksi strands. The post-tensioning ducts were grouted.

The cost of casting the panels for the Iowa DOT project was approximately $190,000, or $44 per ft^2 compared to $13 per ft^2 for cast-in-place double reinforced approach pavement. This higher cost was anticipated, however, due to the experimental, small-scale nature of the project. As contractors become more familiar with precast paving techniques, and as the projects become more plentiful, the initial cost will steadily decrease—and the true value of this system will be seen in the life-cycle benefits.

The performance and evaluation of the precast and cast-in-place slab sections will be monitored by the Iowa State University Bridge Engineering Center. The final results of the Iowa study will not be known for some time but it is expected that the precast system will provide a viable solution for rapid reconstruction of bridge approach slabs.

For More Information

A comprehensive report on a PPCP project in California by David K. Merritt, B. Frank McCullough, and Ned H. Burns was published in the *PCI Journal*, Vol. 50, No. 2, March-April 2005, pp. 18-27. The article is titled "Design-Construction of a Precast, Prestressed Concrete Pavement for Interstate 10, El Monte, California." Copies are available from PCI at www.pci.org or info@pci.org.

For more information on this or other projects, visit www.aspirebridge.org.

PRECAST CONCRETE / IOWA DEPARTMENT OF TRANSPORTATION, AMES, IOWA, OWNER

DESIGNERS OF PRECAST PANELS: Office of Bridges and Structures, Iowa Department of Transportation, Ames
Iowa State University Bridge Engineering Center, Ames
Transtec Group, Austin, Tex.

PRECASTER: IPC Inc., Iowa Falls, Iowa, a PCI-Certified Producer

COST: $190,000

Expanded Shale, Clay, and Slate Institute

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