UPDATE ON PREFABRICATED BRIDGE NATIONAL IMPLEMENTATION ACTIVITIES

Mary Lou Ralls, Bridge Division, Texas Department of Transportation
Ronald D. Medlock, Bridge Division, Texas Department of Transportation
Sharon Slagle, Bridge Division, Texas Department of Transportation

ABSTRACT

In 2001, the AASHTO Technology Implementation Group (TIG) established the Panel on Prefabricated Bridge Elements and Systems to promote and extend the use of prefabrication to minimize traffic disruptions and expedite construction. This paper is a report on progress to date.

Keywords: Prefabrication, Prefabricated bridges, Bridge elements and systems.

INTRODUCTION

The American Association of State Highway and Transportation Officials (AASHTO) Technology Implementation Group (TIG) Panel on Prefabricated Bridge Elements and Systems has been working since 2001 to champion the use and facilitate the implementation of innovative prefabrication in bridges. AASHTO has been partnering with the Federal Highway Administration (FHWA) in this initiative; prefabricated bridge elements and systems are consistent with FHWA's goal to mitigate congestion through accelerated construction techniques, and this initiative is a direct response to the traveling public's cry of "get in, get out, and stay out." By moving activities out of the work zone, prefabrication offers a number of advantages to bridge owners, builders, and users, including minimized traffic disruptions, improved safety, minimized environmental intrusion, and improved constructability. With prefabrication, performance of work in more controlled environments also improves quality and durability. As the drivers for the use of prefabricated bridge elements and systems vary depending on the needs of the specific project, the construction cost of prefabrication also varies, sometimes higher and other times lower than conventional construction. When user costs are included, the cost of prefabricated bridges is typically lower than conventionally constructed bridges because of the time savings that can be achieved at the construction site.

This paper summarizes the panel's various activities and highlights several innovative prefabricated bridge projects. Future implementation of this technology as the initiative is mainstreamed to the bridge community is also discussed.

ACTIVITIES OF THE TIG PANEL

To facilitate implementation of innovative prefabrication, the AASHTO TIG panel has developed and published a promotional brochure, produced video clips publicizing advantages of bridge prefabrication, published a promotional CD/DVD/VHS of the video clips, sponsored workshops and sessions, provided speakers to conferences and meetings, and published a web site providing a wide variety of technology-transfer information on prefabricated bridge elements and systems.

BROCHURE

In May 2002, the panel published, "Prefabricated Bridges—Get in, get out, stay out," a brochure that describes the implementation of innovative bridge prefabrication projects by bridge owners, engineers, and builders. The panel distributed the brochure by mail to state Departments of Transportation, by hand at appropriate conferences and speaker forums, and electronically by posting it on the AASHTO TIG website, www.aashtotig.org.

VIDEO CLIPS

In June 2002, the panel released a set of eight video clips that tout the advantages of bridge prefabrication and describe fifteen exemplary bridges from six states and Puerto Rico. The panel posted the video on www.aashtotig.org.

CD/DVD/VHS

The panel produced an interactive CD containing the promotional video clips, mailed it out to bridge owners nationwide, and distributed it at bridge conferences with national and international audiences. The panel also produced the videos on DVD and VHS for use by speakers at meetings and conferences nationwide.

WORKSHOPS/SESSIONS

The panel has co-sponsored workshops with FHWA and others as listed below:
- Workshop on Prefabricated Bridge Systems to Eliminate Traffic Disruptions, co-sponsored with the Texas Department of Transportation (TxDOT) in September 2001 in Austin, Texas.
- Precast Concrete Bent Cap Demonstration Workshop, co-sponsored with TxDOT in March 2002 near Dallas, Texas, featuring TxDOT's State Highway 66 Lake Ray Hubbard bridge project's use of precast caps on multiple columns.
- National Prefabricated Bridge Elements and Systems Conference, co-sponsored with the Midwest Transportation Consortium in February 2003 in St. Louis, Missouri.
- Precast Concrete Bent Cap Demonstration Workshop, co-sponsored with TxDOT in July 2003 in Temple, Texas, featuring TxDOT's State Highway 36 Lake Belton bridge project's use of hammerhead-style precast bent caps.

Attendees at the above workshops included representatives from state Departments of Transportation, FHWA, contractors, suppliers, consultants, academia, and other professionals. The panel has produced and made available CD-ROMs containing presentations from these workshops. For the St. Louis conference, AASHTO offered a $500 scholarship to each State DOT to facilitate attendance.

Another national conference is being planned for Spring 2003. Scholarships for DOT attendance will also be available for this event. More information will be publicized and published on the AASHTO TIG website as it becomes available.

TECHNICAL SESSIONS AND SPEAKERS

The panel has hosted technical sessions on prefabricated bridge elements and systems at a number of national conferences, including the Transportation Research Board (TRB) Annual Meeting in January in Washington, D.C., the International Bridge Conference in June in Pittsburgh, and the Precast/Prestressed Concrete Institute (PCI) Annual Convention.

The panel has sponsored speakers at a number of forums, including the annual meetings of the AASHTO Standing Committee on Highways; the AASHTO Highway Subcommittees on Bridges and Structures, Construction, and Materials; and the Western Association of State Highway and Transportation Officials (WASHTO); and also various State DOT-sponsored conferences and seminars.

WEB PAGES

The panel has developed and published web pages on the AASHTO TIG website, www.aashtotig.org. These web pages can be accessed by clinking "Focus Technologies" and then "Prefabricated Bridge Elements and Systems" to obtain descriptions, contact information, and details on a number of projects that illustrate the use of innovative prefabrication in bridge design and construction. The website is arranged such that these projects can be accessed by advantage (i.e., reduced traffic disruption, construction safety, environmental sensitivity, and constructability) or by element or system (i.e., decks, total superstructure systems, bent caps, columns, total substructure systems, and totally prefabricated bridges).

The "Prefabricated Bridge Elements and Systems" web pages also allow users to search the repository of innovative projects by State or by key words (e.g., the name of a specific project). In addition, the pages allow users to download the brochure and video clips developed by the panel. The web pages provide a calendar of events, information about published and ongoing research, and available publications. Details about the activities of the panel, including a listing of panel members and friends and the panel's work plan, are also provided.

PAPERS AND ARTICLES

A number of papers and articles have been published about prefabricated bridge elements and systems. Information on many of these papers and articles is available on the web site (www.aashtotig.org) "Prefabricated Bridge Elements and Systems" pages through the Research and Publications links.

INNOVATIVE PREFABRICATED ELEMENTS AND SYSTEMS

Traditional bridge prefabrication, such as prestressed concrete beams, steel beams, and segmental superstructures, are an established part of bridge construction. Newer prefabricated bridge elements and systems include:

- Substructures – Bent caps and total substructure systems.
- Superstructures – Full-depth deck panels and total superstructure systems including pre-constructed composite units.
- Totally prefabricated bridges – Bridges for which all components are prefabricated.

Bridge owners, designers, and contractors are becoming increasingly creative in their efforts to provide cost-effective bridges that meet the specific requirements of local sites and users. The following projects provide examples of the use of innovative prefabrication and describe the advantages achieved by each.

SUBSTRUCTURES: BENT CAPS

Prefabricating bent caps facilitates construction in hard to reach places that are typical of bent caps, achieving speed and improving safety. Like other precast products, prefabricated bent caps also realize efficiency when multiple identical caps are used on a project.

On the Beaufort and Morehead Railroad Trestle Bridge over the Newport River between Morehead City and Radio Island, North Carolina, constructed in 1999, the design-build team chose precast bent caps to help facilitate replacement of trestle spans during weekly outages of four days. The caps were precast upside-down to accommodate handling of the reinforcing steel that protruded from each cap to ultimately be placed in steel pipe piles. Precasting the caps achieved speed and also made the bridge easier to construct by eliminating the need to cast the cap concrete in place over water.

Photo courtesy of the North Carolina Department of Transportation

Fig. 1 Bent Caps on the Beaufort and Morehead Trestle Bridge in North Carolina

SUPERSTRUCTURES: DECKS – FULL-DEPTH DECK PANELS

Full-depth deck panels speed bridge construction by moving deck construction operations away from the job site. The time required for cast-in-place operations is saved, although use of full-depth panels can be complicated by the need to find an effective means to achieve composite action and by the need to add a wearing course.

When the Illinois Department of Transportation redecked its Route 29 over Sugar Creek bridge, it reused existing steel beams and made them composite with precast deck panels. A total of 29 panels were laid along the length of the bridge. Shear keys between the panels were post-tensioned longitudinally with high-strength steel bars.

Photo courtesy of the Illinois Department of Transportation

Fig. 2 Full-Depth Deck Panels on the Route 29 over Sugar Creek Bridge in Illinois

SUPERSTRUCTURES: TOTAL SUPERSTRUCTURE SYSTEMS

Totally prefabricated superstructure systems include decks that are precast onto beams remotely and then set into place as a unit. Such units are useful for achieving rapid superstructure replacement or for achieving constructability in hard-to-access areas.

On the New York State Robert Moses Causeway over Great South Bay, the contractor substituted prefabricated "quad-tee" superstructure units for a traditional beam with cast-in-place superstructure through a value-engineering proposal. Use of the units allowed the contractor, Weeks Marine, to take advantage of its own marine-based heavy lifting equipment and provided easier access to the superstructure over the water. Weeks Marine based their winning low bid on anticipated acceptance of their system, demonstrating the cost-effectiveness of their prefabrication solution.

Photo courtesy of the New York State Department of Transportation

Fig.3 “Quad-Tee” Superstructure Units on the Robert Moses Causeway in New York

TOTALLY PREFABRICATED BRIDGES

In a growing number of cases, owners have turned to totally prefabricated bridges to achieve speed or minimize impact on the environment. With a totally prefabricated bridge, all bridge components are prefabricated and brought to the site ready for assembly.

Walt Disney World’s 1997 Reedy Creek Bridge in Orlando, Florida, was totally prefabricated to help minimize environmental disturbance to the wetlands it crosses. The 1,000-ft long bridge is divided into five 200-ft segments, each with five 40-ft simple spans. Construction of the bridge was top-down because no construction equipment was allowed in Reedy Creek. Slab spans were placed on precast caps supported on steel pipe piles.

The Reedy Creek Bridge highlights the use of slab spans. The slab spans are precast concrete panels that fully comprise the bridge superstructure, i.e., the panels do not rest on beams but span from abutment to abutment. Slab spans are useful when it is desirable to minimize cast-in-place concrete to achieve speed or due to lack of access, when a shallow superstructure depth is needed, and when shorter span lengths are not an issue. The Reedy Creek bridge panels are 6 ft wide and haunched for a 24-inch superstructure depth at the ends and a 15-inch depth at mid-span.

Photo courtesy of BERGER/ABAM Engineers Inc.
Fig. 4 Totally Prefabricated Reedy Creek Bridge in Florida

FUTURE IMPLEMENTATION

The AASHTO TIG panel is now transitioning its activities to the AASHTO Highway Subcommittee on Bridges and Structures (HSCOBS) and FHWA as it sunsets its operations. At the June 2003 AASHTO HSCOBS Annual Meeting, a resolution in support of the continued implementation of the prefabricated bridge elements and systems initiative was unanimously adopted. The resolution acknowledges the importance of prefabricated bridges in achieving HSCOBS goals, affirms the HSCOBS leadership role in further development and refinement of this technology in partnership with FHWA, and supports FHWA in its technology transfer activities related to this initiative.

CONCLUSIONS

Much information on innovative prefabricated bridge projects has been compiled and shared since the creation of the AASHTO TIG Panel on Prefabricated Bridge Elements and Systems in 2001. Research on various aspects of prefabricated bridge technology has been completed and new research projects to further enhance the technology have been initiated during this time. Awareness and understanding of this technology have increased, with accelerated implementation the result. The AASHTO TIG panel is completing its purpose as it transitions its activities to the AASHTO HSCOBS and the FHWA.