Prefabricated Bridges 2004

Good Business—Best Practice

AASHTO Technology Implementation Group (TIG)
Federal Highway Administration

The American Association of State Highway and Transportation Officials (AASHTO) Technology Implementation Group (TIG) has been working in partnership with the Federal Highway Administration (FHWA) since 2001 to champion the use and facilitate the implementation of innovative prefabrication in bridges. By moving activities out of the work zone, prefabrication offers a number of advantages to bridge builders, owners, and users, including minimized traffic disruptions, improved safety, minimized environmental intrusion, and improved constructibility. With prefabrication, performance of work in more controlled environments also enhances quality and durability to achieve structures with longer service lives and lower maintenance needs.

This brochure, a companion publication to the 2002 “Prefabricated Bridges: Get In, Get Out, Stay Out,” highlights best-practice applications of bridge prefabrication across the United States, listed below in the order shown in this brochure:

- Totally prefabricated bridges in Florida, Colorado, California, and Alaska
- Bridges with totally prefabricated superstructures in Connecticut, Vermont, Illinois, and Louisiana
- Bridges with prefabricated superstructure full-depth decks in Virginia, Washington, and Maryland
- A bridge with prefabricated substructure caps in Texas

We are impressed by the speed with which bridge owners, engineers, and builders have recognized the value of this technology, and we congratulate them for their innovative best practices.

The AASHTO TIG prefabricated bridges panel is now mainstreaming its activities and will sunset in 2005. Working with FHWA, AASHTO will continue its development and refinement of prefabricated systems through its Highway Subcommittee on Bridges and Structures. Working with AASHTO, FHWA will provide the leadership role and some program support for technology transfer of this innovative technology.

Mary Lou Ralls, P.E., Chair
AASHTO TIG Panel on Prefabricated Bridge Elements and Systems
State Bridge Engineer
Texas Department of Transportation

Benjamin Tang, P.E.
Senior Structural Engineer and Team Leader
Office of Bridge Technology
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Totally Prefabricated Bridge—Precast Deck Panel Superstructure with Precast Caps and Steel Pipe Piles

Reedy Creek Bridge, Florida

Two 1,000 ft. long structures, each having five 43-53 ft. wide bridges with five 40-ft. spans

Located at the entrance to Walt Disney World's Animal Kingdom in Orlando, Florida, the Reedy Creek Bridge was bid as a conventional contract, and then the winning contractor and engineer reworked the initial design using prefabricated components on the same alignment. Bridge requirements included that it be a low-profile structure approved by the Florida Department of Transportation, that it be constructed entirely from the top with no impact to the creek bed below, and that it be a low-maintenance structure with utility lines carried in the 14 ft. that separated the eastbound and westbound bridges. Work was completed in 1997.

Steel pipe piles support the shallow precast pile caps, which support the shallow 2 ft. 5 in.-deep precast deck panel superstructure. Except for touch-up painting of the steel piles, all work was completed from the top with no activity on the creek bed below.

Contact: Linden Parchment, P.E., Walt Disney World Company, (407) 828-2546.

Advantages at a Glance

- ***Bridge Owner*—For Walt Disney World Companies, using prefabrication resulted in a bridge completed ahead of its construction schedule and under budget.**
- ***Contractor*—Hardaway Construction offered a net cost savings to the bridge owner for accepting the alternate design, and BERGER/ABAM Engineers Inc., responsible for redesign, won a PCI Design Award for innovative use of prefabrication.**
- ***Bridge Users*—For bridge users, prefabrication not only allowed early completion of the bridge but also helped protect Reedy Creek, an important regional environmental resource.**

Totally Prefabricated Bridge—Single-Span Side-by-Side Precast Slab Girders with Precast Abutments and Wingwalls and Steel H Piles

Mitchell Gulch Bridge, Colorado

One bridge 44 ft. long and 44 ft. wide with one span

Originally designed as a three-box culvert, this replacement bridge was built to a value-engineering proposal that provided a totally prefabricated single-span structure. Prefabrication allowed crews to build the bridge in just less than 48 hours—demolition of the old bridge began at 7:30 p.m. on Friday and the new bridge opened to traffic at 5:00 p.m. on Sunday. Completed in 2002, the bridge is on SH86 between Castle Rock and Franktown in Colorado.

It has side-by-side precast slab girders welded onto precast abutments and wingwalls welded to driven-steel H piles. Piles were driven in advance outside the existing bridge. Railing was precast into the outside girders.

Contact: Pamela Hutton, P.E., Colorado Department of Transportation (Colorado DOT), (303) 757-9118.

Advantages at a Glance

- ***Bridge Owner*—For Colorado DOT, use of prefabrication produced a bridge that could be replaced quickly with minimal traffic disruption.**
- ***Contractor*—Their innovative use of prefabrication greatly improved work-zone safety for the crews erecting the bridge, and it won Lawrence Construction Co. and its consultant, Wilson and Company, an Engineering Excellence Award from the American Council of Engineering Companies in Colorado.**
- ***Bridge Users*—For users, prefabrication reduced construction detours from an estimated two-to-three months to less than 48 hours.**

Totally Prefabricated Bridge—Precast Superstructure System with Precast Cap Shells and Precast Piles

Richmond-San Rafael Bridge, California

Two bridges 3,624 ft. and 2,843 ft. long and 44 ft. wide

These 1956 bridges connect Marin and Contra Costa Counties in California. When heavy traffic and exposure to the marine environment necessitated replacement of the existing concrete trestle structures on the same alignments, the California Department of Transportation (Caltrans) selected prefabrication. Allowing two lanes of traffic on both structures at all times during the day, the construction sequence closes one structure for 10 hours maximum at night. Work on the westbound bridge will be completed in Fall 2004, and work on the eastbound bridge will be completed in Spring 2005.

Crews install new cast-in-steel-shelled-drill-hole concrete piles outside the travel lanes of the existing bridge, install new precast prestressed bent cap shells on the piles, and pour concrete and then prestress the caps. Then crews start from the abutment using a barge-mounted crane to sequentially replace the superstructure. Two 50-ft. spans totaling 100 ft. of existing superstructure are lifted out, and a new 500-ton 100-ft. precast span is installed. Crews then install a 25-ft. transition span to close the offset between new and old bents, and by morning traffic is running again. After installing four new spans on successive nights, crews stress them together to make a 400-ft. continuous unit.

Contact: Usen Inyang, P.E., Caltrans, (510) 231-7828.

Advantages at a Glance

- *Bridge Owner*—The use of prefabrication provided Caltrans with a new bridge that meets seismic codes with minimal traffic disruption.
- *Contractor*—By fabricating off site, Tutor Saliba/Koch/Tidewater JV was better able to control quality and safety.
- *Bridge Users*—Prefabrication enabled users to access the bridge constantly, with limited disruption only at night.

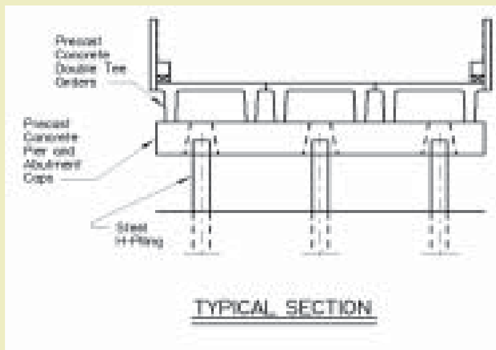
Totally Prefabricated Bridge—Precast Decked Double-Tee Girders with Precast Caps and Steel Piles

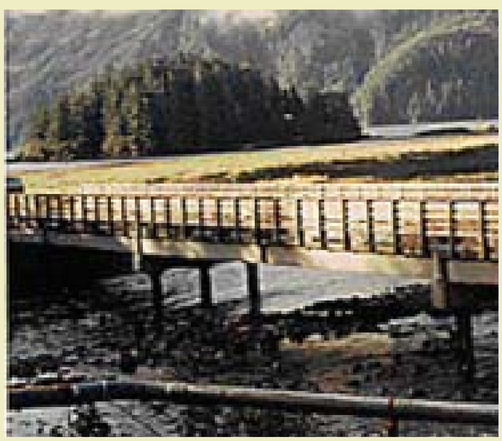
Pelican Creek Bridge, Alaska

One bridge 178 ft. long and 18 ft. wide with three spans

After wash-out flooding and the purchase of a fire truck too heavy for its old timber bridge, a small fishing community on Chicagof Island in southeast Alaska needed a new bridge quickly. Construction requirements included staying out of the sensitive creek bed and completing work within a short time defined by the Department of Fish and Game. All construction was completed in approximately five weeks in 1992.

The Alaska Department of Transportation & Public Facilities (ADOT & PF) chose a totally prefabricated bridge with all material, including rock for the approach fill, barged to the work site. The contractor floated in barges at high tide and anchored them in the creek. Crews drove steel piles from barges, drove a large wheeled crane onto the barges, and then used the crane to install first caps and then decked double-tee girders, post-tensioning the diaphragms. No heavy equipment was lodged in the creek bed.





Contact: Mike Higgs, ADOT & PF, (907) 465-8896.

Advantages at a Glance

- ***Bridge Owner***—Prefabrication provided ADOT & PF with a new bridge with a longer service life and lower maintenance costs, and it facilitated safe construction in a sensitive environment.
- ***Contractor***—Total prefabrication improved constructibility for Trucano Construction crews and reduced labor costs.
- ***Bridge Users***—Residents of the island got a new bridge quickly constructed and strong enough to support their civic vehicles.

Total Superstructure System—Truss Span

Church Street Bridge, Connecticut

One bridge 1,280 ft. long with eight spans including a 320-ft. span, 50 ft. high and 60 ft. wide

The Church Street South Extension project provided a new steel truss bridge over the New Haven Interlocking and Rail Yard, directly linking downtown New Haven and the Long Wharf and waterfront areas. To minimize disruption in the rail yard and improve work-zone safety for a crew working over active rail lines, Connecticut Department of Transportation (ConnDOT) required that this portion of the bridge be completed in a single weekend night. Work was completed in 2003.

The 320-ft. long, 850-ton prefabricated truss center span was constructed over several months next to the active rail lines and then lifted into place on an early Sunday morning in May by a single high-capacity crane owned by Lampson International LLC. The crane lifted the entire truss span 65 ft. and moved it 100 ft. to its final position.

Contact: Larry D'Addio, P.E., ConnDOT, (860) 594-3308.

Advantages at a Glance

- ***Bridge Owner***—Specifying prefabrication saved ConnDOT about a year on its overall contract time and at least $1.1 million.
- ***Contractor***—Prefabrication of the center span greatly improved constructibility for O&G Industries; the center span could not have been built during the limited working hours allowed by the rail yard.
- ***Bridge Users***—Using prefabrication on this project avoided closure of four rail tracks during bridge construction.

Total Superstructure System—Concrete Deck on Steel Girders

Richville Road Bridge, Vermont

One single-span bridge 69 ft. long and 32 ft. 8 in. wide

The superstructure of the Richville Road Bridge in the town of Manchester, Vermont, was in poor condition, but the existing abutments were in good enough shape to be reused with only minimal repairs. The Town limited bridge closure time to 14 days and then chose bridge prefabrication after comparing costs. Work was completed in 2000.

Bridge designers chose total superstructure prefabrication with the Inverset System™ constructed off-site and transported to the site on trucks and lifted into place by a crane. Each of three prefabricated units consisted of two rolled beams with a precast reinforced concrete bridge deck. In place, the three units provided a complete superstructure except for the sheet membrane, paving, curb, and railing. Richville Road was closed for only the specified 14 days.

Contact: Lee Krohn, Town of Manchester, (802) 362-1313.

Advantages at a Glance

- ***Bridge Owner***—**Use of total superstructure prefabrication saved the Town of Manchester approximately $20,000 over conventional construction plus the cost of a temporary bridge.**
- ***Contractor***—**Use of prefabrication enabled Dubois & King, Inc., to meet the Town of Manchester's 14-day closure requirement. In addition, the design firm received the American Consulting Engineers Council of Vermont's 2001 Grand Award for Engineering Excellence in Transportation for design of the bridge.**
- ***Bridge Users***—**Because of the prefabrication, bridge users avoided a lengthy detour with its resulting traffic disruption, travel costs, and time delays.**

Total Superstructure System—Steel Span Replacement

Wells Street Bridge, Illinois

One bridge with three spans (111-ft. center span)

Part of a large project to rebuild Chicago's Wacker Drive involved rebuilding an 1899 steel bridge for the Chicago Transit Authority's (CTA) elevated trains. The original specification required rebuilding the bridge in sections on weekends in one month; however, the bridge owner approved the contractor's value-engineering proposal to pre-build the bridge and then moved it into position over a single weekend. With stiff contractual penalties for any delay ($1,000 per minute), work was completed over a weekend in May 2002 with two hours to spare.

The 425-ton, 111-ft. long and 25-ft. high center-span superstructure was prefabricated. It was constructed near the site and moved on a special hydraulic carrier about 75 ft. west and 5 ft. north, where it was placed on new foundations and connected to two shorter spans on either side.

Contact: Thomas Powers, P.E., Chicago Department of Transportation (Chicago DOT), (312) 744-3591.

Advantages at a Glance

- ***Bridge Owner***—CTA avoided significant disruption to travelers commuting into the city from the north. CTA would have had to provide additional, costly shuttle services.
- ***Contractor***—Prefabrication allowed Walsh Construction to operate in a more controlled environment and to avoid the major shoring effort that would have accompanied rebuilding the existing structure while keeping it open for weekday traffic, thus limiting company liability for financial penalties.
- ***Bridge Users***—The use of prefabrication reduced disruption to vehicle drivers from six months to a single weekend; it reduced disruption to transit users from four to six weekends to a single weekend.

Total Superstructure System—Concrete Span Replacement

I-10/Lake Pontchartrain Bridge, Louisiana

One bridge span 65 ft. long and 46 ft. wide

As part of a project that included construction of several emergency crossovers between existing twin spans, realignment of nine existing spans, and approach slab repairs, the Louisiana Department of Transportation and Development (LADOTD) removed and replaced a 350-ton span. The single span removal and replacement cost 8% of the total project cost. The contract allowed a period of 24 consecutive hours of roadway closure for span removal and replacement under an incentive/disincentive clause. Work was completed in the summer of 2002. With its 7½-inch concrete slab cast on precast prestressed concrete girders, the new span was built on a barge on the north shore of Lake Pontchartrain and then moved to the bridge site.

The crews removed the old span and replaced it with the new one on a single Saturday in much less time than the contract allowed.

Contact: Lynn Marsalone, P.E., LADOTD, (504) 278-7457.

Advantages at a Glance

- ***Bridge Owner*—Prefabrication enabled LADOTD to minimize closure of I-10, the main artery into New Orleans and the Gulf coast with average daily traffic of about 48,000 vehicles.**
- ***Contractor*—Prefabrication enabled Johnson Brothers' Louisiana Team to complete its work on the span in less than 24 hours and earn the maximum $20,000 incentive award.**
- ***Bridge Users*—Prefabrication minimized traffic disruption for users of the bridge. The designated alternate detour for westbound traffic to New Orleans was approximately 100 miles.**

Superstructure—Full-Depth Precast Deck Replacement on Steel Girders

Dead Run and Turkey Run Bridges, Virginia

Four bridges: two 305 ft. long with three spans; two 402 ft. long with four spans

The George Washington Parkway bridges over Dead Run and Turkey Run carry average daily traffic of about 43,000 vehicles, and they needed to be kept open on weekdays during replacement of bridge decks and bridge rail systems. The use of precast deck panels allowed the casting of the panels and attachment of the bridge rail systems off site in sections. They were then transported to the site and erected during weekends. This technique allowed a construction rate for replacement of two spans per weekend, and construction was completed in just 10 weekends, ending in 1998.

Each site consists of twin bridges, each carrying two lanes of traffic and including an 8-in. concrete deck supported on steel beams designed for non-composite action. The non-composite aspect of the original design, along with the use of precast concrete post-tensioned full-depth deck panels, facilitated quick deck replacement and allowed all four lanes of the structures to be kept open during weekday traffic.

Contact: Hala Elgaaly, P.E., Eastern Federal Lands Highway Division (EFLHD), (703) 404-6232.

Advantages at a Glance

- ***Bridge Owner***—For the National Park Service, use of prefabrication meant requirements were met and overall costs associated with preliminary and construction engineering came in under budget.
- ***Contractor***—Work of the Federal Highway Administration's (FHWA) EFLHD and Shirley Construction was recognized with an FHWA Award for Engineering Excellence.
- ***Bridge Users***—For bridge users, prefabricated bridge decks meant no traffic disruption during weekday commutes, and minimal traffic disruption on the weekends.

Superstructure—Full-Depth Precast Deck Replacement on Steel Through Truss

Lewis and Clark Bridge, Washington

One bridge 5,478 ft. long and 34 ft. wide with 34 spans

A joint project by the Oregon and the Washington State Departments of Transportation (WSDOT) to widen and replace the deteriorating deck on this historic 1929 steel through-truss bridge allowed full closures between 9:30 p.m. and 5:30 a.m. for only 120 nights, plus four weekend closures. Alternative plans to replace the bridge deck would have required replacing it lane by lane (four years), full closure of the bridge for several months, or full closure every weekend for six months. Work will be completed by December 2004.

The majority of the existing bridge deck was replaced with precast concrete deck panels made of lightweight concrete with a modified concrete overlay and supported by two longitudinal steel stringers with intermediate transverse stringers. The contractor was able to meet scheduling constraints by using prefabricated deck panels—a large transport device moved the new panel to the top of the bridge, removed the old panel that crews had just cut out, and then lowered the new panel into place before taking the old panel off the bridge. The bridge also used prefabricated widening sections supported by a single longitudinal steel girder. In addition, the project included precast approach slabs.

Contact: Jerry Weigel, P.E., WSDOT, (360) 705-7207.

Advantages at a Glance

- ***Bridge Owner***—Oregon and WSDOT extended the life of the bridge by an estimated 25 years. In addition, prefabrication allowed inspection of the new deck before installation without use of specialized equipment.
- ***Contractor***—For Max J. Kuney Company of Spokane, use of prefabricated elements and systems reduced workers' exposure to traffic during construction and improved the constructibility of the bridge.
- ***Bridge Users***—Use of prefabrication allowed the bridge to remain open for normal weekday operation, particularly important for Port of Longview traffic.

Superstructure—Full-Depth Fiber-Reinforced Polymer Deck Replacement on Steel Through Truss

MD Route 24 over Deer Creek, Maryland

One bridge 122 ½ ft. long and 30 ft. clear roadway width with one span

When the deck needed to be replaced on a steel through-truss bridge in 2001, the Maryland Department of Transportation (Maryland DOT) chose a fiber-reinforced polymer (FRP) deck. The bridge was built in 1934 and is eligible for inclusion in the National Register of Historic Places. The overhead cross connecting members of the through truss impeded installation of deck panels with a crane. However, the FRP panels were light enough to be installed with a forklift. Because the FRP panels can support loads immediately after placement, the forklift could start at one end of the bridge, set a panel, and then move onto that panel to set the next. Work on the new deck was completed in 2001.

The deck panels used an attachment system requiring steel angles to be welded to the sides of stringers to form a haunch. The FRP deck, connections, grout, concrete curbs, and asphalt overlay weigh 70 lbs. per sq. ft. vs. 115 lbs. per sq. ft. for a concrete deck.

Contact: Jeff Robert, P.E., Maryland DOT, (410) 545-8327.

Advantages at a Glance

- ***Bridge Owner*—Use of corrosion-resistant prefabricated FRP deck panels ensures a longer-lasting service life for this replacement structure. Additionally, the weight of the new deck with wearing surface was about 40% less than a conventional deck, resulting in increased live load capacity.**
- ***Contractor*—The light weight of the prefabricated FRP panels improved constructibility for JJID General Contractors.**
- ***Bridge Users*—The easily installed FRP deck panels shortened construction time, making the replacement bridge available to public use more quickly—the bridge was able to accept traffic in 14 days.**

Substructure—Precast Cap on Cast-in-Place Columns

Lake Belton Bridge, Texas

One twin-substructure bridge 3,840 ft. long and 84 ft. wide

Designers selected precast caps to improve work-zone safety and to speed construction for replacement of the SH36 bridge over Lake Belton near Waco, Texas. Lake Belton is an important flood-control resource for the area, and its water level varies as much as 48 ft. Because of uncertainties about performance of underwater precast column joints, designers chose cast-in-place (CIP) concrete for the columns. Requirements included delivering construction materials by water. Work for the first half of the structure was completed in 2004.

The bridge features 62 identical 75-ton precast reinforced concrete hammerhead caps that have some of the highest-moment-demand cap-to-column connections used in Texas. Prefabrication allowed placement of about two caps per week compared with one per week for conventional CIP caps. Prefabrication also allowed the use of higher quality concrete, with fly ash for lower permeability and f'c of 9,000 psi vs. 3,600 psi for conventional CIP concrete. The bridge also uses precast prestressed partial-depth deck panels and precast prestressed U-beams.

Contact: Gregg A. Freeby, P.E., Texas Department of Transportation (TxDOT), (512) 416-2192.

Advantages at a Glance

- ***Bridge Owner***—For TxDOT, using prefabrication provided cap construction speed and the use of higher quality concrete.
- ***Contractor***—For Midwest Foundation Corporation of Illinois, contractor for the work, using prefabrication meant workers had to operate over water half as long, improving worker safety and saving time. In addition, Midwest bought the caps from the fabricator, Bexar Concrete, for plant-controlled quality.
- ***Bridge Users***—Using prefabrication sped construction of these bridges, reducing inconvenience to the traveling public.

American Association of State Highway and Transportation Officials

AASHTO Technology Implementation Group
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