

# Prefabricated Bridges

“ Get in, get out, stay out. ”



AASHTO Technology Implementation Group (TIG)





The American Association of State Highway Transportation Officials (AASHTO) Technology Implementation Group (TIG) was formed in December 2000 to facilitate rapid acceptance and implementation of high-payoff and innovative technologies, and it has selected prefabricated bridge elements and systems as one of its technologies to champion for rapid implementation.

The following pages celebrate the emergence and growth of innovative prefabricated bridge technology and its implementation by forward-looking bridge owners, engineers, and builders. Prefabricated bridge elements and systems improve bridges and bridge building by affording the following advantages:

- Prefabricated elements and systems make bridge building less disruptive to the traveling public.
- Prefabricated elements and systems make bridges safer to build.
- Prefabricated elements and systems make bridge building less disruptive to the environment.
- Prefabricated elements and systems make bridge designs more constructible.

The innovative bridge projects featured in these pages solved site-specific challenges using the following prefabricated elements and systems:

Bent caps, deck panels, stay-in-place deck forms, piling, deck planks, beams of various types, segmental match-cast pier units, concrete and steel composite superstructure units, box pier units, cylinder pile support columns, ramp sections, stair sections, crash walls, and truss spans.

## The bridges and their project contacts are as follows:

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- Keaiwa Stream Bridge—State of Hawaii Department of Transportation: Paul Santo, P.E.; [paul\\_santo@exec.state.hi.us](mailto:paul_santo@exec.state.hi.us); (808) 692-7611.
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- Highway 47 over Seelye Brook—Minnesota Department of Transportation: Paul Kivisto, P.E.; [paul.kivisto@dot.state.mn.us](mailto:paul.kivisto@dot.state.mn.us); (651) 747-2130.
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- SH 66/Lake Ray Hubbard Bridge—Texas Department of Transportation: Lloyd M. Wolf, P.E.; [lwolf@dot.state.tx.us](mailto:lwolf@dot.state.tx.us); (512) 416-2279.
- Wesley Street Bridge—Texas Department of Transportation: Steven Hall, P.E.; [shall3@dot.state.tx.us](mailto:shall3@dot.state.tx.us); (903) 586-9878.
- I-65/I-59 Interchange—Alabama Department of Transportation: Fred Conway, P.E.; [conwayf@dot.state.al.us](mailto:conwayf@dot.state.al.us); (334) 242-6007.
- I-95/Chester Street Bridge—Pennsylvania Department of Transportation: R. Scott Christie, P.E.; [schrist@dot.state.pa.us](mailto:schrist@dot.state.pa.us); (717) 787-2881.



## I-95/James River Bridge, Virginia

Used preconstructed composite units consisting of precast 8-3/4-inch deck over steel plate girders.

Minimized traffic disruption by facilitating replacement of the bridge superstructure without ever closing the highway to rush hour traffic.

**M**inimal impact on motorists was a project goal for replacement of the superstructure of the I-95/James River Bridge, which



carries approximately 110,000 vehicles per day through the city

of Richmond. After considering alternatives, the Virginia Department of Transportation opted for night-only construction, most of which occurred between 7 PM and 6 AM Sunday through Thursday nights. During nighttime construction, one lane of traffic was kept open in each direction. For most spans, bridge preconstructed composite units (PCU's), which include an 8-3/4-inch deck over steel plate girders, were precast at a nearby casting yard and then transported to the work site. Work crews cut out the old bridge span and removed it, prepared the gap for the new PCU, and set the new PCU in place.

## Route 7 over Route 50, Virginia

Used lightweight precast deck panels.

Minimized traffic disruption by reducing construction time, and minimized equipment needed and dead load on the existing structure.

**R**eplacement of the Route 7 over Route 50 bridges in Fairfax County required Virginia DOT to replace approximately 14,000 square feet of

deteriorating bridge deck.

Virginia DOT opted to use precast deck panels to satisfy community concerns about reductions in the level of service. Operating only at night, crews saw-cut sections of the existing deck, lifted and removed them by crane, and immediately

installed new deck panels that matched the deck cavity. They then placed a rapid-setting concrete overlay that supported full traffic after only three hours of curing. The bridge was completely open to traffic during the day.

## George P. Coleman Bridge, Virginia

In 1995, the largest double-swing bridge in the United States was dismantled and replaced in record time. A major goal was limiting bridge closure to avoid disrupting traffic of more than 27,000 vehicles a day. Lighter-weight modern materials allowed Virginia DOT designers to widen the new bridge but use the existing foundation. While approach spans were widened, truss spans were prefabricated nearby and then barged to the construction site.

Used prefabricated steel truss spans.

Minimized traffic disruption by constructing truss spans off-site and then barging them into place.

Six old spans were removed and six new ones placed in only nine days.





## Route 57 over Wolf River Bridge, Tennessee

Used precast bent caps, precast prestressed concrete stay-in-place deck forms, precast prestressed I-beams, and steel pipe piles.

Minimized environmental disruption by eliminating the need to place equipment in surrounding wetlands, and minimized traffic disruption of an important east-west corridor.

The Wolf River Bridge in Fayette County, Tennessee, crosses sensitive wetlands and carries the only east-west route through its



geographic region. For the 20-span replacement bridge, the Tennessee Department of Transportation chose staged construction, maintaining one lane of traffic with timed signals. TDOT designers selected precast prestressed beams to facilitate speedy construction and allowed optional stay-in-place precast prestressed concrete deck forms. TDOT and the contractor

developed details for precasting bent caps in two pieces to suit staged construction. Construction of the 1,408-foot long, 46-foot wide bridge was completed in 11 months without putting any equipment in the surrounding wetlands.

## Keaiwa Stream Bridge, Hawaii

A record rainstorm in late 2000 caused major damage to the only route on the southeast side of the Big Island of Hawaii. The State of Hawaii Department of Transportation chose to replace the 80-foot Route 11 bridge near Pahala with a longer structure to prevent future damage from flooding. The new 7-span, 230-foot concrete bridge, using precast prestressed concrete planks on wall piers,

Used 4-foot-wide by 11-inch-thick precast prestressed concrete planks.

Minimized environmental disruption because deck topping did not require shoring or falsework in the streambed, and minimized traffic disruption because precast planks were fabricated during pier construction.

with cast-in-place concrete topping, was in operation within seven months.



## Cross Westchester Expressway Viaducts, New York

Used precast segmental match-cast pier units, precast longitudinally post-tensioned decks, and steel tub girders.

Minimized traffic disruption by reducing construction time from 34 to 26 months.

**R**equired to maintain six lanes of congested traffic and limit



construction on a restricted site during replacement of two major I-287 viaducts in Westchester County, the New

York State Department of Transportation accepted the contractor's value-engineering proposal to incorporate precast segmental voided pier sections for each of the 42 piers, which consisted of 8-foot match-cast segments vertically post-tensioned together and to the footings. It also changed the cast-in-place deck to 10-foot-long by 9-inch-thick precast panels, 42 to 50 feet wide to match longitudinal construction stages, supported on pairs of multi-span continuous steel tub girders.

## Main Street over Metro North Railroad, New York

Used precast prestressed concrete and steel composite superstructure units.

Improved constructibility by allowing staged construction over a busy commuter railroad.

**R**eplacement of a through-girder bridge over a busy commuter railroad in the village of Tuckahoe presented challenges for

NYSDOT: maintaining 2-way traffic, conducting all work between 2 and 4 AM on weekends to limit disruptions for rail commuters and adjacent stores, maintaining utility lines while relocating them on the new bridge, and raising the railroad vertical clearance five inches without materially affecting the street



profile. NYSDOT chose a proprietary system of precast prestressed concrete/steel composite superstructure modules that allowed for

smaller beams than conventional construction, which helped attain the increased vertical clearance and had a short installation time.

## Route 9/Metro North Pedestrian Bridge, New York

**B**uilding a pedestrian bridge in the village of Croton-on-the-Hudson involved site restrictions, a requirement for aesthetic design, and the need to limit disruption on a heavily traveled highway and a major commuter railroad. NYSDOT chose two proprietary prefabricated composite superstructure spans with concrete parapets to bridge the 4-lane highway, service road, and five sets of railroad tracks. Twelve-inch diameter precast piles support 3-section piers made of precast boxes stacked vertically and post-tensioned to a cast-in-place



Used precast prestressed concrete/steel superstructure units, precast box pier units, precast prestressed cylinder piles, precast ramp sections, precast stair sections, and precast crash walls.

Improved constructibility and minimized traffic disruption by reducing the staging area required and the construction time.

concrete footing, with precast parapets and a cast-in-place deck. Ramps are 35-foot-long precast concrete units and 20-foot precast stair sections, supported directly on precast columns with cast-in-place seats. Precast concrete's many available architectural treatments enabled meeting project aesthetic goals.

## I-5/South 38<sup>th</sup> Street Interchange, Washington

Used precast stay-in-place deck panels and precast post-tensioned tub girders.

Minimized traffic disruption by reducing construction time.

To reduce construction time and minimize traffic disruption, the Washington State Department of Transportation chose precast stay-in-place deck panels in the design of this 2-span, 325-foot replacement bridge over I-5 in Tacoma. The new

post-tensioned box girder bridge uses precast tub girder segments. With no need to construct and remove conventional deck forms, lane closures on I-5 were greatly reduced. Leveling screws were used to adjust camber on the 3-½-inch-thick precast pretensioned panels, and all 766 panels were placed within a week of limited nighttime I-5 lane closures.



## Highway 47 over Seelye Brook, Minnesota

This bridge replacement project required a shallow structure that was durable, economical, and quick to construct because no detour route was available.

The Minnesota Department of Transportation opted for a low depth, rectangular precast beam system because the cast-in-place deck option would have required falsework below the structure that would have been susceptible to flood waters. The bridge has a 51-foot beam span, and the 9-inch deck



Used precast prestressed solid rectangular beams.

Minimized traffic disruption by reducing the time needed to construct falsework for the cast-in-place deck.

is supported by the solid rectangular prestressed beams. Because the beams were shallower than the deeper I-shaped sections, they also eliminated the need to raise the existing profile grade and satisfied

hydraulic and right-of-way constraints for the project.

## I-45/Pierce Elevated, Texas

Used precast bent caps, precast prestressed deck panels, and precast prestressed I-beams.

Minimized traffic disruption, reducing construction time from an estimated one and a half years to 190 days, with user delay costs estimated at \$100,000 a day.

When two 113-span sections of I-45 in Houston's central business district needed replacing, Texas Department of Transportation



designers opted to speed construction by using precast bent caps on the existing columns. The bridge consists of twin structures, one northbound and one southbound, and each structure was completed in 95 days, a total of 226 spans

replaced in 190 days. To connect the precast caps to the existing columns, the precast caps were anchored with post-tensioning bars and hardware.

## SH 66/Lake Ray Hubbard, Texas

Used precast bent caps, precast prestressed deck panels, and precast prestressed I-beams.

Increased work-zone safety by eliminating the need for a barge crane, reducing work time near power lines and over water (80% of work on caps was done on the ground).

After 40 years of service, the narrow crossing of SH 66 over Lake Ray Hubbard was congested with commuters from suburbs east of Dallas. A replacement project to construct a pair of conventional

prestressed concrete I-beam bridges changed after letting when the contractor asked to precast the substructure bent caps to eliminate the need for a barge crane, reducing time workers needed to operate near power lines. TxDOT designed a precast bent cap option with a cap-to-column connection and a

construction procedure allowing early placement of caps and prestressed beams based on achieved cap concrete and cap grout connection strength. Using 43 precast bent caps saved nearly a week per cap on tasks associated with formwork, reinforcement, casting, curing, and inspection.

## Wesley Street Bridge, Texas

One of only two routes into or out of a populated housing community, Wesley Street crosses Ragsdale Creek in Jacksonville, Texas. When the bridge required replacement, TxDOT opted for accelerated construction using precast

Used precast prestressed slab beams.

Minimized traffic disruption, reducing inconvenience to local commuters.



prestressed slab beams. Work on the project began in October 2001 and was completed in January 2002.



## I-65/I-59 Interchange, Alabama

Used precast prestressed bulb tee beams.

Minimized traffic disruption by reducing construction time and limiting lane closures.

When a fuel truck collision damaged a Birmingham bridge in the I-65/I-59 interchange in January 2002, the Alabama Department of Transportation opted for a wider replacement bridge with a longer span over the northbound lanes of I-65, the main north-south

route through Alabama. The interchange carries an estimated 100,000 vehicles per day, and the bridge needed to be replaced quickly. For the 140-foot main span and the 75-foot approaches, the contractor proposed a value-engineering girder re-design using bulb tee beams with a 14-day strength of 8,000 psi. Traffic was stopped for only 12 nighttime hours to set the 15 girders on the 140-foot span overhead. Construction was completed in just 37 days.

## I-95/Chester Creek Bridge, Pennsylvania

Used steel plate girders.

Minimized traffic disruption by rapid bridge replacement.

On Memorial Day weekend in 1998, a fuel truck caught fire, closing this 358-foot long, 3-span continuous bridge. Severe sagging

required the Pennsylvania Department of Transportation to replace approximately two-thirds of the superstructure. Shop drawings of the original girders were available, facilitating immediate material order and fabrication. New girders were delivered within two weeks of the fire, and the bridge was open by July 4th.

# American Association of State Highway and Transportation Officials

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## Photo Credits

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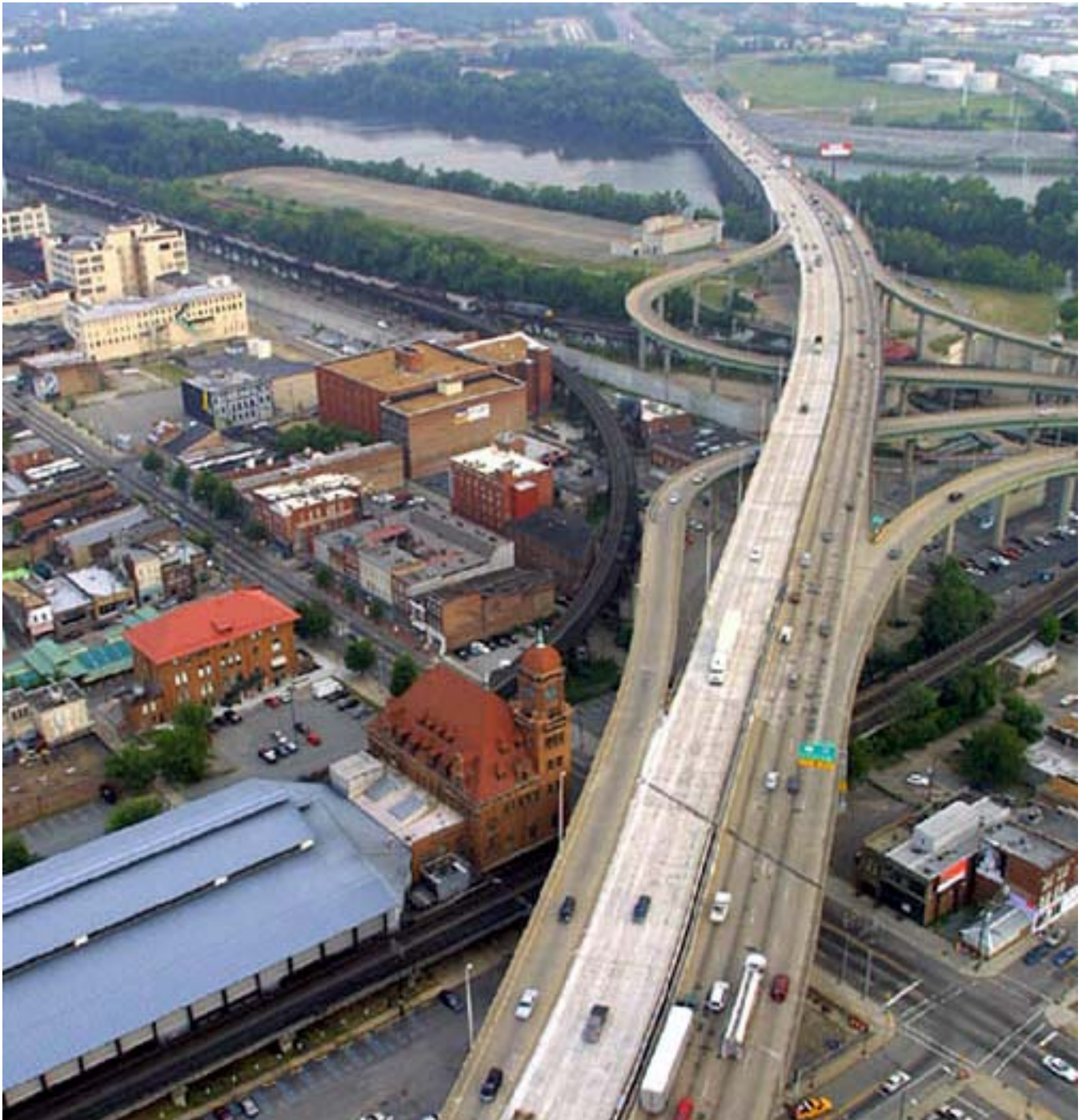
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