*Supplement to ASPIRE™*

Precast/Prestressed Concrete Institute

# The 2009 PCI **Bridge Design** Awards

## The Search for Excellence



# Winning Designs

## The 2009 PCI Design Award winners once again prove that precast concrete can meet the structural, aesthetic, scheduling, and budgetary goals of project owners.

The 47th annual Design Awards Competition sponsored by PCI drew projects from across the industry, showcasing the ways that precast concrete has become an indispensible option in the quest to build exceptional structures across America. The award winners comprise an array of complex projects, including several bridges soaring over high-traffic interchanges and environmentally delicate waterways.

Seven projects won awards in a variety of categories. The judges also conferred the Harry H. Edwards Industry Advancement Award.

The following pages showcase the bridge projects selected by the bridges and special awards juries. The honors will be presented to representatives of each project during PCI's 55th Annual Convention and Exhibition and National Bridge Conference September 12–15, 2009, in San Antonio, Tex., at the Marriott Rivercenter and Henry B. Gonzalez Convention Center.



Courtesy of Paul Grigonis.

**Bridges jury (from left)**

**Jim Guarre, P.E.**
Senior Vice President
BergerABAM Inc.
Federal Way, Wash.

**Myint Lwin, P.E., S.E.**
Director of the Office of Bridge Technology
Federal Highway Administration
Washington, D.C.

**Mark Richardson, P.E.**
Bridge Design Bureau Administrator
New Hampshire Department of Transportation
Concord, N.H.

Courtesy of Paul Grigonis.

**Special awards jury (from left)**

**Roger Becker, P.E., S.E.**
Precast Division Vice President
The Spancrete Group, Inc.
Waukesha, Wisc.

**Doug Widener, LEED AP**
Chicago Chapter Executive Director
U.S. Green Building Council (USGBC)
Chicago, Ill.

**David P. Nasser, P.E.**
Texas Office Vice President
The Consulting Engineers Group, Inc.
San Antonio, Tex.

Owner
Colorado Department of Transportation, Denver, Colo.

Bridge Engineer of Record
Summit Engineering Group Inc., Littleton, Colo.

Project Engineer of Record
CH2M Hill, Englewood, Colo.

Contractor
Ames Construction Inc., Aurora, Colo.

Precaster
Encon Bridge Co. LLC, Denver

Design Check
Max Condiotti, Longmont, Colo.

# Harry H. Edwards Industry Advancement Award

# SH 58, Ramp A Flyover Bridge

## Golden, Colo.

*"This project represents the latest state of the art in the use of curved precast bridge girders on a … public transportation project."*

*—Gregg Reese, engineer*

The sweeping 2115-ft-(645 m)-long Ramp A Flyover Bridge on Interstate 70 (I-70) in Golden, Colo., showcases the beauty, functionality, and economy of using precast concrete for complex, long-span bridges. The $30 million project was the fifth bridge in Colorado to use curved, precast concrete girder construction and has the longest span using constant-depth, precast concrete U-girder construction in the state.

"This project represents the latest state of the art in the use of curved precast bridge girders on a … public transportation project," says engineer Gregg Reese of Summit Engineering Group Inc. in Littleton, Colo. "The bridge utilizes a number of innovations that demonstrate the flexibility inherent in the use of precast U-girders."

The new structure uses a constant, 38-ft-wide (12 m) cross section comprising one lane and two large shoulders along its length. The layout includes a four-span unit to cross over I-70 and two three-span units to bring the roadway back to grade. Bridge spans vary from 147 ft to 235 ft (45 m to 72 m) in length.

The bridge begins in a spiral curve with an 809 ft (247 m) horizontal curve at the center of the bridge deck. All curved girders were plant manufactured, and curved formwork was designed with discreet panels with break points at each end that could be adjusted to provide the necessary curvature. The curved girders were manufactured with conventional reinforcment and small quantities of monostrand post-tensioning to control stresses when the girders were removed from the casting beds.

The girders were erected in three phases and were braced during erection with double angles that were field welded to the falsework to prevent rolling. Conventional hydraulic and crawler cranes were used to set the girders.

"This project clearly demonstrates the advantages of using commercially [available] precast concrete products to construct cost-effective, complex long-span structures in high-profile applications where aesthetics and urban geometrics are significant design considerations," Reese says.

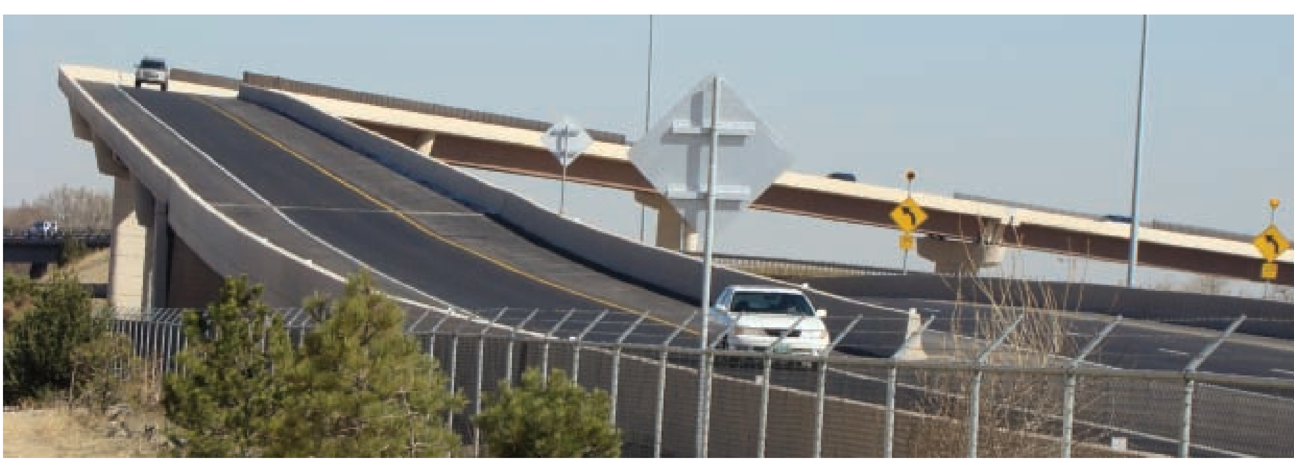

Photo courtesy of Summit Engineering Group Inc.



## JUDGES' COMMENTS

*This project was a unique application of precast, prestressed bridge elements to a flyover ramp where the U-shaped sections were curved, and in fact this is a terrific direction that precast concrete ought to be going to challenge the steel people in the marketplace: a marketplace where precast concrete hasn't been before. The thing that really caught my eye on this project was the fact that the girders were curved and all of the potential issues with curved elements were resolved, that the structure could be constructed economically, and that it became a very viable solution in precast, prestressed concrete.*

# Best Bridge with Spans Less than 75 ft, Co-winner

# The Jakway Park Bridge

## Buchanan County, Iowa

**Owner**
Buchanan County Secondary Roads, Buchanan County, Iowa

**Engineer of Record**
Iowa Department of Transportation, Ames, Iowa

**Contractor**
Taylor Construction Inc., New Vienna, Iowa

**Precaster**
Lafarge North America, Winnipeg, MB, Canada

**Project Cost**
$600,000

*Because shear stresses were taken up by the UHPC, which contained steel fibers, no conventional steel reinforcing bars were required.*

Photo courtesy of Iowa Department of Transportation.

The Jakway Park Bridge in Buchanan County, Iowa, is the first highway bridge in North America to be built with a new generation of ultra-high performance concrete (UHPC) pi girders, as well as being the first to incorporate UHPC batching in ready-mix trucks, establishing it as a model for bridge designs around the world.

UHPC provides compressive strengths up to 30,000 psi (210 MPa) and flexural strengths up to 6000 psi (42 MPa), as well as ductility, durability, and a range of aesthetic design possibilities.

The bridge is 112 ft long × 25 ft wide (34 m × 7.6 m) and was built using cast-in-place concrete slabs for the end spans and a center span consisting of three precast concrete pi-shaped girders. Because shear stresses were taken up by the UHPC, which contained steel fibers, no conventional steel reinforcing bars were required. The material's low permeability also makes the structure resistant to deicing salts and harsh environmental conditions.

The center span is 51 ft long (16 m) from center to center of the pier caps, and the girders are pretensioned longitudinally and tied together transversely with mild-steel reinforcement and steel diaphragms. A concrete bucket, which was almost as wide as the pi-shaped forms, was used to place the material in a way that would allow it to flow and properly align the fibers at the same time.

Once the pi girders were in place at the bridge site, cast-in-place concrete end diaphragms were used to encase the beam ends and tie the girders together at the pier. Total cost for the project was $600,000.

"This important, collaborative project provided the opportunity to gain additional experience in the designing, testing, mixing, and casting of UHPC in this first-ever use of the material in the FHWA-developed pi girder," says Norm McDonald, bridge engineer for the Iowa Department of Transportation in Ames, Iowa.

TA

## JUDGES' COMMENTS

*This ultra-high-performance concrete project is a good demonstration of the use of an emerging technology for expanding the application of precast, prestressed concrete to improve durability, reduce weight, and increase speed in construction. This project pushes the envelope of design by utilizing an ultra-high-performance concrete member that provides a very economical section for the project and has a variety of applications for future projects.*

Owner
County of Lancaster, Lancaster, Pa.

Engineer of Record
RETTEW Associates Inc., Lancaster

Contractor
Kinsley Construction Inc., York, Pa.

Precaster
Newcrete Products, Roaring Spring, Pa.

Precaster Specialty Engineer
Pennoni Associates, State College, Pa.

# Best Bridge with Spans Less than 75 ft, Co-winner

# Big Chickies No. 2 Bridge over Chiques Creek

# Lancaster, Pa.

*No temporary formwork or scaffolding was placed in the creek during the construction of the new bridge, which saved the contractor time and money.*

Photo courtesy of Kinsley Construction.

The engineers who designed the replacement for the two-lane Big Chickies No. 2 Bridge over Big Chiques Creek, in Lancaster, Pa., chose a precast concrete solution to mimic the distinctive architectural features of the original 1920s design, but with a more durable structure that could sustain greater loads, minimize flooding, and increase sight lines for safety.

The new bridge, which opened December 2008, features precast concrete tied-through arches and a cast-in-place concrete deck that replicates the graceful appearance of the original. The engineer lengthened the bridge to a 70 ft (20 m) span to facilitate hydraulic improvements and to minimize the frequency of floodwater overtopping the road.

The massive arches were cast in the manufacturer's plant and were then erected in a single-night operation in the field.

During fabrication of the arches, the team used 1/16 in. (2 mm) form tolerances measured with a transit so that the enormous amount of reinforcement and post-tensioning steel would fit in the forms and meet clearance and cover requirements. The fabricator used additional reinforcement and temporary post-tensioning in the arches to accommodate handling forces, which permitted the arches to be safely transported from their plant to the jobsite. No temporary formwork or scaffolding was placed in the creek during the construction of the new bridge, which saved the contractor time and money. A 22-in.-thick (560 mm) deck spanning the distance between arches eliminated the need for embedded steel floor beams.

"While the design team faced numerous design challenges with the bridge replacement project, the team's efforts resulted in a bridge that pays homage to the original structure and the historic setting in which it is located," says senior bridge engineer Dan Rogers.

TA

## JUDGES' COMMENTS

*Precast concrete provides an excellent solution for the replacement of a historic bridge.*

# Best Bridge with Spans between 75 and 150 feet

# Route 70 over Manasquan River, September 11 Memorial Bridge

## Ocean and Monmouth Counties, N.J.

Photo courtesy of Eric Yermack, P.E.

*The bridge was designated a memorial to the 170 people from Monmouth and Ocean counties who died in the September 11 terrorist attacks.*

### Owner
New Jersey Department of Transportation
Trenton, N.J.

### Architect
HZLZ LLP
New York, N.Y.

### Engineer of Record
Arora and Associates PC
Lawrenceville, N.J.

### Contractor
George Harms Construction Co. Inc.
Farmingdale, N.J.

### Precaster
Northeast Prestressed Products LLC
Cressona, N.J.

### Project Cost
$65 million

TB

Developers of the $65 million project to replace a structurally deficient 70-year-old movable bridge over the Manasquan River in New Jersey faced many aesthetic, structural, and environmental challenges.

Along with creating a gateway to Monmouth and Ocean counties, the bridge was designated a memorial to the 170 people from those counties who died in the September 11, 2001 terrorist attacks, which meant careful attention had to be paid to every architectural detail. Developers were also required to work around migrating and spawning fish runs, which limited in-water construction to six months out of the year.

Choosing a precast concrete design enabled the project team to overcome many of these challenges while creating a beautiful and functional bridge that meets the needs of the community and the environment.

The 724-ft-long (221 m) bridge features twin structures, each with two three-span continuous superstructure units comprising 120-ft-long (37 m) bulb-tee girders spaced at 8 ft (2.4 m) on center.

The original bridge's substandard 15 ft (4.6 m) vertical underclearance was raised to 25 ft (7.6 m), and the navigation channel was widened from 50 ft to 75 ft (15 m to 23 m). The resulting span arrangement and geometry allowed the first half of the bridge to be constructed next to the existing bridge foundations without any traffic disruption.

The superstructure is supported on stub abutments behind mechanically stabilized earth walls and five in-water piers with deep foundations. The architecturally treated pier columns and caps were constructed using precast concrete components connected through post-tensioning. The pier foundations were constructed at the waterline within precast concrete cofferdam shells, which offered significant cost and schedule advantages over traditional cofferdams.

"Using precast [concrete] eliminated the need for traditional cofferdams, minimized riverbed disturbances, and facilitated the construction of a high-quality signature bridge 25 months ahead of schedule," says project manager Eric Yermack of Arora and Associates in Lawrenceville, N. J.

## JUDGES' COMMENTS

*The thing that caught our eye on this project was really the extensive use of precast concrete in the cofferdams, in the piers, the caps, and the bridge superstructure. The use of precast concrete shortened the construction time by 25 months. Another thing was the use of an innovative diaphragm between superstructure elements, which really was borrowed from other states.*

# Best Bridge with Spans More than 150 ft
# Angeles Crest Bridge No. 1
# Wrightwood, Calif.

**Owner**
California Department of Transportation
Sacramento, Calif.

**Engineer of Record**
California Department of Transportation
Sacramento

**Contractor**
Griffith Co.
Brea, Calif.

**Precaster**
Pomeroy
Perris, Calif.

*"The modular nature of the precast girders proved to be key to the success of this project." —Jose Higareda, project engineer*

After a landslide closed the main highway linking a resort town near Wrightwood, Calif., to the major metropolitan area, the California Department of Transportation (Caltrans) wrestled with various solutions to reopen the pass. The side of the mountain continued to slump more than 500 ft (150 m) to the valley floor, and the landslide was active. Efforts to stabilize the mass of rock were ineffective, which made it necessary to place abutments on stable soil comfortably outside the slide limits. This decision meant that the bridge span would reach more than 200 ft (60 m).

A cast-in-place (CIP) concrete option was eliminated because falsework could not be placed on the sliding mass, and steel was not used because of its cost and six-month delivery schedule. After careful consideration, an 8-ft-deep (2.4 m) and 4-ft-wide (1.2m), spliced, precast concrete bulb-tee-girder design was selected.

Due to the narrow mountain roads, the girder had to be fabricated in pieces short enough to maneuver the two-lane road that leads to the site. The 208-ft-long (63 m) girder was divided into three pieces: two 56-ft-long (17 m) end sections that house the post-tensioning anchorages, and one 92-ft-long (28 m) center section with a 2-ft-long (0.6 m) CIP concrete closure pour between the segments.

Because girders of this size can become laterally unstable when subjected to cross slopes that place the center of mass of the girder offset from the support, special hauling rigs equipped with hydraulics were used to adjust for the superelevation and maintain the girder in a vertical position.

Special bearing seats were built into the ends of the girders to accommodate the 5.3% profile grade and reduce the bearing-pad thickness.

"The modular nature of the precast girders proved to be key to the success of this project," says Jose Higareda, project engineer for Caltrans.

## JUDGES' COMMENTS

*Precast concrete was used to create a bridge that was almost truly invisible in this beautiful landscape. Three large precast concrete segments were transported to the site up a very steep mountainous road, assembled into a continuous 208-ft-long girder, and then erected over this landslide. It was the mission of this bridge.*

TC

Photo courtesy of Pomeroy.

# Best Non-highway Bridge, Co-winner

# David Kreitzer Lake Hodges Bicycle/Pedestrian Bridge

# San Diego, Calif.

TE

**Owner**
San Dieguito River Park
Escondido, Calif.

**Engineer of Record**
T. Y. Lin International
San Diego, Calif.

**Contractor**
Flatiron Construction Corp.
San Marcos, Calif.

**Precaster**
U.S. Concrete Inc.
San Diego

**Additional Team Members**
Safdie Rabines Architects
San Diego

*"Without precast prestressed concrete, this bridge would not have been possible." —Anthony Sánchez, senior bridge engineer*

Photo courtesy of Mark Defeo.

The 1000-ft-long (300 m) David Kreitzer Lake Hodges Bicycle/Pedestrian Bridge in San Diego, Calif., is the world's longest stress-ribbon bridge. The stress-ribbon style, which is a suspension bridge with cables embedded in an ultrathin concrete deck, was chosen because it causes minimal disruption to the local ecology and blends naturally into the surroundings, all thanks to the strength and versatility of precast concrete.

"The choice to use an innovative stress-ribbon design was only possible by means of precast, prestressed concrete technology," says senior bridge engineer Anthony Sánchez of T. Y. Lin International in San Diego, Calif.

Erecting the bridge also had its challenges. The design required complex analytical methods to capture the nonlinear behavior of the cable system and the time-dependent effects from concrete creep and shrinkage, as well as staged construction analysis to capture the stresses that are locked in as the bridge is constructed.

Due to its location in an environmentally sensitive area, access to the construction site was only allowed during winter months.

The use of precast concrete enabled the project team to accommodate the limited construction schedule and minimize environmental impacts. Because the superstructure was constructed of precast concrete panels suspended on cables, it was erected quickly with no need for falsework.

Post-tensioning of the precast concrete deck panels closed the transverse joints and gave the bridge its required stiffness for live loads. The visual impact was minimized through the use of a slender 16-in.-thick (410 mm) deck and 330-ft-long (100 m) spans and only two piers.

"By using this specialized form of precast, prestressed concrete, [we] were able to design a bridge that could span the required distance with an amazingly thin deck and only two supports in the lake," Sánchez says. "Without precast prestressed concrete, this bridge would not have been possible."

## JUDGES' COMMENTS

*Its use of precast concrete panels in this stress-ribbon bridge provided a very slender, elegant structure. The solution used resulted in minimal harm to the environment.*

Owner
Sound Transit Authority
Seattle, Wash.

Project Engineer of Record
Hatch Mott McDonald
Millburn, N.J.

Bridge Engineer of Record
International Bridge Technologies Inc.
San Diego, Calif.

Contractor
PCL Construction Services
Bellevue, Wash.

Contractor's Specialty Engineer
T.Y. Lin Intenational
Olympia, Wash.

Precaster
Bethlehem Construction Inc.
Cashmere, Wash.

# Best Non-highway Bridge, Co-winner

# Seattle Sound Transit Tukwila Segment Light Rail

## Seattle, Wash.

TE

The Seattle Sound Transit Tukwila Segment is a 4.9-mi-long (8 km) light-rail bridge in Seattle, Wash., that provides the final link in a 20-mi-long (32 km) mass-transit system known as the Sound Transit Central Link Light Rail.

The project was the last phase in an effort to connect the southern limit of the city to the Sea-Tac airport, but the project faced significant challenges to completion, including limited access to the project site, long-span crossings over major thoroughfares, environmental concerns, and seismic activity.

"Using precast concrete offered solutions to all of these challenges," says Christopher Hall, guideway engineer for International Bridge Technologies Inc. in San Diego, Calif.

The use of precast concrete with a design compressive strength of 6500 psi (45 MPa) allowed the dimensions of the box girder to be streamlined, delivering a lighter guideway and reducing seismic loads. External diaphragms at the ends of the span provided a wider bearing spacing to add stability, and the bottom face of the diaphragm was adjustable and set to the proper grade and cross-fall in the precast concrete manufacturer's yard so that only minor adjustments were needed when the span seated on the bearings.

This precast concrete segmental box-girder design resulted in a $20 million savings on the project and accelerated the original construction schedule by six months.

Space and scheduling challenges were further addressed by limiting span lengths to increments of individual precast concrete segments and by using a standard curved vertical profile on long-span structures.

Precasting of superstructure segments took place in parallel with foundation and pier construction operations, and a single erection gantry was used to place most of the superstructure segments at a rapid pace, including periods where three spans were constructed within a week.

"Erecting from the top also eliminated many access issues associated with ground-based cranes or falsework and minimized impact to traffic and the environment," Hall says.

## JUDGES' COMMENTS

*The application of precast concrete sections demonstrates the versatility of this type of construction in meeting the needs of many projects. The segmental construction allows the aesthetics of the project to be easily demonstrated with a slender structure that meets the horizontal and vertical alignment constraints of the project.*

*This precast concrete segmental box-girder design resulted in a $20 million savings on the project and accelerated the original construction schedule by six months.*

Photo courtesy of International Bridge Technologies Inc.

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