Reducing Risk

American Structurepoint's attention to detail and design techniques help ensure bridges are constructed quickly and provide long life

by Craig A. Shutt

American Structurepoint in Indianapolis, Ind., has become well-known to officials at the Indiana Department of Transportation (INDOT) and other clients state-wide, as well as many in Ohio after it opened its Columbus office 10 years ago. Having just celebrated its 45th anniversary in 2011, the firm looks to build on its strong reputation for designing innovative concrete bridges that stand the test of time.

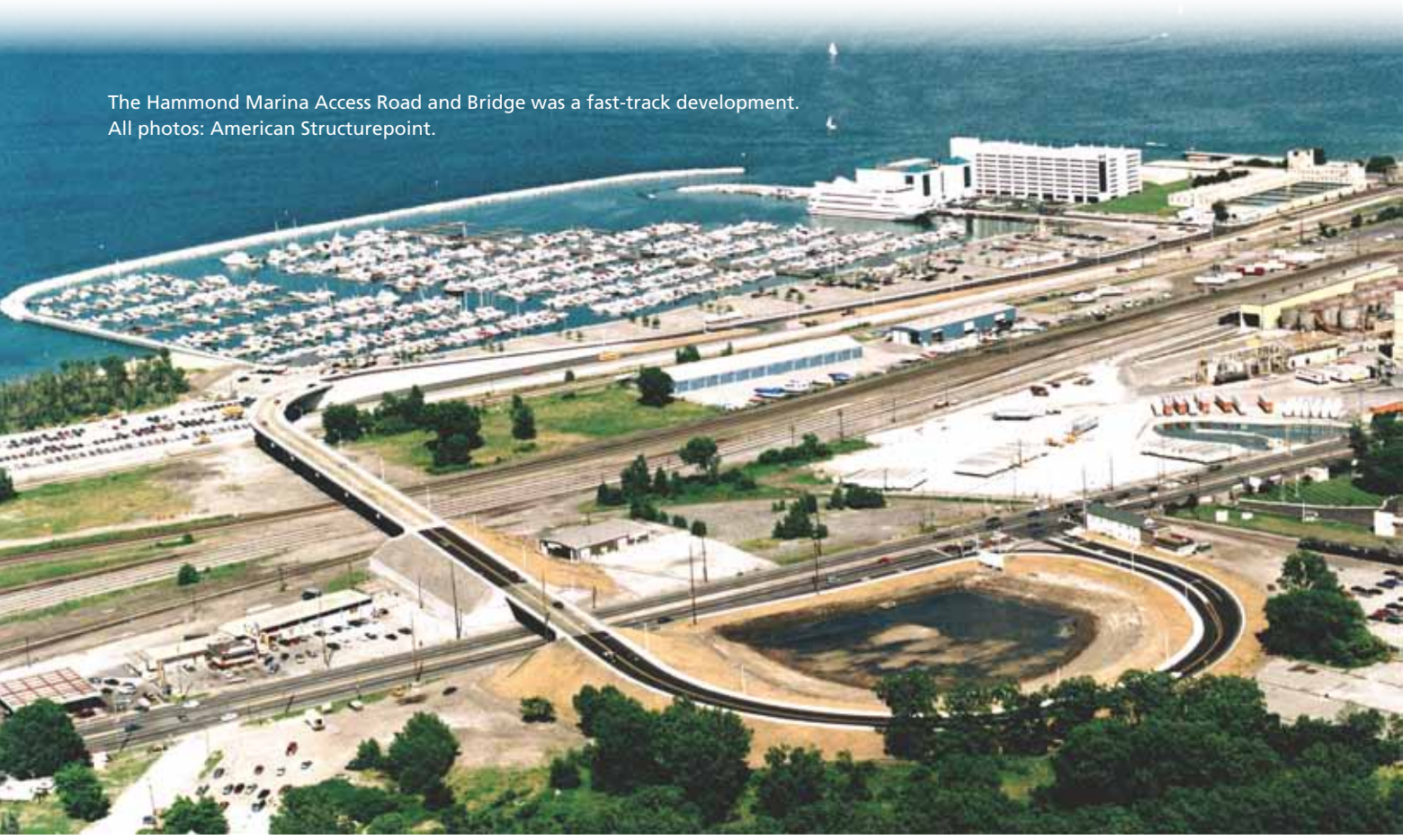
"I think our clients agree that the quality of our work surpasses that of our competition," says Mike Wenning, manager and chief bridge engineer for the Bridge Transportation Group. "Our plans are well thought through, and contractors tell us they require fewer contingencies with our designs. That's a great compliment."

The firm often works in design-build partnerships, taking advantage of its focuses on constructability, design speed, and responsiveness. "Some of the bridges being built today are constructed in amazing times. With design-build processes, speed is of the essence every step of the way." The company also works in other delivery methods, often with the focus on constructing bridges as quickly as possible.

Fast-Track Marina

An example of the company's fast-track is illustrated by the Hammond Marina Access Road and Bridge, which was developed for Lake County, Ind., and the city of Hammond. The award-winning project included 1.1 miles of road and bridges featuring cast-in-place prestressed concrete bulb tees over 13 rail lines to provide access to the marina, casino, water works, and a county park.

"The casino was concerned about completing the project on time, so there was a penalty clause of $1 million per day," Wenning explains. That required plans to be completed in a short timeframe so construction could begin quickly—in the dead of winter. "The snow was flying all around as the contractor was working with the heated forms to build piers."



The Hammond Marina Access Road and Bridge was a fast-track development. All photos: American Structurepoint.

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The Keystone Parkway Corridor consists of six intersections that eliminated congestion and lowered emissions while easing access between residential and commercial areas.

An even more ambitious fast-track project was undertaken at the Keystone Parkway Corridor in Carmel, Ind., where the entire U.S. 431 corridor was relinquished to the city by the state to speed work and create a smoother flow of traffic. The work involved not only creating seven bridges in two years but devising roundabouts at six locations to eliminate all traffic signals. Precast concrete I-beam bridges were used for the structures. See *ASPIRE*™ Fall 2010 for more details.

The roundabouts, most of which were double-teardrop designs, have proven extremely effective for moving traffic, says Dave Day, senior project manager for the Bridge Transportation Group. "Each time we removed the traffic lights, traffic in the area got better," he says. At one intersection, a double-teardrop roundabout with a frontage-road system was created.

The design required no realignment, eliminating the original plan to buy 30 adjacent properties. It also created easy pedestrian access through the intersections, which was significant, as the highway separated residential areas from the main commercial district. "The design created intersections unlike any others in the U.S.," Wenning said.

Concrete Designs Rule

These innovative approaches, and others like them, have been created with concrete bridge components, which the designers favor. Wenning estimates that more than 90% of the firm's designs today focus on concrete bridges.

It wasn't always that way, notes Day. "Thirty years ago, we were rehabbing a lot of steel bridges from the original interstate construction, and we used steel. But concrete has become relatively cheaper, and its pricing has been more consistent."

Concrete technology also continues to evolve, notes Wenning. "We can stretch spans longer than we could have 10 years ago and achieve more goals." INDOT allows designers to use a semi-lightweight concrete with larger strands, which extends ranges farther, he adds. INDOT has developed new sections, including adapting the typical AASHTO Type IV I-beam to create an Indiana bulb tee with a different top flange.

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It's also approved a "squat" bulb tee that's shorter and fatter. "It lets us span longer lengths with less depth," says Wenning. "Indiana is pretty flat, so structure depth is important here, as there's little elevation to work with."

The versatile designs have helped make concrete the dominant design choice, Wenning says. "What's proven out over time is that prestressed concrete beams create good, solid, competitively priced bridges that meet all of the client's goals. We look at all sources on every project, but prestressed concrete beams typically are what we end up with."

Jointless Designs Dominate

The firm also has become a proponent of designing jointless structures, which INDOT has encouraged by extending its design limits. Previously, it allowed jointless bridges only up to 250 ft for steel and 300 ft for concrete. Today, either material can be designed to 500 ft. That change in part resulted from American Structurepoint's success with the concept, including the design in 2000 of a concrete bridge nearly 1000 ft long.

The bridge, on State Route 249 over U.S. 12 in Porter County, Ind., consists of a 10-span, continuous, composite, prestressed concrete bulb-tee design without expansion joints. The design was created in conjunction with INDOT and engineers at Purdue University, who conducted initial tests and continued to monitor the bridge to develop new design procedures for jointless bridges.

"At the time, the empirical limit for jointless concrete bridges was 300 ft, and this one was 302 m (991 ft)," Wenning says. Built using standard design and construction techniques, it's still twice as long as today's accepted standard. "This bridge has national significance for its capabilities to show how to eliminate joints and create a durable structure."

Joints are a key concern in any bridge, he says, and techniques to enhance

The 10-span bridge on SR 249 over U.S. 12 in Porter County, Ind., features a continuous composite, prestressed concrete bulb-tee design constructed without any joints.

their abilities continue. "But the best joint we can have is no joint. With more salt used every year, any joint failure can allow moisture into the ends and bearings and create problems."

The key to jointless success is to provide limber end abutments or bents that allow movement. INDOT has encouraged this approach by adding a semi-integral, end-bent detail as a design alternative. It resembles an integral bent but separates the lower portion of the cap from the pile so it doesn't induce pile bending, Wenning explains. A bearing pad under the beam at the end bent accommodates expansion. Concrete at the tops of the end bents is placed around the beam ends as is typical with an integral bent, eliminating the joint but allowing for movement.

"We try to do every bridge we can without joints," Wenning says. Today, about nine out of ten of the firm's designs feature jointless bridges.

Concrete Durability

Jointless construction enhances durability, which already is significant with concrete designs, the designers say. "One reason we prefer concrete is that the beams are larger and heavier," Day explains. "They don't take the beating that steel bridges do. There are a number of older concrete structures in counties where less salt is used that still look very good today. That's important, because counties have low maintenance budgets and need to extend bridge service lives."

The designers seldom use additives in their concrete to add durability, they note, as they don't find them necessary. They did perform QC/QA tests on superstructures of six of the bridges involved in the I-80/94 revamp at SR 912 in Hammond, Gary, Highland, and Griffith, Ind.

The project involved a new directional interchange with 18 bridge structures, 8 ramps, and replacement of all signs and lighting. The intersection had the highest traffic count in Indiana's interstate highway system and was rated the worst prior to construction. The project was separated into seven contracts spanning a seven-year period to construct all of the bridges, which consisted of precast concrete beams.

"We easily can achieve concrete compressive strengths of 5000 to 8000 psi, and can go higher, but we need approval from the client," says Day. "Higher strength concrete is becoming pretty routine these days."

Rehabilitation Work Grows

The need for added durability also has led to more rehabilitation work, as more states look to minimize construction costs. "States and counties don't have the budget to replace their bridges if they have any other choice that will last," Wenning says. Rehabilitation not only cuts demolition and material costs but can save further by eliminating road realignments and property acquisition.

Rehabilitation also preserves details communities identify with. "We often work closely with the community to ensure we retain the key portions,"

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The new directional interchange on I-80/94 at SR 912 in Indiana includes 18 bridges, 8 new ramps, and all new signs and lighting.

45 Years of Success

Co-founders James A. Wurster and William E. Gervasio opened the doors of American Structurepoint in Indianapolis, Ind., in November 1966, working from Wurster's home. Originally called American Consulting Engineers (ACE), its two-person staff has grown to more than 300 employees, including 18 bridge engineering experts.

The firm designed a variety of concrete slab bridges in the 1970s and 1980s but now primarily focuses on prestressed concrete bridges. Its designers have participated in improvements to the INDOT Design Manual, with Mike Wenning serving on the committee to rewrite the 1975 manual and Dave Day serving on the committee to create the 2011 version.

In 2011, the firm was ranked No. 180 in *Engineering News-Record's* listings, up from 462 in 2002. *Midwest Construction* named the firm the top-performing Indiana design firm in 2010, and the *Indianapolis Business Journal* named American Structurepoint the largest engineering firm in the region in 2011 and 2012. Average revenues per year exceed $50 million, up from just $3 million in 1987.

Day says. "That can get us involved with some of the accessories and the project architecture." The designers take advantage of old postcards and other documents from local historical societies to research the original design. "Whenever we get the chance to enhance a bridge's aesthetics, we take it," Wenning says.

A prime example is Jefferson Boulevard Bridge over the St. Joseph River in South Bend, Ind. Built in 1913, the four-span bridge, an earth-filled concrete Melan-arch design, originally was determined to be unsalvageable, requiring a $4-million replacement. American Structurepoint was asked for a second opinion and determined that it could be repaired. "The other consultants didn't have our experience to see the potential," Wenning explains.

Some of the bridge's problems resulted from its original design, "so we had to design around that," he says. The firm spent two years ensuring the bridge was structurally sound and then replaced most of the superstructure as well as a small steel railing added at later date with a more imposing and authentic concrete design that accommodated the lookouts at each pier.

The project saved millions of dollars in both replacement and demolition costs, plus savings in property purchase for realignment. "We are very proud of the result," Wenning says. "There's often a lot more life in these bridges if they can be rehabbed, because they were over-engineered when they were built."

Each rehabilitation project is unique, he notes, and the designers learn many lessons about the history and unique approaches to bridge design through the years. "Some of the aggregates used in the concrete didn't perform as well as others, but many of the bridges still stand up today, especially the arched bridges," he says. "Concrete arched bridges are inherently stable and very solid."

The Future

The firm sees a solid future ahead for itself, too, but one with many challenges in today's economic climate. "The lack of funding from Washington, D.C., has caused a lot of problems for states, because they can't develop long-term budgets without direction and commitment from the federal government," says Wenning. "Most of their budgets are based on out-of-date taxing bases, so we have to do more with less all the time."

Those challenges will push the designers to look for more innovations and improved design techniques. "The states and consultants have risen to the challenge, but there's only so much that can be done without more commitments," Day says. "That means we have to continue to do our own materials research and look at using higher-strength concrete all the time. That may lead us to using 10,000 or 15,000 psi concrete and developing new sections. There are always changes and things we can do to improve."

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.

The four-span Jefferson Boulevard Bridge over the St. Joseph River in South Bend, Ind., was rehabilitated by American Structurepoint to retain its original earth-filled concrete Melan-arch design.