PARSONS adapts to the MARKET

by Craig A. Shutt

From Tacoma to Abu Dhabi, Parsons uses local expertise to create efficient, attractive designs

Parsons operates around the world, conquering tough logistical challenges and delivering landmark projects in many countries and climates. But while it works globally, it designs locally. Designers take advantage of the expertise available in each area to ensure that they create the most efficient, durable, and aesthetically pleasing structure.

"Parsons is a diverse company, with diverse capabilities," says Greg Shafer, southeast subsector manager in the Baltimore office. The company's services include bridge planning, design, and construction of all types, including design-build programs. It provides construction engineering and inspection, bridge rehabilitation and retrofit, and condition inspection and seismic analysis. That combination keeps the company involved in bridges at all stages of their life cycle, providing a good perspective on the industry.

"We work pretty hard to investigate all types of construction when we begin a project, including precast concrete, cast-in-place concrete, segmental precast girders, and structural steel. We always consider alternatives, and our choice usually depends on the region and conditions. If the contractors are familiar and comfortable with a specific technology, it is more attractive to design that way."

That expertise is often driven by how the Departments of Transportation (DOTs) operate, notes Paul Goryl, construction services manager in the San Francisco, Calif., office. "DOTs often become comfortable with certain bridge types, which leads to standards being developed around a certain construction approach. As a result, local contractors become very cost competitive, and the DOTs gain a lot of price history for cost estimates."

Parsons can adapt to the local contractors' expertise, which ensures the most efficient design for that area, even though the same challenges in another area may result in a different structure. For instance, California only has a few designs incorporating precast concrete I-beams or segmental construction, Goryl notes, whereas states such as Texas use mostly precast I-beams. "Concrete I-beam bridges are the most competitive approach in Texas, so we design to that unless special circumstances dictate otherwise."

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Most Designs Feature Concrete

Despite the adaptability, a large percentage of Parsons' designs feature concrete today, Goryl estimates. The reasons for that include economics, constructability, aesthetic capabilities, durability, and speed of construction.

"Constructability has become a key concern, and it's growing, especially in urban areas," he says. "Maintaining traffic while construction is underway has become a top priority. As urban areas become more congested, you have more to contend with, and you have to look at alternatives for minimizing the disruption to traffic, such as night work and detours."

Concrete designs also have become more popular with owners as they change their approach to economics. "There's more focus on the hard dollars being spent on each individual project as opposed to larger program budgets," he says. "Now, they're looking closer at the costs on a project-by-project basis and looking at the risks associated with different factors—such as what the cost will be if the design is late, how many contractors will bid the project, or will it take longer to build than expected."

Owners also are changing their calculations to consider the long term, says Shafer. "They want more durable structures. It's not uncommon for owners to ask for a 100-year service life. They are thinking more about life-cycle costs.

To blend the new Woodrow Wilson Memorial Bridge with other Potomac River crossings, Parsons' designers used V-shaped precast concrete piers with curved legs. Photos: Parsons.

The 5400-ft-long Tacoma Narrows Bridge is one of only two suspension bridges built in the United States in the past 40 years. It features 510-ft-tall cast-in-place concrete towers and was completed in only 14 months. Photos: Parsons.

And when you compare concrete and steel, concrete is more competitive when you look at life-cycle costs. You don't have the costs for maintenance and repainting."

Those needs recently came into play for Parsons' designers on the John James Audubon Bridge in Louisiana, which will be the longest cable-stayed bridge to be built in the western hemisphere, when completed in 2010. The design-build project, with a main span of 1583 ft, was planned to withstand barge impacts and hurricanes. In total, 80% of the bridge length of all of the bridges in the project feature precast concrete girder components.

"One of the key requirements for the proposal was to demonstrate that the cable-stayed bridge could achieve a 100-year service life and that the precast concrete bridges could achieve a 75-year service life," explains Shafer. The company performed a life-cycle cost analysis for all of the bridges to show how its design would reach those goals. As part of that plan, the cable-stayed bridge will include polyethylene-sheathed, galvanized-steel stay cables encased in polyethylene pipes to achieve a three-way protection system.

Durability Gains Attention

Durability has also gained attention from contractors, especially those involved with design-build-operate-maintain projects, Goryl notes. In these projects, the contractor constructs the bridge and then is responsible for its maintenance, typically for 25 to 30 years. "In those instances, contractors are more concerned with creating a design that minimizes maintenance, so they're looking at concrete options."

That also was a driving factor in specifying concrete for parts of the $2.4-billion Woodrow Wilson Memorial Bridge, a replacement project that serves as the only Potomac River crossing in the southern half of the Washington, D.C., Metropolitan area. Approximately 6000 ft long, the new 234-ft-wide bridge contains 34 fixed spans, divided between two structures, and a 260-ft-long, eight-leaf bascule span.

State-of-the-art concrete mixtures, including high-range water-reducing admixtures, were used to allow the concrete to flow around the dense reinforcement without creating voids. A zero-bleed grout also was used for extensive amounts of the post-tensioning cable-duct grouting. The anchorage-protection grout also featured special epoxy grout.

In addition, the owners set a goal of never having to replace the bridge deck on the movable segment, Shafer says. To achieve that, designers used stainless-steel strand. "It added only 1% or 2% to the overall bridge cost, but it will make a big difference in long-term durability for that element."

A key goal was to design the bridge to blend with other Potomac River crossings, which typically have arch designs. But the site was not well suited to a conventional arch design.

To replicate that appearance, V-shaped precast concrete piers with curved legs were created to form an arch-like appearance that met the owners' requirements," Shafer says.

On Time, On Budget

The project was honored by the American Segmental Bridge Institute (ASBI) with a 2007 Bridge Award of Excellence for its design and construction and by the American Society of Civil Engineers (ASCE) with its 2008 Outstanding Civil Engineering Achievement Award. "It really was a success," says Shafer. "All the decisions proved to be good ones. The best part was that it was completed on time and on budget."

The bridge was not the only one Parsons has designed that combined steel and concrete components—nor the only one to win awards for that combination. The company's expertise and design-build capabilities were key factors in its selection as the joint-venture lead on the Tacoma Narrows Bridge scheduled for fast-track completion in 55 months. The new bridge was constructed adjacent to the structure that had replaced "Galloping Gertie," the well-known 5939-ft-long bridge that was torn apart in November 1940 as a 42-mph windstorm caused it to undulate until it broke apart.

The new bridge, with dramatic concrete towers, is only the second suspension bridge to be built in the United States in the last 40 years. The other is California's Carquinez Bridge, for which Parsons provided design services and engineering support. The concrete caissons are some of the largest ever built, equivalent to an underwater 20-story building supporting the 510-ft cast-in-place concrete towers. The caissons were constructed under environmentally extreme conditions that comprise 150-ft-deep water, currents up to 7 knots, and 50-mph winds.

The client challenged Parsons to deliver parts of the caisson design within 1 month after notice to proceed and to deliver the complete caisson design before completing the superstructure design. The designers worked closely with both the design-build client and the Washington State Department of Transportation, to make accurate assumptions regarding the design loads, mitigate risk, and deliver the design early.

Parsons' work on the Dallas High Five project was driven by the need for fast construction and to minimize traffic impact. Two of the five concrete segmental ramps, with span lengths up to 300 ft, opened early, with the other three completed on schedule. Photos: Texas Department of Transportation and Parsons.

The entire design was completed within 12 months of notice to proceed. The finished project was recognized by ASCE as a finalist for the 2008 Outstanding Civil Engineering Achievement Award and by American Council of Engineering Companies (ACEC) as a Grand Award winner.

The 5400-ft-long bridge features a 2800-ft main span and includes four eastbound lanes of traffic. The design also can accommodate a second deck for future light-rail use or additional highway lanes.

Both the Carquinez and Tacoma Narrows suspension bridges feature cast-in-place concrete towers constructed with jump forms, notes Goryl. "Cost was a key factor, along with the schedule," he says. "The concrete towers could be constructed at the site while the steel deck sections were being fabricated overseas, shipped directly by ocean-going vessels to the project site, and lifted from below."

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Design-Build Grows Popular

Parsons' adaptive ability works especially well on design-build projects, and that project-delivery method is one of the company's strengths, Goryl adds. "An owner might have a preference or past history with a bridge type that may not provide the most cost-efficient design. But when we're working directly with a contractor on a design-build project, especially with a lump-sum contract, a good starting point is to have a clear understanding of the contractor's most competitive capabilities."

Design-build methods are being used more today, he notes. "Some DOTs are further ahead on the curve than others, for different reasons." Speed is one benefit that design-build methods can provide. "Shorter schedules have become more important to all owners, which leads many to the design-build project-delivery method."

Faster construction and the ability to minimize impact to traffic were key goals for Parsons' work on concrete segmental ramps on the Dallas High Five project, which consisted of five ramps with span lengths up to 300 ft. Two of the five ramps were opened to traffic early, with the other three completed on schedule. Beating the planned schedule reduces concerns about worker safety and minimizes user costs by reducing congestion or eliminating detours earlier.

Overseas Mindset Differs

The ability to shorten project-completion schedules is a key consideration in much of the work the company does in the Middle East, especially the United Arab Emirates and Qatar, Goryl notes. He recently completed the design and bid for the Saadiyat Bridge in Abu Dhabi, United Arab Emirates. The Middle East's single largest natural-island development lies almost 1 mile off the shore of the capital city. Called the Island of Happiness, it will include downtown and marina districts with single- and multi-family golf-course communities, 12 resort hotels, and world-class museums.

Parsons is designing and managing construction for an estimated $2.2-billion infrastructure project including earthwork, roads, water and wastewater infrastructure, and multiple bridges linking Saadiyat Island to Abu Dhabi. The Saadiyat Bridge, currently under construction, will be the first concrete segmental roadway bridge ever built in the United Arab Emirates. The bridge will be open to traffic in mid 2009, and the Saadiyat Island project is expected to be fully developed by 2018.

The segmental design was used due to its long-span capability and low maintenance, explains Goryl. "It's a new construction technology for this country. They're very capable with conventional cast-in-place concrete, post-tensioned box-girder bridges that are used in most of their highway systems," he says. "They've made amazing progress in the past 20 years with conventional designs, and the local contractors produce good quality cast-in-place box-girder bridges."

In the United States, he explains, a lot of focus is placed on long-term permanence, and that's increasing with the emphasis on life-cycle costs. Whereas, in parts of the Middle East that are experiencing a construction boom, owners want value and are more focused on the next two to three years and opening bridges to traffic quickly.

"They are building the infrastructure for their major cities, and they have a difficult time attracting investors and residents to the development projects until the infrastructure is underway," he explains. "So they are more concerned that the project be constructed and usable in a shorter time frame. As these projects are built, they learn more about the capabilities of concrete and expand their own expertise."

Parsons also has worked on several innovative U.S. highway projects. The firm served as part of a joint-venture team to design and build the Southeast Corridor Transportation Expansion Project (T-REX), the largest transportation contract in Colorado history. The design-build project includes highway, light-rail transit, pedestrian, and bicycle facilities along the I-25 and I-225 corridors in Denver. The firm was responsible for approximately 50% of the total project design.

The designers' plan reconfigured the interchange to move light-rail trains from the highest level to the lowest, resulting in significant cost savings, aesthetic improvements, and enhanced temporary traffic control. Parsons acted as the primary designer of 19 miles of double-track light-rail transit, including 13 new transit stations, park-and-ride lots, three parking structures, 25 light rail bridges, a new operations control tower, power and signal systems, and supervisory control and data-acquisition systems for the existing transit lines. T-REX also included 17 miles of highway construction, with 33 new bridge structures, 13 bridge widenings, and six pedestrian bridges. The $1.6-billion project was completed in 2006.

Designers on the Southeast Corridor Transportation Expansion Project (T-REX), the largest transportation contract in Colorado history, reconfigured the interchange to move light-rail trains from the highest level to the lowest. The changes resulted in significant cost savings, aesthetic improvements, and enhanced temporary traffic control. Photo: Parsons and Colorado Department of Transportation.

New Techniques Continue

Designers expect the dominance of concrete in their projects to continue, especially as new engineering techniques are unveiled. The Woodrow Wilson Bridge, for instance, used lightweight concrete on the deck slabs for its movable span. "When moving a big mass like that, it makes a lot of sense to use lightweight materials wherever possible," says Shafer. "We used lightweight concrete combined with normal weight mixtures to create an efficient system that took advantage of the best properties of both." Weight also becomes a concern for large components that must be transported and lifted under challenging conditions, he notes.

Low water-cementitious materials ratios also are being used more often, he says. "We can achieve a nice, low permeability mix by using a lower ratio and improved curing techniques. These help provide better durability, which is in demand today." High-performance concrete (HPC) also helps meet challenging goals, he adds. "We're using HPC more and more, because it provides strength that can create longer spans and eliminate piers. But it's also being used more often for its durability, which helps when the client wants a 100-year service life."

The designers also are intrigued by the advancements being made in reinforcing steel. Stainless-steel strand, such as used on the Woodrow Wilson Bridge, is becoming more popular, along with galvanized and epoxy-coated options. "The idea of stainless-steel reinforcement, both in solid forms and as a cladding over a carbon steel core, creates real possibilities," says Shafer. "They are relatively new technologies that are still not readily available or always cost-effective, but we expect to see them more and more."

As their volume increases, the prices will come down, adding more demand—which will increase volume and help drop the price further. Adds Goryl, "There is a lot of research going on with reinforcement in concrete. We sometimes get into complex designs that push the limits, and we like to see new techniques come out."

As those techniques arrive, Parsons will work with local contractors and concrete suppliers to find the most efficient solution. "We always look at what local concrete producers are accustomed to providing," says Shafer. "We ask if they have experience with certain techniques to ensure we are specifying something that can be built in the local business climate."

That approach ensures the design creates the most efficient approach possible, says Shafer. "New techniques and growing familiarity with them in new areas go a long way toward giving owners what they want, which is something that will last a long time and save them money in the long run."

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