PBS&J

STANDARDIZING SUCCESS

by Craig A. Shutt

PBS&J creates innovative solutions by focusing on efficiency, constructability, and long life

Many complex, long-span structures receive plaudits for innovative concepts that stretch bridge design and material properties. PBS&J has done its share of such projects, but its designers pride themselves more on their ability to bring innovation to the more conventional structures that are designed every day. And their work to standardize components and extend durability attributes help create more efficient and economical designs that benefit the industry.

"Clients come to us because of our general design philosophy, which is to create safe designs that are constructable," explains Amir Kangari, national transportation structures director in the firm's Tampa, Fla., office. "Probably most important, in this litigious environment today, we aim to create high-quality, error-free construction documents that provide an economical solution that's innovative and holistic to the overall transportation need, not just a bridge that connects two points. We apply this philosophy in all of our bridge designs throughout PBS&J's varied client base, which includes surface-transportation, airports, transit, and pedestrian and wildlife-crossing type projects."

The 40th Street Bridge in Tampa, Fla., features a single post-tensioned concrete span with special aesthetic treatments created by local high-school art students. They learned the basics of conceptual design, and contest winners had their designs' ideas, colors, and shapes incorporated into the formal aesthetic plan.

Adds Joseph McGrew, division manager for national transportation structures in the Atlanta, Ga., office, "One key goal is constructability. We are always looking for opportunities to save money during construction by better understanding the concerns of the contractor who is constructing our design."

That focus has led the firm's designers to specify concrete components most often, he says. "The majority of our designs use concrete, with a mix of both cast-in-place and precast concrete designs." The final design often plays to the region's own strengths, notes Ram Kozhikote, group manager of structures in the Orlando, Fla., office. "It depends on the availability of precast concrete plants in the area and what contractors are most familiar with," he explains. In the East and South, precast concrete designs predominate, whereas West Coast designs often feature cast-in-place concrete. "We are working with the precast industry in many regions to revamp I-girder shapes to be more efficient and competitive."

"Concrete's flexibility allows us to do things we couldn't do with steel structures," agrees Glenn Myers, principal technical professional in the Fort Lauderdale, Fla., office. "We can cast any shape needed, which gives us the ability to overcome many challenges."

An example can be seen in the design for the north taxiway at the Cincinnati/Northern Kentucky International Airport in Erlanger, Ky. The single-span, 214-ft wide cast-in-place concrete bridge allows planes weighing up to 1.6 million pounds to traverse its length, spanning an existing two-lane service road that ultimately will widen to four lanes. The bridge required a shallow profile due to the existing roadway beneath.

During the planning phase, designers suggested a shallow voided-slab concrete deck superstructure post-tensioned in both longitudinal and transverse directions. "This design addressed several issues, including construction efficiency and low, long-term maintenance needs," says Kangari. "We created a longer, more open span with no intermediate pier, so it doesn't box in the client for future expansion."

'One key goal is constructability.'

The design for the new taxiway at the Cincinnati/Northern Kentucky International Airport features a cast-in-place voided-slab concrete deck superstructure with a 4.5-ft structural depth to maximize clearance for an existing underpass. Post-tensioning eliminated the need for an intermediate pier, allowing future expansion of the road.

Such spans show concrete's flexibility and are becoming more common, the designers note. "Concrete is a much easier material with which to design unusual shapes than other materials," says McGrew. Kozhikote agrees. "Many of our bridge projects are in the mid-length span range, and the concrete designs compete very effectively with steel. And now segmental precast concrete girders are helping to eliminate any disadvantage for longer spans as well."

PBS&J's work for the State Highway 45 Interchange project in Austin, Tex., features full program-management services on the diamond interchange consisting of 10 major bridges and structural designs for several high-level structures, and a double-deck structure with on/off ramps. Precast concrete beams were used for all of the bridges' superstructures. Photos: PBS&J.

New Standards Coming

To encourage that competition, PBS&J and others in the precast industry are working with the central office of the Florida Department of Transportation to implement new standards for prestressed concrete beams, with the goal of extending their span range to 200 ft. The designs will take their cue from girders being used in other states, Myers notes. "New shapes and higher concrete strengths are allowing us to look at concrete for more efficient designs," he says. "This work will create a more competitive alternative and open new design options."

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But while PBS&J creates its share of long-span designs, it shines brightest on its work with midrange, conventional designs. Bringing their innovative concepts to these designs creates great challenges, says Kangari. "All of our clients are looking for innovative ideas, and to create innovative designs that help achieve their goals within a conventional design is our greatest challenge."

Long-span, complex bridges offer greater freedom to create innovative designs, he notes, because they're expected in that context. "But to convince bridge owners to use new concepts for designs that are done day in and day out provides a much greater challenge, because of the expected boundaries. It forces us to use all of our creativity in the concept-study and preliminary-engineering phases. Those portions have become pretty robust as we engage the client with our ideas for achieving the goals in the most efficient manner."

An example can be seen in PBS&J's work on the State Highway 45 Interchange in Austin, Tex. The firm provided full program-management services over a 10-year period for the 16.7-mile-long roadway improvement project involving 10 major bridges. In addition, PBS&J provided structural designs for a portion of the project including a double-deck structure using precast concrete Type IV AASHTO girders with simple spans and conventionally reinforced concrete straddle bents.

The straddle bents' unique shape, requested for aesthetic reasons, was effectively utilized to create a more efficient structural design. Piers received a special aesthetic treatment, including ashlar stone patterns. "It was a simple design, which had many aesthetic features and the creative touches that helped its efficiency," says McGrew.

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Keys to Constructability

Innovations with conventional designs typically focus on issues of constructability, economics, and maintenance, Kangari notes. Those are the key topics that arise with every project.

Constructability issues play to concrete's strengths, the designers note. Not only do the designers work with local contractors and precasters to ensure each company's strengths are maximized, but they take full advantage of concrete's capabilities for replicating components cost-effectively. "We focus on finding ways to increase repetition in our designs to save cost," McGrew explains. "Carefully selecting standard sections early in the design can save a great deal of fabrication time and cost for the precaster and forming expense for the contractor."

The efficiencies of that approach were shown with the design for the I-4/Lee Roy Selmon Connector Interchange in Hillsborough County, Fla. The multi-level $450-million complex project, one of the largest ever in the area, features both steel and segmental-concrete options. The segmental option consists of both span-by-span and balanced cantilever construction methods. The segmental boxes benefit from the creative use of external post-tensioning, which allows a reduction in the principal stresses, shear reinforcement, and web thickness. Utilizing this creative approach, the PBS&J segmental design experts substantially reduced the estimated cost of the concrete option.

"By standardizing sections in both types of construction and using similar cross-sections, we reduced costs substantially," McGrew says. Standardization also resulted in the capability to use typical pier widths, allowing a great deal of repetition for piers, which added to the savings. Designers also selected one size of drilled shafts, standard footing dimensions, and elastomeric bearings for all span-by-span construction. "Standardization resulted in tremendous savings.

Economic issues permeate the design process, Kangari notes, taking in not only efficiency of component design but also speed of construction to lessen user costs and durability issues to extend the bridge's service life. "Our designs today must help clients in more than one way," he says. "They must solve greater and more long-term transportation problems, such as traffic issues during construction and maintenance needs."

Lessening traffic disruptions during construction has become a key concern, he notes. "Officials are more aware of the costs associated with those disruptions and the need to reduce them," says Kangari. That has led to the expansion of Accelerated Bridge Construction (ABC) concepts, adds Kozhikote. These techniques include building the bridge at a nearby location and then moving it into place, requiring only a brief road closure. Girder launchers and modular designs offer more options. "The less mobilization you need at the site, the more reduction in cost, time, safety needs and disruption to users. The public is demanding faster construction."

Longer Service Life Needed

Maintenance needs have become a key issue as demands are being placed to create 100-year service lives and find ways to reduce the long-term costs required to maintain bridges. "A 100-year service life is becoming more popular because clients

The I-4/Lee Roy Selmon Crosstown Connector in Tampa, Fla., will create a new interchange between the two freeways. Six PBS&J bridge design teams from different offices are providing the design work, which will feature both steel and concrete options. The concrete option will utilize a combination of segmental construction and cantilevered post-tensioned spliced concrete beams. Standardized components throughout the project will greatly reduce costs. The project is expected to be let for construction in summer 2009 and take up to 5 years to complete.

The U.S. 17A/SC 41 Bridge over the Santee River in Georgetown, S.C., sits downstream of Wilson Dam and the St. Stephens Power House, making it subject to frequent flooding. The 1.5-mile-long precast concrete bridge was designed for construction in either wet or dry conditions and meets seismic performance "B" category requirements. Photo: PBS&J.

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are very concerned about their structures' life spans, and they know such durability is available," says McGrew. "Concrete has an incredible advantage in that area." New admixtures are improving quality and durability, adds Kozhikote, especially for bridges in aggressive environments such as coastal areas.

Myers serves as project coordinator for the R19A project of the Strategic Highway Research Program conducted by the National Academy of Sciences. The project is examining bridge components and systems to find ways to make them last more than 100 years. Concrete work focuses on overcoming corrosion concerns. "We're very early in evaluating options and concepts, but we absolutely are at the forefront of finding ways to extend durability. It appears that funding will be available to get projects going, but maintenance funds are still constrained."

From Four to 4000

PBS&J got its start in late 1959, when Howard M. "Budd" Post, a young resident engineer with the Florida State Road Department, met Bill Graham while visiting a contractor's office. The prominent South Florida dairyman offered Post an engineering position with his fledgling land-development company, Sengra, which was considering converting pastureland into what is now known as Miami Lakes, the first planned "new town" in Florida.

Post recommended hiring an engineering company instead, suggesting the firm that employed two of his best friends, George G. Mooney and Robert P. Schuh, as well as John D. Buckley, one of the top sanitary engineers in the state. When Graham expressed a disinterest in hiring a large firm, Post offhandedly offered to form a company to do the work. To his surprise, the offer was accepted.

The four men quickly established a corporation, with Schuh being the first to put up his money. As a result, Robert P. Schuh & Associates was born on February 29, 1960. In 1970, the firm was renamed Post, Buckley, Schuh & Jernigan Inc. (PBS&J). The firm grew steadily and then took off during in the 1990s when it acquired a series of related companies in architecture, engineering, and environmental fields.

Today, the employee-owned firm has a staff of more than 4,000 in 80 offices across the United States and abroad, offering services in transportation, infrastructure planning, construction management, environmental consulting, urban planning, architecture, and program management. The firm is ranked by *Engineering News-Record* as the 25th largest consulting firm.

In addition, PBS&J is developing new design criteria to identify the minimum reinforcement required in concrete bridge members (NCHRP Project No. 12-80). PBS&J's Dr. Jay Holombo, Dr. Sami Megally, and Morad Ghali are working with Dr. Maher Tadros of the University of Nebraska. Their research could improve constructability and reduce the costs of concrete bridge members.

Indeed, the new administration's stimulus package will provide the impetus for more projects to begin in both design and construction. "We expect we will be seeing more projects being funded in the near future," says McGrew. "And we expect to be involved in finalizing many of the existing designs that are ready but just need approval, with more going into the pipeline. The designs will be across the spectrum, including quite a few large projects."

The need for efficiency will increase the interest in alternative delivery systems, notes Myers. "Design-build options are growing, not only because they provide speed of construction but also because they improve efficiency, which saves money. The design-build approach allows us to work with contractors in ways that are most effective for them based on their capabilities. Doing that provides a better approach and a better price than a typical design can provide. The state DOTs are open to this system, and it plays to our own strengths."

Funding also will be supplemented by external sources, predicts Kangari. "There is growing interest in public/private partnerships, with private money being invested in infrastructure to aid local developments," he says. That can bring more challenges, as it creates more needs and different agendas, and it also puts the focus on durability. "If private companies are providing the long-term maintenance, they are very interested in not only good designs but also low maintenance costs."

PBS&J's designers welcome those challenges as they work to wring more efficiency from every structure they create. "Our clients appreciate practical solutions that meet all of their needs," says Myers. "But when something different or unique is warranted, we find the solution."

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