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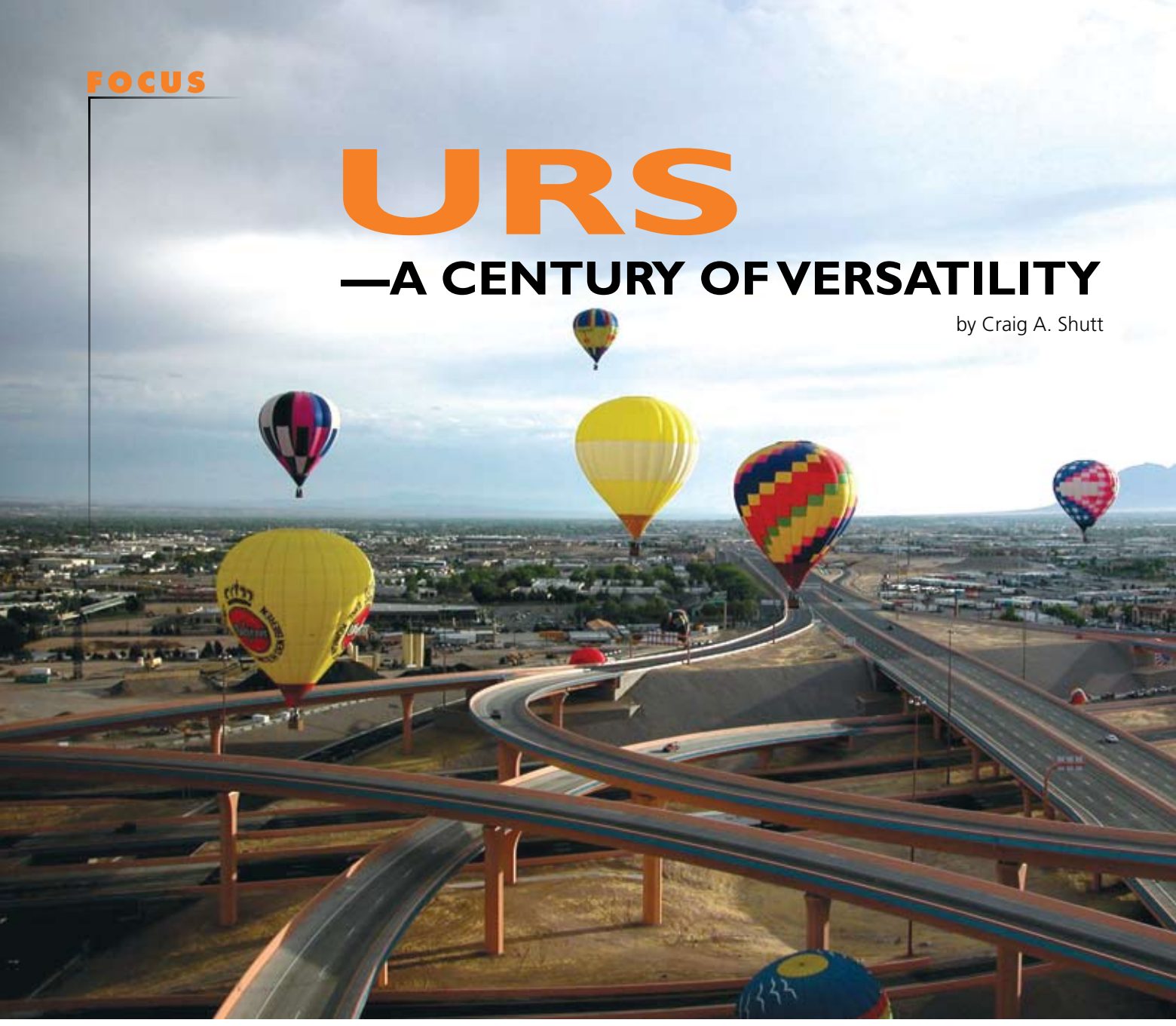
URS —A CENTURY OF VERSATILITY

by Craig A. Shutt



The Big I project in Albuquerque, N.M., is the only full freeway-to-freeway interchange in the state. The $300-million project included 62 bridges and was completed ahead of schedule and within budget

Using expertise gained from a 100-year history with all types of bridges to meet owners' needs

Since URS established its roots more than a century ago, the bridge industry has evolved and adapted to meet new needs and challenges. The company has done likewise, expanding and building on its expertise to secure its position as the largest bridge design firm in the country. While reaching those heights, the firm has tackled projects of every size, every material, and nearly every style, watching trends develop along the way.

"We have a wide experience with every type of bridge and material, including concrete, steel, timber, and even composites," explains Steven L. Stroh, vice president and deputy director of surface transportation for major bridges. "We don't limit ourselves to one bridge type, and we've handled everything from simple-beam bridges to complex, cable-supported structures and even movable bridges; the entire gamut."

That expertise ensures the designers find the best solution to each challenge, adds David Jeakle, senior structural engineer.

'Owners are faced with very severe budgetary limitations today, so they want durable and cost-effective bridge designs.'

"We don't have a particular product we push; we can show strength in a wide variety of structure types." Even so, the designers note, some materials and styles are gaining ground today, due to evolving technologies and owners' focus on changing needs.

"Owners are faced with very severe budgetary limitations today, so they want durable and cost-effective bridge designs," says Stroh. "We have to get creative with our design ideas, including the overall approach to the project." More often today, he notes, that can mean using a design-build delivery method or working with a public/private partnership. "There can be very creative contract mechanisms to stretch the available dollars and move projects forward before the funding actually is available."

Design-Build Growing

For that reason and others, design-build is definitely gaining supporters, he adds. "The industry is going to have to adapt to this delivery method. It's a challenge, but it can offer benefits to owners." Design-build-operate formats, in which the contractor maintains ownership for some time afterward, also are gaining interest. "The industry is still in the early stages of developing these arrangements, and owners are still experimenting with the options, which will continue to play out over the next few years. The jury is still out on which approaches are more effective."

The range of such collaborations—and the unique designs that can be achieved using them—can be seen in two recent examples from the firm's portfolio. The cable-stayed Kap Shui Mun Bridge, with the connecting Ma Wan Viaduct in Hong Kong, China, were delivered via the design-build method. The $250-million structures, part of the Lantau Fixed Crossing system of toll bridges, connect Hong Kong and Kowloon to Hong Kong International Airport.

The double-deck bridge is 4040 ft long, with a cable-stayed steel main span of 1410 ft and side spans featuring post-tensioned concrete box girders that were incrementally launched into their final position. "The combination of materials resulted in a very efficient and cost-effective design that could be completed within the project's stringent time frame of 42 months from notice-to-proceed to turnover of the rail envelope for testing," says Stroh.

The bridge, which provides 164 ft of vertical navigational clearance, provides three vehicle lanes in each direction on the upper deck while the lower deck contains dual rail-transit lines and enclosed roadways for emergency vehicles during tropical storms. It is the world's largest fully enclosed, double-deck cable-stayed bridge that carries auto and heavy commuter rail traffic.

The adjoining viaduct structure is approximately 1630 ft long and consists of twin six-span, cast-in-place on falsework, multi-cell, concrete box girders, with span lengths of 240 to 285 ft. The traffic arrangement replicates the format for the main bridge. The viaduct's

The cable-stayed Kap Shui Mun Bridge in Hong Kong, China, is part of the crossing to the Hong Kong International Airport. The side spans use post-tensioned concrete box girders that were incrementally launched into their final position.

The Arapaho Road Bridge, Addison, Tex. won a PCI 2006 Design Award for Best Bridge with Spans Greater than 135 ft for extensive use of precast, prestressed U-beams and deck panels.

'Some owners have very clear standards for what they want, while others rely on our expertise.'

Precast concrete deck panels are being used to replace the deck on the Chesapeake Bay Bridge.

box-girder superstructure rests on cast-in-place concrete piers that are about 150 ft tall in most areas.

Closer to home, the Big I project, involving the I-25/I-40 interchange in the heart of Albuquerque, N.M., features a unique public/private partnership. State officials used a new risk-management approach to obtain private industry buy-in to the public agency goals for the $300-million project, the only full freeway-to-freeway interchange in the state.

"The schedule was extremely aggressive—requiring all design work to be completed in 16 months, with construction completed in 24 months," says Stroh. The designers had to create a plan that could work for that time frame, including handling traffic issues. The entire project involved 62 bridges, including eight precast concrete, segmental box-girder flyover structures that were the first such designs ever used in the state.

More than 165,000 yd^3 of concrete were used in the total project, which included five miles of freeway reconstruction and 10 miles of new frontage roads paralleling the freeway. The project remains the largest transportation project ever constructed in the state, and it was completed ahead of schedule and within budget.

Designs Depend on Owners

The design approaches considered depend on the owners' comfort level and familiarity with designs, notes Stroh. "Some owners have very clear standards for what they want, while others rely on our expertise," he says. "Some are more sophisticated in their approach, with huge research programs that help them create clear ideas of what works best for them. There are always opportunities to promote new ideas if we can make a case, but some states are more willing to listen and learn new techniques."

Many times, designs are determined by the local landscape, as well as local expertise, in an effort to play to local strengths. Similarly, states often learn new techniques from each other, picking up successful approaches. For the recent expansion of the Paseo Bridge in Kansas City, Mo., for instance, the Missouri Department of Transportation officials used a design-build delivery system in which they allowed any technology already used successfully in other states, even if they were unfamiliar with it.

Owners are trying new techniques—and demanding more creativity from their construction teams—because their needs are more diverse, the designers say. "Owners' needs are changing,"

says Jeakle. "Durability is a major issue during the design phase, and many decisions are being made on that basis alone." They also want accelerated construction schedules, to reduce user costs and improve safety, while also maintaining good aesthetics. And, needless to say, it all must be achieved more cost effectively than ever.

Concrete More Popular

For these reasons, Jeakle sees a trend toward the use of more concrete components, especially precast ones. "We're precasting everything possible today: box girders, edge girders for cable-stayed bridges, pile bent caps, deck panels, footing caps, anything. The main impetus is to minimize disruptions for the traveling public and shorten construction duration."

High-quality precast concrete components can be produced quickly off site while other prep work is underway, he explains, and they can be erected efficiently once they arrive on site. "The goal today is to get in, install the bridge, and get out," he says. "The fast erection also can minimize labor and provide a safer environment. I'd much rather have construction crews working in a well-defined casting yard with set procedures than performing work over water or live traffic."

Creating precast concrete designs puts more demands on the engineers during the design phase, he notes. "We need to know a lot more about the means and methods that contractors use. We have to thoroughly understand the construction process." That can mean discussing key points, such as tolerances, weights, and delivery issues, with contractors early in the design phase, especially for unusual structures.

"The initial design fees may be higher because there's more planning and coordination work to be done early, but that's a small percentage of the overall cost, and that initial planning pays off with reduced construction costs. So there is a net savings in the end."

Speed is a key ingredient in the westbound Chesapeake Bay Bridge project currently underway. The deck on the suspension spans and through-cantilever truss spans is being replaced with match-cast precast concrete deck panels that are post-tensioned together. All the work is being accomplished at night while the westbound traffic is diverted onto the eastbound bridge,

'The goal today is to get in, install the bridge, and get out.'

URS is the engineer of record for the cast-in-place segmental, cable-stayed bridge across the Ohio River between Pomeroy, Ohio and Mason, W.Va.

The Palm Valley Bridge over the St. John River in Florida uses spliced, post-tensioned concrete I-girders for the main span of 290 ft.

'LEED for bridges may be coming in the not-too-distant future.'

A Century of Development

URS Corporation's oldest predecessor company—Greiner Engineering—was founded in 1904. URS was established in 1951 and incorporated as Broadview Research in 1957. Its management developed a growth strategy 10 years later that focused on building the company into a multidisciplinary professional services firm. In 1968, Broadview Research acquired United Research Inc. of Cambridge, Mass. The company's name was changed to United Research Services and finally to URS.

Greiner Engineering established by J. E. Greiner—a noted structural engineer—was acquired by URS in 1996. Greiner Engineering specialized in bridge design and achieved significant success in its early years, and provided URS with a large measure of their bridge design capabilities.

URS has continued its policy of aggressive acquisitions and internal growth and, today, it is organized into three divisions: The URS Division provides all the services required to rehabilitate and expand public infrastructure, including bridges and every type of transportation network, as well as water supply, conveyance, and treatment systems and many types of facilities, such as healthcare complexes, schools, and courthouses. The EG&G Division provides system engineering and technical support services to U.S. federal government agencies, including NASA and the Departments of Defense, Homeland Security, and Treasury. The Washington Division provides engineering, construction, and technical services for environmental management, industrial processes, infrastructure, mining, and power projects.

Overall, URS operates in more than 30 countries with more than 50,000 employees. In the 2008 rankings by *Engineering News-Record,* it was listed as the largest engineering firm in the country and the largest bridge design firm.

Its long and extensive experience in bridge design has allowed URS to maintain a staff of more than 500 structural engineers supported by an equally sized staff of CADD structural draftsmen and technicians. The firm also has more than 35 off-the-shelf and proprietary software-application packages specifically created for designing bridges and structures.

with the bridge reopening at 5 a.m. each day. Included in the work is the installation of a new deck-joint system and an aerodynamic-stabilization system for the main suspension spans.

Design Options Expand

Another tool being used more often is the spliced concrete girder, says Jeakle. "For many of our projects today, owners are requiring at least one segmental alternative be considered during the preliminary phase," he says. "Previously, we'd create one only in special situations. It's becoming very popular." Stroh adds, "It's an economical way to create relatively long spans. We have designed spliced concrete I-girder spans as long as 290 ft, and that's an attractive alternative to steel bridges."

The firm has designed a plethora of segmental concrete and spliced-girder concrete structures across the country, including the segmental box girders used in the Big I interchange in Albuquerque, N.M.; two segmental concrete box-girder bridges designed for the I-35 Crosstown connector project in Minneapolis, Minn.; eight segmental concrete bridges created for the Palmetto/Dolphin Interchange project in Miami, Fla.; and the spliced, post-tensioned concrete, I-girder design, complete with a 290-ft main span, for the Palm Valley Bridge over the St. Johns River in Florida.

"Overall, I do believe we're creating more concrete bridges today than any other kind," says Jeakle. "When we provide steel and concrete alternatives for long-span bridges, the steel alternative may be more competitive

at first, but the owners have recently been selecting the concrete design due to its durability and minimal long-term maintenance. It's challenging to quantify life-cycle costs appropriately versus in-ground costs, but when steel and concrete are reasonably cost competitive, more clients are choosing the concrete alternative. They have the money to build the bridge but not to maintain it. They want something today that is less maintenance intensive."

Encouraging New Ideas

For that reason alone, URS' designers continue to stay abreast of new techniques and new ideas. These come from their suppliers, owners, and their own efforts, which are funneled into their Center of Excellence in Tampa, Fla., where both Stroh and Jeakle work.

URS' designers, for instance, currently are conducting experiments with the Florida Department of Transportation and the University of Southern Florida on double-composite box girders. The girders feature a steel box section with a concrete slab on top, as well as a concrete slab in the negative-moment region on the bottom. The girder currently is being fatigue tested at Florida DOT's structures laboratory in Tallahassee, after which it will be tested for serviceability and ultimate strength.

"We're always looking at new research and new concepts," says Stroh. "We're seeing more places where lightweight concrete, self-consolidating concrete, and high-strength or high-performance concrete can be used effectively. Whenever anyone has something new to talk about, we'll listen."

The designers pick up techniques from all of the company's offices and projects, both domestically and in their international markets. "When we find techniques that are proving successful, we bring them back and pollinate the rest of our organization with them," he says. That distribution ensures that URS remains on the leading edge and keeps it growing no matter what challenges lie ahead.

For more information on this or other projects, visit www.aspirebridge.org.

The Isle of Palms Bridge in South Carolina was constructed using the top-down approach to minimize impact to the pristine saltwater marshland and shell fishery.

'Green' Building Becoming Key

"A bridge's impact on the environment also is becoming a more significant factor to consider," says Steven L. Stroh. "We're going to see more of a trend toward green building and using renewable resources wherever possible." A key influence will come from the Leadership in Energy & Environmental Design (LEED) standards established by the U.S. Green Building Council for buildings of all types. Those standards focus on energy savings, water reclamation, recycled and recyclable products, and energy used in the manufacture and transportation of construction materials.

"LEED for bridges may be coming in the not-too-distant future," he says. URS has looked into ways to adapt the standards for bridges, he adds, as more owners are expressing an interest in meeting the goals, at least as they can be translated to bridges. "We have implemented some of the ideas they present." Key aspects may involve salvaging materials from existing bridges and performing rehabilitation that will extend a bridge's service life.

"I expect that some decisions on bridge design will soon be made based on the impact of the structure's overall carbon footprint. Clearly, a lot of work will need to be done for that to happen, but I believe we're headed in that direction now."

The impact on the environment has led to a variety of new erection processes, including girder launchers and other techniques that allow top-down construction to minimize disruptions to the land and waterways below. The firm's work on the Isle of Palms Connector Bridge in Charleston County, S.C., shows one way this is happening. URS led a joint venture that provided complete service, including an environmental impact study, for creation of one of the longest bridges in the state.

The structure provides the only access between the mainland and the barrier island community, and was constructed after the previous access, via an obsolete swing bridge, was destroyed during Hurricane Hugo. The 2-mile-long bridge spans a pristine saltwater marshland and shell fishery. "The prescribed environmental conditions required that we keep construction out of the waterway," Stroh explains.

To achieve that, the design used precast, prestressed concrete I-girders, which were erected using a work bridge that only touched the pilings within the tight environmental requirements. Completed in 1993, it was one of the first projects to use this approach, providing the top-down construction that left the waterway intact. "This solution is being use more today in these situations, as are gantries and other techniques," he says. "It gives us one more tool in our tool box."

Mattaponi River Spliced Girder Bridge,
West Point, Virginia

Lalon Shah Precast Segmental Bridge,
Bangladesh

Hood Canal Floating Bridge,
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Arthur Ravenel Jr. (Cooper River)
Cable-Stayed Bridge,
Charleston, South Carolina