DAVID EVANS AND ASSOCIATES

GOING BEYOND ENGINEERING

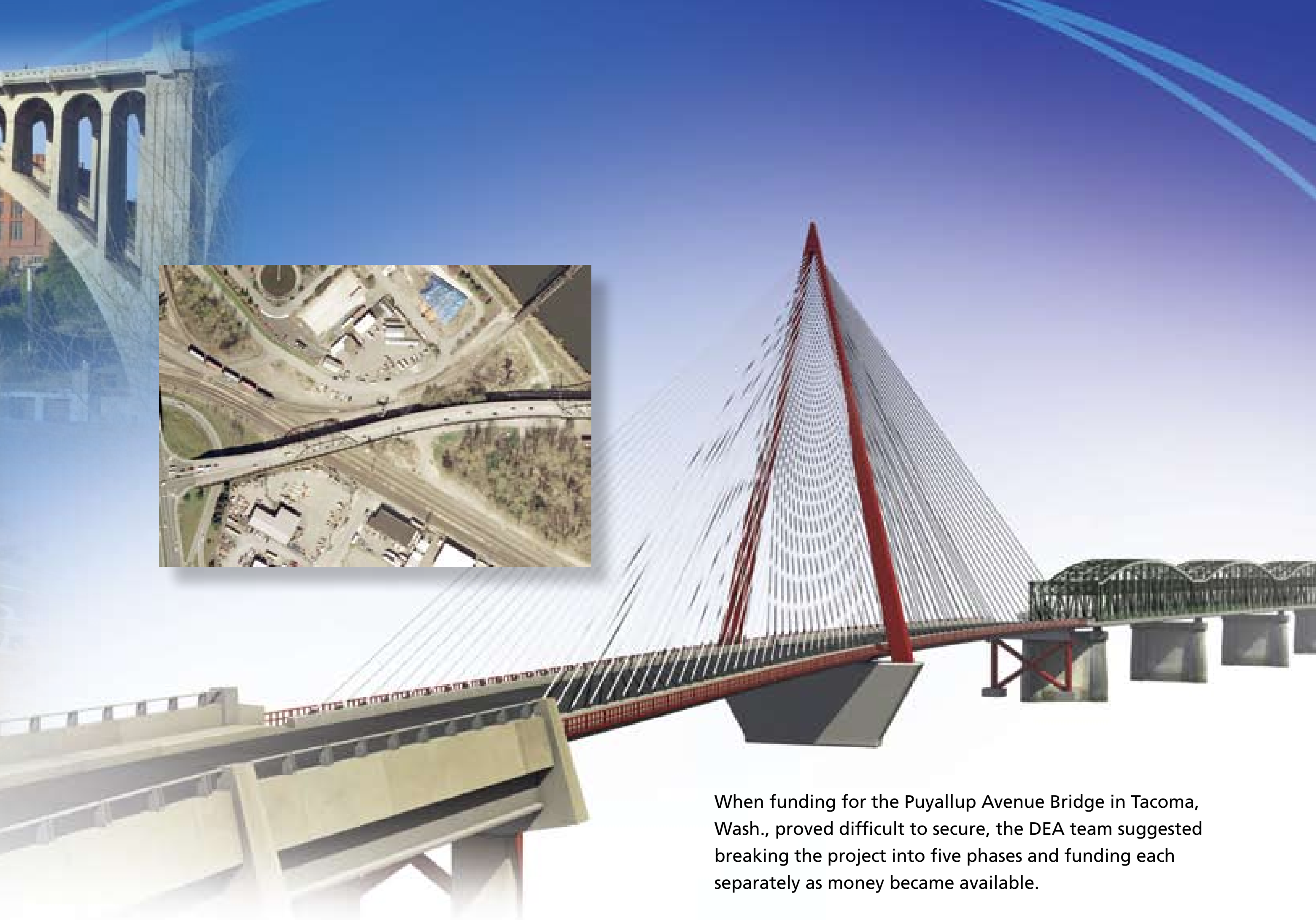
by Craig A. Shutt

A holistic commitment to owners and staff drives David Evans and Associates' success

Since its founding 33 years ago in Portland, Ore., David Evans and Associates Inc. (DEA) has focused on successfully serving an expanding array of client needs and ensuring employees share in that success. That two-pronged focus has allowed the company to grow quickly and diversify its talents, making it more of a partner with both its clients and its staff.

DEA follows two key principles, says founder David F. Evans. "Our core purpose is to improve the quality of life while demonstrating stewardship of the built and natural environments," he says. That stewardship extends to working relationships, he adds. "Our founding philosophy has been to find outstanding professionals and give them the freedom and support to do what they do best." Their reward derives in part from ownership of the firm, based on an Employee Stock Ownership Plan, which has been in place from early in the company's history.

"Our success comes from having a well-rounded team with a lot of diverse expertise that everyone will listen to," Evans says. "That helps us create projects that will cost less money, provide higher quality, and meet all of the owners' needs."



When funding for the Puyallup Avenue Bridge in Tacoma, Wash., proved difficult to secure, the DEA team suggested breaking the project into five phases and funding each separately as money became available.

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Multi-Faceted Approach

Those needs are evolving, say DEA designers, to include services that make our engineers more of a full strategic partner with clients. "We found that, today, a bridge project is not a pure bridge project any more," says Raj Bharil, DEA's director of the bridge discipline, who is based in the Olympia, Wash., office. "We aren't being asked to simply give the owner plans that can be bid and you're done. There's much more to it."

The requirements can include a range of disciplines, including environmental impacts, sustainability goals, and evaluating historical and cultural contexts, hydraulic and resource needs, constructability, and permitting requirements. "More often, we are acting as a consultant on project management, discussing how to gain funding, how best to advertise the project, which permits are needed," he says. "It becomes a multi-faceted approach." Being involved early-on in a project can reap significant results. "You can't be just a pure bridge engineer today."

The Puyallup Avenue Bridge replacement project provides a good example of how early involvement pays off. The 2453-ft-long bridge comprises seven segments that connect downtown Tacoma, Wash., to the Port of Tacoma and the City of Fife. It crosses six sets of railroad tracks as well as the Puyallup River. City officials struggled with how to fund the project, until the DEA team suggested breaking it into five projects and funding each as money became available. As a result, the design of the first two segments for a new cast-in-place concrete viaduct and a concrete box-beam bridge, are almost finished. The rest will follow as funding allows.

"This approach means that new segments can be added easily without holding up progress," Bharil explains. "We could help define what the project actually was and what would be the most successful approach from the client's perspective."

DEA engineers also are doing more high-end specialized analysis work, especially for seismic needs, as so many of their clients are located in high seismic zones along the West Coast. The San Diego office in particular performs these analyses, and it has a close relationship with the bridge seismic researchers at the University of California, San Diego. "There are many more techniques available today for seismic analysis," explains Bob Dameron, regional manager for Southern California.

DEA analyzed the 554-ft-long concrete North Torrey Pines Bridge in Del Mar, Calif. Its analysis led to partially isolating the superstructure from the highly skewed bents and jacketing columns to provide more seismic resistance.

That focus began after the 1989 Loma Prieta earthquake, which emphasized the need to upgrade infrastructure. Today, most lifeline and other major bridges in the West have been retrofitted, he notes, but there are still many more that need to be improved.

DEA performs a wide range of seismic studies, which often lead to retrofit projects. An example is the work done on the North Torrey Pines Bridge in Del Mar, Calif. The 554-ft-long bridge, built in 1933, is a multi-span cast-in-place concrete bridge, which is eligible for the National Register. It was designed with highly skewed bents on the center spans over the railroad, and these bents were a focus of seismic upgrading. As part of a Simon Wong Engineering team, DEA performed global nonlinear seismic analysis that led to a design for partially isolating the bents, post-tensioning the entire bridge for continuity, and jacketing the columns to provide more seismic resistance.

Feasibility Studies Grow

"The new tools help us analyze all types of structures, big or small," says Gernot Komar, senior bridge engineer and manager of the San Diego office. "We can examine the construction sequencing on bigger structures and look at the impacts of various combinations of materials and determine feasibility." In some cases, these studies have found that certain design approaches won't be feasible, or the construction must be performed in a specific way. "How you approach the construction can be critical."

An example can be seen in the "shear link" towers being studied by DEA for the new Gerald Desmond Bridge in Long Beach, Calif., due for completion in 2016. The 2000-ft-long steel and concrete cable-stayed structure features a 1000-ft-long center span and two 525-ft-tall shear-link cast-in-place concrete towers. The towers ensure all parts of the structure experience primarily elastic behavior during an earthquake, except for the links, which can be driven far into the inelastic range, explains Komar. This allows them to absorb large amounts of energy while the bridge's vertical load-carrying capacity remains intact. The technique previously was used on the San Francisco-Oakland Bay Bridge, he notes.

Other creative concepts also are aiding DEA's designs. For its work on the Depot Street replacement project in Jackson County, Ore., the firm replaced an existing steel-truss bridge with a 411-ft-long concrete structure. It consists of a 105-ft-long, six barrel, cast-in-place concrete, post-tensioned approach box girder span. The main span is a signature, 306-ft-long, 63-ft-tall concrete tied arch utilizing a cast-in-place "waffle" shaped deck. Advanced design analysis and high-performance concrete enabled this to be the first concrete tied arch bridge to be constructed in the United States in more than 70 years. The main span arch was constructed on a temporary offset alignment so local access to the original bridge could be provided during construction. After the bridge section was completed, it was rolled laterally 26 ft into its final position using heavy-moving technology and opened to traffic in September 2006 within a week of closure to traffic.

Innovations offer great potential, but DEA's designers are acutely aware of the need to produce designs that can be constructed efficiently. "Constructability has become a key goal for all of our projects," says Ted Aadland, bridge construction engineer and

On the Depot Street Bridge in Jackson County, Ore., DEA created a plan to replace the existing steel-truss bridge with a 411-ft-long concrete tied-arch. A unique technique allowed the 306-ft-long main span to be built alongside the bridge and then rolled into place, maintaining local access to the original bridge for as long as possible, and reopening the bridge to traffic within a week.

president of Aadland Evans Constructors Inc. (AECI), a sister company to DEA. AECI was formed in 2006 as a subsidiary of David Evans Enterprises Inc., the holding company for DEA.

DEA holds constructability reviews with contractors to review alternatives and create an efficient plan, and those often involve members of the AECI staff, even if the company isn't providing construction services. "Engineers and contractors have different mindsets on projects, and our goal is to create elegant, functional designs that are easy to build."

More Emphasis on Sustainability

Owners also are emphasizing the desire to create sustainable designs that have low environmental impact during construction. This mindset fits with DEA's stewardship, says Evans. "A lot of issues that are important today—global warming, carbon footprints, green products, and design—have always been high on our own list." A project's carbon footprint is a key factor in design for owners, he notes. "Not just the construction itself but how to build without taking anything to the landfill. We are looking at many ways to recycle materials and improve our existing techniques in those areas."

The combination of new management techniques and cutting-edge design tools is aiding DEA's capability to produce sustainable designs. The more integrated approach allows the company to leverage cost-effective sustainability opportunities into all it's projects. This is something fairly new to bridge and other infrastructure design. Factoring life-cycle costs into the design has become a key ingredient, as operating and maintenance costs, as well as long-term durability, have a great impact on a bridge's ultimate cost effectiveness.

An example can be seen in the company's work on the Columbia River Crossing connecting Washington and Oregon. The $4-billion, multi-modal project includes new bridges and light rail plus a major reconstruction of 5 miles of I-5 between Portland, Ore., and Vancouver, Wash. As lead project consultant, DEA will be publishing the final environmental-impact statement and creating a Record of Decision. It is designing more than 50 bridges, most constructed with reinforced concrete, for the major interchanges and transit extension.

Sustainable design is such a key element of the program that the design team intends for the project to be the first capable of achieving LEED certification, even though no such certification exists for bridges. They look at how those concepts for material use, construction, and use of energy can be applied to bridges. The existing 90-year-old I-5 bridge has an extraordinarily high maintenance budget. One of two bridges at the site, it was constructed in 1917 as Highway 99 and later designated as I-5. A second bridge was added in 1958. One of DEA's goals is to reduce that maintenance cost substantially through good design.

Sustainable-design concepts will be followed so rigorously on the $4-billion Columbia River Crossing project connecting Washington and Oregon that DEA designers want it to meet LEED certification standards, even though none exist for bridges.

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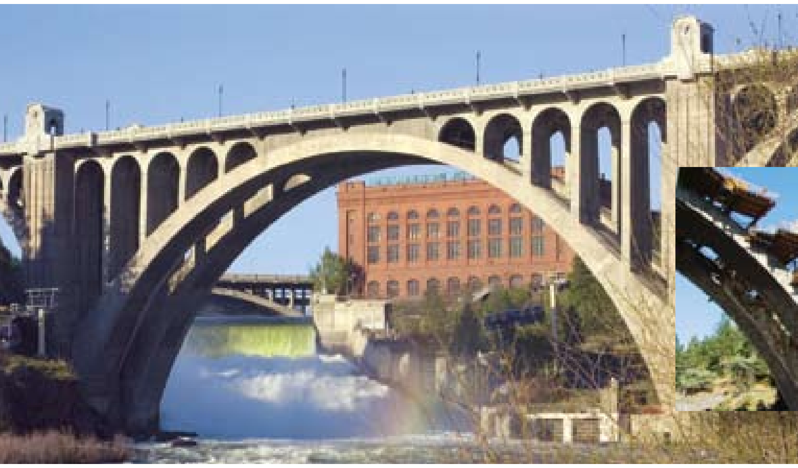
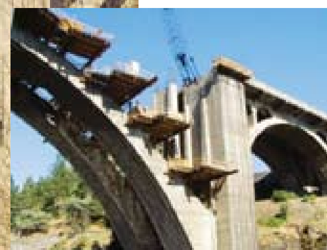
From Two Employees to over 900

David Evans and Associates Inc. (DEA) opened its doors on April 1, 1976, with just Evans and his former drafting partner, Dave Gould, who is now retired, on staff. The two had worked for a larger company where Evans served as regional manager. Soon he realized his division was successful and others were not—however, the company resisted his ideas. "I saw we should be doing things differently, but when they weren't receptive, I realized I needed to move in a different direction."

The two-man company took on a variety of site-development projects for housing developers and grew rapidly, employing 70 people by 1980. When a recession hit, Evans knew he would have to diversify and expand outside of the Northwest to retain people and keep growing.

The company, which had always shared its profits with employees, created an Employee Stock Ownership Plan (ESOP) in 1985, and has continued to grow and add new companies to its fold. Today, it operates more than 20 offices in seven states and employs more than 900 people.

DEA has won numerous awards, but it is most proud of its 2008 honors as the No. 73 best company to work for in the United States; as the No. 1 best large civil engineering firm and the No. 9 best overall firm to work for in the United States by *CE News Magazine*; and the 2007 Ethics Award from the Oregon Ethics in Business organization.

DEA's plan helped restore the look of the 97-year-old Monroe Street Bridge over the Spokane River while replacing a superstructure that will permit future widening from four to six lanes and extend the bridge's service life by another 75 years.

Rehabilitation Work Expands

Rehabilitation also offers options for sustainable design, as it drastically reduces new material use. An example of the possibilities can be seen in the Monroe Street Bridge over the Spokane River connecting the two sides of Spokane, Wash. DEA conducted a technical and economic feasibility study for restoring and modifying the existing 1911 bridge, a three-span, cast-in-place concrete, open-spandrel deck arch structure. The new superstructure was designed to allow future widening from four to six lanes and will extend the bridge's service life by another 75 years. A more detailed description is provided in *ASPIRE*™ Fall 2007.

In some cases, rehabilitation can be accomplished because original design loads were not well understood, creating over-designs that can be leveraged. "Some of the structures have never been reanalyzed, and they have a lot of reserve capacity," says Tom Whiteman, a senior bridge project manager based in the Olympia, Wash., office. "If we take the time to analyze them, we can restore them and provide a new 100-year life in addition to the years they've already served."

The company performs a variety of rehabilitation studies in addition to forensic work that helps to better understand existing structures and apply that expertise to new designs. One example is the San Diego office's forensic assessment of the I-405/55 HOV connector in Orange County, Calif., which was led by Dameron. The 2466-ft-long, 11-span bridge features curved concrete girders to accommodate a 900-ft-radius horizontal curve. When the tendons were stressed, some of the concrete on the curved portions cracked along interior girder webs, and DEA was asked to determine the cause and find a solution.

The team constructed global and local finite-element models to quantify the damage and provide analytical results. Shortly after this work, DEA analyzed generic curved girders to support the National Cooperative Highway Research Program Report 620, titled "Development of Design Specifications and Commentary for Horizontally Curved Concrete Box-Girder Highway Bridges." The 2-year program resulted in updated AASHTO guidelines for designing curved prestressed concrete girders. "Our goal is to squeeze out as much performance as possible from the materials," says Dameron.

'More times than not, the use of concrete for bridges makes sense today.'

Concrete Aids Innovation

DEA is doing more work on concrete structures these days, Bharil notes, because it has become the material of choice for bridges in the West. "The West Coast primarily uses concrete today," he says. "We have producers who give us high quality products and work closely with us on challenges; so concrete has become the predominant material."

Concrete manufacturers and fabricators have aided that process by continuing to expand its properties, he adds. "Concrete bridges can now span longer distances, and that expands its capabilities. More times than not, the use of concrete for bridges makes sense today."

The company often uses high-performance concrete, Whiteman notes, although it typically is provided without being specified because it develops strength faster and accelerates the construction schedule. "We specify concrete with a compressive strength of 4000 psi, but we often receive 6000 to 7000 psi concrete anyway." High-performance concrete and self-consolidating concrete are being considered and used more often by state DOTs as well, he says.

Durability is the goal more than added strength, he adds. Often, that added durability comes from the addition of fly ash, silica fume, slag, and other admixtures that also achieve sustainable-design goals.

Evolutions in concrete materials will continue, says Evans, as designers work closely with contractors and concrete companies to meet new challenges as they arise. "We expect to see more green materials being created, and as they become available, we will incorporate them," he says. Carbon fibers offer great potential, he notes, as they can provide strength and reduce the potential for corrosion in strands.

"There is a constant need for new ideas," adds Aadland, "In-water construction windows are being reduced, and it's becoming more difficult to build in the terrain that is available to us with minimal impact. New materials, such as lightweight concrete, can help us meet those challenges, which are getting more complex all the time."

Those challenges will be met with DEA's winning combination of strategic planning, involved teamwork, and concern for the entire bridge process. Going beyond the design phase to consider all aspects of the project ensures that owners receive the most efficient, highly aesthetic, and most cost-effective structure possible.

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