FOCUS

Full-Service Engineering

Stantec's bridge division serves clients' bridge needs from conceptual design through inspection, maintenance, and rehabilitation, using whatever techniques are required.

by Craig A. Shutt

Stantec is recognized around the world for providing a wide range of architectural and engineering solutions. Its North American bridge division enhances that reputation by providing a full complement of bridge engineering services, from concept to rehabilitation.

"In the bridge sector, we pride ourselves on being a full-service company in all aspects of bridges," says Tony Hunley, vice president in Stantec's bridge sector. "We're not just known as new-bridge designers. We do it all."

Reed Ellis, vice president and bridge sector leader adds, "One thing that sets us apart is the complete range of bridge engineering services we provide our clients through all stages of a bridge's life cycle. That includes inception, planning, conceptual design, design, and construction. It continues through regular and rope-access inspections, maintenance, repair, rehabilitation, load rating, and strengthening. We also implement bridge management systems, help bridge owners manage and prioritize repairs, and decommission structures."

Given this range of services, Stantec establishes strong ties with departments of transportation (DOTs) and other owners that last after a specific project ends. "We form long-standing relationships, becoming a partner and consultant over the long term on that structure," says Ellis.

Expanding Inspection Services

Bridge inspections have been a recent area of growth for Stantec. "In the past 10 years, we've seen a considerable increase globally in owners wanting to inspect their bridges to improve their asset management," says Ellis.

Using rope access, Stantec performed the first routine inspection on the 1896-ft-long Mike O'Callaghan–Pat Tillman Memorial Bridge in 2013. The bridge is 870 ft above the Colorado River. All Photos: Stantec.

The Terwillegar Park Footbridge consists of 86 precast concrete deck panels supported by bearing cables cast into the deck with 7.3-ksi high-performance cast-in-place concrete.

The Terwillegar Park Footbridge over the North Saskatchewan River is Canada's longest stress-ribbon bridge, spanning 859 ft 6 in. The structure is the first of its kind in Edmonton, Alberta, and the northernmost bridge of this type in the world.

Frequently, inspections require a variety of approaches, including rope access.

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"Our philosophy for inspections is to use the most effective accessibility techniques necessary to ensure we see everything. We often combine mechanical access equipment, such as underbridge and snooper trucks, with rope-access techniques, especially on major bridges," says Ellis.

Such inspections can create challenging situations. This was the case during the inspection of the 1896-ft-long Mike O'Callaghan–Pat Tillman Memorial Bridge, 870 ft above the Colorado River and downstream from the Hoover Dam. Working for the Nevada Department of Transportation, Stantec provided the first routine inspection of the massive structure while under live traffic in 2013, and then inspected it every other year through 2019.

In 2019, the inspection crew finished its work on the concrete, open-spandrel arch structure in only six days, using rope access. The structural engineering climbing team followed practices of the Society of Professional Rope Access Technicians, Ellis notes. "It was a complex, hands-on inspection."

The company is evaluating new inspection tools, including drones. "We're looking internally to see how we can best utilize them to provide the appropriate level of inspection for each bridge," says Ellis. "They definitely show promise, but we have to determine what value is there and if we can use them effectively."

Rehabilitation Work

The growth in inspections has in turn led to an increase in rehabilitation work. "Often, DOTs are looking to extend the service lives of their existing bridges rather than replacing them completely," Ellis says.

Bridge decks are usually the first area targeted for replacement, but joints typically receive the most attention. "Joints are the number-one challenge for existing bridges, because they can lead to deterioration of the underlying girders and substructure piers and caps. The biggest part of our rehabilitation work is addressing deterioration under the joints," says Ellis. To aid that work, Stantec incorporates new patching techniques and protections, such as galvanic-anode and other active cathodic protection systems.

Hunley currently is leading Stantec's work on a major bridge rehabilitation and replacement initiative for the Kentucky Transportation Cabinet. To reduce the number of substandard bridges, which reached more than 1000 in 2018, Kentucky launched Bridging Kentucky, an ambitious six-year, $700 million program designed to restore state and locally owned bridges.

Stantec is serving as the prime consultant, along with QK4 Inc. and AECOM as lead partners. The project team also includes 22 engineering, environmental, and specialty firms. "We are performing a full-service effort: program management, evaluation, asset management prioritization, rehabilitation or replacement designs, and construction-phase support," Hunley says. The firms are taking a programmatic approach, bundling bridges by type and location rather than letting contracts bridge by bridge, and they are using both traditional design-bid-build and design-build contracts.

A customized life-cycle cost evaluation was performed for each bridge considered for rehabilitation or replacement, which determined that about 40% of the structures could be rehabilitated. As of August 2019, Kentucky had awarded $113.8 million in construction contracts for 190 bridges, and its costs were more than

The precast concrete deck panel design combined with the use of high-performance cast-in-place concrete allowed the Terwillegar Park Footbridge to maintain a thin deck profile that minimized the environmental and visual impact of the bridge on the North Saskatchewan River valley.

20% below anticipated budgets. By mid-2020, contracts for more than 450 bridges will be let.

Kentucky's rehabilitation projects are designed for a minimum design service life of 30 years. Concrete repair methods for these projects will involve determining the best patching approach, resolving the source of the deterioration, and proactively protecting new and existing concrete surfaces from water and chloride infiltration by sealing repaired substructure concrete with a high-quality epoxy-coating system.

Since the launch of Bridging Kentucky, more than 150 additional bridges have been determined to be substandard due to condition or necessary weight restrictions. "Kentucky was slowly losing ground to deterioration faster than it could replace bridges," Hunley says. "By addressing 1000 of the worst bridges in the inventory in a short period of time, the Bridging Kentucky program will allow the state to turn the tide and be in a position to maintain and improve the overall condition of their bridges into the future." (See the Fall 2019 issue of *ASPIRE*® for a State article on Kentucky with more details of the Bridging Kentucky program.)

Signature New Construction Projects

At the other end of the spectrum, Stantec has recently been involved in major new bridge projects, including projects using alternative project delivery methods, such as design-build and public-private partnerships.

"DOTs have tight budgets, and while they are stretching their resources, they also have to address their biggest problems, and that often means their largest or most complex bridges or major corridor improvements that include a large number of bridges," says Hunley. "What we don't see as much right now is the average, routine bridge replacement. There are far fewer of those being done individually."

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One notable construction project is the Terwillegar Park Footbridge over the North Saskatchewan River in Edmonton, Alberta. Stantec designed this bridge—Canada's longest stress-ribbon bridge and the second longest in the world—to link Terwillegar Park with an existing trail system on the other side of the river. Spanning 859 ft 6 in., the structure is the first of its kind in Edmonton and the northernmost bridge of this type in the world.

"This bridge structure was only possible through advancements in concrete products," says Ellis, who served as project leader. "The City challenged engineering firms to propose a solution that would be innovative, have a low impact on the river valley both environmentally and visually, and then achieve these goals within a tight budget and timelines."

The stress-ribbon bridge achieved the goals by using precast, prestressed concrete. "It allowed for efficient and cost-effective construction, producing a slender and elegant bridge form."

The superstructure consists of 86 precast concrete deck panels and is supported by bearing cables cast into the deck with 7.3-ksi high-performance cast-in-place concrete. This design allowed the panels to be cast only 16.3 in. thick. "This option was the most economical and best met the City's vision and sustainability goals. And it was delivered on schedule and within budget."

Design-build delivery methods often provide the best approach for large projects, Hunley notes, as they allow the design team to leverage their expertise and collaborate with the contractor to create efficiencies. That approach worked well for the U.S. Route 460 Connector project on the Virginia-Kentucky border through the Appalachian Mountains. The project included the Grassy Creek Twin Bridges, two six-span, 1733-ft-long structures that feature a four-span cast-in-place segmental concrete box-girder unit with 489-ft-long main spans and two approach spans with precast concrete I-beams. The depths of the segmental box girders varied from 12 ft 6 in. at midspan to 30 ft 3 in. at the piers.

For this project, Stantec managed field surveying; geotechnical, roadway, and structure design; permitting; right-of-way planning and mineral acquisition; and relocation of utilities and a small cemetery. At more than 250 ft high, the two cast-in-place, post-tensioned segmental bridges are the highest in Virginia.

Stantec was the overall project design manager in a design-build contract for the Grassy Creek Twin Bridges, a part of the U.S. Route 460 Connector project in Virginia. Each of the two 1733-ft-long bridges features a four-span post-tensioned segmental concrete box-girder unit and two approach spans with precast concrete I-beams.

"The key challenge was the extremely steep mountain slopes at each end," explains Hunley. "We used long spans to minimize the impact of cutting into the slope to create foundations and potentially undermine the next pier. Terrain issues were a huge concern and drove the design and construction methods."

The segments were constructed from the top down, using a form traveler along with tower cranes. "We needed as much access as we could achieve in an isolated area," Hunley says. "It was unusual to see tower cranes usually used for tight, urban high-rises working in this very rural location." (See the Fall 2014 issue of *ASPIRE* for a Project article on the U.S. Route 460 Connector.)

Leveraging the Benefits of Concrete

These projects show some of the ways Stantec has been leveraging concrete's capabilities to meet bridge challenges. "Concrete designs are preferred by many owners," notes Hunley. "There are always regional preferences, but it is the workhorse for small- to medium-span bridges. We can tailor it to their needs, and they see durability and reduced life-cycle costs."

Service life is a dominant focus today among owners. "For major bridges, they're often looking to achieve 100 years of service in the initial design and construction," says Hunley. For that reason, Stantec designs projects with long-term maintenance in mind. "We emphasize clean, simple details, eliminating joints, and using replaceable bearings."

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Concrete suppliers are aiding that work. "There is more attention paid to mix designs, admixtures, exposure zones, and salt resistance," explains Hunley. "We're providing more reinforcement bar cover and increased corrosion-resistant reinforcement to aid those changes, and suppliers are responding with concrete mixtures with higher strength and improved beam shapes, which are helping us meet the needs."

ABC Solutions

New techniques are needed to meet current and future challenges. "The biggest challenge we face today is designing in difficult conditions under ongoing traffic," says Hunley. "Accelerated bridge construction (ABC) methods are becoming vital to minimize construction delays."

Stantec has used a variety of ABC approaches, including prefabricating as many components as possible to assemble quickly at the site. "This approach is used most often where there are lower volumes of traffic," says Hunley. Stantec recently completed two ABC projects in Connecticut using precast concrete elements for abutments and wingwalls.

The company also has been involved with sliding structures into place using various types of equipment. "Owners are becoming more aggressive in returning roads to users quickly, so they're looking at more options. As some become comfortable using ABC, other owners are warming to it when they look for those benefits too."

One such project was the Interstate 84 Bridges over Marion Avenue in Southington, Conn., where all three lanes of traffic in each direction had to remain open during construction. The twin bridges featured Prestressed Concrete Committee for Economic Fabrication (PCEF) 47-in.-deep beams. Two sets of self-propelled modular transporters—one for each bridge—were used on the project. (See the Summer 2015 issue of *ASPIRE* for a Project article on these bridges.)

Staying open to new ideas and adopting new techniques will keep Stantec moving forward. "We anticipate an increase in more efficient concrete beam shapes to extend spans even further," says Hunley. "We're seeing more shapes being tried by several owners. And more DOTs are gaining comfort levels with accelerated bridge construction, post-tensioned concrete bridge designs, and enhanced rehabilitation strategies for extending service life of bridges."

Stantec's Service

Stantec was founded in 1954 as D.R. Stanley Associates in Edmonton, Alberta, by Donald Stanley, the first Canadian to earn a PhD in environmental engineering. After expanding through a variety of acquisitions, the company was reorganized in the early 1990s as the Stanley Technology Group. The company went public in 1994 as Stantec.

Stantec has continued to expand through acquisitions, adding more than 130 firms since it went public. It has approximately 22,000 employees operating out of more than 400 offices in North America and globally.