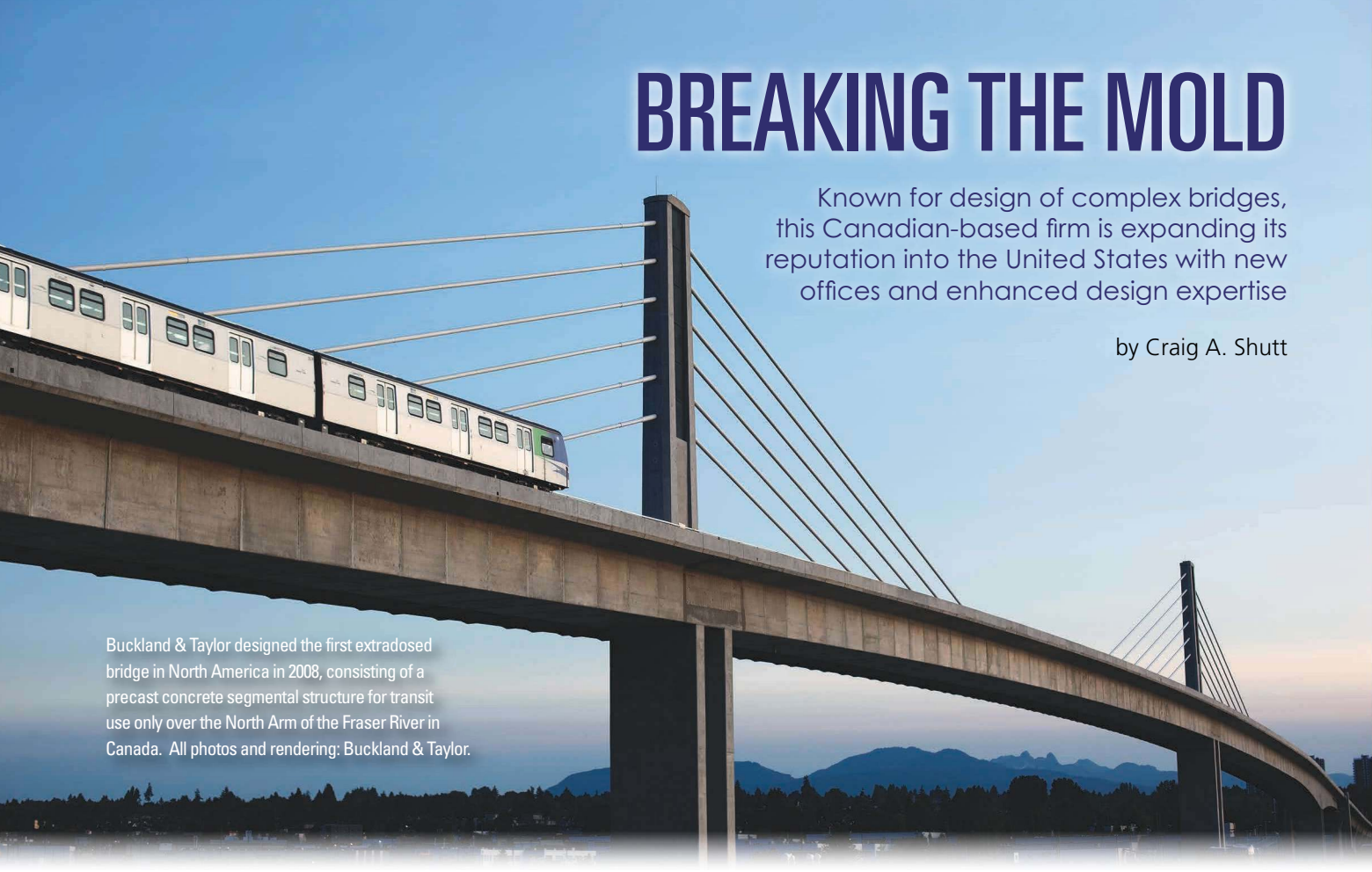
BREAKING THE MOLD

Known for design of complex bridges, this Canadian-based firm is expanding its reputation into the United States with new offices and enhanced design expertise

by Craig A. Shutt



Buckland & Taylor designed the first extradosed bridge in North America in 2008, consisting of a precast concrete segmental structure for transit use only over the North Arm of the Fraser River in Canada. All photos and rendering: Buckland & Taylor.

During its 42 years of operation, Buckland & Taylor (B&T) has developed a reputation for taking on complex projects, often with cable-stayed or suspension bridge designs. In recent years, B&T has also been expanding its business into the United States and bringing a wider range of project types with them. B&T's bridge experience in the United States began with construction and erection engineering on complex projects. Since 2010, as work to replace America's infrastructure increased, B&T has expanded its scope to provide design services on projects of varying complexity.

"We're known for doing cable-stayed bridges, but I'd like to change and broaden that perception," says Darryl Matson, president and CEO of the North Vancouver, BC, Canada-based engineering firm. "And we've taken a very strategic and systematic approach to expanding our business and changing that view."

Adds Scott Roux, vice president of U.S. operations, "of the more than 2000 projects we've completed, the vast majority are bread-and-butter, short- and medium-span bridges. We have a reputation for being the foremost expert on cable-stayed bridges and being well-versed in suspension bridge designs. But we are working to educate clients about our capabilities beyond these long-span, complex bridges and assure them that we can execute less complex, smaller designs with great success too."

An example can be seen in the 80th Street Overpass in Delta, BC, Canada. The $12-million, grade-separation structure over BC Rail comprises a 107-ft-long, two-lane bridge featuring precast concrete box beams. The simplicity of B&T's design helped win the job for the design-build team with both savings in cost and minimal rail traffic disruption.

Even so, the firm's capabilities with complex projects and innovation have led it to create a variety of world firsts. Among these is the Alex Fraser Bridge in British Columbia in 1986, which provided the first use of a composite-deck for a cable-stayed bridge.

The firm's reputation for cable-stayed bridges has developed since the firm's earliest days, Matson says. "Cable-stayed bridges are high-tech designs, and we've consciously tried to grow our expertise in that area since the company was started," he says. "They're incredibly cost-effective designs, especially with main spans of 750 to 2000 ft. They're fairly straight-forward and efficient structurally, and that's a good combination."

Cable-stayed bridges' use of concrete or steel girders varies, he notes, depending on the situation and bridge length. But the towers, deck, and other components almost always are concrete. "Cable-stayed bridges can be said to really be concrete bridges hiding a little bit of steel."

Extradosed Designs Expand

The firm is taking its knowledge of cable-stayed bridges and applying it to extradosed bridges on a more regular basis, Matson notes. Five such projects have been completed in North America, and B&T has been involved in four of them—and the fifth, in Texas, was designed by an engineer now working in the company's New York office. "Our firm easily has the most experience with

The St. Croix River Crossing from Oak Park Heights, Minn., to St. Joseph, Wis., features an extradosed bridge design, in which post-tensioned box-girders are supplemented with post-tensioning outside the box sections. The external post-tensioning helps support the loads but provides a shallower cable inclination and shorter towers.

North American extradosed bridges," says Roux.

The concept features post-tensioned box-girders with post-tensioning outside the box sections, which serve much like the cables in a cable-stayed bridge but have a shallower inclination, Roux explains. "It precompresses the deck, so loads are shared between the cable stays and the girders. Extradosed bridges can fill an interesting niche in span length for cable-stayed bridges, and they're quite cost-effective at those lengths."

The design has been used in Europe and Asia for decades and has spread to other countries in past years for medium-length spans. "It's taken a long time for them to work their way over here," says Matson. "They're very effective, because there's a gap in the 350- to 750-ft span length, where it is harder to make a cable-stayed span efficient. That length is where extradosed bridges are most effective, so they're being considered more often."

The firm designed the first extradosed bridge in North America in 2008, a precast concrete segmental structure for transit use only over the North Arm of the Fraser River between Vancouver and Richmond, BC. The structure features two 143-ft-tall pylons and two approach piers on each side. The 590-ft-long main span provides comfortable clearance to the 492-ft-wide main navigation channel, while the 456-ft-long side span easily clears the 187-ft-wide north navigation channel. "The substructures avoided direct encroachment on the environmentally sensitive shoreline areas of the Fraser River," explains Matson.

The most recent extradosed project is the St. Croix River Crossing from Oak Park Heights, Minn., to St. Joseph, Wis., which is scheduled to open in the fall of 2016. A joint design-bid-build project of the Minnesota and Wisconsin Departments of Transportation, the new four-lane structure connects highways on either side of the St. Croix River, replacing an 80-year-old lift bridge. The total length of the bridge is 5579 ft. It features a 3360-ft-long main bridge with five, 600-ft-long extradosed segmental concrete spans and several segmental concrete box girder approach spans.

"The extradosed design was chosen due to the natural environment," Roux says. "The DOTs wanted smaller towers so as not to overwhelm the site with higher towers required by cable-stayed designs." The towers use cast-in-place concrete

The $12 million 80th Street Overpass in Delta, BC, Canada, is a design-build project encompassing 500 ft of road upgrades, retaining wall designs using lightweight backfills, and a 107-ft-long concrete bridge.

The South Fraser Road project, a public-private partnership completed on a design-build basis, involved 16 bridges along a 25-mile-long, four-lane highway in Vancouver, BC, Canada. The bridges feature mostly precast, prestressed, concrete girders due to site conditions and the ability to reduce costs by repeating the design and gaining efficiencies of scale. From top, Ladner Trunk Road, Highway 99, and BNSF viaduct.

with large cutouts and fins to add visual interest. The bridge also features a shallow section, which challenged the designers. "The DOTs liked the low maintenance and high durability aspects of concrete, and this design eliminated two towers in the river, which saved material cost and construction time. It was one of our most complex assignments to date, in terms of design."

Throughout its history, B&T has thrived on such complexity, says Matson. "We really love a challenge, something that takes a lot of structural understanding as well as requiring solutions that have never been used before. We strive for innovation in our designs, to come up with a better mousetrap that's cost-effective."

A recent complex project required designing 16 new bridges on the South Fraser Road, a 25-mile-long, four-lane highway along the south side of the Fraser River in Vancouver, BC, Canada. Delivered in a design-build format as a public-private partnership (P3) project, it used primarily precast, prestressed concrete girders to complete bridges with single spans ranging from 34 to 164 ft.

"We are best known for our long-span bridge work, but our workload is actually well balanced between long-span bridges and projects with a variety of more conventional bridges, including new design, inspection, load rating, and rehabilitation," says Matson. "There are challenges associated with bridges of all sizes, and we take on all of them."

The precast, prestressed concrete girders and partial-depth precast concrete deck panels used for most bridges on the project helped control costs, he explains. "The repeated use of standardized details on many bridges drove down construction costs by amortizing the initial set-up costs over several bridges. Vancouver has a very capable precasting industry, and we made use of forms that local precasters already had available, contributing to cost-effective designs."

P3 Projects Popular

The company is doing more P3 projects, says Matson. "P3 projects are definitely growing, and it fits with our background. We've been doing design-build projects for 20 years, and they've become a fairly significant portion of our business." The company's founders, Peter Buckland and Peter Taylor, worked originally with fabricators and erectors, so constructability and contractor relationships have been ingrained since the company began.

P3 projects put more emphasis on durability, operations, and maintenance. "In a sense they are the natural evolution to the fundamental design principles and relationships Buckland & Taylor preached early on," he says. The P3 approach was one driver for the design on the South Fraser Road project, notes Roux. "With P3 projects, you want to find solutions that are repeatable and offer efficiencies. You also want to maximize durability, because the concessionaire will be maintaining the project."

While P3 projects generally put more emphasis on long-term durability than most public projects can, Matson says, and they can take more risks. "In some cases, the concessionaire will build more bridge than is currently needed to anticipate adding revenue in the future. They will sometimes pay upfront for higher-quality materials that will guarantee longer life and pay off in the long run. Governments can't always take that approach."

B&T's relationships with contractors make them prime candidates for these projects, Roux says. "Other companies have to really press to get

involved, but our phone often rings with calls from contractors wanting our involvement. It's a nice position to be in." For one recent project, the Tappan Zee Bridge in New York State, the firm was invited to join all four teams bidding on the $3.2 billion project. In those cases, the company picks a preferred team and works with it exclusively.

"Our experience level on design-build and P3 projects is unmatched in North America," says Roux. "It's a big differentiator for us. Canada has been at the forefront of P3 projects, and the trend is moving into the United States. That's great for us."

Such projects also have frustrations, he says. The firm worked on a bid for the Goethals Bridge replacement in New York City, N.Y., and the designers' plan offered the lowest initial cost and the highest technical score. But the plan's 30-year operation and maintenance budget came out higher than others, so they lost the bid. "Engineering is further from the final decision point in P3 projects, and we often can't influence those costs, which is sometimes frustrating."

ABC Solutions Grow

P3 projects also are driving innovations in accelerated bridge construction (ABC) techniques, says Matson. "The faster the bridge is finished, the faster it creates a revenue stream. There are getting to be tremendous time pressures on all types of bridges." The St. Croix project, for instance, was a design-bid-build project completed on a design-build schedule, says Roux. "Typically, design-bid-build projects have more forgiving design schedules, but time was of the essence. We were going flat-out to finish, and it was done in record time. It was really intense."

"There's definitely more ABC usage today," says Matson. "Owners are more open to ideas due to time constraints. We're seeing more possibilities for sliding bridges into place and other alternatives." Owners also are more interested in rehabilitating bridges or replacing only the superstructure and retaining piers to obtain speed and cost benefits. "Demolishing a bridge and building new can take 2 or 3 years, and the public can't do without the bridge for that long," says Matson. Even reusing the original alignment can save significant time.

Several creative ABC techniques were used to build the new Capilano River Bridge in West Vancouver, BC, Canada. The existing two-span, steel-truss bridge was slid upstream of its original alignment to serve as a temporary bridge during construction. The new structure, which included concrete piers and deck, was erected on the existing alignment, speeding construction and minimizing construction needs.

'Systematic' Expansion

B&T's focus on large, complex projects has led to dramatic growth in the past four years. "In 2010, we saw the substantial size of upcoming major projects," Matson explains. "We asked how we could do as much work as possible with big, signature projects. At our size then (70 people and one office), we estimated we could do only one project. We wanted more, but that meant we'd have to grow and find people to bring onto projects."

The firm devised a plan that has led to six offices and 185 people. It currently works on four major projects of more than $1 billion in size. "We anticipate staying at this size into 2015," he says. "But we're tracking 13 projects currently that are in excess of $1 billion. So we may need to grow again in the future to gain more of this business."

B&T also is expanding its skill set, with such projects as the Oculus, the $3.7 billion Multi-Modal Transportation Hub in the World Trade Center complex in New York City, which will open in 2015. "It's a challenging and complex project that stretches our expertise, which is what we like most," Roux says.

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