OBEC Focuses on Key Niches

by Craig A. Shutt

Several key areas of expertise—with innovative designs in each—keep OBEC on a successful track

Since it opened in 1966, OBEC Consulting Engineers has been a driving force for evolutions in Oregon's concrete bridge designs. Those efforts continue today, with new concepts for pedestrian bridges, arched bridges, rehabilitation, and high-performance concrete.

"We've done a lot of prestressed concrete slabs and bridges over the years, but we've grown a lot," says Guy Hakanson, vice president of technical services for the Eugene, Ore.-based transportation-engineering consulting firm. "We work on a variety of transportation projects, including many types of concrete bridges, from start to finish. And we've expanded to include roadway and heavy civil projects."

The firm's "concept-to-construction" approach to project creation gives them a unique perspective on constructability and meeting transportation officials' needs, he says. "We pride ourselves on being able to take a project from initial design through completion of construction. And the quality of the product we produce is viewed by a variety of clients as very high."

In recent years, that has meant about 90% of their bridges feature cast-in-place and precast concrete designs, he says. "We try to meet the owners' needs, and many of them prefer concrete bridges for a variety of reasons, including long-term, low maintenance, durability, and competitive initial costs."

Tradition of Advances

From its earliest days, the company gained a reputation for innovation with its designs for precast concrete, notes Larry Fox, who was named OBEC president last year. That work began with founder Lou Pierce, who produced a variety of designs that advanced the concepts of precast, prestressed concrete bridge design in the late 1960s. The company was the first in the nation to design a segmental, precast, post-tensioned concrete girder bridge, which was used over a county river.

"His goal then, as with many of the designs we do today, was to minimize piers in the river and minimize the use of falsework," explains Fox. "That often leads us to precast concrete designs. We did quite a few early on, and we still do them today." To aid that, the firm helped the Oregon Department of Transportation devise precast concrete girder cross sections that are more efficient than the standard AASHTO girders, he notes.

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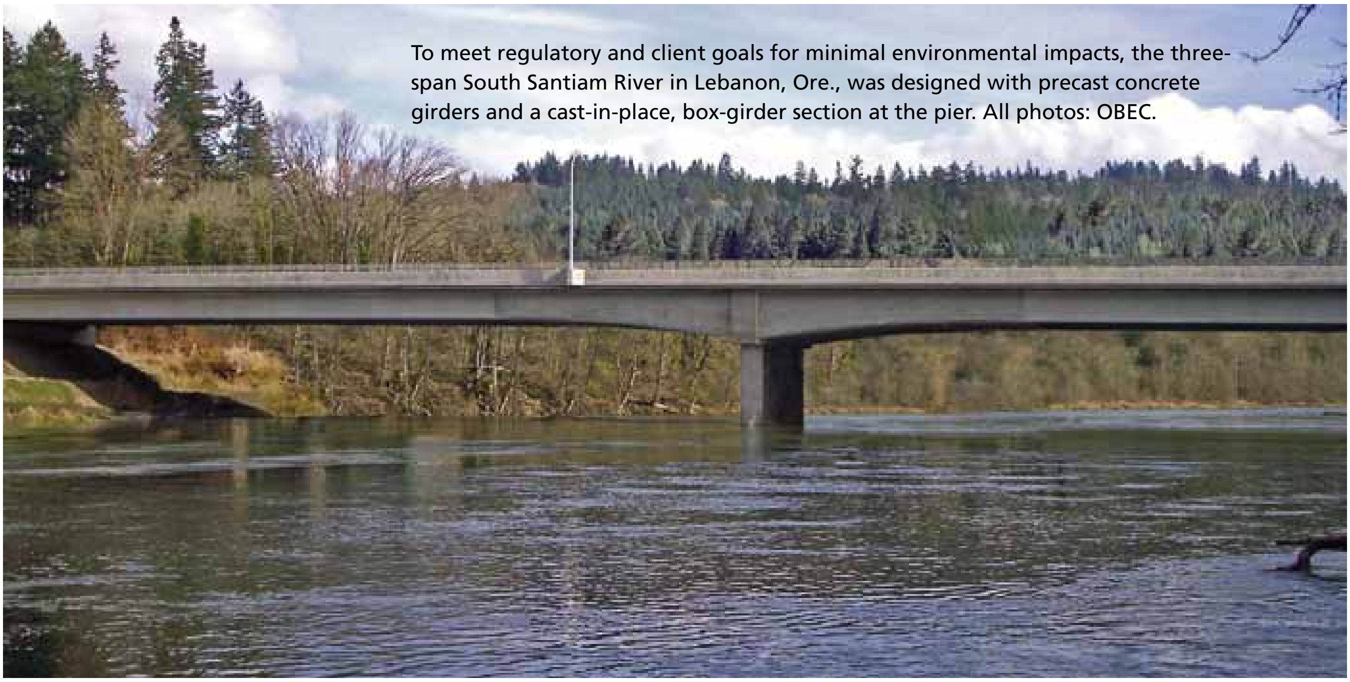
An example of their segmental work is the South Santiam River (Grant Street) Bridge in Lebanon, Ore. The three-span, 495-ft-long structure features a combination of precast and cast-in-place concrete sections. It consists of a 55-ft-long precast, prestressed concrete slab approach span and two main spans. The center pier between the main spans supports a variable-depth cast-in-place (CIP) box girder, which extends into both spans. The remainder of each span comprises precast concrete girders that are connected to the box girders with CIP closures and post-tensioning. "The design was created



To meet regulatory and client goals for minimal environmental impacts, the three-span South Santiam River in Lebanon, Ore., was designed with precast concrete girders and a cast-in-place, box-girder section at the pier. All photos: OBEC.

The I-5 twin arch bridges in Eugene, Ore., now under construction, are the largest concrete arch spans to be built in the state.

in part to address regulatory and client goals for minimal impacts at the environmentally sensitive site," says Fox.

Willamette River Bridges

OBEC continues to push the boundaries of concrete bridge design, as seen in its work on the twin I-5 bridges over the Willamette River, now underway. The project features 1759-ft-long and 1985-ft-long structures including main arch spans of 390 and 416 ft cast with 6 ksi concrete. A girder-floor-beam-slab system comprises the superstructure, with one girder in the vertical plane of each arch rib. The project is ODOT's largest to be completed under the Oregon Transportation Investment Act of 2003 and the largest Oregon concrete arch bridge.

The complete project features a combination of bridging techniques including a cast-in-place, post-tensioned, concrete girder span with two, concrete deck arch main spans crossing the Willamette River. In addition, three spans of cast-in-place, constant-depth, post-tensioned, box girders extend over Franklin Boulevard, and three or four spans of cast-in-place, haunched, post-tensioned, box girders are used over railroad tracks, and an exit ramp.

"The desire for a signature bridge that provided very little environmental impact led us to these long concrete arch spans," says Hakanson. "They created an efficient, cost-effective approach that produced a tiny touchdown spot in the river for a very big bridge."

The design builds on another of the company's well-regarded projects, the Maple Avenue Bridge in Redmond, Ore. Design similarities include slender, unbraced ribs, composite crowns for lateral stability, compact support rib intersections, double columns for bearing-free thermal joints, and clean lines with an uncluttered appearance. (For more on the Willamette project, see the Summer 2012 issue of *ASPIRE*™; for more on Maple Avenue, see the Winter 2009 issue.)

Pedestrian Bridges

The company also has made a name for itself with distinctive pedestrian bridges. "Oregon has a reputation for being progressive in its design of multi-modal transportation facilities, and we have worked closely with state and local agencies on many of these," says Fox. "There definitely is an opportunity here for pedestrian bridges."

The company's work dates to the 1990s, when Fox collaborated with California-based consulting engineer Jiri Strasky, who designed one of the first precast concrete, stress-ribbon bridges in the Czech Republic. They met while Fox was employed in California, and he worked with Strasky on the first stress-ribbon bridge built in the United States in Redding, Calif.

The design uses precast concrete deck panels supported on bearing cables and post-tensioned to create long-span bridges. Cables are buried in the deck, creating a slight sag that replicates the look of a rope bridge, he says. "But they're extremely rigid and amazingly solid."

The firm produces a variety of styles of pedestrian bridges, including signature cable-stayed designs. The Delta Ponds Pedestrian Bridge in Eugene, Ore., for instance, is a 760-ft-long concrete bridge with a 340-ft-long, asymmetric,

The 760-ft-long Delta Ponds Pedestrian Bridge in Eugene, Ore., features a 340-ft-long, asymmetrical, three-span, cable-stayed section with fanned stays.

The Maple Avenue Bridge in Redmond, Ore., features cast-in-place concrete arches consisting of two side-by-side ribs fixed at the base while pinned to and continuous across the intermediate footings.

three-span, cable-stayed section with fanned stays. The main span features partial-depth precast concrete deck panels with cast-in-place composite topping for a maximum thickness of 1 ft 2¼ in., post-tensioned with adjacent cast-in-place concrete spans. (For more on this project, see the Spring 2012 issue of *ASPIRE*.)

"We've developed a strong expertise, which leads to more projects," Fox notes. "We've been contacted by officials around the country who have seen reports on our bridges, including those in *ASPIRE*. That's helped spread the word outside Oregon."

Community Gateways

Pedestrian bridges often feature signature styling, he notes, because they serve as gateways to communities or as landmarks for pathways. "Communities don't want just plain appearances for these structures. And the technology is economical." The firm produces many of these designs for under $400/ft^2.

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"We often use cable-stayed designs because form should follow function," says Hakanson. "Owners want low profiles and shallow walking surfaces to provide high clearance. So the choices result from a combination of logistics and aesthetics."

This design style can add cost to the structure, he notes, but it pays off with less long-term maintenance and reduced approach-path work. "The bridges aren't as high, so they require fewer mechanically stabilized earth walls, and they're more user-friendly because they're not higher than the surrounding paths, making it more efficient to meet the Americans with Disabilities Act requirements."

In addition to its pedestrian bridges, the firm also has gained renown for its work on bike trails, paths, and covered bridges. Although these bridges typically replicate original timber-covered designs, the foundations usually are cast-in-place concrete, he says.

Arched Bridges Grow

The company has developed a strong expertise in arched construction, too, which often replicates existing designs. "Cast-in-place, concrete-deck arch bridges have definitely become a strong niche for us," says Fox. "They're usually modern versions of traditional styles."

The inventory of such work derives in part from renowned bridge designer Conde McCullough's designs in the 1920s and 1930s, especially along Oregon's coast. "He created a number of beautiful arched bridges that are being preserved today," Fox explains. OBEC's updated approach includes eliminating spandrel columns wherever possible. They also minimize transverse cross bracing between arch ribs by making the arches monolithic with the superstructure at the arch's crown.

The Maple Avenue design featured dramatic cast-in-place arches, consisting of two side-by-side ribs fixed at the footing while pinned to and continuous across the intermediate footings. Each of the three continuous 210-ft-long arch spans has a different parabola to conform to the contours of Dry Canyon, which it spans.

"Our goal is to add modernizing features to create a similar appearance to Oregon's historic arch bridges while enhancing the aesthetics created with our designs," Fox says. "But we also want to provide as few structural columns and braces as possible, because that makes them easier to maintain."

Rehabilitation Work Expands

Easy maintenance has become a watchword with bridge officials today, both engineers agree, as funds must stretch further. For that reason, the firm has found a strong niche in rehabilitation. "We have seen a huge push for funding more rehabilitation, due to the aging of infrastructure and the current funding constraints," says Fox. "We've created a good niche in that area and have helped ODOT with a number of projects."

One recent innovative design repaired the Oregon City Arch Bridge, a Conde McCullough design. The $10.6-million rehabilitation project used creative concrete techniques to rehabilitate the 755-ft-long bridge, which was built with structural steel covered with gunite, cast-in-place concrete, and other coatings. The weakened structure required extensive repairs, including a new concrete deck overlay and replacement of a variety of concrete elements, including floor-beam end and hanger concrete, arch-chamber bottom slabs, sidewalks, railings, and pylons.

Shotcrete replaced the deteriorating gunite. "Finding the proper mix to accurately create the concrete encasements that would stick to the original steel was more challenging than we expected," Fox explains. "But we expect to see a lot more of such unusual work as we deal with our aging infrastructure. We have a responsibility to maintain our historic bridges whenever possible."

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Concrete Advances

Creating new concrete mixtures offers great potential, Hakanson notes. The firm has been experimenting with various high-performance concrete options, to improve durability rather than strength. "Oregon has a wet climate, along with salt water along the coast, so we're looking at a variety of additives to decrease permeability." Durable deck concrete offers great opportunities, as decks experience the most exposure to weather and therefore need the greatest protection, Fox notes.

For a recent bascule-bridge replacement, the owners required a 5-in.-thick concrete deck and demanded that it be crack-free. "It was a major challenge," Fox says. "But we did extensive research and found a mix design that worked."

The firm also is frequently using a "quaternary" concrete that blends cement, fly ash, silica fume, and slag cement. "The chemistry of the four creates reactions that produce catalysts that create additional reactions. The end result is lower permeability and increased durability," explains Hakanson. "It becomes greater than the sum of the parts."

OBEC also is adding reinforcing fibers to key concrete areas. "We've achieved pretty high-quality results, and we expect to be able to build on that for future designs."

Hakanson also has seen impressive results from increasing the amount of slag cement in concrete. "I look at it from a material properties standpoint and see advantages, while owners and suppliers see it as a green product that reuses waste products," he notes. "It also can decrease costs and improve durability. So there are many good reasons for its use to grow."

Those capabilities will expand as owners stress doing more with less, Fox says. "Transportation dollars are becoming more constrained, so rehabilitation will be used to help spread funds to more locations to keep bridges open. It may not be the ideal approach, but it's practical, and that's the philosophy that will be needed."

A complex rehabilitation project of the Oregon City Arch Bridge used an innovative, custom shotcrete mix specifically designed to adhere to the existing steel.

46 Years of Designs

The Oregon Bridge Engineering Co., Consulting Engineers, was founded in Eugene, Ore., in 1966 by partners Wally Palmateer and Lou Pierce.

The partners split off from Hamilton Construction Co., creating such early designs as the Mary Beckley cast-in-place concrete replacement bridge in Elkton in 1966 and the Seven-Mile Bridge for Weyerhaeuser Co. in Coos Bay in 1967.

The company, which shortened its name to OBEC in 1977, currently has 102 employees in five offices, with most located in the Eugene headquarters. The other offices comprise Salem, Medford, Lake Oswego (which in February moved to a larger location), all in Oregon, and their newest office in Vancouver, Wash.

OBEC understands the market's realities, too. It has begun expanding its efforts in other fields, such as non-highway transportation projects, including water reservoirs. "We developed that work early on, but recently we have begun to grow that segment to become more diversified and find new ways to help owners," says Fox.

Such new challenges keep the designers excited, Hakanson says. "Owners are developing new requirements, which make each job a new challenge. But that's what keeps us going and drives our work. It's fun to attack new challenges to find the best solutions."

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