

Diversification Brings Growth, Innovation

Burns & McDonnell's engineering construction allows it to incorporate best practices that create innovative bridges

by Craig A. Shutt

Burns & McDonnell's 114-year history shows the firm has staying power. It owes that longevity in large measure to its diversification of services and markets, which not only helps it weather economic storms, but allows it to apply new ideas and best practices to other fields.

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"Our diversification across many markets—transportation, energy, industrial processes, transmission and distribution, federal, and aviation,

among others—ensures that we can retain a stable base and create steady growth even as individual markets go up and down," says Ben Biller, general manager of the firm's Transportation Global Practice. "Some of our competitors have retrenched in the last few years, but we've invested and grown. That allows us to always have the resources at hand to serve our customers, and that gives them confidence in us."

Two Additions

Recent growth has been solidified by two additions: the July 2010 merger with bridge-design firm Harrington & Cortelyou Inc. (H&C) and the addition of Steve Hague, formerly with HNTB in Kansas City, as chief bridge engineer.

"Burns & McDonnell has traditionally not pursued acquisitions as a growth

strategy," says Greg Graves, chairman/CEO. "But this opportunity to merge with a highly respected firm with historic roots in Kansas City was too good to pass up." Its background with design-build projects made it especially attractive, says Biller. "Design-build is increasingly the contracting method of choice."

Formed in 1907, H&C had worked as a subconsultant to Burns & McDonnell, explains Kevin Eisenbeis, who was principal at H&C prior to the acquisition. "We had experience with design-build projects but were too small to compete for many larger projects," he says. "We also had design capabilities for bridge types they did not, such as major river crossings and movable structures. It created an outstanding strategic mix." The company cultures also were similar, as both are employee-owned.

The I-470/Route 50 Interchange in Lee's Summit, Mo., features two horizontally curved 1200-ft-long viaducts and two horizontally curved 1500-ft-long flyovers. Some 25 spans of prestressed concrete NU girders were used, saving more than \$6 million over a steel alternative. All photos: Burns & McDonnell.



Hague's addition in 2011 strengthened the company's design skills and helped expand its scope, particularly its expertise in cable-stayed bridges. "His expertise sends a strong message that we are here for the long term," says Biller.

Burns & Mac, as they call themselves, also has differentiated itself by splitting revenues evenly between engineering and construction, Biller adds. "It's an intentional balance, because it's very good for us to see both sides." The company constructs only projects it has designed, which fits with its emphasis on design-build projects. "Design-build is growing in the transportation industry, but it is definitely behind other markets. It's time it entered the design-build market on a larger scale."

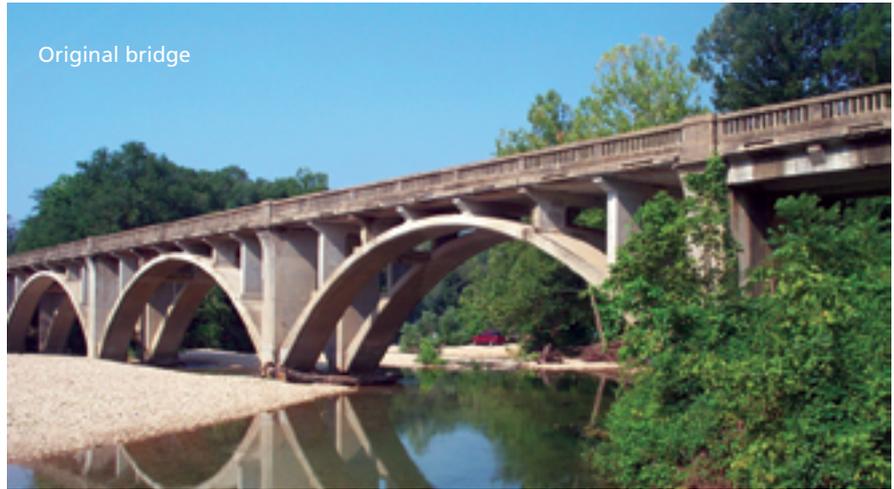
Design-Build Grows

The firm formed a Design-Build division in 1995. Headed by Don Greenwood, the group's 500 staffers work across all markets. "The division has greatly elevated our work in this delivery method, and we are now bringing it to this part of the company," says Biller.

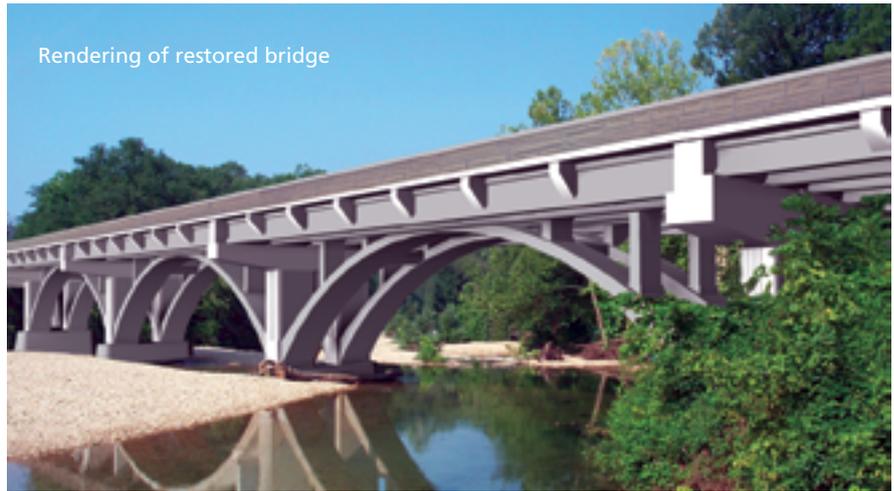
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More states are embracing design-build methods, he notes, and Burns & Mac is encouraging that trend. Recently, Burns & Mac helped the Kansas Department of Transportation create a design-build policy that goes into effect in 2014 with the \$250-million, I-435/I-35/K-10 Interchange, phase two of the Johnson County Gateway. "They saw in us a group that knew the best practices across the country so we could create an approach for their design-build projects that would be efficient."

States are more interested in design-build methods as they are pressed to do more with less. "Design-build will continue to grow as states see what others are doing and want to tap into those efficiencies," Biller says. "It causes them to get outside their comfort zone and look at projects in new ways, which



Original bridge



Rendering of restored bridge

A precast concrete solution allowed the attractive arches on the Sinking Creek Bridge in the Ozark Scenic Riverways National Parkland to remain in place while appearing to support the bridge loads.

carries more risk. But if we can show them that those ideas have worked on other projects, the results speak for themselves."

As lead design consultant, Burns & McDonnell's recent design-build solution for the \$117-million, Daniel Boone Missouri River bridge replacement project near St. Louis maximized mobility, capacity, and safety improvements in the I-64 project corridor. Precast, prestressed concrete NU (Nebraska University) girders, used in new approach spans and a new highway overpass, contributed to the successful solution.

Railroads Support ABC

Design-build concepts help achieve faster construction, which is being aided by a variety of accelerated bridge construction (ABC) methods. The firm has significant expertise with ABC techniques, as they have long been used for railroad bridges, where the

company has substantial experience. "Railroad bridges are similar to highway bridges in their designs except for the significantly higher live loads that have to be accounted for," says Eisenbeis.

Concrete girders, especially double-cell box beams, are popular with railroad companies. The Union Pacific and BNSF railroads have created standardized designs that feature 2-ft increments of concrete spans, which simplify designs. Pretensioned T-beams, box-beams, and slab sections are also popular, due to the wide availability among precasters, which keeps prices competitive.

"Concrete provides a durable structure and a long life," Eisenbeis explains. "It offers a short production time with minimal fabrication issues, and it can be shipped to the site quickly."

Speed is of the essence in railroad projects, he says, because shoo-fies aren't practical. As a result,

With owners looking to save funds wherever possible and focusing on sustainable design, more bridges are being rehabilitated rather than built new.

contractors often take structures out of operation for only four to eight hours. That requires innovative design and construction techniques to keep trains rolling.

Often, new foundations are constructed beneath the existing structure while it remains active. Once a train passes, a span is pulled and the new one is erected, after which the bridge is reopened until the next span can be switched out. In some cases, older bridges have short spans, so two existing spans can be replaced with one new span. Piers typically are placed between existing piers, sometimes requiring a short jump-span.

"Precast concrete lends itself to that work very well, allowing us to pick girders with on-track equipment," he says. "These techniques have been in place in the railroad industry for some time, and we are now looking to adapt them to highway bridge designs."

One example is the bridge near Wellsville, Kans. A double-track, three-span, prestressed concrete, T-beam bridge replaced the existing double-track, 70-ft through-plate girder structure. The abutments and two intermediate bents used precast concrete caps with embedded steel plates to weld to the piles. The intermediate bent caps were placed while the tracks remained open, whereas, the abutment caps were placed behind the existing abutments during a track closure.

The center span was replaced in two stages, one bridge at a time, leaving one track open to traffic. The knee braces and floor beams were cut to remove the outside girders as the precast concrete abutments were placed and welded. Once half of the bridge and abutments were removed, the new T-girders were installed, and ballast and track were replaced. The other track was then closed and the other two lines of girders were removed.

Innovations Wanted

New ideas are being requested from owners more often today, Biller notes. "Owners are asking for faster construction times, more durability, and many other factors. But most importantly, they want innovation. They want to ensure they are taking advantage of the latest ideas nationwide."

Concrete options are helping the company innovate. "Span lengths, longer life cycles, aesthetic options, all are improving," says Biller. "Concrete designs offer better and better solutions as the material's durability and strength increase." Precast concrete's speed of casting also aids projects by shortening schedules," Eisenbeis notes. "In many cases, we can get precast, prestressed concrete I-beams in six weeks versus six months for steel."

Concrete spans also are getting longer, especially with segmental concepts, he adds. Even if the owners require steel beams for long main spans, the firm typically uses precast, prestressed concrete girders for approach spans. "The 100- to 130-ft approach spans are very economical in precast concrete," Eisenbeis explains. "As these sections become more efficient, we take more advantage of the longer spans and shallower sections that are available."

One help in that regard is the NU girder, which the company uses extensively. "It's a very efficient design that gives us shallower sections and more economy."

An example is the I-470/Route 50 Interchange in Lee's Summit, Mo., which consists of two, horizontally curved, 1200-ft-long viaducts over Route 50 and two, horizontally curved, 1500-ft-long flyovers above I-470. The design features 25 spans, nearly 15,000 linear ft, of prestressed concrete NU girders. Use of the

114 Years of Innovation

Burns & McDonnell Consulting Engineering was formed in 1898 by Clinton S. Burns and Robert E. McDonnell to design sewer systems, water works, and lighting infrastructure. Their first major projects came in 1900, when they designed water and light plants for the communities of Iola, Cherryvale, and Osawatomie in Kansas.

In 1930, the company changed its name to Burns & McDonnell Engineering Co., by which time it had completed 1200 projects in 34 states and Mexico. By 1948, their fiftieth anniversary, the firm had designed 2100 projects worth \$664 million.

In 1986, the company's employees purchased the outstanding stock from Armco Steel, which had acquired the firm from its partners 12 years earlier. Greg Graves was named president/CEO in 2003, the firm's sixth president. Today, the company operates 29 domestic offices as well as offices in several countries, with about 3500 employees.

efficient precast concrete sections resulted in an estimated savings of more than \$6 million in structure costs over initial steel alternate estimates.

Sustainability Emphasized

Owners are also looking for more sustainable-design concepts in all of their projects, says Biller. "They all want to know what we can do to help sustain the environment and recycle natural materials where possible. Our approach has been to be a leader in that area." The firm's Kansas City headquarters has achieved Silver LEED certification, and it has more than 300 LEED-accredited staffers.

A focus on sustainability also focuses owners on longer service life, pushing past 75 years to 100 years.



Rockhill Road over Brush Creek, in Kansas City, Mo., was constructed with cast-in-place concrete box beams.

“A key goal is to mitigate the impact of the construction process,” Biller explains, especially when crossing rivers and wetlands, and to control runoff. “We don’t see this changing in the future or going away.”

A focus on sustainability also focuses owners on longer service life, pushing past 75 years to 100 years, adds Eisenbeis. The key is to protect the bridge from corrosion, either with corrosion inhibitors or other solutions on a case-by-case basis, he says. “The biggest impact can be made with adjustments to the concrete deck. If we can add protection there, it slows corrosion into the deck and then into the beams.” A key weapon in that regard may be high-performance concrete, he notes. “We specify it for high durability and low permeability, not necessarily for high strength.”

With owners looking to save funds wherever possible and focusing on sustainable design, more bridges are being rehabilitated rather than built new. “Many times, we find we can replace the superstructure and

retain the substructure to cut costs,” Eisenbeis says. “Any time we can save money with practical solutions, owners are in favor of it today.”

Rehabilitation isn’t necessarily easier, adds Eisenbeis. “It can require as much design work as a new bridge, because extensive evaluations are needed to understand what is really there. If you have a good design plan and a good understanding of the existing components, it can work. But it may take significant effort to properly analyze the existing bridge.”

An example is the firm’s work for the Missouri Department of Transportation (MoDOT) when officials needed a study to upgrade existing arch bridges in the Ozark Scenic Riverways National Parkland in south central Missouri. The recommendation at the Sinking Creek Bridge included precast, prestressed concrete I-girders spanning pier to pier and spaced to miss the arch crowns. This concept puts the wider bridge deck and vehicular live loads on the new I-girders, while allowing the existing aesthetic arch ribs to remain

without carrying the increased truck loads.

Burns & McDonnell’s company culture helps it adapt to changing needs and seek innovation. The firm became employee owned in 1986, with all stock owned by employees. “That changed the culture and mindset of everyone,” says Biller. “Our employee-owners have a sense of pride in affecting their company’s success. Our motto is, ‘Work Like An Owner Today,’ and employees see their job as satisfying clients.”

The company’s success also keeps it expanding, with two new bridge-design employees added in recent months. “Our recent success in landing and delivering projects will help us grow,” Eisenbeis says. “And as we do, we’ll add designers to accommodate the growth.” 

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