

THE QUIET COMPANY

Modjeski and Masters builds its expertise with concrete bridges through continuing innovations and making its first acquisition in 123 years

by Craig A. Shutt

Well known for the steel bridges it has designed since its founding in 1893, Modjeski and Masters (M&M) had gained less attention for its advancements with concrete designs. That work is now coming to the fore thanks to innovative concrete designs and its acquisition in 2015 of Summit Engineering Group, which specializes in segmental and spliced-girder concrete designs.

"The bridge industry typically views the firm's specialty as being one of designing, rehabilitating, and inspecting complex steel structures," explains Michael F. Britt, senior vice president and director of business development for the Mechanicsburg, Pa.-based firm. "While our project portfolio is dominated by being the designer of record for numerous steel bridges, M&M has also developed innovative concrete designs that have introduced new concrete bridge technology for new and rehabilitated bridges throughout the nation."

"We've been the quiet company when it comes to talking about our accomplishments with concrete bridges," says Barney T. Martin Jr., president/CEO. "In fact, throughout our history, there have been years when we designed more square feet of concrete bridges than steel."

Precast Concrete Deck Panels Grow

One key area where the firm has innovated has been with precast concrete deck panels, which it first used in 1980 on the Bayview Bridge over the Mississippi River at Quincy, Ill. A key driver for its design was the need to complete the work in 18 months. The project became the first cable-stayed bridge in the country to feature precast,



The Bronco Bridge in Denver, Colo., a 371-ft-long, three-span, rigid-frame bridge, features spliced precast, pretensioned and post-tensioned concrete U-girders, as well as precast concrete curved piers, integral abutments, and precast concrete deck panels. All Photos: Modjeski and Masters.

post-tensioned concrete deck panels. "The end result was a more evolved and robust structure," says Britt.

More recently, the firm used precast concrete panels to replace the existing reinforced concrete deck and railing in approach spans on the Ambassador Bridge connecting Detroit, Mich., with Windsor, Ontario, Canada. At one time the longest suspension bridge in the world, it now has precast concrete

panels in the 5600-ft-long approach spans of the 7500-ft-long structure.

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"We expect precast concrete deck panels will be used more often in

the future," Britt says. "We use them frequently in rehabilitation projects to better control construction while leaving lanes open to traffic." Not only can the panels be installed quickly, often at night, but they are manufactured under factory-controlled conditions. "Vibrations from traffic can encourage cracking in cast-in-place concrete while curing," he points out. "Precast concrete is fabricated under ideal conditions, so it minimizes that concern."

Summit 'A Great Fit'

Innovative designs using concrete will no doubt continue after the acquisition of Littleton, Colo.-based Summit last fall. Its addition creates "a symbiotic relationship that brings to the table aspects that round out our expertise and bolster our capabilities," says Martin. "It's a great fit." Gregg A. Reese, president of Summit, agrees. "Our partnership opens up new markets for our small, niche-based firm that weren't available before."

The agreement resulted from serendipity, Martin notes. "We developed a strategic plan that included a goal of expanding our concrete projects, and we knew of the work Gregg was doing at Summit." At the same time, Reese was looking to expand his business into new markets. "We all realized what a good fit merging our firms would be, so the deal went together very quickly."

Reese opened Summit in 1995 and saw it evolve over time, reacting to changes in the construction market. For the past 10 years, the firm has focused on providing construction-support services for contractors. "There's not a lot of competition in that niche, and we focused on local markets," Reese explains. He positioned the firm as a 'rent-an-engineer' program at a time when construction companies were transitioning to using outside consultants. "That opened a real opportunity for us later when contractor-driven designs became more popular."

It also provides an ideal fit with M&M. "Modjeski and Masters has strong relationships with its owner clients, with 90% of its business coming from repeat customers, whereas our strongest relationships have been with



The Bronco Bridge in Denver, Colo., was value-engineered, virtually eliminated traffic disruption, and finished on budget.

contractors," says Reese. "We know how to work with different clients and understand their needs, so we can provide any services required."

U-Girder Designs

One area where Summit's expertise expands M&M capabilities is with spliced, post-tensioned precast concrete U-girders. That work began about 15 years ago through close cooperation with the Colorado Department of Transportation, which has led the nation in using those types of beams. "We were engaged for constructability reviews as well as value-engineering designs and even complete designs," Reese says. "We went from being a support firm to becoming more of a design firm, although we continued to focus on contractor services."

The projects have included Ramp G at the Parker Road Interchange in Aurora, Colo., in 2000 and the Ramp K Bridge in Denver, Colo., in 2004. "Those projects really brought to light the advantages of this bridge type," says Britt. "The structural shape is suitable for complex interchange projects with both long and short spans, and it creates an attractive structure. It also offers significantly shorter fabrication times, reduces the number of joints and bearings, and offers extensive span continuity."

A prominent project to take advantage of this design involved replacing the Bronco Arch Bridge in Denver. The 371-ft-long, three-span, rigid-frame bridge consists of spliced precast, pretensioned and post-tensioned concrete U-girders; precast concrete curved piers; integral abutments; and full-depth precast concrete deck panels. It was completed in 2013, 2 months ahead of the original plan due to value-engineering into this format. It also virtually eliminated traffic disruption and finished on budget.

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Although the Bronco Bridge's spans were from 95 to 148 ft long, creating U-girder bridges in the 250-ft-long range has become common, and they can easily reach 300 ft, Reese says. "The U-shaped cross section provides robust enough capacity to erect them on curves, opening new possibilities for efficient designs."



Modjeski and Masters provided preliminary engineering for concrete and steel alternatives and also reviewed the final plans for the concrete alternate design prepared by the design-build team for the Carey Avenue Bridge across the Susquehanna River at Hanover Township, Pa.

U-girders will grow to be more common, Martin adds. "They offer many benefits for interchange designs. It is becoming extremely difficult for other options to defeat. The precast concrete option wins every time." Those advantages are especially apparent in value-engineering designs, says Reese. "We find that by redesigning a steel bridge, the contractor can pay our engineering and start-up fees with the savings they generate and still come out ahead over the steel design."

"It's a very exciting field," Martin says. "U-girders open interchange construction to a total-precast concrete solution that works well. We design each bridge to fit its location using the best materials available—but the steel guys are worried."

That expertise led Reese to the chair of the Curved Bridge Committee at the Precast/Prestressed Concrete Institute (PCI). "We discuss better design guidelines for engineers and other techniques that will improve efficiency



The three-span Wadsworth Light-Rail Transit Bridge in Denver, Colo., features a design that ensured that spliced, post-tensioned, precast concrete girders could support two rail lines and a new transit station and platform above the street.

and simplicity," he says. "There is a lot of movement to advance and consolidate the technology, and PCI has been a big part of its growth. It's exciting."

M&M has long been involved with creating bridge specifications and standards. In the late 1980s, it led a team developing the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications* and assisted departments of transportation in modifying their specifications to conform. "We're confident that the U-girder standards we've helped develop also will be approved in the near future," Britt says.

New Delivery Methods

M&M's expertise allows it to adapt to new delivery methods growing in popularity. "The entire delivery system is different today, with different types being used," says Martin. "As they change, we have to adapt to the unique needs of each client."

The firm was one of the first to work with Pennsylvania's alternate-delivery format, creating concrete alternatives when requested. An example is the Carey Avenue Bridge that crosses the Susquehanna River between Hanover Township and Plymouth Borough, Pa. M&M provided preliminary engineering

for concrete and steel alternatives and also reviewed the final plan by the design-build team. The end result was a \$27.5-million, four-lane, 2395-ft-long crossing consisting of 16 spans of prestressed concrete I-beams.

Today's increased focus on design-build projects plays well to the firm's expertise. "You have to be adaptable," says Reese. "Design-build offers an accelerated pace of construction, but it's a little more planned." That doesn't mean they disdain traditional design-bid-build projects, adds Martin. "We have experience representing both owners and contractors, depending on the project."

M&M also has worked efficiently in the newer hybrid form, Construction Manager/General Contractor (CM/GC), also known as Construction Management at Risk. "We find it to be more effective due to the continuous collaboration between the contractor, engineer, and owner," says Britt. "The owner never loses control of the design development. With design-build, once the initial plan is developed, a new team takes over with its plan. With CM/GC, the engineer follows the design all the way to final design."

Summit was part of the CM/GC-driven Wadsworth Bridge, which is a section of a light-rail extension connecting Denver

and Golden. The firm proposed a precast concrete, spliced bulb-tee girder alternative to the original steel-plate design due to the high cost of steel at the time.

"I really liked the CM/GC experience," Reese says. "It was a comfortable and very cooperative environment with the flexibility to do innovative things during the process to improve the project. It fostered partnership such that no additional schedule time was required to make the necessary modifications."

Public-private partnerships also are growing and adding new factors. "They put greater emphasis on durability and service life," Britt explains. "The total expense of operation and maintenance is more in the beginning. They require good, solid designs and constructability values, but they don't minimize expenses of materials at the cost of long-term durability."

Rehabilitation Proliferates

M&M's long history sometimes brings it back to its original designs. "We always feel fortunate when we have a chance to extend a bridge's life for another generation," says Britt.

That experience occurs more often today, says Martin. "America's aging infrastructure and the unwillingness to absorb the high cost for new bridges has led many owners to look to repair structures." M&M offers an inspection service that can perform a cost-benefit study, make suggestions on key repairs as well as create designs to accomplish them.

"The needed repairs are often on a case-by-case basis, owner by owner, with few similarities," Martin notes. "A lot depends on how proactive the owner's maintenance program has been over the years and what construction techniques were being used at the time."

One example is the Wissahickon Memorial Bridge (also known as the Henry Avenue Bridge) over the Wissahickon Creek in Fairmont Park in Philadelphia, Pa. The structure consists of a reinforced concrete arch with a 300-ft-long span, which is faced with stone. Built in 1927 with M&M as the



The Wissahickon Memorial Bridge in Philadelphia, Pa., on which Modjeski and Masters was the lead engineer in 1927, was rehabilitated in 2010 by the firm, rehabilitating its original reinforced concrete arch design using colored concrete and strategic lighting to add aesthetic touches. The work won several awards from local and state preservation groups.

lead engineer, the company returned to renovate it in 2010, using colored concrete and strategic lighting to add to the aesthetic touches. Their preservation efforts won awards from

the Preservation Alliance for Greater Philadelphia and the Pennsylvania Preservation Award for Excellence in Transportation.

M&M also is looking to future bridge designs by continuing its innovative efforts with concrete projects. "Our work with U-girders and drop-in spans has led us to focus on ways to minimize expansion joints and bearings in projects, which are critical points," Britt says. "They are the first two elements to deteriorate, and our goal is to minimize or eliminate them. There is great potential for achieving that."

The firm's own evolution isn't complete either. The master plan that brought Summit into the fold is continuing to develop, with more acquisitions and collaborations planned, but Martin declined to name specifics. "There is more on the horizon, I can promise that," he says. "But we're not the kind of company that dictates its size and schedule for changes. We focus on the services we want to provide and what fits with our existing philosophy, and that leads us to grow the clients we serve and the employees we need to reach those goals." **A**

M&M's 123 Years of Service

Modjeski and Masters (M&M) was founded by Ralph Modjeski (born Rudolf Modrzejewski), a Polish engineer who immigrated to America and opened his own firm in Chicago in 1893. He was joined in 1924 by Frank M. Masters. One of the first bridges they designed as M&M in the 1920s was the Clarks Ferry Bridge, featuring 15 reinforced concrete arches, each with a 140-ft-long span.

M&M operates nine regional offices primarily in the eastern United States, from its corporate headquarters in Mechanicsburg, Pa. The firm ranked No. 260 in the 2015 listing of top design firms by *Engineering News Record*, moving up 50 spots from 2014. Summit Engineering was the first acquisition in the company's history.