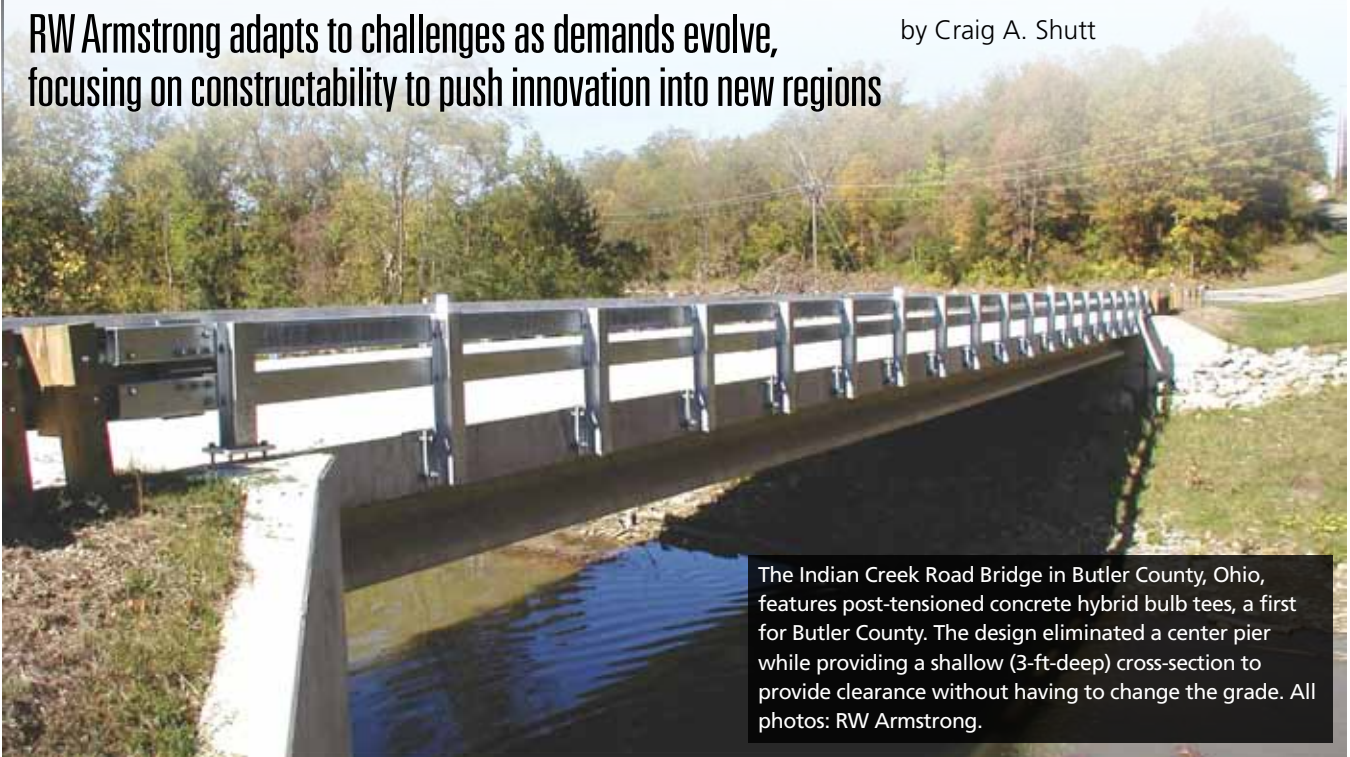


Innovation on the *FLY*

RW Armstrong adapts to challenges as demands evolve, focusing on constructability to push innovation into new regions

by Craig A. Shutt



The Indian Creek Road Bridge in Butler County, Ohio, features post-tensioned concrete hybrid bulb tees, a first for Butler County. The design eliminated a center pier while providing a shallow (3-ft-deep) cross-section to provide clearance without having to change the grade. All photos: RW Armstrong.

We are a 'go-to' firm for fast-track and high-profile projects.

RW Armstrong's transportation practice has built its reputation on providing value-engineered solutions and working closely with contractors to deliver fast, cost-effective construction. It leverages this reputation to get its foot in the door in new markets and to bring state-of-the-art design and engineering solutions to clients and communities around the world.

Based in Indianapolis, Ind., the firm has served the Indiana Department of Transportation (INDOT) and surrounding state and local agencies for nearly 50 years. In the last decade, it has been involved with more than \$1.5 billion worth of transportation design and construction projects.

"We are a 'go-to' firm for fast-track and high-profile projects and INDOT's largest local consulting partner," says Troy Jessop, domestic structures team leader. "Because of our close association, we understand their decision-making

processes and have developed excellent working relationships with key personnel." Many of RW Armstrong's transportation staff previously worked at INDOT, which brings a wealth of experience and relationships to the firm.

Relying on Relationships

RW Armstrong also works closely with about 15 key heavy civil contractors, which regularly hire the firm to value-engineer a design, enhance constructability after the bid, or provide design-build services. "We are in a different mode than the typical design-bid-build firm," says Seth Schickel, Indiana bridge operations manager. "We often are called in by the bridge owner when an emergency occurs, and we work with contractors when problems arise. We take pride in working closely with contractors to find solutions."

Value-engineering work has been instrumental in RW Armstrong's expansion to 18 offices (13 domestic). "Gaining credibility and work in a new region takes time," says Jessop. "You need momentum and a talented staff to earn DOT and local agency business. It's hard to generate those first projects without a unique way to show value."

Typically, the company's national bridge team works with local contractors and performs value engineering or joins the contractor's design-build team. That gains attention and the momentum that leads to higher-profile projects. This strategy proved successful with the Columbus, Ohio, office, Jessop says, and the team now is focusing on the same template to expand its Austin, Tex., office.

Trying New Techniques

RW Armstrong has also found success in the Midwest by leveraging its expertise on post-tensioning projects. "There are few reputable post-tensioning players in this region, so we often come in with post-tensioning solutions when clients get into difficult situations," says Schickel. Typically, city and county clients are more open to those solutions, he notes, because they see benefits and are willing to try a new approach that will save money.

One example is the 113-ft-long Indian Creek Road Bridge in Butler County, Ohio, which replaced a deteriorated truss structure. County officials wanted a single-span bridge because the stream collects debris, Jessop explains. "It was a

50 Years of Designs

RW Armstrong was founded in 1961. Today the firm provides construction management, design, planning, and program-management services to projects involving buildings, transportation structures, aviation, and other categories.

With nearly 500 employees in 18 international offices (including 13 domestic), RW Armstrong ranks No. 37 in *Engineering News-Record's* list of program-management firms, No. 54 in construction-management firms, and No. 150 in design firms. The firm also has been ranked among the top firms for Best Places to Work in Indiana by the Indiana Chamber of Commerce and the *Indianapolis Star*.

simple crossing, but they didn't want a typical solution of a three-span structure on the existing alignment."

RW Armstrong designed a precast concrete hybrid bulb-tee structure that required only a 3-ft beam depth. The beams were prestressed to aid transport and post-tensioned for final load conditions. The structure is the first in Butler County to use post-tensioned, wide-flange, modified bulb-tee girders.

In another new application, precast concrete hybrid bulb tees were used in Indianapolis on the 82nd Street Bridge over I-465 to replace a four-span, steel-beam bridge. The new two-span precast concrete bridge features 72-in.-deep bulb tees with a 60-in.-wide top flange and a 40-in.-wide bottom flange. The spans are 164 ft each, making them among the longest nonpost-tensioned, two-span precast concrete girders in the state.

"Our goal is to create the best design possible, and that often entails educating our client about the benefits of an engineering solution they are unfamiliar with," says Schickel. "We

The Edwin C. Moses Boulevard Bridge features 48-in.-deep precast concrete U-beams, a first for Ohio. The approach allowed wider beam spacing while creating an aesthetically pleasing girder shape, of which designers took full advantage.

always want to present the best solution and make our case to implement new, innovative ideas."

Another example was a design created for the city of Dayton on Edwin C. Moses Boulevard as it crosses Wolf Creek. The structure reused the existing substructure and replaced the superstructure with 48-in.-deep precast, prestressed concrete U-beams. The design marked the state's first use of prestressed U-beams, which allowed wider beam spacing (12 ft 3 in. on center) and created an elegant edge profile. (For more on this project, see the Winter 2011 issue of *ASPIRE*™.)

Speed, Cost Drive Designs

Bridge owners are beginning to accommodate unfamiliar design concepts for two main reasons: speed and cost. "The need to get bridges built faster has made more states open to new ideas," says Jessop. "There is a big push to build quickly, and more often this emphasis results in using precast concrete options. Steel availability has varied over the last several years and often takes longer to fabricate, but it could offer longer span capabilities. That's much less true today."

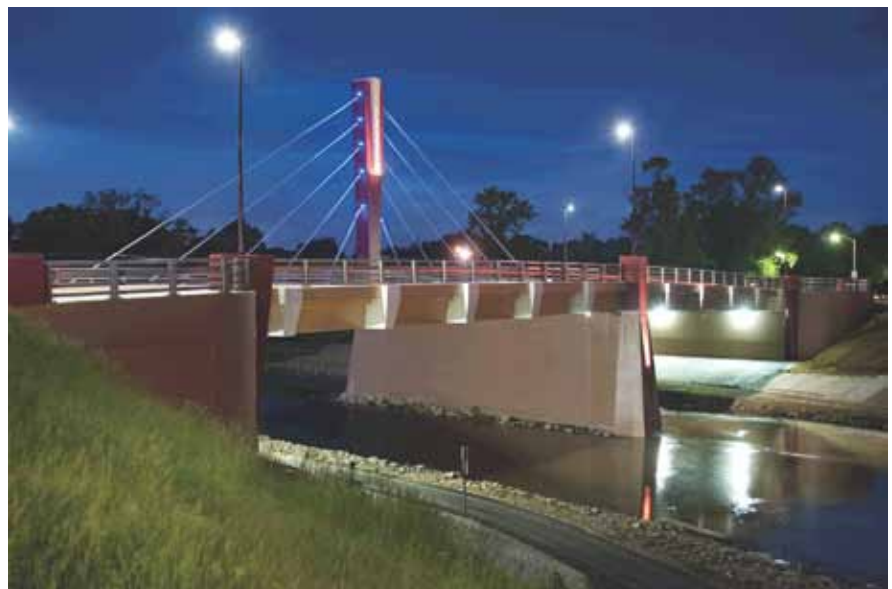
Ten years ago, RW Armstrong's designers would have the occasional fast-track project in-house at any time, Schickel notes. "Today, they're all fast-track projects, because owners see that completing the work quickly benefits the community and the users."

Accordingly, the team continues to evaluate new concepts, such as preassembling more components and using self-propelled modular transporters (SPMTs). "A significant amount of our time now is spent not just designing bridge components but also assisting contractors with accelerated-bridge concepts, such as falsework design and lifting devices required for these new types of construction," says Jessop.

The need for speed also has prompted more contractors to use a large amount of precast concrete such as precast pier caps and columns, he adds. "This is a relatively new trend on both large and small projects."

Budget restrictions are changing design approaches, Schickel adds. "With the economy as it is, efficiency is on everyone's mind, so we have to prove to the public that the money is being spent prudently. We spend a lot more time developing preliminary designs and working out every detail to ensure the design is as cost-effective as possible before we present it to the client and the public."

That can be seen on the \$487-million U.S. 31 reconstruction and upgrade project currently underway in Hamilton County, Ind. This corridor consists of 12 miles of reconstruction north of Indianapolis, and includes eight grade-separated interchanges. Among the structures are 30 precast, prestressed concrete girder bridges, eight precast



Our goal is to create the best design possible, even if it's unfamiliar to the client.



To replace an existing four-span steel-beam bridge at 82nd Street over I-465 in Indianapolis, Ind., RW Armstrong designers used a two-span precast concrete bridge with hybrid bulb tees. The two 164-ft spans are among the longest nonpost-tensioned girders in the state.

concrete flat-arch structures and four post-tensioned concrete bridges. Several public meetings and design charrettes were held to fully engage the public and help explain the project and minimize inconvenience.

"This project required a lot of preliminary design. We even had other in-house staff value-engineer our work to ensure we had the right type of interchange bridges at each location," says Schickel. "We needed to push hard to meet the scope and budget on an accelerated time frame and design a solution that met the needs of all stakeholders."

Design Scope Changes

Design scope has become a volatile concept, notes Jessop. "Years ago, we followed the client's project scope and the fees developed for that scope. Today, it's a new game. We're constantly adjusting project scope in the early stages, investigating more alternatives and plans as we go, which adds challenges to establishing sound contracts and design fees." This also requires designers to be "flexible and innovative on a day-to-day basis," adds

The \$487-million U.S. 31 reconstruction and upgrade project in Hamilton County, Ind., involves 12 miles of reconstruction and construction of a variety of precast and post-tensioned concrete bridges. The design team gained considerable feedback from the public and used a variety of methods to communicate, including a website devoted to the project.

Schickel. "We know things will change—schedule, budget, scope—but we don't know when or how. So we continually look for new ways we can adjust."

One area with significant value to clients is the firm's knowledge of funding types. RW Armstrong has a staff devoted to helping clients obtain funding, Jessop says. "We've evolved from simply creating studies that point out needs to helping clients justify expenses and obtain funding. Smaller clients

in particular need assistance, so that's become a bigger part of our role as consultants."

Replacement versus rehabilitation has become a bigger question as owners look to save money, which can result in a move toward ineffective returns on investment. "We want to help them spend wisely in the short term and not give in to the pressure to do lower-budget quick fixes," says Jessop. "We want solutions that serve the client now and will be durable and cost-effective over the long term."

That also creates pressure to produce precise estimates, he says. "There's been a shift to wanting perfect plans with exact quantities. Design fees are becoming tighter while expectations are higher for accuracy of plan quantities and elimination of change orders. With pressure to perform the lowest capital

cost quick fixes, there is a need to expand our reports to examine full life-cycle costs and other factors."

To that end, the company has created a weighted-matrix analysis that compares structure types and construction techniques based on the owner's prioritized goals. Such a matrix, which was used on the Moses Bridge, weighs capital costs plus aesthetics, durability, life-cycle costs, and environmental impact. "It helps clients evaluate their priorities and allocate their budget to achieve their key goals," says Jessop.

Examples of client goals can be seen on specialty projects, such as airport taxiways, where blast resistance and durability might rank higher than aesthetics. "That may justify a more massive concrete box structure that we wouldn't necessarily use on projects where those are not requirements," he explains. "The matrix helps clients see how each factor impacts the others and leads to the best design solution overall."

Aviation Synergies

The RW Armstrong Structures group often works with the firm's Aviation practice when specialty structures are required, Jessop notes. "We get called into their projects when they have to deal with an interesting structure—navaids, taxiway bridges, and others."

Several such projects have been completed recently. They include Taxiway B at the Tampa International Airport, which was developed on





RW Armstrong's transportation team often works closely with its aviation team, such as at the Port Columbus International Airport in Columbus, Ohio, where cast-in-place, post-tensioned, variable-depth box girders were used to create a new taxiway. The project was built on grade, then soil excavated from beneath it to avoid needing falsework.

an extremely fast-track, design-build schedule to meet the deadline for federal stimulus funding. The \$5.7-million project features a post-tensioned concrete box girder bridge, which provided the aesthetics the owner sought for this high-profile crossing. RW Armstrong provided the front-end design-build criteria package for the taxiway on the accelerated schedule.

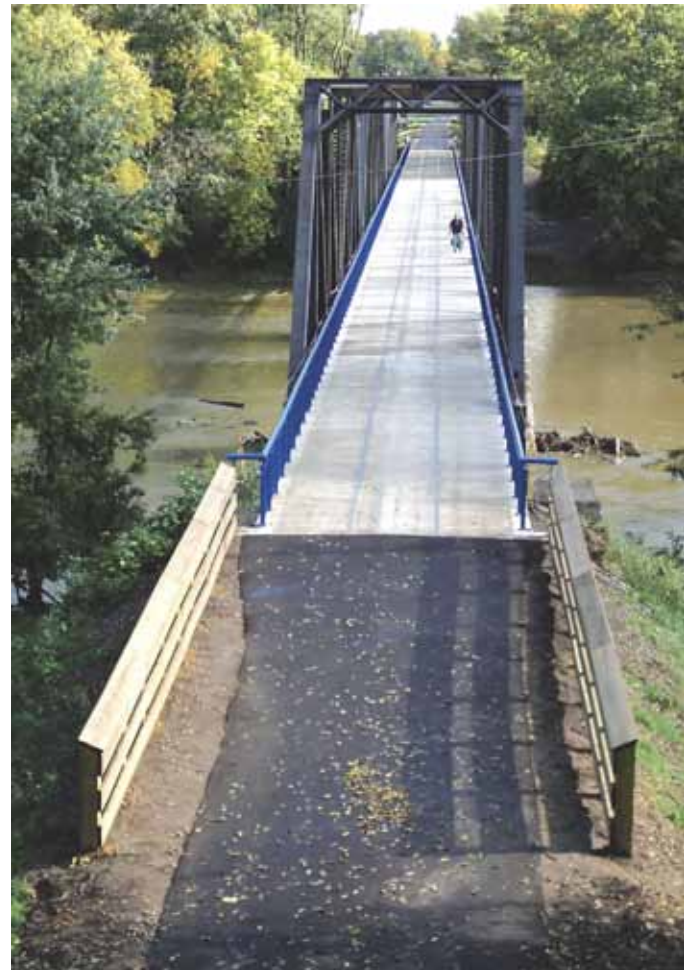
Another such project was the single-span, cast-in-place, variable-depth, post-tensioned concrete box-girder design for the new taxiway at the Port Columbus International Airport in Ohio. Three-dimensional finite analysis and modeling were performed to determine construction staging and long-term creep and shrinkage effects. (For more on this project, see *ASPIRE*, Winter 2009 issue.)



A focus on context-sensitive solutions has led to more attention on aesthetics, such as this use of reveals and textures on the MSE walls on a bridge over I-465 in Indianapolis, Ind.

Aesthetics are playing a larger role in every project, the designers note, with context-sensitive solutions becoming a high priority. "We're doing much more with formliners and tints, because they're easy and make a big impact," says Schickel. "The public likes those details, but engineers traditionally shied away from them because they add complications and have no structural design function."

One of the more interesting bridge applications is the conversion of abandoned railroad structures into pedestrian and bicycle trails. Existing steel truss structures have ballast and ties removed, a cast-in-place concrete deck placed and decorative safety rails installed. At the Nickel Plate Trail in Peru, Ind., the trail owners asked for the deck to be embossed with recessed grooves to pay homage to the original steel railroad tracks.



"Aesthetic ideas that would have gotten us kicked out of a contractor's office years ago are now gaining acceptance," says Jessop. "Contractors and clients are increasingly open to new ideas and fabricators are capable of creating a much wider range of shapes and forms today. Previously, we were limited to adding tinted sealers and formliners, but with the improvement in formwork and falsework, we can be much more creative with aesthetic concepts.

RW Armstrong's designers are helping to reuse abandoned railroad trestles, like this one in Peru, Ind., by replacing ballast and deteriorated ties with a grooved concrete deck that provides a smooth surface for pedestrians and bicycles.

As these concepts develop, our relationships with contractors are crucial to ensure that our ideas can be built."

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.