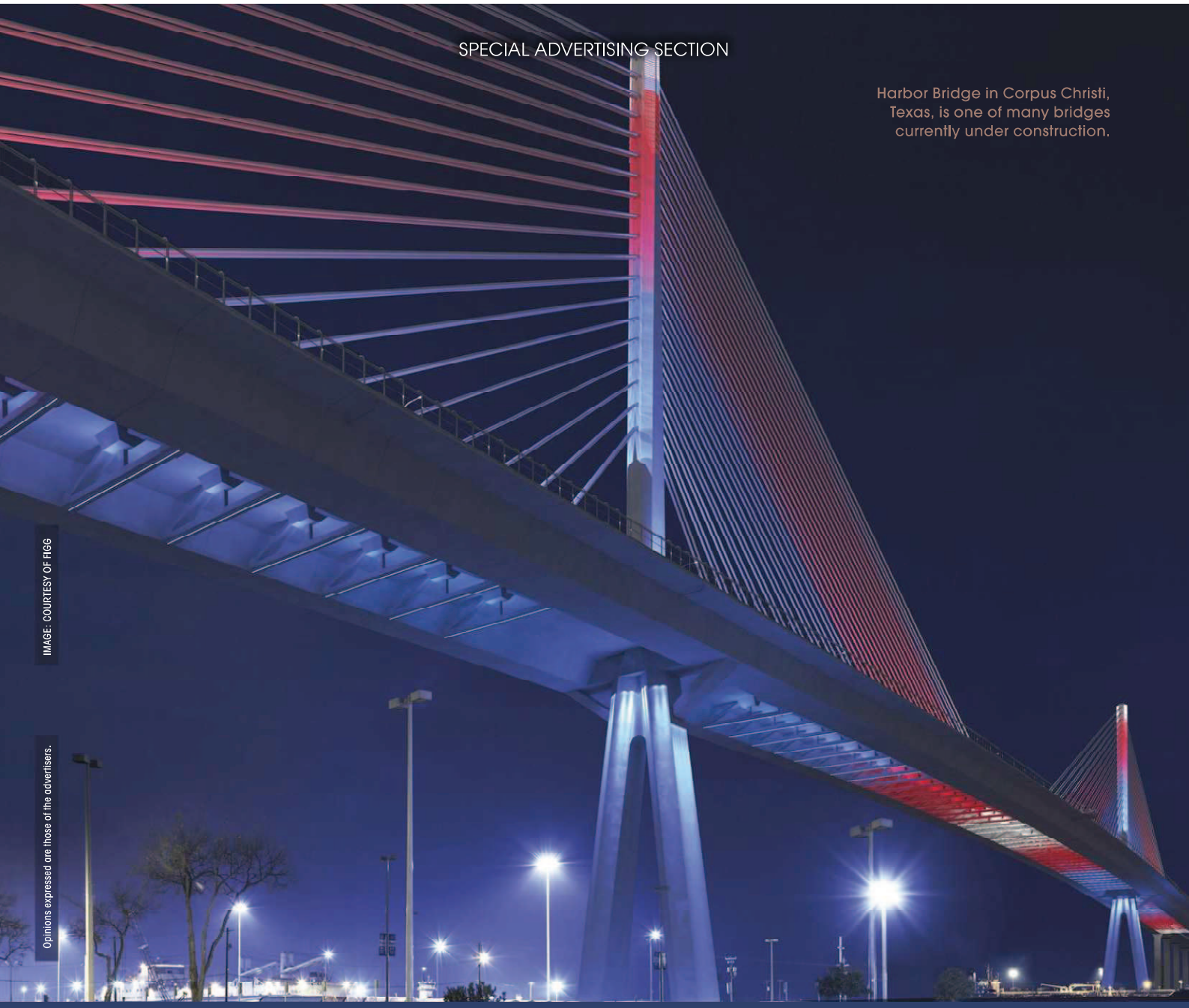

Harbor Bridge in Corpus Christi, Texas, is one of many bridges currently under construction.

IMAGE: COURTESY OF FIGG

Bridges Today III

The Fine Art of Bridge Building

Equipment, technology and ingenuity are vital for improvements and renovations

By Kate Gawlik

WHAT'S INSIDE

Making Claims on Bridge Construction

A lot of companies and markets make claims about creating the biggest, strongest, longest or newest. When talking about bridges, some of these statements actually are true because of the amount of attention needed in this market. In the United States alone, the American Society for Civil Engineering believes $123 billion is required to address the current maintenance issues with bridges. Of the nation's more than 600,000 bridges, 56,007 (9.1%) were deemed structurally deficient in 2016.

Construction leaders are rising up to show their impact in this growing market. Their work is impressive, and their technology will make travel safer. Here, market experts share their insights into currents trends, challenges and progress.

What do you consider the greatest current innovation in the bridge market?

Jim Benzing, Project Manager, Structural Services: State-of-the-art heavy hydraulic towers can lift a whole span up and move it, allowing a crew to replace the old span with the new one within 24 hours. The new span is built a few miles away and transported to location using high-capacity trailers, and the old span is replaced with the new one using heavy hydraulic towers in a matter of a day. Coated rebar, composite material and concrete bridges are great innovations as well.

David Brodowski, PE, Vice President, Inventure Civil: Innovations in materials like high-performance concrete, steel and plastic, especially when prefabricated into customized components for the bridge, have resulted in multiple benefits for all stakeholders. These materials make it possible to span longer or use less components for the superstructure than conventional materials, drastically reducing labor and accelerating construction. Additionally, the resulting bridge is stronger and more durable while requiring less maintenance over time.

John Michael Pardo, Senior Vice President and Chief Human Resources Officer, Dragados USA: What is changing the industry now is accelerated bridge construction, the use of construction techniques that minimize impacts to areas underneath, the capacity to span longer obstacles and the impressive design life currently achieved by using the latest state-of-the-art materials.

What is challenging in the bridge market?

Benzing: The skilled labor shortage. It can be difficult to find highly skilled and safe workers. Thanks to Iron Workers, we have skilled ironworkers and welders, but we have trouble finding other skilled craftspeople.

Brodowski: Along with shorter project schedules to reduce disruption to traffic, the highest quality of materials and construction is also expected to ensure a long service life of 75 to 100 years. The industry will continue to be challenged to provide expertise in the design and supply of systems that help contractors build within these constraints.

Zachary Gorman, Midwest Regional Director, IMPACT: Bridges are not funded from state to state. Underfunded maintenance and replacement is a major issue.

Pardo: From the design side, we have seen how the increasingly powerful CAD techniques have allowed the optimization of the materials to a point where the construction process becomes critical. Furthermore, the current aesthetic requirements have forced the designers to produce more signature and complicated structures with very demanding construction schemes. And we have had to respond to these design advances with parallel advances.

Bridge design and construction is also facing the challenge of increased durability requirements and long-term behavior for new high-capacity materials. Environmental concerns are affecting the way in which bridges are being constructed, and we see an increase in the application of top-down construction technologies in environmentally sensitive areas.

Another major challenge today, which we look forward to, is the increase in design-build procurement for major bridge projects. This allows us to provide input to the design that results in faster, longer-lasting and more economical solutions, as well as tailor-made designs that best fit our means and methods approach and technology.

How does your company contribute to improvements in the market?

Brodowski: Inventure Civil has been partnering with contractors on some of the largest and most demanding infrastructure projects in the United States, providing innovation in MSE walls with the SINE WALL MSE Panel System. Just this year, the company introduced ClearCast Forms, a transparent stay-in-place bridge deck forming system from our TrueTech Bridge system. ClearCast Forms help contractors build the bridge deck quickly and safely, while the form's transparency allows bridge owners to comply with bridge inspection standards and maintain the bridge deck over time.

Pardo: Our company has built more than 1,500 bridges worldwide, including more than 400 signature bridges. Innovation has always been key to our success, as is our approach to continuous development of optimization.

Our team is focused on developing state-of-the-art and elegant solutions, which will create world-class landmark structures, perfectly integrated with their environments. A multidisciplinary team, led by experienced bridge designers, was actively involved from the conception to the final development,

providing feedback from different disciplines.

Harvey Swift, Southwest Regional Director, IMPACT: Our partner contractors and ironworkers build the bridges. Iron Workers' contractor-ironworker partnership, IMPACT, provides comprehensive training, including safety training for the ironworkers to ensure a job-ready skilled workforce.

How is the bridge market becoming more sustainable?

Benzing: The bridge market is using modern materials to build stronger and more sustainable bridges. It now uses stronger steel with 70 ksi and stronger concrete.

Pardo: Resiliency, aesthetics, environmental protection (including storm water treatment requirements), new materials, reduced maintenance and life-cycle considerations (design for 100 years or even longer) are getting more important in recent designs. This will result in a new era for bridge construction.

Innovative Leaders

Over the St. Lawrence River in Montreal, Quebec, Canada, construction is underway for the new Champlain Bridge. The previous structure was one of the busiest in the country, with about 40–60 million annual vehicle crossings. From a trade standpoint, more than $20 billion of cross-border goods annually pass this trade corridor.

Sarens was asked by Signature sur le Saint Laurent, a joint-venture company between SNC Lavalin, Dragados, Flatiron and others, to install 38 footings for the new bridge. In total, the bridge will be made up of 74 footings; 38 will be prefabricated at the jetty, and 36 other footings will be made by pouring concrete directly into foundations in the river bed. The weight of a single footing is 600–1,000 tons.

To complete the complicated project, Sarens designed and built special equipment for the project called the Floating Foundation Installer (FFI). The FFI is a self-propelled catamaran that can lift, transport and install foundations. It can operate in strong currents and lift and transport parts weighing up to 1,000 tons. The lifting apparatus has a turntable, allowing for a 360-degree rotation of parts.

Sarens Operations Manager Sven Janssens says, "Sarens undertook a daunting technological and operational feat by flawlessly handling the installation of the footings for the notable Champlain Bridge Project. It is by far the most challenging project I had the opportunity to be a part of at Sarens."

The Forth Replacement Crossing in Scotland recently opened to traffic, and it is a good example of Dragados' contribution to the improvement of the bridge market. The 1.7-mile (2.7-km) bridge is the longest three-tower, cable-stayed bridge in the world. It also is by far the largest to feature cables, which cross mid-span. The design provides extra strength and stiffness, allowing the towers and deck to be more slender and elegant. Pardo adds, "For the first time at this scale, the crossing cables technique has been employed to overcome the flexibility problems that multiple-span cable-stayed deck present."

Dragados also is working on the new six-lane Harbor Bridge in Corpus Christi, Texas. It will boast the longest cable-stayed span in the United States at 1661 ft and is slated for completion in spring 2020. It also will be the longest cable-stayed bridge in the world constructed with precast concrete box girders and a single centered plane of cables. The bridge will feature a clearance of 205 ft above water, enabling navigation for the new Panama class vessels.

Discover more about these and other projects, completed by the innovative minds in the bridge market, in the following pages. ◆

Shored MSE Wall Makes Difference

The Freemansburg Avenue Bridge over SR 33 in Easton, Pa., was a double-span bridge with abutments on piles. Each abutment was built with a mechanically stabilized earth (MSE) wall in front and flared MSE wing walls. The project involved widening the bridge to accommodate more traffic.

The abutment seat extension had to cross the interface of the existing and proposed MSE wall. To leave the existing MSE backfill undisturbed, the project team (PennDOT, Pennoni Associates, Borton-Lawson, JD Eckman and The Reinforced Earth Co.) designed a length of abutment footing from the last existing pile, spanning an extra distance to the new piles in the proposed MSE structure. This allowed the new pile installation to occur only in the zone of the new MSE wall backfill.

The interface of the new and existing MSE walls formed an acute angle, and the tight spacing of the new piles made a conventional MSE wall design in the corner not feasible. A zone of flowable fill was placed the full height of the wall, with MSE wall panels connected to the existing wall. It allowed for a stabilized wall segment until a conventional acute corner could be accommodated. What resulted was a "shored" MSE wall: a wall built in front of an existing structure while using the existing structure to stabilize or reduce loads on the new structure. ◆

A shored MSE wall stabilized the bridge.

PHOTO: COURTESY OF THE REINFORCED EARTH CO.