Changing Perceptions

DYWIDAG-Systems International's new high-tech inspection and monitoring tools add to its selection of post-tensioning products and services, enhancing its role as a specialty contractor.

by Craig A. Shutt

While DYWIDAG-Systems International (DSI) is best known for its array of post-tensioning and geotechnical products, its role as a specialty contractor has been growing. Now, with the addition of several high-tech companies, DSI intends to expand its prominence and market penetration as a service provider.

New Scope of Services

"We're no longer just the post-tensioning product supplier that people knew in the past," says Jason Caravello, director of business operations for DSI's Global Services business unit in North America. "For example, we are active in the inspection, restoration, and maintenance of parking structures, stadiums, high-rise buildings, tanks, and bridges. We are experts at design-build structural-strengthening solutions, often utilizing a variety of systems, including post-tensioning or CFRP [carbon-fiber-reinforced polymer], and even coatings. We obviously use our products where they apply, but we do much more than that."

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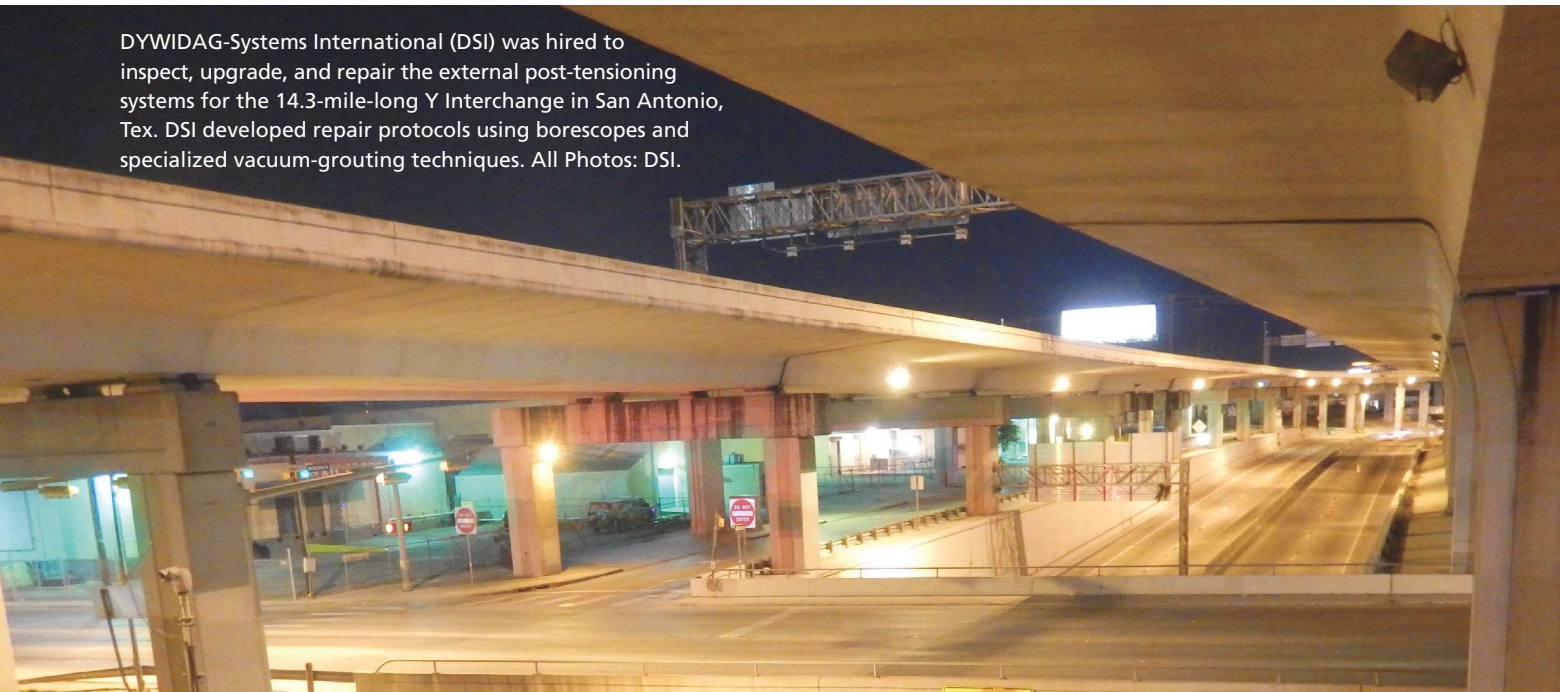
Many recent changes at DSI began after Matti Kuivalainen was appointed chief executive officer of DSI Construction in the United States in September 2017. DSI Construction was split from DSI Underground the previous year by the Germany-based parent company DSI. In January 2018, the North American divisions were organized into the Global Services (contracting), Geotechnical, Post-Tensioning, and Concrete Accessories business units. Global Services focuses on three key service offerings: repair and strengthening for structures, robotic inspections, and infrastructure health monitoring, which includes cloud-based data acquisition for structural predictive analysis, among other services.

"Clients don't see a difference in the way they interact with us," Caravello notes of the reorganization. "But it gives us new efficiencies and initiatives for expansion." Those efforts are being aided by recent domestic and international acquisitions:

- In October 2017, DSI Construction announced a strategic partnership in the United States with Infrastructure Preservation Corp., a robotic engineering firm, to develop technology to aid in the nondestructive inspection of bridges.
- In March 2018, the parent company acquired Alpin Technik und Ingenieurservice, which provides robotic inspection and maintenance of infrastructure. Services include corrosion protection, special assemblies, and repairs.
- In October 2018, the parent company acquired Datum Group, a global monitoring company that performs structural health–monitoring services to enhance safety, sustainability, and cost savings.



DYWIDAG-Systems International (DSI) was hired to inspect, upgrade, and repair the external post-tensioning systems for the 14.3-mile-long Y Interchange in San Antonio, Tex. DSI developed repair protocols using borescopes and specialized vacuum-grouting techniques. All Photos: DSI.

"We hope to see significant growth in our capabilities for doing robotic inspections and repairs for tendons and cable stays," Caravello says. The robots can move along cables to make polyethylene repairs, perform water-jet cleaning, inspect via camera links, and document conditions in high resolution. "It's cutting-edge technology."

According to Caravello, the international companies will provide expertise to the U.S. division, and DSI plans to ramp up development throughout 2019. DSI has already used the robotic systems on the cable-stayed Fred Hartman Bridge in Houston, Tex., with excellent results, he notes.

Caravello acknowledges that robotic inspection technology is still developing. "But we're very excited about the potential," he says. "It offers ways to do inspections and repairs that are more efficient and safer." Drones can do some of that inspection work, he notes, but their use raises liability issues related to their potential to distract traffic and the challenges of controlling them in wind currents. "We think robotic options offer much more potential."

The Datum Group acquisition offers DSI the opportunity to expand health-monitoring services, especially for railroad structures, an area of specialization for the U.K.-based company. "Using inclinometers, accelerometers, and specialized sensors to gain real-time data on performance provides a clearer picture of a bridge's status," says Caravello. The firm monitors assets on highways and railroads internationally to assess performance of aging infrastructure, according to former Datum Group owner Rory O'Rourke. Its cloud-based database, Platform Interactive, harvests, validates, interprets, and presents data from any source. The firm's latest addition is an automated pile static-load testing system that can remotely apply a load up to 30 MN (6750 kip) to a pile. Used in Europe for some time, the system was recently shipped to its first U.S. customer.

These new technologies and expertise will be developed and marketed in the coming months, Caravello says. "There will be a period of development, but they add some high-tech tools to our toolbox and allow us to bring more services to the table."

Installation of a split-duct system for permanent repair of external tendons for the Y Interchange project in San Antonio, Tex.

Growth in the Repair Market

The repair market is growing substantially as states look to maximize the service life of bridges in an era of limited federal funding. "It's a critical market that's really growing substantially and yields good opportunities even in tough economic times."

An example of DSI's repair work can be seen in its services for the Y Interchange in San Antonio, Tex. The 14.3-mile-long elevated viaduct, built in the 1980s to merge Interstates 35 and 10, used 755 precast concrete segmental box-girder spans post-tensioned with longitudinal and transverse tendons. In 2014, DSI was hired to inspect, upgrade, and repair the external post-tensioning systems.

The project involved distinctive challenges. "When the bridge was built, project specifications did not reflect the importance of properly grouted tendons," says Caravello. Also, bridge construction was completed in three phases using three design/construction teams and post-tensioning suppliers. DSI inspected the anchors and tendons of each of the three phases and developed repair protocols using borescopes and specialized vacuum-grouting techniques that measured void volumes and then filled the voids with grout.

For external ducts that had incurred major damage over the years through splitting or cracking, DSI designed and installed a special split-duct system for permanent repair. Gaining access inside the precast concrete segments was a major challenge, Caravello notes. It was done from beneath the segments through integrated hatches, which were often located directly above heavy traffic areas, requiring traffic control and night work. DSI logged more than 75,000 work hours to complete the project.

Post-Tensioning Expertise

DSI's new offerings will enhance the company's existing expertise in post-tensioning services and products. "Post-tensioning is becoming more popular and mainstream across the country," says Joseph Salvadori, former Eastern U.S. regional manager for the Post-Tensioning & Reinforcing business unit. "We are seeing more segmental designs that need our products."

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The trend offers great potential on the West Coast, where the company primarily works as a post-tensioning subcontractor. "California and the West are largely supply-and-install markets," says Bryan Lampe, U.S. Western regional manager for the Post-Tensioning & Reinforcing unit. "Many DOTs [departments of transportation] and the FHWA [Federal Highway Administration] are focusing attention on quality control of post-tensioning and the certification of field personnel, and most general contractors are not equipped to perform this work. As a result, we see an expansion of our installation work here and in states like Texas and Florida."

For example, DSI is providing longitudinal and transverse post-tensioning for the cast-in-place segmental box-girder approach spans for the 5134-ft-long Gerald Desmond Bridge in Long Beach, Calif. This bridge is currently under construction and will be, when completed, the second-highest cable-stayed bridge in the United States. The spans are being

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The typical span uses four or five tendons with twenty-seven 0.6-in.-diameter strands running full length in each girder web. Partial-length strand tendons, typically twenty-seven or thirty-seven 0.6-in.-diameter strands, pass longitudinally through the top decks, which are also transversely post-tensioned using tendons with four 0.6-in.-diameter strands in flat ducts with flat anchorages. Several units feature partial-length tendons that required tensioning from within the box girder's interior, which was achieved through close collaboration with the contractor.

On the Desmond project, DSI has already installed more than 3300 tons of bonded tendons ranging in size from four to thirty-seven 0.6-in.-diameter strands with anchorages. In all, nearly 10 million ft or about 7.3 million lb of tendons will be installed. DSI has also performed tensioning and grouting operations, including transverse deck post-tensioning. DSI's work on this project will be completed in mid-2019.

On the East Coast, where general contractors typically undertake post-tensioning duties, DSI's most frequent role remains that of product supplier. For example, DSI supplied its multi-strand post-tensioning products for the Interstate 91 Brattleboro Bridge in Brattleboro, Vt. This design-build project in an environmentally sensitive area featured cast-in-place segmental construction using the balanced-cantilever method with a form traveler (see the Project article in the Spring 2018 issue of *ASPIRE*®). The three-span, 1036-ft-long structure employed a straightforward post-tensioning design with only minor variations, Salvadori says. The 814 transverse tendons in the top slab used four 0.6-in.-diameter strand flat-anchor bodies with stainless steel local-zone anchor reinforcement.

The cantilever and continuity post-tensioning consisted of eight tendons with twelve 0.6-in.-diameter strands, 57 tendons with nineteen 0.6-in.-diameter strands, and 90 tendons with twenty-seven 0.6-in.-diameter strands, all of which used corrugated polypropylene ducts. The design also utilized permanent 36-mm-diameter (1.4-in.-diameter) Grade 150 threaded-bar tendons for longitudinal post-tensioning in the superstructure and in the tops of piers.

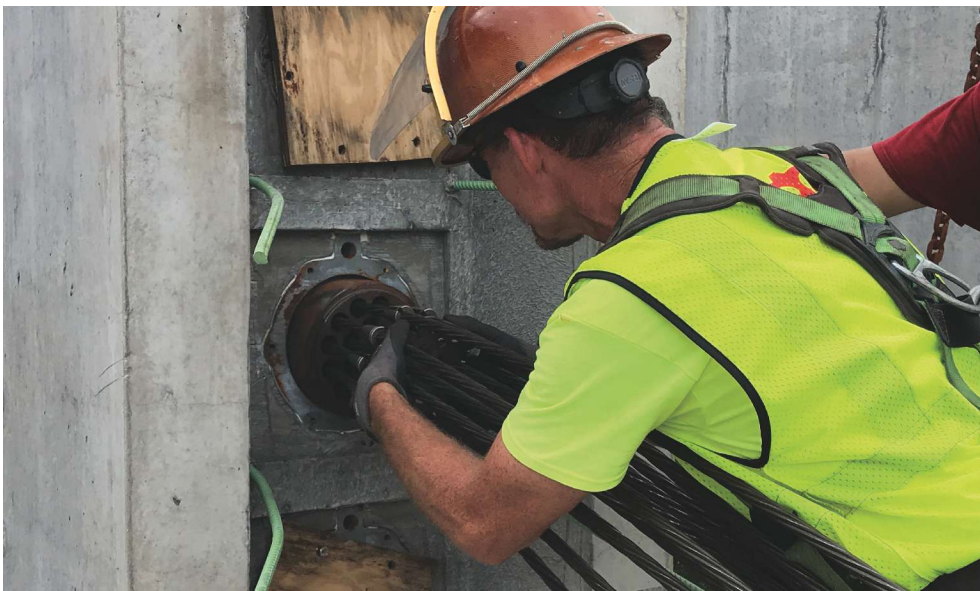
"There are always challenges with major projects, but Brattleboro was successful for both DSI and the contractor, with no major hiccups," Salvadori says. DSI is currently undertaking a growth initiative to expand the scope of its programs to furnish and install products in the Eastern region, he notes.

Upholding Grouting Standards

To ensure its expertise can extend a bridge's service life, DSI prefers to do its own grouting installations. Nationally, requirements have definitely become more stringent since bridges like the San Antonio Y Interchange were built. "Today, grouting specifications are a key focus for designers and contractors," says Caravello. "They understand the value it [grouting] provides."

Lampe agrees. "Owners and designers understand today that grouting is a critical component to the durability of a structure. It's become an area of focus in the past 15 years, with significant

Electrically isolated tendons (EITs) were included in the top tendon (of four) in each of the five girder lines making up the main channel unit of the Coplay-Northampton Bridge between the Pennsylvania boroughs of Coplay and Northampton. Their use in this bridge marks the first application of EITs in the United States.



upgrades to standards along with awareness and training on techniques and inspections. Grouting used to be an afterthought, and that's changed. Now it's recognized as arguably the most important element."

Execution is at least as important as specifications, he notes. "In the Western United States, post-tensioning is performed almost exclusively by specialty subcontractors, and their field personnel have extensive expertise. Workmanship is often the weak link, and it's critical. We're also seeing a major push to revise grout materials and methods and focus more attention on new technologies, which will help extend the structure's life."

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Innovation

New technology was a key element of the design for the Coplay-Northampton Bridge in Coplay, Pa. The eight-span, 1118-ft-long precast concrete girder bridge features a three-span (181-181-186 ft), continuous post-tensioned, spliced prestressed concrete bulb-tee girder river crossing, the first of its type in the state. Five girder lines make up the main channel unit cross section, with girders in the pier segments varying in depth from 6 ft 7 in., the depth of the constant depth drop-in and end segments, to 9 ft 7 in. at the piers. All girders are made continuous by four longitudinal post-tensioning tendons with fifteen 0.6-in.-diameter strands.

DSI supplied engineering services, materials, and field-installation contracting for this project. It also installed electrically isolated tendons (EITs). This installation, which was requested by FHWA as a demonstration project, was the first use of EIT technology in the United States and its first use ever in a bridge with spliced precast, pretensioned concrete girders.

Because domestic electrically isolated anchor bodies are not available, DSI used its own ETAG (European Technical Approval Guideline[1])-approved anchors. An EIT was installed as the top tendon (of four) in each of the five girders. "The EITs provide the highest level of corrosion protection possible, as they isolate the strands completely so no electrical path exists from the strand to the structural concrete for corrosion to develop," Salvadori explains.

Post-tensioning strands have been installed and tensioning operations are underway for the main spliced-girder unit on the Coplay-Northampton Bridge between the Pennsylvania boroughs of Coplay and Northampton.

Engineers at Lehigh University deployed a monitoring system for impedance and capacitance, which is intended to provide an indication of performance of the corrosion protection system. Initial results at 28 days met expectations, and designers expect electrical resistance readings will rise as the grout ages. A significant drop in resistance would be indicative of leakage or ingress of moisture.

DSI participated in an FHWA-sponsored workshop on the EIT technology hosted by Lehigh University in October 2018, shortly after the last tendon was grouted. DSI is also looking to help update specifications related to EIT anchoring and duct ventilation. (For more information on EITs, see the Concrete Bridge Technology article in this issue of *ASPIRE* on page 36.)

DSI is also focusing on ways to strengthen members with carbon fibers and meet seismic requirements with AASHTO-type girders. The need to control long-term strand costs to reduce market volatility and allow for more precise cost estimates also remains a key need, Salvadori notes. "Challenges will always arise, and we intend to continue to work on improvements and advances."

Innovative approaches provided by its new partnerships will help DSI reach that goal. "We see these new technologies as a way to pull us into the market with expanded services," says Caravello. "We want the industry to see DSI as a bridge-repair contractor as well as a post-tensioning product supplier. It's hard to change perceptions, but we expect that to change as our offerings grow."

Reference

1. European Organisation for Technical Approvals (EOTA). 1997. *Metal Anchors for Use in Concrete.* European Technical Approval Guideline (ETAG) 001. Brussels, Belgium: EOTA.

DSI's 150-Plus Years of Service

Dyckerhoff & Widmann AG, later shortened to DYWIDAG International and then to DYWIDAG Systems-International (DSI), was founded in 1865 as Lang & Cie by German concrete manufacturer Wilhelm Gustav Dyckerhoff. The company's name and business strategy changed in 1866 when Dyckerhoff's son, Eugen, joined forces with his father-in-law, Gottlieb Widmann, to refocus on construction engineering.

The firm worked on some of Europe's earliest rammed-concrete bridges and developed an array of products and technical innovations for post-tensioning concrete. By the 1950s, it was offering licenses and consulting contracts for its products and construction methods around the world.

The firm employs about 2300 people worldwide. For more on its history, see the Partner Spotlight in the Summer 2016 issue of *ASPIRE*.