A NEW NEW YORK GIANT

A $3.9-billion, 3.1-mile-long new Tappan Zee Bridge is rising fast (P. 20)
The SoftStop® is the first and only tangent energy absorbing guardrail end terminal on the market today that meets all mandatory crash test requirements set forth in AASHTO’s Manual For Assessing Safety Hardware (“MASH”). The SoftStop is eligible for Federal-aid reimbursement for use on the National Highway System.
HALFWAY THERE ON THE HUDSON

Construction of the $3.9-billion ‘New NY Bridge’ has hit its stride—and passed the midpoint—with big components and a very big crane

By Aileen Cho in Tarrytown, N.Y.

PHOTO BY REHEMA TRIMIEW FOR ENR
When “I Lift NY,” formerly known as the Left Coast Lifter—one of the world’s largest floating cranes—hoisted a 645-ton crossbeam into place this February, it marked a milestone in the construction of the $3.9-billion replacement of the Tappan Zee Bridge over the Hudson River, 30 miles north of New York City. The four crossbeams, collectively weighing almost 3,000 tons, mark the halfway point in building two pairs of 419-ft-tall pylons for the pair of structures that constitute the New New York Bridge—and the halfway point for the five-year project.

With substructure work substantially complete, “this year construction will be much more visible to the public,” says Jamey Barbas, project director for the New York State Thruway Authority (NYSTA).

The first crossbeam installation was postponed a week due to icy river conditions, but that’s negligible, considering the 30 years of discussion about what to do with the existing 61-year-old Tappan Zee Bridge, a deteriorating truss structure that has required millions of dollars in patchwork repairs since the 1990s.

After much controversy, bidding drama and a rocky start that included a partially collapsed silo on a barge-mounted concrete plant, the consortium of Fluor Enterprises, Granite Construction Northeast, American Bridge Co. and Taylor Bros Inc. is swiftly progressing on its $3.14-billion design-build job to construct the two 3.1-mile-long crossings with 1,200-ft-long cable-stayed main spans, between Rockland and Westchester counties.

Located just north of the existing bridge, which carries 140,000 vehicles daily, the 96-ft-wide new northern structure will begin carrying eight temporary lanes of traffic before the end of 2017. Once its southern twin is complete, each crossing will carry four lanes of traffic. The northern bridge will include a bicycling and pedestrian lane.

While the public now can see tangible evidence of the soaring superstructures to come, much of the

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RISING RAPIDLY
The New NY Bridge piers and pylons are taking shape next to the aging Tappan Zee Bridge on the Hudson River.
But by 1997, it was clear that it would not be cost-effective to keep the existing bridge functioning. NYSTA launched a $120-million effort for temporary repairs (ENR 6/9/97 p. 19). Eight years later, planners rejected a tunnel and an alternative light-rail route and, instead, closed in on the idea of a new cable-stayed bridge (ENR 12/12/05 p. 13).

But the environmental review process lagged for years—until 2011, when a perfect storm of key events (ENR 3/24/14 p. 10) allowed state agencies to complete a new permitting process, receive a $1.5-billion federal loan and award the Tappan Zee Constructors (TZC) consortium the state’s first design-build contract.

TZC’s design offered a shallow, streamlined superstructure profile with a composite deck and outwardly inclined towers. It proposed to trim the original $5.2-billion estimate by minimizing the amount and sizes of piles and dredging for the New NY Bridge, which has a 100-year design life.

“We did a lot of work to use as [many] precast elements as we

Foundations
In 1985, New York state transportation officials fired the opening salvo in a long-term campaign to deal with projected traffic growth on the Tappan Zee Bridge (ENR 10/10/85 p. 12). A study suggested the most cost-effective approach would be to add an express bus lane to the six-lane bridge carrying increasing amounts of traffic on the Interstate 287 corridor.

prodigious design and geotechnical, substructural and environmental efforts took place out of sight. 
could,” says Jeffrey Han, senior vice president with HDR, one of TZC’s main designers, along with Buckland & Taylor, URS and GZA. “The pile caps, pier caps, deck—all are precast. Some of the picks on the pile caps were 500 tons. Everything on this job is just large.”

Everything about the job is busy, too. Along with the I Lift NY crane and some 30 smaller cranes are more than 100 barges, two concrete batch plants, two 1,000-ft-long temporary work trestles, recreational river traffic, the 140,000 daily commuters crossing the old bridge, a pair of protected peregrine falcons, two types of endangered fish and constant community and media boat tours. “This is an unforgiving river. In some areas, it’s as dangerous as coastal work,” says Walter Reichert, TZC vice president. At the outset, the team retrofitted equipment and developed special ladder systems for work barges. There have been no major injuries on the job.

However, up until 2014, the team had to address, repeatedly, barges that became unmoored. Two boaters were killed in 2013, when they collided with a barge that was properly moored (ENR 4/7/14 p. 13). And recently, on March 12, three crew members died when their tugboat crashed into a construction barge. TZC is participating in an ongoing investigation.

**Piling It On**

TZC won the bid in July 2012 and began work in 2013. No time was wasted: Even during the proposal process, the NYSTA had begun preliminary borings and cone penetration tests to investigate geological conditions. Soon after, TZC did supplementary borings as deep as 440 ft, says Bob Palermo, TZC lead geotechnical engineer.

The profile consists of organic silts as thick as 200 ft, with intermittent sand layers beneath, then soft clays, glacial till and, finally, bedrock. The layers also vary in thickness. “On the west side, the third layer, of clay, goes down to 750 feet,” says Palermo. “We wanted to limit the number of piles and maxi-
mize their capacity.” That goal resulted in piers spaced out at 350-ft intervals, he adds.

The 43 piers—all but two in water—range from 60 to 260 ft long and are supported on steel-pipe piles as deep as 330 ft, says Palermo. The 1,100 piles, totaling 80,000 tons of steel, have diameters of 36, 48 and 72 in.

To optimize subsequent design and location of some 1,000 piles, the team conducted an extensive load-testing program—16 static axial load tests, 160 dynamic tests and three static lateral load tests—of up to 7 million lb, adds Palermo.

The first pile test went less than perfectly. “It was a 6-foot-diameter pile, and everyone was out there watching,” recalls Reichert. The hammer damaged the tip of the pile, which resulted in meetings with pile-driving experts. The rest of the 6-ft-dia piles, which mostly support the main span, received 5-ft-long, 2-in.-thick welded steel reinforcements, and the team changed its pile-driving methodology, says Palermo.

Rather than driving piles as hard as possible throughout, crews varied the forces at strategic points, Palermo notes, saying, “We had no more damaged piles after the first, except for one in which we hit a boulder that wasn’t supposed to be there.”

The team also had to make sure it didn’t damage the well-being of two types of federally endangered sturgeon. It decided to create bubble curtains around piles of 4 diameters and up, says John Duschang, HDR environmental compliance manager. Each curtain consisted of a series of aluminum rings through which pressurized air was pumped to create bubbles that mitigated sound waves emanating from the pile-driving.

The project also features what officials believe is the first-ever 24/7 public access to noise-monitoring data, available on the website. “We sited monitors for air quality, vibrations and noise … in sensitive areas,” says Duschang. The information can be played back to determine if the noise was construction-related or “a train, a landscaper or a kid at the park,” he says. Moreover, the NYSTA and
TZC each chipped in $10 million for a grant program to which residents can apply, requesting soundproofing renovations.

**Capping It Off**

“From the beginning, the subsurface conditions drove our thinking” about the main spans and approach structures, says HDR’s Han. To minimize impact on the foundations, “we ended up with a girder substringer system. The main girders are 12 feet deep. We used five-span units, each 1,750 feet long. To support the deck and minimize the load on it, we used 36-inch-deep substringers between the main girders,” he notes. Typically, a bridge’s main girders would be the sizes of the substringers here, Han adds.

Unistress Corp., Pittsfield, Maine, precast almost 6,000 steel-reinforced concrete panels, each about 12 ft long at up to 45 ft wide. They are being placed on the steel-girder system, supported by 68 football-field-sized pile caps, the bottoms of which were precast by Cape Charles, Va.-based Bayshore Concrete Products. Crews placed the last of the 300-ton pile caps last summer, reinforcing each cap with galvanized steel and sealing it with up to 750 cu yd of concrete.

Chesapeake, Va.-based Coastal Precast Systems convinced TZC to let it precast the caps for the columns that sit atop the pile caps, says Paul Ogorchock, president of CPS. “They told us it would take two to three months to build one cap cast in place,” he says. On the other hand, CPS could precast and send eight caps at a time for them to install, all within the space of a few weeks.

CPS precast 59 caps, each 13 ft tall, 10.5 ft wide, up to 92 ft long and about 300 tons. Each cap is reinforced with 70,000 lb of galvanized steel rebar and prestressed with 28 galvanized strands, then filled with 150 cu yd of concrete, says Ogorchock. Subsequently, CPS precast the four crossbeams placed this year. To handle such gigantic components in its casting yard, “we have
jacks pulled on cables woven through each tub, lowering it slowly onto the piles. It took about eight hours to lower each 14-ft-tall tub by 9 ft, says Reichert. This alternative method alleviated risks associated with the Hudson River main channel’s strong currents and 6-ft tidal swells.

The two pairs of main-span towers are supported on the two foundations—in contrast to the rest of the two bridges, which sit on separate foundations. “Combining the main-span supports into a single pile cap will allow that foundation to resist ship impacts,” says Don Bergman, Buckland & Taylor’s vice president for major projects.

Last year, TZC crews began construction of the main span’s pile caps. In lieu of traditional cofferdams, the team used a system devised by VSL to lower 360-ft x 60-ft concrete-and-steel “tubs” onto the piles. Thirty-four computer-guided hydraulic jacks pulled on cables woven through each tub, lowering it slowly onto the piles. It took about eight hours to lower each 14-ft-tall tub by 9 ft, says Reichert. This alternative method alleviated risks associated with the Hudson River main channel’s strong currents and 6-ft tidal swells.

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A driving force behind the main-span design was the need to accommodate a future Metro-North commuter rail line. “The foundations needed to support heavy rail without [crews] needing to work in the river,” says Bergman. The outward-leaning legs of the main-span towers are designed so that a third deck can be built between the twin structures to handle commuter rail, he says. “The towers are arranged such that the inner legs can be connected at the top and cable anchorages installed between,” he says.

The NYSTA invested $300 million to prepare the structures for future rail, but, when open, the new
The bridge will have room for dedicated bus lanes.

To handle the supersized aspects of the project, TZC’s key weapon is the I Lift NY crane, which arrived in fall 2014 (ENR 10/13/14 p. 9). With its 1,900-ton capacity and 328-ft boom length, the crane began work last spring by placing a 600-ton approach-span pile cap. Among its final tasks will be lifting out sections of the old Tappan Zee Bridge—up to 1,100 tons—once all traffic is operational on the twin spans in 2018.

Crews use smaller cranes to place structural steel for the approaches. On the Westchester County side, crews connected individual girders into a single assembly and pushed it out over Metro-North Railroad. Subsequent assemblies kept cantilevering the structure out to the first bridge pier. The work trestles used on both banks, plus low-draft tugboats and prefabrication, reduced the need to dredge to less than 1 million cu yd—only half the amount the NYSTA had anticipated, says Reichert.

Construction will continue this year on the 419-ft-tall towers. Crews are using self-climbing jump forms to build the towers in segments. Within the jump forms, workers assemble and encase in concrete steel rebar cages. Then, the forms are jacked up to build the next 12- to 18-ft segment. Crews also will begin placing 973 precast deck panels, provided by The Fort Miller Co., Schuylerville, N.Y., for the main span.

In 2015, the team did some $800 million in construction, and this year will be similar, says Reichert. “The plan is to be able to walk [across the northern bridge] by the end of the year.”

TOUGH GEOLOGY
Foundation work had to account for varying levels of different soils including silts and clay.