#1

PROJECT: Rte. 460 Connector Phase 1 Design-Build, Grassy Creek Bridge

LOCATION: Breaks, Va.

OWNER: Virginia DOT

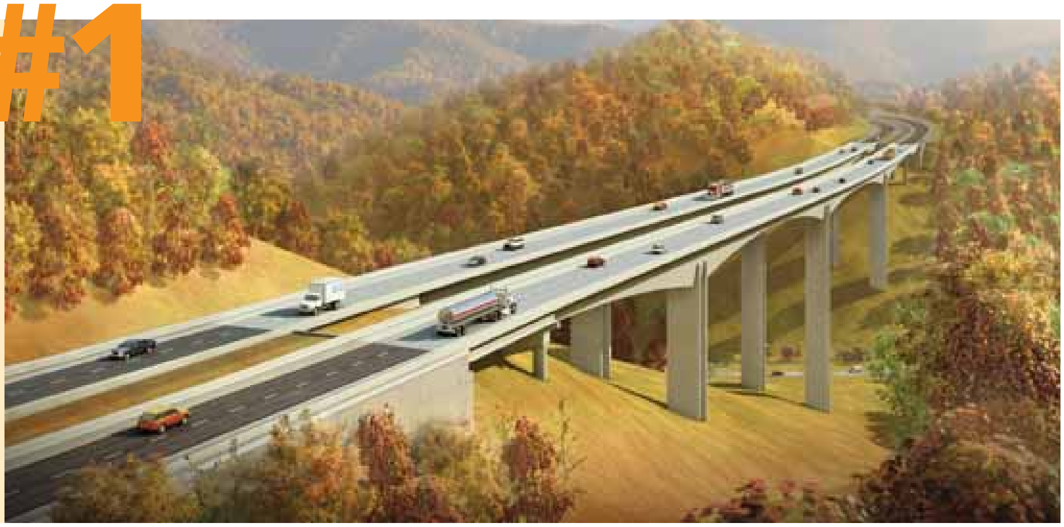
DESIGNERS: Stantec (prime), Jansen Spaans Engineering Inc. (bridge)

CONTRACTORS: Bizzack Construction LLC (prime), CJ Mahan Construction Co. (bridge subcontractor), RS&H CS (owner's rep/CEI)

COST: $105 million

START DATE: Aug. 7, 2009

COMPLETION DATE: June 8, 2015



Locationally challenged

Remote Appalachian hills pose steep test for bridge builders

By Allen Zeyher
Managing Editor

Height is a relative measure. You might think the tallest bridge in Virginia would tower over its surroundings. Actually, it is just level with the mountains around it.

The tough mountainous and unstable terrain influenced much of the bridge's design and construction.

Grassy Creek Bridge has a vertical clearance of 250 ft above Grassy Creek in a project area with more than 400 ft of vertical elevation differential. The bridge consists of twin 1,700-ft-long cast-in-place segmental bridges, each with a deck width of 43 ft, carrying two lanes of traffic in both directions.

Constructed deep in the Appalachian Mountains, Grassy Creek Bridge is part of Phase 1 of the Rte. 460 Connector design-build project and No. 1 on ROADS & BRIDGES' 2013 Top 10 Bridges list. The bridge is currently about 55% complete.

The bridge is owned by the Virginia Department of Transportation, with RS&H CS contracted as the owner's representative. The design-build team includes prime contractor Bizzack Construction, with bridge subcontractor CJ Mahan Construction Co., and prime designer Stantec, with bridge design subconsultant Jansen Spaans Engineering Inc.

The roadway and bridge approaches required a significant amount of both conventional and shape-charge blasting in order to prepare the site, which contains a variety of rock and soil conditions.

Rocky ground

The foundations for the bridge structures had to be quite diverse to compensate for the complex terrain. Because of the steep slopes on the site, the team had to evaluate slope stability as well as the usual factors in foundation design, such as eccentricity, overturning moment, sliding and bearing capacity.

"We not only have the terrain but we have coal seams in the area," Mandy Cox, program manager for VDOT, told ROADS & BRIDGES. "Subsurface investigation was a very strategic component during the design process."

In one area of the bridge, the foundation was designed using micropiles, because of their advantages in locations with limited access, environmental sensitivity and close proximity to rock walls. The 36 micropiles on the project each has a design capacity of 182 tons and range in length from 40 to 80 ft deep.

The main piers of both the eastbound and the westbound bridges are reinforced concrete columns. The vertical reinforcing steel is 75 ksi surrounded by a low-permeability, 5,000-psi-compressive-strength concrete. The reinforcing steel is a corrosion-resistant, low-carbon/chromium steel, made by MMFX Steel Corp. of America, that also offers increased strength and should add significantly to the bridge's durability.

Each pier on average uses 300,000 lb of reinforcing steel and 900 cu yd of concrete, cast in 20-ft sections.

The columns have a horizontal cross section that resembles an H. Because of the balanced-cantilever construction method of the superstructure, the columns have to be constructed to withstand a tremendous amount of bending moment.

"I understand originally they were going to be sort of a box-shaped pier column," Mark Hirsch, program manager for RS&H, told Roads & Bridges, "and this was an innovation from the contractor to go with the H shape."

The superstructure of the bridge is a 43-ft-wide, cast-in-place, variable-depth, segmental box. The depth of the segments varies from 30 ft at the piers to 12 ft at the mid-span closures. The variable-depth segments enable longer spans and give an aesthetically pleasing arch to the segments. The team chose to construct the superstructure by the cast-in-place, segmental, balanced-cantilever method because of the impracticality of hauling precast segments to the site through the surrounding mountains.

The team is constructing the superstructure using multiple sets of form travelers, which were designed and fabricated specifically for this project. Once construction of the piers has been completed, a pier table is constructed atop the piers. The form travelers are erected on either side of the pier table and surveyed into place. The next step is to set the reinforcing steel and post-tensioning ducts and tendons and then place the concrete. Once the concrete has reached a predetermined compressive strength, the post-tensioning tendons are stressed to a prescribed force in both the longitudinal and transverse directions. Each bridge is made up of 84 cast-in-place segments.

Mix-in-place construction

To supply the 16,000 cu yd of concrete needed to complete the project—and be sure it was delivered to the remote location in a timely manner—the team built an on-site concrete batch plant. The Johnson & Ross plant has the capability to produce 120 cu yd/hr of concrete. Since the plant became operational, the contractor has submitted—and the plant has produced—nearly 60 different custom concrete mix designs.

The bridge construction site is subject to intense weather conditions, including strong, gusting winds. To monitor the changing weather, the team installed a weather station and made the data remotely accessible.

The team also makes real-time pictures of the construction site available by way of a web camera. The camera is solar powered and operates on a cellular network. It aides the client in keeping up with the construction progress, as well as allows the general public to track the project.

The site is not just far away from any significant population center, it is 40 miles from the nearest town, so the project faced challenges attracting the skilled workforce it needed, procuring and delivering materials and maintaining communications with limited cell and Internet service.

For day-to-day project communications, the contractor instituted the use of two-way radios for all workers.

With limited options for housing the large workforce required to construct a project of this size, most of the management and labor force commute from the four neighboring states of West Virginia, Kentucky, Tennessee and Ohio. A project of this complexity also requires highly specialized talent and equipment for features such as the cast-in-place segmental construction process, blasting for site preparation, post-tensioning and grouting of steel tendons, etc. In order to attract the workers needed, the contractor is paying a premium, which is factored into the overall budget.

"This roadway truly is a bridge to economic development for this region," Cox said. "The opportunities once this road is completed to be able to drive over into Kentucky in a timely manner is tremendous. They'll be able to get to some of the larger communities in Kentucky and get a job." R&B

PROJECT: Foothills Parkway Bridge No. 2

LOCATION: Great Smoky Mountains National Park (Tenn.)

OWNER: National Park Service

DESIGNERS: Eastern Federal Lands Highway Division; Corven Engineering

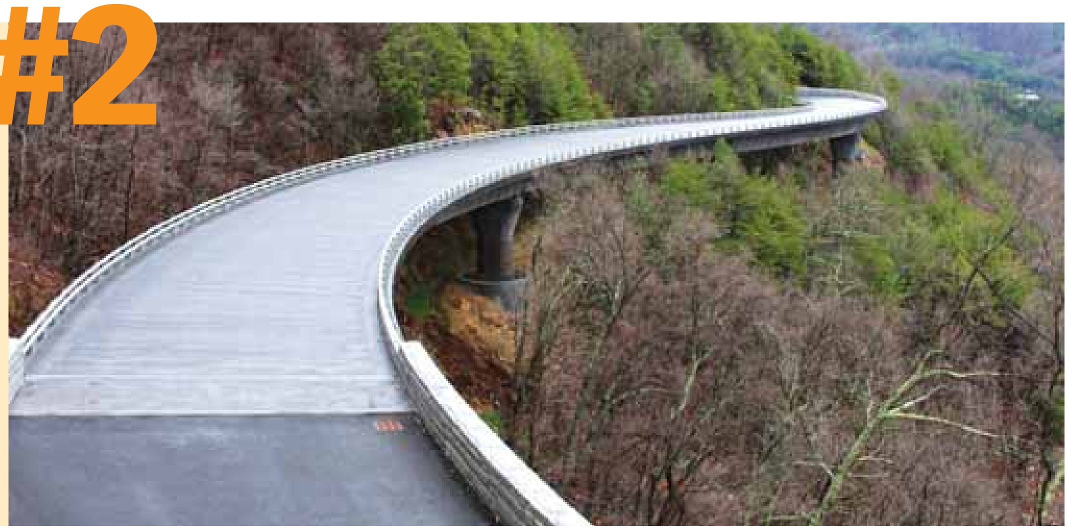
CONTRACTORS: Bell & Associates; Corven Engineering

COST: $26 million

START DATE: Jan. 15, 2010

COMPLETION DATE: Aug. 11, 2012

#2



King of the mountain

Bridge project overcomes tough terrain

By Jeff Zagoudis
Associate Editor

Who would have thought the Missing Link would be found in Tennessee?

The Missing Link, in this case, is a 1.6-mile portion of the Foothills Parkway in Great Smoky Mountains National Park. Commissioned by Congress in 1944 as a 72-mile scenic route, the Foothills Parkway remains unfinished today, with only 22.6 miles completed. It is the oldest unfinished highway project in the state of Tennessee.

More specifically, the Missing Link is in Section 8E, a 9.7-mile portion of the Foothills Parkway that is nearly complete. Ten bridges make up the Missing Link. Bridge No. 2 is the largest span in the section, with a series of reverse curves that cut through some of the steepest terrain—vertical grades range from 6.75% to 8.02%.

The site itself was far and away the biggest challenge on the project, according to Hratch Pakhchanian of the Eastern Federal Lands Highway Division (EFLHD). As a result of the steep grade on the site, workers had to be extremely careful where and how they cut.

"Any disturbance of the ground could cause instability," Pakhchanian told Roads & Bridges. "The slightest cut could take out a whole side of the mountain."

Geography and environmental concerns restricted the available working space on the jobsite as well. A previous environmental assessment confined the scope of work to the limits of the bridge itself, which is only 37 ft wide. Topping off the laundry list of difficulties, workers only had access from the eastern approach.

Faced with these challenging conditions, the project team decided to precast Bridge No. 2. (The other bridges in the Missing Link have all been cast-in-place.) The superstructure is made of 92 segments, each one unique due to the geometry of the site.

To facilitate construction on such a difficult jobsite, EFLHD constructed falsework and a specialized gantry crane, dubbed the Segment Walker. Crews bored holes for micropiles for the falsework foundations. Once established, the crane traveler attached directly to the falsework and progressed forward throughout construction, lowering the precast pier and superstructure segments into place. "We could not have built this bridge without it," Pakhchanian said.

The new bridge has an expected design life of 100 years. As of press time, construction was continuing concurrently on bridges 3 through 7. EFLHD and the National Park Service are currently on target to open the Missing Link to traffic in 2016. R&B

PROJECT: Alexander Hamilton Bridge Rehabilitation

LOCATION: Manhattan and Bronx, N.Y.

OWNER: New York State DOT

DESIGNER: Jacobs

CONTRACTORS: CCA Civil/Halmar International LLC

COST: $407 million

START DATE: March 2009

COMPLETION DATE: December 2013

Back-to-back victory

Crews overcome unexpected delay in largest rehab project in NYSDOT history

By Bill Wilson
Editorial Director

Two backs pressing against each other usually creates some leverage. For those involved in the Alexander Hamilton Bridge rehabilitation project in New York City, it weakened the knees of a schedule that was tight from the start.

The floor beams on the arch side of the bridge were back-to-back members of steel. During inspection, workers could not see between them, so when they were finally pulled, the deterioration was seen firsthand for the first time. It was much worse than expected.

"This deterioration of the floor beams also extended to the interface with the spandrel girders that run longitudinal on the arch portion," Manual Silva, area construction supervisor for the New York State Department of Transportation (NYSDOT), told Roads & Bridges.

A problem like this is never factored into any schedule, and due to the extent of corrosion a lot of design was required. The contractor needed to draw up a solution, which had to be approved, and also produced a 3-D model of the interface of the floor beams with the spandrel girders.

"That whole process takes so long and involved all of the stages on the schedule," said Silva.

Work on the bridge was delayed almost 11 months. To help make up time each of the six stages of construction were tweaked. The contractor had what Bruce Ogurek, director of construction for the bridge, called a "priority portion" to the mounds and mounds of shop drawings that needed to be reviewed.

"They sent to the reviewers a weekly priority schedule, so not everything was approved at once, but it never delayed something getting to the job," he told Roads & Bridges.

Elements of the fix also were assembled at the fabricator, so entire sections could be placed at the jobsite all at once, and at press time the job was back on schedule, with full completion set for Dec. 31.

Keeping traffic moving was the top priority during the largest rehabilitation project in NYSDOT history. More than 200,000 vehicles cross the bridge, and four temporary ramps were constructed. A cantilevered section was added on both the southbound and northbound portions of the bridge to widen the deck, and more space was added between the two structures.

A counterflow lane also helped keep cars moving coming from the westbound direction. Stages four and five called for one-lane reductions, so to keep the flow from clogging crews took advantage of the fact that it was a bi-level bridge.

"You sacrificed one, say you take a lane from the lower level, but you take away a merge condition in the upper level," said Ogurek. "So with that framework we were able to improve traffic flow." R&B

PROJECT: Monongahela River Bridge

LOCATION: Brownsville, Pa.

OWNER: Pennsylvania Turnpike Commission

DESIGNER: FIGG

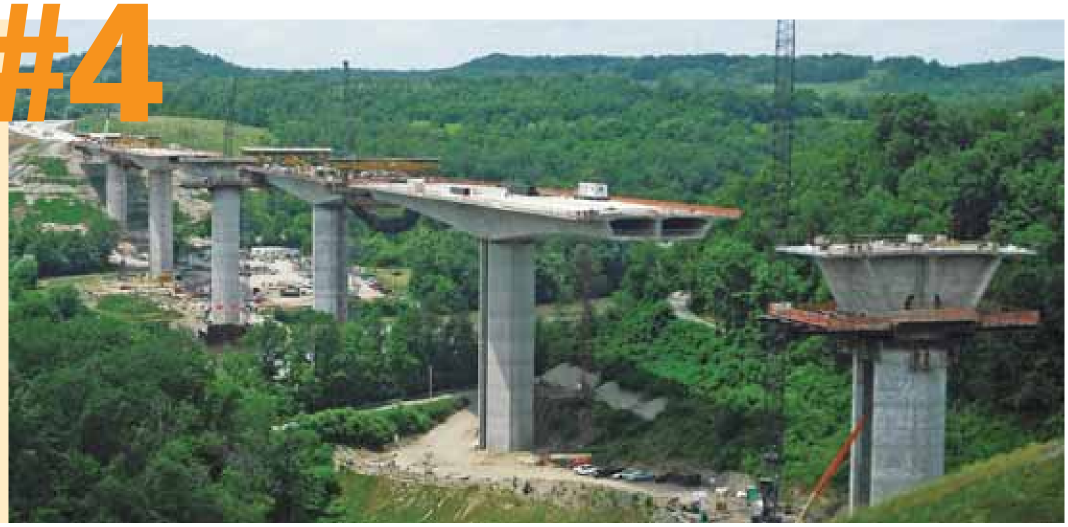
CONTRACTOR: Walsh Construction Co.

COST: $97.9 million

START DATE: Sept. 2, 2008

COMPLETION DATE: Nov. 18, 2011

#4



From coal to colossal

Giant piers help make bridge in rural Pa. possible

By Bill Wilson
Editorial Director

There are a few abandoned coal mines around Brownsville, Pa. Work also has stopped on the Monongahela River Bridge, but you can feel the energy in the air now more than ever.

The deep valley of the Monongahela River required a bridge nearly 200 ft tall and a structure length of 3,000 ft. The high-strength piers, 30 ft by 23 ft, were created with 15-ft-tall jump forms that were advanced upward as the concrete lifts below were sufficiently cured. The piers consist of 5,500-psi concrete with some locations requiring Type II cement for moderate sulfate resistance. Added protection was warranted because the site is near an old mining quarry with sulfates in the soil. The approach piers farther inland were designed as C-shaped twin-wall columns that used the octagonal design split in two, leaving an open side. This design created flexibility to mitigate the long-term creep and shrinkage of the superstructure while providing the strength and stability needed during cantilever construction without special support framework.

The abandoned coal mines created complicated restrictions on pier locations. Extensive mine grouting and stabilization, which was minimized by the elimination of two piers, was required prior to deep foundation construction. This work kept the integrity of the mines and the surrounding area intact and provided for efficient foundations.

"Designing the pier was one of the most challenging parts of the project, because not only did we have to try to match that shape on the existing footprint but also because it's tall. These are tall piers, and you have all of the load considerations because they are so tall," Jay Rohleder Jr., senior vice president at FIGG, told Roads & Bridges.

The superstructure box girders feature low-permeability 6,000-psi concrete with variable depths between 12 ft toward the midspan and 27 ft 2 in. at the piers. Some portions of the concrete superstructure were poured during the winter, requiring more attention to curing methods. These consisted of using wet burlap and a heating element, as well as three curing blankets to reach 3,500 psi.

In all, 51,000 cu yd of concrete, 7 million lb of reinforcing steel and 3 million lb of post-tensioning strand were used in the project.

The bridge is part of an extensive expansion to the Mon/Fayette Expressway that supports efforts by the National Road Heritage Park. The goal was to make nearby Rte. 40 less of a transportation artery and more of a local traffic corridor and tourist destination. The Monongahela Bridge improves access, addresses future capacity requirements and pulls traffic, including trucks, off of Rte. 40. R&B

PROJECT: Lowry Avenue Bridge

LOCATION: Minneapolis

OWNER: Hennepin County

DESIGNERS:
SRF Consulting Group; T.Y. Lin International

CONTRACTOR: Lunda Construction Co.

COST: $88.5 million

START DATE: July 1, 2007

COMPLETION DATE: Oct. 27, 2012

#5

New span a sight to see

Lowry Avenue Bridge adds new attraction to Minneapolis skyline

By Jeff Zagoudis
Associate Editor

If you've traveled through northeast Minneapolis anytime in the last year, you probably noticed the new bridge that is literally lighting the way for motorists across the Mississippi River.

Originally constructed in 1904, the Lowry Avenue Bridge in Minneapolis had received a major lift in the late 1950s, when the superstructure was replaced and raised. At the time, the new river piers were constructed around the originals, Rick Brown, P.E., of SRF Consulting Group told ROADS & BRIDGES.

During some regularly scheduled maintenance in 2007, however, bridge owner Hennepin County discovered that one of the river piers was actually moving. This was more than enough to spur the county into action.

When the project team spoke to the local community, they found that many of them liked the design of the old bridge, which was a simple through-truss configuration. "They liked being able to see the guts of the bridge as you drove through it," said Brown. At the same time, the city had plans to convert the industrial area to park space and wanted something a little more eye-catching. So SRF and T.Y. Lin International decided to make the new span a tied-arch bridge.

Rather than a straight tied arch, the Lowry Avenue Bridge uses what Brown calls a "basket handle" configuration, which was dreamed up by T.Y. Lin. In this case, the two main arches are not perfectly vertical, angling in 20° from the vertical at the top.

Being in the middle of a heavily traveled urban corridor, the right-of-way was "incredibly tight," Brown said. SRF and contractor Lunda Construction Co. expanded the bridge from two lanes to four and eliminated a curb wall embankment, along with other measures intended to open up the space for future land-use plans.

To truly make the new Lowry Avenue Bridge a stand-out Minneapolis landmark, SRF decided to cover the bridge facade in color-changing LED lights. "It's not the most convenient thing to go up on the bridge and change light bulbs," Brown joked about the reason for using longer-lasting LEDs.

The lights can be changed to celebrate any situation or season, from green for St. Patrick's Day to purple and gold for Minnesota Vikings football games.

In addition to creating the bridge itself, the project team designed and installed an underground sand filter to treat storm water from the bridge site and the surrounding 127-acre area. At 100 ft long and 40 ft wide, it is the largest filter of its kind in the upper Midwest. R&B

#6

RED GATE ROAD BRIDGE
St. Charles, Ill.
COST: $30 million
LENGTH: 1,140 ft
DESIGNER: Alfred Benesch & Co.
CONTRACTOR: James McHugh Construction Co.
OWNER: City of St. Charles, Ill.

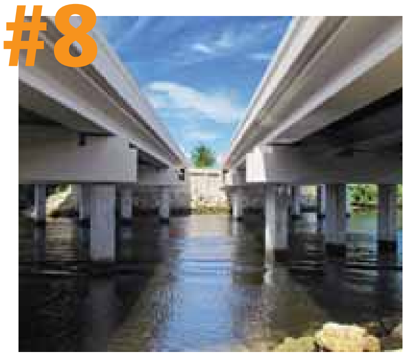
Red Gate Road Bridge proved to be a gateway to St. Charles, Ill., for thousands of vehicles a day and a life saver for the congestion-choked downtown. The eight-span bridge features a cable-stayed pedestrian bridge beneath the roadway. Using the same piers to support both structures brought a signature element to the bridge and allowed for more efficient construction with less material. Cantilever lookouts at mid-span of the trail bridge give users the feeling of floating above the water with unobstructed views over the Fox River.

#7

130TH & TORRENCE TRUSS BRIDGE
Chicago
COST: $21 million
LENGTH: 394 ft
DESIGNER: Alfred Benesch & Co.
CONTRACTOR: Walsh Construction
OWNER: Chicago DOT

Depression is no laughing matter in psychology or in bridge work. The intersection of 130th Street and Torrence Avenue is being depressed 30 ft under the Norfolk Southern Railway tracks to eliminate conflicts with the at-grade rail line. Value planning resulted in raising the Chicago South Shore & South Bend commuter and freight railroad on a new 394-ft, 4.75 million-lb, double-track, ballasted-deck, steel through-truss bridge. The project team overcame many challenges by rolling the new bridge into place using self-propelled modular transporters.

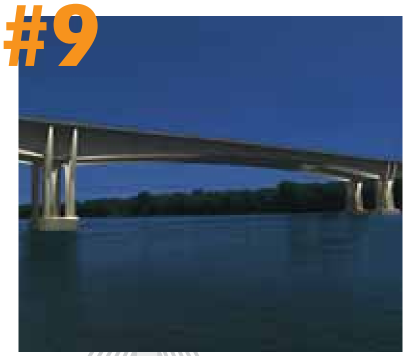
#8



U.S. 1 (S.R. 5) LOW-LEVEL BRIDGE REPLACEMENTS DESIGN-BUILD
Jupiter, Fla.
COST: $11.6 million
LENGTH: 0.6 miles
DESIGNER: BHA Engineers
CONTRACTORS: Johnson Bros. (contractor); RS&H (CEI)
OWNER: Florida DOT, District 4

Using top-down construction methods, the U.S. 1 team replaced four low-level bridges along U.S. 1 over the Lake Worth Oxbow, which is designated an Outstanding Florida Water. The designation meant the team had to employ innovative construction methods to protect the environment of the waterway. The construction involved temporary work trestles at each of the four bridge locations. The trestles were built so the cranes used to demolish the old and erect the new structures were able to move over the top of the structure with no impact to the waterway below.

#9



I-90 OVER THE MISSISSIPPI RIVER
Dresbach, Minn.
COST: $81.5 million
LENGTH: 2,593 ft
DESIGNER: FIGG
CONTRACTOR: Ames Construction
OWNER: Minnesota DOT

Residents of La Crosse, Wis., will be crossing the Mississippi River on a modern bridge in 2017, when the new twin post-tensioned concrete segmental bridges are completed. The existing bridge is fracture-critical in addition to having shoulders and approach geometry that are not up to modern standards. The new bridge is being constructed from above with form travelers in balanced cantilever using eco-conscious construction methods with a focus on minimizing disruption to wetlands and fishing holes of the nearby wildlife and fish refuge.

#10

MEMORIAL BRIDGE REPLACEMENT PROJECT
Portsmouth, N.H., and Kittery, Maine
COST: $88 million
LENGTH: 1,200 ft
DESIGNER: Ted Zoli; HNTB Corp.
CONTRACTORS: Walsh Group/Archer Western Contractors
OWNER: New Hampshire DOT

A gussetless steel-truss bridge may sound like pie in the sky, but the first of its kind will soon be completed joining Portsmouth, N.H., and Kittery, Maine. As notable for its schedule as for its lack of gussets, the new Memorial Bridge is being designed and constructed in just 18 months, including the time to demolish the old bridge. The old bridge was designed by JAL Waddell, and the design is echoed by the new bridge. Other innovations include a metalized zinc coating, using a consistent profile of three spans and cold bending of steel.