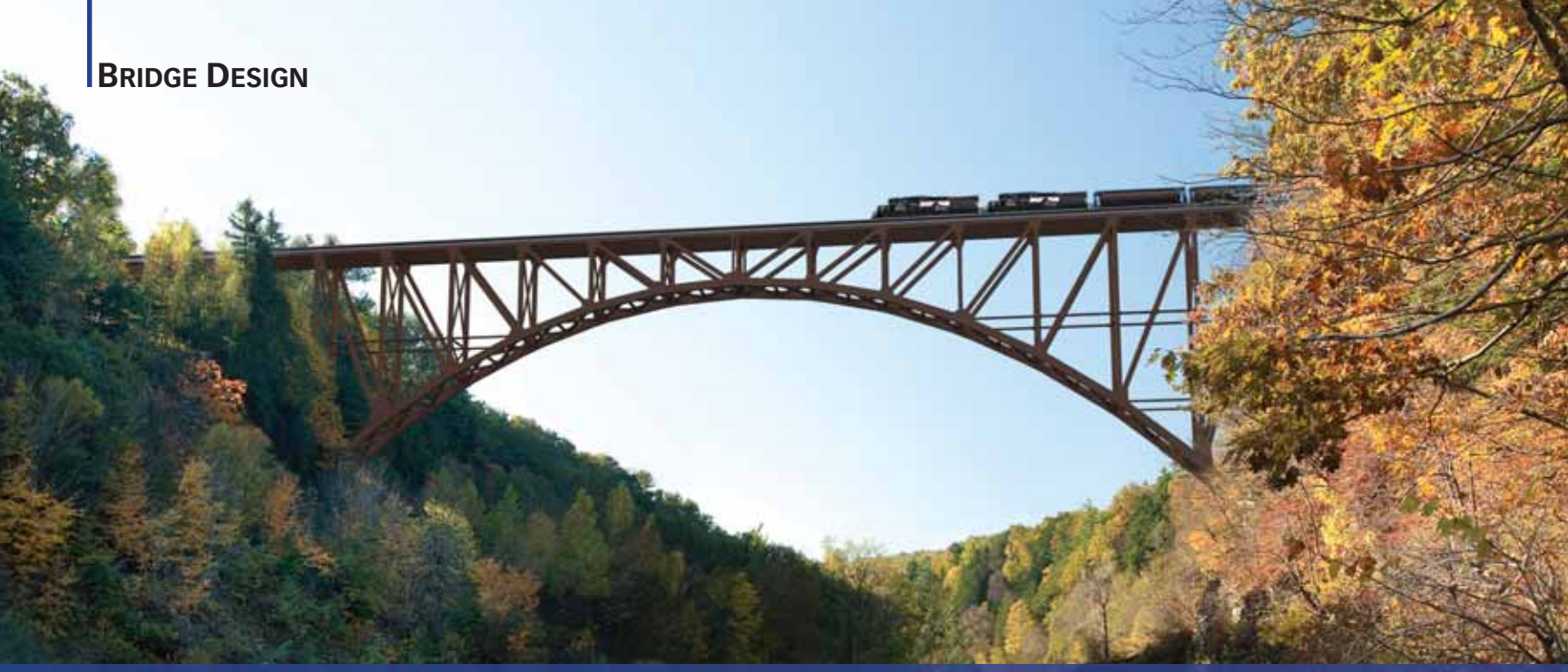

Iron on

Western New York continues High Iron legacy

By Kevin Johns, P.E., and Daniel Irwin
Contributing Authors

Set high above a river gorge against a backdrop of waterfalls and lush forest, the Portageville Bridge is considered a vital shipping link for Norfolk Southern along the Southern Tier Route.

The 819-ft steel-framed viaduct nicknamed the "High Iron Bridge" crosses the Genesee River in Letchworth State Park.

Originally constructed in the 1850s, the bridge was, at the time, the largest wooden trestle in the world. After a fire destroyed the bridge in 1875, the structure was replaced with a wrought iron trestle bridge. In 1903 the spans between the trestle towers were replaced with the trusses that are in use today. After well over a century of service, the existing bridge is in need of replacement in order to meet the demands of modern shipping requirements. Today, the bridge's posted load is 273,000 lb per axle, which is below the industry standard of 286,000 lb, and trains are required to reduce their speed to 10 mph instead of 35 mph, which is the preferred operating speed in this corridor.

Because the bridge is deemed vital to the regional economies of Buffalo and Binghamton, the privately owned bridge qualified for state funding through a public-private partnership between Norfolk Southern and the New York State Department of Transportation (NYSDOT). Modjeski and Masters was selected for bridge design. Because construction resulting from an intensive rehabilitation would likely interrupt rail operations for an extended amount of time, and the cost of such a rehabilitation was the same as constructing a new bridge, the preferred alternative to rehabilitation was a complete replacement of the bridge on an adjacent parallel alignment.

Nothing rivals the arch

Several factors needed to be considered when creating preliminary bridge designs, including future maintenance, cost of construction, environmental impact and stakeholder preference. Conceptual bridge replacement designs were created, ranging from a modern-day version of the existing bridge to an iconic steel arch spanning the entire width of the gorge.

The steel arch was ultimately selected for a number of important reasons. The design can be constructed without using falsework in the river and eliminates the need for piers embedded in the river, which reduces future maintenance costs and environmental impact.

Further, it preserves scenic views of nearby waterfalls and is economically competitive with other structures considered. After evaluation alongside the modern version of the existing bridge in a visual-impacts assessment, the steel-arch bridge also was favored by the public. The selected bridge design also is appropriately suited for a railroad structure, because it allows very little deflection when a train crosses.

Vertically challenged

In order to move forward with the long-span arch bridge, it first needed to be confirmed that the vertical rock face on either side of the gorge could support the new arch span. Modjeski and Masters analyzed the loads from the structure together with subconsultant Golder Associates. The investigation involved a total of 17 borings, including inclined borings necessary to examine the rock surface that would actually be supporting the span. Ultimately, the investigation concluded that the rock face is capable of supporting the bridge, but it identified a layer of shale that could affect the bridge's bearing capacity and settlement. The firm recommended that construction teams excavate the shale and infill with concrete before constructing the bridge.

As the vertical rock face will behave elastically, the engineering teams expected slight horizontal and vertical movement of the gorge walls from the arch reaction once the arch span is in place. Determining the amount of expected movement and its impact on the arch span became critical. The geotechnical team conducted a numerical model of the gorge walls to evaluate movement after pressure is applied to the arch skewback foundations. Seven different modeling parameters were used, and in the end, it was verified that the structural performance criteria in regards to incremental horizontal movement and total vertical movement were achievable.

Park protection

Once determined that the vertical rock face was capable of supporting the structure, additional environmental and tourism factors needed to be considered. Loud construction noises, particularly those that occur for extensive periods of time, can have an impact on tourism and park wildlife. Design concepts avoided the use of driven piles in the foundations in order to minimize noise disruption.

Excavation recommended by the geotechnical team also poses an environmental threat, as falling rock and soil can disrupt the gorge bed and/or river flow, thus controlled rock blasting was recommended for construction teams.

Additionally, state law requires that Norfolk Southern provide mitigation for the state park land that will be needed to build the new bridge. This mitigation includes providing to the park an equally suitable piece of land. This requirement will be partially satisfied by providing to the park some portions of Norfolk Southern's existing right-of-way, which contains the existing bridge and will therefore no longer be needed. However, the question remains whether the existing bridge will be demolished or if it will become a pedestrian crossing for the river gorge.

Construction teams will be faced with the additional challenge of creating the new bridge on an alignment that is a mere 75 ft from the alignment of the existing bridge. The railroad will continue normal operations throughout the duration of the replacement project, limiting space for construction teams to work and requiring crews to take additional safety precautions.

Mending the weak

Final designs for the new Portageville Bridge will be completed in 2013. Construction is expected to begin immediately following completion of final design and be completed in late 2015. Final designs will utilize a single-track spandrel-braced arch railroad bridge flanked by steel I-girder approach spans. The 963-ft ballasted deck structure will be 28 ft wide with the 483-ft-long steel arch as the main span.

The bridge will be designed to meet the American Railway Engineering and Maintenance-of-Way Association (AREMA) specifications, although the AREMA-designated standard load for wind loading on the train needed to be increased due to frequent passage of double-stack cars on the bridge. In addition, temperature stresses needed to be included within the arch-span design-load cases since it is a fixed span. AREMA does not include temperature stresses within its design loadings, since it prefers that bridges be simply supported. It is estimated that approximately 7.3 million lb of steel will be used to construct the new arch span.

Once complete, the Portageville Bridge replacement project will mend the weakest link along this Norfolk Southern route, ultimately replacing a historic structure with one that maintains the same scenic views, reduces future maintenance costs, minimizes environmental impact on Letchworth State Park and improves rail traffic vital to the economy of western New York. **R&B**

Originally constructed in the 1850s, the bridge was, at the time, the largest wooden trestle in the world. After a fire destroyed the bridge in 1875, it was replaced with a wrought iron trestle bridge.

Johns is a senior associate and project manager and Irwin is a senior design engineer at Modjeski and Masters.

For more information about this topic, check out the Bridges Channel at www.roadsbridges.com.