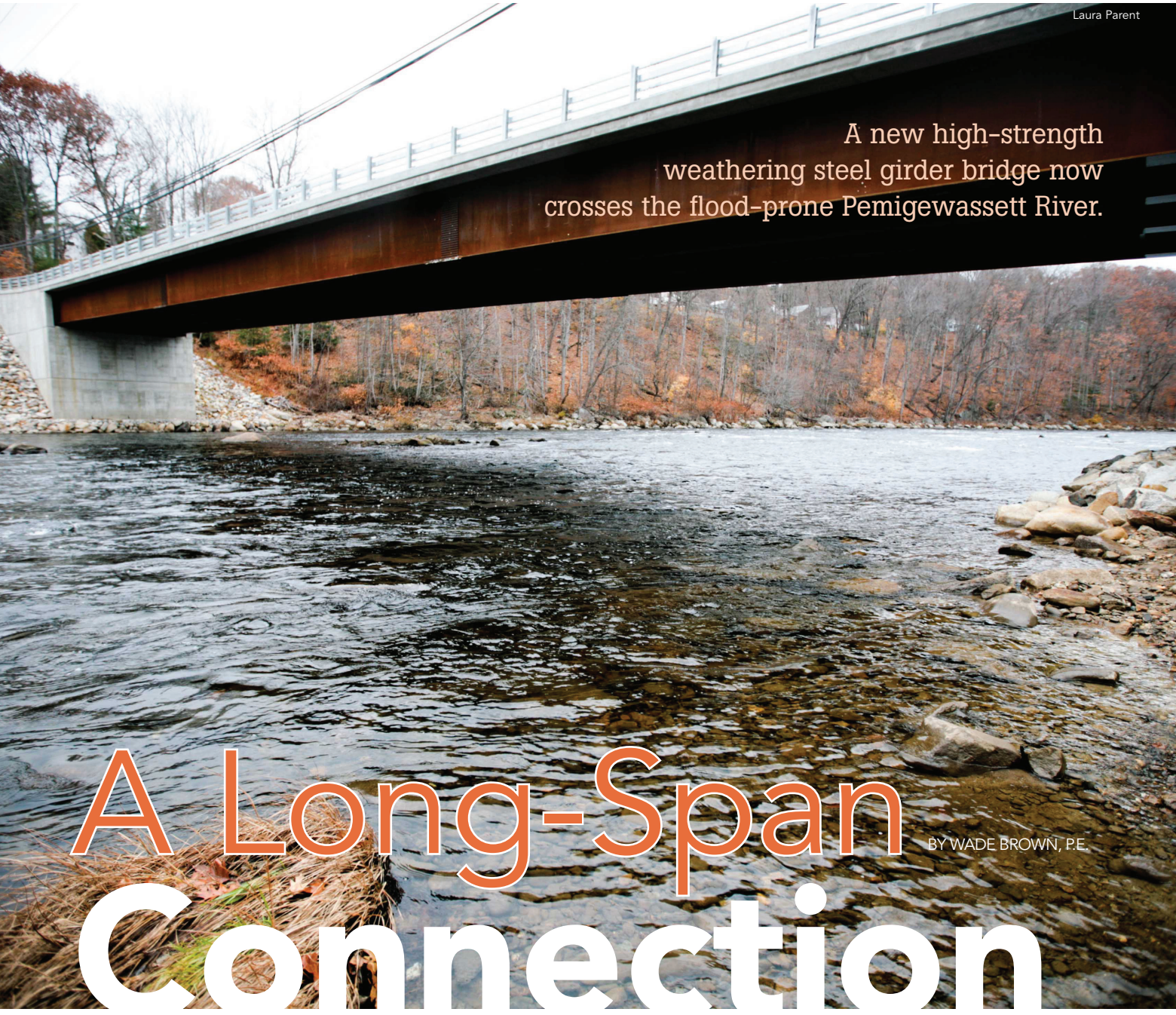

Laura Parent

A new high-strength weathering steel girder bridge now crosses the flood-prone Pemigewassett River.

A Long-Span Connection

BY WADE BROWN, P.E.

FOR NEARLY TWO CENTURIES, a bridge of some variety has spanned the Pemigewassett River, connecting the communities of Bristol and New Hampton, N.H. The latest structure, which opened to traffic in September 2009, holds the distinction of being the longest single-span bridge of its kind in New Hampshire.

The new Central Street Bridge features 8-ft-deep high-strength weathering steel girders spanning 240 ft. The bridge also features a steel bracing system that will help the structure resist floodwater forces, a regular challenge at this location. Already, the attractive structure is serving as a source of civic pride for the towns it connects.

The $4.7 million Central Street Bridge replaces a structure that opened in 1928. The old structure consisted of a High Parker truss with a polygonal top chord. The single-span, 245-ft-long, 18-ft-wide bridge was deemed "functionally obsolete" by the New Hampshire Department of Transportation several years ago.

Several interior steel diaphragms on the new Central Street Bridge are designed to transfer the force of floodwaters to each end of the bridge where it is resisted by steel restraint members embedded in each abutment just downstream from the third girder.

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An earlier bridge succumbed to a more violent end. That structure opened in 1836 and was a two-span, covered truss bridge with a single stone pier near the center of the river. It fell victim to the Pemigewassett's ongoing floodwaters in March 1928.

Designed to Resist Floods

The river's penchant for flooding was a significant consideration during the design phase of the new bridge. The weight and depth of the girders were reduced through the use of high-strength (Grade 70) steel. This particular design element created a more slender and streamlined appearance, and allowed using smaller cranes to erect the girders. More importantly, however, it served to increase the clearance above the Pemigewassett by approximately 4 ft, while the elevation of the roadway was raised by approximately 10 ft.

Even so, the bridge was designed to resist floodwater forces that would result from a breach of the upstream Ayers Island hydroelectric dam. The force resisting system includes several interior steel diaphragms designed to transfer the floodwater force from the upstream girder to the concrete bridge deck. The bridge deck, acting as a rigid horizontal diaphragm, collect the force from each interior diaphragm and transfer it equally to each end of the bridge. There the steel end diaphragms, between the girders, collect the total force and transfer it down to a 3,000-lb structural steel restraint member embedded in the concrete abutment. This restraint member is located just downstream from the third of four bridge girders. A small gap separates the girder from the steel restraint block. This gap will close as the girder's steel reinforced elastomeric bridge bearing deforms transversely from the floodwater force.

Minimizing Impacts

In order to minimize construction and permanent impacts to the steeply sloping western river bank, the abutment was designed with tall, curved wingwalls that step up into the hillside. The walls, 60 ft in length and up to 42 ft in height, are curved to parallel the roadway approach and minimize side impacts. The footing is stepped in increments of 13 ft, which significantly reduced the cost of reinforced concrete, rock excavation, and temporary earth retention.

While usually a temporary system, the steel sheet piles used for the west abutment cofferdam were designed to remain in place by anchoring to a 6-in.-thick reinforced concrete sub-footing, and serve as permanent scour protection for the abutment's footing.

An Unforeseen Hurdle

The wars in Iraq and Afghanistan made the procurement of steel difficult during the bridge's construction period. Because one of two U.S. steel mills was engaged in tank production for the U.S. military, the other mill was faced with an overload of domestic orders, which resulted in a delay to the project. The high-strength (Grade 70) rolled plates, required to fabricate the steel plate girders, became available seven months late, which delayed steel fabrication and extended the steel erection phase of the project to beyond the following year's high-water season. Even with the delay, good management of the construction phase helped keep the total construction cost, including construction engineering, below the 2007 bid price.

The new Central Street Bridge has been designed to use low-cost, durable materials including elastomeric bridge bearings, weathering steel girders, silicone deck expansion joints, and granite block retaining walls, that will keep maintenance costs at a minimum.

It also features level spreaders with stone fill to naturally treat stormwater runoff before it reaches the Pemigewassett. Plantings throughout the riprap stone slopes minimize the impact of absorptive heat transfer from the rocks to the river's waters. Shallow steel girders and tall abutments were included in the overall design, enabling visual separation of the bridge from the river and other natural aspects of the site. During construction, a new river access pathway was created, which features granite steps built with material recycled from the old bridge abutments.

Approaches to the old bridge contained steep grades and tight turns. When opposing cars would come across the bridge, one vehicle would typically need to stop for the other to pass. With the new bridge, realigned approaches, wider travel lanes (28 ft between curbs), flatter grades, softened curves, and a 6-ft-wide sidewalk means vehicular and pedestrian safety has been greatly increased.

With the new Central Street Bridge, the citizens of Bristol and New Hampton are not only getting a vital transportation link, but a durable and attractively designed structure that blends in majestically with the natural environment. MSC

Owner

Municipalities of New Hampton, N.H. and Bristol N.H. (Funding assistance and oversight provided by the New Hampshire Department of Transportation.)

Structural Engineer

Kleinfelder/S E A Consultants, Manchester, N.H.

Steel Fabricator

Casco Bay Steel Structures Inc., Saco, Maine (AISC and NSBA Member)

Steel Detailer

Tensor Engineering, Indian Harbour Beach, Fla. (AISC and NSBA Member)

General Contractor

Winterset Inc., Lyndonville, Vt.

Laura Parent

Replacing a functionally obsolete truss bridge, the new Central Street Bridge connecting Bristol and New Hampton, N.H., is the longest single-span bridge of its type in the state.