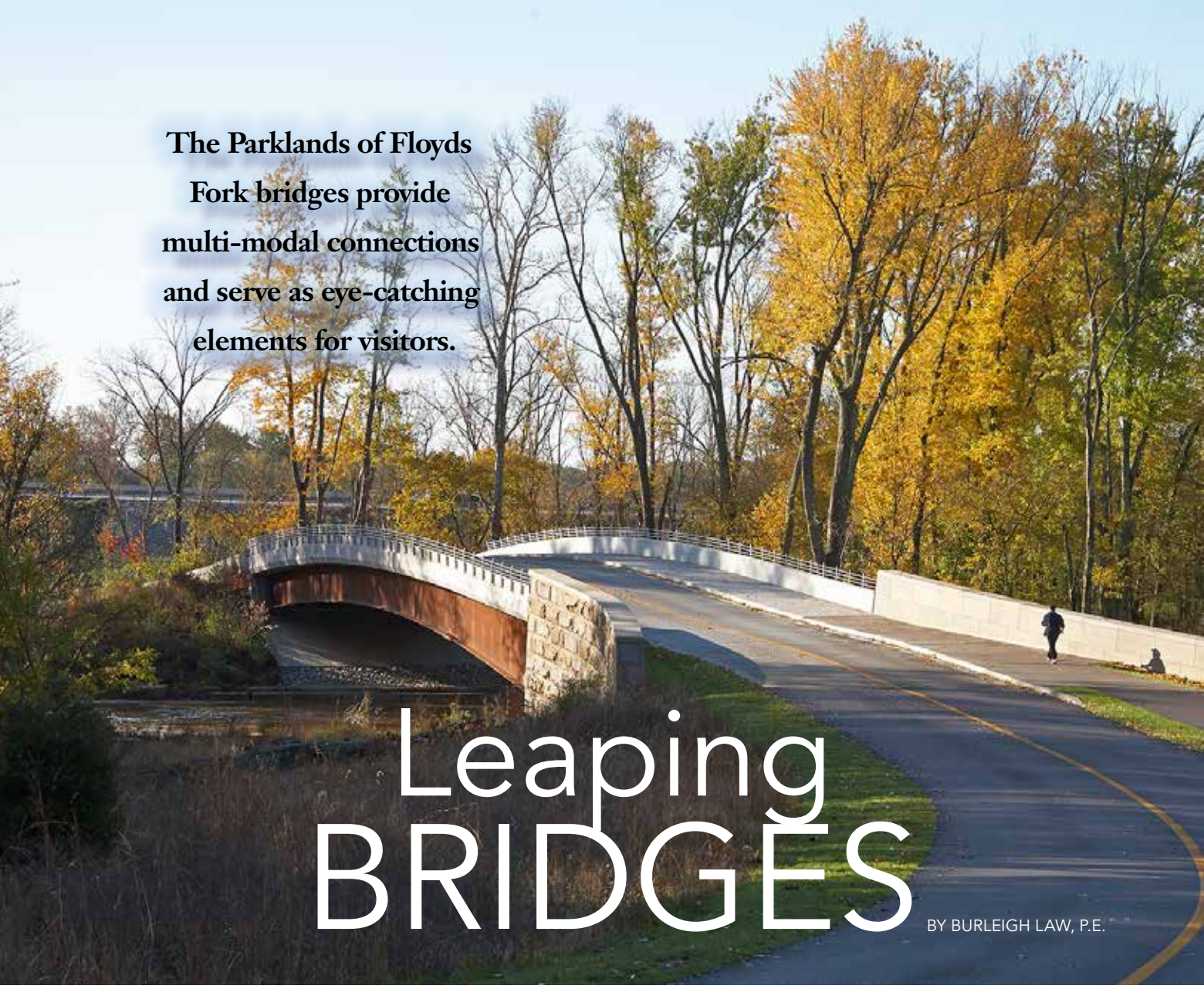

The Parklands of Floyds Fork bridges provide multi-modal connections and serve as eye-catching elements for visitors.

Leaping BRIDGES

BY BURLEIGH LAW, P.E.

GREAT PARKS ARE PART of Louisville's history.

The city's park system was designed in the 1890s by world-renowned landscape architect Frederick Law Olmsted, who sought to incorporate nature into neighborhoods and enhance social interactions and economies.

With more than one million visitors in the past year, the Parklands of Floyds Fork is a world-class park that serves as a model for other communities across the country. The park's four new leaping bridges (three cross Floyds Fork in the Beckley Creek section of the Parklands and the fourth is in the Broad Run section) fulfill its goals of fostering a well-used and well-loved place and playing a role in shaping the community, while also providing access and circulation.

Inspired Jump

Inspired by a deer leaping over a fence, the bridges are composed of haunched welded steel plate girders fabricated from M270 Grade 50W weathering steel to match the natural surroundings of the park. Depths vary from 60 in. to 120 in., and the girders are painted at both ends and include drip bars to mitigate staining of the abutment. The high arches accentuate the passage of water beneath the bridge and provide overlooks from the bridge centers and abutments. At 38 ft wide with single spans ranging from 160 ft long to 170 ft long, the bridges are shared by pedestrians and vehicles. Each of the bridges features coordinated elements, but each is also place-specific to create distinct landmarks.

For example, instead of a typical flat bridge, the leaping Thornton Bridge grades are 8% at both the leaping and landing ends, resulting in an arch effect. When the bridge's five 170-ft girders, each weighing approximately 40 tons, were lifted into place to splice the field pieces together, the steel erector initially feared a fabrication error because the girders were unlike anything they had previously seen. Steel girders, by design, require upward camber in the web to account for all the dead loads that eventually deflect the bridge downward, but this unique profile required 50 in. of additional camber.

No Skew

As the bridges (which each use approximately 245 tons of steel) are straight with no skew, this enabled an architecturally rich structure to be simplified. The girders were designed in steel bridge design program MDX using a line girder analysis in lieu of the more complex girder system

▲ The leaping bridge grades are 8% at both the leaping and landing ends, resulting in an arch effect.

▲▼ A curved girder, gradually making its way over Floyds Fork. The high arches accentuate the passage of water beneath the bridge and provide overlooks from the bridge centers and abutments.

analysis required for curved or sharply skewed bridges. The fabricator asked for one splice plate thickness change to be consistent with other sizes used on the girders, but otherwise the shop drawings were very consistent with the design plans. Camber met expectations and resulted in no unexpected challenges while setting overhang forms and brackets, the stay-in-place metal forms or the screed elevations.

Details and recommendations found in the AASHTO/NSBA *Steel Collaboration Guidelines for Design Details* and the *Mid-Atlantic States Structural Committee for Economical Fabrication Details* resulted in simplified design and detailing while providing a cost-effective solution for fabricators. The architect sought to minimize the visible connections and miscellaneous members beyond the girder itself. Maximum fabrication depth and shipping lengths dictated the need for field splices, but the number of transverse stiffeners and connection plates was minimized by increasing the

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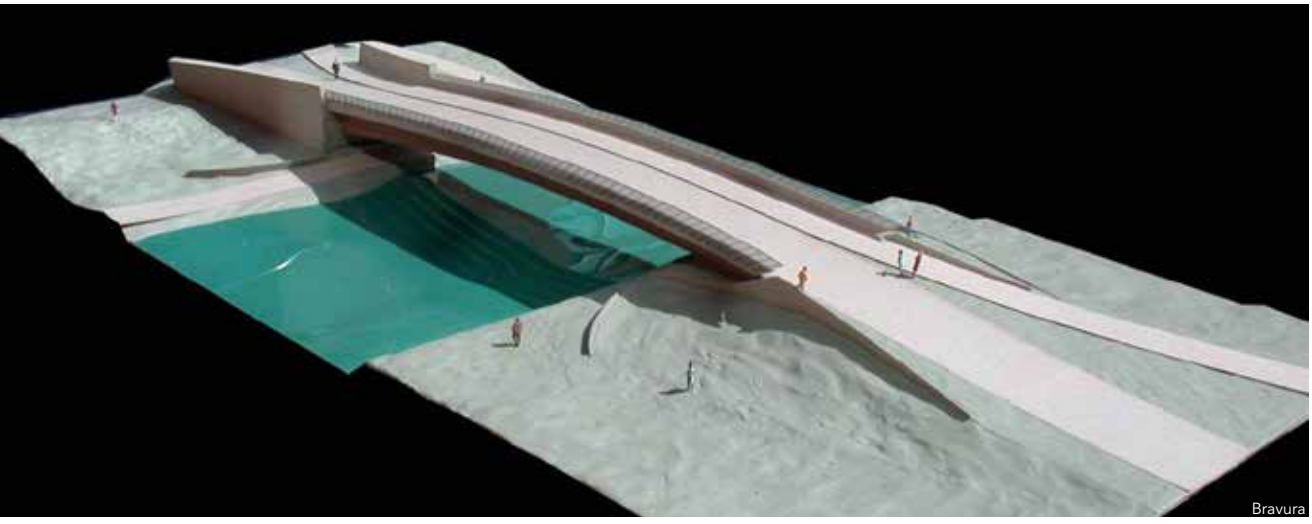
▲ The bridges are composed of haunched welded steel plate girders fabricated from M270 Grade 50W weathering steel.

▼ A model of one of the bridges.

▲ A second girder following the first one.



web thickness, only providing them at the intermediate cross-frames, and by pushing the intermediate cross frame spacing to the code-allowed maximum. The abutment and end bent are semi-integral with concrete end diaphragms and no steel end diaphragms, so the first intermediate cross-frames were placed within 10 ft of the substructures to strengthen stability during erection and slab pour.

The bridge arch not only met the architect's aesthetic requirements, but also increased the hydraulic opening for a bridge that hugs the river's edge. Much of the Parklands is located in a floodplain and if the bridges had been designed to meet typical Kentucky Transportation Cabinet hydraulic requirements, higher profiles and additional spans would have been required. Because the land is owned by 21st Century Parks, a private nonprofit organization, they and the architect were able to select a smaller-footprint, single-span bridge with a high-arch opening that provided sufficient freeboard in the middle of the bridge. These bridge components are designed to withstand flooding conditions for a 75-year design life, including large debris moving down Floyds Fork.

Weathering steel, with its dark, rustic brown color, was chosen for its ability to blend in with the park surroundings. Prestressed precast concrete beams would have weighed almost three times more and required unique forms and fabrication to create the same variable-depth arch shape, but for a much higher cost. In addition, a cast-in-place concrete beam option would have required falsework within the river, which was not permissible by regulatory agencies and would have restricted river traffic. Structural steel resulted in lighter members and smaller cranes during the erection process, keeping the bridges' costs lower. The staging and laydown area was limited since the regulatory agency permits required a 250-ft limit of disturbance and tree clearing along the length of the river. Fortunately, the contractor was able to place cranes next to the rear of the abutments and hoist the field sections out over the river.

To create a sense of movement, the steel pedestrian bridge railings include posts that are set at different angles. An incremental difference of 1.2° varies the post railings from -7.2° to match the leaping abutment sloping face to 45° to match the landing end bent sloping face. The differing angles and the profile grade added complexity to the fabrication and installation of the railings, while further enhancing the arch.

A Sense of Place

From the air, the Louisville Loop Trail (part of a 100-mile multi-recreational trail) winds under the bridge to mimic the movement and flow of Floyds Fork. Along the trail and under the bridge is a decorative variegated limestone block stepping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The staging and laydown area was limited, but the contractor was able to place cranes next to the rear of the abutments and hoist the field sections out over the river.

The bridges are inspired by the arc of a deer leaping over a fence.

Crossframe drawings for the Thornton Bridge.


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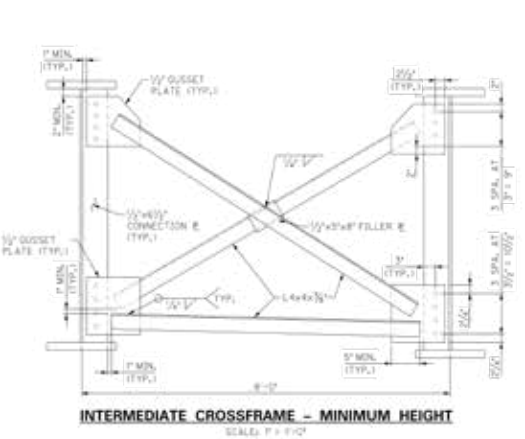

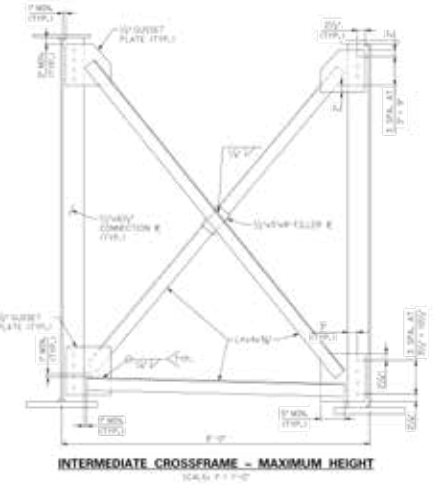

and seating area. The massive stone blocks are as big as 3 ft high by 5 ft wide by 8 ft long and weigh up to 10 tons each.

Fishermen can cast for trout, catfish, bass and bluegill, while visitors can enjoy picnics and a view of the expansive Egg Lawn, a 22-acre oval-shaped lawn, surrounded by a 0.7 mile paved, tree- and light post-lined walking trail. The Thornton Bridge, part of the Beckley Creek Park area, provides a connection to trails, lakes, a dog park, picnic areas, a canoe launch and other park amenities including a community center, an education/interpretation center, playgrounds, a splash pad and pavilions.

The leaping bridges are the result of collaboration between structural engineer HNTB Corporation and architect Bravura. At the beginning of the planning and design process, the team drew inspiration from walking the 3,200-acre park, of which 80% is naturally restored or managed woodlands, wetlands and meadows. In addition to preserving large natural areas, the park provides active recreation areas, including sports fields, community parks, multi-use trails for bikers, horses, hikers and launches for boaters. Final design of the bridges was completed in three months, with no major changes during the design process, and construction took just under a year.

While the cost of a typical highway bridge is about $110 per sq. ft, the leaping bridges cost around $400 per sq. ft due to the added aesthetics and the limestone-clad abutment, for a total of $2.6 million for the Thornton Bridge. The park's bridges and roads were federally funded through $38 million in federal funds from the Federal Highway Administration's "Safe, Accountable, Flexible, Efficient Transportation Equity Act, A Legacy for Users" for the park's infrastructure. Private donors provided about $70 million, which funded several of the park's amenities.

Through this collaborative process and by using ordinary materials in unique ways, the signature leaping bridges help define the world-class park that is and will be well-used and well-loved by current and future generations. ■

Owner
21st Century Parks

General Contractor
MAC Construction and Excavating, New Albany, Ind.

Architect
Bravura

Structural Engineer
HNTB Corporation

Steel Fabricator and Detailer
Stupp Bridge Company, Bowling Green, Ky. (AISC Member/NSBA Member/AISC Certified)