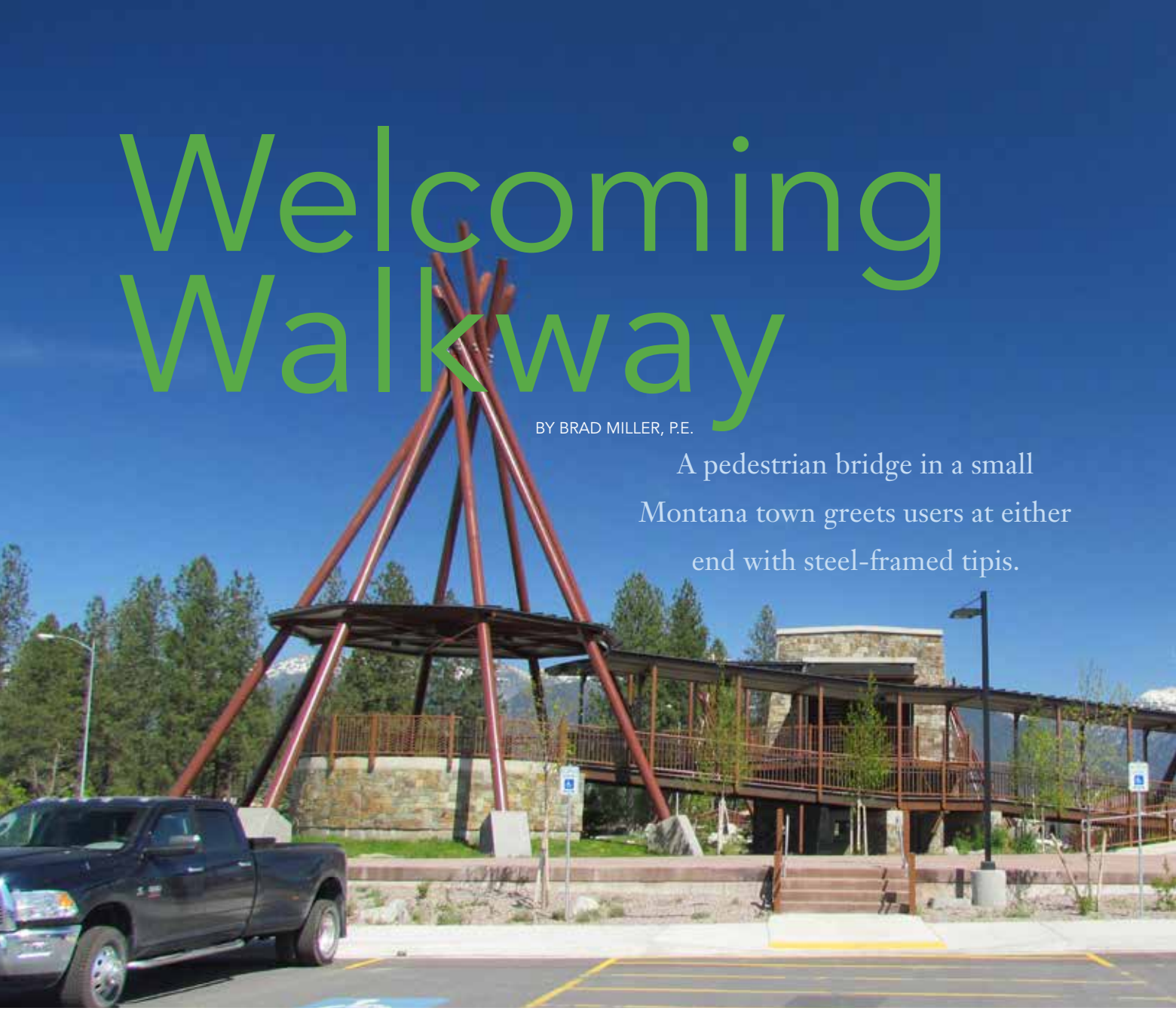
Welcoming Walkway

BY BRAD MILLER, P.E.

A pedestrian bridge in a small Montana town greets users at either end with steel-framed tipis.



THINGS ARE MOVING FASTER in the small town of Pablo, Mont., these days.

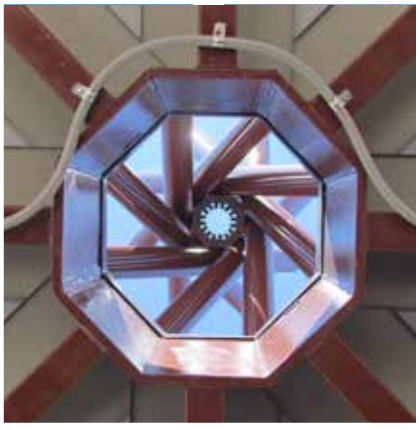
The reconstruction of Highway 93 into a new four-lane highway, which bisects Pablo, has increased traffic in the area and separates Salish Kootenai College from the town's central core. Crossing the roadway on foot or bike has become a more risky proposition, thus building the case for a new pedestrian overcrossing.

The answer came in the form of the Pablo Pedestrian Bridge, a $3.2 million project funded by the American Recovery and Reinvestment Act (AARA) that was built for the Confederated Salish and Kootenai Tribes (CSKT) and local residents in western Montana over Highway 93, which the tribes call the People's Way.

The Montana Department of Transportation (MDT), in conjunction with the Federal Highway Administration (FHWA), developed initial concepts for the overcrossing, including concrete and steel options. However, CSKT felt that the appearance did not fit into the surrounding environment and did not reflect their culture. MDT and FHWA therefore decided to give CSKT an active role in the design and construction process, as well as let them manage the project, and agreed to have MDT take ownership of the bridge and maintain it once construction was complete. HDR Engineering was chosen to design the project and assist CSKT in administering construction (construction cost for the project was $2.5 million, while the total cost, including engineering and administration, was $3.2 million).

Span and Ramp Development

Several designs were initially considered for the bridge: short-span, long-span and center-pier. Safety concerns, as well as anticipated construction and visual impacts, kept the center pier option from moving forward. And while the short-span option meant using less material, it too was eventually ruled out due to a MDT study revealing the high cost of moving adjacent utilities ($500,000) compared to the projected additional cost for a longer span.



All photos this spread: Brad Miller

▲ The tipi structures, two at each end, are 60 ft tall.

◀ Tipi roof with oculus framing the reciprocal frame top connection.

▲ Finished zigzag ramps and landings under tipi frames at each end of the bridge.

▲ Night placement of bridge span sections on falsework.

The long-span option was therefore chosen on this basis, with the added benefit of being deemed superior from an aesthetics standpoint. The final length of 265 ft allowed the bridge to adequately span the intersection without significantly impacting the adjacent utilities. About 150 tons of structural steel was used for the span, while the approach ramps and landings used 75 tons.

A prefabricated steel box truss (12 ft wide and 16 ft deep at mid-span) was chosen for the span. A timber deck was chosen over a concrete deck, as it allowed the use of 12-in. by 12-in. HSS for the truss chords; a concrete deck would have required approximately 16-in. by 16-in. truss chords. This option also allowed for the use of weathering steel, as 12 in. by 12 in. was the largest HSS size that was readily available in weathering steel at the time without having to use a special built-up section. Diagonal chords on the bridge truss are configured to match common tribal geometric patterns, and the cambered variable depth truss is reminiscent of a bow.

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Chris Kelly

▲ Tribal elders cutting the ribbon.

▼ The completed bridge, looking east.

Tom Hanou

▲ An attractive, safer pedestrian route over Highway 93.

◀ Finishing the roof structures and flatwork.

For the ramp, multiple configurations were investigated and presented to CSKT, including circular and modified circular configurations, a zigzag configuration and switchback ramps. Each of the ramp configurations made use of raised landscaping on each side of the highway, reminiscent of the pine-studded sand dunes that are common to the area, in order to greatly reduce the length of elevated ADA ramps required. Four 30-ft-long ramps with a 1:12 slope and four horizontal landings were required. Sidewalks with a 5% maximum slope lead up to the base of the ramps to facilitate two-way pedestrian and bicycle traffic in various directions depending on the trails and building locations near the bridge. The zigzag configuration was eventually chosen because of its compactness and aesthetic considerations, and metal roofs were placed over the bridge, ramps and landings roofs to protect pedestrians and cyclists from the elements. The ramps were framed with wide-flange sections and channels, and HSS was used to frame the roofs.

Steel Tipis

Two tipi structures with exposed steel frames were located at the landings at both ends of the bridge, symbolizing the Salish and Kootenai tribes that coexist on the CSKT reservation. The four tipis are 60 ft high and are constructed from eight 12-in.-diameter HSS that form a reciprocal frame, a very simple and efficient structural configuration. A roof covers each tipi landing with a 22-in.-diameter oculus (rain hole) providing an upward view of the reciprocal frame top connection. Each of the four tipi landings has a unique railing design including various geometric patterns.

Determining how to frame the tipis posed a challenge. HDR decided that this would be a good application for a reciprocal frame and modeled this in 3D to determine the size and placement in order to provide the proper clearance and headroom. HDR started the process by making a simple model from pencils in order to show the designers and drafters the concept, then refined this by making a 3D CAD model and sharing it as a 3D PDF that could be opened and rotated in space.

Spread footings were selected for all of the foundations. The underlying materials consisted of dense gravels to a depth of about 20 ft with clays and silts below this. The geotechnical members of

➤ A truly 3D model of the tipi structure.

Brad Miller

the design team expressed some concerns that the weight of the massive concrete abutments (faced with natural rock) that were used, in conjunction with the weight of the long bridge span, would cause long-term settlement. Similar concerns had arisen with other recent highway projects in the area. In order to minimize the dead load of the abutments and the potential for long-term settlement, HDR designed the abutments to be hollow or have Styrofoam blocks embedded in each column leg.

The project was completed in the spring of 2011. Thanks to its lightness and aesthetic considerations, including the use of weathering steel and steel-framed tipi structures, the bridge fits into its rich scenic and cultural surroundings in the beautiful Mission Valley, while providing safe passage over Highway 93 and connecting Salish Kootenai College with the rest of Pablo. MSC

Owner
Montana Department of Transportation

Client
Confederated Salish and Kootenai Tribes (CSKT)

Structural Engineer
HDR Engineering, Inc., Missoula, Mont.

Architectural Design
MacArthur Means and Wells Architects, Missoula

General Contractor
Quality Construction, Missoula