

All photos: Central Federal Lands

SIX RIVERS NATIONAL FOREST has certainly earned the right to be named a National Forest.

Established in 1947 by President Harry Truman, it is nearly 1,500 sq. miles in size, including 137,000 acres of old-growth forest, and has 366 miles of wild and scenic rivers, distinct botanical areas and public use areas for camping, hiking and fishing—a nature-lover's paradise in northwestern California.

Given the sheer number and mileage of rivers in the park, there are, of course, several bridges. In 2012, the Central Federal Lands Highway Division of the Federal Highway Administration (FHWA), in cooperation with Six Rivers and Del Norte County, Calif., began the process of constructing the second phase of an improvement plan project to CA FH 112, also known as the South Fork Smith River Road, which spans the Smith River in the northernmost section of the forest. The project included the replacement of two bridges on the road: the Steven Memorial and Hurdy Gurdy Creek Bridges, both designed to AASHTO LRFD *Bridge Design Specifications*. The \$8.6 million project is entirely funded by FHWA and is part of a larger project to upgrade all of the one-lane sections of South Fork Smith River Road to allow traffic in both directions. A bridge selection study evaluated structural options based on: required bridge length, the remoteness of the construction sites, transporting girders to these sites via forest roads with difficult angles, initial cost, the use of deep foundations in a highseismic area, maintenance and minimal impact of the bridge piers on the environmentally sensitive areas and waterways that they would cross—and a steel plate girder design was chosen as the best option for both bridges. In addition, staged construction wasn't required for either bridge.

Hurdy Gurdy Creek Bridge

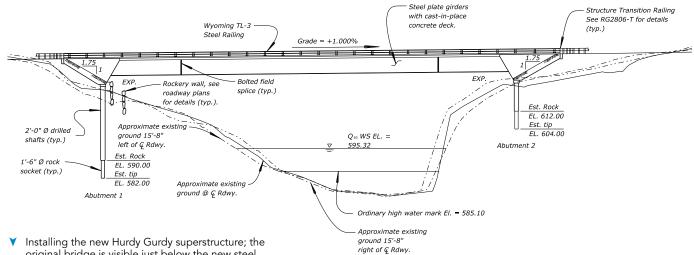
The original Hurdy Gurdy Creek Bridge was a one-lane, 170-ft-long bridge with two simple spans: a rolled beam approach span and a riveted steel plate girder main span. The approach was 30 ft long and the main span was 140 ft long, and the bridge's total width was 15 ft, 6 in., resulting in a clear roadway width of 14 ft.

For the replacement, a single-span bridge was selected to avoid the need for, significant cost of and environmental degradation inherent to pier construction in a streambed. The new bridge is a two-lane, 190-ft-long, steel plate girder bridge consisting of four 189-ft, 4-in. spliced girders (7 ft deep) with a 110-ft long midsection, two 37-ft, 2-in. end sections and a cast-in-place concrete deck.

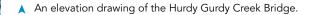




- The Hurdy Gurdy Creek Bridge spans were placed with two cranes, one on each side of the river.
- The two-lane, 190-ft-long bridge replaces a 170-ft span.
- The bridge consists of four 189-ft, 4-in. spliced girders, 7 ft deep, with a 110-ft long midsection and two 37-ft, 2-in. end sections.



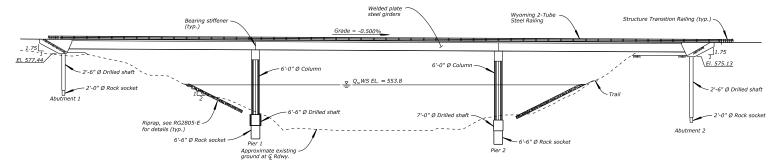
original bridge is visible just below the new steel.







Modern STEEL CONSTRUCTION



- An elevation drawing of the Steven Memorial Bridge.
- ▼ The new bridge is 470 ft long.





- ▲ The new design increased the crossing's width to 31 ft, 4 in., providing a clear roadway width of 28 ft.
- The superstructure rests on two piers, 48 ft tall and 52 ft tall, as it crosses the river.



The new width is 31 ft, 4 in., providing a clear roadway width of 28 ft. Bridge abutments were founded on 2-ft, 6-in. drilled shafts socketed into bedrock.

The new alignment was shifted to the upstream (north) side of the existing structure to allow the existing bridge to stay in service during construction. The county and Forest Service approved WYDOT standard TL-3 bridge rail to be used on the structure, with a WYDOT standard corrugated beam approach guardrail transition section. The chosen rail was ideal for scenic views, with minimal obstruction, while also meeting safety requirements.

Approach slabs were connected to the cantilevered end walls at both ends of the bridge, and these end walls were designed to engage the soil behind the abutments in case of an earthquake. In addition, a gravityretaining rockery was used to provide slope stability at the abutment of one embankment, a solution that ended up being cost-effective, aesthetically appealing and sustainable.

Steven Memorial Bridge

The original Steven Memorial Bridge was a one-lane, 330-ft-long, three-span riveted steel plate girder bridge with a suspended middle span. The span configuration was 94.4 ft-140 ft- 94.4 ft, and the bridge's total width was 16 ft, 4 in., providing a clear roadway width of 15 ft. The new bridge is a two-lane, 470-ft-long, three-span steel plate girder bridge consisting of four spliced girders (6 ft deep) with a 180-ftlong center span, two 145-ft outer spans and a cast-in-place concrete deck. The new design increased the crossing's width to 31 ft, 4 in., providing a clear roadway width of 28 ft, and 15-ft and 20-ft approach slabs were constructed at the ends of the bridge. As with the Hurdy Gurdy Bridge, abutments were founded on 2-ft, 6-in. drilled shafts socketed into bedrock, and the 48-ft-tall and 52-ft-tall, 6-ft-diameter piers were founded on 6-ft, 6-in.-diameter drilled shafts socketed into bedrock and encased with 1-in.-thick galvanized steel.

The three-span Steven Memorial Bridge consists of four 6-ft-deep spliced girders.

In addition, hammerhead pier caps with round columns were used to create a slender and open structure. To evaluate the effects of seismic forces on the superstructure, the piers and the drilled shafts supporting the piers and abutments, a complete 3D finite element model of the structure was developed to accurately predict the bridge's behavior.

The new bridge was constructed adjacent to (north of) the existing one to allow the latter to stay in service during construction, and the new alignment was shifted to the downstream side of the existing structure.

Over 415 tons of structural steel were used to build both bridges. Girders were shop painted using a three-coat system and were all preassembled at the fabrication shop for quality control purposes. Construction of the bridges began in May of 2013 and was completed in less than 12 months. The new pair now provides improved, scenic access through Six Rivers National Forest.

Owner

Six Rivers National Forest

Structural Engineer

Central Federal Lands Bridge Office, Lakewood, Colo.

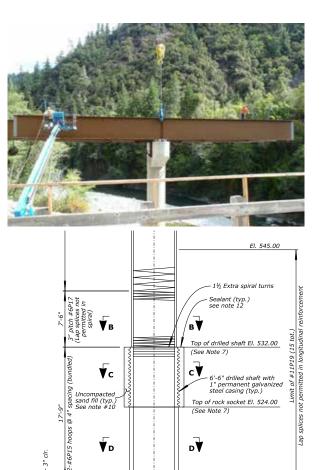
General Contractor

West Coast Contractors, Inc., Coos Bay, Ore.

Steel Fabricator, Erector and Detailer

Fought and Company, Inc., Tigard, Ore. (AISC Member/NSBA Member/AISC Certified)

> A column-shaft rock socket connection detail for Pier 1 of the Steven Memorial Bridge.



1

Bottom of rock socket El. 514.00

(See Note 7