Narrow Margin

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It's a tight—but successful—squeeze for a replacement steel span in a remote Idaho canyon.

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WHILE CERTAINLY SCENIC, the steep nature of a V-shaped canyon near Riggins, Idaho, created quite the challenge for the designers of a replacement bridge over the Salmon River.

The original Manning Crevice Bridge carried Salmon River Road over the river at this location, providing access to residences, resorts and commercial rafting ventures and acting as a main artery for recreational users of the river and surrounding forest lands.

By 2010, the bridge (built in 1938) had reached the end of its service life, and the decision was made to replace it. But this would be no easy feat. The site, located in a steep canyon, had limited access for trucks and limited space available to stage construction equipment and materials, not to mention sharp bends in the road. The choice of steel for temporary and permanent works was crucial to developing a feasible erection scheme on this difficult site and addressed the following requirements for the replacement project:

- A bridge deck clear width of 16 ft for a single lane
- A minimum vertical clearance of 18 ft
- A minimum load capacity of AASHTO HL-93 and a 45-ton logging vehicle
- Roadway curvature at the bridge ends had to be able to accommodate a logging truck crossing the bridge
- No permanent construction could be placed within the 100-year flood plain
- Traffic had to be maintained on the existing bridge during construction
- The river had to remain open to rafters during construction
- Construction equipment was not allowed in the river

Not-So-Easy Access

After evaluating six different structural configurations, a single-tower, asymmetric suspension bridge scheme was chosen. Competent bedrock at the site provided ample capacity for anchoring large horizontal forces, thus favoring arch and suspen-

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The new bridge spans 300 ft.

Roadway curvature at both ends was required to allow a logging truck to cross the bridge.

Photo Courtesy of FHWA-WFLHD

sion bridge types over cable-stayed structures. Given the limited access for construction equipment, cable suspension was judged to be more constructable than an arch because of the light weight and flexibility of steel cables. The bridge span length is 300 ft and with a cable sag of 18.5 ft at mid-span, the resulting sag ratio (span/sag) of 16.2 is much flatter than the classical suspension bridge sag ratio of 10. The bridge uses a total of 180 tons of structural steel.

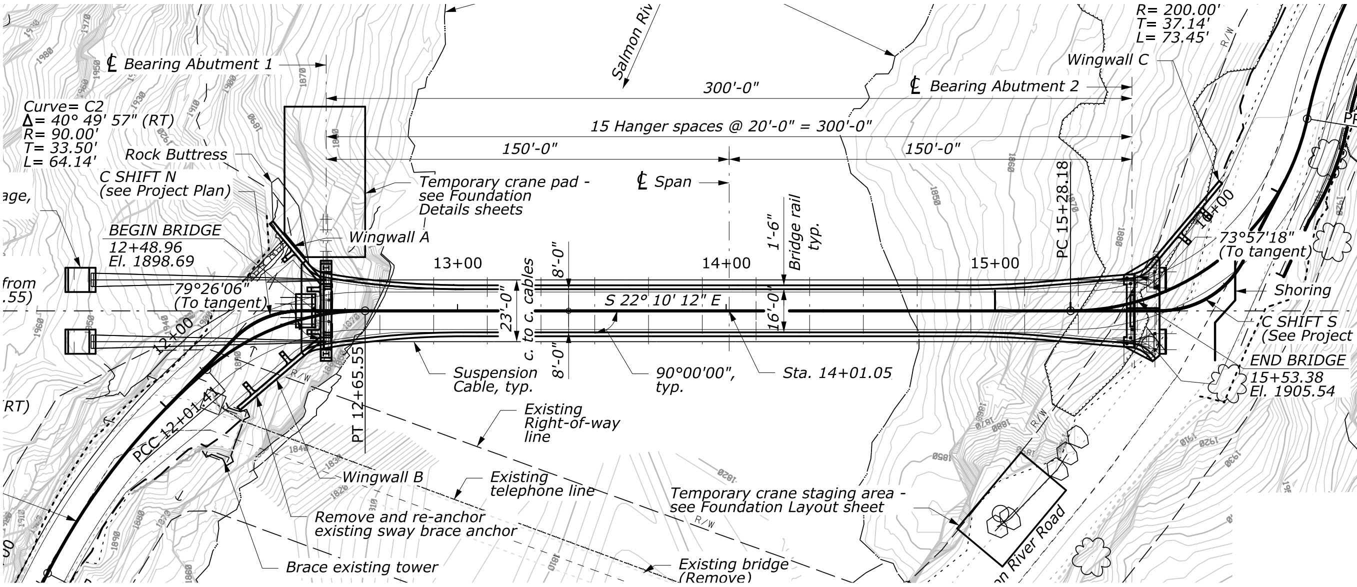
A number of factors led to the single-tower configuration. For one, the rock face adjacent to the north tower of the existing bridge required a minimum tower height of at least 60 ft to place anchorages on favorable rock geometry. A large debris flow zone and a continual water seep on the south hillside made this an unfavorable location for a new tower and anchorage. Finally, the size of crane that could be placed on the south side of the river was highly uncertain given that the only two access routes to the south side are either over an unpaved high mountain pass with very tight switchbacks or across the existing bridge, which had neither the geometry nor load capacity to handle a large crane. (Note that the CM/GC was able to deliver a large lattice crane over the high mountain pass to the south side of the structure.) As such, a tower on the south side of the river would not be feasible.

Orienting the new bridge was a balance between providing roadway alignment geometry to allow a WB-62 vehicle to negotiate the approaches, providing the shortest overall bridge length, maintaining the existing bridge in operation during construction and choosing a favorable tower and anchorage location on the north side of the river. The south abutment and anchorage were placed close to the river and, being below the road surface, has protection from hillside debris flows. The south abutment and anchorage placement also struck a balance between keeping all permanent construction outside the 100-year floodplain and providing sufficient room beyond the anchorage to allow traffic to pass during construction.

The site features a narrow shelf road with steep drop-offs in hard rock terrain. Standard construction techniques for such steep sites typically involve temporary benching. However, the hard rock site and pristine canyon location made benching both cost-prohibitive and inappropriate at the north abutment. Luckily, the presence of soil overburden on the south river bank allowed a cost-effective cut bench to be used at the south abutment. During the design phase, a temporary crane platform was located on the north side of the river for erection of the tower and cable anchorages. Additional temporary platforms were also used for construction at the north anchorage and behind the tower base. The existing south-side roadway bench was wide enough to accommodate a crane for erection and still allow vehicles to pass, and all construction materials were staged and delivered from Riggins to the north end of the bridge.

Steel Simplifies Erection Scheme

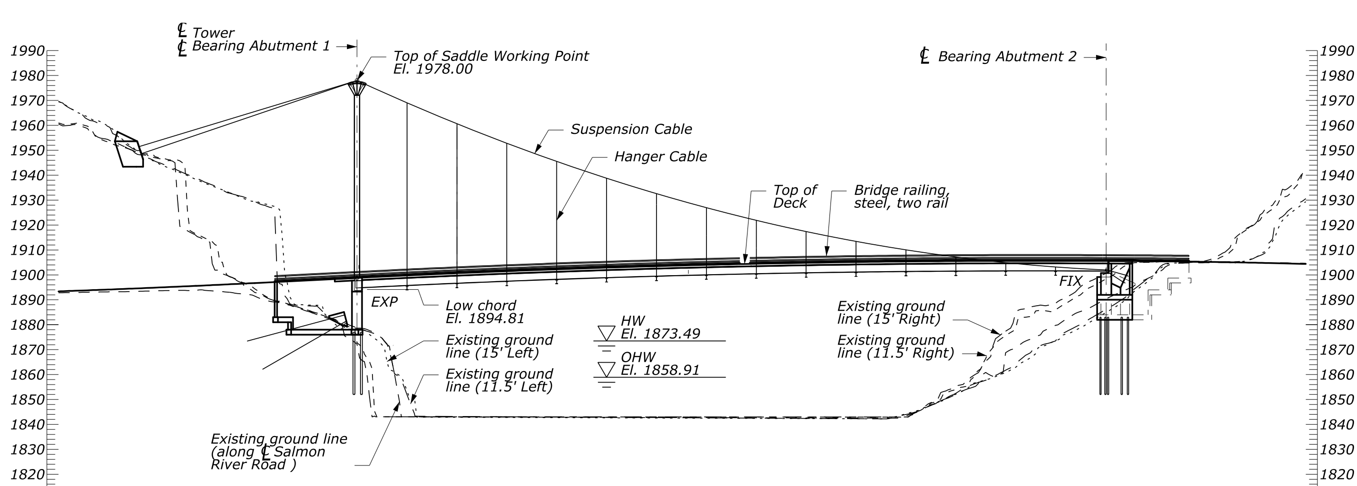
Helically wound galvanized wire (ASTM A586) was used for the main cables and hangers. The main cable and hanger cable



An overhead view of the tight project site and sharply turning roadway.

A view (looking west) of logistics on the south bank of the river, with the existing bridge in background.

Cable installation from the tower to the south abutment anchorage.



An elevation drawing of the new bridge.

connections consist of heavy steel castings with molten zinc spelter sockets, and the cable system saddles consist of 1-in.-thick steel plates and steel castings with groove and fillet welds throughout. The tower consists of welded I-sections for the battered legs and rolled W-shapes for the diagonal bracing. The superstructure framing was designed for simplicity and economy, and all members are rolled steel sections with W-shapes for the stiffening girders and floor beams and WT shapes for the lateral bracing. The stacked superstructure framing configuration was conceived to permit easy assembly from the bottom up, starting with the floor beams followed by the lateral bracing and then the stiffening girders. High-strength bolts were used in all field connections.

Tower erection was a breeze given the small reach and piece weights of about 9.5 tons. The main cables were erected using a cableway accordion sling (designed and patent-pending by Inland Crane) to support each strand at regular intervals on the temporary cables as it was pulled across the river from the tower to the south abutment. Erecting the cable hangers and bridge superstructure framing from the two fixed crane locations required crane reaches of up to 160 ft at mid-span. Hangers, floor beams and lateral bracing had piece weights of 2.25 tons or less, so the long crane reach was not a problem for these items. The stiffening girder piece weights varied with the exterior 50-ft-long sections weighing around 5.5 tons and the interior 40-ft-long sec-


Photo Courtesy of FHWA-WFLHD

Erecting the tower from a temporary crane platform.


Ken Saindon

Cable installation.


Photo Courtesy of FHWA-WFLHD

A minimum tower height of at least 60 ft was required in order to place anchorages on favorable rock geometry.


Inland Foundation Specialties

A view of the fixed crane positions for superstructure erection.

tions weighing 4.5 tons. Splice locations and piece weights were designed to reduce the demands on the cranes, and superstructure erection was completed in less than three weeks.

The new single-tower bridge opened this past June, bringing a touch of uniqueness to the canyon and respecting the constraints of the site with its force layout. With longevity in mind, especially considering the winter climate, Class C galvanizing was specified for the steel cables, and Grade 50 weathering steel was used for the towers and superstructure—not only for corrosion resistance but also to reduce visual contrast with the weathered granite prevalent at the site. The project's reception by the community has been overwhelmingly positive, and it is anticipated to last well beyond the century mark. ■

Owner
FHWA-Western Federal Lands, Vancouver, Wash.

Construction Manager/General Contractor
Record Steel Construction, Inc., Boise

Structural Engineer
Atkins, Denver

Steel Team

Fabricator
Rule Steel, Caldwell, Idaho AISC CERTIFIED FABRICATOR

Detailer
ABS Structural, Melbourne, Fla. AISC DETAILER

Temporary erection platforms on the north side of the river.