NEVADA’S
GALENA CREEK BRIDGE
by Brad F. Durski, Nevada Department of Transportation

A context-sensitive solution that will be the world’s largest concrete cathedral-arch bridge

PROFILE

GALENA CREEK BRIDGE / RENO, NEVADA
BRIDGE DESIGN ENGINEER: Nevada Department of Transportation, Carson City, Nev.
PROJECT ENGINEER OF RECORD: CH2M Hill, Englewood, Colo.
The Galena Creek Bridge near Reno, Nev., will be the world's largest concrete cathedral-arch bridge when completed in 2011. A cathedral arch supports the bridge only at the crown; there are no intermediate spandrel columns. The bridge, in turn, is part of the state's largest ever transportation project, the $450-million, 8.5-mile-long I-580 Freeway Extension that will help connect Reno and Carson City with an improved freeway system. During construction, however, the contractor requested a change in construction plan, moving from the original steel pilot-truss design to a cast-in-place concrete alternative.

The existing highway is under great strain because of increased commuter traffic and development in the area. The freeway extension will provide a safer and more efficient route to serve growing traffic needs. However, the area presents a number of challenges because of its rugged terrain and occasional high winds.

Four Goals Established

Four key goals were set out for the project when the plan was developed and put out for bid in 2003:

1. Select a bridge type that will function efficiently as potentially the longest and highest bridge in Nevada.
2. Develop a design that blends with the terrain, minimizes impacts and is aesthetically pleasing, working with local stakeholders to ensure the design fits the community's needs.
3. Optimize alignment that balances earthwork, addresses geotechnical challenges, reduces visual and noise impacts, meets geometric freeway standards, and avoids significant impacts to wildlife and vegetation.
4. Incorporate maintenance and operational requirements, specifically addressing snow removal, bridge and roadway de-icing, drainage and incident management.

The freeway project was designed by CH2M Hill of Englewood, Colo., while the design for the Galena Creek Bridge was done by NDOT, the only portion of the project designed in-house. The initial contract for the Galena Creek Bridge, along with construction of a second bridge on the project and related improvements, was awarded to Edward Kramer & Sons (EKS) in Castle Rock, Colo. Initially, the

To use traditional falsework for the bridge, about 523,000 yd³ of earth cut from the nearby embankment were used to raise the grade 140 ft over the creek. The fill measures approximately 385 ft wide at the base and tapers to approximately 210 ft wide at the top.

Photos: Julie Duewel, NDOT.
Rendering: CH2M Hill.
A temporary 400-ft-long tunnel was built below the earth fill embankment to protect the creek, with its walls set 30 ft on either side of the creek to ensure minimal impact to the environment.

The drawing shows the general shape of the two concrete box girders, 62 ft wide and 8 ft 6 in. deep. Drawing: NDOT.

bridge was to be built using a pilot truss. However, when the project was about 40% complete, EKS and NDOT reached an agreement not to proceed. NDOT then repackaged the remaining work of finishing the bridge into a new contract.

New Concept Developed
Fisher Industries won the rebid and worked with subcontractor C.C. Myers Inc. in Rancho Cordova, Calif., to evaluate options. They proposed using another construction alternative, with conventionally reinforced, two-cell concrete box girders and cast-in-place concrete arches. The arches and columns are hollow to allow access during inspections. This approach did not change the bridge geometry, only some of the materials used within it. To adjust to a cast-in-place concrete design, reinforcing bars were added and additional concrete was required, but no major redesign work was needed.

The Galena Creek Bridge, now under construction, consists of two parallel cast-in-place concrete arches with a span of 689 ft. Each arch has a width of 19.7 ft and a depth of 11.8 ft. The wall thickness is 1.6 ft. The arches are supported on thrust blocks founded on bedrock. Each arch supports a cast-in-place conventionally reinforced, two cell box girder, 62 ft wide and 8 ft 6 in. deep. Each box girder will carry three lanes of traffic. The columns have overall cross sectional dimensions of 19.7 ft by 9.8 ft with a wall thickness is 3.25 ft. These columns are supported by footings on piles.

This approach required the use of traditional falsework, which was placed on
Epoxy-coated reinforcement was used throughout the bridge, including the barrier rails, due to the large amount of deicing salts used to keep the bridge accessible through the winter. Fisher Industries built a concrete batch plant along the north side of the project and is using aggregate mined from along the highway's route to save costs and speed construction. All concrete in the project included fly ash while the concrete in the deck also used silica fume. The specified concrete compressive strength for the abutments, wingwalls, thrust blocks, footings, and columns was 4060 psi. The specified strength of the concrete for the bottom slabs, diaphragms, webs, approach slabs, barrier rails, and decks was 4500 psi. Adjacent to the arch span, at piers 2 and 3, the specified concrete compressive strength for the bottom slabs and webs was 5800 psi.

The second bridge arch was constructed faster than the first one as the crew has gained experience with placing concrete on a large vertical curve. The amount of falsework needed to create the arch is impressive and complicated, but it proved to be fairly conventional in its design.

To lower the formwork for the arch, the contractor used 12 strand jacks with a capacity of 85 tons each rather than cables and winches. The strand jacks, costing $1.2 million, were computer controlled to ensure synchronization during lowering. The jacks were protected by steel enclosures.

Some minor patching and finishing of the existing columns, built several years earlier, were required prior to restarting construction. Following the completion of each arch, the box girders were cast-in-place using formwork and falsework supported by the arches. The box girders are connected integrally with the arch at the crown.

To date, the project is ahead of schedule, with all work planned for completion and the roadway expected to be opened to traffic in fall 2011 and perhaps sooner. The result will be an attractive and efficient bridge that serves the community and provides a distinctive, landmark look.

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