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.

INITIAL (2003) CONTRACTOR: Edward Kramer & Sons, Castle Rock, Colo.

COMPLETION (2007) CONTRACTOR: C.C. Myers Inc., Rancho Cordova, Calif.

PROJECT GENERAL CONTRACTOR: Fisher Industries, Phoenix, Ariz.

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 structure serves as the centerpiece on a project that includes eight other cast-in-place concrete box girder bridges. It will complete highway improvements that the Nevada Department of Transportation (NDOT) has been planning for several decades to raise I-580 to full interstate highway standards for its entire length within the state. This segment extends the freeway from the Mt. Rose Highway to the Bowers Mansion cutoff in the Northern Washoe Valley.

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

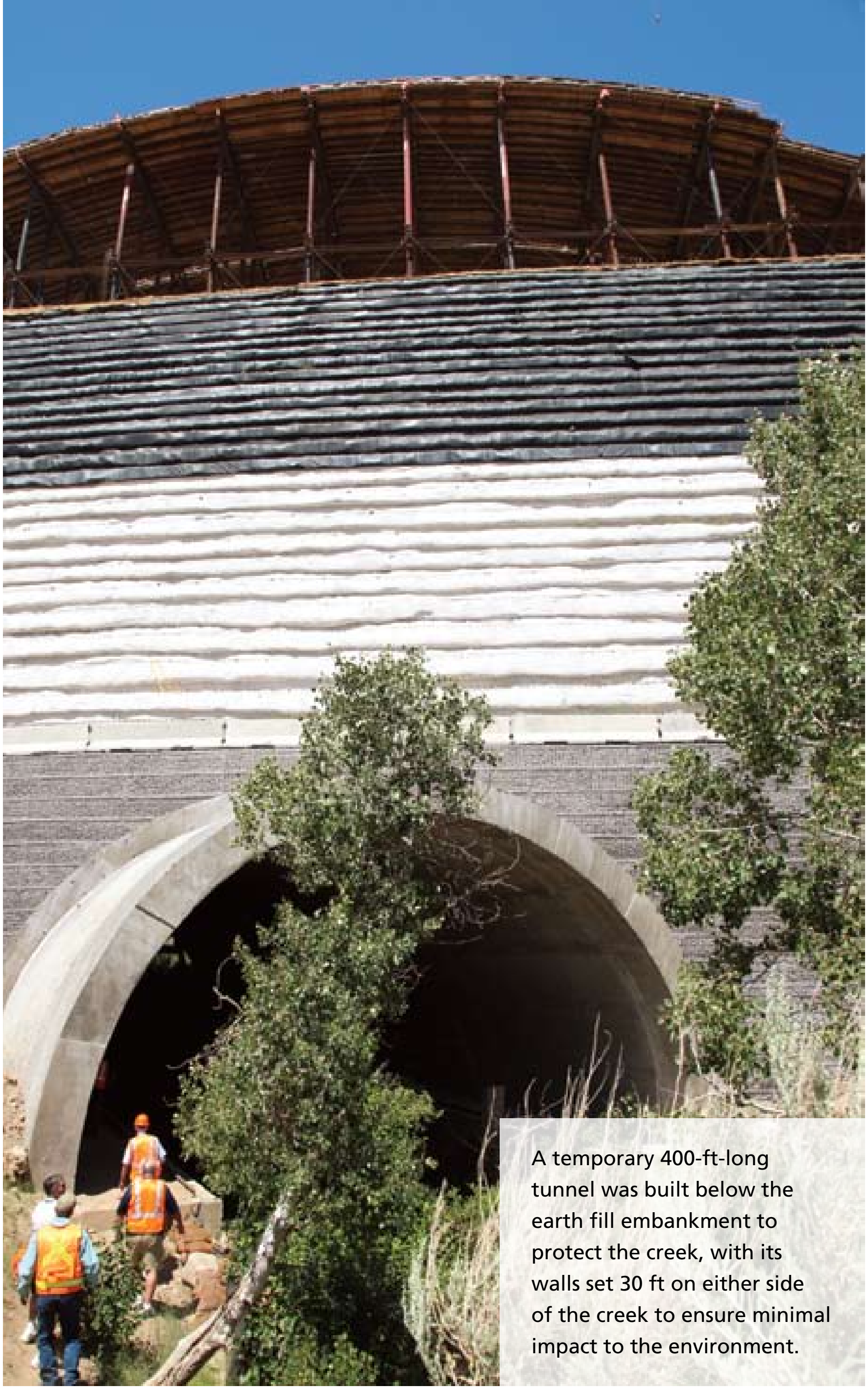
To use traditional falsework for the bridge, about 523,000 yd^3 of earth cut from the nearby embankment were used to raise the grade 140 ft over the creek. The fill measures approximately 385 ft wide at the base and tapers to approximately 210 ft wide at the top. Photos: Julie Duewel, NDOT. Rendering: CH2M Hill.

TWIN, 1725-FT-LONG, CAST-IN-PLACE, CONVENTIONALLY REINFORCED CONCRETE BOX-GIRDER BRIDGES WITH A CATHEDRAL ARCH HAVING A 689-FT ARCHED MAIN SPAN / NEVADA DEPARTMENT OF TRANSPORTATION, OWNER

POST-TENSIONING CONTRACTOR: AVAR Construction Systems Inc., Fremont, Calif.

REINFORCING STEEL SUPPLIER: Pacific Coast Steel, Henderson, Nev.

CONSTRUCTION COST: Total project: $450 million; Galena Creek Bridge cost: $80 million (plus $53 million cost for initial contract)



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.

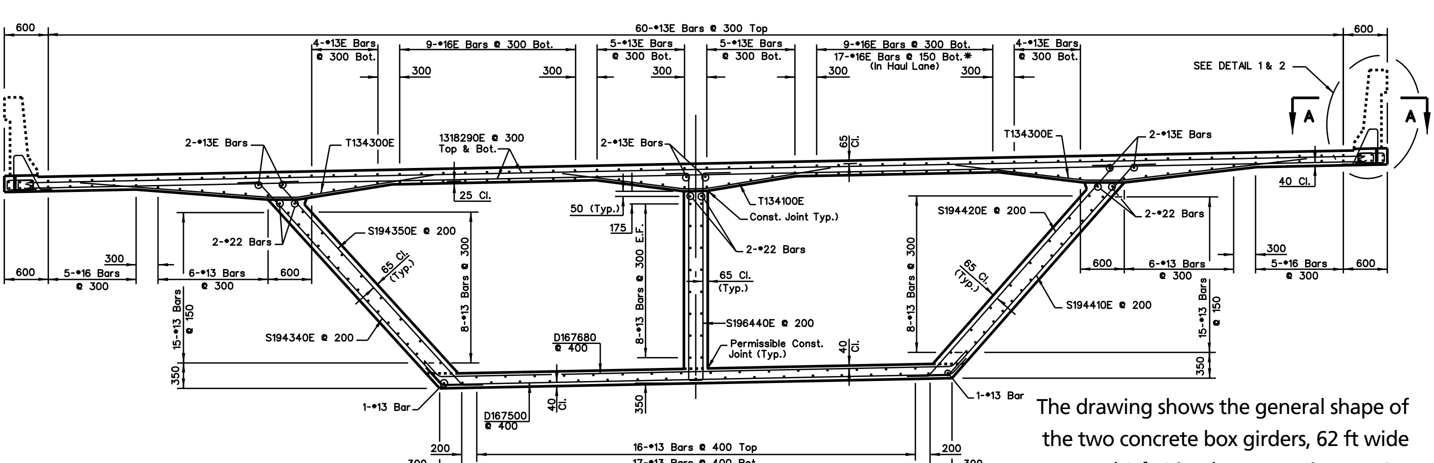
bridge was to be built using a pilot truss. However, when the project was about 40% complete, EKS and NDOT reached an agreement not to proceed. NDOT then repackaged the remaining work of finishing the bridge into a new contract.

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



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

After removal of the falsework under the arch, construction continues on the cast-in-place, conventionally reinforced concrete box girders.

The structure serves as the centerpiece on a project that includes eight other cast-in-place bridges.

a foundation created by filling the creek bed. About 523,000 yd^3 of earth cut from the nearby embankment were used to raise the level 140 ft. The fill measures approximately 385 ft wide at the base and tapers to approximately 210 ft wide at the top. A temporary 400-ft-long tunnel was built to protect the creek, with its walls set 30 ft on either side of the creek to ensure no impact to the environment. The new approach required a four-month approval process, and work then began again in early 2007 to finish construction. The earthen fill will be removed and vegetation restored after the bridge is complete.

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.

Brad F. Durski is the senior resident engineer with the Nevada Department of Transportation in Reno, Nev.

For more information on this or other projects, visit www.aspirebridge.org.

Public Involvement

The arched design of the project resulted from NDOT implementing a Context Sensitive Solution format early in the process. This involved an integrated public-outreach plan to solicit public involvement and communicate openly with stakeholders about the design concept. During the final design, NDOT received integrated-stakeholder input for the proposed roadway alignments and bridge designs, to develop a project that blended with the terrain, minimized environmental impact and had community support. It also had to maintain safety and mobility.

The Galena Creek Bridge project has generated a tremendous amount of public interest. The communities impacted by the freeway extension have historically proven to be highly active and involved in the project from its start. Recognizing this, NDOT's multifaceted public-involvement program included the Stakeholder Working Group to keep everyone directly involved. Formed in 1998, the group met monthly to discuss design considerations, including noise and dust. Since 1999, the group has met every 6 months, and that will continue while construction is underway.