CLARK COUNTY, NEVADA & MOHAVE COUNTY, ARIZONA

Hoover Dam Bypass Bridge

A dramatic new concrete arch joins the setting of the historic Hoover Dam, spanning the Black Canyon between the States of Arizona and Nevada. The 1,900-foot-long Colorado River crossing is the centerpiece of the $240 million, four-lane Hoover Dam Bypass Project, which included 3.5 miles of new approaches on both sides of the river and seven other bridges.

With a 1,060-foot main span, the Mike O'Callaghan-Pat Tillman Memorial Bridge or Hoover Dam Bypass Bridge is the fourth-longest, single-span concrete arch bridge in the world and exemplifies innovation at work. The project team overcame formidable obstacles and, as a result, a world-class structure was born. It now frames the view of the Black Canyon from Hoover Dam for the coming generations of tourists, and is the cornerstone in a new, efficient highway system funneling commercial traffic between the states of Nevada and Arizona. The project reflects the skill and determination of the people who built it, all of whom take pride in their accomplishment. Delivered on time and within budget, America's newest wonder bridges between the iconic marvel it protects and the brilliant problem solving of modern engineering. A groundbreaking dedication ceremony was held on October 14, 2010. The bridge opened to traffic on October 19, 2010.

Innovation of Design and/or Construction

The bridge design satisfied objectives for both architectural and performance. The environmental document required an open structure that would not encroach on the views of the dam or the surrounding terrain of the national historic landmark at Hoover Dam. The engineering performance needed to withstand the demands of wind, earthquake, and service loads well beyond the codified 75-year life.

The approach to design addressed each criterion with a deliberate engineering evaluation and design. The twin arch ribs evolved from the assessment of seismic performance. The arch ribs are reinforced concrete members, designed to be cast with the stayed-cantilever construction method. Cantilever construction of a reinforced concrete box section is rare. This approach was carefully engineered during design on the basis of controlled crack width as well as strength. The elimination of temporary post-tensioning for the arch was a significant savings for construction.

The design team conducted special site studies to address the seismicity of the site and performed an extensive geological reconnaissance as part of a probabilistic site hazards analysis. The resulting design was based on a 1,000-year event, and the PGA was set at approximately double the then codified value. The new AASHTO PGA, established four years after the start of design is approximately the same value as selected for design.

The Hoover Dam Bypass Bridge was built using a variety of limited access techniques in order to gain access from the canyon rims. Excavation was pioneered from the Nevada cliff using mining techniques for limited road access. Two unique 2,500-foot cableways carried workers and 45 tons of material and equipment into place during construction. With cables hanging from 330-foot-tall towers, a 13.5 ton trolley and load block assembly was the key to delivery of men and materials to the work front. The concrete segments for the arches were poured using four headings of self-advancing form travelers. Most of the arch segments were placed at night to avoid the triple-digit desert temperatures reaching as high as 120°F.

Jury Comments

This project resulted in an iconic landmark structure set in the Colorado River's Black Canyon with a view to Hoover Dam. The Hoover Dam Bypass Bridge is an extreme solution to an extreme challenge. Spectacular!

Liquid nitrogen was required to control the peak curing temperature of the high performance concrete. Every second arch segment was supported by a temporary stay cable, with tuning required at many stages in order to control geometry. The arch was closed in August of 2009.

Computer models run on site were used by the contractor to calibrate controls used to set headings for the arch cantilevers. This real-time process led to greater construction efficiency, allowing the contractor and designer to communicate in live time with construction, providing for immediate reviews of adjustments to the erection procedures and target geometry. An automatic surveying and monitoring system helped the team to record and analyze how construction operations impacted behavior of the bridge structure, as well as measuring the deflections due to wind and temperature. This data was critical to the arch ribs being properly aligned within ¾ of an inch at closure as the ribs met in the middle of the canyon. A specialized wind monitoring system throughout the project site, including atop the cranes, helped to provide continuous readings to address wind effects on construction operations.

With an average of 14,000 vehicle crossings per day, the stretch of U.S. 93 crossing Hoover Dam impeded the safe flow of traffic along the corridor. The new bridge reroutes traffic from the two-lane bottleneck across the dam, therefore improving driver and pedestrian safety, as well as air quality. Bypassing the dam reduced travel time and fuel consumption for motorists traveling between Las Vegas and Phoenix. Following the 9/11 terrorist attacks, trucks were detoured 23 miles from the dam, costing $30 million annually in delays and fuel consumption along a critical North American Free Trade Agreement (NAFTA) trade route. The Hoover Dam Bypass Bridge benefits the local economy by restoring a critical NAFTA trade route for about 2,000 trucks per day ensuring a safer and faster U.S. 93. America's newest wonder helps protect the iconic Hoover Dam from possible future threats, while reducing travel congestion for millions of motorists, as well as enhancing the visitor experience for the 3,000 daily tourists visiting the Hoover Dam.

Aesthetics and/or Harmony with Environment

With the project site in the shadow of an American landmark, the entire project team felt a responsibility to respect the historical context and complement the design of the Hoover Dam. The design team reported to an independent advisory panel regarding historic, aesthetic and cultural aspects of the project. The challenge of the design advisory panel was to "...strive for engineering excellence in the design of today that honors the engineering excellence that went into the Dam in its day."

CREDITS

Owner:
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T.Y. Lin International (River Bridge Lead) and **HDR Engineering, Inc.** (Overall Bypass Lead)

Contractor: Obayashi-PSM JV

Construction Engineering Services:
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Construction Engineering Inspection:
FHWA/CFL with **Parsons Brinckerhoff, PBS&J**

Precast Producer: Obayashi PSM, JV

Formwork for Precast Segments:
EFCO Corp.

Form Travelers for Cast-in-Place Segments:
NRS

Post-Tensioning Materials:
Schwager Davis, Inc.

Stay Cable Materials:
Schwager Davis, Inc.

Bearings: **R.J. Watson, Inc.**

Expansion Joints: **Watson Bowman Acme—A BASF Company**

Epoxy Supplier: **Sika Corporation**

Prepackaged Grout: **Sika Corporation**

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