

casings to lengthen three of the shorter columns provides a more uniform seismic response.

Construction

NDOT delivered the first phase of the Centennial Bowl Interchange via the design-bid-build delivery method in October 2015. The construction of the WS Flyover was completed in 375 working days, for a total cost of \$110 per square foot.

Construction of long-frame CIP post-tensioned box girders in an urban setting poses several challenges. Due to the use of falsework, maintenance of traffic becomes an issue for construction. Careful planning during design, and coordination in construction, allowed the contractor to successfully manage traffic. For U.S. 95 traffic, adjacent collector/distributor roads served as detours for the erection and removal of falsework and during concrete placement. For daytime traffic, a minimum of three

lanes in each direction was maintained. Due to the sharp skews of the WS Flyover alignment and U.S. 95, the contractor used a tunnel bent with a tiered-falsework system to maintain the minimum number of lanes.

Grouting of the longitudinal post-tensioning ducts proved to be another construction challenge, due to the vertical geometry, frame length, and the hot climate of southern Nevada. NDOT requires the use of prebagged thixotropic grout. Grouting pressures regularly exceeded 100 psi, with typical grouting durations of more than one hour for the long frames. The contractor used chilled water and took precautions to protect the grout bags from sun exposure. The grout material proved to be forgiving with respect to grouting times and temperature, maintaining its fluidity despite the long grouting durations and ambient temperatures greater than 100°F.

Conclusion

The WS Flyover, which opened to traffic

in July 2017, demonstrates how CIP post-tensioned concrete bridges can provide an economical and resilient structure type for modern urban interchanges in Nevada. The CIP, post-tensioned concrete box girder structure type is well suited for the curved geometrics while maintaining a strong aesthetic appeal. Careful planning, coordination, and partnering through the construction phase successfully mitigated the typical risks associated with CIP construction. Use of high-performance deck concrete with a shrinkage-reducing admixture, as well as transverse post-tensioning at the pier caps, helps maximize the durability of the structure. With the second phase of the interchange preparing to advertise and the final phase beginning design, NDOT is confident in the choice of CIP post-tensioned box girders as the best solution for the Centennial Bowl Interchange. 

Michael Taylor is a senior structures engineer with the Nevada Department of Transportation in Carson City, Nev.



AESTHETICS COMMENTARY

by Frederick Gottemoeller

For aesthetic as well as structural and economic reasons, box girders are an eminently suitable structural type for the flyover ramps of complex interchanges. All the lines of the superstructure—the tops of the parapets, the edges of the slabs, and the corners of the box girders—are parallel to each other and to the trajectories of the vehicles traveling across the bridge. The thin, single-shaft piers with hidden or minimal pier caps impose no cross lines or barriers to this visual flow. The pier shafts themselves

are thin enough to keep the space of the interchange visually open and unencumbered, allowing drivers to see through to converging ramps and merge areas.

Although the use of cast-in-place concrete box girders can be problematic in locations where construction has to be done over existing roadways, this project successfully met the challenge. With a great deal of ingenuity, the team found methods to build the girders while still

keeping traffic moving underneath. Hopefully, their experience will reassure others who are considering applying this structural type.

The slightly dropped pier caps at all of the intermediate piers add an intriguing rhythm to this structure. They punctuate the eye's progress along the curves, while at the same time creating some visual consistency with the dropped pier caps at the expansion joints. Coloring the box girder itself with a hue that contrasts with the colors of the slabs, parapets, piers, and pier caps makes obvious the visual ribbon of the girder. When viewed in the Las Vegas sunshine, the ramp is a memorable structure.



Progress photo of placement of falsework for frame 2. Photo: Nevada Department of Transportation.