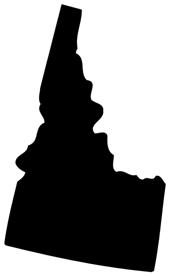


SPANNING THE PAST AND FUTURE

Idaho Looks to Preserve Existing Bridges while Expanding Capabilities for New Structures

by Matthew Farrar, Idaho Transportation Department

Along with many other states, Idaho faces challenges in managing its bridge assets by cost effectively extending their service life or replacing them. For bridges with spans of less than 130 ft, the need for economical, durable, and quickly constructed bridges usually makes prestressed concrete the first choice. Innovative options, especially with accelerated bridge construction (ABC) techniques, also have proven to work well with precast concrete.

Precast, prestressed concrete bridges have become Idaho Transportation Department's (ITD) first choice for a variety of reasons, particularly because they usually provide the lowest first-cost solution. But they also offer low, long-term maintenance costs due to their high durability. They provide flexibility, offering many cross sections to choose from and providing a range of ways they can be used.

Precast concrete bridge components are readily available in the state, and several fabricators regularly supply products. In some cases, for bridges with spans under 30 ft, ITD uses cast-in-place or precast concrete box culverts or three-sided structures.

Generally, the ITD undertakes 50 to 60 bridge projects each year, but they vary widely in their scope. Only about 10 of those projects are complete replacements for existing structures. The rest are rehabilitations, widening, and upgrades of all types. Keeping the existing bridges accessible and functional is a key part of the work.

Rainbow Bridge Restored

An example of rehabilitation work is the State Highway 55 Bridge over the north fork of the Payette River. This structure, known as the Rainbow Bridge, is a 411-ft-long, open-spandrel, cast-in-place concrete arch bridge. Built in 1936, it is now on the National Register of Historic Places and has become well recognized in the state. It's definitely considered a keeper, and great efforts have been taken to preserve its structural integrity. In 2007, it was completely rehabilitated. Techniques included chloride extraction and the installation of materials to mitigate corrosion in the future.

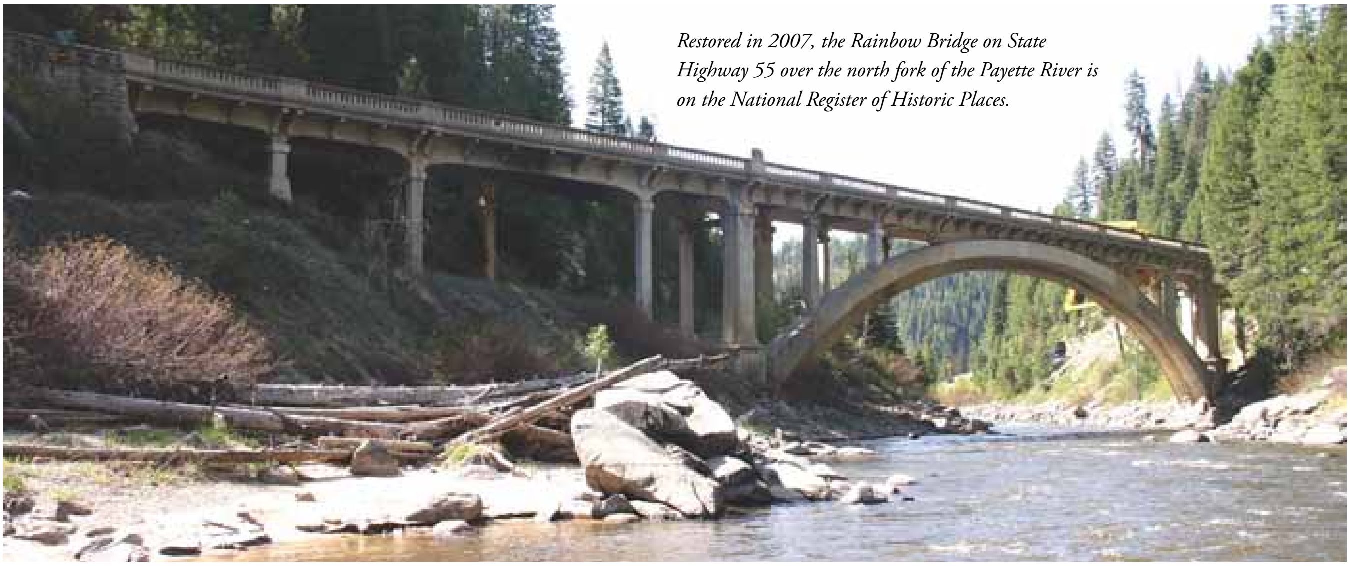
A few components were replaced during the work, such as the end portion of some stringers. Also, the existing railing had deteriorated, so it was demolished and a precast concrete railing replaced it. As this design had to perfectly replicate the original, it was fabricated in a precast concrete plant and shipped in segments to the site to provide better control over its character and quality. All of the work was done in stages, to allow vehicle access to the bridge throughout the construction. The local office of CH2M-Hill assisted ITD with the restoration project.

The I-84 Ten Mile Interchange in Meridian, Idaho, features a 189-ft single-span, cast-in-place concrete box girder. A single-point urban interchange (SPUI), the post-tensioned design provided cost effectiveness and constructability at the complex site.

Snake River Bridge Completed

At the other end of the spectrum on bridge construction is the new U.S. 95 Spur over Snake River near Weiser, Idaho, which was completed in 2010. The $10-million project replaced a bridge originally built in 1950, providing wider lanes (a total of 46 ft 4 in. versus 30 ft 6 in.) and capable of carrying greater traffic volumes.

The 876-ft-long bridge features six spans of precast, prestressed concrete girders comprising 144 ft-long, 84-in.-deep, modified bulb-tee



Restored in 2007, the Rainbow Bridge on State Highway 55 over the north fork of the Payette River is on the National Register of Historic Places.

The U.S. 95 Spur Bridge over the Snake River features six spans of precast, prestressed concrete modified bulb-tee girders 144 ft long and 84 in. deep.

girders. The 144-ft girders are the longest yet to be used in Idaho, and they were selected while working closely with city officials to replicate the look of the original bridge. A cast-in-place concrete railing was provided, along with vintage light standards to create the proper tone.

As the 144-ft-long girders indicate, ITD has been pushing to achieve longer spans with precast concrete girders. They eliminate the need for piers in the water, which has become a much larger concern. Handling and transporting such long spans can create its own challenges, however, so a balance must be maintained between effective span lengths and efficient handling methods.

Another complex bridge to be completed this year is the I-84 Ten Mile Interchange in Meridian, Idaho. The project was singled out by the ITD and the Community Planning Association of Southwest Idaho as the highest priority for a new interchange in the 2001 I-84 Corridor Study and it is finally nearing completion. The project will result in a new interchange and improvements to the surrounding roadways.

The 189-ft-long, single-span bridge consists of post-tensioned, cast-in-place concrete box girders designed as a single-point urban interchange (SPUI). The post-tensioned design was chosen for its cost effectiveness and constructability at this complex site. The concrete boxes were necessary to provide the span length needed to complete the SPUI geometry and to ensure the design was aesthetically pleasing. HDR Engineering assisted ITD with this project.

Segmental Design Used

When long-span bridges are necessary, ITD found that concrete segmental construction is cost effective. One of the largest of those projects is the Veterans Memorial Centennial Bridge over Bennett Bay and Sunnyside Road near Coeur d'Alene, Idaho. It was completed in 1991.

The $20-million project produced a 1730-ft-long cast-in-place, post-tensioned segmental concrete box-girder bridge. The four-span bridge features end spans of 345 ft and two interior spans of 520 ft. The design, by HNTB, was the most economical approach for this unique situation, but it remains the only segmental cast-in-place concrete bridge on the state highway system.

As several of these projects indicate, ITD works with outside designers on complex bridges. However, the majority of the bridges are designed in house. Another significant state bridge designed in conjunction with an outside designer was the Bryden Canyon Road Bridge over the Snake River in Lewiston, Idaho.

Designed by T.Y. Lin International in San Francisco, Calif., and completed in 1981, the 1750-ft-long bridge is located on a local road and spans between Idaho and Washington. The structure consists of cast-in-place, post-tensioned segmental concrete box girders. The long-span design was used to span the backwaters of a dam that was being raised.

Longevity Is Key Concern

With all of the state's projects, durability and longevity have become key focus concerns. A primary goal is to ensure that bridges last longer and require less maintenance so the state is better able to manage its assets. To extend service life, all cast-in-place, post-tensioned concrete bridges today are designed for zero tension. Fly ash and other additives are used to add durability and reduce the cement content.

ITD also has experimented with Type K cement, a hydraulic cement for use in shrinkage-compensating concrete. It helps mitigate cracking caused by drying shrinkage. Monofilament fibers also have been used in

Idaho uses consulting engineers for complex projects. HNTB designed the I-90 Bridge over Bennett Bay, known as the Veterans Memorial Centennial Bridge. The bridge is the only cast-in-place, post-tensioned segmental concrete box-girder bridge on the state highway system. All photos: Idaho Transportation Department.

some cases to stitch together micro-cracks that might arise.

Concrete with monofilament fibers was used for the Wye Interchange on I-184 in Boise, Idaho, in 2000. When originally constructed in 1969, the interchange could easily carry 33,000 vehicles per day. By 1998, the average daily traffic had reached 92,000 vehicles. The redesign allows it to carry about 120,000 vehicles per day, the anticipated traffic level in 2020. The project was constructed in two stages at a total cost of about $80 million. Throughout the construction, two lanes of traffic remained open in all directions—the same level of service available before construction began.

The 817-ft-long bridge features cast-in-place, single-cell concrete box girders that were post-tensioned both transversely and longitudinally. The bridge consists of four spans, with 187-ft end spans and two interior 222-ft spans. The structure is 58 ft wide with just a single-cell box. This approach, which is more common in California, helped meet a multitude of challenges resulting from the curvature of the roadway.

On the Wye Interchange on I-184 in Boise, the 817-ft-long, fly-over bridge features cast-in-place, single-cell concrete box girders that were post-tensioned both transversely and longitudinally.

ABC Concepts Used

ITD has also been examining a variety of ABC methods. One of the approaches that has proven effective is precast concrete columns and pier caps. This technique allows the components to be fabricated as other work progresses, speeding up installation when the site is ready.

This approach was used on three interchanges or overpasses in the past 2 years, on Black Cat Road, Robinson Road, and the Vista Interchange over I-84 in Boise. The two overpasses feature precast, prestressed concrete girders, precast concrete columns, and precast pier caps. The Vista Interchange uses precast, prestressed concrete girders with precast concrete pier caps but cast-in-place concrete columns, because the construction staging did not benefit from accelerating the column construction. The local offices of HDR Engineering, Forsgren Engineers, and Stanley Engineers assisted on these projects.

Mixing the two types of components and targeting those elements where accelerated construction can be most effective offers significant benefits for future designs. Where appropriate, ITD intends to continue to use these concepts, while tweaking them to gain maximum effectiveness. The experience represented a fairly innovative approach and showed us how we can utilize ABC techniques.

Another project using all precast concrete components is on the drawing boards. The State Highway 200 Bridge over Trestle Creek, to be constructed in 2013, consists of a 105-ft-long, simple-span structure using entirely precast concrete elements, including deck bulb-tee beams and precast concrete abutments. The road is not heavily trafficked, but it provides an opportunity to test ABC principles in practice. If this project proves successful by significantly cutting construction time, the concepts will be expanded.

These projects show the wide range of designs and construction methods being used by ITD. The state tracks its bridge conditions closely, although funding to accomplish all that should be done creates a great challenge. Fortunately, the state is focusing more attention on bridges today as it realizes the great value in providing effective asset management to make best use of taxpayer dollars. No doubt, with past history as a guide for future projects, many of those bridges will feature innovative concrete methods.

Matthew Farrar is the state bridge engineer with the Idaho Transportation Department in Boise, Idaho.

For more information on Idaho's bridges, visit www.dot.state.idaho.gov.

Precast concrete bent caps and columns were used on the Robinson Road over I-84 Bridge, one of several recent projects to incorporate accelerated bridge construction (ABC) techniques.