Idaho

Idaho leverages pooled fund initiatives and develops seismically resilient precast concrete pier connection details

by Elsa Johnson, Idaho Transportation Department

The Idaho Transportation Department (ITD) makes effective use of limited funding by collaborating with neighboring states to tackle a variety of transportation challenges. For many years, one of the ways that the agency has achieved its strategic goals is through the Transportation Pooled Fund (TPF) program, which is a collaborative effort among multiple state and/or federal agencies and other entities that is administered by the Federal Highway Administration (FHWA). The TPF program enables agencies to pool their funds and conduct research to solve shared transportation problems.

Transportation Pooled Fund Initiatives

Overheight Truck Impacts

One TPF initiative addresses accidental bridge strikes and methods to repair prestressed concrete girders. Across the United States, overheight vehicle impacts are a frequent cause of bridge damage. Through the TPF program with the Missouri Department of Transportation as the lead organization, ITD and other state agencies are evaluating the load-carrying capacity of damaged concrete bridge girders and prioritizing girders in need of repair through their involvement with TPF-5(462), Assessment and Repair of Prestressed Bridge Girders Subjected to Over-Height Truck Impacts (OHTI). The project is testing fourteen 50-ft-long, full-scale, prestressed concrete bridge girders subjected to overheight vehicle impact. Four of the girders will be experimentally tested to determine their residual load-carrying capacities under static load, and ten girders will be repaired using different repair options, which will then be compared. The final report for the project is expected to be published in fall 2025.

In the last few years, ITD has seen an increase in the number of overheight vehicle bridge strikes across the state. In November 2024, the bridge carrying Brunner Road over U.S. Route 95 (U.S. 95) was struck by an oversized trailer load. That same week, Bunco Road over U.S. 95 was struck by a truck hauling an improperly secured load. Having improved tools to assist in the evaluation of the damaged girders will be extremely beneficial.

Alkali-Silica Reactivity Evaluation Methods

Another TPF initiative is TPF-5(521), New Performance Approach to Evaluate ASR in Concrete. Participating states are evaluating new methods to determine the likelihood of alkali-silica reactivity (ASR) gel formation in concrete. The American Association of State Highway and Transportation Officials' (AASHTO's) test methods for aggregates, TP144-23, *Standard Method of Test for Determining the Potential Alkali–Silica Reactivity of Aggregates (TFHRC-TFAST)*,[1] and T416-24, *Standard Method of Test for Determination of Alkali Threshold for Alkali–Silica Reactivity in Aggregates Used in Concrete (ATT)*,[2] are being appraised in conjunction with local concrete mixture design data, cement mill reports, and supplementary cementitious material properties. States are looking to the more accurate TFAST method because it predicts ASR expansion using chemical measurements, and the ATT method because it measures the likelihood of ASR formation in concrete, not just the aggregate reactivity. Understanding the likelihood of ASR formation will alleviate ITD's concerns regarding the long-term durability of the concrete if reactive aggregate sources are used.

ITD Research Projects

Type IL Cement

In addition to participation in TPF projects, ITD has been working on several of its own research projects. One project underway is the investigation of the use of Type IL cement (also known as portland-limestone cement). Type IL cement improves sustainability by decreasing carbon dioxide emissions, but its impact on bridge construction is not fully documented. Currently, ITD specifications for Type IL cement limit limestone content to a maximum of 12.5% (10% ± 2.5%). On average, Type IL cement specifications across the United States allow up to 15% limestone content, but ITD is gathering additional data before fully embracing that threshold. The effects of Type IL cement on prestress losses, shrinkage, creep, camber, cure time, and strength raise questions about the long-term performance of Type IL cement in Idaho bridges. (See the Winter 2022 issue of *ASPIRE*® for more information on Type IL cement.)

To measure the consequences of an increase in limestone content in Type IL cement, ITD is actively collecting data and monitoring strength gains from recent construction projects. Concrete mixtures that use Type IL cement do not follow the typical 28-day strength development curve but reach maturity closer to 56 days. ITD will be modifying Idaho specifications to accept the 56-day strength test

Across the United States, overheight vehicle impacts are a frequent cause of bridge damage. The Idaho Transportation Department is participating in a Transportation Pooled Fund initiative to research ways to assess and repair prestressed concrete girders impacted by bridge strikes. All Photos: Idaho Transportation Department.

Precast concrete columns and pier caps receive the same rustic quarry stone pattern used throughout the Fort Hall interchange project near Blackfoot, Idaho.

results for all cement types to better capture the appropriate testing for Type IL cements. Because the properties and water demands of Type IL concrete mixtures can sometimes lead to increased shrinkage, ITD is collecting data on bridge deck cracking. The objective is to better understand the concrete performance and refine the concrete mixture designs before the state accepts the average industry standard of 15% maximum limestone content for Type IL cement.

Camber Predictions

ITD is also conducting research to develop more reliable camber predictions for prestressed concrete girders. ITD currently uses formulas based on research that does not represent modern prestressed concrete girder shapes or the higher concrete strengths commonly used in construction today. Accurate camber predictions are especially critical for deck bulb-tee girders, where the top flange is the riding surface and mitigation methods for camber variations are limited and difficult to perform in the field. In contrast, camber variations in standard bulb tees or AASHTO girders with a cast-in-place (CIP) concrete deck can be accommodated by varying the haunch thickness. The current camber formulas are underpredicting girder cambers, and this excess camber has sometimes exceeded the haunch depth, causing the girders to encroach into the CIP deck. This issue has been addressed by either grinding down beam seats or raising the grade over the bridge. Both methods are costly and time-consuming. More accurate camber-prediction formulas will minimize the impact of camber during construction.

Strand Debonding

Idaho has historically not permitted debonding of strands in prestressed concrete girders, but ITD is currently investigating the best ways to optimize girder designs. To control stresses and subsequent cracks in the end regions of pretensioned concrete girders, transportation agencies specify the use of strands that are either harped (deflected) or debonded. ITD design policies discourage debonding, preferring to harp strands. While harping comes with potential safety hazards associated with tensioned strands, both methods have been successfully used in pretensioned concrete beams. ITD is researching the use of debonded strands, particularly in prestressed concrete voided slabs where harping is not possible. The current practice is to provide top strands to help reduce the girder stresses; however, the addition of top strands becomes less effective as span length and stresses increase. This research will help designers develop more-efficient girder designs for prestressed concrete voided-slab bridges.

Ultra-High-Performance Concrete

Ultra-high-performance concrete (UHPC) has been used in Idaho for longitudinal closure pours between deck bulb-tee girders and between side-by-side voided slabs. While these keyway applications have been the primary focus in Idaho, ITD is also considering UHPC for girder repairs and looking for a project that is a good fit for a UHPC overlay.

The recent project to replace the Division Street and Elizabeth Park overpasses on Interstate 90 (I-90) near Kellogg, Idaho, used UHPC. Work began in 2022 on the I-90 bridges over the two local streets, but the project was suspended during winter months. Designed to improve safety, the I-90 bridge over Division Street is supported by a spread footing and steel H-pile foundation with concrete columns. The three-span structures use side-by-side precast, prestressed concrete voided slabs which are connected using shear keys filled with UHPC. After curing, the tops of the shear keys were ground smooth, and a polyester polymer concrete overlay was applied to provide the final riding surface.

ITD is using AASHTO's *Guide Specifications for Structural Design with Ultra-High*

The Interstate 90 over Division Street project near Kellogg, Idaho, features multispan precast, prestressed concrete voided slabs. Construction crews place ultra-high-performance concrete in the shear keys to make the connections.

Precast concrete arch sections create a safe passage for herds of deer, elk, and other wildlife over State Highway 21 near Boise, Idaho.

The overcrossing at State Highway 21 near Cervidae Peak complements the topography of the natural landscape while reducing the risk of wildlife-vehicle collisions.

Performance Concrete,[3] which addresses the design of UHPC structural components. This specification was a collaborative effort among AASHTO, FHWA, and other industry leaders to understand how the design of bridges using UHPC compares to design using conventional concrete. A companion material specification is under consideration by the AASHTO Committee on Bridges and Structures, and ITD plans to adopt it once it is available.

The use of nonproprietary UHPC mixtures for the construction and rehabilitation of Idaho bridges is a goal of the agency. An optimum nonproprietary UHPC mixture that incorporates locally sourced materials will lower costs and decrease construction lead times. ITD intends to adopt a nonproprietary performance specification by the end of 2025 to allow customized UHPC mixtures that meet specific project requirements.

Precast Concrete Pier Connections

ITD is working in conjunction with Idaho State University (ISU) to develop seismically resilient precast concrete pier-element connection details. The research was initiated to develop a connection that is simple, easy to use, and faster to construct, and that eliminates potential concerns regarding the seismic performance of traditional pier connections at the top and bottom of pier columns. This endeavor has involved two separate research projects: one to study the precast concrete element connections for response during an earthquake and another to investigate the retrofitting of damaged precast and CIP concrete bridges following an earthquake.

With the help of an AASHTO High Value Research grant, a unique precast concrete pier system was developed and implemented on Interstate 15 (I-15) at Exit 80 in Fort Hall, Idaho. The new Fort Hall interchange features a precast concrete pier supporting the 222-ft-long, 88-ft-wide bridge spanning I-15. The pier system incorporates a combination of structural elements where the connections between the elements are crucial for seismic resiliency. The developed system uses structural steel tubes filled with concrete strategically placed in the plastic hinge zones, which are critical locations that dissipate the energy associated with a seismic event and reduce the enormous stresses put on the piers during an earthquake. This new method replaces a method that uses proprietary couplers to connect a precast concrete column with the pier caps and foundation.

The response from contractors involved in the Fort Hall interchange project was overwhelmingly positive and indicated that the new method of constructing precast concrete piers is much easier and faster to install than previous methods. Idaho plans to adopt this system on future projects where accelerated bridge construction methods are warranted.

Wildlife Crossings

In addition to research, ITD has several areas of focus behind project development. The safety of the traveling public is of paramount importance to ITD, and strategies that protect the environment at the same time are win-win solutions. Idaho is committed to reducing wildlife-vehicle collisions by introducing concrete culverts, voided-slab bridges, or concrete arches for wildlife crossings. ITD was recently awarded a $21 million grant to construct three wildlife underpasses flanked by 8-ft-tall fencing. The project spans 6 miles along U.S. Route 30 in rural Bear Lake County and will reduce collisions along the mule deer migration route.

A successful example in support of habitat linkage is the concrete arch constructed over State Highway 21 (SH 21) at Cervidae Peak northeast of Boise, Idaho. The overpass along this mountainous roadway is ideally located to improve safety along a heavy migration route for mule deer. The project involved constructing a 150-ft-long wildlife overpass with an 18-ft vertical clearance over SH 21. The structure incorporates a precast concrete arch connected to CIP concrete footings with a grouted keyway. The span width of 54 ft is sufficient for two lanes of traffic with 4-ft-wide shoulders. The arch structure is composed of 25 precast concrete segments that have a nominal length of 6 ft and a 13-in.-thick wall. Each segment consists of two precast concrete halves joined at the crown with a CIP concrete closure pour. The segments are also bolted together to complete the connection. Since the crossing was completed, the U.S. Forest Service has been monitoring its use and has identified multiple wildlife species using the crossing, resulting in fewer wildlife-vehicle collisions.

Aesthetics

While the budget for aesthetics is small, ITD makes every effort to use formliners or other components to blend work along a corridor with the aesthetics of the surrounding community. For gateway projects that lead into cities, ITD works with local communities, business owners, and other stakeholders to determine affordable aesthetic treatments. On occasion, the local groups can fund some of those efforts, so there is an opportunity to include artwork, decorative fencing, textured concrete, drought-resistant landscaping, formliners, specific color schemes, and anti-graffiti applications. For example, as a part of the reconstruction of the interchange at I-90 and State Highway 41 in Post Falls, Idaho, improvements were made to the underpass at Greensferry Road, which now features patterned concrete and sheet-metal fish attached to the parapet wall.

Addressing Workforce and Inspection Challenges

In the field, it is a challenge to keep up with the demand to perform inspections and load ratings on the 1848 highway bridges and 2375 local bridges across the state. ITD outsources some inspection work to consultants, who also provide supplemental training for young engineers in the


The interchange of Interstate 90 and State Highway 41 in Post Falls, Idaho, includes improvements to Greensferry Road. The underpass features formliner and russet-colored concrete adorned with sheet-metal fish.

field. ITD's in-house inspection team is seeking inspectors who are also engineers-in-training or professional engineers. This background will assist them if they encounter issues in the field. For example, inspector engineers may update the load rating, create initial repair plans, or suggest fixes and repairs, which would then be corroborated by a consultant or maintenance team. In the past, an inspection report was submitted to an engineer, but in the future, the inspection-intervention process will be a more streamlined and collaborative effort.

Conclusion

Known for its natural beauty and diverse terrain, Idaho relies on its bridges to promote safety, mobility, and economic opportunity, while enhancing tourism and supporting connectivity with neighboring states. ITD is making the most of its budget by pooling funds with other states and working with universities and federal agencies to develop innovative solutions to manage Idaho's assets.

References

1. American Association of State Highway and Transportation Officials (AASHTO). 2023. *Standard Method of Test for Determining the Potential Alkali–Silica Reactivity of Aggregates (TFHRC-TFAST)*. TP144-23. Washington, DC: AASHTO.
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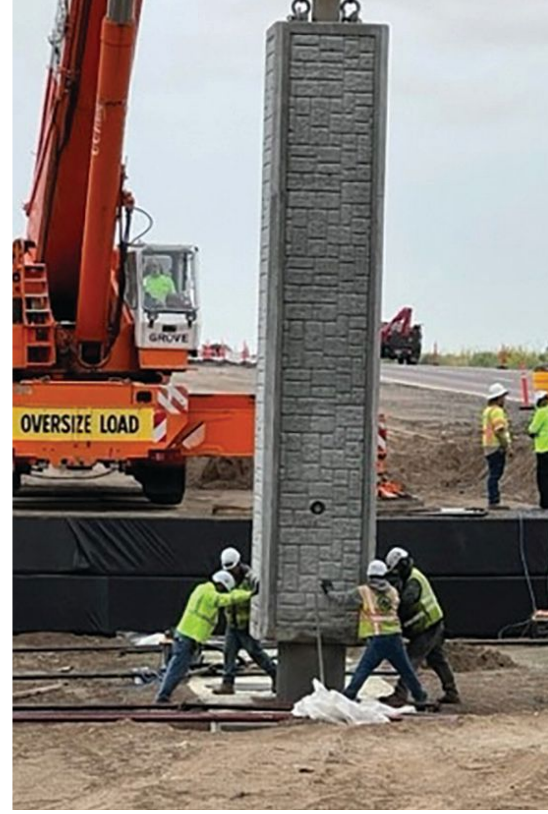

As part of improvements along the Interstate 15 corridor, crews install precast concrete columns over driven steel H-piles for the Fort Hall interchange near Blackfoot, Idaho.

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