

Arizona

Striving for a first-rate transportation system



by David B. Benton, Arizona Department of Transportation

According to 2023 data from the American Road and Transportation Builders Association,¹ only 1.1% of the 8544 bridges in Arizona are classified as structurally deficient. Arizona's low humidity helps extend the lives of bridges, but the state also dedicates substantial financial resources to its bridge program. The Arizona Department of Transportation (ADOT) is committed to keeping its people, businesses, and economy moving by continually improving the state's transportation infrastructure.

Arizona Infrastructure

In Arizona, the surge in population across the Southwest has increased the demand for new roads and bridges. Tourism to remote places like the Grand Canyon and Sedona also encourages the state to significantly invest in local infrastructure.

Arizona has a diverse geography with high-elevation mountains and plateaus. Across the state's vast land mass and range of elevations, there are a variety of microclimates. Few transportation agencies deal with the range of weather conditions experienced in Arizona. The dry season is ripe for dust storms that limit visibility for motorists, and monsoons create torrential rain in a brief time.

In monsoon season, flash flooding may occur, posing a risk of scour of bridge piers. ADOT takes scour very seriously in bridge designs. Typically, deep shaft foundations are drilled, and

the agency employs two-dimensional hydraulic models to help predict scour. These models can provide estimated scour depths and establish sufficient streambed depths around bridge piers and abutments.

As in many states, bridge deck conditions are an ongoing challenge in Arizona, and most of the state's bridge projects include deck rehabilitation or replacement. Bridge conditions in higher elevation areas and on the interstates that were built in the 1960s are of particular concern. The original interstate structures had minimal concrete cover and thin decks, so ADOT is now faced with numerous deck replacements. ADOT uses deicing salts on roads above elevations of 4000 ft, and it specifies silica fume concrete for decks in higher elevations to improve concrete durability.

Project Delivery

ADOT is keeping pace with advancements in digital technology and delivery. Driven by its three technical divisions—roadway design group, bridge design group, and traffic group—the agency is moving toward 100% digital delivery of projects. The goal is to change to digital bidding and to transition to three-dimensional modeling for design and construction starting on December 31, 2025. Ultimately, the technology will enable data-rich models of projects. The new system captures information that will be used to enhance

inspections and asset management, while also improving budgeting and resource allocation.

ADOT uses design-build and construction-manager-at-risk alternative delivery methods as well as the more traditional design-bid-build method. The agency has entered into public-private partnerships (P3s) to manage major projects, including the South Mountain Freeway, Interstate 10 (I-10) Broadway Curve, and Interstate 17 (I-17) improvement projects. P3 delivery is appropriate for such projects because they have large-scale design-build requirements. Also, P3 encourages innovation in construction techniques, materials, and project phasing that cannot be accomplished with traditional delivery methods.

South Mountain Freeway

Loop 202/South Mountain Freeway opened in December 2019, and at the time, it was ADOT's largest freeway construction project. The 22-mile bypass provides an alternate route around downtown Phoenix. It was the state's first use of P3, and the delivery method facilitated time and cost savings on the \$1.7 billion project. In the past, ADOT had specified American Association of State Highway and Transportation Officials (AASHTO) details for standard precast concrete girder sections. With the P3 South Mountain Freeway project, the agency pivoted to Utah bulb-tee girders. Following this initial success, ADOT adopted the bulb-tee (BT) girder as its new precast

The 11-mile stretch of Interstate 10 in Phoenix is the busiest in the state, carrying more than 300,000 vehicles per day through the Broadway Curve. Photo: Arizona Department of Transportation.





In March 2024, workers constructed the concrete straddle bent in the Interstate 10 median work zone between Broadway Road and State Route 143. The structure will carry ramps connecting high-occupancy vehicle traffic between I-10 and SR 143. Photo: Arizona Department of Transportation.

concrete bridge standard section. Because local precast concrete producers had already invested in the forms for other regional projects, this change has helped with efficiency and cost effectiveness.

To span the Salt River and its floodplain, 16-span precast concrete girder bridges with 15 piers each were designed. The two half-mile-long bridges required 292 BT82 girders, with each 170-ft-long girder weighing 169,000 lb. Each pier is supported by four 72-in.-diameter drilled-shaft foundations.

Interstate 10 Broadway Curve Project

The state's largest urban freeway reconstruction project to date, the 11-mile-

long I-10 Broadway Curve project in Phoenix, is currently under construction through a P3 agreement. This ambitious project aims to reduce travel times on a vital stretch of interstate that is traveled by more than 300,000 vehicles each day. The project will also provide better access to Phoenix Sky Harbor International Airport and to thousands of businesses along the corridor, offer safety improvements by reducing lane changes, and lay the groundwork for future growth.

The \$776 million project involves the construction of 16 bridges, including 2 pedestrian structures, and the widening of 5 bridges. The concrete vehicular bridges use various sizes of the precast, prestressed concrete

BT girders. The girder sections vary from BT42 for the shortest spans of 76 ft up to BT90 for spans up to 177 ft. The final design will widen I-10 to six general-purpose lanes and two high-occupancy vehicle lanes in each direction, modify interchanges, and build sound walls.

Precast concrete construction plays a big part in this project. The girders used for the new Broadway Road Bridge over westbound I-10 measure 180 ft long, making them the longest precast concrete girders in Arizona.

Ultra-High-Performance Concrete

ADOT has used ultra-high-performance concrete (UHPC) for closure pours and precast

During construction of the largest freeway project in Arizona, the 22-mile South Mountain Freeway, precast concrete girders were transported to the site, where two cranes worked in tandem to erect each one. Each BT82 girder weighs 169,000 lb and is 170 ft long. Photos: Arizona Department of Transportation.





Construction of new Interstate 10 bridges over Gila River is part of the Wild Horse Pass Corridor Project, located in the sovereign nation of the Gila River Indian Community. Photo: Arizona Department of Transportation.

concrete approach slabs. The agency is actively looking for more opportunities to use UHPC. In the summer of 2024, UHPC was used for the first time in Arizona as an overlay of the bridge deck slab, after hydrodemolition of the existing surface, on Dead River bridges on Interstate 40 (I-40) in Apache County.

Bridge Inspections

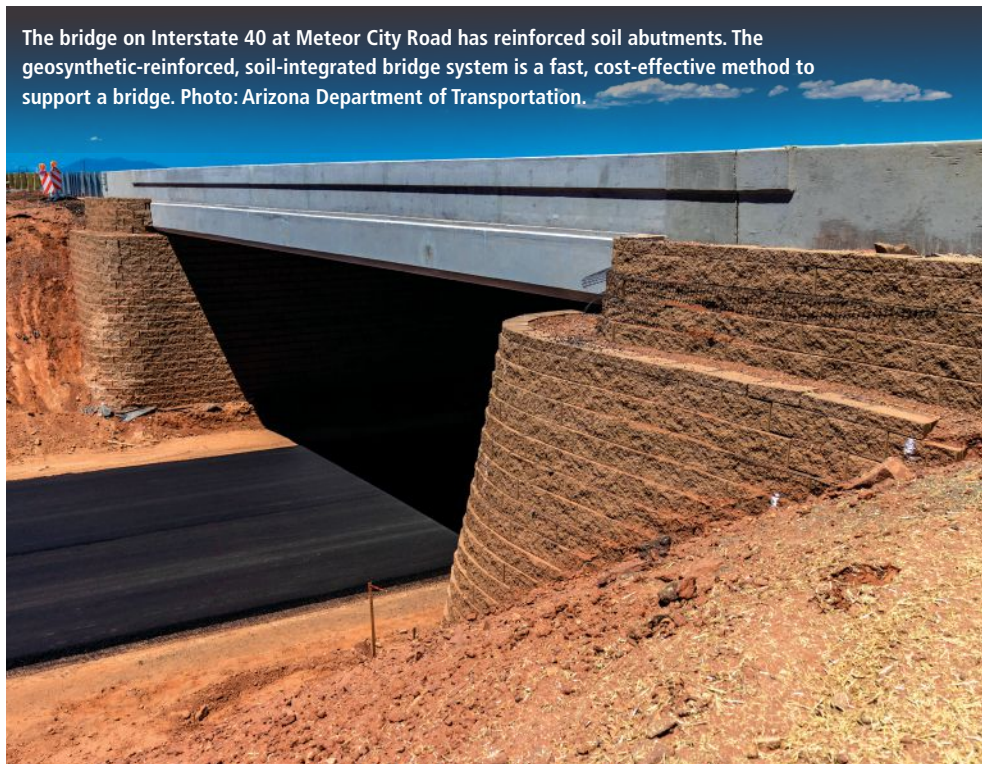
ADOT has three certified, unmanned aerial vehicle pilots within the agency's inspection group and a fleet of drones. The drones are tools for the bridge inspection program. Arizona has extremely high elevations and deep canyons on some rural routes. The drones can supplement inspectors' efforts where there is limited access, or they can be used to determine whether a closer look at a structure is needed. ADOT personnel perform routine inspections, whereas the fracture-critical and in-depth skilled inspections are outsourced to specialty consultants.

Every Day Counts

ADOT is involved in the Federal Highway Administration's Every Day Counts (EDC) initiative. Using proven technology, ADOT is expanding the use of lightweight aggregates and exploring the EDC's Enhancing Performance with Internally Cured Concrete (EPIC²) program. (See the Summer 2024 issue of *ASPIRE*[®] for more information about the use of internally cured concrete in bridge decks.) ADOT is also using fiber-reinforced polymers for strengthening applications on concrete decks, columns, and concrete girders.

Accelerated Bridge Construction

ADOT incorporates accelerated bridge construction (ABC) methods, especially in urban areas, to minimize the impact of construction on the traveling public. Every project goes through an analysis following ADOT guidelines to determine whether ABC techniques such as bridge slides, prefabricated bridge elements and systems (PBESs), or self-propelled modular



The bridge on Interstate 40 at Meteor City Road has reinforced soil abutments. The geosynthetic-reinforced, soil-integrated bridge system is a fast, cost-effective method to support a bridge. Photo: Arizona Department of Transportation.

transporters are appropriate.

On the Rio de Flag Bridge project in Flagstaff, ADOT replaced the structure in less than a week. During the weeklong closure in June 2021, crews demolished the old bridge and installed the new bridge using PBESs such as modified AASHTO BI-48 (24-in.-deep) precast, prestressed concrete box beams and precast concrete abutment caps. Fabricating the components ahead of time shortened the time to completion and minimized the project's impact on the public.

ABC methods were used to move a new bridge into its permanent position above the Gila River in Florence. While ABC slide projects typically involve shifting a single or double span, the 14-span State Route 79 (SR 79) over Gila River Bridge project involved moving four different three-span continuous units at a time. In January 2023, crews worked around the clock over two weekends to slide the three-

span sections of the new structure into place. Preparations for the bridge slide started with constructing new piers under the existing structure and casting concrete bridge segments on either side of the existing bridge. Traffic was shifted to the new sections, and the existing bridge in the center was removed.

Wild Horse Pass Corridor Project

Construction of new I-10 bridges over Gila River, some 30 miles downstream from the SR 79 crossing, used prestressed concrete bulb-tee girders. The crossing used 50-in.-deep Utah bulb tees for girder lengths of 104 ft across 13 spans. Work began in May 2024 as part of the Wild Horse Pass Corridor project located in the sovereign nation of the Gila River Indian Community. The project runs along 26 miles of I-10 between the Santan/South Mountain



The Rio de Flag Bridge in Flagstaff was replaced in less than a week using accelerated bridge construction methods like prefabricated box beams and precast concrete abutment caps. Photo: NFra Inc.

While accelerated bridge construction slide projects typically involve shifting a single or double span, the 14-span State Route 79 over Gila River Bridge project involved moving four different three-span continuous units at a time. Photo: AECOM.

Freeway and State Route 387. The first of four phases is underway with the construction of new bridges adjacent to the existing structures. This first phase of the I-10 over the Gila River project involves constructing an additional lane in both directions, reconfiguring the bridge approaches, and widening shoulders. The upgrades will enable three lanes of traffic between Phoenix and Tucson. Later phases of the Wild Horse Pass Corridor project will extend high-occupancy vehicle lanes in each direction, improve interchanges, and install fiber optics for sensors, cameras, and variable message signs, as well as other highway operations and safety-related technology. The entire project corridor is expected to be completed in 2028.

Interstate 17 Improvement Project

ADOT's \$522 million, 23-mile-long I-17 improvement project north of Phoenix is being delivered by a P3 design-build-operate-maintain contract and is scheduled for completion in 2025. The scope includes the addition of a third lane in each direction along I-17 and an 8-mile flex-lane system north of Black Canyon City. The flex-lane system is intended to alleviate traffic congestion during peak times. The flex lanes shift traffic from northbound Monday through Saturday to southbound on Sunday and as needed for scheduled events or unplanned emergencies. At the New River Road interchange, the northbound and southbound bridges are being widened from two lanes to three in each direction. Crews set nine precast concrete girders on each bridge during a two-night operation. The precast concrete girders are Utah bulb tees that span 60 to 90 ft and weigh 30,000 to 45,000 lb. This interchange includes the first 2 of 10 bridges that will be widened as part of the I-17 improvement project. An innovative construction material, ultra-lightweight foamed glass aggregate, is being used

for fill material. It is made from 100% recycled glass and will help reduce the dead load on the existing box culverts so they can withstand the weight of the additional lanes.

Meteor City Road Traffic Interchange

As part of the I-40 project west of Winslow, improvements to the Meteor City Road traffic interchange included the replacement of two obsolete structures. For the abutments, the Meteor City Road project used a geosynthetic-reinforced, soil-integrated bridge system, which is composed of geosynthetic soil modular blocks. This system uses alternating granular fill reinforced with synthetic material where the soil is compacted behind the block. Its use reduced the time that the old bridges were closed to traffic, and the new system will also reduce long-term maintenance.

In addition, the project was the state's first use of polyester-polymer concrete overlay in new construction. The polymer overlay was selected for its speed of construction compared with traditional concrete overlay on adjacent precast


concrete box beams.

Whereas replacing the structures with traditional construction methods would have taken months, the road was closed for less than three weeks. The overpass was completed within 18 days in 2019.

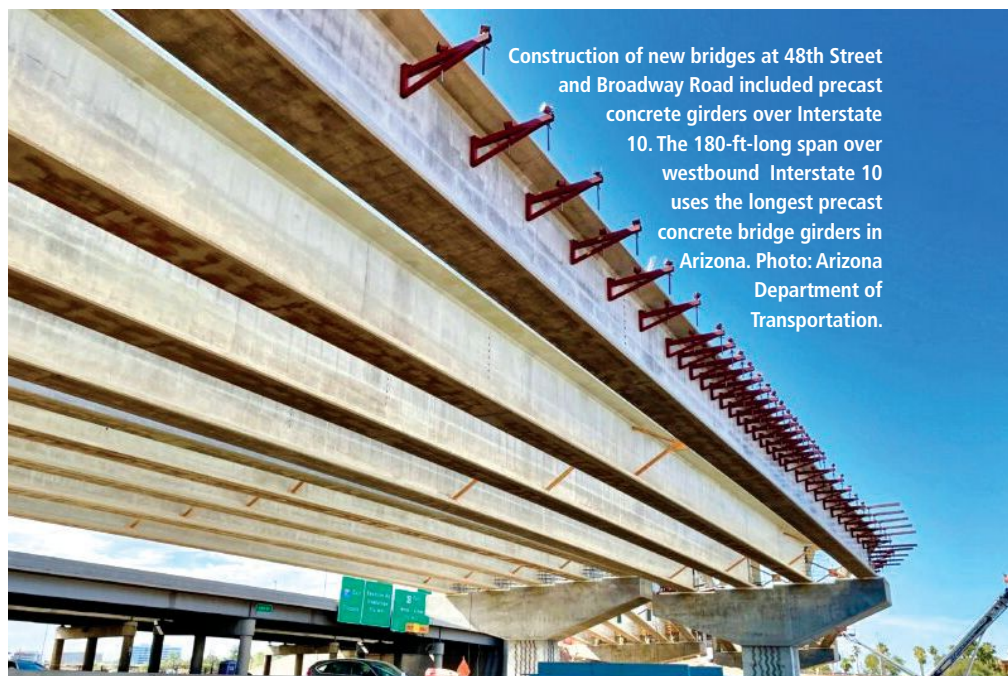
Conclusion

ADOT is setting their sights on building and maintaining a first-rate transportation system. The department continues to investigate initiatives and applications that will help the state save money and improve the safety and reliability of Arizona's transportation infrastructure.

Reference

1. American Road and Transportation Builders Association. 2023. "National Bridge Inventory: Arizona." <https://artbridgetreport.org/state/profile/AZ>. 

David B. Benton is the state bridge engineer for the Arizona Department of Transportation.



Construction of new bridges at 48th Street and Broadway Road included precast concrete girders over Interstate 10. The 180-ft-long span over westbound Interstate 10 uses the longest precast concrete bridge girders in Arizona. Photo: Arizona Department of Transportation.