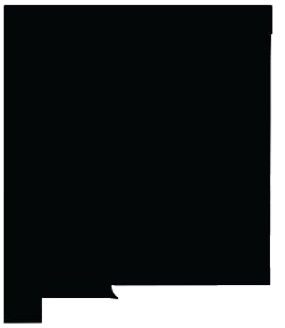
New Mexico



by Kimberly Coleman, New Mexico Department of Transportation

With a current staff of 18 engineers, analysts, and technicians in its design and management sections, the New Mexico Department of Transportation (NMDOT) Bridge Bureau manages an inventory of 2980 state-owned bridges and bridge-size culverts (greater than 20-ft span). Of these, 1140 are prestressed or reinforced concrete girder bridges. The Bridge Bureau also inspects 802 locally owned bridges.

NMDOT's role includes internal design, consultant oversight, construction technical support, emergency damage inspection and recommendations, management of the National Bridge Inspection Standards inspection program, load rating, and oversize and overweight permitting.

NMDOT has a distinctive collection of challenges for bridge construction and maintenance. Many of the state's bridges are in very remote areas, where projects may involve long lead times on delivery and face challenges with construction staffing. New Mexico has a wide range of elevations: from 2800 ft at Red Bluff Reservoir in the southeast to more than 13,000 ft at Wheeler Peak in the northern part of the state. The variations in elevations translate to substantial climate differences: bridges in the southwest desert region experience very hot and dry conditions, where crack prevention during concrete curing is paramount, and bridges in the northern mountain region experience frequent freezing and thawing and applications of deicing salts. In most areas of the state, daily temperatures can swing as much as 50°F, so thermal expansion details are critical for these bridges!

Figure 1. New Mexico's oldest concrete arch bridge carries Bridge Street over the Gallinas River in Las Vegas, N.Mex. It was built in 1909 and is still in service today. Photo: New Mexico Department of Transportation.

Concrete Bridges in New Mexico throughout History

New Mexico has relied heavily on concrete over the years. The state has several notable old concrete bridges that have stood the test of time and remain in service today.

One of New Mexico's oldest in-service concrete bridges is a locally owned concrete arch in central Las Vegas, N.Mex., built in 1909 (**Fig. 1**). This bridge carries Bridge Street over the Gallinas River, which is part of the historic Santa Fe Trail. Even though this bridge has been in service for over 110 years, it is still in fair condition—truly an example of concrete performing to its best advantage!

Another of New Mexico's oldest bridges is in the heart of Santa Fe. This concrete through-truss bridge, dubbed the "Rainbow Bridge," was built in 1920 and carries Grant Avenue over Arroyo de Las Mascaras (**Fig. 2**). This bridge is load posted at 10 tons, but it is still in fair condition and is still performing its intended function.

Figure 2. One of New Mexico's oldest bridges carries Grant Avenue over Arroyo de Las Mascaras in the heart of Santa Fe. The concrete through-truss bridge, dubbed the "Rainbow Bridge," was built in 1920. Photo: New Mexico Department of Transportation.

Figure 3. Two of the New Mexico Department of Transportation's concrete K-frame bridges carry Interstate 40 in Tucumcari, N.Mex. There are eight K-frame bridges in the state. Photo: New Mexico Department of Transportation.

Use of reinforced concrete in New Mexico began around 1912. Multiple-span concrete slab bridges became the predominant bridge type beginning in the 1930s, and this trend held steady until around 1990. Owing to their relatively low construction costs, cast-in-place, reinforced concrete slab bridges are now enjoying a small resurgence in the state's dry arroyos (water-carved gullies or channels that fill and flow seasonally).

New Mexico's multispan, rigid K-frame structures represent an unusual type of reinforced concrete bridge (**Fig. 3**). NMDOT owns six of these bridges, four of which were built in 1980 and 1981 and are in satisfactory condition. Two were built in 1990 and are in good condition. NMDOT looks forward to many more years of use from these bridges.

New Mexico's first prestressed concrete girder bridge, Alameda Boulevard over the Rio Grande, was built in Albuquerque in 1956. It was replaced in 1993 by an adjacent bridge and decommissioned in place to support a multiuse trail.

Prestressed concrete girder bridge construction gained traction in New Mexico in the 1960s, peaking in the 1970s. The pace of this type of construction has held steady since—an average of approximately 150 prestressed concrete girder bridges have been built each decade since the peak of 279 bridges in the 1970s. This is clearly a workhorse bridge type for NMDOT, a trend that will likely continue as the state has three precast concrete producers and no local steel producers. Currently, only one of these in-state producers is casting prestressed concrete girders for highway projects.

NMDOT's first concrete segmental bridges carry the flyover ramps at the interchange of Interstate 25 (I-25) and Interstate 40 (I-40). These eight precast concrete segmental bridges were completed in 2002 and have been performing well. One of NMDOT's challenges with this bridge type is that the enclosed interior cells have become sites for encampments of homeless people, which have presented biohazard and other environmental issues.

In 2021, construction was completed on NMDOT's first cast-in-place concrete segmental bridge, U.S. Route 54 over the Canadian River in Logan, N.Mex., featured in the Winter 2021 issue of *ASPIRE*® (**Fig. 4**). This bridge type was selected because it could be constructed from above, thus surmounting environmental constraints caused by wetlands and endangered fish species in the Canadian River below. The bridge, which was opened in June 2021, was awarded the 2021 American Segmental Bridge Institute's Bridge Award of Excellence and the 2022 American Council of Engineering Companies' Grand Conceptor Award.

Ultra-High-Performance Concrete

NMDOT's experience with ultra-high-performance concrete (UHPC) kicked off in 2008 with a four-phase research project in collaboration with New Mexico State University (NMSU). Phase I of this research began with a literature review on the benefits of UHPC and several preliminary designs for UHPC girder replacements for New Mexico bridges. Phase II included development and compressive-strength testing of a nonproprietary UHPC mixture developed by NMSU using local materials. This concrete achieved compressive strengths in the range of 21 ksi. Phase III involved casting and testing of two production-size UHPC girders. The successful results of these tests convinced NMDOT to proceed with a bridge replacement using UHPC girders. NM 186 over La Union Main Canal near Anthony, N.Mex., built in 2017, is a two-span bridge where one span was constructed using conventional 9.5-ksi precast, prestressed concrete and the second span was constructed using NMSU's nonproprietary, 20-ksi UHPC. Both spans use channel girders for the 24-ft 10-in. spans. The conventional concrete girders are 1 ft 3 in. deep, and the UHPC girders are 1 ft ½ in. deep. All girders contained the same prestressing and mild reinforcement.

The bridge was instrumented with internal and external strain gauges and load tested several times to establish a baseline for future testing and provide comparisons between the behavior of the two concrete types (**Fig. 5**). In Phase IV, NMSU undertook development and testing of nonproprietary UHPC mixtures for joints and overlays. A 1-in.-thick UHPC overlay concrete was

Figure 4. The U.S. Route 54 over Canadian River Bridge was New Mexico's first cast-in-place concrete segmental bridge. Shown here under construction, with form travelers being used for the balanced-cantilever construction. Photo: Malcolm International

applied to L-00012 over I-25 in Socorro, N.Mex. During placement, the UHPC was not adhering well to the deck concrete beneath. This problem may have been caused by difficulty in attaining a true saturated surface-dry condition—the contractor struggled with both too much and too little moisture in different areas of the deck. The nonproprietary joint concrete has not yet been used in a production bridge.

As NMSU's research on nonproprietary UHPC was progressing, NMDOT used proprietary UHPC mixtures on several other projects: one UHPC deck overlay and four precast concrete bridges with UHPC closure joints. New Mexico's most recent precast concrete bridge with UHPC closures is NM 50 over Glorieta Creek. In the 2023 PCI Design Awards, it received the All-Precast Concrete Solution award and an honorable mention for Bridge with a Main Span under 75 ft (**Fig. 6**).

Now that NMDOT and the local contracting community have gained experience and seen success on several UHPC projects, the agency expects to continue using UHPC as an available tool for future projects where greater strength and accelerated construction methods are needed.

Figure 5. Load testing on the NM 186 over La Union Main Canal. This is the New Mexico Department of Transportation's first use of ultra-high-performance concrete (UHPC) for a prestressed concrete girder bridge. One span of the two-span bridge used UHPC, and the other span used a conventional concrete mixture. Photo: New Mexico Department of Transportation.

Accelerated Bridge Construction

Like many other states, New Mexico has ventured into accelerated bridge construction (ABC). NMDOT's use of ABC has been primarily focused on schedule savings that can be realized using prefabricated bridge elements and systems.

NMDOT's first accelerated project was the 28-day construction of a two-span adjacent box-girder bridge carrying Mountain Valley Road over I-40. This bridge was completed in 2005 and features precast concrete abutments and pier caps and precast concrete box girders with a 5-in. topping slab. Another ABC project, the Las Vegas Airport Interchange carrying NM 250 over I-25, was completed in 2014 under a 45-day bridge closure. This bridge was featured in the Winter 2017 issue of *ASPIRE*. NMDOT's most recent ABC project was the previously mentioned seven-week construction of NM 50 over Glorieta Creek.

Emergency Repairs

On occasion, vehicular impacts damage bridges. NMDOT Bridge Bureau staff respond to several bridge strikes and emergencies each year, inspecting damage, coordinating with district staff on necessary lane closures, and providing repair recommendations.

A recent emergency occurred on an interstate flyover ramp in Las Cruces, N.Mex. On the evening of July 11, 2023, a fuel tanker truck tipped on its side, catching fire and spilling burning fuel near the departure abutment. It burned for approximately 80 minutes, causing explosive spalling and strength loss to the deck, concrete bridge rail, and downslope wingwall (**Fig. 7**). NMDOT's emergency repair contractor used hydrodemolition to remove the fire-damaged concrete and recast or patch the damaged components. Repairs were completed and the bridge was reopened to traffic on December 13, 2023.

Figure 6. Installation of ultra-high-performance concrete joints on the NM 50 over Glorieta Creek Bridge. Photo: New Mexico Department of Transportation.

Figure 7. In July 2023, a fuel tanker truck overturned and burned, resulting in fire damage to a concrete bridge deck and barriers. The fire-damaged concrete was repaired or removed and replaced. The structure was reopened five months later. Photo: New Mexico Department of Transportation.

Figure 8. In October 2022, the NM 129 overpass over Interstate 40 was hit by an excavator and all strands were severed on two of the five prestressed concrete girders. One lane was immediately closed and remains closed. Construction to replace the damaged span is anticipated to begin in late 2024. Photo: New Mexico Department of Transportation.

Another source of significant damage has been vehicular collisions with girders. The resiliency and redundancy of concrete girder bridges allow many of these damaged girders to be repaired. NMDOT has used strand couplers, cementitious patch materials, and sometimes carbon-fiber wrap to quickly put the damaged girders back into serviceable condition. However, some damages defy repair. In October 2022, the NM 129 overpass over I-40 was hit by an excavator, which severed all strands on two of the five girders over the eastbound lanes (**Fig. 8**). NMDOT staff immediately closed the lane carried by the two damaged girders, and the bridge is still restricted to one lane in this span. A design project is currently underway to replace the damaged span, with construction anticipated to begin in late 2024.

Conclusion

NMDOT has a long and successful history of building and maintaining concrete bridges, one that the agency hopes to build on and continue to improve in the years to come.

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