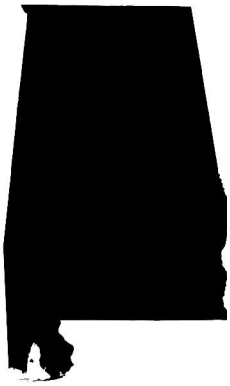

Alabama

by William (Tim) Colquett, Alabama Department of Transportation

Precast concrete caps were set onto precast concrete columns for the Interstate 59/20 Central Business District Bridge project. Photo: ALDOT.

A segment for the Interstate 59/20 Central Business District Bridge project is removed from the casting bed. Photo: ALDOT.

Micropiles were used in some locations of the Interstate 59/20 Central Business District Bridge project because of the varying soil conditions in the area. This was the first use of micropiles in the state. Photo: ALDOT.

Concrete has been a mainstay of Alabama's highway bridge infrastructure for many years. There are concrete-superstructure standard drawings that date to the 1920s, and some of the bridges built from those drawings are still in service. With advances in technologies, materials, and construction techniques, bridges that would have traditionally been constructed of steel are now designed using concrete.

Alabama's bridge inventory consists of 15,980 bridge structures, including 5757 bridges and culverts that are owned and maintained by the State. Approximately 69% of those structures (excluding culverts) have concrete superstructures. Concrete construction has proved to be efficient, economical, and aesthetically pleasing.

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These benefits are nowhere more apparent than with the current Interstate 59/20 Central Business District bridge replacement project currently underway in downtown Birmingham, Ala. The largest contract ever let by Alabama Department of Transportation (ALDOT), the $475 million project replaces 6600 ft of steel girders and several fracture-critical steel bent caps for structures that run through the downtown area. The circa-1971 bridges were designed for average daily traffic (ADT) of 80,000; however, ADT is projected to reach 225,000 in 2035. The old bridges lack shoulders and have obsolete geometry, with some entrance and exit ramps placed on the left.

The new bridges, which have wider cross sections to accommodate additional lanes and full shoulders, eliminate some of the entrance and exit ramps and utilize segmental concrete box girders. Constructability, schedule, and aesthetics were among the reasons that this approach was chosen. The segmental girders provide longer span lengths, eliminating substructure and providing more space beneath, which city officials intend to use for public events. Also, noise levels, both above and below, will be reduced because concrete provides much-improved noise abatement under the bridges and because longer span lengths and continuity will eliminate joints, reducing noise from wheel strikes.

The segments are being cast off site and stockpiled until a section of the bridge is closed, at which time the contractor will set the segments. Prior to closure, while the existing bridges are still in place, foundation work is being completed using low-overhead equipment that can operate in the confined space.

Because of the area's karst geology, subsurface conditions vary within small distances; therefore, foundations include micropiles, driven-steel piling, and drilled shafts. Micropiles are being used for the first time in a widespread application on a bridge project in Alabama. Precast concrete columns and caps are further expediting construction, with grouted splice sleeves being used for connections between precast concrete elements and the footings.

The contractor has 14 months (from January 2019 to spring 2020) to complete and open the new bridge system. It will be erected using the span-by-span method with ground-based shoring. An aesthetics package includes Wi-Fi-controlled multicolored lighting installed beneath the bridge that can be programmed for events at the bridge. To further expedite construction, electrical infrastructure was preinstalled in the segments.

Use of Accelerated Bridge Construction Techniques

Accelerated bridge construction (ABC) techniques have been in use in Alabama for many years. In some ways, the state was advancing ABC methods before ABC became an industry buzzword. For example,

Construction of one of the new twin bridges on the Ross Clark Circle (U.S. Route 231) over Beaver Creek culvert in Dothan, Ala. The rollers and steel tracks shown in the photo on the right were used with hydraulic jacks to slide the new bridge into place. Photos: ALDOT.

short-span precast concrete bridges and substructures have been a common feature of Alabama's off-system roadways for years.

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Perhaps the most prominent use of ABC on state highways came in 2002 and 2004, when two different structures in the Interstate 59/20 interchange were damaged beyond repair after tractor trailers wrecked under the bridges and their fuel loads were ignited. These bridges, located in what is sometimes called the "Malfunction Junction" due to the heavy traffic and diverging-diamond geometry, had to be replaced as rapidly as possible to minimize travel disruptions on an already difficult route. Steel spans were replaced with prestressed concrete bulb-tee girders on an accelerated schedule. One span was replaced in 36 days, and the other was back in service in 38 days. Prefabrication of span components while the site was prepared was a key to that speed. ALDOT has incorporated similar techniques into other projects to help reduce user costs and keep traffic moving smoothly.

Recently, another ABC technique was successfully deployed for the bridge slide in the $2.43 million culvert replacement on Ross Clark Circle (U.S. Route 231) in Dothan, Ala. (see the article on this project in the Fall 2016 issue of *ASPIRE*®). The objective was to widen the structure from two to three lanes in each direction as quickly as possible to minimize traffic disruptions in an area with high ADT. In lieu of constructing a new culvert, ALDOT's solution was to retain the existing culvert, partially remove the fill from the culvert's top, and span over it with parallel 120-ft-long bulb-tee girder spans, 54 ft and 63 ft wide, each supported by steel piles and cast-in-place concrete abutments.

The contractor constructed the abutments beneath live traffic by using steel trench boxes with removable lids that accommodated traffic during peak hours and then could be removed in off-peak times to allow piles to be driven. Once the piles were driven, the lids were put back in place while workers beneath completed construction of the abutment caps.

The superstructure was constructed on roller bearings, so it could be rolled into place during specific windows of closure times. When the slide was ready, traffic was shut down, the trench boxes were removed, and the spans were rolled into place. The first bridge was rolled into place and completed in three days, while the second was completed in two.

Successfully completing this project required ALDOT to take a proactive approach with the contractor. This close relationship allowed dialogue and suggestions to flow easily, facilitating the quick processing of issues and creating a pattern that can be used on future projects where such ABC techniques may be appropriate.

Although these projects demonstrate ALDOT's willingness to use new techniques when needed, Alabama's bridge projects typically use conventional construction methods. Most bridges are built with traditional concrete designs, typically using AASHTO-type and bulb-tee girders. These designs usually provide the best economy, aesthetics, durability, and speed of construction for the state.

Emerging Delivery and Design Methods

Design options for bridges may expand as ALDOT ventures into new delivery methods. For example, for the Interstate 10 (I-10) Mobile River Bridge, a planned six-lane structure that will be the state's second cable-stayed bridge, three prequalified teams now are putting together design, cost, and schedule proposals for the project, which is being financed through a public-private partnership. This approach offers the only way that the state can afford the project, which will cost between $800 million and $1 billion.

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The I-10 Mobile River Bridge will also be the state's first design-build project, which became possible when legislation was passed to allow the use of that delivery method on projects costing more than $100 million. Clearly, many new concepts will emerge from this process, and ALDOT is watching closely to determine what benefits these approaches can provide for future projects.

Bridge Aesthetics

New design ideas will also aid in creating more aesthetically pleasing bridges, which has become a higher priority. The range of aesthetic options available with concrete has

broadened, with new decorative methods being produced and material costs declining. Decorative railings, abutments, and even lighting systems, such as the one for the Birmingham Central Business District project, are becoming more prominent.

A recent project emphasizing aesthetics is the replacement of the Moores Mill Road Bridge in Auburn, which spans the busy Interstate 85 corridor between Atlanta, Ga., and Montgomery, Ala. Faced with growing ADT, Auburn wanted a wider bridge, with a dedicated sidewalk and aesthetic treatments that suited the structure's high-visibility location. The new design features two 120-ft-long spans using 54-in.-deep modified prestressed concrete bulb-tee girders, a 74-ft-wide deck between gutters, and a 9-ft-wide sidewalk. Precast concrete pier columns expedited the work in the I-85 median. Formliners were used to simulate brick on the barrier rails, portions of the columns, abutment wings, and toe wall. They were stained to closely resemble the brick color used at nearby Auburn University. Decorative lighting and railing were installed to complement the simulated brick. The $3.79 million bridge opened in the spring of 2018.

Even along Alabama's coast, where durability is the primary consideration, aesthetic design is a growing priority. The recent bridge replacement on State Route 182 in Gulf Shores, Ala., shows how durability and aesthetic details can be combined. The new bridge is a 191-ft-long, three-span continuous structure that uses precast concrete arch girders with just mild reinforcement (no prestressing or post-tensioning). The bents are composed of spun precast concrete cylinder piles and precast concrete caps, which were chosen for their durability. The abutments feature square prestressed concrete piles with cast-in-place concrete caps and deck.

Formliners were used to simulate brick on the Moores Mill Road Bridge over Interstate 85 in Auburn, Ala. The "brick" was then stained to resemble the brick used for buildings at nearby Auburn University. Photo: ALDOT.

Decorative reliefs were cast into the outside fascia of the girders, and a varied height, custom aluminum "wave" shape was designed for the railing to complement the beach environment. The $1.71 million bridge opened in 2015.

Looking to the Future

More construction options will be added to the toolbox as the state adjusts to advanced techniques. For example, ALDOT will soon let its first project using Northeast Extreme Tee (NEXT) beams. They are a good solution for specific applications, and ALDOT expects to use them on other future projects as well. Florida I-beams (FIBs) are another option, with good potential for specific applications. ALDOT is closely watching the use of 100-ft-long FIB36 beams for a privately funded bridge to be built in Huntsville, Ala.

Also, owing to the varied and complex soil conditions in Alabama, micropiles are expected to be used more often in the future. They offer a good alternative when soil conditions create challenges and the Birmingham Central Business District project has demonstrated their advantages.

Alabama's future may include more design-build and public-private partnership projects, as those delivery methods potentially provide benefits and more innovative designs in some situations. Traditional approaches often offer the best solution, but the state is open to new options that will help create economical, efficient, and aesthetically pleasing designs.

William (Tim) Colquett is state bridge engineer with the Alabama Department of Transportation in Montgomery.

The top priority for the new State Route 182 Bridge over the channel at Little Lagoon in Gulf Shores, Ala., was durability, but designers also added aesthetic touches to play off the structure's oceanside setting. Photo: Scott Bridge Company.

To reflect the maritime location, decorative elements including dolphin shapes, were cast into the fascia and a custom aluminum "wave" shape for the railing was added to the State Route 182 Bridge over the channel at Little Lagoon in Gulf Shores, Ala. Photo: ALDOT.