In recent years, the state of South Dakota has focused its attention on designing bridges for longer life and addressing maintenance concerns earlier to alleviate replacement needs. These efforts, along with continued investigation of new concrete mixtures and different types of reinforcement, are aimed at increasing durability throughout the state network.

The South Dakota Department of Transportation (SDDOT) owns approximately 1800 structures and local governments own approximately 4000 structures that are included in the National Bridge Inventory. The majority of the bridges in South Dakota consist of relatively short spans, with the average state-owned bridge being about 40 ft wide and 210 ft long. Of the state-owned bridges, concrete superstructures are the most common type, making up approximately 65% of the total. The oldest concrete bridge in the state-owned inventory dates to 1924, while the oldest precast, prestressed concrete-girder bridge was built in 1959.

One of the oldest bridges is the scenic Beaver Creek Bridge on SD 87 in Wind Cave National Park, which consists of an open-spandrel concrete arch structure owned by the National Park Service. Built in 1929 and now on the historic register, it offers a 20-ft-wide roadway with curved approach spans and is a signature example of the durability and flexibility of building with concrete.

Over the past 9 years, SDDOT has constructed on average about five new bridges per year on the state-owned highway system and about 10 on the local government-owned system. The bridges built on the state-owned system typically are either cast-in-place continuous concrete slab spans or cast-in-place concrete slabs on prefabricated girders. The supporting girder types are either precast, prestressed concrete-I-shaped or steel I-shaped sections.

SDDOT has a long and favorable history of performance with cast-in-place continuous concrete slab-span bridges. Jointless bridges that have cast-in-place concrete deck slabs on precast, prestressed concrete girders that are made continuous for live load and have integral abutments have also performed very well, albeit with a shorter history of experience.

An example of a typical slab span is the Davis Bridge on U.S. 18 over the Vermillion River, built in 1933. It features four continuous spans, with two interior spans of 47.5 ft and two end spans of 38 ft. The roadway is 40 ft wide.

Preservation a Top Priority

SDDOT has been in a preservation mode with its highway system in recent years, which has reduced the number of new bridges it has constructed. Bridge preservation has long been a significant portion of SDDOT’s bridge project programming. Its goal has been to extend the lives of existing bridges by addressing
maintenance needs early rather than have to replace the bridges later.

Decks have been a major focus of South Dakota’s bridge-preservation program. Since the mid-1970s, SDDOT has been applying concrete overlays to existing bridge decks containing uncoated reinforcing steel, and eliminating or replacing deck joints wherever possible. Initially these 2-in.-thick overlays were latex-modified concrete. More recently a low-slump, dense concrete type has been used. Some of these earlier deck overlays are now having a second overlay applied. As a result of the overlay program, SDDOT has replaced very few bridge decks over the years.

At about the same time that the rigid deck-overlay program was initiated for existing bridges, SDDOT began designing new bridges with integral abutments and jointless concrete decks with increased clear cover (2 ½ in.) and incorporating epoxy-coated reinforcing steel. These bridge decks are proving to be very durable, even with South Dakota’s relatively severe winter climate.

Our focus on longevity and preservation is driven in part by our concern over availability of reliable and adequate long-term funding. Our goal is to effectively design bridges for long-term durability with minimum required maintenance and within the available budget. The uncertainty in our funding sources makes it imperative we use our budget wisely each year.

Concrete Use Grows

SDDOT has been using concrete more often in recent years due to its cost competitiveness, especially for the relatively short-span applications that are common in the state. Its favorable durability history with concrete bridges and long-term maintenance considerations also are factors. As a result, about 80% of the bridges being built today on the state-owned system are concrete, while virtually all of those being built on the local-owned system are concrete.

Local fabricators work closely with SDDOT to keep designs efficient and cost effective. Since they can now provide longer spans (up to 130 ft), our thinking about design options has changed. As a result, longer bridges that had been built with steel girders in the past are now being replaced with concrete designs in some cases.

An example of the span lengths being used is the Liberty Road Bridge over I-90, at the east entrance to Ellsworth Air Force Base. Constructed in 2002, it features eight girder lines of Type 72M prestressed concrete girders with spans of 129 and 119 ft and a 60-ft-wide roadway.

SDDOT keeps up to date with new techniques being introduced in its state and others. The 8th Street Bridge in Custer, a locally owned structure, recently was completed using geosynthetic reinforced soil (GRS) abutments. The precast, prestressed concrete deck units consist of 10 side-by-side solid slab sections, with a 24-ft span over French Creek, which were grouted in 2 days, according to the precaster.

SDDOT continues to evaluate potential improvements in concrete (especially high-performance concrete). It is currently utilizing Class F fly ash in deck concrete to densify the matrix and reduce permeability. In the past, the department has tried techniques such as using well-graded aggregate mixtures to try to control cracking.

Recently, in an effort to gain a 100-year service life, SDDOT has utilized stainless-steel reinforcing bars in a few projects, and is considering allowing other alternative corrosion-resistant bar materials such as dual-coated, metallized-steel reinforcing bar with an epoxy topcoat (ASTM A1055). These approaches are being used for major projects and on complicated, urban interchanges where maintenance or replacement would be disruptive.

SDDOT does not design many bridges with special aesthetic treatments, although it does frequently use special surface finishes on concrete slabs, girders, and barriers. Often, this consists of special color treatments and may be coordinated with local wishes. SDDOT has also used formliners on substructures, along with colored surface treatments, in a few cases.

Mostly, designs are presented for clean, smooth lines adhering more to the “form follows function” aesthetic principles and shy away from special add-on type treatments. We believe the clean lines of concrete look good by themselves.

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