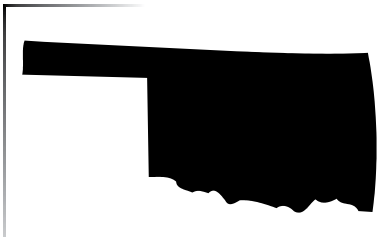

Oklahoma's Bridge Blitz

Governor's aggressive $550-million, 8-year plan to wipe out deficient bridges in Sooner State raises the bar nationwide

by Craig A. Shutt

In October 2011, as the Oklahoma Department of Transportation (ODOT) was observing its 100th anniversary, it received an unprecedented birthday present: Gov. Mary Fallin announced an aggressive plan to address all currently known, structurally deficient bridges on the state-highway system. The $550-million plan would essentially fully fund the existing 2012-2019 Eight-Year Construction Work Plan, which ODOT has found to be an effective tool in working efficiently to replace and maintain bridges.

The announcement was "a pleasant surprise," says Bob Rusch, state bridge engineer. "The Work Plan has proven to be a reliable and effective way to achieve key objectives," he says. More attention has been paid to addressing Oklahoma's growing inventory of deteriorating bridges in recent years, but much more has been needed, adds David Streb, director of engineering. Now, the program will receive that additional funding.

The two-phase initiative will address all of the state's current 706 structurally deficient highway bridges by the end of the decade, Streb explains. The first phase replaces or rehabilitates 539 structurally deficient bridges, including 126 added to the existing Work Plan. Phase Two, which requires legislative approval, increases funding to replace or rehabilitate the remaining 167 structurally deficient, highway-system bridges that weren't included in the Work Plan. The construction is expected to consist of about half replacement projects and half rehabilitation, says Rusch.

Eight-Year Blueprint

The Work Plan is created each year by ODOT and approved by the Oklahoma Transportation Commission. Updated annually with plans for the 8th year, it outlines design and construction work based on current funding levels. "Over the years, it has allowed the department to stay on top of its goals and create credibility for the department with the public and the legislature," says Streb.

The current 8-year plan includes the largest number of bridges ever targeted for work and already represents a renewed focus on highway improvements, he notes. Current law gradually increases transportation funding each year until a $435-million cap is reached in 2017. The new plan will add $15 million annually to the increase and raise the cap to $550 million, without raising state taxes.

The plan also includes county bridges by increasing funding for the County Improvements for Roads & Bridges initiative from $80 million to $105 million annually. It also allows recycling of highway bridge beams, which will be done with beams from the 8800-ft-long I-40 Crosstown Expressway Bridge in Oklahoma City. Its beams will be shipped to counties for local bridges. This work will be complemented by ODOT's recent release of the first half of new LRFD county-bridge standards, which consist primarily of precast, prestressed concrete beams.

The program's design work will be provided by outside contractors, a rarity in the state, as shorter-span and rural bridges often are designed in-house, says Rusch. Most of the replacement bridges will feature concrete, which has been the material of choice for most state bridges for decades.

2002 Turning Point

Oklahoma officials have understood the need for more attention to substandard bridges since the pivotal moment during the Memorial Day weekend in 2002 when two barges collided with a pier on the Webbers Falls Bridge in Muskogee County, Streb explains. The accident caused a 580-ft section of the I-40 steel bridge to collapse, killing 14 people.

The bridge was immediately repaired, replacing three steel approach spans with precast, prestressed concrete I-beams to spread out material fabrication and speed construction. The three concrete approach spans ultimately were erected faster than the remaining steel span, making an impression for concrete's capabilities. The bridge was restored to service in only 65 days.

Also leaving an impression was the deteriorated state of many of the highway bridges onto which vehicles had to be rerouted during construction, says Streb. "That led us to focus on inventorying and improving the number of deficient bridges in the state." They discovered that Oklahoma had the third highest number of structurally deficient bridges in the nation, with the majority built during the interstate construction boom in the 1950s and 1960s.

The decline arose from flat funding from 1985 to 2005, providing no opportunity to impact the growing list, explains Rusch. "An attempt to raise the gasoline tax to fund an expanded program was resoundingly defeated, but the legislature saw that defeat as a mandate to generate funds from existing sources." The result was a commitment of an additional $100 million in 2007 to address the state's 137 load-posted bridges. The current program will eliminate those restrictions, although 32

The Western Avenue Bridge over I-40 in Oklahoma City represents ODOT's first use of precast concrete U-beams and of self-consolidating concrete. SCC ensured smooth flowability through the complex reinforcement and delivered an aesthetically pleasing appearance.

bridges since added to the list also will have to be addressed, he says.

The vast majority of bridges in the state consist of short-span structures crossing streams or highways, Rusch says. "These structures almost universally consist of concrete bridges of various kinds, including precast concrete beams with compressive strengths up to 10,000 psi."

Key Concrete Designs

A variety of notable bridges have been constructed that take advantage of concrete's capabilities, notes Greg Allen, assistant to the chief engineer. These designs include:

- **State Highway 74 (Lake Hefner Parkway) at Hefner Road in Oklahoma City**: Built in 1991, this 215-ft, single-span, cast-in-place concrete structure features the state's second-longest concrete span. "The box girder design was used to span the parkway without a center pier," Allen explains. The bridge was built on a new alignment, with the existing Hefner Road remaining open during construction.
- **U.S. 59 over Grand Lake (The Sailboat Bridge) near Grove**: This 3043-ft-long bridge is the state's only precast concrete segmental, box girder bridge. Consisting of 25 spans, each 121.7 ft long, and match-cast segments, the design was a response to the required bridge length. It gained its name from the fact that the majority of sailboats can pass beneath it. "Its clearance was set after public meetings were held and sailboat configurations were researched," Allen explains. Another unique aspect was the creation of the initial wearing surface as an integrally cast portion of each segment. The bridge was deemed to have the best riding surface in the state.
- **State Highway 4 over South Canadian River between Mustang and Tuttle**: This 1751-ft-long, precast, prestressed concrete bulb-tee structure has twelve 146-ft-long spans, the longest precast concrete spans in the state. "The design aimed to minimize piers in the water by using Texas Type J bulb-tee beams, which allowed an extra 10 ft of length in each span compared to the deepest section used in Oklahoma," says Allen.

The 215-ft-long, single-span, Lake Hefner Parkway Bridge in Oklahoma City features Oklahoma's second longest concrete span. The cast-in-place concrete, box girder structure spans the parkway without a center pier. All photos: Oklahoma Department of Transportation.

"The Sailboat Bridge" near Grove, the only precast concrete, segmental box-girder bridge in the state, features 25 spans at 121.7 ft each.

The longest precast, prestressed concrete spans in the state are featured on the SH 4 Bridge over South Canadian River between the towns of Mustang and Tuttle. The 1751-ft-long bridge has 12 spans of Type J Texas bulb tees, each 146 ft long.

The Eight-Year Construction Work Plan had created credibility with the public and the legislature.

The two-span, precast, prestressed concrete SH 102 Bridge over Turner Turnpike near Wellston was the state's first structure to feature a special aesthetic treatment consisting of colored components and an embedded concrete theme cap at the juncture of the center pier and superstructure.

- **State Highway 102 over Turner Turnpike in Wellston**: Built in 2008, this two-span, precast, prestressed concrete bridge contains AASHTO Type IV beams spanning 109 and 114 ft. It was the state's first bridge to feature a special aesthetic treatment. The bridge features color tints as well as a special concrete "theme cover" where the median pier joins the superstructure. The cover has the battle-shield emblem from the state flag embedded in the concrete and overlaid with ceramic tiles. Since this use, several other projects have received this aesthetic treatment.

New Design Ideas

"We continue to look for new techniques to resolve key challenges," says Streb. One such can be seen in the Western Avenue Bridge over the realigned I-40 highway in Oklahoma City. In 2010, it became the first bridge in the state to use precast concrete U-beams.

"That design was selected because the girders provided a more aesthetically pleasing appearance to the box-girder shape," explains Rusch. Aesthetics were enhanced by using self-consolidating concrete, although that wasn't the intention, he adds. The U-beams were fabricated in Texas, where they are more commonly used. But the fabricators wanted to create the girders in two placements, casting the bottom slab and then the walls. ODOT suggested SCC to ensure full coverage without honeycombs in the congested space. "The fabricator was unfamiliar with SCC, but the resulting girders fulfilled all the structural needs and provided an excellent aesthetic appearance," he says. "That bonus ensured these concepts will be added to our arsenal of options."

Oklahoma needs as many options as possible to meet its challenges, the designers say. Environmental regulations protect a variety of endangered fish, mussels, clams, and birds from impacts from both construction and structural impediments. "To meet the needs of these regulations without slowing down our schedules, we're focusing more attention on how to get projects started more quickly," says Rusch.

ODOT evaluates a variety of concepts that allow for faster construction, he adds. One technique learned from the Webbers Falls project is to use maturity meters during curing of the concrete. They are used to determine the concrete's strength as it cures, which allows forms to be stripped faster while ensuring that the component will function as a structural member. "The meters worked so well that we have used them on several projects since to speed construction."

"We are always looking for ways to build a better mousetrap so bridges can be constructed quicker, more economically, and better," says Allen. Those techniques will be necessary as the Sooner State's bridge program becomes front and center during the next 8 years of aggressive replacement and rehabilitation.

For more information on Oklahoma's bridges, visit www.okladot.state.ok.us.