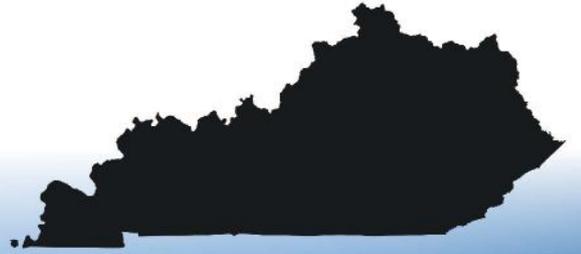


# Kentucky



by Royce Meredith, Kentucky Transportation Cabinet, and Dr. Tony Hunley, Stantec Consulting Services



*This bridge in Scott County, Ky., was among the first bridges replaced as part of the Bridging Kentucky program. All Photos: Kentucky Transportation Cabinet.*

Maintaining and improving Kentucky's inventory of more than 14,000 aging bridges is a big task, which grows larger each year. Like so many other states, Kentucky has had precious few dollars allocated in recent years for major transportation projects. Given the financial constraints, leaders have focused primarily on protecting current assets and investing strategically in key expansion projects. Meanwhile, the state's inventory of smaller bridges that are key connectors but often have limited traffic volumes has been a lower priority. The state is now making a concerted effort to rectify this situation.

## State Program to Address Safety Concerns

As of mid-2018, Kentucky had more than 1000 structures with posted weight restrictions or National Bridge Inventory (NBI) ratings of 4 (poor) or below. About half of these structures have concrete superstructures. Bridges in the state were receiving substandard ratings faster than they could be repaired or replaced. Most of these substandard structures were smaller bridges owned by county governments and other local agencies that could not afford to fix them.

The Kentucky Transportation Cabinet (KYTC) knew that the condition of the bridges was becoming a safety issue that needed to be addressed for the long-term benefit of the state. Enter *Bridging Kentucky*, a six-year, \$700 million program to restore approximately 1000 state and locally owned bridges. Its goal is to

ensure bridges throughout the state are safe and sound for crossings by school buses, emergency vehicles, and commercial traffic.

The program, launched in 2018, is providing significant savings for Kentucky and allowing the state to restore, on average, three to four times as many bridges as it previously would have in a typical year. In the first year of the program, the rate of design and delivery has been about six times the normal pace. To date, Kentucky has awarded \$79.8 million in construction contracts for 139 bridges (realizing a savings of about 23% compared to the budget for these projects), with a goal of delivering more than 400 program bridges to construction phase through the end of fiscal year 2020 (June 30).

## A Programmatic, Rehab-First Approach

To maximize available funding and restore so many bridges in a relatively short period, KYTC knew it needed a new way to address the state's needs. Working with a 22-firm general engineering consultant (GEC) team led by Stantec, QK4 Inc., and AECOM, KYTC set up a bridge-restoration program focused on saving structures and maintaining current assets.

A key element of the Bridging Kentucky program is to reduce project development costs and accelerate delivery of bridges by using innovative approaches and limiting the scope of work for each project. Historically, bridges in Kentucky with significant deterioration and/or load restrictions

were fully replaced and, in many cases, expanded to address nearby roadway deficiencies or accommodate potential future needs.

To stretch program dollars KYTC committed the program to perform only the work that was needed to restore the bridge to an NBI rating of 7 or above and an appropriate load rating (44 tons for state routes and 40 tons for county routes). The program also set a minimum design service life of 75 years for replacement projects and 30 years for rehabilitation projects and provided exceptions for historic bridges such as covered bridges and some steel truss bridges.

*A Bridging Kentucky project in Kenton County, Ky., added at least 30 years of service life to the bridge by eliminating joints at piers, resurfacing and protecting the deck, rebuilding curbs, and patching abutments and piers. The historic railing was rebuilt and preserved.*





Another view of the Bridging Kentucky repair project in Kenton County, Ky.



A construction crew in Franklin County, Ky., places concrete for the deck of a new concrete bridge that is part of the Bridging Kentucky program.

In cases where full replacements were necessary to accomplish these objectives, KYTC and the program team adopted the goal of generally replacing the existing bridge with a structure of the same size, in the same location, and with the same hydraulic opening. These basic criteria have helped rein in costs and speed up delivery of projects by limiting right-of-way acquisition, additional environmental permitting, and utility relocations.

### Life-Cycle Cost Model

To help determine the right design solution for each bridge, the Bridging Kentucky program team screened each bridge using data already collected by KYTC bridge inspectors, including inspection reports, photos, and notes; NBI ratings; load ratings; element-level condition states; and posting results and notes. This process allowed the team to distinguish potential rehabilitations from replacements. In some cases, the need for major or minor changes

yielded an obvious decision to replace or rehabilitate the bridge, and those bridges moved directly to design to expedite projects.

The remaining bridges underwent a life-cycle cost evaluation to determine the most cost-effective solution. The program team worked with Paul D. Thompson, an internationally recognized expert in transportation asset management, to compare life-cycle costs of rehabilitating versus replacing each of these bridges. The analysis included a deterioration model customized for Kentucky's environment, user costs developed by the program team, and estimated construction costs to restore elements in poor condition. This cost estimate was baselined against similar recent work on Kentucky projects. Through this life-cycle cost analysis for the greater cost advantage, the team found that about 40% of the bridges could be rehabilitated rather than replaced.

### Project Bundling

Another cost-saving and time-saving approach used by the Bridging Kentucky program team has been project bundling, which KYTC and the program team have pursued with input from the Federal Highway Administration (FHWA) Every Day Counts (EDC-5) initiative team. Following an FHWA-supported peer exchange with states such as Ohio, Pennsylvania, and Georgia, KYTC finalized its plans for project bundling. This is the first time that Kentucky had used widespread bundling for bridge construction projects.

KYTC began bundling construction projects in March 2019 and has continued to consolidate projects based on location, scope of work, and project priority. Full bridge replacements and rehabilitation projects with superstructure replacements are grouped together when possible, as are other rehabilitation projects of similar-type structures.

To date, KYTC has awarded a dozen project bundles ranging in size from 2 to 13 bridges per bundle, for a total of 53 bridges. The average

cost savings on these bundled projects has been 12%, with more significant savings seen with the larger bundles.

Kentucky also is using design-build as a delivery method. KYTC recently announced a design-build project to replace 102 bridges in eastern Kentucky. Five teams responded to the request for qualifications, and a design-build team is expected to be selected later in 2019.

### Kentucky's New Standards for Concrete Bridges

Beyond expediting critical bridge projects and providing millions in costs savings, the Bridging Kentucky program has brought an additional benefit to Kentucky as the program team has worked with KYTC bridge engineers to develop new design and repair standards, particularly for concrete bridges. Several of these standards are highlighted here.

#### Prestressed Concrete Box-Beam Bridges

Many of the program bridges to be replaced have short spans, which are well suited for adjacent prestressed concrete box-beam bridges. Designers are specifying concrete decks on all replacement projects to extend the life of the structures and achieve the program's 75-year service-life goal. Adjacent box beams allow for an expedited construction schedule because deck forming is not required. One challenge is that many of the projects cannot be completed using phased construction due to the narrow bridge widths, and often road closure is the only economical option.

#### Specifications for 3-ft-Wide Prestressed Concrete Box Beams

KYTC currently has standard designs and drawings using 4-ft-wide box beams, and these standard drawings allow for an "off-the-shelf" design that can be used by the state and counties for future projects. The program team is expanding the state's standard designs to add



A construction worker assists in placement of a new concrete deck on a bridge in Nelson County, Ky.



*This concrete arch bridge in Louisville, Ky., is among the historic bridges being rehabilitated and restored through the Bridging Kentucky program.*

3-ft-wide box beams. These narrower beams provide two main benefits:

- They allow for custom fits of new superstructures on existing substructures that previously supported concrete, steel, or slab superstructures.
- They can be used on replacement projects to match existing bridge widths, minimizing impacts on right-of-way and utilities and reducing costs.

### Innovative Concrete Repair Methods

In many rehabilitation projects, the team has used innovative processes that reduce overall project costs while meeting the program's 30-year service-life goal. These innovations include:

- Developing an aggressive procedure for concrete patching by surveying industry specialists. This procedure includes removing concrete beyond reinforcing steel, saw cutting repaired edges, using abrasive blast cleaning to create an appropriate surface profile, utilizing self-consolidating concrete and a form-and-pour technique on repairs greater than 1 ft<sup>2</sup>, requiring contractors to perform quality-control testing, and adding a galvanic protection system with embedded galvanic anodes to extend the life of concrete

and protect reinforcing steel from corrosion.

- Resolving the source of water and chloride infiltration by eliminating transverse deck joints on superstructure rehabilitation and replacement projects. Additional measures include retrofitting deck drains to deflect water away from girders and piers and adding drip strips along fascia girders on bridges that have over-the-side drainage.
- Proactively preserving new and existing concrete surfaces from water and chloride infiltration by sealing repaired substructure concrete on rehabilitation projects with a high-quality epoxy-coating system and treating concrete decks with silane sealers.

### Superstructure Strengthening

When possible, the team is strengthening concrete bridges to meet program goals. This has primarily been achieved by adding structural concrete overlays to achieve composite action of conventionally reinforced concrete or prestressed concrete girder bridges and by using carbon-fiber wrap systems to strengthen conventionally reinforced concrete girders.

### Looking to the Future

By the end of fiscal year 2020, KYTC plans to have designed projects and awarded

construction contracts for more than 450 of the 1000 bridges being restored through the Bridging Kentucky initiative. However, much work remains to keep the program on track.

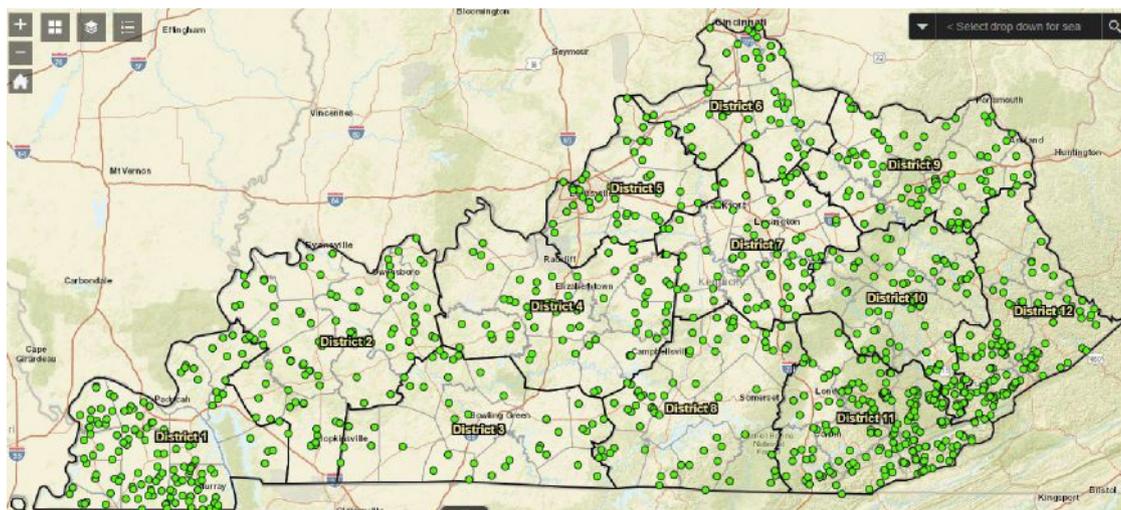
Since the program's inception, about 160 more bridges in Kentucky have been load posted or closed by the state's bridge engineers due to unsafe conditions. KYTC is preparing its transportation budget and road plan for fiscal year 2021–2022, which starts in July 2020. To support Kentucky's data-driven approach to planning, the program team currently is using the life-cycle cost model it developed to screen the additional bridges and reprioritizing its list of remaining bridges to help KYTC and state leaders determine which bridges should be restored next and included in the road plan for the next two years.

The program team will repeat this process in two years, bringing additional value to a program that already is saving Kentucky millions of dollars and fixing bridges that the state needs to maintain a strong transportation system. **A**

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### EDITOR'S NOTE

*For more information on Bridging Kentucky, visit the website at [bridgingkentucky.com](http://bridgingkentucky.com)*



*An overview of all of the bridges included in the Bridging Kentucky program from the program website.*