RESEARCH ADMINISTRATION
Bureau of Field Services
Michigan Department of Transportation

Research Spotlight

Ready-to-use designs help local agencies build cost-effective, quality bridges

MDOT has developed four ready-to-use bridge designs to assist counties, cities and villages that face expensive bridge replacement projects. Local agencies and their consultants are being encouraged to review the design guides and templates for the four bridge types, consider life-cycle costs and long-term service projections of the designs, and tailor plans to local site conditions.

Project Information

REPORT NAME: Development of Secondary Route Bridge Design Plan Guides

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TOTAL COST: $219,974

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Problem

Of the nearly 6,500 bridges in Michigan that are owned by local agencies, about 1,000 have been assessed as structurally deficient and in need of replacement. Some of the villages, cities and counties that own these bridges lack experience in bridge design, and often turn to MDOT plans and design guides for guidance. These designs, however, usually address larger structures with higher traffic volumes than local agencies require, and the plans for larger, more expensive bridges do not always fit local needs. Local agencies may then look at designs based on previously built bridges of their own, which may not be cost-effective in terms of design, durability and lifetime costs. The results have been a wide variety of bridge types and performance quality, and increased design and construction uncertainties for local agencies and contractors.

MDOT has developed plans for four styles of rural bridges that will expedite the design and construction of cost-effective replacements for locally owned bridges that have deteriorated.

Research

MDOT worked with researchers from Wayne State University to examine bridge

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> *"These plans will assist local agencies and their consultants with selecting and constructing some of the most cost-effective bridge designs that are out there right now. Anything we can do to streamline the process will help local agencies stretch their budgets."*
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> **Keith Cooper, P.E.**
> Project Manager

design practices around the state; consult with stakeholders, including local agencies and their consultants; and develop a set of bridge designs specifically suited to smaller agencies and low-volume roads.

Researchers conducted a literature review to identify potential bridge types for plan development. They considered existing bridge plans, reviewed MDOT research, and analyzed the local agency bridge inventory. The team identified 12 potential bridge concepts and presented them to MDOT bridge engineers and a panel of local agency representatives, consultants, contractors, and steel and prestressed concrete fabricators. The team collected input from the panel and from a survey of bridge conference attendees.

Researchers narrowed the pool of design concepts down to four bridge types. After creating designs for these four types, the team conducted a detailed life-cycle cost analysis for each, considering costs and timing of initial construction, inspection, repair and maintenance, demolition, and replacement, as well as road user costs. The research team then refined the designs to balance economy and constructability, and developed four sets of plans ready for use by local agencies.

Results

Researchers found that the bridges managed by local agencies in Michigan are 86 percent rural, and more than 60 percent of these bridges have average daily traffic volumes of fewer than 1,000 vehicles. More than half were built between 1961 and 2000, and 83 percent are no greater than 60 feet in length.

Researchers and stakeholders agreed that galvanized steel, spread box beam, side-by-side box beam, and spread bulb-tee structures were the most viable bridge types for plan development. They determined that plans should be provided in three widths (30, 34 and 40 feet) suitable for lower traffic volumes, with spans from 20 to 110 feet and skew angles from zero to 30 degrees. Life-cycle cost analysis established similar trends in initial and life-cycle costs for all four bridge types, with galvanized steel beam bridges generally the most expensive. Researchers determined that steel-girder bridges were suitable for spans up to about 60 feet, and bulb-tee bridges for spans greater than 70 feet. Box beam bridges were appropriate throughout the range of span lengths considered.

Researchers developed detailed plans for each of the four bridge types in the selected widths, span lengths and skews. Guides, plans and procedures will be available from MDOT in AutoCAD and MicroStation formats.

Value

By using these plans to replace deteriorating bridges, local agencies can optimize costs with savings in design, construction and maintenance over the lifetime of the new bridges. The plans will also help local agencies meet Federal Highway Administration directives for quality control and assurance. Over time, these designs will become increasingly familiar to local agencies and their contractors, reducing design and construction uncertainties, further reducing construction costs and improving bridge quality.

MDOT is leading an outreach effort to build awareness and encourage local agencies to take advantage of the bridge designs. This research was presented at the 2018 Michigan Bridge Conference, which is attended by bridge engineers from agencies across the state. Local agencies and design consultants will be notified when the plans and guides are posted on the Local Agency Bridge Program website.

Research Administration

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