



Revised design standards for prefabricated single-span bridges give counties options for bridge needs around the state.

RESEARCH SOLUTIONS

Increasing design options with revised standards for single-span prefabricated bridges

Prefabricated concrete box beams provide a fast and simple way to construct single-span bridges. Design standards developed in 2016 are widely applicable to county roads in Iowa. As implementation of the standards began, however, some fabricators encountered an obstacle in the casting process. A design alternative to address the issue needed to be incorporated into the standards. In addition, a new software platform required that the computer-aided design and drafting (CADD) files be transitioned to the new system. This project accomplished both tasks, and the updated standards are now available for county use.

THE NEED

Prefabricated concrete box beams for single-span bridges provide a significant benefit to Iowa counties. Construction is accelerated, and smaller equipment can be used to place the beams, which are positioned side by side to create the roadway and eliminate the need for a bridge deck. Additionally, the fabrication process includes robust quality control.

Iowa DOT developed design standards for single-span prefabricated bridges in 2016. Applicable to span lengths from 30 to 70 feet and roadway widths from 24 to 30 feet, the design is ideal for numerous small creek crossings around the state. Precast concrete beams are embedded with steel reinforcements. The standard included pretensioned wire strands in the top of the beam. Concrete is

cast around a stretched strand that is gradually released once the concrete is cured, causing the concrete to compress and strengthen.

After Iowa DOT secured a federal grant to implement the standards on up to 14 bridges across the state, a precast fabricator requested the top tensioning strand be eliminated because the fabricator's tensioning beds and formwork could not



“We’ve revised the short-span prefabricated bridge standards based on lessons learned in using the previous versions of the standards and converted the design files to our new software. The new standards are posted and ready to use.”

— JAMES HAUBER,
Iowa DOT Chief Structural Engineer

accommodate the forces created by the top strand. The fabricator and Iowa DOT developed effective modifications at the time, but the solution needed to be incorporated into the design standards.

Additionally, a change in the software platform used to maintain the CADD files necessitated a transition of the standards to the new platform. The needed design change and new software platform prompted Iowa DOT to revise the design standards for single-span prefabricated bridges.

PROJECT APPROACH

Investigators first converted the existing bridge standard files to the new program software. Originally, the standards were developed using MicroStation V8i software; the agency has since converted to the MicroStation CONNECT platform. Numerous formatting changes, including text, symbols, and dimensions, needed manual input. The size of the plan sheets also changed, which required the detail components to be manually rearranged to fit the new format. A careful review ensured the CADD file changes were correct and nothing was deleted.

To provide a design option that eliminated the top fully tensioned prestressing strand, investigators analyzed other mechanisms and design characteristics that would meet

AASHTO specifications for beam tension.

WHAT IOWA LEARNED

The short-span standards for single-span prefabricated bridges were successfully updated to provide an alternative design for fabricators unable to accommodate the fully tensioned top strand. The revised standards, in addition to the original design that was retained, were accurately converted to the new software platform.

The alternative design eliminates the fully tensioned prestressing strands in the top of the box beams. Calculations revealed the amount of mild reinforcing steel — or rebar — that could be substituted in beams for all relevant span sizes. The design also used prestressing strands in which concrete is not bonded at the strand ends in the beam’s bottom flange. Together with the partially debonded prestressing strand, tapered Styrofoam forms for the beam voids controlled top tension and flange cracking near the beam’s end.

The alternative design eliminating the fully tensioned top strands required 18 new drawings. In addition, modifications were made to an existing drawing for the 24- and 30-foot roadway standards. Researchers also considered another design amendment involving a new configuration of the keyway (the area between adjoining beams).

Incorporating this change, however, would have required reanalyzing the design of the box beams.

PUTTING IT TO WORK

The [County Bridge Standards](#) are available on Iowa DOT’s website. The agency will observe implementation of these revisions before making further design changes.

ABOUT THIS PROJECT

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