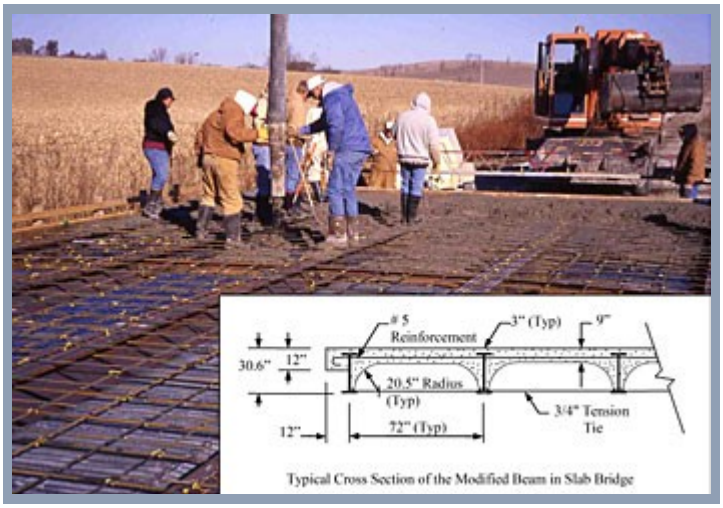
TECH NEWS
TECHNOLOGY NEWS

January-February 2005

Building bridges with long spans on low-volume roads

A new alternative bridge design for low-volume roads—the modified beam-in-slab bridge (MBISB)—accommodates spans up to 80 feet. It can be built by county crews with minimal equipment and at lower cost than conventional designs for similar applications.



Tama County bridge under construction. Inset: Typical cross-section of the modified beam-in-slab bridge.

Existing system

The original beam-in-slab bridge (BISB) design was developed about 30 years ago by former Benton County Engineer Jerry Petermeier.

This design consists of W sections spaced on 24-inch centers. Unreinforced concrete is placed between the beams to form the deck. The deck concrete is struck evenly with the top beam flanges to eliminate the need for additional formwork.

Field and lab tests have determined, however, that while the BISB system is adequate for spans up to 50 ft, it wouldn't work as well for longer bridge spans.

Above are two other Tama County modified beam-in-slab demonstration bridges.

Modifications

Recently, researchers with ISU's Bridge Engineering Center (BEC) collaborated with the Tama County Engineer Lyle Brehm to modify the BISB design to increase applicable span lengths. The project was sponsored by the Iowa Highway Research Board (TR-467).

Two modifications were introduced:

Alternative shear connector. The first modification was to use an alternative shear connector (ASC) to develop composite action between the steel beams and the concrete deck.

The ASC consists of holes that are torched or drilled in the web of the girder. Reinforcement is placed through every fifth hole to confine the deck concrete in the holes. This forms a mechanical connection between the two materials.

With the resulting composite action, the concrete deck contributes to the strength and stiffness of the bridge and reduces the amount of material required.

Transverse arches. The second modification was to reduce the self-weight of the system by incorporating a transverse arch that rests on the bottom flange of the longitudinal beams.

A reusable, custom-rolled formwork system, made of corrugated metal, forms the arched deck. Due to the arching action in the deck, the amount of reinforcement required is reduced to that required to complete the ASC and provide crack control.

Both modifications were tested by constructing and loading to failure a full-scale, 30.5-foot long by 20-foot wide model bridge. Results indicated that the modifications made it possible for the system to be used in spans in excess of 50 ft.

Field tests

Tama County road crews constructed two demonstration MBISBs. The first bridge (50 feet long by 31 feet wide) is similar to the original BISB design but incorporates both modifications.

The second bridge (70 feet long by 32 feet wide) is somewhat similar to a typical steel beam/concrete deck bridge. It has six W27x129 beams on 72-inch centers. The cast-in-place transverse arched deck forms the driving surface, and the ASCs provide the composite action.

Field tests by ISU researchers determined that both structures have more than enough capacity to resist legal loads.

Each MBISB realized a cost savings of about 20 percent compared to conventional bridge designs.

Other designs

To help other agencies implement MBISBs on low-volume roads, researchers also developed designs for nine different lengths and five different beam spaces, as well as a generic set of construction plans.

For more information

Contact

- Travis Konda, graduate research assistant, 515-294-8838, tkonda@iastate.edu;
- Terry Wipf, professor of civil engineering at ISU, 515-294-6979, wipf@iastate.edu;
- Wayne Klaiber, professor of civil engineering at ISU, 515-294-8763, klaiber@iastate.edu; or
- Lyle Brehm, Tama County engineer, 641-484-3341, tamaeng@pcpartner.net.

Also see the BEC website, bec.iastate.edu/.