

Building steel beam precast unit bridges

This article is the second of three exploring low-cost bridge replacement alternatives.

HELPING COUNTIES find ways to cost-effectively replace and repair bridges has been an objective of several studies conducted by Iowa State University researchers Wayne Klaiber and Terry Wipf, both professors of civil and construction engineering. In their mid-1990s evaluation of bridge replacement alternatives for Iowa's county bridge system (Iowa DOT project HR-365), Klaiber and Wipf learned that 69 percent of Iowa counties had staff who were willing and able to design and construct fairly simple short span bridges (i.e., 40 feet or less).

Since that study, Klaiber and Wipf have supervised laboratory testing of a couple of alternatives and field tested one of them; both bridge replacement

alternatives are primarily for low-volume roads. The method described in this article involves fabricating precast units made from two steel beams connected by a concrete slab. The precast units can be made by county workers and then

transported to the bridge site where they are connected and the remaining portion of the deck is placed.

Overview of steel beam precast units

The steel beam precast units can be constructed at a county shop. Either new or used steel beams may be used in the construction. Two beams are connected by a reinforced concrete deck four or five inches thick. The limited thickness keeps the weight of the precast unit manageable.

The number of precast units fabricated depends on the desired width of the bridge. Once the units are connected, a cast-in-place (CIP) reinforced concrete deck is placed and the bridge railing is attached.

The research

The researchers conducted laboratory "handling tests" to determine if the units were strong enough to resist the handling loads imposed on them during construction and transportation. They found that if the portland cement concrete is given enough time to cure, there should be no distress from lifting, transporting, or placing the units. (In the Black Hawk County demonstration bridge, the slabs were allowed to cure for 21 days.)

The research team also conducted tests of the connectors between the individual units, and found

that they have adequate strength to resist highway loads.

Demonstration bridge

A 64-foot long, 30-foot wide demonstration bridge was constructed in Black Hawk County in 1998 using four, steel beam precast units. The units were made by the research team



The Black Hawk County bridge crew worked with researchers to build the precast units (left). Below is an overhead view of the units. Photos courtesy of Wayne Klaiber.



and the county bridge crew. The demonstration bridge was a replacement structure.

The bridge took about two months to build, says Mike Kindischi, a technician with Black Hawk County, which is about the same construction time as other types of replacement bridges. The total time included removing the old structure, building abutments, and building the precast units.

Cost estimates are subjective for this project because there was a lot of design time since it was a research project, Kindschi says. Nevertheless he believes that, depending on the bridge span, this type of replacement bridge can be built by a county crew for less than \$50,000. Some of the work, such as guardrail and dirt work, could be let to make sure the costs stay under \$50,000, he says.

Dennis Edgar, currently assistant county engineer of Fayette County and former assistant county engineer of Black Hawk County, says the steel beam precast unit bridge "is a competitive alternative to concrete slab bridges." He sees it filling a niche between precast quad-T type bridges, which are available commercially, and concrete slab bridges.

Advantages

The steel beam precast unit bridge has several advantages:

- It can be used in simply supported spans up to 85 feet.
- Minimum field form work is required, which reduces the amount of time the road is closed; thus, inconvenience to the public is also minimized.
- Salvaged steel beams can be used, significantly reducing the materials costs (about \$27,000 was spent on new steel beams for the Black Hawk County bridge).
- Various types of abutments may be used.
- Standard construction methods are used.
- It can be constructed with a limited staff.
- If a county has the room, the precast units could be built inside during the winter.

Kindischi points out that the steel beam precast unit bridge has better hydraulics because it is a single

span structure; there are no piers to constrict flow or catch debris. Erecting the bridge in the field "is much quicker," he says. A single-span concrete beam bridge would be much more expensive and would require that the entire deck be formed and cured.

A couple of slight disadvantages Kindischi sees are the needs for a certified welder and special welding equipment for part of the construction and for large equipment to transport the slabs and move them into position.

Edgar sees a disadvantage in the two- to three-foot thickness of the beam and deck: The road grade has to be raised to accommodate the flood clearance level and the height of the bridge deck.

For more information

A slide show and video have been prepared of the steel beam precast unit bridge construction process. To obtain a copy of the final research report,

Investigation of Two Bridge Alternatives for Low-Volume Roads—Phase II: Concept I: Steel Beam Precast Units (Iowa Highway Research Board project TR-410), contact Mark Dunn, Iowa DOT research engineer, 515-239-1447.

For information about Iowa's research, contact Wayne Klaiber, 515-294-8763, klaiber@iastate.edu, or Terry Wipf, 515-294-6979, wipf@iastate.edu. For information about the Black Hawk County bridge, contact Mike Kindschi, 319-833-3008, or Dennis Edgar, 319-422-3552. •



The precast units were set in place quickly.