CONCRETE BRIDGE SURVIVES CRASH TO RISE AGAIN

by Wayne A. Endicott

After a backhoe ripped through the Hays, Kansas, bridge, the damaged span was repaired with cast-in-place concrete to reopen the roadway in just six months

February 13, 2006, might not have been a Friday, but it was unlucky for the Hall Street Bridge just outside Hays, Kansas. That's when the arm of a backhoe being transported on a low-boy trailer eastbound along the interstate below inexplicably raised up and smashed through the concrete span, severely damaging it. The good news? The damaged portion of the bridge was replaced in less than six months with a cast-in-place box girder.

The Hall Street Bridge is a four-span, cast-in-place, three-cell, reinforced concrete box girder bridge. The cross section is 4-1/2 ft deep with 6- to 10-in.-thick webs spaced at 8 ft on center. The top and bottom slabs are 8 and 6 in. thick, respectively. The total length of the bridge is 268.5 ft.

The impact forced the bridge to be closed, as the backhoe's arm remained wedged tightly in the shattered concrete. Even more critical to transportation in the area, I-70 eastbound had to be closed while damage was assessed and a plan was devised for removing the backhoe and damaged portions of the bridge. That created a detour onto the U.S. 183 bypass that officials wanted to minimize.

Almost immediately, a team of engineers was dispatched to the site in northwest Kansas to devise a plan to repair the bridge and get it back into service. The team, comprising Edward Burdiek, Clemens Boos, and Daniel Crosland of the Kansas Department of Transportation (KDOT) Bridge Management Section and Stephen Burnett of KDOT's Bridge Design Section, arrived the next day and began their assessment of the situation.

"We found that the two most western webs of the bridge were completely destroyed for a length of 6 ft and that

profile

HALL STREET BRIDGE / HAYS, KANSAS
ENGINEER Kansas DOT
PRIME CONTRACTOR King Construction Inc., Hesston, Kan. (Demolition and new construction)
CONCRETE SUPPLIER Apac Inc., Hays, Kan.
REINFORCEMENT SUPPLIER Sheffield Steel, Kansas City, Kan.

Kansas DOT crews moved quickly to prop up the damaged bridge in Hays, Kansas. The central column of the bridge, which spans I-70 near the west-central Kansas town, was undamaged by the impact with the backhoe.

the bottom half of the east web was destroyed for a length of 12 ft," reports Burnett. "The remaining interior web was somewhat obscured by the rubble, but while it seemed to be intact, it exhibited several shear cracks."

Also destroyed were a 6 ft width of the bridge deck and the bottom slab of the box girder stretching from the west edge to the face of the remaining intact interior web. Additional damage was observed in the bottom slab along the east half of the bridge. The boom of the backhoe had caused spalling in the concrete on the bottom slab and reinforcing steel had been ripped out of the slab.

Almost immediately, King Construction's crews began removing the damaged portion of the bridge.

No Sign of Sag

Despite the observed damage, the bridge showed little sign of sag along the rails, and then only at the impact area. Also, there were no new cracks in the bridge's piers. Within hours, KDOT supplied Super Props to stabilize the damaged bridge. The four Super Props were installed under each web to support the weight of the now almost suspended portion of the superstructure so that the backhoe could be removed.

By Wednesday, the boom and the backhoe were removed and a closer

BOX GIRDER BRIDGE/KANSAS DOT, OWNER

BRIDGE DESCRIPTION A four-span continuous, 268.5-ft-long, three-cell, cast-in-place, reinforced concrete bridge that spans a 28-ft-wide roadway

STRUCTURAL COMPONENTS A 45-ft-long cast-in-place box section replacement in a 76-ft-long span

CONSTRUCTION COST $625,000 (including $134,000 for demolition)

inspection was made. This inspection showed that the remaining intact web was also cracked. The team, consisting of, KDOT area personnel, district personnel, and headquarters personnel, with advice from bridge construction personnel and insurance company personnel, created their plan for reopening the bridge. Their decision was to remove the damaged span and rebuild with the same cast-in-place concrete design of the original structure. In fact, the contractor selected for the job was the same as the firm that originally built the bridge in 1964, King Construction Inc. of Hesston, Kansas.

The first step was to remove the damaged section of the bridge. King Construction crews stabilized the bridge and removed the damaged portion one week after the accident, completing those tasks in just four days. That left a 45-ft-long hole in the bridge. The team determined that the

Demolition crews left 3 ft or more of reinforcement exposed to allow splicing of new reinforcement.

Scaffolding supported the forms while a new concrete box girder was cast to replace the missing damaged bridge section.

The new section of the Hays bridge is nearly indistinguishable from the original portions of the structure. The bridge was reopened to traffic in less than six months after the accident.

damaged bridge could be safely repaired, since the single 4 1/2-ft-diameter column in the median remained undamaged.

It was decided to replace the section using the same construction as the original structure rather than try to widen the bridge during this rapid replacement project. This required casting a three-cell concrete box. To tie the new section into the existing construction, the demolition crew left 3 ft or more of the existing reinforcing bars exposed on either side of the opening. This exposed reinforcement was then lap-spliced with Grade 60 uncoated steel reinforcement. A new box-girder section then was cast in place.

"We considered several alternatives for replacing the damaged portion," explains Burnett, "but we felt that using a cast-in-place concrete box section was the most expedient and also promised the greatest long-term durability." Using the concrete box section also meant that the appearance of the repaired bridge is virtually unchanged, allowing this unusual (and hopefully unique) accident to fade into memory.

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