The finished bridge has 18 spans with simple pretensioned concrete beams and 17 spans with post-tensioned spliced girders.

DEEP SPLICED GIRDERS SAVE TOLLWAY $8 MILLION
by Daniel C. Brown

DES PLAINES RIVER VALLEY BRIDGE ON I-355 / LEMONT, ILLINOIS
ENGINEER: Janssen & Spaans Engineering Inc., Indianapolis, Ind.
PRIME CONTRACTOR: Walsh Construction Group, Chicago, Ill.
PRECASTER: Prestress Engineering Corp., Prairie Grove, Ill., a PCI-Certified Producer
SECONDARY GIRDER PRECASTER: Prestress Services, Decatur, Ind., a PCI-Certified Producer
Bridges like this one don’t come along very often. The 1.3-mile-long Des Plaines River Valley (DPRV) Bridge on I-355 near the Chicago suburb of Lemont, Illinois, is the state’s first to use post-tensioned, precast, prestressed concrete spliced bulb-tee girders. Its success means that it also won’t be the last.

Opened last November, the DPRV Bridge combines the use of post-tensioned spliced bulb-tee concrete girders and pretensioned concrete bulb-tee girders. The post-tensioned spliced girder span lengths range from 216 to 270 ft, while the pretensioned concrete girders have span lengths ranging from 114 to 170 ft.

Officials at the Illinois State Toll Highway Authority (Tollway) had originally designed the bridge in two other configurations: a steel plate-girder bridge and a segmental concrete box-girder structure. “Shortly before the project was advertised for bids, there was a lot of fluctuation in material prices, especially steel,” says Paul Kovacs, Chief Engineer for the Tollway.

“Not only did the performance specification allow us to mitigate the price fluctuations and save money, it gave the contractor the flexibility to build what he was comfortable with, and saved us 6 to 8 months in design,” says Colin Makin, the Tollway’s Deputy Program Manager for Bridges.

Indeed, the Walsh-Janssen team was awarded the contract in December 2005, before design was complete. By

Creating a performance specification cut costs, created flexibility, and saved 6 to 8 months.
Each side of the bridge has six beam lines.

Two cranes prepare to place a drop-in segment. A strong-back is located at the right-hand end of the beam being lifted.

the following March, the contractor had begun drilling foundation caissons. Meanwhile, Janssen & Spaans finished superstructure design. The DPRV Bridge spans over two canals, several railroad lines, two local roads, the Des Plaines River, and forest preserve land.

The bridge has a total of 34 piers and 35 spans. The bridge features 18 pretensioned concrete spans and 17 post-tensioned spans. The tallest pier cap is 82 ft above grade, with the bridge deck rising to 90 ft at the highest point.

The simple spans at the DPRV Bridge are made continuous with closure pours over their pier caps. “Over the piers, there’s about a 1-ft-wide gap between the ends of the bulb-tee girders,” says Brian Slagle, Vice President at Janssen & Spaans. “Reinforcing steel protrudes from the ends of the beams into the gap. And when you cast the deck and make the closure you lock the beams in at that point, establishing continuity. There are no joints at the piers.”

A typical simple-span prestressed concrete girder is a 90-in.-deep bulb tee, with a top flange width of 4 ft 11 in., a web width of 6 in., and a bottom flange width of 24 in. The typical post-tensioned bulb-tee girder is 102 in. deep with a top flange width of 5 ft 1 in. and a bottom flange width of 26 in.

“We haunched the girders on the 270-ft-long spans,” Slagle explains. “We
made the typical girder 102 in. deep, but it’s haunched to 120 in. over the piers, where you get maximum negative moment.” Typically, each haunched girder was made in 120-ft lengths, but one was 138 ft long.

**Falsework Supports Beams**

For the post-tensioned spans, Walsh used falsework to support one end of the beams during erection, so that the beam rested on both a pier and the falsework. Two beams would extend toward each other, leaving space between for a drop-in segment with a length varying between 124 and 150 ft. The drop-in segment was lifted with a crane at each end. A temporary strongback was clamped to each end of the drop-in segment to provide an overhang that rested on the adjoining beam end.

“The strong-backs supported the beam in place, after which we could release the cranes,” said Slagle.

Once the girder was released from the crane, the contractor connected the post-tensioning ducts between the beam ends. Formwork then was placed, and the closure pour was made. “There’s a nominal 1-ft gap at the splice,” said Slagle. “We coupled the ductwork, set all the reinforcement and formwork, and then made the closure placements across all six beam lines at once. That way, the closure acted as a monolithic diaphragm.”

Once the concrete in the closure reached 5000 psi compressive strength, the post-tensioning contractor installed the strand and tensioned it with hydraulic jacks. Each girder had four ducts for...
the post-tensioning strand, explains Slagle. “Generally speaking, the ducts are arranged to be high over the piers and low at mid-span—points where the beam is in tension.”

Ongoing construction of the piers.

“We had to purchase seven additional acres,” says Terry Muntz, Vice President of Operations at PEC’s Blackstone, Illinois, plant. “Half of the land went for storage of product and the other half was used to build the two casting beds.” Each casting bed is 400 ft long by 20 ft wide by 10 ft deep.

The prairie winds blow strongly in Blackstone, so PEC built the beds in-ground to help keep the concrete warm during casting. The in-ground casting beds also permitted PEC to use shorter travel lifts. “This way we only had to lift the product the height of the beams before we could carry them,” says Muntz. “If we had a 10-ft-high form and a 10-ft-deep beam, we’d need to lift the beams to a point 20 ft above ground.”

Training the new employees was the biggest challenge, he adds. They also had to create a new safety plan to deal with the larger beams. The largest beams the company had previously cast were 72 in. deep, and the deepest beams at the DPRV Bridge were 120 in. deep.

New Forms Created

The $24-million contract for the precast, prestressed concrete girders produced the largest-ever contract for Prestress Engineering Corp. (PEC), which is Illinois’ largest precast concrete bridge supplier. To handle the order, the precaster built two in-ground casting beds in 5 months, bought three beam forms, doubled its workforce to 200 people, and purchased eight 10-axle trailers.

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Tollway officials take justifiable pride in their new bridge. “This bridge provides a great benefit to the driving public,” said Lis Henderson, a spokesperson for the Tollway.

For more information on this or other projects, visit www.aspirebridge.org.

Minimal Environmental Impact

The spliced girder design allowed the Tollway to use spans long enough to minimize the bridge’s impact on the wetlands through which it passes. The bridge and its construction had to meet environmental requirements set by the U.S. Army Corps of Engineers, the Illinois Department of Natural Resources, the Illinois EPA, and the U.S. Fish & Wildlife Service.

“This design allowed us to come in under the wetland acreages that we could impact on both a temporary and permanent basis,” says Paul Kovacs, Chief Engineer for the Tollway. “We were able to affect only 8.77 acres during construction and only 3.87 acres permanently. We built 34 piers, and 16 of those are in wetland areas.”

Protected Species

Believe it or not, a rare dragonfly helped influence the design of the DPRV Bridge. The area around the bridge serves as habitat for the Hine’s Emerald Dragonfly, which was listed as an endangered species in 1995.

“The Hine’s Emerald Dragonfly is one of the reasons the bridge was built as high as it is,” says Kovacs. “We identified the dragonfly and studied its habitat. So we built the bridge 10 ft higher to keep cars out of the path of the dragonfly.” At its highest point, the bridge is 90 ft above grade.

The area is also inhabited by the Blanding’s Turtle, which needs to be protected. Colin Makin, the Tollway’s Deputy Program Manager for Bridges, said the turtles have been found and fitted with electronic locators. If a Blanding’s turtle roamed too close to the construction area, a group of environmentalists would pick up the turtle and relocate it.
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Photos: Illinois State Toll Highway Authority.
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