

PROJECT

I-69 Twin Bridges over the Patoka River

Many challenges overcome for longest bridge on longest new section of interstate

by Samuel Sarvis, Indiana Department of Transportation

Building the longest bridge on the nation's longest continuous section of new interstate highway in an environmentally sensitive area, all on an accelerated schedule, posed a special set of challenges. Add in variable rock depth in a seismic zone and months of sustained flooding, among other construction challenges, and the Interstate 69 (I-69) Twin Bridges over the Patoka River has proven a unique project.

The new stretch of I-69 between Indianapolis and Evansville, Ind., is widely regarded as a key component to the future economic vitality of southwestern Indiana, and will connect an entire region with improved access to jobs, education, and healthcare. A vision discussed for decades culminated in the 2003 Tier 1 Final Environmental Impact Statement, which was approved by the Federal Highway Administration with a 2004 Record of Decision.

Environmental, Historic Context

As part of the project's environmental commitments, the Indiana Department of Transportation (INDOT) agreed to span the entire 4400-ft-wide floodplain at the Patoka River National Wildlife Refuge and Management Area. At nearly a mile long, the bridge would be unique outside of coastal areas or navigable river crossings.



As the seasons changed, so too did the I-69 Bridges over the Patoka River floodplain as shown from the same elevated position in late August, mid-October and late November of 2012. Photos: Bernardin Lochmueller & Associates.

profile

I-69 TWIN BRIDGES OVER THE PATOKA RIVER / PIKE-GIBSON COUNTY LINE, IND.

BRIDGE DESIGN ENGINEER: Janssen & Spaans Engineering Inc., Indianapolis, Ind.

OTHER CONSULTANTS: Parsons Brinckerhoff, Indianapolis, Ind.

PRIME CONTRACTOR: Kokosing Construction Company, Columbus, Ohio

CONCRETE SUPPLIER: Irving Materials Inc., Petersburg and Fort Branch, Ind.

PRECASTER: Prestress Services Industries LLC, Lexington, Ky., a PCI-certified producer

The wildlife refuge encompasses wetlands and forest along 30 miles of the Patoka River in Pike and Gibson Counties in southwestern Indiana. The 6600-acre refuge preserves bottomland hardwood forests and is home to 380 wildlife species, including a large nesting colony for the Interior Least Tern. In addition, the bridge passes through the Patoka Bridges Historic District, which is listed in the National Register of Historic Places.

Numerous steps were taken by the project team to preserve environmental and historic resources and mitigate any impacts. Project impacts to wetlands and upland forests were mitigated above the required ratio in part by purchasing land along the bridge, which became a part of the efforts to expand the refuge. INDOT also committed matching funds for rehabilitation of historic Pike County Bridges Nos. 246 and 81, and to provide a visual buffer of trees.

From the Ground Up

In 2009, former Indiana Governor Mitch Daniels accelerated construction for 67 miles of I-69, taking advantage of recession construction prices with funding from the 2006 lease of the Indiana Toll Road. INDOT let a design-build contract for the I-69 Twin Bridges over the Patoka River in October 2010.

In an effort to minimize impacts to the wildlife refuge, designers eschewed the normal foundations for the 118 piers in favor of two drilled shafts per pier. The pier caps were 40-ft-wide by 5-ft 9-in.-thick by 4-ft 6-in.-tall supported on two 4-ft 6-in.-diameter round columns that were continuous into 6- to 7-ft-diameter drilled shafts. None of the piers, which ranged in height from 15 to 19 ft above ground, were built within the river itself, fully eliminating the need for cofferdams. Geotechnical and construction crews discovered that the soft soils that line the flood plain range in depth from 45 to 80 ft. The

depth of the drilled shafts ranged from approximately 60 to 100 ft.

“Along that length there’s great variation in what we found, even with the northbound and southbound bridges right next to each other,” said Jared Spaans of Janssen & Spaans Engineering.

During construction, the contractor was permitted to build a causeway of stone to carry construction equipment across the river. The water flow was channeled through large metal pipes. However, sustained floods from November 2011 to February 2012 suspended construction and geotechnical surveys for the bridge, which was scheduled to open in November 2012.

“All of a sudden we woke up in April, 2012, having barely even started, and discovered we had twice the amount of rock drilling ahead of us,” said Tom Graf, assistant vice president of Kokosing Construction.

The varying foundation depth changed each pier’s response during an earthquake, requiring individualized analysis and detailing.

But it wasn’t just the drilling depth that posed a challenge in designing and building the foundations. Much of southwest Indiana is located within the Wabash Valley seismic zone, which produced a magnitude 5.4 earthquake in April 2008. The varying foundation depth changed each pier’s response during an earthquake, requiring individualized analysis and detailing. In addition, seismic restrainers



The I-69 Twin Bridges over the Patoka River as seen from air during construction in June 2012. Photo: Indiana Department of Transportation.

were installed in the deck to prevent unseating of units at the expansion joints.

Superstructure

The design-build contractors were given the option of using concrete or steel beams, and the contractor chose concrete beams. If laid end to end, the beams used to build the first 67 miles of the I-69 extension would circle the 2.5-mile-long track at the Indianapolis Motor Speedway more than nine times, thanks in large part to the 244 beams needed for the twin 4400-ft-long Patoka River bridges.

As a result of a horizontal curve, the southbound structure of the twin bridges has 31 spans while the northbound structure has 30. Span lengths ranged from 140 to 154 ft with beams spaced at 11 ft 4 in. centers. For each structure, the 43-ft-wide

INDIANA DEPARTMENT OF TRANSPORTATION AND FEDERAL HIGHWAY ADMINISTRATION, OWNERS

BRIDGE DESCRIPTION: Twin, 4400-ft-long, concrete bulb-tee bridges

STRUCTURAL COMPONENTS: 244 precast concrete bulb-tee girders with an 8-in.-thick, cast-in-place concrete deck and cast-in-place pier caps, columns, and drilled shafts

BRIDGE CONSTRUCTION COST: \$40 million

reinforced concrete deck was cast-in-place with a thickness of 8 in. and a specified compressive strength of 4 ksi.

The 7-ft-deep, 5-ft-wide beams (BT84x60) were constructed using a sand-lightweight concrete with a target density of 125 lb/ft³—saving about 20 lb/ft³ compared to normal weight concrete. The beams were made continuous for superimposed dead load and live loads. Four to five spans were made continuous per unit with expansion lengths ranging roughly from 560 to 710 ft as the units varied to avoid certain site features. The beams used 0.6-in.-diameter, 270-ksi, low-relaxation strands, each strand being tensioned to 43.9 kips, or 2019 kips total for the longest girder. The longest girders had 46 strands including eight draped strands. The compressive strength of the concrete in the girders was 8 ksi. A minimum strength of 6 ksi was required at prestressing transfer.

A Journey for Concrete Beams

The largest of the beams weighed 87 tons and measured 154 ft 8 in. in length, which posed special challenges in delivery across the Ohio River and onto the jobsite. INDOT and other Indiana agencies worked closely with the contractors on permitting that



Cranes set concrete beams for the I-69 Twin Bridges over the Patoka River. Photo: Indiana Department of Transportation.

navigated an array of weight and length restrictions. Police halted traffic on the I-64 Sherman Minton Bridge, which carries 80,000 vehicles per day when the large beams crossed. Beams had to be rerouted further still during the five-month closure of the bridge for inspections and structural repairs.

All runoff collected into bridge deck drains runs into plastic pipes along

the beams and then flows into steel containment basins. In these basins, all runoff is filtered through riprap and sand to prevent spills from entering local waterways.

On Schedule

The I-69 Twin Bridges over the Patoka River was the last puzzle piece to fall into place before Governor Daniels opened the new 67 miles of I-69 for business on November 19, 2012, by leading a caravan on his Harley-Davidson motorcycle. A severe drought in the summer of 2012 allowed more fair weather days for construction. This, along with the project team bringing in additional resources, allowed the bridge to open on schedule along with the remaining highway.

“When you’re working over something that long, you don’t realize how many people are out there,” said INDOT project manager Brian Malone. “But when you get to counting, it added up to more than 100 people each day.” 



Concrete is pumped for a deck placement. Photo: Indiana Department of Transportation.

Samuel Sarvis is deputy commissioner for capital program management for the Indiana Department of Transportation.

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