

# Road to Innovation

THE INDIAN RIVER INLET BRIDGE IS THE DELAWARE DOT'S LARGEST PROJECT EVER. BY BROOKE INFUSINO

Civil | DELAWARE DOT: INDIAN RIVER INLET BRIDGE

In Sussex County, Del., perched over the Indian River – an inlet to the Atlantic Ocean – is a concrete bridge that, to the unaware, appears to be a perfectly sound structure. Although the existing Indian River Inlet bridge is safe, severe scouring that has taken place over the years combined with the corrosive action of saltwater on the bridge's steel H-piles eventually will compromise the bridge's safety.

To eliminate the concern over scouring, the Delaware Department of Transportation (DelDOT) embarked on a new replacement cable-stay span bridge over the river. One of the major requirements for the design/build project is for the bridge to span the 500-foot river inlet entirely, eliminating the need to place piers in the water.

In February 2008, DelDOT embarked on the process of narrowing down a short list of design/build contractors to build the Indian River Inlet Bridge. Skanska Southeast was awarded the \$150 million design/build project in August 2008. Of the three proposals received for the project, Skanska had the lowest price, highest technical score and proposed the quickest estimated completion time, Skanska Project Manager Jay Erwin Jr. says.

"This was a more aggressive delivery method in which the contractor was responsible for a portion of the design," Erwin notes. "The design/build procurement process was more aggressive and more economical for the owner."

The existing Indian River Inlet Bridge is monitored to ensure it remains safe while the new bridge is being constructed. Monitoring techniques include yearly visual inspections, underwater dive inspections, annual bathymetric surveys, sonar devices and pier sensors.

## Designing the Structure

The Indian River Inlet Bridge will feature two 240-foot-high towers, or pylons, on each side of the bridge with single plane cable stays. The current Indian River Inlet Bridge has support piers in the inlet and no supporting towers.

"This is the fourth bridge that has been constructed over this inlet since 1934, so it proves that it is a very harsh environment," DelDOT Assistant Project Manager Karen Cormier



» The new Indian River Inlet Bridge in Sussex County, Del., will utilize an innovative wireless monitoring system.

explains. "We had to be very careful with the geological conditions. It's in the middle of a state park and recreational area with tourism and boating going on year-round."

Under the contract, Skanska had to avoid placing any shoring or scaffolding in the water while building the structure. This required the construction of a long-span bridge.

The new bridge also will be 2,600 feet long, including a 900-foot clear span over the inlet, with 1,700 feet of bridge decking over the land. All supports will be out of the water, eliminating the conditions that now exist with the

## Delaware DOT: Indian River Inlet Bridge

[www.deldot.gov](http://www.deldot.gov)

- Project value: \$150 million
- Site: Sussex County, Del.
- Scope: Construction of a 2,600-foot-long cable-stay bridge

"The design build procurement process was more aggressive and more economical for the owner." – Jay Erwin Jr., Skanska PM

» Construction items well under way on the bridge include the falsework towers (support structure for building deck of bridge) and the concrete towers.



existing bridge. The new bridge will have a minimum 100-year design life. The foundations will be supported on 36-inch-square piles, which will be manufactured by Bayshore Concrete Products, a subsidiary of Skanska Southeast. Skanska had used these types of piles on Florida's Escambia Bay I-10 Bridges.

Under the new design, the minimum vertical clearance will increase from the existing 35 feet to 45 feet over the navigational portion of the inlet. The bridge will have two 12-foot-wide travel lanes, a 10-foot-wide outside shoulder and a 4-foot-wide inside shoulder in each direction. Additionally, a 12-foot-wide sidewalk will be accessed from the east side of the bridge.

#### Seeking Public Input

In the design stages of the project, Skanska and DelDOT turned to the public for help in determining some of the architectural and visual

**'The design/build procurement process was more aggressive and economical for the owner.'**

features of the bridge. These include lighting fixtures on the pedestrian walkways, the color of the cable stays, as well as the design for the tops of the pylons. Additionally, one of the most innovative features of the bridge involves

## Monitoring Performance

### University of Delaware researchers produce first-of-its-kind monitoring system for the Indian River Inlet Bridge

The Indian River Inlet Bridge will use a state-of-the-art, first-of-its-kind monitoring and inspection system developed by researchers at the University of Delaware. A \$1.1 million grant from DelDOT will aid in the design and installation of a fiber-optic structural monitoring system.

The system is being designed by a team of professors, including Michael Chajes, Harry (Tripp) Shenton of the University's Department of Civil and Environmental Engineering, and Robert Hunsperger of the Department of Electrical and Computer Engineering.

"The university has been involved with the assessment and evaluation of bridges for a number of years, so when the idea for the new bridge came up, we proposed to DelDOT that we would be the consultant for the design and development of a monitoring system," Shenton says.

According to Shenton, the system includes 119 sensors distributed throughout the structure to measure several different parameters, including strain, temperature, motion, vibration and corrosion. Sensors will be embedded in the concrete deck and pylons at various locations on stay cables, and some will be placed externally on top of the deck. Each sensor is connected with fiber-optic cables, connected to a central monitoring system. Sensors will provide continuous monitoring of the various parameters, and data will be collected intermittently by the university and DelDOT. "We will look at the data collected and provide the DOT with monthly reports and then a more comprehensive annual report," Shenton says.

Until now, bridge monitoring technology in the United States — which received increased attention after the collapse of the I-35 bridge in Minnesota — has been short-term and only takes place on more vulnerable parts of the bridge. Fiber-optic monitoring is commonly used in Europe and Asia, but is only now taking hold in the United States, Shenton notes. "Fiber-optic sensors in systems of this type have been around for a decade, but only recently have they moved from the research arena to the production side," he notes.

The university researchers partnered with Cleveland Electric Labs, the fiber-optic consultant on the project, which will provide the hardware for the system, as well as assist in the installation of the sensors. "The idea is to gather quantitative data on how the bridge is performing so that the owner can better maintain it over its lifetime," Shenton says.

# 'This is the fourth bridge that has been constructed over this inlet since 1984.'

incorporating a fiber-optic structural monitoring system. Working with the University of Delaware's Department of Civil and Environmental Engineering, DelDOT will be able to measure the long-term performance of the structure.

## Making Progress

Due to the logistics of building near the waterway, Skanska is using an off-site casting facility in Virginia. There, the floor beams and T girders are being constructed and shipped to the site using just-in-time delivery, Erwin says. "We are working closely with the Virginia, Maryland and Delaware departments of transportation to ship the materials," he notes.

The concrete piles, floor beams and the bulk of the T girders were pre-cast, while the remaining materials will be cast-in-place. As of mid-October, 280 of the 288 piles were delivered, with Skanska utilizing a lay-down area right next to the construction site where cranes can easily reach and place the materials. Skanska is working with as many as 35 subcontractors on the project, who participate in Skanska's regular safety and environmental compliance inspections.

In early November, the crew completed the concrete pile driving and final tower foundation elements and began pouring the cast-in-place concrete. By year's end, a significant portion of the backspan tow-



ers will be erected along with the shoring towers, the precast floor beams on the superstructure, the edge girders will be placed and concrete casting will begin on the main deck, Erwin notes. The cable stays will be erected toward the end of 2010, followed by a public opening in early 2011.

A separate contract will be initiated to build new roadway approaches for the new bridge. This same contract will permit the removal of the entire existing bridge structure down to the stream bed. The schedule for this work will coincide with the completion and opening of the new bridge structure.

This project also has positive economic impact for the construction community and Sussex County. Delaware Gov. Jack Markell recognized the creation of jobs and other economic benefits of the project, saying, "The positive economic impact of the new Indian River Inlet Bridge construction is that it is creating jobs, bringing business to local companies and is benefiting the local resort community." ♦

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