REPLACEMENT OF THE
I-10 Twin Span Bridges over Lake Pontchartrain

by Artur W. D'Andrea, Louisiana Department of Transportation and Development

The damage that Hurricane Katrina caused to the I-10 Twin Spans over Lake Pontchartrain created a need for both temporary repairs and a permanent replacement. The size and nature of the project, the schedule, and the project's location, demanded a very efficient solution for the replacement bridge.

The I-10 Twin Spans cross Lake Pontchartrain between Slidell and New Orleans, La. This crossing is approximately 5.5 miles long resulting in a project with a total bridge length of 11 miles. This corridor is important both nationally and locally. It connects the city of New Orleans, New Orleans' ports, and the petro-chemical industry along the Mississippi River. The main navigational channel provides 73 ft of vertical clearance and 200 ft of horizontal clearance and serves both commercial and personal boat traffic. The new bridges provide three lanes in each direction and serve as one of the main evacuation routes for New Orleans.

The concerns by the owner and public for expedient construction had to be tempered with the realities of the emergency recovery budget. This $753 million project, entirely funded by the Federal Highway Administration, was constructed by two separate contracting teams. Project budget and schedule had to take into account traffic maintenance, building within the state's rights-of-way, and the limitations of undertaking a construction of this magnitude in a post-Katrina environment. The project is currently over 97% complete and the new bridges should be delivered ahead of schedule.

Design Goals

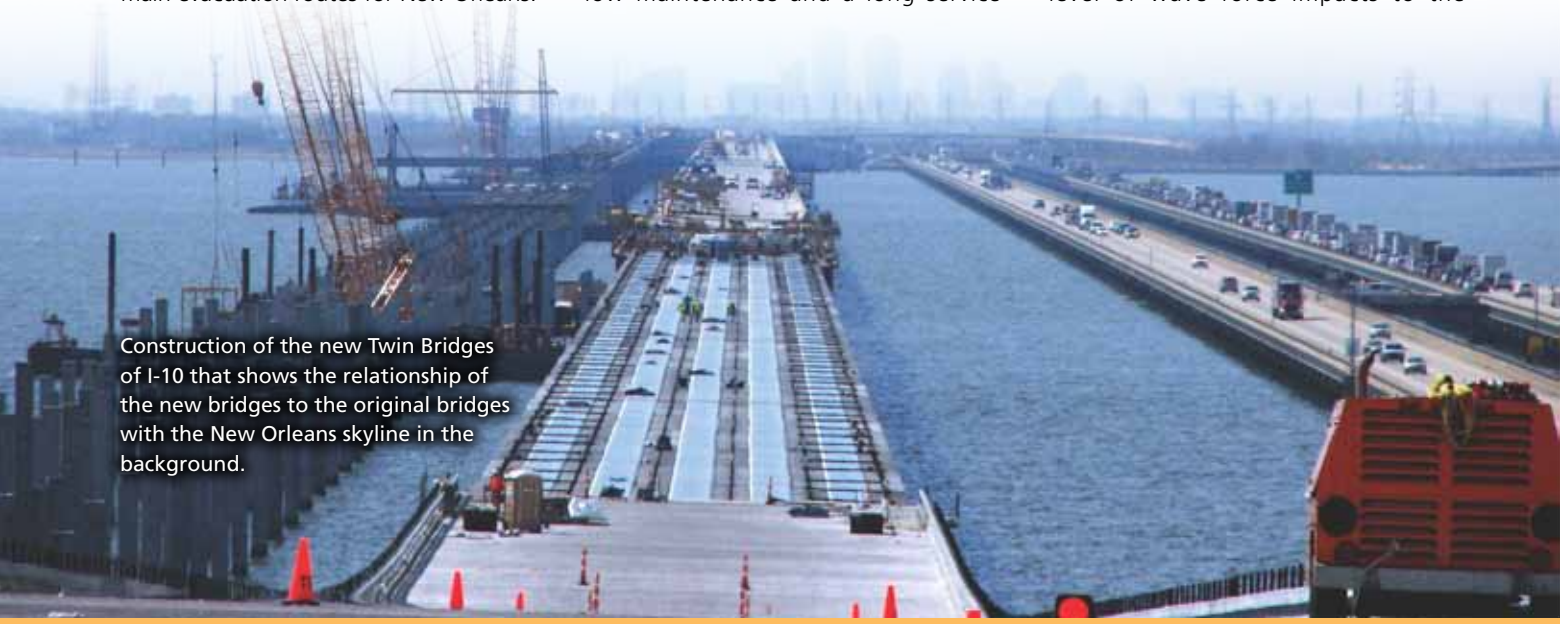
The goals for these replacement structures included better storm protection, safe accommodation of six traffic lanes, enhanced barge collision resistance, and utilization of well-known materials and techniques to provide for low maintenance and a long service life. Seven requirements became the blueprint for the project planning.

1. Meet I-10 traffic demands
2. Design a structure that can both resist storm surge and barge impact
3. Provide a 100-year service life
4. Provide for rapid service
5. Minimize environmental impact during construction and operation
6. Avoid interference with existing traffic patterns
7. Work within existing rights-of-way

The twin, 5.5-mile-long structures were divided into three parts depending on the structure type.

Part 1 consisted of building the horizontal and vertical transitions and ramps with flaring widths. Approximately a ½ mile of structure needed to be designed to resist storm surge.

Part 2 consisted of constant width and level-grade spans set above the level of wave force impacts to the



Construction of the new Twin Bridges of I-10 that shows the relationship of the new bridges to the original bridges with the New Orleans skyline in the background.

profile

I-10 TWIN SPAN BRIDGES OVER LAKE PONCHARTRAIN/ BETWEEN NEW ORLEANS AND SLIDELL, LOUISIANA

BRIDGE DESIGN ENGINEER: Louisiana Department of Transportation and Development (LaDOTD), Baton Rouge, La.

CONSTRUCTION ENGINEERING AND INSPECTION: Volkert Inc. and LaDOTD, Baton Rouge, La.

GENERAL CONTRACTOR, PARTS 1 AND 2: Boh Bros. Construction Company LLC, New Orleans, La.

GENERAL CONTRACTOR, PART 3: Traylor, Kiewit, Massman JV, Slidell, La.

superstructure. These spans were designed to minimize the number of bents used and minimize impacts to boat traffic on the lake.

Part 3 consisted of twin, 1-mile sections over the navigational channel. These portions of the twin bridges were designed to resist large barge impacts, provide higher navigational clearance, and resist wave loads on the substructure elements. These sections have a significant number of above-water footings. Parts 1 and 2 were in a single contract and Part 3 in a second contract. Both contracts were conventional design-bid-build.

Prefabrication

In consideration of their location, size, and functional requirements, the bridges were designed to take advantage of prefabrication as the primary construction method.

The precast bridge elements include:

- 36-in.-square hollow precast, prestressed concrete piles
- 4 ft by 5.5 ft by 59.25-ft-long precast concrete bent caps
- 135-ft long, 78-in.-deep Florida Bulb-tee girders
- stay-in-place precast concrete box forms for the footings on the piles

The majority of the spans were built with Florida Bulb-tee girders supported by pile bents. The higher elevation sections of the bridges near the main channel crossing contain column bent structures supported on two main pile footings. The main navigational channel spans used steel plate girders.

Typical moment connections were made between piles and footings by placing 6-ft-long reinforced plugs in the ends of the piles.

Piles

The geological structure of the Louisiana coastal region favors large precast, prestressed concrete displacement piles. They are capable of developing large axial capacity with side friction, pile setup, and sometimes point bearing. This project utilizes 36-in.-square hollow piles containing twenty-eight 0.6-in.-diameter strands. This pile shape and strand configuration are capable of developing large moment capacity. It also enables fabrication and transportation in long lengths that varied between 100 ft and 180 ft. More than 433,000 linear ft of piles were used on the project.

Pile-to-Cap and Pile-to-Footing Moment Connection

Depending on specific design requirements, the 36-in., precast concrete pile hollow core was reinforced by placing a 6-ft-long cast-in-place concrete moment plug in the top end.

The project has a total bridge length of 11 miles.

In other situations, the solid plug was extended to 30 ft in length. Piles are expected to resist moments and in some cases significant uplift loads.

Precast Concrete Caps

Whenever they could, the Contract 1 contractor elected to use a precast concrete pile cap alternate offered in the original design. Working with the precast manufacturer, Gulf Coast Pre-Stress Inc., and the owner, the original design was modified to accommodate vertical and batter piles, as well as the moment connection of the cap and restraining walls. The precast cap weighed about 80 tons and contained conventional nonprestressed reinforcement. These caps were used for the majority of the spans where span length, bridge width, and pile configurations were the same. Over 20,000 yd^3 of concrete were used in the 496 pile caps.

Precast concrete elements being readied for use as a stay-in-place footing form.

TWIN, 5.5-MILE-LONG PRECAST, PRESTRESSED CONCRETE TRESTLES / LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT, OWNER

PRECASTERS: Gulf Coast Pre-Stress Inc., Pass Christian, Miss., a PCI-certified producer, Prestress Services Industries LLC, Memphis Tenn., a PCI-certified producer, Boykin Brothers Inc., Baton Rouge, La., a PCI-certified producer, and Traylor, Kiewit, Massman JV, Slidell, La.

BRIDGE DESCRIPTION: Parallel bridges that incorporate high-performance concrete in all of their components and include precast, prestressed concrete piles, AASHTO I-beams, Florida Bulb-tee beams, precast concrete pile caps, and precast concrete footing forms

BRIDGE CONSTRUCTION COST: $753 million

The design provides a 100-year service life.

Permanent Precast Footing Form

The typical footing dimension was 44 ft by 44 ft by 7 ft thick on 24 piles. The footings were set above the low water elevation to facilitate construction. The plans allowed the use of stay-in-place precast concrete segments for formwork to support all footing construction and accommodate all pile arrangements. The footing forms were fabricated by the contractor.

Superstructure Girders

Contracts for the bridges specified AASHTO Type III precast, prestressed concrete girders in the vertical transition portion of the bridges (Part 1). Type III girders are very economical and versatile in the 70-ft-span range in conditions where grade flares and ramps exist. In locations below the design wave elevation, the girders were anchored to resist uplift. Approximately 29,500 linear ft of Type III girders were used.

On Parts 2 and 3 of the bridge, Florida Bulb-tee 78-in.-deep girders were used in the majority of situations. The shape is very efficient in the 130-ft-span range. This shape permits the use of wide girder spacing and significantly larger prestressing forces. Site conditions facilitated the use of large barges to transport the bulb-tee girders eliminating any land transportation issues associated with long precast members. Some 317,500 linear ft of 78-in.-deep bulb tees were used. Specified concrete compressive strength for the girders was 8500 psi.

Precast concrete pile caps were used on the 36-in.-square piles in 496 bents.

All girders were required to age a minimum of 90 days prior to making the span continuous through the cast-in-place concrete deck. The maximum distance between expansion joints is 810 ft.

Concrete Decks

Cast-in-place concrete on stay-in-place metal forms was required by the owner. Spans were made continuous thus minimizing expansion joints. In order to control shrinkage, closure placements were not made until after a predetermined waiting period. The decks encompassed 3,770,000 ft^2 and required 130,000 yd^3 of concrete.

Demolition of the Original Bridges

The original bridges were retired in April 2010, and two additional contracts let to demolish them. These contracts involved removing two 5.4-mile-long bridges using an environmentally sensitive process. The material will be used to create shoreline protection, create fishing reefs, and provide fishing piers in the region. These efforts were partially funded by various entities tasked with protecting and enhancing the environment.

Acknowledgements

Disasters often bring out the best in people. Many from the private sector, agencies, and organizations worldwide lent assistance. Louisiana thanks everyone who helped so willingly.

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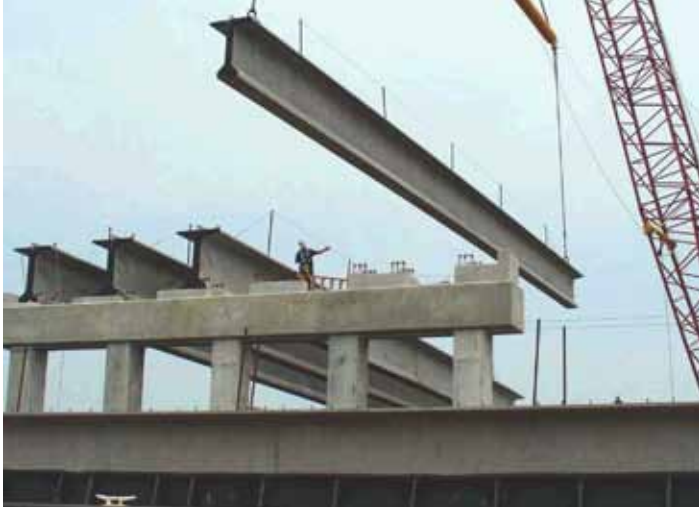

The typical spans included 135-ft-long, 78-in.-deep Florida Bulb-tee beams set on precast pile caps on 36-in.-square, hollow, precast, prestressed concrete piles.

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.

Sustainability

Sustainability was a focus throughout this project in several ways:

- maximize the use of precast elements
- minimize the construction footprint near and around the bridge site
- design for 100-year service life
- restore service to the original twin spans while constructing the new bridges
- recycle bridge material for shoreline protection and aquatic life habitatt

Long-Term Durability

Increased concrete cover and controlled permeability of the concrete mixes will extend the design life of the components for the bridges. The extensive use of high-performance concrete was a key element specified to ensure a 100-year design life for this project situated in brackish water. Design concrete compressive strengths ranged from 4500 psi to 8500 psi and the permeability threshold was set at a maximum of 1000 coulombs at 28 days. Other mix improvements included the use of Class F fly ash or ground-granulated blast-furnace slag for portland cement. A minimum of 5% silica fume was also required. Detailed curing criteria were established such as match-curing of test cylinders to establish the strength of precast elements at transfer of the prestressing force. In addition, temperature ranges were monitored for all mass concrete used throughout the project.

Fog envelopes construction of the twin spans of the I-10 replacement bridges over Lake Pontchartrain, La.