Marc Basnight Bridge

Category: Bridges Over Water

Photo Courtesy of
PCL Civil Constructors, Inc.

Nearly three decades in the making, the new 2.8-mile, $252 million Marc Basnight Bridge is a remarkable achievement. Using first of-their-kind design and construction methods, the new bridge conquers the Oregon Inlet, minimizes environmental impacts in the crucial ecosystem, and provides a lifeline to Hatteras Island capable of withstanding the worst storms the Atlantic Ocean offers, while accounting for vessel collision and an unparalleled 84 ft of scour.

Innovation of Design and/or Construction

The 2.8-mile bridge is designed to provide a 100-year service life and, at 42 ft, 7 in. wide, the new bridge accommodates two 12-ft-wide traffic lanes and 8-ft-wide shoulders, providing a safer traveling experience over the inlet.

The segmental unit of the new Basnight Bridge features foundations designed to meet unprecedented design requirements of up to 84 ft of scour, 12-ft-per-second currents, 105-mile-per-hour winds, and vessel impacts up to 2,151 kips. To capture all the effects of tropical systems and nor'easters, the modeling effort included employing wind and pressure fields for inputs into both hydraulic and wave models, resulting in 100,000 storm simulations dating back 160 years.

The centerpiece of the new bridge is a 3,550-ft-long continuous segmental box girder unit, erected using the balanced cantilever method and supported by single, segmental hollow rectangular columns. Comprised of 264 precast superstructure segments, ranging in depth from 9 ft to 19 ft, and 62 rectangular precast column segments, the segmental unit gracefully arches 90 ft above the rolling waters of the Oregon Inlet. The bridge's nine, 350-ft-wide spans allow the channel to naturally shift along a 2,400-ft-wide navigation zone, minimizing dredging requirements relative to the old bridge and providing vertical and horizontal clearances of 70 ft and 290 ft, respectively.

The post-tensioned segmental design provided span lengths that accommodate required navigational clearances, while also providing the durability necessary to achieve the specified 100-year service life.

The increased durability, speed, and simplicity of post-tensioned segmental construction were carried beyond the navigation unit to the adjacent transition spans' substructure. In these regions of the bridge, 25 two-column bents, comprised of 96 post-tensioned, solid, precast segments up to 28 ft, 8 in. long with precast bent caps, carry the transition spans rising to meet the segmental unit.

Rapid Construction

The project schedule benefited from simultaneous work along three different headings, each featuring unique characteristics, construction access, and methods. In the Oregon Inlet, segmental unit construction began at the center and worked in each direction using the balanced cantilever erection method. Using precast segments reduced reliance on concrete delivery to the remote construction site, permitted the segment fabrication while the foundation elements were being installed, and accelerated the erection process by installing up to two segments per day.

Simultaneously with segmental navigation span erection, cranes and equipment worked from the ground to construct the South approach spans over land. Meanwhile, the construction team built a 1,600-ft-long temporary work trestle to construct the 1.5-mile-long North approach units. By "leap-frogging" the work trestle, the team limited the total work trestle length and greatly reduced shading and other adverse impacts on over a mile-long stretch of environmentally sensitive submerged aquatic vegetation (SAV) habitat.

The Oregon Inlet can be a very inhospitable place to work in general, and particularly so for constructing large marine structures such as the Marc Basnight Bridge. During the three years of construction, 12 hurricanes, Nor'easters and major storms assaulted North Carolina's Outer Banks. However, thanks to a robust preparedness plan and a highly proactive approach to construction schedule management, the team encountered no major project setbacks and completed construction on schedule, opening the new bridge to traffic February 25, 2019.

Aesthetics and/or Harmony with Environment

Connecting two of the most environmentally vulnerable barrier islands in the country, the new bridge minimizes impacts on the area's 20 environmentally protected species, National Register of Historic Places-listed and eligible resources, and North Carolina's most extensive

Jury Comments

The clean, repetitive lines are well-suited to the site, with clear consideration to the impact to the community on many levels. Precast segmental construction along with the use of additional precast elements simplified erection activities and reduced construction times relative to other methods. Segmental spans to help accommodate the ever-shifting channel or "navigational zone" was a perfect application for Segmental Bridge Technology proving the desired horizontal and vertical clearance need to shift the navigational channel between different spans allowing nature to designate the natural flow of the inlet. This project also demonstrates the robustness and redundancy found in Concrete Segmental Bridges in one of the harshest environments with wave, wind, salt and scour all impacting the overall structure.

collection of seagrass beds. The navigation unit's slender, variable depth superstructure, with its long, open spans, results in an aesthetically pleasing and economical solution that accelerated the schedule and required fewer piers. This, combined with balanced cantilever erection, reduced temporary and permanent in-water construction. Meanwhile, in the North approach spans, an innovative "leap-frog" approach for the work trestle reduced its footprint throughout the nearly 1.5-mile-wide stretch of environmentally sensitive submerged aquatic vegetation beds. These tailored construction approaches, combined with extensive use of precast materials, minimized temporary environmental impacts and shortened the construction duration, much to the delight of stakeholders and agencies. Further, the old bridge will be deconstructed and sunk offshore to create new fish habitats.

The project also provides a vital lifeline for the residents of Hatteras and Ocracoke Islands. Products, services, and more than 2 million tourists cross the bridge annually — which also provides an evacuation route when hurricanes approach.

The project overcame lawsuits, channel migration, erosion, and a remote location to provide a safe, reliable, and navigable crossing. The team's proactive, partnering approach to design, permitting, and construction processes will prove instrumental in future projects.

Nearly three decades in the making, the new Marc Basnight Bridge is proof that unique and economical engineering solutions can solve environmental concerns while also meeting community needs.

Cost Competitiveness

The bridge's 100-year service life, like its reasonable cost and constructability, comes not only from cutting-edge technological advances but also from innovative combinations of proven, reliable methodologies.

Precasting proved more economical and reliable than trying to deliver cast-in-place concrete to the remote project site. Minimizing field construction work from barges and work trestle also led to much faster and safer construction.

At $399 per square foot, the final price of the Basnight Bridge is heavily influenced by the demolition and disposal of the existing Bonner Bridge, escalation related to nearly four years of litigation, and the significant foundation design requirements. However, at $215.8 million, the team's bid was 23% lower than the second place bid and more than $25 million less than NCDOT's estimate.

Minimized of Construction Impact on the Traveling Public

The Basnight Bridge is on a new alignment, so the majority of the project did not impact the traveling public. The use of balanced cantilever segmental construction significantly reduced the amount of work required in the channel and limited impacts on boaters.

Though the Outer Banks attracts millions of visitors each year, the Oregon Inlet is, from a construction standpoint, relatively remote — which challenged material delivery. Using precast concrete and delivering most elements 90 nautical miles by barge over the Atlantic Intracoastal Waterway minimized the quantity of materials transported over the narrow, two-lane NC Highway 12.

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