CHINCOTEAGUE ISLAND BRIDGE REPLACEMENT

Environmentally sensitive asset alleviates seasonal demands

by Henri Sinson, Hardesty & Hanover LLC

The Virginia Department of Transportation (VDOT) was in need of a new bridge to replace the existing 1940s era span in Accomack County, Va. The existing bridge, which carries Route 175 over the Black Narrows and the Chincoteague Channel, was deemed structurally deficient and functionally obsolete. In addition, the maintenance and repairs for the 60-year-old swing span were proving cost prohibitive. The location of the existing bridge also caused adverse impacts on the Town of Chincoteague, most notable was heavy traffic congestion on Main Street affecting residents, tourists, and emergency-response vehicles.

The selected option was an off-line 4035-ft-long trestle Mainline Bridge, including a single leaf bascule, spanning environmentally sensitive wetlands and a navigable channel. A 729-ft-long connector bridge provides the necessary link from the new Route 175 Mainline Bridge to Marsh Island. Superstructure units for the approach spans consist of VDOT bulb-tee precast, prestressed concrete beams with custom variable-depth precast, prestressed concrete fascia beams on curved alignments. The beams support an 8.5-in.-thick reinforced concrete deck slab containing epoxy-coated reinforcing steel. The bridge elements were chosen to minimize the visual clutter and impacts to the scenic vista.

Aerial view of the new Chincoteague Island Bridge site. Photo: Patrick J. Hendrickson.

Construction commenced in December 2006 and was completed in December 2010.

Challenges and Solutions

Geometry

The determination of the preferred alignment required the collection of considerable information, community perspectives, and significant data from the numerous stakeholders. The selected alignment alleviated the summer congestion, reduced the number of openings at the movable span, and reduced the length of the movable span due to the narrower channel at that location. Commitments were made to minimize the amount of construction impacts to the environmentally sensitive wetlands and oyster beds whose harvests are primary income for many of the inhabitants.

Once the bathymetric survey data was received, the design team analyzed the water depths and draft requirements for the construction equipment. It was determined that the alignment be changed to make the best use of the natural channels in this predominantly shallow marshland. This shift increased the length of the connector bridge but significantly reduced the length of temporary trestle needed to perform the construction activities, minimizing impacts to the channel bottom, and considerably reducing the overall cost of the project.

profile

CHINCOTEAGUE ISLAND BRIDGE REPLACEMENT / CHINCOTEAGUE ISLAND, VIRGINIA

BRIDGE DESIGN ENGINEER: Hardesty & Hanover LLC, New York, N.Y.

CIVIL DESIGN ENGINEER: MMM Design Group, Norfolk, Va.

GEOTECHNICAL ENGINEER: Schnabel Engineering, Glen Allen, Va.

HYDRAULIC DESIGN ENGINEER: Ayres & Associates, Atlanta, Ga.

TRAFFIC DESIGN ENGINEER: JMW Engineering Inc., Fairfax, Va.

PRIME CONTRACTOR: American Bridge Company, Coraopolis, Pa.

CAST-IN-PLACE CONCRETE SUPPLIER: Branscome Concrete, Nassawadox, Va.

PRECASTER: Bayshore Concrete Products Corp. (subsidiary of Skanska USA Civil), Cape Charles, Va., a PCI-certified producer

The substructure consisted of 36-in.-diameter cylinder piles. Photo: Hardesty & Hanover.

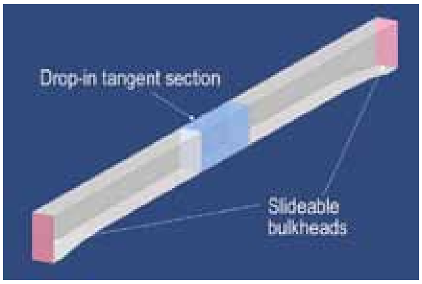
Substructure

The soils below the marshy Chincoteague Channel are so poor, for the first 30 ft, that just the weight of the hammer, resting on top of the pile, is enough to cause the pile to move downward. In response to the need to minimize the visual clutter of the new bridge and satisfy the settlement and load requirements, 36-in.-diameter precast, prestressed concrete hollow cylinder piles with 6.5-in.-thick walls were the chosen foundation elements. The piles varied from 84 to 108 ft in length. One fifth of the approximately 300 piles driven had to have tip elevations extended beyond the typical -85 to -129 ft elevation by using a 30-ft-long follower. This installation is the first instance of a hollow cylinder pile being driven 25 ft underwater.

Superstructure

An aesthetic study was performed with stakeholder input and guidance from the design team yielding a bridge facade with arched fascia beam elements and cheekwalls. This selection helped to minimize the vertical elements and match the quaint architecture of the town and environs. The spans were optimized to yield a typical 80-ft span length for the majority of the project.

Forty-five-inch-deep precast, prestressed VDOT bulb-tee beams were used for the interior beams. The custom arched load bearing beams on the fascia had a depth ranging from 54 to 45 in. To minimize the cost of the custom forms and decrease costs through production repetition, the design team added drop-in form sections at the midspan and slideable bulkhead sections at the form ends. The drop-in sections, with a constant depth, form tangent soffit geometries that allowed the



Rendering showing variable length tangent section and fixed length arched sections of the fascia beams. Rendering: Hardesty & Hanover.

Fascia beam being erected for the new Chincoteague Island Bridge. Photo: Hardesty & Hanover.

VIRGINIA DEPARTMENT OF TRANSPORTATION, OWNER

BRIDGE DESCRIPTION: A 4035-ft-long trestle structure spanning environmentally sensitive wetlands and a navigable channel. Intersecting it is the 729-ft-long Connector Bridge linking the new Route 175 Mainline Bridge to Marsh Island.

STRUCTURAL COMPONENTS: 173 VDOT Type PCBT 45 prestressed concrete bulb-tee beams, 120 load carrying prestressed concrete arched fascia beams, and 300 36-in.-diameter prestressed concrete hollow cylinder piles

BRIDGE CONSTRUCTION COST: $68.7 million

AWARDS: 2012 Engineering Excellence Award in Category H: Transportation for the Replacement of the Chincoteague Bridge

The diagonal dapped beam spans between the mainline pier and a bracket on the fascia beam of the connector bridge. Photo: Virginia Department of Transportation.

Sustainability

The Town of Chincoteague Island encompasses a scenic historic town nestled in pristine wetlands. Residents tend the small shops and harvest the oyster beds. Commitments were made during the design phase to construct the new bridge with minimal damage to the environment. The bridge alignment was changed in order to utilize the natural channels for barge construction without dredging.

Temporary construction trestles were used near the bridge abutments in order to not impact the wetlands in the vicinity.

curved forms to be reused without compromising the aesthetic effects and still accommodate all the different beam lengths needed for the curved horizontal alignment. The bridge width is 43 ft 4 in. in the mainline and 32 ft 4 in. at the connector with girder spacing of 9 ft 5 in. (mainline) and 8 ft 9 in. (connector). The spans were designed as simple spans for live and dead load and the deck continuous for live load. The bent caps are 4 ft 6 in. wide and 4 ft 2 in. deep. Specified concrete compressive strengths for the girders and piles were 8000 and 7000 psi, respectively, for design and 5600 and 4000 psi, respectively, at prestress transfer. Specified concrete compressive strength of the deck concrete was 4000 psi.

The intersection between the mainline and connector bridges presented a geometric challenge. Typically these types of intersections utilize steel or cast-in-place concrete superstructure elements that can be formed to match the tight radii of the flare. The intersection geometry was achieved by framing a short dapped-end beam supported at the pier adjacent to the mainline bridge at one end and on a bracket on the fascia beam along the connector bridge at the other end.

The identical formwork used for the typical fascia beams was utilized with small modifications to the bulkhead to create the dapped end. The fascia beam supporting the dapped beam had an arch shape on one side only. The short supported beam and the fascia beam together were able to satisfy the tight flare radii and at the same time maintain the same aesthetic arch fascia. Additionally, prestressed concrete elements were used in lieu of cast-in-place concrete or steel elements, which would have greatly increased the maintenance burden of the intersection superstructure.

Conclusion

The new Chincoteague Bridge provides the community with the only access to the historic Town of Chincoteague. The project succeeded in providing a durable, structurally sound, and functionally modern facility alleviating severe seasonal congestion. This was achieved without disturbing the environmentally sensitive area and maintaining the scenic vistas for residents and travelers. This project is a shining example of finding the balance between development and sustainability: both environmental and human.

Henri Sinson is an associate and Tampa Branch manager for Hardesty & Hanover LLC.

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

The new Chincoteague Island Bridge elevation. Photo: Virginia Department of Transportation.