Texas cargo dock meets design, strength requirements with precast concrete

The Port of Corpus Christi North Bank Cargo Dock 16 in Corpus Christi, Tex., is a loading dock used to offload ships that are filled with cement, which is then transported to onshore storage silos. In building the dock, the architects/designers opted for precast, prestressed concrete pile-supported concrete beams; precast, prestressed concrete slabs; and a cast-in-place topping slab.

This was a design-build project, and precast concrete proved to be a very competitive solution in that it would save both time and money. In addition, one of the toughest challenges was meeting a very stringent concrete mixture design specification, which would have been difficult, if not impossible, to accomplish without the use of plant-cast precast concrete. With the tight quality control procedures in place with plant-cast precast concrete, specification requirements were able to be met.

Another challenging aspect of the design was providing an equivalent amount of strand reinforcement to account for differing piece geometries and ensure the designs accounted for the effects of prestressing strand development, transfer, and losses.

"Some of the precast components had large voids and different geometries that required lifting and handling checks for primary transverse bending," says Kirk Lovinger, a structural engineer with Eriksson Technologies in Temple Terrace, Fla., the architectural firm responsible for the project. "Both of these aspects required more engineering time but did not specifically cause any increase in difficulty."

Production also posed some challenges. One of the biggest was creating blockouts for the caps. "The voids had a great deal of strand and rebar running through them, so it required ingenuity and custom woodwork to form them up," says Eric Springer, plant manager for Heldenfels Enterprises Inc. in San Marcos, Tex., the precast concrete producer chosen for the project. "Fortunately, we have some very talented and creative folks on our team."

The major challenge relating to the delivery of the precast concrete pieces was the project location. "The jobsite had limited space and access, so all the deliveries had to be by barge," Springer says. "Great communication and planning with the contractor ensured that the project always had what it needed, and the erection crew wasn't delayed."

Overall, precast, prestressed concrete proved to be an excellent design medium for this marine structure. The driven concrete piles used in the foundation provided structural efficiency, durability, and cost effectiveness. Precast concrete beams provided the strength, durability, and dimensional precision required for this structure. In addition, the precast concrete slabs provided the strength and functionality to resist the design loads while serving as an in-place forming system over water. All these precast concrete elements served to enhance the project schedule while improving worker safety.

—William Atkinson

The Port of Corpus Christi North Bank Cargo Dock 16 in Corpus Christi, Tex., uses precast, prestressed concrete pile-supported concrete beams; precast, prestressed concrete slabs; and a cast-in-place topping slab. Courtesy of Orion Construction LP.

The north approach span of the new State Route 191 bridge replacement inside Stites Tunnel in East Stroudsburg, Pa., includes two tapered precast concrete segments. Photo by Larson Design Group.

Using precast concrete speeds bridge replacement project through Pennsylvania tunnel

The new State Route 191 bridge inside Stites Tunnel in East Stroudsburg, Pa., was designed to replace a steel through-girder bridge that passed through one barrel of an existing concrete tunnel supporting railroad tracks that could not be disturbed.

The owner determined that the tunnel needed rehabilitation and the bridge structure carrying the roadway over the overflow channel and through the tunnel needed to be replaced.

The contractor was awarded the construction project for the tunnel rehabilitation and reconstruction of the roadway with a 345 ft (105 m) long reinforced concrete culvert structure inside the tunnel and two new post-tensioned reinforced concrete approach spans.

The contractor teamed with an engineer to develop an innovative alternate precast concrete design for the approach structures that facilitated the timing and scheduling of the multiple site activities required for this complex project.

The approach span structures have the unique arrangement of the overflow channel of the creek taking two 90-degree bends under the spans. To accommodate this layout, a precast concrete deck was designed transverse to the roadway and supported by new integral abutments under the outside shoulder and new longitudinal 94 ft (29 m) long post-tensioned concrete edge girders on the creek side.

In terms of design, there were several challenges. "The pieces required large-diameter rebar, post-tensioning ducts of different sizes, embed plates, a sawtooth bulkhead design, and post-tensioning blockouts," says Randy Whalen, production document supervisor for Northeast Prestressed Products in Cressona, Pa. "We utilized several different programs to ensure that everything fit perfectly."

Production also posed a challenge. "The unique design and shape required us to cast the pieces in two separate pours," Whalen says.

Lifting and handling also posed some challenges. "PennDOT requires products like this to be fabricated indoors," says Troy Jenkins, vice president and chief engineer for Northeast Prestressed Products. "Our overhead cranes have more than enough capacity for the weight, but the head room constraints required some ingenuity to ensure the pick was safe for our employees, along with not overstressing the member."

Hauling was not a problem, Jenkins says. To facilitate delivery and erection, the combined concrete slab and edge girder were precast in 8 ft (2.4 m) segments and post-tensioned in place after being erecting on temporary supports. "Heavy-duty flatbed loads are easy, compared to 180 ft long, 118 ton concrete girders," he says.

—William Atkinson

The new State Route 191 bridge replacement project inside Stites Tunnel includes a 345 ft (105 m) long precast concrete box culvert structure inside the tunnel and two new post-tensioned precast concrete approach spans. Photo by Larson Design Group.