Tendons, precast concrete construction give Lehigh Valley Bridge several firsts

The success of the Lehigh Valley Bridge Project in Coplay, Pa., is the result of a lot of teamwork, as well as a lot of innovative thinking and effort. The project was such a success that the bridge was able to open earlier than originally anticipated. The bridge was completed in 2019 and is currently open to traffic.

The 1124 ft (343 m) long bridge consists of three post-tensioned spans and five spans of prestressed beams. It replaces a bridge over the Lehigh River that was built in the 1930s. From a precast concrete perspective, it includes 27 prestressed bulb-tee beams and 25 prestressed and post-tensioned bulb-tee segments of various sizes.

The bridge is also the first project in the United States to use electrically isolated tendons (EITs). EITs allow for verification that the post-tensioned cables have been encapsulated according to the plans and specs and provide enhanced durability.

The EIT process uses a tight polymer duct that encapsulates the high-strength steel along with grouting that creates a protective alkaline environment for the steel strands and an anchor head that is isolated from the ground and the normal reinforcement of the structure. The electrically isolated anchorages allow the team to check the integrity of the plastic duct during and after construction and to monitor the corrosion protection of the high-strength steel during the whole service life with electrical impedance measurements.

The Lehigh Valley Bridge uses spliced girders to support bulb-tee beams. Photo by Danielle M. Fleagle.

This project included a number of challenges, especially because of the innovative design and production requirements. In addition to using EITs, the project features prestressed and post-tensioned bulb-tee beam construction that includes spliced girders, the first use of this technology in Pennsylvania.

"We had done some similar projects in other states, but the last one we completed was about 10 years ago, so this was the first one of this type of project for us in about a decade," says Troy Jenkins, chief engineer for Northeast Prestressed

The Lehigh Valley Bridge in Coplay, Pa., replaced a deteriorating 1930s-era structure with a bridge that uses prestressed and post-tensioned bulb-tee beam construction with spliced girders. The bridge is also the first in the United States to use electrically isolated tendons. Photo by Matt McSweeney.

A prestressed and post-tensioned bulb-tee beam is being lowered into place for the Lehigh Valley Bridge. Northeast Prestressed Products LLC of Cressona, Pa., manufactured and installed the precast concrete elements used in the project. Photo by Danielle M. Fleagle.

Products LLC of Cressona, Pa., the firm that was selected to perform the precast concrete portion of the project.

Another challenge was that the center section of the bridge involved a variable-set bulb tee, which posed some challenges in the plant. Everyone had to do a lot of work to make sure that the strands were in the right location in the beams. "In the center of the bridge, the beams were about 10 feet deep," says Gary Lehman, Northeast Prestressed Products plant manager. "The highest strands we had done in the past were about 5 feet, so we had to increase the strands to the top flange."

A related challenge was that the full width of the bottom flange of the ball bulb tee in the center involved a large mass of concrete. "We had to make sure it didn't move when the concrete was being poured," Jenkins says. "We had to get the concrete around the post-tensioning ducts to get to the bottom of the beam, and make sure that there was enough of it to meet the strength requirements that the project required."

Jenkins says that the key to success with these challenges was a lot of teamwork among quality assurance, production, and engineering. "We spent a lot of time working together, with a lot of preplanning," he says. "We also came up with several extra sketches to help work through the process."

The company also worked with the company that provided the forms for the project to address another challenge. "Some of the beams we had to pour two at a time, so we worked with the company that provided the forms to come up with a scheme so we could pour one beam with an end block in the middle," Lehman says. "This allowed us to purchase just one form instead of multiple forms in order to meet the lengths we needed."

In addition to design and manufacturing challenges, there were also some delivery challenges, such as making alterations to the equipment. "We had to modify the equipment to meet the profile of the beams and bring it up high enough so that they wouldn't bottom out during transportation," says Heidi Burnhauser, dispatcher for Northeast Prestressed Products.

Another transportation challenge involved the delivery route. "Our logistics coordinator, Joe Lopez, traveled with every load and had to lift high wires in order to safely get the beams to the site," Burnhauser says. "Originally, we had a direct route there, but we ended up having to be rerouted at the last minute. We were able to find an alternate route, but because of the wires that crossed this new route, our equipment and beams ended up being so high that the wires had to be lifted. Joe would lift the wires as the beams would go under."

There were no specific installation challenges for the company because the contractor had hired an erector to perform that work. "Our responsibility ended after the pieces were unloaded from our trucks," Jenkins says.

The overall keys to the success of the whole project, Jenkins says, were planning and coordination. "We had multiple coordination meetings with the contractor, the erector, the state, and the design engineers because this was the first bridge of its kind being built in Pennsylvania," he says. "We wanted to make sure we were all on the same page."

"Transportation also had some logistics meetings with everyone on the project, too, to make sure that everything was coordinated," Burnhauser says. "For example, we had to arrange for state police involvement throughout the whole delivery route. Overall, as a result, everything did mesh well and come together well."

—William Atkinson

Some beams for the Lehigh Valley Bridge are as deep as 10 ft, requiring the prestressing strands for the top flange to be positioned much higher than usual. Photo by Gary Lehman.