NUCOR® SKYLINE

CASE STUDY

Holtwood Hydroelectric Power Plant

Slope Stabilization – Holtwood, Pennsylvania

HISTORY

The Susquehanna River is one of the oldest existing rivers in the world, older even than the mountain ridges it runs through. At 464 miles long, it is the longest river on the East coast of the United States. The river drains more than 27,000 square miles, including nearly half of the land of Pennsylvania.

The Holtwood Hydroelectric Dam is the oldest of the three major dams built on the lower Susquehanna River. Constructed between 1905 and 1910 by the Pennsylvania Water & Power Company, the dam began generating electricity through a powerhouse originally built as a 55-foot ferry dam. The dam measures 2,392 feet long – at the time of its completion second-longest in the country – and is a key location for two animals, the American shad and the bald eagle. To spawn, shad annually migrate from the salt water of the Atlantic Ocean up into the fresh water of the Susquehanna River. Holtwood enables this migration with the country's largest elevator-like fish lifts, capable of carrying tens of thousands of fish over the dam and into the river each season.

Now owned by Pennsylvania Power & Light (PPL), Holtwood began an expansion project in late 2009 to expand the combination of land management, environmental consciousness, and recreational activities, alongside power management.

PPL unveiled plans for a new powerhouse, directly east of the old power station, which would remain operational. With just two turbines, the new powerhouse is capable of turning out 125 megawatts of energy.

PROBLEM

The project plans included the excavation of the new powerhouse site, spill ways, draft tube extensions, and tailrace to carry the water. Clearing each of the individual areas required extensive blasting through hard bedrock, as well as a support system to stabilize the slope and prevent future failures as large volumes of water flow down the Susquehanna through the power facility.

The bedrock along the river was inconsistent in terms of its depth and strength, requiring deeper drilling and soil samples every few feet. The project sought minimal interruptions to the surrounding environment, thus lengthening the project timeline.

SOLUTION

Working closely with the project partners, Nucor Skyline offered rock anchors to keep the bedrock intact, first temporarily during construction of the new powerhouse, and then as a permanent slope stabilization in the form of rock reinforcement along the spillway.

It was the largest rock bolt project going on in the United States at the time, and became a signal that Skyline would play a key role in geostructural solutions becoming widely accepted within the steel industry.

To clear space for the new Holtwood powerhouse, Maine Drilling & Blasting removed 310,000 yards of rock. The blasting and removal of the bedrock was done in six-foot increments to allow for temporary rock reinforcement.

In the second phase – creating the spillway and tailrace below the powerhouse – the sub-contractors alternated between the blast

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PROJECT PARTNERS

Owner
Pennsylvania Power & Light (PPL) – Allentown, PA

Contractor
Walsh Construction – Chicago, IL

Sub contractor
Maine Drilling & Blasting – Myerstown, PA

Engineers
Kleinschmidt Associates – Pittsfield, ME

PRODUCT

1", 1-¾" and 2'-½" Gr. 150 protected threaded bar anchors

1" and 1-¼" epoxy coated anchors

1" hot rolled threaded bars

Hex nuts, couplers, jam nuts for all bar diameters

Fabricated bearing plates with welded trumpets and grout ports

schedule, excavation, and the installation of the anchor system as part of the 30-meter wide cut.

Designed by Kleinschmidt Associates with steel manufactured by Nucor Skyline, the system included more than 2,500 permanent and temporary rock anchors and dowels designed to hold back the wall of bedrock.

Nucor Skyline manufactured the double corrosion protected rock anchors at its Camp Hill facility, just 50 miles from the project site. The varying depths of the bedrock required flexibility in the lengths of the threaded bar. Given the proximity of the Camp Hill facility, Skyline was able to deliver lengths as long as 93 feet to the job site. A majority of the lengths were shipped at 67 feet, right from the Camp Hill plant, eliminating the need for fabrication on the job site and saving valuable time.

The fabricated double corrosion protected rock anchors consist of a grout filled factory installed corrugated tubing to protect the high strength threaded bar from corrosion. The versatility of lengths was necessary due to the inconsistency of the soil. In some areas, the drilling went deeper to get through the bedrock. Once the optimum drilling depth was found, a cementitious grout was pumped and the threaded bar inserted. When the grout cured, a hex nut was screwed down on the bar until the steel plate tightened against the rock face. Across the face of the bedrock, the post-tensioned force in the rock anchor system measured upwards of 620,000 pounds.

An immediate test for the slope stabilization system came in Sept. 2011 when Tropical Storm Lee brought heavy rains to Pennsylvania, the level of the Susquehanna River rose nearly 17 feet above flood stage. According to Pennsylvania Power & Light and their workers, there was no appreciable damage to the facility when they returned to cleanup and perform a thorough inspection.

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For technical questions and engineering support, please contact us via our technical hotline at: **1-866-875-9546** or email us at: **engineering@nucorskyline.com**.