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Ric-Man Construction And Northern Concrete Pipe, Inc. Set A New North American Record For Micro Tunnel Length

We are all familiar with the concept of Open-cut pipe installations. It is the most common method of installing new pipe lines or replacing existing pipe lines. Everything is done from the ground surface, but what happens when your new pipe line needs to go 25-feet below the bottom of Lake Erie?

Painesville, OH, is on the threshold of completing it's new raw water intake system, which included installation of the longest micro tunneled pipe system in North America.

The current intake system was installed in 1957, using an intake that was 1,000 feet from shore and just 8 feet below the water surface. At such a shallow depth, it forced Painesville Water Processing Plant to filter and treat a higher amount of debris and particles than a deeper intake water line would require.

In 2015, harmful algae blooms (HAB) started to appear in Lake Erie, creating the need for a deeper raw water intake system. The City of Painesville decided to take advantage of the zero interest loan the Ohio EPA was offering for communities dealing with intake issues because of HAB concerns.

The $17 million intake project began in November of 2016 and should be activated by the spring of 2020. Burgess & Niple were the design engineers contracted for the project. The original design included a two-pass tunnel using rib and lagging and a 36-inch carrier pipe inside a 60-inch liner pipe, extending 3,947 feet into Lake Erie. With over 50-years of experience specializing in the construction of open cut and tunneling of soft grounds and hard rock soils, Ric-Man Construction, Inc, based in Sterling Heights, MI, was awarded the project.

As part of a Value Engineering effort, Ric-Man Construction partnered with GEI Consultants, and Hubble Roth & Clark, on the pipe design to take the project from a two-pass tunnel design, to a one-pass tunnel by installing 60-inch Reinforced Concrete Pipe using a micro tunnel boring machine, (MTBM). This also provided more available water volume that will allow future expansion of their water distribution system.

MTBM's are machines built to bore through anything from soft ground, including sand and clay, to rock. Under the bottom of Lake Erie, Ric-Man Construction needed to bore through full-face shale, as well as a mixed face of shale, clay, limestone, sand gravel, cobbles and boulders. The MTBM was outfitted with a mixed ground-cutter, equipped with both disc cutters and carbon tipped cutting teeth to penetrate through either shale or clay, as well as limestone, sand, gravel, cobbles and boulders.

The launching platform shaft, used to push the pipe being installed, is 30-feet in diameter and 67-feet deep. Divers will be utilized to retrieve the equipment once the pipe has been micro tunneled into place.

To provide the best end product, it was essential for all parties involved to work together. A reinforced concrete pipe installed by jacking, or tunneling, is subjected simultaneously to axial and transverse forces. Axial loads are most important as you are compressing the pipe at both ends, which on this project could have been up to 1,100 tons of jacking force.

Transverse loads include the soil prism above the pipe, weight of the pipe, plus the fluid weight and pressure in and around the pipe. It is imperative that the Designer of the pipe consider all anticipated loads on the pipe for the structural design of the pipe.

Axial loads are the forces transmitted through the pipe as it is pushed through the hole tunneled in the soil. Axial strength of the pipe is mainly a function of the compressive strength of concrete and the surface area of the contact face of the pipe being advanced through the soil. The required axial force is greatly variable and to determine it, the installer and pipe designer must carefully estimate the axial loads transmitted through the pipeline based on factors such as pipe diameter, length of the pipeline, soil friction and the type of lubricant being used.

GEI Consultants worked with Ric-Man Construction to develop anticipated jacking forces on the reinforced concrete pipe. Based on over 60-years of experience manufacturing precast concrete products, including many successful long tunneling and jacking projects, Northern Concrete Pipe was selected to be the manufacturer of the tunnel pipe for this project. Northern Concrete Pipe produced 10-foot reinforced concrete pipe sections, with C-Wall forms. To provide the most compression surface and contact area between adjoining pipe and to resist the shear forces generated in joints of the pipe during jacking operations, a 3/8” thick x 9-inch long steel bell band was used as the bell of the pipe. A round o-ring gasket in a confined groove meeting ASTM C-361, was designed by Press Seal Corporation and used to meet the 50 psi joint test requirements. The Project Managing and Inspection was performed by the Mannik Smith Group.

A ¾-inch marine grade plywood joint packer was used as cushion material between the end surfaces of the joints to prevent stress concentrations during the tunneling operation. This joint cushion distributes the axial force preventing point loads on the joint and minimizing potential joint damage.

For a long pipeline, the frictional forces between the jacking pipes and the soil can be high. When the jacking forces required exceed the capacity of the main jacking system, intermediate jacking stations (IJS) can be utilized to reduce the forces required to advance the pipe. Due to the length of the pipeline, it was decided that 7 intermediate jacking stations should be installed. IJS’s can allow shorter runs of pipe to be advanced forward independent of the rest of the installed pipeline. Spaced evenly throughout the length of the pipeline, IJS’s are able to be activated to move shorter segments of the pipeline forward independently if such an operation becomes necessary. After the jacking operation is complete, the cylinders

in the IJS's are removed. Ultimately, only 6 IJS were installed in the tunnel, and it was not necessary to engage any of them during the jacking process, because the jacking forces only reached approximately 350 tons out of 1,100 tons of allowable force.

Ric-Man's average installation rate was 5 sections of pipe per day. Now that the main line is installed, a prefabricated 90-degree pipe bend will be added at the end of the intake pipe along with a riser pipe that will be extended about 5-feet above the lake bottom. Soon, divers will retrieve the MTBM from 13' below the bottom of Lake Erie.

This project would not be possible without the collaborative efforts of all parties involved. When the final project is completed in the Spring of 2020, the City of Painesville will have a new raw water intake system that will supply the city's water needs for years to come. Ric-Man Construction has installed the longest micro tunnel project in North America and Northern Concrete Pipe supplied the reinforced concrete pipe for the longest 60-inch micro tunnel project in the world.