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PipeLine

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Contents

BELOW
The Northside Sewer Relief Tunnel reached depths of 50 to 60 feet below grade.

Large Diameter Rehabilitation in Houston

The City of Houston operates and maintains approximately 6,000 miles of gravity sewers with diameters ranging from 6-inch to 144-inch in diameter. The average daily wastewater flow through the system is estimated at 277 million gallons per day (MGD). With some depths reaching 80 feet, the City's extensive urban population makes access to these sewers for inspection and repair difficult.

Constructed in the mid 1980s, the Northside Sewer Relief Tunnel (NSRT) was the largest of Houston's deep sewer tunnels. In 1988, the NSRT was completed and put into service. It was lined with a mechanically attached liner of high density polyethylene (HDPE) and in the early 90s sections of the liner began to fail leading to overflows and the removal of the liner. In 1994, an inspection found that more than half of the tunnel showed signs of corrosion.

In early 2000, multiple engineering firms began designing the rehabilitation of roughly eight miles of the reinforced concrete pipe (RCP) tunnel. This was known as the Northside Sewer Rehabilitation Program. Due to funding constraints these projects were put on hold until around 2007-08 and beginning with the largest diameter sections first, NSRT was bid in phases.

Continued on page 2

Year of construction
2011 - 2016
Total length of pipe
10,000 feet
Diameter
120-inch
Stiffness class
72 psi
Installation method
Rehabilitation
Application
Sanitary sewer
Client
City of Houston
Installer
Boyer, Inc. and Oscar Renda Contracting
Advantages
Deep installation, various lengths, corrosion resistance

Continued from page 1

Innovative Installation Techniques

NSRT- Area 5, Phase One was put out to bid in September 2011. It was decided in the design process to slipline the RCP with Fiberglass Reinforced Thermosetting Plastic (FRP) pipe. Boyer, Inc. of Houston was awarded this phase. They installed 2,200 feet of 120-inch centrifugally cast, fiberglass reinforced, polymer mortar (CCFRPM) pipe. The flush reline CCFRPM pipe was manufactured by HOBAS Pipe USA of Houston. The existing tunnel was approximately 132-inches in diameter and the 120-inch CCFRPM pipe has an outside diameter (O.D.) of 126-inches. "This size pipe had never been installed before inside a 132-inch tunnel and Boyer was ready to take on the challenge. In fact, HOBAS had never manufactured this size pipe before," stated Datta Shirodkar, P.E., project manager, Boyer, Inc.

NSRT- Area 5, Phase One was designed by the Engineer as a sliplining project to be installed in live flow. "We knew from the beginning that it was not possible to install such a large pipe in minimum live flow and decided to carry the pipe in place one joint at a time," explained Shirodkar. "Bill Ofiel, one of our senior project managers, designed a custom pipe carrier to transport the 120-inch pipe inside the 132-inch tunnel and a custom pipe pusher to push one joint of pipe into another (Bell & Spigot connection). Boyer, Inc. also developed a very innovative way of making miters on site by cutting two pieces of pipe at an angle and then joining the pieces together using a FWC coupling. This method of making miters using FWC couplings had been used on smaller size pipe but never on a pipe with 126-inch O.D. The size and weight of the pipe along with the constraint of installing it inside a 132-inch I.D. tunnel forced us to think outside the box and come up with new and innovative methods. There were lot of stressful moments and passionate discussions within our team during the course of this project, but the successful installation of the pipe without any re-work made it all worth the effort."

Restoring Structural Integrity

NSRT-Area 4 bid in April 2012 and consisted of about 4,900 feet of the same 120-inch flush reline pipe. Oscar Renda Contracting of Roanoke, Texas was the low bidder on NSRT-Area 4. NSRT-Area 5, Phase Two was awarded to Oscar Renda in March 2014 and they installed 3,000 feet of 120-inch pipe in early 2016. Before Oscar Renda could begin the installation they had to prepare the existing tunnel. "Most of the joints had deteriorated and were leaking ground water," explained Bart Adams, Houston area project manager, Oscar Renda Contracting. "The former corrosion protection system was in disrepair and had to be removed. Finally, many areas of the tunnel contained up to three feet of debris that had settled into the existing system. The cleaning process required us to remove the debris as well as sheets, battens and anchors from the protection system." In addition, Oscar Renda prepped the tunnel by essentially pressure washing the tunnel to remove any loose debris and inject the joints to stop the groundwater infiltration.

The flush reline pipe was manufactured with a flush bell-spigot. The flush bell-spigot joint consists of an integral straight bell fixed to one pipe end that seals to the spigot end of another pipe by compressing an elastomeric gasket contained in a groove on the spigot. An important characteristic of this joint in relation to this project is that the joint has approximately the same outside diameter as the pipe, so when assembled, the joint is essentially flush with the pipe outside surface. "This allowed a clearance of only three inches around the pipe and a very tight fit. The existing tunnel was 50 to 60 feet below grade and only a limited number of access shafts were installed," explained Adams.

Overcoming Challenges

A project of this scope has its challenges. During the bid phase there was no confirmed method of by-passing the flows in the Northside Sewer system. The exact flows going through the NSRT 4 portion of the system were not known at the time of the bid. The bid documents explained that the contractor was responsible for by-passing, blocking, and/or diverting 33 million gallons per day of average daily flows. After the system was installed, adjustments had to be made due to the average daily flows being much higher than anticipated.

"The biggest issue for the NSRT 4 project, was how to by-pass the flows in the system," stated Adams. "The City of Houston Wastewater Operations was a big help in working with us to figure out the best route to divert the flows within the system to maintain operations and be able to install the pipe. Over several months, many coordination meetings were conducted, and several iterations of the by-pass system were developed before Oscar Renda and the City of Houston was able to agree on a path forward. An additional complexity to the NSRT 4 project was that both projects were dependent on the same by-pass system. An additional by-pass system was setup on the NSRT 5 project to by-pass additional lines coming into that system. All flows were being diverted to the 69th Street Wastewater Treatment Plant."

The traditional segmental slipline installation method of a liner pipe being pushed or pulled into an existing pipe usually during episodes of live flow was not utilized on this project. The existing RCP tunnel was made of mitered sections that would not allow the traditional sliplining method. Instead a combined method of sliplining and tunneling was used to install the new 120-inch pipe. The pipe sections were carried into place and assembled inside the tunnel, much like a two-pass operation with the host pipe serving as the primary tunnel. There are a number of curves throughout both phases; this along with the condition of the existing RCP made traditional segmental sliplining difficult.

"Sliplining could not be used because the relining pipe could not be pushed through the mitered sections of the existing tunnel using a true sliplining method," explained Adams. "Pipe carriers had to be used in order to take individual pipe pieces through the tunnel to the point of installation. Extensive surveying and modeling was used to map the miters in the existing tunnel. This information was used to develop the layout for the reline pipe segments. During the installation, once the straight run of pipe reached a mitered section, dimensions were confirmed, and a system was developed in the field to miter each section of pipe as required. This method allowed us to make adjustments in the field in order to minimize delays to the installations." HOBAS manufactured the pipe in varying lengths to assist with this process.

"The HOBAS FWC gasket-sealed, push-on coupling seals directly to the unmodified exterior pipe surface," explained Randy Whiddon, field service manager, HOBAS Pipe USA. "Since the O.D. is constant along the entire pipe section, field length changes may be accomplished by simply cutting the pipe at the desired location, chamfering the cut end and joining with the FWC coupling. This is true for pressure applications as well as non-pressure service."

Successful Installation

To summarize, approximately 10,000 feet of 120-inch CCFRPM pipe was installed deep beneath Houston. Creative installation techniques allowed for a successful project. The remaining phases of the NSRT are currently under design.

LEFT AND CENTER
The pipe sections were carried into place and assembled inside the tunnel, much like a two-pass operation with the host pipe serving as the primary tunnel. The condition of the existing sewer made this the best installation method.

BELOW
Short segments of CCFRPM pipe were manufactured by HOBAS Pipe USA to facilitate assembly into the existing curved host.

Naches-Selah Irrigation District Upgrades System

In the United States an irrigation district is a cooperative, self-governing public corporation set up as a subdivision of the State government, with definite geographic boundaries, organized and having taxing power to obtain and distribute water for irrigation of lands within the district. It is created under the authority of a State legislature with the consent of a designated fraction of the landowners or citizens. Washington State Water Resources Association (WSWRA) is the coordinating agency for the irrigation districts in Washington State. It includes 35 irrigation district members covering 1.1 million irrigated agricultural acres.

Naches-Selah Irrigation District (NSID) encompassing 11,000 acres is located in north Yakima County, Wash. It is near the towns of Naches and Selah and serves over 1,700 landowners. The Naches River, a tributary of the Yakima River in central Washington, is about 75 miles long. After the convergence of the Little Naches and Bumping River, the name becomes the Naches River. The Naches and its tributaries drain a portion of the eastern side of the Cascade Range, east of Mount Rainier and northeast of Mount Adams. In terms of discharge, the Naches River is the largest tributary of the Yakima River.

Year of construction
2014 - 2015
Total length of pipe
3,600 feet
Diameter
96-inch
Stiffness class
36 psi
Installation method
Direct bury
Application
Irrigation
Client
Naches-Selah Irrigation District
Installer
Tapani, Inc
Advantages
Maintenance-free, quick delivery

System Upgrade

Selah Valley Canal (NSID's Main Canal) was put into operation in 1892. As with many older systems, replacement was required as the facilities had passed their useful life and continued maintenance and repairs could not guarantee reliable operation. Also, the manually controlled canal system made it a challenge to operate. Selah Valley Canal includes 8,000 feet of wood flumes which are nine feet in diameter as well as concrete canals. Repairs up to this point have included approaches such as placing plywood sheeting over the leaking wood stave flumes. In other cases, where the flumes collapsed, the time required to fix them could be around two weeks. During the watering season, any disruption could be damaging to the crops.

The 2015 Main Canal Flume Replacement and Other Canal Improvements Project are the most recent phase toward the overall modernization and improvement plan. This project has a cost of around $7 million. Between 1910 and 1956, a series of improvements were made to the original materials installed in 1892, resulting in today's existing wood and concrete facilities. This new phase is an improvement to these 60-plus year old improvements.

Replacement of the wood flume trestles was included in the 1995 Comprehensive Water Conservation Plan and again in the 2007 Modernization Plan. The amount of $9 million in capital improvements was completed during 2005 to 2014. "Improvements included canal lining, replacement of some wooden flumes, replacement of wood pipe and open canals with gravity pressurized pipe networks, modern pressurized farm deliveries and canal automation," said Justin Harter, district manager, Naches-Selah Irrigation District.

The topography of NSID's service area provides 200 to 300 feet of fall (available head pressure). Deliveries range from minimal pressure up to 40 to 90 PSI depending on the elevation difference from the canal that flows into the pipe networks. Over 3,000 acres have eliminated their need to pump resulting in a power cost savings.

LEFT
Light weight and easy to handle, the CCFRPM pipe awaits installation in a remote area.

LOWER LEFT
Ease of installation allowed Tapani, Inc. to meet the project schedule in time for the start of the 2015 watering season.

LOWER RIGHT
The existing wood stave flumes were replaced with 96-inch inverted siphons made of HOBAS Pipe.

Design Considerations

The replacement of 4,600 feet of wood flumes was completed along with 2,800 feet of canal lined with concrete. The wood flumes were replaced with 3,600 feet of centrifugally cast, fiberglass-reinforced, polymer mortar (CCFRPM) pipe with the remaining footage converted into sections of concrete lined canal. The concrete canal sections include a polyethylene lining that is placed under the reinforced concrete that prevents leakage. HOBAS Pipe USA supplied 96-inch diameter CCFRPM pipe with a stiffness class of 36 psi.

"A number of pipe materials were considered. Steel pipe required maintenance of coatings with potential to require coating replacement in 50 years or less to manage corrosion," said Harter. "Although higher in initial costs, non-ferrous pipes provide a lower overall cost with a longer lifespan and less maintenance. HOBAS was one of the few pipes that could meet the project schedule and performance criteria." HOBAS was not intentionally sole sourced, but the higher specification requirements limited competition.

Quick Installation

Tapani, Inc. of Battle Ground, Wash., began construction in November 2014 and was finished before the April 1st season start. There is limited time between October and April when the canal is not flowing. "This project had a very tight schedule to meet in order to supply water to the local farms for the 2015 growing season," said Aaron Halling, project manager, Tapani, Inc.

There were eight wood trestles from heights of five to 75 feet and draws of 20 to 500 feet wide. In this case, a trestle is a rigid frame used as a support, especially referring to a bridge composed of a number of short spans supported by such frames. Many wooden roller coasters are built using design details similar to trestle bridges.

Other sections of wood flume were on grade, resting on existing soils that were leveled 80 or more years ago. "The 96-inch pipe was installed on grades as steep as 50+% and the existing access roads had to be widened in order to get the pipe to the place of installation. Access was limited and delivering to the further locations with off-road equipment took over a half hour per piece of pipe," said Halling.

Wood stave flume trestles were replaced with inverted siphons. The large inverted siphons are used to convey water being carried in canals or flumes across valleys for irrigation. With no pump, they are powered by the fall of the water as it flows down the pipe under the pull of gravity, and discharged at a level lower than the surface of where it originated.

The pipe provided to Tapani included factory assembled FWC couplings. Useful for direct bury applications, the FWC coupling is a structural filament wound sleeve overwrapped and mechanically locked to an internal full-face elastomeric membrane. "We faced challenges, but the project was still an overall success and the pipe performed well," said Halling.

Year of construction
2015
Total length of pipe
1,200 feet
Diameter
36-inch
Stiffness class
95 psi
Installation method
Sliplining
Application
Sanitary sewer

Client
Niagara Falls Water Board
Installer
Yarussi Construction
Advantages
High stiffness, corrosion resistance, quick installation

TOP
An old sewer in the process of failing has been replaced with one expected to provide many decades of reliable service.

INSET
Pushing forces were recorded from a load cell which was mounted to the push ring and attached to a short section of HOBAS pipe and used for installation.

HOBAS Pipe Used to Rehabilitate Niagara Falls Sewer

The city of Niagara Falls, New York is located on the Niagara River, across from the city of Niagara Falls, Ontario, and named for the famed Niagara Falls which they share. Water and sewer services within Niagara Falls, NY and adjoining areas are provided by the Niagara Falls Water Board (NFWB). The NFWB serves 50,000 people through more than 16,000 accounts, including residents, businesses and industries. Their vision is very specific, "The goal of the Niagara Falls Water Board is to become a first class competitive utility in the next five to seven years" and NFWB has a strategy to get them there including continually investing in infrastructure to maintain facilities while economically providing customer service. This is exactly what spurred the recent Iroquois Street Sewer Lining Project.

Outdated Infrastructure

Segmental block pipe came into use in the early 1900s, and was used until the 1930s, when precast pipe became more readily available. The original Iroquois Street sewer was built in 1917 and utilized segmented block to construct the 54-inch diameter sewer.

In the late 1980s, NFWB began a series of projects aimed at reducing significant groundwater infiltration present in this portion of their service area. The projects included downstage and chemical grouting, internal and external pipe seals and flow rerouting. In the early 2010s sewer flows were again rerouted to abandon and seal off the most heavily damaged and leaking section of the sewers.

The past repairs on sewers and tunnels provided some good benefits. However, the Iroquois Street sewer was recently found to have serious structural problems in addition to prominent infiltration. The groundwater infiltration was estimated at about five million gallons per day. In the spring of 2013, an investigation into the problems and evaluation of corrective alternatives commenced. The specific stretch of sewer under investigation was the 2,200 foot length from Buffalo Avenue to the Southside Interceptor.

"What was first thought to be an infiltration problem evolved to include serious sewer structural and longevity concerns," John Goeddertz, Ph.D., Sr. Project Manager, AECOM.

"Due to the depth of the sewer and the presence of

underground utilities associated with both a nearby chemical plant and an electrical substation, a minimal amount of excavation was preferable. The industrial nature of the surrounding land and interfering utilities favored a sliplining approach for sewer rehabilitation. The specifications were written around sliplining the sewer and connecting tunnel with a small variety of acceptable liners." It was determined that a 36" inside diameter liner pipe was suitable for conveying the anticipated sewage flow.

Material Options

The contract documents allowed the use of three different pipe materials including fusion welded HDPE, fusion welded PVC, or centrifugally cast fiberglass reinforced polymer mortar (HOBAS). The HOBAS pipe was the only gasket sealed pipe allowed due to the fact that it was the only one that could withstand the potential compressive forces needed to push 1,500 feet of pipe from a single push pit. One push pit was specified to minimize the potential for uncovering contaminated soils while excavating.

Yarussi Construction of Niagara Falls, NY was awarded the project and chose to utilize HOBAS pipe for the installation. "The overall cost of using HOBAS with the segmental joints was less expensive as a total installed cost," stated Camil Pachucki, Estimator and Project Manager for Yarussi.

As part of the sewer cleaning operation, intermediate manholes were excavated and a mandrel was pulled to verify proper clearance for liner insertion. "We shipped all of the pipe from Houston, Texas to Niagara Falls via truck within a week's time in September of 2015" stated Rob Epstein, Commercial Manager with HOBAS Pipe USA in Houston, Texas.

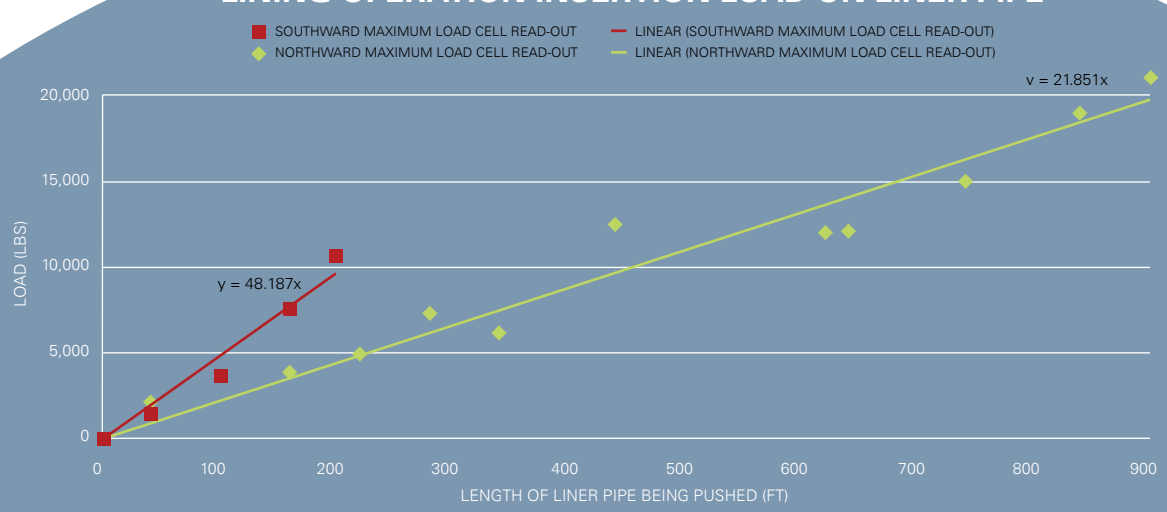
Once the host pipe was prepared, Yarussi sliplined 80 percent of the length in three days from a single push pit, inserting liner pipe in both directions. In all, 1,175 feet of the segmented block sewer were cleaned and lined. There were two separate lining operations, one proceeding southward from the push pit and one proceeding northward. The southward lining operation pushed approximately 900 feet of pipe, with about 300 feet being installed to the north. The stretch was completed by open cut methods into the rock tunnel section, again using HOBAS pipe.

"We were able to easily install all the sliplining pipe from one pit and as a requirement of the specifications, we used a load cell on the push frame and it recorded the load on the pipe. We pushed the pipe in with flow, and it slid in very well," stated Pachucki.

The recorded loads increased consistently as subsequent segmental pipes were added to the line. The maximum load on the northward run was approximately 10,000 pounds, and roughly 21,000 pounds for the southward section. The calculated friction factor for the two runs was 0.21 and 0.45 respectively. "This value is very typical of what is reported in HOBAS sliplining installations," stated Rene Garcia, Engineering Supervisor with HOBAS.

Mission Accomplished

Richard Roll, Technical Services Director for the NFWB, remarked that "The principal goal of the project was to reduce inflow and infiltration, and the results have been promising, reducing chemical usage and pumping costs at the treatment plant while also reducing wet-weather combined sewer overflow. In addition, an old sewer in the process of failing has been replaced with one expected to provide many decades of reliable service."



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Another Penstock Installation Complete

Putnam, Connecticut's downtown business district is home to the Cargill Falls Mill, America's oldest permanent mill site. This near vacant 130,000-square-foot mill is in the process of being restored into 82 residential living units and over 30,000 square feet of commercial space. Water from the Quinebaug River that once powered the mill will once again be harnessed to provide electricity to the residential and commercial tenants of The Lofts at Cargill Falls Mill. As stated on the developer website, The Lofts are poised to become Connecticut's first fully sustainable adaptive reuse mill development.

HOBAS is providing 78-, 36- and 24-inch pipe for this project. A special "s-curve" fitting was recently manufactured for project and is the centerpiece of the mill's hydro restoration. It is 78 inches in diameter, 30 feet long and becomes fully pressurized as it supplies 29 feet of operating head to the hydro turbine.

A wide variety of fiberglass fittings for non-pressure and pressure applications are available from HOBAS Pipe USA. Fittings include elbows, tees, wyes, laterals, reducers and flanges, but almost any mitered fitting can be constructed. The fittings are manufactured with the same materials as the pipe. This means you receive all of the benefits of HOBAS such as corrosion resistance and high stiffness design.