FEATURE

Facility Consolidation Made Feasible Through Microtunneling

How Microtunneling is helping Houston achieve project goals for deep gravity sewers

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Chelford City Diversion Program

The City of Houston (City), like many cities across the country, is working to improve resiliency and reduce operations and maintenance costs. One project to help accomplish this goal involves a large-scale facility consolidation on the City's west side.

The project's primary objective is to divert flow from the Chelford City Municipal Utility District (MUD) Wastewater Treatment Plant (WWTP) via deep gravity sewer to an existing City WWTP facility that has capacity to process current and projected future flows.

Akkerman SL 38 Slurry Microtunnel Machine

As a direct result of this project, the City will be able to consolidate nine lift stations, significantly reducing their operations and maintenance costs. Due to the substantial development in this service area, the project was designed to use microtunneling to facilitate construction. The project alignment is more than 26,000 lf and pipe sizes range from 8 to 60 in. in diameter.

THE BACKGROUND

To increase resiliency, the City has elected to construct a corrosion-resistant system, including fiberglass-reinforced polymer (FRP) pipe, polymer concrete manholes, and composite manhole frames and covers. According to city project manager Raghad AlHajj, E.I.T, (PM), "While these materials include an increased capital cost, they will significantly reduce long-term maintenance costs and provide an increased useful service life."

City of Houston residents will see benefits primarily from the reduced operations and maintenance costs due to the elimination of nine lift stations. "This saves capital costs of equipment, labor costs for operators, and electricity costs associated with operating the pumps and other electrical equipment at each facility," AlHajj added. "Additionally, the City of Houston will save $600,000 a year in the annual fee it was paying to the M.U.D. for the treatment of its wastewater. Facility consolidation also reduces the risk of lift stations being damaged or becoming inoperable during natural disasters."

Houston Public Works and Lockwood, Andrews & Newnam Inc. (LAN), along with other design consultants utilized a thoughtful and methodical approach to review the plans for the lift station consolidation. Construction considerations for this project included installation means and methods, traffic control, ease of installation, and future construction connection. Additionally, items such as sewer depth, manhole spacing, maintenance traffic impacts, material lifespan, and maintenance access were evaluated to identify the most advantageous materials and methods of construction.

"Due to the depth of the sewers, 25 to 30 ft deep, a heavily congested corridor laden with existing utilities, and the involvement of major traffic arteries, this project would not be feasible without the use of trenchless technologies," AlHajj continued. Therefore, trenchless construction methods are being utilized to the greatest extent possible and practical throughout the project.

MICROTUNNELING IS THE ANSWER

The trenchless methods evaluated were Microtunneling, Pilot Tube Guided Boring, and hand minding. All three methods were

Hobas FRP Jacking Pipe

identified as acceptable and are being utilized. Hand mining is being used in sensitive areas, such as in the connection points between projects.

Package II, designed by LAN, involves 7,400 lf of 36-in. microtunnel underneath Richmond Avenue, one of Houston's most heavily traveled east-west thoroughfares. The project also includes approximately 2,300 lf of 18-in. pilot tube guided bore on Westhollow Drive, another heavily traveled street, which is in both a residential and commercial corridor.

Applicable piping materials for microtunneling, pipe-jacking and pilot tube auger boring include: FRP pipe, extra strength vitrified clay pipe (VCP), or plastic-lined reinforced concrete pipe (RCP) for sanitary sewers. In some applications, ductile iron pipe (DIP) may be considered as well but was not included in this project evaluation due to the desire for a corrosion-resistant materials. Based on the City's previous experience using plastic-lined RCP, where liners began to fail three years after installation, and concerns with the brittleness of vitrified clay pipe during construction, FRP pipe was identified as the preferred pipe material. FRP's primary benefits in the application is its resistance to corrosion in typical sanitary sewer environments, high strength without being brittle, and no chance for liner failure. For this type of environment, two types of FRP can be considered: centrifugally cast and filament-wound. Both are supplied in classes suitable for installation by trenchless methods, though filament-wound FRP requires much more raw materials to reach the same compressive strength required for tunneling applications.

No-Dig VCP Jacking Pipe

For small diameter sections, where sufficient materials competition was not available, extra strength VCP is also allowed as an alternative to FRP.

Materials and installation of manholes were another critical consideration. Due to the depth, locations and desired corrosion resistance of the proposed manholes, polymer concrete was selected as the preferred material. During the evaluation process, FRP manholes were considered, however, current City specifications do not allow the use of fiberglass manholes under paved areas.

Ultimately during design, FRP and extra strength VCP were recommended as the most suitable pipe materials, while Precast Polymer Concrete was specified for all manhole structures. These materials were selected based on their long-life span, reduced maintenance costs, and applicability to microtunneling.

CONTINUED EVALUATION

While extensive research and coordination to identify the proper materials for these projects occurs during the preliminary and final design, it is also important to continue that coordination well into construction. During project construction, the contractor requested several manhole modifications. Due to the cost, weight, and lead times on precast polymer concrete manhole bases, the contractor requested the use of an FRP T-base encased in reinforced concrete, in lieu of the standard precast manhole base section. "Doghouse" manholes were also used as an alternative to full precast base sections to decrease material lead times. ("Doghouse" manholes are constructed around an existing pipeline or utility without disrupting its service.) The risers remain Polymer Concrete and will be doweled into the reinforced concrete block.

To strive for the best outcome, additional research and coordination is required between design engineer, owner, contractor, and construction manager to evaluate substitutions. In this case, the goal was to identify if the substitution provided an equivalent product to the specified manhole while balancing the required installation challenges. Ultimately, the City approved modifications based on the following factors: ease of construction, future access requirements, and equivalent lifespan to the originally specified manhole. Material selection remains an ongoing process throughout construction as the owner, engineer, and contractor work collaboratively to deliver the most beneficial project.

The contractor is utilizing an Akkerman SL 38 Slurry Microtunnel Machine, with a closed face to complete the 36-in. pipe portion of the project, which is currently under construction. The budgeted construction cost of the project is approximately $18 million.

Jordon Thomas-Harris, P.E., with Lockwood, Andrews & Newnam, Inc. (LAN) is experienced in designing a variety of municipal infrastructure projects with a specialization in wastewater collection systems and treatment facilities. He has worked extensively on lift stations and gravity sewers and holds NASSCO MACP, PACP, and LACP certifications.