A city's renaissance

Garret Richardson on upsizing a dilapidated sewer in a tricky residential area

INNOVATIVE construction techniques can provide solutions to the problems of decaying underground infrastructure seen in many cites in the developed world.

A typical example is Riverside, California, US, which recently solved a challenging design problem by combining a traditional material with new installation techniques.

Riverside's wastewater-collection system comprises 1,392km of pipelines, serving a population of 300,000 and transporting approximately 117ML daily. A section of sewer line in a densely populated downtown area needed urgent replacement, and the city needed to overcome several design obstacles.

The Downtown Sewer Main Replacement scheme is part of the Riverside Renaissance, a US$1.57 billion investment in the community and the most ambitious programme in Riverside's history.

The decayed sewer, installed in the 1930s, flowed beneath narrow alleyways that were between residential buildings. Upsizing the existing 150mm pipe to 200mm would form part of the installation process.

However, using an open-cut installation technique in such a situation would have caused disruption to several streets in the neighbourhood and blocked residents' traffic access, while the layout of the houses meant that any open excavations would be narrow and difficult.

In addition, most of the buildings were multi-unit residences and disruption to their wastewater services needed to be kept to a minimum, so time was also a major factor. Because rerouting the pipe during the work would have been impractical, it was crucial that the line was returned to full service at the end of each day.

These conditions favoured a fast, no-dig technique to minimise disruption and result in a cost-effective rehabilitation. And given the requirement to upsize the pipe, the city chose pipe-bursting as the preferred method, replacing the existing pipe with a new vitrified clay pipe (VCP) that has a service life of at least 200 years.

Machine manufacturer TT Technologies, co-ordinating with VCP manufacturer Mission Clay Products (MCP), designed a static pull pipe-bursting machine capable of installing segmented clay pipes. TT Technologies and the US's National Clay Pipe Institute worked closely – at the design stage – with Riverside's engineering division, offering advice and technical expertise on both method and material.

Clockwise from top left: manoeuvring, inserting, pull-through and bursting

"Partnership and communication between the city, equipment manufacturer, material supplier, and contractor is important," says Bryan Vansell of the National Clay Pipe Institute. "That was something that was really a positive on this project. We all learned a lot from each other."

The city released the 'Downtown Sewer Main Replacement by Pipe Bursting Method' project for bidding. The scheme comprised around 700m of sewer, and specified that VCP was installed by static pipe bursting. The engineers' estimate was US$693,000, and Arizona Pipeline Co (APC) of Corona, California, was awarded the contract with a bid of US$630,866. Construction began in early 2009.

Mission Clay Products supplied its No-Dig VCP jacking pipe in 1,500mm lengths, with 316 stainless collars and EPDM rubber compression gaskets. APC used TT Technologies' Grundoburst 800G static burst machine.

The hydraulically operated machine pushes interlocking steel rods backwards through the existing pipe, from the receiving pit to the launch pit. In the launch pit, the bursting head and expander are attached to the bursting rods.

The rods are fitted through each new No-Dig clay pipe joint to follow, and the segments of pipe are held in compression behind the expander by a hydraulic end plate that fits behind the end piece of the pipe train.

The expander and new pipe are pulled back toward the receiving pit, bursting the old pipe and displacing the fragments into the surrounding soil. The equipment's jobsite footprint above ground is minimal, and was further reduced by the use of the stacked segments of clay pipe.

Although proper geotechnical investigation is always vital on any trenchless project, there were no particular geotechnical issues in this case.

The multi-unit residences lining the alleyways resulted in a high concentration of laterals, which can be prohibitive for a trenchless project.

The lateral reconnections showed the critical problem of working time: in order to keep laterals in service for residents throughout the duration of the project, the contractor was required to reconnect all laterals for each newly-burst and installed section at the end of each business day. The contractor would complete a pipe-bursting section, make small excavations at each lateral point, and reconnect them all in a day.

In another example of the collaborative effort between city and manufacturers, a more rapid way of accomplishing this was developed using a core drill and Mission Clay's TwisTee tapping saddle. Once holes were cored in the mainline pipe, the EPDM rubber saddle and ABS tee were installed by hand in seconds.

Lying at a typical depth of around 2.4m, the 70 sewer laterals could be excavated more easily, otherwise, they would have posed too much of an obstacle. But, Lonny Young, city of Riverside senior engineer, says: "The high number of laterals did pose a problem. But one real positive was that after the contractor's learning curve with the new method, I would say it was 30% faster, or more, than open trench."

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