Southern African Society for Trenchless Technology P O Box 13048 CLUBVIEW 0014

SASTT NEWS – JUNE 2009

Editor: Joop van Wamelen, PrEng Tel: +27 (012) 567 4026 Cell: 074 416 4811 E-mail: director@sastt.org.za

Home page: http://www.sastt.org.za

Fisantekraal bulk sewer installation: 1000 mm dia steel pipe installation by means of pipe ramming

by Neil van Rooyen, TT Innovations (Pty) Ltd

Introduction

Martin and East was awarded a tender to install an 800 mm GRP bulk-sewage pipeline in Fisantekraal, located on the outskirts of Durbanville, Western Cape. The project included the construction of a pump station and wastewater treatment works. At the inception, the contractor knew that the roadway crossing would be once of its greatest challenges. A trenchless solution was required as open-cut excavation would be impractical. A specialist contractor, TT Innovations, was approached to provide a feasible trenchless solution.

Work in progress

Why go trenchless?

Considering the nature of the contract, which largely comprised open-trench excavation, the contractor had a fair assessment of what the cost implications were for installation by this means. The design depth of the installed pipeline was approximately 3 m below natural ground level. The elevation of the roadway which needed to be crossed further complicated the exercise. The direct costs are easily determined but the unforeseen and indirect costs are often difficult to calculate. This roadway is used as thoroughfare for both farm owners and businesses as well as the local community. Installation of this pipeline by means of open-trench excavation would disrupt traffic routes and would be too expensive and impractical.

The environmental impact of open-trench excavation of this magnitude would be significant and not feasible for a 50 m pipeline installation. Health and safety considerations associated with deep excavation also influenced decision making.

Considering all the risks, effort and costs for the installation of 50 m of pipeline, a safer, more efficient and innovative solution was sought. It was clear that trenchless technology provided the solution with the only consideration being which technology to implement.

Having just acquired a Vermeer D36/50 directional drilling rig, the initial response was to install the 800 mm diameter pipeline using this rig. After further consideration, taking into account critical and flat gradients, it was decided to make use of pipe ramming as the trenchless solution.

A 1000 mm diameter steel sleeve would be installed and serve as the conduit for the 800DN HDPE sewer pipeline. The HDPE pipeline would then be joined to the GRP pipeline at both ends.

Equipment

To facilitate the installation of such a large diameter pipe, a 24 inch pneumatic rammer was bought. This rammer is considered to be the largest of its kind in South Africa.

The pipe ramming process, unlike other trenchless techniques which use innovative and complex systems, relies on brute force. The ramming process can be summarised into four steps: procurement of materials, site preparation, installation of the steel sleeve and finally the installation of the product pipe.

The implementation of the job

Procurement of materials

A steel sleeve with a wall thickness of 16 mm was used, which was strong enough to withstand the impact force exerted by the pneumatic rammer. The engineer also specified a corrosion-protection lining to be applied to the exterior surface of the steel pipe.

This lining was applied at the factory, leaving the steel pipeline with a smooth outer surface. The completed steel sleeves were then transported to site in 12 m lengths.

Site preparation

The job required an excavated trench as well as a concrete slab. The excavation was long enough to house a 12 m length of steel sleeve as well the pneumatic rammer attached to the rear of it. A concrete slab was then cast and a 12 m steel I-beam placed on top of it. The concrete slab and I-beam were set to the correct alignment and gradient of the pipeline. The steel sleeve was positioned on top of the I-beam which served as the “rail” on which the pipe moved. Concrete strength and quality were carefully monitored as any deflection in the concrete slab or rail would lead to a misalignment during installation. The rammer alone weighs approximately 5 tons!

Installation of the steel sleeve

Once the steel pipe had been lowered into position and set on the rail, the pneumatic rammer was attached to the rear of the pipe by means of interlocking metal disks called collets. Two air compressors producing a combined airflow of 1750 CFM were used to power the rammer. A hammer action inside of the rammer assembly provides the kinetic energy which drives the steel pipe forward into the soil. This hammer action occurs at a rate of approximately 177 blows per minute when set at maximum, delivering 1010 tons per blow. The process continued until the required length of pipe had entered the soil. Consecutive lengths of pipe were then set in position and welded to the rear of the installed pipe. The rammer was then re-attached to the rear of the newly welded pipe and the ramming resumed. This project required a sleeve length of 44 m. Once the steel sleeve was installed, compacted material from the inside of the pipe was removed, leaving the sleeve ready for the product pipe.

Installation of product pipe

The 800 mm diameter HDPE pipe which was welded into a complete length totalling 46 m was tested to operating pressure before being ready for installation. A directional drilling rig was then used to pull the HDPE product pipe into the steel sleeve. The HDPE pipe was connected to the GRP pipeline at both ends leaving the annulus between the HDPE and the steel sleeve to be grouted if required, once the installation was complete.

"Hold still now... Well done guys, you did it!"

The spin-offs for trenchless technology

Using pipe ramming as a trenchless method not only allowed for a quick and problem-free installation, it also allowed the trenchless contactor to pursue new avenues of trenchless technology. This in turn will make the implementation of future ramming projects more cost effective. Such implementation of innovation allows the South African market to benefit from well-researched techniques as this type of process becomes more widely used in South Africa.

Many municipal officials and engineers also benefited from this project as the ramming installation was well broadcast and publicised amongst these professionals. Future planning and decision making can now benefit from the use of pipe ramming as key decision makers are introduced to and understand the concepts of trenchless technology.

Last but not least, a final spin-off was that this project received the *SASTT Award of Excellence* for 2008, in the face of stiff competition from a number of meritorious projects.

Technical data

Project summary

- Reason for installation: bulk sewer pipeline crossing road way
- Project start date: 3 September 2008 (commencement of ramming)
- Type of service installed: bulk sewer rising main
- Pipe material: HDPE class 6 (800 mm dia)
- Steel sleeve: Spirally wound steel, 1010 mm outside diameter, 16 mm thickness
- Trenchless method used: pipe ramming
- Length of rammed pipe: 44 m
- Length of installed product pipe: 46 m
- Depth of installed pipe: approx 10 m below road level
- Time required to complete installation of 44 m sleeve: 3½ weeks (including welding and rain delays)

Considerations and precautions

- Adjacent 300 mm diameter water main in excavation area
- Entry pit located at the toe of a steep embankment - increasing the risk of slope failure resulting from excessive vibration caused by ramming action
- Insitu soil condition under the roadway largely unknown

Pneumatic rammer

- Size: 24 inch Hammerhead pneumatic rammer
- Dimensions: length 3 m, mass 4,5 tons (excluding steel collets)
- Impact force: 1010 tons of force per blow
- Rate of blows: 177 blows per minute at maximum capacity
- Compressor requirements: 1750 CFM at 7,6 bar pressure

Steel sleeve specifications

- Diameter:1030 mm ID
- Thickness: 16mm
- Grade: SANS 1431 Grade 300 WA (manufactured in Gauteng)
- Special treatment: Powercrete PW/DD coating, 1 mm thick
- Length: 44 m in total, manufactured in three 12 m lengths and one 8 m section

The role players

- Client: City of Cape Town
- Consulting engineers: Ninham Shand
- Engineer: Stephen Kleynhans
- Main civil engineering contractor: Martin and East
- Specialist subcontractor: TT Innovations