As part of a flood alleviation project in the Thundersley area of Essex, UK, Lancashire-based Tunnel Engineering Services (UK) Ltd of Oldham recently provided the latest in microtunnelling technology innovation from US-based systems manufacturer Akkerman, Inc., to the project contractor. The new system is known as the Pilot Tube Microtunnelling Technique (PTMT) or Powered Cutter Head.

The project, known as S0103 Flooding, SEW-05097 Thundersley, Westwood, Flood Alleviation, was being undertaken by Barhale Construction plc as part of the @one Alliance AMP 4 delivery for Anglian Water. The project was designed to alleviate potential flooding problems for some 20 properties in the village of Thundersley.

**PLANNING**

After careful consideration of the circumstances in the vicinity of the project, Barhale decided that the best option for installing two new 450 mm i.d. clayware pipelines, which were required to pass beneath two roads and some of the residential properties, was to utilise a microtunnelling technique.

Ground investigations over the proposed bore routes were carried out using percussive borehole techniques which showed the ground conditions comprised firm clays. This confirmed that microtunnelling was indeed a viable option.

Given the diameter of the new pipelines required, it was further decided that a pilot auger boring technique was applicable. This was due, in no small part, to the fact that both bores were only to be about 50 m in length. This length would have meant that establishing a standard microtunnelling operation would have carried a much greater cost. The 450 mm i.d. clayware pipes used for both installations were provided by Naylor Drainage of Barnsley, Yorkshire.

**PILOT TUBE MICROTUNNELLING (PTMT)**

The difference between standard pilot auger boring system and the new Pilot Tube Microtunnelling Technique (PTMT) employed on the Thundersley project is that, subsequent to the installation of the guided pilot bore and an initial expansion of the bore diameter with a reaming head and auger chain, the final ream to the pipe diameter and installation of the jacking pipe is achieved using a powered microtunnel cutter head.

The PTMT system is designed for use by contractors installing pipe in diameters from 500 mm (20 in) outside diameter up to 1,220 mm (48 in) outside diameter. The PTMT operates in a three-pass process. Using the Akkerman Guided Boring Machine (GBM) frame and guidance system, first the pilot tubes are installed. Second, the bore diameter is increased by installing temporary casings and augers. The third step is accomplished by installing the powered cutter head behind the temporary casings and reversing the auger flow toward the reception shaft.

After the powered cutter head is connected to the hydraulic supply of the power unit, it is thrust into the soils and its rotating cutter bit excavates the soil to the final diameter needed for the product pipe. The spoils are transported through the temporary casings to the reception shaft and new pipe sections are added in the launch shaft as needed. When the cutter head reaches the reception shaft the hydraulic supply

![A schematic of the three-stage operation required for the installation of a pipeline using the PTMT technique.](image_url)
hoses are disconnected and removed from within the pipeline. The cutter head is then lifted from the reception shaft signalling the completion of the bore.

The PTMT range is designed to offer more power to the cutter head face. It is also designed to work with a variety of guided and auger boring systems. The powered cutter head offers more flexibility in soil conditions for rapid and accurate bores. The jetting ports in the cutter face attach to a single hose that distributes water to its four nozzles. The three pipe lubrication ports, located in the rear of the machine, reduce jacking force. Similar methodologies in pilot tube microtunnelling use a reaming head and a single motor for breaking up and removing spoils at the cutter face. This process limits use in many ground conditions and increases jacking force. Akkerman’s powered cutter head units use independent cutter face and auger drive motors for lower jacking force and a faster advance rate.

THUNDERSLEY INSTALLATION OPERATIONS

The two bores on the Thundersley project were completed between July 2008 and May 2009 to fit in with other construction operations being undertaken as part of the remainder of the flood alleviation project.

The first installation which was 50 m in length took a total of 12 days to complete. The process comprised the pilot bore, which was completed in 1 day. The pilot bore was guided by the Akkerman guidance theodolite system to establish the required line and level of the pipeline. The second phase of the installation was expansion of the bore to 230 mm (9 in) diameter using the auger/reaming head and auger or thrust casings. The final phase utilised a 610 mm outside diameter powered cutter head system to open the bore to the full extent required to jack into place the 450 mm internal diameter clayware pipe. This final phase took a total of 6 days to complete.

The second bore which took place in 2009 was some 47 m long. In this instance the pilot bore took 1 day to complete as previously. However, the auger phase and the powered cutter head phase took 3 and 4 days respectively. Again the 610 mm diameter powered cutter head system was utilised.

The improvement in production from the first bore to the second was put down to the increasing experience of the operators who, as they became more and more familiar with the unit, were able to improve productivity by standardising operations particularly at pipe changes. This was despite the fact that pipe storage facilities were around 1 km (½ mile) from the shaft sites on both drives due to limited site storage space. Pipe transport and availability at the machine were therefore vital components in the logistics of the project’s progress. Ultimately both bores were completed on time and in budget to the satisfaction of all parties concerned with the project.

Commenting on the project Terry Warrie site agent for Barhale said: “Considering this was the first time this method had been used in anger in the UK by all involved, this aspect of the project was very successful. The productivity of the system increased dramatically as the operatives perfected the work method.”

For the equipment provider, Tunnel Engineering Services, Geoff Clarke, managing director said:
“This was an excellent first project for the new PTMT system in the UK. We have an excellent working relationship with Akkerman, Inc. and have represented the company in the UK for many years. Our combined expertise in trenchless applications of this kind means that we can provide not only superb planning, technical know-how and back up should it be needed, but also the latest technology, all at a good price.” Website: www.tesuk.co.uk

Collecting and removing spoil generated by the advance of the powered cutter head unit in the ground at the reception shaft.