

Guided Auger Boring in South America

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Introduction

Bohrtec is a worldwide known manufacturer and supplier for Guided Auger boring machines and equipment. Since 30 years customers trust in the quality of Bohrtec machines. Meanwhile 1 million meters of sewers and other lines were installed by using Bohrtec machines for trenchless installation. Especially in bigger cities the trenchless method is the method of choice when to avoid or reduce traffic jams and other influences on infrastructure while installing new supply lines.

Guided Auger Boring or Pilot Pipe Jacking is a trenchless method for installing pipes in the ground. There are two different categories of Pilot Pipe Jackings: one with soil displacement and one with soil removal, known also as the Front Steer Method.

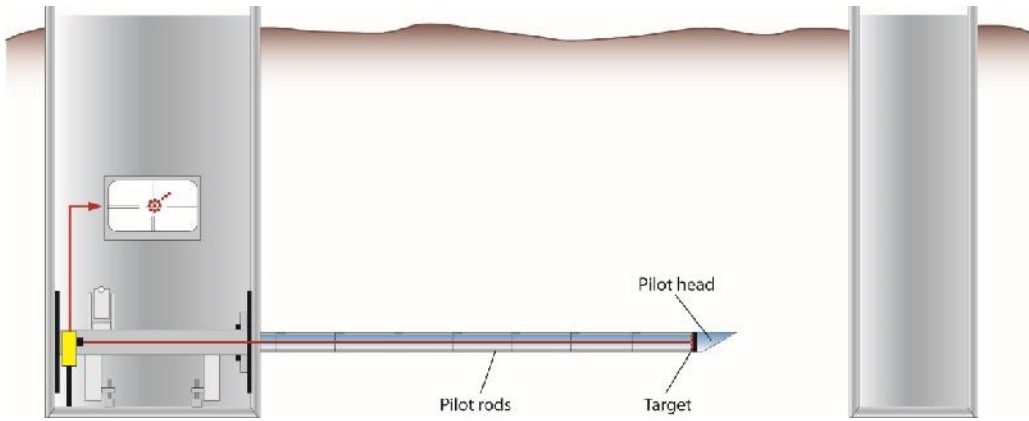
These two methods are different solutions for different ground conditions. The Pilot Pipe method is suitable for soft and displaceable soils. The Front Steer method is suitable for harder ground conditions up to hard rock.

Based on the information of the ground conditions the contractor has to decide which method will be the most suitable. To avoid problems or claims the owner of the project has to investigate the ground as best as possible.

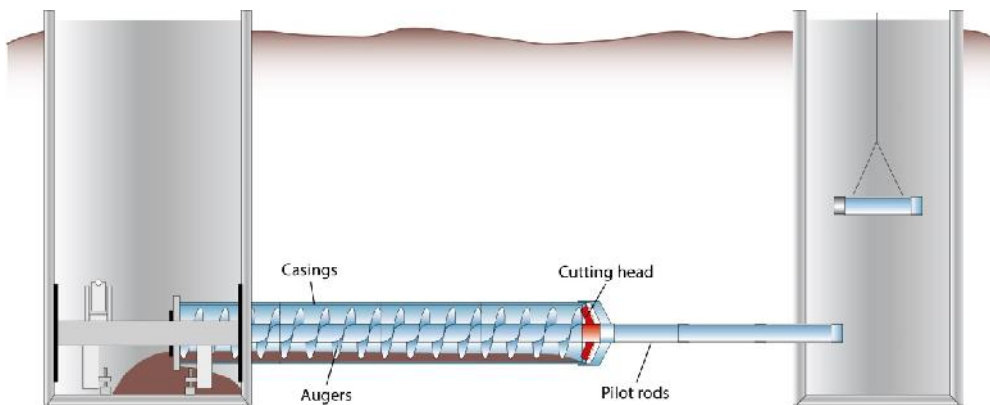
Pilot Pipe Jacking with Soil Displacement

The Pilot Pipe method is a very simple method for trenchless installation of supply lines. It is done in several steps:

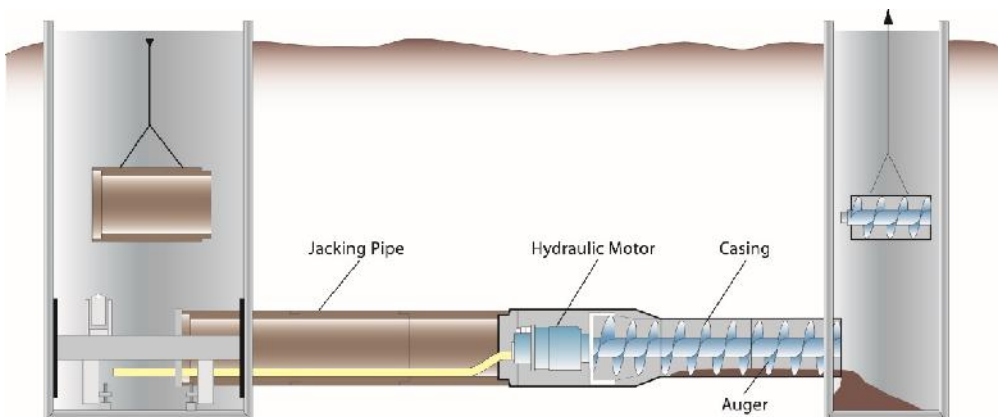
In the 1st step a Pilot Pipe is jacked into the ground. The pilot pipe has an OD up to 114 mm. The steering is done with a chamfered pilot tip.



In the 2nd step a first extension with steel pipe casings is connected to the pilot string. The excavated soil will be removed by augers in the casings. The soil is transported to the starting shaft.



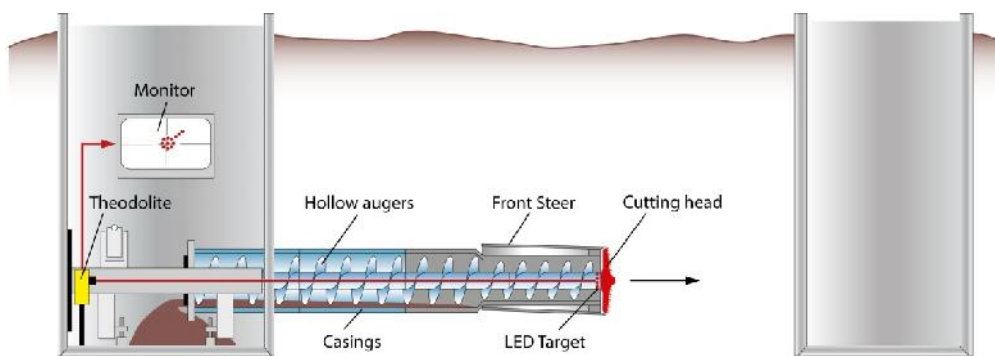
In the 3rd step the final product pipes are pushed behind the steel casings or a hydraulic driven second extension is used for bigger product pipes to extend the hole in the ground to the desired outer diameter (OD) by transporting the soil into the target shaft.



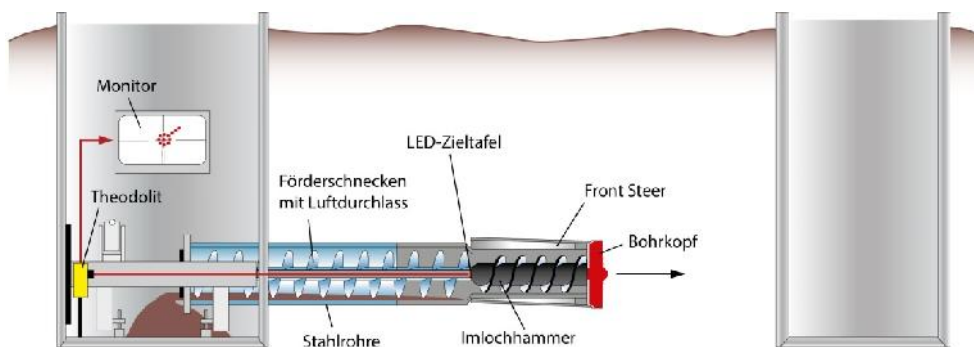
The pilot pipe method is limited to ground condition with SPT values smaller than 35, with no cobbles bigger than 80 mm, with ground water less than 3 m above invert and a drive length less than 100 m.

Pilot Pipe Jacking with Soil Removal

If not only single but more obstacles are expected or if the ground is not displaceable like soils and rock up to 40 MPa the choice would be to switch to the Front Steer system. With the Front Steer system the soil is immediately excavated by the cutting head, removed by the augers and any correcting of the drilling direction is done by the outer steering pipe of the Front Steer.



In case of very hard ground like rock up to 250 MPa the Front Steer can be equipped by a down-the-hole hammer.



The Front Steer method can be applied for all types of pipes like. In hard ground conditions it is often used with steel pipes.

The following key projects show the big advantages of the very simple pilot tube method and these project were the initial start of a very successful story of guided auger boring in Latin America.

Fontibón Oriental II, Bogota in 2007

Pilot Tube Method

In October 2006 La Empresa de Acueducto called for tenders for a project with the name „Construcción del Alcantarillado Pluvial del Fontibón Oriental Fase II”. The project plan was to lay 28.4 km new rain water sewers with nominal diameters from 300 mm through 2000 mm in Fontibón, a district in the eastern sector of Bogotá, the capital city of Columbia. About 6.4 km of the project budgeted with 60,665.00 USD were planned in conventional open trench method, approx. 16.3 km with nominal diameters of 400 mm, 600 mm and 900 mm should be laid using pilot pipe drilling and approx. 5.6 km of the nominal diameters 1,500 mm, 1,800 mm and 2,000 mm should be driven with microtunnelling machines. The project had a high political value in the capital city of Columbia, since the district of Fontibón is flooded every year during the rainy season due to the deficient canalisation.



Bohrtec BM 500 in a 3,2 m diameter launch shaft

The planning phase of the project was supported from the very beginning by the companies Herrenknecht and Bohrtec. They suggested the pilot drilling technology as an economic alternative for the max. 100 m-long drillings with small diameter (ID 400, ID 600 and ID 900) in geological conditions which mainly presented cohesive

grounds and sandy clays (displaceable grounds), two of the main conditions for the application of pilot pipe drillings. If we consider that the Bohrtec ground water auger offers since years a reliable solution for working below the ground water level, all conditions for the use of the pilot drilling technology were fulfilled. The decision between a compact or a long frame machine was taken very soon. As small starting shafts were required due to the narrow jobsite conditions a compact machine was chosen.

Early in December 2006 the order was given to a consortium consisting of the companies Union Temporal CCM (Mexico), KMA Ltda. (Columbia) and OCEISA (Columbia). Early in March 2007 the contract for the purchase and delivery of two Bohrtec pilot drilling machines of the type BM 500 was signed in Bogotá by the companies Herrenknecht AG, KMA and OCEISA. The two systems already left the factory in Alsdorf/Germany in May 2007.

The machines which are able to jack 2 m-long jacking pipes out of 3.2 m circular starting shafts are equipped with each 100 m double-walled pilot rods as well as 100 m casings Ø 419 mm with the corresponding augers. Additionally two extensions of OD 580 mm and OD 785 mm were delivered for the diameters ID 400 and ID 600 respectively.

After two weeks training, one in the factory of Bohrtec and the second one on a jobsite in Berlin August 2007, started the support on the jobsite in Bogotá. Two operators of both executing companies were instructed simultaneously on one drilling system. After finishing the first drive and after a short training period it was possible to work parallel with both machines of the companies KMA and Oceisa at the same time.

The project Fontibón in Bogotá proved impressively after a few weeks that that the trenchless technology can be used successfully on problematic conditions due to the simple and robust machinery, the process technology, the possibility of good planning and the on-site training and support.

Calle 94, Bogota, 2010

Pilot Tube Method

In June 2010, almost exactly 3 years later, again a BM 500 pilot drilling machine from the company Bohrtec was used for a new project in Bogotá.

The company Microtunel S.A de C.V received the order to renew the sewer in the street "Calle 94" from Empresa de Acueducto y Alcantarillado de Bogota E.S.P. The project with an estimated total budget of 3.5 million USD includes the new construction of 1.955 meters of sewers ID 300 and ID 400. The hydraulic performance of the existing sewer in the „Calle 94“ which is located in a residential and commercial quarter with very high traffic volume, is so much affected by root penetration, that the laying of a

new sewer is inevitable. The new sewer will be laid in the area of the outer lane, close to the walkway.

In total 1.485 m of steel concrete jacking pipes ID 300 and 470 m of steel concrete jacking pipes ID 400 will be laid in a depth between 3 and 4 m. 14 starting shafts and 16 target shafts have to be built in total.



Site Setup Calle 94, Bogota

Since the drilling lengths with a max. of 100 m are relatively short and the ground on site is comparatively soft, the project is virtually ideal for pilot tube microtunnelling. Furthermore the pilot pipe technology is characterized by short set-up times and low efforts for the preparations on-site. Like this a minimum effect on the traffic in the residential and commercial quarter of the Colombian metropolis around „Calle 94“ could be guaranteed.

The company Microtunel S.A., an experienced user of microtunnelling slurry machines, used a BM 500 from Bohrtec for the project in Bogotá. Regarding the pipe diameters of ID 300 and ID 400, a BM 400 would have been sufficient. Nevertheless Antonio Torres, owner of Microtunel S.A., decided to buy a BM 500, because he plans to jack pipes with OD's of up to 1000 mm in the future with this machine, which is designed for a 3.2 m standard jacking shaft.

Due to the soil conditions on site (soft clay), contractor and machine manufacturer decided together for the so-called 3-phase procedure. First the guided pilot drilling is performed followed by the first extension step with steel casings Ø 279 mm. In the third step the drilling is reamed up to the OD of the jacking pipes. The excavated soil is transported to the reception shaft. This process technology allows for covering different jacking pipe diameters with only one set of steel casings.

As in the year 2007, when pilot pilot tube microtunnelling was successfully used in Bogotá in the quarter of Fontibón for the first time, also the project „Sewer Renewal on the street Calle 94“ has proved that sewers with small diameters can be laid extremely economically even in short drilling lengths due to the simple machine and process technology.

Sewers for the new treatment plant in Quitumbe, Ecuador, 2015

Pilot Tube Method and Front Steer Method

The houses in the comparatively poor borough Quitumbe, in Quito's southern part, did not use to be connected to the public sewer system. The wastewater was led into creek Ortega (pic. a) and flowed from there via creek Shanshayacu into the river Machangara. To ease these unpleasant and in times of flooding – in Quito there are 1.000 mm of rainfall mean per year – uncontrollable situations, Quito's urban drainage authority (EPMAPS: Empresa Pública Metropolitana de Agua Potable y Saneamiento) decided to build a modern sewage treatment plant.

The goal was to collect the wastewater from creek Ortega and to lead it controlled to the about 1km distanced treatment plant. Therefore, new drains ID 400 and ID 600 had to be built along the Avenida Guayanay up to 8 m underneath the ground.

Because of the depth and to keep the disturbance of the Avenida Guayanay, which is a highly used arterial road, at its minimum, the designing consultant Lotti decided to take a trenchless technology (pipejacking) for the construction. GRP Hobas jacking pipes were put out to tender.

In Oktober 2013, company. Eseico, resident in Quito, got the job for the whole project with a volume of about 12,5 Mio USD consisting of the sewage treatment plant and the sewers. Eseico did not have any pipe jacking experience at that point in time. However, the company management decided not to subcontract the tunnelling work.

Due to the varying soil conditions (partly displaceable and partly not displaceable) and due to the different diameters of the Hobas jacking pipe two different procedures were available (see pictures 1 and 2)

1. For OD 616 mm: 3-step-procedure; piloting and extension with steel casings 406 mm and subsequent hydraulically powered extension from 406 mm to the outside diameter of the Hobas jacking pipes
2. For OD 401 mm: 2-step-procedure; with Front Steer with steel casings 406 mm. and pushing these out by the Hobas jacking pipes with the same OD.



Bohrtec BM 400 LSC with hydraulic driven extension



Bohrtec BM 400 LSC with Front Steer

The Project in Quito impressively showed the advantages of a flexible usable machine and process engineering. The way Eseico uses the advantage of the BM 400 LSC: utilising different diameters as well as completely different drilling methods applying to the pilot drilling technique and the Front Steer with only one set of steel casings.

Conclusion:

The pilot tube and also the Front Steer method are applicable to a wide range of ground conditions and for almost all kinds of pipe material.

The Bohrtec guided Auger Boring methods are robust, affordable, easy to handle and unbeatable accurate.

Beside the methods mentioned in the Latin America key projects there are a lot of different applications of the Bohrtec auger boring equipment available, like trenchless laying of plastic pipes with a high precision and drainage applications.

Furthermore with the Bohrtec Front Steer system and down-the-hole hammer most accurate pipe jackings even in hard rock are possible.