TERRATEC

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Microtunnelling Systems

Microtunnelling Technology

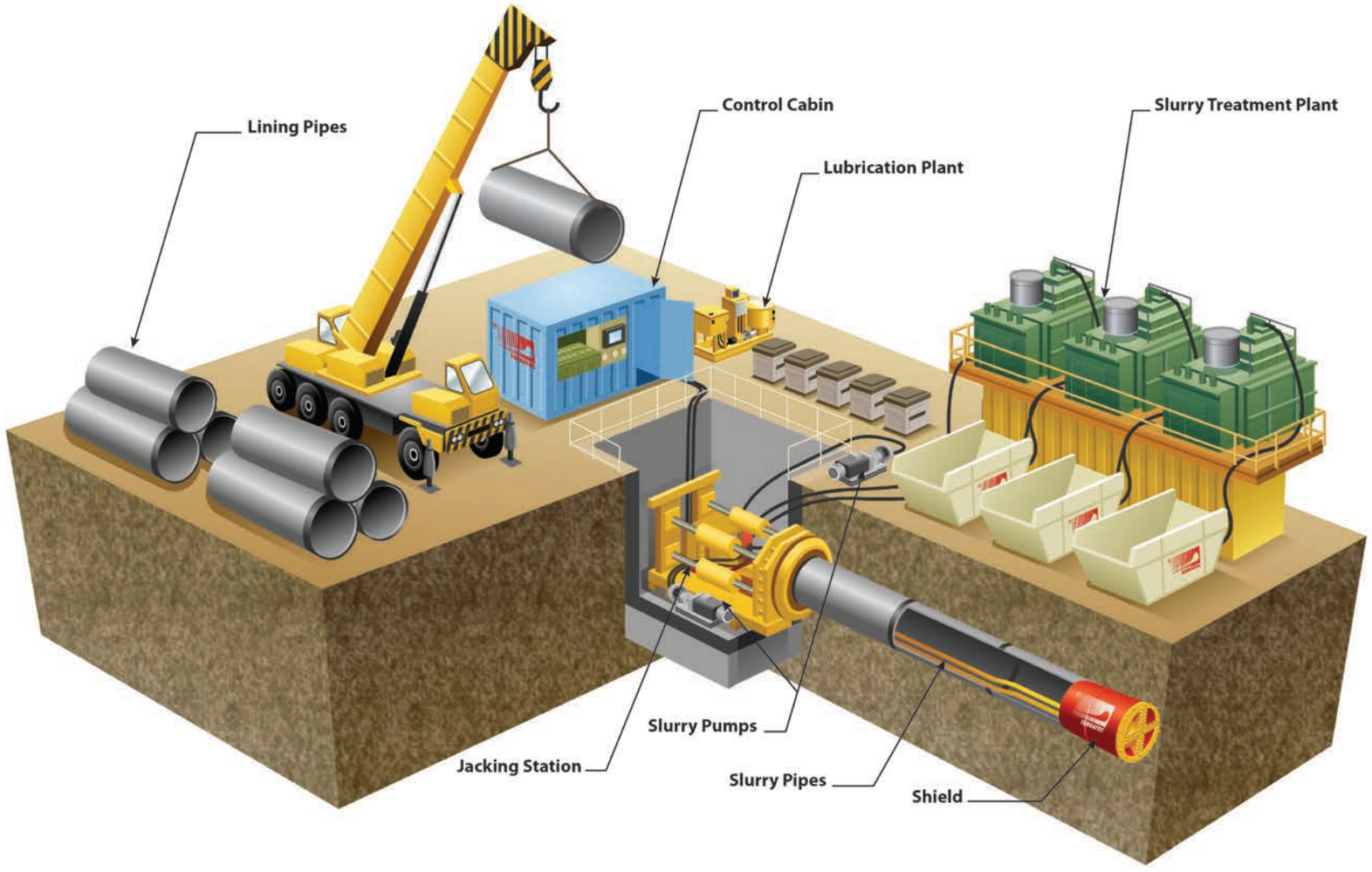
Microtunnelling, or Pipe Jacking Method, is a trenchless solution for constructing small diameter tunnels, used especially for projects that require the tunnel to cross under dense traffic roads, railways, rivers, etc.

This method minimizes disruptions on the surface during the tunnel construction in comparison with traditional open trench method, and there is no requirement for personnel inside the tunnel during operation.

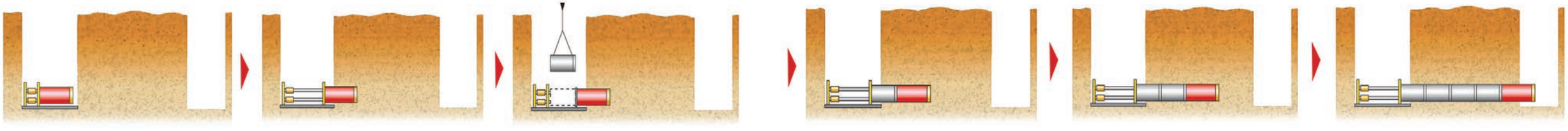
This technique installs concrete Pipes, by a Pushing or Jacking Frame installed in the Launching Shaft. A special Boring Machine or Shield, called the Micro Tunnel Boring Machine (MTBM), is attached to the head of the Pipe that follows the path of the tunnel as it is being bored.

Main applications of Microtunnelling are:
- Sewerage Networks
- Drinking Water Networks
- Communication and Power Supply Networks

TERRATEC MTBMs are suitable for the construction of tunnels with an inner diameter ranging from 500mm up to 2,800mm. However, for tunnels requiring an inner diameter bigger than 1,800mm the construction can be undertaken by Shield TBM, installing segmented concrete lining with an Erector Arm.



PIPE JACKING SEQUENCE



STEP 1
Load MTBM into the Jacking Station at launching shaft.

STEP 2
Extend Hydraulic Jacks to push the MTBM into the ground.

STEP 3
Retract Hydraulic Jacks and loading a pipe into the Jacking Station.

STEP 4
Extend Hydraulic Jacks allowing the MTBM and Pipe to advance simultaneously.

STEP 5
Repeat Step 3 and 4 until reaching the arrival shaft.

STEP 6
MTBM breakthroughs at the arrival shaft.

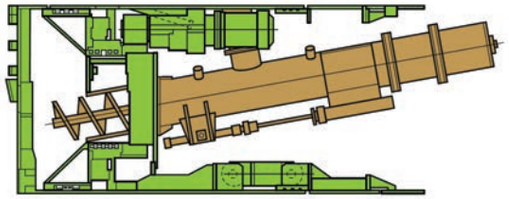
Microtunnelling Technology

SHIELD

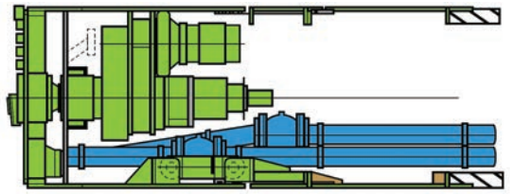
For projects under water condition, TERRATEC Microtunnelling TBM can be Earth Pressure Balance (EPB) or Slurry Type. The first one removes the spoil from the face through a Screw Conveyor, whereas the second one by pumping it.

For projects to excavate in rock without water pressure, Open Mode excavation is adopted for the MTBM, making the evacuation of the spoil trough a Hopper that feeds a Belt Conveyor.

For tunnels with inner diameter less than 1,500mm, the microtunnelling works are performed only with Slurry Shield, due to space restrictions.



EPB Type MTBM



Slurry Type MTBM

CUTTERHEAD

Despite microtunnelling technique is best deployed in cohesive soil, modern face supporting methods are available to manage a wide range of ground conditions.

TERRATEC MTBMs can effectively deal with a variety of conditions, including:

- Cohesive or non-cohesive soils,
- Dry or watery conditions,
- Hard rock or soft ground, and
- Mixed composites, including cobbles and boulders.

Due to these varied environments, each CutterHead is designed according to the Geological Conditions. For soft grounds it mounts some Scrappers and Blades, while for rocky grounds the CutterHead will mount Roller Disc Cutters, which can be Single, Double or Triple.

TUNNEL LINING

The inner diameter of installed pipes ranges from 500mm to 2,800mm.

These pipes are commonly fabricated as Reinforced Concrete (RCP), Glass Reinforced (GRP) or Steel Casing. Other options such as Polymer Concrete, Clay, and Ductile Iron are occasionally adopted.

The Pipes have a working length of 2m or 3m. Between them, there is a “Collar” which can be internal or external and made of steel or PVC. This Collar seals the joint between the pipes ensuring that the finished tunnel is water tight.

SPOIL TREATMENT

The evacuation of the muck from the tunnel face up to the Launching Shaft can be done by Sludge Pump or Trolley Muck Car (in the case of EPB Shield), by Recirculation Pumping System (in the case of Slurry Shield), or by Belt Conveyor (in the case of Open Shield).

In the case of Recirculating Pumping System for the Slurry MTBM, it is necessary to install a Separation Tank (the simplest case) or a modern Slurry Treatment Plant.

ALIGNMENT

The MTBM advances due to the thrust provided by the Jacking Frame in the Launching Shaft. The stress is passed through the pipes as they are installed according to the progression of the MTBM. The pipes have a working length of 2m or 3m.

The maximum distance covered in one single drive by a MTBM varies in the range of 200m to 500m, depending on the diameter of the tunnel and the geological conditions. For long continuous drives, intermediate thrust jacking stations are required to be installed every 200m or 300m in order to reduce the maximum jacking force needed.

For diameters less than 1,000mm the alignment is considered straight. For diameters greater than 1,000mm, the alignments can tolerate gradual curves. The alignment of the MTBM is very precise due to its sophisticated laser guidance system and its capacity to correct the alignment by using steering cylinders which enable the head of the MTBM to be oriented.

Nowadays the pipelines constructed by Microtunnelling are more accurate and evenly stressed than those laid using conventional open trench method.

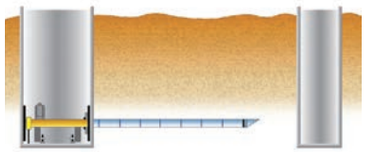
Microtunnelling Technology

HORIZONTAL AUGER BORING

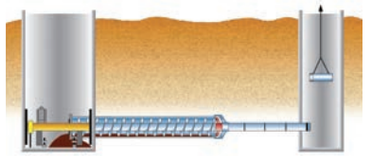
Since the conventional microtunnelling method by Pipe Jacking has been proven to be too costly for construction of small diameter and short length tunnels, the Auger Boring Method has been developed in recent years as a simple and easy-to-use trenchless alternative.

The Auger Boring Technique consists is a three-step method. At first stage a pilot hole is bored to define the tunnel alignment, after this the Pusher/Cutter Head and Screw Augers are jacked through the Pilot Hole, reaming it to the final tunnel diameter while soiling the muck out. Finally, the tunnel lining pipes are pushed through in the last step.

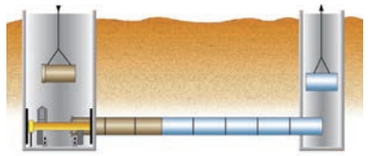
The Auger Boring Method is suitable for Connecting Sewer Tunnels that comprise a short distance of up to 100m in length and soil with SPT (Standard Penetration Test) Value N<30.



STEP 1
Bore Pilot Hole



STEP 2
Reaming and Soil-out Muck



STEP 3
Pushing Lining Pipes

TOTAL SOLUTION

TERRATEC's supply of equipment is not limited to the MTBM. TERRATEC can provide the complete Pipe Jacking System including all the Jobsite facilities:

- Slurry Transport System
- Slurry Treatment Plant
- Main Jacking Station
- Intermediate Jacking Stations
- Lubrication System

TERRATEC's in-house Engineering and Field Service Teams can assist the Client from the Planning Stage for the selection of the suitable equipment to suit the specific project needs, and for the assembly and operation of the MTBM once the actual works begin at Site.

In addition, since TERRATEC keeps an extensive Microtunnelling inventory, the company can carry out the complete Pipe Jacking Works under a subcontract scheme.

Case Study:

Project Name: BMA Nong Bon Drainage Project
Location: Bangkok, THAILAND
Year: 2012, 2013, 2016
Client: Bangkok Metropolitan Authority of Thailand
Machine Diameter: MTBM: DN1000 x 1, DN1500 x 1, ABM: DN300/600 x 6
MTBM Type: Auger Boring Machine, Slurry MTBM

Project: The Environment Reservation and Study Center: BMA 7, commissioned by the Bangkok Metropolitan Authority, involves three contracts. Contract 1 is for constructing a Wastewater Treatment Plant by Ch. Karnchang PCL. Contract 2 covers the Wastewater Collection System and Treated Water Discharge to the Canal on the North side of Bangsue District, handled by A.S. Associated Co., Ltd. (Nawarat Patanakarn PCL.). Contract 3 deals with the same system on the South side, managed by See Sang Karn Yotah (1979) Co., Ltd.

Equipment: Auger Boring Machines (300mm to 800mm) and Micro Tunnel Boring Machines (1000mm to 1500mm) were used for Contracts 2 and 3.

Execution: The completion of Contracts 2 and 3 was a significant achievement. The ABM units surpassed expectations, achieving span lengths of 100-125m, compared to the initial 70m design. This success was attributed to the effective use of ABM machines, which required less space and completed tasks faster than larger MTBM units.

Duration: The project lasted from September 13, 2011, to March 23, 2016, transporting up to 120,000 cubic meters of water per day over approximately 40km of pipe.

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