

STANDARD FOR THE FUTURE



MARUIWA

Future Standards for Urban Development


 **Maruiwa-Suikou Ltd.**

Head Office 67 Chikumori-cho, Minato-ku, Nagoya City, Aichi 455-0057
●TEL. +81 52-652-5971 (Main) ●FAX +81 52-652-3260
URL <https://www.mriwa.com>

Gifu Branch 1156 Sunomata, Sunomata-cho, Ogaki City, Gifu 503-0102
●TEL. +81 584-62-3366 (Main) ●FAX +81 584-62-3425

Mie Branch 2020-4 Shoda-cho, Tsu City, Mie 514-1255
●TEL. +81 59-256-3955 ●FAX +81 59-256-3945

Kanto Branch 7-8 Midorino-Higashi, Tsukuba City, Ibaraki 305-0883
●TEL. +81 29-828-7478 ●FAX +81 29-828-7479

 **Maruiwa-Suikou Ltd.**

MARUIWA Offers New Future Standards for Total Support for Urban Development

We believe that developing urban areas where people can live with ease, comfort and functionality is key for next-generation creation.

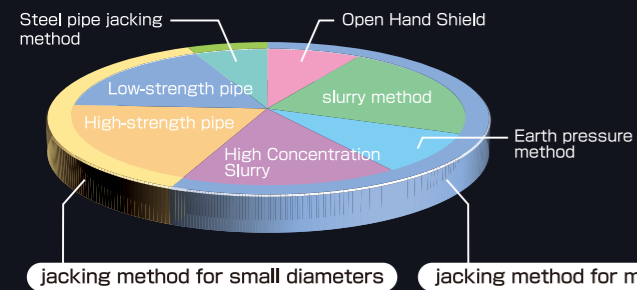
An important challenge for next-generation creation is what to develop with respect to the earth and our living environment, and how to develop it.

MARUIWA conducts underground installation work with speed and accuracy, using the best jacking method for each field environment or situation. In addition, we aim to create work environments where safety is always the first concern, paying attention to residents around the construction site, existing buried installations, current urban functions, etc.

From a global perspective, we will contribute to the building of future environments as a total engineering company for urban public works.



Our jacking methods



Standard for the Future



Expert Jacking Construction Available for Any Environment



What is the Jacking Method?

Jacking Method is

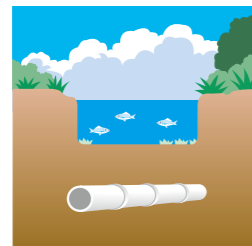
In this method, a tunnel boring machine is installed to the end of a reinforced concrete pipe/hard polyvinyl chloride pipe/ductile iron pipe/steel pipe etc. The relevant pipe is pressed into the underground earth by jacking, thereby building a sewer/culvert for clean/waste water, electricity, gas, communications or other medium.

The jacking method is used in the following construction cases.

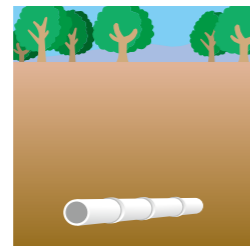
- Where it is difficult to excavate earth from the above ground on a high-traffic road or on a road crowded with buried structures.
- Where pipes cross a track or river, which makes it impossible to excavate earth from above ground.
- Where a sewer/culvert is buried deeply, it becomes uneconomical to build a pipeline by above ground excavation.
- Where the large vibration or noise generated by above ground excavation will be a great nuisance to residents around a construction site.



Under high-traffic roads



Excavation where pipes cross rivers



Sewers/culverts buried at depth



Consideration to surrounding environmental conditions

Maruiwa-Suikou Ltd. belongs to:

Japan Microtunnelling Association / The Japanese Geotechnical Society / Geo Lead Association (SS-Mole method, Cobra method, Mud-max method) / Iron-Mole Association / Uncle-Mole Tunnelling Association / Ace mole Method Association / LMS SYSTEM(Lubricant Mix Soil System)Association / KOUWA Method Engineering Association / Two-Way Pipe Jacking Method Association / Baby-Mole Association / UNICORN Association / UNICORN ES Method Research Society / PIT&DRM Association

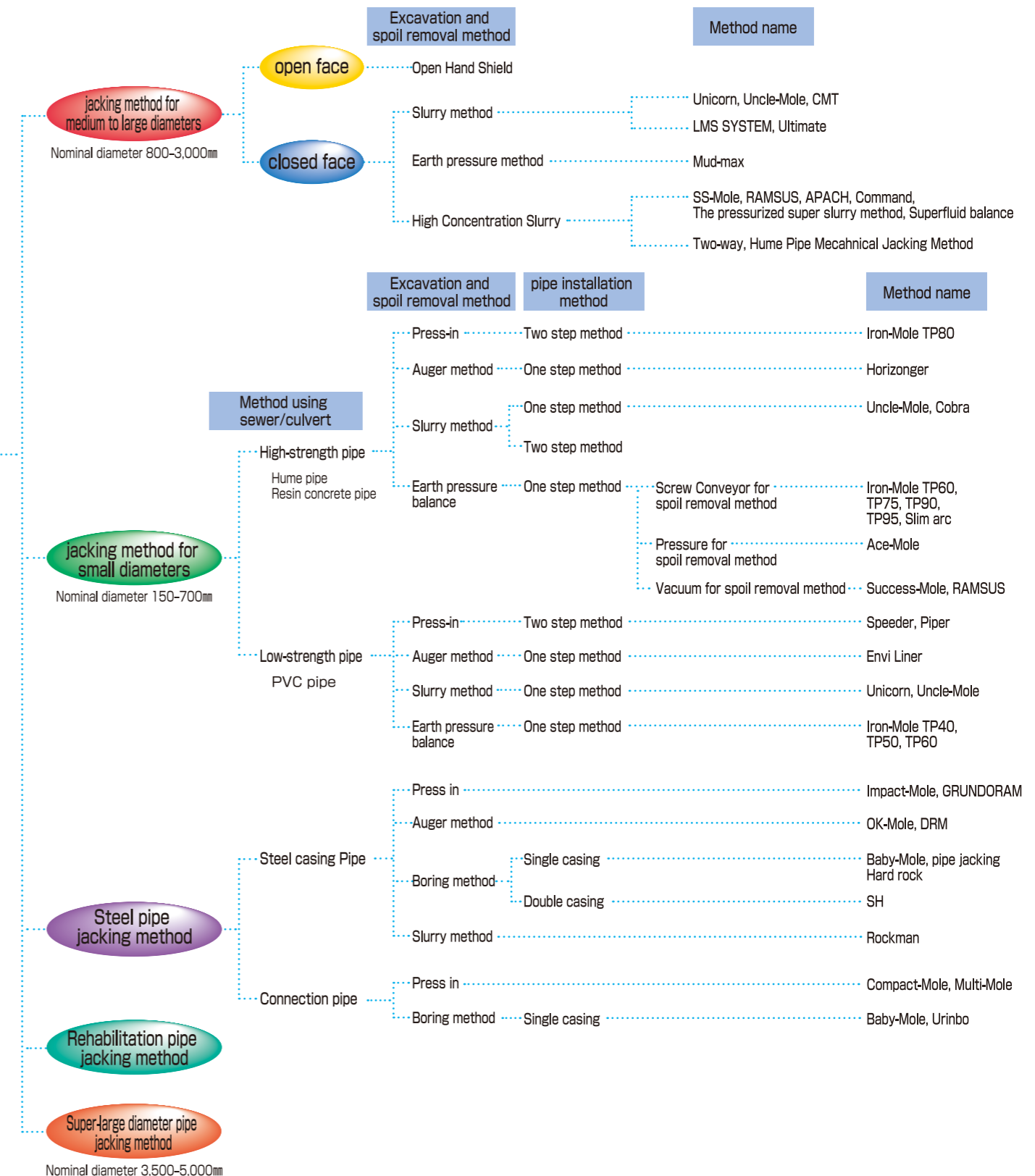
Classification of Jacking Methods

Jacking methods

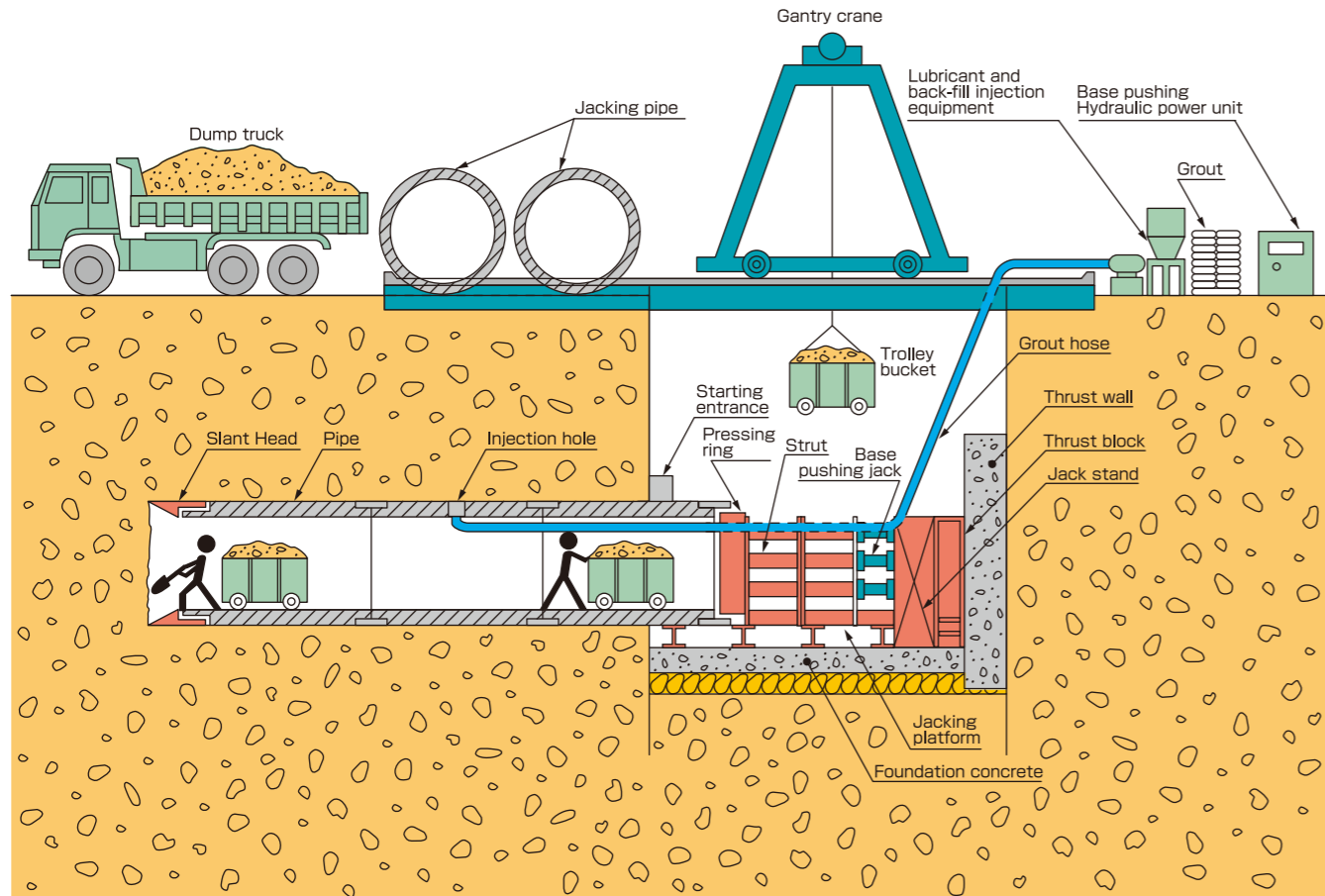
It is important to select the method that conforms to the construction requirements.

Construction Requirements

- Pipe type ■ Nominal diameter ■ Length ■ earth cover ■ Groundwater level
- Soil conditions — ● Soil name ● N value ● Grain size structure ● Permeability coefficient ● Gravel diameter (sand gravel) ● Compressive strength (bedrock)
- Shape of drive/arrival shaft ■ Construction site environment



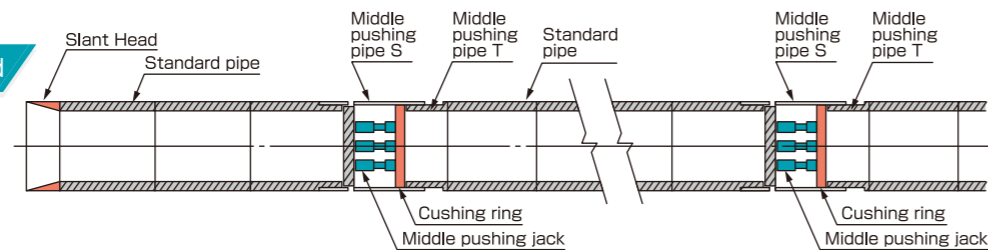
Open Hand Shield (Nominal diameter 800–3,000 mm)



The Slant Head is added to the end of the jacking pipe as a leading head, and jacking is done with manual excavation and mucking. This technique is the basis of jacking methods and requires only simple equipment. Due to the release of a cutting face, it is necessary to consider the stabilization and independence of the ground. The nominal diameter of the pipe is 800 mm or more due to manned excavation in the pipe, which allows for manual removal of large boulders or obstacles.

A drive length is 50 to 70 m with the base pushing method. The length can be extended by using the middle pushing method.

Middle Pushing Jacking Method



State of cutting face



State of pipe excavation



State of underground mucking

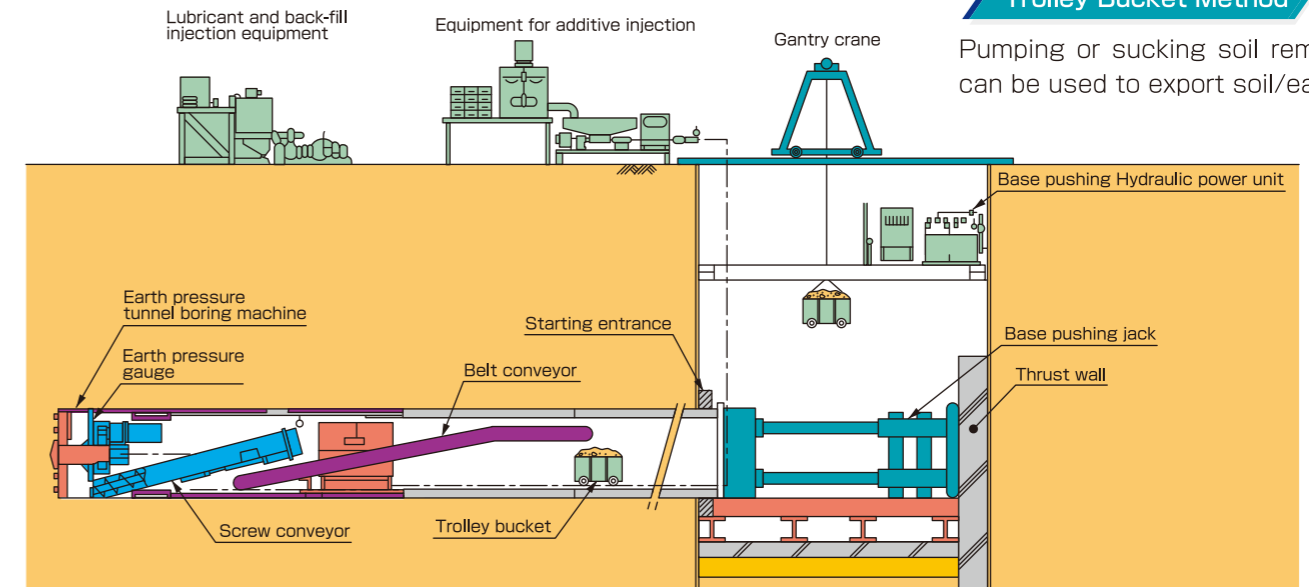


Gantry crane and dump truck on shaft

Earth Pressure Jacking Method (Nominal diameter 1,000–3,000 mm)

Trolley Bucket Method

Pumping or sucking soil removal can be used to export soil/earth.



An inner cutter chamber of the earth pressure tunnel boring machine is filled with mud mixed with excavated earth and additives to maintain the inner pressure to a pressure matching the earth/underground pressure, thereby stabilizing the cutting face.

The pipe is pushed with the base pushing jack, while a layer of soil is cut by rotation of the cutter head. While the amount of removal of the soil is adjusted with the screw conveyor, the pipe is driven by the base pushing jack. Excavated soil/earth is discharged into the trolley bucket and exported by winch or battery car.

This method is often used for large-diameter pipes, and can be implemented with narrower working bases than closed-face jacking methods.



Support for Long Distances/Curves

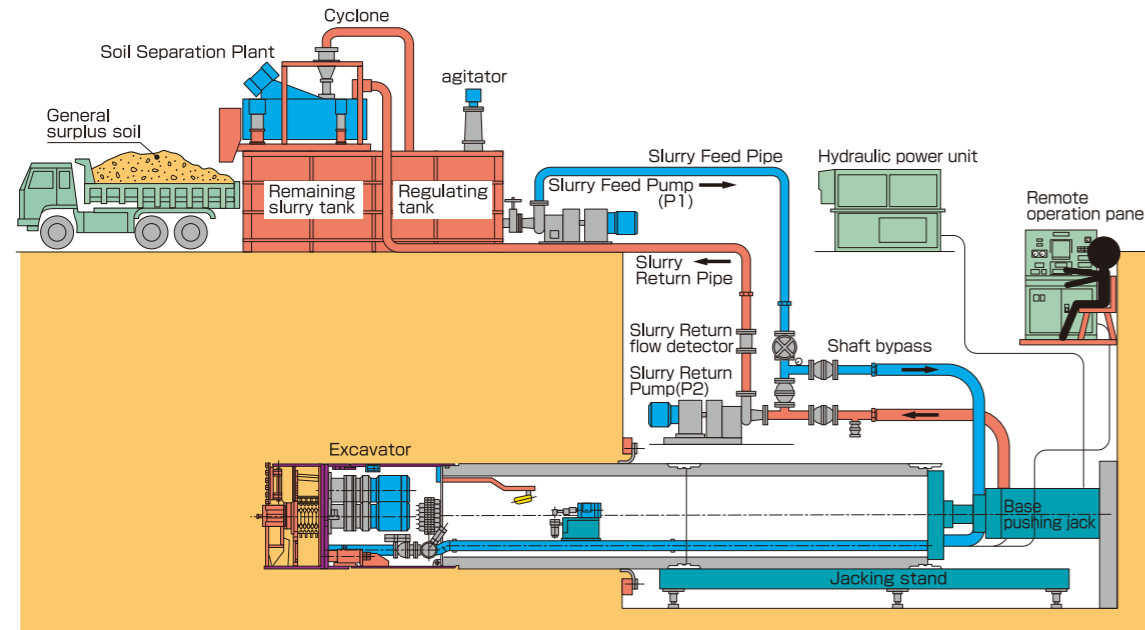
Mud-Max Method

A division and recovery excavator is used in the slurry and earth pressure jacking method to gain manhole arrival, and a thrust reduction system (S.M.C system) as an accessory, allowing long-distance execution.



Division and recovery by the excavator

Slurry Jacking Method (Nominal diameter 600–3,000 mm)



The pressure of slurry filling the inner cutter chamber of the excavator is maintained at a pressure matching the earth/underground pressure of the cutting face, thereby stabilizing the face. The method is the best at stabilizing the cutting face under the severest underground water conditions in closed-face jacking methods.

Soil cut by the rotating cutter head is mixed with slurry and transported, thereby driving the pipe with the base pushing jack.

The transported slurry is separated into soil and slurry by soil separation plant. After that, the slurry is sent to the cutting face again.

Excavation and soil removal work is systemized as a series of circulation systems. Accordingly, these systems lower the risk of underground transportation and other work, and provide favorable underground working environments.



Primary treatment of slurry



State of operation



State of jacking

Earth subject to the primary separation process is general surplus soil. It is necessary to dispose of clay/silt intruded into the slurry as industrial waste, but a second treatment of the clay/silt by the slurry can be also done, in which the slurry containing a flocculant is pressed and dehydrated by a filter press to separate very fine particles in the slurry.



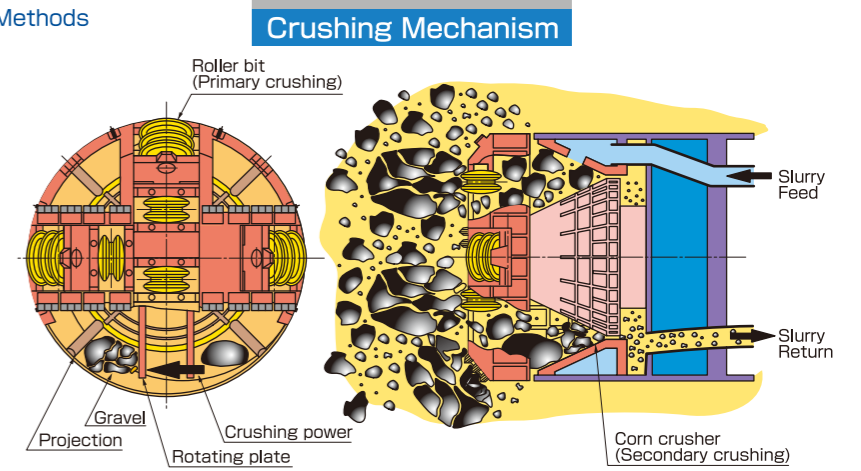
Secondary treatment of slurry



Representative Technique in the Slurry Jacking Methods

Unicorn Method

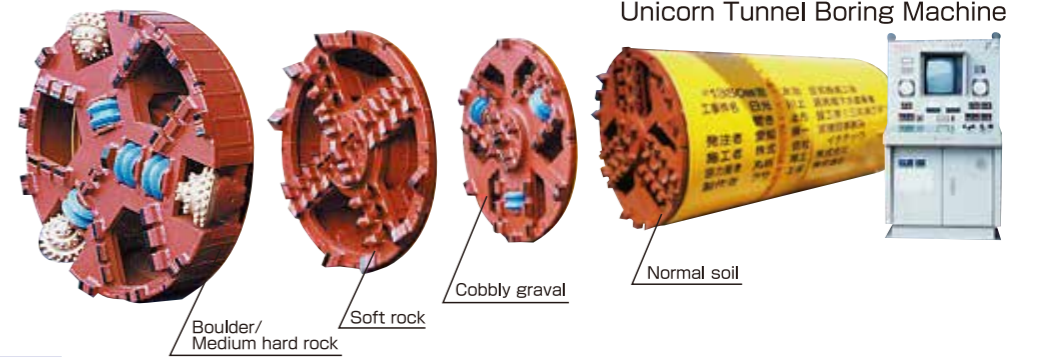
This method can be applied to a wide spectrum of layers with a high torque, and a cutter tailored to the soil. In particular, faceplate crushing using a roller bit and a crushing mechanism with a built-in corn crusher deliver outstanding performance for rock or boulder layers.



Unicorn Tunnel Boring Machine



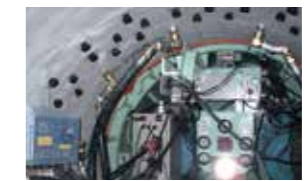
Cutter Disk for Different Layers



Thrust Reduction Method

Lubricant Mix Soil System

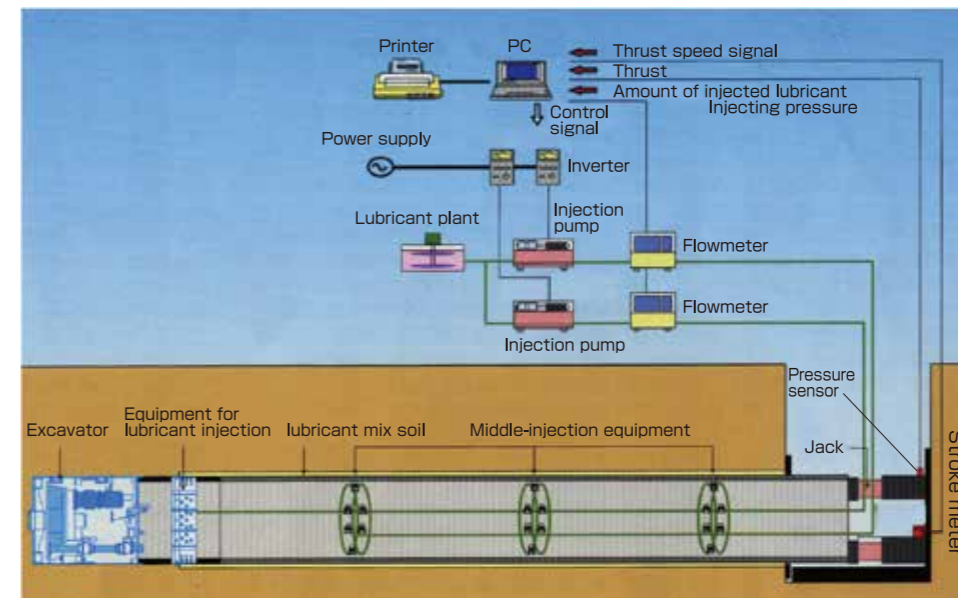
Equipment for end injection of lubricant is connected to the immediate rear of the tunnel boring machine to evenly spray the lubricant around the jacking pipe, while mixed and stirred natural ground and lubricant is also sprayed automatically and continuously from equipment for middle injection of lubricant. This technique reduces thrust and enables long-distance/curve execution. Our company has an execution record of a 1 span length of 1,010 m.



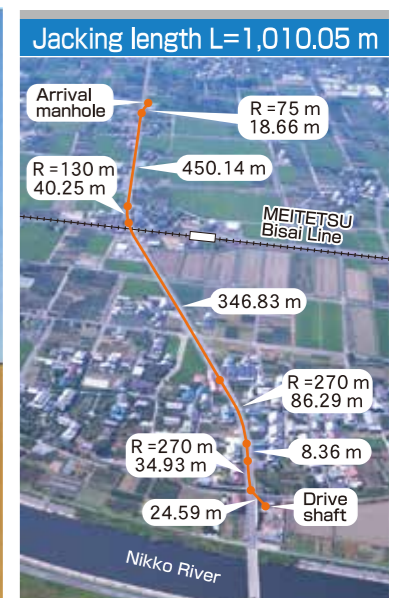
Equipment for end injection of lubricant



Equipment for middle injection of lubricant

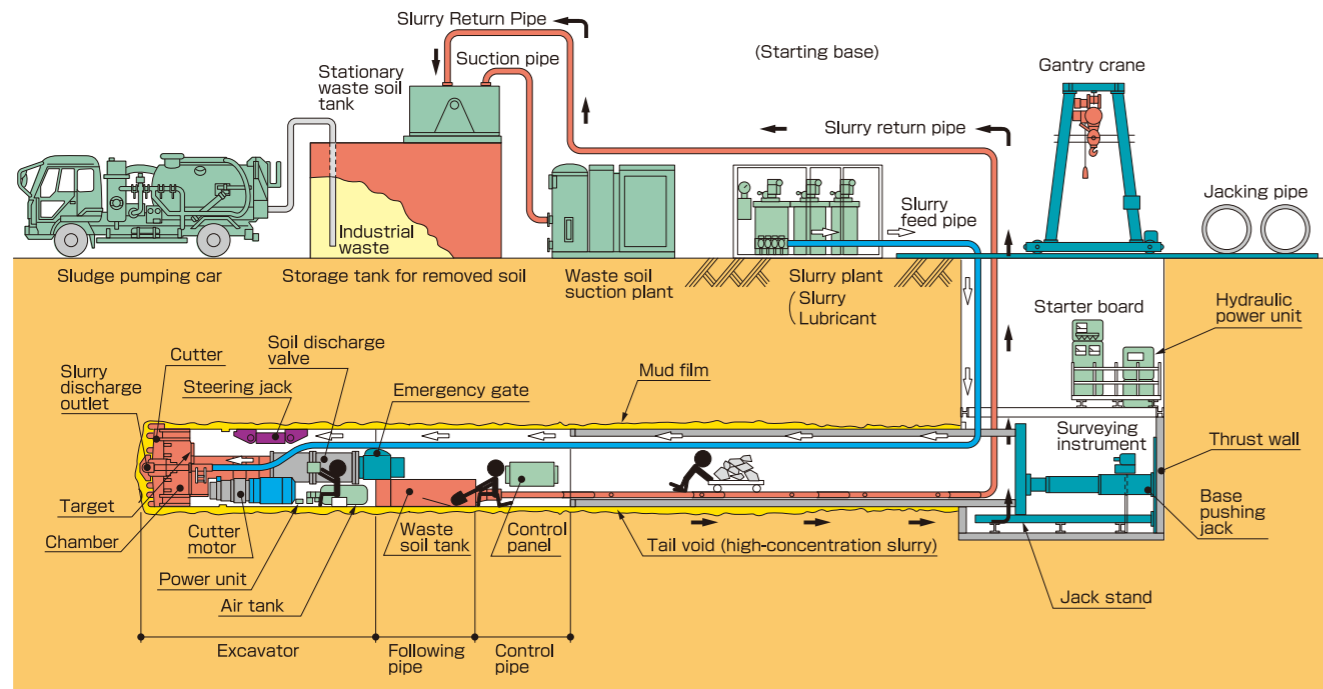


Lubricant injection system



Execution record of 1,350 mm diameter and 1,010 m length in Aichi Prefecture

High Concentration Slurry (Nominal diameter 700-2,200 mm)



Soil excavated with the cutter and slurry injected to the cutting face are mixed and stirred inside the cutter chamber, thereby producing high-concentration slurry (stabilized liquid) that contains a large amount of filler. The inner cutter chamber is pressurized and filled with the slurry to stabilize the cutting face.

The excavated soil, which is fluidized by mixing and agitation, opens/closes the air pinch valve, and is intermittently discharged to the inner machine by the differential pressure between the pressure of the high-concentration slurry and atmospheric pressure. The discharged soil is transported to the outside of the shaft as a fluid by the vacuum unit.

Without crushing gravel, the whole gravel is taken in from the sludge discharge outlet that is about 1/3 of the nominal diameter of the pipe. The gravel, which cannot be sucked by vacuum, is classified and manually removed from the underground area using a trolley bucket.

All of the excavated soil is disposed of as industrial waste.

The tail void overcut (35mm) is filled with the high-concentration slurry, pressurized, and then stabilized. This reduces the resistance value around the pipe and achieves low thrust. This method is best for long-distance/curve execution among closed-face jacking methods.

The excavator is basically operated internally. Tunnel boring machines with a nominal diameter of 700 to 900 have an option for remote control.



State of inside pipe



State of shaft



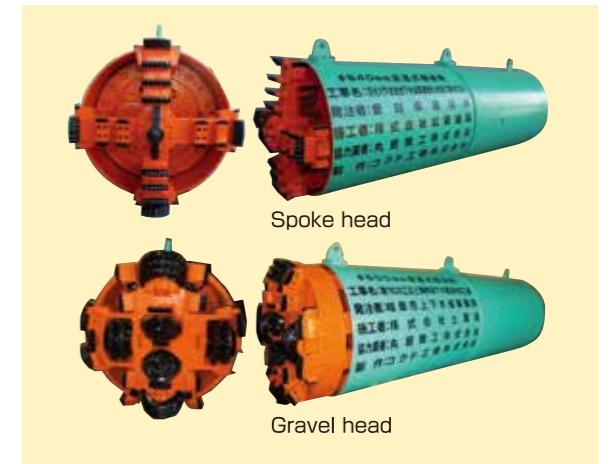
Full view of Construction



Plant

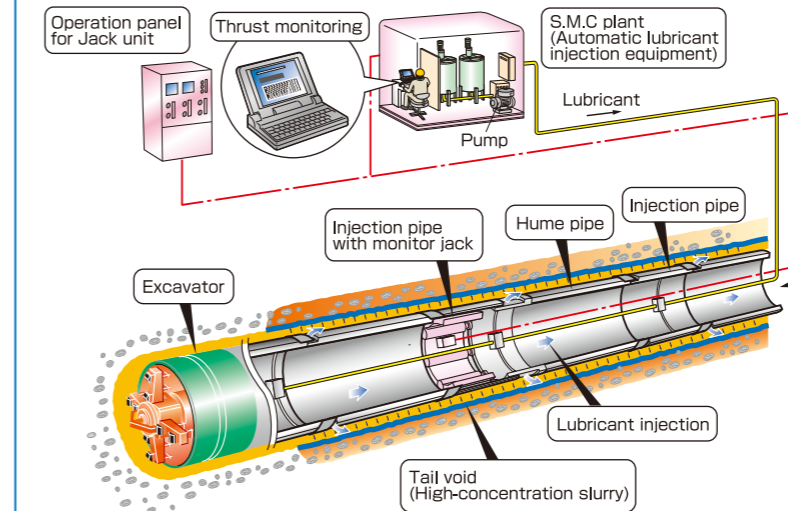
SS-Mole Method

Most Widely Used of the high concentration Slurry Jacking Methods



S.M.C System

(Thrust reduction system)



● The thrust reduction system performs in long-distance/curve/difficult-to-excavate ground more safely and consistently.



The installed monitor jack can grasp the trend of thrust. This allows lubricant to be injected to the perimeter of the jacking pipe correctly and uniformly. The system greatly reduces friction with the natural ground and allows for low-thrust execution.

Success-Mole Method

(Environmental measures type)

The Success-Mole method builds on the high-concentration slurry method, adding a continuous soil classifier with the function of a shower from the standpoint of environmental countermeasures, thereby separating mud and reducing industrial waste.



Continuous soil classifier

Success-Mole ω Method



The Success-Mole ω method is a small-diameter pipe, high-concentration slurry jacking method that allows for curve execution of a small-diameter pipe.

Two-Way Jacking Method

With the high-concentration slurry jacking method, the pipe is made to directly arrive at an existing underground structure. After its arrival, the inner equipment of the tunnel boring machine is disassembled and collected. The outer hull of the tunnel boring machine is used as a part of a pipeline. A concrete inner panel is placed on the inner wall of the hull, thereby finishing the inner surface of the partial pipeline.



1 Arrival

2 Disassembly and collection of inner equipment

After the completion of back-fill injection, the inner equipment is disassembled and removed from the arrival shaft or drive shaft.

3 Assembly of inner panel

Assemble the inner panel. The number of divisions of the panel depends on the nominal diameter. (Nominal diameter 4-division for 800mm, 8-division for 2,000mm)

4 Inner panel finish

Filler is injected into the clearance between the outer diameter of the inner panel and the inner diameter of the outer hull of the excavator. The partitioned parts of the panel, grout holes, and each clearance are subject to joint finishing.

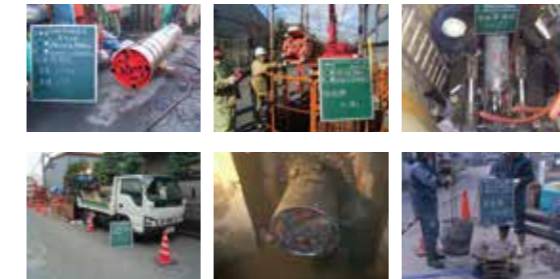
Uncle-Mole Method

A small slurry excavator is the best at stabilizing cutting faces and allows jacking for 100 m or more. The machine can also drill aquifers or sandy gravel layers, and crushes gravel to 40% of its nominal diameter and transports it as a fluid.

It Can Start from a Small Shaft with the Slurry Method

Uncle-Mole Mini Method

Hume pipes of 200 to 300 mm diameter are started from 2.0 m circular shafts, and Hume pipes of 350 mm or greater diameter from 2.5 m circular shafts.



Uncle-Mole V method

PVC pipes with 200 mm or greater diameter are started from 2.0 m circular shafts.



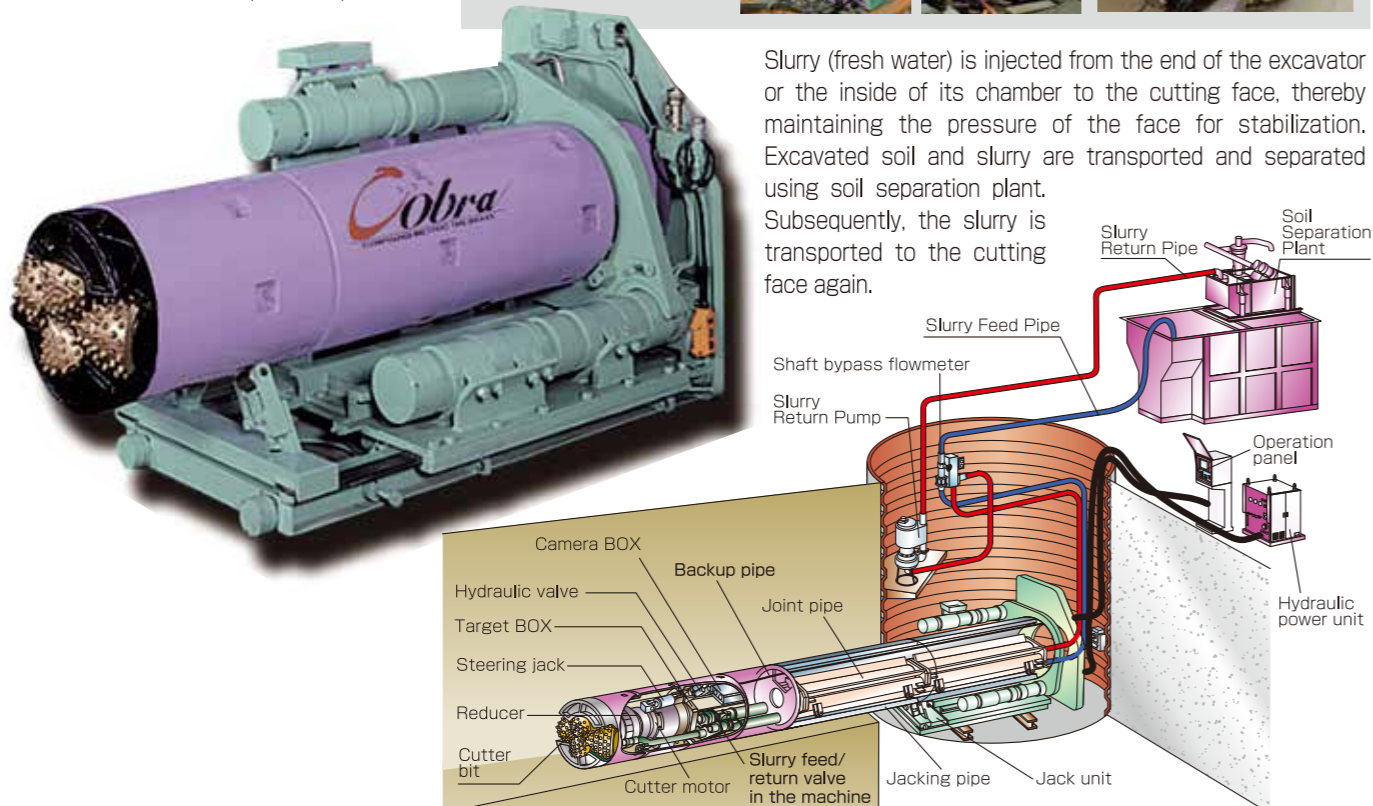
Cobra Method

Supporting all types of soil from normal soil to bedrock, this method allows a shield machine to start from a small shaft* and offers the highest level of excavation.

- * Shaft diameter 2,000 (250-350)
- * Shaft diameter 2,500 (400-600)



Slurry (fresh water) is injected from the end of the excavator or the inside of its chamber to the cutting face, thereby maintaining the pressure of the face for stabilization. Excavated soil and slurry are transported and separated using soil separation plant. Subsequently, the slurry is transported to the cutting face again.



Long-Distance Driving of PVC Pipe

UNICORN DH-ES

End resistance is imposed on the casing with loaded thrust, and only shaft resistance on the PVC pipe, thereby driving a low-strength pipe with the slurry method.

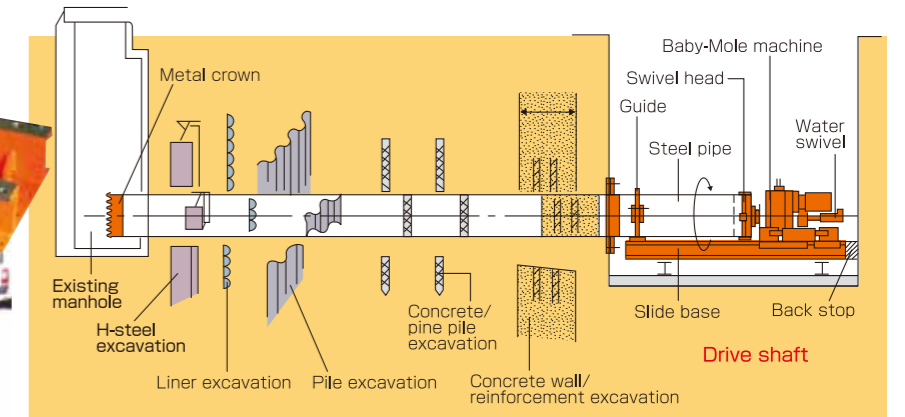


Baby-Mole Method

With the addition of a hard cutting bit (metal crown) to the end of the steel pipe, the whole pipe is rotated and driven. The mechanism of this method is simple and applied to a wide variety of soil. The bit can also cut wooden piles, concrete, and steel.



Baby-Mole Jacking Method



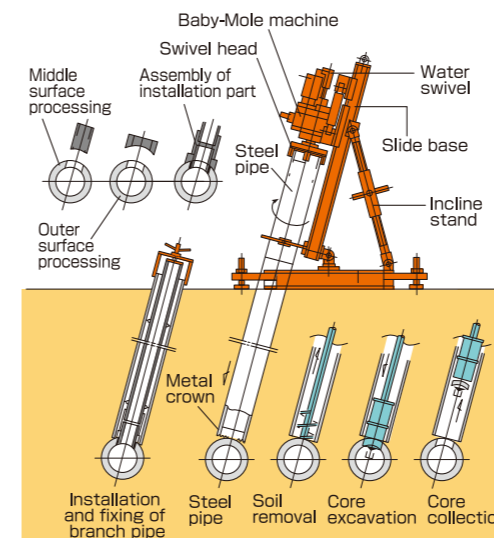
Rotational casing method



Metal crown Steel pipe Hydraulic power unit Insertion of main pipe Injection of filling material

Baby-Mole Method with Installation of Special Pipe

A branch pipe can be installed on an existing pipe without an open cut.



Method for installation of special pipe

Jacking method for small diameters

● Earth pressure balance/one step method (High-strength/low-strength pipe)

Iron-Mole Method

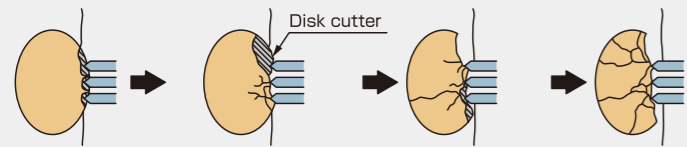
The Most Promising Method for Gravel/Boulder Crushing

TP95S



Mechanism for Crushing of Gravel/Boulders

- Gravel/boulders are crushed from the surface into small pieces.
- The shaded area is separated and crushed.
- It is divided into 2 to 3 sections and greatly crushed.
- Crushing proceeds.



Before crushing



After crushing

The earth pressure balance, which has a combination of a disk cutter with an excellent gravel crushing mechanism, a large pinch valve and excavation additives, allows the machine to drive even through water-bearing sandy gravel layers. TP95S uses independent motors for excavation and soil removal and increases the torque of the cutter head, improving the performance of gravel/boulder crushing. It supports gravel diameters equal to 50 to 90% of the nominal diameter (depending on types/diameters).

Most Appropriate for Driving a PVC Pipe through a Water-Bearing Sand Layer

TP50SCL

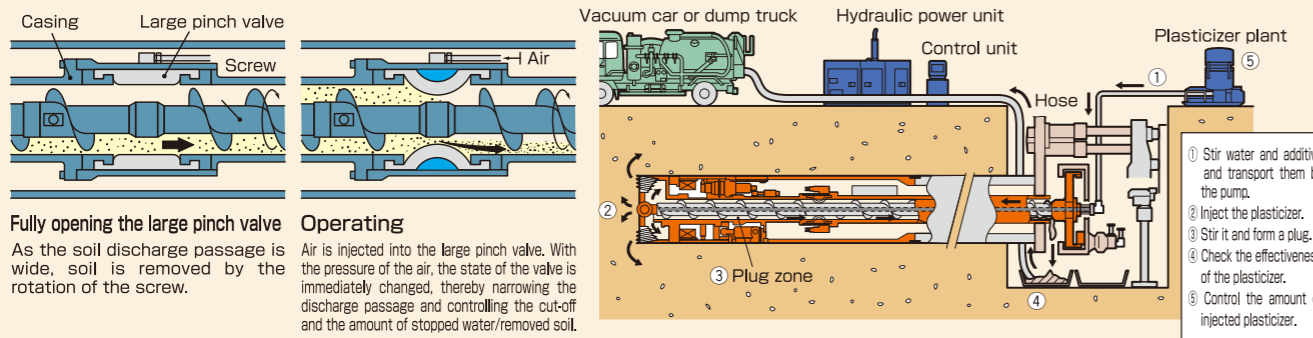
It supports a wide variety of soil from cohesive soil to water-bearing sand layer. Excavation front resistance is transmitted to and imposed on the casing, and only pipe perimeter resistance on the PVC pipe, thereby preventing the pipe from being broken.



- Iron-Mole TP40/TP50 Start a PVC pipe (φ200-) from a circular shaft (φ1,800 / φ2,000).
- Iron-Mole TP60/TP75 Start a Hume Pipe (φ200-300 / φ350-500) from a circular shaft (φ2,000 / φ2,500).
- Iron-Mole TP95/TP125 Start a Hume Pipe (φ350-φ700 / φ800-1,000) from a rectangular/elliptical shaft.

Earth pressure balance method Controlling the Amount of Stopped Water/Removed Soil in an Aquifer

With the start of the large pinch valve, the inner casing from the cutter head to the large pinch is filled with improved excavated soil to make a plug zone for improved soil. A balance between the pressure of the plug zone and the pressure of a cutting face in front of the cutter is established to control the amount of soil removal or water-bearing, thereby preventing the collapse of the cutting face that results from liquefaction, and stabilizing the face. The problem of the auger method has been remedied.



Fully opening the large pinch valve

As the soil discharge passage is wide, soil is removed by the rotation of the screw.

Operating

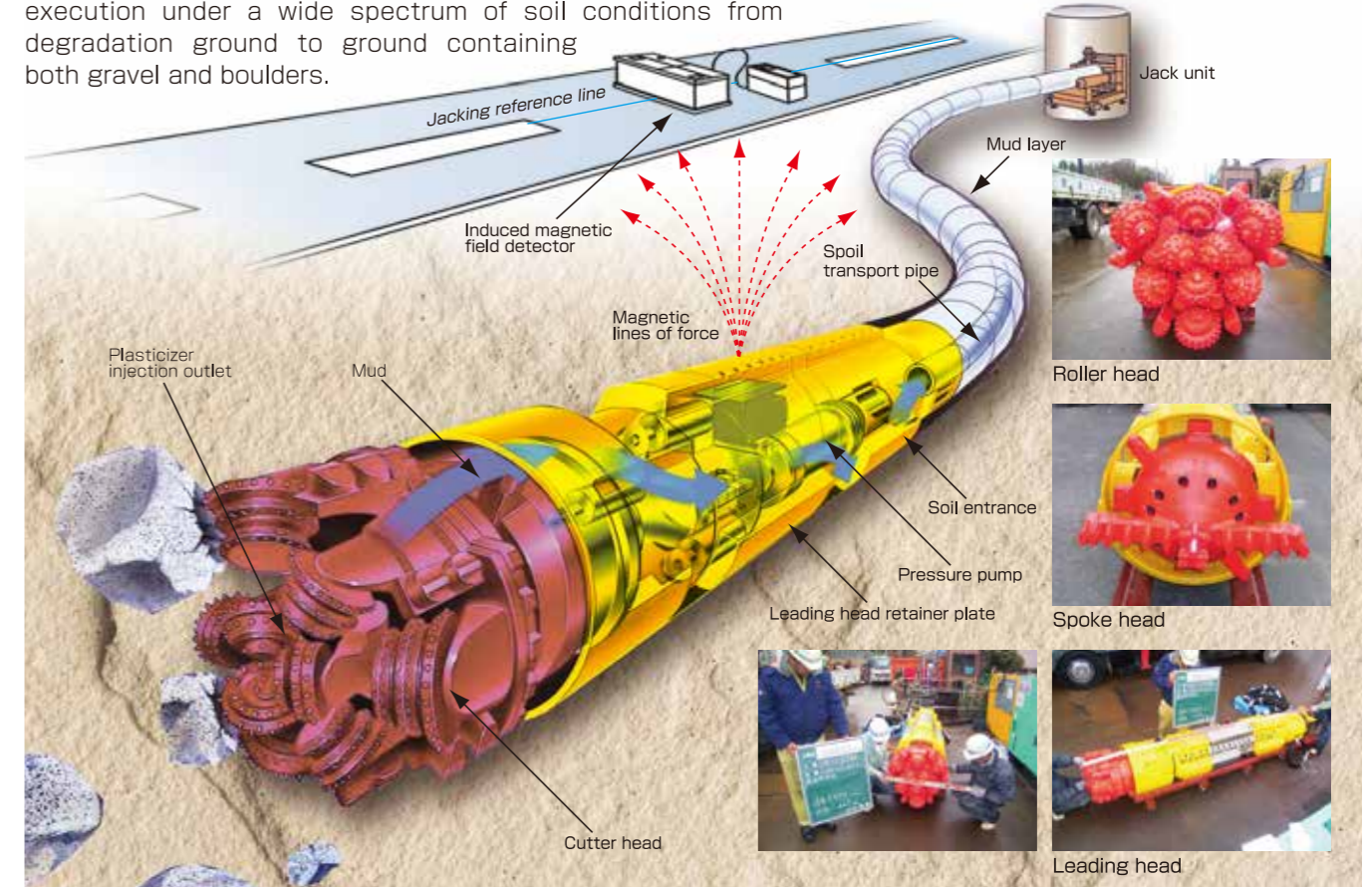
Air is injected into the large pinch valve. With the pressure of the air, the state of the valve is immediately changed, thereby narrowing the discharge passage and controlling the cut-off and the amount of stopped water/removed soil.

Jacking method for small diameters

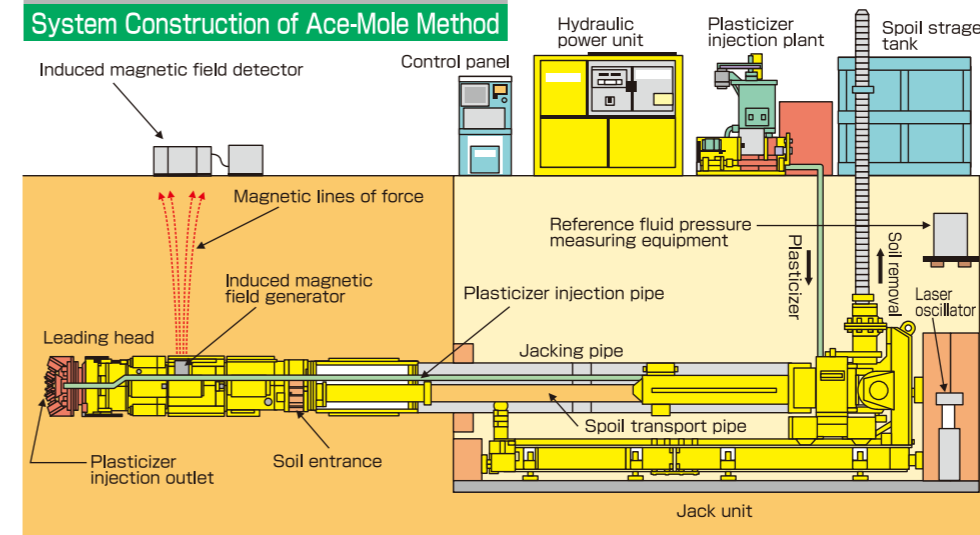
● Earth pressure balance/one step method (High-strength pipe)

Ace-Mole Method

An excavation/press soil removal mechanism based on the earth pressure balance, and a position detection mechanism (electromagnetic/fluid pressure difference method) allow for high-precision long-distance/curve execution under a wide spectrum of soil conditions from degradation ground to ground containing both gravel and boulders.



System Construction of Ace-Mole Method



The cutter head is rotated with the injection of plasticizer into the end of the cutting face, thereby converting excavated soil to mud (slurry) used for cut-off and fluidity.

The slurry is transferred to the rear of the leading head along its outer periphery, taken in from the rear, and pumped to the drive shaft through the soil transport pipe by the press pump within the leading head.



Position detection using the electromagnetic detection method



Plant



State of jacking (Standard type)



State of jacking (Division starting type)

Shaft Construction Method

KOUWA Method

The full-perimeter rotary press fitting machine presses a steel casing into the underground area, while fully rotating the casing and using it to conduct inner excavation, for construction of a shaft. The machine offers low-vibration and low-noise excavation.



KBE-20 press machine
(Standard nominal diameter 1,500-2,000mm)



KBE-30 press machine
(Standard nominal diameter 2,500-3,000mm)



Press in (KBE-20)



Press in (KBE-30)



Steel casing



State of welding



State of excavation

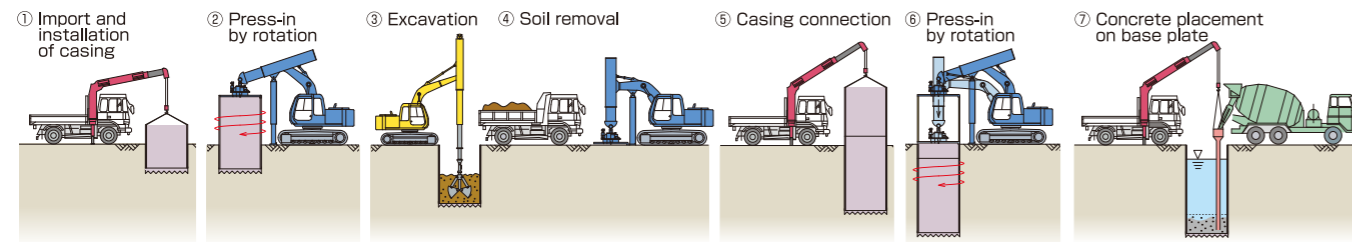


Bottom slab concrete



Circular covering plate

Standard execution step



The casing is not lifted after concrete placement on the base plate.

●Features of the KOUWA Method

The machine is small with excellent free mobility, and good for execution in narrow spaces or special construction.

- Due to its full-perimeter rotation, the machine can be applied to a wide variety of soil types including soft ground, hard soil, boulders, and bedrock.
- The nominal diameter of the steel casing can be flexibly set from 900 to 3,000.
- The machine can independently run to a construction site through narrow roads (with a minimum width of 2.5m).
- This allows for construction under low aerial wires (with a minimum height of 4.5m), and execution within buildings.
- It can construct shafts in close proximity to existing structures (minimum spacing 10m between shafts).
- It allows for execution on sloping land (with an incline of 9%) or stepped topography (step of 1m).
- It can construct a shaft around the full perimeter of the press machine (360°).
- Casing installation, rotary press-fitting, and excavation work independently with a small machine.

●Types of Small Shaft Construction Methods



Auxiliary Method

Chemical grouting method

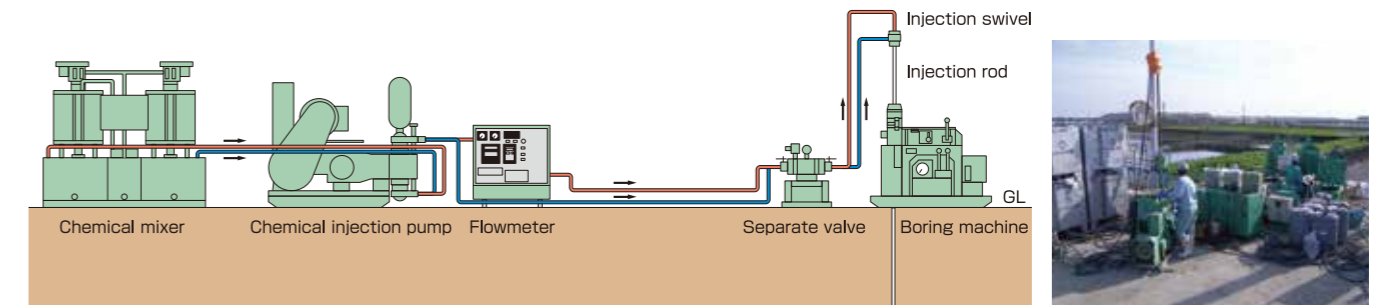
The chemical grouting method is a soil improvement technique to inject a chemical into the ground to reduce the permeability of or strengthen the ground.

●Classification of Chemicals

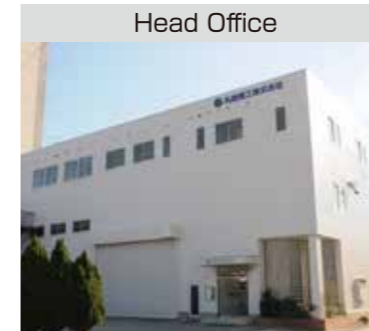
Classification I	Classification II	Classification III
(1) Solution type	(1) Alkali system	(1) Inorganic system
(2) Suspension type	(2) Neutral/acid system	(2) Organic system

●Classification of Injection Methods

Injection method	Gel time	Mixing method
① Double tube strainer	Single phase	Flash setting
	Diploid phase	Flash setting, slow setting
② Double packer	Slow setting	1 and 1.5 shots



Business offices, Maruiwa-Suikou Ltd.



Head Office
67 Chikumori-cho, Minato-ku, Nagoya City, Aichi



Gifu Branch
1156 Sunomata, Sunomata-cho, Ogaki City, Gifu



Mie Branch
2020-4 Shoda-cho, Tsu City, Mie



Kanto Branch
7-8 Midorino-Higashi, Tsukuba City, Ibaraki



Yatomi Equipment Center
2-1-5 Kuridashi, Yatomi City, Aichi



Tsukuba Equipment Center
2488 Tsukuriya, Tsukuba City, Ibaraki