UGITEC
Underground Infrastructure Technologies

2025.6

UGITEC
Underground Infrastructure Technologies

Tunnel Boring Machines

English

Our mission

We do more than just excavate tunnels—we create new spaces for the growth of humanity

Underground Infrastructure Technologies Corporation (UGITEC) was established on October 1, 2021, via a joint incorporation-type company split that integrated the TBM (tunnel boring machine) businesses of Kawasaki Heavy Industries, Ltd. and Kanadevia Corporation (formerly Hitachi Zosen Corporation).

This merger brings together both company's half century of TBM technology and experience, both in Japan and overseas. This allows UGITEC to provide customers with solutions and services perfectly tailored to any challenge or need.

UGITEC is boldly working to become the preeminent solutions provider in underground space development, contributing to the advancement of underground infrastructure and the creation of a more sustainable society.

We sincerely thank you for your continued support.

UGITEC
Underground Infrastructure Technologies

地中空間開発株式会社

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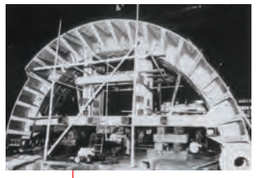
1957

Roof TBM delivered (Φ11.6 m)

This first machine led Kawasaki to become a leading developer and manufacturer of TBM. It was the first application of the roof shield tunneling method to a subway tunnel project in Japan. This machine was used to excavate a 231 m section of the Marunouchi Line running from Kokkai-gijidomae Station to Shinjuku.



1988

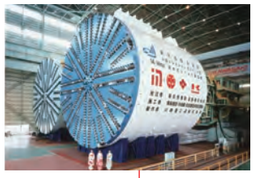
TBM goes into use (Φ8.78 m)

This machine capable of boring through soft ground and hardrock was used for the excavation of the Channel Tunnel. It contributed significantly to the success of the project, completing excavation of the planned 16 km section a full eight months ahead of schedule and then excavating an additional 4 km when requested.

1994

Slurry TBM delivered (Φ14.14 m)

This machine was used to excavate the undersea tunnel section of the Trans-Tokyo Bay Expressway. It boasted the largest diameter of any TBM in the world at that time. The machine was used to dig two 10 km tunnels, one atop the other. It was called a "slurry machine" because it mixed the excavated soil with water to create slurry and discharge it.



2004

Open TBM delivered (Φ12.84 m)

This machine was used to construct the Hida Tunnel on the Tokai-Hokuriku Expressway. TBM are equipped with a roller cutter on the anterior surface of the cutterhead, which is used to cut through solid rock mass. Since their introduction, they have been modified to handle a wide range of soil geology, not just hard rock.

2006

APORO cutter TBM delivered (W10.64 m × H7.44 m)

This machine was used for underground construction of the Tokyu Toyoko Line from Shibuya Station to Daikanyama Station. A non-circular shield was needed in order to keep as much distance as possible between the sewerage piping and the tunnel. The bi-sectional cutterheads on the machine rotate around one another in a circle as they spin.

2016

World's first spiral tunneling using H&V method (W11.79 m × H5.85 m)

This machine was used for the Tachiai River Rainwater Conduit Development Project. The spiral tunneling method involves running two TBM side-by-side which, as they progress, change positions with one another in a spiraling fashion, moving from a side-by-side alignment to a top-and-bottom alignment and vice versa.

2019

Excavation completed of hardrock with planned water pressure of 2.0 MPa (Φ2.99 m)

This machine was used to construct a water conduit tunnel connecting the Sada River and Koishiwara River in Fukuoka Prefecture's Chikugo River system. In addition to hardrock, the project was made even more difficult by the 2.0 MPa of planned water pressure, but with the use of two machines incorporating cutting-edge technology borne from many years of experience, a total tunnel length of 5 km was excavated.

1960 1970 1980 1990 2000 2010 2020

History

More than half a century of TBM. Capitalizing on reliable technology to create new underground space.

From railways and roads to underground rivers and enormous underground cities, the potential for underground space is limitless. And in order to carry out the excavation work to create these underground spaces, you need tunnel boring machines (TBM). Thanks to their outstanding technological strength, Kawasaki Heavy Industries and Hitachi Zosen (currently Kanadevia) have led the industry for more than half a century.
Now, these two companies have merged their TBM business to develop more robust technological strength and a wider range of operations enabling the creation of new and innovative underground space.

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2021

Establishment of UGITEC

1970 1980 1990 2000 2010 2020

1967

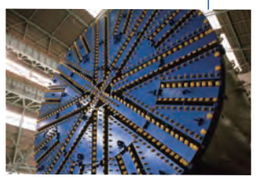
Start of TBM production (Φ2.7 m)

Hitachi Zosen made use of its shipbuilding technology to develop and manufacture the first open, hand digging-type TBM. This represents the start of TBM history at Hitachi Zosen. It was used in sewerage construction in Yokohama City.

1987

World's first multi-face TBM (Φ7.42 m x 12.19 m)

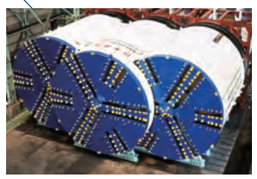
This machine was used to construct the Kyobashi Tunnel on JR East's Keiyo Line. It was the world's first multi-face TBM equipped with two cutterheads. Because it was able to build multiple tunnels at the same time, it helped to cut down on construction costs.



1993

Work completed on slurry TBM with largest diameter in the world (Φ14.14 m)

This slurry TBM was delivered for use on the Trans-Tokyo Bay Expressway (Aqua Line) and was the largest of its kind at the time. It was equipped with originally developed fully automatic segment assembly, which greatly accelerated the rate of construction. Of the eight machines used for this project, this one was used to excavate the longest section.



1994

World's first tri-sectional multi-face TBM delivered (Φ7.8 m x W17.3 m)

Hitachi Zosen completed production of the world's first tri-sectional multi-face TBM, which was capable of simultaneously excavating rail line tunnel space and platform space. It was used to construct Osaka Business Park Station on Osaka Municipal Subway's (now Osaka Metro) Nagahori Tsurumi-ryokuchi Line.

2005

Pressurized hardrock slurry TBM delivered (Φ7.85 m)

Used to construct the Marmaray Tunnel in Istanbul, Turkey. This machine, which operated using high-speed rotation and was able to pulverize hardrock, helped to build a railway tunnel that connects Europe and Asia.

2011

EPB TBM with largest diameter in the world delivered (Φ17.45 m)

Used to construct Seattle's State Route 99 tunnel in the U.S. This machine incorporated a variety of then-cutting-edge technologies and had the largest diameter for a machine of its kind at the time.

2015

Rectangular TBM with bi-sectional synchronized retractable cutter delivered (W7.29 m × H4.69 m)

This machine was used to construct the passageway tunnel from Ginza Station to the Ginza Six shopping complex. A TBM with a rectangular cross section was needed in order to make effective use of the limited underground space beneath Ginza. It was able to excavate a tunnel a mere 2.6 m beneath the surface of a metropolis without having any effect on the ground above.

We can accommodate everything from small to ultra-large diameters, deep or long-distance excavations, highly specific tunnel cross sections, sharp curves, and much more with a diverse lineup of more than

2,700 proven machines.

Slurry TBM

A slurry mixture is circulated inside the cutter chamber, with the slurry pressure being used to stabilize the face and facilitating safe excavation through solid rock mass. The excavated earth is mixed with the slurry and transported as liquid up to the surface where treatment equipment separates it into slurry and sediment. Slurry TBM adapted for large diameter/high water pressure-bearing tunnels are perfect for handling seabed and riverbed tunneling and other projects with similarly harsh operational requirements. The largest machine we have manufactured has a diameter of 14.14 m.

1994 Kanagawa Prefecture, Japan

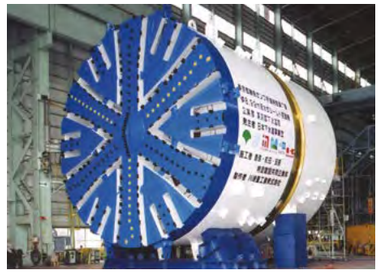
Trans-Tokyo Bay Expressway Kawasaki Tunnel Kawajin North (No. 1) Construction
Trans-Tokyo Bay Expressway Central Tunnel Kawajin North (No. 1) Construction
Trans-Tokyo Bay Expressway Central Tunnel Kisarazu North (No. 1) Construction
Trans-Tokyo Bay Expressway Kawasaki Tunnel Ukishima North (No. 1) Construction

Project owner	Trans-Tokyo Bay Expressway Corp.
Contractor	Kajima/Konoike/Sumitomo JV Nishimatsu/Toda/Zenitaka JV Maeda/Tekken/Fujita JV Kumagai/Hazama/JDC JV
Machine outer dia.	14.14 m
Excavation length	1,800 m 2,100 m 2,419 m 2,500 m
Features	Automatic segment assembly system

2017 Kanagawa Prefecture, Japan

Yokohama Ring Expressway Northwest Route Tunnel Construction

Project owner	City of Yokohama Road Bureau
Contractor	Hazama Ando/Iwata Chizaki/ Toshida/Miyamoto Doboku JV
Machine outer dia.	12.64 m
Excavation length	3,889 m
Features	Simultaneous excavation, no backup car



2003 Tokyo, Japan

Tokyo Metropolis Katsushima Pumping Station Conduit Construction

Project owner	Japan Sewage Works Agency
Contractor	Kajima/Maeda/Ando JV
Machine outer dia.	8.99 m
Excavation length	383 m
Features	Mechanical bit exchanging device, steel pipe pile cutterhead

- Slurry TBM use pressurized slurry circulated inside the cutter chamber to cut through rock mass, which prevents collapse of the face. The excavated earth is transported as a liquid up to slurry treatment equipment, which separates it into slurry and sediment. The slurry is carried back to the face as part of an integrated, sequential system.
- The pressurized slurry, mud film, and cutterhead interact synergistically to counter the earth and groundwater pressure and stabilize the face.

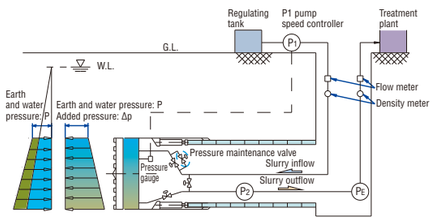
Features

Slurry TBM adapted for large diameter/thick earth cover/high water pressure-bearing tunnels are perfect for handling seabed and river tunneling and other projects with similar operational requirements. Because the excavated earth is transported up to the surface as slurry (a liquid), it can be continuously extracted, and because the lubricating effect of the slurry reduces abrasion for the excavating member, the machine can be operated over longer distances.

Achievements

We have a great deal of experience from 2 m-class small-diameter to large-diameter tunneling. Examples of large-diameter machines we have delivered include a φ 14.14 m unit for the Trans-Tokyo Bay Expressway, a φ12.64 m unit for the Otsu Floodway, and a φ12.34 m unit for the Kawasaki Shibukawa Reservoir.

System Flow



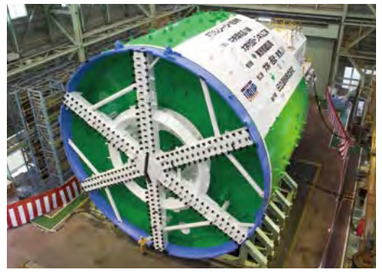
EPB (Earth Pressure Balance) TBM

Excavated soil is stored inside the cutter chamber, where it is combined with an additive and mixed to undergo plastic fluidization, thereby facilitating stabilization of the face under earth pressure for safe excavation through solid rock mass. The soil is carried out via a screw conveyor. The shield configuration can be adapted for highly water-permeable hardrock, shallow earth covering, boulders, and a wide range of other soil conditions and difficulties. A ribbon screw conveyor transports coarse gravel and other types of ground soil. The largest machine we have manufactured has a diameter of 17.45 m.

2011 Osaka Prefecture, Japan

Yamatogawa Route Tunnel Construction

Project owner	Hanshin Expressway Co. Ltd.
Contractor	Kajima/Tobishima JV
Machine outer dia.	12.47 m
Excavation length	4,012 m
Features	Mechanical bit exchanging device



2010 Tokyo, Japan

Central Circular Route Shinagawa Line Oi Zone Tunnel Construction

Project owner	Tokyo Metropolitan Government Bureau of Construction
Contractor	Obayashi/Seibu/ Keikyu Construction JV
Machine outer dia.	13.6 m
Excavation length	550 m/345 m
Features	URUP method

- In order to counter earth and water pressure on the face, excavated soil is stored inside the cutter chamber, thereby controlling the internal chamber earth pressure and stabilizing the face.
- When there is not much binder material within the excavated soil itself and waterproofing and flowability are poor, an additive is injected through the face. The excavated soil is kneaded to improve extraction.

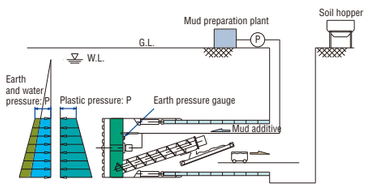
Features

The shield configuration can be adapted for highly water-permeable hardrock, shallow earth covering, boulders, and a wide range of other soil conditions and difficulties. A ribbon screw conveyor transports coarse gravel and other types of ground soil. This improves sediment extraction efficiency, which also facilitates faster tunneling.

Achievements

We have a great deal of experience from 2 m-class small-diameter to large-diameter tunnel excavation. Examples of large-diameter machines we have delivered include a φ13.6 m unit for the Tokyo Central Circular Route, a φ9.21 m unit for the Hong Kong Express Rail Link, and an φ8.25 m unit for subway tunnel construction.

System Flow



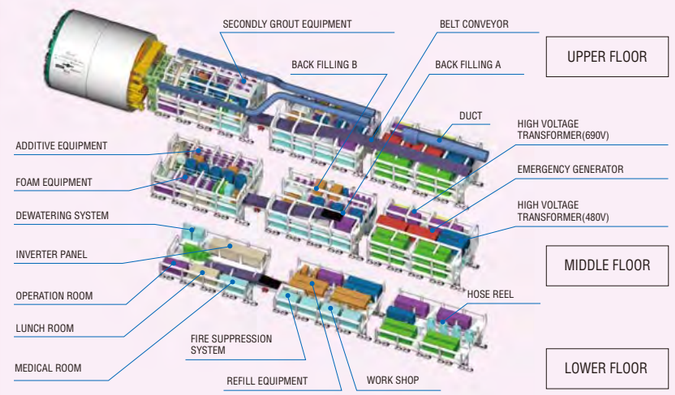
The EPB TBM with the largest diameter in the world (at the time). A full suite of shield tunneling backup equipment was delivered together with this unit.

2013 United States

State Route 99 Tunnel Construction

Project owner	Washington State Department of Transportation
Contractor	Seattle Tunnel Partners
Machine outer dia.	17.45 m
Excavation length	2,856 m
Features	Bundled delivery with backup equipment, double arm erector (vacuum type), cutter bit and disk roller cutter exchanging device

BACKUP FACILITIES



Hardrock and Boulder TBM

These TBM can pulverize rock at the face to excavate boulder-filled soil and hardrock. Three types of cutterhead shapes—flat, semi-domed, and domed—are available to accommodate the specific ground conditions. The mounted disk roller cutters can be switched between an ultra-hard chip insert type and a ring exchangeable type to provide optimal performance in any situation. The largest machine we have manufactured has a diameter of 10.82 m.

1988 France

Channel Tunnel T2

1989 France

Channel Tunnel T3

Project owner	Eurotunnel
Contractor	T.M.L.
Machine outer dia.	8.78 m
Excavation length	20,010 m/18,858 m
Features	Vacuum erector

2017 Fukuoka Prefecture, Japan

Koishiwara River Dam Water Conveyance Facilities Construction

Project owner	Japan Water Agency
Contractor	Taisei Corp.
Machine outer dia.	2.97 m
Excavation length	10,795 m
Features	Planned water pressure of 2.0 MPa, oil backup system

2014 Singapore

Singapore Power EW1 Construction Section

Project owner	Singapore Power Assets
Contractor	Obayashi Corp.
Machine outer dia.	6.88 m
Excavation length	3,018 m
Features	Hardrock focused, equipped with segment conveyance apparatus, simultaneous excavation, no backup car

2004 Kyoto Prefecture, Japan

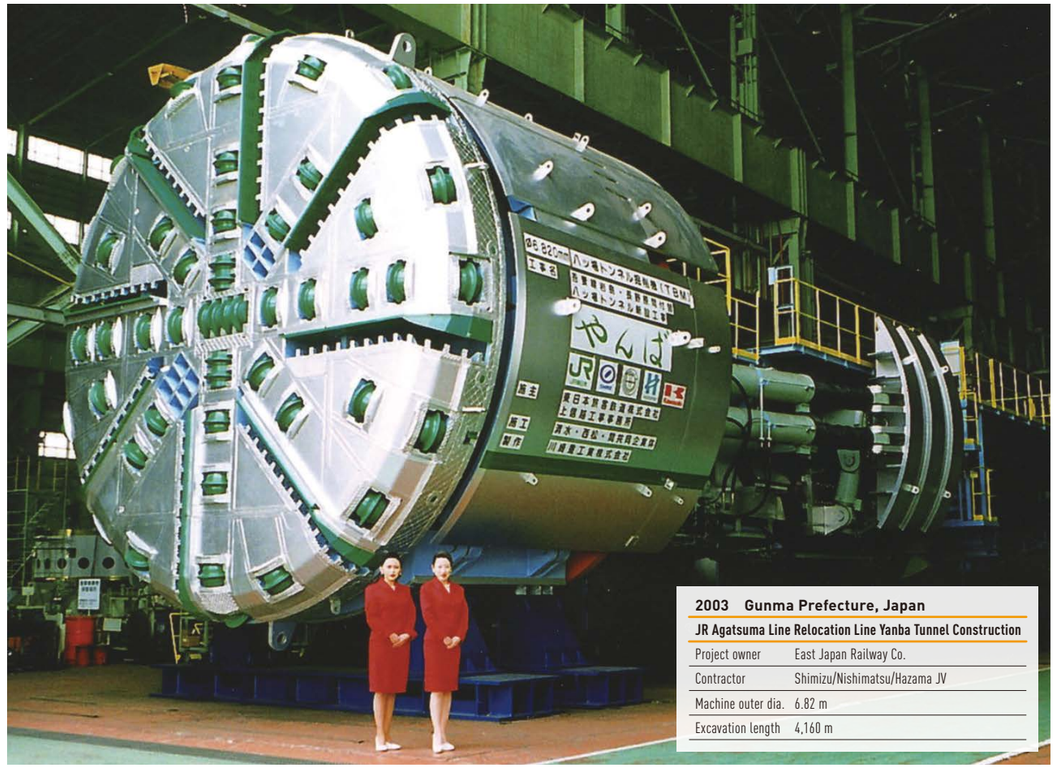
Fushimi Section Tunnel Construction

Project owner	Hanshin Expressway Public Corp.
Contractor	Obayashi/Sato Kogyo/Seibu Construction JV
Machine outer dia.	10.82 m
Excavation length	1,704 m
Features	Slurry TBM with largest diameter

Various TBM

Open TBM

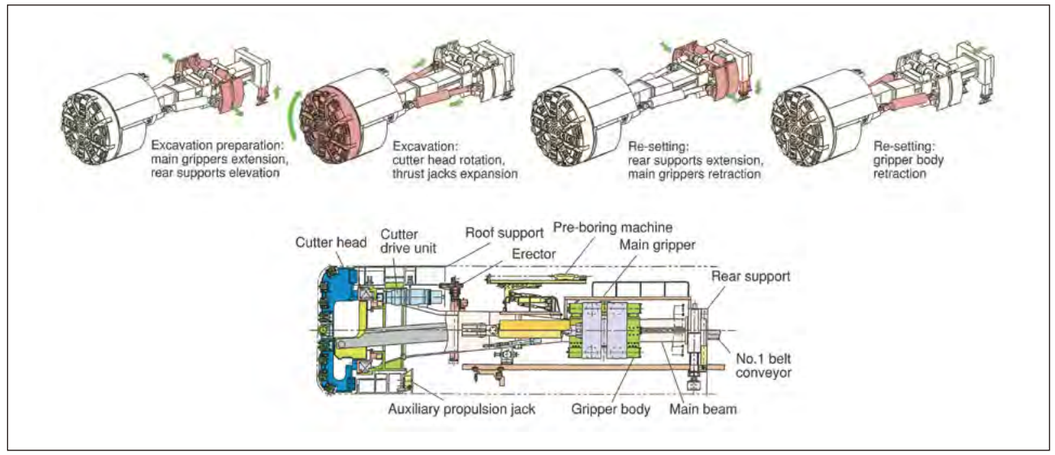
The main components in these machines include a cutterhead, cutter drive unit, main beam, gripper, and roof support. This simple structure enables operators to work on the cutterhead in close proximity to the face. Open TBM provide high performance and economical operation under solid hardrock conditions. They are excellent for linear excavation, as the boring direction is regulated by the main beam.



2003 Gunma Prefecture, Japan

JR Agatsuma Line Relocation Line Yanba Tunnel Construction

Project owner	East Japan Railway Co.
Contractor	Shimizu/Nishimatsu/Hazama JV
Machine outer dia.	6.82 m
Excavation length	4,160 m

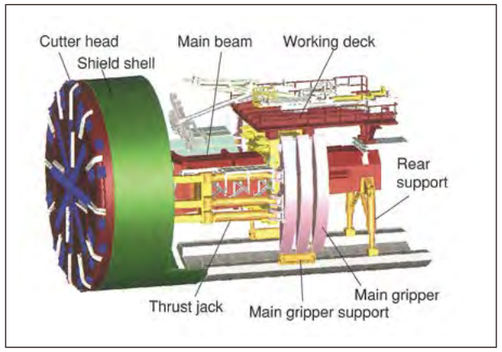


Various TBM

New Open TBM

These TBM are suited to a wide range of ground conditions, just like a full shield TBM, while also being particularly effective for high-speed excavation in solid ground conditions, just like an open TBM. The shield shell resists ground loosening and falling rocks while enabling operators to work on the cutterhead in close proximity to the face.

2004 Gifu Prefecture, Japan	
Tokai-Hokuriku Expressway Hida Tunnel Construction	
Project owner	Japan Highway Public Corp.
Contractor	Taisei/Nishimatsu/Sato JV
Machine outer dia.	12.84 m
Excavation length	4,290 m

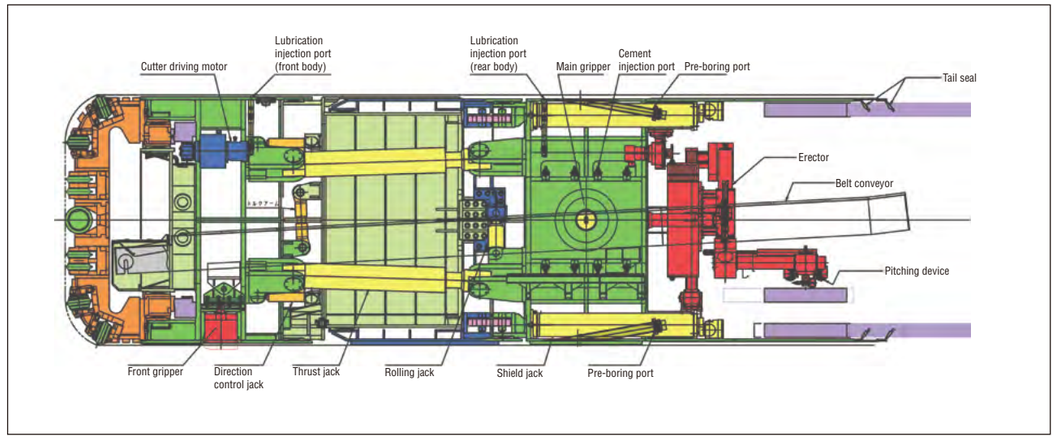


Φ12.84 m new open TBM structure

Full Shield TBM

A cylindrical shell structure accommodates a broad range of ground conditions, from hard rock to soft ground, including fracture zones.

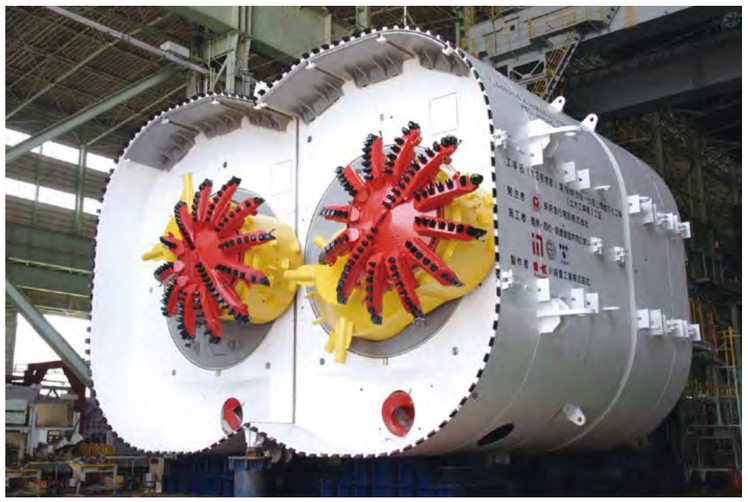
2007 South Korea	
Geoyo Karak Cable Tunnel	
Project owner	Korea Electric Power Corp.
Contractor	Daewoo Engineering & Construction, Dong-Ah Geological Engineering Co. Ltd.
Machine outer dia.	12.84 m
Excavation length	4,290 m



Rectangular TBM

APORO Cutter

This cutter allows users to select a circular or non-circular—such as rectangular—excavation cross section. The cutter mechanism utilizes a sophisticated cutter positioning system to ensure highly precise excavation cross sections. This cutter is highly effective for excavating hard ground and ground that contains obstructions.



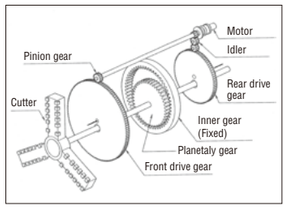
2016 Tokyo, Japan

(No. 13 Mutual Line Operation) Shibuya–Daikanyama Underground Construction (Public Works Construction No. 1 Section)

Project owner	Tokyu Railways Co., Ltd.
Contractor	Kajima/Nishimatsu/Tekken JV
Machine outer dia.	7.44 m × 10.64 m
Excavation length	577 m

OHM Method

By changing the direction and speed of rotation of the revolving shaft and the axis with which it is eccentrically fixed, a single rotating cutter can excavate a variety of cross sections, including rectangular, recessed-sided, expanded, and elliptical. The inner space within a square cross section can be effectively utilized to also achieve a shallower cutting depth.



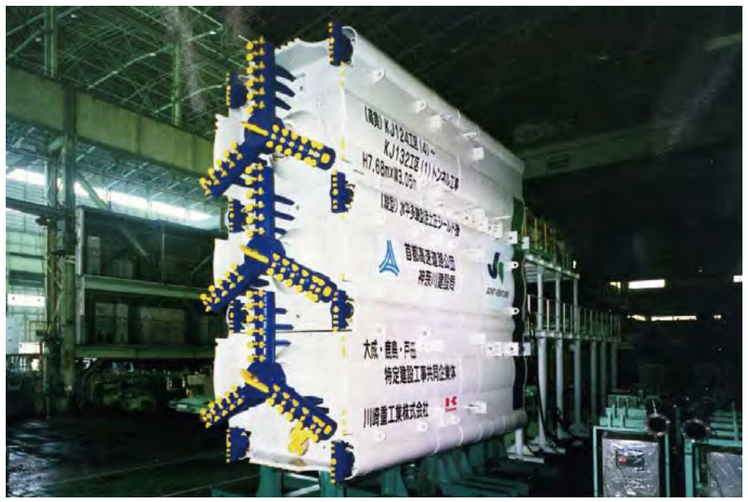
2002 Kyoto Prefecture, Japan

Kyoto City Subway Tozai Line Ishida Station Accessway Part 2 Construction

Project owner	Kyoto Municipal Transportation Bureau
Contractor	Tobishima/Nishimatsu/Morimoto/Kohsei/Kcon JV
Machine outer dia.	4.28 m × 3.83 m
Excavation length	142 m
Features	Rectangular (OHM)

MMST (Multi-Micro Shield Tunneling) Method

This method involves shield tunneling of multiple smaller cross sections within the outer shell of a large cross-section tunnel, with the internal earth being excavated after the outer shell has been shaped. We have manufactured vertically aligned slurry and EPB rectangular TBM for small cross sections used for excavation within an outer shell.

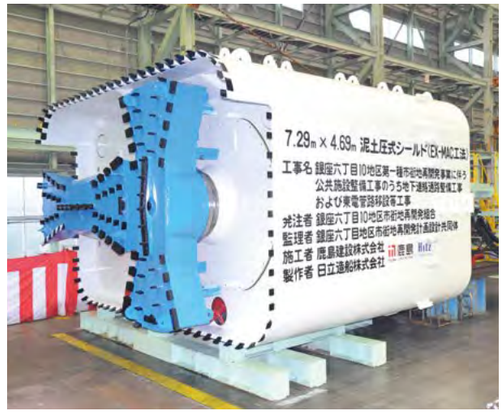


2002 Kanagawa Prefecture, Japan

(High Load) KJ124(4)–KJ132(1) Tunnel Construction

Project owner	Metropolitan Expressway Public Corp.
Contractor	Taisei/Kajima/Toda JV
Machine outer dia.	7.68 m × 3.05 m
Excavation length	1,080 m

Other Types



2016 Tokyo, Japan

Underground Accessway Improvement and TEPCO Conduit Relocation for Public Facilities Improvement Work Accompanying Class One Urban Redevelopment of Ginza Roku-chome District 10

Project owner	Ginza Roku-chome District 10 Urban Redevelopment Association
Contractor	Kajima Corp.
Machine outer dia.	8.99 m
Excavation length	383 m
Features	Equipped with two cutterhead units for oblong rectangular cross-section excavation and two retractable cutter units for excavating rectangular corner sections. A hood is attached to control electrical interference with the retractable cutters. Minimal earth covering of 2.6 m.

2014 Tokyo, Japan

Tokyo Metro Yurakucho Line Kotake-mukaihara Station–Senkawa Station

Project owner	Tokyo Metro Co., Ltd.
Contractor	Kumagai Gumi Co., Ltd.
Machine outer dia.	5.7 m × 6.8 m
Excavation length	175 m/145 m
Features	Composite circular (circular cutter + retractable spokes)

Special TBM

H&V Method

The machine excavates two independent tunnels in close proximity running parallel to one another. It can also create divergent branches and have the cutterheads rotate (spiral) around one another as they move forward. Of the eight projects that have used this method in Japan in the past, we have provided the machines for seven.

2015 Tokyo, Japan

Tachiai River Main Rainwater Conduit Construction	
Project owner	Tokyo Metropolitan Government Bureau of Sewerage
Contractor	Shimizu Corp.
Machine outer dia.	3.29 m/2.89 m
Excavation length	736 m/929 m
Features	Spiral excavation

1998 Tokyo, Japan

Minamidai Main Pipeline Construction	
Project owner	Tokyo Metropolitan Government Bureau of Sewerage
Contractor	Nishimatsu/Takenaka Civil Engineering & Construction/ JDC JV
Machine outer dia.	7.06 m/13.18 m
Excavation length	118 m
Features	Branch divergence during excavation

1998 Tokyo, Japan

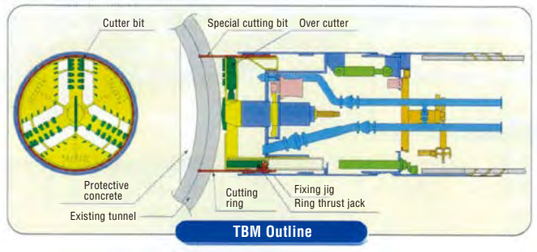
Subway No. 12 Roppongi and Aoyama Section Construction	
Project owner	Tokyo Metropolitan Subway Construction Co., Ltd.
Contractor	Hazama/Aoki/Aisawa/Tokura/Ito JV
Machine outer dia.	7.06 m/13.18 m
Excavation length	118 m
Features	World's first TBM equipped with a parallel articulating mechanism; four cutters equipped on the same surface

T-BOSS (T-type basement Branch Off Shield System) Method

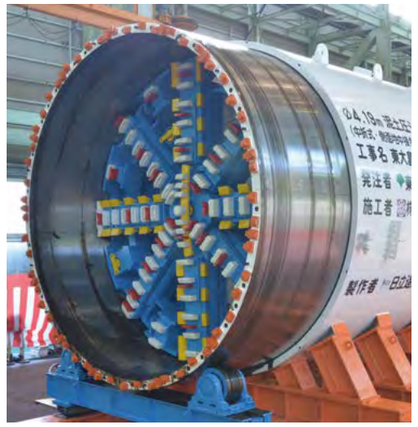
A cutting ring comprised of cutting bits housed in the shield is rotated via the rotational torque of the cutterhead, directly cutting and penetrating the existing tunnel and mechanically joining a new tunnel to it in a T-shaped junction. When joining the tunnels, the cutting ring serves to prevent soil and water infiltration, thus reducing the need for ground reinforcement and improving the safety and efficiency of the joining process.

2022 Tokyo, Japan

Higashi-ojima Main Pipeline Construction	
Project owner	Tokyo Metropolitan Government Bureau of Sewerage
Contractor	Kumagai Gumi Co., Ltd.
Machine outer dia.	4.19 m
Excavation length	1,880 m
Features	T-BOSS



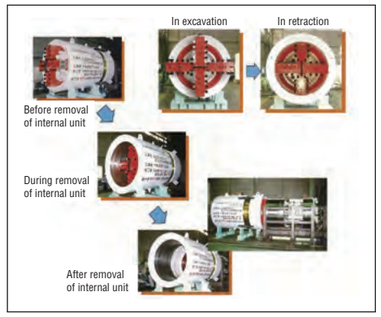
TBM Outline


When cutting existing pipework

Special TBM

DSR (Draw a Shield for Recycle system) Method

The TBM's external casing and internal unit are constructed as independent units, and the internal (drive) unit is removed following completion of tunneling of the first section. It is taken to the launch shaft, where a new external casing is fitted, and excavation is then begun on the next construction section. Because the TBM's internal unit is reused, there is no need to construct an arrival shaft. The launch shaft can be set up anywhere along the construction route.



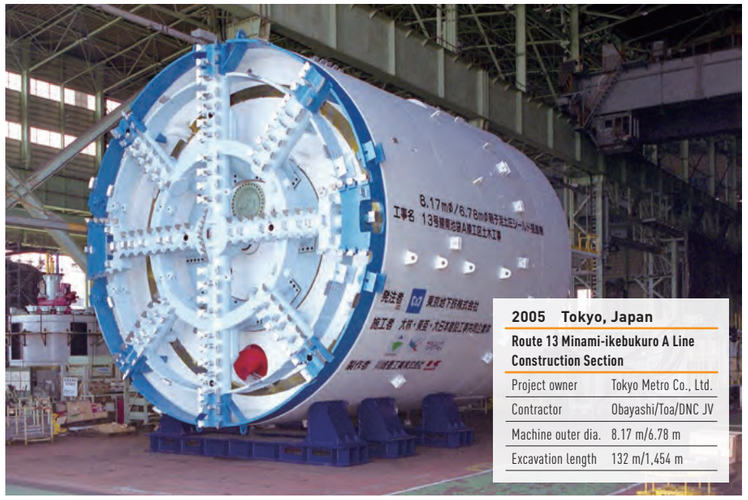
2001 Tokyo, Japan

Bunkyo Ward Honkomagome 1/3-chome Area Reconstruction

Project owner	Tokyo Metropolitan Government Bureau of Sewerage
Contractor	Arai/Shiraishi JV
Machine outer dia.	2.68 m
Excavation length	686 m

Parent–Child Shield Method

Inside the machine is a child unit that can be detached underground, thereby facilitating continuous construction of tunnels of varying diameters within a single shield. A variety of methods can be used for cutter separation, depending on such factors as cutterhead configuration, size, and difference in diameter between the parent and child units.

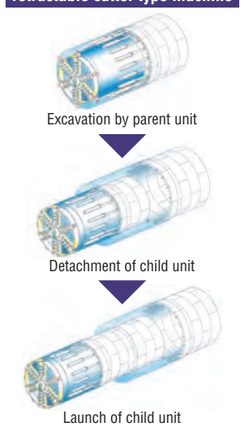


2005 Tokyo, Japan

Route 13 Minami-ikebukuro A Line Construction Section

Project owner	Tokyo Metro Co., Ltd.
Contractor	Obayashi/Toa/DNC JV
Machine outer dia.	8.17 m/6.78 m
Excavation length	132 m/1,454 m

Detachment procedure of retractable cutter type machine



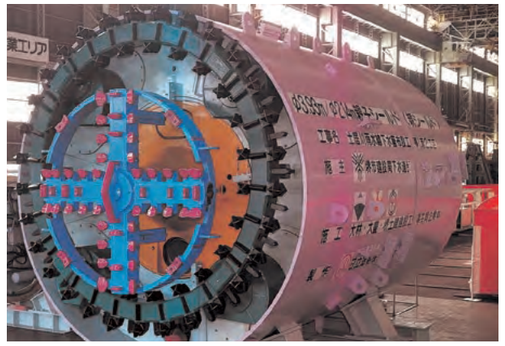
DPLEX (Developing Parallel Link Excavation) Shield Method

Multiple parallel links supporting the cutterhead are used to drive the excavation process. Various excavation cross sections can be created by changing to a non-circular shaped cutterhead.

1999 Hyogo Prefecture, Japan

Kanaoka Rainwater Storage Piping Construction

Project owner	Itami City
Contractor	Shimizu/Kumagai/Maeda JV
Machine outer dia.	7.67 m
Excavation length	1,150 m



2002 Osaka Prefecture, Japan

Doi River Rainwater Drainage Pipe Installation (No. 2 Section)

Project owner	Sakai City Construction Bureau Sewerage Department
Contractor	Obayashi/Daiho/Sakai Engineering and Construction JV
Machine outer dia.	7.67 m
Excavation length	1,150 m
Features	Parent–child and DPLEX methods

MF Shield Method

Multiple circular shield cutterheads are staggered in front and back one another, and the overlapping shields are used to construct various tunnel cross sections. Because this method allows excavating tunnels with large cross sections, both vertically and horizontally, it can be tailored for excavation in sites where there are limitations or are already many other underground structures. It can also efficiently build tunnel cross sections for the given project requirements or intended site usage.

2000 Tokyo, Japan

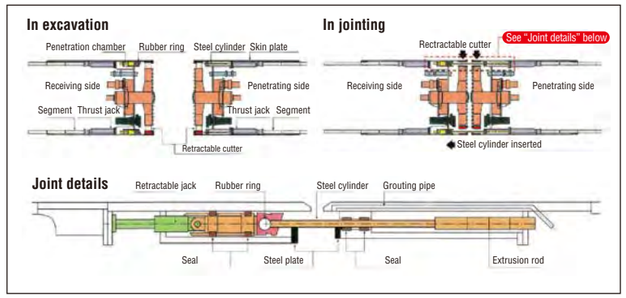
Teito Rapid Transit Authority Line 11 Kiyosumi Section Public Works Construction

Project owner	Teito Rapid Transit Authority
Contractor	Kumagai/Maeda/Mitsui JV
Machine outer dia.	7.44 m/16.44 m
Excavation length	373 m

Special TBM

MSD (Mechanical Shield Docking) Method

A receiving TBM and penetrating TBM excavate towards one another and dock underground, joining to create a single tunnel. The two units are joined by a steel cylinder within the penetrating TBM, which is pushed into the penetration chamber of the receiving TBM. The junction part resists the surrounding earth and water pressure and prevents soil and water from entering. After the junction is created, the steel cylinder is utilized as a structural body strengthening the tunnel and preventing water inflow for completion of the tunnel's secondary lining.



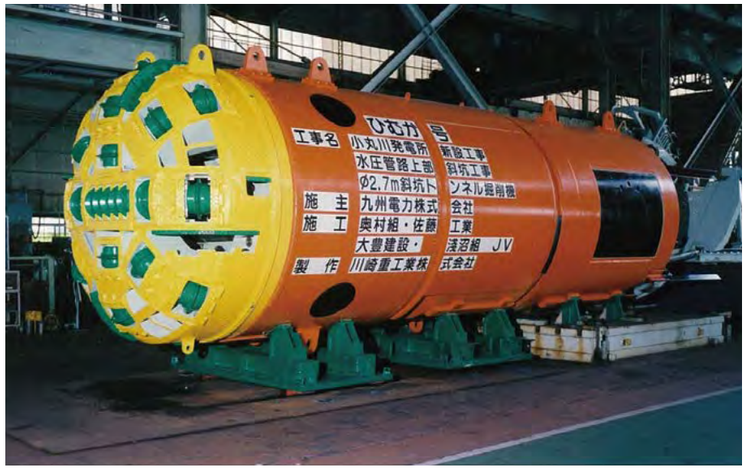
2010 Tokyo, Japan

Water Pipe (1,500 mm) Tunnel Construction from No. 2781 to No. 1241 in Aihara-machi, Machida City

Project owner	Tokyo Metropolitan Government Bureau of Waterworks
Contractor	Shimizu/Fudo Tetra JV
Machine outer dia.	2.59 m
Excavation length	1,538 m
Features	MSD extrusion face (articulated)

Incline Shaft TBM

This TBM is used for steep-gradient tunneling, where the upward gradient of the tunnel exceeds 30%. In order to excavate steep tunnels, a large gripper and slip-prevention steel parts or invert blocks are used with a shield jack to keep the machine from slipping as it digs. Of four projects carried out in Japan, our machines have been used for the pilot tunnel in three of them.



2002 Miyazaki Prefecture, Japan

Omarugawa Power Station Hydraulic Piping Inclined Tunnel Construction

Project owner	Kyushu Electric Power Co., Inc.
Contractor	Okumura/Sato/Daiho/Asanuma JV
Machine outer dia.	12.47 m
Excavation length	4,012 m

Vertical TBM

This slurry shield TBM is used to excavate vertical shafts, including deep hardrock shafts. In addition to various seals capable of withstanding high water pressure, a two-part soil removal system for reducing water pressure during boring is used to ensure the stability of excavation.

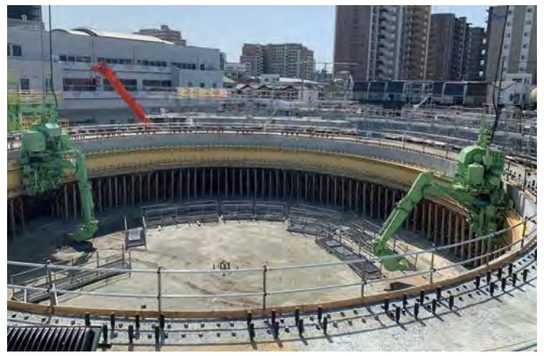
2006 Okayama Prefecture, Japan

Kurashiki Base Propane Storage Tank I Construction (Water Supply and Ventilation Shaft)

Project owner	Japan Oil, Gas and Metals National Corp.
Contractor	Shimizu/Hazama/Okumura JV
Machine outer dia.	4.76 m
Excavation length	146 m

Automated Underwater Excavators

These machines are equipped with excavation patterns for automatically boring the ground directly beneath the cutting edge in order to ensure smooth installation of caissons under a wide variety of ground conditions.



2021 Osaka Prefecture, Japan

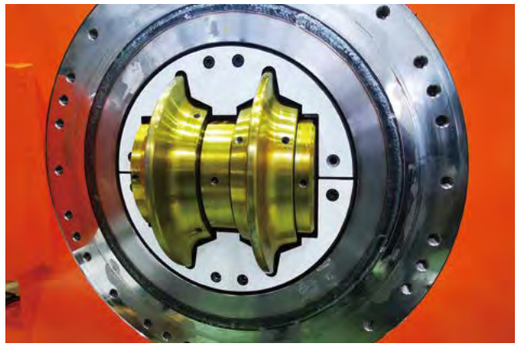
Neyagawa North Underground Channel Johoku Vertical Shaft Construction

Project owner	Osaka Prefecture
Contractor	Toda/Hanshin/Daiyo JV
Caisson inner dia.	28 m
Caisson depth	102 m

Cutter Exchange

Slide Rotary-Type Disk Roller Cutter Exchanging Device

This device allows disk roller cutters to be exchanged safely from inside the TBM (cutter frame) and under normal atmospheric pressure, thereby ensuring operators do not have to work in dangerous spaces, such as near the face or inside the cutter chamber, when excavating hardrock.



Cutter face during excavation

Cutter frame interior during cutter exchange

Features

1. Can be equipped anywhere on the cutter frame cross section

- A twin-ring-type disk roller cutter minimizes the total amount of equipment.
- The number of cutter frames is reduced to ensure effective soil intake opening.

2. Capable of withstanding high water pressure

- Cutter exchange has been successfully demonstrated at earth and slurry pressures of 2.0 MPa.

3. Can be converted to cutters that can excavate soft ground

- Applicable to complex ground conditions (hardrock, earth and sand mixtures).

4. Equipped with a soil consolidation prevention system and disk roller cutter abrasion detection system

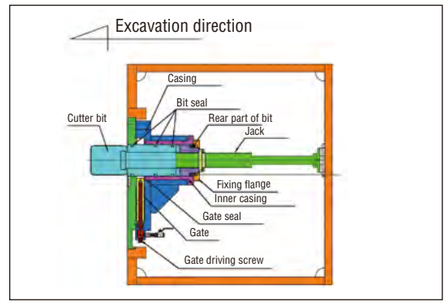
- A soil inflow prevention plate and additive discharge prevent consolidation within the cutter holder.
- A magnetic abrasion detector prevents uneven wear, and a physical abrasion detector measures the amount of abrasion.

5. Easy maintenance

- The device (including the ball gate holder unit) can be replaced under existing water pressure.

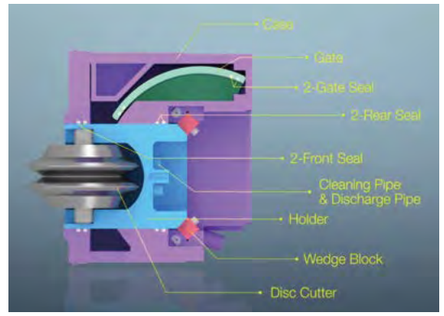
Double Casing Slide Gate-Type Cutter Bit Exchanging Device

- Cutter bits can be safely replaced under normal atmospheric pressure.
- When the gate is opening or closing, the inner casing retracts so that the gate and seal do not come into contact, thereby ensuring smooth gate operation and reduced risk of seal damage.
- A gate seal presses against the gate after gate closure to ensure there is no water inflow.
- Has a compact structure, which enables greater interlinkage for more cutter bits to be installed closely together.
- After cutter bits are taken out, filler material (e.g., grease) is injected into the empty space to keep out rock mass debris or inflow.
- All main components, including the gate, can be replaced, thereby ensuring excellent maintainability.
- The inner casing can be taken out for replacement when the gate seal is damaged.



Arc Gate-Type Bit Exchanging Device

- Cutter bits can be safely replaced under normal atmospheric pressure.
- When the arc gate is closed, it is designed to be pulled backward so that external pressure ensures it remains tightly closed against water, even when subjected to strong water pressure.
- When opening or closing, the gate seal is separated from the seal surface, thereby facilitating smooth operation and a reduced risk of damage to the seal.
- Has a compact structure well suited to devices for replacing large excavation tools, such as disk cutters.
- After cutter bits are taken out, filler material (e.g., grease) is injected into the empty space to keep out rock mass debris or inflow.
- Can be equipped with a variety of excavation tools, such as replacing a disk cutter with toothed cutter bits.
- Has a removable gate, thereby allowing for exchanging in the event that the seal is damaged.



Mechanical Bit Exchanging Device for Large-Diameter TBM

An access hole installed in the central or leg section of the cutterhead allows operators to enter the cutter spoke and, with the use of a simple jig, exchange worn cutter bits. Cutter bits can be exchanged not only when they are worn but also to accommodate the conditions of the face. Since 2002, we have delivered nine machines equipped with this device.

High-Speed Excavation

Simultaneous Excavation (Long Stroke)

The shield jack stroke and tail interior space can be extended to enable tunneling at the same time as segment assembly. Incorporating a semi-automated erector, which automatically transports segments to the segment assembly site, allows greater operational efficiency and safety.

2009 Tokyo, Japan

Central Circular Route Shinagawa Line Shield Tunnel (North) Construction

Project owner	Metropolitan Expressway Co. Ltd.
Contractor	Kajima/Kumagai/Penta-Ocean JV
Machine outer dia.	12.5 5m
Excavation length	8,030 m
Features	Mechanical bit exchanging device, vacuum erector

Simultaneous Excavation (Double Jacks)

An advance jack and erection jack are installed in the internal unit to enable tunneling at the same time as segment assembly.

2003 Tokyo, Japan

East-West Gas Pipeline Construction

Project owner	Tokyo Electric Power Co.
Contractor	Kajima/Nishimatsu/Obayashi JV
Machine outer dia.	3.62 m
Excavation length	9,030 m
Features	Max. monthly distance 1,168 m Avg. monthly distance 665 m

Automatic Segment Assembly System

This system automates the entire segment assembly process, including segment delivery, supply, gripping, positioning, and fastening. A variety of segment coupling methods can be accommodated (short bolts, long bolts, cotters, etc.), thereby facilitating better assembly quality and safety and, particularly in the case of large diameters, speed.

Short bolt system

Automated backup equipment

Cotter driving

Sensing apparatus positioning

Hardrock and Boulders

Front Crusher

Boulders can be crushed by this device inside the front of the TBM. It helps to reduce operational downtime caused by blockages in the slurry discharge pipe. It also improves intake, which reduces abrasion to the front of the cutterhead.

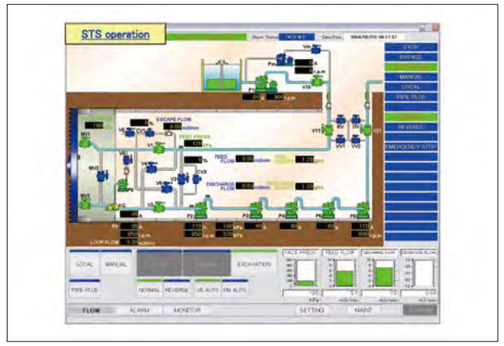
Reduced Work Site Operations

Deck-Mounted Power Unit

By putting the power unit, which is usually mounted on the backup car, onto an operation deck within the TBM, less temporary launch hoses and cables are needed, thereby speeding up initial set-up operations.

Bundled Delivery of Backup Systems

All of the slurry transport equipment and slurry treatment equipment needed for operation of a slurry TBM can be delivered together with the machine.



Units Delivered

UGITEC TBM are recognized throughout Japan and around the world

For more than half a century, we have been manufacturing TBM tailored to the needs and conditions of different countries and regions. Today, UGITEC machines are used all over the world.

Φ8.11 m EPB TBM (United Kingdom)

Europe

- United Kingdom
- France
- Denmark

Φ9.22 m EPB TBM (Hong Kong)

Φ7.8 m Slurry TBM (South Korea)

Φ6.24 m EPB TBM (Taiwan)

East Asia

- China
- Hong Kong
- Taiwan
- South Korea

Φ5.22 m EPB TBM (United Arab Emirates)

Middle East

- United Arab Emirates
- Turkey

Φ6.44 m Slurry TBM (India)

South Asia

- India

Φ6.9 m Slurry TBM (Singapore)

Southeast Asia

- Philippines
- Singapore
- Thailand
- Indonesia
- Malaysia

Φ17.45 m EPB TBM (United States)

North America

- United States

Network

Trade Name	Underground Infrastructure Technologies Corporation Abbreviation: UGITEC
Established	October 1, 2021
Head Office	3F, Dojima Plaza Building, 1-5-30 Dojima, Kita-ku, Osaka 530-0003, Japan Tel: +81-6-7222-0837 Fax: +81-6-7222-8420
Capital	480 million yen
Business	Tunnel excavation business (tunnel boring machines); civil engineering machinery-related design, development, repair, and sales; other related business

Offices and Plants

Head Office 3F Dojima Plaza Building, 1-5-30 Dojima, Kita-ku, Osaka 530-0003, Japan
Tel: +81-6-7222-0837 Fax: +81-6-7222-8420

Access
- 4 min. walk from Kitashinchi Station on JR Tozai Line
- 4 min. walk from Nishi-Umeda Station on Osaka Metro Yotsubashi Line
- 5 min. walk from Watanabebashi Station on Keihan Nakanoshima Line
- 10 min. walk from JR Osaka Station

Tokyo Office 8F Shibaura Renasite Tower, 3-9-1 Shibaura, Minato-ku, Tokyo 108-0023, Japan
Tel: +81-3-6777-7101 Fax: +81-3-3457-7026

Access
- 4 min. walk from JR Tamachi Station
- 7 min. walk from Toei Subway Mita Station

Partner Plants Sakai Works, Kanadevia Corporation
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Ariake Works, Kanadevia Corporation
1 Ariake, Nagasu-machi, Tamana-gun, Kumamoto 869-0113, Japan

Harima Works, Kawasaki Heavy Industries, Ltd.
8 Niijma, Harima-cho, Kako-gun, Hyogo 675-0180, Japan