

JAPAN

Doors to Tunneling Technology in Japan

Hazama

HAZAMA's tunnel achievement in Southeast Asia

HAI VAN PASS TUNNEL is the longest road tunnel in Southeast Asia and the first road tunnel constructed by the NATM method in Vietnam. It's on National Highway No.1 in Vietnam, which is 6,274 m length. Hazama was in charge of the northern part of the tunnel.

HAZAMA's latest tunnel technologies

1. Closed Double Tube with No-Center Pillar Method

The No-Center Pillar method is used in the closed double tube to reduce the construction period and construction cost. Hazama succeeded in adapting this method to the highway tunnel in Toyota City, Japan.

2. NEW PLS Method

NEW PLS is a pre-lining method for tunnel that uses an arch-shell excavation machine with double chain cutter and formed arch concrete shell. Hazama achieved this NEW PLS method through three projects in Japan.



KAJIMA CORPORATION

KAJIMA's newest tunnel technologies

1. First double-deck road tunnel

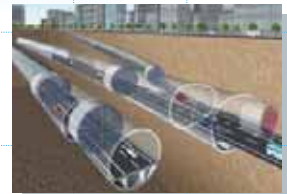
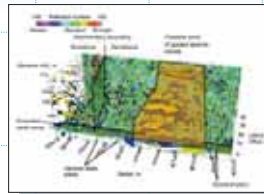
The multi-level bench-cut method was used by dividing the total section area into four levels. To prevent surface settlement, the AGF method, horizontal jet grouting, footing piles and temporary bearing piles were adopted.

2. True Reflective Tomography (TRT)

An isometric plot of detected reflection anomalies along the tunnel alignment give a 3-D image of the geologic structure for some distance along the tunnel alignment.

3. The Shield Tunneling System

Various new shield tunnel technologies can be applied to a large underground space without open cutting.



KONOIKE

1. Oshiro Tunnel (Expressway)

- Twin bore-tunnel with 3 lanes x 2 lines (Finished cross-section area: 130 m² x 2)
- Shallow depth
- Passing under a historic site

2. Koseko Tunnel (Expressway)

- Adopting the K-NTL (Nippon Tunnel Lining) instead of Shotcrete
- Non rebound, no dust emission

3. Kobe Subway Tunnel (Sin River Sec.)

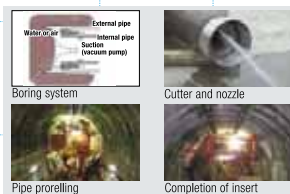
- Adopting the CPS (Chemical Plug Shield) method
- CPS is a kind of earth pressure balanced shield in a gravel layer under high water pressure (1.0MPa) instead of slurry shield method
- Reduction of pollution and Waste => Cost reduction



KUMAGAI GUMI

Pre-Supporting System Arch (PSS-Arch)

The PSS-Arch technique inserts curved steel pipes from the center drift of a binocular tunnel, into the ground along the excavation circumference of the main tunnels. Since main tunnels are excavated inside the supports installed in advance, higher safety is ensured and ground settlement is well controlled.

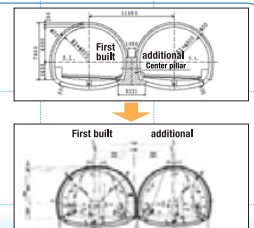


MAEDA CORPORATION

MAEDA's Binocular Tunnels

Sometimes "Binocular tunnels" (i.e. two closely constructed tunnels) are adapted for economic and operation reasons.

In the past, the center and/or side pillars of "Binocular tunnels" had to be constructed prior to the tunnels. However, thanks to development of a new construction method, and monitoring / analysing technique, the construction of "Binocular tunnels" is now possible without advanced pillar construction.



Doors to Tunneling Technology in Japan

Nishimatsu Construction Co., Ltd.

● Construction of Major Road Projects

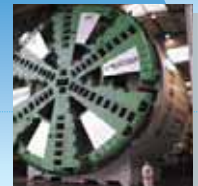
Nishimatsu has an impressive record of contributions to social and economic development in Asia. In addition to a continuing presence in several Asian countries, the Company is currently involved in large-scale projects in Europe. As for major road projects outside of Japan, we have constructed the Tate's Cairn Tunnel, Western Harbour Crossing and Route 3 in Hong Kong. The Dublin Port Tunnel Project in Ireland will be completed in 2006.



Tate's Cairn Tunnel



Western Harbour Crossing



Dublin Port Tunnel Project

OBAYASHI Corporation

● State-of-the-art Road Tunneling Technologies by Obayashi Corporation

1. Shimizu No. 4 Tunnel: Large Bore for the Second Tomei Highway by pilot TBM and Shotcreting
2. Nakaochiai Shield: Large Bore for the Metropolitan Expressway by 12.02-m diameter EPB Shield
3. URUP method: Rapid Underpass Construction without trenched excavation
4. Subsurface Intersection by Non-trench method for Road Shield Tunnels



Shimizu No. 4 Tunnel



Nakaochiai Shield



URUP method



The new developed parent-child shield

The new method for coupling two shields together

PENTA-OCEAN CONSTRUCTION CO., LTD.

● Tunneling of PENTA-OCEAN

The Shimizu No. 1 Tunnel, which was designed to accommodate the three-lane New Tomei Expressway, has a tunnel section area of 200 m². First, the pilot tunnel for up and down lines was excavated by a 5 m diameter TBM, and then NATM was applied to enlarge the tunnel area. In Takahara Tunnel at Fukuoka Route 442, a portal area consisting of a fragile layer has been successfully excavated by reinforcing the advance core with a face bolting system.



Shimizu No. 1 Tunnel: TBM



Shimizu No. 1 Tunnel: Enlargement of excavation area by NATM



Takahara Tunnel: View of the face

SHIMIZU CORPORATION

● Tunneling Technology of SHIMIZU

1. Large Cross-Sectional Tunnel: Fujigawa Tunnel (The Second Tomei Highway), excavation of a huge crushed zone
2. Underground intersection construction with existing tunnel and new tunnel
3. Development of divergence construction technology for deep road tunnels



Fujigawa tunnel



Ginga tunnel



ES-J method

TAISEI CORPORATION

● Example of the Company's Efforts

1. Seikan Tunnel (Tsugaru-Channel Line): the world's longest tunnel, L=53.9 km
2. Hida Tunnel (Tokai Hokuriku Expressway): TBM, the world's largest diameter of 12.84 m
3. Ome Tunnel (Metropolitan Inter-City Expressway): double-tier tunnel with large cross section of 220-260 m²

