

Tunnels

The long, thin chain of islands that compose Japan has a spine of steep mountains running north to south down the island chain. The elevations reach 2,000m to 3,000m above sea level and about 70% of the land is mountainous. Therefore, roads must be constructed on the narrow strips of land between steep slopes and the sea, alongside rivers winding between mountains, and sometimes through mountains. Tunnels are increasingly used when constructing roads in highly populated areas due to the shortage of land and to protect the environment.

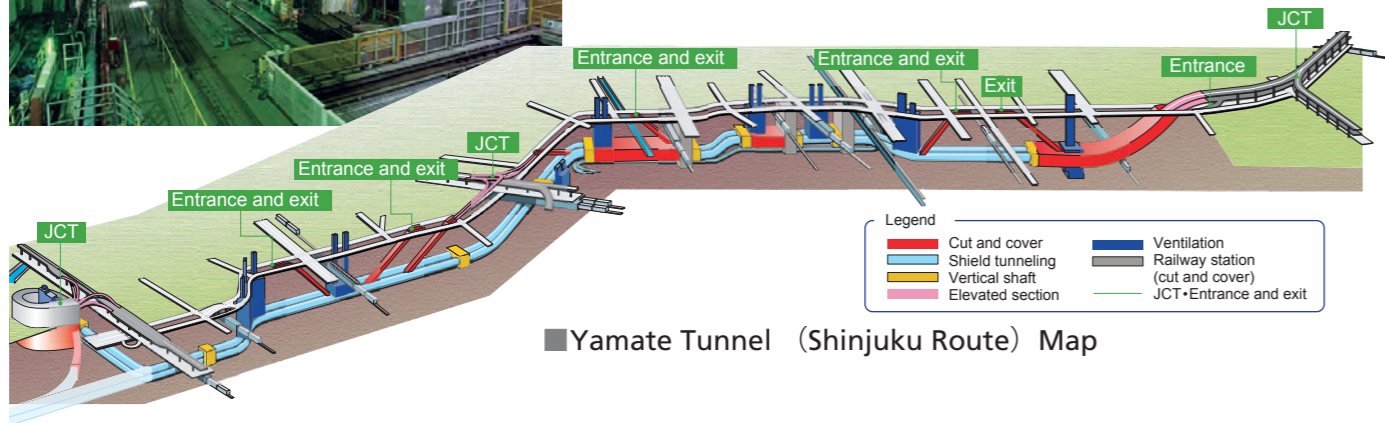
Kan-etsu tunnel (Kan-etsu Expressway)

The Kan-etsu Tunnel is 11km long and is the longest mountain tunnel in Japan. At its lowest depth the tunnel passes 1,100m below the mountain's peak. Of its four lanes, the outbound lanes were opened in 1985 and the inbound lanes were completed in 1991.



Yamate tunnel (Central Circular Oi~Ikebukuro Route of the Metropolitan Expressway)

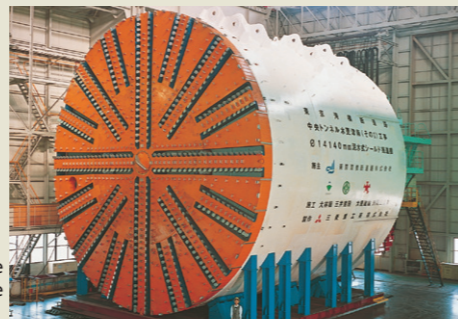
Yamate tunnel connects Shinagawa, Shibuya, Shinjuku and Ikebukuro, which are major sub-centers of Tokyo. The tunnels is 18.2km long and is the longest Expressway tunnel in the world. The tunnel were completed in 2015.



Tunnel boring machine

The tunnel boring machine consists of both a tunnel shield and a front rotating cutting wheel. As the front cuts into the ground, it assembles concrete segments inside the machine, and as it advances it constructs the tunnel behind it. Advanced robotic technologies are used, with a computer controlling a series of activities required for the tunneling work.

World class Large Tunnel boring machine (diameter: 14.14m) used to construct the Tokyo Bay Aqua-line Expressway



Bridges

Japan consists of four major islands, Hokkaido, Honshu, Kyushu, along with Shikoku, and a number of smaller islands. Straits and inland seas hinder traffic between the islands. For well-balanced development, transportation access is required, so bridges connecting islands have been constructed. Also, since Japan is highly prone to earthquakes, typhoons and strong winds, cutting-edge technologies are used to construct and maintain long-span bridges that can withstand severe weather and natural disasters

Honshu-Shikoku expressway

The Honshu-Shikoku Expressway was completed in 1999 and connects the main island of Honshu with the island of Shikoku. It has three routes, including: the Kobe-Naruto route (the Kobe Naruto Expressway), the Kojima-Sakaide route (the Seto-Chuo Expressway and the JR Seto-Ohashi line), the

Onomichi-Imabari route (the Nishi-Seto Expressway). The total length of these roads is approximately 173km. The center span of the Akashi Kaikyo Bridge is 1,991m, making it the longest in the world. Additionally, the height of the main tower is approximately 300m above sea level.



Akashi Kaikyo Bridge



Tatara Bridge



Seto Bridge

Tokyo bay aqua-line expressway

The Tokyo Bay Aqua-line Expressway, which allows a motorist to transverse the Tokyo Bay, was completed in 1997. About 10km, out of its total 15.1km, are under the Bay and the remaining 5km are configured as the Aqua Bridge. A ventilation tower ("Kaze-no-to") was constructed in the middle of the tunnel, and a manmade island ("Umihotaru") was constructed where the tunnel and the bridge meet.



The manmade island "Umihotaru" and the Aqua-line Bridge

Reinforcement and management of long bridges



Non-destructive inspection of hangers



A model experiment using a 1/6-scale model of buckling restraint braces.

Use of a damage control earthquake-resistant design on the Minato-ohashi Bridge helped reduce the construction cost (Hanshin Expressway).



Long bridges are inspected daily using advanced technologies in order to prolong their service life. For instance nondestructive methods are used to inspect hangers on suspended bridges. Implementation of damage control earthquake-resistant designs to retrofit existing long bridges has reduced the cost of constructing long bridges to 65%.