

World's First Spiral Excavation Using H & V Shield Method

— Construction of Rainwater Discharge Pipe under Tachiaigawa River —

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1. Introduction

In this project, two sewer culverts with inner diameter of 5 meters each were constructed right under the Tachiaigawa River in Shinagawa Ward, Tokyo, to reduce flood damage and improve water quality.

Due to the narrow river width and existing underground structures, the tunnel alignment was horizontally and vertically restricted, thus the spiral excavation by H&V (Horizontal & Vertical variation) shield method was used (Fig. 1). The H&V shield tunneling method, developed to construct a wide variety of tunnels depending on the tunnels' location and intended use, enables simultaneous excavation of two very close circular tunnels, twisted routes (spiraling) and single circular tunnels branching from a dual one.

The project was the first in the world to carry out spiral excavation in actual construction.

2. Spiral Drilling Section

Starting with the two shield machines connected side by side, the right-side shield was spiraled by 90° around the left-side shield in approximately 137-meter section. As the spiraling proceeds, each shield machine drills through the ground of different depths and geology.

3. Drilling Maintenance and The Result

In order to maintain a linear shape in a spiral drilling, the drilling must be carried out while maintaining a constant rolling amount. For this reason, linear control was carried out with an emphasis on attitude control of the machine such as maintenance of the swing angle (angle difference between rear bodies of right and left machines). In the spiral excavation, the results of the prior analysis by the H&V shield simulator were used as the initial values of the machine operation. During the excavation, the position and attitude of the machine and the behavior of the joint were grasped, and machine operations such as selection of jacks, thrust, extra excavation and articulation were carried out on a real-time basis.

As a result, the spiral excavation was finished within the linear control value without any trouble such as damage of the joint.

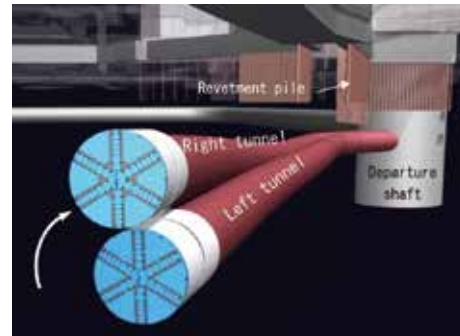


Fig. 1 Image of spiral drilling section



Fig. 2 H&V shield machines



Fig. 3 H&V shield machines in vertical shaft



Fig. 4 Inside photo of the spiral drilling section

PHOTO: Kenichi Komeiji