Started Large-section Shield Tunneling with Small Earth Covering of 1.1m

— Yokohama South Ring Expressway (Ken-O-Dou) Kuden-Kasama Tunnel —

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1. Introduction

"Kuden-Kasama Tunnel" on Yokohama South Ring Expressway is an annex tunnel whose total length is about 1.7km.
A shied machine with about 15m diameter leaves from a departure/arrival shaft to construct an outward tunnel first, turns within a rolling shaft, and restart to construct a return tunnel.
The earth covering ranges from about 1.1m-38.5m, and the shield machine starts where the earth covering is about 1.1m.

2. Geology Outline

The geology that this tunnel goes through consists of Kamifusa formation of Neogene-Pliocene to early Quaternary-Pleistocene.
The basement layer, called Ofuna formation, is a hard layer mainly made of mudstone, but at the start point of the shield machine with earth covering about 1.1m, there is soft alluvium (cohesive soil layer/organic soil layer) (Figure-1).
In addition, the groundwater level is high for the entire length of the tunnel; it is about 1 to 3m from the ground surface for about 70% of the 1.7km length of the tunnel, excluding hilly sections.

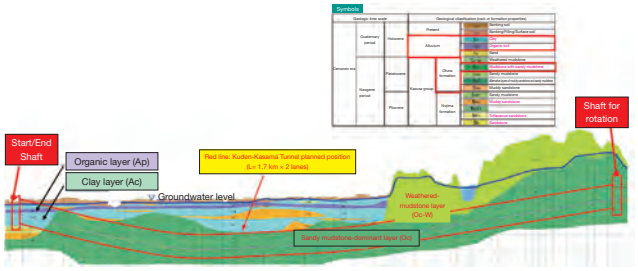


Fig. 1 Geologic cross-section map

3. Measures against Floating

In addition to the fact that the earth covering at the start point of the shield machine is small, since the groundwater level is high, measures against floating should be provided.
As the measures against floating, the surcharge load was increased by adding iron plates at the ground level, and the dead load was increased by adopting steel filled segments which are heavier the synthetic segments normally used for tunnel lining (Figure-2).
However, since those measures do not satisfy the given safety factor, steel ingots whose unit weight is larger than that of concrete were installed to the interior of the tunnel.
The shape and position of those ingots were designed not to interfere the passage of backup car, and were installable during the tunneling cycle using an erector for segment assembly (Figure-3).
Photo-1 shows the actual construction situation. The installation has been done as planned using the erector, the impact on the process was minimized.

In addition, the ingots were installed symmetry to prevent rolling, and no sing of rolling or floating has been observed during the post-installation form check.

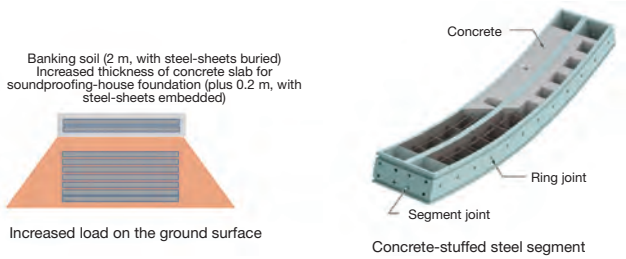


Fig. 2 Increase in load on the ground surface

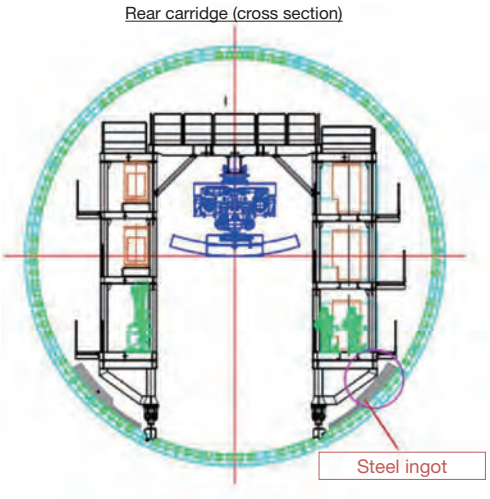
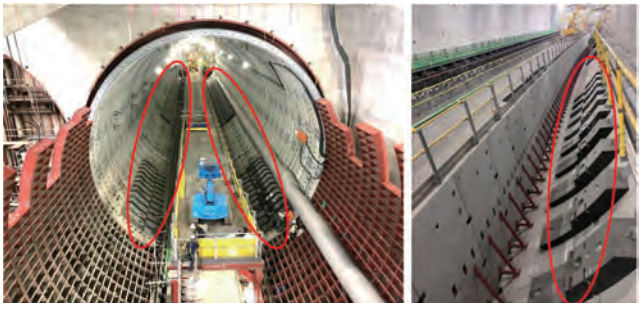


Fig. 3 Outline of steel ingot plan



Whole view　　Close-up view

Photo 1 Steel ingot placement