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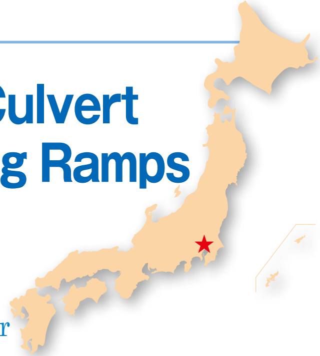
# Construction of a Large-Scale Composite Box Culvert Encompassing a Complex System of Intertwining Ramps



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## Introduction

The Tokyo Gaikan Expressway is an 85-km-long automobile-road that connects a 15-km radius of central Tokyo in a circular direction and serves to disperse traffic concentrated in the city center by interconnecting inter-regional trunk roads in radial directions.

The construction work for a part of the Chuo JCT, which connects the Chuo Expressway, the Gaikan Expressway, and the Tokyo Metropolitan Expressway, and where seven ramps are concentrated, was carried out under a design-build, lump-sum order system. This paper introduces the features of the composite box culvert structure proposed by the contractor (Fig. 1), which combines the large-scale open-cut method and the pneumatic caisson method, and the status of the construction work.

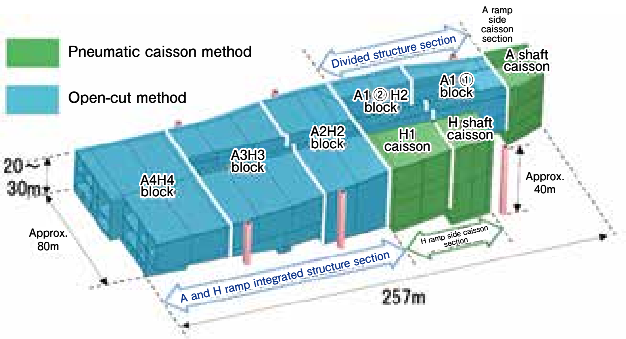
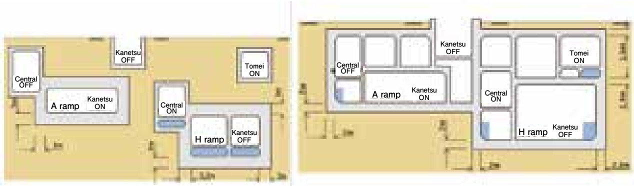



Fig. 1 Overall view of composite box culvert structure

## 1. Main body structure rationalization

When constructing a structure with only the space required for the road, the shapes of the sidewalls and top slabs change in a complicated manner, making it necessary to increase the thickness of the material and the amount of reinforcement at the corners where stress is concentrated, which poses a risk to the quality of the concrete, due to temperature cracks and poor filling. In this project, a composite box culvert structure was adopted (Fig. 2) to share the vertical load with the axial force of the structural wall and reduce the overburden pressure due to the reduction of the backfilled soil volume (soil volume reduced by about 80%), thereby eliminating the overcrowded reinforcing bars at the corner (reinforcing bar volume reduced by about 20%) and reducing the thickness of the material, resulting in a slimmer structure. (Fig. 3)




Structure of road space only (original)　　Composite box culvert structure (modified)

Fig. 2 Changes in the main structure

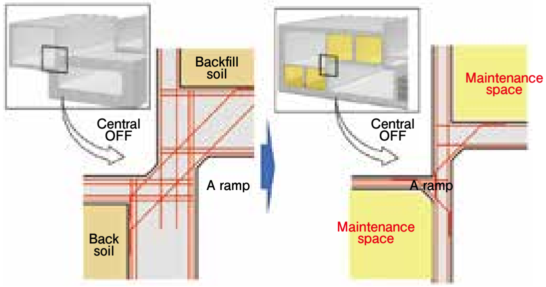



Fig. 3 Streamlining of the structure

## 2. Temporary structure and construction rationalization

Since the work site is small compared to the construction area, a full lining structure (A=15,000 m2, Fig. 4) was adopted. By fixing the ends of the girders to the earth retaining wall, the horizontal force acting on the end-supported piles of the lining was reduced and reinforcing materials such as diagonal materials were omitted to rationalize the temporary structure. As a result, a large space was secured above the ground and inside the shaft (Fig. 5), creating an easy and safe work environment and reducing the amount of temporary steel used by about 10%.

Fig.4 Securing the work area through full lining

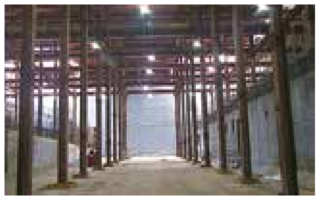
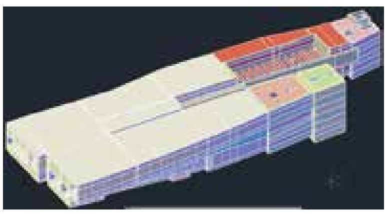


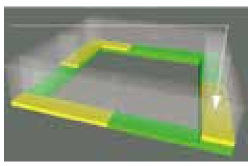
Fig.5 Rationalization of temporary structures

## 3. Use of ICT technology to ensure quality and improve management accuracy

Information for each transport vehicle with an agitator, including the time from concrete mixing to the completion of concrete placement and the location of concrete placement, was integrated into a 3D model. This improved the efficiency of concrete lay-up time management, material and construction history information management, and contributed to quality assurance by reducing the occurrence of cold joints and shortening the working hours for quality control work. (Fig. 6)



3D model



Management screen during concrete placement

Fig.6 Concrete placement management system