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9. Kahei Spiral Ramp, Tokyo

Owner: *Metropolitan Expressway Public Corporation (MEPC)*

Engineer: *MEPC*

Contractor: *Taisei Corporation*
Shinnihon Doboku Co., Ltd.
JDC Corporation
Totesu Kogyo Co., Ltd.

Dimensions:
Diameter of outer edge: *100 m*
Diameter of inner edge: *75 m*
Maximum grade: *7%*

Quantities of materials:
Foundation pile: *447*
Concrete *pile: 40800 m^3*
footing: 15700 m^3
wall, column and slab: 29400 m^3
Reinforcing bar *pile: 2280 t*
footing: 980 t
wall, column and slab: 3430 t

Construction Period: *50 months*

Service date: *1985*

Introduction

A pair of spiral-shaped ramp ways called Kahei Ramp has been constructed to connect the arterial Ring Road No. 7 and Metropolitan Expressway No. 6 which runs from Tokyo to the northern district.

This type of a ramp was planned and designed so as to enable the access of all directions with left turn only and to minimize the area of land for the expressway.

The ramp structure was constructed using cast-in-situ concrete.

Design

Since the type of ramp is very special involving a spiral shape, some structural types were studied such as steel girder, reinforced concrete and suspension structure. As a result the reinforced concrete type was adopted for the slab, and wall in combination with footing. This type was superior from the aseismic point of view, had less influence due to noise and vibration on the environment, and was more amenable to aesthetic treatment.

As is shown in the figure, there are two kinds of structural section: single deck and double deck. In the single deck section the slab is supported by two continuous walls, while in the double deck part the slab is supported by one continuous wall and two rows of columns.

Fig. 1 Kahei Ramp

By regarding the structure as an assemblage of plane rigid frames, structural analysis was carried out in the design of the frame.

Various loading conditions such as L loading (line load) and distributed loading, T loading (ccncentrated loads by 20 t truck) were used for the structural design to investigate the distribution area.

Construction

The structure was completed in the order of the construction of foundation pile, footing, wall, column and slab divided into several blocks.

Reverse circulation drill piling was used for foundation piles with $\varnothing = 1.5$ m and $L = 50$ m. In the single deck section, a row of piles was aligned below each wall, and in the double deck section six rows of piles were arranged under the footing. Concrete for the footing and slab was cast at one time in each block. On the other hand, concrete for the wall and column was cast in several steps depending on their height. Though the whole structure is continuous it is not possible to cast concrete at the same time as mentioned above.

Therefore it is unavoidable to generate many cold joints in the structure, and there is a possibility of occurrence of initial cracking by thermal stress near cold joints. To prevent the occurrence and development of cracks by repeated live load, prestressing force was applied by two steps: about 60% of design force at the third day and 100% at the seventh day.

To harmonize with the surroundings and to provide a good aesthetic appearance some ornamental treatments have been done. A crushed block texture was adopted on the surface of the wall and the lower surface of the slab by using urethane rubber form. Several concave stripes were put on the surface of the columns vertically to emphasize the vertical direction. There are many curved surfaces on the structure and special consideration was also given to the appearance of toll gate.

(T. Komura)

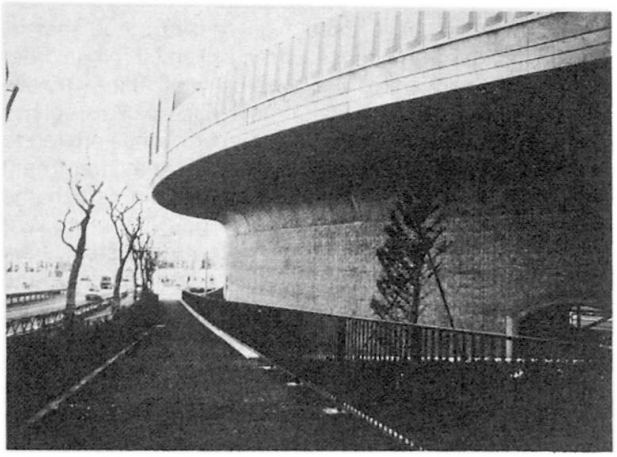

Fig. 2 Exterior view of Kahei Ramp

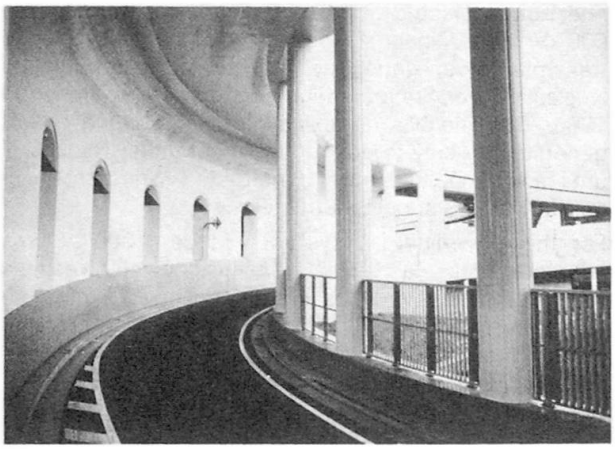

Fig. 3 Interior view of Kahei Ramp

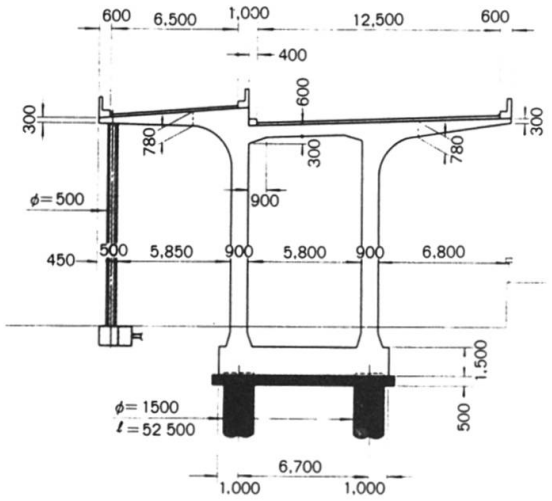

Fig. 4 Single deck section

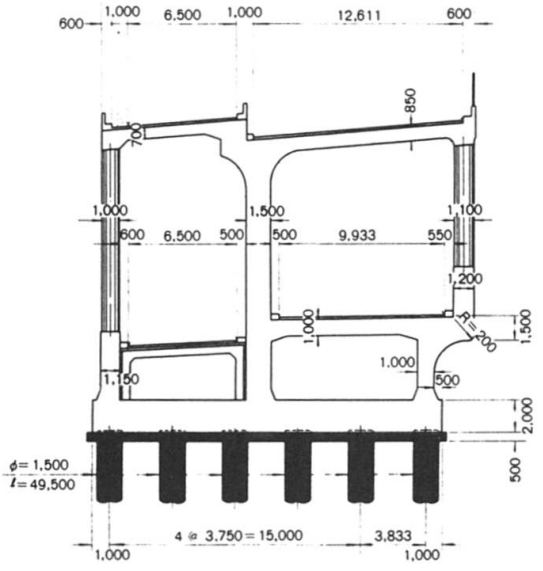

Fig. 5 Double deck section