Accelerated Construction Solution with Span-by-Span Construction — Katano Viaduct —

スパンバイスパン工法を採用したPC橋の超急速施工 — 交野高架橋 —

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Synopsis

The Katano Viaduct project is a bridge construction project consisting of an expressway section and a general access (non-expressway) section. The expressway section forms a part of the Daini-Keihan Road in Katano City, Osaka, Japan. The project was accepted on the basis of plans for a span-by-span construction method using an erection girder to erect the viaduct in sequence. However, the substructure work was partly delayed, seriously constraining the superstructure schedule. We had to find ways to accelerate the construction in order to make the viaduct available for service within Mar.2009. As a result we used the hanger-style erection girders that could move sideways, and used staging and supports for erection of the structure. This combination of approaches enabled the schedule to be accelerated by about four months, completing the construction in only about 18 months after commencing.

Structural Data

Structure:
<Expressway> 6-span continuous prestressed concrete rigid frame box girder bridge +17, 14-span prestressed continuous concrete box girder bridge (Both directions)
<General access> 17+12-span continuous prestressed concrete box girder bridge (Both directions)

Bridge Length:
<Expressway> 1507.5 m
<General access> 1157.7m (Up), 1164.3m (Down)

Span:
<Expressway>
[6 - span] 44.1+2@50.0+43.5+41.5+38.55m
[17-span] 36.35+2@43.5+4@37.0+2@43.5+3@41.5+4@37.5+37.85m
[14-span] 34.5+4@44.0+4@40.5+4@38.5+36.5m
<General access>
[17-span]
(Up) 36.15+2@42.8+2@36.6+2@36.8+2@43.5+3@41.5+2@38.5+39.5+34.0+37.55m
(Down) 37.55+2@44.2+2@37.4+2@37.2+2@43.5+3@41.5+2@34.0+2@40.5+39.05m
[12-span]
(Up) 34.7+4@44.0+4@40.5+2@38.5 +36.0m
(Down) 34.7+4@44.0+4@40.5+2@38.5+36.0m

Width: <Expressway> 29.24m (13.66, 13.78 m)
<General access> 7.49m (6.5m)

Girder depth: <Expressway> 2.700m
<General access> 2.700m

Erection method:
Span-by-span (hanger-style, support-style and staging)
Cast-in-place (Expressway section P50-P53)

Construction Period: Oct. 2007 – Mar. 2010
Location: Osaka Prefecture, Japan
Owner: West Nippon Expressway Co. Ltd.

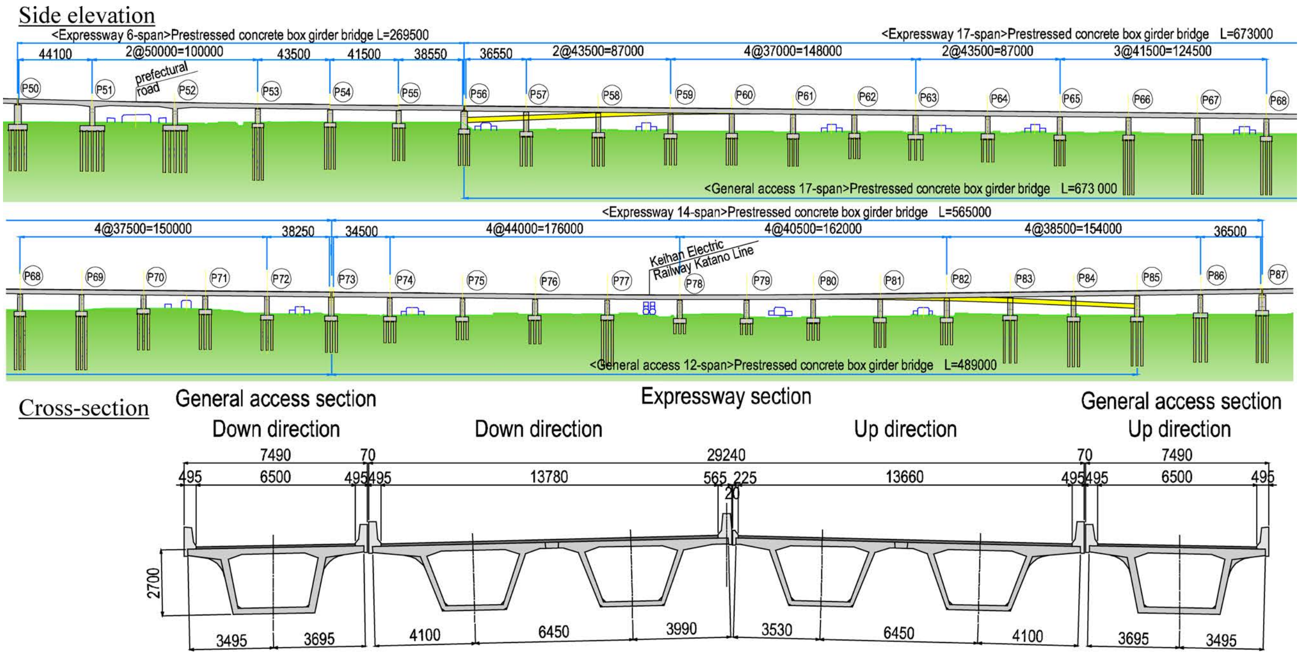

Fig.1 General view of Katano Viaduct

1. Introduction

The Katano Viaduct project is a bridge construction project consisting of an expressway section (controlled access highway, both directions) and a non-expressway section (general access highway, both directions). The expressway section is a 1507.5m, 6 + 17 + 14-span continuous prestressed concrete structure, forming a part of the Daini-Keihan Road in Katano City, Osaka, Japan, from the Aoyama area to the Kisabenishi area. The general access section is a 1,160m, 17 + 12-span continuous prestressed concrete structure (**Fig.1**).

This bridge passes through a quiet residential zone, and crosses 12 roads and a railroad. Using ordinary cast-in-place methods would lengthen the construction time at the site, and require large numbers of concrete trucks and other vehicles to transport materials. To reduce these requirements it was decided to fabricate precast segments at a plant, and use a span-by-span construction method. On the original construction plan we would erect the segments sequentially from the starting point using erection girders (**Fig.2**). However, the substructure work was affected by archaeological surveys at the site, and the transfer of the site was partly delayed, seriously constraining the schedule for superstructure work. Given these circumstances, we had to start constructing

Fig.2 Span-by-span erection using hangers

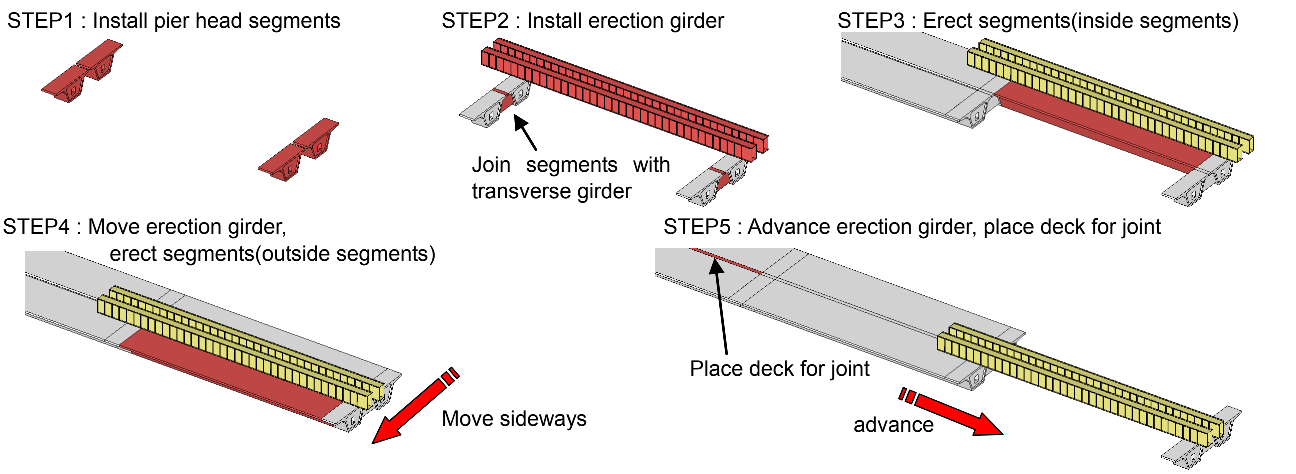

Fig.3 Erecting both main box girders for each span by moving erection girder sideways

Fig.4 Connecting pier head segments first with transverse girders

the main girder for those parts where the substructure was already completed, and attempted to find ways to accelerate the construction work.

2. Adoption of erection girder capable of moving sideways

The original plan for construction of the expressway section used a span-by-span construction method with two erection girders to erect the segments in sequence from the start point. When we had to find a way to accelerate the erection of segments without increasing the number of erection girders, we had the idea of enabling the erection girders to move from side to side, so that a single erection girder could erect both of the main box girders for the same span (**Fig.3**). This approach freed up the other erection girder to be used for work backwards, erecting segments in reverse sequence from the end point. That enabled erection work to proceed in sequence from both ends of the viaduct simultaneously.

3. Connecting pier head segments with transverse girders

In order to enable the erection girder to move sideways and handle the erection for both sides of a span, it is necessary to prevent the erection girder from falling over when moving sideways, when erecting segments, and if an earthquake occurs during the erection process. To prevent falling over when erecting segments, the pier head segments can be used as a counterweight. To achieve this, we used transverse girders to connect the two pier head segments at first (**Fig.4**).

4. Using staging for erection of segments

The approach described above of moving erection girders from side to side to erect segments was still insufficient to ensure that the project could be

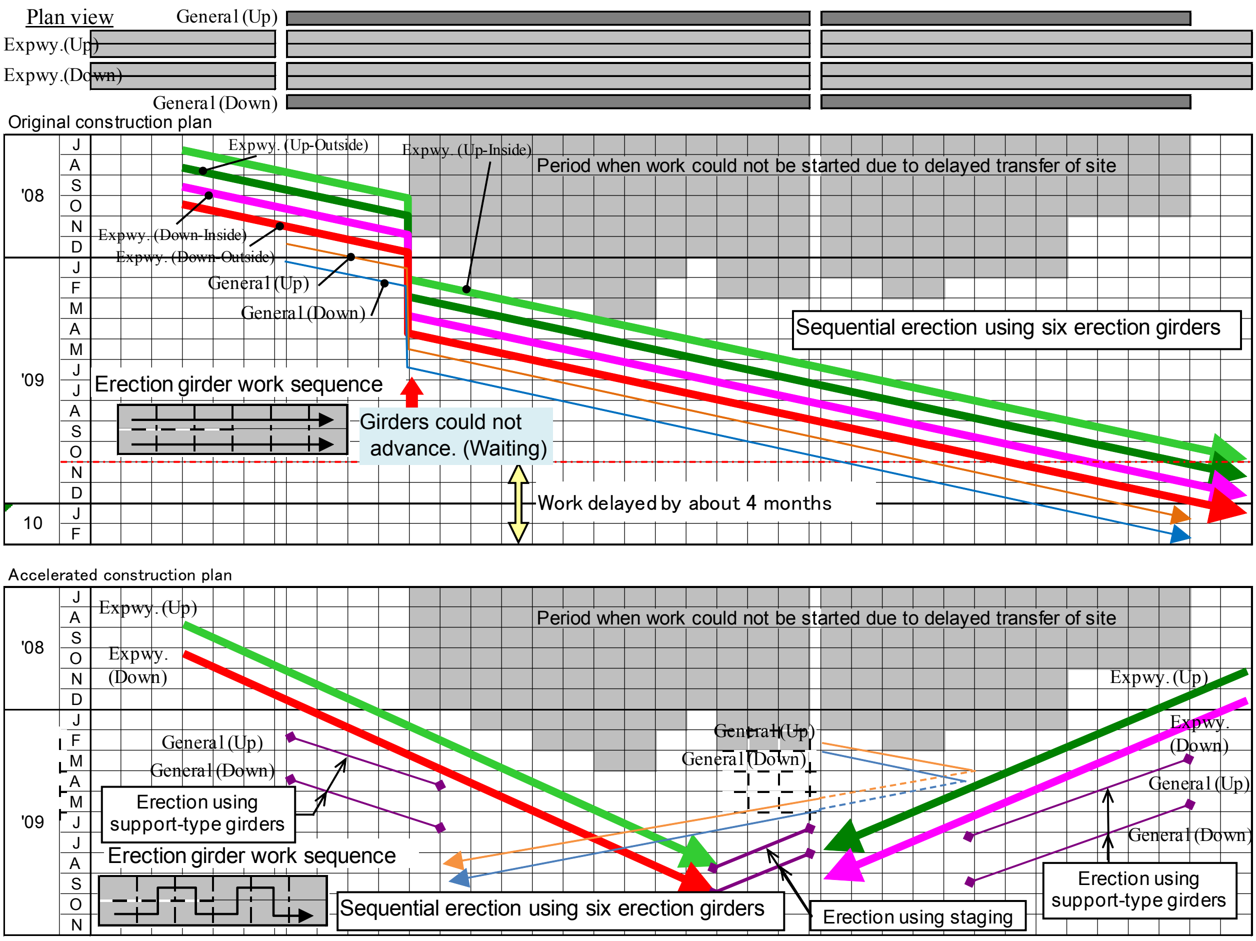

Fig.5 Segment construction schedule

Fig.6 Span-by-span erection using supports

Fig.7 Erection using staging

completed within the contracted period. For this reason, we also used staging for the erection of some segments (**Fig.6,7**). For the general access section, we used hangers to erect the segments for five spans, beginning with the first span where the hangers were possible working towards the end point. Then the erection girders were shifted back to the beginning of that section. They were recommenced and worked towards the starting point. In addition, at the ends where longitudinal gradient was quite steep, we accelerated construction by adopting a span-by-span method using supports instead of hangers (**Fig.6**).

5. Reducing the number of segments and splitting fabrication into three plants

To raise segment fabrication efficiency, in addition to minimizing the number of adjustment segments and segments with deviators for the external cables, thereby increasing the number of standard segments, we revised the segment arrangement plans with the aim of reducing the total number of segments required. As a result, 3,257 segments could be fabricated at three different plants. Hence, the construction was accelerated.

Fig.8 Completed viaduct

6. Effect of changing construction procedure

We discovered soon after taking on the contract that completion and transfer of the substructure work would be partially delayed. However, we were able to apply a number of design and execution measures to bring the project back on track ready for the Katano Viaduct to go into service within Mar. 2009 as scheduled.
We adopted a method of first connecting the pier head segments with transverse girders to prevent the erection girder falling over during execution. This in turn enabled the erection girder to be moved from side to side so that it could be used to erect both of the main box girders for each span. This approach, together with the additional use of staging for some spans, allowed construction to be accelerated by approximately four months (**Fig.5**), enabled us to complete our part of the project on schedule and contributed to the viaduct going into service within 2009.
View of the completed viaduct is shown in **Fig.8**.
The approach detailed in this report is potentially useful when planning the execution of similar precast segment projects.

概　要

交野高架橋は，第二京阪道路大阪府交野市青山地区から私部西地区にかけて，延長1,507.5mのPC連続橋である専用部，延長1,160mのPC連続橋である一般部からなる橋梁上部工工事である。本工事では架設ガーダーを用いてセグメントを起点側から片押しで架設する計画のスパンバイスパン工法で発注された。しかし，遺跡調査の関係から下部工引渡時期が部分的に遅れることとなり，遮音壁，裏面吸音板設置などの後続する付帯工事の工程からも非常に厳しい工程的制約条件を受けた。このため，下部工が完成している箇所から主桁架設を実施することを余儀なくされ，平成21年度内供用開始に向け工程短縮が必須であった。本橋では，ハンガー式架設ガーダー横取りによる2主箱桁架設と固定支保工架設およびサポート式架設を併用した。その結果，約4カ月の工程短縮が可能となり，着工から約1年6カ月という短期間で工事を終えることができた。