Design and Construction of Pre-tensioned Prestressed Concrete Box-Girders in Incheon Bridge Viaduct

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Summary

This study intends to explain the design and construction of the prestressed concrete(PSC) box-girders used for Incheon Bridge Viaduct. The superstructure of the Viaduct was planned and designed to be built with PSC box-girders, which consists structurally continuous 5 spans. Total 336 box-girder elements, each one is 15.7m wide, 50m long, 3m high, and weighing about 1,360 tons, were made by the pre-tensioned prestressing method at a specially built casting factory, transported to the construction site at sea, and erected by the FSLM(Full Span Launching Method), using specially developed methods and equipments. The details of prestressing tendons/bars and reinforcement were designed according to the AASHTO LRFD Bridge Design Specifications. In this paper, the major design items of PSC box-girders as well as related brief construction methods and sequences are introduced.

Keywords: FSLM; PSC box girder; Pretensioning; Holding down equipment; Incheon Bridge.

1. Introduction

Incheon Bridge is a marine bridge that stretches for 12.343km over the sea, connecting Songdo City with the Incheon International Airport. The bridge is composed of the cable-stayed bridge with a 800m main span, the approach bridge built by the FCM(Free Cantilever Method), the viaduct constructed by the FSLM(Full Span Launching Method). Since its commencement in June 2005, construction of the bridge has been progressing smoothly, aiming for completion in October 2009. The viaduct measures 8,400m in total length. It is a PSC (Prestressed Concrete) box girder bridge with 5 continuous spans where the FSLM is applied for the first road bridge in Korea. This study intends to introduce key items of the design and construction of Incheon Bridge's superstructure to which the FSLM is applied.

2. Features of design

2.1 Pre-tensioning method

The viaduct of Incheon Bridge is the first PSC Box girder bridge in Korea where the pre-tensioning method is applied in both longitudinal/transverse directions. For efficient application of the FSLM, the longitudinal/transverse pretensioning method, which can reduce the period required for fabrication, was applied.

2.2 Holding-down equipment

When applying the pretensioning method, limitations in the tendon layout can be removed by using the holding-down equipment. In order to reduce the negative moment at the support point caused due to the tendon and to improve resistance against diagonal cracks, the holding-down equipment

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was applied to the web tendon.

2.3 Openings of diaphragms

The viaduct diaphragm each has a large opening of 4.7m × 1.79m to operate and remove the inner mould. In the case of the viaduct, it has large openings and thus has relatively clear flow of stress. Consequently, structural check was performed through frame analysis.

2.4 Carrier

The girders of the viaduct are transported by carrier, which is moving on the girders installed in advance. Therefore, the most governing load in the construction stage is the self weight of the carrier and the girder loaded on the carrier. The carrier distributes load as much as possible using 4 vehicles composed of 20 axes. And, since the carrier moves being close to the girder web, the transverse loading effect was minimized.

2.5 Design of lifting parts

The chosen lifting method is bar-buried type. With the method, interference with the bearings can be controlled. And, by strengthening the areas around the buried bars with rebars, safety of girders can be secured. And, by carrying out all the connection and dismantlement works required for the lifting bars on the top, good constructability is secured.

3. Key features of construction

3.1 Fabrication

For quality control and to minimize effects of weather, the fabrication of girder is carried out in a shed-like factory built within the casting yard.

3.2 Transport

The girders completely fabricated at the factory are transported to the open storage yard by bogie or overhead crane and then carried to the construction site along the marine transportation route.

3.3 Girder installation

Girders are installed using three types of large equipments such as the carrier, the LG(launching girder), and the UB(under bridge).

3.4 Continuation of girders

In order to make the superstructure continuous, cast-in-place concrete is placed to the joint between the PSC box girders which are simply supported. After inserting tendons into the already-installed sheath, prestressing is applied by post-tensioning to make the superstructure continuous.

4. Conclusion

In this study, the key items in the design and construction of Incheon Bridge viaduct, which is under construction by FSLM, were introduced. We hope this paper to be helpful as a reference for the design and construction of the bridges utilizing FSLM afterwards.