Design and Safety Control in Construction Stage of Prestressed Concrete
Box Girder Bridge with Corrugated Steel Web

Kwang-Soo Kim
Hwamyung Grand Bridge Construction Project, Hyundai Engineering & Construction Co., LTD
(Received January 22, 2008 / Accepted April 10, 2008)

Abstract: The Ilsun Bridge is the world’s longest box girder bridge (801m) with corrugated steel webs and has the widest width (21.2~30.9m: tri-cellular cross section) among these kinds of composite girder bridges. It has fourteen spans (50m, 10 at 60m, 50m, 2 at 50.5m) where twelve spans are erected by the incremental launching method and two spans by full staging method. Special topics related to the structural safety of prestressed concrete box girder bridge with corrugated steel web in construction stage and service were reviewed. Investigations focus on the span-to-depth ratio, shear stress of corrugated steel webs and optimization of the length of steel launching nose. The span-to-depth ratio of Ilsun bridge has been found to be well-planned while the corrugated steel web has been designed highly conservative and it has been observed that the conventional nose-deck interaction equation do not fit well with corrugated steel web bridges. As a result, detailed construction stage analysis was performed to check the stress levels and the safety of preceding design conditions. Finally, from the design review of Ilsun bridge, this study suggests optimal design issues which should be of interest in designing a prestressed concrete box girder bridge with corrugated steel webs.

Key Words: prestressed concrete box girder bridge with corrugated steel web, incremental launching, span-to-depth ratio, design shear stress, nose-optimization, construction stage analysis
were required for Ilsun bridge to be compatible with the existing road network and it was hydraulically more lucrative to reduce the number of piers with one wide tri-cellular cross section than having a double number of piers supporting each single-cellular box girder for opposite traffic lanes. Transverse pre-tressing was also applied in the concrete slab in order to resist the traffic live load since the tri-cellular cross section was designed to be supported by the corrugated steel webs every 5.4m.

Four types of bridges, a steel box girder bridge with a concrete deck, a prestressed concrete box girder bridge, an extradosed bridge and a prestressed concrete box girder bridge with corrugated steel webs were selected as possible options during the first planning of this bridge. The alignment, hydraulic characteristics of the river, structural efficiency, economic thresholds, aesthetic standards and environmental conditions had been considered in discussions before choosing the final type. The alignment of the bridge was limited to 0.3% approach gradients with a 60% of upstream linear alignment (skewed 30 degrees to the flow direction) and the carriageway width was planned to be 21.2m, respectively to be compatible with the existing road network. The number of piers and the span length were determined from hydraulic analysis results in order to control the design flood water level under 39.34m for a flood discharge of 12,580m³/sec within a 100-year design frequency.

As a result, the total bridge length (801m) was divided into 10 spans of 60m, 2 spans of 50m and 2 spans of 50.5m with 13 piers (Fig. 1). Moreover, environmental conditions of the river having a water intake nearby prevented the use of temporary support structures usually submerged in the river during the construction, and so the deck had to be constructed using the incremental launch method, similar as the Serio River Bridge in Italy. The design span length of 60m in 10 spans decided from the hydraulic analysis results and the construction method selected by taking environmental conditions in consider, has limited the use of steel box girders for complex camber control during the launching process. In addition, the use of prestressed concrete box girders had been preferred to steel box girders because of the instability problems faced in designing steel structures. On the contrast, combining the use of concrete slab and steel web with external prestressing increases the radius of

![Fig. 1. Longitudinal view of Ilsun Bridge(unit: m).](image)

![Fig. 2. Typical superstructure transverse cross-section(unit: m).](image)