

Design of Cheong-Poong (Steel-concrete Hybrid cable-stayed) bridge

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Summary

'Cheong Poong' Bridge is a cable-stayed bridge, which has a main span of 327 meters crossing over the lake 'Chung Ju', Korea. After careful investigation of site conditions, the bridge was planned with span composition of 57.5m+327m+57.5m.

The unbalance of span composition and the uplift reaction (due to the unbalance) have to be carefully treated during detailed design stages. Hybrid construction, that is, the combination of steel girder with concrete deck slab and concrete girder for the bridge girder was applied and proven to be very efficient in such an unbalanced arrangement. In addition, the extra pier support at side span and cable spacing variation provide the uplift reaction countermeasure. Under this kind of superstructure composition, superstructure erection in center span would be possible with normal truck crane that can travel over the side span superstructure built up by full staging method and special equipment such as derrick crane became to be unnecessary, therefore.

Hybrid connection detail has been studied based upon the member forces history acting on the connection throughout the erection stages and after completion. Connection scheme is dependent on the external forces introduced into the connection location. As one can recognize the characteristic of cable-stayed bridge, the superstructure near the pylon location is subjected to axial load mainly introduced by the horizontal component of cable tension; therefore, the amount of the axial load is gradually increasing throughout the erection stages due to free cantilever construction. In the early stage of cantilever construction with few cables installed, the bending moment applied by the vertical component of cable tension may be the governing factor for the stress distribution, but in low-tension level, in the section.

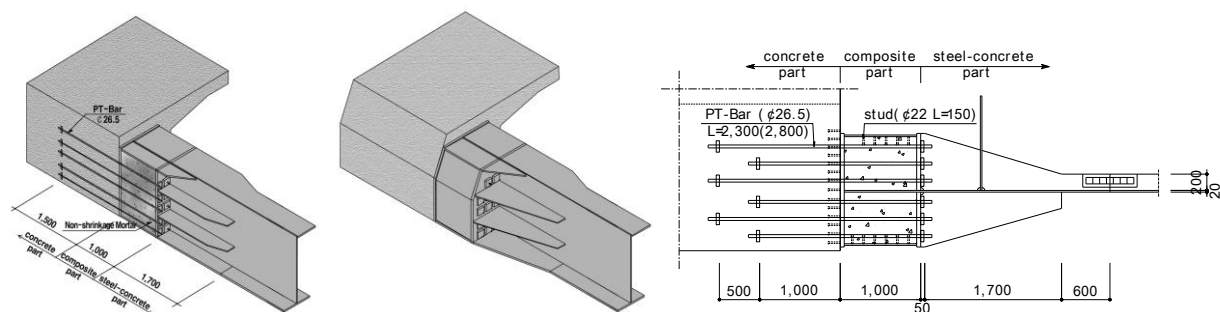


Fig. 1: Hybrid connection.

During the erection process, the horizontal component of the cable tension forces will be accumulated and there is a huge amount of axial compression at the connection location, which easily neglects the tensile stress by bending moment that has been decreasing down as erection stage proceeds.

Wind tunnel test has been carried out to figure out wind vibration characteristic of the bridge during erection and after completion. From the test results, it was decided to attach 'extension flap' at both sides of the superstructure in main span to mitigate and/or suppress the vibration due to vortex and torsional flutter.

Figure 2 shows construction status of the bridge and a computer graphic image of 'Cheong Poong' Bridge according to the bridge planning described in this article. 'Cheong Poong' bridge which is located in Lake 'Chungju' is planned as cable-stayed bridge where its components are hybrid girder made of composite I-girder and concrete girder, modified H-shaped concrete pylon and open caisson foundation direct contact with rock under water.

It is now under construction and expected to open to traffic at year of 2009. The 'Cheong Poong' cable-stayed bridge would play a role of symbolic landmark for the tourism development in Chungcheong province, Korea, as well as of transportation by replacing the existing concrete girder bridge.



Fig. 2: 'Cheong Poong' bridge.

Keywords: Cable-stayed bridge, Hybrid section, Hybrid connection, Construction Stage Analysis, In-land bridge construction, Wind tunnel