The Planning and Design of the Gwangyang Suspension Bsridge in Korea

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Summary

This paper describes the features of the structural design including the investigations performed along the planning and design stages of the long-span suspension bridge connecting Myodo and Gwangyang. The total length of 2,260m with a central span of 1,545m will be the bridge at the fourth place among the longest suspension bridges in the world. The long central span, the 270m high pylons and the sag ratio of 1/9 will secure 18,000TEU-class shipping serviceability, reduce risk of ship collision, diminish the size of anchorage, and reduce the construction cost. By introducing twin box girder, the aerodynamic stability of this bridge could be guaranteed. The most optimized section of twin box girder suppressing the vortex shedding vibration and minimizing the drag force coefficient could be found through wind tunnel tests. The innovative structural systems are composed of high-strength main cable of 1,860MPa, and stoppers at the pylons and buffers at the ends of stiffening girder.

Keywords: long-span suspension bridge; innovative design; twin box girder; aerodynamic stability; swing method; innovated a/s method.

1. Introduction

The long-span suspension bridge connecting Myodo and Gwangyang in Korea is due to be constructed in the third section of approach road works of Yeosu National Industrial Complex from 2007 to 2012. The total span length of the bridge reaches 2,260m and the central span length of that reaches 1,545m, which will be ranked fourth longest in the world (Fig. 1). The central span length is planned to be 1,545m for the passage of 18,000 TEU-class container ships in the future. Therefore, to overcome the severe environmental condition of the super long-span bridge, e.g. wind, earthquake, driving serviceability, and construction methods etc, it is absolutely necessary to innovate structural systems of existing suspension bridges. Consequently, at the stage of planning the bridge, after investigating design of existing suspension bridges, newly developed technologies, and newly applied construction methods, the most suitable solution was chosen as the final structural system.

Fig. 1: The aerial view of the bridge connecting Myodo and Gwangyang

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2. Innovative contents of structural design

Firstly in the world, the main cable used wires with the high-strength of 1,860MPa is applied as the central span length is longer. As a result, the self-weight of main cable is reduced by 6% and the drag force for wind is also reduced by the minimized cable area. Therefore, the structural safety and economical efficiency is improved. The twin steel box girder satisfy the aerodynamic stability, the reduction of self weight, and the traffic serviceability. The longitudinal displacement of this bridge adopted floating system, which has no longitudinal fixed support at the pylon, is caused by live loads such as temperature load, wind load, traffic load, and so on. Because the following longitudinal displacement is increasing as the span become larger, buffer and stopper system were planned to be installed in the longitudinal direction on the side of the girder near the pylon as the longitudinal displacement control system.

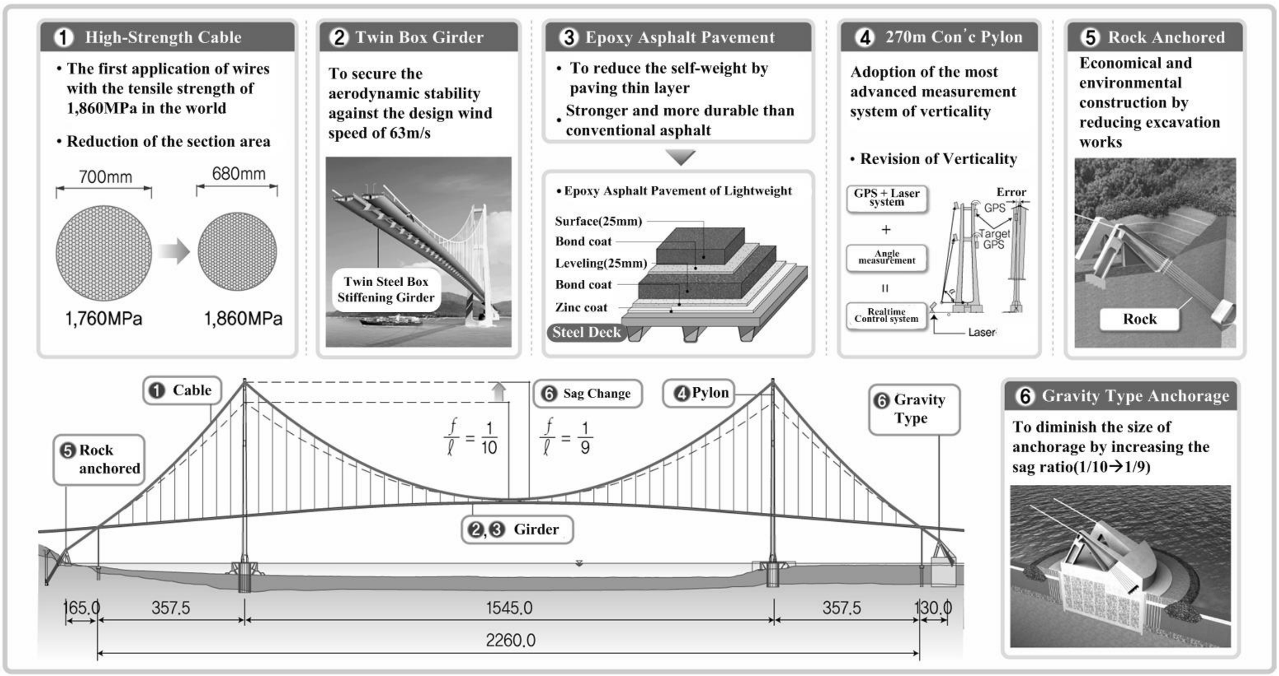

Fig. 2: Design to realize the long-span suspension bridge

3. High-tech construction method

In installing main cable, the innovated A/S(air spinning) method, which improved the conventional free hanging A/S method, is used. In this method, strands are formed by pulling out with a tension lower than free-hang tension while the cable former is made to bear a part of the weight of the wire. The arrangement of erected strands is forming the rectangular type improved the conventional arrangement of hexagonal type, so the number of strands is reduced. And, as a result, the saddle and anchorage become slim and, simultaneously, the air spinning speed improves. The work period of air spinning will be shortened about 4 months. Also, pylon with 270m high concrete tower will be constructed by slip-form method, which uses the successively and automatically climbing form with the scaffolding system to reduce the construction schedule.

4. Conclusions

To get over the difficulties, e.g. the world's fourth longest central span, the securement of 18,000TEU-class ship navigable waterway, world top-class design wind speed, and reduction of construction cost, the high-tech complex structural system could come into the world. First of all, the streamline-type twin box girder, high-strength wires with 1860MPa, the STL buffer system, and the innovated A/S method can be mentioned as the newly devised high-tech structural system components. It is judged that the present devised bridge systems can be the good choice as the standard bridge systems of the long-span suspension in the case that the central span becomes longer than 1,500m.