Unbalanced Application of Wind Stabilizing Cables for the Free Cantilevered Construction of a Cable-Stayed Bridge

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Summary

Since the buffeting induced force effects exceed the design strength of the cross-section of pylon for a 500m cable-stayed bridge, several mitigation plans have been investigated with the use of stabilizing cables. The design wind speed of the stabilizing cable was determined from the long-term wind speed data of the nearby Automatic Weather System and the conversion of the wind speed to the bridge site was performed by the Measure-Correlate-Predict Method with the help of ultra-sonic anemometers installed in the construction site. A frequency-domain buffeting analysis, based on the aeroelastic formulation with flutter derivatives, is applied for the design of stabilizing cables. Two acceptable measures are proposed with the application of unbalanced stabilizing cables to enable vessel traffic in the center span. The proposed stabilizing measures by a series of buffeting analysis are verified through three-dimensional experiments in a wind tunnel with the scale of 1:150.

Keywords: design, wind speed, buffeting, stabilizing cable, cable-stayed bridge, wind tunnel test

1. Introduction

Since most of cable-stayed bridges are constructed with the free cantilever method, the critical stage of the structure due to wind buffeting will be the longest cantilevered state in both spans. At this stage, the bending moments due to the seesaw-like motion of the cantilevered structure magnifies so as to exceed the design strength of the cross-section of pylon. Several mitigation measures can be proposed and evaluated by exploiting so-called buffeting analysis.

This paper proposes several wind stabilizing measures, which are verified through 3-D wind tunnel test with 1:150 scale, for a 3 span continuous cable-stayed bridge with a main span of 500m as shown in Fig. 1. The aerodynamic and aeroelastic wind effect are formulated with the three components of static wind coefficients and flutter derivatives obtained from the 2-D wind tunnel tests. Dynamic properties of wind turbulences were measured from the ultra-sonic anemometers installed on the top of the pier in approaching span.

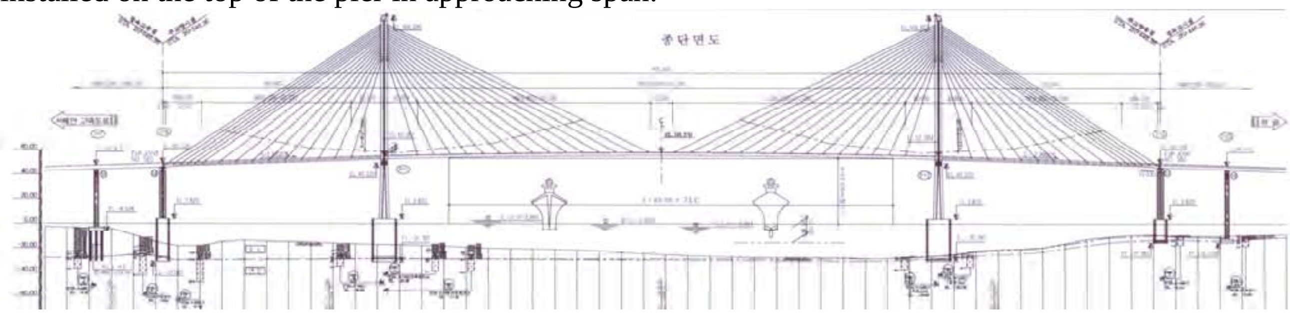

Fig. 1: A 3-span cable-stayed bridge

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