New system for aerodynamic stability of suspension bridge

New System for Aerodynamic Stability of Suspension Bridge

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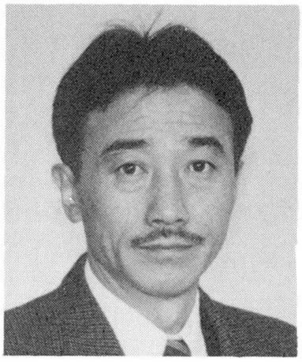

Toshihiro Yoshimura has experience in design and construction of major bridges at Honshu-Shikoku in Japan. He is currently a resident engineer for construction management of Yongjon Grand Bridge in Korea.

Summary

Aerodynamic stability is one of major issues to be considered in designing long span bridge with more than 3,000 meter of cable span length.
In this paper an attempt is made to discuss the use of cable formers for the system with four main cables, each of which is located at certain distance from others cables. The effectiveness of the new system for 3 span suspension bridge as well as 5 spans suspention bridge was examined by means of dynamic analysis.
It was found that the new system shall improve the torsional rigity of suspension bridge and also increase the frequency of the torsional vibration.

1. Concept of the New System

Strait-crossing bridges with more than 3,000 meter of span length are now being planned all over the world. Among them include Messina Crossing (Italy),Gibraltar Strait (Spain-Morocco) and Tugaru Strait (Japan). These longer span bridges, if implemented, will encounter the difficulty in maintaining the stability against drag forces.
The Key to solve this problem is to use main cables and let the torsional strength have an effect on the drag resistance, in order to improve the torsional rigidity of the suspension bridge. The feature of torsional vibration is explained by the forces which drag the right and left cables in the opposite direction. Therefore keeping the constant distance of cables was estimated to increase the frequency of torsional vibration (See Fig.1).

2. Result of the Vibration Analysis

In this paper cable formers were set up to keep the constant distance of cables and height of the cables. The initial finding is that cable formers were effective to increase the aerodynamic stability. After the vibration analysis, the effects of the new system are summarized as follows;

1) Installation of cable formers increased the freqency of torsional vibration(See Fig.2)
2) Difference of the height improved the efficiency
3) New system increased the torsional rigidy, up to the same level as that of the stiffenning girder(See Fig.3)

Applying the Selberg's equation, it was found that the critical wind velocity for flutter can be increased more than 20% by using this system, without increasing additional weights of stiffenning girder.

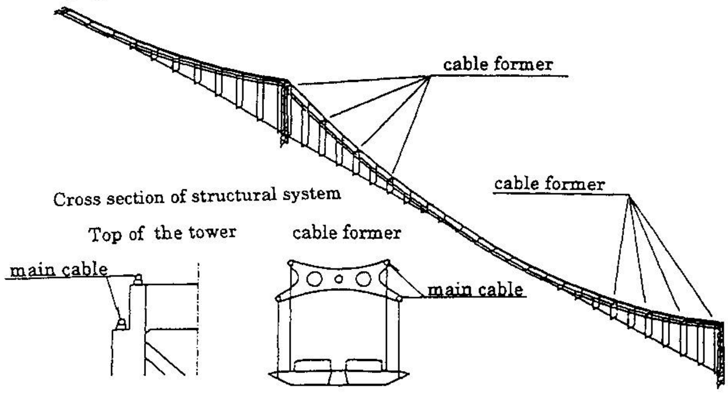

Fig.1 Illustration of the New System

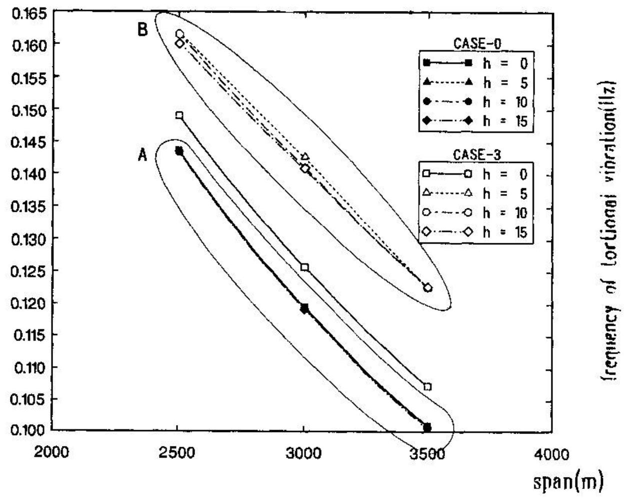

Fig.2 Influence of span-length on torsional vibration

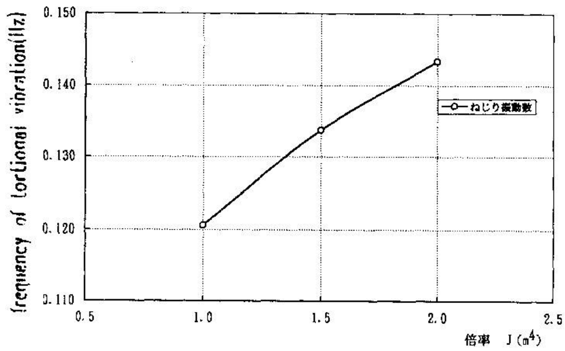

Fig.3 Magnification of tortional rigidy to stiffenning girder