

# Vortex-induced Vibration and Aerodynamic Countermeasures for Long-span Cable-supported Bridges with Twin Box Girder

## YongXin YANG

Associate Professor  
State Key Lab for Disaster  
Reduction in Civil Eng.  
Tongji University  
Shanghai, 200092, China  
[yang\\_y\\_x@tongji.edu.cn](mailto:yang_y_x@tongji.edu.cn)

YongXin Yang, born 1974, received his Ph. D degree from Tongji University in 2002. He has worked in Tongji University for 10 years.



## Yao Jun GE

Professor  
State Key Lab for Disaster  
Reduction in Civil Eng.  
Tongji University  
Shanghai, 200092, China  
[yaojunge@tongji.edu.cn](mailto:yaojunge@tongji.edu.cn)

Yaojun Ge, born 1958, and received his Ph. D degree from Tongji University. He is currently the Lab Director and the Chairman of Department of Bridge Engineering.



## Summary

VIV performance of twin box girders for three long-span cable-supported bridges in China was investigated through large scaled sectional model wind tunnel tests. Vortex-induced vibrations with large amplitude were detected for all three different types of twin box girders. Based on Particle Image Velocimetry technique, large scale vortices in the central vent were visualized and considered to have significant influence on the aerodynamic performance of twin box girder, especially vortex-induced vibration. Aerodynamic control measures, including guide vane, grid plate and adjustable wind barrier, were proposed to suppress this kind of self-excited vibration. The comparison and optimization of these countermeasures were then carried out to choose the best control scheme.

**Keywords:** Vortex-induced vibration; twin box girder; aerodynamic control measure; wind tunnel testing; large scaled sectional model; flow visualization.

## 1. Introduction

For cable-supported bridges with ever-growing span length, one of the most challenging problems encountered is aeroelastic instability. Based on the experience gained from existing long-span bridges, the span length of 1,600m seems to be the aerodynamic limit for suspension bridges with a streamlined box girder, and the adoption of twin box girder is found to be an effective solution to improve the aerodynamic stability of cable-supported bridges beyond this limit. Twin box girder can also be applied to long-span bridges with single column pylon or single cable plane for structural efficiency. For these reasons, three long-span cable-supported bridges with twin box girder have been built in China in recent five years.

Although twin box girder has been proven to be very effective to enhance the flutter performance of super-long span bridges, more attention should be paid to the vortex-induced vibration performance of this innovative girder section, since the existence of central vent will make the vortex shedding process and its interaction with the movement of the bridge girder more complicated. In this paper, the aerodynamic investigation on the vortex-induced vibration performance of three long-span cable-supported bridges in China, through large scaled sectional model wind tunnel tests, will be introduced. Vortex-induced vibrations (VIV) with large amplitude were detected in three different types of twin box girder. Since the occurrence of severe vortex-induced vibration will jeopardize the bridge serviceability, aerodynamic control measures were proposed to suppress this kind of self-excited vibration. The comparison and optimization of various aerodynamic countermeasures for vortex-induced vibration will also be presented.