



Structural Configuration of Cable-stayed Suspension Bridge from Aerodynamic Stability Point of View

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Abstract

Structural configuration of a cable-stayed suspension bridge with the main span length of 2,500m was analytically studied from aerodynamic stability point of view. Effects of cable-stayed section length, tower height and safety factor of cables were investigated. As a result, the lower tower height and smaller safety factors make the cable-stayed suspension bridge advantageous to the same scale suspension bridge in terms of the structural weight and flutter critical wind speed.

Keywords: Cable-stayed suspension bridge; natural frequency; flutter critical wind speed; safety factor

1 Introduction

A cable-stayed suspension bridge, which was proposed by Franz Dischinger [1] in 1938, is considered as one of the solutions for a super long-span cable-supported bridge with high aerodynamic stability. In fact, one cable-stayed suspension bridge was proposed for the Gibraltar Strait crossing project [2,3], however an undersea tunnel was decided recently to be feasible. Currently, the first long-span application, the 3rd Bosphorus Bridge with the main span length of 1408m in Turkey is now under construction.

It is considered that a cable-stayed suspension bridge has both advantages of a cable-stayed bridge and a suspension bridge. Main cables carry a large amount of load of the long span and stay cables increase the rigidity of bridge deck. This is the reason that a cable-stayed suspension bridge

is suitable for a long-span bridge. Since there are two different mechanical actions, optimization of the section length of suspension bridge and cable-stayed bridge is necessary. In addition, ultimate strength and safety factors of suspension and stay cables are also influential factors for the structural optimization. It is considered to be a key to the realization of an aerodynamically stable long-span bridge. Studies [2, 3] on the structural configuration have been done by several researchers, however a comprehensive parameter study from the viewpoint of aerodynamic stability has not been done.

In this study, firstly structural models of a 2,500m main-span cable-stayed suspension bridge were developed based on a previous study [4]. Then the effect of cable-stayed section length was analytically investigated from the viewpoint of structural and aerodynamic characteristics. In