Static Behaviour of Cable-stayed Suspension Bridge with a Transition Zone

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Abstract

A simplified two-dimensional numerical analysis is proposed and applied to study the static behaviour of cable-stayed suspension bridges with a transition zone under symmetrical and asymmetrical traffic loads. The structural analysis model is composed of geometric nonlinear truss elements for suspension and stay cables. Using the simplified analysis method, parametric studies are also conducted to investigate the effects of some design variables on deflection and deformation of the bridge, and a structural efficiency is analysed by comparing the results of cable-stayed suspension system and conventional suspension system.

Keywords: cable-stayed suspension bridge; dead load distribution factor; transition zone; static behaviour.

1 Introduction

Since the suspension bridges using iron chain bars as suspended members were developed in the late 1700s, cable supported bridges have been generally employed to connect two faraway places and overcome long spans during the past century. In the early 1800s, cables using thousands of parallel wires were firstly applied to the main cable of suspension bridges, but several suspension bridges in Europe were unfortunately collapsed due to wind-induced motions. Thus, a new suspension system strengthened by a fan-shaped stay system was developed and applied to many suspension bridges including the Niagara Bridge, the Wheeling Bridge and the Brooklyn Bridge in USA[1,2]. The stay system is installed to the deck section near the pylons, and supports a part of dead load and live load. This new system was called Roebling system as shown in Figure 1(a). However, the Roebling system had not been constructed after the early 1900s because bridge engineers had no solution for such a highly indeterminate structures and it was very difficult to install the stay system without construction error at that time. In 1930s, a distinctive cable system was proposed by Dischinger, and the new cable system had no overlapped zone between hanger ropes and stay cables along the longitudinal direction of a bridge(Figure 1(b)). Dischinger system had never been realized for actual construction until the 1990s because structural discontinuity problems at the border between two cable systems had not solved. Recently, a new combination of Roebling system and Dischinger system has been developed to overcome the structural discontinuity of the Dischinger system by installing the overlapped

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