Analysis of Reasonable Longitudinal Restraint System of Four-Tower Cable-Stayed Bridge

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Abstract

The four-tower cable-stayed bridge with four towers and three main spans can be set up with various symmetrical and asymmetrical longitudinal restraint schemes for the whole bridge. Different longitudinal restraint systems will directly affect the load transfer path and change the mechanical behavior of the four-tower cable-stayed bridge structure, which in turn affects the structural design of the bridge. Taking a four-tower cable-stayed bridge as the research object, the structural mechanical behaviors of semi-floating system, temperature adaptive system, middle two-tower elastic cable restraint system, and middle single-tower longitudinal fixed restraint system under the effect of temperature load, longitudinal wind load, and load combination are compared and analyzed. The results show that the semi-floating system will cause a larger longitudinal displacement of the main beam, which will increase the internal force of the side towers substantially. Increasing the restraint of the main beam and the middle towers can make the four towers' forces uniform.The temperature adaptive system and the middle two towers elastic cable system have better feasibility.

Keywords: multi-tower cable-stayed bridge; longitudinal restraint system; stiffness; mechanical behaviour.

1 Introduction

In recent years, the growing demand for traffic across straits, valleys, and other terrain has increased the demand for a bridge spanning capacity [1], and the economic and technical advantages of multi-tower cable-stayed bridges make them a highly competitive structural solution [2]. However, compared with the conventional twin-tower cable-stayed bridge, the middle tower of the multi-tower cable-stayed bridge is not equipped with end anchor cables to control the deflection, and there are no auxiliary piers on both sides, thus weakening the overall stiffness of the structure, resulting in a more flexible cable-stayed bridge. Therefore, multi-tower cable-stayed bridges have obvious differences in structural mechanical behavior from conventional two-tower cable-stayed bridges, and for the overall structural stiffness, the contribution of the cable system is reduced, and the overall deformation of the structure is usually limited only by the stiffness of the main beam and the bridge tower, resulting in larger live-load deflections and internal forces in the intermediate tower, and a significant increase in the displacement of the main beam under live load [3]. The structural system is the main factor affecting the mechanical characteristics of multi-tower cable-stayed bridges. A reasonable

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