Cable Force Analysis of Extradosed Bridge Based on Comprehensive Optimization Method

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Abstract

In order to determine the rational cable force of the extradosed bridge, a comprehensive optimization method of cable force is proposed. The method is based on the influence matrix method and adopts the data standardization method to change two or more different types of discrete data into dimensionless uniform data, with the objective of minimizing the combined displacement and bending moment of the structural control section. Relying on the extradosed bridge of Nanjing Intercity Rail Transit Ningju Line as an engineering example, the results show that the calculated cable force of the integrated optimization method can reduce the maximum compressive stress at the top and bottom edge of the main girder by 3.3 % and 3.8 %, respectively, compared with the original design cable force.

Keywords: cable force optimization; numerical calculation; extradosed bridge; influence matrix method; rational bridge completion state.

1 Introduction

The extradosed ridge is a combination system between general cable-stayed bridge and continuous girder bridge, with the characteristics of "short tower, rigid beam and concentrated cable" Its cable stress changes little and its overall stiffness is large, and it has outstanding advantages for railway bridges with large load and high standard [1-2]. The optimized design of cable force is an indispensable part of the design of cable-stayed bridges, and a lot of research has been carried out by related scholars. Jie Dai et al [3] reviewed the optimization methods of cable-stayed bridges, analyzed the advantages and limitations of each method and summarized the development trend of cable force optimization at the present stage; Renan Yuan et al [4] proposed a fast and accurate method of cable force adjustment for cable-stayed bridges in the target state by using numerical optimization methods and combining the initial state of cable force calculation; Cunxin Yin [5] developed a set of cable force adjustment calculation for cable-stayed bridges based on the combination of energy method and influence matrix method. Bin can [6] used the standard particle swarm algorithm based on the forbidden search algorithm for cable-stayed bridge force optimization. Liming Zhu et al [7] carried out a secondary optimization of the boom force of a spatial three-cable deck heterogeneous arch bridge by min-max standardization.

Most of the existing cable force optimization studies only aim at a single structural performance optimum, such as bending energy minimization and minimization with cable beams, which is difficult to consider the force requirements of the structure comprehensively. In this paper, we

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