Axial Force Transfer Mechanism of Steel-Concrete Joint in Hybrid Girder for Railway Cable-Stayed Bridge

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Abstract

The hybrid girder for a railway cable-stayed bridge consists of the steel-concrete composite girder at the main span and the prestressed concrete (PC) girder at the side span. The two spans are connected by the steel-concrete joint (SCJ) with multiply concrete filled steel cells (CFSC). The mechanical behavior of SCJ is investigated using three-dimensional finite element analysis (FEA). Results show that the internal force can be effectively transferred from the composite girder to the PC girder through CFSC without sever stress concentration. The two bearing plates remain the major force transfer components with the force sharing ratio of 60%, while both the shear connectors and the top concrete slab play important roles with the force sharing ratio of 20% respectively. The unique CFSC with extended force transfer path may improve the mechanical behavior of SCJ and is recommended for the application in the high-speed railway cable-stayed bridge.

Keywords: high-speed railway bridge; hybrid cable-stayed bridge; steel-concrete composite joint; mechanical behavior; finite element analysis.

1 Introduction

The hybrid cable-stayed bridge makes full use of the material advantages of steel and concrete respective. Typically, the main span adopts a steel girder or a composite girder to achieve a large spanning capacity, and the side span adopts a concrete girder to increase the global and local stiffness, stability, and cost-effectiveness [1]. In general, concrete girders have high self-weight and can provide an anchoring effect for the steel girder and improve the aerodynamic response. For this reason, hybrid girder has been used in the cable-stayed bridge worldwide [2-4].

The steel-concrete joint (SCJ) is the key segment of the hybrid girder to bear the force and coordinate the deformation and the abrupt segment of material and cross-section. So, it is necessary to design the connecting structure to reduce the

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