The Evolving Metropolis
2019 IABSE Congress New York City

IABSE 90 YEARS

Performance Study of a Steel-Concrete Joint for Hybrid Cable-Stayed Bridge with 800m Main Span

Xiangmin YU

Ph.D. Candidate

Tongji University

Shanghai, China
1510002@tongji.edu.cn

Specialized for the structural analysis and erection control for cable-stayed bridge

Dewei CHEN

Professor

Tongji University

Shanghai, China
83086@tongji.edu.cn

Specialized for the bridge design, construction, erection control and structural analysis, especially for cable-stayed bridge

Contact: 1510002@tongji.edu.cn

1 Abstract

Yachihe Bridge is a record-breaking cable-stayed bridge with 800m steel truss deck in the main span. As the bridge side spans are limited in size due to environmental constraints, 220m concrete decks are the optimized solutions for the side spans to balance the weight of steel truss deck in the main span. The joint of concrete deck and steel truss deck is one of the most complex points of the bridge, as it bears the maximum axial force and the structural cross sections, rigidities and material properties are changed at this position. This paper mainly presents the detailed design and numerical analysis for the steel-concrete joint of Yachihe Bridge to investigate its structural performance. Meanwhile, the numerical results of concrete and steel decks, bearing plate and shear studs of the joint are also discussed.

Keywords: cable-stayed bridge; steel-concrete joint; numerical analysis; bearing plate; shear studs

2 Introduction

The cable-stayed bridge has become one of the most popular large-span bridge systems because of its structural efficiency and outstanding aesthetics [1]. Wherein, hybrid cable-stayed bridges, which comprise a steel deck in the main span and concrete decks at the side spans, have a tendency to be more and more popular in recent years due to the rational use of the structural materials and economy [2]. Prestressed concrete is usually cheaper and heavier than that all-steel solutions, which makes it particularly adaptable for the shorter side spans. However, all-steel decks are much lighter and easier to assemble and erect compared with prestressed concrete; therefore, they are more appropriate for long main spans. Therefore, the hybrid cable-stayed bridge can span long distance with good mechanics and lower cost as the heavier concrete decks serve as counterweights to balance the lighter steel main span [3].

For the hybrid deck, the concrete and steel cross sections are coupled at or near the pylon with shear studs and prestressed tendons generally, which is called a steel-concrete joint. The steel-concrete joint is essential for the hybrid cable-stayed bridge, as it bears the maximum axial force and the structural cross sections, rigidities and material properties are changed at this position [4-5]. For a rational design of a steel-concrete joint, it shall transfer the internal forces smoothly between concrete part and steel part [6]. Meanwhile, the graceful appearance, good durability and fatigue resistance shall be considered. Therefore, the reasonable position, structural type and shear connector of the steel-concrete joint are essential for its design and function accomplishment.

https://doi.org/10.2749/newyork.2019.1753
Distributed by Structurae