



Analysis and Optimization on Orthotropic Steel Deck System of Hutong Yangtze River Highway and Railway Bridge

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Abstract

The main-span of Hutong Yangtze River Bridge is 1092m, and will be the largest span cable stayed highway and railway bridge after it is built. The steel truss girder and steel box girder were employed in highway and railway orthotropic bridge deck systems, respectively. Because of their complex structures, the mechanical characteristic is difficult to be determined. In order to master the mechanical behavior of the deck systems, Finite Element models on both highway and railway orthotropic bridge decks were established by Abaqus software, and the fine finite element analysis was carried out. Combined with the character of the railway load, the comparative analysis on the force state for the upper plate, lower plate, cross beam web and U-shape rib in the railway deck system was carried on subjected to different train live load forms. Normally the fatigue cracks initiate frequently from the weld between deck plate and U-shape rib and the weld between cross beam web and U-shape rib in highway deck system, therefore, finite element analysis mainly focused on the stress distribution and concentration in these two positions under horizontal and transverse road vehicle wheel load conditions. Meanwhile, the effect of the arc profiles shape on the stress distribution around the weld between cross beam web and U-shape rib was investigated. The results of the analysis demonstrate that the construction details of the deck system are reasonable, which have good mechanical properties. The design of the orthotropic deck for Hutong Yangtze River Bridge meets the requirements of the steel bridge design codes.

Keywords: orthotropic bridge deck; analysis and optimization; mechanics characteristic.

1 Introduction

Hutong Yangtze River Bridge, designing of quadruple track and six-lane highway with full-length of 11.0763km, combines Yangtze River Delta intercity railway and Wuxi-Nantong highway planning. It is composed of main bridge, which has a 1092m span and is steel truss girder cable-stayed, and southern and northern bridge approach. Upon completion, it will be the largest in China.

The orthotropic steel bridge deck was employed in the main navigation tunnel highway and railway bridge deck system. Fatigue cracks have been

found in steel bridge deck^[1-3]. Especially, the fatigue performance of U-shape rib fillet weld connecting structure is directly related to the durability of bridge deck pavements and once fatigue cracks occur, the majority of them will extend along the direction of deck thickness and penetrate the pavements. However, this type of cracks is hard to be found in daily inspections, with longer maintenance cycle and higher cost. Therefore, like the choice, matching of the thickness of structures and the welding quality, have to be strictly controlled. Orthotropic steel bridge decks design specifications have not yet been officially published in China, so the