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Experimental study of rib distortion in orthotropic steel decks

Heng Fang
Doctoral researcher
Ghent University
Gent, Belgium
Heng.Fang@UGent.be

Heng Fang is currently working at Ghent University as a doctoral researcher. He is mainly focusing on fatigue performance of orthotropic steel deck, specifically the rib-to-crossbeam joint.

Nouman Iqbal
Doctoral researcher
Ghent University
Gent, Belgium
Nouman.Iqbal@UGent.be

Nouman Iqbal is currently working at Ghent University as a doctoral researcher. He is mainly focusing on fatigue performance of orthotropic steel deck, specifically the rib-to-deck joint.

Amelie Outtier
Visiting professor
Ghent University
Gent, Belgium
Amelie.Outtier@UGent.be

Muhammad Kashif
Doctoral researcher
Ghent University
Gent, Belgium
Muhammad.Kashif@UGent.be

Hans De Backer
Professor
Ghent University
Gent, Belgium
Hans.DeBacker@UGent.be

Contact: Heng.Fang@UGent.be

1 Abstract

Longitudinal ribs with the trapezoidal section are broadly adopted in orthotropic steel decks especially for long span bridges. When the tire load is eccentric from the axis of the rib, the torsional rigidity of ribs is critically reduced by distortion which impedes the horizontal dispersal of load. Because of the existence of cutouts in crossbeam, the high stress concentration at the rib-to-crossbeam joint caused by the rib distortion makes the joint easily prone to fatigue damage. In this paper, based on the parametric analysis of several classical design parameters, static load experiments of an orthotropic steel deck specimen are performed. Measurement results support the positive correlations between the weld length of rib-to-crossbeam joint and the distortional stress. The most unfavorable load position of stress concentration induced by rib distortion is also verified, which is about 1600 mm away from the investigated crossbeam. Experimental results indicate that ribs are deformed toward different directions at the midspan section and the crossbeam section separately when the load is eccentric from the axis of rib.

Keywords: orthotropic steel deck; rib-to-crossbeam joint; rib distortion; static load experiment

2 Introduction

The orthotropic steel deck is a prevailing option for long span bridges since it has several advantages, e.g. light weight, rapid construction speed, high load-bearing capacity, etc. After decades of evolution, there are mainly two types of cross sections of ribs, namely the open ribs and the closed ribs. Nowadays, the trapezoidal section is one of the most widely adopted geometries for ribs. Due to the numerous welds and the complex structure, fatigue damage caused by stress concentration has become the main problem of orthotropic steel deck. It was revealed in previous research[1] - [3] that typical fatigue cracks are most likely to appear at four locations, namely the splice joint of the longitudinal

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