Fatigue Resilient Design of Bridge Orthotropic Steel Deck

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Abstract

It is difficult to precisely predict the fatigue life of orthotropic decks due to random initial defects and high-cycle loading conditions. Two typical fatigue failures occurr in orthotropic steel decks, which hinder both the capacity and the efficient life of modern steel bridges. The Type 1 crack is along the super-long weld joints between the cover plate and U-shaped rib, while Type 2 crack develop within the diaphragm adjacent to the fillet joints. While both cracks originate and develop from weld toes, and the Type 2 crack usually develop along the near-horizontal direction. Among the many factors contributing to the failure, the notch type, notch size, vehicle loads uncertainties related to positions, magnitudes and frequency were uncertain. Thus, it is reasonable to apply different strategies to achieve more resilient orthotropic decks. It is recommended new weld improvement has to be introduced to mitigate initial notch for type Ⅰ details, and structural flexibility has to be selected to improve the fatigue performance for type Ⅱ detail.

Keywords: Orthotropic steel deck; Diaphragm; Fatigue Crack; life prediction; Resilient;

1 Introduction

The effective operation period of several details is far below the expected within design documents and specific codes (Miki, 2007; Conor,2012; Jong, 2007). The widely deteriorate due to fatigue cracks not only limit the loading capacity of structures, but also require unreasonably high budgets. Many researches have been proposed various solution trying to mitigate the problem. it seems that the fundamental question remains open: how to meet the traffic loading demand and the durable fatigue resistance within the orthotropic steel decks.

The fatigue failure originates as a result of both cycled loadings and initial damage at joints. On the one hand, the orthotropic decks were fabricated with super long welds, which results in uncertain distributed micro damage and types, on the other hand, the vehicle loading position, amplitude and frequency are all uncertain. Therefore, it is an even difficult task to predict and manage OSD's working life.

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