

Numerical study on rehabilitation of the U-rib butt weld fatigue crack in orthotropic steel deck using carbon fiber reinforced polymer strip

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Abstract

The U-rib butt weld fatigue crack is a typical crack form in orthotropic steel bridge decks. However, there is no completely mature rehabilitation method so far. In this paper, the carbon fiber reinforced polymer (CFRP) strip is used to reduce the stress concentration at the crack tip. Finite element model of U-rib segment was established and parameter analysis was conducted to investigate the influence of the CFRP strip design parameters on the rehabilitation effect. The results indicate that the influence of the three parameters on the reduction of stress concentration is: CFRP layer number > paste width > paste area. Specifically, it is recommended that number of CFRP layers does not exceed 3. For paste width and area, it is only required that the CFRP strip can cover the cracked area.

Keywords: U-rib butt welds; CFRP; fatigue crack; finite element analysis.

1 Introduction

With the wide application of orthotropic steel bridge deck in long-span bridges at home and abroad, its fatigue problem has received more and more attention due to its complex structure. Fatigue cracking of orthotropic steel deck is an

important factor which affects the service life of steel bridges. Therefore, the study of the repair methods of fatigue cracks in orthotropic steel bridges is of great significance [1,2]. According to the statistical investigation of multiple steel box girders, the U-rib butt weld fatigue crack is a typical crack form [3,4] as shown in Figure 1.