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Fretting wear and fatigue in press-fitted railway axle: a simulation study of the influence of stress relief groove

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Abstract: In this paper, a finite element model for the prediction of fretting fatigue crack initiation in the full-scale railway axle was proposed, which took into account the influence of the stress redistribution due to fretting wear on the fretting fatigue. Then, this model was used to investigate the influence of stress relief groove on the fretting wear and fatigue of the railway axle. The simulation results show that the stress concentration at the contact edge is gradually relieved with an increase in fretting cycles due to the fretting wear, while a new stress concentration appears at the edge of fretting wear scar, which gradually increases and moves towards the inner side of the contact area. The stress concentration in the inner side is considered to cause the fatigue crack initiation. Either the increase in groove depth or the decrease in groove radius can reduce the fretting wear and improve the fretting fatigue strength through relieving the stress concentration. Accompanying the improvement of fretting fatigue strength, the potential site of crack initiation gradually moves towards the contact edge. The simulation results stated above agree with the published experimental results.

Key words: Railway axle; Fretting fatigue; Fretting wear; Stress relief groove; Finite element model

1 Introduction

Axle is one of the most important components in railway vehicles with regard to safety. The press-fitted parts, such as the wheel seats and gear seats, are the critical parts of the railway axle, since

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