Fatigue prediction of rail welded joints

C. Lu* 1,2, J. Nieto 1,2, I. Puy 1, J. Melendez 1,2, J.M. Martínez-Esnaola 1,2

1Ceit, Manuel Lardizabal 15, 20018 San Sebastián, Spain.
2Universidad de Navarra, Tecnun, Manuel Lardizabal 13, 20018 San Sebastián, Spain.

2018.02

Abstract

A multiaxial fatigue criterion recently developed by the authors for 2D conditions is extended here to 3D situations and applied to predict fatigue damage in rail welded joints with the help of an explicit finite element model. Contact theory and axle box acceleration response in frequency domain are used to validate the finite element model. The influence of depth and length of the welded joints is analyzed. It is found that fatigue damage is more severe with shorter and deeper welded joints. When the length of the welded joints is less than 150 mm, fatigue damage is greatly increased with the increasing of the depth. When the depth is less than 0.1 mm, fatigue damage is not relevant, regardless of the length. When the depth is greater than 0.3 mm, fatigue damage increases significantly with the decreasing of the joint length, especially when the length is less than 150 mm. When the welded joints are long enough, the depth restriction can be relaxed. This work can provide guidance and theoretical support for maintenance and repair of rail welded joints.

Keywords

Rail welded joints; Multiaxial fatigue; Explicit finite element model; Axle box acceleration; Wheel-rail impact.

1. Introduction

Railway transportation system is becoming increasingly important with the progress of high speed and heavy haul vehicle. However, some problems arise accompanied by the advantages [1,2], for example, much more severe damage of the rail. There are different forms of rail damage, namely, fatigue, wear and plastic flow. With the development of advanced materials, smelting processing and optimization of wheel and rail profiles, the damage of wear and plastic flow is more controlled nowadays, and fatigue damage is becoming the most serious problem in rails [3]. Being one of the weakest points in railway systems, the damage of welded joints is a delicate problem; what is more, welded joints appear repeatedly along the track.

Due to the discontinuities and profile changes, intense wheel-rail impact can occur at welded joints, which significantly increases the contact force and causes harmful vibrations of the vehicle and the track system. This results in damage of the track system and the vehicle. Research into welded joints is urgently needed to increase the economic benefits of railway transportation and the operational safety of vehicles.

*Corresponding autor: C. Lu. Email: clu@ceit.es; se7en_luchun@163.com
Address: Parque Tecnológico de San Sebastián Paseo Mikeletegi, Nº 48 20009, Donostia - San Sebastián
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات