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Abstract

The design guides of railway axles prescribe these axles to have an infinite life based on fatigue limit and to estimate the local stresses in transition fillets or grooves by using the nominal stresses derived by beam calculations. Our previous report described that the press-fitted wheel induced stress concentration on the adjacent transition. In this study, the effect of interference fitting on stress concentration of the transition was experimentally and analytically evaluated using scaled specimens. Finite element analyses of realistic wheelsets based on Japanese and European axle transition geometries were conducted to assess the interference fitting effect on full-scale axles.

Keywords: Railway axles; Stress concentration factor; Fatigue; Design

1. Introduction

Failure in railway axles may cause serious accidents such as derailment of vehicles. The design guides of railway axles, such as EN 13104 [1] or JIS E 4501 [2], prescribe axles to have an infinite life based on fatigue limit. Some differences exist in the assumed force condition acting on the axles, steel grades, or fatigue criteria, but the stress calculation procedures in these guides are based on the classical beam theory. Fig. 1 shows the illustration of a powered axle. Axles have some fillets or grooves because some equipment such as wheels or a driving gear unit is press-fitted in the axles, and their seat diameters slightly differ from one another. Grubisic and Fischer [3] reported that press-fitted seats and axle fillet roots are critical areas of fatigue failure in railway axles. Press-fitted seats of axles such as wheel seats or gear seats are damaged due to fretting fatigue. The transition grooves or fillets are affected by the stress concentration. The