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Grzegorz Lesiuk · Mieczyslaw Szata · Wojciech Blazejewski · Abílio M. P. de Jesus · José A. F. O. Correia *Editors*

Structural Integrity and Fatigue Failure Analysis

Experimental, Theoretical and Numerical Approaches

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Editors
Grzegorz Lesiuk
Faculty of Mechanical Engineering
Wrocław University of Science
and Technology
Wrocław, Poland

Wojciech Blazejewski
Faculty of Mechanical Engineering
Wroclaw University of Science
and Technology
Wrocław, Poland

José A. F. O. Correia
CONSTRUCT & INEGI, Department
of Civil Engineering
Faculty of Engineering
University of Porto
Porto, Portugal

Mieczyslaw Szata
Faculty of Mechanical Engineering
Wroclaw University of Science
and Technology
Wrocław, Poland

Abílio M. P. de Jesus
INEGI, Department of Mechanical
Engineering, Faculty of Engineering
University of Porto
Porto, Portugal

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Chapter 1
Experimental Verification of the Survivability Model Under Mixed I+II Mode Fracture for Steels of Rolling Rolls

S. V. Belodedenko, V. I. Hanush, and O. M. Hrechanyi

Abstract The model of fatigue mixed fracture, which follows from the amalgamation rule of resource safety indices, has been experimentally confirmed. It does not require finding an effective SIF, but is based on the construction of survivability curves for pure modes. Survivability in a mixed process is defined as the result of combining individual fracture processes. Peculiarities of steels of rolling rolls fracture under conditions of cyclic deformation according to the scheme of four-point asymmetric bending are revealed. Although such a test scheme is designed to obtain the fracture of the II mode, in existing studies, this has not been achieved. The crack from the notch, practically, immediately went away at an angle ~45° toward the tensile zone, which indicates a mixed I+II fracture. With sufficient accuracy to predict survivability, the exponent of the Paris's region of the fatigue crack growth diagram (FCG) can be taken as $n_{\mathrm{I}} = 4$ (I mode), $n_{\mathrm{II}} = 3$ (II mode). As a parameter of schematization, it is possible to use the value of SIF at an FCG rate of 10^{-7} m/cycle. Its value for steels of rolling rolls can be 60–70 MPa$\sqrt{\mathrm{m}}$ in mode I. For mode II, this index decreases by 2.5–3 times.

Keywords Mixed fracture · Steels of rolling rolls · Survivability curve

1.1 Introduction

For a considerable of time, the rolling roll operates in a damaged state, when it is slowly destroyed. This process has a mixed character, when at the same time the defect (crack) is affected by deformations of the I, II and III fracture modes. Among them, II mode plays an important role. This type of fracture acts both during the initiation of pits and lamination (spalling) of contact fatigue in the work places of the rolls, as well as on the development of defects arising in the end (neck) zones of the rolls. The contribution from the destruction of the II mode increases with the

S. V. Belodedenko (✉) · V. I. Hanush · O. M. Hrechanyi
Department "Machines and Units of Metallurgical Production", National Metallurgical Academy of Ukraine, Dnipro, Ukraine

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