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Marton Groza, Yves Nadot, Karoly Varadi

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Defect size map for nodular cast iron components with ellipsoidal surface defects based on the Defect Stress Gradient approach

Marton Groza^a, Yves Nadot^b, Karoly Varadi^a

^aTU Budapest, Department of Machine and Product Design, Műegyetem rkp. 3, Budapest 1111, Hungary

^bInstitut Pprime, CNRS, ISAE-ENSMA, Université de Poitiers, Téléport 2, 1 Avenue Clément Ader, 86961 Futuroscope Chasseneuil Cedex, France

ABSTRACT

The impact of surface defects on the fatigue properties of cast iron material cannot be neglected in the fatigue design process. Allowable defect size maps are a practical tool for the quality control of surface defects on castings. These results present a compliance between the detrimental effect of surface inhomogeneities and the primary requirement of structural integrity during service life. The Defect Stress Gradient approach from Vincent et al. [11] has been further improved by a general ellipsoidal geometry model for surface defects, and has been utilized for the fatigue assessment of defective nodular cast iron. After the study of defect size, shape and orientation effects calculations are compared with experimental results for high-strength ferritic nodular cast iron and 1045 steel. Two methods are proposed for an allowable defect size map based surface defect assessment using ellipsoidal description of the defect. The ellipsoidal description of the defect size, shape and orientation offers a more precise representation of real defects leading to more accurate results than the established hemispherical notch or surface crack methods.

Keywords: multiaxial fatigue, high-cycle fatigue, surface defects, allowable defect size, nodular cast iron, Kitagawa diagram

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