Early cracking orientation under high stress gradients: The fretting case

J.A. Araújo, G.M.J. Almeida, J.L.A. Ferreira, C.R.M. da Silva, F.C. Castro

PII: S0142-1123(16)30421-2
DOI: http://dx.doi.org/10.1016/j.ijfatigue.2016.12.013
Reference: JIJF 4164

To appear in: *International Journal of Fatigue*

Received Date: 9 October 2016
Revised Date: 2 December 2016
Accepted Date: 6 December 2016

Please cite this article as: Araújo, J.A., Almeida, G.M.J., Ferreira, J.L.A., da Silva, C.R.M., Castro, F.C., Early cracking orientation under high stress gradients: The fretting case, *International Journal of Fatigue* (2016), doi: http://dx.doi.org/10.1016/j.ijfatigue.2016.12.013

Submitted to *International Journal of Fatigue*, Revised December 2016

Early cracking orientation under high stress gradients: The fretting case

J.A. Araújo [*], G.M.J. Almeida, J.L.A. Ferreira, C.R.M. da Silva, F.C. Castro

Department of Mechanical Engineering, University of Brasilia, 70910-900 Brasilia, DF, Brazil

[*] Corresponding author. Tel.: +55 61 3107-1148
E-mail address: alex07@unb.br

ABSTRACT

Many fretting contacts experience a rapid variation of the magnitude and relative contribution of the stress components away from the surface. This feature of the fretting problem poses an additional difficulty for the modeling of the early cracking orientation. In this work, critical plane approaches associated with a process zone are evaluated by taking into account the fretting crack behavior observed in two different steels. The results show that the conventional approaches may provide inconsistent cracking directions. A new method for early cracking orientation prediction is developed by employing the average values of the normal and shear stresses along a critical direction. This method is simpler to implement and improves the estimates when compared to the other approaches.

Keywords: fretting; stress gradient; critical plane approach; cracking orientation

Nomenclature

a	semi-width of the contact
$a_1(\varphi)$, $a_2(\varphi)$	half-sides of a φ-oriented rectangular hull
E	Young's modulus
f	coefficient of friction
k	material constant in the Fatemi−Socie parameter
L	material characteristic length
P	normal load (per unit length of contact)
Q_a	tangential load amplitude (per unit length of contact)
R	radius of cylindrical contact pad
t	time
x	ordinate parallel to contact surface
y	ordinate normal to contact surface
ΔK_{th}	threshold stress intensity factor range
$\Delta\sigma_{-1}$	uniaxial fatigue limit range