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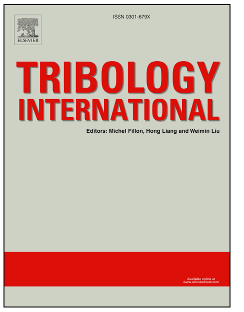

On the running-in behavior of cam-follower mechanism

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On the Running-in Behavior of Cam-Follower Mechanism

Abstract

A line contact thermo-elasto-hydrodynamics analysis is developed to study the behavior of the cam-and-follower contact. The elasto-plastic model takes into account the asperity pressure and asperities' flattening due to plastic deformation. The modified Reynolds equation is solved to predict the hydrodynamic pressure. The change in the surface roughness and friction coefficient during the running-in period is taken into account with provision for thermal effects. The results show the performance parameters of the cam-follower during the running-in period are strongly affected by the rotational speed and thermal effects. In particular, the variations of film thickness and the frictional force of this mechanism, not hitherto reported in the literature, are discussed in depth. It is shown that the rate of flattening of surface roughness is a crucial factor during the running-in period.

Keywords: Cam and follower; thermo-elastohydrodynamic; mixed Lubrication; surface roughness; running-in

Nomenclature:

A_a	Total real area of contact (m^2)
A_h	Area associated with hydrodynamic effect (m^2)
A_n	Nominal area of contact (m^2)
C_k	Damping Coefficient (Nsm^{-1})
C_p	Thermal capacity at Constant pressure (KJ/KgK)
D_{ij}	Coefficients of deflection matrix
E'	Equivalent Young's modulus (Pa)
F	Preload force (N)
FC	Friction coefficient
F_n	Load (N)
F_t	Friction force (N)
G	Non-dimensional material number
H	Non-dimensional film thickness
K	Thermal conductivity (KJ/KgK)
L	Follower lift (m)
N_a	Number of Asperity
P	Non-dimensional Pressure
P_H	Maximum Hertzian pressure distribution(Pa)
P_a	Non-dimensional asperity Pressure
P_h	Non-dimensional hydrodynamic Pressure
f_0	Spring natural frequency (Hz)
h	Lubricant film thickness (m)
h^*	$=h/\sigma$
h_0	Lubricant film thickness at center of coordination (m)
$\bar{h}_T$	Average gap between two rough surfaces (m)
k	Stiffness (N/m)
k_0	Spring Stiffness (N/m)
k_{s1}	Stiffness of part 1 Spring (N/m)
k_{s2}	Stiffness of part 2 Spring (N/m)
R	Equivalent radius of curvature of the cam and follower (m)
$R_{1,2,3,4}$	Length vector (m)
R_b	Base circle radius of the cam (m)
R_{cam}	Radius of the cam (m)
T	Temperature (K)
T_0	Reference temperature (K)
U	Non-dimensional velocity ($u_E\mu_0/(RE')$)
V	Non-dimensional hardness number (HD/E')
W	Non-dimensional load
W_t	Asperity contact load
X_C	Coordinate of contact point between cam and follower (m)
X_{CC}	Coordinate of the center of curvature of the cam (m)
Y_C	Coordinate of contact point between cam and follower (m)
Y_{CC}	Coordinate of the center of curvature of the cam (m)
Z	Viscosity pressure index
a	Hertzian half-contact width(m)
c_i	Relaxation factor
c_{s1}	Damping coefficient of part 1 spring (Nsm^{-1})
c_{s2}	Damping coefficient of part 2 spring (Nsm^{-1})
d	Cam width (m)
y_s^*	$=y_s/\sigma$
z	Distance of asperity summit to mean asperity height (m)
z^*	$=z/\sigma$
ΔFC	Friction coefficient difference (%)
ΔX	Distance between two mesh(m)
$\Delta\bar{t}$	Time step
α_{EHL}	Elastohydrodynamic pressure-viscosity coefficient
β	Asperity Radius (m)
$\bar{\beta}$	$=\beta/R$