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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-andfollower 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 runningin 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 (m²)**
- A_n Nominal area of contact (m^2)
-
- C_k Damping Coefficient (Nsm⁻¹)
 C_p Thermal capacity at Constant pressure (KJ/KgK) T Thermal capacity at Constant pressure (KJ/KgK)
- *D*_{ij} Coefficients of deflection matrix *T*₀ Reference temperature (K)
-
-
-
- F_n
- $\frac{F_t}{G}$
-
-
-
-
-
-
- P_H Maximum Hertzian pressure distribution(Pa) C_{s1}
 P_a Non-dimensional asperity Pressure C_{s2}
- Non-dimensional hydrodynamic Pressure
- f_0 Spring natural frequency (Hz) y_s^*
-
- *h * =h/*^σ z
-
- $\bar{h}_{\rm T}$ \bar{h}_{T} Average gap between two rough surfaces (m) ΔX Distance between two rough surfaces (m) $\Delta \bar{t}$ Time step
- *Stiffness* (N/m)
-
- k_{α}
- k_{52} Stiffness of part 2 Spring (N/m) $\bar{\beta}$ = β/R
- ct thermo-elasto-hydrodynamics analysis is developed to study the behavior of the can
nata. The elastic placitic model takes into account the saperity pressure and apple
tic pressure. The change in the surface roughness a R Equivalent radius of curvature of the cam and follower (m) ${\cal R}_{1,2,3,4}$ Length vector (m) R_b Base circle radius of the cam (m)
 R_{cam} Radius of the cam (m) Radius of the cam (m)
Temperature (K) E' Equivalent Young's modulus (Pa) U Non-dimensional velocity (u_Eµ₀/(RE'))
 V Non-dimensional hardness number (HD/) *F* Preload force (N) *V* Non-dimensional hardness number (HD/E') *FC* Friction coefficient Non-dimensional load Load (N) Asperity contact load Friction force (N) X_C Coordinate of contact point between cam and follower (m)
Non-dimensional material number X_{CC} Coordinate of the center of curvature of the cam (m) *G* **Non-dimensional material number** X_{cc} **Coordinate of the center of curvature of the cam (m)**
H **Non-dimensional film thickness** Y_c **Coordinate of contact point between cam and follow** *H* Non-dimensional film thickness Y_c Coordinate of contact point between cam and follower (m)
 K Coordinate of the center of curvature of the cam (m) *K* **Thermal conductivity (KJ/KgK)** Y_{CC} **Coordinate of the center of curvature of the cam (m)** *Z* **Coordinate of the cam (m)** *Z* **V COORDING 2 V COORDING 2 COORDING 2 V COORDING 2 V COORDING 2 V C** Viscosity pressure index N_a Number of Asperity α Hertzian half-contact width(m) *P* **Non-dimensional Pressure c**_{*c*} Relaxation factor Damping coefficient of part 1 spring (Nsm^{-1}) P_a Non-dimensional asperity Pressure c P_h Damping coefficient of part 2 spring (Nsm⁻¹)

Non-dimensional hydrodynamic Pressure d Cam width (m) $=y_s/\sigma$ h Lubricant film thickness (m) z Distance of asperity summit to mean asperity height (m) z^* =z/σ h_0 Lubricant film thickness at center of coordination (m) ΔFC Friction coefficient difference (%)
 \bar{h}_x Average gap between two rough surfaces (m) ΔX Distance between two mesh(m) k_0 Spring Stiffness (N/m) α_{EHL} Elastohydrodynamic pressure-viscosity coefficient Stiffness of part 1 Spring (N/m) β Asperity Radius (m)

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