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Thermal and Starvation Effects on Lubricated Elliptical Contacts at High Rolling/Sliding Speeds

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Abstract : The objective of this theoretical study is to develop simple design formulas for the prediction of minimum film thickness and maximum mean film temperature rise in lightly loaded high-speed rolling/sliding lubricated elliptical contacts incorporating starvation effect. Herein, the reported numerical analysis focuses on thermoelastohydrodynamically lubricated rolling/sliding elliptical contacts, considering the Newtonian rheology of lubricant for wide range of operating parameters, namely load characterized by Hertzian pressure (PH = 0.01 GPa to 0.10 GPa), rolling speed (>10 m/s), slip parameter (S varies up to 1.0), and ellipticity ratio (k = 1 to 5). Starvation is simulated by systematically reducing the inlet supply. This analysis reveals that influences of load, rolling speed, and level of starvation are significant on the minimum film thickness. However, the maximum mean film temperature rise is strongly influenced by slip in addition to load, rolling speed, and level of starvation. In the presence of starvation, reduction in minimum film thickness and increase in maximum mean film temperature are observed. Based on the results of this study, empirical relations are developed for the prediction of dimensionless minimum film thickness and dimensionless maximum mean film temperature rise at the contacts in terms of various operating parameters.

Keywords : starvation, lubrication, elliptical contact, traction, minimum film thickness
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