Film thickness equations for line-contact thermal elastohydrodynamic lubrication under misaligned loads

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The film thickness is the important index in line-contact thermal elastohydrodynamic lubrication. From the viewpoint of engineering application, the simplified film thickness equations are more convenient than numerical computation. Recently, the formulas simulated by Dowson and Higginson, Pan and Hamrock are widely-used. The effect of misalignment, thermal and finite length could not be considered in them. While it has been verified these factors can apparently influent film thickness by Xiaoling Liu, Haoyang Sun and Xiaoyang Chen.

The model on thermal elastahydrodynamic lubrication under misaligned loads has been established by the author's former work. In the present paper, the effect of dimensionless load, speed, and material parameters on film thickness is discussed(see Fig.1-2). Figs.1-2 show the variation of the central and minimum film thicknesses with dimensionless load parameter in different misaligned angles. As the dimensionless load parameter increases, the central and minimum film thicknesses decrease. And the effect of misaligned angles on the central film thickness is very little, while it apparently influent the minimum film thickness, especially in heavy load. The results of numerical computation are used to developed suitable equations for determining the central and minimum film thickness.

$$H_{cen} = 1.649W^{-0.031}U^{0.620}G^{0.502}e^{-0.006S+0.018\theta}$$

$$H_{min} = 0.108W^{-0.244}U^{0.717}G^{0.775}e^{-0.1S-25.15\theta}$$

If slid/rolling ratios and misaligned angle are set to zero, the current formulas are converted to simpler equations. By comparing to the widely-used equations, the validity of the present equations is proved(see Fig.3-4). It shows the results of our current equations are close to those reported by Dowson and Hamrosk.

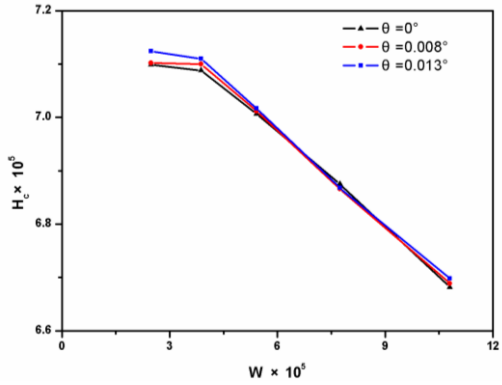


Fig.1 Effect of dimensionless load on dimensionless central film thickness (U=5.54×10-11, G=4972, S=0)

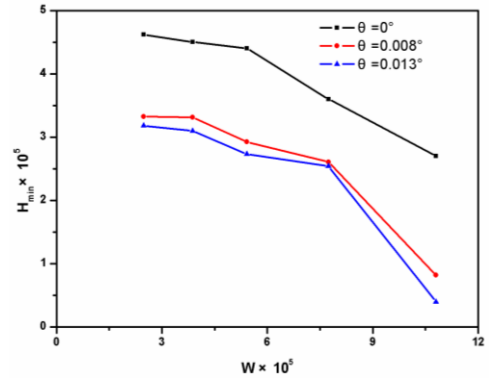
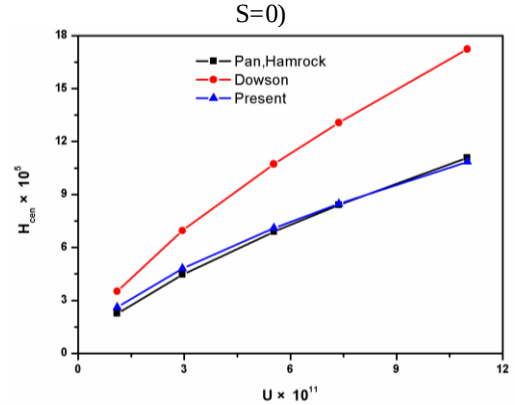


Fig.2 Effect of dimensionless load on dimensionless minimum film thickness (U=5.54×10-11, G=4972, S=0)



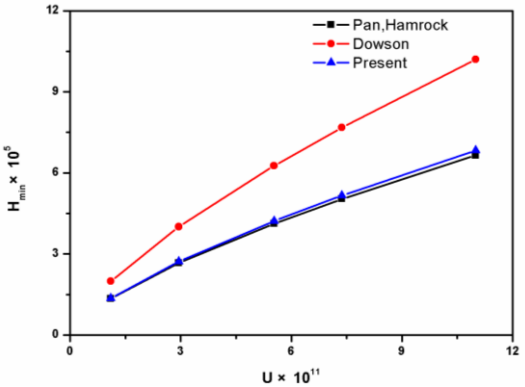


Fig.3 Verification of formulas