1 **Exercise** Assuming that $\alpha = 2 \cdot 10^{-8}$ Pa^{-1}, compute the pressure for which the viscosity is twice its atmospheric value, according to Barus. Then calculate the pressure for which the viscosity increases by a factor of 1000, then by a factor of 10^6.

2 * **Exercise** Show that using the definition of α as the slope at zero (ambient) pressure for both viscosity pressure equations, one obtains indeed that $\alpha p_0/z = \ln(\eta_0) + 9.67$.

3 * **Exercise** Using the figures 3.9 - 3.14 show that $\partial(\rho h)/\partial x = 0$ is indeed found in the high pressure zone. Comment on the film thickness evolution from 3.9 - 3.14. Relate this evolution to the evolution in the pressure distribution.

4 * **Exercise** Show that $H(X - T) = X^2 - 2XT + T^2$ is indeed a solution of the reduced Reynolds equation for high pressures: $\partial H/\partial X + \partial H/\partial T = 0$.

5 * **Exercise** Check the derivation of the three dimensionless equations.

6 * **Exercise** Give the reduced forms of the Reynolds equation in the zone $\theta < 1$ and $\theta = 1$?

7 * **Exercise** Derive the Reynolds equation from the mass flow continuity equation over a rectangle, comments with respect to the discrete equation?

8 **Exercise** (Line Contact) Express the Hertzian pressure p_h in terms of w_1, E' and R only. In order to double the pressure, p_h, how much should the load w_1 change, how much the contact radius R, and how much the reduced Elastic modulus E'?

9 **Exercise** Compute δ for a contact with $b = 0.001$ m and $R = 0.05$ m. If the reduced elastic modulus $E' = 2 \cdot 10^{11}$ Pa what is the load per unit length w_1, what is p_h?

10 **Exercise** Figure 3.1 shows the deformed and the undeformed geometry for a line contact. From the difference the maximum deformation can be estimated as 0.6. Deduce which dimensionless film thickness relation has been used to obtain H.

11 **Exercise** (Circular Contact) Express the Hertzian pressure p_h in terms of w, E' and R_x only. In order to double the pressure, p_h, how much should the load w change, how much the contact radius R_x, and how much the reduced Elastic modulus E'?

12 **Exercise** Compute δ for a contact with $a = 0.001$ m and $R_x = 0.05$ m. If the reduced elastic modulus $E' = 2 \cdot 10^{11}$ Pa, what is the load w, what is the value of p_h?

13 **Exercise** Figure 3.2 shows the deformed and the undeformed geometry for a circular contact. From the difference the maximum deformation can be estimated as 1. Deduce which dimensionless film thickness relation has been used for H.

14 * **Exercise** Check that for the case of a circular contact $k = 1$, the equations for a, b and δ reduce to the ones found in the previous section.

15 * **Exercise** Compute a, b, p_h and δ for a contact with $R_x = 0.005$ m, $R_y = 0.05$ m, $E' = 2 \cdot 10^{11}$ Pa and $w = 10^4$ N?

16 **Exercise** (Ertel Grubin) Check the two asymptotes of q for $p \to 0$ and for $p \to \infty$?

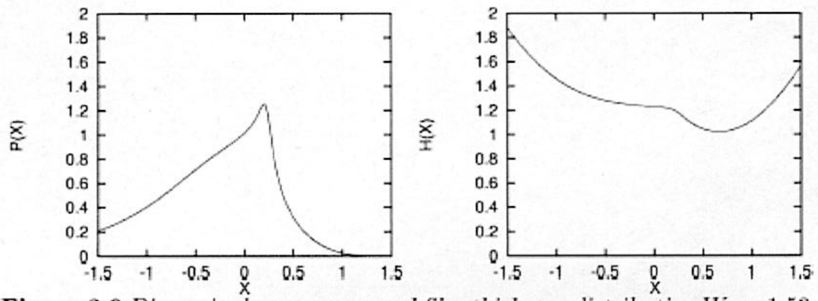

Figure 3.9 *Dimensionless pressure and film thickness distribution* $W_1 = 1.53 \cdot 10^{-5}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

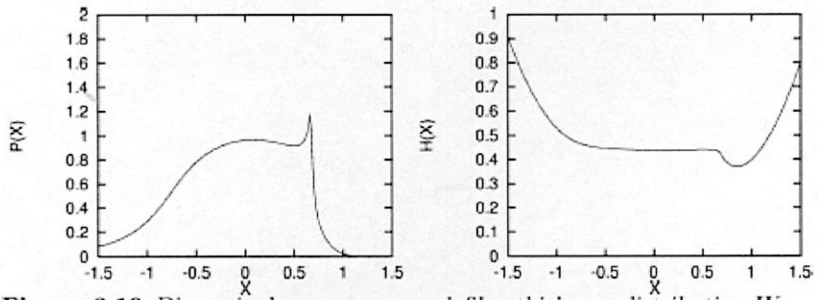

Figure 3.10 *Dimensionless pressure and film thickness distribution* $W_1 = 3.84 \cdot 10^{-5}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

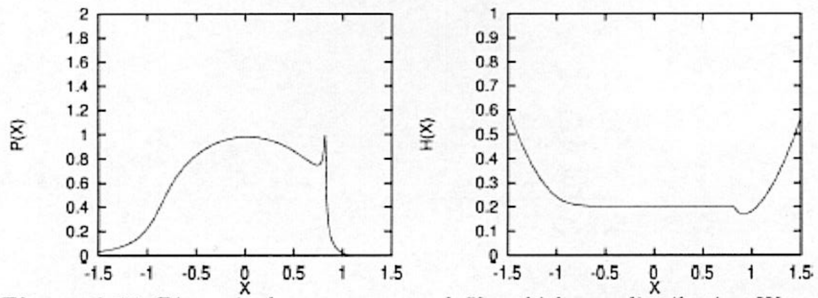

Figure 3.11 *Dimensionless pressure and film thickness distribution* $W_1 = 7.67 \cdot 10^{-5}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

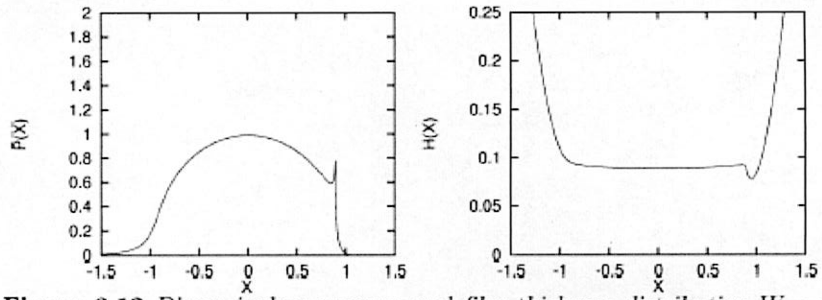

Figure 3.12 *Dimensionless pressure and film thickness distribution* $W_1 = 1.53 \cdot 10^{-4}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

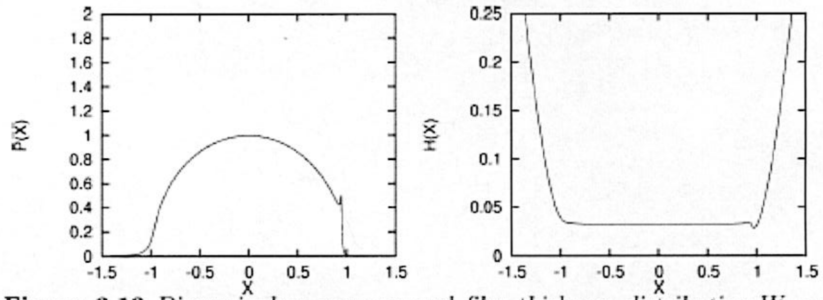

Figure 3.13 *Dimensionless pressure and film thickness distribution* $W_1 = 3.84 \cdot 10^{-4}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

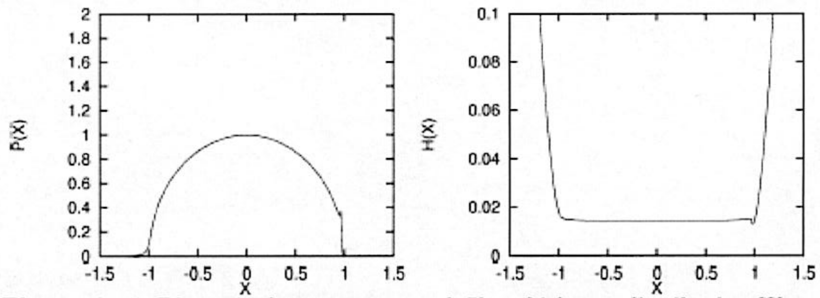

Figure 3.14 *Dimensionless pressure and film thickness distribution* $W_1 = 7.67 \cdot 10^{-4}$, $U = 5.89 \cdot 10^{-11}$, $G = 4000$.

Geometry

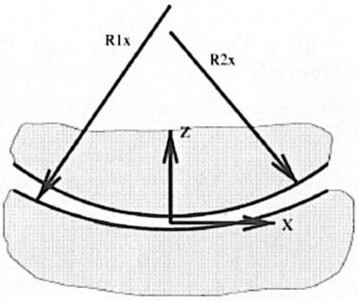

Figure 2.3 *Conforming contact.*

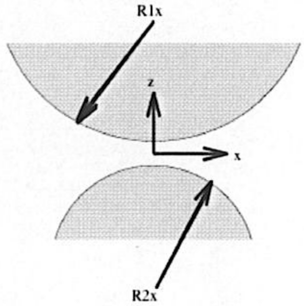

Figure 2.4 *Non-conforming contact.*

Line contact

$$h(x) = h_0 + \frac{x^2}{2R} - \frac{2}{\pi E'} \int_{-\infty}^{+\infty} p(x') \ln \left(\frac{x - x'}{x_0} \right)^2 dx'$$

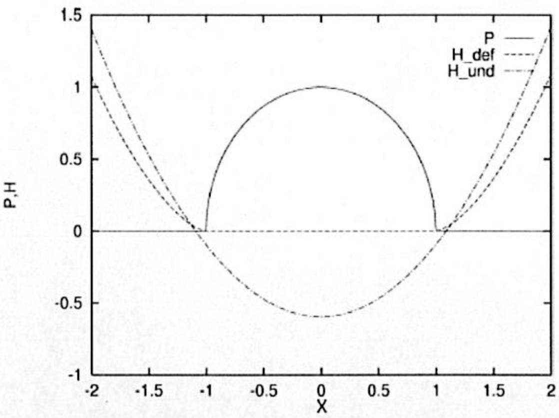

Figure 3.1 *Dimensionless Hertzian contact pressure, dimensionless deformed and undeformed geometry, for the line contact case.*

Circular contact

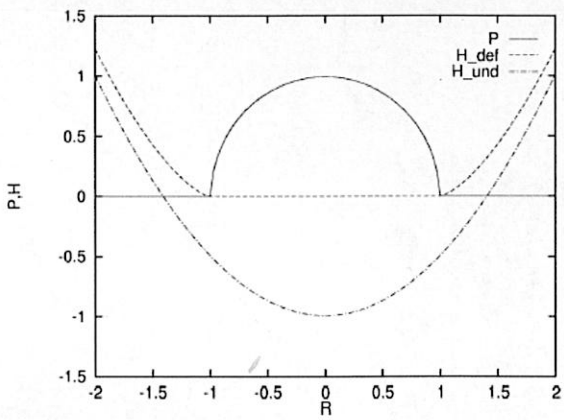

Figure 3.2 *Dimensionless Hertzian contact pressure, dimensionless deformed and undeformed geometry, for the circular contact case.*