

where

$$m = 4\pi/\alpha \quad (99)$$

If N_s is the number of segments then $m = 2N_s$.

The shear force $\tau_{r\theta}$ must balance the pin force P shown in Figures 80 and 81. From Figure 80, it is seen for equilibrium of P , that it is required

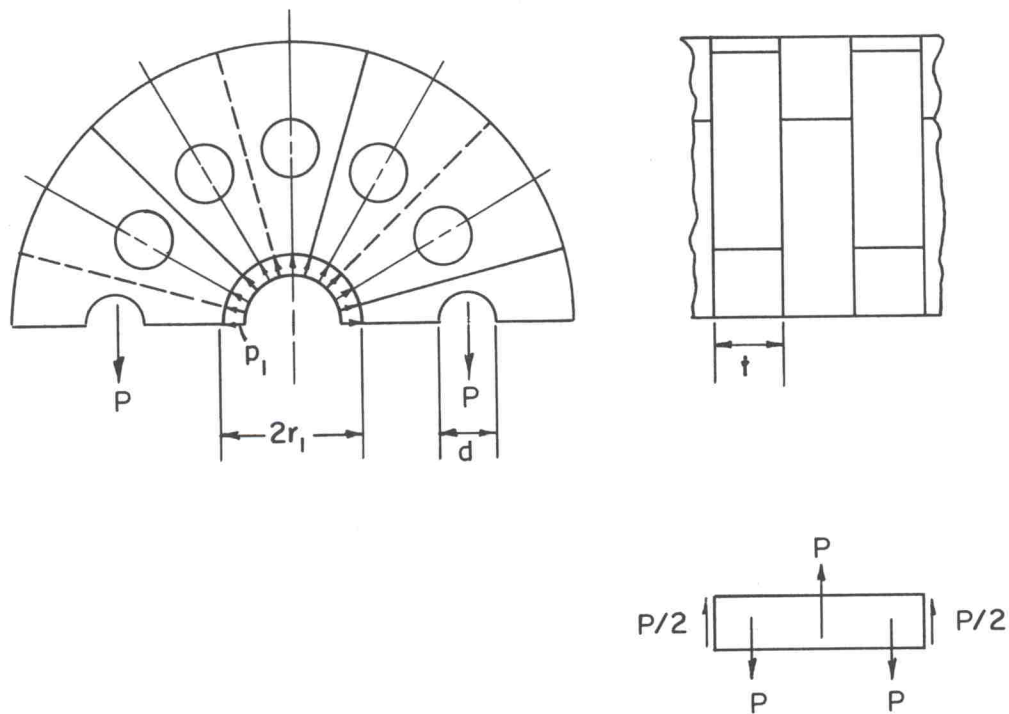
$$t \int_{\alpha/4}^{\alpha/2} \tau_{r\theta} \cos \left(\theta - \frac{\alpha}{4} \right) r_2 d\theta = P/2$$

where t is the segment thickness. Substitution of (98c) into this integral and integration gives

$$\tau = \frac{(m^2 - 1) P}{2mtr_2 (1 + \cos \pi/m)} \quad (100)$$

where P must be in equilibrium with p_1 as shown in Figure 81, i. e.,

$$P = p_1 r_1 t \quad (101)$$



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FIGURE 81. LOADING OF PINS

For radial equilibrium of the loadings shown in Figure 80, p_2 can be found by integration, i. e.,

$$2 \int_0^{\alpha/2} [\tau_{r\theta} \sin \theta - \sigma_r \cos \theta] r_2 d\theta \Big|_{r_2} = 2p_1 r_1 \sin \frac{\alpha}{2} .$$

Substitution for $\tau_{r\theta}$ and σ_r from (98b, c) and integration gives

$$p_2 = \frac{1}{(m^2-2)} \left[(m^2-1) \frac{p_1}{k_2} - m\tau \right] . \quad (102)$$

The stresses in a pin segment are found by superposition of three solutions: the Lamé solution for constant pressures p_1 and p_2 at the r_1 and r_2 respectively, a sinusoidal solution for the variable σ_r loading $-p_2 \cos m\theta$ at r_2 , and a bending solution to remove the hoop stress of the first two solutions from the sides of the segments. The Lamé solution is given by Equations (13a-c) and (14a, b) in the text. The sinusoidal solution, taken from the $\cos m\theta$ part of Equation (81) in Timoshenko and Goodier(41), is

$$\begin{aligned} \sigma_r &= \left[m(1-m) a_m \rho^{m-2} + (2-m)(1+m) b_m \rho^m \right. \\ &\quad \left. - m(m+1) c_m \rho^{m-2} + (2+m)(1-m) d_m \rho^{-m} \right] \cos m\theta \\ \sigma_\theta &= \left[m(m-1) a_m \rho^{m-2} + (m+2)(m+1) b_m \rho^m \right. \\ &\quad \left. + m(m+1) c_m \rho^{m-2} + (m-2)(m-1) d_m \rho^{-m} \right] \cos m\theta \\ \tau_{r\theta} &= m \left[(m-1) a_m \rho^{m-2} + (m+1) b_m \rho^m - (m+1) c_m \rho^{m-2} \right. \\ &\quad \left. + (-m+1) d_m \rho^{-m} \right] \sin m\theta \end{aligned} \quad (103a-c)$$

where

$$\rho \equiv r/r_2 . \quad (104)$$

From the boundary conditions $\sigma_r = 0$, $\tau_{r\theta} = 0$ at r_1 and $\sigma_r = -p_2 \cos m\theta$, $\tau_{r\theta} = -\tau \sin m\theta$ at r_2 for the sinusoidal solution, the constants a_m , b_m , c_m , and d_m are found to be

$$\begin{aligned} a_m &= \left(\frac{-p_2}{2} + \frac{\tau}{2} \right) \left[\frac{m^2 + (1-m^2) k_2^2 - k_2^{2m+2}}{\beta_2 (m-1)} \right] \\ &\quad + \left(\frac{-p_2}{2} - \frac{\tau}{2} \right) \frac{k_2^2 (1 - k_2^{2m})}{\beta_2} \end{aligned}$$