where

$$m = 4\pi/\alpha \tag{99}$$

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

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

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

$$P = p_1 r_1 t \ . \tag{101}$$

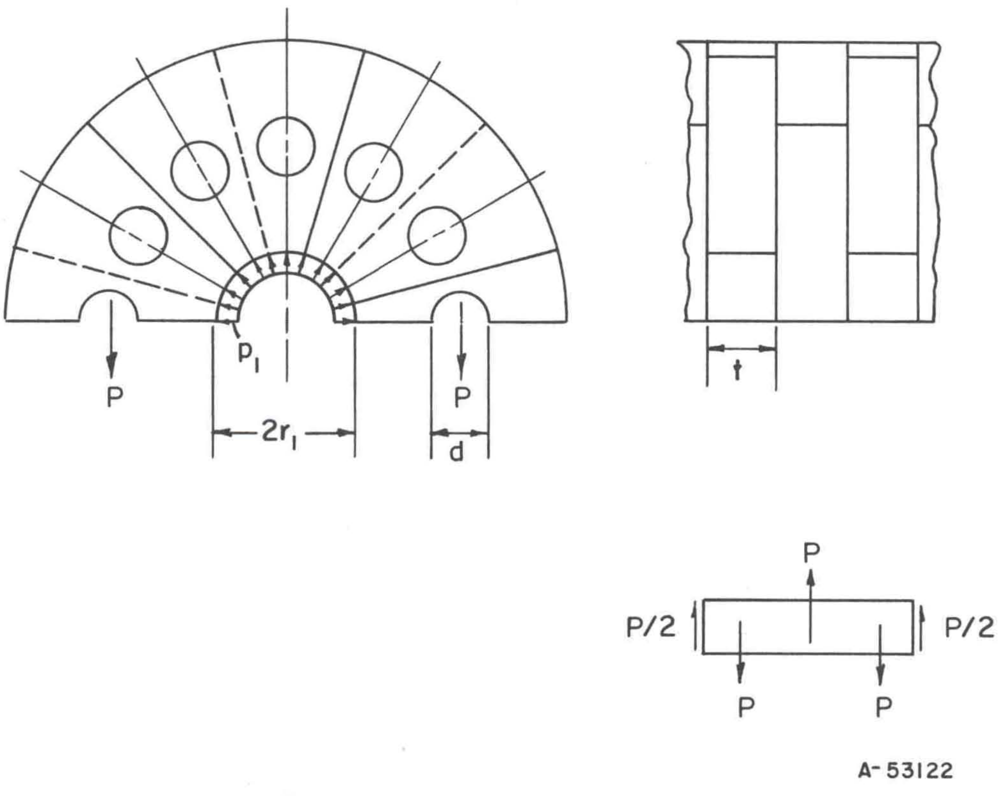

FIGURE 81. LOADING OF PINS

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

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

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

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

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

$$\sigma_r = \Big[m(1-m)\,a_m\,\rho^{m-2} + (2-m)(1+m)\,b_m\rho^m - m(m+1)\,c_m\,\rho^{m-2} + (2+m)(1-m)\,d_m\,\rho^{-m}\Big]\cos m\theta$$

$$\sigma_\theta = \Big[m(m-1)\,a_m\,\rho^{m-2} + (m+2)(m+1)\,b_m\,\rho^m + m(m+1)\,c_m\,\rho^{-m-2} + (m-2)(m-1)\,d_m\,\rho^{-m}\Big]\cos m\theta \qquad (103a\text{-}c)$$

$$\tau_{r\theta} = m\Big[(m-1)\,a_m\,\rho^{m-2} + (m+1)\,b_m\,\rho^m - (m+1)\,c_m\,\rho^{-m-2} + (-m+1)\,d_m\,\rho^{-m}\Big]\sin m\theta$$

where

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

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

$$a_m = \left(\frac{-p_2}{2} + \frac{\tau}{2}\right)\left[\frac{m^2 + (1-m^2)\,k_2{}^2 - k_2{}^{2m+2}}{\beta_2\,(m-1)}\right] + \left(\frac{-p_2}{2} - \frac{\tau}{2}\right)\frac{k_2{}^2\,(1 - k_2{}^{2m})}{\beta_2}$$