where

$$m = 4\pi/\alpha \qquad (A.8)$$

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 32 and 33. From Figure 32, 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 (A. 7c) into this integral and integration gives

$$\tau = \frac{(m^2 - 1)\, P}{2mtr_2\,(1 + \cos \pi/m)} \qquad (A.9)$$

where P must be in equilibrium with p_1 as shown in Figure 33, i.e.,

$$P = p_1 r_1 t \ . \qquad (A.10)$$

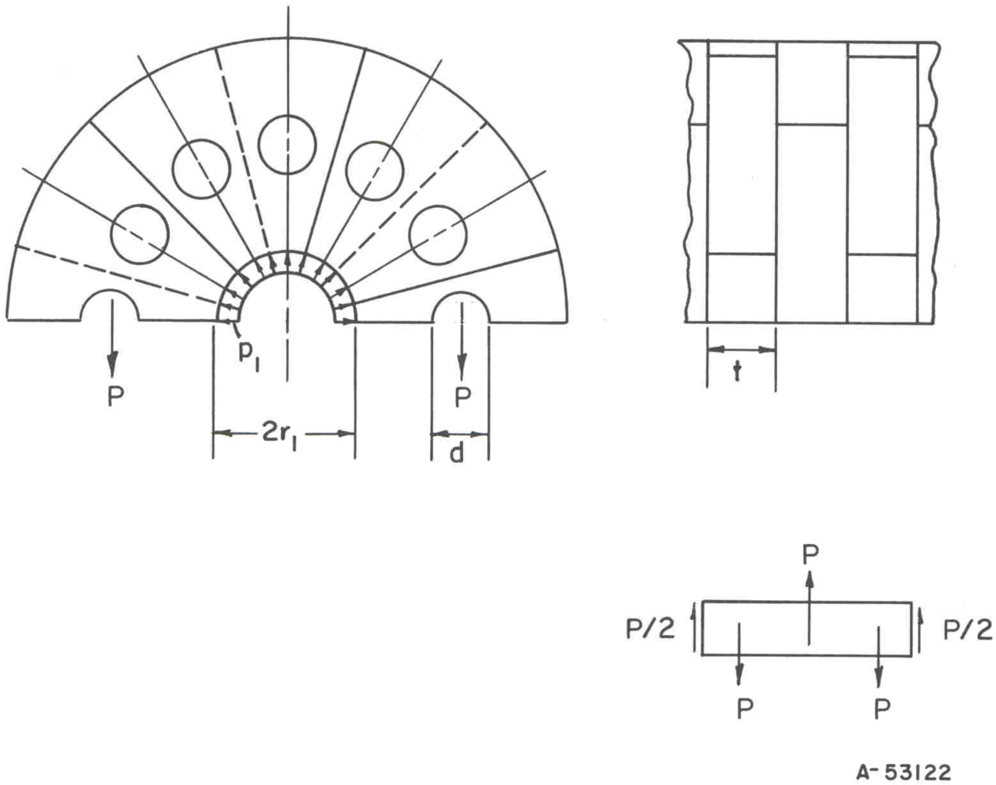

FIGURE 33. LOADING OF PINS

For radial equilibrium of the loadings shown in Figure 32, 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 (A. 7b, c) and integration gives

$$p_2 = \frac{1}{(m^2-2)} \left[(m^2-1) \frac{p_1}{k_2} - m\tau \right] . \qquad \text{(A. 11)}$$

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 (16a-c) and (17a, b) in the text. The sinusoidal solution, taken from the cos $m\theta$ part of Equation (81) in Timoshenko and Goodier[19], is

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

$$\sigma_\theta = \Big[m (m - 1) a_m \rho^{m-2} + (m + 2)(m + 1) b_m \rho^m + m (m + 1) c_m \rho^{-m-2} + (m - 2)(m - 1) d_m \rho^{-m} \Big] \cos m\theta \qquad \text{(A. 12a-c)}$$

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

where

$$\rho \equiv r/r_2 . \qquad \text{(A. 13)}$$

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

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