14–2 A steel spur pinion has a diametral pitch of 10 teeth/in, 18 teeth cut full-depth with a 20° pressure angle, and a face width of 1 in. This pinion is expected to transmit 2 hp at a speed of 600 rev/min. Determine the bending stress.

$$\sigma = \frac{K_v W^t P}{F Y} = \frac{1.24 \cdot 233 \text{ lb } 10 \text{ }^1/_{\text{in}}}{1 \text{ in} \quad 0.309}$$

$$= 9326 \text{ psi}$$

$$K_v = \frac{1200 + V}{1200} = \frac{1200 + 283}{1200} = 1.24$$

$P = 10 \text{ teeth/in}$

$F = 1 \text{ in}$

$Y = 0.309 \qquad$ (Tab 14-2)

$$V = rw = \frac{d}{2} w = \frac{1.8 \text{ in}}{2} \, 600 \frac{\text{rev}}{\text{min}} \, \frac{2\pi \text{ rad}}{1 \text{ rev}} \, \frac{1 \text{ ft}}{12 \text{ in}} = 283 \text{ ft/min}$$

$$d = N/P = 18/10 = 1.8 \text{ in}$$

$$W_t = \frac{H}{V} = \frac{2 \text{ hp}}{283 \text{ ft/min}} \, \frac{33000 \text{ ft lb/min}}{1 \text{ hp}} = 233 \text{ lb}$$

14–6 A 20° full-depth steel spur pinion has 20 teeth and a module of 2 mm and is to transmit 0.5 kW at a speed of 200 rev/min. Find an appropriate face width if the bending stress is not to exceed 75 MPa.

$m = d/N \qquad d = Nm = 20 \cdot 2\,mm = 40\,mm$

$V = rw = \frac{d}{2}w = 20\,mm\ 200\ \frac{rev}{min}\ \frac{2\pi\ rad}{1\,rev}\ \frac{1\,min}{60\,s}\ \frac{1\,m}{1000\,mm} = 0.419\ m/s$

$k_v = \frac{6.1+V}{6.1} = \frac{6.1+0.419}{6.1} = 1.07$

$Y = 0.322$

$W^t = \frac{H}{V} = \frac{500\,W}{0.419\,m/s}\ \frac{1\,J/s}{1\,W}\ \frac{1\,Nm}{1\,J} = 1193\ N$

$\sigma = \frac{K_v W^t}{F m Y}$

$F = \frac{K_v W^t}{\sigma m Y} = \frac{1.07 \cdot 1193\ N}{75\,MPa\ 2\,mm\ 0.322}$

$= 26.4\ \frac{N}{MPa\ mm}\ \frac{1\,MPa}{1\times10^6\,Pa}\ \frac{1\,Pa}{1\,N/m^2}\ \frac{1000\,mm}{1\,m}$

$= 0.0264\ m = 26.4\ mm$