

Answers to Selected Problems

Appendix

B

B-1 Chapter 1

- 1-8** $10 \leq F \leq 10.5$ lbf, $13.5 \leq N \leq 14.2$ lbf,
 $K = 0.967$, $19.3 \leq T \leq 20.3$ lbf · in
1-12 (a) $e_1 = 0.006\,067\,977$, $e_2 = 0.009\,489\,743$,
 $e = 0.015\,557\,720$, (b) $e_1 = -0.003\,932\,023$,
 $e_2 = -0.000\,510\,257$, $e = -0.004\,442\,280$
1-15 (a) $\sigma = 13.1$ MPa, (b) $\sigma = 70$ MPa,
(c) $y = 15.5$ mm, (d) $\theta = 5.18^\circ$

B-2 Chapter 2

- 2-1** $\bar{x} = 122.9$ kilocycles, $s_x = 30.3$ kilocycles
2-2 $\bar{x} = 198.55$ kpsi, $s_x = 9.55$ kpsi
2-3 $\bar{x} = 78.4$ kpsi, $s_x = 6.57$ kpsi
2-11 (a) $\bar{F}_i = 5.979$ lbf, $s_{F_i} = 0.396$ lbf;
(b) $\bar{k} = 9.766$ lbf/in, $s_k = 0.390$ lbf/in
2-19 $L_{10} = 84.1$ kcycles
2-23 $R = 0.987$
2-25 (a) $w = 0.020 \pm 0.015$ in, (b) $w = 0.020 \pm 0.005$ in
2-32 $\bar{D}_0 = 4.012$ in, $t_{D_0} = 0.036$ in;
 $D_0 = 4.012 \pm 0.036$ in
2-39 $\bar{x} = 98.26$ kpsi, $s_x = 4.30$ kpsi
2-46 $\mu_n = 122.9$ kcycles, $\hat{\sigma}_n = 34.8$ kcycles

B-3 Chapter 3

- 3-9** $E = 30$ Mpsi, $S_y = 45.5$ kpsi, $S_{ut} = 85.5$ kpsi,
area reduction = 45.8 percent
3-11 $(S_y)_{0.001} \doteq 35$ kpsi, $E_{\sigma=0} = 25$ Mpsi,
 $E_{\sigma=20 \text{ kpsi}} = 14$ Mpsi
3-14 $G = 77.3$ GPa, $S_{ys} \doteq 200$ MPa
3-18 $\bar{S}_{ut} = 125.2$ kpsi, $\hat{\sigma}_{S_{ut}} = 1.9$ kpsi
3-20 (a) $u_R \doteq 34.5$ in · lbf/in³, (b) $u_T \doteq 66.7(10^3)$ in · lbf/in³

B-4 Chapter 4

- 4-4** (a) $V(x) = -1.43 - 40\langle x - 4 \rangle^0 + 30\langle x - 8 \rangle^0 + 71.43\langle x - 14 \rangle^0 - 60\langle x - 18 \rangle^0$ lbf
 $M(x) = -1.43x - 40\langle x - 4 \rangle^1 + 30\langle x - 8 \rangle^1 + 71.43\langle x - 14 \rangle^1 - 60\langle x - 18 \rangle^1$ lbf · in
4-6 (a) $M_{\max} = 253$ lbf · in, (b) $(a/l)^* = 0.207$,
 $M^* = 214$ lbf · in
4-8 (a) $\sigma_1 = 14$, $\sigma_2 = 4$, $\sigma_3 = 0$, $2\theta = 53.1^\circ$ ccw;
(b) $\sigma_1 = 18.6$, $\sigma_2 = 6.4$, $\sigma_3 = 0$, $2\theta = 55^\circ$ ccw;
(c) $\sigma_1 = 26.2$, $\sigma_2 = 7.78$, $\sigma_3 = 0$, $2\theta = 139.7^\circ$ cw;
(d) $\sigma_1 = 23.4$, $\sigma_2 = 4.57$, $\sigma_3 = 0$, $2\theta = 122^\circ$ cw
4-13 $\sigma = 10.2$ kpsi, $\delta = 0.0245$ in, $\epsilon_1 = 0.000\,340$,
 $\nu = 0.292$, $\epsilon_2 = -0.000\,099\,1$, $\Delta d = -0.000\,049\,6$ in
4-18 $\sigma_1 = 30$ MPa, $\sigma_2 = 10$ MPa, $\sigma_3 = -20$ MPa,
 $\tau_{\max} = 25$ MPa
4-22 (a) $M_{\max} = 21\,600$ kip · in, (b) $x_{\max} = 523$ in
from left or right supports
4-23 (a) $\sigma_A = 42$ kpsi, $\sigma_B = 18.5$ kpsi, $\sigma_C = 2.7$ kpsi,
 $\sigma_D = -52.7$ kpsi
4-27 $M_{\max} = 219$ lbf · in, $\sigma = 17.8$ kpsi,
 $\tau_{\max} = 3.4$ kpsi, both models
4-33 The same
4-37 Two $\frac{1}{16}$ -in-thick strips: $T_{\max} = 29.95$ lbf · in,
 $\theta = 0.192$ rad, $k_t = 156$ lbf · in/rad. One $\frac{1}{8}$ -in-thick
strip: $T_{\max} = 59.90$ lbf · in, $\theta = 0.0960$ rad,
 $k_t = 624$ lbf · in/rad
4-43 $d_C = 45$ mm
4-47 $\sigma_{\max} = 11.79$ kpsi, $\tau_{\max} = 7.05$ kpsi
4-53 $p_i = 639$ psi
4-57 $(\sigma_r)_{\max} = 3656$ psi
4-65 $\delta_{\max} = 0.038$ mm, $\delta_{\min} = 0.0175$ mm,
 $p_{\max} = 147.5$ MPa, $p_{\min} = 67.9$ MPa
4-69 For δ_{\max} , $p = 33.75$ kpsi, $(\sigma_t)_o = 56.25$ kpsi,
 $(\sigma_t)_i = -33.75$ kpsi, $\delta_o = 0.001\,11$ in,
 $\delta_i = -0.000\,398$ in
4-72 $\sigma_i = 26.3$ kpsi, $\sigma_o = -15.8$ kpsi

4-77 $\sigma_i = 71.3$ kpsi, $\sigma_o = -34.2$ kpsi

4-81 $p_{\max} = 399F^{1/3}$ MPa, $\sigma_{\max} = 399F^{1/3}$ MPa,
 $\tau_{\max} = 120F^{1/3}$ MPa

B-5 Chapter 5

5-1 (a) $k = (1/k_1 + 1/k_2 + 1/k_3)$, (b) $k = k_1 + k_2 + k_3$, (c) $k = [1/k_1 + 1/(k_2 + k_3)]^{-1}$

5-10 $\lambda = 8a^2/(3l)$

5-12 $\sigma_{\max} = -20.4$ kpsi, $y = -0.908$ in

5-15 $y_{\text{left}} = -0.0506$ in, $y_{\text{right}} = -0.0506$ in,
 $y_{\text{midspan}} = 0.0190$ in

5-18 $y_{\max} = -0.0130$ in

5-20 $z_A = 0.0368$ in, $z_B = 0.00430$ in

5-26 Use $d = 1\frac{3}{8}$ in

5-30 $y_B = 0.0459$ in

5-37 $y_A = -0.101$ in, $y_{x=20 \text{ in}} = -0.104$ in

5-45 $y_A = -0.133$ in

5-48 $y_{x=10 \text{ in}} = -0.0167$ in

5-51 (a) $\sigma_b = 76.5$ kpsi, $\sigma_c = -15.2$ kpsi,
 (b) $\sigma_b = 78.4$ kpsi, $\sigma_c = -13.3$ kpsi

5-56 $R_O = 3.89$ kip, $R_C = 1.11$ kip, both in same direction

5-59 $\sigma_{BE} = 140$ MPa, $\sigma_{DF} = 71.2$ MPa,
 $y_B = -0.670$ mm, $y_C = -2.27$ mm,
 $y_D = -0.341$ mm

5-64 $\delta_A = (\pi + 4)PR^3/(4EI)$, $\delta_B = \pi PR^3/(4EI)$

5-67 $\delta = 0.476$ mm

5-73 (a) $t = 0.5$ in, (b) No

5-81 $y_{\max} = 2k_1a/(k_1 + k_2)$

B-6 Chapter 6

6-2 (a) MSS: $n = 4.17$, DE: $n = 4.17$, (b) MSS: $n = 4.17$, DE: $n = 4.81$, (c) MSS: $n = 2.08$, DE: $n = 2.41$, (c) MSS: $n = 4.17$, DE: $n = 4.81$

6-3 (a) MSS: $n = 2.17$, DE: $n = 2.50$, (b) MSS: $n = 1.45$, DE: $n = 1.56$, (c) MSS: $n = 1.52$, DE: $n = 1.65$, (c) MSS: $n = 1.27$, DE: $n = 1.50$

6-9 (a) DE: $\sigma' = 12.29$ kpsi, $n = 3.42$

6-10 (a) DCM: $\sigma_1 = 90$ kpsi, $\sigma_2 = 0$, $\sigma_3 = -50$ kpsi,
 $r = -0.56$, $n = 1.77$

6-12 (a) M2M: $n = 3.89$

6-13 (a) $\sigma_A = \sigma_B = 20$ kpsi, $r = 1$, $n = 1.5$

6-18 $(\sigma_t)_{\max} = 13.21$ kpsi, $\sigma_t = 6.42$ kpsi,
 $\sigma_r = -500$ psi, $\sigma' = 11.9$ kpsi, $n = 3.87$

6-21 Using BCM, select $d = 1\frac{3}{8}$ in

6-25 $d = 18$ mm

6-32 (a) $\delta = 0.0005$ in, $p = 3516$ psi,
 $(\sigma_t)_i = -5860$ psi, $(\sigma_r)_i = -3516$ psi,
 $(\sigma_t)_o = -9142$ psi, $(\sigma_r)_o = -3516$ psi

6-35 $n_o = 2.81$, $n_i = 2.41$

6-40 $p = 29.2$ MPa

B-7 Chapter 7

7-1 $S_e = 94.4$ kpsi

7-3 $S'_e = 33.4$ kpsi, $\sigma'_F = 112.4$ kpsi, $b = -0.0836$,
 $f = 0.899$, $a = 106.1$ kpsi, $S_f = 48.2$ kpsi,
 $N = 409\,530$ cycles

7-5 $(S_f)_{\text{ax}} = 162N^{-0.0851}$ kpsi, $10^3 \leq N \leq 10^6$ cycles

7-6 $S_e = 243$ MPa

7-10 $S'_e = 221.8$ MPa, $k_a = 0.899$, $k_b = 1$, $k_c = 0.85$,
 $S_e = 169.5$ MPa, $K_t = 2.5$, $K_f = 2.09$,
 $F_a = 21.6$ kN, $F_y = 98.7$ kN

7-12 Yield: $n_y = 1.18$. Fatigue: (a) $n_f = 1.06$,
 (b) $n_f = 1.31$, (c) $n_f = 1.32$

7-17 $n_y = 5.06$, (a) $n_f = 2.44$, (b) $n_f = 2.55$

7-23 At the fillet $n_f = 1.70$

7-24 (a) $T = 3.42$ N · m, (b) $T = 4.21$ N · m,
 (c) $n_y = 1.91$

7-27 (a) $P_{\text{all}} = 16.1$ kN, $n_y = 5.69$, (b) $P_{\text{all}} = 51.4$ kN,
 $n_y = 3.87$

7-29 (a) 24 900 cycles, (b) 27 900 cycles

7-34 Rotation presumed. $S'_e = 55.7$ LN(1, 0.138) kpsi,
 $k_a = 0.768$ LN(1, 0.058), $k_b = 0.879$, $S_e = 37.6$ LN(1, 0.150) kpsi, $K_f = 1.598$ LN(1, 0.15),
 $\sigma = 22.8$ LN(1, 0.15) kpsi, $z = -2.373$, $R = 0.991$

B-8 Chapter 8

8-1 (a) Thread depth 2.5 mm, thread width 2.5 mm,
 $d_m = 22.5$ mm, $d_r = 20$ mm, $l = p = 5$ mm

8-4 $T_R = 16.23$ N · m, $T_L = 6.62$ N · m, $e = 0.294$

8-8 $T = 16.5$ lbf · in, $d_m = 0.5417$ in,
 $l = 0.1667$ in, $\sec \alpha = 1.033$,
 $T = 0.0696F$, $T_c = 0.0328F$, $T_{\text{total}} = 0.1024F$,
 $F = 161$ lbf

8-11 $L_T = 1.25$ in, $L_G = 1.109$ in, $H = 0.4375$ in,
 $L_G + H = 1.5465$ in, use 1.75 in, $l_d = 0.500$ in,
 $l_t = 0.609$ in

8-13 $L_T = 1.25$ in, $L > h + 1.5d = 1.625$ in,
 use 1.75 in, $l_d = 0.500$ in, $l_t = 0.625$ in

8-15 (a) $A_d = 0.442$ in², $A_{\text{tube}} = 0.552$ in²,
 $k_b = 1.02(10^6)$ lbf/in, $k_m = 1.27(10^6)$ lbf/in,
 $C = 0.445$, (b) $F_i = 11\,810$ lbf

8-18 Frusta to Wileman ratio is 1.11/1.08

8-22 $n = 4.73$

8-23 $n = 5.84$

8-27 $k_b = 4.63$ Mlbf/in, $k_m = 7.99$ Mlbf/in using
 frustums

8-34 (a) $L = 2.5$ in, (b) $k_b = 6.78$ Mlbf/in,
 $k_m = 14.41$ Mlbf/in, $C = 0.320$

8-37 Load: $n = 3.19$. Separation: $n = 4.71$. Fatigue:
 $n = 3.27$

8-43 Bolt shear: $n = 3.26$. Bolt bearing: $n = 5.99$.
 Member bearing: $n = 3.71$. Member tension:
 $n = 5.36$

8-48 $F = 2.22$ kN

8-50 Bearing on bolt, $n = 9.58$;
 shear of bolt, $n = 5.79$;
 bearing on members, $n = 5.63$;
 bending of members, $n = 2.95$

B-9 Chapter 9

9-1 $F = 17.7$ kip

9-3 $F = 11.3$ kip

9-5 (a) $\tau' = 1.13F$ kpsi, $\tau_x'' = \tau_y'' = 5.93F$ kpsi,
 $\tau_{\max} = 9.22F$ kpsi, $F = 2.17$ kip; (b) $\tau_{\text{all}} = 11$ kpsi,
 $F_{\text{all}} = 1.19$ kip

9-8 $\tau' = 0$ (why?), $F = 49.2$ kN

9-9 A two-way tie for first, vertical parallel beads, and
 square beads

9-10 First: horizontal parallel beads. Second: square
 beads

9-11 Decisions: Pattern; all-around square
 Electrode: E60XX
 Type: two parallel fillets, two transverse fillets
 Length of beads: 12 in
 Leg: $\frac{1}{4}$ in

9-20 $\tau_{\max} = 18$ kpsi

9-22 $n = 3.57$

B-10 Chapter 10

10-3 (a) $L_0 = 5.17$ in, (b) $F_{S_y} = 45.2$ lbf,
 (c) $k = 11.55$ lbf/in, (d) $(L_0)_{\text{cr}} = 5.89$ in, guide
 spring

10-5 (a) $L_0 = 47.7$ mm, (b) $p = 5.61$ mm, (c) $F_s =$
 81.1 N, (d) $k = 2643$ N/m, (e) $(L_0)_{\text{cr}} = 105.2$ mm,
 needs guidance

10-9 Not solid safe, $L_0 \leq 0.577$ in

10-15 Not solid safe, $L_0 \leq 66.6$ mm

10-19 (a) $p = 10$ mm, $L_s = 44.2$ mm, $N_a = 12$ turns,
 (b) $k = 1080$ N/m, (c) $F_s = 81.9$ N, (d) $\tau_s =$
 271 MPa

10-29 (a) $L_0 = 16.12$ in, (b) $\tau_i = 14.95$ kpsi,
 (c) $k = 4.855$ lbf/in, (d) $F = 85.8$ lbf,
 (e) $y = 14.4$ in

10-33 (a) $k' = 24.7$ lbf · in/turn each, (b) 297 kpsi

10-34 $k = 2EI/[R^2(19\pi R + 18l)]$

B-11 Chapter 11

11-1 $x_D = 540$, $F_D = 2.278$ kN, $C_{10} = 18.59$ kN,
 02–30 mm deep-groove ball bearing, $R = 0.919$

11-4 $R = R_1 R_2 = 0.927(0.942) = 0.873$, goal not met

11-8 $x_D = 180$, $C_{10} = 57.0$ kN

11-11 $C_{10} = 8.88$ kN

11-13 $R_O = 195$ N, $R_E = 196$ N, deep-groove
 02–25 mm at O and C

11-18 $l_2 = 0.267(10^6)$ rev

B-12 Chapter 12

12-1 $c_{\min} = 0.000\,75$ in, $r = 0.500$ in, $r/c = 667$,
 $N_j = 18.3$ r/s, $S = 0.261$, $h_0/c = 0.595$, $rf/c = 5.8$,
 $Q/(rcNl) = 3.98$, $Q_s/Q = 0.5$, $h_0 = 0.000\,446$ in,
 $H = 0.0134$ Btu/s, $Q = 0.0274$ in³/s,
 $Q_s = 0.0137$ in³/s

12-3 SAE 10: $h_0 = 0.000\,275$ in, $p_{\max} = 847$ psi,
 $c_{\min} = 0.0025$ in

12-7 $h_0 = 0.0165$ mm, $f = 0.007\,65$,
 $Q = 1263$ mm³/s

12-9 $h_0 = 0.010$ mm, $H = 34.3$ W, $Q =$
 1072 mm³/s, $Q_s = 793$ mm³/s

12-11 $T_{\text{av}} = 65^\circ\text{C}$, $h_0 = 0.0272$ mm, $H = 45.2$ W,
 $Q_s = 1712$ mm³/s

12-20 15.2 mPa · s

B-13 Chapter 13

- 13-1** 35 teeth, 3.25 in
13-2 400 rev/min, $p = 3\pi$ mm, $C = 112.5$ mm
13-4 $a = 0.3333$ in, $b = 0.4167$ in, $c = 0.0834$ in,
 $p = 1.047$ in, $t = 0.523$ in, $d_1 = 7$ in, $d_{1b} =$
 6.578 in, $d_2 = 9.333$ in, $d_{2b} = 8.77$ in,
 $p_b = 0.984$ in
13-5 $d_P = 2.333$ in, $d_G = 5.333$ in, $\gamma = 23.63^\circ$,
 $\Gamma = 66.37^\circ$, $A_0 = 2.911$ in, $F = 0.873$ in
13-8 (a) 13, (b) 15, (c) 18, (d) 16
13-10 10:20 and higher
13-13 (a) $p_n = 3\pi$ mm, $p_t = 10.40$ mm,
 $p_x = 22.30$ mm, (b) $m_t = 3.310$ mm,
 $\phi_t = 21.88^\circ$, (c) $d_p = 59.58$ mm,
 $d_G = 105.92$ mm
13-15 $e = 4/51$, $n_d = 47.06$ rev/min cw
13-22 $n_A = 68.57$ rev/min cw
13-27 $n_b/n_a = 11/36$ same sense
13-33 $\mathbf{F}_A = 71.5 \mathbf{i} + 53.4 \mathbf{j} + 350.5 \mathbf{k}$ lbf,
 $\mathbf{F}_B = -149.5 \mathbf{i} - 590.4 \mathbf{k}$ lbf
13-40 $\mathbf{F}_C = 1565 \mathbf{i} + 672 \mathbf{j}$ lbf;
 $\mathbf{F}_D = 1610 \mathbf{i} - 425 \mathbf{j} + 154 \mathbf{k}$ lbf

B-14 Chapter 14

- 14-1** $\sigma = 7.63$ kpsi
14-4 $\sigma = 82.6$ MPa
14-7 $F = 2.5$ in
14-10 $m = 2$ mm, $F = 25$ mm
14-14 $\sigma_c = -617$ MPa
14-17 $W^t = 16\,890$ N, $H = 97.2$ kW
 (pinion bending); $W^t = 3433$ N, $H = 19.8$ kW
 (pinion and gear wear)
14-18 $W^t = 1356$ lbf, $H = 34.1$ hp (pinion bending);
 $W^t = 1720$ lbf, $H = 43.3$ hp (gear bending),
 $W^t = 265$ lbf; $H = 6.67$ hp (pinion and gear wear)
14-22 $W^t = 775$ lbf, $H = 19.5$ hp (pinion bending);
 $W^t = 300$ lbf, $H = 7.55$ hp (pinion wear) AGMA
 method accounts for more conditions
14-24 Rating power = min(157.5, 192.9, 53.0, 59.0) =
 53 hp
14-28 Rating power = min(270, 335, 240, 267) =
 240 hp
14-34 $H = 69.7$ hp

B-15 Chapter 15

- 15-1** $W_P^t = 690$ lbf, $H_1 = 16.4$ hp, $W_G^t = 620$ lbf,
 $H_2 = 14.8$ hp
15-2 $W_P^t = 464$ lbf, $H_3 = 11.0$ hp, $W_G^t = 531$ lbf,
 $H_4 = 12.6$ hp
15-8 Pinion core 300 Bhn, case, 373 Bhn; gear core
 339 Bhn, case, 345 Bhn
15-9 All four $W^t = 690$ lbf
15-11 Pinion core 180 Bhn, case, 266 Bhn; gear core,
 180 Bhn, case, 266 Bhn

B-16 Chapter 16

- 16-1** (a) Right shoe: $p_a = 111.4$ psi cw rotation,
 (b) Right shoe: $T = 2530$ lbf · in; left shoe:
 1310 lbf · in; total $T = 3840$ lbf · in, (c) RH shoe:
 $R^x = -229$ lbf, $R^y = 940$ lbf, $R = 967$ lbf; LH
 shoe: $R^x = 130$ lbf, $R^y = 171$ lbf, $R = 215$ lbf
16-3 LH shoe: $T = 161.4$ N · m, $p_a = 610$ kPa; RH
 shoe: $T = 59.0$ N · m, $p_a = 222.8$ kPa, $T_{\text{total}} =$
 220.4 N · m
16-5 $p_a = 203$ kN, $T = 38.76$ N · m
16-8 $a' = 1.209r$, $a = 1.170r$
16-10 $P = 1560$ lbf, $T = 29\,980$ lbf · in
16-14 (a) $T = 8200$ lbf · in, $P = 504$ lbf, $H = 26$ hp;
 (b) $R = 901$ lbf; (c) $p|_{\theta=0} = 70$ psi,
 $p|_{\theta=270^\circ} = 27.3$ psi
16-17 (a) $F = 1885$ lbf, $T = 7125$ lbf · in;
 (c) torque capacity exhibits a stationary point
 maximum
16-18 (a) $d^* = D/\sqrt{3}$; (b) $d^* = 3.75$ in, $T^* = 7173$
 lbf · in; (c) $(d/D)^* = 1/\sqrt{3} = 0.577$
16-19 (a) Uniform wear: $p_a = 82.2$ kPa, $F = 949$ N;
 (b) Uniform pressure: $p_a = 79.1$ kPa, $F = 948$ N
16-23 $C_s = 0.08$, $t = 5.30$ in
16-26 (b) $I_e = I_M + I_P + n^2 I_P + I_L/n^2$;
 (c) $I_e = 10 + 1 + 10^2(1) + 100/10^2 = 112$
16-27 (c) $n^* = 2.430$, $m^* = 4.115$, which are
 independent of I_L
- B-17 Chapter 17**
- 17-1** (a) $F_c = 0.913$ lbf, $F_i = 101.1$ lbf, $F_{1a} = 147$ lbf,
 $F_2 = 57$ lbf; (b) $H_a = 2.5$ hp, $n_{fs} = 1.0$;
 (c) 0.151 in

- 17-3** A-3 polyamide belt, $b = 6$ in, $F_c = 77.4$ lbf, $T = 10\,946$ lbf · in, $F_1 = 573.7$ lbf, $F_2 = 117.6$ lbf, $F_i = 268.3$ lbf, dip = 0.562 in
- 17-5** (a) $T = 742.8$ lbf · in, $F_i = 148.1$ lbf; (b) $b = 4.13$ in; (c) $F_1 = 293.4$ lbf, $F_c = 17.7$ lbf, $F_i = 147.6$ lbf, $F_2 = 41.5$ lbf, $H = 20.6$ hp, $n_{fs} = 1.1$
- 17-7** $R^x = (F_1 + F_2)\{1 - 0.5[(D - d)/(2C)]^2\}$, $R^y = (F_1 - F_2)(D - d)/(2C)$. From Ex. 17-2, $R^y = 1214.4$ lbf, $R^x = 34.6$ lbf
- 17-14** With $d = 2$ in, $D = 4$ in, life of 10^6 passes, $b = 4.5$ in, $n_{fs} = 1.05$
- 17-17** Select one B90 belt
- 17-20** Select nine C270 belts, life $> 10^9$ passes, life $> 150\,000$ h
- 17-24** (b) $n_1 = 1227$ rev/min. Table 17-20 confirms this point occurs in the range 1200 ± 200 rev/min, (c) Eq. (17-40) applicable at speeds exceeding 1227 rev/min for No. 60 chain
- 17-25** (a) $H_a = 7.91$ hp; (b) $C = 18$ in; (c) $T = 1164$ lbf · in, $F = 744$ lbf
- 17-27** Four-strand No. 60 chain, $N_1 = 17$ teeth, $N_2 = 84$ teeth, rounded $L/p = 134$, $n_{fs} = 1.17$, life 15 000 h (pre-extreme)

B-18 Chapter 18

- 18-1** (a) Maximum bending moment 2371 lbf · in, (b) $d_A = 1.625$ in, $d_B = 1.810$ in, average diameter ≥ 1.810 in
- 18-2** (a) $d = 1.725$ in, (b) $d = 1.687$ in
- 18-13** $d = 1.371$ in; $d = 1.630$ in for $n_d = 2$
- 18-18** $d = 24$ mm, $D = 32$ mm, $r = 1.6$ mm
- 18-20** (a) Static: $d = 1.526$ in; (b) DE-Gerber: $d = 1.929$ in; ASME-elliptic: $d = 1.927$ in; MSS-Soderberg: $d = 1.932$ in; DE-Goodman: $d = 2.008$ in
- 18-24** Slope: $y'_m = y'$; deflection: $y_m = sy = y/2$; moment: $M_m = s^3 M = M/8$; Force: $F_m = s^2 F = F/4$; same material, same stress levels
- 18-26** (a) $\omega = 868$ rad/s; (b) $d = 2$ in; (c) $\omega = 1736$ rad/s (doubles)
- 18-28** (b) $\omega = 466$ rad/s = 4450 rev/min