

2.7-13. (a) $\tau_{avg} = 31.3 \text{ kPa}$ (b) $\gamma = 0.0521 \text{ m/m}$,
(c) $\delta = 1.302 \text{ mm}$

2.7-15. (a) $\tau_{avg} = \frac{P}{2\pi rh}$, (b) $\delta = \frac{P}{2\pi Gh} \ln \left(\frac{D}{d} \right)$

2.8-1. $d_{min} = 0.412 \text{ in.}$

2.8-3. $(P_C)_{allow} = 1.781 \text{ kN}$

2.8-5. $T_{allow} = 1080 \text{ lb}$

2.8-7. $(d_w)_{req'd} = 4 \text{ mm}$, $(d_p)_{req'd} = 4 \text{ mm}$

2.8-9. (a) $t = 12.00 \text{ mm}$, (b) $d_C = 9.73 \text{ mm}$

2.8-11. $d_{req'd} = \frac{7}{8} \text{ in.}$

2.8-13. $W_{allow} = 2.72 \text{ kips}$

2.8-15. $(A_1)_{min} = (A_2)_{min} = 223 \text{ mm}^2$,
 $(A_3)_{min} = 471 \text{ mm}^2$

2.8-17. (a) —, (b) $(L_3)_{wmin} = 29 \text{ in.}$,
 $W_{min} = 3.31 \text{ lb}$

2.9-1. (a) $P = 21.3 \text{ kips}$, (b) $\tau_{nt} = -4.62 \text{ ksi}$,
 $\tau_{max} = 5.33 \text{ ksi}$

2.9-3. $\sigma_n = 150 \text{ MPa}$, $\tau_{nt} = -86.6 \text{ MPa}$,
 $\sigma_t = 50 \text{ MPa}$, $\tau_{tn} = -86.6 \text{ MPa}$

2.9-5. (a) $\theta_{na} = 63.4^\circ$, (b) $\theta_{nb} = 26.6^\circ$

2.9-7. (a) $\sigma_y = -3.89 \text{ ksi}$,
(b) $\sigma_n = -857 \text{ psi}$, $\tau_{nt} = -1613 \text{ psi}$

2.9-9. (a) $\frac{P_{f,allow}}{P_{d,allow}} = 3.14$, (b) $\frac{P_{f,allow}}{P_{d,allow}} = 3.63$

2.12-1. (a) $F_x = 3b^2\sigma_0$, (b) $y_R = \frac{5}{6}b$

2.12-3. $\sigma_{xD} = 16 \text{ ksi}$, (b) $F_x = 384 \text{ kips}$,
(c) $M_y = -42.7 \text{ kip}\cdot\text{in.}$

2.12-5. $(V_y)_{max} = 133.3 \text{ kN}$

2.12-7. $T = \left[\frac{\pi(r_o^4 - r_i^4)}{2r_o} \right] \tau_{max}$

2.12-9. $\Delta L = \int_0^L \epsilon_x(x) dx$, (b) $\Delta L = 0.533 \text{ mm}$

2.12-11. $\epsilon_n = \left(\frac{\delta_x}{L} \right) \cos \theta + \left(\frac{\delta_y}{L} \right) \sin \theta$

2.12-13. $\gamma_{xy} = \tan^{-1} \left(\frac{0.1x}{a} \right)$

2.12-15. $\gamma_{xy}(x, y) = \frac{y(a-x)}{50a^2}$

2.13-1. $\sigma_x = \frac{E}{1-\nu^2}(\epsilon_x + \nu\epsilon_y)$, $\sigma_y = \frac{E}{1-\nu^2}(\epsilon_y + \nu\epsilon_x)$

2.13-3. $\epsilon_x = 214 \mu\text{m/m}$, $\epsilon_y = -33.3 \mu\text{m/m}$,

$\epsilon_z = 28.6 \mu\text{m/m}$, $\gamma_{xy} = 248 \mu\text{m/m}$,

$\gamma_{yz} = 185.7 \mu\text{m/m}$, $\gamma_{zx} = 123.8 \mu\text{m/m}$

2.13-5. (a) $\Delta a = 9.99(10^{-3}) \text{ in.}$,
 $\Delta b = -2.66(10^{-3}) \text{ in.}$, $\Delta c = -0.330(10^{-3}) \text{ in.}$,
(b) $\epsilon_V = 1.69(10^{-4}) \text{ in}^3/\text{in}^3$

2.13-7. (a) $\sigma_y = -\nu\sigma_0$, (b) $\Delta a = \frac{a\sigma_0}{E}(\nu^2 - 1)$,

(c) $\Delta t = \frac{\nu t \sigma_0}{E}(1 + \nu)$

2.13-9. (a) $\epsilon_z = -171.4 \mu$, (b) $\sigma_x = 149.5 \text{ MPa}$,
 $\sigma_y = -35.2 \text{ MPa}$, $\tau_{xy} = 15.38 \text{ MPa}$,
(c) $\epsilon_V = 2.28(10^{-4}) \text{ mm}^3/\text{mm}^3$

2.14-1. $E_{||} = 17.85 \text{ GPa}$, $E_{\perp} = 7.22 \text{ GPa}$

CHAPTER 3

3.3-1. $e = \frac{3PL}{bh(E_1 + 2E_2)}$

3.3-3. (a) $\sigma_1 = 3.00 \text{ ksi}$, $\sigma_2 = 9.00 \text{ ksi}$,
(b) $y_P = 0.550 \text{ in.}$, (c) $e = 6.00(10^{-3}) \text{ in.}$

3.3-5. (a) $\sigma_c = -0.341 \text{ ksi}$, $\sigma_s = -2.84 \text{ ksi}$,
(b) $e = -1.364(10^{-2}) \text{ in.}$

3.3-7. (a) $e = \frac{PL}{Et(b_2 - b_1)} \ln(b_2/b_1)$, (b) $e = 3.96 \text{ mm}$

3.3-9. $\delta \equiv -e = 5.21(10^{-3}) \text{ in.}$

3.3-11. $u(x) = \frac{\gamma}{E} \left(Lx - \frac{x^2}{2} \right)$

3.3-13. (a) $e = \frac{2c_1L}{3}$, (b) $c_1 = 1.137(10^{-4}) \text{ mm/mm}$,
(c) $e = 0.303 \text{ mm}$

3.3-15. $e = 1.267(10^{-2}) \text{ in.}$

3.4-1. (a) $e_a = 1.839 \text{ mm}$, (b) $e_b = fP = 1.567 \text{ mm}$

3.4-3. (a) $\sigma_1 = 4.79 \text{ ksi}$, $\sigma_2 = 4.89 \text{ ksi}$, $\sigma_3 = 3.33 \text{ ksi}$,
(b) $u_B = 3.20(10^{-3}) \text{ in.}$, $u_C = 6.46(10^{-3}) \text{ in.}$,
 $u_D = 8.67(10^{-3}) \text{ in.}$

3.4-5. $u_A = \frac{L}{E_{st}} \left[\frac{P_A}{A_1} + \frac{(P_A + P_B)}{A_2} \right]$, $u_B = \frac{(P_A + P_B)L}{E_{st}A_2}$

3.4-7. $t_{min} = 0.0511 \text{ in.}$

3.4-9. (a) $x = 1.469 \text{ m}$, (b) $u_A = u_B = 0.891 \text{ mm}$,
(c) $\sigma_1 = 62.4 \text{ MPa}$, $\sigma_2 = 93.5 \text{ MPa}$

3.4-11. (a) $\sigma_1 = -13.33 \text{ ksi}$, $\sigma_2 = -6.67 \text{ ksi}$,
(b) $u_A = 0.0640 \text{ in.}$, $u_C = 0.0213 \text{ in.}$

3.4-13. (a) $\sigma_{DC} = \frac{2}{3} \frac{WL}{A\sqrt{L^2 - 9a^2}}$,

(b) $\delta_C = \frac{2}{3} \frac{WL^3}{AE(L^2 - 9a^2)}$

3.4-15. (a) $\sigma_{AB} = \frac{P}{A \cos \theta}$, (b) $u_B = \frac{PL}{AE \cos^2 \theta}$

3.5-1. (a) $\sigma_1 = \frac{f_2 P_B}{A_1(f_1 + f_2)}$, $\sigma_2 = \frac{-f_1 P_B}{A_2(f_1 + f_2)}$

(b) $u_B = \frac{f_1 f_2 P_B}{f_1 + f_2}$, where $f_i = \left(\frac{L}{AE} \right)_i$, $i = 1, 2$

3.5-3. (a) $\frac{L_1}{L_2} = 3$, (b) $u_B = \frac{P_B L_1}{7AE}$

3.5-5. (a) $\sigma_1 = 3.28 \text{ ksi}$, $\sigma_2 = 7.56 \text{ ksi}$,
(b) $e = 1.009(10^{-2}) \text{ in.}$

3.5-7. (a) $\sigma_1 = 5.25 \text{ ksi (T)}$, $\sigma_2 = 16.32 \text{ ksi (T)}$,
 $\sigma_3 = 10.84 \text{ ksi (C)}$,

(b) $u_B = 5.25(10^{-3}) \text{ in.}$, $u_C = 5.42(10^{-2}) \text{ in.}$

3.5-9. (a) $\sigma_1 = \sigma_3 = \frac{P}{7A} \text{ (T)}$, $\sigma_2 = \frac{3P}{7A} \text{ (C)}$,

(b) $u_B = \frac{2}{7} \left(\frac{PL}{AE} \right)$, $u_C = -\frac{1}{7} \left(\frac{PL}{AE} \right)$

3.5-11. (a) $F_1 = 33.9 \text{ kN (T)}$, $F_2 = 10.17 \text{ kN (T)}$,
(b) $e_1 = 0.323 \text{ mm}$