9.2-9. $t_{min} = 1$ mm
9.2-11. (a) $\sigma_h = 499$ psi, (b) $\tau_{\substack{abs\\max}} = 280$ psi
9.2-13. (a) $(t_c)_{min} = 3.52$ mm, (b) $(t_s)_{min} = 1.758$ mm, (c) $(t_w)_{min} = 2.81$ mm
9.2-15. $P_{max} = 117.8$ kN
9.3-1. $(\sigma_x)_B = 150\dfrac{w_0}{b}$, $(\tau_{xy})_B = -11.25\dfrac{w_0}{b}$

$(\sigma_1)_B = 150.8\dfrac{w_0}{b}$, $(\sigma_2)_B = -0.839\dfrac{w_0}{b}$, $(\theta_{p1})_B = -4.27°$
9.4-1. Set $y = c_y$, $z = -c_z$ in Eq. 9.11.
9.4-3. $M = 14.00$ kip·in.
9.4-5. (a) $\sigma_x = 12.81$ MPa, (b) $\sigma_x = 5.40$ MPa
9.4-7. $\sigma_{max\,C} = -5.74$ ksi 9.4-9. $P_{max} = 23.0$ kN
9.4-11. $\sigma_1 = 944$ psi, $\sigma_2 = -1344$ psi, $\tau_{max} = 1144$ psi
9.4-13. $(\sigma_1)_A = 200$ MPa, $(\sigma_2)_A = -122.2$ MPa, $(\tau_{max})_A =$ 161.3 MPa
9.4-15. $M = 73.6$ N·m
9.4-17. $(\sigma_1)_A = 1.263$ MPa, $(\sigma_2)_A = -4.11$ MPa, $(\sigma_1)_B = 0$, $(\sigma_2)_B = -87.2$ MPa
9.4-19. $(\sigma_1)_A = 11.58$ ksi, $(\sigma_2)_A = -52.3$ ksi, $(\tau_{max})_A =$ 32.0 ksi
$(\sigma_1)_B = 24.4$ ksi, $(\sigma_2)_B = -24.4$ ksi, $(\tau_{max})_B = 24.4$ ksi
9.4-21. (a) $\sigma_x = 2.01$ MPa, $\sigma_y = 0$, $\tau_{xy} = 4.01$ MPa
(b) $\sigma_1 = 5.13$ MPa, $\sigma_2 = -3.12$ MPa, $(\tau_{max})_{in\text{-}plane} = 4.13$ MPa
(c) $(\sigma_{x'})_{max} = 219$ MPa
9.4-23. $\sigma_1 = 379$ kPa, $\sigma_2 = -230$ kPa
9.4-25. $(\sigma_1)_D = 1.697$ ksi, $(\sigma_2)_D = -0.246$ ksi

CHAPTER 10

10.1-1. $P_{cr} = \dfrac{kL}{4}$ 10.1-3. $P_{cr} = \dfrac{kL}{6}$ 10.1-5. $P_{cr} = \dfrac{3k_\theta}{2L}$
10.2-1. $P_{cr} = 43.9$ kips
10.2-3. $(I_{min})_a = \frac{4}{3}b^4$, $(I_{min})_b = \frac{5}{6}b_4$
Therefore, cross section "a" will have a higher buckling load than cross section "b."
10.2-5. W10 × 60
10.2-7. $P_{cr1} = \dfrac{\pi^3}{4}\left(\dfrac{Er^4}{L^2}\right)$, $P_{cr2} = \dfrac{\pi^4}{12}\left(\dfrac{Er^4}{L^2}\right)$,

$P_{cr3} = \dfrac{\sqrt{3}\pi^4}{18}\left(\dfrac{Er^4}{L^2}\right)$; $P_{cr3} > P_{cr2} > P_{cr1}$
10.2-9. $I_{min} \geqslant 1.26$ in^4 → L4 × 4 × $\frac{3}{8}$ has $I_{min} \equiv I_z = Ar_z^2 = 1.76$ in^4
10.2-11. $\Delta T_{cr} = \dfrac{\pi^2 I}{\alpha A L^2}$
10.2-13. (a) $W_a = \dfrac{5}{6}\dfrac{\pi^2 EI}{L^2}$, (b) $W_b = \dfrac{\pi^2 EI}{L^2}$
10.2-15. $T_{max} = 21.1$ kips
10.2-17. (a) $W_{cr} = 18.20$ kips, (b) $d_{min} = 1.036$ in.
10.2-19. $(P_{BC})_{cr} = 65.6$ kN, $FS = 2.93$
10.3-1. (a) $(P_{cr})_a = 54.7$ kips, $(P_{cr})_b = 111.6$ kips, $(P_{cr})_c = 219$ kips
10.3-3. $(P_{cr})_a = 35.9$ kN, $(P_{cr})_b = 73.3$ kN, $(P_{cr})_c = 143.7$ kN
10.3-5. $FS = 25.2$ 10.3-7. $P_{cr} = 503$ kN
10.3-9. (a) $\Delta T_{cr} = \dfrac{4\pi^2}{\alpha(L/r)^2}$, (b) $\Delta T_{cr} = 111.6$°F
10.3-11. $w_{cr} = \dfrac{\pi^2 E_w b^4}{6a(KL)^2}$ 10.3-13. $P_{cr} = \dfrac{\pi^2 EI}{4L^2}$
10.4-1. (a) $v_{max} = e(\sec\lambda L - 1)$, (b) $M_{max} = Pe\sec\lambda L$
10.4-3. (a) $v_{max} = 9.29$ mm, (b) $M_{max} = 3.93$ kN·m
10.4-5. $L_{max} = 3.19$ m
10.4-7. (a) $\sigma_{max} = 18.69$ kips, (b) $P_{allow} = 1.029$ kips
10.4-9. (a) $d_{min} = 1.4$ in., (b) $e_{max} = 0.9$ in.
10.4-11. (a) $\sigma_{max} = 31.7$ ksi, (b) $P_{allow} = 15.21$ kips, (c) $d_o = 5.0$ in.
10.4-13. (a) $(P_{cr})_y = 2.30$ kN, (b) $(P_Y)_z = 21.3$ kN
(c) Failure will occur by elastic buckling in the xz plane.
10.4-15. (a) Use Eq. 10.46 to plot σ_{max} versus P.
(b) Use Eq. 10.43 to plot v_{max} versus P.
(c) The factor of safety should be based on load, not stress, since the plots indicate nonlinear behavior.
10.5-1. (a) $\delta_{max} = 0.353$ in., (b) $\sigma_{max} = 5.31$ ksi
10.5-3. (a) $\delta_{max} = \dfrac{b}{3}$, (b) $\sigma_{max} = \dfrac{\pi^2 Eb^2}{16L^2} = \dfrac{3P}{b^2}$
10.5-5. (a) $\sigma_{max} = 110.2$ MPa, (b) $P_{allow} = 189.2$ kN, (c) $d_o = 120$ mm
10.5-7. (a, b) $A = b^2 + (b - 2t)^2$, $I = \frac{1}{12}[b^4 - (b - 2t)^4]$,

$r = \sqrt{I/A}$, $c = b/2$, $\alpha = \dfrac{1}{\pi^2 E}\left(\dfrac{P}{A}\right)\left(\dfrac{L}{r}\right)^2$,

$\sigma_Y = \dfrac{P_Y}{A}\left[1 + \dfrac{\delta_0 c}{r^2(1-\alpha)}\right]$, Plot for $P = P_Y$.
(c) As δ_0 increases, a column's ability to carry compressive load decreases.
10.6-1. (a) $L_c = 18.95$ ft, (b) $P_t = 195$ kips
10.6-3. (a) $L_c = 10.73$ ft, (b) $P_t = 254$ kips
10.7-1. $(P_{allow})_{12'} = 191.5$ kips, $(P_{allow})_{16'} = 160.4$ kips, $(P_{allow})_{24'} = 87.7$ kips
10.7-3. $(P_{allow})_{18'} = 176.8$ kips, $(P_{allow})_{22'} = 123.2$ kips, $(P_{allow})_{26'} = 88.2$ kips
10.7-5. $(P_{allow})_{4m} = 438$ kN, $(P_{allow})_{5m} = 289$ kN, $(P_{allow})_{6m} = 201$ kN
10.7-7. (a) $L_{max} = 28.3$ ft, (b) $L_{max} = 13.69$ ft
10.7-9. (a) $L_{max} = 25.3$ ft, (b) $L_{max} = 20.4$ ft
10.7-11. $(P_{allow})_{K=0.6} = 137.6$ kips, $(P_{allow})_{K=0.7} = 106.9$ kips, $(P_{allow})_{K=0.8} = 81.8$ kips
10.7-13. $(P_{allow})_{3'} = 120.2$ kips, $(P_{allow})_{4'} = 76.3$ kips, $(P_{allow})_{5'} = 48.8$ kips
10.7-15. (a) $b_{min} = 3$ in., (b) $b_{min} = 3\frac{1}{8}$ in.
10.7-17. $b_{min} = 1\frac{11}{16}$ in.
10.7-19. (a) $P_{allow} = 123.5$ kips, (b) $t_{min} = \frac{9}{16}$ in.
10.7-21. (a) $L_{max} = 9.08$ ft, (b) $L_{max} = 6.89$ ft, (c) $L_{max} = 4.98$ ft
10.7-23. (a) $(P_{allow})_{6'} = 16.44$ kips, (b) $(P_{allow})_{8'} = 11.52$ kips, (c) $(P_{allow})_{10'} = 8.00$ kips