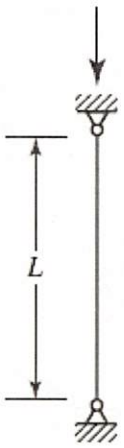
4.3-1 Use AISC Equation E3-2 or E3-3 and determine the nominal axial compressive strength for the following cases:



W10 × 100 (W250 × 149)
A992 steel
(F_y = 50 ksi (345 MPa))

W10×100: $r_x = 4.60$ in $r_y = 2.65$ in

$K = 1.0$ $A = 29.3\ in^2$

a) $L = 10$ ft $\quad \frac{L}{r} = \frac{10\,ft(12in/ft)}{2.65in} = 45.28$

$$F_e = \frac{\pi^2 E}{(Lc/r)^2} = \frac{\pi^2(29{,}000ksi)}{(45.28)^2} = 139.58ksi$$

$$4.71\sqrt{E/F_y} = 4.71\sqrt{\frac{29{,}000ksi}{50ksi}} = 113.43$$

SINCE $\frac{Lc}{r} < 113.43 \Longrightarrow$ USE EQ. E3-2

$$F_n = \left(0.658^{F_y/F_e}\right)F_y = \left(0.658^{(50/139.58)}\right)50ksi$$

$$= 43.04\ ksi$$

$$P_n = F_n A = 43.04\,ksi(29.3in^2) = \underline{1{,}261.0k}$$

$$\phi P_n = 0.9(1{,}261.0k) = 1{,}134.9k$$

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b) $L = 30\,ft$ $\quad \frac{L}{r} = \frac{30ft(12in/ft)}{2.65in} = 135.84$

$$F_e = \frac{\pi^2 E}{(L/r)^2} = \frac{\pi^2(29{,}000ksi)}{(135.84)^2} = 15.51ksi$$

$$4.71\sqrt{E/F_y} = 4.71\sqrt{\frac{29{,}000ksi}{50ksi}} = 113.43$$

SINCE $\frac{L}{r} > 113.43$ USE EQ. E3-3

$$F_n = 0.877\,F_e = 0.877(15.51ksi) = 13.60ksi$$

$$P_n = F_n A_g = 13.60ksi(29.3ksi) = \underline{398.6k}$$

$$\phi P_n = 0.9(398.6^k) = \underline{358.7^k}$$