Topic CLASS 7-1: MINOR AXIS BENDING; SHEAR; DEFLECTIONS

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EXAMPLE

GIVEN: A W24X84, A992 Steel, loaded to bend about its strong-axis (X-X)

REQD: a) L_p c) $\phi_b M_p$ e) $\phi_b BF: \dfrac{(\phi_b M_p - \phi_b M_r)}{(L_r - L_p)}$

b) L_r d) $\phi_b M_r$

Y-Y is secondary

SOLN: W24X84:

$S_x = 196\ in^3$ $\quad Z_x = 224\ in^3$

$I_x = \cancel{94.4}\ in^4$ 2370 $\quad r_{ts} = 2.37\ in$

$h_o = 23.3\ in$ $\quad J = 3.7\ in^4$

$r_y = 1.95\ in$ $\quad C_w = 12800\ in^6$

$C = 1.0$ (for all W-shape)

a) (F2-5) $L_p = 1.76 r_y \sqrt{\dfrac{E}{f_y}} = \dfrac{300 r_y}{\sqrt{f_y}} = \dfrac{300(1.95\ in)}{\sqrt{50\ ksi}} = 82.73\ in$ (6.9 ft)

b) (F2-6) $L_r = 1.96 r_{ts} \dfrac{E}{0.7 f_y} \sqrt{\dfrac{J_c}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76 \left(0.7 \dfrac{f_y}{E} \dfrac{S_x h_o}{J_c}\right)^2}}$

$= 247.3"$ (20.3 ft)

c) $\phi_b M_p = 0.9 f_y Z_x = 0.9(50^{ksi})(224\ in^3)\left(\frac{1}{12}\right) = \underline{840}\ ^{k\text{-}ft}$

d) $\phi_b M_r = \phi_b 0.7 f_y S_x = 0.9(0.7)(50^{ksi})(196\ in^3)\left(\frac{1}{12}\right) = \underline{515}\ ^{k\text{-}ft}$

e) $\phi_b BF = \dfrac{(\phi_b M_p - \phi_b M_r)}{(L_p - L_r)} = \dfrac{(840 - 515)}{(20.3 - 6.9)} = \underline{24.26}\ ^{k}$