5.6-2 A W14 × 99(W360 × 147) of A992 steel ($F_y = 50$ ksi(345 MPa)) is used as a beam with lateral support at 10-foot (3,000 mm) intervals. Assume that $C_b = 1.0$ and compute the nominal flexural strength.

FROM TABLE 1-1 (1-24) $\frac{b_f}{2t_f} = 9.34$ $\frac{h}{t_w} = 23.5$ $S_x = 157\,in^3$

$Z_x = 173\,in^3$

CHECK COMPACTNESS

$\lambda = \frac{b_f}{2t_f} = 9.34$ $\lambda_{pf} = 0.38\sqrt{E/F_y} = 9.15$

$\lambda_{rf} = 1.0\sqrt{E/F_y} = 24.08$

$\therefore \lambda_{pf} < \lambda < \lambda_{rf} \Rightarrow$ FLANGE NON COMPACT

WEB $\lambda = \frac{h}{t_w} = 23.5$ $\lambda_p = 3.76\sqrt{E/F_y} = 90.55$ COMPACT

* COMPUTE STRENGTH BASED ON LOCAL FLANGE BUCKLING

$M_p = F_y Z_x = 50ksi(173\,in^3) = 8{,}650\,k\cdot in$

$M_N = M_p - (M_p - 0.7F_y S_x)\left[\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right]$

$= 8650\,k\cdot in - (8650\,k\cdot in - 0.7(50ksi)(157\,in^3))\left[\frac{9.34 - 9.15}{24.08 - 9.15}\right]$

$= 8{,}609.85\,k\cdot in = 717.49\,kft$

* CHECK LATERAL TORSIONAL BUCKLING

FROM TABLE 3-2 (3-24) "Z TABLE" FOR W14 x 99

$L_p = 13.5\,ft$ $L_r = 45.3\,ft$ $\therefore L_b < L_p$

$L_b = 10\,ft$

$M_n = M_p = 8{,}650\,k\cdot in = 720.83\,k\,ft$

* LOCAL FLANGE BUCKLING CONTROLS

$\therefore M_n = 717.49\,k\,ft$