SOLUTION

Since $B_1 = 1.0$, the factored load bending moment is
\[ M_{ux} = B_1 M_{ntx} = 1.0(100) = 100 \text{ ft-kips}. \]

The effective length for compression and the unbraced length for bending are the same:
\[ KL = L_b = 16 \text{ ft}. \]

The bending moment is uniform over the unbraced length, so $C_b = 1.0$.

Try a W10 shape. Select an average value of $m$ from Table 6-1 ($M_y = 0 \therefore n$ is not needed).

For $KL = L_b = 16 \text{ ft}$,
\[ m = 5.59 \times 10^{-3} \]

Solve for $b$ from Equation 6.5. Let
\[ bP_u + mM_{ux} + nM_{uy} = 1.0 \]
\[ b(300) + (5.59 \times 10^{-3})(100) + 0 = 1, \quad b = 1.47 \times 10^{-3} \]

From Table 6-2, **Try a W10 × 60**, with $b = 2.01 \times 10^{-3}$ and $m = 3.47 \times 10^{-3}$. The constant $m$ is smaller than what was assumed, but $b$ is larger than what is needed, so they may compensate. The sum of the products on the left-hand side of Equation 6.5 must be less than 1.0, but as close to 1.0 as possible.

From Equation 6.5,
\[ bP_u + mM_{ux} + nM_{uy} = (2.01 \times 10^{-3})(300) + (3.47 \times 10^{-3})(100) + 0 \]
\[ = 0.950 < 1.0 \quad \text{(OK)} \]

Verify that Equation 6.5 is the correct one:
\[ \frac{P_u}{\phi_c P_n} = bP_u = (2.01 \times 10^{-3})(300) = 0.603 > 0.2 \therefore \text{Equation 6.5 controls, as assumed. To be sure that we have found the lightest W10, try the next lighter one, a W10 × 54, with} \]
\[ b = 2.25 \times 10^{-3} \text{ and } m = 3.92 \times 10^{-3}. \]

From Equation 6.5,
\[ bP_u + mM_{ux} + nM_{uy} = (2.25 \times 10^{-3})(300) + (3.92 \times 10^{-3})(100) + 0 \]
\[ = 1.07 > 1.0 \quad \text{(N.G.)} \]

Try a W12 shape. **Try a W12 × 58**, with $b = 2.12 \times 10^{-3}$ and $m = 3.08 \times 10^{-3}$. From Equation 6.5,
\[ bP_u + mM_{ux} + nM_{uy} = (2.12 \times 10^{-3})(300) + (3.08 \times 10^{-3})(100) + 0 \]
= 0.944 < 1.0  (OK)

Verify that Equation 6.5 is the correct one:

\[ \frac{P_u}{\phi_c P_n} = b P_u = (2.12 \times 10^{-3})(300) = 0.636 > 0.2 \quad \therefore \text{Equation 6.5 controls, as assumed.} \]

To be sure that we have found the lightest W12, try the next lighter one, a W12 × 53, with

\[ b = 2.34 \times 10^{-3} \text{ and } m = 3.45 \times 10^{-3}. \]

From Equation 6.5,

\[ b P_u + m M_{ax} + n M_{ay} = (2.34 \times 10^{-3})(300) + (3.45 \times 10^{-3})(100) + 0 \]

\[ = 1.05 \quad \text{(N.G.)} \]

Check other categories of shapes to be sure that we have found the lightest shape. The lightest W14 that is a possibility is a W14 × 53, with \( b = 3.13 \times 10^{-3} \) and \( m = 3.39 \times 10^{-3}. \)

From Equation 6.5,

\[ (3.13 \times 10^{-3})(300) + (3.39 \times 10^{-3})(100) = 1.28 > 1.0 \quad \text{(N.G.)} \]

There are no other possibilities in the deeper W-shape groups.

**ANSWER**  Use a W12 × 58.