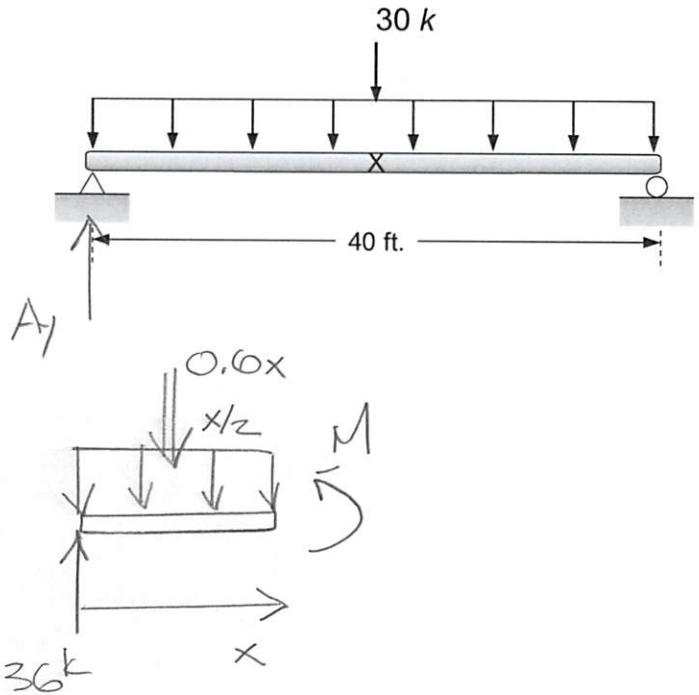
Classroom Problem 5.10-3: Select a **W** section of **A992** steel (F_y = 50 *ksi*; F = 65 *ksi*) for the following beam. The beam is laterally braced at the ends and at mid-span. The beam supports a uniform dead load of 0.5 *k/ft* and a live load of 30 *k* at the center of the span. There is no limit on deflection. Use Table 3-10 in the Manual.



$$w_u = 1.2(0.5k/ft) = 0.6k/ft$$

$$P_L = 1.6(30^k) = 48^k$$

$$\circlearrowleft + \Sigma M_B = 0 = 0.6k/ft(40\,ft)(20\,ft) + 48^k(20\,ft) - A_y(40\,ft)$$

$$A_y = 36^k$$

$$\circlearrowleft + \Sigma M_{CUT} = 0 = M + 0.6x\left(\frac{x}{2}\right) - 36x$$

$$M(x) = \left[-0.3x^2 + 36x\right] k\,ft$$

$M_A(x = 5\,ft) = 172.5\,k\,ft$

$M_B(x = 10\,ft) = 330\,k\,ft$

$M_C(x = 15\,ft) = 540\,ft\,k$

$M_{MAX}(x = 20\,ft) = 600\,k\,ft$

$$C_b = \frac{12.5(600)}{2.5(600) + 3(172.5) + 4(330) + 3(540)} = 1.513$$

Classroom Problem 5.10-3: Select a **W** section of **A992** steel (F_y = 50 *ksi*; F = 65 *ksi*) for the following beam. The beam is laterally braced at the ends and at mid-span. The beam supports a uniform dead load of 0.5 *k/ft* and a live load of 30 *k* at the center of the span. There is no limit on deflection.

$$\frac{M_u}{C_b} = \frac{600 k\text{-}ft}{1.513} = 396 k\text{-}ft \text{ WITH } L_b = 20 ft$$

FROM TABLE 3.10 (3-119) W18×76

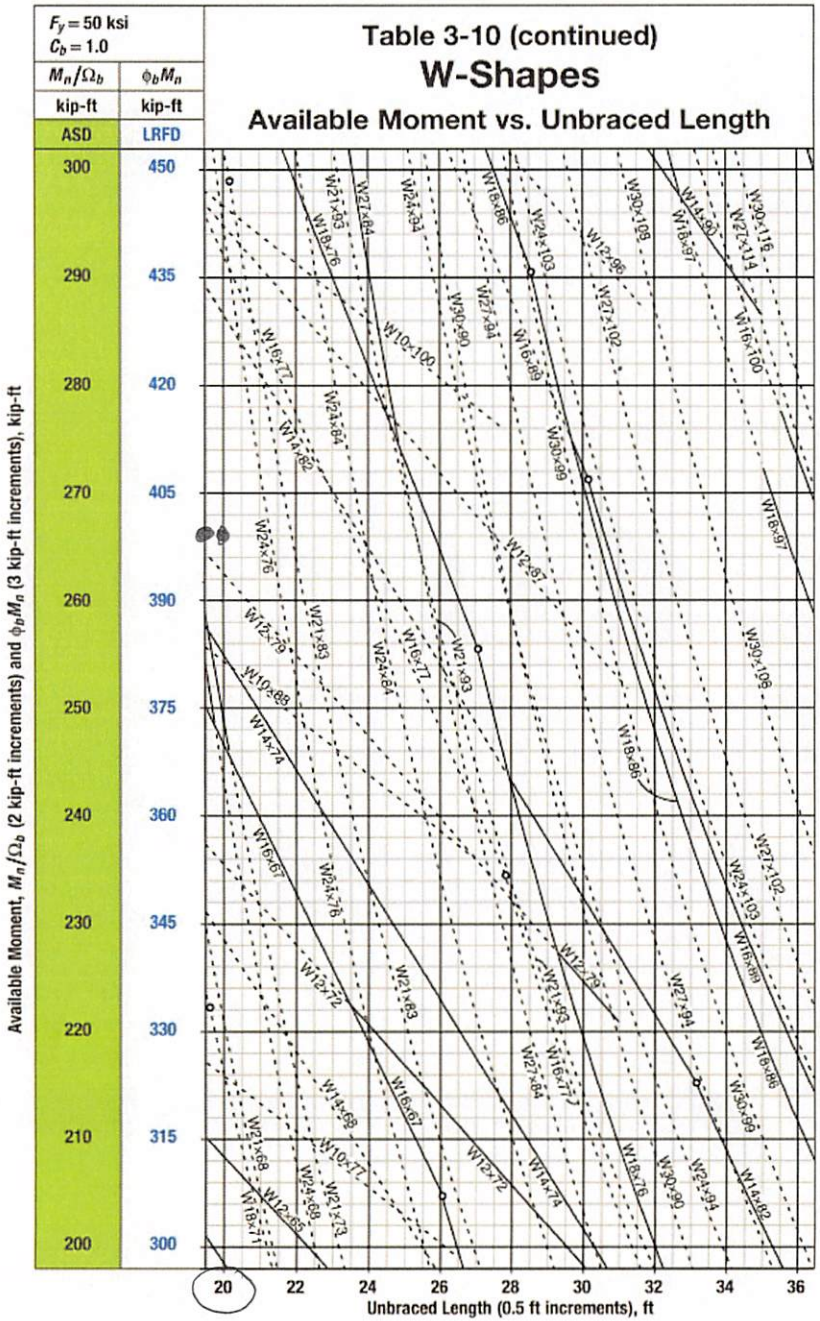
$\phi M_n = C_b(474 k\text{-}ft) = 717.2 k\text{-}ft$

(FROM TABLE 3.10 (3-117)

$\phi M_{n_{MAX}} = 612 k\text{-}ft$ FROM TABLE 3.10 (3-114)

$\phi M_{n_{MAX}} = 612 k\text{-}ft > M_u = 600 k\text{-}ft$

W18×24 o.k.



CR PROBLEM 5.10-3

$$W_u = 1.2(0.5\,k/ft + 0.076\,k/ft) = 0.691\,k/ft$$

$$P_L = 1.6(30^k) = 48^k$$

$$M_u = \frac{W_u L^2}{8} + \frac{P_L L}{4} = \frac{(0.691\,k/ft)(40ft)^2}{8} + \frac{48^k(40ft)}{4} = 618.24\,k\cdot ft$$

$$\phi M_n = 613\,k\,ft < M_u = 618.24\,k\cdot ft \quad \underline{N.G.}$$

- TABLE 3.10 → NEXT CURVE TO RIGHT $\underline{W18\times86}$

$$\frac{M_u}{C_b} = \frac{618.24\,k\,ft}{1.513} = 409\,k\,ft \text{ WITH } L_b = 20ft$$

FROM TABLE 3.10(1-114) → W18×86 → $\underline{\underline{W27\times84}}$ $\phi_b M_n = 579\,k\,ft$ $C_b = 1$

$$\phi M_n = 1.513(579\,k\,ft) = 939\,k\,ft \qquad \phi M_{n_{MAX}} = 915\,k\,ft > M_u = 618.24\,k\cdot ft$$

o.k.

$\underline{\underline{USE\ W27\times84}}$