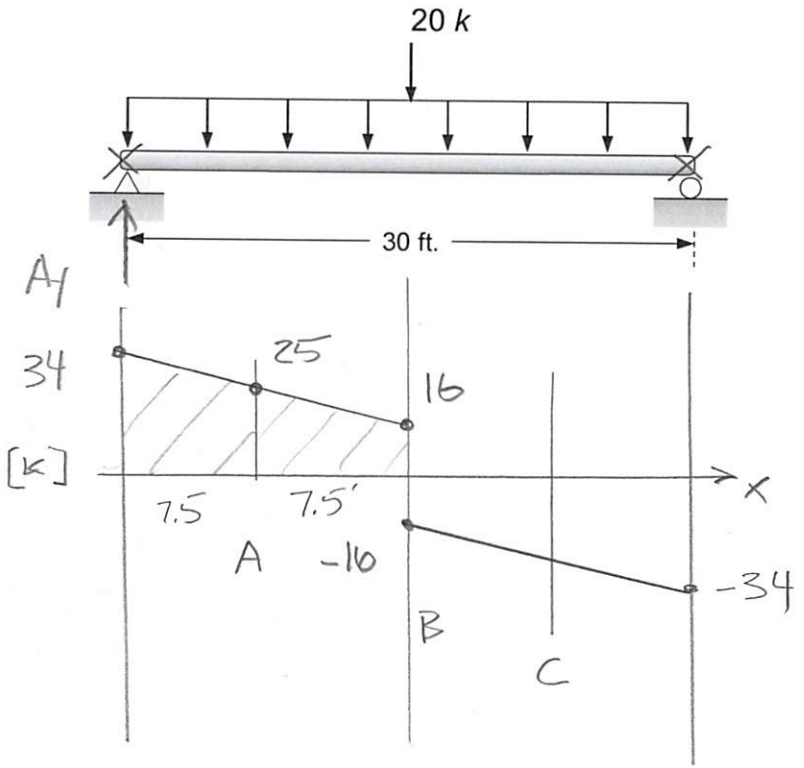
Classroom Problem 5.10-4: Select a **W** section of **A992** steel (F_y = 50 *ksi*; F = 65 *ksi*) for the following beam. The beam is laterally braced at the ends and supports a uniform dead load of 1 *k/ft* and a live load of 20 *k* at the center of the span. There is no limit on deflection. Use Table 6-1 in the Manual.



$W_D = 1.2(1k/ft) = 1.2\ k/ft$

$P_L = 1.6(20^k) = 32^k$

$L_b = 30\ ft$

$\curvearrowleft +\Sigma M_B = 0 = 1.2k/ft(30ft)(15ft) + 32^k(15ft) - A_y(30ft)$

$\underline{A_y = 34k} \Rightarrow B_y = 34k$

$M_A = M_C = 221.25\ k\text{-}ft$

$M_{MAX} = M_B = 375\ k\text{-}ft$

$$C_b = \frac{12.5(375)}{2.5(375) + 3(221.25) + 4(375) + 3(221.25)} = 1.245$$

TABLE 6.1 WITH $L_b = 30$ ft & $\dfrac{M_u}{C_b} = \dfrac{375 \text{ k-ft}}{1.245} = \underline{301.2 \text{ k-ft}}$

SECTION	$\phi_b M_n$ (k-ft)
W10x88	342
W12x79	337
W14x74	302 *
W14x82	349
W16x77	318
W18x76	329 ⟸
W21x93	321

$\phi M_n = 329 \text{ k-ft}(1.245) = 409.6 \text{ k-ft}$

BEAM WEIGHT $W_D = 1.2(1 \text{ k/ft} + 0.076 \text{ k/ft}) = 1.291 \text{ k/ft}$

$$M_u = \frac{W_D L^2}{8} + \frac{P_L L}{4} = \frac{(1.291 \text{ k/ft})(50 \text{ ft})^2}{8} + \frac{32^k (30 \text{ ft})}{4} = 385.3 \text{ k-ft}$$

$\phi M_n = 409.6 \text{ k-ft} > M_u = 385.3 \text{ k-ft}$ O.K.

USE W18x76