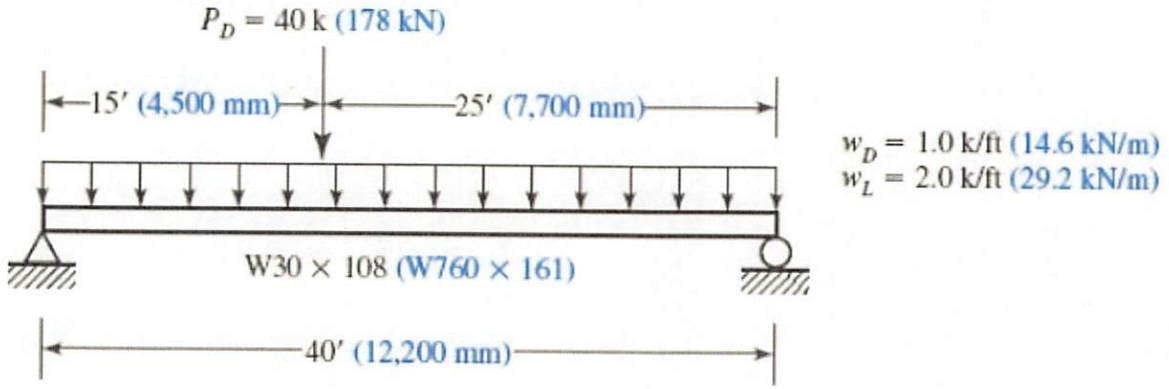
5.5-3 A simply supported beam is subjected to a uniform service dead load of 1.0 kips/ft **(14.6 kN/m)** (including the weight of the beam), a uniform service live load of 2.0 kips/ft **(29.2 kN/m)**, and a concentrated service dead load of 40 kips **(178 kN)**. The beam is 40 feet **(12,200 mm)** long, and the concentrated load is located 15 feet **(4,500 mm)** from the left end. The beam has continuous lateral support, and A572 Grade 50 steel ($F_y = 50$ ksi**(345 MPa)**) is used. Is a W30 × 108**(W760 × 161)** adequate?



FROM TABLE 1-1 (1-16) $b_f/2t_f = 6.89$ $h/t_w = 49.6$ $Z_x = 346 in^3$

FLANGE $\lambda < \lambda_p$? $\lambda_p = 0.38\sqrt{E/F_y} = 9.15$

$\lambda < \lambda_p$ ✓ COMPACT

WEB $\lambda < \lambda_p$? $\lambda_p = 3.76\sqrt{E/F_y} = 90.55$

$\lambda < \lambda_p$ ✓ COMPACT

$M_n = M_p = F_y Z_x = 50ksi(346 in^3) = 17,300 k\cdot in$

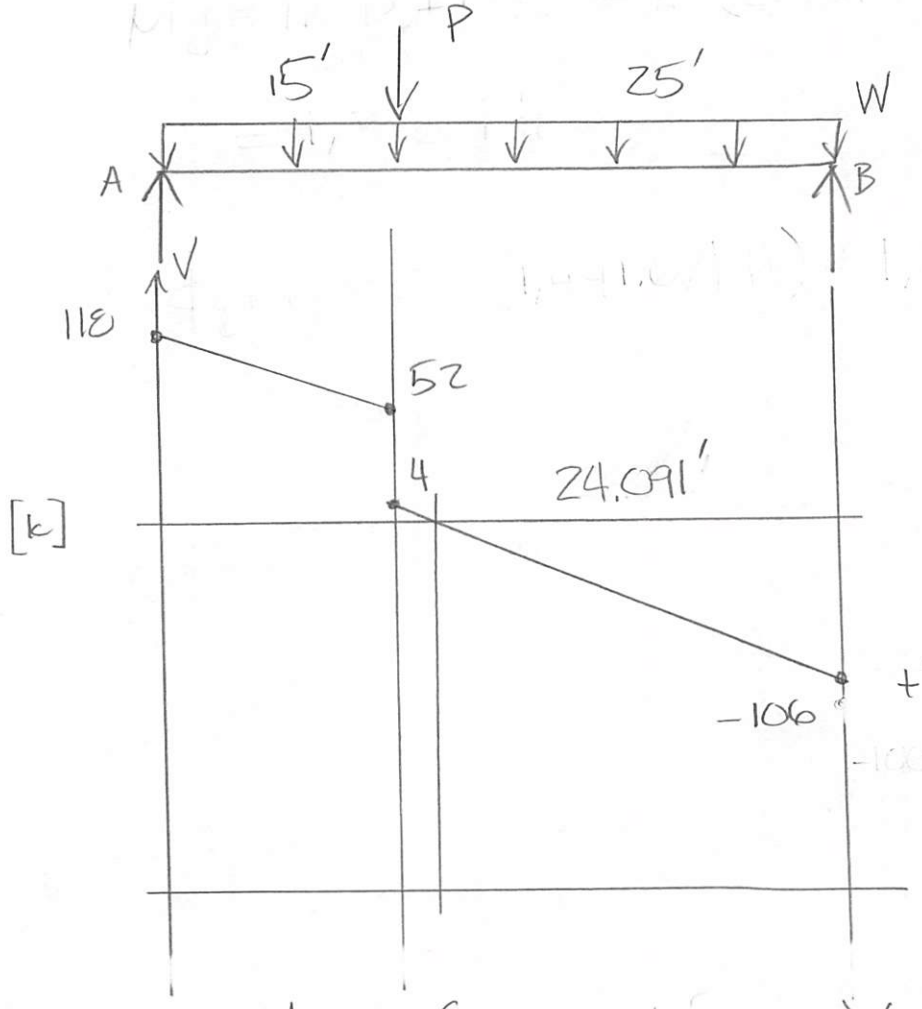
$= 1,441.67 k\cdot ft$

$M_u \Rightarrow$ UNIFORM DEAD $= \frac{1\,k/ft(40ft)^2}{8} = 200\,k\,ft$

UNIFORM LIVE $= \frac{2\,k/ft(40ft)^2}{8} = 400\,k\,ft$?

POINT LOAD DEAD $= \frac{40k(15ft)(25ft)}{40ft} = 375\,k\,ft$

* DRAW V & M DIAGRAM



$W = 1.2(1k/ft) + 1.6(2k/ft)$

$= 4.4\,k/ft$

$P = 1.2(40k) = 48k$

$\circlearrowleft + \sum M_B = 0 = 40w(20') + P(25') - A_y(40')$

$A_y = 118^k$

$+\uparrow \sum F_y = 0 = A_y + B_y - wL - P$

$B_y = 106^k$

$M_{MAX} = \int V dx = \frac{1}{2}(24.091')(106k) = 1,276.8\,k\,ft$

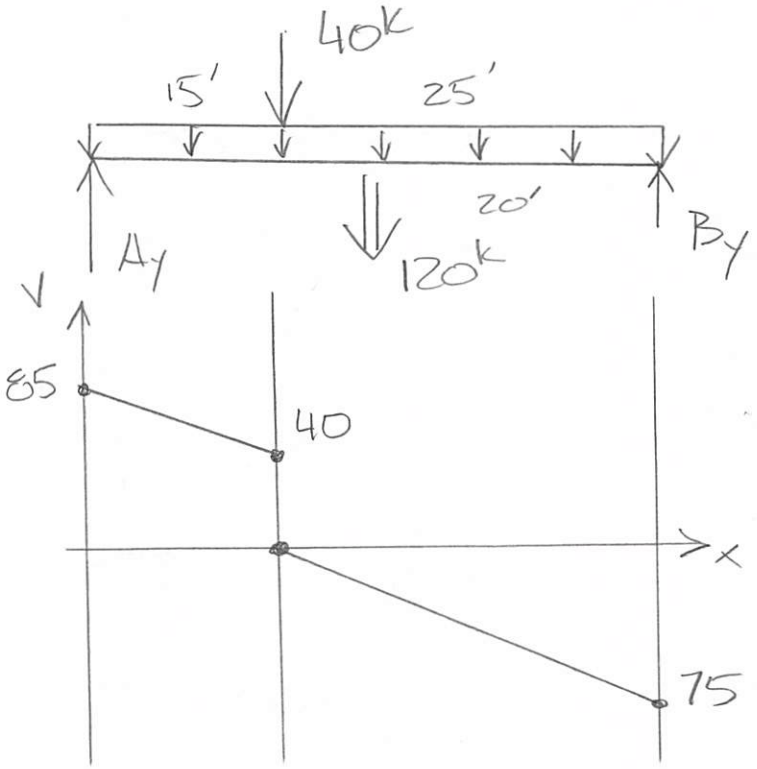
$\phi_B M_n = 0.9(1,441.67\,k\,ft) = \underline{1,297.5\,k\,ft > M_u}$

W30x108 OK

5.5-3

b) ASD $\quad W = 1k/ft + 2k/ft = 3k/ft$

$P = 40^k$



$\circlearrowleft + \sum M_B = 0 = 120^k(20') + 40^k(25') - A_y(40')$

$A_y = 85^k$

$B_y = 75^k$

$M_{MAX} = \frac{1}{2}(25')(75k)$

$= 937.5 kft$

$\frac{M_n}{\Omega_b} = \frac{1,441.67 kft}{1.67} = 863.28 kft < 937.5 kft$

N.G.