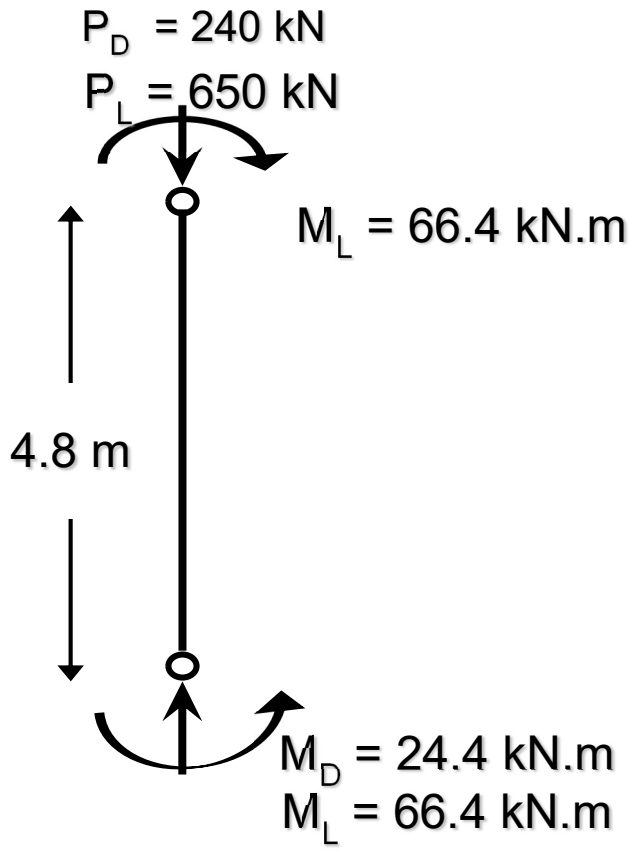
Select a W shape of A992 steel for the beam-column of the following figure. This member is part of a braced frame and is subjected to the service-load axial force and bending moments shown (the end shears are not shown). Bending is about the strong axis, and Kx = Ky = 1.0. Lateral support is provided only at the ends. Assume that B1 = 1.0.



- **Step I:** Compute the factored axial load and bending moments

  $P_u = 1.2P_D + 1.6P_L = 1.2(240) + 1.6(650) = 1328$ kN.

  $M_{ntx} = 1.2M_D + 1.6M_L = 1.2(24.4) + 1.6(66.4) = 135.5$ kN.m.

  $B_1 = 1.0$ ➔ $M_{ux} = B_1 M_{ntx} = 1.0(135.5) = 135.5$ kN.m

- **Step II:** compute ϕM_{nx}, ϕP_n
  - The effective length for compression and the unbraced length for bending are the same = $KL = L_b = 4.8$ m.
  - The bending is uniform over the unbraced length , so C_b=1.0

- Try a W10X60 with ϕP_n = 2369 kN and ϕM_{nx} = 344 kN.m

- **Step III:** Check interaction equation

$$\frac{P_u}{\phi_c P_n} = \frac{1328}{2369} = 0.56 > 0.2$$

$$\frac{P_u}{\phi_c P_n} + \frac{8}{9}\left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}}\right) = \frac{1328}{2369} + \frac{8}{9}\left(\frac{135.5}{344} + 0\right) = 0.91 < 1.0$$

- **Step IV:** Make sure that this is the lightest possible section.

➔ Try W12x58 with ϕP_n = 2247 kN and ϕM_{nx} = 386 kN.m

$$\frac{P_u}{\phi_c P_n} = \frac{1328}{2247} = 0.59 > 0.2$$

$$\frac{P_u}{\phi_c P_n} + \frac{8}{9}\left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}}\right) = \frac{1328}{2247} + \frac{8}{9}\left(\frac{135.5}{386} + 0\right) = 0.90 < 1.0$$

➔ **Use a W12 x 58 section**