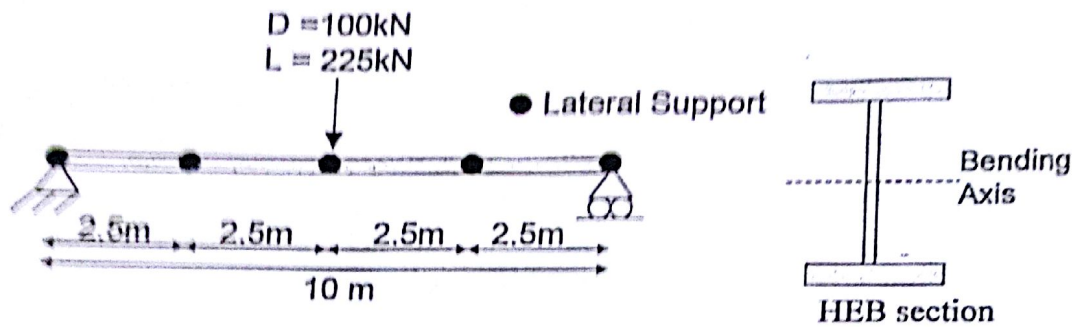
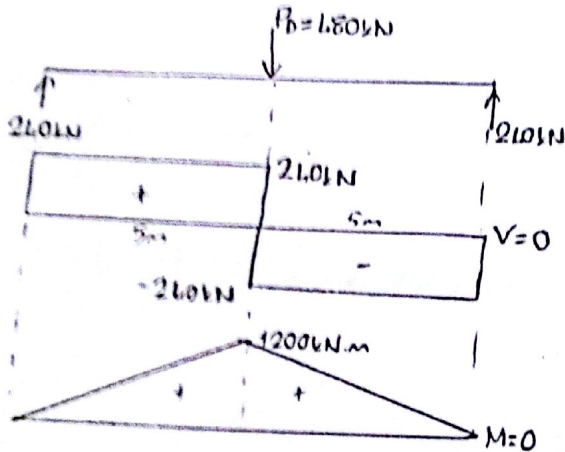


3. For the flexural member shown below determine the lightest **HEB** section of S355 Steel (F_y (σ_y) = 355 MPa) that can safely support the given loads according to AISC 360-10 provisions. Consider all possible limit states. The given dead load (D) of 100 kN and live load (L) of 225 kN are service loads (unfactored loads). Use LRFD and the associated load combination $1.2D+1.6L$. Lateral braces are provided at the supports and along the span with 2.5 meter intervals. The service live load deflection should not exceed $L/800$ where L is the beam span. Note that for a simply supported beam loaded at the mid-span the maximum deflection is $\Delta = \frac{PL^3}{48EI}$. Take $E = 200\text{GPa}$.



$$P_D = 1.2D + 1.6L = (1.2 \times 100) + (1.6 \times 225) = 480\text{ kN}$$



$$M_{max} = 1200\text{ kN.m}$$

Assume compact section;

$$M_p = 0.9 \times Z_x \times \sigma_y > M_{max} = 1200 \times 10^6 \text{ N.mm}$$

$$Z_x > 375586.8 \text{ mm}^3 = 3755.87 \text{ cm}^3$$

HEB 450
500
550
...
1000

choose HEB 450 firstly!
the lightest one among the options.

Check HEB 450 for shear

$$V_n = 0.6 \times F_y \times A_w \times C_v \rightarrow C_v = 1, A_w = d \times t_w = 450 \times 14 = 6300 \text{ mm}^2$$

$$V_n = 0.6 \times 355 \times 6300 \times 10^{-3} = 1341.9 \text{ kN}$$

$$\phi V_n = 1 \times 1341.9 \text{ kN} = 1341.9 \text{ kN} > V_{max} = 240 \text{ kN}$$

Members are safe for shear since d and t_w gets higher with increasing weight and the lightest one (HEB 450) has already provided safety for shear.