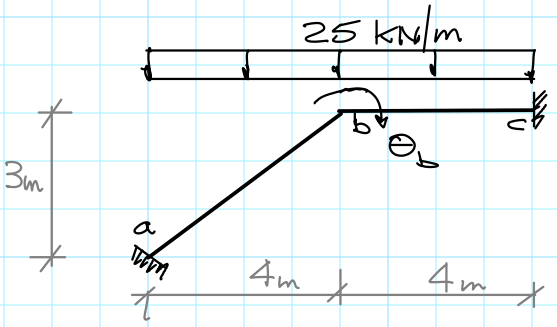
Problem 10.2.5-5



1 D.O.F. – rotation of b, θ_b

EI const

$$= 200\,000 \frac{N}{mm^2} \times 200\times10^6 mm^2 \times \frac{10^{-9} kNm^2}{N\,mm^2}$$

$$= 40\,000\ kN\,m^2$$

Fixed End Moments

$$M^f_{ab} = \frac{-25 \times 4^2}{12} = -33.33\ kN\text{-}m$$

$$M^f_{ba} = 33.33\ kN\text{-}m$$

} see last page

$$M^f_{bc} = -33.33\ kN\text{-}m$$

$$M^f_{cb} = 33.33\ kN\text{-}m$$

Slope Defln Eqns

$$M_{ab} = \frac{EI}{5}(2\theta_b) - 33.33 = \frac{2EI}{5}\theta_b - 33.33$$

$$M_{ba} = \frac{EI}{5}(4\theta_b) + 33.33 = \frac{4EI}{5}\theta_b + 33.33$$

$$M_{bc} = \frac{EI}{4}(4\theta_b) - 33.33 = EI\theta_b - 33.33$$

$$M_{cb} = \frac{EI}{4}(2\theta_b) + 33.33 = \frac{EI}{2}\theta_b + 33.33$$

Equilibrium

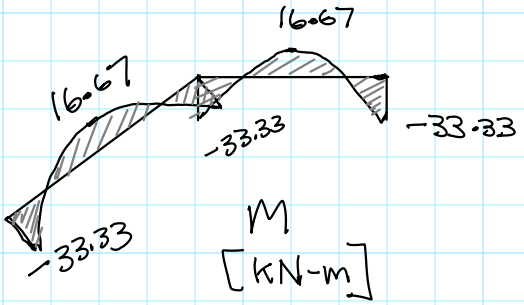
$$M_{ba} + M_{bc} = 0$$

$$\frac{4EI}{5}\theta_b + 33.33 + EI\theta_b - 33.33 = 0$$

$$\theta_b = 0$$

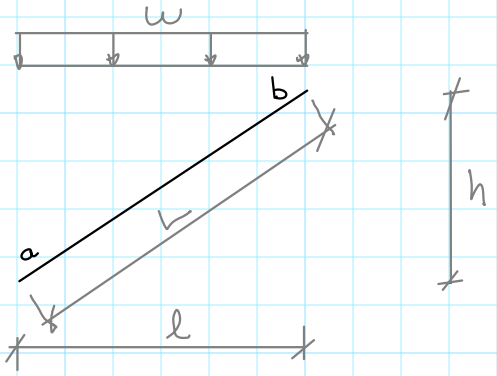
Back substitute

$$M_{ab} = -33.33$$
$$M_{ba} = 33.33$$
$$M_{bc} = -33.33$$
$$M_{cb} = 33.33$$



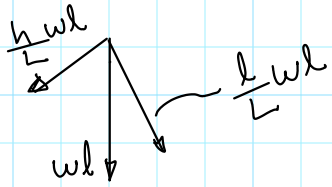
M
[kN-m]

Fixed-End Moments on Sloping Members



$$L = \sqrt{h^2 + l^2}$$

Resolve total load, wl, into $\perp$ & $\parallel$ components:

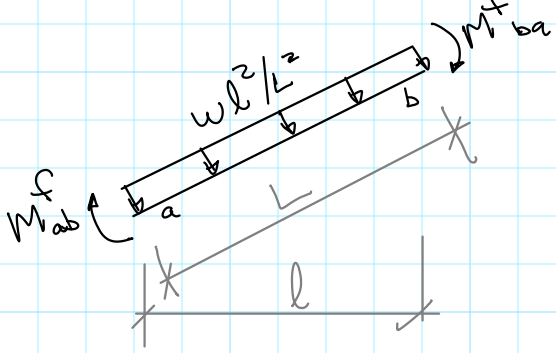


$$\text{total } \perp \text{ component} = \frac{wl^2}{L}$$

Distributed $\perp$ component:

$$\perp \text{ component} = \frac{\frac{wl^2}{L}}{L} = w\frac{l^2}{L^2}$$

Fixed End Moments:



$$M^f_{ab} = -\frac{\frac{wl^2}{L^2} \times L^2}{12} = -\frac{wl^2}{12}$$

$$M^f_{ba} = +\frac{wl^2}{12}$$

∴ for vertical dist. loads, use length projected on horizontal surface.