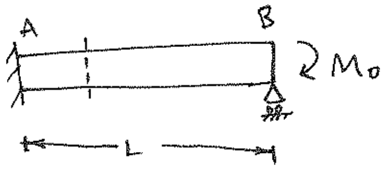
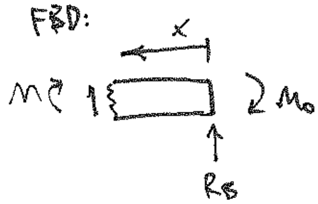
15.18. SOLUTION



Find reaction at B

FBD:



$\Sigma M_{cut} = 0 \Rightarrow -M - M_o + R_B x$

$\Rightarrow M = -M_o + R_B x$

$\Sigma F_y = 0 \Rightarrow R_B = -V.$

So we have 3 unknowns (M, R_B, V) and only 2 equations: the structure is statically indeterminate. We have a family of solutions in terms of R_B. So we need another equation relating R_B to M and M_o. & Let's look at the curvature:

Boundary Conditions

$y(0) = 0$

$y(L) = 0$

$\frac{dy}{dx}(L) = 0$

x measured from RIGHT side of beam

$$EI\frac{d^2y}{dx^2} = M = -M_o + R_B x$$

$$EI\frac{dy}{dx} = -M_o x + \frac{R_B x^2}{2} + C_1$$

$$EI\,y = -\frac{M_o x^2}{2} + \frac{R_B x^3}{6} + C_1 x + C_o$$

Apply BCs:

$y(0)$: $EI(0) = -\frac{M_o(0)^2}{2} - \frac{R_B(0)^3}{6} + C_1(0) + C_o$

$\Rightarrow \underline{C_o = 0}$

$y(L)$: $EI(0) = -\frac{M_o L^{\cancel{2}}}{2} + \frac{R_B L^{\cancel{3}2}}{6} + C_1 \cancel{L}$

$$+\frac{M_o L}{2} - \frac{R_B L^2}{6} = C_1 \quad (*)$$

$\frac{dy}{dx}(L)$: $EI(0) = -M_o L + \frac{R_B L^2}{2} + C_1 = 0$

$$M_o L - \frac{R_B L^2}{2} = C_1 \quad (*)$$

Combine $*$'s:

$$\frac{M_o L}{2} - \frac{R_B L^2}{6} = M_o L - \frac{R_B L^2}{2}$$

$$\Rightarrow R_B = \frac{3M_o}{2L} \quad \Rightarrow \quad \boxed{R_B = \frac{3M_o}{2L}}$$