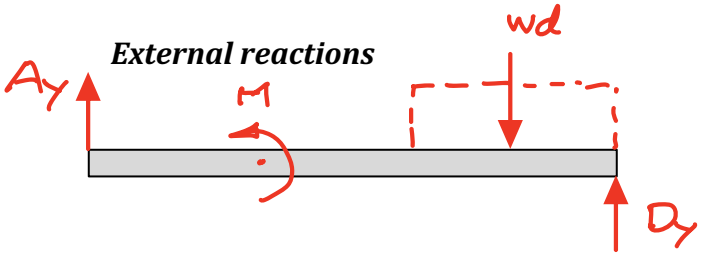
Quiz No. 9 ***Name*** SOLUTION
ME 270 – Summer 2024 - Prague

Given: Simply-supported beam with the line loading w and concentrated couple loading M shown.

Find: Construct the shear force and bending moment diagrams for this beam. Provide the details of your analysis including: the analysis for external reactions, the shear force/bending moment calculations, and the checks on your answers.

For this problem, use the following parameters: M = 220 kip-m, w = 10 kips/ft and d = 2 ft.

External reactions



- $\Sigma M_A = M - (wd)\left(\frac{5}{2}d\right) + D_y(3d) = 0$

  $\hookrightarrow D_y = \frac{5}{6}wd - \frac{M}{3d}$

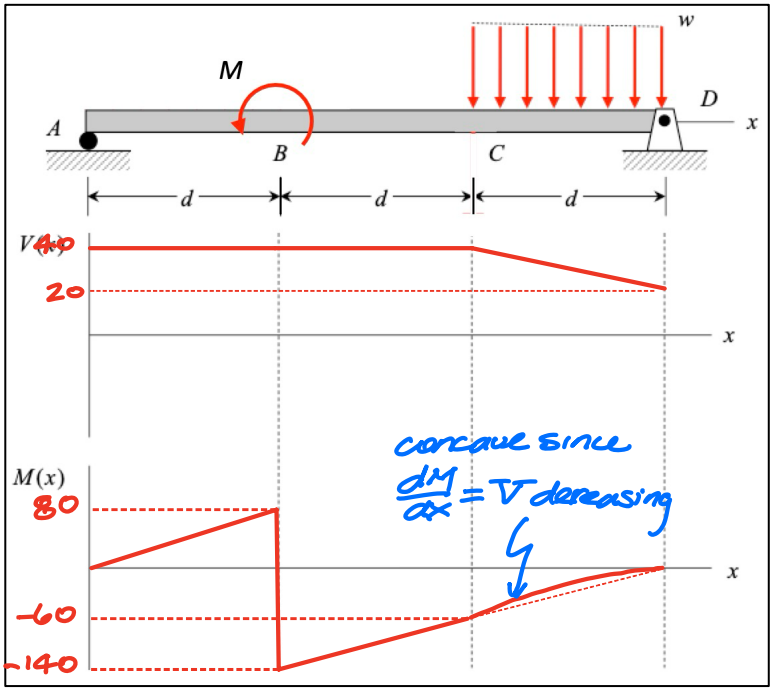
  $= \left(\frac{5}{6}\right)(10)(2) - \frac{220}{(3)(2)}$

  $= -20$ kips

- $\Sigma F_y = A_y + D_y - wd = 0$

  $\hookrightarrow A_y = wd - D_y$

  $= (10)(2) - (-20) = 40$ kips



$V(0) = A_y = 40$ kips

$V(4) = V(0) + \int_0^4 p(x)\,dx = 40$ kips

$V(6) = V(4) + \int_4^6 p(x)\,dx$

$= 40 + (-10) = 20$ kips

Note: $V(6) = -D_y = +20$ kips ✓ (Checks)

Since there is no beam at $x = 6^+$, it is not meaningful to calculate $V(6^+)$ and $M(6^+)$. At the right boundary, check shear force and bending moment at $x = 6^-$.

$M(0) = 0$ (roller support)

$M(2^-) = M(0) + \int_0^2 V(x)\,dx$

$= (40)(2) = 80$ kip·ft

$M(2^+) = M(2^-) - M$

$= 80 - 220 = -140$ kip·ft

$M(4) = M(2^+) + (40)(2) = -60$ kip·ft

$M(6) = M(4) + (20)(2) + \frac{1}{2}(20)(2)$

$= 0$

Note: $M(6) = 0$ (pin support) ✓ (Checks)