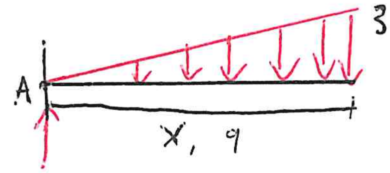
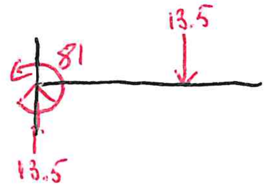
Feb 26 2020

1.



(I) $-\frac{3 \cdot 9}{2} = -13.5$



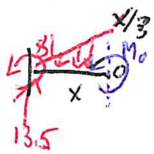
$\Sigma F_y = 0, \therefore F_A = 13.5$

$9 \cdot \frac{2}{3} = 6$

$\Sigma M_A = 0, \; M_A - 13.5(6)$

$M_A = 81$

(II)



$0 \le x \le 9$

$\Sigma M_o = 0, \; M_o + 81 - 13.5 + \frac{x}{3} \cdot \frac{x}{3} \cdot x \cdot \frac{1}{2}$

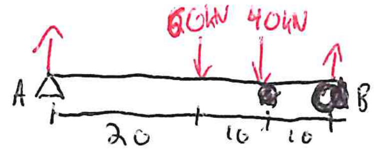
$M_o = 13.5x - 81 - \frac{x^3}{18}$

(III) $EI \frac{d\theta}{dx} = \frac{13.5x^2}{2} - \frac{x^4}{72} - 81x + C_1, \; C_1 = 0$

$EI\, y(x) = \frac{13.5}{6}x^3 - \frac{x^5}{360} - \frac{81}{2}x^2 + C_2, \; C_2 = 0$

Therefore $y(x) = \left[\frac{13.5}{6}x^3 - \frac{x^5}{360} - \frac{81}{2}x^2\right] / EI$

2.



Feb 26 2020

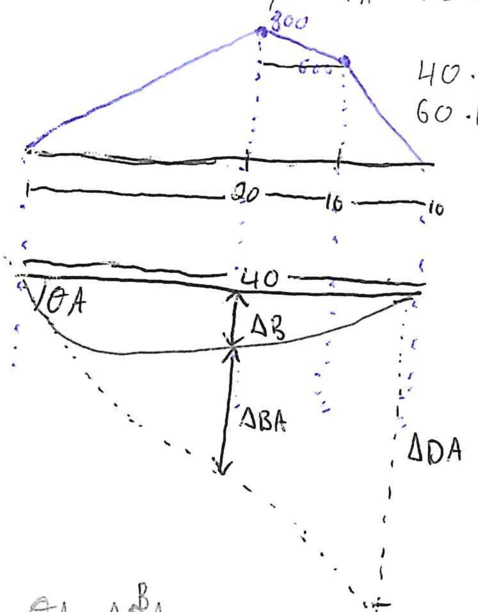
(I) $\Sigma F_y = 0,\ F_A + F_B - 60 - 40$

$F_A + F_B = 100$

$\Sigma M_A = 0,\ -60 \cdot 20 - 40 \cdot 30 + F_B \cdot 40 = 0$

$F_B = 60\ kN \quad \therefore F_A = 40\ kN$

(II)



$40 \cdot 20 = 800$

$60 \cdot 10 = 600$

(III) $\theta A = \dfrac{\Delta BA}{40}$

$\Delta BA = \int \dfrac{M\bar{x}}{EI} dx$

$= \int \left[\dfrac{600 \cdot 10}{2} \cdot \dfrac{2}{3} \cdot 10 + \dfrac{200 \cdot 10}{2} \cdot \left[10 + \dfrac{20}{3}\right] + 600 \cdot 10 \cdot 15 + \tfrac{1}{2} \cdot 20 \cdot 800 \cdot \left[20 + \tfrac{1}{3} \cdot 20\right]\right] / EI$

$\Delta BA = \dfrac{340000}{EI}\ k \cdot ft^3$

(IV)

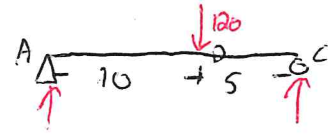
$\theta A = \dfrac{\Delta DA}{2} = \dfrac{340000}{EI \cdot 40}$

$\theta A = \theta DA_1 = \int \dfrac{M}{EI} dx$

$\theta DA: M_D = \dfrac{1}{2}(20)(800)\left(\dfrac{20}{3}\right)$

$= \dfrac{53333.3}{EI}$

(V) $\theta A = \dfrac{\Delta B + \Delta DA}{20},\quad 20 \cdot \dfrac{340000}{40} \cdot \dfrac{1}{EI} - \dfrac{53333.3}{EI} = \dfrac{116606.67}{EI}$

3. 

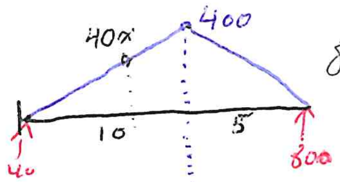
Feb 27 2020

(I) $\sum F_y = 0,\ -120 + F_A + F_C = 0$

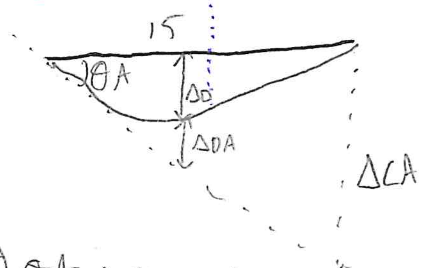
$F_A + F_C = 120$

$\sum M_A = 0,\ -120(10) + F_C(15) = 0$

$\therefore F_C = 80\text{ kN},\ F_A = 40\text{ kN}$

(II) 

$80 \cdot 5 = 400$



(III) $\theta A = \dfrac{\Delta CA}{15}\ \dfrac{1}{LEI}\left[\dfrac{1}{2} \cdot 5 \cdot 400 \cdot \dfrac{2}{3} \cdot 5 + \dfrac{1}{2} \cdot 10 \cdot 400 \cdot \left(5 + \dfrac{10}{3}\right)\right]$

$\theta A = \dfrac{20000}{LEI}\ ,\ \theta A = \dfrac{1333.33}{EI}$

(IV) $\theta A = \theta DA$

$\dfrac{1333.33}{EI} = \left[\dfrac{1}{2} \cdot x \cdot 40x\right] / EI$

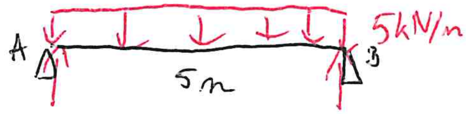
$x = 8.165$

(V) $\Delta AD = \left[\dfrac{1}{2} \cdot x \cdot (40x)\right] \cdot \dfrac{2}{3} x$

$= \dfrac{1}{2} \cdot 8.16 \cdot 40(8.16) \cdot 2/3 \cdot 8.16$

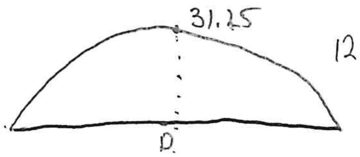
$= 7244.5$

4.

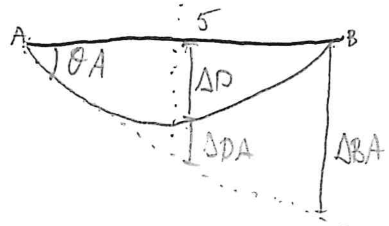


(I) $5\,kN/m \cdot 5m = 25$. Since symmetric,
$F_A = F_B = 12.5\,kN$

(II)



$12.5 \cdot 2.5 = 31.25$



(III) $\Delta BA = \dfrac{\left[\frac{4}{3} bh\right]\bar{x}}{EI}$, $\dfrac{\frac{4}{3} \cdot 5 \cdot 31.25}{EI} \cdot 2.5 = \dfrac{520.8\bar{3}}{EI}$

(IV) $\theta A = \dfrac{\Delta BA}{5} = \dfrac{104.1\bar{6}}{EI}\,kN \cdot m^2$

$\theta A = \theta BA$

(V) Although max deflection clearly @ 2.5, here is proof:

$y = -5x^2 + 25x, \quad 0 \leq y \leq 5$

$$\frac{104.16}{EI} = \frac{1}{EI}\int_0^D -5x^2 + 25x \, dx$$

$$\frac{104.16}{EI} = \frac{1}{EI}\Big|_0^D \frac{-5x^3}{3} + \frac{25}{2}x^2$$

$$104.16 = \frac{-5}{3}D^3 + \frac{25}{2}D^2$$

w/ eqn solver, $D = 2.5$ ✓

(VI) $\Delta DA = \left[2/3 \cdot 2.5 \cdot 31.25\right]\left[\frac{3}{8} b\right]$
$= \left[2/3 \cdot 2.5 \cdot 31.25\right]\left[3/8 \cdot 2.5\right]$
$= 48.828125$

(VII) $104.1\bar{6} = \dfrac{48.828125 + \Delta D}{2.5}$

$\Delta D = 211.5885415$

Therefore max deflection: 211.5885415