Questão 1

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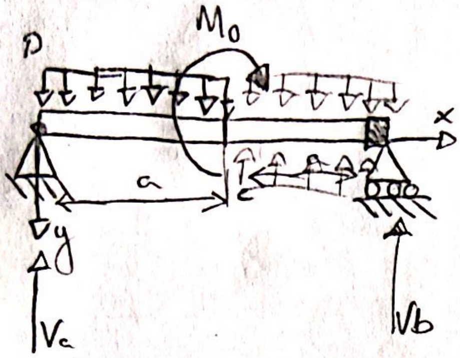
RA: 19.02466-5



$\sum F_V = 0$

$+Va + Vb - pa = 0$

$pa = Va + Vb$

$Va = pa - Vb$

$= pa - \frac{5}{4} pa$

$Va = -\frac{1}{4} pa$

$M\langle x\rangle = M_0 \langle x - L\rangle^0$

a-)

$\sum M_A = 0$

$-M_0 - pa\left(\frac{a}{2}\right) + Vb \cdot 2a$

$-2pa^2 - \frac{pa^2}{2} + 2a\,Vb = 0$

$-\frac{5}{2} pa^2 = -2a\,Vb$

$Vb = \frac{-5pa^2}{-2 \cdot 2a} = \frac{5pa}{4}$

$$\boxed{M\langle x\rangle = -\frac{pa}{4}\langle x\rangle^1 - \frac{p}{2}\langle x\rangle^2 + \frac{p}{2}\langle x-a\rangle^2 + 2pa^2\langle x-a\rangle^0}$$

b-)

$\varphi(x) = \int d\varphi = \int -\frac{M(x)}{EI}\,dx + C_1$

$= \frac{1}{EI}\int -M(x)\,dx + C_1 = \frac{1}{}\int$

$$\varphi_x = \frac{1}{EI}\left(\frac{1}{8}pa\langle x\rangle^2 + \frac{p}{6}\langle x\rangle^3 - \frac{p}{6}\langle x-a\rangle^3 - 2pa^2\langle x-a\rangle^1 + C_1\right.$$

$$Y(x) = \frac{1}{24}pa\langle x\rangle^3 + \frac{p\langle x\rangle^4}{24} - \frac{p}{24}\langle x-a\rangle^4 - pa^2\langle x-a\rangle^2 + C_1 x + C_2$$

$Y(0) = 0 \qquad Y(2a) = 0$

$\boxed{C_2 = 0}$

$\frac{1}{24}pa(2a)^3 + \frac{p}{24}(2a)^4 - \frac{p}{24}(a)^4 - pa^2(a)^2 + 2 \cdot a \cdot C_1 = 0$

$\frac{1}{EI}\left(\frac{8pa^4}{24} + \frac{16pa^4}{24} - \frac{pa^4}{24} - \frac{24pa^4}{24} + 2a\,C_1\right) = 0$

$C_1 = \frac{pa^4}{24 \cdot 2a} = \frac{pa^3}{48} \rightarrow \boxed{C_1 = \frac{pa^3}{48}}$

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c-)

$$\boxed{\varphi(x) = \frac{1}{EI}\left(\frac{Pa}{8}\langle x\rangle^2 + \frac{P}{6}\langle x\rangle^3 - \frac{P}{6}\langle x-a\rangle^3 - 2Pa^2\langle x-a\rangle^1 + \frac{Pa^3}{48}\right)}$$

d-)

$$\boxed{y(x) = \frac{1}{EI}\left(\frac{Pa}{24}\langle x\rangle^3 + \frac{P}{24}\langle x\rangle^4 - \frac{P}{24}\langle x-a\rangle^4 - Pa^2\langle x-a\rangle^2 + \frac{Pa^3x}{48}\right)}$$

e-) $\varphi_A = \varphi_{(x=0)}$

$$\varphi_A = \frac{1}{EI}\left(\frac{Pa^3}{48}\right)$$

$$= \frac{1}{210.10^3 . 430.10^4}\left(\frac{50.1500^3}{48}\right) = \frac{1}{90300.10^7}\left(\frac{3.375.000.000 . 50}{48}\right)$$

$$= \frac{337,5 . 50}{90300 . 48}$$

$$= 0,0039 \text{ rad}$$

$$\boxed{\varphi_a = 0,2234^\circ}$$

J-) $y_c = \frac{1}{EI} Pa^4\left(\frac{1}{24} + \frac{1}{24} + \frac{1}{48}\right)$

$$= \frac{1}{EI}\left(\frac{5Pa^4}{48}\right) = \frac{1}{210.10^3 . 430.10^4}\left(\frac{5.50.1500^4}{48}\right)$$

$$= \frac{1}{90300.\cancel{10^7}}\left(\frac{5,0625.\cancel{10^{12}}.50.5}{48}\right)$$

$$= \frac{506250 . 50.5}{90300 . 48}$$

$$\boxed{y_c = 29,1995 \text{ mm}}$$

Questão 2

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a-) CB = B C

$\boxed{mt = -500 \, N.m}$

b-) CD = DC

$\boxed{mt = 0 \, N.m}$

c-) $\Delta \varphi_{A/D} = \Delta \varphi_{DC} + \Delta \varphi_{CB} + \Delta \varphi_{BA}$

$= 0 + \dfrac{500 \cdot 10^3 \cdot 600}{77 \cdot 10^3 \cdot \frac{\pi}{32}(D^4)} + \dfrac{800 \cdot 10^3 \cdot 400}{77 \cdot 10^3 \cdot \frac{\pi}{32}(D^4)}$

$\dfrac{620000}{77 \cdot 10^3 \frac{\pi}{32} D^4} = 0{,}02618$

$D = \sqrt[4]{\dfrac{620000}{0{,}1974}} \Rightarrow \boxed{D = 42{,}07}$

d-) CB:

$\tau_{max} = \dfrac{500 \cdot 10^3 \, d/2}{\pi/32 \, d^4} \leq 600$

$\dfrac{250000}{5{,}89} \leq d^3$

$d^3 \geq 34{,}88 \, mm$

BA:

$\tau_{max} = \dfrac{800 \cdot 10^3 \, d/2}{\pi/32 \cdot d^4} \leq 60$

$d^3 \geq \dfrac{400 \cdot 10^3}{\frac{\pi}{32} \cdot 60}$

$\boxed{d \geq 40{,}798 \, mm}$