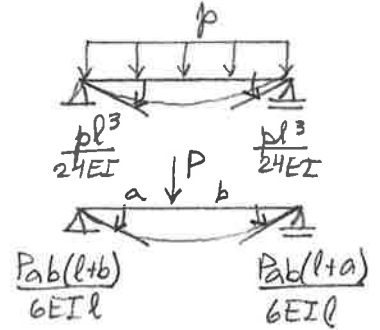
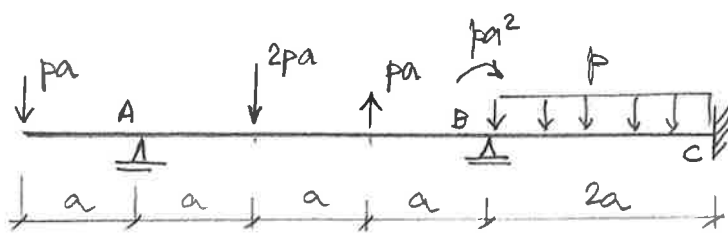
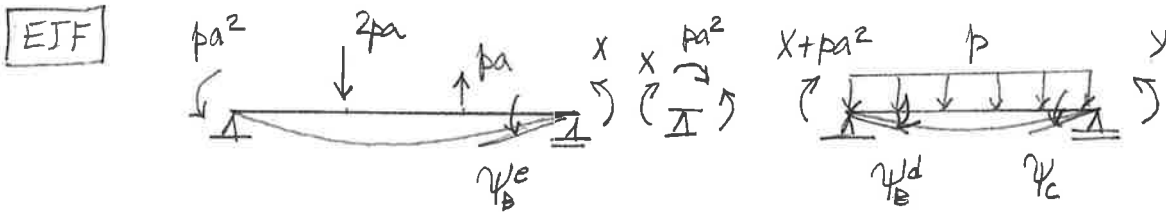


Ex. Determine os diagramas de estado e a rotação da apoio B.



$GH = 5 - 3 = 2 \Rightarrow X$ e Y mom. em B e C.



Convenção: Os sentidos positivos de ψ (psi) na viga biapoiada produzem uma "barriga" para baixo.

Sugestão: Os sentidos das incógnitas X e Y produzem deflexão p/ baixo.

$$\psi_B^e = -\frac{(pa^2)3a}{6EI} + \frac{(2pa)a \cdot 2a(4a)}{6EI \cdot 3a} - \frac{(pa)a \cdot 2a(5a)}{6EI \cdot 3a} + \frac{X3a}{3EI} = \frac{Xa}{EI} - \frac{pa^3}{6EI}$$

$$\psi_B^d = \frac{(X+pa^2)2a}{3EI} + \frac{p(2a)^3}{24EI} + \frac{Y(2a)}{6EI} = \frac{2}{3}\frac{Xa}{EI} + \frac{1}{3}\frac{Ya}{EI} + \frac{pa^3}{EI}$$

$$\psi_C = \frac{(X+pa^2)2a}{6EI} + \frac{p(2a)^3}{24EI} + \frac{Y(2a)}{3EI} = \frac{1}{3}\frac{Xa}{EI} + \frac{2}{3}\frac{Ya}{EI} + \frac{2}{3}\frac{pa^3}{EI}$$

Equação de compatibilij:

$$\begin{cases} \psi_B^e = -\psi_B^d & \Rightarrow \frac{Xa}{EI} - \frac{pa^3}{6EI} = -\frac{2}{3}\frac{Xa}{EI} - \frac{1}{3}\frac{Ya}{EI} - \frac{pa^3}{EI} \Rightarrow \frac{5}{3}X + \frac{Y}{3} = -\frac{5}{6}pa^2 \\ \psi_C = 0 & \Rightarrow \frac{1}{3}\frac{Xa}{EI} + \frac{2}{3}\frac{Ya}{EI} = -\frac{2}{3}\frac{pa^3}{EI} \Rightarrow \frac{1}{3}X + \frac{2}{3}Y = -\frac{2}{3}pa^2 \end{cases}$$

Resolvendo o sistema:

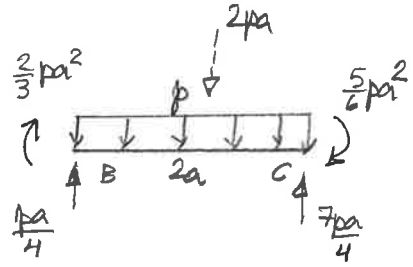
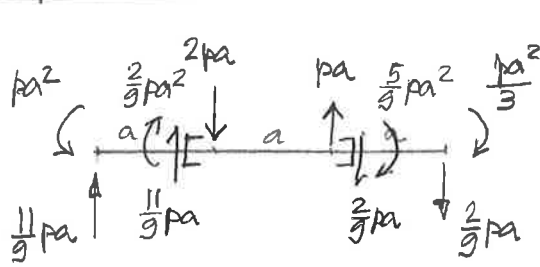
$$\det = \begin{vmatrix} 5/3 & 1/3 \\ 1/3 & 2/3 \end{vmatrix} = \frac{10}{9} - \frac{1}{9} = 1$$

$$X = \frac{\begin{vmatrix} -5/6 & 1/3 \\ -2/3 & 2/3 \end{vmatrix} pa^2}{\det} = \frac{-10}{18} + \frac{2}{9} pa^2 = -\frac{pa^2}{3} \quad Y = \frac{\begin{vmatrix} 5/3 & -5/6 \\ 1/3 & -2/3 \end{vmatrix}}{1} = -\frac{5}{6}pa^2$$

a) Rotação em B $\varphi_B = \psi_B^d = \frac{2}{3}\left(-\frac{pa^2}{3}\right)a + \frac{1}{3}\left(-\frac{5}{6}pa^2\right)a + \frac{pa^3}{EI} = \frac{1}{2}\frac{pa^3}{EI} (\downarrow)$

$$-\frac{2}{9} - \frac{5}{18} + 1 = \frac{-4-5+18}{18}$$

b) Diagramas de estado



$$\sum \mathcal{M}_B \left\{ R_A \cdot 3a - pa^2 - 4pa^2 + pa^2 + \frac{pa^2}{3} = 0 \right.$$

$$R_A = \frac{11}{9} pa \quad R_B^e = -\frac{2}{9} pa$$

$$\sum \mathcal{C} \left\{ R_B^d \cdot 2a + \frac{2}{3} pa^2 - 2pa^2 - \frac{5}{6} pa^2 = 0 \right.$$

$$R_B^d = \frac{pa}{4} \quad R_C = \frac{7pa}{4}$$

Os diagramas são traçados a partir dos valores nos extremos de los trechos das vigas biapoiadas.

