

• $M_A = M_{AB} + \beta_{AB}\psi_A + \beta_{BA}\psi_B$

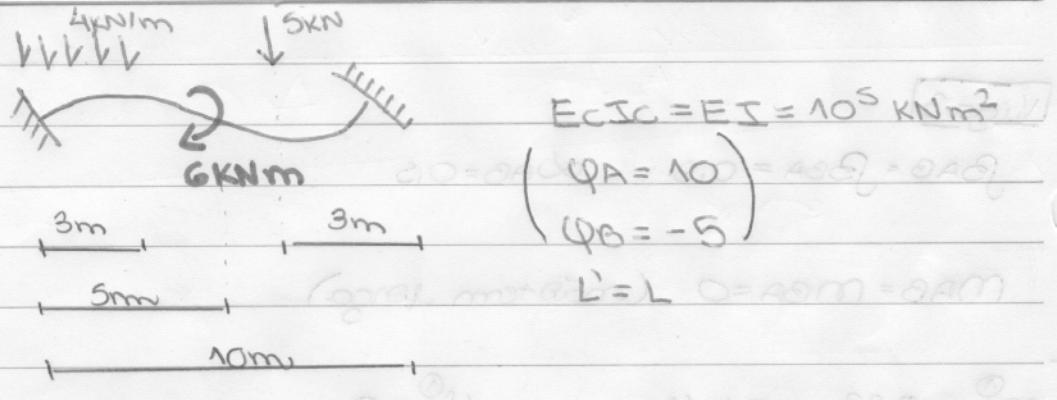
• $M_B = M_{BA} + \beta_{AB}\psi_A + \beta_{BA}\psi_B$

• $\beta_{AB} \cdot \psi_{AB} = \beta_{BA} \cdot \psi_{BA} = -3$

$$\text{Edu} = g \cdot j = 3^2$$

$$\text{Edu} = \frac{\text{Edu}}{s_0} = \frac{0.09}{s_0} = 0.09$$

Exercício



• devido à carga distribuída:

* $M_{AB} = P \cdot c^2 \cdot (6b^2 + 4bc + c^2)$

* $M_{BA} = -P \cdot c^2 \cdot (4bc + c^2)$

$\theta = 0$

$(\text{Edu})_{H.O} + (\text{Edu})_{S.O} + (\text{Edu})_{B.D} = 0.09$

$\therefore M_{AB} = 1.6$

$M_{BA} = -2.8$

• devido aos momentos:

$\theta = (\text{Edu})_{H.O} + (\text{Edu})_{S.I} + (\text{Edu})_{B.D} = 0.09$

* $M_{AB} = m \cdot \frac{b}{e^2} (3b - 2a)$

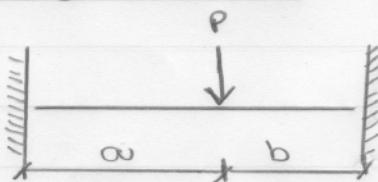
* $M_{BA} = -m \cdot \frac{a}{e^2} (2a - 3b)$

$\therefore M_{AB} = -1.5$

$M_{BA} = -1.5$

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* devido a carga concentrada:



$$* M_{AB} = \frac{P \cdot ab^2}{l^2}$$

$$* M_{BA} = -\frac{P a^2 b}{l^2}$$

$$* M_{AB} = 3,15$$

$$* M_{BA} = -7,35$$

TOTAL: $M_{AB} = M_A - 1,5 + 3,15 = 13,25$

$$M_{BA} = -2,8 - 1,5 - 7,35 = -11,65$$

- $M_A = 13,25 + 0,4 \varphi_A + 0,2 \varphi_B \rightarrow \varphi_A = 10, \varphi_B = -5$
- $M_B = -11,65 + 0,2 \cdot \varphi_A + 0,4 \varphi_B$

$$\left\{ \begin{array}{l} M_A = 16,25 \\ M_B = -11,65 \end{array} \right.$$

* Método das forças (outra convenção)

$$- \varphi_A = E \cdot \beta + g \cdot M_A - \beta \cdot M_B$$

$$- \varphi_B = D \cdot \beta + \beta \cdot M_A + g \cdot M_B$$

* Dados M_{AB}, M_{BA} , quais valores de E, D para vigas prismáticas?

$$E = \alpha \quad D = \beta$$

$$\beta \quad \beta$$

$$0 = \alpha m + \beta m = (\alpha + \beta) m$$

$$* M_A = M_{AB} + \frac{4}{l} \varphi_A + \frac{2}{l} \varphi_B = 0$$

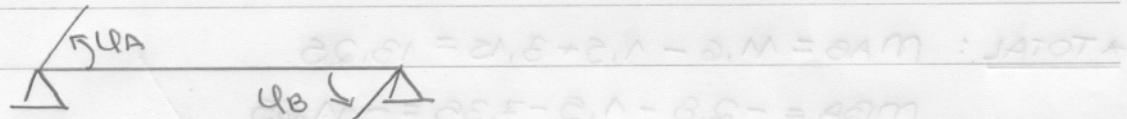
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$$* M_B = M_{BA} + \frac{2}{l} \varphi_A + \frac{4}{l} \varphi_B = 0$$

Isolando o sistema, chegamos em:

$$\left\{ \begin{array}{l} Q_A = -12m_{AB} - m_{BA} \frac{l}{6} \\ Q_B = -12m_{BA} - m_{AB} \frac{l}{6} \end{array} \right.$$

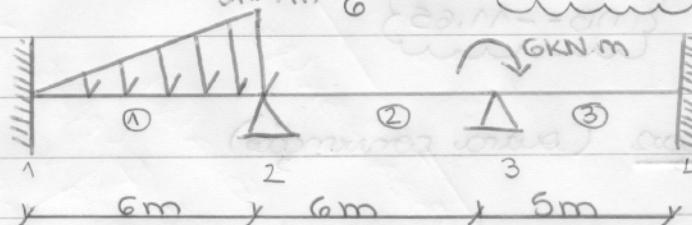
Na convenção de Grüter, temos



$$a = -Q_A = 12m_{AB} - m_{BA} \frac{l}{6} \rightarrow E = 2m_{AB} - m_{BA}$$

$$B = +Q_B = -12m_{BA} - m_{AB} \frac{l}{6} \rightarrow D = -2m_{BA} + m_{AB}$$

Exercício



$$EI_1 = EC_1 I_0$$

* métodos dos deslocamentos

$$EI_2 = 2EC_1 I_0$$

$$EI_3 = EC_1 I_0$$

① Grado de Liberdade GDL: Q_2 e Q_3

② Equações de Equilíbrio: $m_2 = m_B^{\circledR} + m_A^{\circledR} = 0 \rightarrow$ Verifique Θ
 $m_3 = m_B^{\circledR} + m_A^{\circledR} = -6$ $\text{dam} = \text{dam}$

③ Caracterizações das Vigas:

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Viga 1 $\delta = l \cdot \frac{E_c I_c}{EI} = 6 \quad \beta = \frac{4}{6} = 0,667 \quad \alpha = 0,5$ (viga prismática)

$$\cdot M_{AB} = \frac{P \cdot \delta^2}{30} = \frac{5 \cdot 36}{30} = 6 \text{ kNm} + \cancel{M_{BA}} - 0 = 6 \text{ kNm}$$

$$\cdot M_{BA} = -\frac{P \delta^2}{20} = -\frac{5 \cdot 36}{20} = -9 \text{ kNm}$$

Viga 2 $\delta = 3 \quad \beta = \frac{4}{3} = 1,333 \quad \alpha = 0,5$

$$\cdot M_{AB} = M_{BA} = 0 \quad (\text{não tem carregamento})$$

Viga 3 $\delta = 5 \quad \beta = 0,8 \quad \alpha = 0,5$

$$\cdot M_{AB} = M_{BA} = 0$$

④ Expressões fundamentais

O (engaste)

$$\cdot M_A = 6 + 0,667 \cdot Q_1 + 0,333 Q_2$$

$$\cdot M_B = -9 + 0,333 Q_1 + 0,667 Q_2$$

$$\cdot M_A = 0 + 1,333 Q_2 + 0,667 Q_3$$

$$\cdot M_B = 0 + 0,667 Q_2 + 1,333 Q_3$$

$$\cdot M_A = 0 + 0,8 Q_3 + 0,4 Q_4$$

$$\cdot M_B = 0 + 0,4 Q_3 + 0,8 Q_4$$

⑤ Equilíbrio global

$$\left\{ \begin{array}{l} 2Q_2 + 0,667 Q_3 = 9 \\ 0,667 Q_2 + 2,133 Q_3 = -6 \end{array} \right.$$

$$Q_2 = 6,07$$

$$Q_3 = -4,71$$

$$\cdot M_A^{(1)} = 8,02$$

$$\cdot M_A^{(2)} = 4,95$$

$$\cdot M_A^{(3)} = -3,77$$

$$\cdot M_B^{(1)} = -4,95$$

$$\cdot M_B^{(2)} = -2,23$$

$$\cdot M_B^{(3)} = -1,88$$

* FAZER DIAGRAMAS //