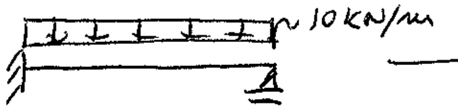
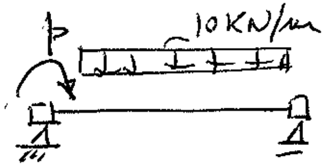
# MÉTODO DAS FORÇAS



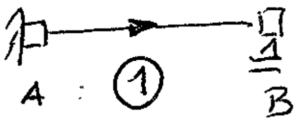




4.0

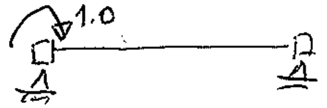
$\alpha = 1$

(ESCOLHA DO SISTEMA - BASE)

$\alpha$ LIBERTAÇÕES




## SOLUÇÃO COMPLEMENTAR




$$\underline{X}_c = \begin{bmatrix} 1.0 \\ 0.0 \\ 0.0 \end{bmatrix} \times p$$

$$\underline{u}_c = \underline{F}\,\underline{X}_c$$

$$= \frac{4}{6EI}\begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & 0 \\ 0 & 0 & 6EI/A \end{bmatrix}\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} p$$

$$= \frac{4}{6EI}\begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} p$$

$$\theta_{A_c} = B^T \underline{u}_c$$

$$= \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \frac{4}{6EI}\begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} p$$

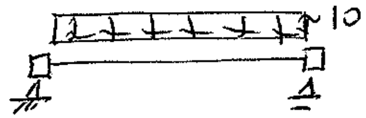
$$\theta_{A_c} = \frac{4}{6EI} \times 2p = \frac{4}{3EI} p$$

$$\theta_{A_c} = \underline{B}^T \underline{u}_c$$

$$= \underline{B}^T (\underline{F}\,\underline{X}_c)$$

$$\boxed{\theta_{A_c} = \underline{B}^T \underline{F}\,\underline{B}\,p}$$

## SOLUÇÃO PARTICULAR




$$\underline{X}_0 = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\underline{u}_0 = \underline{F}\,\underline{X}_0 + \underline{\bar{u}}$$

$$= \frac{10 \times 4^3}{24EI}\begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$

$$\theta_{A_0} = \underline{B}^T \underline{u}_0$$

$$= \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \times \frac{10 \times 4^3}{24EI}\begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$

$$\theta_A^0 = \frac{10 \times 4^3}{24EI}$$

$$\theta_A^0 = B^T u_0$$

$$\boxed{\theta_A^0 = \underline{B}^T \underline{F}\,\underline{X}_0 + \underline{B}^T \underline{\bar{u}}}$$

## SOBREPOSIÇÃO

$$\underline{X} = \underline{B}\,p + \underline{X}_0$$

$$= \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} p + \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

COMO DETERMINAR O VALOR DE $p$?

$$\theta_{A_c} + \theta_{A_0} = 0$$

$$\frac{4}{3EI} p + \frac{10 \times 4^3}{24EI} = 0$$

$$p = -\frac{10 \times 4^3}{24} \times \frac{3}{4}$$

$$p = -\frac{10 \times 4^2}{8}$$

$$\boxed{p = -20}$$