Processo dos deslocamentos

ETAPAS: A   B   C
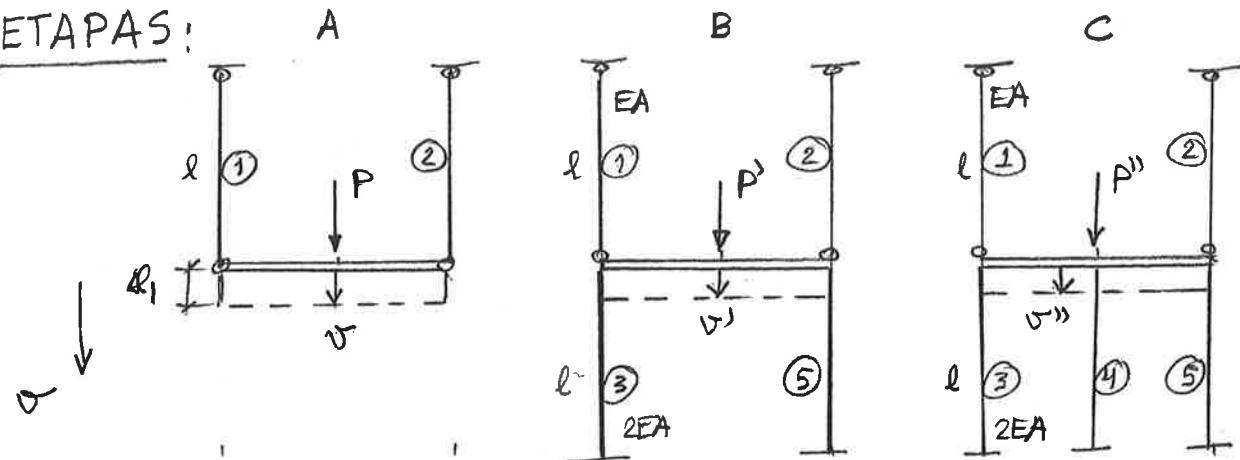
A. até o fechamento da folga δ

- **Compatib.** $\boxed{v = \Delta\ell_1 = \delta} \Rightarrow \dfrac{N_1 \ell}{EA} = \delta \Rightarrow N_1 = \dfrac{EA}{\ell}\delta = \dfrac{10^4 \times 10}{100} \times 0,1 = 100\,kN$

- **Eq. Constitutivas**

- **equil.** $P = N_1 + N_2 = 2N_1 = 200\,kN$ (simetria)

∴ $\boxed{P^A = 200\,kN}$ $N_1^A = 100\,kN$ $N_3^A = 0$ $v_Q^A = 0$

$\sigma_1^A = \dfrac{100}{10} = 10\,\dfrac{kN}{cm^2}$ $\sigma_3^A = 0$

B. até o fechamento da folga 2δ

- **Compatib.** $v' = v - \delta = \delta \Rightarrow \boxed{v' = \Delta\ell_1' = -\Delta\ell_3' = \delta} \Rightarrow$

- **Eq. constitutivas** $\dfrac{N_1' \ell}{EA} = \dfrac{N_3' \ell}{2EA} = \delta$ $\begin{cases} N_1' = N_2' = \dfrac{EA}{\ell}\delta = 100\,kN \\ N_3' = N_5' = -\dfrac{2EA}{\ell}\delta = -200\,kN \end{cases}$

- **Equil.** $P' = 2N_1' - 2N_3' = 600\,kN$
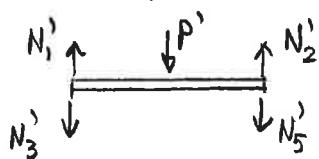
∴ $\boxed{P^B = 800\,kN}$ $N_1^B = 200\,kN$ $N_3^B = -200\,kN$ $v_Q^B = \dfrac{\Delta\ell_5}{2} = \dfrac{\delta}{2}$

$\sigma_1^B = 20\,\dfrac{kN}{cm^2}$ $\sigma_3^B = -10\,kN$ $= 0,05\,cm$

C. até P atingir $1600\,kN$, ou $P'' = 1600 - 800 = 800\,kN$

- **Compatib.** $\boxed{v'' = \Delta\ell_1'' = -\Delta\ell_3'' = -\Delta\ell_4''}$

- **Eqa constitutivas** $\dfrac{N_1'' \ell}{EA} = -\dfrac{N_3'' \ell}{2EA} = -\dfrac{N_4'' \ell}{2EA} \Rightarrow N_3'' = N_4'' = -2N_1''$

- ## Equil
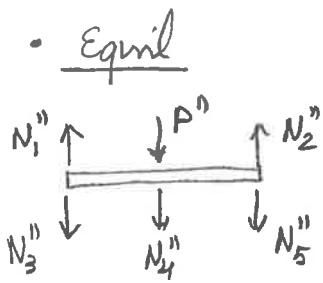
$$P'' = 2N_1'' - 2N_3'' - N_4'' \implies 800 = (2+4+2)N_1''$$

$$N_1'' = 100\,kN, \qquad N_3'' = -200\,kN, \qquad N_4'' = -200kN.$$

$$v'' = \frac{N_1''\ell}{EA} = 0{,}1\,cm \qquad v_Q'' = \frac{v''}{2} = 0{,}05\,cm$$

$$\boxed{P^c = 1600\,kN}$$

$$N_1^c = 300\,kN \qquad N_3^c = -400\,kN$$
$$\sigma_1^c = 30\,\frac{kN}{cm^2} \qquad \sigma_3^c = -20\,kN$$

$$v_Q^c = v_Q^B + v_Q''$$
$$= 0{,}1\,cm$$

Gráficos