Universidade Federal do Rio de Janeiro

Escola Politécnica

DATA / /

GRAUS:

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o: GABARITO - P1. -

plina: MECÂNICA DOS SÓLIDOS I

Turma: 2013.1

essor: FERNANDO TROCHINHA

1ª. QUESTÃO (2,0 PONTOS)

OBS.: PODE SER RESOLVIDA ATRAVÉS DO CÔMPUTO DOS AUTO-VALORES DA MATRIZ!

DIREÇÕES PRINCIPAIS → $\theta_{MAX} \therefore \frac{d\sigma_x'}{d\theta} = 0$

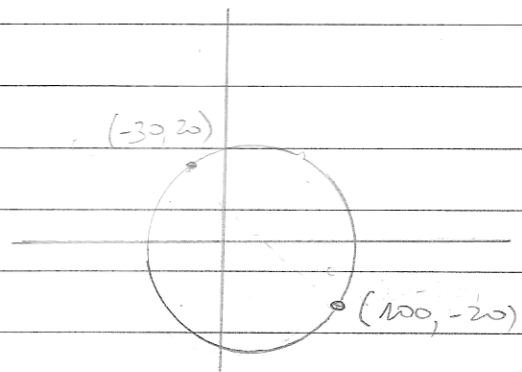
$\sigma_x - \sigma_z \operatorname{sen}(2\theta) - \sigma_{xz} \cos 2\theta = 0 \quad \operatorname{tg} 2\theta = \frac{20}{130}$

$\theta_{MAX} = 0.1526 \text{ rad}$

$\sigma_1 = 35 + 65.0.8 + 20.0.3 = 102.75 \text{ MPa}$

$\sigma_2 = -33.25 \text{ MPa}$

$\tau_{MAX} = 68 \text{ MPa}$



2ª. QUESTÃO (4.0 PONTOS)

EQUILÍBRIO $\quad \frac{dN}{dx} + f = 0 \qquad 0 < x < L$

$$N(L) - N(0) = -fL \rightarrow N(0) = fL$$

$$N(x) - N(0) = f(x) \rightarrow N(x) = f(L-x)$$

$$\boxed{\sigma(x) = N(x)\,A = fA(L-x)}$$

\# DEFORMAÇÃO:

$$\varepsilon(x) = \begin{cases} fA(L-x)/E_1 & 0 < x < L/2 \\ fA(L-x)/E_2 & \frac{L}{2} < x < L \end{cases}$$

\# CONFIGURAÇÃO DEFORMADA:

$$\frac{du}{dx} = \frac{fA(L-x)}{E_1} \qquad 0 < x < L/2$$

$$u(x) = -\frac{fA}{2E_1}(L-x)^2 \Big|_0^x = \frac{fA}{2E_1}\left[L^2 - (L-x)^2\right] =$$

$$= \frac{fA}{2E_1}\left[2x - x^2\right]$$

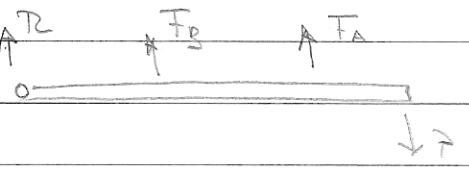
$$\frac{du}{dx} = \frac{fA}{E_2}(L-x) \qquad \frac{L}{2} < x < L$$

$$u(x) - u(L/2) = \frac{fA}{E_2}(L-x)$$

$\Downarrow$ CONTINUIDADE

3ª. QUESTÃO (4.0 PONTOS)

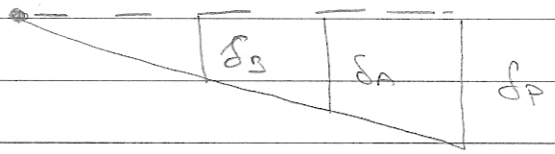
EQUILÍBRIO :



$$R + F_B + F_A = P \quad \text{E} \quad P \times 22\times10^{-3} = F_A \times 17\times10^{-3} + F_B \times 7\times10^{-3}$$

(PB. HIPER-ESTÁTICO)

COMPATIBILIDADE GEOMÉTRICA (GEOMETRIA DA DEFORMAÇÃO)



$$\frac{\delta_A}{\delta_B} = \frac{17}{7}$$

COMPORTAMENTO CONSTITUTIVO : $\delta_A = \frac{9\times10^{-3}}{70\times10^{9}} \frac{F_A}{1250\times10^{-6}}$ m

$$\delta_B = \frac{7\times10^{-3}}{70\times10^{9}} \frac{F_B}{625\times10^{-6}} \text{ m}$$

$\delta_A \approx 1\times10^{-10} F_A$ m E $\delta_B \approx 1.6\times10^{-10} F_B$ m

ENTÃO : $P = \delta_A\ 0.77\times10^{10} + \delta_B\ 0.2\times10^{10}$

E $P = \delta_A \times 0.77\times10^{10} + \delta_A\ 0.08\times10^{10} = \delta_A \times 0.86\times10^{10}$

A RIGIDEZ É DADA POR $K = \frac{P}{\delta_P}$

E $\frac{\delta_P}{\delta_A} = \frac{22}{17}$

LOGO $\left\{ K = \frac{P}{0.9 \times 10^{-10} P} = 1.11 \times 10^{10} \text{ N/m} \right\}$