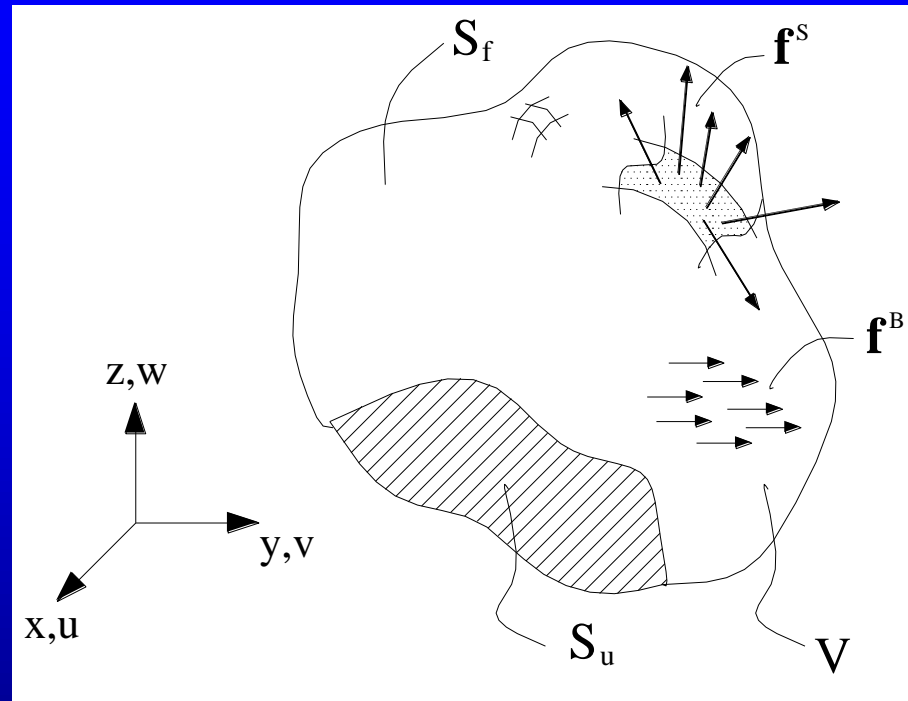


Introdução ao estudo da
elasticidade linear
Estudo das deformações

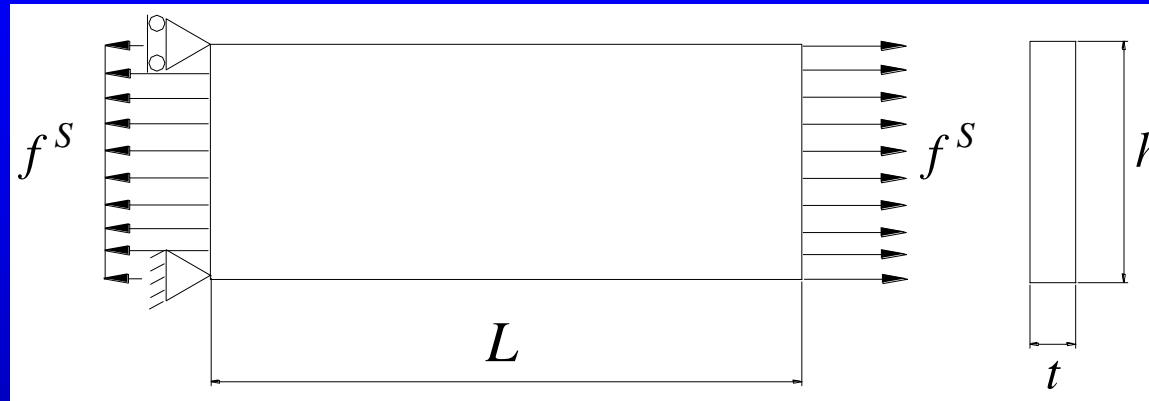
O Problema Fundamental



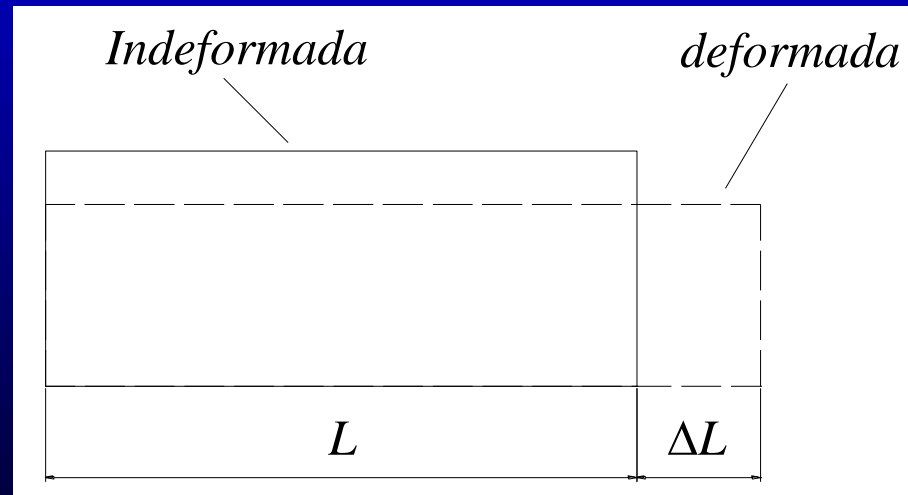
- Sólido deformável que ocupa a região V do espaço tridimensional
- Movimento restringido ou imposto em parte da superfície exterior do sólido representada por S_u
- Ações externas

Estudo das deformações

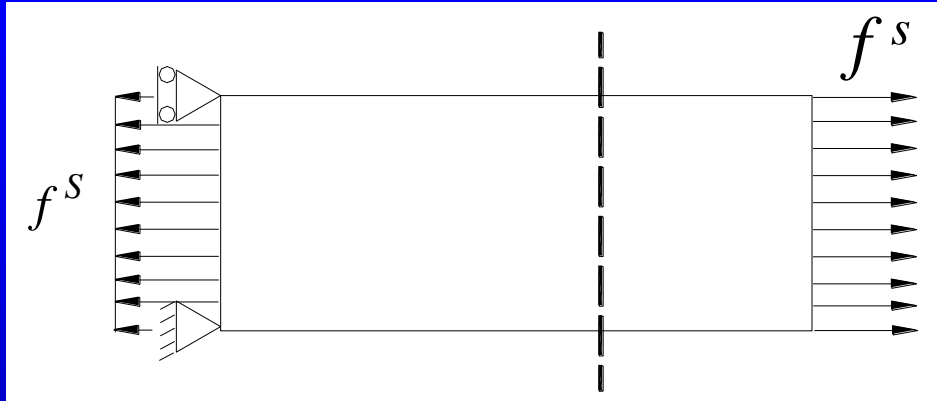
Motivação: Chapa submetida a um carregamento uniforme



Deformada



Equilíbrio

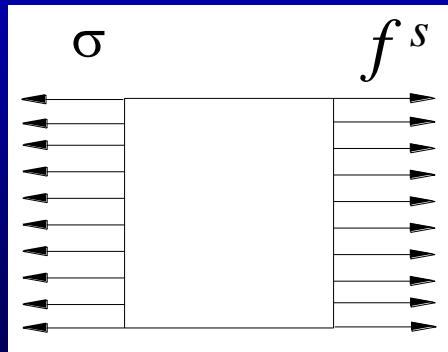


Lei de Hooke

$$\sigma = E \varepsilon$$

$$\sigma = E \frac{\Delta L}{L}$$

$$\Delta L = \sigma \frac{L}{E} = f^s \frac{L}{E}$$

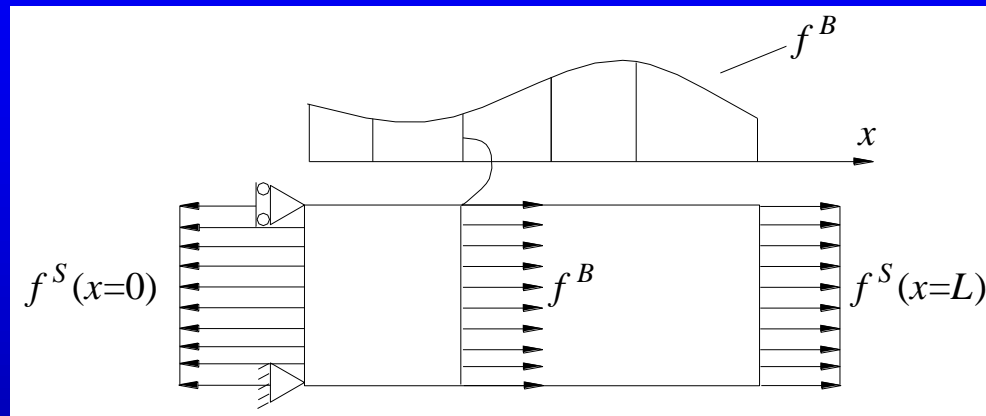


$$\sigma = f^s$$

finalmente

$$u(L) = f^s \frac{L}{E}$$

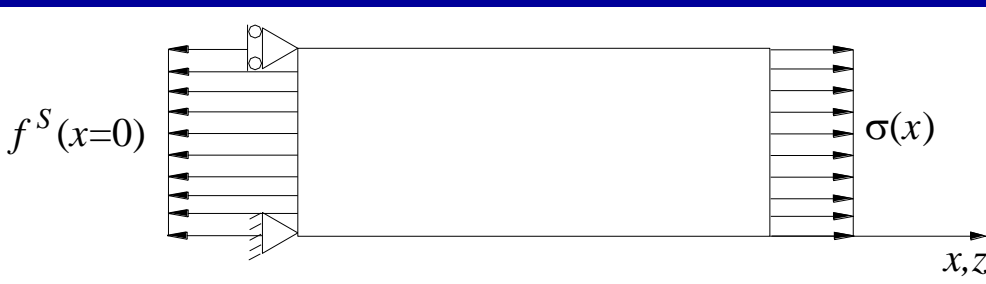
Considerando um carregamento mais geral

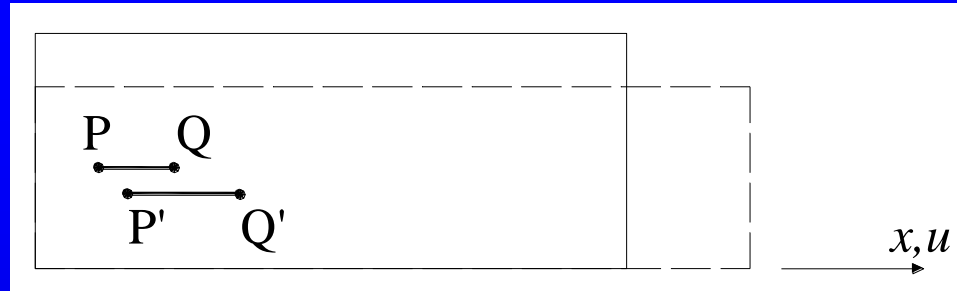


$$\sigma(x) = \frac{1}{A} \left[\int_x^L f^B(z) A dz + f^S A \right]$$

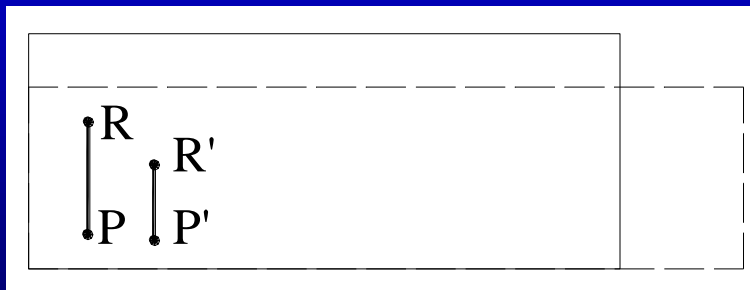
Lei de Hooke

$$\sigma = E \varepsilon \quad \Rightarrow \quad \varepsilon = \varepsilon(x)$$

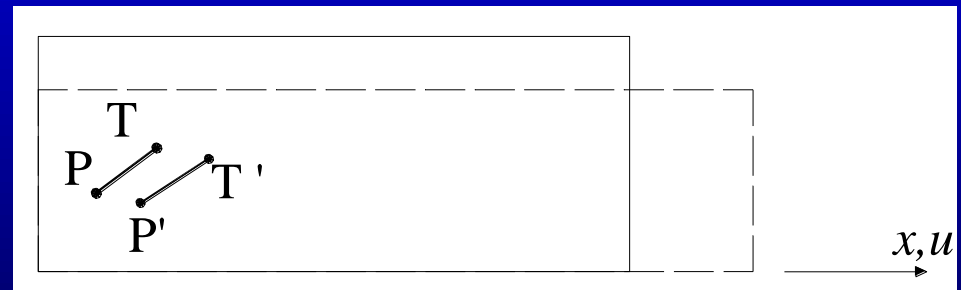




$$\varepsilon = \lim_{Q \rightarrow P} \frac{||P'Q'|| - ||PQ||}{||PQ||} = \left. \frac{du(x)}{dx} \right|_{x_P}$$

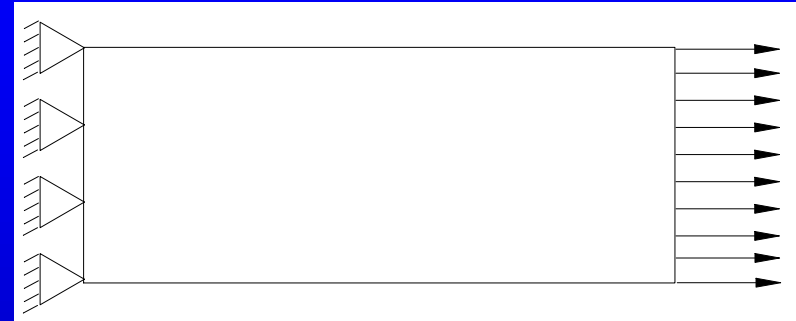
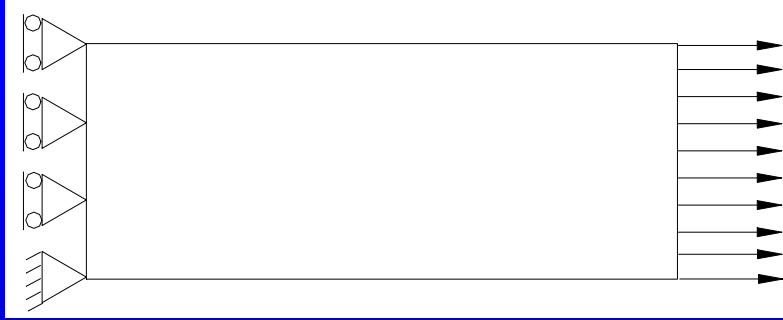


$$\varepsilon = \lim_{R \rightarrow P} \frac{||R'P'|| - ||RP||}{||RP||}$$

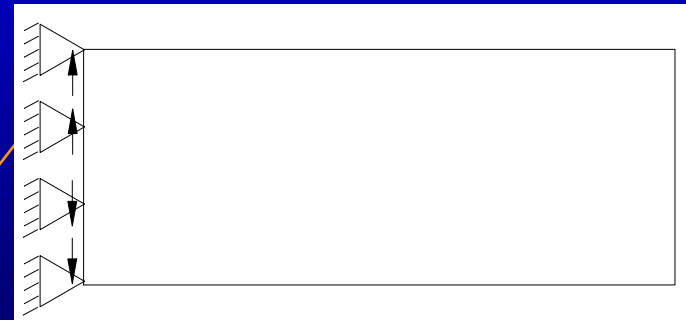
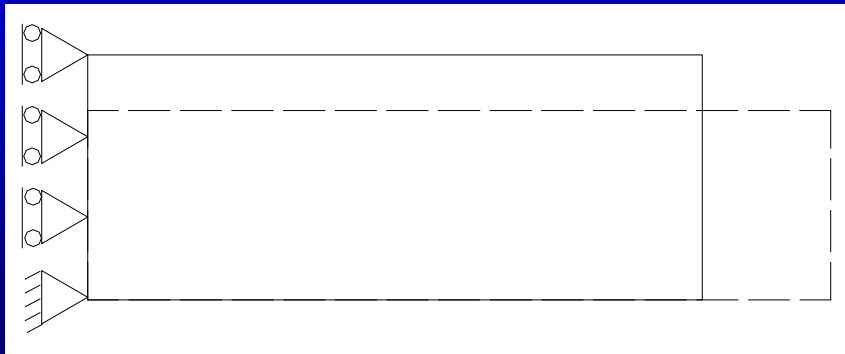


$$\varepsilon = \lim_{T \rightarrow P} \frac{||P'T'|| - ||PT||}{||PT||}$$

Considere o problema inicial com condições de contorno modificadas

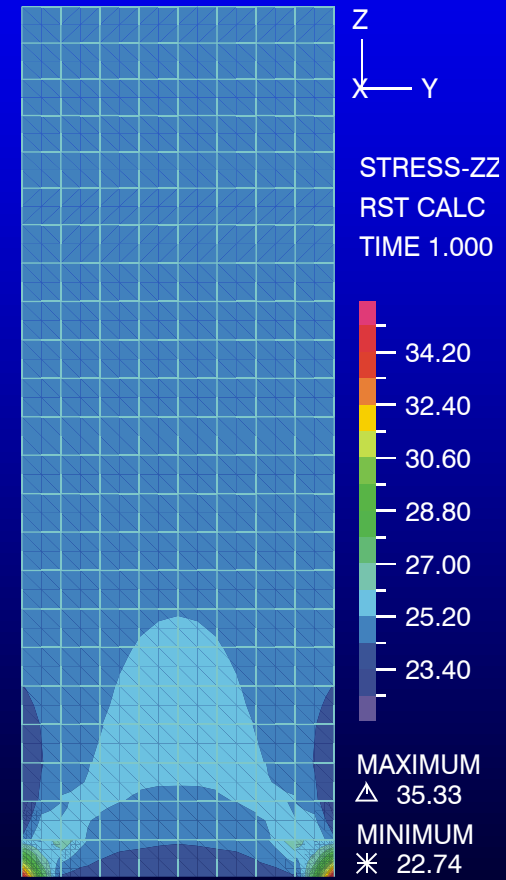
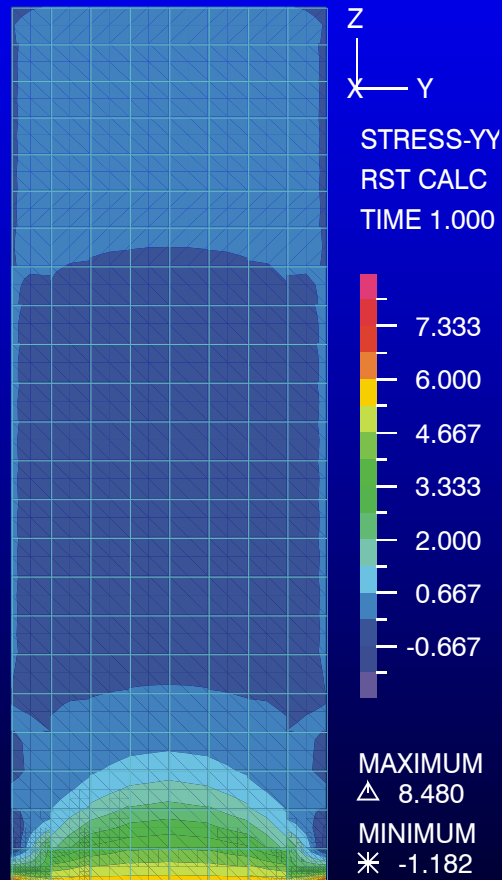
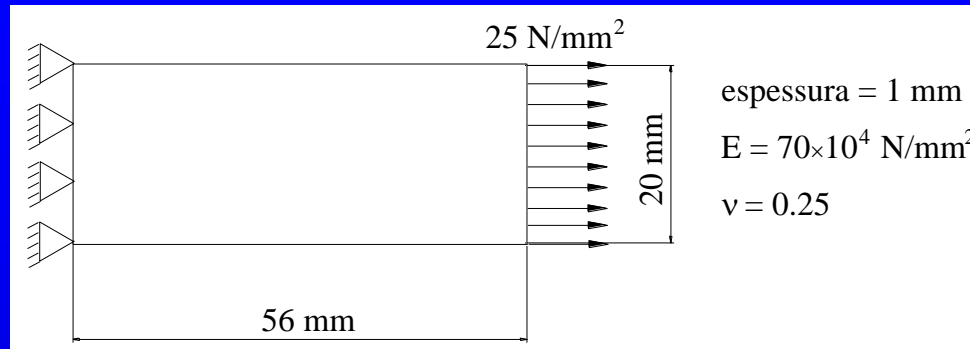


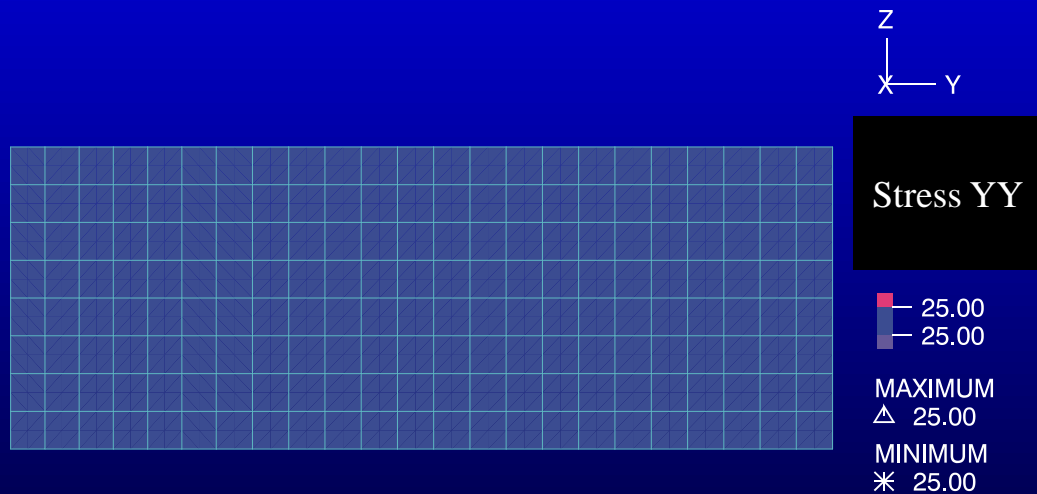
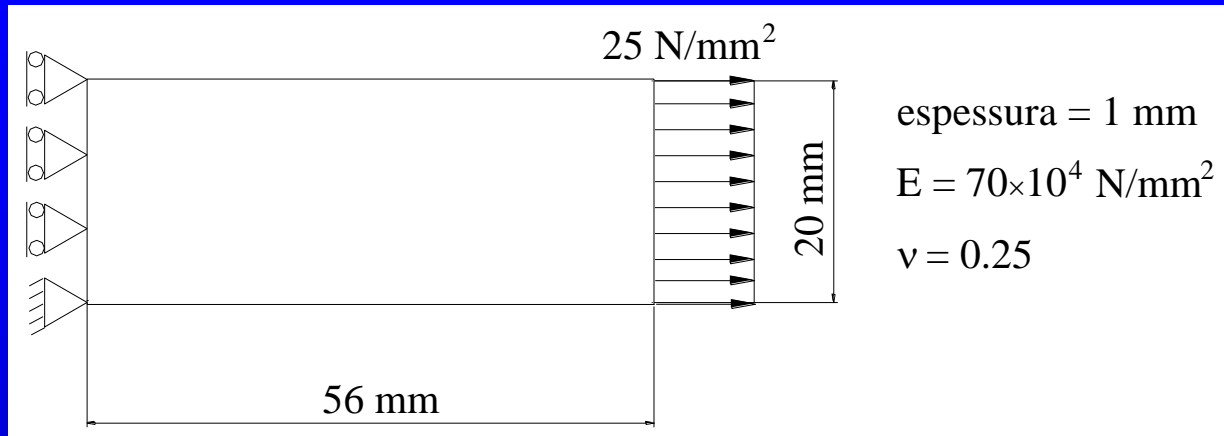
|||

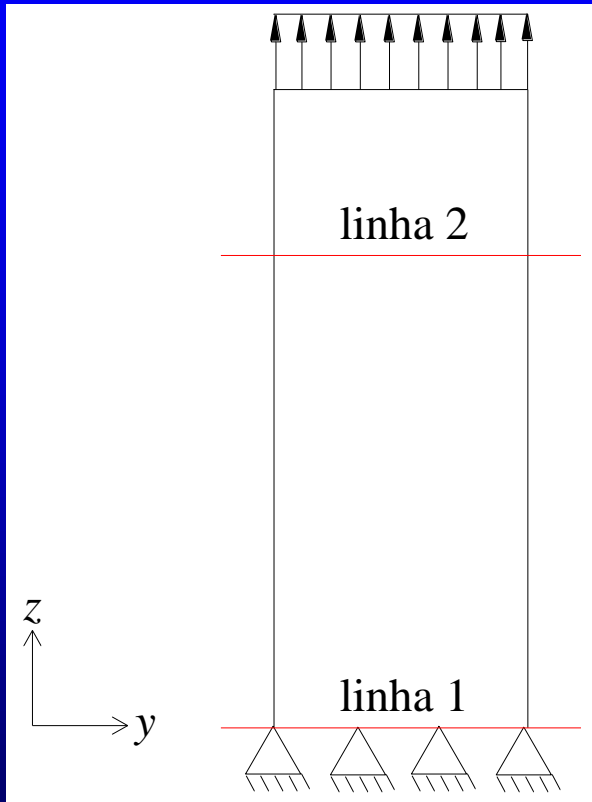


? Deve ser tal que os deslocamentos sejam nulos também na direção y

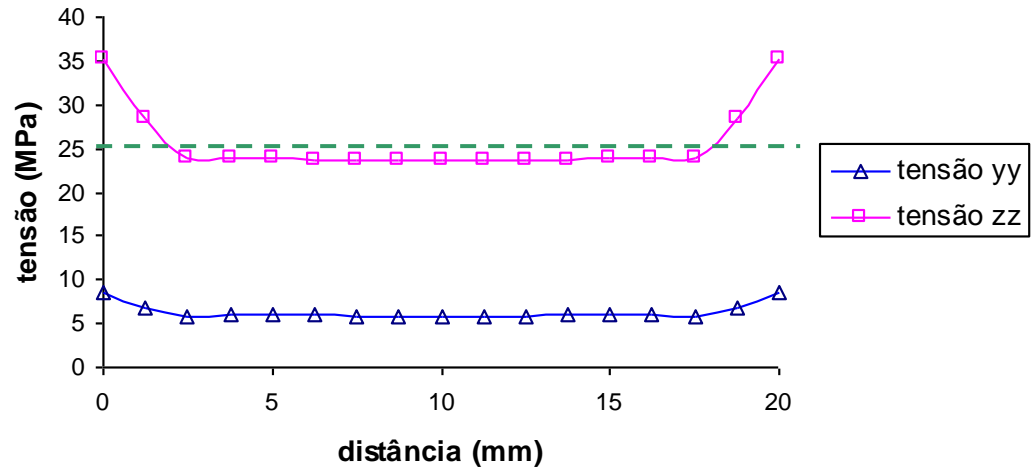
Solução do problema anterior (usando elementos finitos)



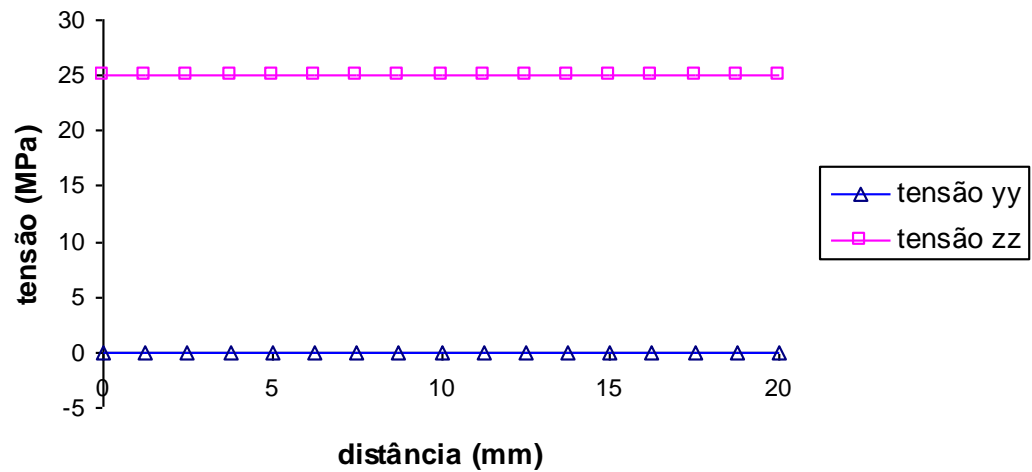




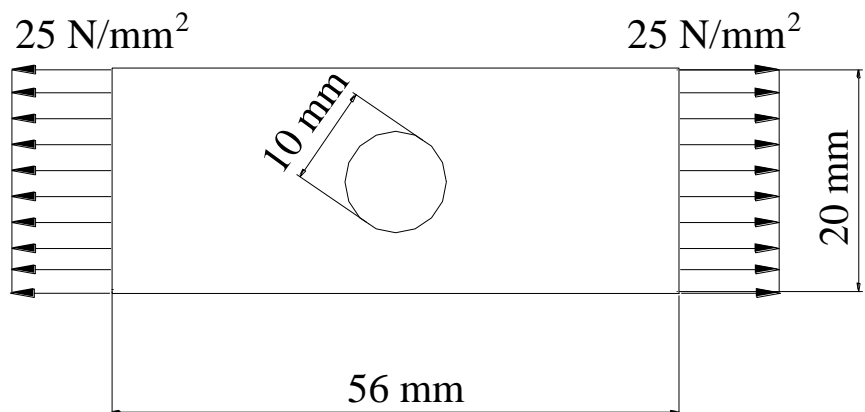
Tensões na linha 1



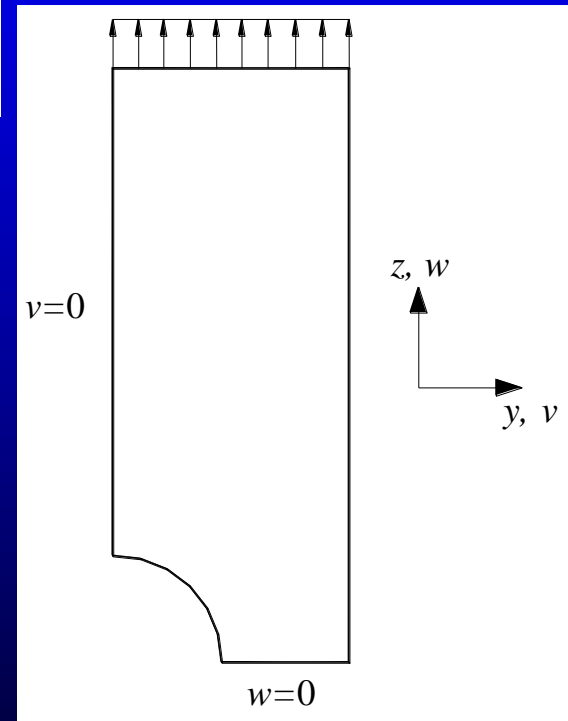
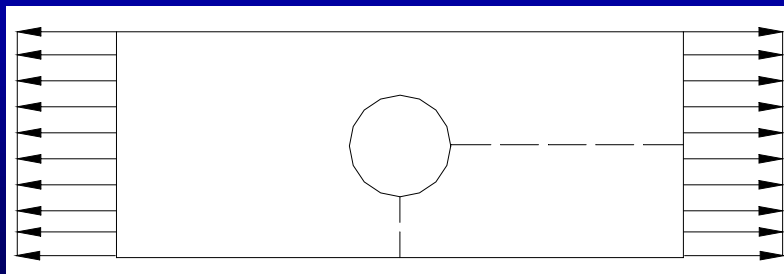
Tensões na linha 2



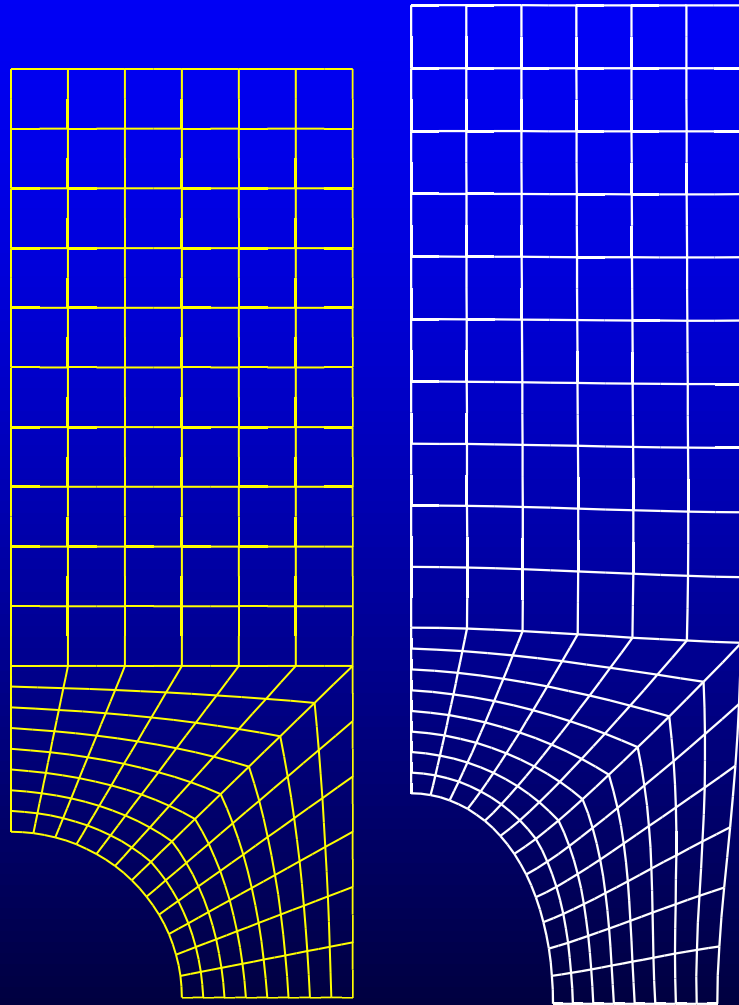
Ainda modificando o problema original



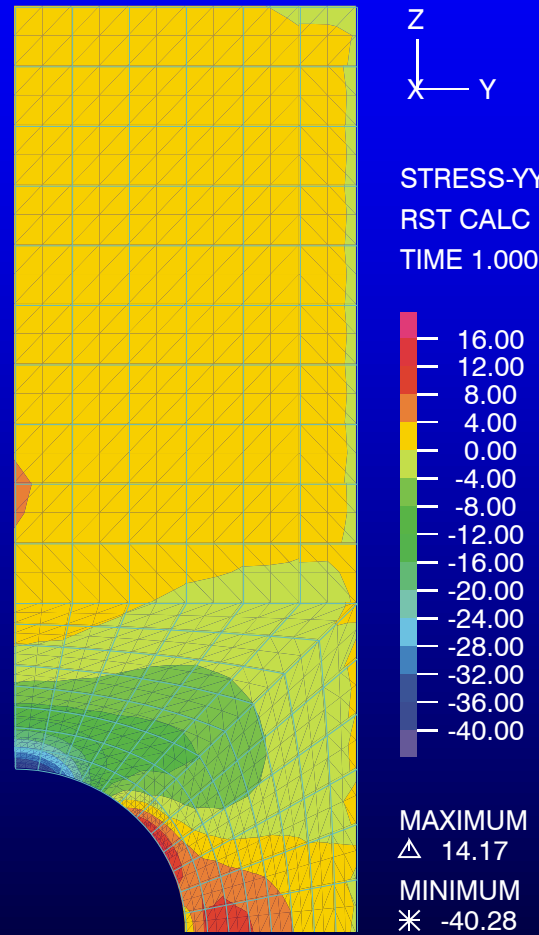
espessura = 1 mm
 $E = 70 \times 10^4 \text{ N/mm}^2$
 $\nu = 0.25$



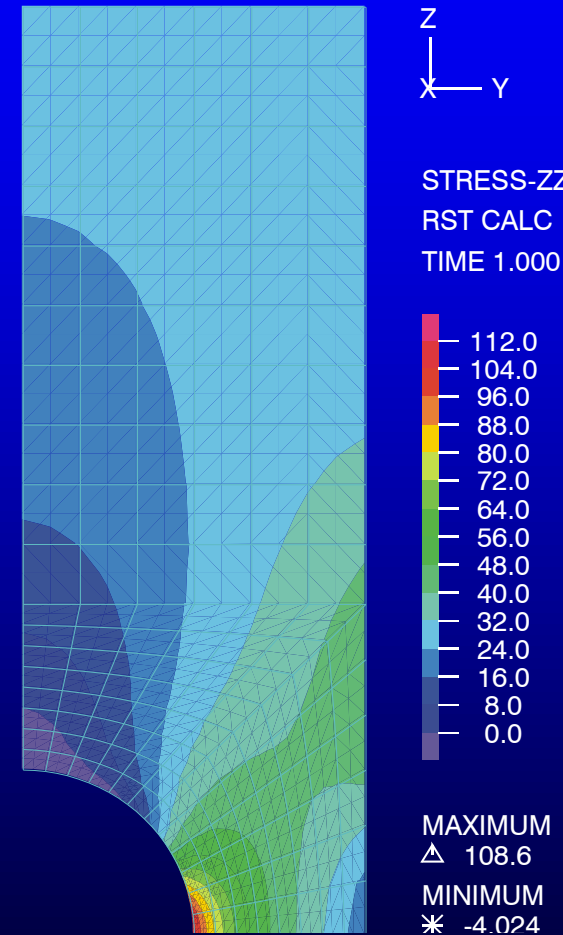
Malha original e deformada



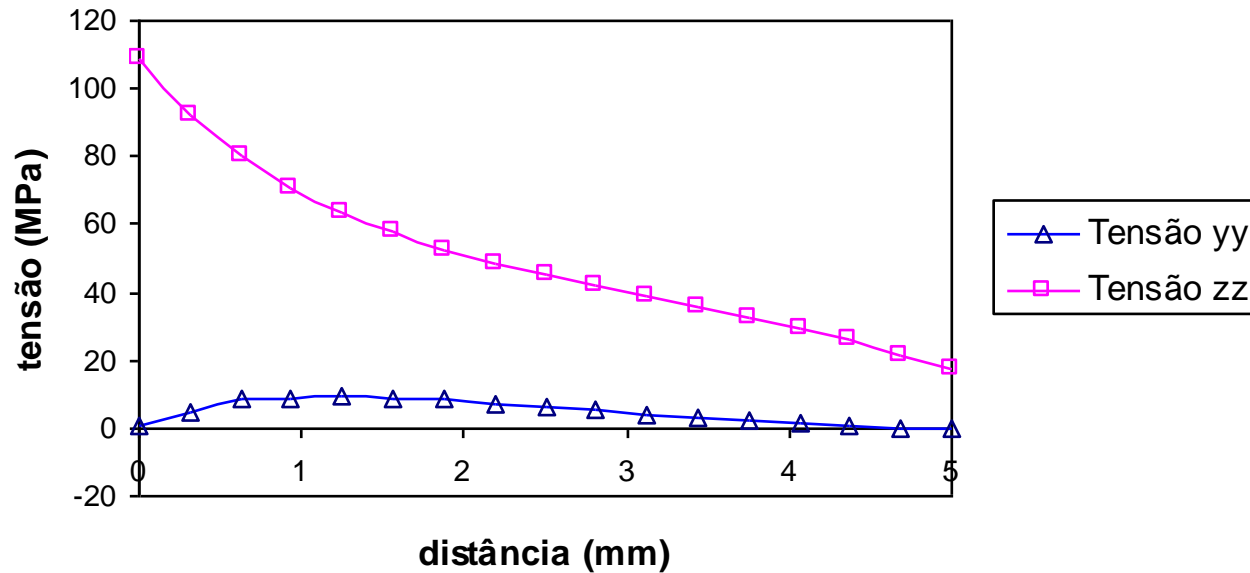
Tensão yy



Tensão zz



Tensões na linha de simetria horizontal



Para poder formular o problema em 2-D e 3-D

Generalizar as relações entre deslocamentos e deformações



Estudo das Deformações

Aprofundar a discussão do estado de tensão em um ponto



Estudo das Tensões

Relacionar o estado de tensão e o estado de deformação



Equações constitutivas