Pergunta 1

Resultante	Automomento ou Momento Resultante	Sistema Equivalente	
		Em *O*	**Em *P***
$\vec{R} \neq \vec{0}$ (Admite ECM)	$A = \vec{R} \cdot \vec{M}_{r,O} \neq 0$	$\vec{R}\,,\vec{M}_{r,O}$	$\vec{R}\,,\vec{M}^{\parallel}_{r,O}$
	$A = \vec{R} \cdot \vec{M}_{r,O} = 0$	$\vec{R}\,,\vec{M}_{r,O} = \vec{M}^{\perp}_{r,O}$	$\vec{R}$
$\vec{R} = \vec{0}$ (Não admite ECM)	$\vec{M}_{r,O} \neq \vec{0}$	$\vec{M}_{r,O}$ (Binário)	−
	$\vec{M}_{r,O} = \vec{0}$	Equilíbrio	−

- $A = \vec{R} \times \vec{M}_{r,O}$

- $\vec{M}_{F,A} = \vec{r}_{AB} \times \vec{R} + \vec{M}_{F,B}$

$$ECM = \begin{cases} M_x - (yR_z - zR_y) = A/R^2 \cdot A_x \\ M_y - (zR_x - xR_z) = A/R^2 \cdot A_y \\ M_z - (xR_y - y R_x) = A/R^2 \cdot A_z \end{cases}$$

Momento do Binário: $\vec{M}_{\vec{F_1},\vec{F_2}} = \vec{r}_{F_1,F_2} \times \vec{F_2}$

Vetor Momento Resultante Mínimo: $\vec{M}_{/\!/} = \vec{M}_{r,O} \cdot \hat{R}$

Pergunta 2

Centro de Massa: $\vec{M}_{r,A} = \vec{0}$
(Intensidade de $\vec{B}$)

Intensidade de $\vec{A}$: $\vec{R} = \vec{0}$

Pergunta 3

Tensor de tensões: $\sigma = \begin{vmatrix} \sigma_{xx} & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_{yy} & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_{zz} \end{vmatrix}$ $\quad \sigma = \begin{vmatrix} \sigma_{xx} & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & \sigma_{yy} & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & \sigma_{zz} \end{vmatrix}$

Tensão axial: $\sigma = \frac{F}{A}$ // Deformação axial: $E = \frac{\Delta \ell}{\ell}$

Tensão de corte: $\tau = \frac{F}{A}$ // Deformação de corte: $\gamma = tg\,\theta = \frac{\delta}{\ell}$

Tensor de deformações: $\varepsilon = \begin{vmatrix} \varepsilon_{xx} & \varepsilon_{xy} & \varepsilon_{xz} \\ \varepsilon_{yx} & \varepsilon_{yy} & \varepsilon_{yz} \\ \varepsilon_{zx} & \varepsilon_{zy} & \varepsilon_{zz} \end{vmatrix}$

- $\varepsilon_{xx} = -\frac{\nu}{E}(\sigma_{xx}+\sigma_{yy}+\sigma_{zz}) + \frac{1}{2G}\sigma_{xx}$
- $\varepsilon_{xx} = -\frac{\nu}{E}(\sigma_{xx}+\sigma_{yy}+\sigma_{zz}) + \frac{1}{2G}\sigma_{yy}$
- $\varepsilon_{xx} = -\frac{\nu}{E}(\sigma_{xx}+\sigma_{yy}+\sigma_{zz}) + \frac{1}{2G}\sigma_{zz}$
- $\varepsilon_{xy} = \varepsilon_{yx} = \frac{1}{2G}\tau_{xy}$

//

- $\nu = \frac{E}{2G} - 1$
- $G = \frac{E}{2(\nu+1)}$
- $\sigma' = T\sigma T^T$

//

Sentido $\oplus$: $\circlearrowleft$ *

$R_x(\theta) = \begin{vmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{vmatrix}$ $\quad R_z(\theta) = \begin{vmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 \end{vmatrix}$

$R_y(\theta) = \begin{vmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{vmatrix}$

//

Direcção Planos Principais:

$$\theta_1 = \frac{1}{2} tg^{-1}\left(\frac{2\tau_{xy}}{\sigma_x - \sigma_y}\right)$$

//

Direcção para τ_{MAX}: $\theta_2 = \pm \frac{1}{2} tg^{-1}\left(\frac{|\sigma_y - \sigma_x|}{2\tau_{xy}}\right)$

Tensões máximas e mínimas:

$$\tau_{MAX} = R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_C = \frac{\sigma_x + \sigma_y}{2}$$

$\sigma_{MAX} = \sigma_C + R$ (>0, Tração)

$\sigma_{MIN} = \sigma_C - R$ (<0, compressão)

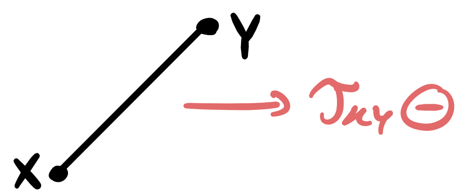
*

$$\sigma_x' = c^2\sigma_x + s^2\sigma_y + 2cs\,\tau_{xy} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) + \tau_{xy}\sin(2\theta)$$

$$\sigma_y' = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) - \tau_{xy}\sin(2\theta)$$

$$\tau_{xy}' = -cs\sigma_x + cs\sigma_y + c^2\tau_{xy} - s^2\tau_{xy} = -\frac{\sigma_x - \sigma_y}{2}\sin(2\theta) + \tau_{xy}\cos(2\theta)$$

Circulo: Ponto X ou A $(\sigma_x; \tau_{xy})$
Ponto Y ou B $(\sigma_y; -\tau_{xy})$



Pergunta 4

Força de corte $V(x)$: $\vec{R} = \vec{0}$

Momento fletor $M(x)$: $\vec{M}_{r,o} = \vec{0}$

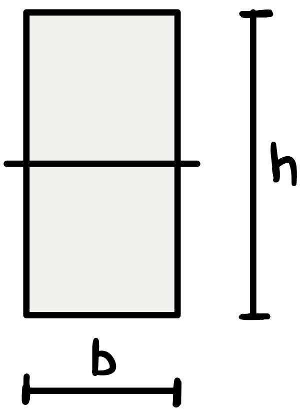
Suporte B_y: $\vec{M}_{r,o} = \vec{0}$

Suporte A_y: $\vec{R} = \vec{0}$

Tensão axial: $\sigma = \frac{M \cdot y}{2}$

Tensão de corte: $\tau = \frac{V \cdot Q}{I b} = \frac{3V}{2h^2}$

$$Q(y) = \frac{b}{2}\left(\frac{h^2}{4} - y^2\right)$$



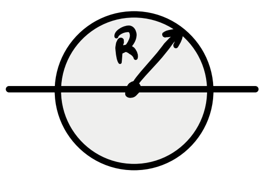
$$A = bh$$

$$I = \frac{bh^3}{12}$$

$$Q_{MAX} = \frac{bh^2}{8}$$

$$\sigma_{MAX} = \frac{Mh}{2I}$$

$$\tau_{MAX} = \frac{3V}{2A}$$



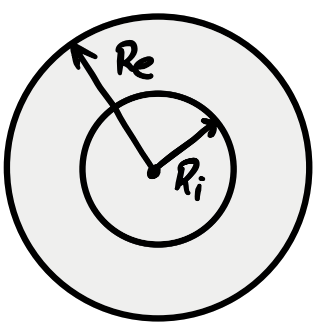
$$A = \pi R^2$$

$$I = \frac{\pi R^4}{4}$$

$$\sigma_{MAX} = \frac{MR}{I}$$

$$Q_{MAX} = \frac{2R^3}{3}$$

$$\tau_{MAX} = \frac{4V}{3A}$$



$$A = \pi(R_e^2 - R_i^2)$$

$$I = \frac{\pi(R_e^4 - R_i^4)}{4}$$

$$\sigma_{MAX} = \frac{MR_e}{I}$$

$$\tau_{MAX} = \frac{2V}{A}$$

$$Q_{MAX} = R_e(R_e^2 + R_i^2)$$