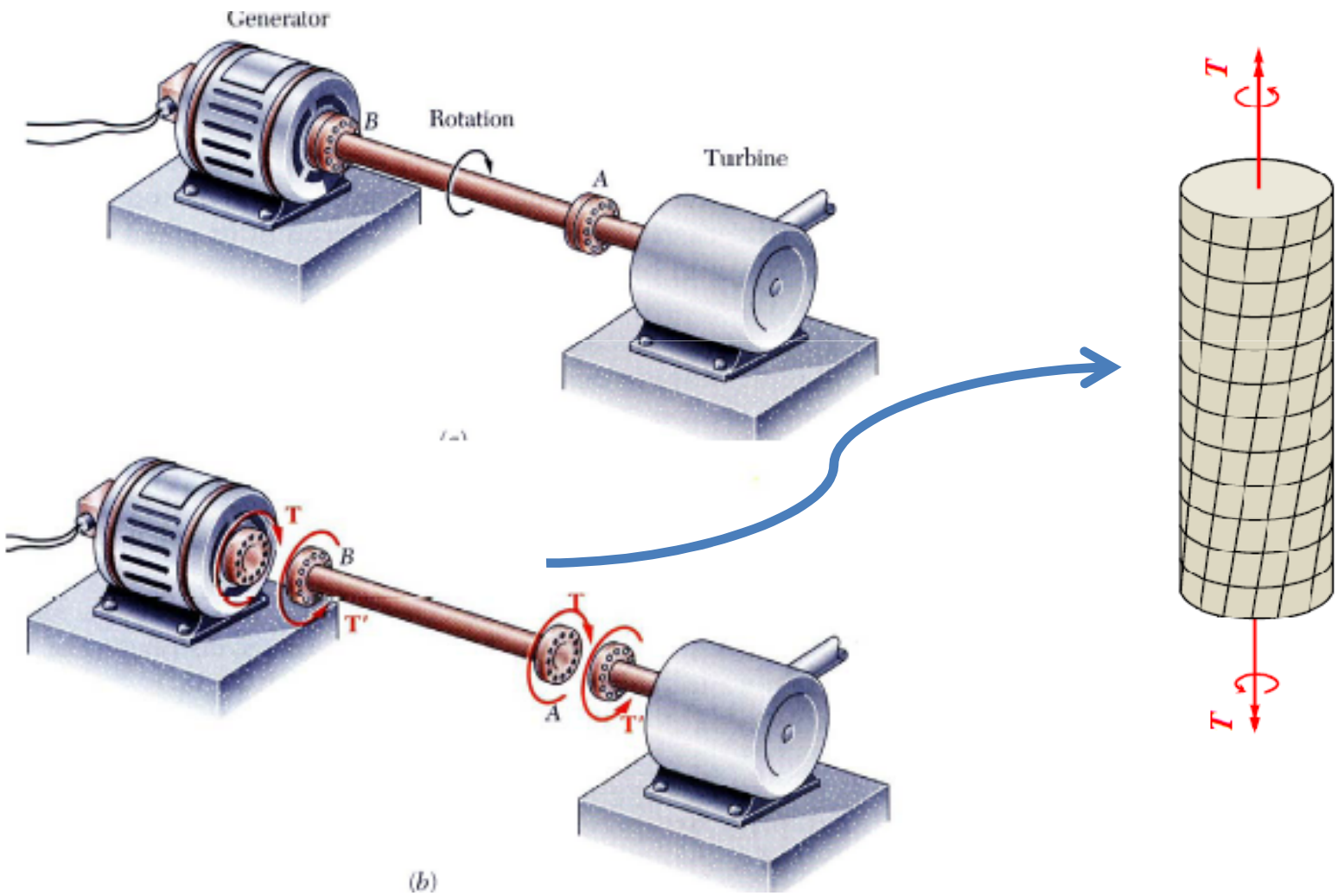
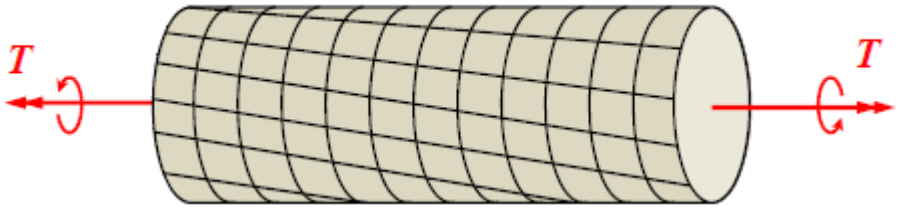
Torção de Barras Cilíndricas

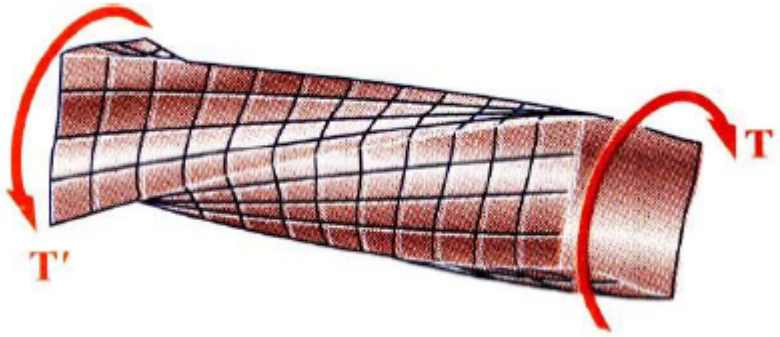
Mecânica dos Sólidos I

Aplicação e Motivações

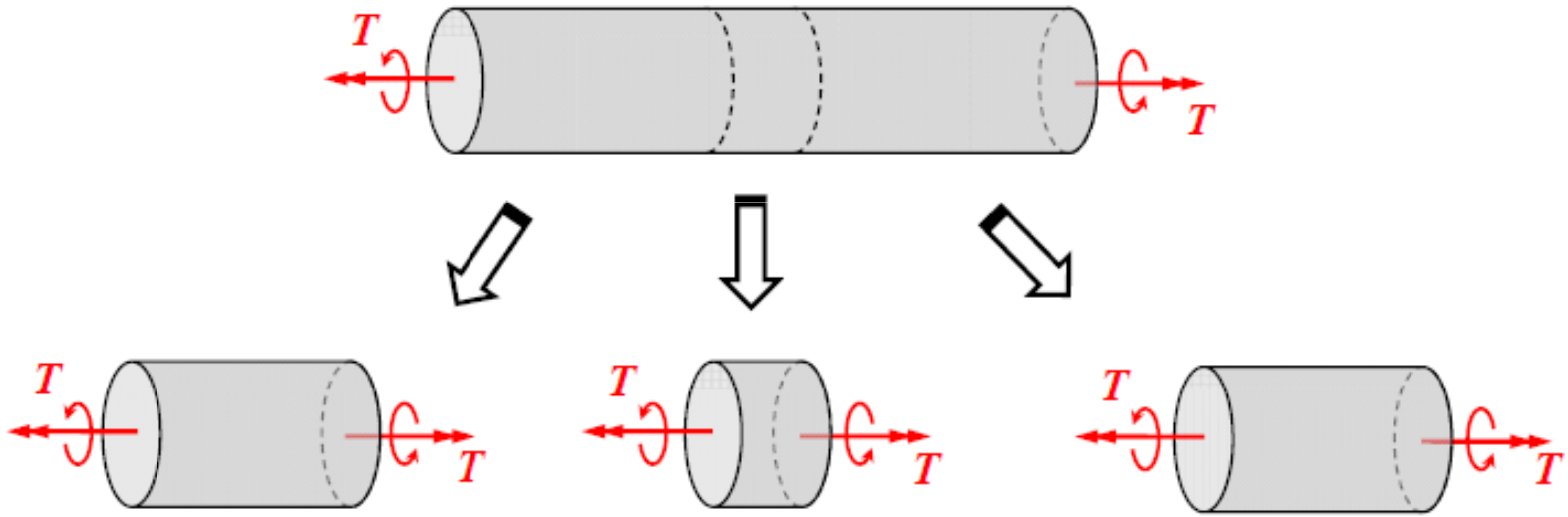


Torção de Barras (Eixos) *Cilíndricos*



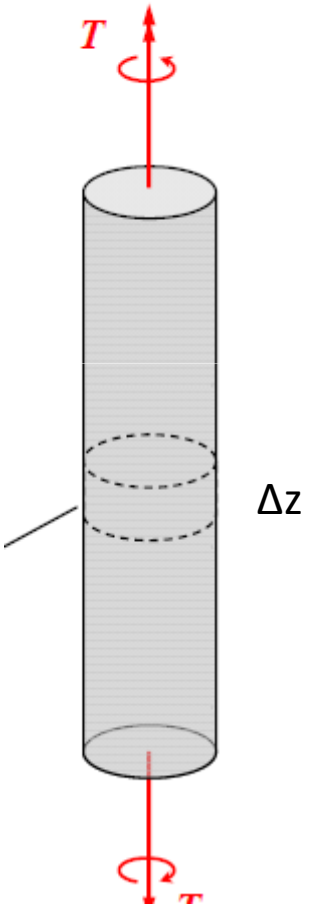


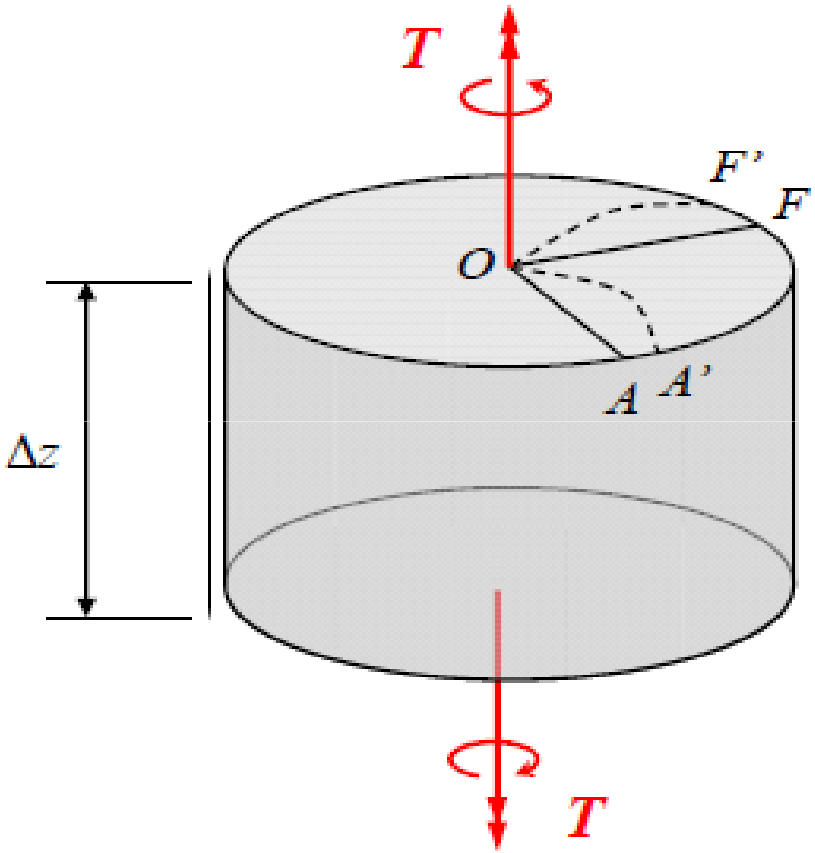
Análise Preliminar:
Equilíbrio



Estados de Tensão e Deformações Homogêneos

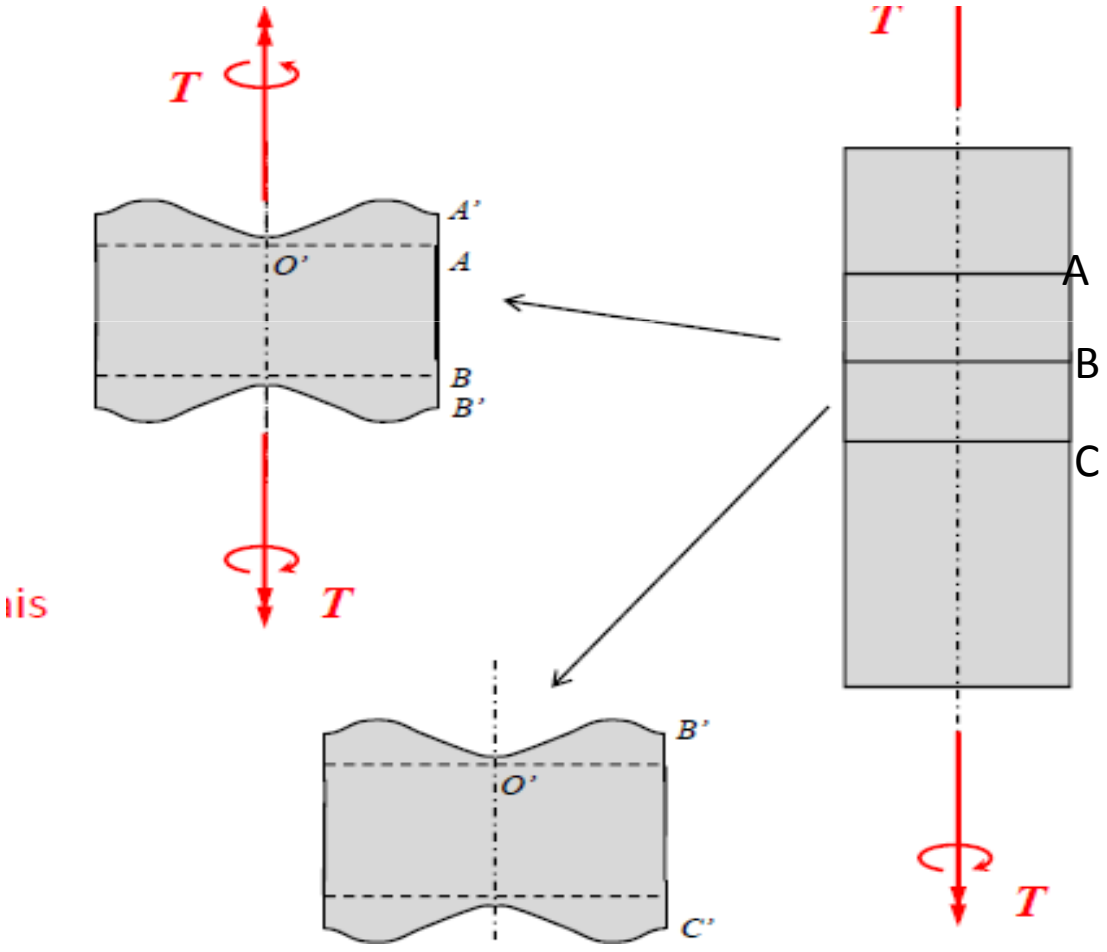
Geometria da Deformação



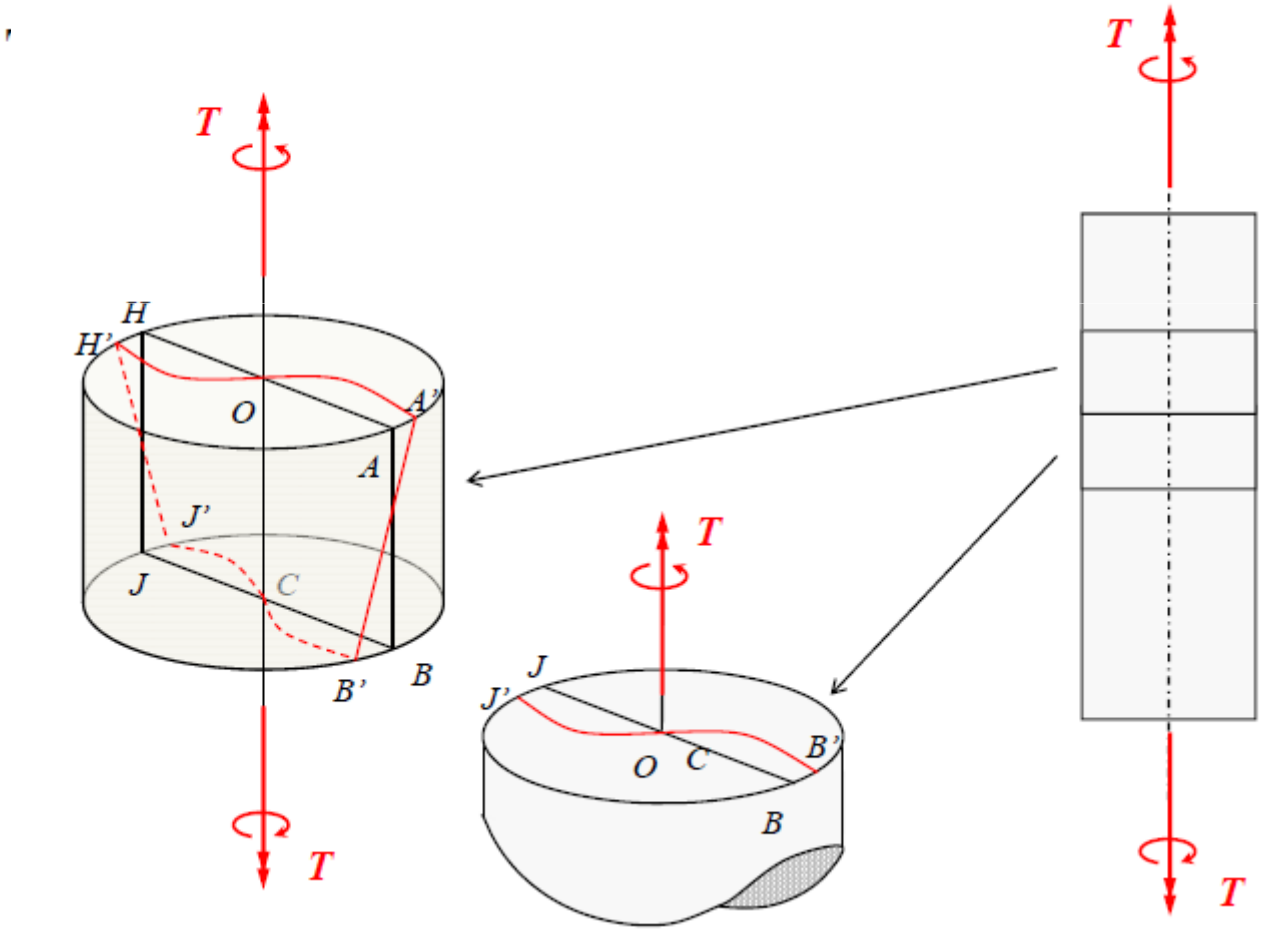


Hip.: Não há deformação longitudinal ou radial (volume do cilindro permanece constante)

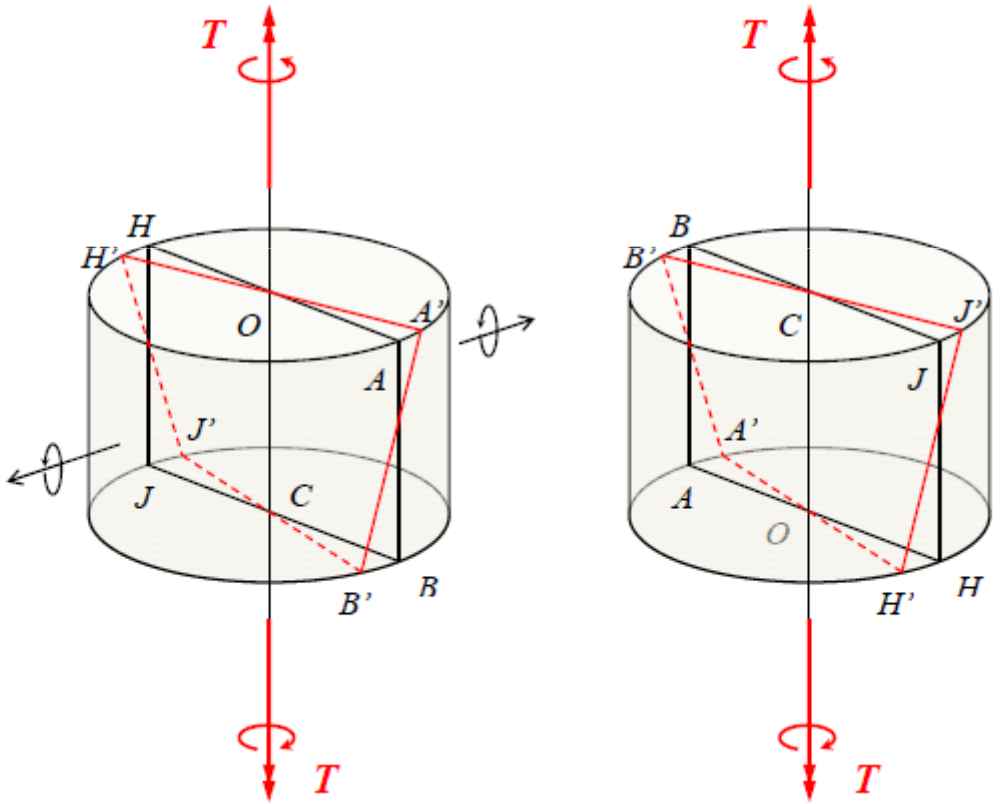
Simetria Axial :
seções inicialmente planas permanecem planas

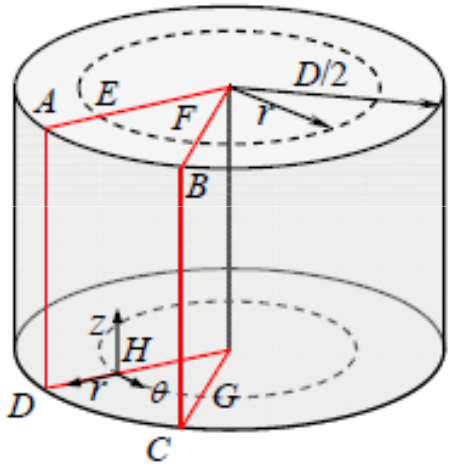


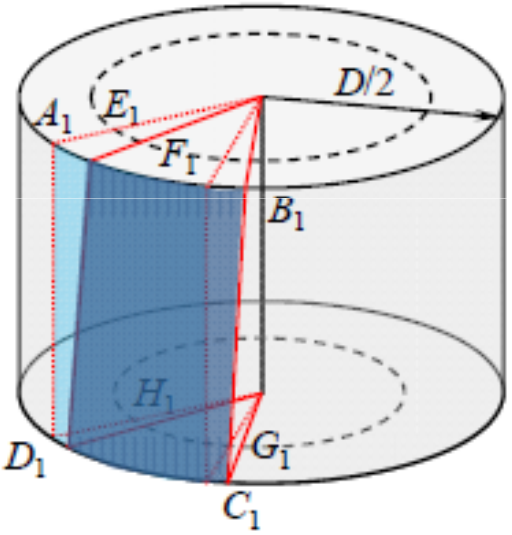
Geometria da Deformação: Direção Radial – Deslocamentos Incompatíveis

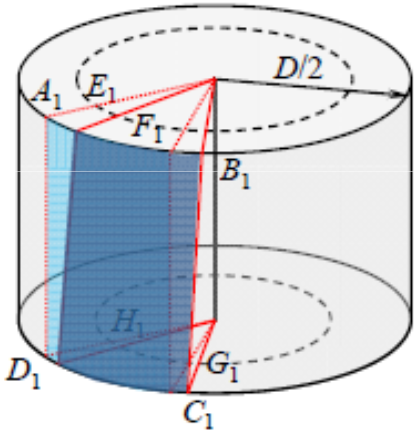


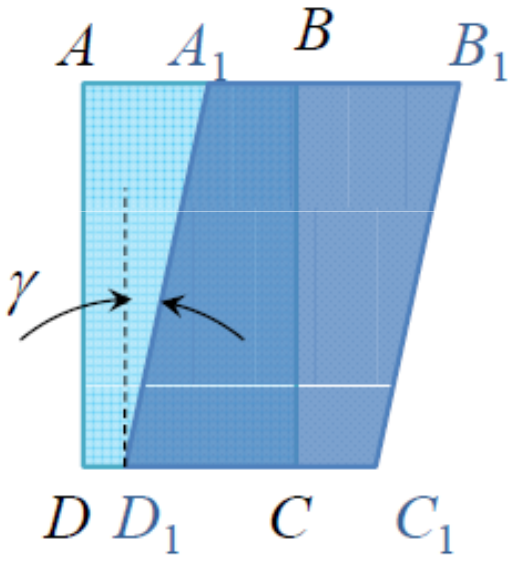
Geometria da Deformação:
Deslocamentos na direção circunferencial variam linearmente com o raio

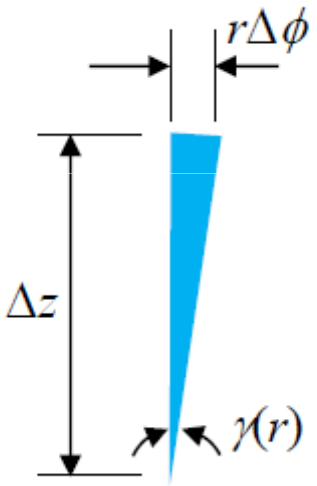



A
E
F
r
D/2
B
Z
H
r
θ
D
G
C


A1
E1
F1
D/2
B1
H1
D1
G1
C1



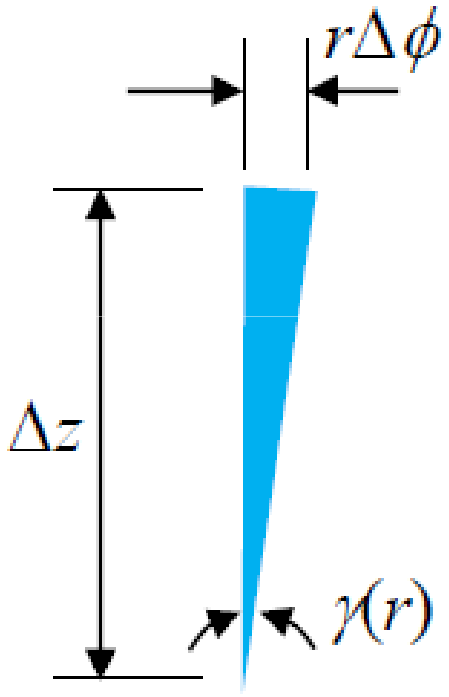




Distorção Angular (zθ)

Distorção Angular

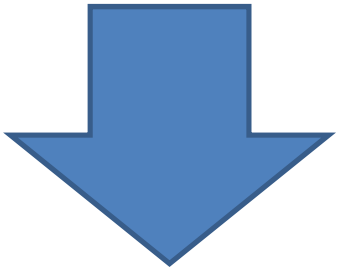
$$\gamma(r) = \lim_{\Delta z \to 0} r \frac{\Delta \phi}{\Delta z} = r \frac{d\phi}{dz}$$



Estado de Tensões

$$\tau_{\theta z} = G\,\gamma_{\theta z}$$

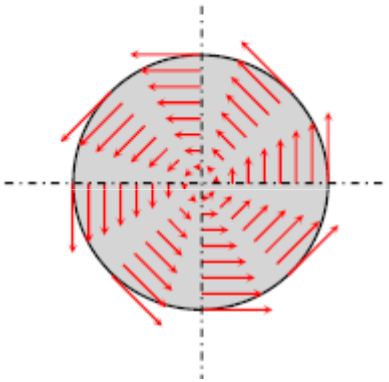
Equação Constitutiva



$$\tau_{\theta z} = G\,r\,\frac{d\emptyset}{dz}$$

Equilíbrio Global

$\tau_{\theta z}$



$$T = \int r\,\tau(r)\,dA = \int r\left(Gr\frac{d\phi}{dz}\right)dA$$

$$= G\frac{d\phi}{dz}\int r^2\,dA = GJ\frac{d\phi}{dz} = \frac{\tau(r)J}{r}$$

$$J = \pi D^4/32$$

Rotação Diferencial : Eixo como uma mola de rotação