PMR 2450 - Projeto de Máquinas

Princípios de projeto de máquinas

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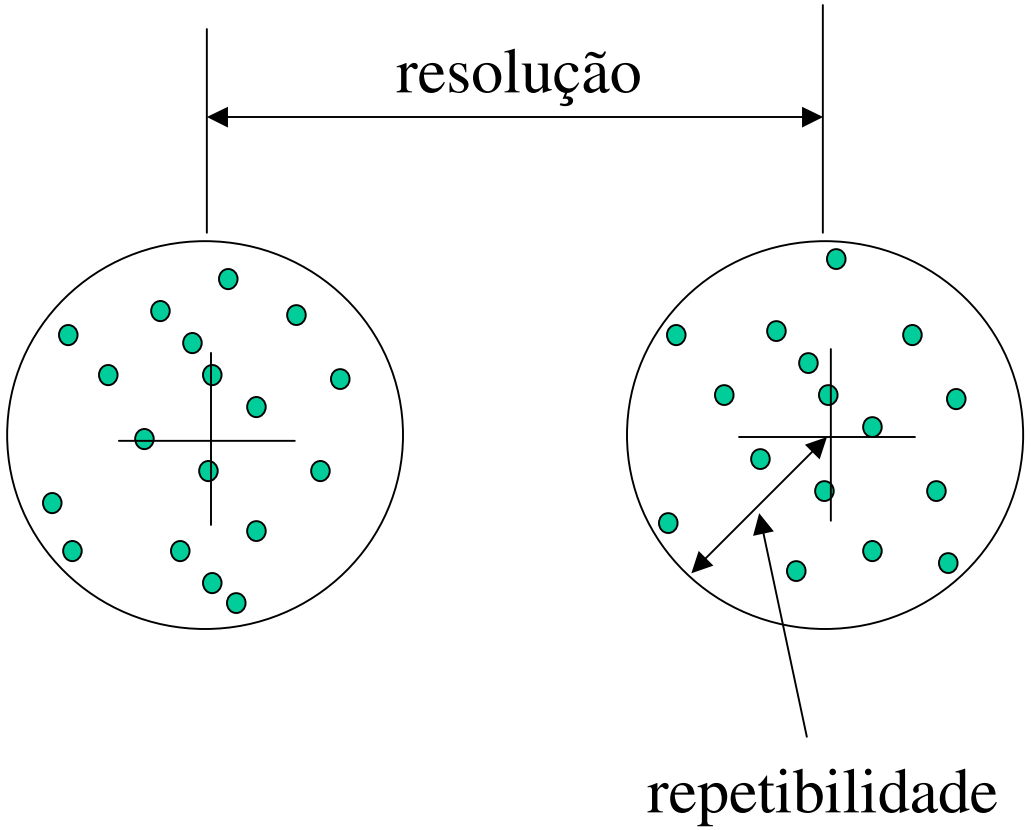
agosto/2005

Resolução, precisão e acurácia

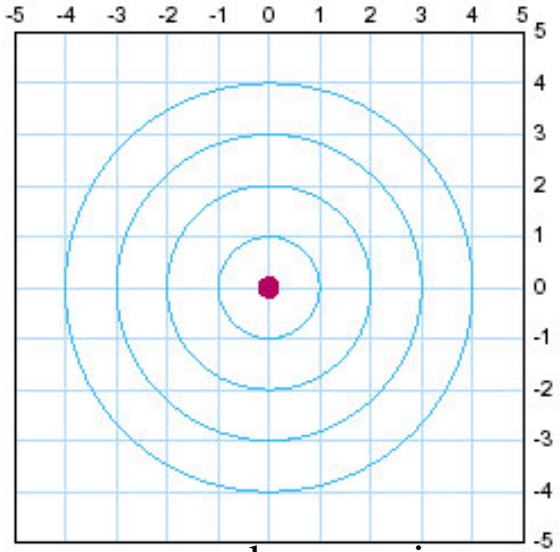
Resolução: menor deslocamento medido pela máquina

Precisão: capacidade de repetir o mesmo deslocamento

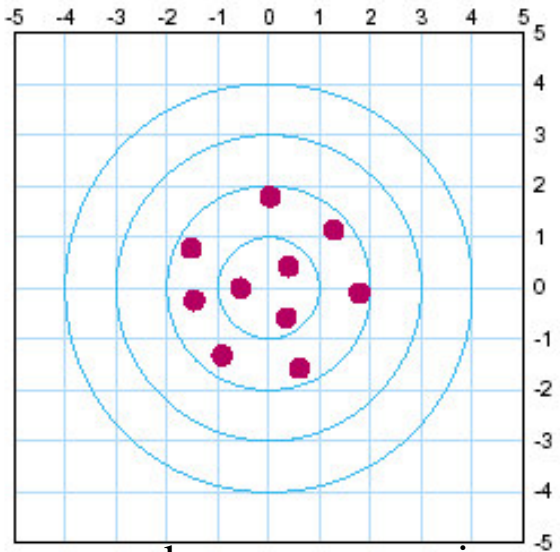
Acurácia: exatidão (padrão de medição)



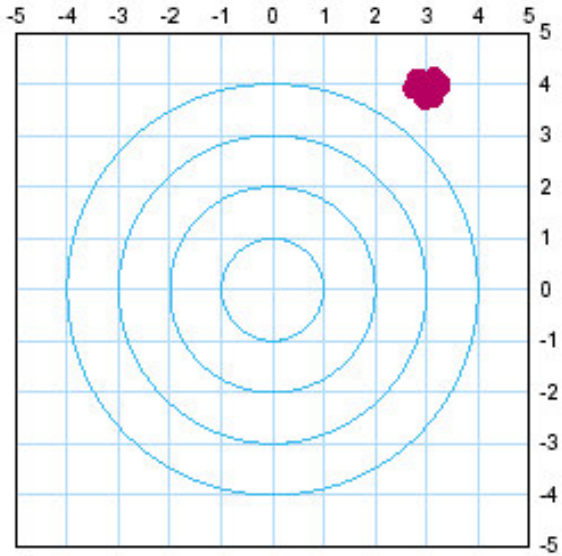
Precisão e acurácia



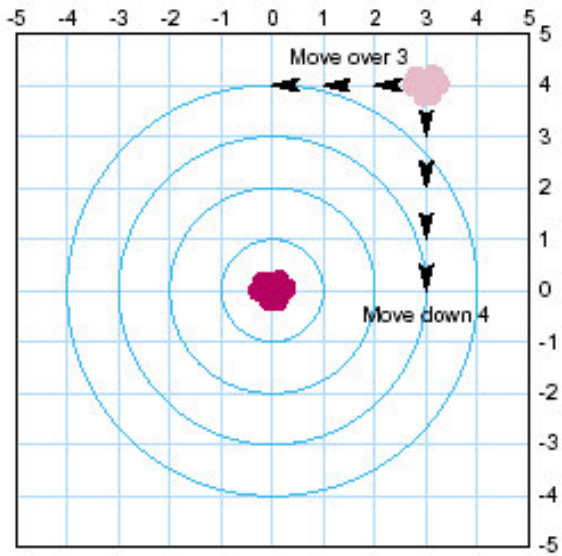
acurado e preciso



acurado e pouco preciso



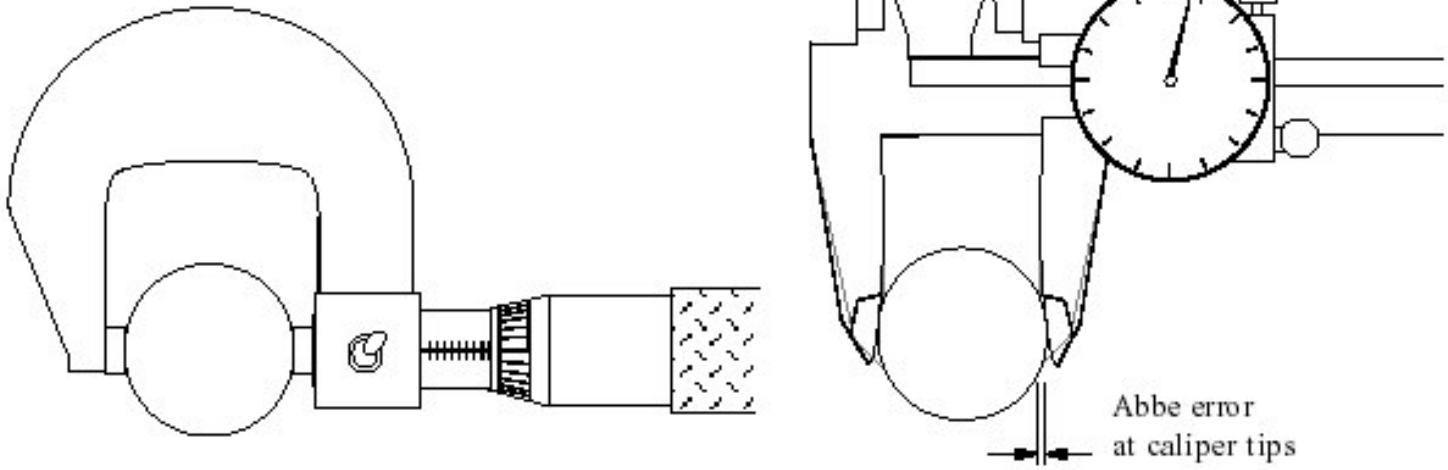
preciso e não acurado

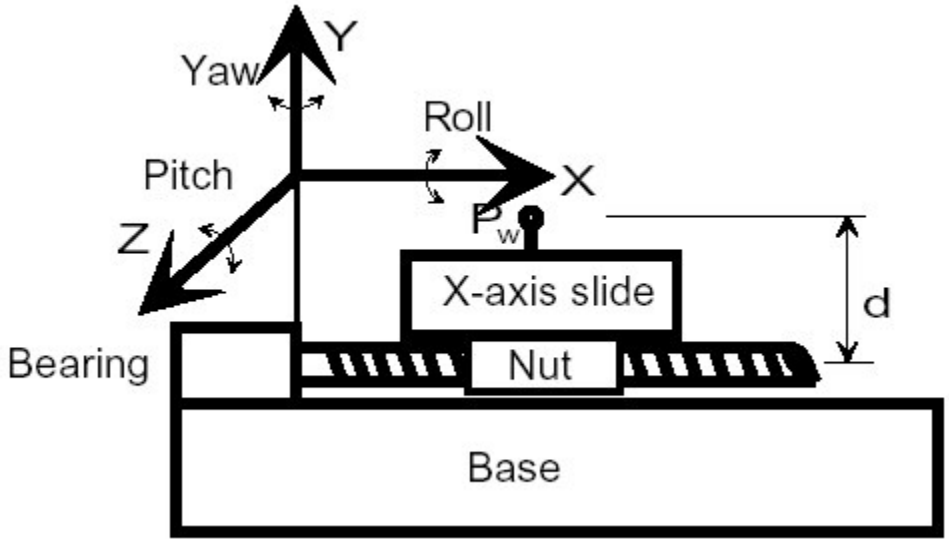


compensação de erro

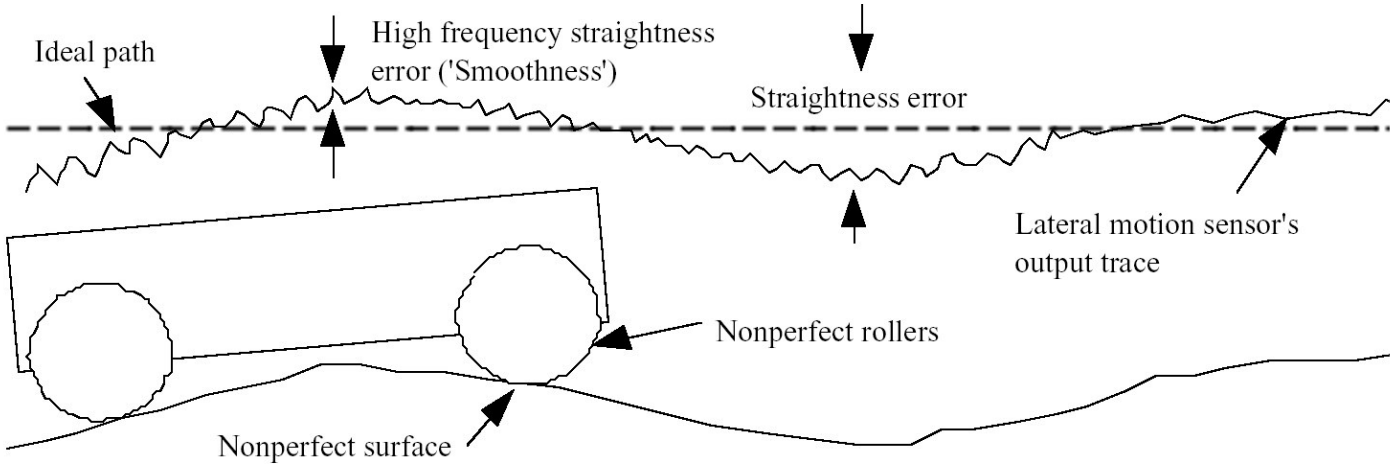
Erros geométricos

Erro de Abbe

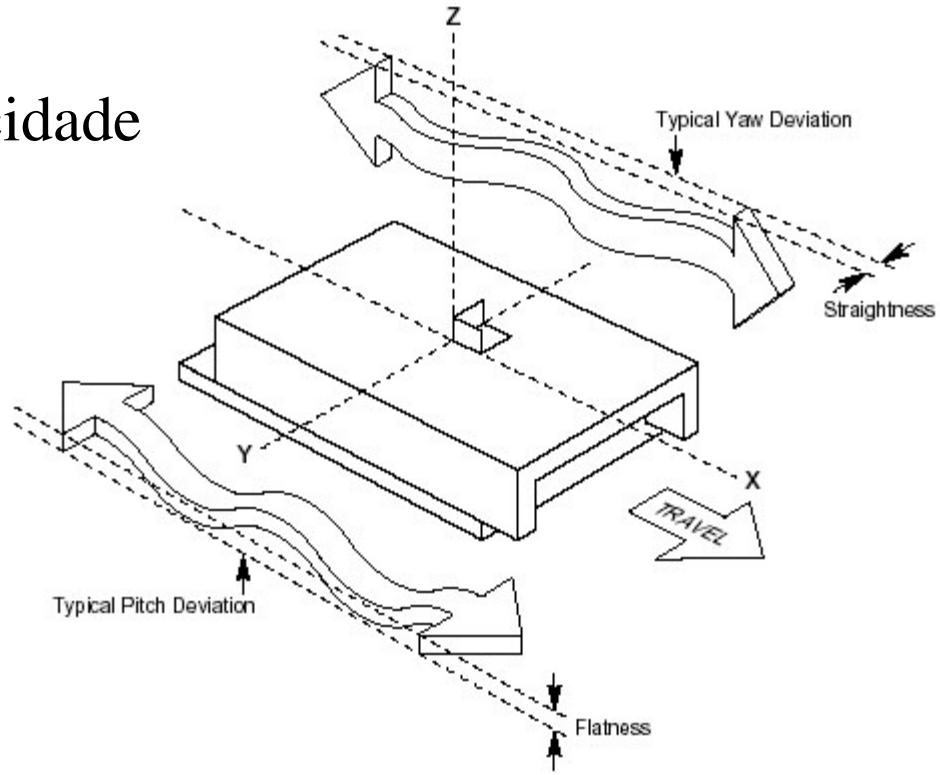




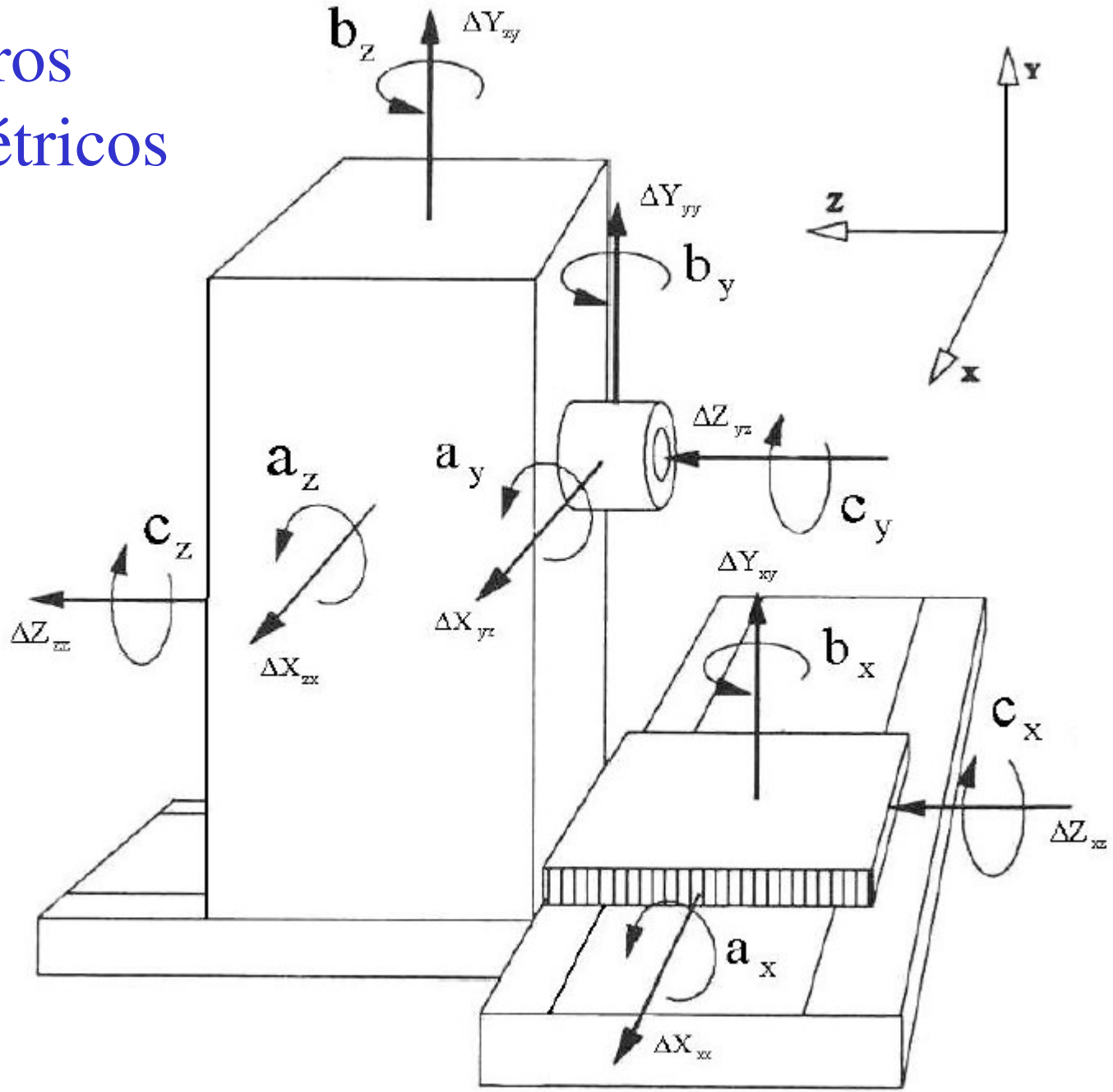
Erros de forma



linearidade e planicidade



Erros geométricos



Erros dinâmicos

Vibrações: freqüências naturais, rigidez dinâmica

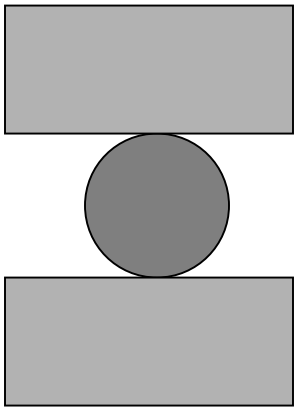
rigidez

massa

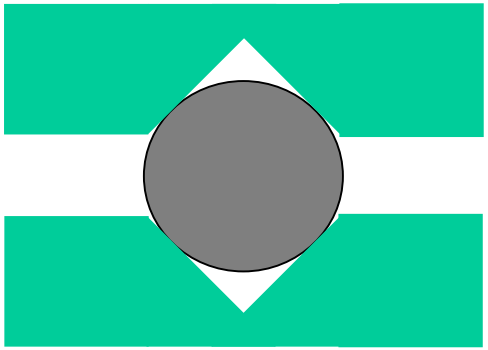
amortecimento

Excitação: rolamentos, eixo árvore, atuação

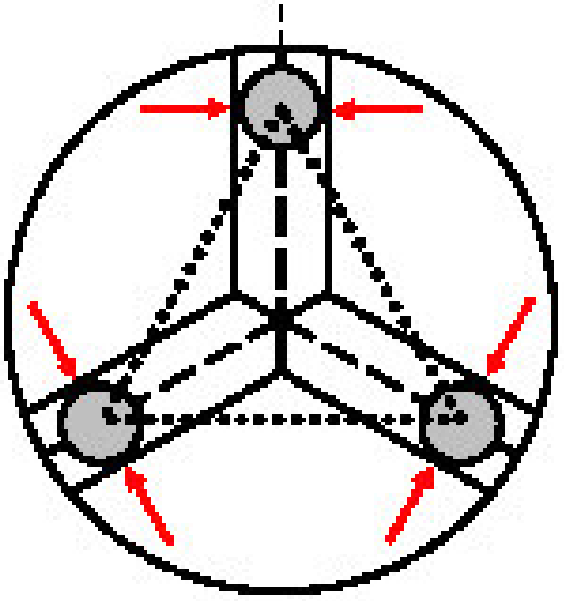
Princípio Cinemático



restringe 1 grau de liberdade

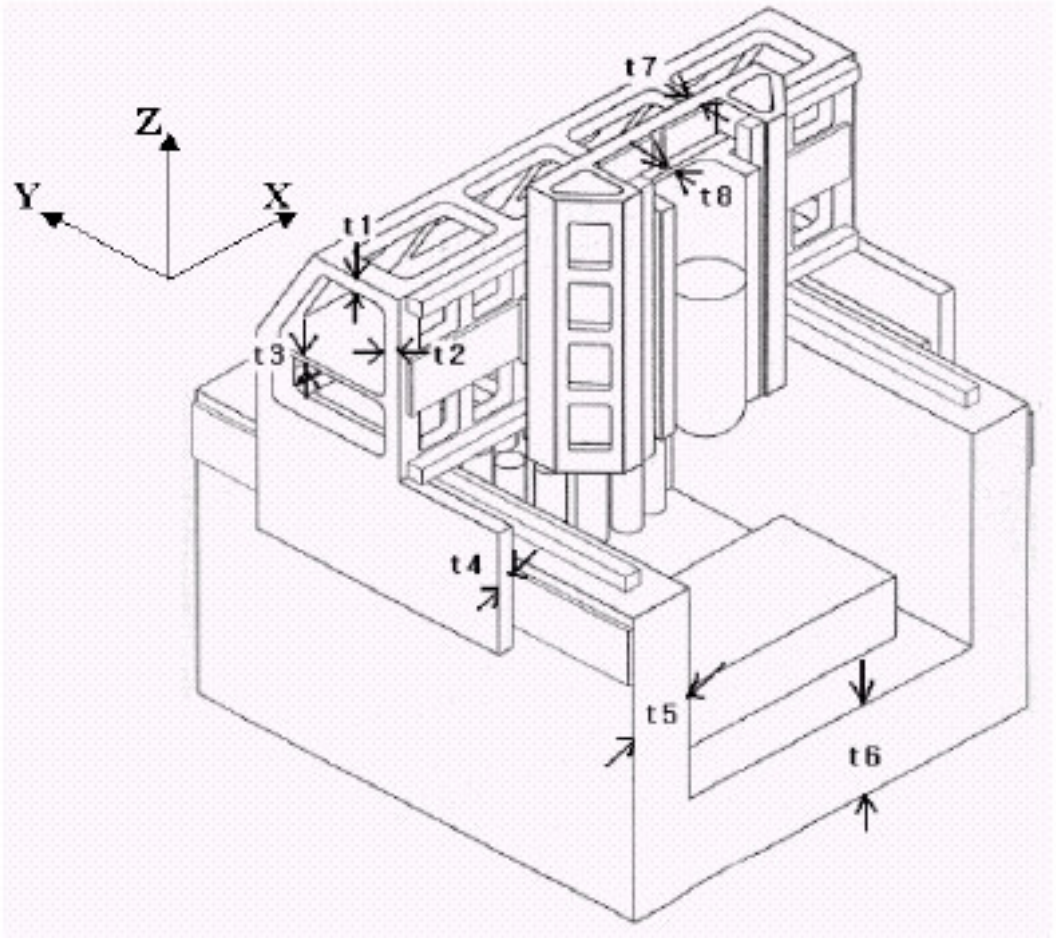


restringe 2 graus de liberdade



restringe 6 graus de liberdade

Estrutura de máquinas



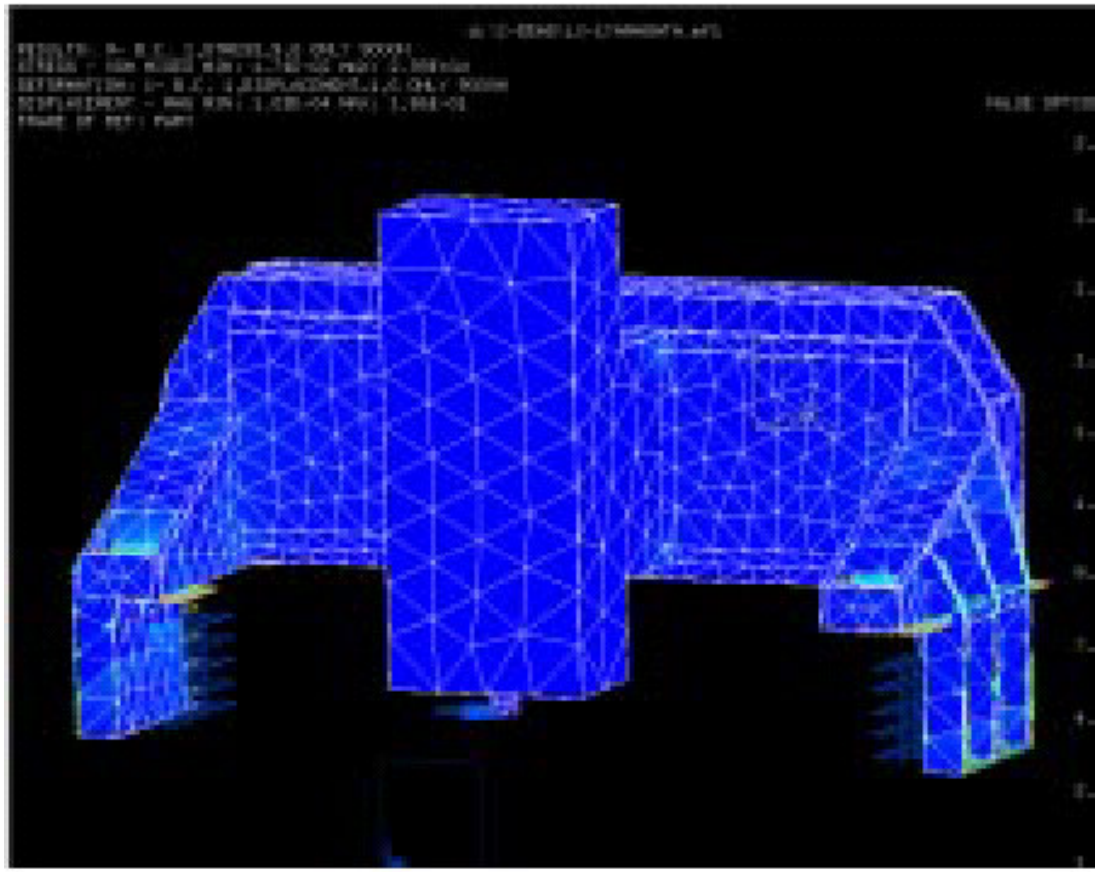
Base da máquina

Fixa:

ferro fundido

Móvel:

alumínio



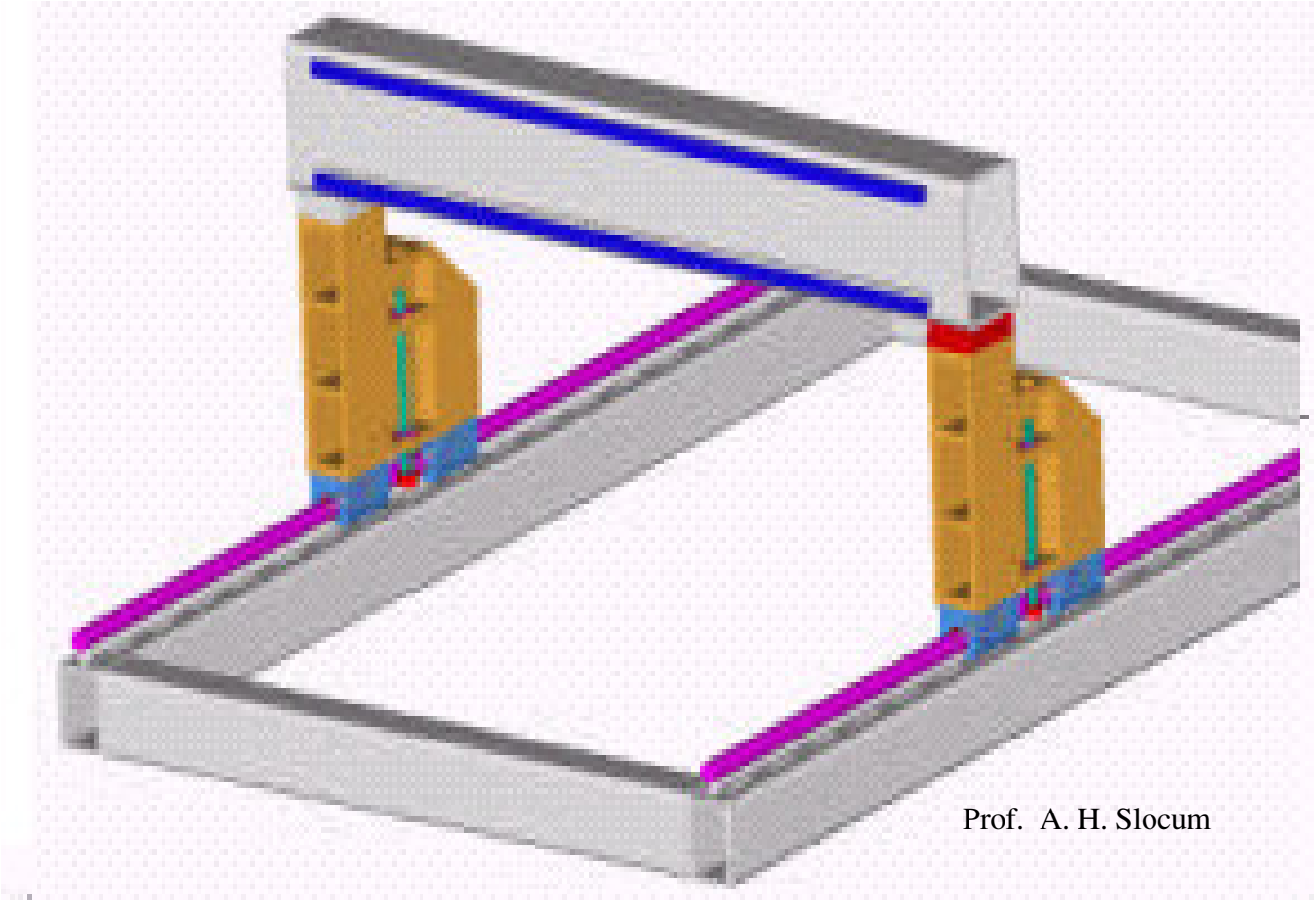
Rigidez

Massa

Deflexão, freqüência natural

Estrutura com chapas e perfis tubulares

uniões: solda, parafuso



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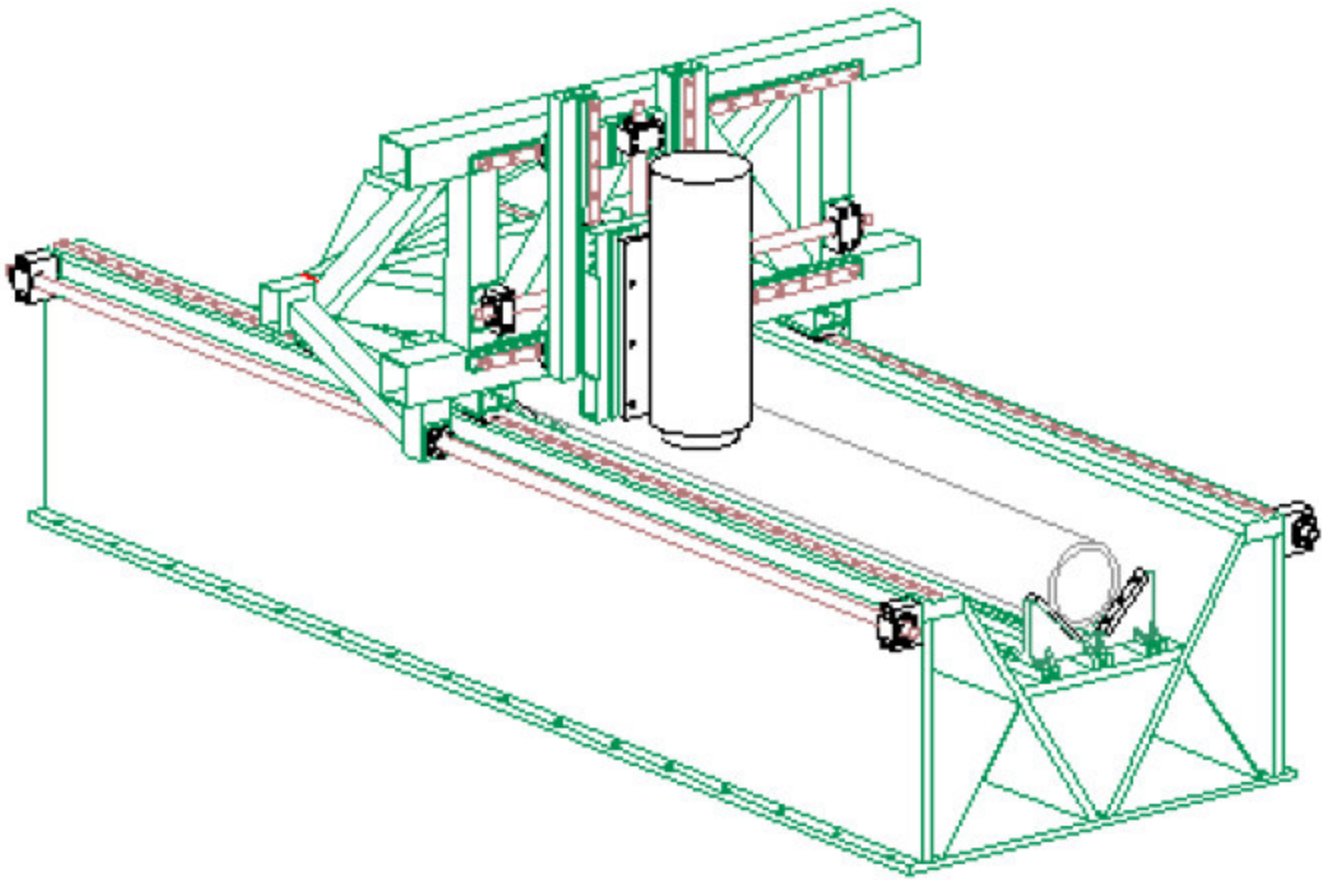
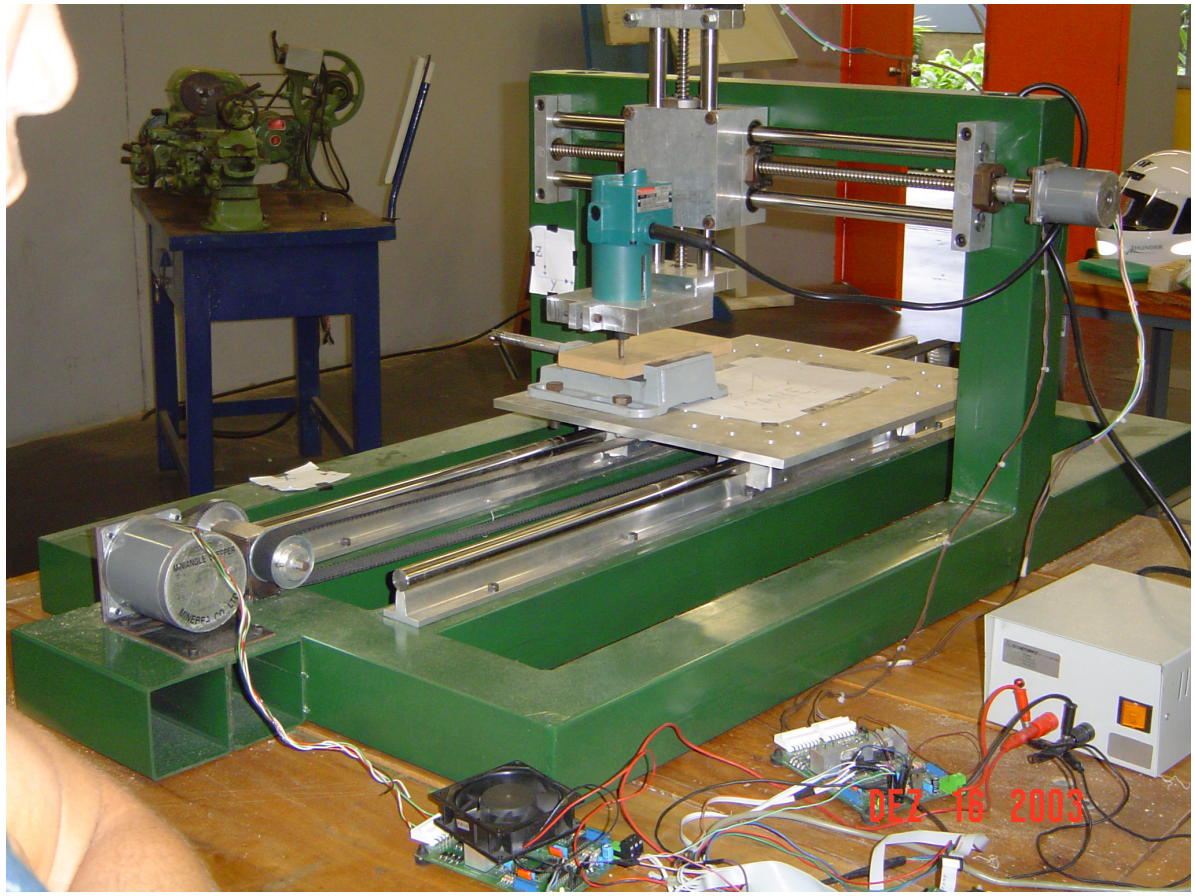
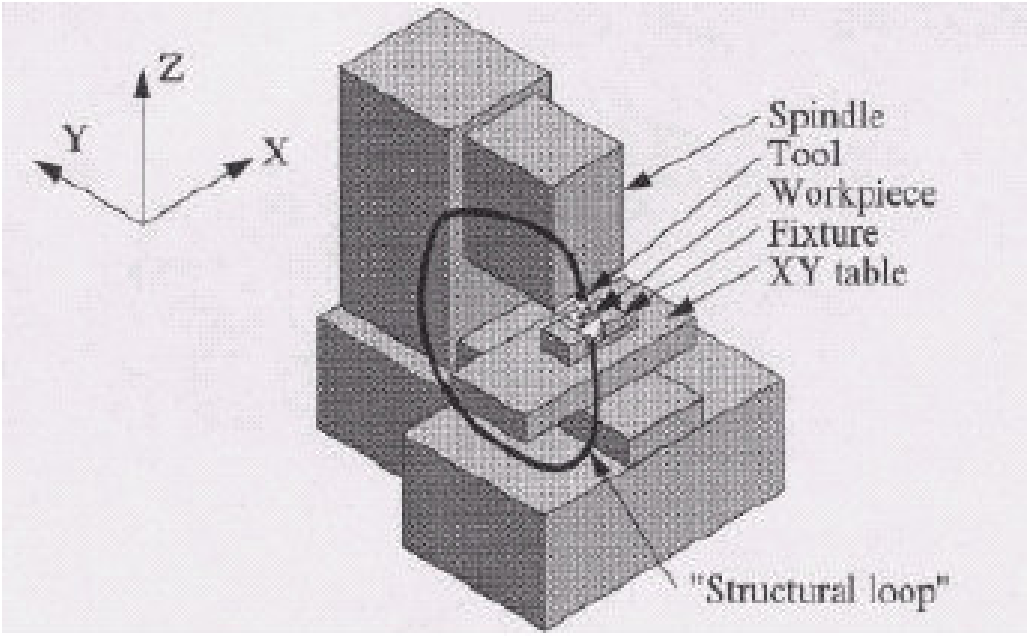
Exemplo de máquina com estrutura soldada

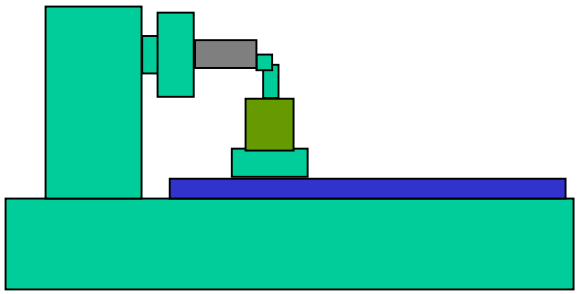



DEZ 16 2003

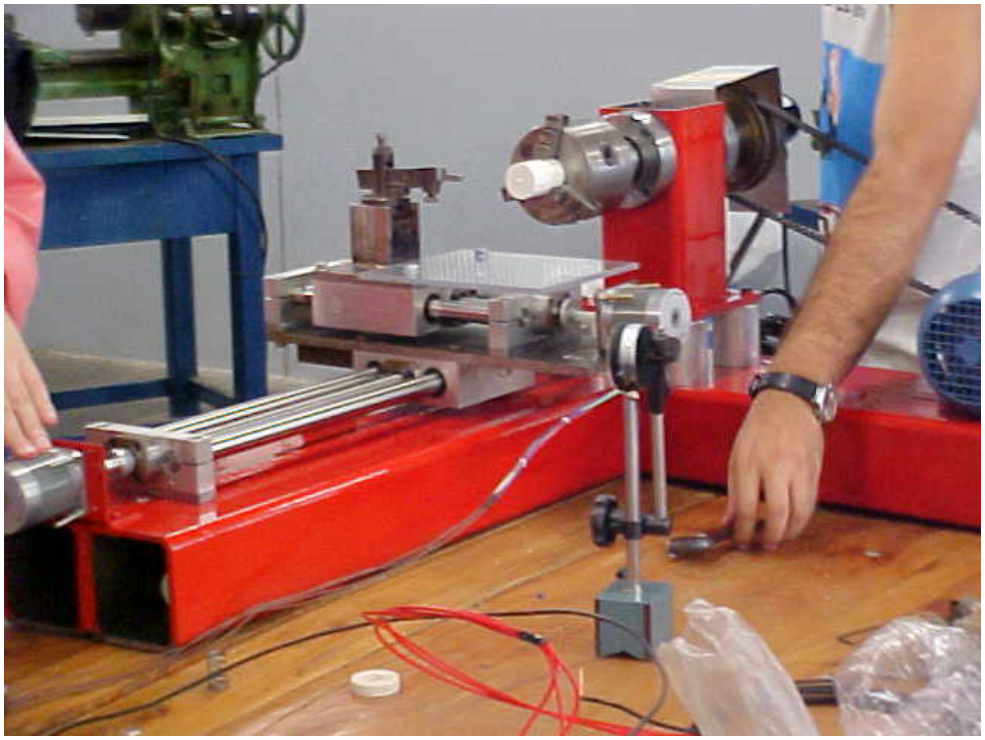
Loop estrutural

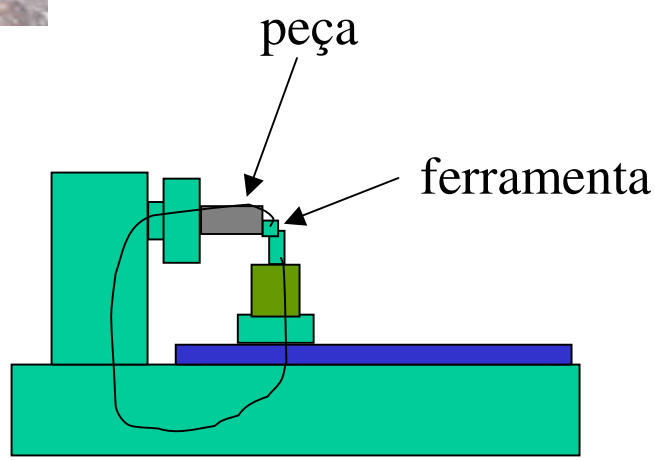


Livro do prof. A. Slocum

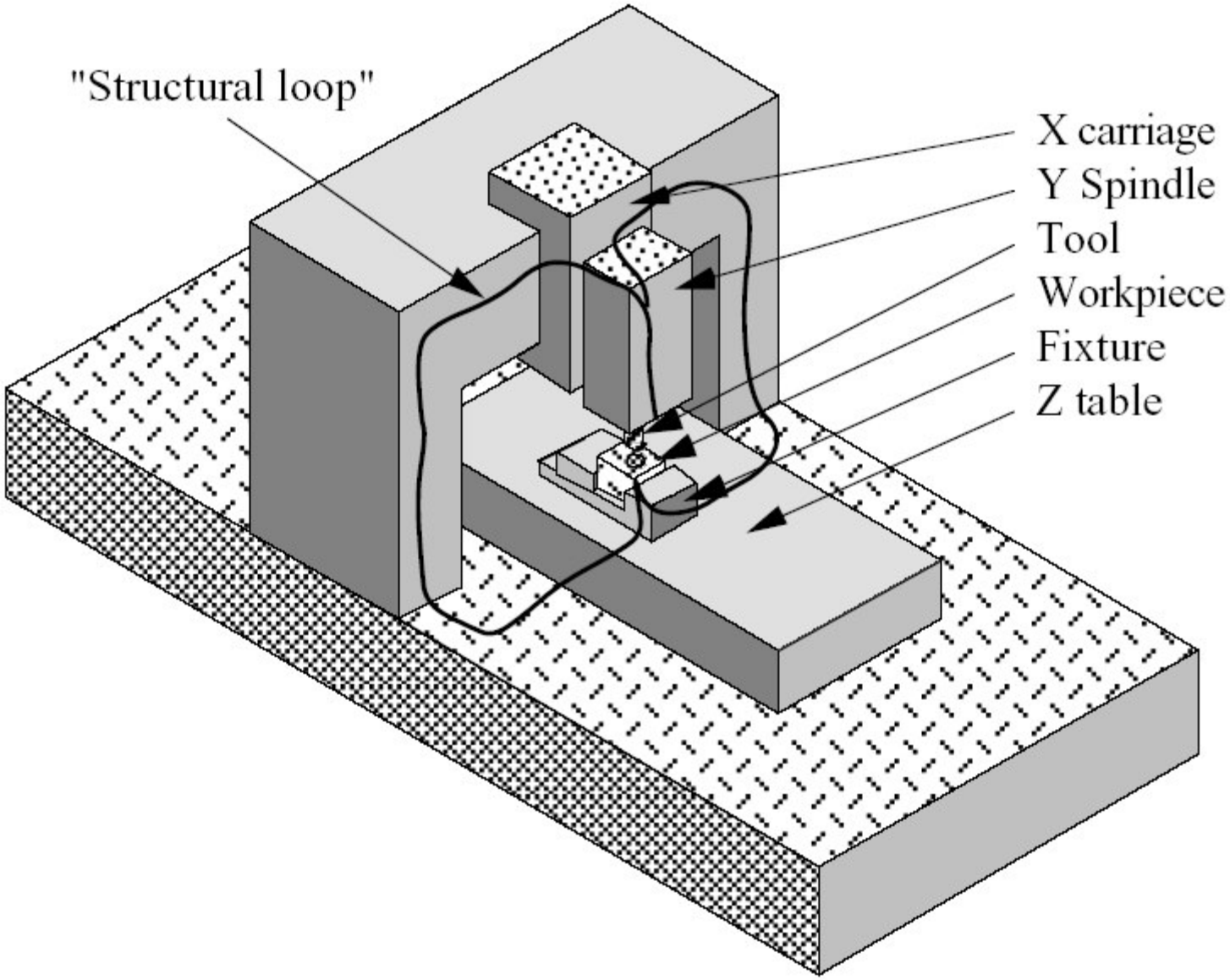


Exemplo

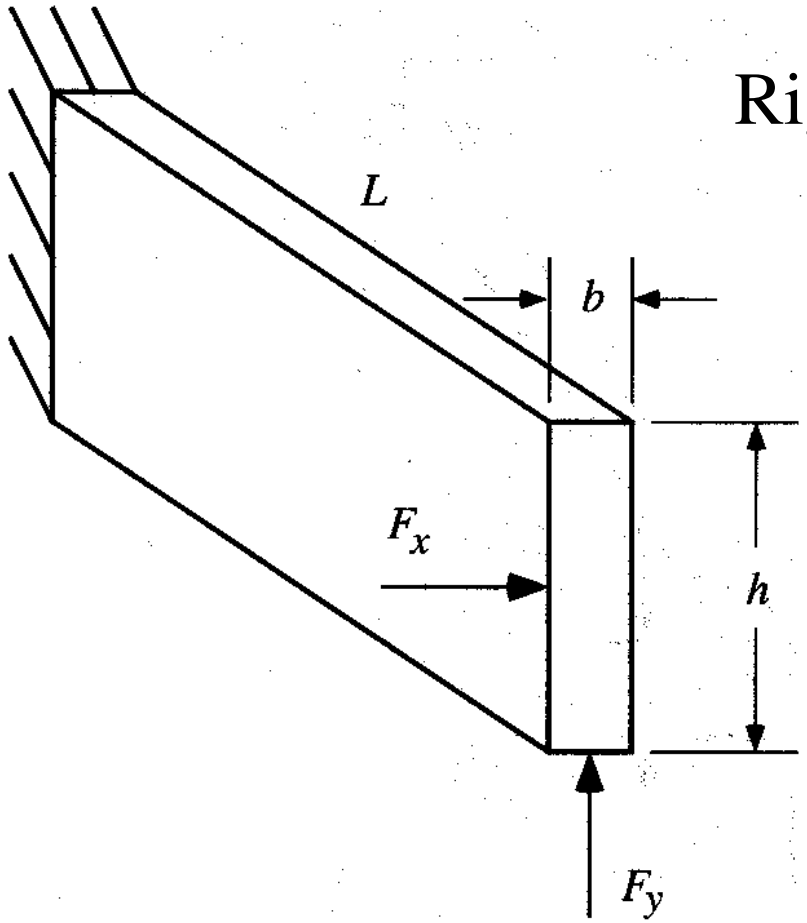




Estrutura tipo pórtico

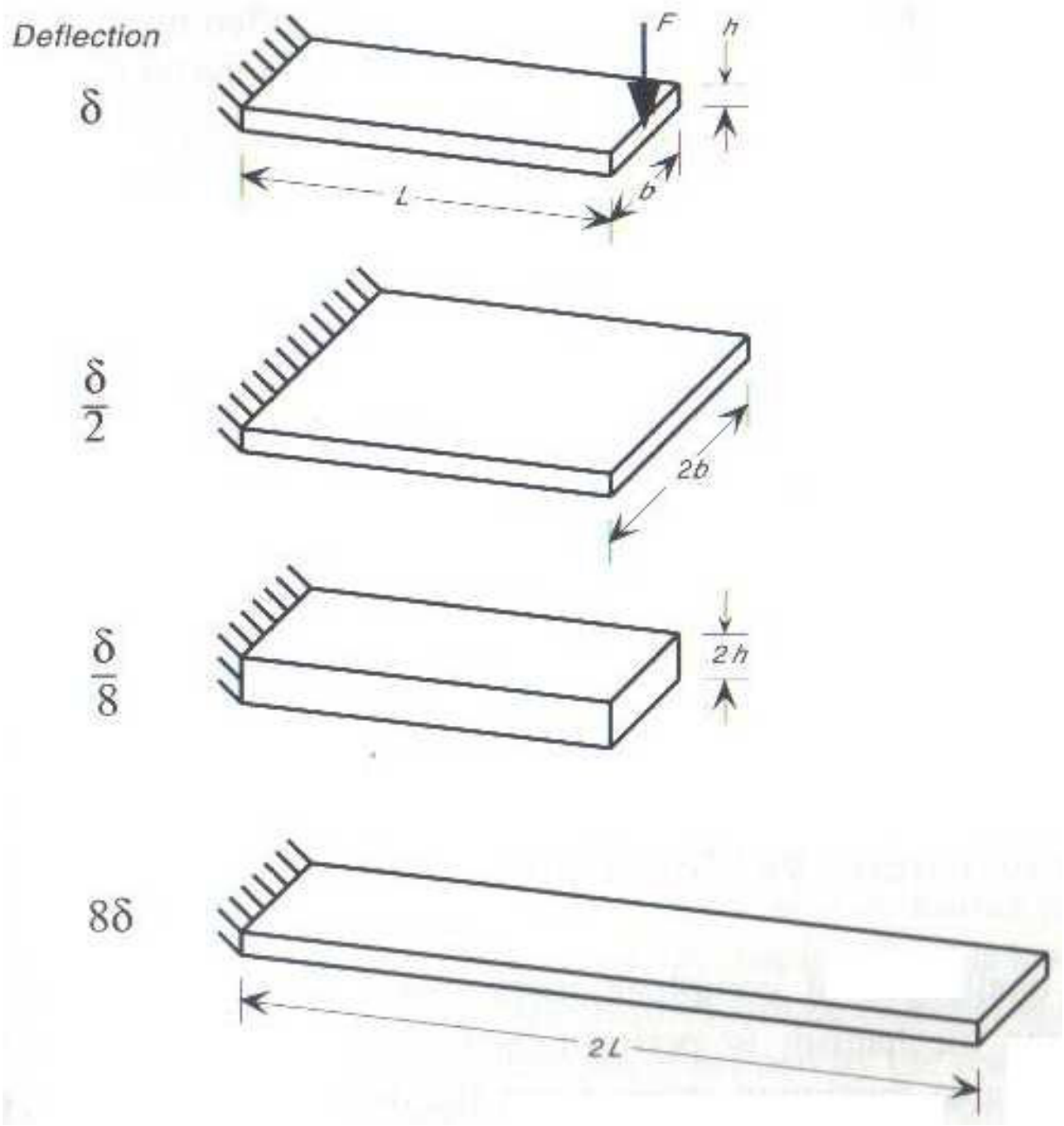


Rigidez



$$\delta_x = \frac{F_x L^3}{3EI_x};\ \mathrm{I_x} = \frac{\mathrm{hb}^3}{12} \Rightarrow \delta_x = \frac{4F_x L^3}{E\mathrm{hb}^3}$$

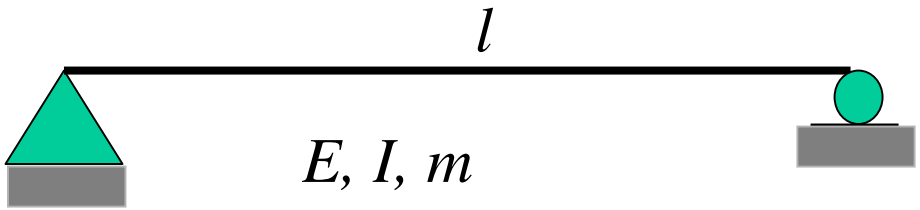
$$\delta_y = \frac{F_y L^3}{3EI_y};\ \mathrm{I_y} = \frac{\mathrm{bh}^3}{12} \Rightarrow \delta_y = \frac{4F_y L^3}{Eb\mathrm{h}^3}$$


Deflection
δ
F
h
L
b
δ/2
2b
δ/8
2h
8δ
2L

Freqüência natural

Modelo simples: $\omega = \sqrt{k/m}$

Exemplo: flexão



Deflexão no centro da viga:

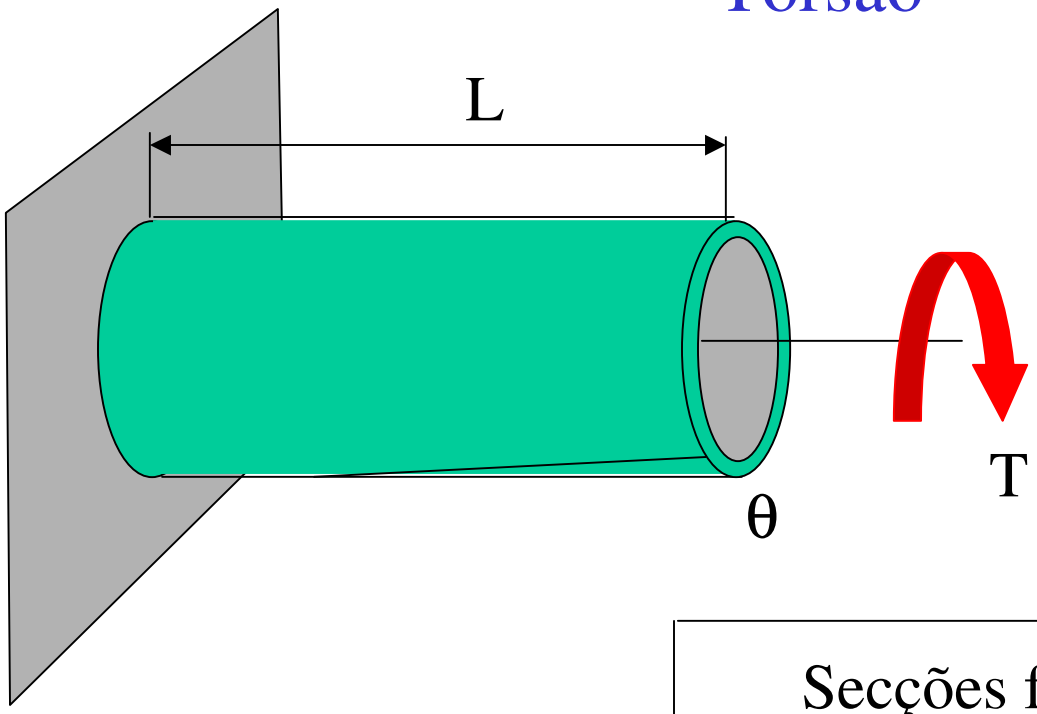
$$\delta = Pl^3/48EI$$

Supondo que m/2 está concentrado no centro:

$$\omega = \sqrt{\frac{48EI}{L^3(m/2)}} = 9.80\sqrt{\frac{EI}{mL^3}}$$

valor exato: 9.87

Torsão



$$\frac{T}{\theta} = \frac{GJ}{L}$$

Tubo (secção circular):

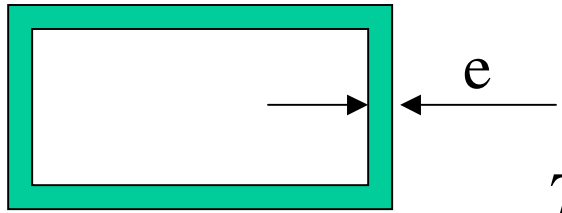
$$J = \frac{\pi\left(D_e - D_i\right)^4}{32}$$

freqüência natural: torsão

$$\omega = \sqrt{\frac{K_\theta}{J_m}}$$

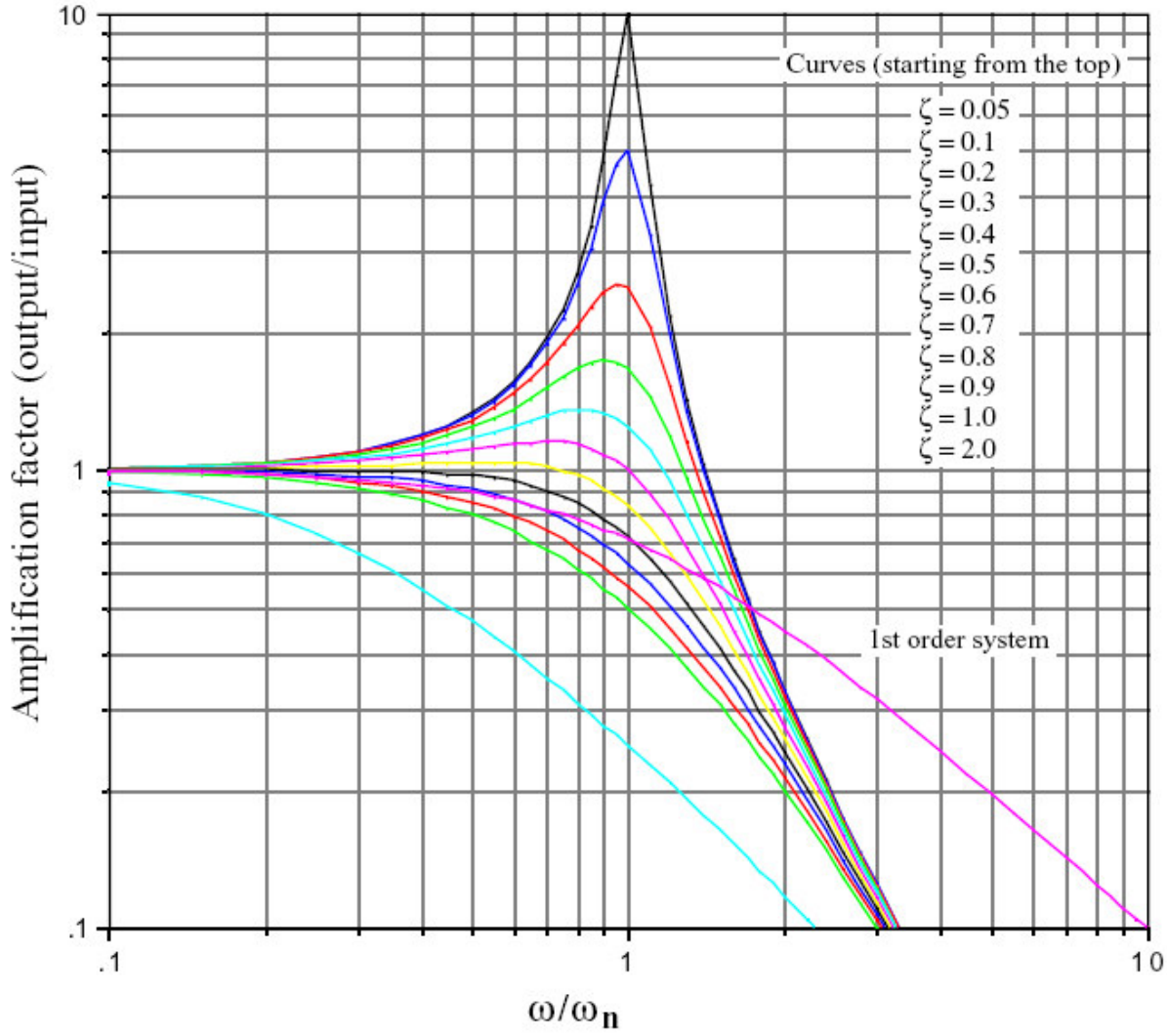
J_m = mom. Inércia de massa

Secções fechadas de paredes finas

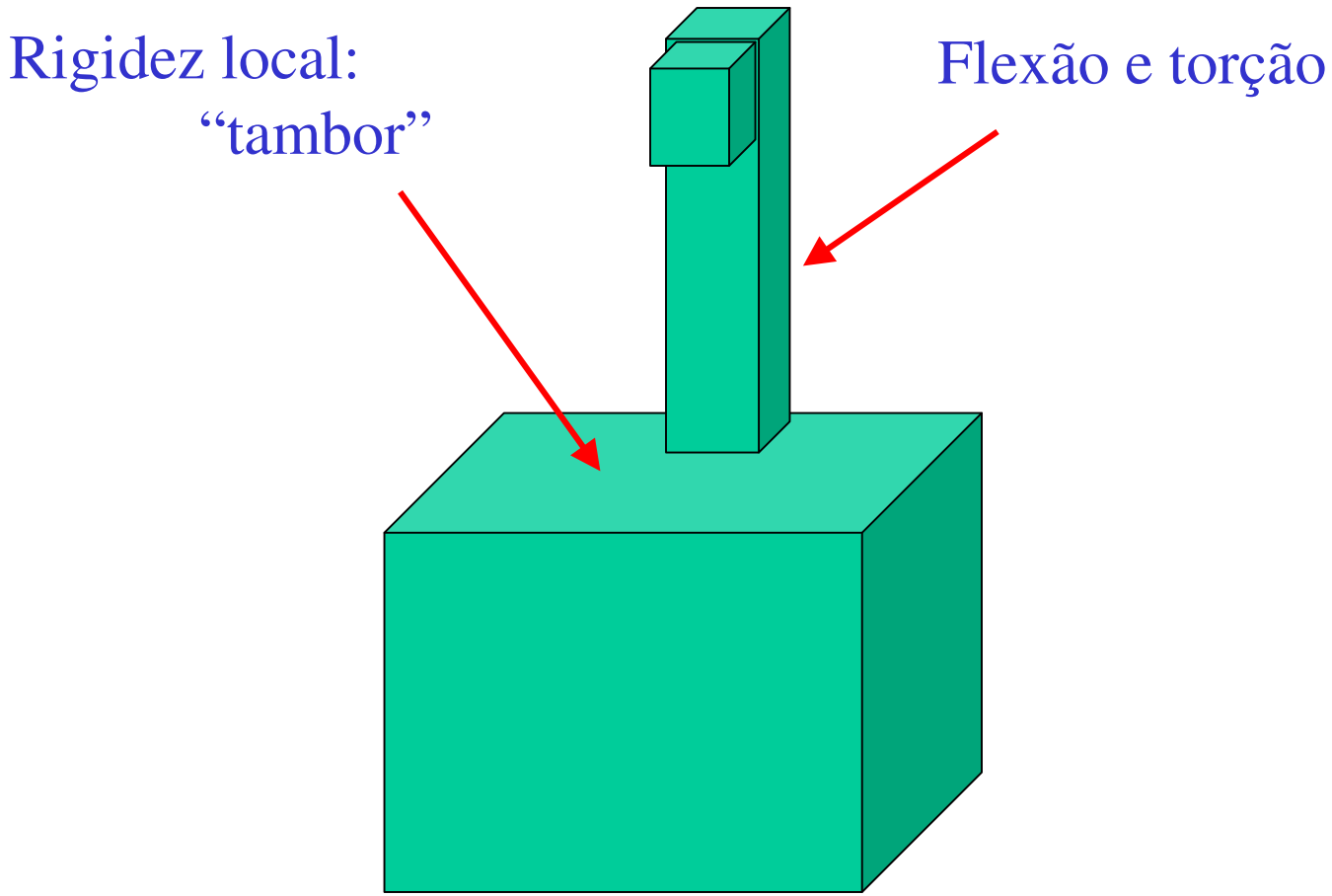


$$\frac{T}{\theta} = \frac{4GA_{sm}^2 e}{P_{sm} L}$$

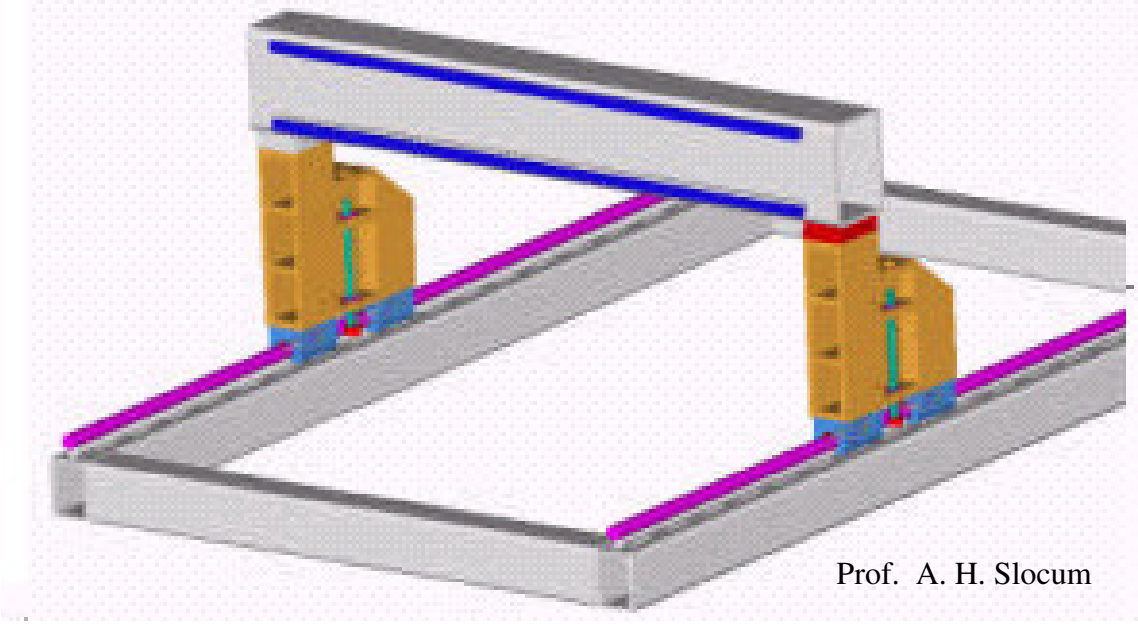
Sistema dinâmico de segunda ordem



Cuidados!



Movimento suave



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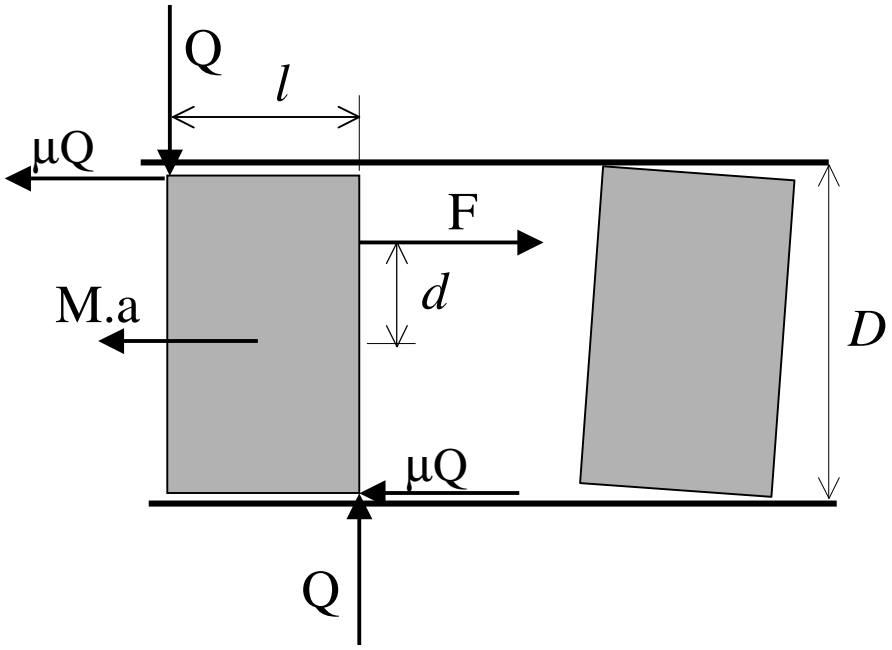
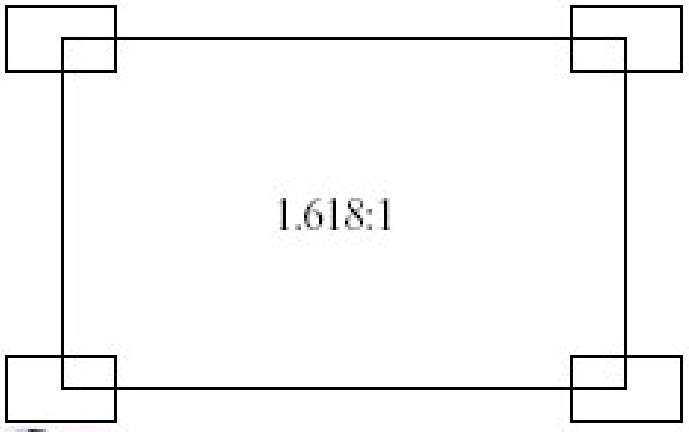
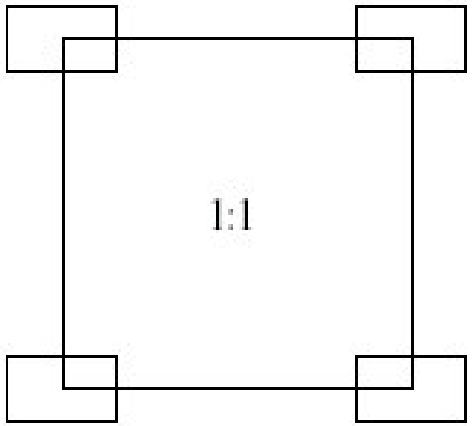


Ideal:

$l \sim 2D$



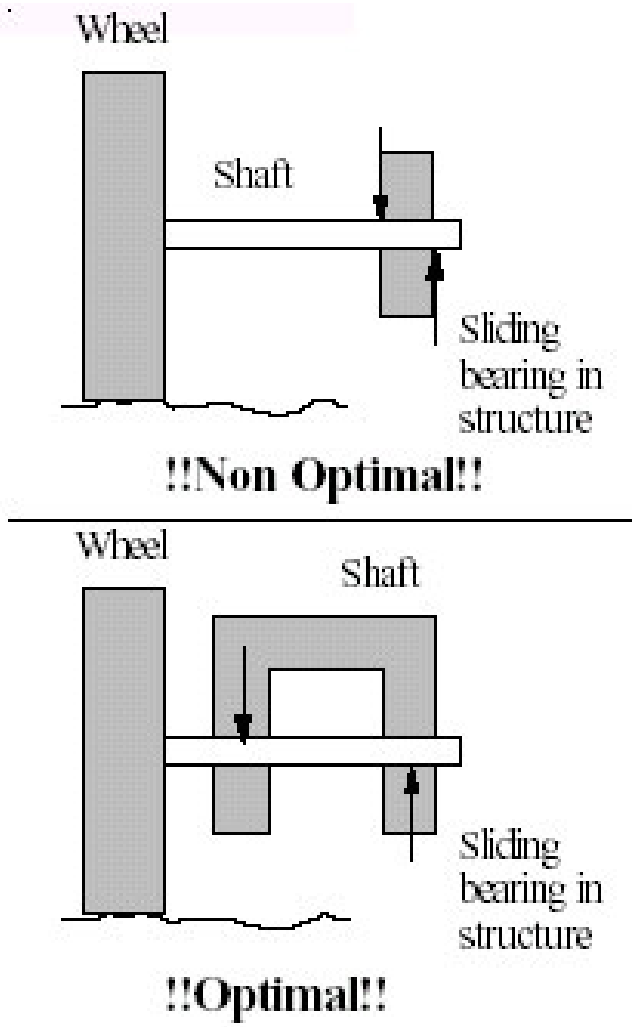
Boa escolha!



Mínimo recomendável

Mancal para eixo

L/D > 3



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