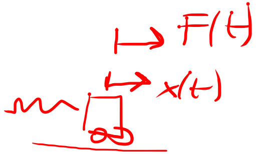
1/12/23

$$x(t) = \underbrace{\frac{F}{K}\,\frac{1}{1-\left(\frac{\bar\omega}{\omega}\right)^2}}\left[\sin\bar\omega t - \frac{\bar\omega}{\omega}\sin\omega t\right]$$



RISPOSTA IN FASE

Concentriamoci su

$$x(t) = x_{st}\,\frac{1}{1-\left(\frac{\bar\omega}{\omega}\right)^2}\,\sin\bar\omega t$$

Se $\bar\omega<\omega$ allora $x(t)$ e x_{st} hanno lo stesso segno $(\;)>0$

Se $\bar\omega>\omega$ " " " hanno segno opposto.

RISPOSTA IN OPPOSIZ. DI FASE

$$x(t) = N\,x_{st}\sin(\bar\omega t - \xi)$$

$\xi = 0$ se $\bar\omega<\omega$

$\xi = \pi$ se $\bar\omega>\omega$

$$N = \frac{1}{\left|1-\left(\frac{\bar\omega}{\omega}\right)^2\right|}$$: FATTORE DI AMPLIFICAZIONE

$\bar\omega/\omega = 1$ CONDIZ. DI RISONANZA

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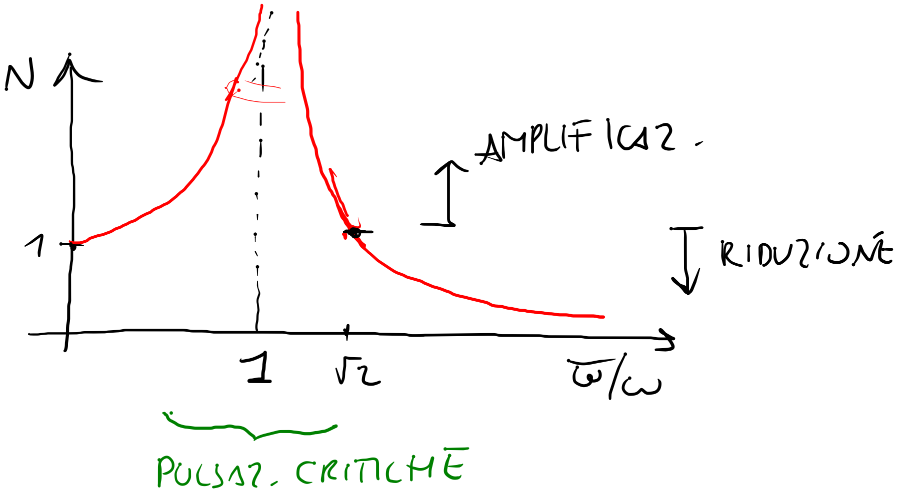
$$x(t)_{max} = N\,x_{st}\,\overbrace{\sin(\;)}^{1}$$

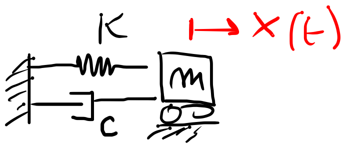
$$N = \frac{x(t)_{max}}{x_{st}}$$



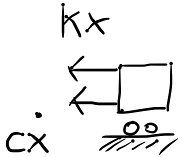
$$N = \frac{1}{\left|1 - \left(\frac{\bar{\omega}}{\omega}\right)^2\right|}$$

$$N|_{\sqrt{2}} = \frac{1}{|1-2|} = 1$$

OSCILLATORE CON SMORZAMENTO (O CON DISSIPAZIONE) — OSCILLAZ. LIBERE



SMORZATORE (DASHPOT)



$$m\ddot{x} = -Kx - c\dot{x}$$

$$m\ddot{x} + c\dot{x} + Kx = 0 \qquad \text{OSC. LIBERE}$$

$$m\omega = \sqrt{Km}$$

$$m^2\omega^2 = Km$$

$$\omega^2 = \frac{K}{m}$$

$$\ddot{x} + 2\frac{c}{2m\omega}\omega\dot{x} + \omega^2 x = 0$$

c: COEFF DI SMORZAMENTO VISCOSO

$$[c\dot{x}] = [F]; \quad c = \left[\frac{FT}{L}\right] \rightsquigarrow \frac{Ns}{m}$$

$$c_{cr} = 2\sqrt{Km}$$

↳ COEFF DI SMORZAMENTO CRITICO

$$\frac{c}{c_{cr}} = \frac{c}{2\sqrt{Km}}$$

$$\frac{c}{2m\omega} = \text{RAPPORTO DI SMORZAMENTO } (\nu)$$

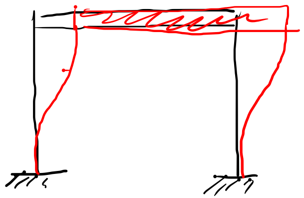
$$[\nu] = [-]$$

$\nu > 1 \quad c > c_{cr}$

$\nu < 1 \quad c < c_{cr}$

ν STRUTTURE CIVILI $\sim 0.03 \div 0{,}07$

↘ ν SI CALCOLA INDIRETTAMENTE PERCHÉ LE FONTI DI DISSIPAZIONE SONO VARIE ←
- MATERIALI
- CONNESSIONI
- AERODINAMICA
- FONDAZIONI



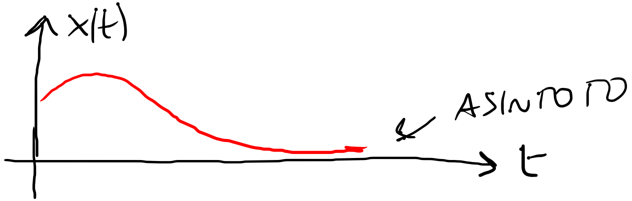
$\ddot{x} + 2\nu\omega\dot{x} + \omega^2 x = 0$; $x(t) = e^{\lambda t}$; $\dot{x}(t) = \lambda e^{\lambda t}$; $\ddot{x}(t) = \lambda^2 e^{\lambda t}$

$$\underbrace{\left(\lambda^2 + 2\nu\omega\lambda + \omega^2\right)}_{=0} e^{\lambda t} = 0$$

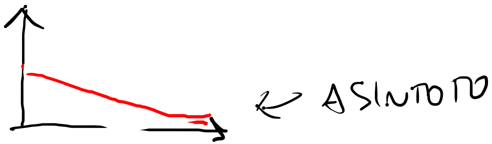
$$\left.\begin{matrix}\lambda_1\\ \lambda_2\end{matrix}\right\rangle = -\nu\omega \pm \sqrt{(\nu\omega)^2 - \omega^2} = \overbrace{\omega}^{>0}\left(-\nu \pm \sqrt{\nu^2 - 1}\right)$$

$\nu > 1$	SMORZ.	SUPERCRITICO
$\nu = 1$	"	CRITICO
$\nu < 1$	"	SOTTOCRITICO

$\nu > 1$; $\lambda_1, \lambda_2 \in \mathbb{R}$; $x(t) = A_1 e^{\lambda_1 t} + A_2 e^{\lambda_2 t}$



$\nu = 1$; $\lambda_1 = \lambda_2 = \lambda = -\nu\omega$; LA SOLUZ. è $x(t) = A_1 e^{\lambda t} + A_2 \lambda e^{\lambda t}$



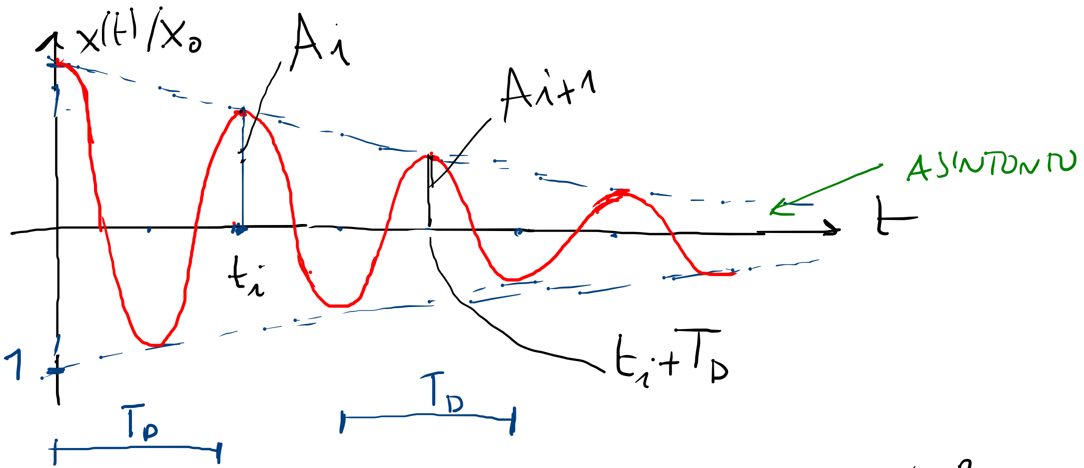
$\nu < 1$: $x(t) = A_1 \, e^{-\nu\omega t + i\underbrace{\omega\sqrt{1-\nu^2}}_{\omega_D} t} + A_2 \, e^{-\nu\omega t - i\underbrace{\omega\sqrt{1-\nu^2}}_{\omega_D} t}$

$$x(t) = \underbrace{e^{-\nu\omega t}}_{\text{MODULANTE}} \Big(\underbrace{B_1 \sin\omega_D t + B_2 \cos\omega_D t}_{\text{OSCILLANTE}} \Big)$$

$\omega_D = \omega\sqrt{1-\nu^2}$

PULSAZIONE RIDOTTA

$T_D = \dfrac{2\pi}{\omega_D}$



$\nu \to 0$; $\omega_D \to \omega$

$T_D \to T$

$\nu \to 1$; $\omega_D \to 0$

$T_D \to \infty$

$E_{mecc}(t_i) = \dfrac{1}{2} K A_i^2$

$E_{mecc}(t_i + T_D) = \dfrac{1}{2} K A_{i+1}^2$

$\Delta E_{mecc} = \dfrac{1}{2} K \left(A_{i+1}^2 - A_i^2 \right) < 0$ PERDITA DI ENERGIA