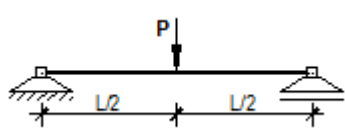
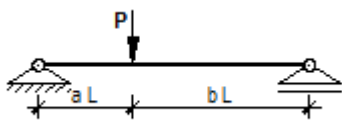
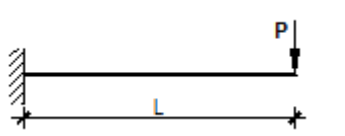
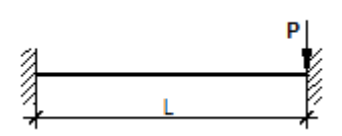
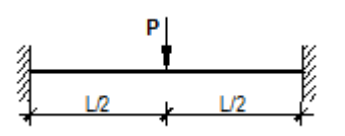
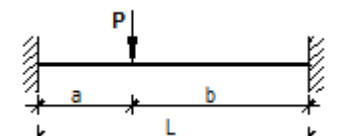
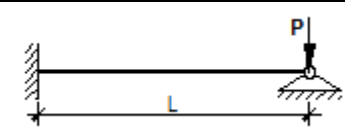
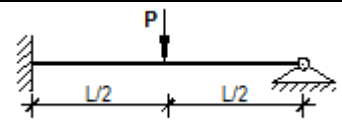


# DINAMIKA KONSTRUKCIJA

## Ekvivalentna krutost

	$k = \frac{48EI}{L^3}$		$k = \frac{3EI}{L^3} \cdot \frac{1}{a^2b^2}$ $a + b = L$
	$k = \frac{3EI}{L^3}$		$k = \frac{12EI}{L^3}$
	$k = \frac{192EI}{L^3}$		$k = \frac{3EI(a+b)^3}{a^3b^3}$ $a + b = L$
	$k = \frac{3EI}{L^3}$		$k = \frac{768EI}{7L^3}$

## Slobodne neprigušene vibracije

$\omega = \sqrt{\frac{k}{m}}$ [rad/s]	$f = \frac{\omega}{2\pi}$ [Hz]	$T = \frac{1}{f}$ [s]
pomak: $x(t) = X \cdot \sin(\omega t + \varphi)$	amplituda pomaka: $X = \sqrt{x_0^2 + \left(\frac{\dot{x}_0}{\omega}\right)^2}$	
brzina: $\dot{x}(t) = X\omega \cdot \cos(\omega t + \varphi)$	fazni pomak: $\varphi = \arctg\left(\frac{x_0\omega}{\dot{x}_0}\right)$	
ubrzanje: $\ddot{x}(t) = -X\omega^2 \cdot \sin(\omega t + \varphi)$		

## Slobodne prigušene vibracije

$\omega_d = \omega\sqrt{1-\xi^2}$	$f_d = \frac{\omega_d}{2\pi}$	$T_d = \frac{2\pi}{\omega_d} = \frac{T}{\sqrt{1-\xi^2}}$
$\xi = \frac{c}{2m\omega} = \frac{c}{c_{cr}}$	$c_{cr} = 2m\omega = 2\sqrt{km} = \frac{2k}{\omega}$	
<b>- slabo prigušenje:</b>		
pomak: $x(t) = Xe^{-\xi\omega t} \cdot \sin(\omega_d t + \varphi)$	amplituda pomaka: $X = \sqrt{x_0^2 + \left(\frac{\dot{x}_0 + x_0 \cdot \xi \cdot \omega}{\omega_d}\right)^2}$	
fazni pomak: $\varphi = \arctg\left(\frac{x_0\omega_d}{\dot{x}_0 + x_0 \cdot \xi \cdot \omega}\right)$	logaritamski dekrement: $\delta = \ln \frac{X_i}{X_{i+1}}$ ; $\delta = \frac{1}{j} \ln \frac{X_i}{X_{i+j}} \approx 2\pi\xi$	
<b>- jako ili kritično prigušenje</b>		
pomak: $x(t) = e^{-\omega t} \cdot (x_0 + (\dot{x}_0 + x_0\omega)t)$	<b>- Coulombovo prigušenje:</b>	
	$\Delta A = 4x_F = 4 \frac{F_t}{k} = 4 \frac{\mu \cdot N}{k}$	
<b>- histerezo prigušenje:</b>		
$\delta = \ln(1 + \pi\mu) \approx \pi\eta$ $c_e = \frac{\eta \cdot k}{\omega}$		

# DINAMIKA KONSTRUKCIJA

## Odziv na harmonijsku uzbuđu

$$F(t) = F_0 \sin \Omega t \quad X_0 = \frac{F_0}{k} \quad r = \frac{\Omega}{\omega}$$

- **prisilni harmonijski odziv neprigušenog sustava:**

pomak:  $x(t) = X \cdot \sin(\omega t + \varphi) + \frac{X_0}{1-r^2} \sin \Omega t \quad \mu_{\text{din}} = \frac{1}{1-r^2}$

- **pulziranje**

pomak:  $x(t) = -\frac{X_0 \Omega}{2\varepsilon} \cos \Omega t \sin \varepsilon t \quad \varepsilon = \frac{\omega - \Omega}{2}$

- **rezonancija**

pomak:  $x(t) = X \cdot \sin(\omega t + \varphi) + \frac{X_0 \omega}{2} t \sin \omega t$

- **prisilne harmonijske vibracije s viskoznim prigušenjem:**

pomak:  $x(t) = X e^{-\xi \omega t} \cdot \sin(\omega_d t + \varphi) + \frac{X_0}{\sqrt{(1-r^2)^2 + (2\xi r)^2}} \sin(\Omega t - \psi) \quad \mu_{\text{din}} = \frac{1}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$

fazni pomak:  $\psi = \arctg\left(\frac{2\xi r}{1-r^2}\right)$

- **oscilacije temelja:**

trajni dio pomaka mase:  $x(t) = \frac{Y \sqrt{1+(2\xi r)^2}}{\sqrt{(1-r^2)^2 + (2\xi r)^2}} \sin(\Omega t - \beta)$

fazni pomak:  $\beta = \gamma + \psi \quad \gamma = \arctg(-2\xi r)$

prenosivost:  $Tr = \left| \frac{X_f}{Y} \right| = \frac{\sqrt{1+(2\xi r)^2}}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$

- **izolacija vibracija:**

sila:  $F_T = kx + c\dot{x} = X_f \sqrt{k^2 + (c\Omega)^2} \sin(\Omega t - \beta)$

$(F_T)_{\text{max}} = X_f \sqrt{k^2 + (c\Omega)^2} = \frac{X_0 \sqrt{k^2 + (c\Omega)^2}}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$

prenosivost:  $Tr = \frac{(F_T)_{\text{max}}}{F_0} = \frac{\sqrt{1+(2\xi r)^2}}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$