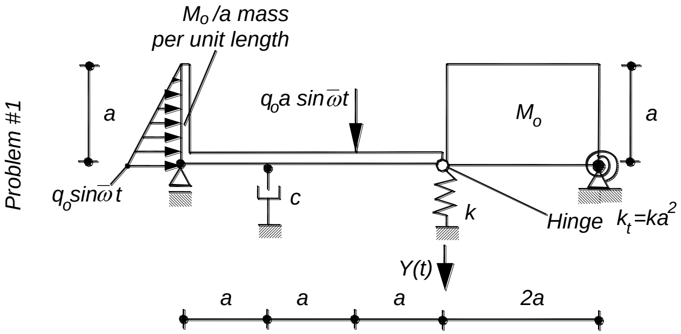
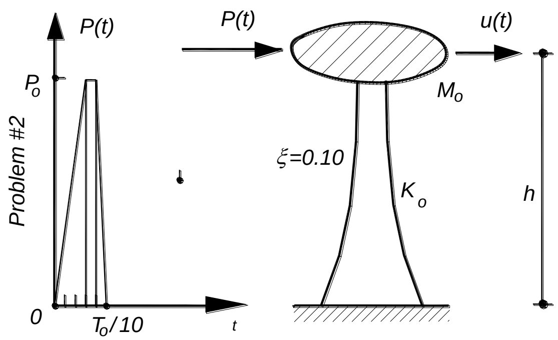
ADVANCED DYNAMICS OF STRUCTURES / Quiz # 1; November 7, 2012

1. Write down the equation of motion of the rigid-body assemblage in terms of $Y(t)$ the vertical displacement of the hinge by using the principle of the virtual work. Obtain the free vibration period $T = \alpha\sqrt{M/k}$ of the assemblage without considering the damping and determine α. Find the resonance condition ($\omega = \bar{\omega}$) in terms of the parameters of the system, when the damping is neglected.





2. The single-degree-of-freedom system shown is subjected to an external load of impulse characters by assuming that the system starts from the rest, i.e., $u(t=0)=0$ and $\dot{u}(t=0)=0$ $M_o\,\ddot{u}(t)+C_o\,\dot{u}(t)+K_o\,u(t)=P(t)$. Find out the displacement $u(t)$, the velocity $\dot{u}(t)$ and the acceleration $\ddot{u}(t)$. Obtain the maximum shear force and bending moment, where T_o is the free undamped vibration period of the system.. $M_o\,g = 200kN$, $K_o = 800kN/m$, $\xi = 0.10$, $P_o = 120kN$, $h = 10.0m$.

$$u(t) = \frac{I}{m\,\omega_D} e^{-\xi\,\omega t}\sin\omega_D\,t \qquad I = \int_0^{t_1} p(t)\,dt \qquad u(t)_{\max} = \frac{I}{m\,\omega}\exp\left[-\frac{\xi}{\sqrt{1-\xi^2}}\arctan\frac{\sqrt{1-\xi^2}}{\xi}\right]$$

$$u(t) = e^{-\xi\,\omega t}\left[\frac{\dot{u}(0)+u(0)\,\xi\,\omega}{\omega_D}\sin\omega_D\,t + u(0)\cos\omega_D t\right] + \frac{1}{m\,\omega_D}\int_0^t p(\tau)\,e^{-\xi\,\omega(t-\tau)}\sin\omega_D\,(t-\tau)\,d\tau$$

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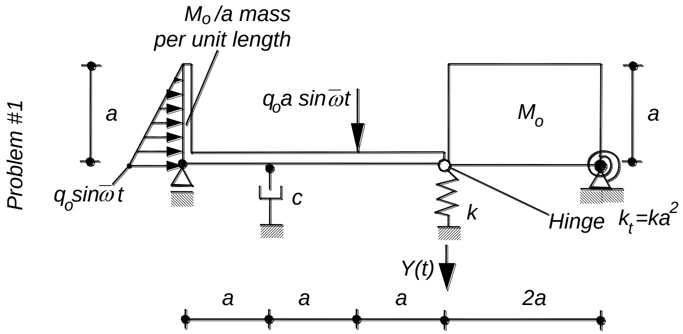

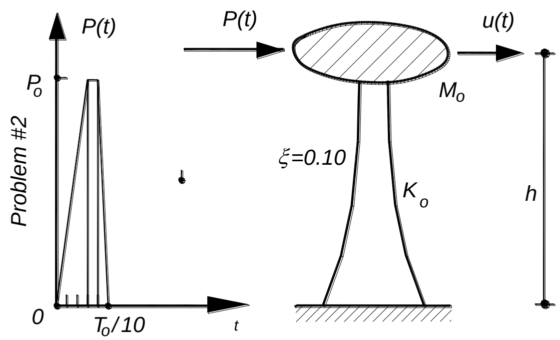

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