**ADVANCED DYNAMICS OF STRUCTURES / HOMEWORK / October 3, 2004**

a. Obtain the undamped and damped free vibration period of the single-degree-of-freedom system shown in the figure. $W = mg = 200kN$ $k = 1000kN/m$ $\xi = 0.05$

b. Evaluate the displacement history of the system subjected to the ground motion history $\ddot{v}_g(t)$ by using step by step numerical integration of the Duhamel integral for $0 \le t \le t_1$ by using Simpson rule under the assumption of the homogeneous initial conditions $v(t=0)=0$ $\dot{v}(t=0)=0$.

$t_o = 0.08s$ $t_1 = 2.0s$ $\Delta\tau = 0.01s$

$$v(t) = -\frac{1}{\omega_D}\int_o^t \exp[-\xi\omega(t-\tau)]\ \ddot{v}_g(\tau)\sin\omega_D(t-\tau)\,d\tau \qquad 0 \le t \le t_o$$

$$v(t) = -\frac{1}{\omega_D}\int_o^{t_o} \exp[-\xi\ \omega(t-\tau)]\ \ddot{v}_g(\tau)\sin\omega_D(t-\tau)\,d\tau \qquad t_o \le t \le t_1$$

| *t (s)* | $\ddot{v}_g(t)/g$ |
|---|---|
| *0* | *0* |
| *0.01* | *0.356* |
| *0.02* | *0.711* |
| *0.03* | *0.800* |
| *0.04* | *0.711* |
| *0.05* | *0.356* |
| *0.08* | *0* |
| *0.10* | *0* |
| *0.20* | *0* |
| *0.40* | *0* |
| *2.00* | *0* |
| | |

c. Obtain the response of the system under the assumption that the ground motion $\ddot{v}_g(t)$ can be represented as a impulse loading. Draw the variation of *v(t)* for the two last cases.

$$v(t) = \frac{I}{m\,\omega_D}\exp[-\xi\ \omega\ t]\sin\omega_D t \qquad I = -\int_o^t m\,\ddot{v}_g(\tau)\,d\tau$$


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