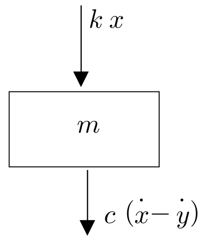
[2.4절]

2.50 응용된 바닥가진 문제

F. B. D.



$$y(t) = Y\ \sin\omega_b t$$

$$-k\,x - c\,(\dot{x}-\dot{y}) = m\,\ddot{x}$$

$$\Rightarrow \quad m\,\ddot{x} + c\,\dot{x} + k\,x = c\,\dot{y}$$

$$= c\ \omega_b\ Y\ \cos\omega_b t$$

$$\ddot{x} + 2\zeta\omega_n\dot{x} + \omega_n^2\,x = 2\zeta\,\omega_n\,\omega_b\,Y\ \cos\omega_b t$$

$$x_p(t) = \frac{2\zeta\omega_n\,\omega_b\,Y}{\sqrt{(\omega_n^2-\omega_b^2)^2+(2\zeta\omega_n\,\omega_b)^2}}\ \cos(\omega_b t - \theta)$$

$$F_{tr}(t) = k\,x_p = F_T\ \cos(\omega_b t - \theta)$$

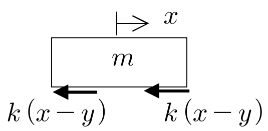
$$F_T = \frac{k\,2\,\zeta\,\omega_n\,\omega_b\,Y}{\sqrt{(\omega_n^2-\omega_b^2)^2+(2\,\zeta\,\omega_n\,\omega_b)^2}} = \frac{\frac{c\,k}{m}\,\omega_b\,Y}{\sqrt{(\frac{k}{m}-\omega_b^2)^2+(\frac{c}{m}\,\omega_b)^2}}$$: 최종 답 (문제의 기호로 표현)

(참고 사항 :)

$$= \frac{(k\,Y)\,2\,\zeta\,\frac{\omega_b}{\omega_n}}{\sqrt{\left(1-\frac{\omega_b^2}{\omega_n^2}\right)^2+\left(2\,\zeta\,\frac{\omega_b}{\omega_n}\right)^2}} = k\,Y\frac{2\,\zeta r}{\sqrt{(1-r^2)^2+(2\,\zeta r)^2}}$$

2.60 $Y = 0.1$ m, $\omega_b = 7.5$ rad/s, $m = 10^5$ kg, $k = 3.519\times 10^6$ N/m, $\zeta = 0$

F. B. D.



$$-2\,k\,(x-y) = m\,\ddot{x}$$

$$\Rightarrow \quad m\,\ddot{x} + 2\,k\,x = 2\,k\,y$$

$$\Rightarrow \quad m\,\ddot{x} + k_{eq}\,x = k_{eq}\,y$$

$$k_{eq} = 2\,k = 2\ (3.519\times 10^6\ \text{N/m}) = 7.308\times 10^6\ \text{N/m}$$

$$\omega_n = \sqrt{\frac{k_{eq}}{m}} = \sqrt{\frac{7.308\times 10^6\ \text{N/m}}{10^5\ \text{kg}}} = 8.389\ \text{rad/s}$$

$$r = \frac{\omega_b}{\omega_n} = \frac{7.5\ \text{rad/s}}{8.389\ \text{rad/s}} = 0.8940$$

$$X = Y\frac{\sqrt{1+(2\,\zeta\,r)^2}}{\sqrt{(1-r^2)^2+(2\,\zeta\,r)^2}} = Y\frac{1}{|1-r^2|} = (0.1\ \text{m})\frac{1}{|1-(0.8940)^2|}$$

$$= (0.1\ \text{m})\ (4.98) = 0.498\ \text{m}$$