

[2.5절]

2.63  $m_0 = 12 \text{ kg}$ ,  $m = 100 \text{ kg}$ ,  $k = 3,000 \text{ N/m}$ ,  $N = 1,800 \text{ rpm}$ ,  $e = 100 \text{ mm}$ ,  $X_r = ?$

$$k_{eq} = k + k = 2 (3.0 \times 10^3 \text{ N/m}) = 6,000 \text{ N/m}$$

$$\omega_r = \frac{(2\pi \text{ rad})N}{60 \text{ s/min}} = \frac{(2\pi \text{ rad})(1,800/\text{min})}{60 \text{ s/min}} = 188.5 \text{ rad/s}$$

$$\omega_n = \sqrt{\frac{k_{eq}}{m}} = \sqrt{\frac{6,000 \text{ kg/s}^2}{100 \text{ kg}}} = 7.746 \text{ rad/s}$$

$$r = \frac{188.5}{7.746} = 24.3$$

$$X_r = \frac{m_0 e}{m} \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} = (0.12)(0.10 \text{ m}) \frac{(24.3)^2}{\sqrt{[1-(24.3)^2]^2}} = 0.01200 \text{ m} \\ = 12.00 \text{ mm}$$

2.67  $m = 150 \text{ kg}$ ,  $k = 1,000 \text{ kN/m}$ ,  $c = 600 \text{ kg/s}$ ,  $N = 3000 \text{ rpm}$ ,  $F_0 = 374 \text{ N}$

$$\omega_n = \sqrt{\frac{1,000 \times 10^3 \text{ kg/s}^2}{150 \text{ kg}}} = 81.6 \text{ rad/s}, \quad \omega_r = \frac{(2\pi \text{ rad})(3,000/\text{min})}{60 \text{ s/min}} = 314 \text{ rad/s}$$

$$r = \frac{314}{81.6} = 3.85, \quad \zeta = \frac{600 \text{ kg/s}}{2(150 \text{ kg})(81.6 \text{ rad/s})} = 0.0245$$

$$(a) X = \frac{m_0 e}{m} \frac{\omega_r^2}{\sqrt{(\omega_n^2 - \omega_r^2)^2 + (2\zeta \omega_n \omega_r)^2}} \quad (m_0 e \omega_r^2 = F_0) \\ = \frac{F_0}{m \omega_r^2} \frac{r^2}{\sqrt{(1-r^2)^2 + (2\zeta r)^2}} \\ = \frac{(374 \text{ N})}{(150 \text{ kg})(314 \text{ rad/s})^2} \frac{3.85^2}{\sqrt{(1-3.85^2)^2 + [2(0.0245)(3.85)]^2}} \\ = 0.0271 \times 10^{-3} \text{ m} = 0.0271 \text{ mm}$$

(b)  $m_0/m = 0.01$

$$m_0 = 0.01 m = 0.01 (150 \text{ kg}) = 1.50 \text{ kg}$$

$$e = \frac{F_0}{m_0 \omega_r^2} = \frac{374 \text{ N}}{(1.50 \text{ kg})(314 \text{ rad/s})^2} = 2.53 \times 10^{-3} \text{ m} = 2.53 \text{ mm} \quad (\text{교재 답 오류})$$